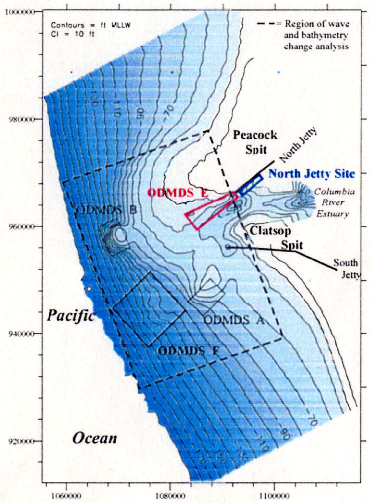
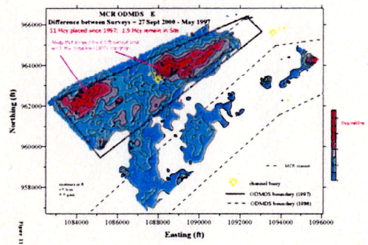
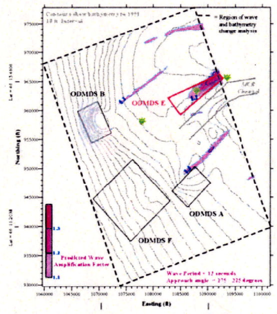
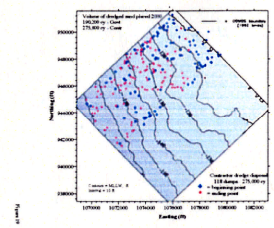
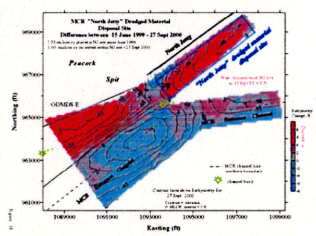
# *Utilization of MCR Ocean Dredged Material Disposal Sites During 2000 and Recommendations for 2001*











**9 January 2001**

## *Utilization of MCR Ocean Dredged Material Disposal Sites During 2000 and Recommendations for 2001*

### Purpose and Summary

The amount of dredged material that can be placed in an ocean dredged material disposal site (ODMDS) is fixed with regard to the site's capacity to accumulate the material without negatively affecting the environment or impairing safe navigation. As part of the management plan for an active ODMDS, the bathymetry of the site is monitored during the dredging/disposal season to determine the extent of dredged material dispersion and accumulation on the seabed. This report:

1) Describes observed bathymetric change at mouth of the Columbia River (MCR) dredged material disposal sites utilized during 2000, based on the comparison of hydrographic surveys;
2) Identifies the potential wave-related impact of (mounded) dredged material placed at ODMDS E during May 1997 to September 2000; and
3) Presents recommendations for utilization of ODMDS E & F and the North Jetty site during 2001.

Approximately 4.1 million cy/yr of sand is dredged at the (MCR) entrance channel, based on 10 year average from 1990-2000. The dredged sand is placed at designated ODMDS or at sites permitted through Section 404 of the Clean Water Act (404 site). Figure 1 shows the regional bathymetry of MCR and dredged material disposal sites.

During the 2000 dredging season (June-October ), 3.9 million cy of sand was dredged from the MCR navigation channel and placed in three disposal sites: The North Jetty (404 site), ODMDS E , and ODMDS F. Approximately 2.9 million cy of dredged sand was placed at ODMDS E, 504,000 cy was placed at the North Jetty site, and 465,500 cy was placed at ODMDS F.

The North Jetty site (the section 404 site) was first used in 1999 and is located along the southern side of the MCR north jetty, in water depths of 40–70 ft. ODMDS E is located 1/4 mile seaward of the MCR north jetty, in water depth of 45-70 ft and was officially designated an ODMDS in 1977. The site now known as ODMDS E has been used since 1973. ODMDS E and the North Jetty (NJ) site are considered to be within the active littoral zone of MCR and are highly dispersive: A sizable fraction of the dredged material placed at these sites is transported out of the site by waves and currents and reintroduced into the littoral system of MCR. For this reason, the NJ site and ODMDS E are used to the maximum extent possible. After being designated in 1977, ODMDS F was first used in 1989. The site is located about 4 miles offshore from the north jetty in water depth of 100-170 ft. Although ODMDS F is located in fairly deep water and not frequently subjected to littoral processes, the site is heavily influenced by the wave, current, and sediment interactions associated with the evolving MCR ebb tidal shoal. Sediment has been observed to be "naturally" accumulating within ODMDS F at a rate of 0.1-0.6 ft/year.

