Section 3
PROPOSED EXPANSION OF ODMDSs B AND E

The volume of sediment annually dredged from the MCR navigation channel and placed into ODMDSs varies between 4-5 million cy/yr. After 1996, the capacity of existing MCR ODMDSs to accept dredged material is expected to be limited to 2 million cy/yr (1 million cy/yr each in site E and F), based on findings presented in section 2 of this report. New ODMDSs will need to be established in order to make-up the 3-4 million cy/yr deficit in disposal capacity and fulfill long-term maintenance dredging disposal site capacity of up to 5 million cy/yr at MCR.

Designation of new ODMDSs at MCR is currently being initiated through the Channel Deepening Feasibility Study and EIS, which will require 3 more years to fully coordinate (1999). Until new MCR ODMDS are formally designated, the only feasible option for providing an additional 3-4 million cy/yr disposal capacity for the MCR navigation project is to ***temporarily expand existing candidate ODMDSs***. The expanded ODMDSs would be used for dredged material placement until which time new ODMDSs are formally designated. As a conservative estimate, the expanded sites were expected to be utilized for 5 years, beginning in 1997.

RATIONALE FOR ODMDS EXPANSION – INITIAL ASSESSMENT

ODMDSs A and F were not be considered for site expansion (continued operational use) for reasons of impeding navigation, as discussed in section 1 and 2 of this report. This rationale leaves ODMDSs B and E as the only remaining candidate sites available for temporary expansion. Both sites B and E were considered for temporary expansion to allow for greater operational flexability and minimize the potential impacts associated with using a single ODMDS for all MCR disposal needs.

During a 5-year utilization period, expanded ODMDSs B and E will need to accept 25 million cy of dredged material (assuming a disposal requirement of 5 million cy/yr). Although ODMDS F could accept 1 million cy/yr, its was not included in this analysis to ensure project capacity is met, in the event that navigation interests require additional restrictions on the use of site F. Two attempts were made to determine the optimum size of expansions for ODMDSs B and E. Initially, the proposed boundaries for expanded ODMDSs B and E were configured as shown in figure 18. Expanded site B would be approximately 12,000 ft x 12,000 ft. Expanded site E would be approximately 2,000 ft x 10,000 ft.

It was initially assumed that expanded site B would receive 4 million cy/yr of dredged material and that expanded site E would receive no more than 1 million cy/yr, due to the proximity of site E to the MCR navigation channel (concern that placed dredged material

