US Army Corps of Engineers ®
Portland District

Rogue River, Oregon Ocean Dredged Material Disposal Site Evaluation Study and Environmental Assessment

U.S. Army Corps of Engineers, Portland District

U.S. Environmental Protection Agency, Region 10

April 2009

Abbreviations and Acronyms

CFR	Code of Federal Regulations
cy	cubic yard(s)
Corps	U.S. Army Corps of Engineers
DDT	dichloro-diphenyl-trichloroethane
DPS	Distinct Population Segment
EA	Environmental Assessment
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FR	Federal Register
mg/L	milligram(s) per liter
MDL	method detection limit
MLLW	mean lower low water
MPRSA	Marine Protection, Research and Sanctuaries Act
MRL	method reporting limit
NAD	North American Datum
NMFS	National Marine Fisheries Service
ODMDS	ocean dredged material disposal site(s)
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
PAH	polynuclear aromatic hydrocarbon(s)
PCB	polychlorinated biphenyl
PCE	primary constituent elements
RM	river mile(s)
SMMP	Site Management and Monitoring Plan
SONCC	Southern Oregon/Northern California Coast
TOC	total organic carbon
TBT	tributyltin and other organotins
ug/kg	micrograms per kilogram
ug/L	micrograms per liter
USGS	U.S. Geological Survey
ZSF	Zone of Siting Feasibility

Rogue River, Oregon
Ocean Dredged Material Disposal Site Evaluation and Environmental Assessment

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PURPOSE AND NEED

This Ocean Dredged Material Disposal Site (ODMDS) 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 an existing Section 103 ODMDS located offshore from the Rogue River, Oregon (Figure 1), which is needed for long-term use by the Corps for the federally authorized Rogue River navigation project and others for the disposal of dredged material meeting ocean disposal criteria. This evaluation will assess the proposed final designation of the Rogue River ODMDS against the statutory requirements set forth in the Marine Protection, Research and Sanctuaries Act, as amended, (MPRSA or Ocean Dumping Act), 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 the MPRSA sections 102 and 103. 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 its evaluation of whether to designate any dredged material disposal sites near the mouth of the Rogue River pursuant to its authority under MPRSA section 102(c) in response to several factors. These factors include the following:

1. The prohibition on further use of the existing Rogue Section 103 disposal site following the close of the 2008-2009 dredging season pursuant to the Corps' site selection authority under MPRSA section 103(b), which allows the Corps, with EPA's concurrence, to designate a Section 103 site for a period of 5 years with a maximum 5 year extension;
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 MPRSA 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 MPRSA section 102(c).

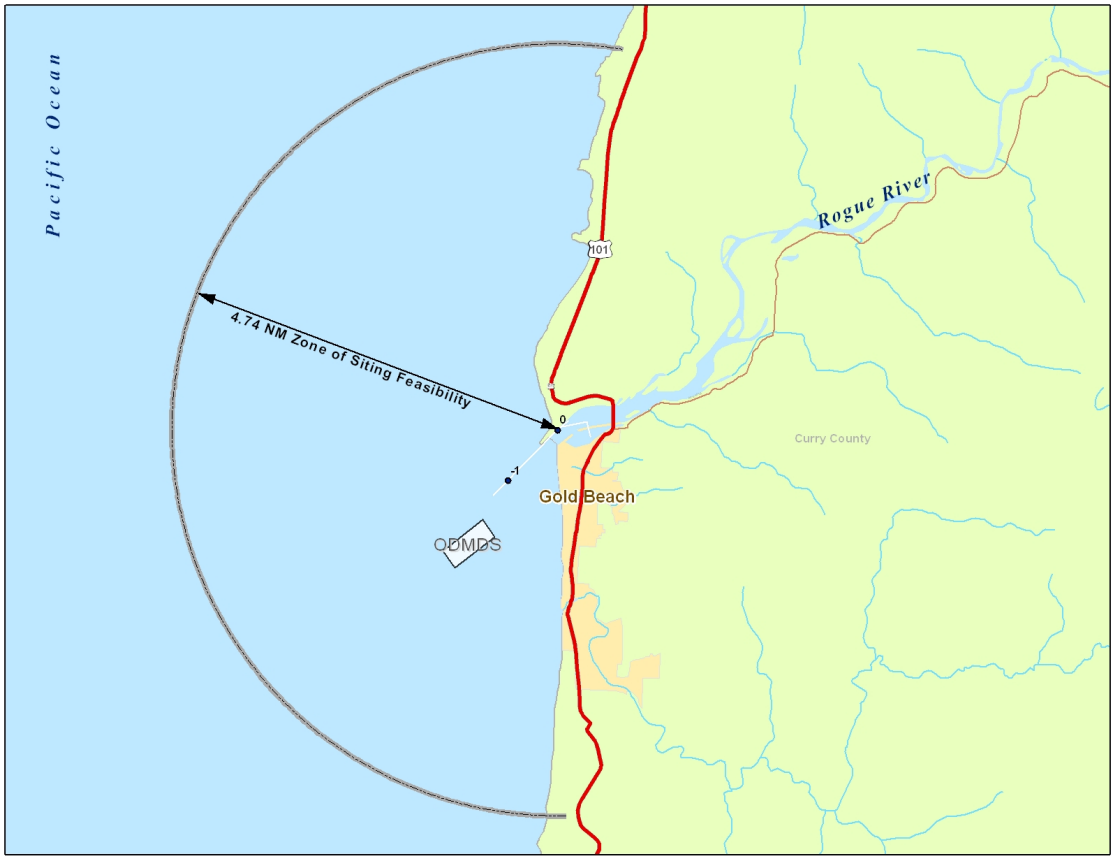
Background

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 transportation 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 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), 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) and (c), when a feasible disposal site has not been designated by EPA, or 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 the 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 ODMDS in itself does not result in disposal of dredged material. A separate evaluation of the suitability of dredged material for ocean disposal must be undertaken for each proposed use of the site by either the Corps or non-Corps permit applicant. Typically this involves evaluation of the specific disposal activity under the criteria, circulation of a public notice (which can include multiple years of use), and specific coordination with stakeholders, as well as concurrence by the appropriate EPA region.

Figure 1. Rogue River ODMDS and Vicinity



Offshore Disposal History

Multiple persons and/or entities may have utilized sites in the vicinity of the Rogue River since 1962 for disposal of dredged material at interim or Section 103 of the MPRSA selected sites. However, the primary user has historically been the Portland District of the Corps, which has used the site in its current location since 1977 (see table 1).

The volume of dredged material deposited offshore and originating from the Corps' Rogue River project from 1976-1985 ranged from zero to 142,260 cy with an annual average of 47,500 cy, all of which was from the main channel. From 1986 to 1989 maintenance activity was less (no dredging occurred in 1988) and Corps disposal volumes were reduced to an annual average of 35,600 cy for the 3 years dredging did occur. From 1986 and 2006, approximately 1.1 million cy have been placed by the Corps at the Rogue River ODMDS for a 20-year average annual loading volume of 54,000 cy/year. From 2000 to 2007 the average annual placement of material at the ODMDS by the Corps was 41,000 cy. Persistent mounding has not occurred at the ODMDS. Other disposal activities may have been approved, but would represent a small percentage of total disposal volumes at the ODMDS.

Table 1. Rogue River Project Dredging Volumes Placed in the ODMDS

Fiscal Year	Dredging Volumes (cy)
1976-1985	474,900
1986	0
1987	55,600
1988	36,400
1989	90,400
1990	70,300
1991	37,000
1992	32,200
1993	94,600
1994	120,000
1995	95,700
1996	44,100
1997	71,100
1998	55,600
1999	0
2000	44,800
2001	52,300
2002	35,100
2003	51,000
2004	31,000
2005	60,800
2006	20,100
2007	31,000

Note: Data includes Corps and contract hopper dredging and mechanical dredging.

The proposed Rogue River ODMDS received Interim EPA designation in 1977 (40 CFR 228.12)[1] and has been in use since that time. EPA proposed to designate the site as a final ODMDS in 1991. That proposed rule, 56 Federal Register (Fed. Reg.) 47173 (September 18, 1991), was never finalized. As proposed, the site was estimated to be 1.75 miles southwest of the Rogue River entrance (see Figure 1), with approximate dimensions of 3,600 feet by 1,400 feet with an average depth of 60 feet. The site occupied about 116 acres. The disposal site, placement area, and drop zone were identical. This Environmental Assessment reviews the statutory and regulatory criteria of the MPRSA to allow EPA to re-propose the site for designation.

AFFECTED ENVIRONMENT

Physical Resources

General

The Rogue River estuary is surrounded by steep, rounded hills that gain 700 feet in elevation within 0.5 mile. Along the coastline, the beach extends inland about 200 yards

[1] EPA's Interim Designations were superseded by later statutory and regulatory changes. The site's current status is as a Section 103(b) Corps-selected site. EPA concurred on the selection and extended its approval of site use on April 15, 2003, allowing use of the site to continue through 2008.

before rising sharply into hilly terrain. Gold Beach, located on the Rogue River, acquired its name from the placer gold found in gravels beneath the sandy beach that were exposed by winter storm waves. Other metallic minerals located in the beach sands of the area include chromite, magnetite, platinum, and zircon. The three sources of sediment in the vicinity of the existing ODMDS are fluvial, dredging disposal, and coastal erosion. The primary fluvial source is the Rogue River which has a mean annual discharge of 7,800 cubic feet per second. Coastal erosion studies show that much of the shoreline north of the Rogue River is unstable and contributes a continuous amount of sediment to the littoral system.

The nearshore mean circulation is alongshore, closely paralleling the bathymetric contours, with a lesser onshore-offshore component. Circulation patterns are variable with season and weather conditions. Monitoring of currents indicates that the predominant nearshore current direction is to the south, with short 2- to 3-month periods each winter of currents to the north. At the ODMDS measured currents are generally north with slightly more of an onshore component in July. For the April-May period, the strongest currents are usually north along the bottom contours. The currents in July are mostly onshore, across bottom contours and northward. No significant current southward has been recorded.

Rogue River Sediments

On August 8, 2007, six surface grab sediment samples were collected from the Rogue River federal navigation channel and the inner channel leading to the Gold Beach boat basin (see Appendix C). All six samples were submitted for physical analyses including total volatile solids. Select sample samples containing higher percent of fine-grained material were analyzed for metals 10 (inorganic), TOC, pesticides, PCBs, phenols, phthalates, miscellaneous extractables, and PAHs.

Physical analyses for material within the outer river channel consisted of 82.5% sand, with shell hash (range 94.1% to 70.9%) and 17.5% fine-grained material (range 29.1% to 5.9%); volatile solids on the one sample analyzed from this area were 4.53%. Material from the inner channel, leading to the boat basin, was 64.9% sand, with shell hash (range 79.3% to 50.2%) and 35.1% fine-grained material (range 49.8% to 20.7%) with volatile solids content ranging from 10.5% to 5.8% (mean 7.5%). The TOC ranged from 0.73% to 2.5% in these samples.

The chemical analyses indicated only very low levels of contamination in any of the samples and all were below the screening levels found in the *Sediment Evaluation Framework* (Corps and others 2006), with the exception of phenol, which was detected above the 420 ug/kg SEF screening level at 1200 ug/kg, in the sample closest to the boat basin. It is suspected that phenol is a possible laboratory cross-contamination, but without being able to verify that with the lab, the dredge material represented by that sample will not be dredged until further characterization or re-sampling, to provide a weight of evidence, can be accomplished.

Nickel (Ni) has historically been detected at levels higher than in most Oregon coastal rivers. The levels of nickel detected at the Rogue project are determined to be from natural sources and are considered background levels; in-water disposal will not create significant additional risk to the environment, beyond what naturally exists in the area. Samples where nickel exceeded 200 mg/kg have supported a diverse population of benthic organisms (one sample was collected in 2007 to verify the diverse benthic population).

ODMDS Sediments

Geological data collected in 2007 by Marine Taxonomic Services (2008) showed that the sediments in the ODMDS are mostly medium-to fine-grained marine sands with at least 99% of the material larger than 0.062 millimeters (mm) except at one station that was mostly coarse gravel (Table 3). Shell debris was present at most stations. These sandy sediments are common to the Oregon Coast with natural variations in percent fines due to variations in current structures and riverine input. Byrne and Panshin (1977) found the area around the ODMDS to be a sandy area with an area of gravel near the east end of the site and the possibility of rock out-crops in the area. Trawling in 2007 confirmed that there are likely some submerged rock outcrops within the ODMDS that may periodically covered with sand during some ocean conditions (Marine Taxonomic Services 2008). Total volatile solids analysis showed low total volatile solids (1.7% to 2.5%) at all stations.

Table 2. Sediment Grain Size and Total Volatile Solids Data, 2007

Sample I.D.	Grain Size Percent (%)				
	Gravel (shell hash)	Sand	Silt/Clay	Volatile Solids	Mean Grain-size (mm)
0807RODMDS-BC-01	0	97.4	2.6	2.1	0.16
0807RODMDS-BC-02	0	96.2	3.8	2.3	0.16
0807RODMDS-BC-03	88.3	7.4	4.3	1.7	9.68
0807RODMDS-BC-04	0.1	97.7	2.2	2.5	0.16
0807RODMDS-BC-05	0	95.4	4.6	2.4	0.16
Mean Value		96.5	3.5	2.2	---

RODMDS = Rogue Ocean Dredge Material Disposal Site; BC = Box core (surface-grab sampler).
% passing 200 sieve (0.075 mm) = silt/clay fraction.

There was no mound of disposal material apparent within the disposal site, which indicated that most material is being dispersed by currents and wave action. The coarseness of the Rogue River entrance sediments, isolation from existing or historical sources of contaminants, and the presence of strong hydraulic regimes allows the material to be deemed suitable for ocean disposal and exempt from further testing according to provisions of 40 CFR 227.13(b).

Oceanographic Circulation

The nearshore mean circulation is alongshore, closely paralleling the bathymetric contours, with a lesser onshore-offshore component. Circulation patterns are variable with season and weather conditions. Monitoring of currents over a 5-year period indicated that the predominant nearshore current direction is to the south, with short 2- to

3-month periods each winter of currents to the north. At the disposal site, measured currents were generally north with slightly more of an onshore component in July. For the April-May period, the strongest currents were usually north along the bottom contours. The currents in July are mostly onshore, across bottom contours and northward. No significant current southward was recorded. Appendix B provides details of the sediment transport processes for the Rogue River and the ODMDS.

Geology

The geological data collected in 2007 showed that the sediments in the ODMDS are mostly medium-to fine-grained marine sands with at least 99% of the material larger than 0.062 millimeters (mm) except at one station which was mostly coarse gravel. Shell debris was present at most stations. These sandy sediments are common to the Oregon Coast with natural variations in percent fines due to variations in current structures and riverine input.

Sediments dredged from the Rogue River entrance channel are coarser than the offshore sediments. Mean grain size ranges from 0.47 to 0.94 mm and is classified as medium to coarse sand. Samples contain as much as 10% gravel. The side channel leading to the boat basin consists of fine sand (0.21 mm) while the boat basin contains silt. The finest material traditionally has been disposed on land by pipeline dredge. A sample taken at the edge of the site is identical with the other native sediments.

Water Quality

Water quality in the vicinity of the proposed Rogue River ODMDS is expected to be typical for seawater of the Pacific Northwest. There is no reason to expect significant chemical contamination in either the water or sediments as few heavy industries are located along the estuary. Basic water quality parameters are taken in field sampling during collections of sediment samples from the entrance channel. All of the values have been within normal ranges for the Oregon Coast.

Biological Resources

This section summarizes biological conditions in the ocean environment offshore of the Rogue River entrance. Additional information is provided in Appendix A. The existing ODMDS site is located in the nearshore area and is typical of oceanic habitat common to the nearshore Pacific Coast off Oregon.

Plankton and Fish Larvae

No specific data is available for zooplankton in the Rogue 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). 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 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 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 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. 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. 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 kilometers off Haceta 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 during the summer off the central Oregon Coast (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 ichthyoplankton sampling along the Newport hydrographic line during the summer is representative of ichthyoplankton assemblages elsewhere along the Oregon Coast.

Benthic Invertebrates

Field sampling in 1984 gathered information on benthic and epibenthic invertebrates and demersal fish at the Rogue River ODMDS (Corps 1988). The benthic infaunal community was dominated by gammarid amphipods and polychaete annelids. Gastropods and cumaceans were also common. Snails were the dominant epibenthic. No significant difference in species diversity between the sampling stations located within the ODMDS and the reference sites were observed. In general, benthic infauna densities were lower as compared to other shallow-water ocean disposal sites.

Field surveys were conducted in August and November 2007 by Marine Taxonomic Services (2008) to provide current information about the benthic invertebrate species present at the Rogue River ODMDS. The benthic invertebrate fauna was found to be typical of the nearshore, high-energy environment found along the Oregon Coast. The benthic community at the ODMDS was driven by the opportunistic polychaetes

Magelona sacculata, *Spiophanes bombyx* and *Chaetozone nr. setosa* and the gammarid amphipods *Mandibulophoxus gilesi* and *Eohaustorius* spp. The only commercially important benthic infaunal species (*Siliqua* spp.) was not very abundant at the ODMDS. 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, Umpqua River, Siuslaw River, and 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 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. 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

The commercially and recreationally important epibenthic species in inshore coastal areas of Oregon include shellfish and Dungeness crab. Razor clam beds are located along the inshore beaches in the Rogue River area. It is generally thought that recruitment of razor clams to the inshore beaches comes from subtidal spawning areas. Gaper clams, cockles, and Pittock clams likely occur near the mouth of the Rogue River and upriver in the estuary proper. Dungeness crab adults occur on sandflat habitat along the Oregon Coast. They spawn in offshore areas and occur in the estuary when conditions are favorable in late summer and fall.

As discussed previously, the nearshore area off the Rogue River supports anadromous salmonids including coho salmon, winter steelhead, and spring and fall Chinook salmon, as well as a variety of other pelagic and demersal fish species.

Commercial and Recreational Fisheries

Based on data from the National Marine Fisheries Service (NMFS 2006), landings delivered to Gold Beach in 2000 were in the following West Coast fisheries (data shown represents landings in metric tons/monetary value of said landings/number of vessels landing; NA = not available): crab (30/$133,107/5), groundfish (43/$236,173/36), salmon (NA/NA/1), and other species (131/$173,950/17). The ocean charter season goes year-round offshore of the Rogue River and targets lingcod and rockfishes. The 2000 recreational salmonid catch in the ocean boat fishery was 74 Chinook salmon. The recreational non-salmonid catch was a total of 15,416 fish. The top species landed included black rockfish, blue rockfish (*Sebastes mystinus*), canary rockfish (*Sebastes pinniger*), and lingcod (NMFS 2006).

Wildlife

As discussed previously, Steller sea lions, harbor seals, and California sea lions are present most of the year in the Rogue River coastal area. The Rogue River nearshore area and shoreline provides important habitat for shorebirds, waterfowl, herons, bald eagles, hawks, and many other species of birds. Pelagic birds likely use the Rogue ZSF

and adjacent waters for foraging. The wildlife areas offshore of the Rogue River entrance (Hubbard Mound, Rogue Reef, and Hunter's Island) provide nesting habitat for many seabird species.

Endangered Species

Southern Oregon/Northern California Coast coho salmon is a federally listed species that occurs in the vicinity of the proposed Rogue River ODMDS. The Rogue River and estuary were designated as critical habitat but the ocean area off the Rogue River was not. Coho salmon are present in the area 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 in the Rogue River ranges from mid-August through November, with a distinctive peak in September to mid-October. Juvenile outmigration extends from April through June and peaks in mid-May to mid-June.

The Southern Distinct Population Segment (DPS) of green sturgeon (*Acipenser medirostris*) is listed as a federally threatened species. Green sturgeon that spawn primarily in the Klamath and Rogue rivers constitute the Northern DPS, which is not federally listed. Southern DPS green sturgeon may occur at or near the Rogue River ODMDS 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 site, but critical habitat has not yet been designated.

The federally threatened Steller sea lion inhabits the lower Rogue River and coastal area. Steller sea lions forage at river mouths and nearshore areas along the Oregon Coast. Rogue Reef is used as a rookery and haul-out area for Steller sea lions. More than 1,800 threatened Steller sea lions (45% of state total) use the reef, forming the largest pupping site for this species in the United States south of Alaska (Hillmann 2006). Peak sea lion attendance at the reef occurs during May, June, and July; sea lions begin to leave the rookeries in August.

Federally listed avian species in the Rogue River offshore area include the marbled murrelet, brown pelican, and short-tailed albatross. 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 Rogue River. Brown pelicans are often associated with spits and offshore rocks in the Rogue River area. The 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 occur as migrants off the Oregon Coast in waters typically farther from shore than the proposed Rogue River ODMDS. 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 Rogue River enters the Pacific Ocean at the City of Gold Beach, Oregon, located approximately 1.5 miles from the proposed Rogue River ODMDS. Gold Beach, which is the Curry County seat, had a population in the 2000 census of 1,897 while Curry County's population in 2000 was 21,137. The town was named for the gold that was discovered there in the early 1850s. Not long after its settlement, lumber manufacturing became the primary economic activity. Today the wood products industry remains valuable, but the tourist and fishing industries have become more important.

Cultural Resources

Appendix D provides detailed information concerning cultural resources in the Rogue River ODMDS area. Prehistoric cultural resources are unlikely to be found within the Rogue offshore area. It is possible that prehistoric Native Americans may have used portions of the Rogue offshore reefs as a fishery. Any remaining remnants of prehistoric fishing activity are unlikely or not retrievable. Shipwrecks are the most probable cultural resources expected to exist within the offshore area. Historical review indicates several recorded shipwrecks in the Rogue offshore area. A side-scan sonar survey was conducted over a large area in and around the Rogue River ODMDS. No shipwrecks or other historic remnants were detected from this survey.

Recreational Uses

Recreational resources in the Rogue River ODMDS area are described in Appendix E. The offshore area and the Rogue River itself are popular with recreationists because of the coastal scenery and excellent fishing and other recreation opportunities during all seasons of the year. The primary activities include sightseeing, fishing, beachcombing, and boating. The area is increasing in popularity as a small boat harbor and has excellent facilities for the many anglers who fish the area annually. Nearby beaches and entrance jetties receive a continual influx of recreationists. The nearshore ocean area is used by recreational anglers and boaters. Clamming is also a popular recreation activity along local beaches. Fishing in the vicinity of the ODMDS is primarily for salmonids and bottom fish.

Commercial Uses

The Rogue River offshore area supports a moderate commercial fishery primarily for salmon, Dungeness crabs, and bottom fish. Clams are also 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 ODMDS.

ANALYSIS OF ALTERNATIVES

EPA and the Corps considered several alternatives for disposal of dredged material generated from the Rogue River navigation project or other authorized users. Those alternatives include no action, upland disposal, and estuarine disposal. The alternatives considered for ocean disposal include disposal off the continental shelf, continued use of the existing ODMDS, and/or designation of a new ODMDS. 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. In addition, other potential users of the site would likely face many of the same constraints as the Corps in the disposal of dredged material. Therefore, 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 an ODMDS 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 Rogue 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 Rogue 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

Potential upland disposal sites are available and are used for portions of the material currently dredged from the boat basin access channel. The material that is disposed of at upland locations is removed using a clamshell dredge and stockpiled at an upland rehandling site prior to sale or use by the Port of Gold Beach. The location of the boat basin, the relatively small quantities of material removed from the boat basin, and the use of mechanical dredging equipment make upland rehandling a feasible option for this material.

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. An in-water sump would need to be dredged and material bottom-dumped into

it, then pumped ashore with a pipeline suction dredge. In addition to 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). Another 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 Rogue 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 (fine grained, clean, etc.) 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 Rogue 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 Rogue River entrance channel.

The Corps has placed portions of the dredged material from the boat basin in intertidal areas for beneficial purposes. Specifically, some of the material dredged by clamshell and pipeline dredges has been placed in an area adjacent to the Gold Beach airport on the beach in the South Beach surf zone. Beneficial use of dredged material is possible in these instances because of the proximal location of the beneficial use site in relation to the dredge location, the type of dredging equipment utilized, and the relatively small quantity of material dredged.

Ocean Disposal Alternatives

Ocean disposal alternatives include disposal of the material off the continental shelf, continued use of the existing ODMDS, and/or designation of a new ODMDS.

Disposal off of 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).

[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)

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 downslope as turbidity currents and offshore by near-bottom currents, potentially affecting organisms outside of any designated site.

Further, disposal off the continental shelf would remove natural sediments from the nearshore littoral transport system, a system that functions with largely non-renewable quantities of sand in Oregon. While the loss of the present volumes of Corps' dredged material are unlikely to result in disruption of the mass balance of the littoral system, the State of Oregon is already experiencing erosion/accretion patterns that are adversely impacting beaches, spits, wetlands, and other shoreline habitats.

The limiting factor in considering a location beyond the edge of the continental shelf is feasibility. At, and in the vicinity of, the Rogue 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 Rogue 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, given the increasing 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. That investigation is not currently warranted given the suitability of the existing site as discussed below.

Continued Use of Existing ODMDS

The existing 103-selected Rogue River ODMDS has been used for disposal of dredged material since at least 1977. From 1986 to 2006, approximately 1.1 million cy of dredged material suitable for ocean disposal have been placed in the 103-selected Rogue River ODMDS for a 20-year average annual loading volume of 54,000 cy/year. A uniform placement strategy has been applied. The site is relatively small which limits disposal options. However, regular bathymetric surveys have shown that persistent mounding has not occurred at the site. Continued management and monitoring of the site would take place in accordance with the Site Management and Monitoring Plan (SMMP) attached in

appendix F. Over the long-term, site capacity seems to be unlimited as material placed redistributes out of the site, feeding the littoral cell.

There is a preference towards using sites that have been used historically as expressed in the regulations at 40 CFR § 228.5(e). The existing Rogue River ODMDS has been in use successfully for 30 years and has not resulted in any mounding or associated environmental effects. Given the problematic nature of other disposal options discussed above, and the proven capability of this site to accommodate dredge material, the following analysis will be limited to an evaluation of the existing site according to the regulatory criteria, to determine its suitability for continued use.

Designation of New ODMDS

A new ODMDS could potentially be evaluated for designation. However, there is an existing site that has been historically used and based on EPA's general regulatory criteria at 40 CFR § 228.5(e), that site will be evaluated for continued use before another location is identified or evaluated.

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 Rogue River ODMDS 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 228.5-228.6 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 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.

Rogue River ODMDS Zone of Siting Feasibility

Although an ODMDS, 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 Rogue River ODMDS is the Corps, who is expected to utilize the site annually for disposal of dredged material from the Rogue River Navigation Project. Potential users of the proposed Rogue River ODMDS 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 Rogue River ODMDS 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 Rogue River ODMDS. The amount of time necessary to maintain the Rogue 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 (i.e., pumps, size of hopper, drag arms, etc.) and the dredging site conditions. The time to discharge material also is basically fixed for a given dredge and the type of material, but may vary slightly depending on the disposal methodology outlined in the Sediment 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 ODMDS. Transport time depends primarily on the haul distance to the disposal site as the speed of different hopper dredges when full are 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 Rogue River ODMDS, certain factors are relatively fixed. The 7-year average (2002-2008) volume dredged from the Rogue River Navigation Project and currently disposed at the 103-selected disposal site is 34,138 cubic yards (CY). Under current and foreseeable conditions at the project the estimated volume of material to be dredged and disposed of annually is expected to remain at the current average of 34,138 CY. Based upon work load, available funding and other constraints, the government-owned hopper dredge YAQUINA is typically available 6.4 days (according to latest 7 year average) at the Rogue River navigation project or, in its absence, a contract dredge is available for a similar length of time. This equates to equipment available for dredging and disposing of, on average, 5427 CY per day. The rated capacity for the YAQUINA is 1,042 CY per load. However, the authorized depth for the Rogue River Navigation Project is shallow, only 13 ft, and the YAQUINA, with a draft of 8 ft, cannot be fully loaded without grounding. Therefore, for the purposes of calculating the ZSF, a partial load was assumed. Load time is typically around 45 minutes at the mouth of the Rogue River. Depending on conditions set in the SMMP, environmental conditions at the disposal site, and characteristics of the dredged material, dump time once at a site ranges from 2 to 5 minutes. The dredge typically operates 24

hours per day except when crews are changed. The ZSF, as determined by haul distance, can be calculated as follows:

Assume 10 partial (1/2) loads per day (5427 CY ÷ (1042 ÷ 2) CY/load = 10.41 loads)

Load time (.77 hr) + Dump time (0.053 hr) = .82 hr/load X 10 loads or 8.2 hr/day

24 hr/day − 8.20 hr/day = 15.80 hr/day for transit to and from the disposal site

15.8 hr/day ÷ 10 loads/day = 1.58 hr transit time for one round trip

1.58 hr ÷ 2 = 0.79 hr transit one way

0.79 hr X 6 kts (vessel speed) = 4.74 nm

Thus the outer limit of the ZSF for the Rogue River ODMDS, as limited by the capacity of the available dredging plant, average annual dredging quantity, and limited dredging time period is 4.74 nm from the Rogue 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 Rogue River ODMDS. A conflict matrix format is utilized in Table 3 to simplify and consolidate scoring for the general and specific site criteria review process. Each area of consideration on the conflict matrix addresses at least one general or specific criterion. A legend defining the matrix categories follows the table.

General Criteria

Minimize Interference with Other Activities (a.). The first of the five general criteria requires that a determination be made as to whether the proposed site or its 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 *Rogue Ocean Dredged Material Disposal Site Evaluation* (Corps 1988) and the more recent appendices prepared for this evaluation. The report presents the overlays on a base map, giving bathymetry and location of the ODMDS and ZSF. The more interactions between various uses and limited resources exist, the more critical the area. The overlay process was used to minimize interference with other uses of the ocean. The 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
6. Cultural, Historically Significant Areas

Figure 2 is a composite of all of the above areas and indicates by various patterns, the relative amount of total usage in the vicinity of the proposed Rogue River ODMDS. The Rogue River ODMDS lies south of the most navigationally and environmentally critical area, the reefs in the northwestern part of the ZSF. These reefs represent valuable habitat for fish such as black and yellow rockfish and lingcod. They are extensively fished. Commercial and recreational salmon fishing occurs in ZSF but it is not limited to that area, occurring (as it does) over a wide nearshore area. Disposal operations and the salmon fishing season do overlap; however, coordination with Oregon Department of Fish and Wildlife personnel indicate no observable conflicts between the two uses. Appendix A discusses all potential conflicts with living resources and concludes 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 *at the Umpqua River*, 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 (Corps, 2008).

Based on an analysis of the sediment quality at both the existing ODMDS and within the Rogue 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 Rogue River Site. 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.

Table 3. Conflict Matrix for the Proposed Rogue River ODMDS

AREA OF CONSIDERATION [1/]	CONFLICT [2/]	POTENTIAL CONFLICT	NO CONFLICT	BENEFICIAL USE	COMMENTS	RELEVANT SPECIFIC FACTORS 11 Specific Factors [3/] (40 CFR 228.6)	RELEVANT GENERAL CRITERIA 5 General Criteria [4/] (40 CFR 228.5)
1. Unusual Topography/Unique Bottom Features			X			1, 6, 8, 11	a
2. Physical Sediment Compatibility			X			3, 4, 9	b, c, d
3. Chemical Sediment Compatibility			X			3, 4, 7, 9	a, b, c, d
4. Influence of Past Disposal			X			5, 7, 9, 10	a, b, d
5. Living Resources of Limited Distribution			X			2, 3, 6, 8, 11	a, b, d
6. Commercial Fisheries		X				2, 8	a, b
7. Recreational Fisheries		X			Salmon	2, 8	a. b
8. Breeding/Spawning Areas			X		Pelagic Birds, Northern Sea Lions	2, 8	a, b
9. Nursery Areas		X			English Sole	2, 8	a, b
10. Feeding Areas			X		Harbor Seals, Brown Pelicans, Pelagic Birds, Northern & California Sea Lions	2, 8	a, b
11. Migration Routes		X			Juveniles & Adults for Pelagic Birds, Whales, Pinnipeds	2, 8	a, b
12. Critical Habitat of Threatened or Endangered Species			X		Brown Pelicans, Peregrine Falcon, Migrants, Forage in Area	2, 8	a. b
13. Spatial Distribution of Benthos			X			2, 8, 10	a. b
14. Marine Mammals			X		Harbor Seals, Northern & California Sea Lions, Whale Migration Route	2, 8	a. b
15. Mineral Deposits		X			Offshore Placer Deposits	1, 8	a. b. c
16. Navigation Hazard			X			1, 8	a, b, d
17. Other Uses of Ocean (cables, pipelines, etc)			X			8	a, b, d
18. Degraded Areas			X			4, 6, 7	a, b, d
19. Water Column Chemical/Physical Characteristics			X			4, 6, 9	a, b, d
20. Recreational Uses		X			Salmon/Reef Fish	2, 8, 11	a, b, c, d
21. Cultural/Historic Sites			X			11	b
22. Physical Oceanography - Waves/Circulation			X			1, 3, 6, 7	a, b, d
23. Direction of Transport/Potential for Settlement		X			To Offshore Rocks	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			Offshore Rocks Adjacent to Site	2, 3, 4, 7, 11	b, d
27. Potential for Cumulative Effects			X			4, 7	c, d

Conflict Matrix Legend

1/ Definition of "Areas of Consideration"

1. Unusual Topography/Unique Bottom Features: Would placement of material in this candidate site affect physical bottom feature that is unique within the local or regional area?
2. Physical Sediment Compatibility: Does the candidate site have similar sediment characteristics to anticipated dredged material?
3. Chemical Sediment Compatibility: Does the candidate site have similar chemical characteristics to anticipated dredged material?
4. Influence of Past Disposal: Would placement of material in this candidate site be affected by previous disposal of dredge material?
5. Living Resources of Limited Distribution: Would placement of material in this candidate site affect any living resources that do not have a coast-wide distribution?
6. Commercial Fisheries: Would placement of material in this candidate site affect any commercial fishing activity (resource impacts are covered in 8-11)?
7. Recreational Fisheries: Would placement of material in this candidate site affect any recreational fishing activity (resource impacts are covered in 8-11)?
8. Breeding/Spawning Areas: Would placement of material in this candidate site affect breeding and spawning areas of any species?
9. Nursery Areas: Would placement of material in this candidate site affect nursery areas of any species?
10. Feeding Areas: Would placement of material in this candidate site affect feeding areas of any species?
11. Migration Routes: Would placement of material in this candidate site affect migration routes of species?
12. Critical Habitat of Threatened or Endangered Species: Would placement of material in this candidate site affect critical habitat of threatened or endangered species?
13. Spatial Distribution of Benthos: Would placement of material in this candidate site change the benthic invertebrate community structure (e.g., fine-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 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.

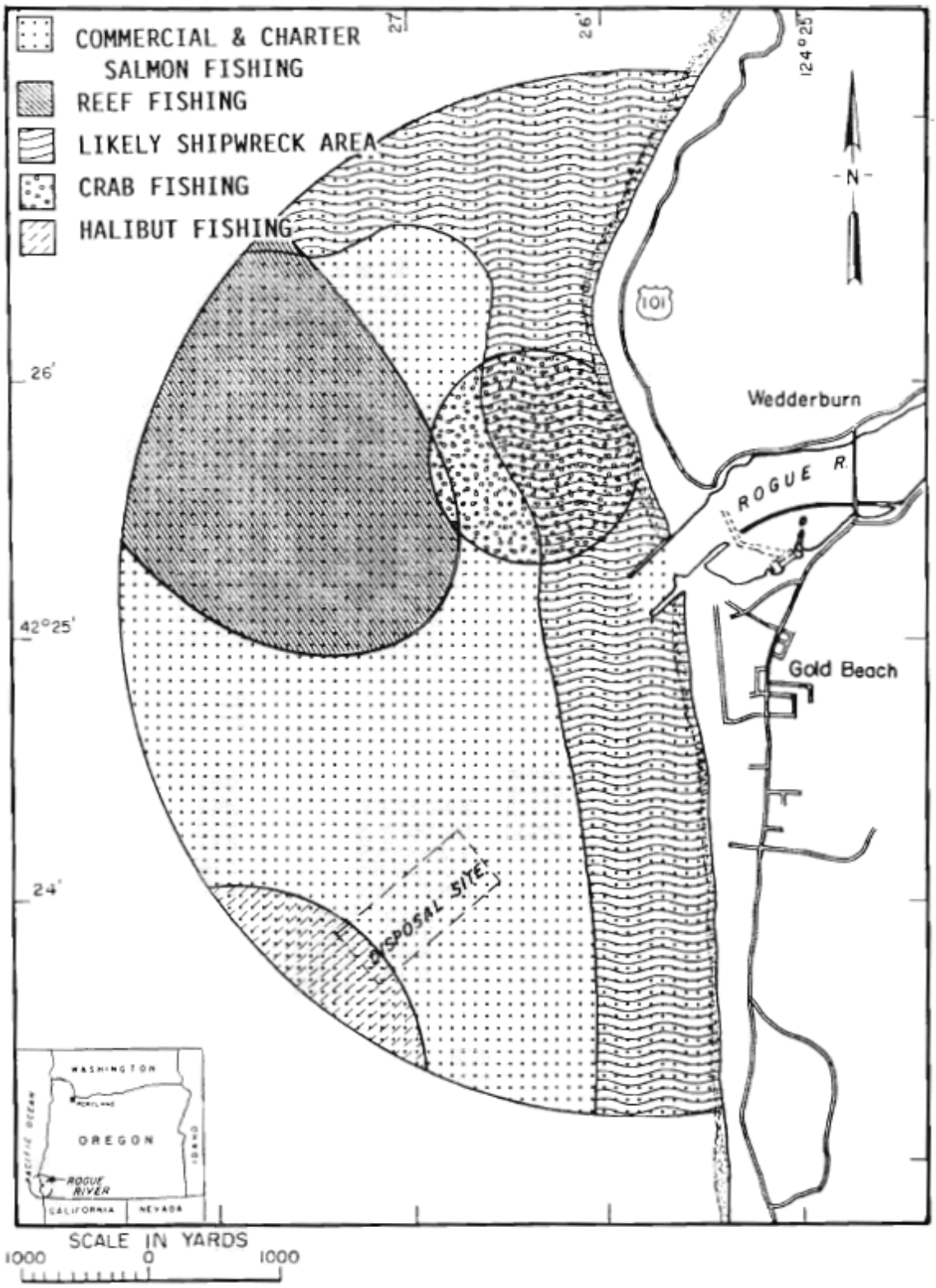
3/ Eleven Specific Factors for Ocean Disposal Site Selection

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 1 immediate adverse impacts and to permit the implementation of effective monitoring and surveillance programs to prevent adverse, long-range impacts. The size, configuration, and location of any disposal site will be determined as a part of the disposal site evaluation or designation study.
e. EPA will, whenever feasible, designate ocean dumping sites beyond the edge of the continental shelf and other such sites that have been historically used.