To avert excessive mounding of placed dredged material within ODMDS E during 2000, an attempt was made to distribute dredged material uniformly throughout the site using a series of pre-assigned grid-cells to control the release point for each disposal event [USACE 1999a]. A similar approach was also used for placement of dredged material at the North Jetty site and ODMDS F. The objective was to prevent mound-induced wave amplification at or near an active ODMDS by limiting the vertical accumulation of dredged material placed at the site. The result of using controlled placement within ODMDS E and F is shown in terms of recorded disposal locations, figures 9 and 19. It is recommended that the contractor dredge continue reporting beginning-ending coordinates for each disposal (compilation of coordinates sent to USACE-NWP at end of MCR dredging work), and the government dredge begin doing so. To fully utilize capacity of ODMDS E and F and the NJ site during 2001, the following site-specific observations and recommendations are made.

**ODMDS E:** As of June 2000, about 90% of all dredged material placed within the site since May 1997 was dispersed; and less than 5% of the dredged material placed at the site during 1999 was transported into the MCR navigation channel. Based on monitoring conducted during 1990-2000, about 40% of the dredged material placed at the site is dispersed during the dredging/disposal season (June-October). The dispersion rate within the site during November-May is 1-1.5 million cy; this occurs regardless of the amount of dredged material placed at the site during the dredging/disposal season. Based on observed dispersion rates, the "average" capacity for ODMDS E is estimated to be 2.8 million cy/yr. Despite the attempt to evenly place dredged material within ODMDS E during 2000, mounding occurred in localized areas and exceeded 8 ft vertically with respect to the site's *baseline* (May 1997) condition. A wave shoaling analysis indicated that during late fall-early winter of 2000, there was a potential for wave amplification within the boundaries of ODMDS E. As waves/currents act to disperse dredged material placed within ODMDS E, the potential for wave amplification within or near ODMDS E is expected to decrease. Continued use of ODMDS E is desirable for maintaining the littoral system of Peacock Spit and locations north, therefore, continued use of ODMDS E is strongly recommended. Only 5% of the dredged material placed during 2000 contributed to excessive mounding. Therefore, minor improvements to the dredged material placement plan will reduce the likelihood of excessive mounding in 2001. See page 7 for specific recommendations.

**Site NJ:** Much of the dredged material placed at the NJ site has abated a potentially destabilizing scour area along the toe of the MCR North jetty. As of June 2000, about half (500,000 cy) of the material placed in the site during 1999 had remained within the site. It appears that some of the material dispersed out of the site was transported east, toward the north edge of the MCR channel near RM 1-2. Almost all of the material (500,000 cy) placed in the site during 2000 remained within the site. As of September 2000, about 1 million cy was present within the site when compared to the baseline condition (June 1999). Based on the vertical extent of dredged material accumulation, it is recommended that the NJ site not attain more than 1 million cy with respect to (w.r.t) the baseline. The annual dispersion rate at the NJ site is estimated to be 200,000-500,000 cy/yr: This defines the operational capacity of the site. See page 9 for additional recommendations.

**ODMDS F:** Approximately 0.3 ft/yr (average) of "natural" deposition is occurring at the site, effectively reducing site capacity by 600,000 cy/yr. Based on the volume of "natural" deposition and projected dredged material placement, the site is estimated to be "filled" within 4 years from June 2001. To avert excessive mounding during disposal, dredged material should be dispersed uniformly within the northern half of the site; excluding the cross-hatched area shown in figure 22. See page 11 for additional recommendations.

At present, MCR dredged material disposal sites collectively possess a finite capacity that may be exceeded within 4 years from June 2001. To avoid overloading existing MCR dredged material disposal sites and prevent impedance of O&M dredging at MCR, designation of a new ODMDS having a minimum capacity of 1.1 million cy/yr should occur within 4 years from June 2001.