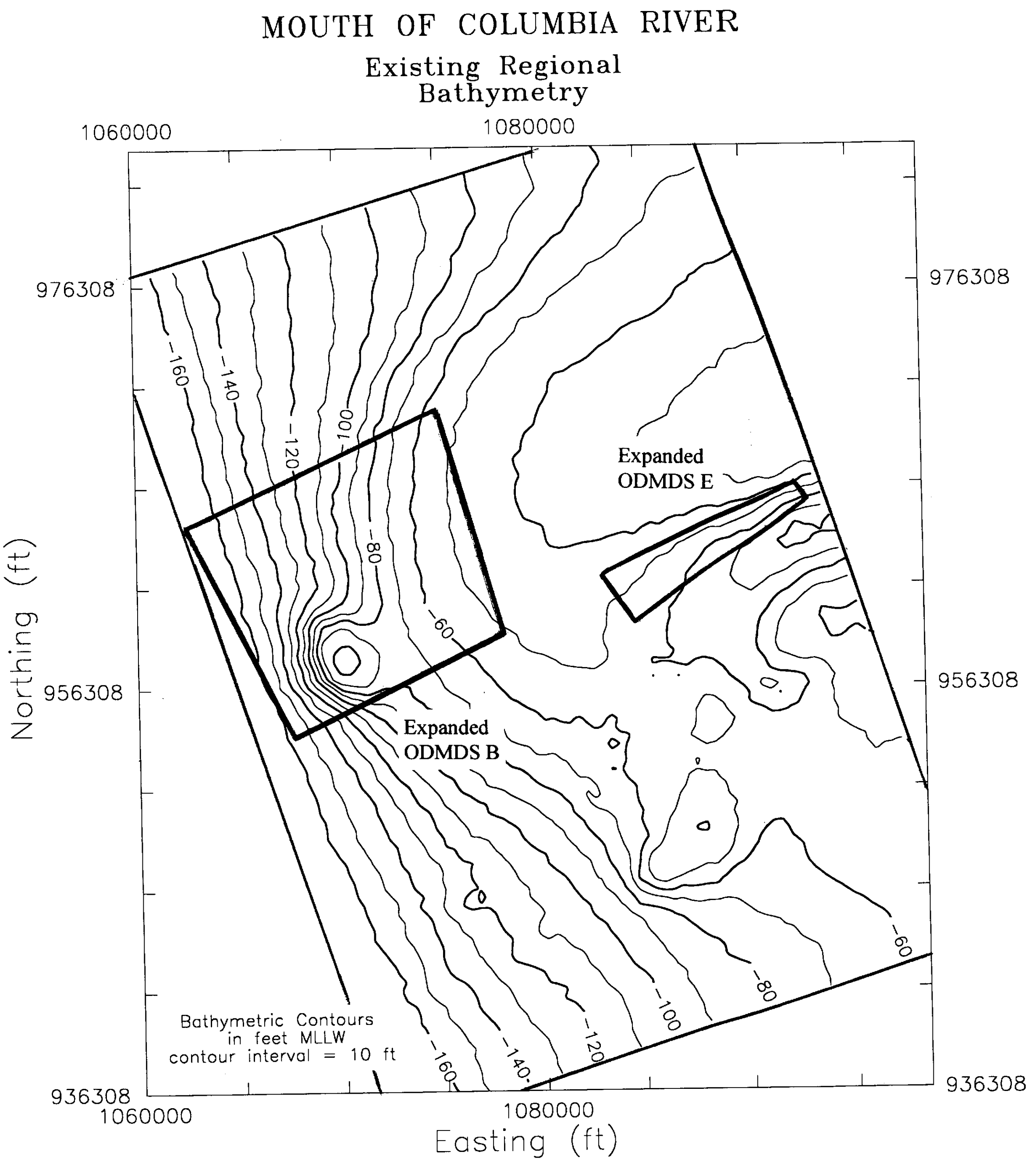


Figure 18. Existing Regional MCR Bathymetry and Initially Proposed Expanded ODMDS Boundaries.

may be transported back into the channel). However, as the analysis of expanded site B progressed, it became apparent that increased volumes of dredged material could be placed within expanded site E, if site monitoring results warranted. This measure would reduce the volume of material to be placed in site B.

Utilization of Expanded ODMDS B

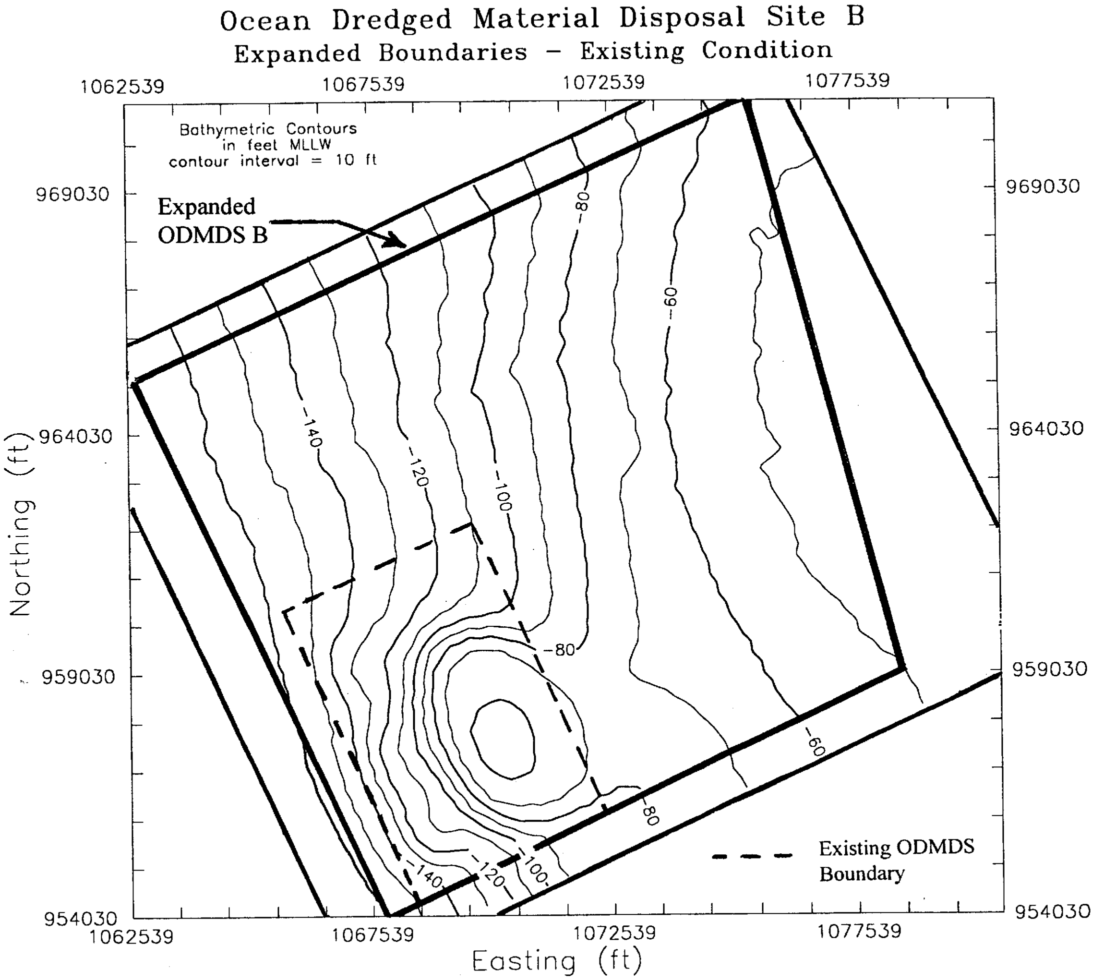
The initially proposed configuration for expanded site B was intended to minimize haul distance from the site of dredging in the MCR navigation channel, while maximizing the return of dredged sediments back to the littoral environment. Minimum existing water depth within the *expanded* site B boundaries is 50 ft, as compared to 80 ft for the present site B boundary. A 50-foot water depth is considered a minimum safe navigable depth for hopper dredges operating at the western flank of Peacock Spit. The upper graphic of figure 19 shows a detailed view of expanded site B.