Figure 2. Overlay Evaluation of Individual Resources of Limited Distribution



Size of Sites (d). The fourth general criterion requires that the size, configuration, and location of the site be evaluated as part of the study and the size to be limited. Ocean disposal sites are sized to localize, for identification and control, any immediate adverse impact and permit the implementation of effective monitoring and surveillance programs. The size, configuration, and location of the proposed Rogue River ODMDS was evaluated as part of the 1988 evaluation (Corps 1988). The proposed ODMDS is 3,600-feet long by 1,400-feet wide. The site is dispersive and of appropriate size to handle the volumes of material it receives annually without resulting in mounding or any associated concerns, as evidenced by the lack of mounding during the 30 years of disposal activities at the Existing ODMDS. Public notices issued for specific, proposed ocean disposal operations, as required by MPRSA, have not generated concerns about undue impacts from the site's use.

Sites Off the Continental Shelf (e). At the Rogue 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 downslope 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 4.74 nautical mile limit of the Rogue Zone of Siting Feasibility, 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.

Lastly, criterion "e" provides a preference for disposal off the continental shelf, or in "other such sites that have been historically used." The existing Rogue site has been in the same location for over 30 years and has not resulted in any known long-term impacts to the environment or other uses of the area. Therefore, in proposing to designate the existing site, EPA is utilizing a site that has been historically used.

Specific Criteria

Geographical Position, Depth of Water, Bottom Topography, and Distance from the Coast (1). The Rogue River ODMDS is approximately 1.75 miles southwest from the entrance to the Rogue River (see Figure 1). Appendix B contains a detailed discussion of the bottom topography of the site. In general, the site lies on bottom contours sloping at a rate of 8/1000 feet to the west-southwest. The designated site would be used for disposal of dredged material from the Rogue River navigation project and other permitted projects. Site coordinates (NAD 83) and dimensions of the proposed Rogue River ODMDS are as follows:

A. 42° 24' 15.40", 124° 26' 52.39"	*Dimensions:*
B. 42° 24' 03.40", 124° 26' 39.39"	1,400-feet wide by 3,600-feet long
C. 42° 23' 39.40", 124° 27' 17.40"	116 acres
D. 42° 23' 51.40", 124° 27' 30.40"	Depth: 50 to 90 feet

Based upon consideration of the location, depth of water, bottom topography, and distance from the coast, the proposed ODMDS has been demonstrated to be suitable for the disposal of dredged material when 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 Rogue 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 *Rogue River, Oregon: Ocean Dredged Material Disposal Site Designation Biological Assessment* (BA), dated June 5, 2008. The proposed ODMDS is located in the nearshore area and many nearshore pelagic organisms occur in the water column over the site. 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 directly off the Rogue River are small compared to the overall coastal population.

The Rogue River mouth contains several neritic reefs within it. These reefs are unusual features along the Pacific Coast and support a variety of aquatic organisms, including bull kelp (*Nereocystis luetkeana*) and its associated fish and invertebrate community. The ODMDS is located approximately 2 nautical miles southeast of the Rogue Reef as shown on Figure 1. Since the disposal material is clean sand that settles quickly within the ODMDS, any movement of the disposed sand into reef areas would occur through natural littoral transport. Also, since the disposal quantity is relatively small compared to the longshore transport, disposal at the ODMDS should not adversely affect marine aquatic communities in the reef areas.

Benthic samples are discussed in Appendix A. Based on the analysis of benthic samples collected in both 1984 and 2007 from the Rogue River ODMDS area, the ocean disposal site contains 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 ODMDS consists primarily of medium-to fine-grained marine sands typical of the Oregon coastal area. The infaunal community of the Rogue 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, Umpqua River, Siuslaw River, and 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 Rogue 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 of releasing a large quantity of eggs so that some individuals will survive a substantial mortality during the larval and juvenile stage. Crabs in particular release large number of eggs into the water column. The larvae that hatch from the eggs are planktonic for several months before settling to the bottom of the estuary and nearshore ocean as young crab. During this time, they are subjected to a variety of environmental factors that affect their survival and have a direct affect on population numbers of adults.

The nearshore area off the Rogue River supports anadromous salmonids including winter steelhead (*Oncorhynchus mykiss*), spring and fall Chinook salmon (*Oncorhynchus tshawytscha*), and federally threatened coho salmon (*Oncorhynchus kisutch*), as well as a variety of other pelagic and demersal fish species. Common pelagic species include the Pacific herring (*Clupea harengus pallasi*), northern anchovy (*Engraulis mordax*), and surf smelt (*Hypomesus pretiosus*). Demersal species present in the inshore area are mostly residents and include a number of sculpins, sea perch, and rockfish species that are associated with Rogue Reef, as well as flatfish species occurring predominantly over open sandflats. Common flatfish species include English sole (*Parophrys vetulus*), sanddab (*Citharichthys* spp.), and starry flounder (*Platichthys stellatus*). English sole and starry flounder, along with the sand sole (*Psettichthys melanostictus*) 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 Rogue 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. Harbor seals breed in the estuary and on nearshore rocks. Steller sea lions forage at river mouths and nearshore areas along the Oregon Coast. Rogue Reef is used as a rookery and haul-out area for Steller sea lions and is designated as critical habitat under ESA. Many harbor seals and California sea

lions are also found at the reef. More than 1,800 threatened Steller sea lions (45% of state total) use the reef, forming the largest pupping site for this species in the United States south of Alaska (Hillmann 2006). Steller sea lion population counts for Oregon have increased since 1977, when the statewide non-pup population totaled 1,431, to 4,169 in 2002, an annual rate of increase of about 3.7% (Brown et al. 2002). Brown, et al. (2002), also found that the pup counts for the Rogue Reef have increased over time, from 492 in 1990 to 746 in 2002, although the pup counts have not been completed annually. Steller sea lion numbers appear to be lower off Oregon in the winter than summer with peak presence occurring June and July (Roffe and Mate, 1984).

Wildlife areas offshore of the Rogue River entrance include Hubbard Mound, Rogue Reef, and Hunter's Island. Hubbard Mound to the north is a nesting area for oystercatchers, gulls, Brandt's cormorants (*Phalacrocorax penicillatus*), pelagic cormorants (*Phalacrocorax pelagicus*), and common murres (*Uria aalge*). Sea lions also haulout on Hubbard Mound. To the northwest, Rogue Reef provides nesting habitat for many pelagic birds including about 4,000 common murres and more than 500 Brandt's cormorants (Hillmann 2006). Hunter's Island to the south provides nesting habitat for storm petrels, cormorants, and gulls. Other seabird species that congregate and nest on the island include Cassin's auklets (*Ptychoramphus aleuticus*), oystercatchers, pigeon guillemots (*Cepphus columba*), rhinoceros auklets (*Cerorhinca monocerata*), and tufted puffins (*Fratercula cirrhata*). Harbor seals use the island as a rookery.

Federally listed avian species that may be present in the Rogue River offshore area include the marbled murrelet (*Brachyramphus marmoratus*, threatened), brown pelican (*Pelecanus occidentalis*, endangered), and 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 Rogue River. Brown pelicans are often associated with spits and offshore rocks in the Rogue River area. 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 ESA. 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 and occur as migrants off the Oregon Coast in waters typically farther from shore than within the proposed Rogue River ODMDS. 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 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.

In general, the location of the proposed ODMDS does not provide any 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 *at the Umpqua River*, water column turbidity would be expected to dissipate within a few minutes to half hour (Corps, 2008). 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 have not indicated that any long-term adverse impacts to living resources have occurred. Therefore, EPA concluded in the BA that the 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 northwest corner of the interim ODMDS is just over 2,000 yards from the end of the South Jetty. The inshore comer of the site lies approximately 1,500 yards offshore. South Beach is located immediately west of Gold Beach and is approximately 7 miles long, spanning from the Rogue River south to Cape Sebastian. Bailey Beach, approximately 3 miles long, is located immediately north of Gold Beach.

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

The majority of the dredged material disposed in the ocean traditionally comes from shoals in the Rogue River entrance channel. They consist primarily of marine sand transported into the entrance. The material is clean, with the exception of nickel contains no contaminants of concern above screening 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. Sediments in the Rogue River and offshore do have elevated levels of nickel compared to other drainage basins along the Oregon Coast. Because of their consistency and lack of known

local sources, these levels are believed to be background in the river system. Material dredged from the boat basin access channel is finer but has been evaluated under the SEF and also found suitable for unconfined open-water disposal. Material dredged from the boat basin access channel may at times be placed in either the ODMDS, an upland rehandling area that is a beneficial use site for the Port of Gold Beach, or adjacent to the Gold Beach airport in the South Beach surf zone. The ODMDS has 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 this site, a draft of which is Appendix F to this document. 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 ODMDS is readily accessible. Most monitoring work can be performed from small, surface research vessels at a reasonable cost.

Dispersal, Horizontal Transport and Vertical Mixing Characteristics of the Area Including Prevailing Current Direction and Velocity, if Any (6). Appendix B provides a detailed discussion regarding this criterion. The material dredged from the Rogue River navigation channel is medium to coarse sand. The Rogue River ODMDS is exposed to normal wave action as described in Appendix B. For the range of depths and grain sizes found at the Rogue River ODMDS, there is nearly constant mobilization of bottom sediment due to wave action. This wave-induced motion is not responsible for net transport, but, once in motion, bottom sediments can be affected by other forces such as gravity or directional currents.

The nearshore circulation patterns at Rogue are unclear. Their complexity is perhaps due to the rocky reefs in the northern part of the ZSF. The prevailing currents at the depth of the disposal site seem to be towards the north. Figure B-6 in Appendix B illustrates the sediment transport system assumed to be active. Although the Rogue River must deliver a large sediment load, the bottom contours suggest a rapid distribution offshore. While there is shoreline accretion 1 to 2 miles to the north, the shoreline to the south seems to be in equilibrium, suggesting littoral transport to the south is balanced by offshore transport. Disposal of dredged material at the ODMDS does not appear to contribute significantly to coastal processes.

Existence and Effects of Current and Previous Discharges and Dumping in the Area including Cumulative Effects (7). Due to coarser sediments being deposited on finer ones at the disposal site, theoretically there is a potential for mounding to occur. Bathymetric surveys, however, have shown no signs of mounding at the ODMDS from past disposal. These surveys actually show erosion of the seafloor in the area of the ODMDS (see Appendix B). Periodic monitoring will continue to evaluate potential mounding and erosion.

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. The major commercial fishing areas in the vicinity of the proposed Rogue River ODMDS are discussed in Appendix A. Based on data from the National Marine Fisheries Service (NMFS 2006) for commercial fishing, a total of 50 vessels, all commercially registered, delivered landings to Gold Beach in 2000. Landings were in the following West Coast fisheries (data shown represents landings in metric tons/monetary value of said landings/number of vessels landing; NA = not available): crab (30/$133,107/5), groundfish (43/$236,173/36), salmon (NA/NA/1), and other species (131/$173,950/17). There were no fish processors operating in Gold Beach in 2000. Gold Beach residents owned 20 vessels in 2000, seven of which participated in the federally managed groundfish fishery. 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.

The major recreational fishing areas in the vicinity of the proposed Rogue River ODMDS are discussed in Appendices A and E. Based on data from the NMFS (2006) for recreational fishing, Gold Beach had at least 27 outfitter guide businesses in 2003. Ten licensed charter vessel businesses were located in the community (two had their homeport in Brookings). There were about 28 sport fishing businesses in 2003. The ocean charter season goes year-round and targets lingcod and rockfishes. Gold Beach has nine licensing vendors and in 2000, the number of licenses sold was 3,566 at a value of $60,984. The 2000 recreational salmonid catch in the ocean boat fishery was 74 Chinook salmon. The recreational non-salmonid catch totaled 15,416 fish. The top species landed included black rockfish, blue rockfish (*Sebastes mystinus*), canary rockfish (*Sebastes pinniger*), and lingcod.

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 indicate that they are not aware of any instance where this has been a problem. 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 final designation of the Rogue River ODMDS.

Mineral Extraction. The Rogue River and its tributaries flow through bedrock containing mineralized zones and have several reaches containing gold placer deposits.

Beach placers at Gold Beach have been mined in the past for gold and platinum. Mining was done in the winter when the sand was stripped from the beaches, exposing the mineral rich gravels. Some placers were also found on uplifted marine terraces (Ramp 1973, Gray and Kulm 1985). Historically the most prominent and extensive zones of heavy mineral concentrations identified on the continental shelf of the Oregon Coast were believed to occur off the mouth of the Rogue River. Chromite, ilmenite, and magnetite make up the bulk of the concentration according to Kulm (1988). The most extensive deposits were thought to be located off the Rogue River with heavy mineral concentrations ranging from 20% to 30%. These deposits were identified as approximately 37 km long extending from the nearshore zone to water depths of 90 meters. It has been suggested that the magnetic anomalies found off the Rogue and Sixes rivers were caused by mineral deposits having dimensions and mineral characteristics similar to those of deposits located onshore in adjacent beach and terrace deposits (Kulm 1988, Peterson and Binner 1988).

The Oregon Placer Minerals Technical Task Force commissioned a reconnaissance-level field investigation of heavy mineral placer deposits offshore of the Rogue River in September and October 1990 (Oregon 1991). The study did not find any heavy mineral deposits that could be mined in the Rogue River area. Previous reports of magnetic anomalies were attributed to near-surface masses of bedrock. Offshore deposits are not currently being mined nor are any currently proposed for mining. While there have been several historical attempts to find oil and gas along the Oregon Coast, test wells have not found significant quantities of oil or gas. As of 2007, no test wells have been drilled south of Cape Blanco on the Oregon Coast. The State of Oregon currently has a moratorium on leasing for purpose of exploration, development, or production of oil, gas, or sulfur up to 3 miles off the Oregon Coast until January 2, 2010.

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

Wave Energy. With the increased interest in alternative energy sources, various wave energy projects have been proposed off the coast of Oregon. The Governor of the State of Oregon, in a November 2007 news release to the Oregon Fishing Industry, stated that he was asking the Federal Energy Regulation Commission to limit the permitting of wave energy to five to seven 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 Rogue River.

Fish and Shellfish Culture. There are no fish or shellfish culture operations in the area of the Rogue River ODMDS.

Shipping and Other Legitimate Uses. No conflicts with commercial navigation traffic have been recorded in the more than 60-year history of hopper dredging activity. The likely reason for this is the light commercial traffic at the Rogue. Navigation hazards

do exist within the ZSF. Figure 3 shows potential navigation hazards in the area. Ships cannot navigate in the northwest part of the ZSF due to the exposed reefs.

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 ODMDS.

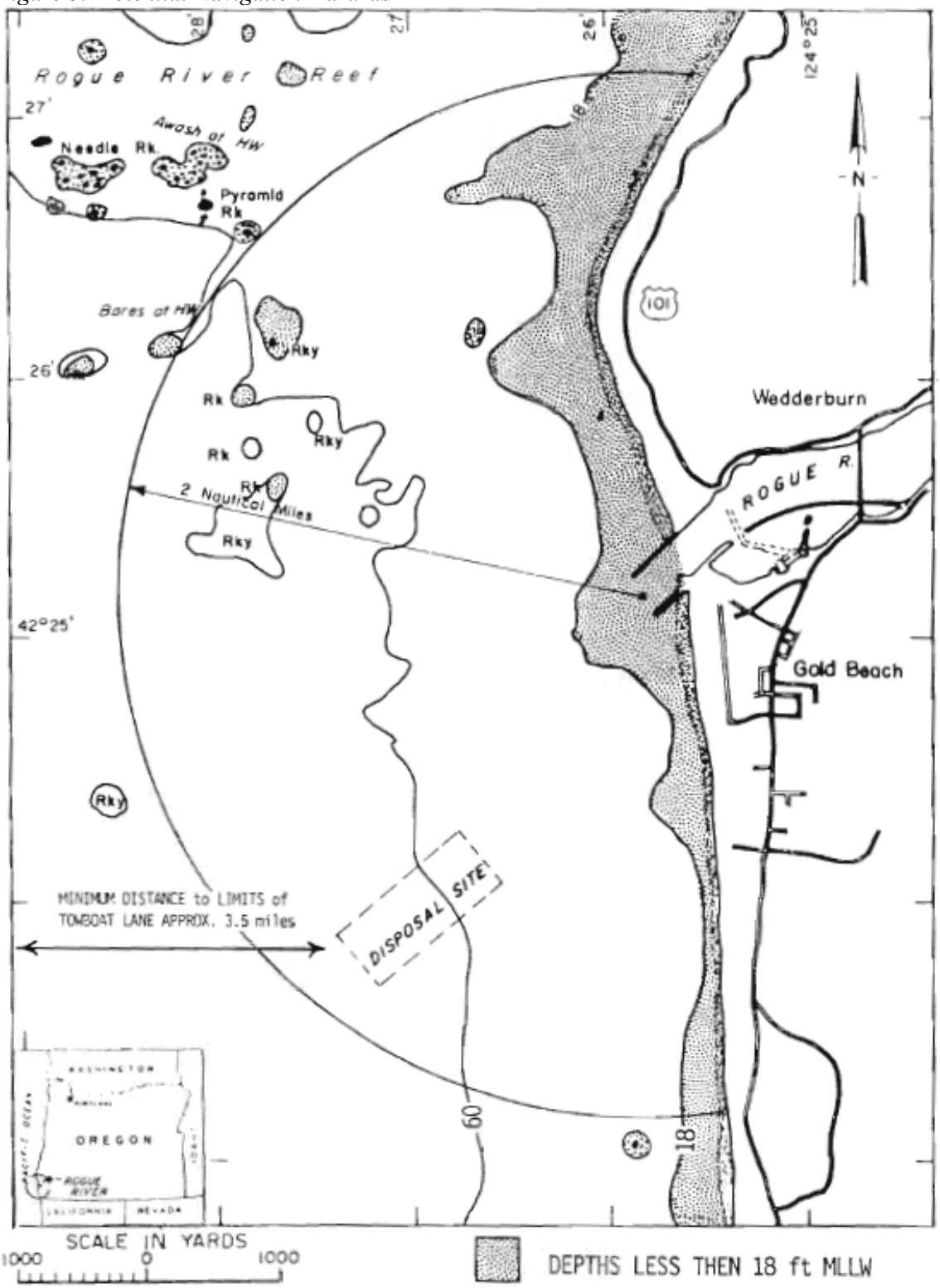
There are no intertidal or subtidal marine protected areas within the proposed Rogue River ODMDS. Rogue Reef is included in the Oregon Islands National Wildlife Refuge and is listed as a priority offshore rock/reef within Oregon's Ocean Plan. However, Rogue Reef is located approximately 2 nm northwest of the proposed disposal site.

Special Scientific Importance. There are no known transects or other scientific study locations that would be impacted by disposal at the Rogue River ODMDS.

General Discussion of Other Uses. There has not been a demonstrated conflict with any of the above listed uses of the existing Rogue River disposal site, which has been in use at the same location under various authorities since 1977. There is a low potential for future conflicts given that the area of the site is not of any unique value, is relatively small, and there are few potential conflicting uses in the vicinity. Since the site has been in use at the existing location for over 30 years, EPA's designation of the proposed Rogue River ODMDS would not 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 ODMDS area and experience with past disposals in this region have not identified any adverse water quality impacts from ocean disposal of dredged material. The ecology of the offshore area is a mobile sand community. This determination is based mainly on fisheries and benthic data. Neither the pelagic or benthic communities should sustain any long-term impacts due to their mobility and widespread occurrence off the Oregon Coast.

Figure 3. Potential Navigation Hazards



Potentiality for the Development or Recruitment of Nuisance Species in the Disposal Site (10). Nuisance species are considered as any undesirable organism not previously existing at the disposal site. They are either transported or recruited to the site because the disposal of dredged materials created an environment where they could establish. Materials dredged and transported to the ODMDS historically have been classified as uncontaminated marine sands similar to the sediment at the site. Potential material dredged from the boat basin access channel and other permitted in-bay projects may include fine-grained material. Limited quantities of fine-grained material form the boat basin access channel 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 any nuisance species could be established at the disposal site since habitat or contaminant levels are unlikely to change over the long-term.

Existence at or in Close Proximity to the Site of any Significant Natural or Cultural Features of Historical Importance (11). The neritic reefs off the Oregon Coast comprise a unique ecological feature. They support a wide variety of invertebrates and fish species, as well as bull whip kelp communities. These areas are sheltered from wave action and receive nutrients from both the ocean and the estuaries and are usually highly productive. The disposal site is located about 2 nautical miles south-southeast from the Rogue Reef complex. Since the disposal material is clean sand that settles quickly, any movement of the disposed sand into the reef area would occur through natural littoral transport. Since the disposal quantity is relatively small compared to the longshore transport, disposal at the Rogue River ODMDS is not expected to adversely affect the aquatic community in the reef areas.

In spite of the heavy ship traffic supplying gold fields in the late 1800s, there do not appear to be any shipwrecks of cultural significance that would be affected by continued use of the Rogue River ODMDS. Documented shipwrecks, as well as potential shipwreck areas are shown and evaluated in Appendix D. However, there are no observed or documented shipwrecks within the proposed Rogue Rover ODMDS.

SUMMARY OF COORDINATION UNDER OTHER APPLICABLE FEDERAL STATUTES

Federal Action

The federal action consists of designation of an ODMDS at the mouth of the Rogue 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

One comment letter dated November 12, 2008, was received from the U.S. Department of Interior. The letter stated that the Department does not have any comments to offer. No other public comments were received in response to the publication of the draft rule. No public meetings were held and none were requested.

Endangered Species Act

EPA's determination that the proposed action may affect, but is not likely to adversely affect (NLAA) listed species was documented in the *Rogue 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 19, 2009.

NMFS concluded that EPA's site designation is not likely to jeopardize the continued existence of SONCC coho salmon or southern DPS green sturgeon and is not likely to destroy or adversely modify SONCC 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 476 yearling SONCC coho salmon and an unquantified but small number of small subadult southern DPS green sturgeon could occur. For Steller sea lions, blue whales, fin whales, humpback whales, and Southern Resident Killer whales, 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, EPA made a determination of NLAA, but 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 *Rogue 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) with NMFS by letter dated June 5, 2008, based on this documentation.

NMFS found that disposal of dredge material, an indirect effect of EPA's action to designate the Rogue River ODMDS, 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 Site 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 to the NMFS Regional Protected Resources Division 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 19, 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 Rogue River ODMDS. EPA provided that determination and supporting evaluation to the State Historic Preservation Officer (SHPO) in the Oregon Parks and Recreation Department by letter dated August 28, 2008. The below listed Tribal Governments 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. No comments were received from any of the Tribal Governments contacted.

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. No comments were received from any of the Tribal Governments contacted.

SELECTION OF OCEAN DISPOSAL SITE FOR FORMAL DESIGNATION

Based upon the evaluation of the criteria contained in 40 CFR Parts 220 through 228, the Corps and EPA have determined that the Rogue River ODMDS is suitable for designation. The ODMDS designation by EPA will be finalized through formal rulemaking adopting this Environmental Assessment/MPRSA Criteria Evaluation and the appendices to support this action.

LITERATURE CITED

Auth, T.D. and R.D. Brodeur. 2006. Distribution and community structure of ichthyoplankton off the coast of Oregon, USA, in 2000 and 2002. *Marine Ecology Progress Series* 319:199-213.

Auth, T.D., R.D. Brodeur, and K.M. Fisher. 2007. Diel variation in vertical distribution of an offshore ichthyoplankton community off the Oregon Coast. *Fish Bulletin* 105:313-326.

Boone, C.G., M.A. Granat, and M.P. Farrell. 1978. Aquatic Disposal Field Investigations, Columbia River Disposal Site, Oregon. Evaluative Summary. Technical Report D-77-30, U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg MS.

Brodeur, R.D., D.M. Gadomski, W.G. Pearcy, H.P. Batchelder, and C.B. Miller. 1985. Abundance and distribution of ichthyoplankton in the upwelling zone off Oregon during anomalous El Niño conditions. *Estuarine Coastal and Shelf Science* 21:365-378.

Brown, R. F., S. D. Reimer, and B. E. Wright. 2002. Population status and food habits of Steller sea lions in Oregon. Marine Mammal Research Program, Oregon Department of Fish and Wildlife, Corvallis, OR.

Corps (U.S. Army Corps of Engineers). 1985. Yaquina Bay Interim Ocean Dredged Material Disposal Site Evaluation Study. Portland District, Portland OR.

Corps (U.S. Army Corps of Engineers). 1988a. Chetco Ocean Dredged Material Disposal Site Evaluation, Final Report. Portland District, Portland OR.

Corps (U.S. Army Corps of Engineers). 1988b. Rogue Ocean Dredged Material Disposal Site Evaluation, Final Report. Portland District, Portland OR.

Corps (U.S. Army Corps of Engineers). 1990. Yaquina Bay Ocean Dredged Material Disposal Site Benthic Infauna Evaluation. Portland District, Portland OR.

Corps (U.S. Army Corps of Engineers). 1993. Tongue Point Monitoring Program 1989-1992 Final Report. Prepared by U.S. Army Corps of Engineers, Portland District, Portland OR and National Marine Fisheries Service, Northwest Fisheries Science Center, Seattle, WA.

Corps (U.S. Army Corps of Engineers). 1999. Yaquina Bay Ocean Dredged Material Disposal Site Benthic Infauna Evaluation. A comparative study 1984-1999. Portland District, Portland OR.

Corps (U.S. Army Corps of Engineers). December 2002. Rogue River Sediment Quality Evaluation. Portland District, Portland OR.

Corps (U.S. Army Corps of Engineers). September 2006. Northwest Regional Sediment Evaluation Framework, Interim Final. Prepared by U.S. Army Corps of Engineers (Seattle, Portland, and Walla Walla Districts and Northwestern Division), Environmental Protection Agency, Region 10, Washington Department of Ecology, Washington Department of Natural Resources, Oregon Department of Environmental Quality, Idaho Department of

Environmental Quality, National Marine Fisheries Service, and U.S. Fish and Wildlife Service.

Corps (U.S. Army Corps of Engineers). May 2008. Umpqua River, Oregon Ocean Dredged Material Disposal Site Evaluation Study and Environmental Assessment Draft Report. Appendix B: Physical Processes and Geologic Features, Umpqua River, Oregon. Prepared by the U.S. Army Corps of Engineers, Portland District and Environmental Protection Agency, Region 10.

Durkin, J.T. and S.J. Lipovsky. 1977. Aquatic Disposal Field Investigations, Columbia River Disposal Site, Oregon. Appendix E: Demersal Fish and Decapod Shellfish Studies. Technical Report D-77-30, U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg MS.

EPA (U.S. Environmental Protection Agency). August 1991. Draft Environmental Impact Statement, Rogue Ocean Dredged Material Disposal Site (ODMDS) Designation. U.S. Environmental Protection Agency, Region 10, with Technical Assistance from the U.S. Army Corps of Engineers, Portland District.

EPA and Corps (U.S. Environmental Protection Agency and U.S. Army Corps of Engineers). 1984. General Approach to Designation Studies for Ocean Dredged Material Disposal Sites. Washington D.C.

Hancock, D.R., P.O. Nelson, C.K. Sollitt, and K.J. Williamson. 1981. Coos Bay Offshore Disposal Site Investigation Interim Report, Phase I, February 1979-March 1980. Report to the U.S. Army Corps of Engineers, Portland District. Oregon State University, Corvallis OR.

Hillmann, L.G. July 2006. Rocky Shore Management in Oregon: Status and Trends of Resources, Uses and Management. Oregon Parks and Recreation Department.

Hinton, S.A., R.L. Emmett, and G.T. McCabe Jr. 1992. Benthic Invertebrates, Demersal Fishes, and Sediment Characteristics At and Adjacent to Ocean Dredge Material Disposal Site F, Offshore from the Columbia River, June 1989 and 1990. National Marine Fisheries Service, Northwest Fisheries Center, Seattle WA.

Hinton, S.A. and R.L. Emmett. 1994. Benthic Infauna, Sediment, and Fish Offshore from the Columbia River, July 1992. National Marine Fisheries Service, Northwest Fisheries Center, Seattle WA.

Hinton, S.A. and R.L. Emmett. 1996. Benthic Infauna and Sediment Characteristics Offshore from the Columbia River, August 1994. National Marine Fisheries Service, Northwest Fisheries Center, Seattle WA.

Keister, J.E. and W.T. Peterson. 2003. Zonal and seasonal variations in zooplankton community structure off the central Oregon Coast, 1998-2000. *Progress in Oceanography* 57:341-361.

Kulm, L.D. 1988. Potential heavy mineral and metal placers on the southern Oregon continental shelf. *Marine Mining* 7(4):361-395.

Marine Taxonomic Services, Ltd. January 2008. Benthic Infauna and Demersal Fish Evaluation, Rogue River Dredged Material Disposal Site. Prepared for the U.S. Army Corps of Engineers, Portland District.

NMFS (National Marine Fisheries Service). 2006. Draft Community Profiles for West Coast and North Pacific Fisheries - Washington, Oregon, California, and other U.S. States. Socioeconomics Program, Northwest Fisheries Science Center and Economics and Social Sciences Research Program, Alaska Fisheries Science Center. Available at http://www.nwfsc.noaa.gov/research/divisions/sd/communityprofiles/index.cfm.

Peterson, W.T. and Miller, C.B. 1977. Seasonal cycle of zooplankton abundance and species composition along the central Oregon coast. *Fishery Bulletin* 75:717-724.

Peterson, C.D. and S.E. Binner. 1988. Compositional variations of coastal placers in the Pacific Northwest, USA. *Marine Mining* 7(4):397-416.

Richardson, S.L. 1973. Abundance and distribution of larval fishes in waters off Oregon, May-October 1969, with special emphasis on the northern anchovy, *Engraulis mordax*. *Fishery Bulletin* 71:697-711.

Richardson, S.L. and W.G. Pearcy. 1977. Coastal and oceanic larvae in an area of upwelling off Yaquina Bay, Oregon. *Fishery Bulletin* 75:125-145.

Richardson, M.D., A.G. Carey Jr., and W.A. Colgate. 1977. Aquatic Disposal Field Investigations, Columbia River Disposal Site, Oregon. Appendix C: The Effects of Dredged Material Disposal on Benthic Assemblages. Technical Report D-77-30, U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg MS.

Roffe, T.J. and B.R. Mate. 1984. Abundances and feeding habits of pinnipeds in the Rogue River, Oregon. *Journal of Wildlife Management* 48(4):1262-1274.

Siipola, M.D., R.L. Emmett, and S.A. Hinton. 1993. Tongue Point Monitoring Program 1989-1992, Final Report. U.S. Army Corps of Engineers, Portland District, Portland OR.

Sullivan, B. and D. Hancock. 1977. Zooplankton and Dredging, Research Perspectives and Critical Review. *Water Resources Bulletin* B(13).

Appendix A

Living Resources
Rogue River, Oregon

April 2009

Appendix A
Living Resources
Rogue River, Oregon

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Appendix A
Living Resources
Rogue River, Oregon

Introduction

Information on living resources in the Rogue 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 Section 103 ODMDS area.

Plankton and Fish Larvae

No specific data is available for zooplankton in the Rogue 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 Rogue 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

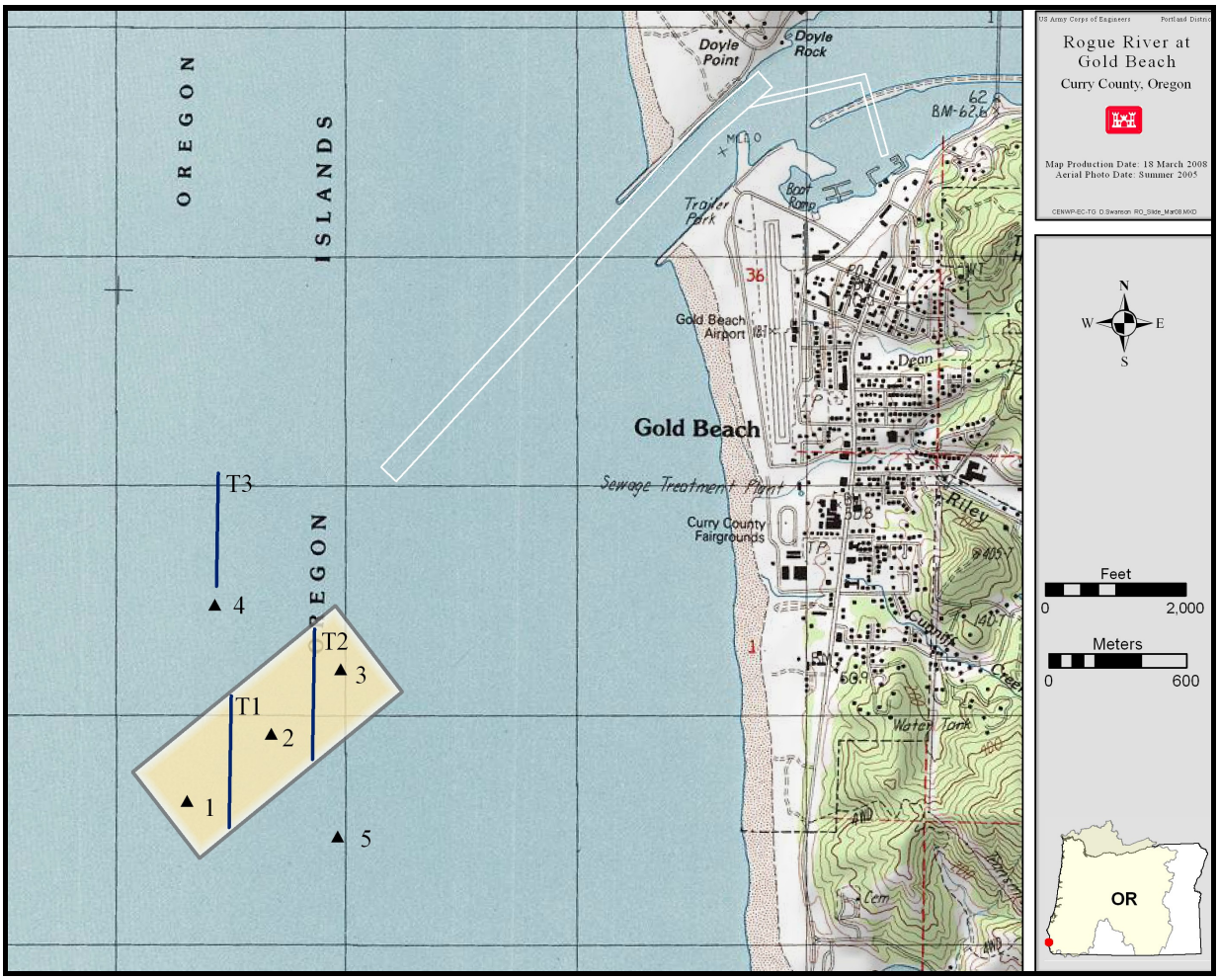
Benthic invertebrates play an important role in secondary productivity in nearshore marine systems. They are not only a direct source of food for many demersal fishes but play an active part in the shredding and breakdown of organic material and in sediment reworking.

Field sampling in 1984 gathered information on benthic and epibenthic invertebrates and demersal fish at the Rogue River ODMDS (Corps 1988). The benthic infaunal community was dominated by gammarid amphipods and polychaete annelids. Gastropods and cumaceans were also common. Snails were the dominant epibenthic. No significant difference in species diversity between the sampling stations located within the ODMDS and the reference sites were observed. In general, benthic infauna densities were lower as compared to other shallow-water ocean disposal sites.

Field surveys were conducted in August and November 2007 by Marine Taxonomic Services (2008) to provide current information about the benthic invertebrate species present at the Rogue River ODMDS. The benthic infaunal study (Task I) used a 0.096 m^2 modified Gray-O'Hara box core to take biological cores at five sampling sites (Figure A-1).