## Utilization of ODMDS E during 2000

The management objective for ODMDS E is to fully utilize the site for the disposal of MCR dredged material, while limiting the average vertical accumulation of placed dredged material to 5 ft, with respect to the site's *baseline* condition (May 1997) [USACE 1998b]. The preference for continued use of ODMDS E is due to:

The dispersive nature of the site - dredged material placed at ODMDS E is quickly transported to the littoral environment of MCR. This allows for the renewal of disposal capacity at ODMDS E while using the disposal operation as a method to place dredged material within the nearshore littoral environment of Washington and abate erosion of Peacock Spit and locations north.

The proximity of the site with respect to the MCR navigation channel – haul distance from MCR dredging to ODMDS E is short, making ODMDS E cost-effective to utilize.

The *baseline* bathymetry for ODMDS E is shown in figure 2. Figure 3 shows the distribution of grid-cells used to guide the placement of dredged material within ODMDS E during 2000. The backside of figure 3 lists the protocol for dredged material placement within ODMDS E.

Figure 4 shows the bathymetry at ODMDS E as of 2 June 2000 and documents the pre-disposal condition of ODMDS E for 2000. Figure 5 shows the difference between the surveys of October 1999 & June 2000. Note the erosion (of placed dredged material) that occurred throughout ODMDS E. About 1.2 mcy (million cy) of sediment was eroded from ODMDS E during the winter 2000 storm season; much of the eroded sediment deposited north of the site (toward Peacock Spit). Although there was some shoaling along the north side of the MCR channel attributed to the use of ODMDS E, it was less that 5% of the material placed within the site during 1999. During winter 2000, shoaling within the MCR channel was dominated by sediment transport from the south (Clatsop Shoal). Results shown in figure 5 are typical for the winter erosion trend at ODMDS E.

Figure 6 shows ODMDS E bathymetry change between the *baseline* condition (May 1997) and June 2000. As of June 2000, there was some dredged material remaining within the western half of ODMDS E from preceding years' disposal operations: Accumulation w.r.t. the *baseline* condition ranged from 1-4 ft high and contained about 900,000 cy. To prevent (average) vertical accumulation greater than 5 ft within the western half of ODMDS E, two restrictions were implemented for 2000 dredging/disposal:

1) Placement of dredged material within the middle region of the western half of ODMDS E was avoided; and
2) The eastern half of the site was used more than the western half of the site for dredged material disposal during 2000.

During 1 July – 14 August 2000, a contractor-operated hopper dredge (*Dodge Island*) placed 550,000 cy of dredged material in the western half (southern third) and 1.05 million cy in the eastern half of ODMDS E. During 2 June – 21 August 2000, the government dredge (*Essayons*) placed 641,000 cy in the western half (northern third) and 655,000 cy within the eastern half of ODMDS E. No dredged material was placed within the western half of ODMDS E after 15 August. Beginning on 14 August, the *Essayons* was restricted to the eastern-most region of ODMDS E to avoid additional mounding in other areas of the site. The 14 August dredge-order was based on the survey of 10 August (figures 7-8), which showed that several areas within ODMDS E had pronounced levels of mounding while the eastern-most area of ODMDS E had no mounding. As of 10 August 2000, the capacity within the eastern-most area of ODMDS E was estimated to be 500,000 cy. By 21 August, about 400,000 cy had been placed within the eastern-most area of ODMDS E. To avoid exacerbating the mounding issue anywhere within the site, use of ODMDS E was discontinued after 21 August 2000, for the remainder of the 2000 dredging season.

ODMDS E was surveyed on 27 September 2000 to document the post-disposal condition of the site for 2000. Figure 9 shows the 27 September survey, with the distribution of disposal events superimposed. Figure 10 shows the difference between the 2 June and 27 September 2000 surveys and documents the total accumulation of dredged material placed within ODMDS E during the 2000 dredging season. The total volume of dredged material (sand) placed within ODMDS E during 2 June – 21 August 2000, was 2.9 million cubic yards (cy). Approximately 1.2 million cy was placed in the western half and 1.7 was placed in the eastern half of ODMS E. As of 27 September, 61% (or 1.7 million cy) of all dredged material placed at ODMDS E during 2000 was observed to have accumulated on the seabed of the site. In other words, *during the 2000 dredging-disposal season* (perhaps during the disposal process), the wave/current environment at ODMDS E had dispersed 39% of all dredged material placed at this site. The short-term dispersion of dredged material placed at ODMDS E during June – September 2000 was consistent with observations made at ODMDS E during 1998 and 1999.