By placing dredged material in a shallower water depth, it was anticipated that more dredged material would be transported (by waves and currents) back into the littoral system. This would maintain ODMDS capacity and minimize any perceived erosion problem north of MCR. During the five year period of expanded site operation, ODMDS B was assumed to receive a total of 20 million cy. It was initially assumed that half of the material to be placed in site B, would be placed in the shallow part of the site (10 million cy during a five year period). The deeper part of the site would receive the other half of the dredged material volume (10 million cy during a five year period).

Dredged material placement within the shallower area (depth = 50-70 ft) of expanded ODMDS B must be conducted in manner which would avoid increasing wave heights greater than 10% over the existing condition. It was initially assumed that formation of a mound feature less than or equal to 8 ft in height would achieve the 10% criterion. Applying 10 million cy into the formation of a mound 8 ft tall, would require dimensions of: 5,900 ft long, and 3,400 ft wide at the base with 0.012 (1V:80H) side slopes.

Within the deeper part (90-160 ft) of expanded site B, it was initially assumed that dredged material placement that avoided the formation of any mound feature greater than 15 ft in height would achieve the 10% wave criterion. Applying 10 million cy into the formation of a mound 15 ft tall, would require dimensions of: 4,500 ft long, and 4,100 ft wide at the base with 0.012 side slopes. The upper graphic of figure 20 shows the configuration of expanded site B with the addition of the two mounds as described above. Both mounds were "constructed" geometrically.

It was anticipated that by limiting dredged material accumulation as indicated above, the wave environment at MCR would not be worsened due to mound-induced wave shoaling. Increasing wave height (for seas or swell) greater than 10% over the existing (non-mound) bathymetric condition was considered unacceptable.