The benthic invertebrate fauna at the ODMDS was found to be typical of the nearshore, high-energy environment found along the Oregon Coast. The benthic community at the ODMDS was driven by the opportunistic polychaetes *Magelona sacculata*, *Spiophanes bombyx* and *Chaetozone nr. setosa* and the gammarid amphipods *Mandibulophoxus gilesi* and *Eohaustorius* spp. The only commercially important benthic infaunal species (*Siliqua* spp.) was not very abundant at the ODMDS. 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, Umpqua River, Siuslaw River, and Chetco River (Hancock et al., 1981; Corps 1985, 1988a, 1988b, 1990, 1999).

Figure A-1. Rogue River ODMDS 2007 Sampling Locations



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 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.

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 August and November 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.

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

Station	# Organisms	# per m^2	# Species	H'	SDV	J'	SR
1	1,772	3,686	45	1.75	0.6341	0.4597	5.8825
2	2,869	5,968	62	1.92	0.7329	0.4652	7.6617
3	3,431	7,136	57	2.31	0.8567	0.5714	6.8791
4	1,833	3,813	61	2.29	0.7852	0.5571	7.9854
5	2,006	4,172	43	1.92	0.7538	0.5105	5.5235

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

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

Station	# Organisms	# per m^2	# Species	H'	SDV	J'	SR
1	1,214	2,525	47	2.49	0.8312	0.6467	6.4773
2	1,582	3,291	41	2.29	0.8342	0.6167	5.4300
3	632	1,315	41	2.72	0.8922	0.7324	6.2026
4	1,049	2,182	51	2.89	0.9038	0.7350	7.1885
5	1,230	2,558	43	2.53	0.8684	0.6727	5.9032

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

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

POLYCHAETA August 2007			POLYCHAETA November 2007		
Sta.	# Of Org.	#/m^2	Sta.	# Of Org.	#/m^2
1	1,407	2,927	1	836	1,739
2	2,449	5,094	2	1,276	2,654
3	2,786	5,795	3	418	869
4	1,322	2,750	4	735	1,529
5	1,556	3,236	5	767	1,595

MOLLUSCA August 2007			MOLLUSCA November 2007		
Sta.	# Of Org.	#/m^2	Sta.	# Of Org.	#/m^2
1	9	19	1	20	42
2	32	67	2	21	44
3	102	212	3	24	50
4	31	64	4	25	52
5	19	40	5	20	42

CRUSTACEA August 2007			CRUSTACEA November 2007		
Sta.	# Of Org.	#/m^2	Sta.	# Of Org.	#/m^2
1	294	612	1	318	661
2	286	595	2	257	535
3	509	1,058	3	169	352
4	361	751	4	240	499
5	384	799	5	417	867

ECHINODERMATA August 2007			ECHINODERMATA November 2007		
Sta.	# Of Org.	#/m^2	Sta.	# Of Org.	#/m^2
1	1	2	1	1	2
2	4	8	2	2	4
3	0	0	3	3	6
4	13	27	4	10	21
5	3	6	5	3	6

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

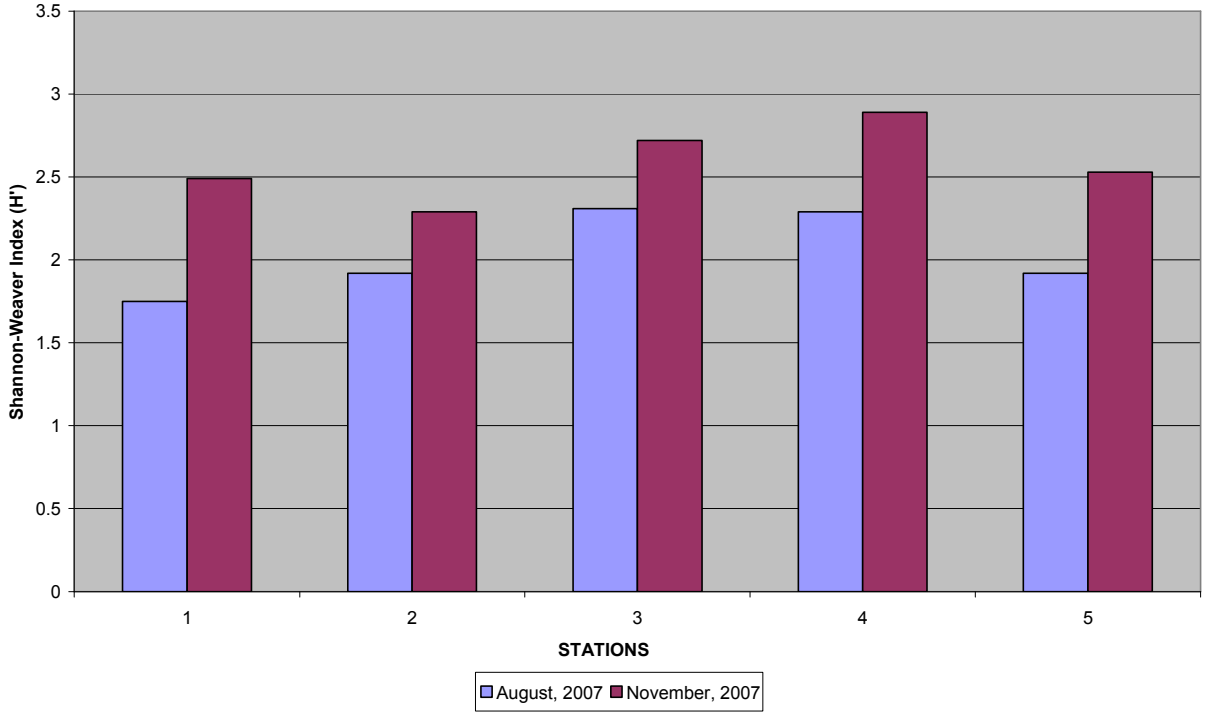


Figure A-3. Diversity (SDV) of Benthic Invertebrates at ODMDS Sampling Stations

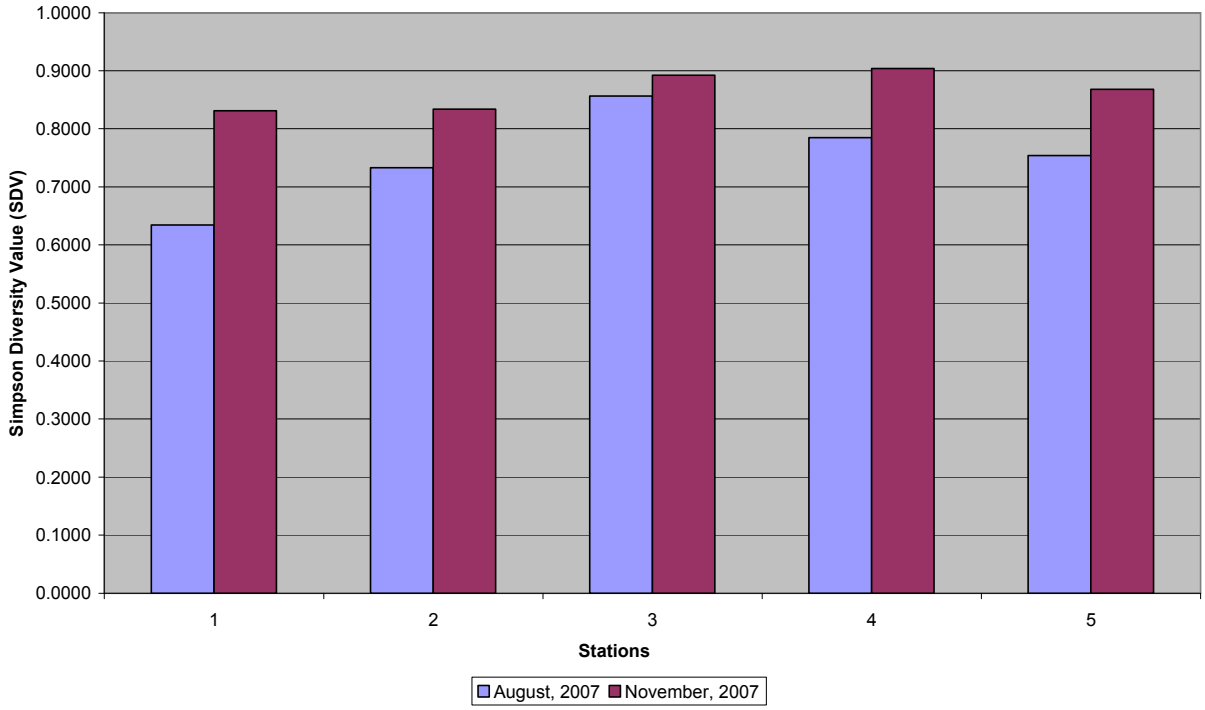


Figure A-4. Evenness (J') of Benthic Invertebrates at ODMDS Sampling Stations

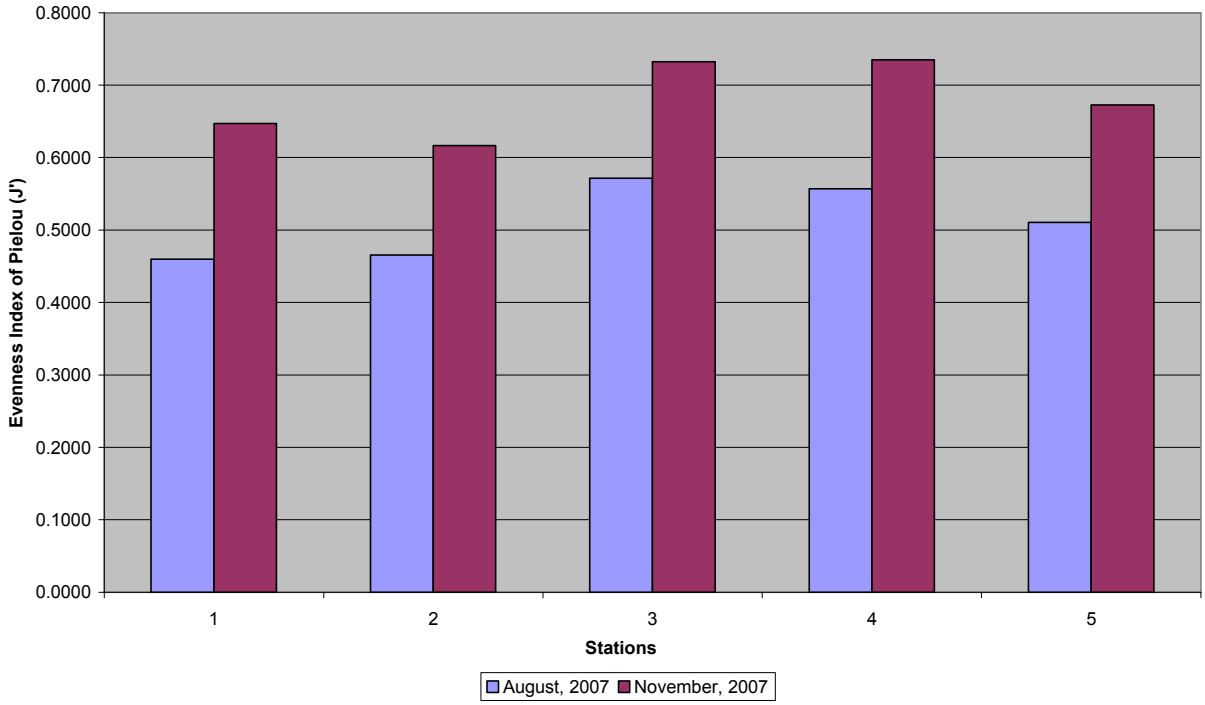


Figure A-5. Species Richness (SR) of Benthic Invertebrates at ODMDS Sampling Stations

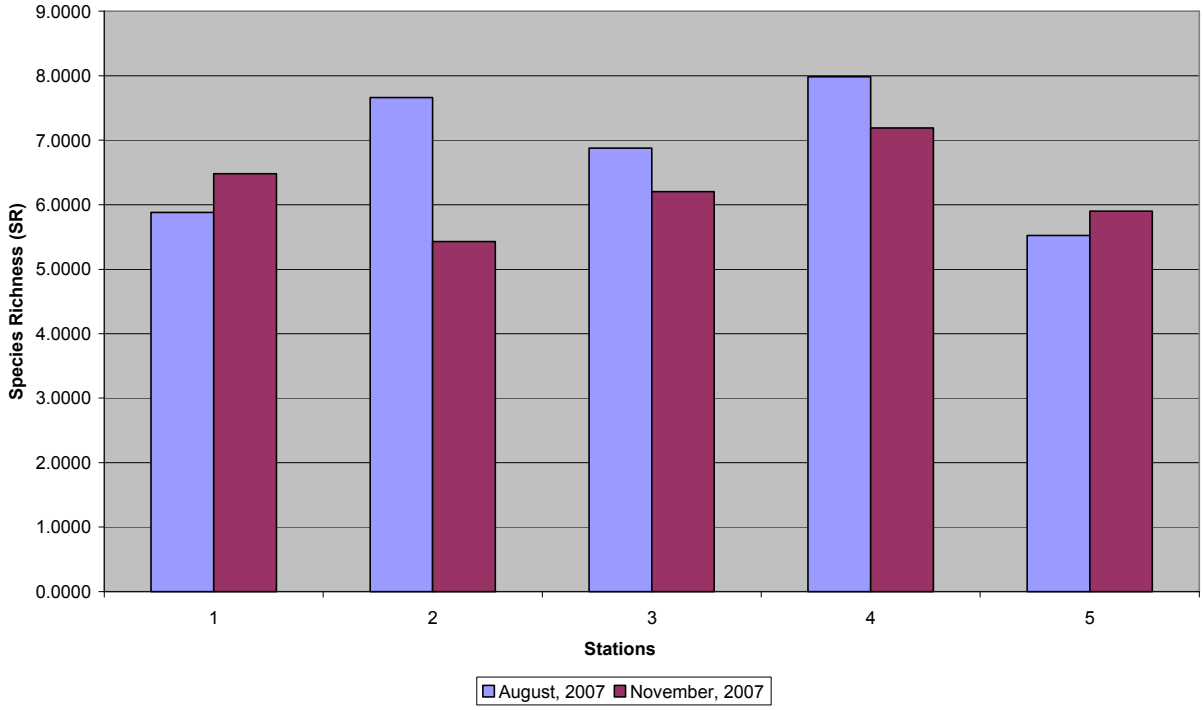
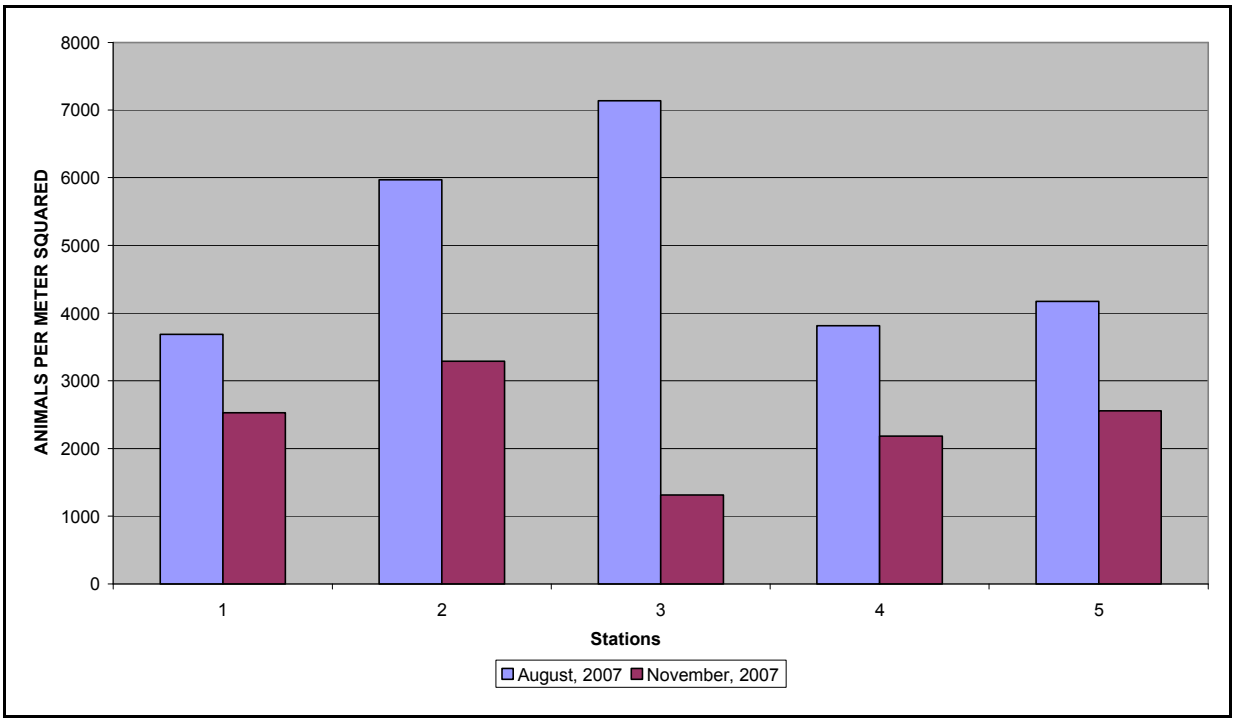


Figure A-6 shows the density of benthic invertebrates at each station. The density distribution data shows higher invertebrate densities in August. The November numbers show a one-third to nearly one-half reduction in density at four of the five sampling sites. The reduction most likely results from natural mortality combined with the early start of winter-type storm fronts that were found along the Oregon Coast in late September through October.

Figure A-6. Densities of Benthic Invertebrates at ODMDS Sampling Stations



Fish and Epibenthic Species

The commercially and recreationally important epibenthic species in inshore coastal areas of Oregon include shellfish and Dungeness crab (*Cancer magister*). Razor clam beds are located along the inshore beaches in the Rogue River area. It is generally thought that recruitment of razor clams to the inshore beaches comes from subtidal spawning areas. Gaper clams, cockles, and Pittock clams likely occur near the mouth of the Rogue River and upriver in the estuary proper. Dungeness crab adults occur on sandflat habitat along the entire Oregon coast. They spawn in offshore areas and occur in the estuary when conditions are favorable in late summer and fall.

The nearshore area off the Rogue River supports anadromous salmonids including coho salmon (*Oncorhynchus kisutch*), winter steelhead (*Oncorhynchus mykiss*), and spring and fall Chinook salmon (*Oncorhynchus tshawytscha*), as well as a variety of other pelagic and demersal fish species. Other pelagic species include the Pacific herring (*Clupea harengus pallasi*), northern anchovy (*Engraulis mordax*), and surf smelt (*Hypomesus pretiosus*). Demersal species present in the inshore area are mostly residents and include a number of sculpins, sea perch, and rockfish species that are associated with Rogue Reef, as well as flatfish species occurring predominantly over open sandflats. Flatfish species include English sole (*Parophrys vetulus*), sanddab

(*Citharichthys* sp.), and starry flounder (*Platichthys stellatus*). English sole and starry flounder, along with the sand sole (*Psettichthys melanostictus*) spawn in the inshore coastal area in the summer and juveniles of these, as well as other marine species, may rear in the estuary.

Rogue Reef is located about 2 miles northwest of the Rogue River entrance and includes three large rocks and many smaller ones that covers over 1.25 square miles. The U.S. Fish and Wildlife Service manage the rocks as part of the Oregon Islands National Wildlife Refuge. There are large bull kelp beds (*Nereocystis*) in the reef complex. The rocky reef substrate, kelp, and strong summer upwelling all combine to result in a very productive reef ecosystem. The reef is a destination for commercial and recreational fisheries (Hillman 2006). The reef fish community differs depending on the depth of the reef below the water surface. The shallower reefs (< 20 meters deep) are dominated by the black rockfish (*Sebastes melanops*), while deeper reefs (20-50 meters deep) are dominated by lingcod (*Ophiodon elongatus*), yellow rockfish (*Sebastes rubemmos*), and black rockfish. Fish found on deeper reefs generally are larger than those found on shallower reefs possibly due to a generalized movement of individuals offshore as they mature. Species composition also changes possibly due to an increase in number of lingcod on the reefs during their winter spawning period. Juvenile lingcod also occur in the estuary in the summer.

Field surveys were conducted in August and November 2007 by Marine Taxonomic Services (2008) to provide current information about the fish and epibenthic species present at the Rogue River ODMDS. The demersal fish and epibenthic invertebrate 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 the three selected trawl tracks. Tables A-4 and A-5 show the species captured by otter trawl. The trawls also included quantities of krill (*Mysidacea*) and various species of sand shrimp, mostly of the genus *Crangon*. The trawl results show several commercially important species present in the area. Most of the specimens were juvenile or sub-legal individuals. Commercially important species included Dungeness crab, sanddab, butter sole (*Isopsetta isolepis*), English sole, sand sole, and big skate (*Raja binoculata*).

Table A-4. Trawl Data, Fish and Epibenthic Species, August 2007

Species	Parameter	Trawl #1	Trawl #2	Trawl #3
Cancer magister - female Dungeness Crab	number of individuals	1	--	29
	size range (mm)	138	--	50-106
	average size (mm)	138	--	86
Cancer magister - male Dungeness Crab	number of individuals	3	--	30
	size range (mm)	94-100	--	63-100
	average size (mm)	98	--	81
Bothidae juvenile	number of individuals	16	25	28
	size range (mm)	38-90	26-105	38-120
	average size (mm)	59	58	68
Chirolophis nugatum	number of individuals	--	1	--
	size range (mm)	--	38	--
	average size (mm)	--	38	--
Cottidae Sculpins	number of individuals	17	14	--
	size range (mm)	21-43	21-44	--
	average size (mm)	27	31	---

Table A-4 (continued). Trawl Data, Fish and Epibenthic Species, August 2007

Species	Parameter	Trawl #1	Trawl #2	Trawl #3
Gadidae Cod	number of individuals	3	--	--
	size range (mm)	30-32	--	--
	average size (mm)	31	--	--
Isopsetta isolepis Butter Sole	number of individuals	--	11	4
	size range (mm)	--	82-180	95-232
	average size (mm)	--	103	130
Osmeridae Smelts	number of individuals	17	6	1
	size range (mm)	25-63	40-50	48
	average size (mm)	45	47	48
Pallasina barbata Tube Nose Poacher	number of individuals	--	1	1
	size range (mm)	--	124	71
	average size (mm)	--	124	71
Pandalus platyceros Coon Striped Shrimp	number of individuals	--	3	--
	size range (mm)	--	--	--
	average size (mm)	--	--	--
Parophrys vetulus English Sole	number of individuals	4	30	7
	size range (mm)	65-217	25-118	41-158
	average size (mm)	129	46	80
Pisaster brevispinus Sea Star	number of individuals	1	--	--
	size range (mm)	--	--	--
	average size (mm)	--	--	--
Pleurenectidae - juvenile Right Hand Flat Fish	number of individuals	4	2	37
	size range (mm)	26-43	20-47	28-47
	average size (mm)	35	34	35
Pleuronichthys coenosus C-O Sole	number of individuals	2	--	--
	size range (mm)	38-38	--	--
	average size (mm)	38	--	--
Psettichthys melanostictus Sand Sole	number of individuals	10	6	8
	size range (mm)	86-430	103-132	82-135
	average size (mm)	136	115	107
Pycnopodia helianthoides Sun Star	number of individuals	--	--	1
	size range (mm)	--	--	--
	average size (mm)	--	--	--
Stellerina xyosterna Prickle Breasted Poacher	number of individuals	--	1	5
	size range (mm)	--	68	32-111
	average size (mm)	--	68	59

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

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

Species	Parameter	Trawl #1	Trawl #2	Trawl #3
Cancer magister - female Dungeness Crab	number of individuals	--	--	1
	size range (mm)	--	--	87
	average size (mm)	--	--	87
Cancer magister - male Dungeness Crab	number of individuals	14	9	4
	size range (mm)	16-36	16-81	15-75
	average size (mm)	22	49	45
Bothidae juvenile	number of individuals	5	4	1
	size range (mm)	28-111	30-104	76
	average size (mm)	73	69	76
Cottidae Sculpins	number of individuals	1	1	--
	size range (mm)	66	40	--
	average size (mm)	66	40	--
Isopsetta isolepis Butter Sole	number of individuals	--	16	--
	size range (mm)	--	40-225	--
	average size (mm)	--	94	--
Leptocottus armatus Staghorn Sculpin	number of individuals	--	--	5
	size range (mm)	--	--	100-133
	average size (mm)	--	--	108
Osmeridae Smelts	number of individuals	152	65	21
	size range (mm)	20-94	30-68	32-68
	average size (mm)	50	50	54
Pallasina barbata Tube Nose Poacher	number of individuals	1	--	--
	size range (mm)	95	--	--
	average size (mm)	95	--	--
Parophrys vetulus English Sole	number of individuals	--	3	--
	size range (mm)	--	67-118	--
	average size (mm)	--	100	--
Pleuronectidae - juvenile Right Hand Flat Fish	number of individuals	3	3	--
	size range (mm)	16-40	38-42	--
	average size (mm)	31	39	--
Psettichthys melanostictus Sand Sole	number of individuals	5	15	1
	size range (mm)	58-159	54-157	57
	average size (mm)	79	81	57
Raja binoculata Big Skate	number of individuals	--	1	--
	size range (mm)	--	435	--
	average size (mm)	--	435	--
Stellerina xyosterna Prickle Breasted Poacher	number of individuals	6	3	--
	size range (mm)	55-142	62-140	--
	average size (mm)	85	109	--

Notes:
1. Mysidae and Crangonidae present in all trawls.
2. All trawls show the presence of small rock outcrops. This evidence consisted of pieces of sponge, cold-water corals, and other miscellaneous hard bottom dwelling organisms.
3. Size range and average size = standard length of fish and carapace width of crabs.

The trawl data indicated that the nearshore area is a nursery ground with seemingly abundant food resources. Most of the encountered species were benthic or detrital feeders that tend to utilize the shallow and somewhat protected area both because of the abundant food sources and the protection from predators. All six trawls (three trawls per sampling event) taken in the area showed signs of encountering hard bottom structures. The evidence consisted of pieces of cold water corals, worm tube fragments from species which attach to hard bottoms (rock) and other pieces of hard bottom organisms. This indicated that there are some low rock outcrops within the area that may be periodically covered with sand during some ocean conditions.

Threatened and Endangered Fish Species

Southern Oregon/Northern California Coast coho salmon was listed as threatened on June 28, 2005 (70 *Federal Register* 37160). Critical habitat also was designated at that time and includes, "…water, substrate, and adjacent riparian zone of estuarine and riverine reaches…" The Rogue River and estuary were designated as critical habitat but the ocean area off the Rogue River was not. Coho are present in the vicinity of the proposed Rogue River ODMDS 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 in the Rogue River ranges from mid-August through November, with a distinctive peak in September to mid-October. Juvenile outmigration extends from April through June and peaks in mid-May to mid-June.

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 site, 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 at or near the Rogue River ODMDS as they migrate to northern estuaries during summer and early fall.

Commercial and Recreational Fisheries

The major commercial fishing areas in the vicinity of the proposed Rogue River ODMDS are shown in Figure A-7. Based on data from the National Marine Fisheries Service (NMFS 2006) for commercial fishing, a total of 50 vessels, all commercially registered, delivered landings to Gold Beach in 2000. Landings were in the following West Coast fisheries (data shown represents landings in metric tons/monetary value of said landings/number of vessels landing; NA = not available): crab (30/$133,107/5), groundfish (43/$236,173/36), salmon (NA/NA/1), and other species (131/$173,950/17). There were no fish processors operating in Gold Beach in 2000. Gold Beach residents owned 20 vessels in 2000, seven of which participated in the federally managed groundfish fishery.

The major recreational fishing areas in the vicinity of the Rogue River ODMDS are shown in Figure A-8. Based on data from the NMFS (2006) for recreational fishing, Gold Beach had at least 27 outfitter guide businesses in 2003. Ten licensed charter vessel businesses were located in the community (two had their homeport in Brookings). There were about 28 sport fishing businesses in 2003. The ocean charter season goes year-round and targets lingcod and rockfishes. Gold Beach has nine licensing vendors and in 2000, the number of licenses sold was 3,566 at a value of $60,984. The 2000 recreational salmonid catch in the ocean boat fishery was 74 Chinook salmon. The recreational non-salmonid catch was a total of 15,416 fish. The top species landed included black rockfish, blue rockfish (*Sebastes mystinus*), canary rockfish (*Sebastes pinniger*), and lingcod.

Figure A-7. Commercial Fishing Areas in the Vicinity of the Proposed Rogue River ODMDS

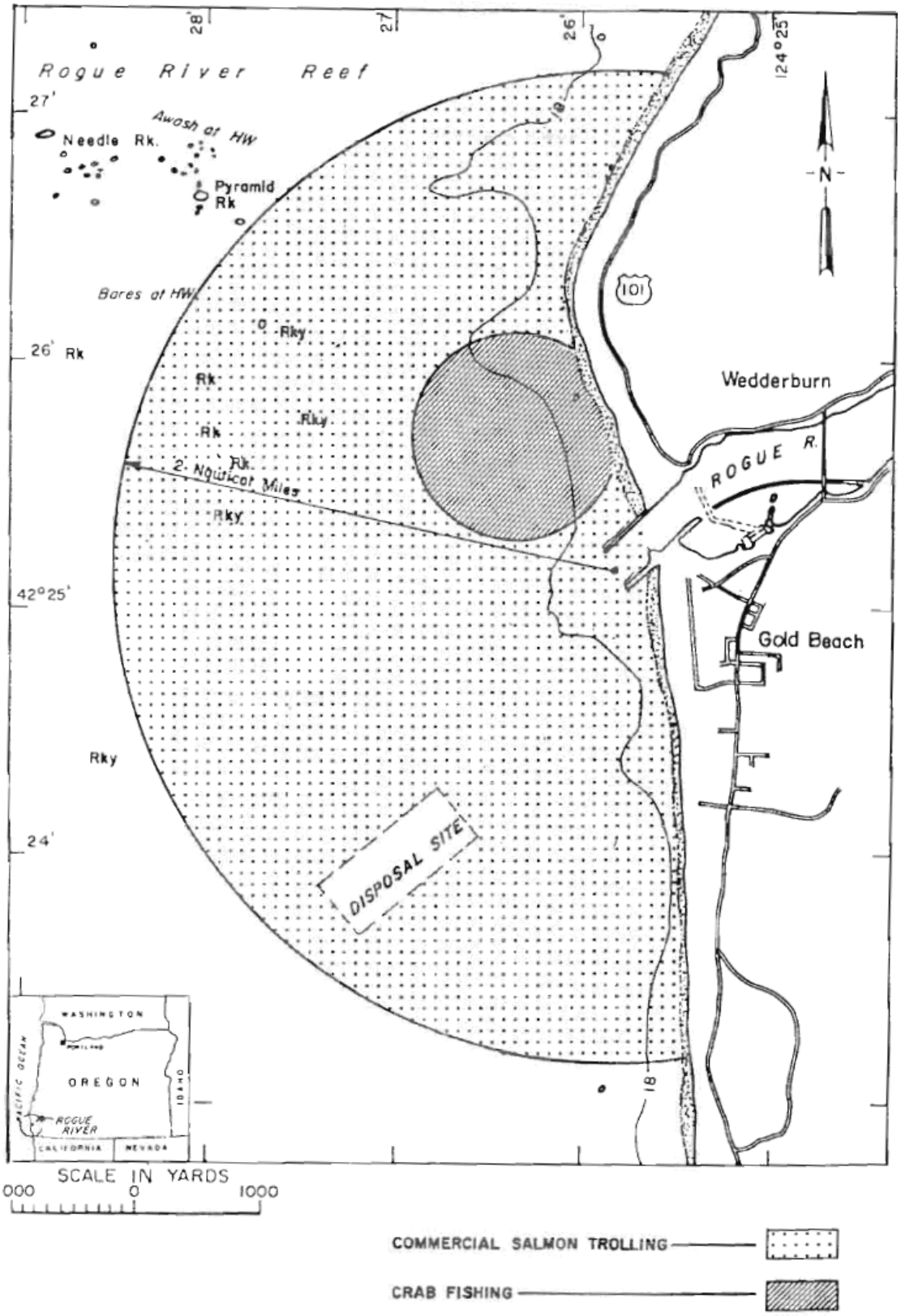
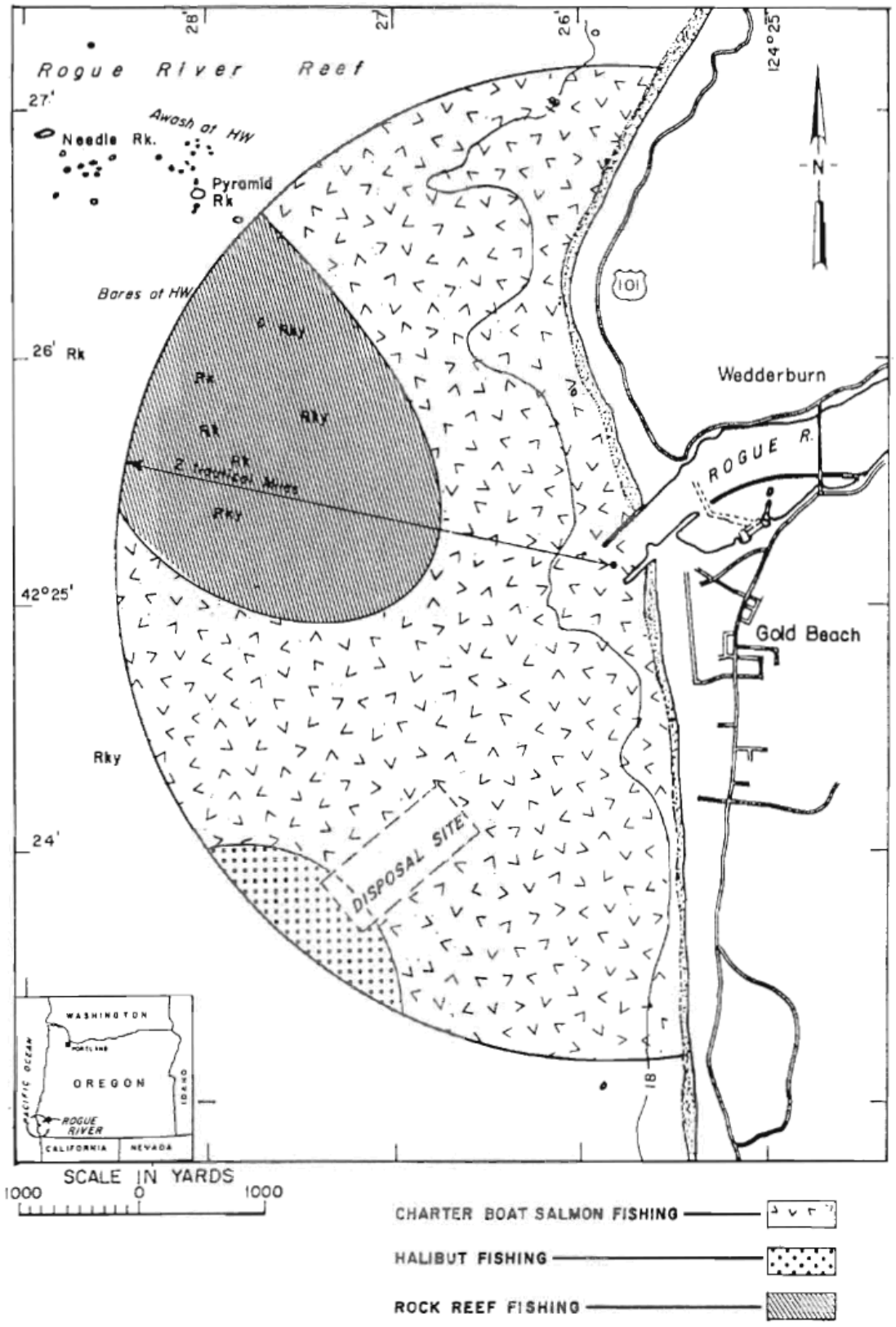


Figure A-8. Recreational Fishing Areas in the Vicinity of the Proposed Rogue River ODMDS



Wildlife

Three species of seals and sea lions inhabit the lower Rogue 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 Rogue 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 Rogue and adjacent waters for foraging.