Figure 10 shows that placement of dredged material within ODMDS E during 2000 produced mounding with maximum height of 5 ft or less, w.r.t. to the June 2000 survey. Note that when the 27 September 2000 survey is compared to the site's *baseline* survey (figure 11) several areas exceeded the 5 ft limit for dredged material accumulation, by more than 3 ft.

On 3 December 2000, a survey was obtained for ODMDS E showing bathymetric change from the September 2000 condition (compare figures 11 & 12). The dredged material mound in the eastern half of ODMDS E was reduced in vertical and lateral extent, but the mound in the western half of the site had increased in size. Sediment was likely transported from the eastern half of the site to the western half. Although the bathymetry at ODMDS E was "reworked" by waves and currents during September – December 2000, with some transport to the west-northwest, localized mounding 6-8 ft high remained within the site with respect to the 1997 condition. It is anticipated that by June 2001 the present mounding within ODMDS E will be reduced vertically by 3-6 ft and the potential for wave amplification will be eliminated.

During winter (October – June), the erosion rate of dredged material placed at ODMDS E is estimated to be 1-1.5 million cy, based on observations made at ODMDS E between 1990 and 1999. Assuming that this long-term erosion rate occurs during winter 2000-2001, 0.2 – 0.7 million cy may be present within ODMDS E in June 2001 (as compared to the site's *baseline* condition). This infers a capacity of 2.4 - 3.2 million cy for disposal within ODMDS E during the 2001 dredging season [USACE 1998a&b], if the entire area of the site is fully utilized and localized mounding is avoided.

**Exceedance of Management Protocols at ODMDS E during 2000**

Target values for allowable vertical accumulation of dredged material (with respect to the *baseline* condition of 1997) were selected based on the water depth dependent thresholds shown in table 1 [USACE 1998 and USACE 1998b]:

*TABLE 1. Limiting dredged material mound height based on water depth.*

| Seabed Elevation | Limiting (mound) Height for Dredged Material Accumulation |
|---|---|
| -50 ft MLLW | 4 ft |
| -60 ft MLLW | 5 ft |
| -65 ft MLLW | 6 ft |

Based on the average water depth of ODMDS E (55 ft for the 1997 *baseline* condition), an average accumulation threshold of 5 ft was adopted for management purposes; 4.5 ft rounded to 5 ft. As of September 2000, about 17% of the bathymetry at ODMDS E had accumulated sediment to a height great than 5 ft high, with respect to the 1997 *baseline* condition.

Note that the "Limiting Height" values are intended to be used as an ODMDS management guide. The values shown in Table 1 apply to a mound feature that occupies an area of 1,400 x 3,200 ft. For small mound features that exceed the above limiting mound height values, there may be little or no wave amplification and a case by case examination of wave amplification potential may be warranted. ***The site management goal for ODMDS E is to avoid modification of the site's bathymetry that would result in wave amplification factor greater than 1.1.*** An amplification factor of 1.1 represents a 10% increase in wave height; with respect to the 1997 baseline condition.

Figure 11 shows the difference between the 27 September 2000 and May 1997 (*baseline*) surveys for ODMDS E. Between May 1997 and September 2000, about 11 million cy had been placed in ODMDS E. Although less than 1/5th of all dredged material placed within ODMDS E during 1997-2000 has remained within the site boundaries, two (2) areas exhibited localized but pronounced mounding. In the northwest corner of the site, mounding was observed to be at least 7 ft high. Near the middle of the site, mounding was observed to be at least 8 ft high. The areas of accumulation exceeding 5 ft in height were restricted to isolated regions less than 1,000 x 1,000 ft in area. Collectively, the region within ODMDS E with mounding exceeding 5 ft (vertical) covered an area of 2,400 x 1,500 ft (or 17% of the site's total area). Note that within ODMDS E (as of

September 2000), the volume of dredged material exceeding 5 ft of accumulation was 140,000 cy. Although there was 1.5 million cy of capacity (volume) remaining below the 5 ft threshold, the available capacity was confined to localized areas distributed throughout ODMDS E (located mostly in the western half of the site). This means that:

1) Only 5% of the dredged material placed within ODMDS E during 2000 contributed to a mounding "problem" (exceedence of 5 ft accumulation). There was sufficient capacity to have avoided the mounding problem, had the dredged material been more uniformly placed (distributed) throughout the site.
2) As of September 2000, most of the capacity remaining within the site (below the 5 ft accumulation limit) was not available for use (disposal), i.e. the western half of the site was not available after 15 August.