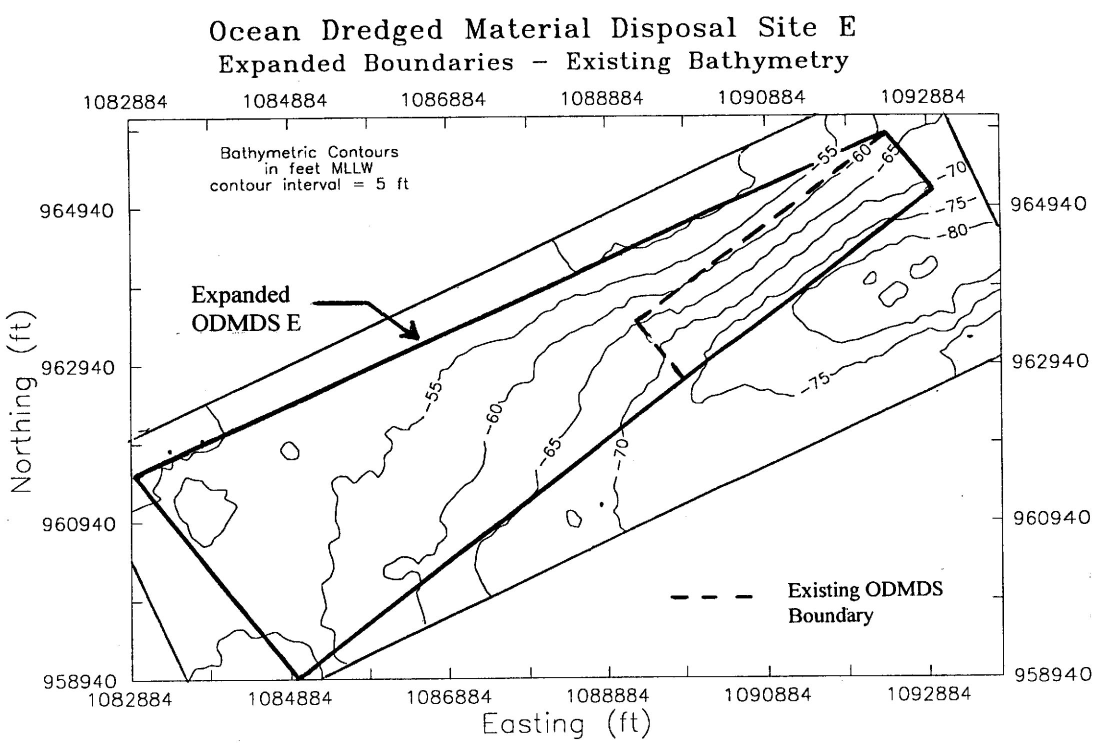
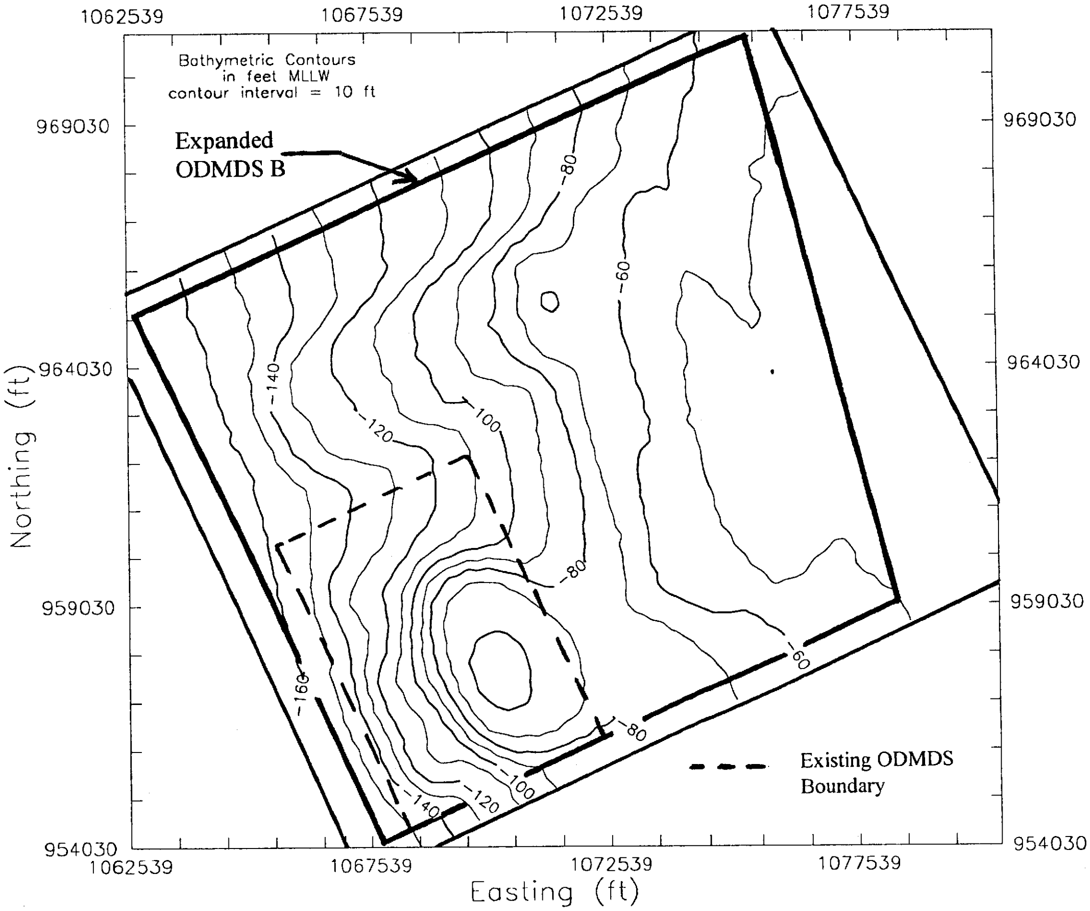


Figure 19. Detailed View of Expanded Boundaries Initially Proposed for ODMDSs B (top) and E (bottom).