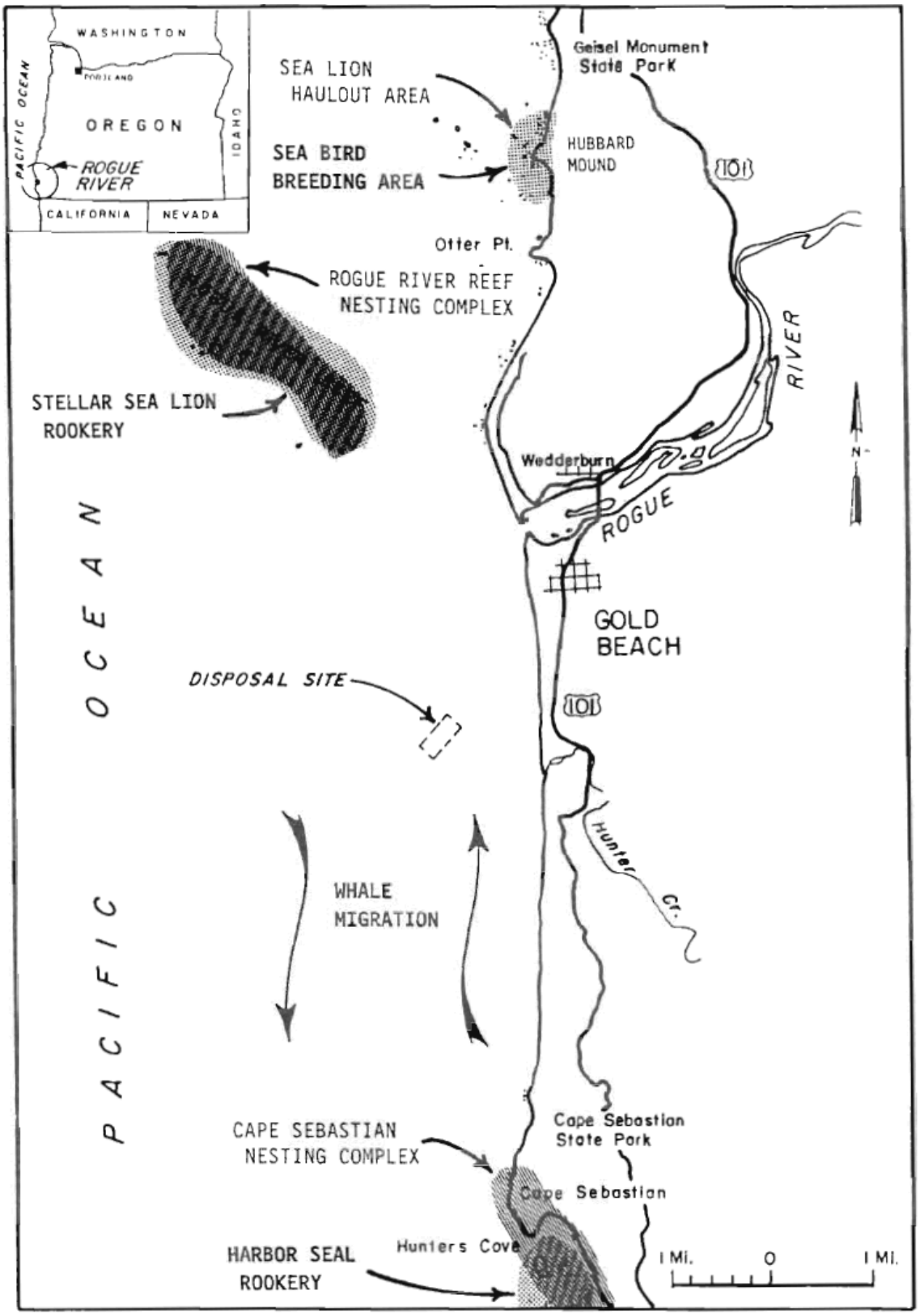
Wildlife areas offshore of the Rogue River entrance are shown in Figure A-9. Hubbard Mound to the north is a nesting area for oystercatchers, gulls, Brandt's cormorants (*Phalacrocorax penicillatus*), pelagic cormorants (*Phalacrocorax pelagicus*), and common murres (*Uria aalge*). Sea lions also haulout on Hubbard Mound.

To the northwest of the Rogue River entrance, Rogue Reef is used as a rookery and haul-out area for Steller sea lions. Many harbor seals and California sea lions are also found at the reef. Pelagic birds nest at the reef, including about 4,000 common murres and more than 500 Brandt's cormorants (Hillmann 2006). More than 1,800 threatened Steller sea lions (45% of state total) use the reef, forming the largest pupping site for this species in the United States south of Alaska. Peak sea lion attendance at the reef occurs during May, June, and July. Sea lions begin to leave the rookeries in August.

To the south of the Rogue River entrance, storm petrels, cormorants, and gulls nest on Hunter's Island. Other species of seabirds that congregate and nest on the island include Cassin's auklets (*Ptychoramphus aleuticus*), oystercatchers, pigeon guillemots (*Cepphus columba*), rhinoceros auklets (*Cerorhinca monocerata*), and tufted puffins (*Fratercula cirrhata*). Harbor seals use Hunters Island as a rookery.

Federally listed avian species that may be present in the Rogue River offshore area include the marbled murrelet (*Brachyramphus marmoratus*, threatened), brown pelican (*Pelecanus occidentalis*, endangered), and 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 Rogue River. Brown pelicans are often associated with spits and offshore rocks in the Rogue River area. 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.

Figure A-9. Wildlife Areas Offshore of the Rogue River



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 Rogue River ODMDS.

Blue whales occur off the Oregon Coast in May and June, as well as 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. In a November 2007 news release to the Oregon Fishing Industry, Governor Ted Kulongoski stated that he was asking the Federal Energy Regulation Commission to limit the number of reserve sites to less than 10 sites. The governor further stated that these reserve sites be large enough to provide for scientifically testing the ecological benefits they produce, but small enough to avoid economic or social impacts such as loss of significant fishing opportunities. Dredging and disposal are identified as disturbances and would be banned from areas designated as marine reserves. At this time, no marine reserves have been designated as the state is still developing the marine reserve selection process. Ocean disposal sites will need to avoid any marine reserve areas.

Literature Cited

Auth, T.D. and R.D. Brodeur. 2006. Distribution and community structure of ichthyoplankton off the coast of Oregon, USA, in 2000 and 2002. *Marine Ecology Progress Series* 319:199-213.

Auth, T.D., R.D. Brodeur., and K.M. Fisher. 2007. Diel variation in vertical distribution of an offshore ichthyoplankton community off the Oregon Coast. *Fish Bulletin* 105:313-326.

Brodeur, R.D., D.M. Gadomski, W.G. Pearcy, H.P. Batchelder, and C.B. Miller. 1985. Abundance and distribution of ichthyoplankton in the upwelling zone off Oregon during anomalous El Niño conditions. *Estuarine Coastal and Shelf Science* 21:365-378.

Corps (U.S. Army Corps of Engineers). 1985. Yaquina Bay Interim Ocean Dredged Material Disposal Site Evaluation Study. Portland District, Portland OR.

Corps (U.S. Army Corps of Engineers). 1988a. Chetco Ocean Dredged Material Disposal Site Evaluation, Final Report. Portland District, Portland OR.

Corps (U.S. Army Corps of Engineers). 1988b. Rogue Ocean Dredged Material Disposal Site Evaluation, Final Report. Portland District, Portland OR.

Corps (U.S. Army Corps of Engineers). 1990. Yaquina Bay Ocean Dredged Material Disposal Site Benthic Infauna Evaluation. Portland District, Portland OR.

Corps (U.S. Army Corps of Engineers). 1999. Yaquina Bay Ocean Dredged Material Disposal Site Benthic Infauna Evaluation. A comparative study 1984-1999. Portland District, Portland OR.

Corps (U.S. Army Corps of Engineers). December 2002. Rogue River Sediment Quality Evaluation. Portland District, Portland OR.

Hillmann, L.G. July 2006. Rocky Shore Management in Oregon: Status and Trends of Resources, Uses and Management. Oregon Parks and Recreation Department.

Keister, J.E. and W.T. Peterson. 2003. Zonal and seasonal variations in zooplankton community structure off the central Oregon Coast, 1998-2000. *Progress in Oceanography* 57:341-361.

Marine Taxonomic Services, Ltd. January 2008. Benthic Infauna and Demersal Fish Evaluation, Rogue River Dredged Material Disposal Site. Prepared for the U.S. Army Corps of Engineers, Portland District.

NMFS (National Marine Fisheries Service). 2006. Draft Community Profiles for West Coast and North Pacific Fisheries - Washington, Oregon, California, and other U.S. States. Socioeconomics Program, Northwest Fisheries Science Center and Economics and Social Sciences Research Program, Alaska Fisheries Science Center. Available at http://www.nwfsc.noaa.gov/research/divisions/sd/communityprofiles/index.cfm.

Peterson, W.T. and Miller, C.B. 1977. Seasonal cycle of zooplankton abundance and species composition along the central Oregon Coast. *Fishery Bulletin* 75:717–724.

Richardson, S.L. 1973. Abundance and distribution of larval fishes in waters off Oregon, May-October 1969, with special emphasis on the northern anchovy, *Engraulis mordax*. *Fishery Bulletin* 71:697-711.

Richardson, S.L. and W.G. Pearcy. 1977. Coastal and oceanic larvae in an area of upwelling off Yaquina Bay, Oregon. *Fishery Bulletin* 75:125-145.

Appendix B

Physical Processes and Geologic Features
Rogue River, Oregon

April 2009

Appendix B
Physical Processes and Geologic Features
Rogue River, Oregon

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SECTION 1. GEOLOGICAL RESOURCES

Regional Setting

The Rogue River empties into the Pacific Ocean about 264 miles south of the mouth of the Columbia River. It lies within the Humbug littoral cell, which extends for approximately 40 kilometers (km) from Humbug Mountain south to Cape Sebastian (Figure B-1). The Rogue River has an estuary of about 667 acres (Percy et al., 1974). The watershed includes parts of the Klamath Mountains and the Cascade Range. To the north and south of the river mouth, the beaches are several hundred yards wide before rising into steep rounded hills that reach an elevation of 700 feet within one half mile of the shore. There are numerous landslides along the coast south of Humbug Mountain. No sand dunes of consequence are found in this area. The continental shelf bulges outward off the mouth of the Rogue River, extending approximately 30 nautical miles offshore. North of this bulge, the Rogue canyon descends down the continental slope to the abyssal plain. A band of fine sand about 5 km wide runs along the coast. After a zone of intermediate sediment, a layer of mud about 10 centimeters (cm) thick covers the surface of the central shelf, with sand exposed again on the outer shelf (Chambers 1969, Kulm 1977).

The coast bordering the Humbug littoral cell consists of about 18 km of slowly retreating rocky cliffs, 16 km of stable beach, and 5 km of generally prograding beaches surrounding the mouth of the Rogue. Smaller streams entering the littoral cell include Euchre, Brush and Hunters creeks.

Regional Geology

The Rogue River is the major stream draining the western Klamath Mountains in Oregon. The Klamath Mountains are made of Mesozoic marine sediments and igneous rocks that have been folded, faulted, and subjected to varying degrees of metamorphism and Tertiary igneous intrusives. The tectonic history of the Klamath Mountains is complex with several episodes of folding and faulting, which continue up to the present. Parts of the Klamath Range have been subjected to tectonic events since the late Jurassic. The late Cretaceous and early Cenozoic was a time of quiescence, but, since the end of the Eocene, faulting and uplift have affected the area (Dott 1971, Baldwin and Beaulieu 1974, Baldwin 1981).

Because the Rogue River originates so far east, it flows through a large number of different formations and rock types. Those closest to the mouth of the Rogue River are the intensely folded and faulted mudstones, sandstones, and conglomerates of the Otter Point, Colebrook schist, and the Dothan formations of Jurassic age (Figure B-2). To the north and east lie more recent marine sediments from the Tertiary. Smaller outcrops of volcanics, serpentines and other sediments and meta-sediments are also encountered. Much of the coastline of the Humbug Mountain littoral cell up to Euchre Creek is Holocene and modern beach sand, with occasional exposures of Otter Point formation rocks. Continuing north are outcrops of volcanics, Colebrook schist, and Cretaceous Humbug Mountain conglomerate (Dott 1971, McKee 1972).

Figure B-1. Major Littoral Cells in Oregon

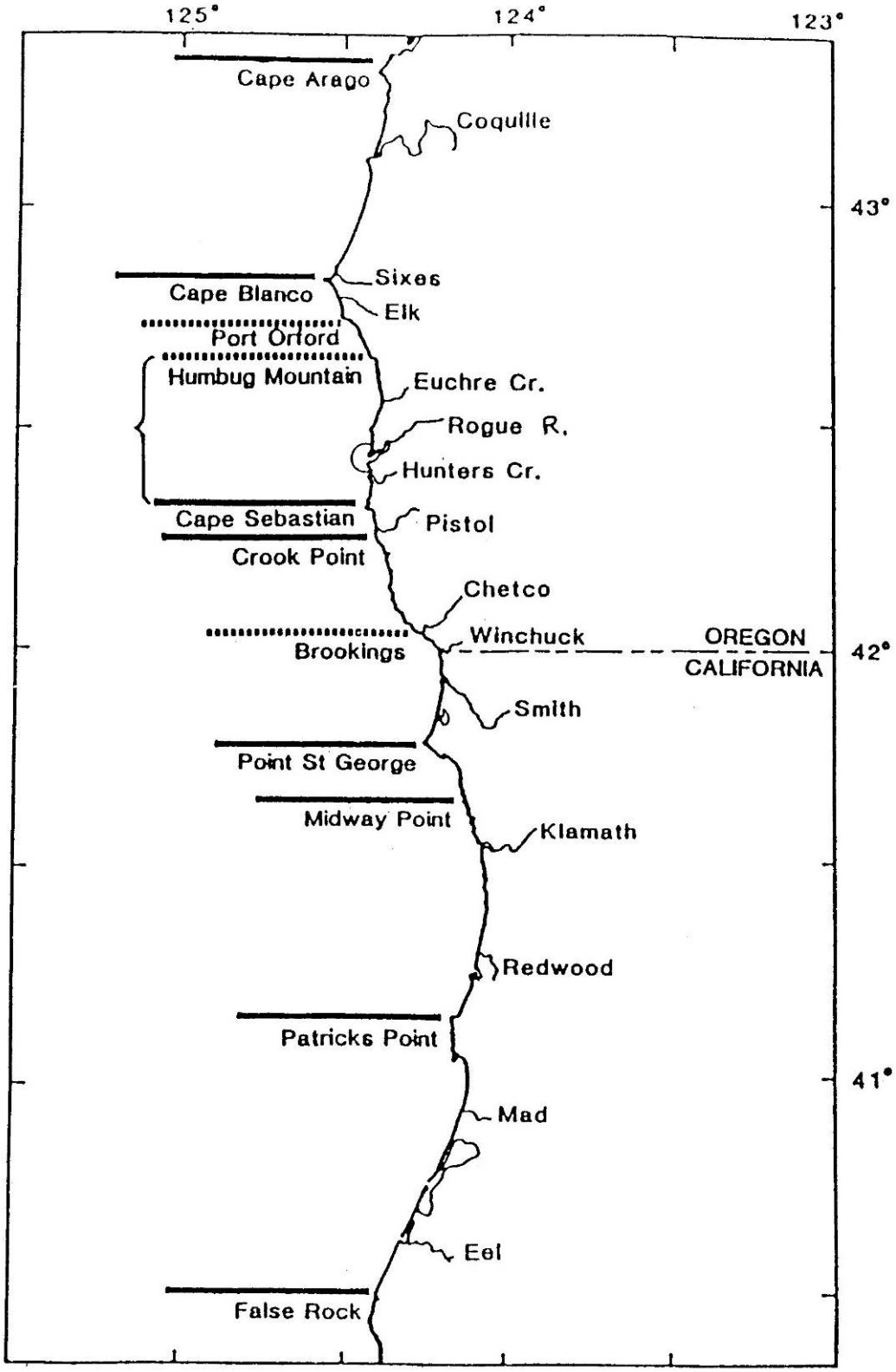
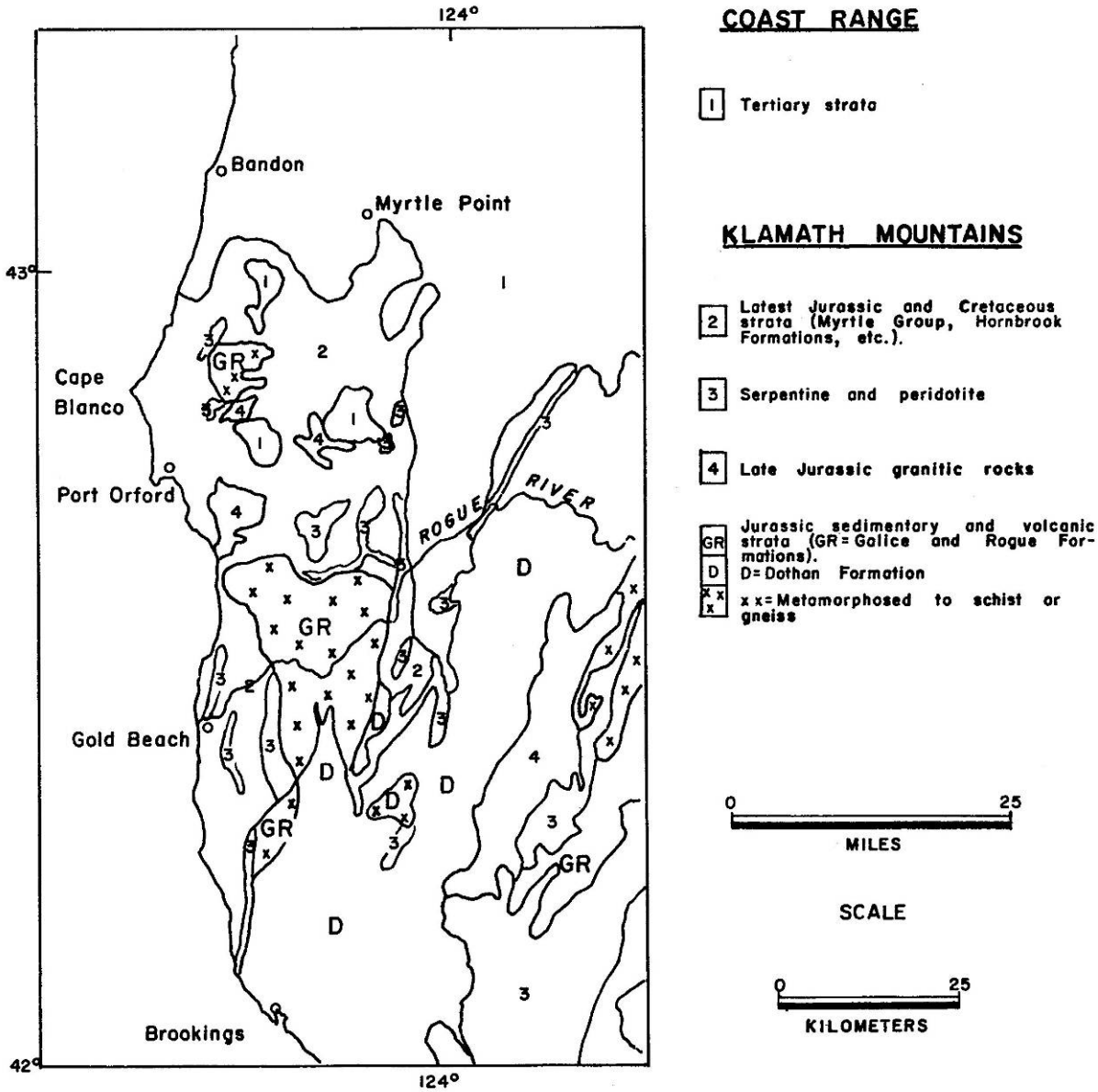


Figure B-2. Rogue River Watershed Geology



Source: McKee 1972

The region is currently undergoing tectonic uplift, but that uplift has been surpassed by the post-Pleistocene rise in sea level. During the Pleistocene glaciations, the massive amount of water stored in the glaciers caused a drop in sea level. The end of the last ice age (melting of the glaciers) resulted in a global sea level rise of 125 meters (Curray 1965). Fluctuating sea level, in conjunction with tectonic uplift of the Klamath Mountains, led to the formation of several raised marine terraces, as well as the incision of valleys below the present sea level. Terraces are prominent along the coastal plain from the Rogue River up to Ophir (Dott 1971). Within that area, at least seven terraces have been identified (Corps 1974). The rise in sea level "drowned" the river and stream valleys that had been incised in the Coast Range and coastal plain. This produced the large coastal estuaries and allowed the development of the alluvial plains bordering the lower reaches of the Rogue River.

The sand deposits that cover the nearshore sea bed were delivered by streams that eroded rocks in the coastal mountains, and by the sea attacking both bedrock and marine deposits left over from previous high stands of the sea. An undetermined amount of bedload material is currently escaping through the estuaries and eroding from the shoreline. Fine silts and clays supplied by these sources are removed or prevented from settling out in the nearshore zone by the high wave energy, leaving fine sand covering the sea bed for a distance of several kilometers offshore.

Economic Geology

The Rogue River and its tributaries flow through bedrock containing mineralized zones and have several reaches containing gold placer deposits. Beach placers at Gold Beach have been mined in the past for gold and platinum. Mining was done in the winter when the sand was stripped from the beaches, exposing the mineral rich gravels. Some placers were also found on uplifted marine terraces (Ramp 1973, Gray and Kulm 1985). Historically the most prominent and extensive zones of heavy mineral concentrations identified on the continental shelf of the Oregon Coast were believed to occur off the mouth of the Rogue River. Chromite, ilmenite, and magnetite make up the bulk of the concentration according to Kulm (1988). The most extensive deposits were thought to be located off the Rogue River with heavy mineral concentrations ranging from 20% to 30%. These deposits were identified as approximately 37 km long extending from the nearshore zone to water depths of 90 meters. It has been suggested that the magnetic anomalies found off the Rogue and Sixes rivers were caused by mineral deposits having dimensions and mineral characteristics similar to those of deposits located onshore in adjacent beach and terrace deposits (Kulm 1988, Peterson and Binner 1988).

The Oregon Placer Minerals Technical Task Force commissioned a reconnaissance-level field investigation of heavy mineral placer deposits offshore of the Rogue River in September and October 1990 (Oregon 1991). The study did not find any heavy mineral deposits that could be mined in the Rogue River area. Previous reports of magnetic anomalies were attributed to near-surface masses of bedrock. Offshore deposits are not currently being mined nor are they likely to be mined in the near future. While there have been several historical attempts to find oil and gas along the Oregon Coast, test wells have not found significant quantities of oil or gas. As of 2007, no test wells have been drilled south of Cape Blanco on the Oregon Coast. The State of Oregon currently has a moratorium on leasing for purpose of exploration, development, or production of oil, gas, or sulfur up to 3 miles off the Oregon Coast until January 2, 2010.

Sediments

There are three external sources for sediment in the Humbug littoral cell: fluvial, littoral, and coastal erosion. Dredging is not a source, but it facilitates the transport of material from the river into the littoral zone. The estuary of the Rogue River covers an area of 667 acres and contains 149 acres of tidal wetland (Percy et al., 1974). The drainage basin covers 5,160 square miles. Mean annual discharge is 7,800 cubic feet per second (cfs) with a maximum of 16,200 cfs in January and a low of 1,200 cfs in September. The mean annual 6-hour discharge is 1.68 x 108 cubic feet; with a tidal prism of 1.2 x 108 cubic feet this gives a hydrographic ratio of less than 1. This means that the estuary is very fluvially dominated and that most river sands should escape into the ocean (personal communication, C.D. Peterson). Among the three other streams which enter the Humbug littoral cell, Euchre Creek and Hunters Creek have hydrographic ratios of about 1 (Chesser and Peterson 1987), but are so small that their contribution to the overall sediment budget is probably minor.

Sediment is also contributed by erosion of the coast. Surveys of erosion patterns along the Humbug littoral cell coastline are not in complete accordance. The National Shoreline Study (Corps 1971) shows historic erosion from south of Humbug Mountain almost to the mouth of the Rogue River. A stretch several miles long north of the Rogue River mouth was identified as suffering from "critical erosion." The Beach and Dune Survey (USDA 1975) showed a similar pattern. However, Stembridge (1976) mapped the area from just north of Euchre Creek to Cape Sebastian in the south as stable, with the coast generally prograding for several miles on both sides of the mouth of Rogue River. The coast between Humbug Mountain and Euchre Creek, classified by Stembridge (1976) as "slowly retrograding rocky cliffs," is subject to landslides. These slides move slowly and intermittently; their rate is increased by heavy rainfall and the removal of their toes by wave action. The slides are continuous sources of sediment for the littoral zone. Unfortunately, none of the surveys provide any quantitative information on rates or volumes of erosion or accretion.

The authorized Rogue River navigation project is a channel 13-feet deep, 300-feet wide, and 3,500-feet long from the river's mouth to the boat basin entrance. The side channel to the boat basin is 10-feet deep and 150-feet wide. Shoals form at the basin entrance and between the jetties during the spring and summer months. The entrance shoal forms in the late winter and spring.

Dredging of the entrance of Rogue River began in 1962. From 1976 to 1985, about 474,900 cubic yards (cy) of dredged material from the entrance channel was deposited at the offshore disposal site (Table B-1). From 1986 to 2007, the total amount placed in the offshore disposal site was about 1,129,000 cy for a total of about 1,604,000 cy since the ODMDS received Interim designation. The maximum amount of material disposed at sea in one year (1983) was 142,260 cy, while some years have no offshore disposal. The 22 year average annual amount placed between 1976 and 2007 was about 72,900 cy. However the average volume placed since 1997 totals about 41,200 cy. Additional material from the boat basin has been pumped to onshore disposal sites by contract pipeline dredge. Other entrance shoals have been flushed out by the Corps' agitation dredge *Sandwick* on ebb tide without removing the material from the water. The *Sandwick* was decommissioned in 2003 and agitation dredging is not practiced at the project.

In determining the importance of the various potential sources, the mineral assemblages of the sediments and the sources can be useful. The clinopyroxene to orthopyroxene ratio (2:l) and the amphibole to pyroxene ratio (4:1), for instance, have been used to define the boundaries of the Humbug littoral cell. Unfortunately for sediment source determination, the mineral assemblages of the Rogue River, eroding marine terrace deposits, and littoral sands are all similar. Thus, while it is clear that both the Rogue and coastal erosion contribute sediment, it is not possible to evaluate their relative contributions (Chesser and Peterson 1987).

The surface sediments of the vicinity of the proposed Rogue River ODMDS sampled in 2007 were fine sand with a uniform grain size of 0.16 mm in all samples except sample 03, which had a 9.68 mm grain size (Table B-2). Sediments collected in 1984 from the Rogue vicinity were uniform fine sand. Mean grain size showed almost no variation, falling between 0.13 mm and 01.6 mm in size (Corps 1988). Physical properties of the offshore disposal site and the Rogue federal navigation project vary in the percent of fine-grained material present. The average percent sand and gravel-sized material in the Rogue River outside of the boat basin entrance is 77.7 % and at the offshore disposal site the percentage of the same classification of material is 96.4%. Material from the channel inside the boat basin jetty increases in fines towards the mooring, from 20% fines to 50% fines (passing 200 sieve). Because the offshore disposal site is

a highly erosive site, fine-grained material is not likely to remain within the ODMDS site boundaries or general area.

Table B-1. Rogue River Project Dredging Volumes Placed at ODMDS

Fiscal Year	Dredging Volumes (cy)
1976-1985	474,900
1986	0
1987	55,600
1988	36,400
1989	90,400
1990	70,300
1991	37,000
1992	32,200
1993	94,600
1994	120,000
1995	95,700
1996	44,100
1997	71,100
1998	55,600
1999	0
2000	44,800
2001	52,300
2002	35,100
2003	51,000
2004	31,000
2005	60,800
2006	20,100
2007	31,000

Note: Data includes Corps and contract hopper dredging and mechanical dredging.

Table B-2. Rogue River Vicinity Sediment Physical Characterization, 2007

Sample I.D.	Grain Size Percent (%)				
	Gravel (shell hash)	Sand	Silt/Clay	Volatile Solids	Mean Grain-size (mm)
0807RODMDS-BC-01	0	97.4	2.6	2.1	0.16
0807RODMDS-BC-02	0	96.2	3.8	2.3	0.16
0807RODMDS-BC-03	88.3	7.4	4.3	1.7	9.68
0807RODMDS-BC-04	0.1	97.7	2.2	2.5	0.16
0807RODMDS-BC-05	0	95.4	4.6	2.4	0.16
Mean Value		96.5	3.5	2.2	---

RODMDS = Rogue Ocean Dredge Material Disposal Site; BC = Box core (surface-grab sampler).
% passing 200 sieve (0.075 mm) = silt/clay fraction.

Conditions in the Vicinity of the Proposed Rogue River ODMDS

Sea stacks and reefs at the mouth of the Rogue River consist of several formations of Mesozoic age. The rocks exposed adjacent to the communities of Gold Beach and Wedderburn at the mouth of the river consist of the Otter Point formation of late Jurassic age and associated serpentinite (Beaulieu and Hughes 1976). The serpentinite is present in the Otter Point formation primarily as fault-bounded sheets. A north-trending fault separates the Otter Point formation on the coast from the sandstones of the Hunter Cove and Cape Sebastian formations to the west. These Upper Cretaceous sandstones underlay the northern and eastern parts of the Rogue Reef. The fault has been tentatively projected into the area, but its existence has not been proven (Koch 1966; Hunter et al., 1970; Beaulieu and Hughes 1976; Corps 1986).

The ocean bottom in the vicinity of the ODMDS slopes seaward fairly evenly at 8/1000, between 36 to at least 72 feet. The bed is featureless except for what appears to be a 25-foot pinnacle a short distance beyond the southwest end of the disposal site. There is no mound of disposal material apparent within the disposal area. A May 1986 bathymetric survey showed a seaward displacement of the contours with respect to those measured in August 1984. This aggradation was not attributed to dredge material disposal, as the volume involved far exceeds that disposed of offshore during those years. A comparison of the bathymetry at the site in 2007 to that in 1986 shows a trend in the opposite direction (Figure B-3). The overall 2007 site bathymetry shows erosion of about 5 to 6 feet with some areas as much as 10 feet deeper. This indicates that there is no dredged material accumulation due to past disposal at the site. Mounding also would not be expected in the future at current disposal rates.

The results of a 1984 side-scan sonar survey of the Rogue vicinity are shown in Figure B-4. The area surveyed by side-scan sonar is primarily fine sand. There are bare rock and scattered rock exposures in the middle of the southwest side, with a few small rock exposures elsewhere in the site. The band interpreted as coarse sand or gravel runs between the 36-and 42-foot contours. No samples were taken from within the band to confirm the presence of gravel or the possibility that it is a bed of sand dollars. The designated disposal site is situated with its southwest end within the bare-rock/scattered-rock area; otherwise, it encompasses fine sand.

Three sub-bottom seismic profiles cross the study area from northeast to southwest (Figure B-5). They show a slightly irregular bedrock surface overlain by a fairly uniform blanket of sediment that averages about 20-feet thick and varies from 10 to 40 feet. The sediment layer appeared to thin slightly in the seaward direction.

Figure B-3. Bathymetry 2007 and Bathymetry Difference Plot 1986-2007

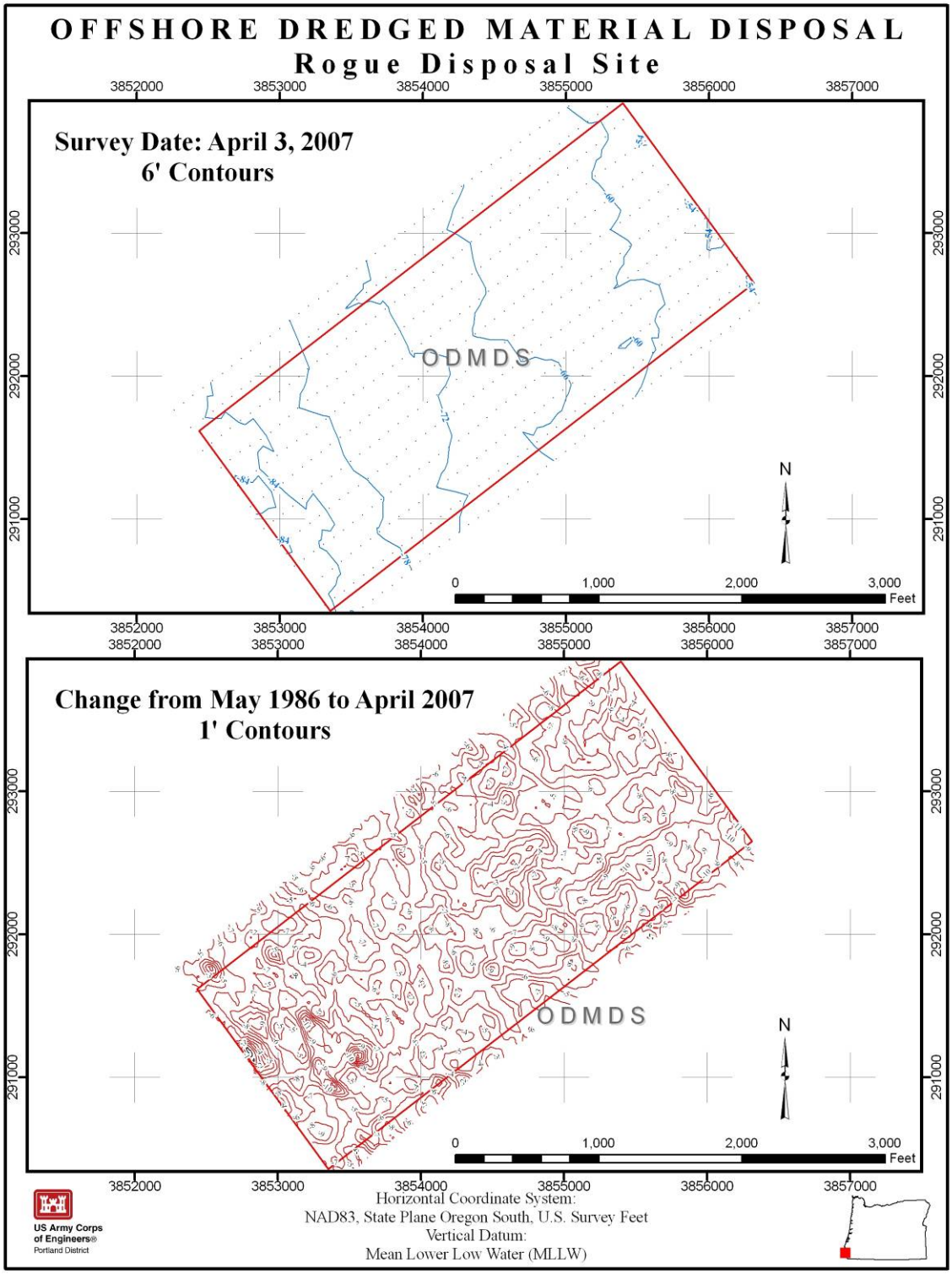
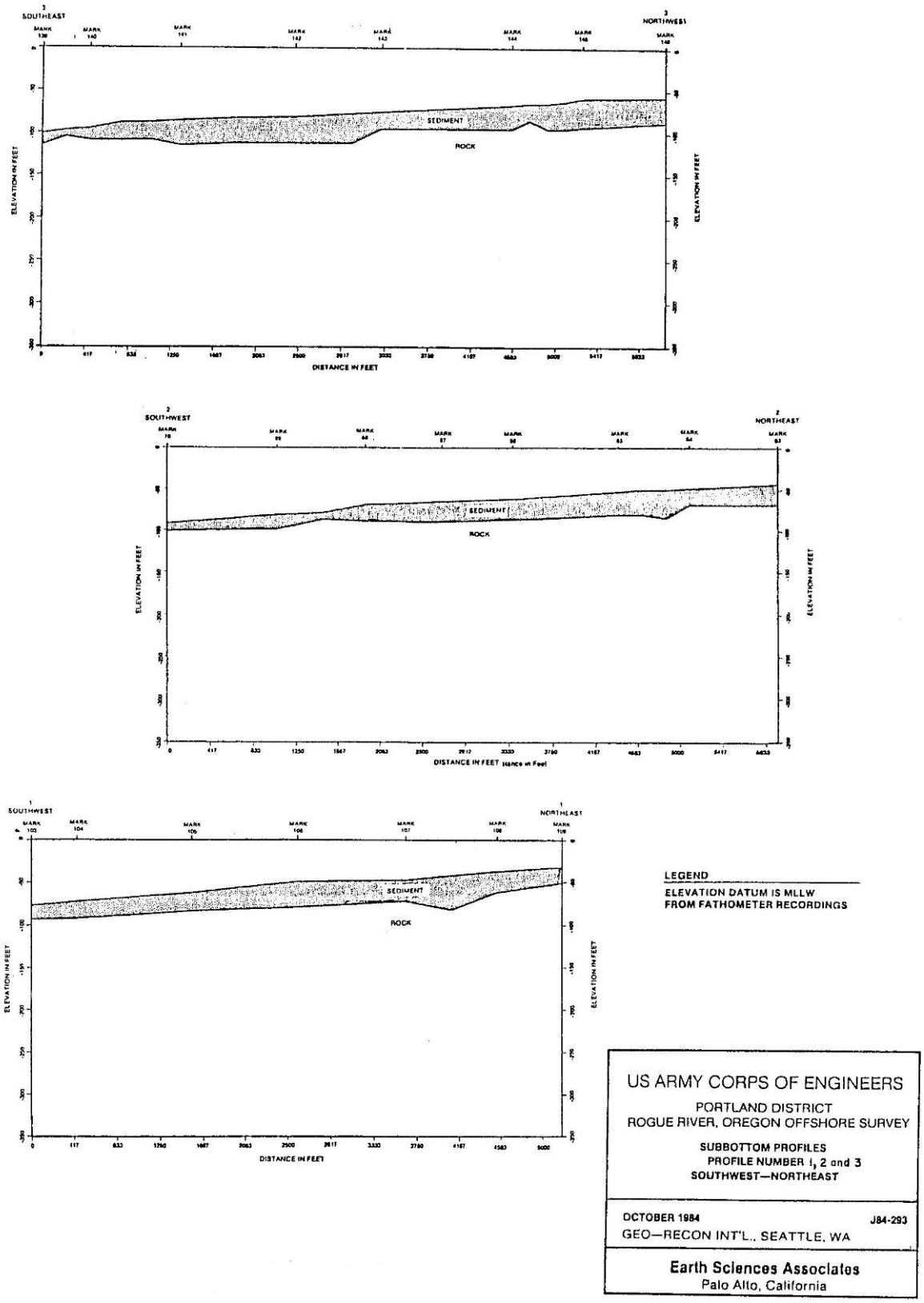


Figure B-4. Side-scan Sonar Map of Rogue Vicinity

Figure B-5. Rogue Seismic Profiles



SECTION 2. OCEANOGRAPHIC PROCESSES

Coastal Circulation

Coastal circulation near the Rogue is directly influenced by large-scale regional currents and weather patterns in the northwestern Pacific Ocean. During the winter, strong low pressure systems--with winds and waves predominantly from the southwest contribute to strong northward currents. During the summer, waves and winds are commonly from the north since high pressure systems are dominant. In both seasons, there are short-term fluctuations related to local wind, tidal and bathymetric effects. The offshore reefs at the Rogue River have an effect on nearshore circulation and waves. Along the southern Oregon Coast, there is a southerly wind in summer which creates a mass transport of water offshore and causes the upwelling of bottom water in the nearshore area.