Based on the level of mounding shown in figure 11, USACE-Portland District performed a wave analysis to assess the effect of mounded dredged material upon ocean waves.

**Regional Bathymetry Change & Wave Amplification at ODMDS E**

A wave analysis was performed using a numerical model (RCPWAVE) to assess the effect of mounded dredged material at ODMDS E upon ocean waves. The analysis specifically examined the potential wave-related impact of (mounded) dredged material placed at ODMDS E during 1997 to 2000 (shown in figure11). Results of the wave analysis are summarized below with details presented in USACE 2000.

The results of the wave analysis consider ONLY the effect of waves interacting with bathymetry (the seabed). The large "box", demarcated by a dashed black line, in figures 1 and 13 shows the region of MCR considered in this wave analysis. Note that the effect of bathymetric change on the MCR ebb tidal shoal and at all ODMDS were included in the RCPWAVE analysis.

Figure 14 shows ***regional*** bathymetric changes observed at MCR during May 1997 to September 2000. During 1997-2000, significant bathymetry change has occurred throughout the MCR region. The tops of the dredged material mounds at ODMDS A and B have been eroded by 6-10 ft and much of the eroded material (sand) has been deposited near the flanks of the dredged material mounds. Near the ocean limit of the MCR entrance channel, 2-4 ft of seabed erosion had occurred. The crest of Peacock spit (MCR ebb tidal shoal) had been eroded by 2-4 ft; with the eroded sediment appearing to have been deposited along the northern and seaward flank of the spit. Deposition of 2-6 ft has occurred near the seaward end of the south jetty and extends into the MCR entrance channel, in the form of a 1,500-foot wide strand oriented north-south. There appears to be a wide tongue of sediment (2 ft thick) that has been deposited on the seabed about 1 mile south of ODMDS B and within ODMDS F. Overall, the MCR ebb tidal delta has experienced net erosion during 1997-2000 with deposition occurring along the toe of the ebb tidal shoal. The above MCR bathymetry changes can be thought of as a "natural" occurrence, due to the process of waves and currents acting to re-distribute MCR bottom sediment.

The survey that was used in the wave analysis to describe the "present" bathymetry condition for ODMDS E was obtained in September 2000. Based on results of this wave analysis (using the RCPWAVE model), there is a potential for wave amplification in the vicinity of ODMDS E due to the change in bottom elevation (accumulation of dredged material within ODMDS E boundaries) between 1997 and 2000.

Estimates of wave amplification for incident waves with period of 12 seconds and approach direction of 225 – 275 degrees (from the *southwest*) are shown in figure 15. Results indicate that small-scale mound features 6-8 ft high within ODMDS E have the potential for amplifying waves by 20 - 30%. An amplification factor of 1.3 represents a 30% increase in wave height from 1997 to 2000. Note that any wave amplification associated with dredged material accumulation at ODMDS E was predicted to be either confined within the eastern half of ODMDS E, or extend eastward toward the north jetty. No wave amplification was predicted to occur within the MCR entrance channel. Areas of potential wave amplification located away from ODMDS E, are associated with the "natural" processes of erosion or deposition at MCR (see previous discussion of MCR bathymetry change).

An analysis of wave "breaking" was also performed with results shown in terms of predicted wave breaking location (figure 16). The bathymetry contours for 2000 are superimposed to permit comparison. Between 1997 and 2000, modification of wave breaking locations at MCR arose mainly from the "natural" changes in seabed elevation at ODMDS A, ODMDS B, or Peacock Spit. Due to localized mounding within ODMDS E, the 12-foot (12 second) wave has the potential to break within the entire length of the site. Note that the effect of mounding at ODMDS E upon wave breaking is contained within the boundaries of ODMDS E. The accumulation of dredged material within ODMDS E during 1997-2000 had no effect on modifying wave breaking location **for areas outside** the ODMDS boundaries.

Based on results from the RCPWAVE model, it is noted that wave conditions within ODMDS E (for Fall 2000) were predicted to be less favorable for navigation, when compared to conditions in 1997. This potentially unfavorable condition will continue until the 6-8 ft high peaks of accumulated dredged material are reduced by 3-4 ft. Dispersal of dredged material mounds within ODMDS E is anticipated to occur during the initial series of winter 2000 storm events at MCR.