Ocean Dredged Material Disposal Site B

Expanded Boundaries – Predicted Bathymetry
After 20 million CY placement (5 years)



Ocean Dredged Material Disposal Site E

Expanded Boundaries – Predicted Bathymetry
After 1 million CY placement (1 year)

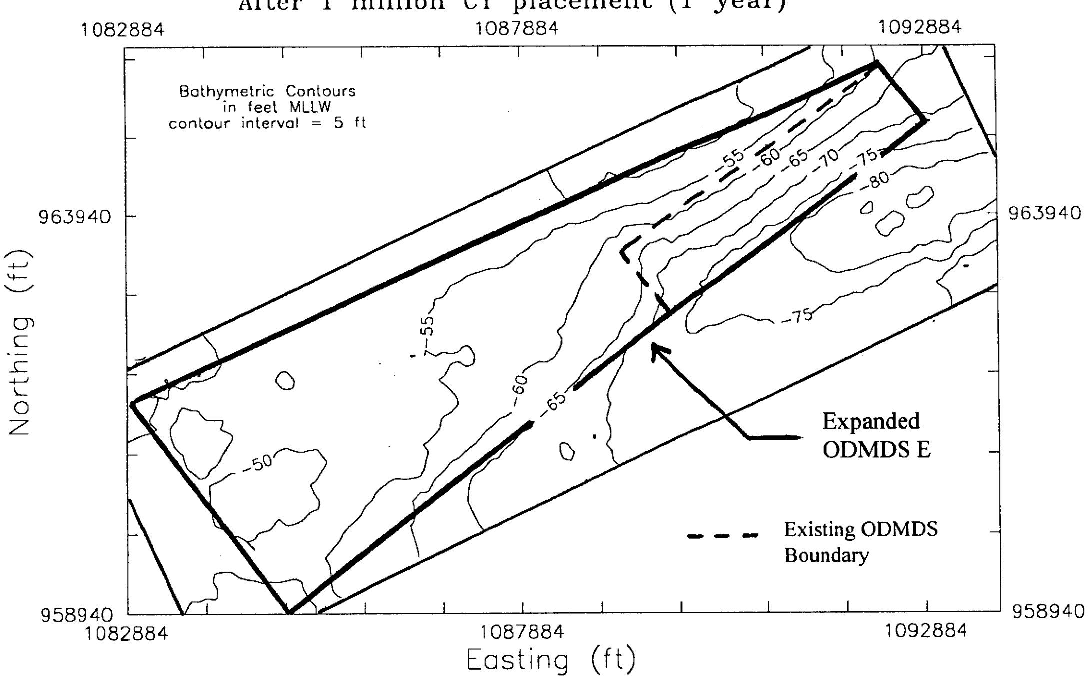


Figure 20. Detailed View of Predicted Mound Bathymetry for Expanded ODMDSs B (top) and E (bottom).

Utilization of Expanded ODMDS E

The proposed configuration for expanded site E was intended to take advantage of the high rate of sediment dispersion that occurs at site E. Site E is a highly dispersive site. Material which is presently placed within the present boundaries of site E (about 1 million cy/yr) does not accumulate within the site: Some of the material is transported northward onto Peacock spit during Fall and Winter where it is re-introduced into the littoral system north of MCR. During summer, the littoral transport at Site E is believed to be southward toward the navigation channel. A volumetric analysis of ODMDS E indicates that from 1990 to 1995, site E has "lost" 3.7 million cy despite 3.4 million cy of dredged material being placed within this site during the same time period. Expanded site E would be in similar water depths as the present configuration. The lower graphic of figure 19 shows a detailed view of expanded site E. Site E was expanded to facilitate the use of this site by two dredges placing dredged sediment at the same time and allow more area to be used for dispersal of dredged material to prevent mounding. Presently, the site is too small for more than one dredge to navigate within while disposing, during a given dredging/disposal operation.