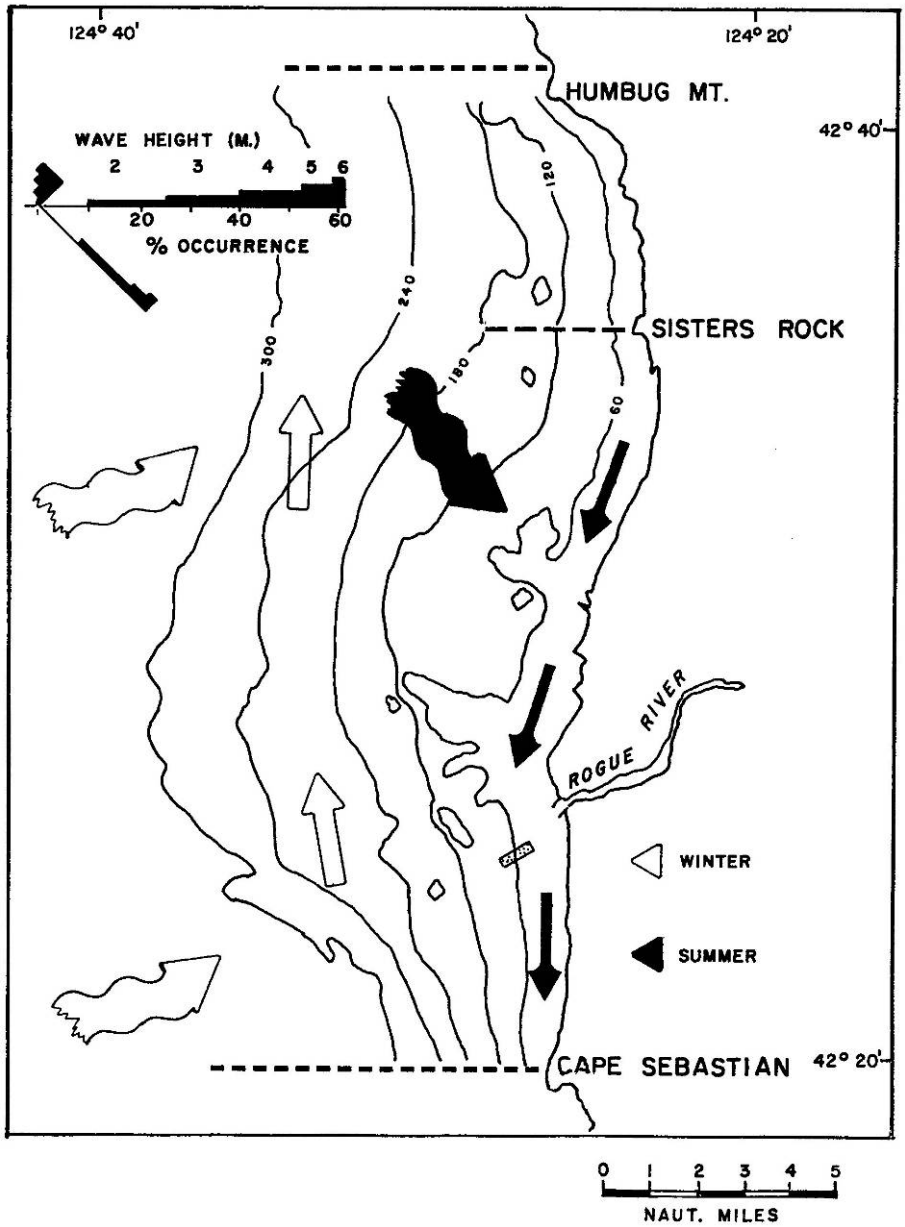
Ocean Waves and Tide

Ocean waves arriving at the Rogue are generated by distant storms and by local winds. Distant storms produce waves that arrive at the coast as swells which are fairly uniform in height, period and direction. The longer period swells generated by more distant storms generally approach from the WNW or WSW sectors. The swells with the longest periods generally occur during autumn while the shortest sea and swell periods occur during the summer. Local winds produce seas which contain a mixture of wave heights, periods, and directions. Generally, local seas have higher waves and shorter periods than incoming swells. Local seas usually approach the coastline from the SSW sector during autumn and winter, but from the NNW sector in spring and summer. Figure B-6 shows nearshore circulation at the Rogue.

Wave hindcast predictions from meteorological records for the period 1956-1975 are available for deepwater stations off the Oregon Coast. Although the largest waves are from the southwest, only 7% of the time waves are from that quadrant. Sixty-one percent of the waves are from within 22.5 degrees of due west. Waves from the northwest occur 31% of the time. This is very generalized data, but useful in thinking of the seasonal wave patterns.

Superimposed upon the slowly-varying regional or seasonal circulation are tidal currents. These currents are very important in the nearshore area. Tidal currents are rotary currents that change direction following the period of the tide. Thus, the tidal currents generally flood and ebb twice daily. The direction and speed of nearshore tidal currents is highly variable. Tidal current speeds have been measured at lightships along the Pacific coast and reported by NOAA (1986). Hancock and others (1981), Nelson and others (1983) and Sollitt and others (1984) summarize current meter data offshore from Coos Bay from May 1979 to March 1983. These reports substantiate the influence of tides on nearshore bottom currents. Bottom current records were found to be dominated by tidal influence. Maximum current velocities were associated with tides, including spring tide effects. These tidal influences added to the currents produced by surface waves and winds. The station closest to the estuary, for example, was noticeably affected by the ebb current.

Figure B-6. Oregon Coastal Circulation at Rogue



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 Rogue River.

Local Processes

The Rogue ODMDS is approximately 1.75 nautical miles from the estuary entrance. The Rogue River has the second largest drainage basin on the Oregon Coast, after the Columbia River, and one of the smallest estuaries. As Table B-3 illustrates, the river flow is highly variable. This constantly varying river outflow combines with tidal flows to produce a highly variable influence on the nearshore circulation. In the estuarine part of the river, the ebbing tide adds to the normal river discharge to produce a net ebb dominance. Thus, the Rogue shows little to no long-term accumulation of fine sediments in the estuary; instead, it allows sand-size sediments to bypass into the ocean.

Table B-3. Important Characteristics of the Rogue River Area

Characteristic	Rogue River
Drainage Basin Area (sq. mi.)	5,160
Estuary Surface Area (sq. ft.)	25 x 106
Mean Tide Range (ft.)	4.9
Diurnal Tide Range (ft.)	6.7
Mean Tidal Prism (cu. ft.)	122 x 106
Diurnal Tidal Prism (cu. ft.)	167 x 106
Minimum Annual Flow (cfs)	1,200 (September)
Maximum Annual Flow (cfs)	16,200 (January)
Mean Annual Flow (cfs)	7,800
Extreme Discharge (cfs)	350,000 (1964)
Mean Hydrographic Ratio (HR)	0.7
Maximum Hydrographic Ratio (HR)	6.7

Note: The data are from Johnson (1972) and Percy and others (1974). The hydrographic ratio (HR) is the tidal prism volume divided by the mean river discharge for a 6-hour period. Peterson and others (1984) used the HR to compare the tidal prism with the river discharge for the same 6-hour period. The tidal prism is estimated as the volume of water brought into the estuary by each flood tide. The 6-hour river discharge is estimated from the annual average discharge. The higher the HR, the more tidally dominated the estuary. For comparison, the table shows two values for HR. The maximum HR only occurs during extreme low summer river flows. The dominance of the river has been demonstrated on several occasions. During the 1964 flood, the entrance channel was reportedly scoured to -44 feet (Corps 1975) while the drought of 1976-1977 produced a shoal 8 feet above MLLW in the entrance (Hartman 1977).

Site Monitoring

Current meters were deployed near the Rogue ODMDS in 1985. The meters were attached to moorings at depths from 66 to 73 feet. Bottom current records were obtained from April 13 to May 7 and from July 13-28 in 1985. These periods were picked to represent typical winter and summer conditions. However, the transition to summer conditions can begin as early as April. Figure B-7 illustrates the daily average bottom current speed and direction for summer and winter records. In the current "rose" each bar represents the direction the current is moving. The length of the bar represents the percent of occurrence of the current in that direction and the width of the bar represents the range of velocity.

Because of the deployment schedule, the meters at Rogue were not in place until mid-April. As the two figures show, there is little difference in direction for the two deployments. Surprisingly, the dominant direction both times is generally north, with slightly more of an onshore component

in July. For the April-May period, the strongest currents are usually north along the bottom contours. The currents in July are mostly onshore, across bottom contours and northward. Neither record shows any significant current southward.

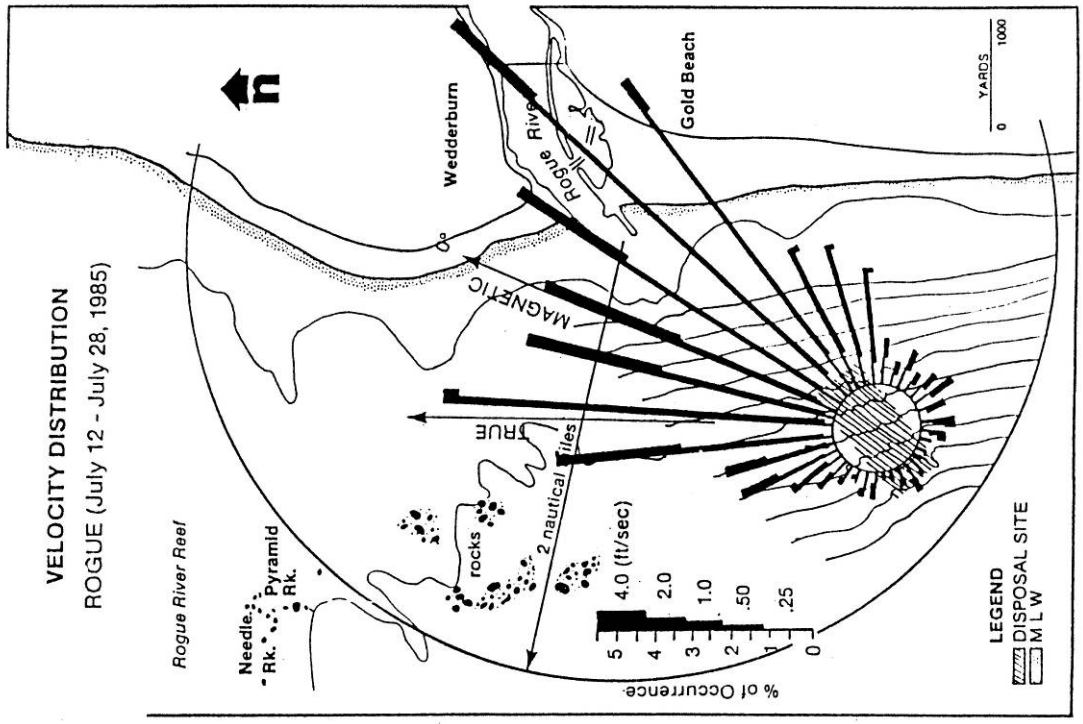
Other sources of current data come from the Littoral Environment Observation (LEO) program. The LEO program collected visual observations of waves and currents in the surf zone on a daily basis from October 1977 through 1982. Wave direction and the direction and speed of the surface current were recorded at the same time each afternoon. Figure B-8 is a plot of the monthly and daily average current speed and direction with negative values indicating the current is to the south. During the five years of recording, the littoral current is predominantly to the south, with short 2-3 month periods each winter of currents to the north. The monthly average can be misleading, as shown by the plot of daily currents for the period October 1978 to February 1979. Although the monthly average is to the north, there are frequently strong currents to the south.

Wave records near the ocean disposal site were obtained from April 13-27 and from July 14-28 in 1985. Significant wave heights were computed for the two periods. Monthly average wave heights have been computed from records at the Newport wavemeter from 1971 to 1981, from hindcast wind data, and from the Coquille gage in 1985. In both April and July, the wave heights were below average at the Rogue, as compared to Coquille and Yaquina. Because the Coquille meter is in a similar water depth and sufficiently close to Rogue River, the periods of record are compared in Figure B-9.

Wave observations by LEO from October 1977 through 1982 were analyzed and compared to available aerial photos. Wave approach was characterized as from the north, from the south or parallel to shore. The photos showed general agreement with the LEO observations, and confirmed that the wave angle to the shore is generally small. This is due to shoaling and refraction effects in the surf zone. Figure B-10 shows the monthly and daily summary of wave directions as the percent occurring from the north (positive values) or south (negative values). Waves at Rogue are predominantly from the north; however, waves from the south occur frequently and are dominant for several months each winter. The daily variability of wave direction is shown for the period from October 1978 to February 1979. Although the monthly averages indicate waves predominantly from the south, there were several 2- to 4-day periods when waves were from the north.

Detailed current measurements have been obtained from other similarly situated Oregon nearshore dredge material disposal sites. Seasonal measurements made over two-week periods at Coos Bay in the mid-1980s showed that currents at the 25-meters deep averaged from 20-30 cm/s at one-third the water depth during the summer and from 30-60 cm/s during the winter and spring. Near-bottom currents were generally from 10-20 cm/s with downslope flow components predominating over upslope components. Near-bottom waters exhibited downslope movement to depths in excess of 40 meters during the summer and deeper than 70 meters during the winter. Similar conditions are expected to exist at the interim Rogue disposal site since both sites are in similar depth regimes.

Figure B-7. Current Data at the Rogue River



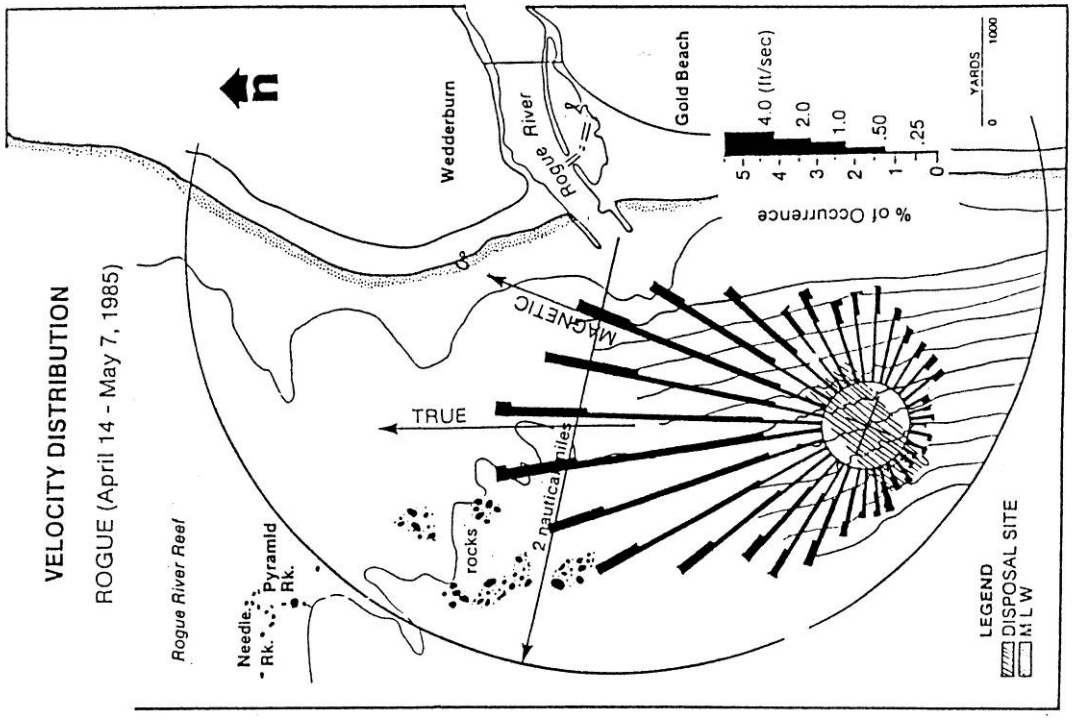
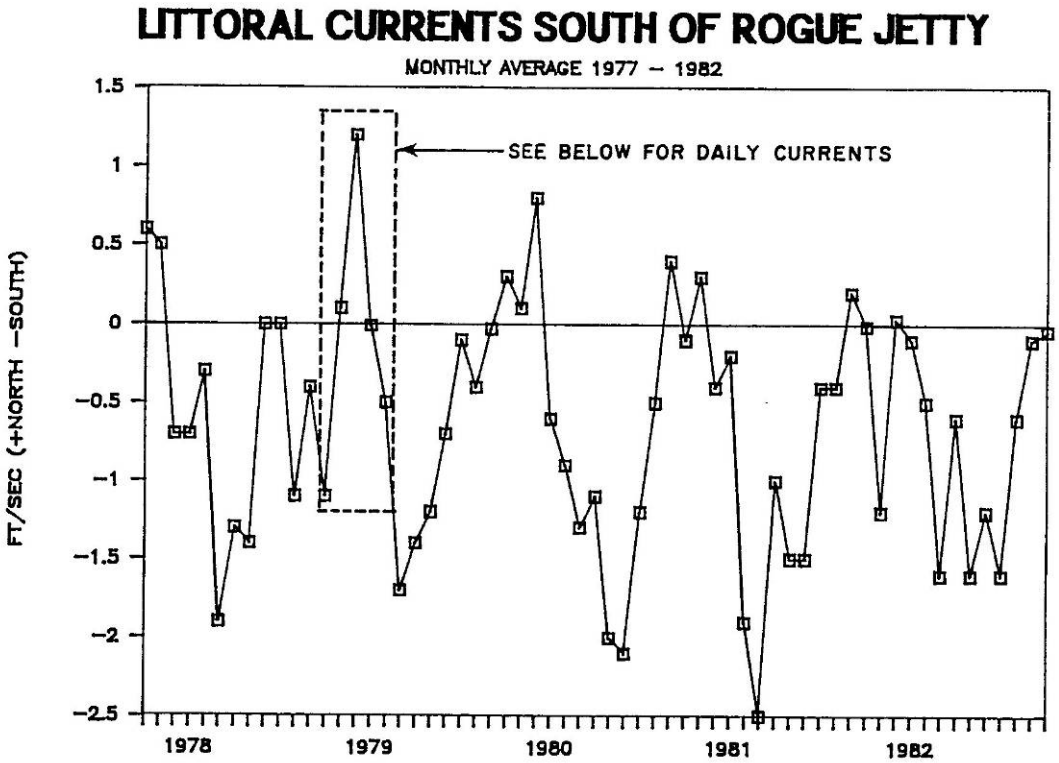


Figure B-8. LEO Monthly and Daily Average Currents



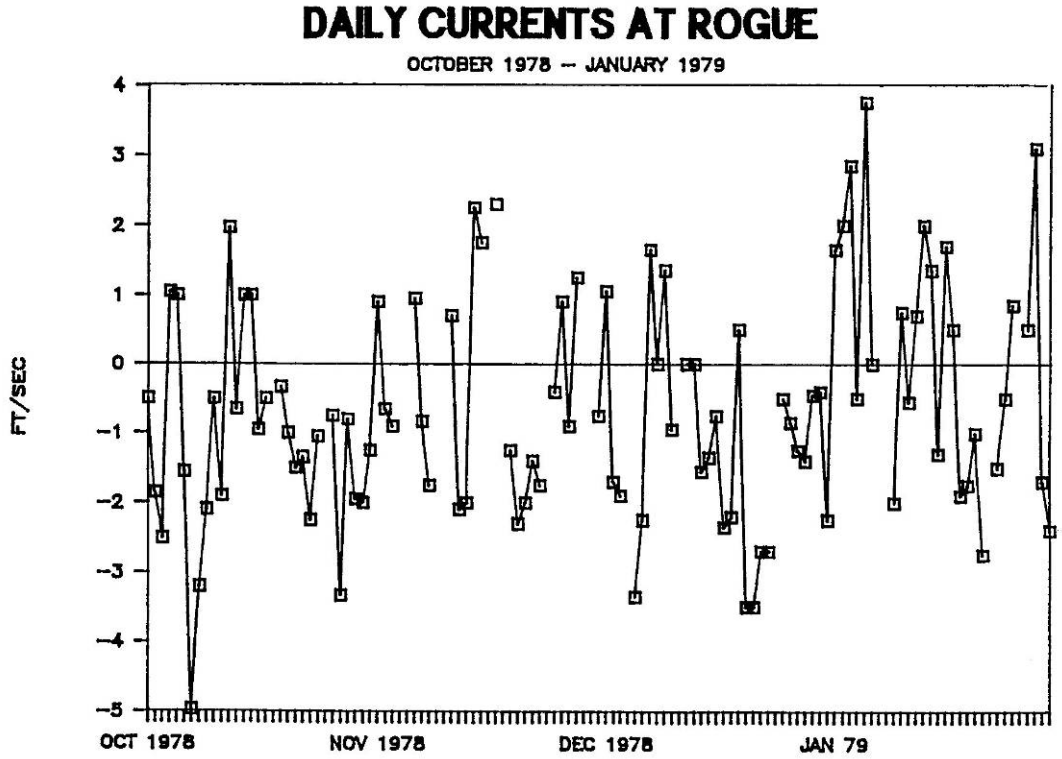
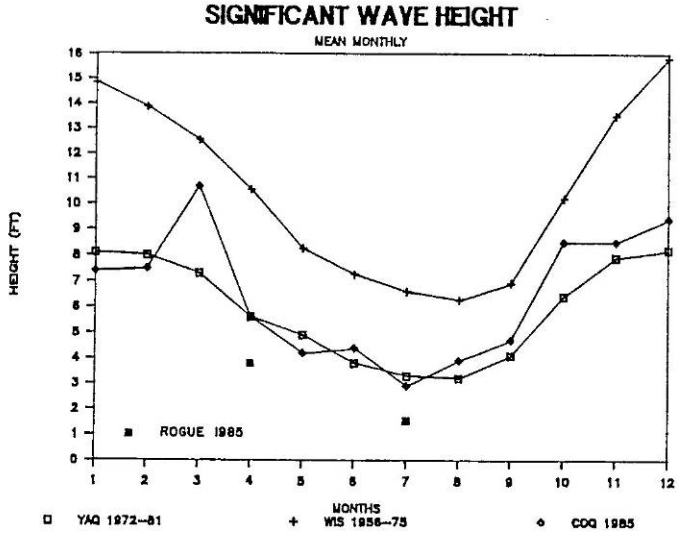
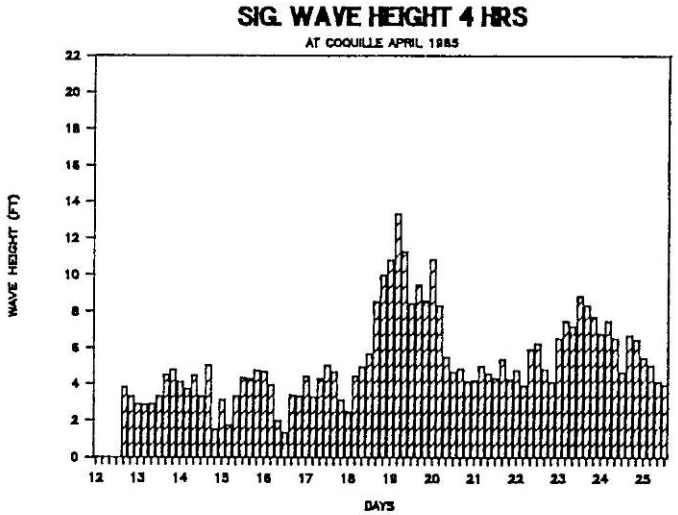


Figure B-9. Wave Height at Rogue Compared to Elsewhere





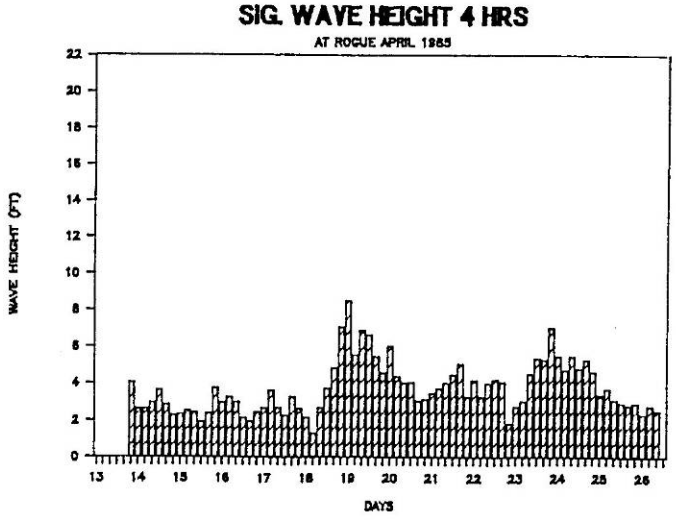
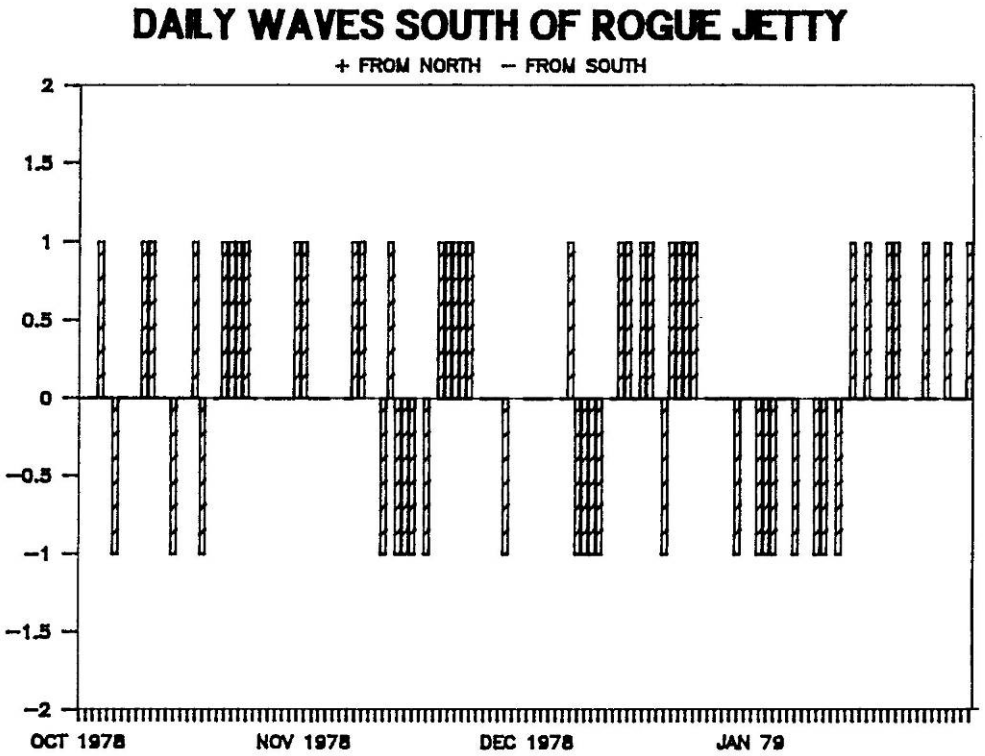
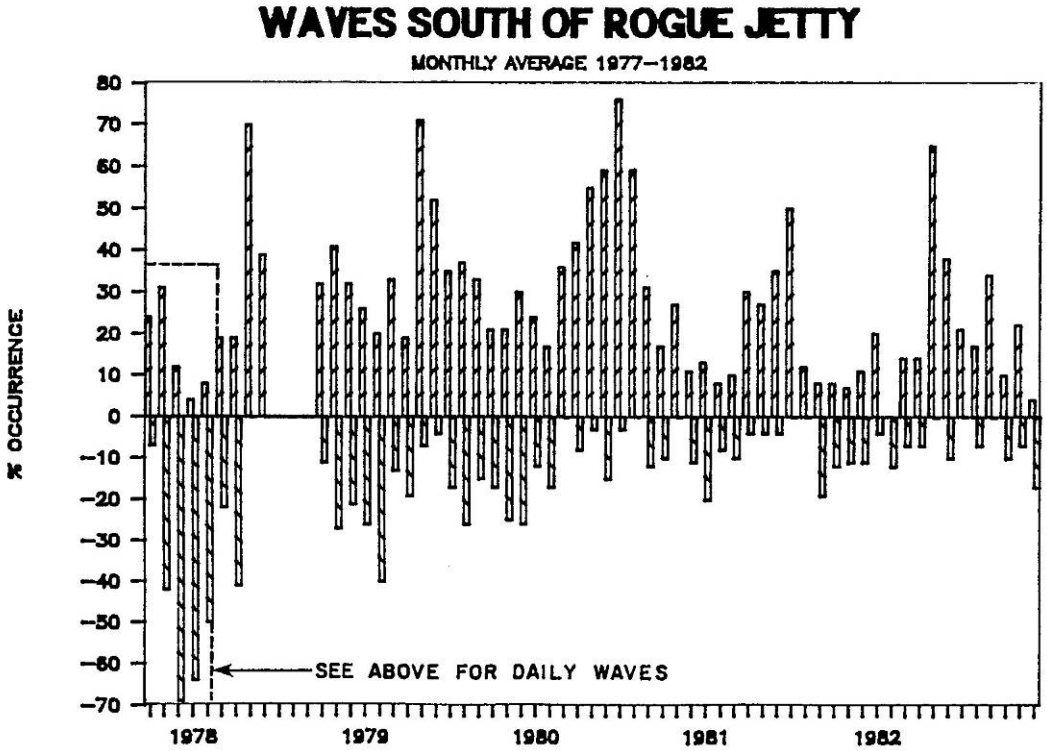


Figure B-10. LEO Monthly and Daily Average Wave Direction





SECTION 3. SEDIMENT TRANSPORT

The Littoral System

Any ODMDS for the Rogue River navigation project needs to be located to prevent the dredged material from returning to the entrance channel. This requires knowledge about the direction and rate of alongshore transport, as well as offshore transport. Sediment movement in the littoral zone consists of two mechanisms, depending upon the size of the sediment. Any material finer than sand size is carried in suspension and is relatively quickly removed far offshore. The almost total lack of silts and clays in the area attests to the efficiency of this mechanism. Sediments that are sand size or coarser may be occasionally suspended by wave action near the bottom, and are moved by bottom currents or 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.

Depth-Limited Transport

Hallermeier (1981) defined two zones of sand transport based on wave conditions. The inner littoral zone is the area of significant year-round alongshore and onshore-offshore transport by breaking waves. The outer shoal zone is affected by wave conditions regularly enough to cause significant onshore-offshore transport. Using Hallermeier (1981) and long-term wave data from Newport (Creech 1981), the limit for strong longshore transport varies from -28 feet in summer to -51 feet in winter. Significant onshore-offshore transport occurs to depths of -83 feet in summer and to -268 feet in winter. Hancock and others (1981) calculated the probability for wave-induced current velocities at various depths off Coos Bay. From other studies, a critical velocity of 20 cm/sec has been shown necessary to erode sediment in the 0.2 mm sand size, common off the Oregon Coast. Using the Coos Bay data, the probability of wave-induced sand movement is very small beyond a depth of about 150 feet. Various studies have suggested an offshore limit of modern sand movement at the 60-foot depth, while others push this limit out to over 100 feet.

Humbug Littoral Cell

The Humbug littoral cell extends approximately 40 km north from Cape Sebastian to Humbug Mountain (Figure B-1). The Rogue is the dominant river entering this littoral cell, with only minor input from Euchre, Hunter and Brush creeks. Mineral assemblages of the Rogue River correlate with littoral sand mineralogy, as well as terrace deposits within the littoral cell (personal communication C.D. Peterson). This indicates that the primary source of sand within the cell is from the Rogue River Basin. Less is known about shoreline source contributions although seacliff retreat is apparent (personal communication C.D. Peterson). Shown below are the possible sources and loss of sediments in the littoral cell.

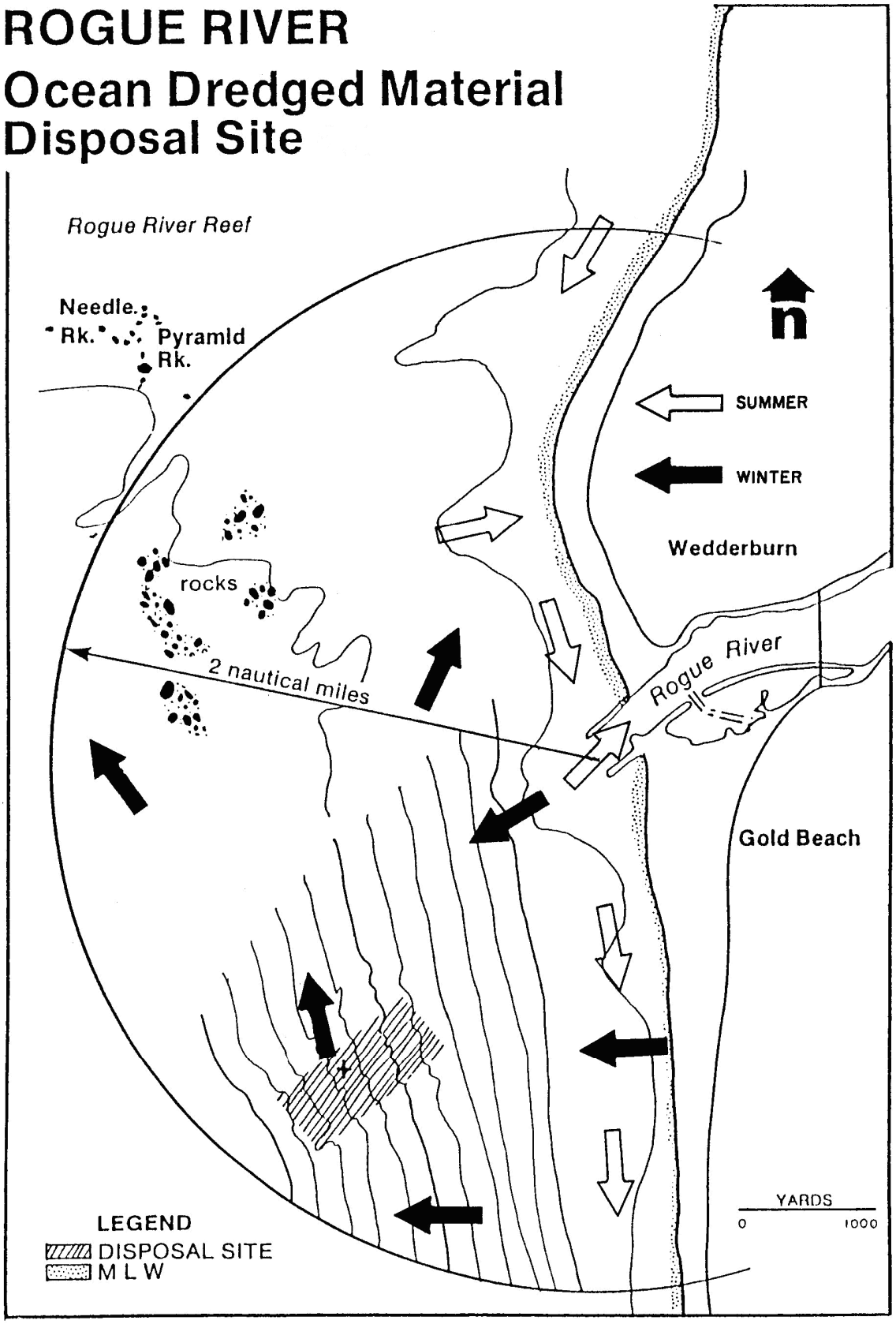
Source of Sediments	Loss of Sediments
1. Rivers	1. Estuaries
Rogue	2. Dune Growth
Various Creeks	3. Headland Bypassing
2. Erosion	4. Offshore Transport
Dunes	5. Ocean Disposal
Terraces	
Seacliffs	
3. Headland Bypassing	
4. Onshore Transport	

Rogue Sediment Transport

The offshore bathymetry just north of the entrance to the Rogue River probably affects sediment transport, but the mechanism is unclear. The recorded bottom currents at the disposal site are contradicted somewhat by long-term LEO current observations. If it is assumed that the net transport is to the north at the depth of the disposal site, then the nearshore or surf zone net transport is to the south. Stembridge (1978) discussed the rapid accretion of the shoreline 1-2 miles north of the Rogue entrance. There is no corresponding accretion to the south, although sand beaches are present. If the nearshore transport to the south is not balanced by a northward transport, then there should be more obvious accretion to the south.