## Recommendations for Future Utilization of ODMDS E

Excessive (dredged material) mounding within ODMDS E during 2000, was due to concentrated placement of a small amount of dredged material. Only 5% (or 140,000 of 2.8 million cy) of all dredged material placed actually contributed to mounding greater than 5 ft high, and mounding greater than 5 ft high covered only 17% of the site's area. Improved use of ODMDS E in 2001 will require:

1) *Measures to avoid placement of dredged material on or near areas exhibiting remnant mounding.* In 2000, this was accomplished for the western half of the site, but not for the eastern half (see figure 6 & 9).

2) *Uniform placement of dredged material throughout the entire site, by all dredges using the site, throughout the entire dredging season.* The Contractor dredge achieved satisfactory dispersal of dredged material, but the government dredge apparently did not (see figure 6 & 9). To minimize the overlapping of individual disposal events, the government dredge could use disposal "lanes" instead of "cells" (see attachment 1, middle caption). After 15 August, much of the western half of the site had capacity to handle additional dredged material, but this area was not available for use.

3) *For advance planning purposes, ODMDS E be considered for no more than 2.5 million cy of dredged material disposal during 2001.* This recommendation will be verified, before commencement of the 2001 dredging-disposal season, when ODMDS E is surveyed in May or June 2001. Based on past experience at the site, the capacity in 2001 should be 2.4 – 3.2 million cy.

**Bathymetry Change at the North Jetty Site during 2000**

Figure 1 and 17 show the location for the NJ site. During 1990-1997, progressive lowering (erosion) of the seabed was occurring along the south side of the north jetty, adjacent to the structure's toe. Placement of up to 1 million cy/yr of sandy dredged material at the NJ site is intended to replace sediment that has eroded from the southern toe of the north jetty, thereby protecting the structure from deterioration (caused by toe scour and related slope instability). The NJ site was used in 1999 when 1.05 million cy was placed. Figure 17 shows the bathymetric change that occurred at the NJ site between June 1999 and June 2000. During winter of 1999-2000, approximately half (500,000 cy) of all material placed within the NJ site (1.05 million cy during summer 1999) was dispersed out of the site: This value defines the estimated dynamic capacity of the site. It is possible that some of the dispersed sediment was transported east of the site, and deposited along the northern edge of the MCR entrance channel. As of June 2000, dredged material remaining within the NJ site was 1-5 ft thick, w.r.t. the June 1999 pre-disposal condition.

Between 15 July and 13 August 2000, the government hopper dredge *Essayons* placed 504,000 cy of dredged sand within the NJ site. Figure 18 shows the difference between the June 1999 and September 2000 surveys at the NJ site. Bathymetry contours shown in figure 18 indicate the seabed elevation within the NJ site as of September 2000, after placement of dredged material at the NJ site. Note the scour area paralleling the north jetty. The objective of placing dredging material within the NJ site during 1999-2000 was to fill the scour area. Although dredged material was placed 300 ft south of the jetty (offset for reasons of navigation safety and jetty slope stability), some of the dredged sand placed in the NJ site did directly accomplish the objective of protecting the toe of the north jetty from scour. As of September 2000, dredged material accumulation with the NJ site was 4-9 ft high, w.r.t. the June 1999 pre-disposal condition and almost all of the material placed within the NJ site during 2000 was present. It is anticipated that up to 500,000 cy will be dispersed out of the NJ site during winter 2000.

**Recommendation for NJ site**: Review recent trends in shoaling along the north edge of MCR channel, between RM 1-2, to determine if dredged material is being transported from the NJ site to the navigation channel. If a significant volume from the NJ site is transported into the navigation channel, utilization of the NJ site may require restriction. Use of NJ site in 2001 should be limited to 500,000 cy or less, and material should be evenly dispersed through site with a preference toward the north jetty and the western-most corner of the site. A pre-disposal survey of the NJ site should be obtained in spring 2001 (similar to coverage as the site's September 2000 survey) to determine how much of the material placed at the NJ site in 2000 remains in 2001. If it is determined that the annual dispersion rate is significantly less than 500,000 cy/yr, then dredged material placement at the NJ site should be reduced accordingly.