Dredged material placement within expanded site E would be conducted in manner that avoids formation of any mound feature greater than 4 ft in height. If a mound feature did form at expanded site E, it is anticipated that would not remain for more than one year before being obliterated by the site's wave and current regime. The formation of a mound 4 ft tall containing 1 million cy of sediment (one year of disposal) would correspond to 5,200 ft long and 1,000 ft wide at the base (0.012 side slope). It is highly unlikely that this type of bathymetric feature would form at an energetic site such as ODMDS E: It was only considered from the stand-point of a conservative site impact assessment. The bottom graphic of figure 20 shows the configuration of expanded site E with the addition of the mound as described above.

As an initial site management goal, expanded ODMDS E would receive 2 million cy/yr of dredged material disposal. As confidence is gained concerning the favorable disposition of placed material (site surveys indicate that material is not accumulating in the expanded site or moving into the navigation channel), the annual volume of dredged material placed into site E will be increased. The amount of dredged material placed into expanded site B will be reduced while placement in expanded site E would increase. This scenario will enhance the transport of dredged sediment into the littoral environment of Peacock Spit, while minimizing benthic impacts to biota at site B.

IMPACT ASSESSMENT FOR EXPANDED ODMDSs

The Ocean Dumping Act and Clean Water Act require that field-verified, state of the art procedures be used for the assessment of possible physical impacts due to the operation of proposed ODMDSs. A key to successful ODMDS designation and management is knowing in advance (or reliably predicting) the fate of dredged material placed at the ODMDS. To meet this need at MCR, several numerical models were used for the analysis of dredged material placed at expanded ODMDS B and E. Results from the numerical modeling of dredged material behavior at MCR guided the proposed ODMDS expansion and ensured that management of the sites meets operational requirements.

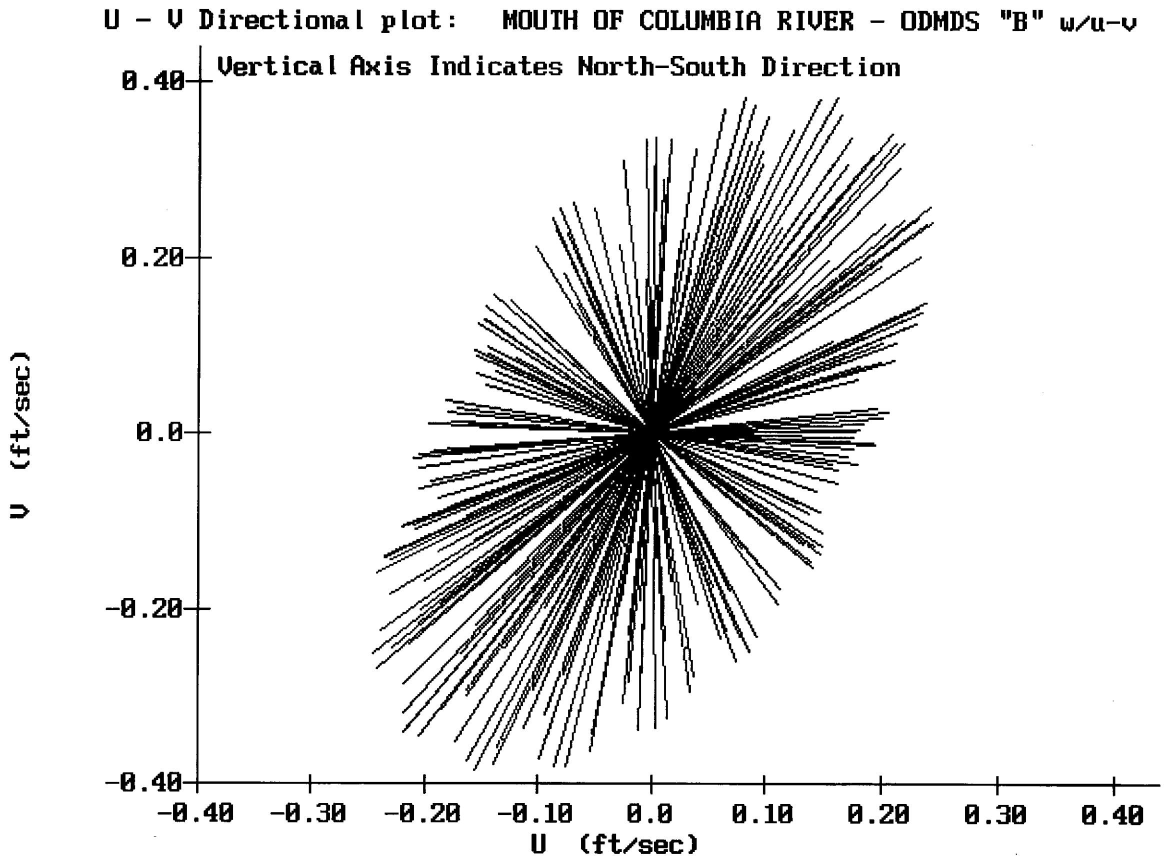
The short-term operational requirements for MCR ODMDSs were assessed to ensure that expanded MCR ODMDSs fulfill a life-cycle of 5 years. Assessments of the potential impacts of dredged material placement into the expanded boundaries of ODMDSs B and E were made. Site impact assessments focused on:

> **Wave conditions** - The use of expanded ODMDSs would not increase (worsen) the wave environment at the MCR approaches and adjacent areas.
>
> **Impacts to benthic in-fauna** - The use of expanded ODMDSs would minimize potential impacts to benthic in-fauna (including shell fish).
>
> **Transport of dredged material into the littoral zone** - The transport of dredged material placed within the expanded ODMDSs would be maximized, within context to minimizing wave and benthic community impacts.

Currents at ODMDSs B and E

In order to assess the *bathymetric impacts* and *transportability* of dredged material placed within the expanded ODMDS boundaries, the current regime at each site must be sufficiently defined. Sediment transport is governed by the current regime observed at a given location. In addition to currents, the presence of waves (sea and swell) increases the potential for currents to transport sediments along the seabed. The current regimes at MCR ODMDSs B and E are completely different due to these sites being situated at different locations with respect to the Columbia River estuary. Before any attempt can be made to quantify short- or long-term sediment behavior at a given ODMDS, the site's current regime must be adequately described. Considerable effort was given to resolve the current environments at ODMDSs B and E.

ODMDS B is located about 4 miles west (offshore) and 2 miles north of the entrance to the Columbia River estuary. Sediment transport at site B is considered to be affected by waves as much as currents. The currents observed at this site are controlled by seasonal coastal circulation, ebb and flood flows from the Columbia River estuary (plume), Newtonian tides, and ocean/coastal currents. The currents in the upper 60 ft of the water column at ODMDS B tend to be affected more by the Columbia river plume than by other processes. The currents in the lower part of the water column at site B tend to be dominated by seasonal coastal circulation and Newtonian tidal flow. The tidal current ellipse for ODMDS B (mid depth) is shown in the top of figure 21 [Sternberg 1977 and USNHO 1954,1960]. Note that the direction convention for currents is opposite that for wind and waves: Currents are defined in terms of the direction which flow is heading toward. Generally, the flow at site B is directed toward the south-southwest during ebb