Figure B-11 illustrates the sediment transport system assumed to be active in the vicinity of the proposed Rogue River ODMDS. Although the Rogue River must deliver a large sediment load, the bottom contours suggest a rapid distribution offshore. The beaches to the south seem to be in equilibrium, suggesting the littoral transport to the south is balanced by offshore transport. The prograding shoreline to the north suggests that Rogue sediments are being added in spite of the apparent littoral transport to the south. One possibility is that offshore sediments are moving to the north and then onshore due to wave and current refraction by the Rogue River Reef.

Figure B-11. Sediment Transport in Rogue Vicinity



SECTION 4. LITERATURE CITED

Baldwin, E.M. 1981. Geology of Oregon. Kendall/Hunt, Dubuque IA.

Baldwin, E.M. and J.D. Beaulieu. 1973. Geology and Mineral Resources of Coos County, Oregon. Bulletin 80, Oregon Department of Geology and Mineral Industries.

Beaulieu, J.D. and P.W. Hughes. 1976. Land Use Geology of Western Coos County, Oregon. Bulletin 90, Oregon Department of Geology and Mineral Industries.

Beaulieu, J.D., P.W. Hughes, and R.K. Mathiot. 1974. Geologic Hazards Inventory of the Oregon Coastal Zone. Oregon Department of Geology and Mineral Industries.

Chambers, D.M. 1969. Holocene sedimentation and potential placer deposits on the continental shelf off the Rogue River, Oregon. MS Thesis, Oregon State University, Corvallis.

Chesser, S.A., and C.D. Peterson. 1987. Littoral cells of the Pacific Northwest coast, pp. 1346-1360 *in* Kraus, N.C. (ed). Coastal Zone '87 Proceedings. ASCE New York.

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

Curray, J.R. 1965. Late Quaternary history, continental shelves of the United States, pp. 723-735 i*n* Wright, H.E., and Frey, D.G., eds. The Quaternary history of the United States. Princeton University Press, Princeton NJ.

Dott, R.H. Jr. 1971. Geology of the Southwest Oregon Coast West of the 124th Meridian: Oregon Department of Geology and Mineral Industries, Bulletin 69.

Gray, J.J. and LD. Kulm. 1985. Mineral Resources Map; Offshore Oregon. Geol. Map Series 37, Oregon Department of Geology and Mineral Industries.

Hallermeier, R.J. 1981. Seaward limit for significant sand transport by waves: an annual zonation for seasonal profiles. Report 81-2, U.S. Army Corps of Engineers.

Hancock, D.R., P.O. Nelson, C.K. Sollit, and K.J. Williamson. 1981. Coos Bay Offshore Disposal Site Investigation Interim Report, Phase 1, February 1979-March 1980. Report to U.S. Army Corps of Engineers, Portland District. Oregon State University, Corvallis.

Hartman, G.L. 1977. Jetty Effects at the Siuslaw and Rogue Rivers, pp. 287-304 *in* Proceedings Coastal Sediments '87.

Hunter, R.E., H.E. Clifton, and R.L. Phillips. 1970. Geology of the stacks and reefs off the southern Oregon coast. *Ore Bin* 32(10):185-201.

Johnson, J.W. 1972. Tidal Inlets on the California, Oregon and Washington Coasts. Hyd. Eng. Lab. Pub. HEL 24-12, University of California, Berkely CA.

Koch, J.G. 1966, Late Mesozoic stratigraphy and tectonic history, Port Orford-Gold Beach area, southwestern Oregon Coast: *Am. Assoc. Petroleum Geologists Bull* 50(1):25-71.

Kulm, L.D. 1977. Coastal morphology and geology of the ocean bottom–the Oregon region, pp. 9-36 *in* Draus (ed.). Marine Plant Biomass of the Pacific Northwest Coast.

Kulm, L.D. 1988. Potential heavy mineral and metal placers on the southern Oregon continental shelf. *Marine Mining* 7(4):361-395.

McKee B. 1972. Cascadia, the Geologic Evolution of the Pacific Northwest. McGraw-Hill, Inc., New York.

Nelson, P.O., C.K Sollit, KJ. Williamson, and D.R. Hancock. 1983. Coos Bay Offshore Disposal Site Investigation interim Report, Phase 11-111, April 1980-June 1981. Report to U.S. Army Corps of Engineers, Portland District. Oregon State University, Corvallis.

Oregon, State of. 1991. Preliminary Resource and Environmental Data: Oregon Placer Minerals, Open-File Report 0-91-02, Joint State-Federal Oregon Placer Minerals Technical Task Force, Oregon Department of Geology and Mineral Industries, Portland OR.

Percy, K.L., C. Sutterlin, D.A. Bella, and P.C. Klingeman. 1974. Description and Information Sources for Oregon Estuaries. Sea Grant/Oregon State University, Corvallis.

Peterson, C.D., K. Scheidegger, W. Nem, and P.D. Komar. 1984. Sediment composition and hydrography in six high gradient estuaries of the Northwest United States. *Jour. Sed. Pet.* 56:86-97.

Peterson, C.D. and S.E. Binner. 1988. Compositional variations of coastal placers in the Pacific Northwest, USA. *Marine Mining* 7(4):397-416.

Ramp, L. 1973. Metallic mineral resources (in) Baldwin, E.M. and Beaulieu, J.D. (eds.). Geology and Mineral Resources of Coos County, Oregon. Oregon Department of Geology and Mineral Industries, Bulletin 80.

Sollitt, C.K, P.O. Nelson, K.J. Williamson, and D.R. Hancock. 1984. Coos Bay Offshore Disposal Site Investigation, Final Report, Report to U.S. Army Corps of Engineers, Portland District by Oregon State University, Corvallis.

Stembridge, J.E. 1976. Recent Shoreline Changes of the Oregon Coast. National Technical Information Service (AD A04 8436), Springfield VA.

Stembridge, J.E. 1978. Oregon Coastal Shoreline Erosion, Vo1. 2, Inventory. Report by Oregon State Soil and Water Conservation Commission, Salem OR.

U.S. Army Corps of Engineers, North Pacific Division. 1971. National Shoreline Study; Inventory Report Columbia North Pacific Region, Washington and Oregon.

U.S. Army Copra of Engineers, Portland District, 1974. Coastal Reconnaissance Study, Oregon and Washington. Prepared by Battelle Pacific Northwest Laboratory.

U.S. Army Corps of Engineers, Portland District. 1975. Chetco, Coquille and Rogue Estuaries, Final Environmental Impact Statement. Portland OR.

U.S. Army Corps of Engineers, Portland District. 1986. Geologic and Seismic Investigations of Oregon Offshore Disposal Sites. Portland OR.

U.S. Army Corps of Engineers, Portland District. 1988. Rogue Ocean Dredged Material Disposal Site Evaluation, Final Report. Portland OR.

U.S. Department of Agriculture (USDA) and Oregon Coastal Conservation and Development Commission. 1975. Beaches and Dunes of the Oregon Coast.

U.S. Department of Commerce/NOAA. 1986. Tidal Current Tables for Pacific North America.

Appendix C

Sediment and Water Quality
Rogue River, Oregon

April 2009

Appendix C
Sediment and Water Quality
Rogue River, Oregon

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Appendix C
Sediment and Water Quality
Rogue River, Oregon

GENERAL

The Marine Protection, Research and Sanctuaries Act (MPRSA) requires that five general criteria and eleven 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 of 40 CFR 228.5 and 228.6 require sediment and water quality analyses indicative of both the dredging areas and disposal sites be reported. Dredged materials placed in ocean dredged material disposal sites (ODMDS) 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 dredged at the Rogue River project and placed in the ODMDS are similar in grain size to those at the disposal site. Because of their coarse nature, similarity to ODMDS 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 of 40 CFR 227.13(b). Data from navigation channel sands and fines in the Rogue River estuary and offshore at the ODMDS are presented in this appendix.

The general criteria and specific factors of the MPRSA have been interpreted as 27 different "areas of consideration" that cover the Rogue ODMDS and the dredged material it receives. These areas of consideration are listed in an ODMDS conflict matrix (see main text), which is used to evaluate each disposal site on its compliance with the requirements for disposal site designation. The results of the ODMDS conflict matrixes are compared and used to select the best ODMDS. 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.

This information including baseline data needed for the seven sediment quality areas of consideration is provided in this appendix.

ROGUE RIVER FEDERAL NAVIGATION PROJECT

Summary information on project water and sediment quality is provided for data collected in 1981, 1982, 1985, 1992, 1997, 2002 and 2007 from the federal navigation project. 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 in the 2006 Sediment Evaluation Framework (SEF). Information and specific data regarding these sediment quality evaluations are maintained and available at the Portland District. Detailed information including specific sample locations, as well as physical and chemical data, is provided for the latest project sediment quality assessment conducted in

2007. Water quality, with elutriate testing, was collected to establish baseline conditions. The 1981 event established that the materials meet the exclusion criteria from further testing as noted in 40 CFR 227.13; this was confirmed in 1985. No further water quality testing has been done.

Water Quality Summary

1981 April. Elutriate testing for to up to 45 parameters showed no release of harmful concentrations of contaminants. These materials are considered to meet the exclusion criteria from further testing as noted in 40 CFR 227.13. Supporting data is available in the U.S. Geological Survey (USGS) Open-File Report 84-133.

1985 April-May. Elutriate analyses were run on only one sediment sample from the main channel. None of the elutriate parameters exceeded allowable limits. Basic water quality parameters were taken in the field during collections of sediment samples from the channel. Surface measurements were taken off the U.S. Coast Guard dock and bottom measurements were taken off the dock and from the river opposite the boat basin (Table C-1). Results of the field measurements, collected with an automated multi-parameter water quality analyzer, are within normal ranges for the Oregon Coast.

Table C-1. Water Quality Measurements, 1985

Parameter	Off Dock		In River Opposite Boat Basin
	Surface	Bottom	Bottom
Dissolved Oxygen (mg/L)	12.20	12.54	12.43
Conductivity	0.002	0.002	0.001
Oxygen Reduction Potential	591	573	542
Temperature (°C)	7.0	6.9	6.9
pH	7.64	7.73	7.68
Time of Day	09:50	09:55	09:57

Sediment Quality Summary

1981 February. Sampling efforts within the navigation channel indicated that sediments in the river consisted of sand, whereas material within the mooring area and at the upland disposal site consisted of sandy-silt. In addition, sediment within the river contained relatively low volatile solids (<2%), whereas sediments in the boat basin and disposal site contained 5% volatile solids.

1982 April. Sediment analyses included elutriate and bulk chemistry, and physical characterizations of the Rogue navigation project and Port of Gold Beach mooring area. Chemical analyses were conducted only on the finer-grained mooring area sediments. The sediments were found to contain no significant levels of contaminates of concern measured. No significant chemical impacts were expected from placement of sediments into the ODMDS.

1992 April. Sediment samples were collected from the navigation channel and boat basin and subjected to physical and chemical analyses. Sediments from the navigation channel were gravely coarse sand suitable for unconfined in-water disposal without further evaluation. Sediments collected outside the navigation channel for EPA, Region 10, were sandy, clayey silt. The sediments were high in chromium and nickel, probably of natural origin. Copper and zinc were slightly enriched in the western dock area. Pesticides and polychlorinated biphenyls (PCBs) were

undetected, phenols were detected in one sample, and several polynuclear aromatic hydrocarbons (PAHs) exceeded EPA, Region 10 screening levels. Tributyltin (TBT) levels were low. Evaluation of the non-navigation channel samples would be required prior to ODMDS disposal.

1997 July. Nine sediment samples were taken from the Rogue River shoals and analyzed for both chemical (5) and physical parameters. Physical analysis indicated the material is primarily gravelly coarse sand low in organic content. Chemical samples were analyzed for metals, TBT, PAHs, total organic carbon (TOC), acid volatile sulfide, pesticides, and PCBs. All chemical and physical analysis indicated that this material is similar to material at the ODMDS, and is suitable for disposal with no expected adverse environmental impact.

2002 August. Seven surface grab sediment samples were collected from the Rogue River federal project. All samples were submitted for physical analyses including total volatile solids. Four of seven sediment samples were analyzed for metals (9 inorganic), TOC, pesticides, PCBs, phenols, phthalates, miscellaneous extractables, TBT, and PAHs. Mean grain size for all samples was 0.10 millimeters, with 16.53% gravel, 58.48% sand, and 24.99% fines with 3.67% volatile solids. Nickel was detected at levels in excess of the 140 mg/kg DMEF screening level; however, this level was consistent with historical levels detected within Rogue River federal navigational project as shown below:

Year Tested	**1982**	**1992**	**1997**	**2002**
Nickel (mg/kg)	162.5	231.5	207.8	219.5

The levels of nickel detected at the Rogue project are determined to be from natural sources and are considered background levels; in-water disposal will not create significant additional risk to the environment, beyond what naturally exists in the area. All sediment was from the project determined to be suitable for unconfined, in-water placement without further characterization.

DETAILED 2007 SEDIMENT QUALITY RESULTS AND DISCUSSION

On August 8, 2007, six surface grab sediment samples were collected from the Rogue River federal navigation channel and the inner channel leading to the Gold Beach boat basin (Figures C-1 and C-2). All six samples were submitted for physical analyses including total volatile solids. Select sample samples containing higher percent of fine-grained material were analyzed for metals 10 (inorganic), TOC, pesticides, PCBs, phenols, phthalates, miscellaneous extractables, and PAHs.

Physical and Volatile Solids (ASTM methods), Total Organic Carbon (EPA method 9060)

Six samples were submitted for testing with data presented in Table C-2. All samples were submitted for physical analyses; material within the outer river channel consisted of 82.5% sand, with shell hash (range 94.1% to 70.9%) and 17.5% fine-grained material (range 29.1% to 5.9%); volatile solids on the one sample analyzed from this area were 4.53%. Material from the inner channel, leading to the boat basin, was 64.9% sand, with shell hash (range 79.3% to 50.2%) and 35.1% fine-grained material (range 49.8% to 20.7%) with volatile solids content ranging from 10.5% to 5.8% (mean 7.5%). The TOC ranged from 0.73% to 2.5% in these samples.

Figure C-1. Rogue River Federal Channel Sediment Sampling Locations, 2007

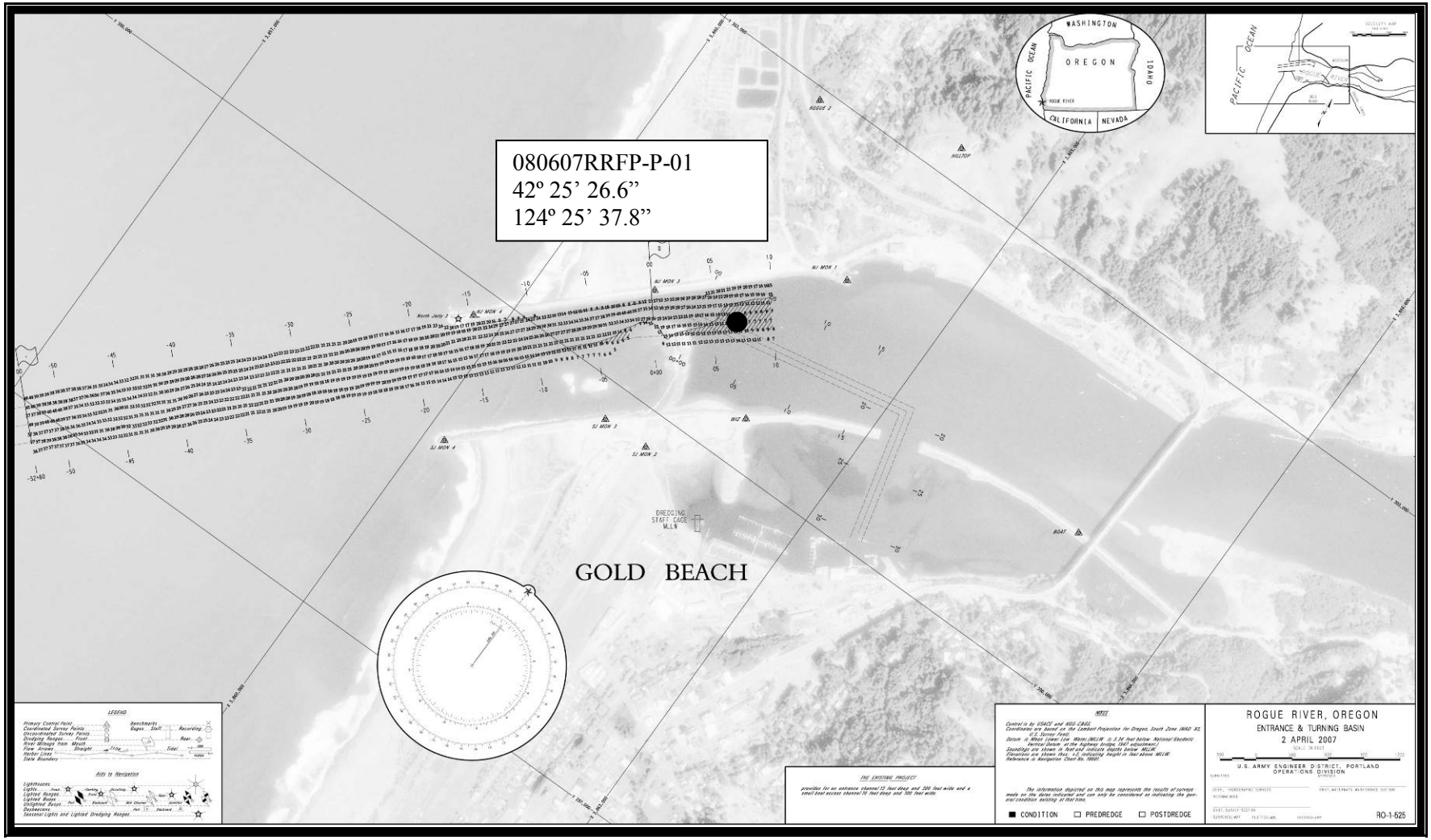


Figure C-2. Rogue River Federal Channel Sediment Sampling Locations, 2007

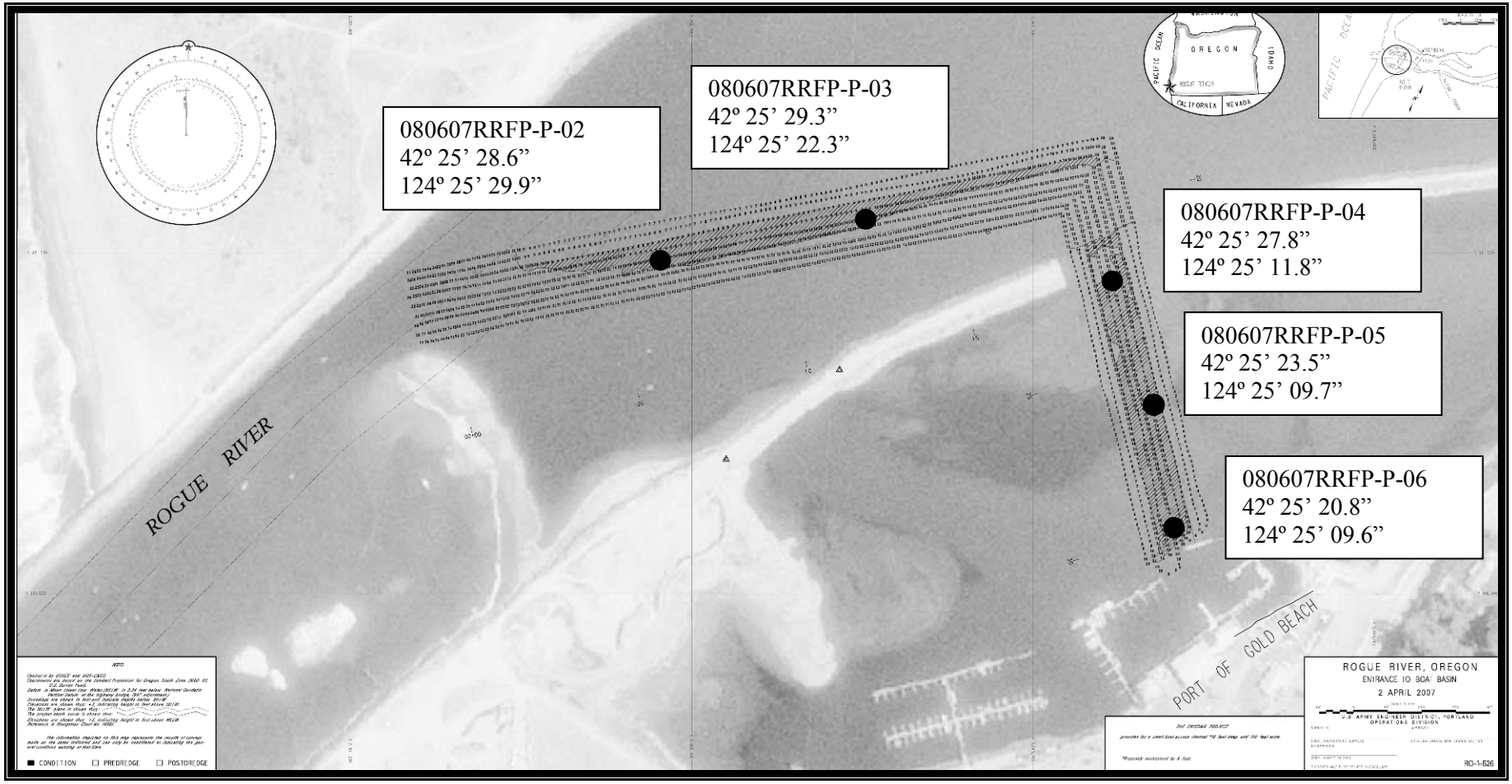


Table C-2. Rogue River Project Physical Analysis, Volatile Solids, and TOC, 2007

Sample I.D.	Percent (%)					
	Gravel-sized Material	Sand	Silt/Clay	Volatile Solids	Mean Grain Size (mm)	TOC
080607RRFP-P-01	70.5	23.6	5.9	--	3.97	--
080607RRFP-P-02	47.6	23.3	29.1	4.53	5.20	--
080607RRFP-P-03	39.8	28.3	31.9	7.21	4.62	0.73
080607RRFP-P-04	3.7	75.6	20.7	5.77	0.172	0.92
080607RRFP-P-05	3.0	58.8	38.2	6.57	0.112	1.43
080607RRFP-P-06	8.0	42.2	49.8	10.5	0.103	2.48
Mean	28.7	42.0	29.3	8.23	2.36	1.39
Minimum	3.0	23.3	5.9	4.53	0.103	0.73
Maximum	70.5	75.6	49.8	10.5	5.20	2.48

P = Ponar (surface grab sampler)
(--) symbol = not analyzed
% passing 200 sieve (0.0750 mm) = silt/clay fraction

Metals (EPA method 6010/7471)

Four fine-grained material samples collected from within the inner channel to the boat basin were submitted for testing, with data presented in Table C-3. The metals silver (Ag), arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), nickel (Ni), lead (Pb), antimony (Sb), mercury (Hg), and zinc (Zn) were detected in all fine-grained samples, but no levels approach their respective SEF screening level and are consistent with historically reported values.

Table C-3. Rogue River Project Inorganic Metals, 2007

Sample I.D.	Metals mg/kg (ppm)									
	As	Cd	Cr	Sb	Cu	Pb	Ni	Ag	Zn	Hg
080607RRFP-P-03	2.51	0.110	73.0	0.040	15.3	2.93	114.0	0.030	35.3	0.038
080607RRFP-P-04	3.46	0.092	156.0	0.070	28.9	4.65	242.0	0.046	58.7	0.057
080607RRFP-P-05	3.91	0.119	144.0	0.080	30.9	5.48	231.0	0.062	60.0	0.068
080607RRFP-P-06	3.07	0.095	104.0	0.060	23.4	4.06	164.0	0.059	49.3	0.075
2006 SEF Screening Level	57	5.1	260	150	390	450	--	6.1	410	0.41

Symbol (--) = Screening level not established.

Nickel has historically been detected at the Rogue River project at levels higher than most Oregon coastal rivers. The levels of nickel detected at the Rogue project are determined to be from natural sources and are considered background levels; in-water disposal will not create significant additional risk to the environment, beyond what naturally exists in the area. In 2007 a benthic sample was collected from the channel near the boat basin, where nickel exceeded 200 mg/kg; this sample demonstrates the ability of benthic organisms to develop a healthy diverse community in sediments with elevated Ni content.

Pesticides/PCBs (EPA method 8081/8082)

Four fine-grained samples collected from within the inner channel leading to the boat basin were submitted for testing, with data presented in Tables C-4 and C-54. Dichloro-diphenyl-trichloroethane (DDT) was detected in one sample between the method reporting limit (MRL) and the method detection limit (MDL) and the value stated is considered an estimate. Low level estimated values were also detected for aldrin. Chlordane was not detected (reported as technical chlordane), but detection levels were elevated due to matrix interference during the analysis. The laboratory provided additional information for alpha and gamma chlordane (alpha and gamma are the primary isomers in technical chlordane), with sufficiently low detection limits individually, to evaluate chlordane as not present at levels of concern. Aroclor 1221 had an elevated detection level, but the screening level for total PCBs (130 ug/kg) was not exceeded due to this individual aroclor detection limit.

Table C-4. Rogue River Project Pesticides, 2007

Sample I.D.	Pesticides ug/kg (ppb)										
	Aldrin	Chlordane			Dieldrin	Hepta-chlor	Gamma-BHC (Lindane)	4,4'-DDD	4,4'-DDE	4,4'-DDT	Sum ∑ DDT
		Technical	Alpha	Gamma							
080607RRFP-P-03	<0.690	<11.0	<0.34	<0.064	<0.45	<1.00	<2.3	<0.190	<0.250	<0.098	ND
080607RRFP-P-04	0.590 J	<5.4	<0.23	<0.064	<0.46	<0.21	<0.24	<0.210	<0.160	<0.590	ND
080607RRFP-P-05	<0.270	<6.7	<0.29	<0.064	<0.51	<0.30	<0.27	<0.210	<0.180	<0.270	ND
080607RRFP-P-06	0.550 J	<5.9	<0.23	<0.064	<0.51	<0.26	<0.54	<0.210	0.019 J	<0.180	0.019J
2006 SEF Screening Level	9.5	2.8	2.8		1.9	11.5	--	16.0	9.0	12.0	

Symbol (<) = Non-detect (ND) at the value listed (MDL).
Symbol (--) = Screening Level not established.
J = Estimated value (reported values are above the MDL, but below the MRL).

Table C-5. Rogue River Project PCBs, 2007

Sample I.D.	PCB Aroclors - ug/kg (ppb)							
	1016	1221	1232	1242	1248	1254	1260	Sum ∑
080607RRFP-P-03	<7.1	<110.0	<16.0	<10.0	<2.6	<2.6	<2.6	ND
080607RRFP-P-04	<3.5	<88.0	<12.0	<5.7	<2.7	<2.7	<2.7	ND
080607RRFP-P-05	<10.0	<74.0	<6.70	<10.0	<3.0	<3.0	<3.0	ND
080607RRFP-P-06	<3.0	<66.0	<10.0	<3.0	<3.0	<3.0	<3.0	ND
2006 SEF Screening Level*							Total	130

*SEF 2006 interim freshwater screening level
Symbol (<) = Non-detect (ND) at the value listed (MDL).

Chlorinated Hydrocarbons, Phenols, Phthalates and Miscellaneous Extractables (EPA method 8270)

Four fine-grained samples collected from within the inner channel leading to the boat basin and were submitted for testing, with data presented in Tables C-6 to C-9. No chlorinated hydrocarbons were detected. Low levels of several phthalates were detected, but at very low levels, well below their respective screening levels. Phenol was detected in sample 080607RRFP-P-06 at 1,200 ug/kg, which exceeds the SEF's 420 ug/kg screening level. Phenol has a wide variety of applications and is contained in disinfectants, solvents, medical and industrial organic compounds and dyes, adhesives and plastics. Because of its wide spread application, it has a high occurrence of cross-contamination into environmental samples and can show up in lab data from sources introduced during either the sampling event or from analytical laboratory practices. Historically phenol has not been detected in samples collected from the Rogue River federal channel at levels of concern (in 2002 was detected at 11.7 ug/kg); there is a distinct possibility that the phenol detected here is a result of cross-contamination. Without being able to verify the currently reported phenol as cross-contamination, the sediment associated with this sample will not be dredged until further characterization can be completed.

Table C-6. Rogue River Project Chlorinated Hydrocarbons, 2007

Sample I.D.	Chlorinated Hydrocarbons - ug/kg (ppb)			
	1,4-Dichloro-benzene	1,2-Dichloro-benzene	1,2,4-Trichloro-benzene	Hexachloro-benzene
080607RRFP-P-03	<8.9	<8.9	<8.0	<3.7
080607RRFP-P-04	<9.2	<9.2	<8.3	<3.9
080607RRFP-P-05	<5.1	<5.1	<4.6	<2.1
080607RRFP-P-06	<11.0	<11.0	<9.0	<4.2
2006 SEF Screening Level	110	35	31	22
Symbol (<) = Non-detect (ND) at the value listed (MDL).				

Table C-7. Rogue River Project Phthalates, 2007

Sample I.D.	Phthalates - ug/kg (ppb)					
	Bis(2-ethylhexyl) phthalate	Butyl benzyl phthalate	Diethyl phthalate	Dimethyl phthalate	Di-n-butyl phthalate	Di-n-octyl phthalate
080607RRFP-P-03	<22.0	<9.8	<4.0	<3.1	41.0	<5.2
080607RRFP-P-04	<23.0	<11.0	<4.2	8.2 J	38.0 J	<5.4
080607RRFP-P-05	<13.0	<5.6	<2.3	<1.8	22.0	<3.0
080607RRFP-P-06	26.0 J	<12.0	<4.5	<3.5	35.0 J	<5.9
2006 SEF Screening Level	1,300	63	200	71	1,400	6,200
J = Estimated value (reported values are above the MDL, but below the MRL). Symbol (<) = Non-detect (ND) at the value listed (MDL).						

Table C-8. Rogue River Project Phenols, 2007

Sample I.D.	Phenols - ug/kg (ppb)				
	2,4-Dimethyl phenol	2-Methyl phenol	4-Methyl phenol	Pentachloro phenol	Phenol
080607RRFP-P-03	<17.0	<4.6	<87.0	<62.0	<120.0
080607RRFP-P-04	<18.0	<4.8	<490.0	<64.0	<6.4
080607RRFP-P-05	<9.7	<2.7	<380.0	<35.0	130
080607RRFP-P-06	<20.0	<5.2	<860.0	<70.0	**1,200**
2006 SEF Screening Level	29	63	670	400	420

J = Estimated value (reported values are above the MDL, but below the MRL).
Symbol (<) = Non-detect (ND) at the value listed (MDL).

Table C-9. Rogue River Project Miscellaneous Extractables, 2007

Sample I.D.	Miscellaneous Extractables - ug/kg (ppb)				
	Benzyl alcohol	Benzoic Acid	Dibenzofuran	Hexachloro-butadiene	N-Nitroso diphenylamine
080607RRFP-P-03	12.0 J	<300.0	<3.7	<7.7	<4.9
080607RRFP-P-04	13.0 J	<310.0	<3.9	<8.0	<5.1
080607RRFP-P-05	4.0 J	<170.0	<2.1	<4.4	<2.8
080607RRFP-P-06	<7.3	<340.0	<5.3	<8.7	<5.6
2006 SEF Screening Level	57	650	540	29/11	28/28

J = Estimated value (reported values are above the MDL, but below the MRL).
Symbol (<) = Non-detect (ND) at the value listed (MDL).

Polynuclear Aromatic Hydrocarbons (EPA method 8270C)

Four fine-grained samples collected from within the inner channel leading to the boat basin were submitted for testing with data presented in Tables C-10 and C-11. Some "low molecular weight" PAHs and "high molecular weight" PAHs were detected, but none approached their respective SEF screening levels. All detection levels were low enough to adequately characterize sediment.

Table C-10. Rogue River Project PAHs, Low Molecular Weight, 2007

Sample I.D.	Low Molecular Weight PAHs - ug/kg (ppb)							
	Ace-naphthene	Ace-naphthylene	Anthracene	Fluorene	2-Methyl naphthalene	Naphthalene	Phen-anthrene	Total Low PAHs
080607RRFP-P-03	<4.3	<3.7	<4.9	<3.4	<6.8	<7.1	6.4 J	ND
080607RRFP-P-04	<4.5	<3.9	<5.1	<3.5	7.8 J	<7.3	10.0 J	ND
080607RRFP-P-05	<2.5	<2.1	<2.8	<2.0	<3.9	<4.1	6.0 J	ND
080607RRFP-P-06	<4.9	5.1 J	8.3 J	4.3 J	15.0 J	9.8 J	33.0	75.5 J
2006 SEF Screening Levels	500	560	960	540	670	2100	1500	5200

J = Estimated value (reported values are above the MDL, but below the PQL).
Symbol (<) = Non-detect (ND) at the value listed (MDL).

Table C-11. Rogue River Project PAHs, High Molecular Weight, 2007

Sample I.D.	High Molecular Weight PAHs - ug/kg (ppb)									
	Benzo(a)-anthracene	Benzo-fluro-anthenes	Benzo-(g,h,i)-perylene	Chrysene	Pyrene	Benzo(a)-pyrene	Indeno-(1,2,3-cd)-pyrene	Dibenzo-(a,h) anthracene	Fluor-anthene	Total High PAHs
080607-RRFP-P-03	<5.2	<4.3	<4.6	<4.6	<4.6	<5.2	<4.6	<4.6	<4.9	ND
080607-RRFP-P-04	<5.4	<4.5	<4.8	<4.8	<4.8	<5.4	<4.8	<4.8	<5.1	ND
080607-RRFP-P-05	<3.0	<2.5	<2.7	<2.7	<2.7	<3.0	<2.7	<2.7	3.4 J	ND
080607-RRFP-P-06	16.0 J	19.0 J	<5.2	19.0 J	**35.0**	<5.9	<5.2	<5.2	**43.0**	132 J
2006 SEF Screening Level	1300	3200	670	1400	2600	1600	600	230	1700	-

J = Estimated value (reported values are above the MDL, but below the PQL).
Symbol (<) = Non-detect (ND) at the value listed (MDL).

Tributyltin (Krone method for total/bulk organotin)

Four fine-grained samples collected from within the inner channel leading to the boat basin were submitted for testing with data presented in Table C-12. Due to a lack of pore water in the samples, only total TBT was analyzed. While 75 ug/kg is the freshwater screening level for total TBT, a marine screening level for total TBT has not been established in the SEF. One low-level estimated value for dibutyltin was all that was detected.

Table C-12. Rogue River Project Organotin, 2007

Sample I.D.	Organotin - ug/kg (ppb)			
	Monobutyltin	Dibutyltin	Tributyltin	Tetrabutyltin
080607RRFP-P-03	--	--	--	--
080607RRFP-P-04	<0.230	0.150 J	<0.120	<0.089
080607RRFP-P-05	<0.270	<0.053	<0.130	<0.098
080607RRFP-P-06	<0.120	<0.052	<0.130	<0.097
2006 SEF Screening Level*				

Due to lack of pore water in the samples, only total TBT was analyzed.
*75 ug/kg is the freshwater screening level; a marine screening level for total TBT has not been established in the SEF.
Symbol (<) = Non-detect (ND) at the value listed (MDL).
Symbol (--) = No sample analyzed

2007 Summary for the Rogue River Project

Physical analyses for material within the outer river channel consisted of 82.5% sand, with shell hash (range 94.1% to 70.9%) and 17.5% fine-grained material (range 29.1% to 5.9%); volatile solids on the one sample analyzed from this area were 4.53%. Material from the inner channel, leading to the boat basin, was 64.9% sand, with shell hash (range 79.3% to 50.2%) and 35.1% fine-grained material (range 49.8% to 20.7%) with volatile solids content ranging from 10.5% to 5.8% (mean 7.5%). The TOC ranged from 0.73% to 2.5% in these samples.

The chemical analyses indicated only very low levels of contamination in any of the samples, with all levels below their respective SEF screening levels with the exception of phenol, which was detected above the 420 ug/kg SEF screening level at 1200 ug/kg, in the sample closest to the boat basin. It is suspected that phenol is a possible laboratory cross-contamination, but without being able to verify that with the lab, the dredge material represented by that sample (080607RRFP-P-06) should not be dredged until further characterization or re-sampling, to provide a weight of evidence, can be accomplished.

Laboratory detection levels were sufficiently low enough to evaluate material proposed for dredging, with the exception of (technical) chlordane. The laboratory originally reported technical chlordane, which contains primarily 2 isomers (alpha and gamma), with MDLs that exceeded the SEF (2006) marine screening level of 2.8 ug/kg. The lab was able to revise their report to include the MDLs for the 2 isomers, which allows characterization of chlordane below the screening level. Historical data (2002) confirms that chlordane has not been present in past sampling events (non-detect at 1.76, 2.49, 2.10, and 2.95 ug/kg in 2002).

Nickel (Ni) has historically been detected at levels higher than in most Oregon coastal rivers. The levels of nickel detected at the Rogue project are determined to be from natural sources and are considered background levels; in-water disposal will not create significant additional risk to the environment, beyond what naturally exists in the area. Samples where nickel exceeded 200 mg/kg have supported a diverse population of benthic organisms (one sample was collected in 2007 to verify the diverse benthic population).