**Bathymetry Change and Disposal Capacity at ODMDS F Site**

Figures 1 and 19 show the location and bathymetry for ODMDS F. After being designated in 1977, ODMDS F was first used in 1989, when 2 million cy of silty sediment (removed from Tongue Point access channel) was placed at the site. At the time of site designation, it was assumed that there would be minimal sediment transport at ODMDS F, due to the water depth being greater than 100 ft. Within 1 year after the placement of silty sediment within ODMDS F, the 10 ft high accumulation of dredged material was covered by more than 6" of native sand, inferring nominal sediment transport (deposition) at the site. During 1990 - 1997, 6 million cy of sand (dredged from MCR) was placed within the southern half of ODMDS F. Figure 20 shows the bathymetry change that occurred at ODMDS F during1981 - 1997. The survey from1981 represents the *baseline* condition for ODMDS F. Note that between 1981 – 1997, 8 million cy of dredged material was placed at ODMDS F yet there was a net accumulation of 11 million cy. The apparent gain of 3 million cy of sediment within ODMDS F infers that the site may be a net depositionary environment.

To avoid mound-induced amplification (shoaling) of waves passing over ODMDS F, the vertical limit for mounding within ODMSD F was determined to be 15 ft. Beginning in 1997, dredged material disposal within ODMDS F was restricted to the northern half of the site. This was done to avoid placing additional material on top of the previously mounded material (10 ft high) located within the southern half of the site. Additionally, dredged material is placed uniformly (as shown by the disposal coordinates in figure 19) to avoid excessive mounding.

Since 1997, about 500,000 cy/yr of dredged sand has been placed within the northern half of ODMDS F. Figure 21 shows the change in ODMDS F bathymetry between 1997-2000. Note that between 1997 – 2000, 2 million cy of dredged material was placed at ODMDS F yet there was a net accumulation of 9 million cy throughout the site. The apparent gain of 7 million cy of sediment within ODMDS F strongly suggests that the site may be a net depostionary environment. Figure 22 shows the overall bathymetry change at ODMDS F during 1981-2000. The "gray box" in figure 22, shows where dredged material is now placed within ODMDS F. There is considerable mounding that has occurred within the northern half of ODMDS F. Note the 14-ft high mound located within the center of ODMDS F (cross-hatched area); mounding in this area has increased since 1997 either due to natural deposition or dredged material placement. Placement of dredged material within the cross-hatched area (figure 22) should be avoided.

Within the northern half of ODMDS F, the total capacity for dredged material disposal was estimated to be 20 million cy, w.r.t the site's 1981 bathymetry. This was based on the average water depth at the site which, as of 1981, could accommodate 15 vertical-ft of deposition before waves are affected by shoaling and refraction. Since 1981 approximately 8 million cy of sediment has accumulated within the northern half of ODMDS F, either by dredged material disposal or natural deposition. Thus, the present capacity for the northern half of ODMS F is 12 million cy. If the cross-hatched area shown in figure 22 is not available for dredged material disposal, then the remaining capacity of ODMDS F is reduced to10 million cy.

Based on surveys conducted in 1981, 1997 and 2000, it was estimated that the rate of "natural" deposition at ODMDS F is 0.3 ft/yr. A deposition rate of 0.3 ft/yr reduces available disposal capacity, within the northern half of ODMDS F, by 600,000 cy/yr. Deposition of sand at ODMDS F and adjacent areas is believed to arise from:

1) Continual seaward migration of the MCR ebb tidal shoal in response to jetty construction and MCR channel deepening (1984) – fine sand is discharged further offshore as the MCR channel has becomes deeper; and
2) An offshore wave climate that has progressively increased in severity since the early 1990's – larger waves mobilize more bottom sediment and change coastal deposition patterns.

Regardless of how the natural deposition is occurring, ODMDS F will require prudent monitoring & management to fully utilize the site's capacity and avoid excessive vertical accumulation of sediment. The following calculation identifies the capacity requirement and estimates the remaining time for utilization of ODMDS F.

*O&M dredging at MCR = 4.1 million cy/yr
*Prudent future Capacity for ODMDS E = 2.8 million cy/yr
*Prudent future Capacity for NJ Site = 200,000 cy/yr
****Volume assumed to be placed within ODMDS F = 1.1 cy/yr**
**(= 4.1m/cy – 2.8m/cy - 0.2 m/cy)**

If ODMDS F is no longer available for dredged material disposal, and disposal is limited to ODMDS E and the NJ site, then MCR dredging capacity may be limited to 3 million cy/yr.