In conclusion, the data represented by samples collected during the 2007 sampling event are consistent with historical sampling results and meet the guidelines established in the SEF for unconfined in-water placement without further characterization, except for the sediment represented by sample 080607RRFP-P-06, which contained phenol above the SEF screening level.

ROGUE RIVER ODMDS

Historic Disposal Volumes

Dredging of the entrance of Rogue River began in 1962. Table C-13 shows the available records for volumes of material placed off-shore of the Rogue River at historic disposal sites and the year placement occurred. Additional material from the boat basin has been pumped to onshore disposal sites by contract pipeline dredge. Other entrance shoals have been flushed out by the Corps' agitation dredge *Sandwick* on ebb tide without removing the material from the water. The *Sandwick* was decommissioned in 2003 and agitation dredging is no longer practiced at the site. The maximum amount of material disposed at sea in one year was 142,260 cy in 1983, while some years have no offshore disposal. The 10-year average volume from 1997 to 2007 was 45,268 cy. The Rogue River authorized project is a channel 13-feet deep, 300-feet wide, and 3,500-feet long from the mouth of the channel to the boat basin entrance. The side channel to the boat basin is 10-feet deep and 150-feet wide. Shoals form at the basin entrance and between the jetties during the spring and summer months. The entrance shoal forms in the late winter and spring.

Table C-13. Rogue River Project Dredging Volumes

Fiscal Year	Dredging Volumes (cy)
1976-1985	474,900
1986	0
1987	55,600
1988	36,400
1989	90,400
1990	70,300
1991	37,000
1992	32,200
1993	94,600
1994	120,000
1995	95,700
1996	44,100
1997	71,100
1998	55,600
1999	0
2000	44,800
2001	52,300
2002	35,100
2003	51,000
2004	31,000
2005	60,800
2006	20,100
2007	31,000

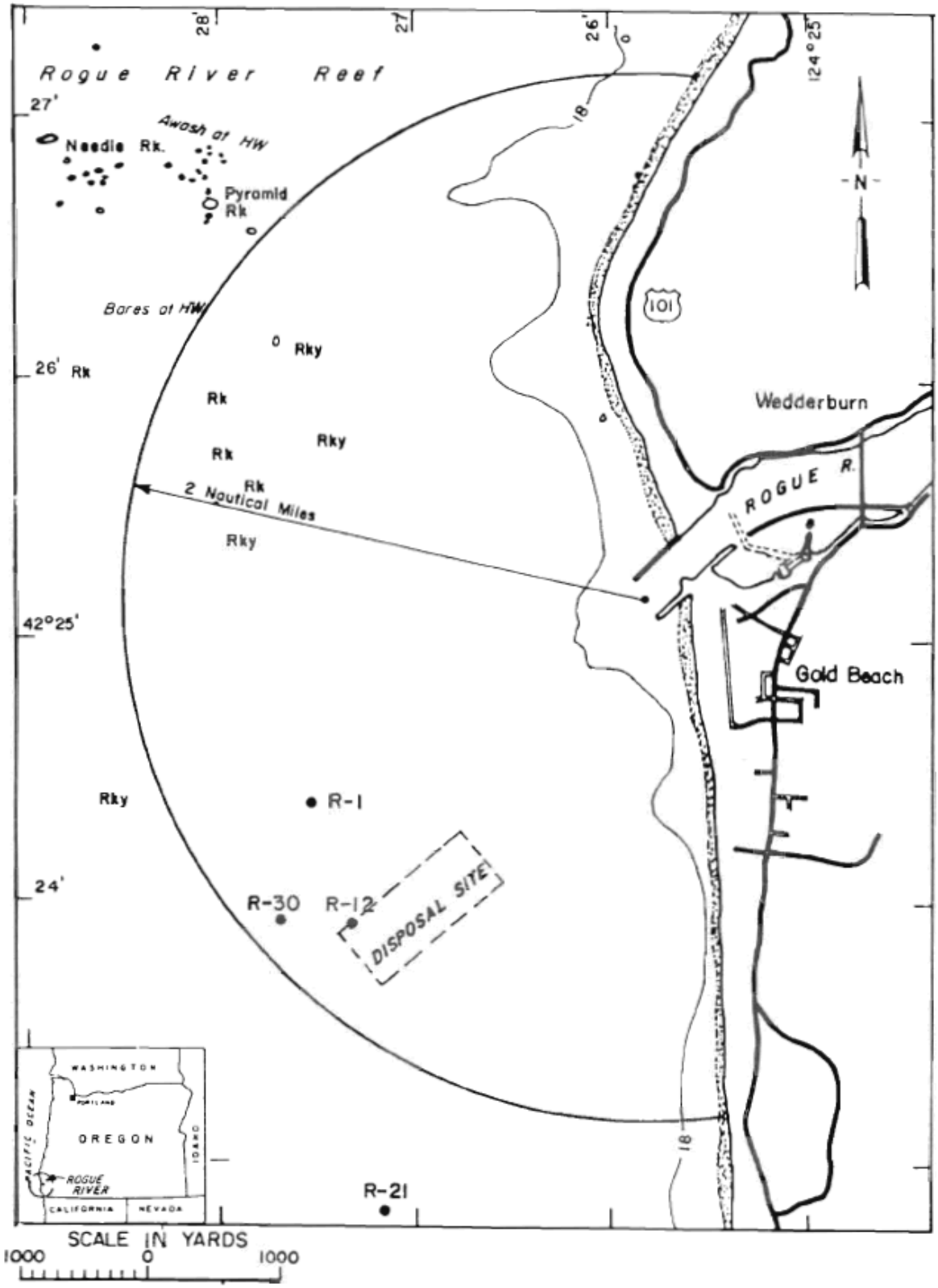
Note: Data includes Corps and contract hopper dredging and mechanical dredging.

Baseline Analysis Results

August 1985. Four sediment samples were collected in the vicinity of the Rogue ODMDS site (Figure C-3). Samples were sent to the Corps' North Pacific Division Materials Testing Laboratory for determination of sediment grain size and organic content. No chemical analyses were conducted.

- Sample R-1 was collected in 80 feet of water north of the disposal site and was classified as (sp), medium to fine-grained sand; 0.13 mm mean grain-size.
- Sample R-12 was collected in 80 feet of water on the west edge of the disposal site and was classified as (sp), medium to fine-grained sand; 0.16 mm mean grain-size..
- Sample R-21 was collected in 80 feet of water south of the disposal site and was classified as (sp), medium to fine-grained sand; 0.13 mm mean grain-size..
- Sample R-30 was collected in 90 feet of water west of the disposal site and was classified as (sp), medium to fine-grained sand; 0.14 mm mean grain-size..

Figure C-3. Rogue River ODMDS Sampling Locations, 1985



DETAILED 2007 ODMDS SEDIMENT QUALITY RESULTS

In June 2007, five surface-grab sediment samples were collected at the existing Rogue River ODMDS site with a 0.96 m^2 modified Gray-O'Hara box core sampler. Three samples (01, 02 and 03) were collected from east to west on the centerline of the site. One sample was collected north of the site (04) and 1 sample was collected south of the site (05; Figure C-4). All samples were subjected to physical and chemical analysis.

Physical and Volatile Solids (ASTM methods)

Five samples were submitted for testing, with data presented in Table C-14. The mean value for a grain-size of sand or greater (sample 03 was 88.3 % gravel sized material) was 96.5% with a mean value of 3.5% fine-grained material (less than 200 sieve); mean value for volatile solids was 2.2%.

Table C-14. Rogue River ODMDS Physical and Total Volatile Solids, 2007

Sample I.D.	Grain Size Percent (%)				
	Gravel (shell hash)	Sand	Silt/Clay	Volatile Solids	Mean Grain size (mm)
0807RODMDS-BC-01	0.0	97.4	2.6	2.1	0.162
0807RODMDS-BC-02	0.0	96.2	3.8	2.3	0.160
0807RODMDS-BC-03	88.3	7.4	4.3	1.7	9.68
0807RODMDS-BC-04	0.1	97.7	2.2	2.5	0.160
0807RODMDS-BC-05	0.0	95.4	4.6	2.4	0.161
Mean Value	96.5		3.5	2.2	2.06

BC = Box core (surface-grab sampler)
% passing 200 sieve (0.0750 mm) = silt/clay fraction

Metals (EPA method 6010/7471) and Total Organic Carbon (EPA method 9060)

Five samples were submitted for testing, with data presented in Table C-15. Sediments were analyzed for 10 heavy metals. Of the 10 metals, all but silver (Ag) and mercury (Hg) were present in all of the samples (Hg was not present in sample 03). No detected metal values approached their respective SEF screening level.

Nickel (Ni) no longer has a marine screening level in the SEF; it has historically been detected in the Rogue River sediment at levels higher than most Oregon coastal rivers. The levels of nickel detected at the Rogue River project are determined to be from natural sources and are consistent with historical background levels. The samples collected both inside and outside of the ODMDS site reflect this elevated Ni level. Benthic community samples (see Appendix A) indicate a healthy diverse benthic population. In addition, there is geological study information (see Appendix B) regarding the high mineral content in this region.

Figure C-4. Rogue River ODMDS Sampling Locations, 2007

Table C-15. Rogue River ODMDS Metals and Total Organic Carbon, 2007

Sample I.D.	Metals - mg/kg (ppm)										TOC %
	Sb	As	Cd	Cr	Cu	Pb	Ni	Ag	Zn	Hg	
0807RODMDS-BC-01	0.04	3.70	0.065	133.0	11.2	3.58	139	<0.02	36.6	0.014	0.14
0807RODMDS-BC-02	0.04	4.06	0.064	124.0	12.1	3.73	137	<0.02	39.9	0.013	0.17
0807RODMDS-BC-03	0.04	1.31	0.045	138.0	6.3	1.30	305	<0.02	14.0	<0.006	0.19
0807RODMDS-BC-04	0.04	3.96	0.066	134.0	13.4	4.13	151	<0.02	42.7	0.017	0.17
0807RODMDS-BC-05	0.04	3.96	0.066	124.0	12.0	3.80	138	<0.02	39.1	0.013	0.16
SEF 2006 Screening Levels	150	57	5.1	260	390	450	---	6.1	410	0.41	NA

--- = No established screening level
Symbol (<) = Non-detect (ND) at the value listed (MDL).
NA = Non-applicable

Pesticides/PCBs (EPA method 8081/8082)

Five samples were submitted for testing, with data presented in Tables C-16 and C-17. DDT was detected in one sample between the MRL and the MDL and the value is considered an estimate. Chlordane was not detected (reported as technical chlordane), but detection levels were elevated due to matrix interference during the analysis. The laboratory provided additional information for alpha and gamma chlordane (alpha and gamma are the primary isomers in technical chlordane), with sufficiently low detection limits individually to evaluate chlordane as not present at levels of concern. No PCBs were detected in these sediments at sufficiently low MDLs.

Table C-16. Rogue River ODMDS Pesticides, 2007

Sample I.D.	Pesticides ug/kg (ppb)									
	Aldrin	Chlordane			Diel-drin	Hepta-chlor	Gamma-BHC (Lindane)	4,4'-DDD	4,4'-DDE	4,4'-DDT
		Tech-nical	Alpha	Gamma						
0807RODMDS-BC-01	<0.19	<4.3	<0.23	<0.064	<0.37	<0.10	<0.19	<0.15	<0.13	<0.08
0807RODMDS-BC-02	<0.20	<4.3	<0.23	<0.064	<0.37	<0.22	<1.0	<0.16	<0.13	<0.08
0807RODMDS-BC-03	<0.16	<3.6	<0.23	<0.064	<0.31	<0.17	<0.16	<0.13	<0.11	0.38JT
0807RODMDS-BC-04	<0.20	<4.5	<0.23	<0.064	<0.38	<0.11	<0.20	<0.16	<0.14	<0.08
0807RODMDS-BC-05	<0.40	<8.8	<0.23	<0.064	<0.74	<0.22	<0.40	<0.32	<0.26	<0.16
SEF 2006 Screening Levels	9.5	2.8	2.8		1.9	1.5	--	16	9	12
Symbol (<) = Non-detect (ND) at the value listed (MDL).										
JT =The result is an estimated concentration that is less than the method reporting limit (MRL) but greater than or equal to the method detection limit (MDL).										

Table C-17. Rogue River ODMDS PCBs, 2007

Sample I.D.	PCB Aroclors ug/kg – (ppb)						
	1016	1221	1232	1242	1248	1254	1260
0807RODMDS-BC-01	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2
0807RODMDS-BC-02	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2
0807RODMDS-BC-03	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
0807RODMDS-BC-04	<2.3	<2.3	<2.3	<2.3	<2.3	<2.3	<2.3
0807RODMDS-BC-05	<4.4	<4.4	<4.4	<4.4	<4.4	<4.4	<4.4
SEF 2006 (Screening level 130 ppb sum of PCB Aroclors). Symbol (<) = Non-detect (ND) at the value listed (MDL).							

Chlorinated Hydrocarbons, Phenols, Phthalates, and Extractables (EPA method 8270C)

Five samples were submitted for testing, with data presented in Tables C-18 to C-21. No chlorinated hydrocarbons were detected. Low levels of several phthalates, extractables, and phenol were detected, but at very low levels, well below their respective screening levels.

Polynuclear Aromatic Hydrocarbons (EPA method 8270C)

Five samples were submitted for testing, with data presented in Tables C-22 and C-23. No "low molecular weight" PAHs or "high molecular weight" PAHs were detected in any of the samples. All detection levels were sufficient to adequately characterize sediment.

Table C-18. Rogue River ODMDS Chlorinated Hydrocarbons, 2007

Sample I.D.	Chlorinated Hydrocarbons - ug/kg (ppb)			
	1,4-Dichlorobenzene	1,2-Dichlorobenzene	1,2,4-Trichlorobenzene	Hexachlorobenzene
0807RODMDS-BC-01	<3.7	<3.3	<3.3	<1.5
0807RODMDS-BC-02	<3.7	<3.3	<3.3	<1.6
0807RODMDS-BC-03	<3.1	<2.8	<2.8	<1.3
0807RODMDS-BC-04	<3.8	<3.4	<3.4	<1.6
0807RODMDS-BC-05	<3.7	<3.4	<3.4	<1.6
2006 SEF Screening Levels	110	35	31	22
Symbol (<) = Non-detect (ND) at the value listed (MDL)				

Table C-19. Rogue River ODMDS Phthalates, 2007

Sample I.D.	Phthalates ug/kg – (ppb)					
	Dimethyl-phthalate	Diethyl-phthalate	Di-n-butyl-phthalate	Butyl benzyl phthalate	Bis(2-ethylhexyl)-phthalate	Di-n-octyl-phthalate
0807RODMDS-BC-01	<1.3	<1.7	27	<4.0	<8.7	<2.2
0807RODMDS-BC-02	<1.3	<1.7	26	<4.1	<8.9	<2.2
0807RODMDS-BC-03	<1.1	1.5JT	21	<3.4	<7.4	<1.8
0807RODMDS-BC-04	<1.4	1.8JT	40	<4.2	<9.2	<2.3
0807RODMDS-BC-05	<1.3	<1.7	23	<4.1	22.0JT	<2.2
SEF 2006 Screening Levels	71	200	1400	63	1300	6200
Symbol (<) = Non-detect (ND) at the value listed (MRL). JT =The result is an estimated concentration that is less than the method reporting limit (MRL) but greater than or equal to the method detection limit (MDL).						

Table C-20. Rogue River ODMDS Phenols, 2007

Sample I.D.	Phenols - ug/kg (ppb)				
	Phenol	2-Methyl-phenol	4-Methyl-phenol	2,4-Dimethyl-phenol	Pentachloro phenol
0807RODMDS-BC-01	5.6JT	<1.9	<1.9	<6.9	<25.0
0807RODMDS-BC-02	6.2JT	<1.9	<1.9	<7.0	<26.0
0807RODMDS-BC-03	7.3JT	<1.6	<1.6	<5.8	<21.0
0807RODMDS-BC-04	10JT	<2.0	<2.0	<7.2	<27.0
0807RODMDS-BC-05	11JT	<2.0	<2.0	<7.0	<26.0
SEF 2006 Screening levels	420	63	670	29	400

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

Table C-21. Rogue River ODMDS Miscellaneous Extractables, 2007

Sample I.D.	Miscellaneous Extractables - ug/kg (ppb)				
	Benzyl alcohol	Benzoic Acid	Dibenzo-furan	Hexachloro-butadiene	N-Nitroso diphenylamine
0807RODMDS-BC-01	4.2JT	<120	<1.5	<1.0	<2.0
0807RODMDS-BC-02	4.2JT	<130	<1.6	<0.65	<2.1
0807RODMDS-BC-03	<2.3	<110	<1.3	<1.0	<1.7
0807RODMDS-BC-04	6.4JT	<130	<1.6	<1.0	<2.1
0807RODMDS-BC-05	<2.7	130	<1.6	<0.54	<2.1
SEF 2006 Screening Levels	57	650	540	11	28

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

Table C-22. Rogue River ODMDS PAHs, Low Molecular Weight, 2007

Sample I.D.	PAHs - Low Molecular Weight - ug/kg							
	Acena-phthene	Acena-phthylene	Anthra-cene	Fluo-rene	2-Methyl-naph-thalene	Naph-thalene	Phen-anthrene	Total Low PAHs
0807RODMDS-BC-01	<1.8	<1.5	<2.0	<1.4	<2.8	<2.9	<1.8	ND
0807RODMDS-BC-02	<1.8	<1.6	<2.1	<1.4	<2.8	<3.0	<1.8	ND
0807RODMDS-BC-03	<1.5	<1.3	<1.7	<1.2	<2.4	<2.5	<1.5	ND
0807RODMDS-BC-04	<1.9	<1.6	<2.1	<1.5	<2.9	<3.0	<1.9	ND
0807RODMDS-BC-05	<1.8	<1.6	<2.1	<1.4	<2.8	<3.0	<1.8	ND
SEF 2006 Screening Levels	500	560	960	540	670	2100	1500	5200

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

Table C-23. Rogue River ODMDS PAHs, High Molecular Weight, 2007

Sample I.D.	PAHs - High Molecular Weight (ug/kg)									
	Benzo (a) anthra-cene	Benzo-fluro-anthenes	Benzo-(g,h,i)-perylene	Chrys-ene	Py-rene	Benzo (a) pyrene	Indeno (1,2,3 cd) pyrene	Dibenzo (a,h) anthra-cene	Fluoran-thene	Total High PAHs
0807RODMDS-BC-01	<2.2	<1.8	<1.9	<1.9	<1.9	<2.2	<1.9	<1.9	<2.0	ND
0807RODMDS-BC-02	<2.2	<1.8	<1.9	<1.9	<1.9	<2.2	<1.9	<1.9	<2.1	ND
0807RODMDS-BC-03	<1.8	<1.5	<1.6	<1.6	<1.6	<1.8	<1.6	<1.6	<1.7	ND
0807RODMDS-BC-04	<2.3	<1.9	<2.0	<2.0	<2.0	<2.3	<2.0	<2.0	<2.1	ND
0807RODMDS-BC-05	<2.2	<1.8	<2.0	<2.0	<2.0	<2.2	<2.0	<2.0	<2.1	ND
SEF 2006 Screening Levels	1300	3200	670	1400	2600	1600	600	230	1700	12000
Symbol (<) = Non-detect (ND) at the value listed (MDL).										

DISCUSSION AND CONCLUSIONS

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 Rogue River federal navigation project and the Rogue River ODMDS were both sampled in 2007 with physical and chemical analyses conducted by Columbia Analytical Services, Kelso, Washington. Physical and bulk chemical analyses were conducted on sediments from five locations from the ODMDS site and six locations from the federal project. Sampling and analyses were conducted in accordance with the 2006 SEF. This included analyzed for metals (10 inorganic), TOC, pesticides, PCBs, phenols, phthalates, miscellaneous extractables, and PAHs. Metal analyses indicate that the sediment in the vicinity is typical of clean marine sands. The organic analyses showed concentrations of many chemicals of concern to be below MDLs and well below established levels of concern for both sites.

Physical properties of the two sites vary in the percent of fine-grained material present. The average percent sand and gravel sized material in the Rogue River outside of the boat basin entrance is 77.7%; at the ODMDS the percentage of the same classification of material is 96.4%. Material from the channel inside the boat basin jetty, increases in fines as you proceed toward the mooring, from 20% fines to 50% fines (passing 200 sieve). Because the disposal site is a highly

erosive site, fine-grained material is not likely to remain within the ODMDS site boundaries or general area.

Chemical analyses between the two sites were very similar. Some concentrations were slightly higher at the Rogue River project, but all chemical of concern even when detected were well below established levels of concern (SEF 2006) at both sites.

Water column chemistry and physical characteristics in the vicinity were studied in the mid-1980s (Fuhrer 1982). The water quality parameters fall within the normal ranges expected for nearshore ocean waters off the Oregon Coast.

Dredged material was placed at the Rogue ODMDS after its designation in 1977. The disposal site has been used through 2007, with approximately 1.6 million cy of dredge material placed there. Early studies indicate that the material in the ODMDS was finer grained than that in the river channel. There is little difference in the offshore and channel sediment samples collected in August 2007. There does not appear to be any long-term impact based upon characteristics of dredged material placed. The ODMDS site has not experienced mounding of material (see Appendix B) and no impacts due to sediment quality are apparent.

REFERENCES

Fuhrer, G. 1984. Chemical Analysis of Elutriates, Native Water, and Bottom Material from the Chetco, Rogue and Columbia Rivers in Western Oregon. Open File Report 84-133. U.S. Geological Survey.

PSDDA. 1996. Puget Sound Dredged Disposal Analysis, Technical Information Memorandum, Testing, Reporting and Evaluation of Dioxin/Furan Data in PSDDA Programs.

SEF. September 2006. Northwest Regional Sediment Evaluation Framework, Interim Final. Prepared by U.S. Army Corps of Engineers Seattle, Portland, and Walla Walla Districts and Northwestern Division; U.S. Environmental Protection Agency Region 10; Washington Departments of Ecology and Natural Resources; Oregon Department of Environmental Quality; Idaho Department of Environmental Quality; National Marine Fisheries Service; and U.S. Fish and Wildlife Service.

Sherman, T. August 2002. Rogue River Channel and Gold Beach Boat Basin Entrance, Sediment Quality Evaluation. U.S. Army Corps of Engineers, Portland District.

Sherman, T. August 2007. Rogue River Sediment Quality Evaluation. U.S. Army Corps of Engineers, Portland District.

U.S. Army Corps of Engineers. 1982. Sediment Physical and Chemical Characteristics, Rogue River Sediment Navigation Project. Portland District.

U.S. Army Corps of Engineers. 1993. Rogue River Sediment Quality Evaluation. Portland District.

U.S. Army Corps of Engineers. 1997. Rogue River Sediment Evaluation. Portland District.

U.S. Army Corps of Engineers. 1988. Rogue River Sediment Quality ODMDS. Portland District.

U.S. Army Corps of Engineers. January 2003. Evaluation of Dredged Material Proposed for Disposal at Island, Nearshore, or Upland Confined Disposal Facilities - Testing Manual (referred to as the "Upland Testing Manual").

U.S. Army Corps of Engineers and U.S. Environmental Protection Agency. February 1991. Evaluation of Dredged Material Proposed for Ocean Disposal – Testing Manual (referred to as the OTM or the "Green Book").

U.S. Army Corps of Engineers and US Environmental Protection Agency. 1992. Rogue River Sediment Quality Evaluation.

U.S. Environmental Protection Agency and U.S. Army Corps of Engineers. February 1998. Evaluation of Dredged Material Proposed for Discharge in Inland and Near Coastal Waters - Testing Manual (referred to as the "Inland Testing Manual").

Appendix D

Cultural Resources
Rogue River, Oregon

April 2009

Appendix D
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Appendix D
Cultural Resources
Rogue River, Oregon

Introduction

This appendix evaluates the cultural resource potential of the Rogue River study area. The study area was set as an arc transcribed 2 nautical miles out from the mouth of the Rogue River and ends both north and south at the beach (Figure D-1). The proposed action consists of final designation of an ODMDS located approximately 1.75 miles southwest of the entrance to the Rogue River. The ODMDS received Interim designation in 1977 (40 CFR 228.12) and has been in use since that time. Site coordinates [North American Datum (NAD 83)] and dimensions of the ODMDS are shown below. The site generally lies on bottom contours sloping at a rate of 8/1000 feet to the west-southwest. The disposal site, placement area, and drop zone are identical.

A, 42° 24' 15.40", 124° 26' 52.39"	*Dimensions:*
B. 42° 24' 03.40", 124° 26' 39.39"	1,400-feet wide by 3,600-feet long
C, 42° 23' 39.40", 124° 27' 17.40"	116 acres
D, 42° 23' 51.40", 124° 27' 30.40"	Depth: 50 to 90 feet

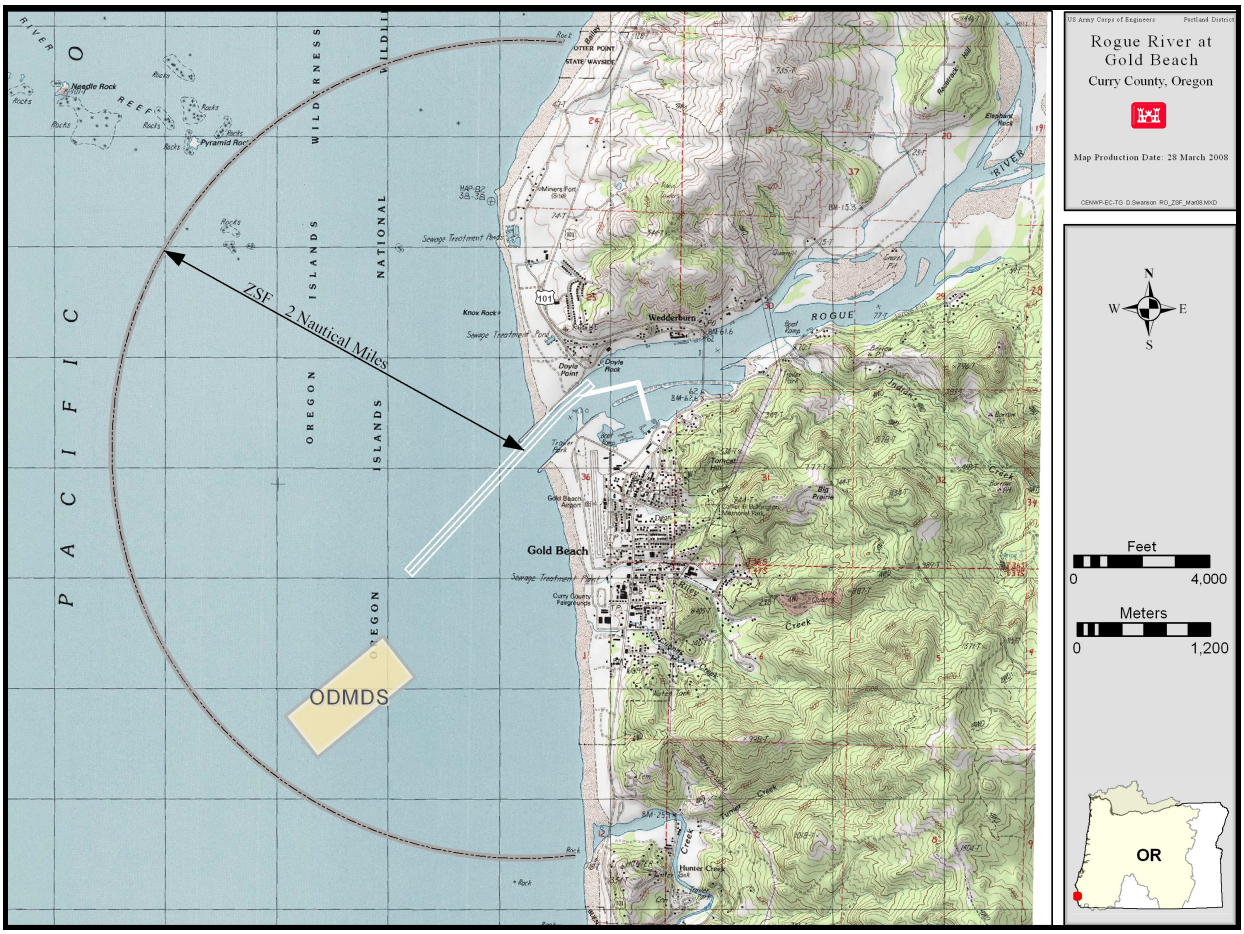
Prehistoric Potential

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 meters 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 1983:1). 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. Rogue River Study Area



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 1988:2). 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.

The probability is also remote that there are more recent prehistoric sites in the study area. Evidence gathered from archaeological sites located on coastal shorelines indicates that prehistoric Native Americans utilized the near shore ocean environments for subsistence activities. Prehistoric Indians gathered clams and mussels from the tidal zones and caught fish which inhabit estuaries and surf zones (Minor, Toepel, Greenspan, Barner 1985:3). In addition, recent archeological investigations have recovered evidence suggesting that certain coastal Indian groups utilized whales. Whether the whales were hunted or were scavenged from individuals stranded on beaches is uncertain based on the information recovered from the site (Minor, Toepel

1986:4). Regardless, the evidence of whale hunting or scavenging, as well as the procurement of shell fish and/or an offshore fishery, is unlikely to leave substantial archeological deposits; although it is possible that fishhooks, stone weights, and other non perishable elements of an offshore technology are present.

During the period of historic contact with the Indians of the Oregon Coast, the Tututni Indians that spoke a dialect of the Athapascan language, inhabited the land in the vicinity of the mouth of the Rogue River. The lifestyle of these people has not been discussed in any great detail. They were reported to have lived in semi-subterranean-planked houses in places along the shoreline of the river and along the ocean beaches. The Tututni are reported to have made intensive use of the seasonal salmon runs and the resources of the estuary and headlands (Ruby, Brown 1977:5). As with the earlier prehistoric period, these activities are unlikely to have left significant cultural deposits within the disposal area; however, village sites, middens, and related activity areas maybe present along the beaches and in the vicinity of the headlands. These areas will not be affected by the proposed project.

Historic Cultural Resources

The majority of background research has been directed at documenting the presence of historic cultural resources, specifically shipwrecks within the ODMDS 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, 1987:6).

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.

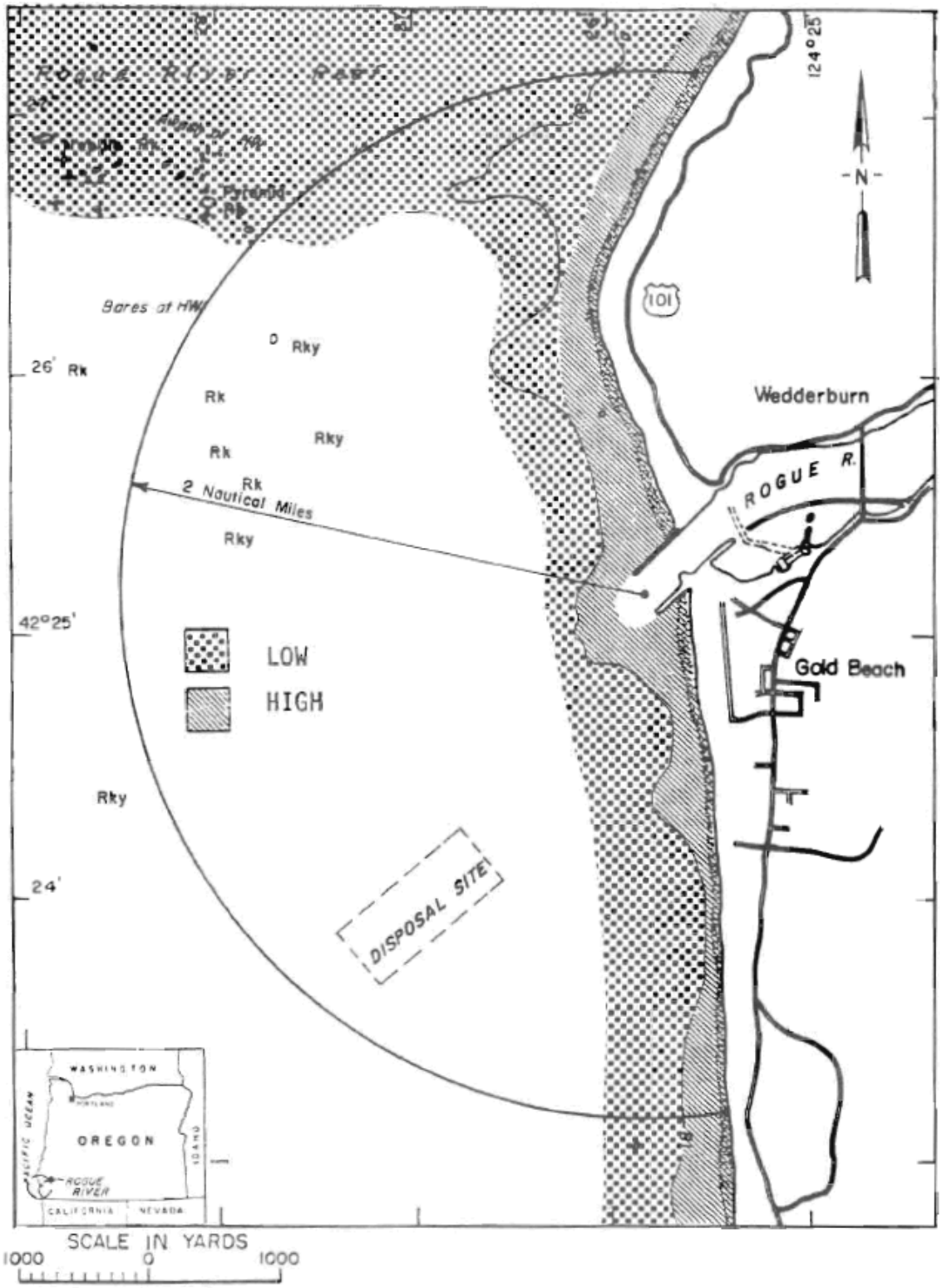
These causal factors also operate on that small set of special cases, the derelict vessels that drift from their point of damage whether it is along the coastal waters of Japan or along the ocean trade routes miles off the coast. Though the absolute number of derelict vessels cannot be determined, when 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 1981:7).
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 1875:8).

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 Northwest coast.

Figure D-2. Rogue River Shipwreck Frequencies



Uses of the Shipwreck Predictive Model

The shipwreck model has two purposes. As a planning tool for the ODMDS 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 Rogue River History

In July 1817, Peter Corney on the schooner Columbia traded with the Indians in the vicinity of the Rogue River (Corney, 1965:9). As the fur trade developed, the Rogue River area was visited by Alexander Mcleod of the Hudson Bay Company in 1827 and American fur trader and explorer Jedediah Smith in 1828 (Douthit 1986:10)

Historic settlement at the mouth of the Rogue River occurred in the 1850s. The communities formed around the search for gold. By 1853 placer mining of the black sands on the ocean beaches adjacent to the Rogue River outlet and mining of gravel bars in the drainage of the Rogue was in full development. A substantial community developed at the river mouth in support of the miners. This was followed by an increase in farmers who saw the miners as a market for their

agricultural products. Mining declined in importance during the late 1850s. Other aspects of the local economy included lumbering, a mill, and a salmon packing facility. Stewart and Michael Riley developed the commercial salmon fishery in the late 1850s. In 1876, D.H. Hume purchased the cannery operation. Hume recruited labors for his cannery in Astoria. On one occasion Hume's vessel the *Alexander Duncan*, grounded on the south spit with 35 Chinese cannery workers aboard. By the 1870s the salmon fishery, canneries, and lumbering were the main economic activities. As the main form of transportation, sailing vessels and small coastal steamers brought miners, cannery laborers, and settlers to the small harbor near the mouth of the Rogue River. On their return voyages, primarily to San Francisco, these vessels carried the export commodities, gold dust, lumber, agricultural products, and preserved salmon to California.

Although the salmon fishery and lumbering provided export commodities, their significance was primarily local. In 1879, Philip Eastwick, Assistant to the Portland District's Engineer, made a field reconnaissance of the Rogue River. He concluded that navigational improvements to the Rogue River to facilitate the local economy were not warranted as settlers were few in number and the value of their products was not sufficient to justify the costs of the improvements (Eastwick 1879:11).

With the decline in the salmon fishery during the early 1900s, the town of Gold Beach remained in relative economic as well as physical isolation from other regional communities. In 1929 Highway 101 was finished tying Gold Beach by road to the other coast communities. Prior to the construction of Highway 101, the only alternative to transportation by sea was by pack train up the trails along the Rogue River.

Rogue River Shipwrecks

The first reported shipwreck within the study area was the wreck of an unidentified Russian Whaler, which occurred sometime during 1830 on the beaches of the mouth of the Rogue River (Ruby and Brown, 1986:12). The first documented wreck was that of the *Wm. G. Hackstaff*, aground at the mouth of the Rogue River on September 9, 1849. Thirty-three additional wrecks occurred over the years following the wrecks of these two vessels.

The shipwreck database for the Rogue River has information on 35 wrecks which have occurred between Cape Sebastian, 7 miles south of the Rogue River mouth, and Humbug Mountain approximately 19 miles north of the Rogue (Table D-1). Of these, 28 wrecks have occurred within the ODMDS project area. The data indicates that 20 of these wrecks were either refloated (12) or salvaged (8) leaving the possibility that 8 wrecks are still present within the study area. Further analysis of the 8 shows that 7 wrecked on beaches and one sank within the vicinity of the project area. The lumber schooner, *San Buenaventura*, was lost 1/4 mile SW of the mouth of the Rogue River (Buenventura 1910:13).

Table D-1. Shipwrecks of the Rogue River

Date of Wreck	Name of Vessel	Site of Wreck	General Wreck Site Location	Distance/Direction from Rogue River
11/24/1874	Alaska	Gold Beach	Beach	0.00
09/14/1879	Alex Duncan	South Spit	Beach	0.00
05/02/1879	Andrew Jackson	Rogue River Vicinity	Offshore	5.00 North
05/02/1954	Berwick	Gold Beach	Beach	0.00 West
11/??/1904	Berwick	Gold Beach	Bar	0.00 West
12/15/1907	Berwick	Gold Beach	Beach	0.00 West
10/27/1949	Ceres	Rogue River Vicinity	Offshore	9.00 West
01/21/1902	Copper Queen	North Spit	Beach	0.00 West
05/28/1903	Copper Queen	Gold Beach	Beach	0.00
03/??/1891	Del Norte	North Spit	Beach	0.00
09/11/1891	Del Norte	Rogue River Bar	Beach Bar	0.00
08/11/1908	Enterprise	Spit ?	Beach	0.00
10/21/1879	Ester Cobos	South Spit	Beach	0.00
11/18/1880	Esther Cobos	South Spit	Beach	0.00
1850 Spring	Flagstaff	Gold Beach	Beach	0.00
03/08/1878	Johanna M. Brock	Rogue River Vicinity	Beach	15.00 North
09/05/1919	Magnolia	North Spit	Beach	0.00
11/21/1875	Milo Bond	Rogue River	Beach	0.00
01/03/1875	Nor'Wester	North Spit	Beach	0.00
11/06/1921	Osprey	South Spit	Beach	0.00
06/??/1913	Randolph	South Spit	Beach	0.00
05/01/1914	Randolph	South Spit	Beach	0.00
07/26/1916	Roamer	Spit ?	Beach	0.00
01/28/1890	Rosalind	Rogue River	Beach	3.00 North
02/24/1917	Rustler	Rogue River	Beach	1.50 North
01/15/1910	San Buenaventura	Rogue River	Offshore	0.25 West
09/02/1888	Thistle	North Spit	Beach	0.00
12/??/1889	Thistle	North Spit	Beach	0.00
03/25/1880	Veruna	South Spit	Beach	0.00
05/21/1911	Washcalore	Hunters Is.	Offshore	7.00 South
05/21/1911	Wasp	Cape Sebastian	Offshore	6.90
12/03/1941	Willapa	Humbug Mtn.	Beach	19.00
09/??/1849	Wm. G. Hackstaff	Rogue River Mouth	Beach	0.00 West
11/03/1875	Willimantic	Gold Beach	Beach	0.00
1830?	Russian Whaler	Rogue River Mouth	Beach	0.00

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 data supports these assumptions. Within the Rogue River database (N-35), 28 wrecks have been deposited on the beaches, 2 wrecks in the surf zones (on the bar at the mouth of the Rogue River), and 5 offshore. The subset of wrecks within the ODMDS project area mirrors the distribution of wrecks within the Rogue River sample. Of the 28 wrecks in the study area, 25 have occurred on the beaches, 2 in the surf zone (on the bar) and 1 offshore.

The fact that fewer wrecks then expected have occurred in the surf zone and the overwhelming majority on the beaches reflects the historical navigational difficulties of identifying and crossing the channel over the Rogue River bar. Philip Eastwick remarked in his report for the Portland District Engineer that the harbor entrance shifted seasonally. During the winter high flows in the Rogue River cut through the south spit letting the river empty into the ocean in a more direct manner; during the summer strong northwesterly winds slowed the flow causing the winter channel to fill which shifted the channel to a more southerly direction before it outlet into the ocean. In addition, both Eastwick and the Oregon Coastal Pilot noted that the depth of the bar at the mouth of the Rogue River might be as shallow 4 to 5 feet deep during the winter. The unpredictability of the bars location and depth provided safe passage only during the summer (Eastwick 1879 and Denson 1889:14). The number of shipwrecks that lined the mouth of the Rouge River confirm the difficulties of navigating into the harbor at Gold Beach.

Project Site Evaluation

The ODMDS for the Rogue River project was subjected to survey by using side-scan sonar. Although the side-scan sonar work was carried out primarily for environmental reason, any sonar images that indicated the presence of shipwrecks would have been noted. This evidence may include the presence of structural remains of ships, sediment mounding indicating the burial of vessels, and/or ballast or cargo remnants indicating the site of a decayed vessel. No shipwreck signature or other evidence of a shipwreck was recorded by the sonar investigation (ESA and GRI 1985:15).

The 2007 edition of the Northern Shipwrecks Database (Northern Maritime Research 2007:16) was reviewed for any entries within the Rogue 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 (AWOIS), the United States Non-Submarine Contact List (NSC), 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 area.

National Historic Preservation Act Compliance

The above information was shared with the State Archaeologist of Oregon through telephone conversations. Because there appears to be no significant accumulation of materials over the seabed resulting from previous use of the area for disposal of dredged materials, it was concluded that there would be no historic properties affected within the Rogue River project area by the continued ocean disposal activities. A letter with a determination of "no historic properties affected" was sent to the Oregon State Historic Preservation Office (SHPO) for concurrence August 28, 2008. The letter was also 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. A response was received from the SHPO on September 8, 2008. No comments were received from any of the Tribal Governments. No further consultation under NHPA is necessary.

Endnotes

1. Fladmark, Knut, 1983, Times and Places: Environmental Correlates of Mid-to-Late Wisconsinan Human Population Expansion in North America. In Early Man in the New World, Edited by R. Shutler, pp. 12-41. Sage Publications, Beverly Hills, California.

2. Kelly, Robert L. and Lawrence C. Todd, 1988, Coming into the Country: Early Paleoindian Hunting and Mobility, American Antiquity, 53(2): 231-244

3. Minor, Rick, Kathryn Anne Toepel, Ruth Greenspan, and Debra C. Barner, July 1985, Archaeological Investigations in the Cape Perpetua Scenic Area, Central Oregon Coast. Heritage research Associates Report No. 40. Heritage research Associates, Eugene.; Zontek, Terry, 1983, Aborginal fishing at Seal Rock (35LNC14) and Neptune 35LNC3): late prehistoric sites on the central Oregon coast. Unpublished M.A. Thesis, Oregon State University.

4. Minor, Rick and Kathryn Anne Toepel, 1986, The Archeology of the Tahkenitch Land Site: Early Prehistoric Occupation on the Oregon Coast. Eugene, Heritage Research Associates Report Number 46.; Lewis and Clark reported that Indians in the Tillamook Bay Vicinity scavenged a whale stranded on the beaches recovering blubber and oil.(in) Thwaites, Ruben Gold, 1969, reprinted from the 1905 ed.), Original Journals of the Lewis and Clark Expedition, 1804-1806, New York Arno Press, vo1. 3, pp. 318-321.

5. Ruby, Robert H. and Job A. Brown, Tututni (Athapascan) in A Guide to the Indian Tribes of the Pacific Northwest. Norman, University of Oklahoma Press; Beckham, Stephen Dow, 1977, The Indians of Western Oregon, This Land Was Theirs. Coos Bay, Arago Books.

6. U.S. Army Corps of Engineers, Portland District, October 1987, Coquille Ocean Dredged Material Disposal Site Evaluation, Appendix E, Cultural Resources. Portland District, Portland.; April 1985, Yaquina Bay Interim Ocean Dredge Material Disposal Site Evaluation. Appendix E., Cultural Resources. Portland District, Portland; March 1987, Columbia River Coal Export Channel: Technical Reports, Vol. III, Environmental Studies. Portland District.

7. Beals, Herbert K. and Harvey Steele, 1981, Chinese Porcelains From Site 35-TI-1, Netarts Sand Spit, Tillamook County, Oregon. Eugene, University of Oregon Anthropological Papers, No 23. On pp. 24-26 they review evidence for the wreck of a Spanish treasure galleon on the Oregon Coast.

8. Brooks, Charles Wolcott, 1875, Report of Japanese Vessels Wrecked in the North Pacific Ocean: From the Earliest Records to the Present Time. San Francisco, Proceedings of the California Academy of Science. Reprinted by Ye Galleon Press, Fairfield, Washington.

9. Corney, Peter, 1965 (reprint), Early Voyages in the North Pacific, 1813-1818. Ye Galleon Press, Fairfield, Washington. p.163.

10. Douthit, Nathan, 1986, A Guide to Oregon South Coast History, Including An Account of the Jedediah Smith Exploring Expedition of 1828 and its Relations with the Indians. River West Books, Coos Bay. p.6.

11. Eastwick, Philip G., 1879, Rogue River, Oregon. Report of Mr. Philip G. Eastwick, Assistant Engineer, 45th Congress, 3rd Session. House of Representatives. Ex. Doc. 97.

12. Ruby, Robert H. and John A. Brown, 1986, A Guide to the Indian Tribes of the Pacific Northwest. Norman, University of Oklahoma Press. p.246.

13. San Buenaventura, Oregonian 1/16/1910; William G. Hackstaff, Oregonian 12/19/1886.

14. Eastwick, (see note 11): pp.7-8; Denson, George, 1889, Pacific Coast Pilot of California, Oregon, Washington. Government Printing Office, Washington. p.370.

15. Earth Science Associates and GeoRecon International, January 1985, Geologic and Seismic Investigations of Oregon Offshore Dredge Disposal Site, Rogue River Disposal Site, pp.21-23. Prepared for the U.S. Army Corps of Engineers, Portland District.

16. The Northern Shipwrecks Database - 2007 Edition, Northern Maritime Research, Bedford, Nova Scotia, Canada.

Appendix E

Recreational Resources
Rogue River, Oregon

April 2009

Appendix E
Recreational Resources
Rogue River, Oregon

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Appendix E
Recreational Resources
Rogue River, Oregon

Introduction

This appendix identifies the major recreational use areas in the vicinity of the proposed Rogue River ODMDS. Figure E-1 shows major adjacent recreational use areas. The information was compiled to determine the potential impacts of disposal operations on recreation.

Recreational Use Areas

Although the Rogue River area receives recreational use year-round, the most popular months are from April through September. The salmon fishery accounts for the largest percentage of the recreational activity, although other forms of fishing, sightseeing, boating, and clamming are also popular.

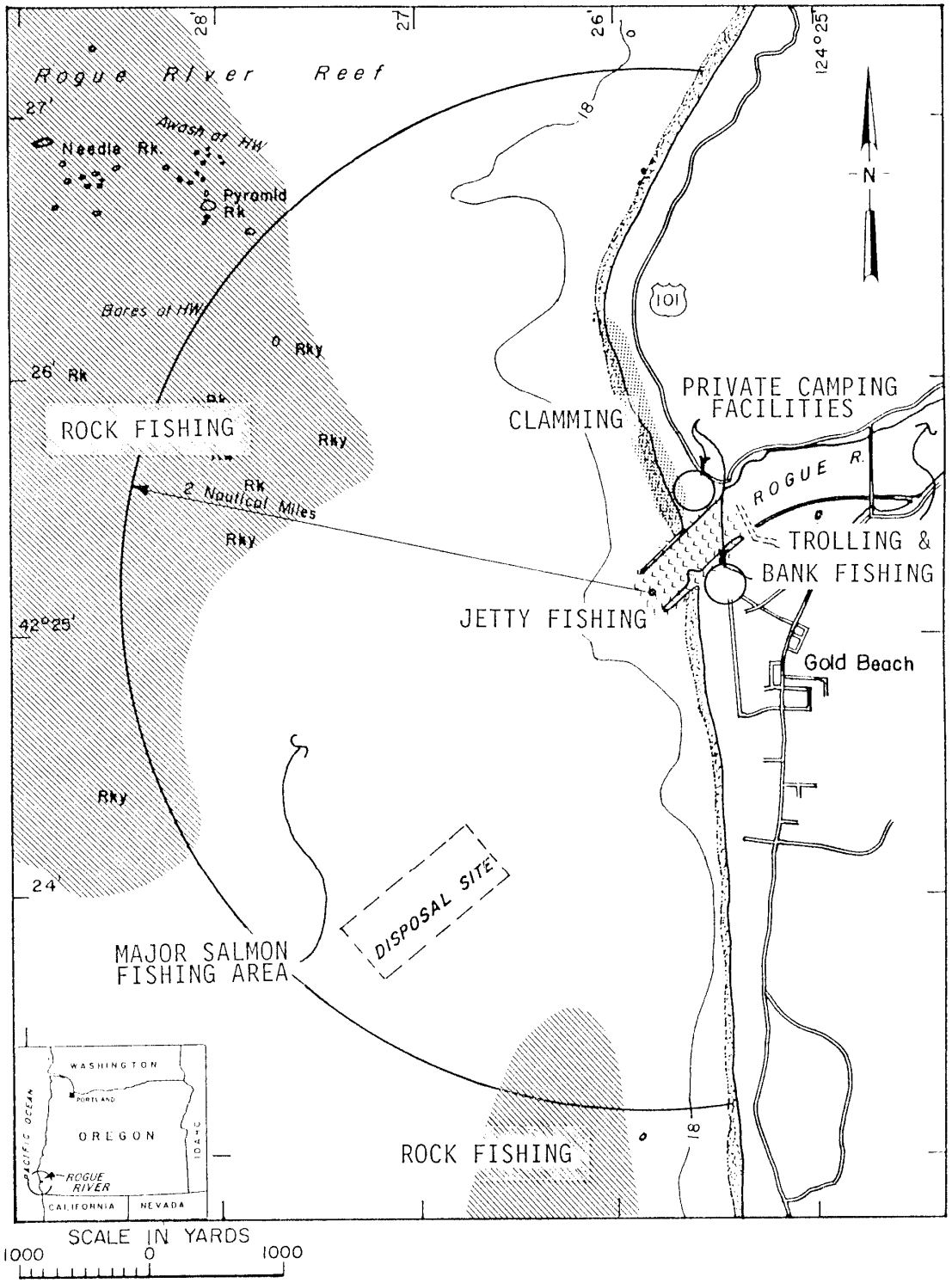
Most of the property along this portion of the Oregon Coast is privately owned. Despite this, many facilities have been provided by the private sector to meet the needs of recreationists. Several RV parks and campgrounds are located on both sides of the lower river at Wedderburn and Gold Beach. These facilities provide overnight accommodations, boat ramps, and access to the river.

Offshore fishing for salmon, rockfish, and bottom fish is popular. Several reefs are located offshore from the Rogue River, including the well-known Rogue River Reef. These reefs provide recreational boaters one of the best sport fisheries along the Oregon Coast. During the summer months, most of the angling effort is for salmon. By August, most of the salmon have begun to move upriver and the offshore fishery is for bottom fish.

Angling from the jetty is popular throughout most of the year. Salmon fishing is popular during the summer, while perch fishing predominates in the spring and fall. The south jetty receives the majority of use, although at times the north jetty is heavily used as well. Jigging for smelt from the north jetty during the summer months is common. Trolling in the lower river and fishing along the north bank are also popular.

The nearby beach area receives most of its recreational use from beachcombers, hikers, and sightseers. Clam digging is popular at a small, sandy beach located north of the Rogue River entrance. Overall, beaches near the Rogue River are used less than other Oregon beaches due to the limited public access and lower population density.

Figure E-1. Recreational Resources in the Vicinity of the Proposed Rogue River ODMDS



Impacts of Disposal Operations

The ODMDS is located within a major salmon fishing area (see Figure E-1). Few conflicts are expected to occur between anglers and dredge operations due to the availability of alternate salmon fishing sites. Conflicts between disposal operations and recreationists may occur as the dredge is enroute to the ocean disposal site. These conflicts may include time delays for recreational boaters caused by the passing of the dredge or an increase in navigational hazards during congested periods. Conflicts such as these can be considered an inconvenience rather than a threat to recreational activity. The only serious problem would be a collision between recreational boaters and dredge traffic. Accidents of this nature are rare because the dredge moves at a slow speed and the potential for collisions is low.

When dredged material is deposited at the ocean disposal site, the turbidity in the surrounding water increases. This results in reduced visual quality of the area and may disrupt the feeding patterns of sport fish. Both of these situations are temporary and limited in area, with normal conditions returning as soon as the sediment settles.

Conclusion

The continued use of the ODMDS at the Rogue River should have little impact on recreation in the area. During disposal operations, the turbidity in the surrounding water increases. Any impact this may have on sport angling or visual quality of the area is temporary and limited in area. Some inconveniences may be experienced by recreational boaters and anglers. Overall, the disposal operations appear to pose no serious threats 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
Rogue River, Oregon

April 2009

Final

Site Management/Monitoring Plan for the Rogue River Ocean Dredged Material Disposal Site Oregon

Section 102 of the Marine Protection, Research and Sanctuaries Act, as amended
Ocean Dredged Material Disposal Site (ODMDS)
April 2009

ABSTRACT

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

Rogue River ODMDS
Site Management/Monitoring Plan

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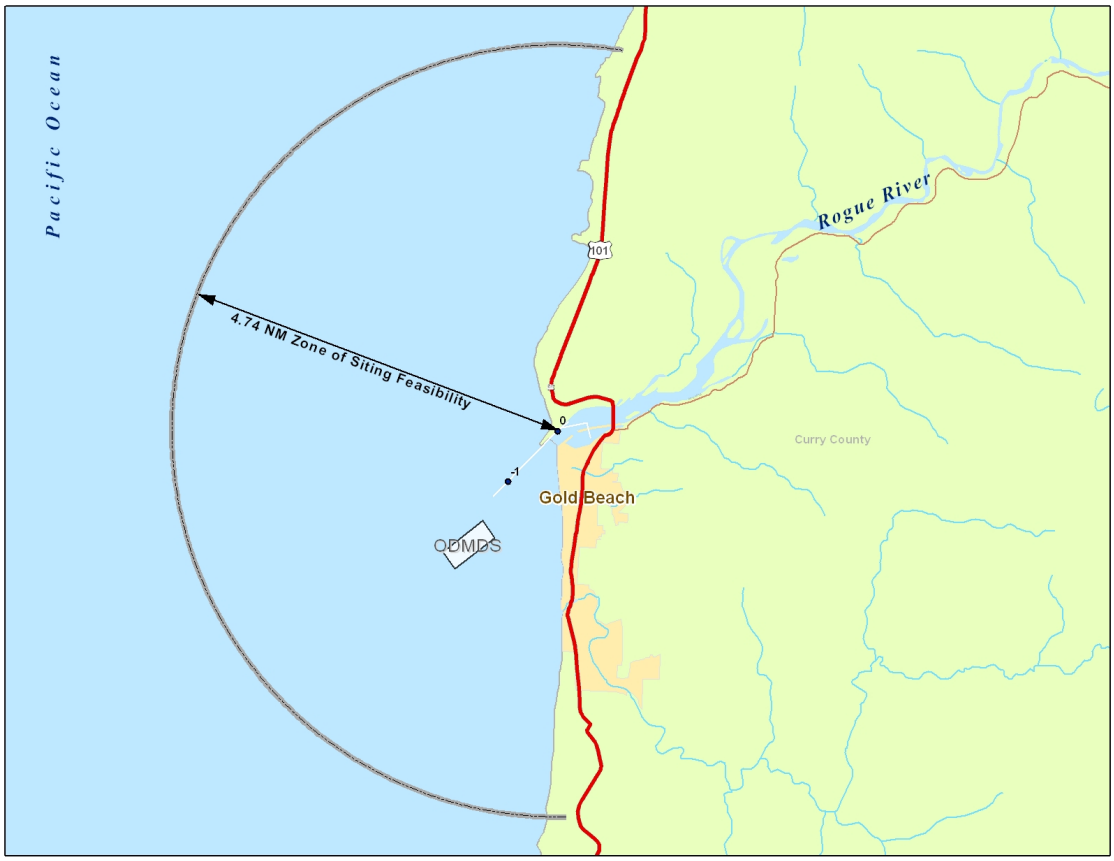
Introduction

This Site Management and 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 EPA-designated ocean dredged material disposal Site located offshore of Rogue River, Oregon, hereafter the Rogue River ODMDS or Site (See Figure 1). This SMMP becomes effective upon the effective date of the site designation and supersedes and replaces any previous SMMP for this location.

Figure 1 : Rogue River ODMDS and Vicinity.



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

Guidance for the preparation of SMMPs for ocean dredged material disposal sites 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 each designated ODMDS involves regulating the times of use, the quantity and the physical/chemical characteristics of dredged material that is dumped at the site; and establishing disposal controls, conditions, and requirements to avoid and minimize potential impacts to the marine environment. Appropriate management of each ODMDS 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 of site management, to ensure that unanticipated or significantly adverse effects are not occurring from use of the disposal site, and to ensure that permit terms are met.

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 ODMDS monitoring update prepared by the Portland District.

The EPA may condition, terminate or restrict site use with cause. Region 10 is responsible for managing and monitoring ocean dredged material disposal sites in ocean waters off the States of Alaska, Washington, and Oregon, including the Rogue River ODMDS addressed in this SMMP.

The USACE is expected to be the primary user of the Rogue River ODMDS for dredged material from federal navigation projects. The USACE also issues 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

meets substantive permit requirements for its own use of this Site and EPA concurs on site use by the USACE.

Baseline Definition

The MPRSA, at section 102(c)(3)(A), requires that the SMMP include a baseline assessment of conditions at the site. The baseline record for the Site 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 Pacific Ocean encompassing the Rogue River ODMDS are described in a 1991 draft environmental impact statement, a draft 2008 environmental assessment for ODMDS site designation, and other technical studies and annual monitoring surveys. There are no rare or unique features or habitats at, or in the vicinity of, the Rogue River ODMDS. The Site is situated within sight of land in an open, dynamic ocean environment. The seafloor is characterized as relatively uniform and featureless with highly active shifting sands grading to rock/gravel as it slopes (10/100 feet) westward into deeper water. The Rogue River ODMDS, or areas in the same vicinity, have been used by Portland District since 1962 exclusively for the placement of dredged material. Between 1986 and 2007, approximately 1.1 million cubic yards (MCY) of dredged material was placed in the Rogue River ODMDS, with no persistent mound resulting.

In general, ocean dredged material dumping sites in the Pacific Northwest are dispersive. However, mounds (and potential navigation hazards) have been known to develop when more material was placed in discrete locations than the ocean had capability to disperse between disposal events. Current understanding, and experience through observation and monitoring indicate rapid dispersion rates within nearshore areas shallower than 18 meters (approximately 60 ft.), and a reduction in dispersion with increased depth. However, at the Rogue ODMDS, no mounding has been observed in more than 30 years of regular disposal and site monitoring. The bathymetric baseline for the Rogue River ODMDS was established in 1986.

Site Definitions and Description

Disposal Site Definitions

For the purposes of management and monitoring of the designated Rogue River ODMDS the following definitions are applicable:

Disposal Site: The sea bottom within the coordinates specified in the applicable *Federal Register* Final Rule designating the individual site and the overlying water column.

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. 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.

Disposal Site Description

The Site is located near the mouth of the Rogue River and is primarily intended to receive suitable dredged material from the USACE Rogue River navigation project, other local USACE projects, and appropriately permitted dredged material from non-USACE projects. The Site location (coordinates) and size are provided below in table 1:

Table 1. Coordinates (NAD 1983) and Dimensions of the Site

42° 24’ 15.40” N	124° 26’ 52.39” W
42° 24’ 03.40” N	124° 26’ 39.39” W
42° 23’ 39.40” N	124° 27’ 17.40” W
42° 23’ 51.40” N	124° 27’ 30.40” W

Dimensions: 3,600 feet long x 1,400 feet wide'

Azimuth (long axis): 230° T

Average Depth: approximately 18 meters (60 feet)

Components of the Disposal Site: The Rogue River ODMDS Disposal Site, Placement Area, and Drop Zone are identical.

Disposal Capacity: Based on placement of dredged material between 1986 and 2007, at the Site prior to designation, approximately 1.1 million cubic yards were placed, for a twenty year average annual loading volume of 51,000 cubic yards/year, without persistent mounding. Annual bathymetry has shown that material placed in the disposal area redistributes out of the Site. Site capacity, at current levels of use, appears over the long term to be unlimited.

Anticipated Site Use

The MPRSA, at section 102(c)(3)(E), requires that the management plan include consideration of the anticipated use of the site. Primary and regular use of the Rogue River ODMDS is expected by the USACE, Portland District, for maintenance material removed from the federal navigation project, a summary of the Rogue River federal project is included in this SMMP. Recent maintenance volumes dredged by the USACE from the Rogue River navigation channel and entrance channel have averaged 54,000 cubic yards annually. It is expected that the Site will also be used in the future for disposal of material dredged by other public or private entities (e.g., U.S. Coast Guard) 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, and EPA concurrence. Individual permits are typically public noticed and require other federal consultations (e.g., ESA, EFH) and authorizations (e.g., water quality certification).

Rogue River Navigation Project Description

The Rogue River federal navigation project was originally authorized by the Rivers and Harbor Act of September 3, 1954, and provided for the construction of jetties, a channel, bank protection, and a turning basin. A second channel and turning basin was also built in response to local construction of a small boat basin. Maintenance dredging as a federal responsibility was authorized in 1962. The authorized project includes:

- A channel 13 feet deep, 300 feet wide and 3500 feet long from the ocean to the boat basin entrance channel;
- The Gold Beach Boat Basin with an access channel 2,100 feet long, 100 feet wide, and 10 feet deep with a turning basin 600 feet long, 150 feet wide, and 10 feet deep;
- A turning basin 650 feet long, 500 feet wide, and 13 feet deep;
- A North Jetty 3,300 feet long and a South Jetty 3,400 feet long; and
- A north shore bank protection structure.

Site Management Objectives

The primary objective of this SMMP is to provide for the safe and efficient disposal of dredged material at the Rogue River ODMDS while minimizing adverse impact on the environment to the greatest extent practicable. General objectives for accomplishing this are to:

1. Avoid 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 ODMDS.

All these general site management objectives are applicable to the Site and additional specific management restrictions may be imposed as necessary. Placement of dredged material consisting primarily of gravel may be restricted to the deeper portions of the Site because side-scan sonar indicates this area is rocky in nature. Specific individual site objectives and restrictions will be periodically reassessed and/or revised in the future.

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. These activities are collectively referred to as "Routine Monitoring" throughout the SMMP. Routine monitoring events may be triggered annually or some other time period (e.g., five years), when a set volume of material has been placed, or a combination of volume and chronology. 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 material (e.g., rocks). 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 the ODMDS 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 took place at the Site; while there may be no change in disposal operations, other actions may be appropriate)

Additional Information Required:

Adjust routine monitoring (e.g., go to more frequent bathymetric surveys, conduct physical, chemical or biological monitoring)

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 manner)
Restrict Type or Quantity of Material Placed

Change Sites:

Relocate disposal activities from one site to another; follow-up with monitoring to determine if additional attention warranted.

Discontinue Disposal Site Use:

Cease Disposal--Short-Term (e.g., 1 season): A known temporary condition occurs which merits discontinued use for a short period of time; subsequent follow-up with monitoring is done

to determine if additional attention is 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).

Routine Monitoring

The 1996 Guidance Documentation (USACE/EPA, 1996) for developing management plans states that continuous monitoring of all physical, chemical, and biological parameters and resources in and around a typical disposal site is not necessary.

Routine monitoring will consist of, annual bathymetric monitoring of dredge material disposal of the Site, typically done in the spring. The annual bathymetry will be compared to the baseline survey from 1986, and 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 Rogue River ODMDS:

- Ensure that dredged material is being placed as required by this SMMP;
- 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 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 Site over time, as predicted, providing long-term capacity without adverse effects.

Rogue River ODMDS Routine Monitoring

For management purposes, routine monitoring will concentrate on determining how the disposed dredge material is behaving within and in the vicinity of the Site. Bathymetric surveys shall be conducted annually. Bathymetric surveys will be used to monitor the disposal mound to assist in verification of material placement, to monitor bathymetric changes and trends and to ensure that the Site capacity is not exceeded, (e.g. that the Placement Area does not exceed the Site boundaries). The entire Site is surveyed to assess the potential capacity of the Site for the next dredging season and for future years. 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 Site or some other similar disposal or management action.

Monitoring the use of the Site and surrounding area for biological resources, and confirmatory characterization of sediment, physical, biological, and chemical studies as determined to be necessary are expected to occur on an approximate 7 to 9 year schedule, with the first monitoring event to occur in 2016. This schedule can be adjusted as necessary (see below Section on Adaptive Management and Monitoring). The level of effort for this reassessment is expected to be similar to effort expended in the 2007 baseline studies at the Site and surrounding area. It is anticipated that such reassessments will be documented as stand-alone reports to directly support monitoring efforts at the Rogue ODMDS. Monitoring reports will be provided to EPA.

Adaptive Management and Monitoring

The Site will be adaptively managed to avoid unreasonable degradation or endangerment of human health or welfare or the marine environment. The Corps and EPA may from time to time, discuss ODMDS monitoring with Federal and State agencies. Site management and monitoring will be adjusted as conditions warrant.

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 on the Site 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 agencies and entities. It is anticipated that special studies would be coordinated with the Northwestern Regional Dredging Team (RDT).

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 Site 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 Site 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 ODMDS will be the USACE for material dredged from federal projects. The summary will identify the capacities of the ODMDS, 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 Site 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 EPA's concurrence before changes are initiated. Such changes could include decisions to increase the spacing between the dumping positions, to shift disposal operations to other portions of the Site, to redistribute material at the 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 the Site 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, Pacific Northwest Ocean Dumping Coordinator). These results will be evaluated by EPA and the USACE. EPA has final authority over site management decisions. In addition, EPA should be notified by the USACE 15 days prior to the beginning of a dredging cycle or project disposal. Holders of Section 103 permits shall notify EPA not less than 10 days prior to use of the Rogue River ODMDS.

Inspection and Surveillance Provisions

Contract dredges are periodically inspected by USACE personnel to ensure dredging and disposal are taking place in the correct locations. USACE dredges are responsible for ensuring their proper positioning. USCG has a surveillance role under the MPRSA. EPA will typically utilize the inspection and surveillance capabilities of these other agencies; however, EPA may choose to implement its own inspection and surveillance requirements using EPA personnel or contractors. It is expected that EPA will 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 Rogue River ODMDS:

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. A Uniform Placement Strategy will be applied. The Site is relatively small which limits disposal options. However, placement at the Site is expected to result in a uniform accumulation on the bottom.

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 Rogue River ODMDS. For the hopper dredges that commonly work at Rogue 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 hopper dredge. Hopper dredges are the dredge type normally deployed at Rogue River for sandy material, however, a clam shell with hopper barges was used in 2007.

Quantity, Seasonal, Weather, and Environmental Restrictions

Dredging and disposal actions are generally concurrent activities. Quantities placed at the Site will vary year-to-year depending on shoaling of the project. 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. Environmental restrictions may be imposed on dredging and / or disposal. In the event that monitoring results reveal the need for any additional restrictions, disposal activities will be scheduled so as to avoid or minimize unacceptable adverse impacts.

Equipment Requirements and Disposal Point

Hopper dredges or clamshell and barge operations could include USACE and private contract dredges. All such operations are required to meet all U.S. Coast Guard 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 Site.

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 Site. 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 the Site 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

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

The dredged material disposed at the Site is not expected to remain within the boundaries of the Rogue River ODMDS after disposal. The rate and direction of movement across the Site boundaries are 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-USACE) or the USACE substantive review process. All sediments to be disposed at the Rogue River ODMDS will be evaluated according to then-current requirements of the MPRSA, national guidance, and

local/regional manual and determined to be suitable for that purpose. 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 Interim Final 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 continue 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 Rogue River ODMDS shall 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 reports 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

The MPRSA, at section 102(c)(3)(F), requires that the management plan include a schedule for review and revision of the plan. SMMP revisions will be made as determined necessary by EPA. Should the results of monitoring or special studies indicate that the continued use of the Site would lead to unacceptable effects, then this SMMP will be modified as necessary to mitigate the adverse effects. No less often than every 10 years after this SMMP is finalized and throughout the life of the Site, EPA will conduct a substantive review of the SMMP. These reviews will involve coordination with other agencies, technical experts, and stakeholders.

Literature Cited

Boesch, D. F. 1984. "Introduction: Field Assessment of Marine Pollution Effects: The Agony and the Ecstasy." In: H. H. White (ed.) Concepts in Marine Pollution. Univ. of Maryland, College Park, Maryland. pp. 643-646.

DMEF. 1998. Dredge material evaluation framework for the lower Columbia River management area. U.S. Army Corps of Engineers, Portland District and Seattle District; U.S. Environmental Protection Agency, Region 10; Oregon Department of Environmental Quality; Washington State Department of Natural Resources and Department of Ecology.

Geo Recon International Lmt., 1989. "Results of a Sidescan Sonar and Sub-Bottom Profiling Study, Coos Bay, Oregon," Prepared for USACE, Portland District, under Contract. p. 7.

Fredette, T. J., G. Anderson, B. S. Payne, and J. D. Lunz. 1986. "Biological Monitoring of Open-Water Dredged Material Disposal Sites." Oceans 86 Conf. Rec. 764—769.

Fredette, T. J., D. A. Nelson, J. E. Clauser, F. J. Anders. 1990."Guidelines for Physical and Biological Monitoring of Aquatic Dredged Material Disposal Sites." Technical Report D-90-12, US Army Engineer Waterways Experiment Station Vicksburg, MS.

Interstate Electronics Corporation, 1973. "An Atlas of Ocean Waste Disposal Sites," Prepared for US Environmental Protection Agency, Ocean Disposal Program, Under Contract 68-01-0796. Six Volumes.

Johnson, B.H. 1990. User's guide for models of dredged material disposal in open water. Technical Report DRP-90-5. U.S. Army Engineer Waterways Experiment Station, Vicksburg MS.

Johnson, B.H. and M.T. Fong. 1995. Development and verification of numerical models for predicting the initial fate of dredged material disposed in open water: Report 2, theoretical developments and verification results. Technical Report DRP-93-1. U.S. Army Engineer Waterways Experiment Station, Vicksburg MS.

Marine Taxonomic Services. 1990. Coos Bay channel invertebrate assessment study. Draft Report. Prepared by Marine Taxonomic Services, Corvallis, Oregon for the U.S. Army Corps of Engineers, Portland OR.

Ogden Beeman & Associates, INC., 1990. "Coos Bay Disposal Site "F" Study," Prepared for USACE, Portland District, under Contract DACW07-89-D-0029, p. 48.

Segar, D. A., and E. Stamman. 1986. "Fundamentals of Marine Pollution Monitoring Programme Design." Mar. Pollut. Bull. 17:194—200.

USEPA 2008. Rogue River, Oregon Ocean Dredged Material Disposal Site Evaluation Study and draft Environmental Assessment.

USEPA/USACE. February 1991. Evaluation of dredged material proposed for ocean disposal – testing manual. Report number EPA-503/8-91/001.

USEPA/USACE. February 1998. Evaluation of dredged material proposed for discharge in inland and near coastal waters – testing manual (referred to as the 'Inland Testing Manual'). Report number EPA-823-B-98-004.

USACE/EPA 1996. "Guidance Document for Development of Site Management Plans for Ocean Dredged Material Disposal Sites." U.S. Army Corps of Engineers, Portland District and Seattle District; U.S. Environmental Protection Agency

USACE. 2005. "Ocean Dredged Material Disposal Sites Management/Monitoring Program, Summary Report: Coos Bay" Portland District

U.S. Army Corps of Engineers (Corps). March 2005. Coos Bay sediment quality evaluation. Portland OR.

USACE. 2005. "Sediment Quality Summary Report: Coos Bay" Portland District.

USACE, 1984. Summary-"Coos Bay Offshore Disposal Site Investigation," of Phase I-V;

Hancock, D. R., Nelson, P. O., Sollitt, C. K. and Williamson, K. J. 1981. Coos Bay Offshore Disposal Site Investigation, Interim Report Phase I. Prepared by Oregon State University for the U. S. Army Corps of Engineers, Portland District.

Nelson, P. O, Sollitt, C. K., Williamson, K. J, and Hancock, D. R. 1983. Coos Bay Offshore Disposal Site Investigation, Final Report Phase II, III. Prepared by Oregon State University for the U. S. Army Corps of Engineers, Portland District.

Sollitt, C. K., Hancock, D. R. and Nelson, P. O. 1984. Coos Bay Offshore Disposal Site Investigation, Final Report Phase IV, V. Prepared by Oregon State University for the U. S. Army Corps of Engineers, Portland District.

USEPA. September 8, 2004. The technical basis for revisions to the dredged material management program's bioaccumulative contaminants of concern list (Draft). Prepared for the Agencies of the Dredged Material Management Program. U.S. Environmental Protection Agency Region 10, Seattle WA.

USEPA. 1991. Handbook: remediation of contaminated sediments. U.S. Environmental Protection Agency, Center for Environmental Research Information. Cincinnati OH.

Zeller, R. W., and T. A. Wastler. 1986. "Tiered Ocean Disposal Monitoring Will Minimize Data Requirements." Oceans 86 Conf. Rec. IEEE Service Center, Piscataway, New Jersey. pp. 1004-1009.