The time remaining for prudent utilization of ODMDS F capacity was calculated as, *total remaining capacity of ODMDS F – (volume lost due to "natural" deposition/yr + volume placed in site/yr) *time which site is used.* If 1.1 mcy/yr is placed in ODMDS F, then the remaining time (T) for which the site can be used before sediment accumulates to 15 ft is calculated as:

$$T = 12 - (0.6 + 1.1)*T = 12 - 1.7T, \quad \text{or} \quad 2.7T = 12$$
$$T = 4 \text{ years.}$$

Table 2 shows various estimates for the remaining time, before the disposal capacity of ODMDS F is fully used. The results shown in table 2 assume the dredged material is optimally placed within ODMDS F: Dredged material accumulates evenly on the seabed.

*TABLE 2. Time remaining before for ODMDS F capacity is fully used.*

| Volume/year Placed in ODMDS F | Time, from June 2001 before Site Capacity is fully Utilized |
|---|---|
| 500, 000 cy/yr | 6 years |
| 800,000 cy/yr | 5 years |
| 1,100,000 cy/yr | 4 years |
| 2,000,000 cy/yr | 3 years |

**<u>Recommendation for ODMDS F</u>**: Due to the cost effectiveness and positive "littoral benefits" of using ODMDS E and the NJ site, use of ODMS F should be minimized: Maximum use of ODMDS E and the NJ site should be achieved before ODMDS F is used. Dredged material disposal within ODMDS F should be limited to 1,100,000 cy/yr, to permit use of ODMDS F for up to more 4 years (from June 2001). Dredged material should be placed uniformly within the northern half of ODMDS F, avoiding the cross-hatched area shown in figure 22. Within 4 years from June 2001, a new MCR disposal site should be designated for placement of O&M dredging and the new site should minimally accommodate the disposal of 1.1 million cy/yr.

## Longterm Bathymetric Change at ODMDS E and Peacock Spit

An attempt was made to estimate the long term fate of dredged material placed at ODMDS E by comparing the present bathymetry of Peacock spit with that of 1958 (using the difference between surveys, figure 23). This comparison integrates the effects of seabed change on Peacock Spit, due to natural forces and placement of dredged material at ODMDS E. Note that since 1973, approximately 59 million cy of dredged sand has been placed at ODMDS E (as compared to 11 million since 1997).

Figure 23 shows that much of Peacock Spit, between 50-60 ft depth, has eroded during 1958-2000 while areas deeper than 70 ft have experienced pronounced deposition. Essentially, the top of Peacock Spit is being sheared-off (by waves and currents) and the sediment is being deposited at the west and northwest base of the spit. Note the significant erosion immediately south of ODMDS E, along the MCR entrance channel. This is believed to be due to:

1) MCR dredging and related channel sideslope adjustment. This is a localized process.
2) Natural channel migration, toward the north. This is a regional process.

It appears that as the "natural" MCR channel migrates northward, Clatsop Spit is following suite, or vice versa: Clatsop Spit is migrating north into the "project" limits of the MCR navigation channel.

Between 1958 and 2000, it appears that dredged material placed at ODMDS E has been transported primarily north-northwest (and then east-southeast) as indicated by the pink vectors in figure 23. Dredged material placed within the eastern half of ODMDS E is believed to be transported north-northwestward onto the ridge of Peacock Spit, and ultimately toward Benson beach. Dredged material placed within the western half of ODMDS E is believed to be transported west-northwestward onto the ocean-facing slope of Peacock Spit. Dredged material that is transported onto the ocean-facing slope of Peacock spit appears to be carried along the flank of the spit (parallel to the bathymetry contours) in a clockwise path, and ultimately carried back toward shore. Dredged material placed in the eastern half of ODMDS E appears to be subjected to a ***higher*** transport potential than dredged material placed in the western half of the site.

It is speculated that if dredged material had not been placed at ODMDS E (59 million cy during 1973-2000), erosion would have occurred over a much larger area of Peacock Spit than what is indicated at present. Consequently, Benson Beach (Ft. Canby State Park) would have experienced significantly higher erosion (landward recession). Based on results shown in figure 23, dredged material placed at ODMDS E does not appear to be moving south toward the navigation channel (at least in any appreciable quantity).