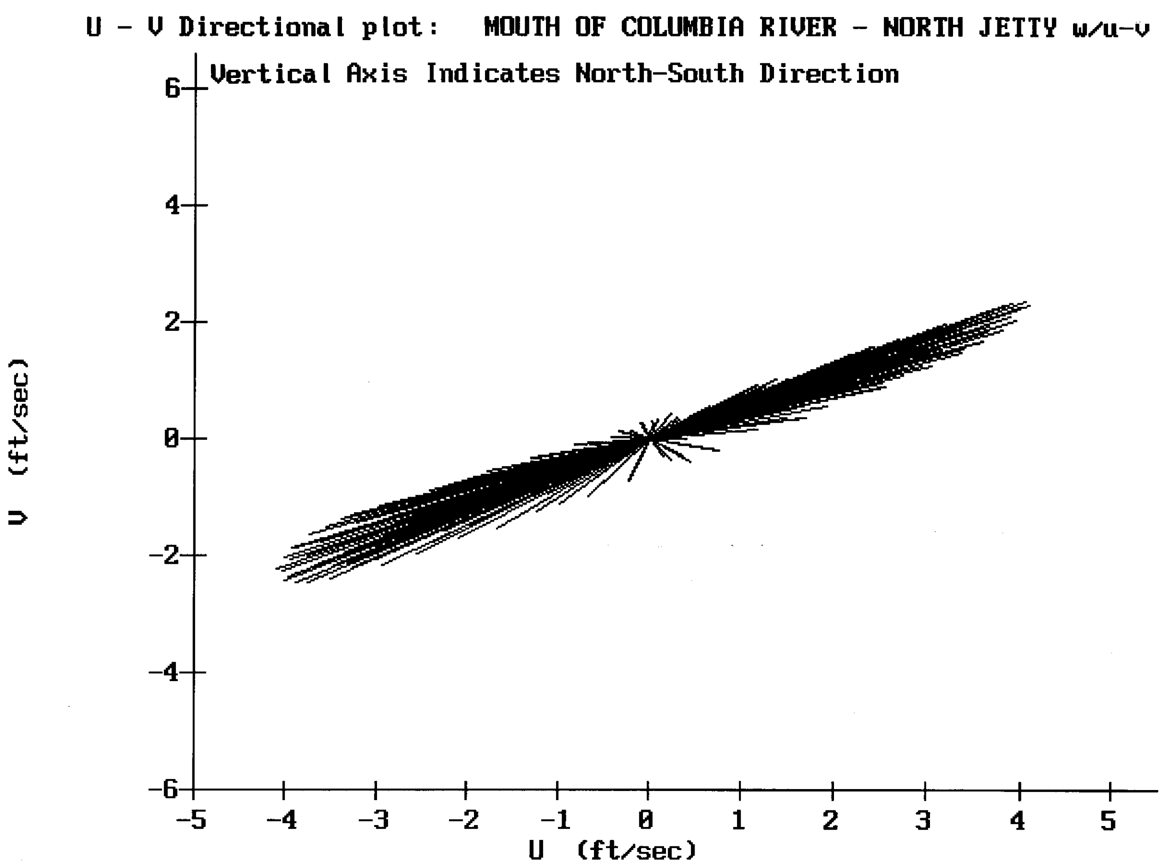


Figure 21. Tidal Current Ellipses for ODMDSs B (top) and E (bottom).

tide and north-northeast during flood tide. ***Seasonal*** changes in the overall current environment at site B are due to changes in coastal circulation, which is expressed as a seasonally averaged residual current (residual current). The residual current at site B is described below in terms of a winter-spring and summer-fall seasonal average [Sternberg 1977 and USNHO 1954,1960]:

Seasonal Residual Current at ODMDS B

Spring residual coastal current = **0.09 ft/sec @ 320°** : during April - June
Summer residual coastal current = **0.60 ft/sec @ 213°** : during July - October
Winter residual coastal current = **0.96 ft/sec @ 294°** : during November - March

At ODMDS B, the magnitude of the seasonal residual current is at times equivalent to or greater than the tidal currents. Net sediment transport observed at site B is most likely influenced by the residual current (speed and direction). The total current (at mid-depth) observed at ODMDS B is obtained by adding the appropriate residual current to the tidal ellipse.

ODMDS E is located ***in*** the entrance to the Columbia River estuary. Sediment transport at site E is considered to be dominated by currents. The currents observed throughout the water column at this site are controlled by the ebb and flood tidal flow associated with riverine flow of the Columbia river and the exchange of the estuary's tidal prism with adjacent ocean waters. Generally, the flow at site E is directed southwest during ebb tide and northeast during flood tide. Current speeds are high: At mid-depth currents can exceed 5 ft/sec. The tidal current ellipse for ODMDS E (at mid depth) is shown in the bottom graphic of figure 21 [Sternberg 1977 and USNHO 1954,1960]. ***Seasonal*** changes in the overall current environment at site E are due to changes in coastal circulation, which is expressed as a seasonally averaged residual current (residual current). The residual current at site E is described below in terms of a winter-spring and summer-fall seasonal average:

Seasonal Residual Current at ODMDS E

winter-spring residual coastal current = **1.16 ft/sec @ 315°** : during November to June
summer-fall residual coastal current = **1.16 ft/sec @ 225°** : during July to October

Although the magnitude to the tidal currents (figure 21) at ODMDS E is much greater than the seasonally averaged (residual) currents, net sediment transport observed at site E may be heavily influenced by the residual current (speed and direction). The total current (at mid-depth) observed at ODMDS E is obtained by adding the appropriate residual current to the tidal ellipse.

Bathymetry Impact Assessment: Short-Term Fate Modeling

Bathymetric impacts are defined in terms of the short-term behavior of dredged material; as dredged material is being released from the disposal vessel and accumulates on the seabed. The **STFATE** model [Johnson 1990, 1995] was used to predict the bathymetric distribution ("foot-print") of dredged material after it has been placed at a disposal site and has passed through the water column, on an individual dump (disposal vessel load) basis. The STFATE model accounts for various disposal vessel, water column, and dredged material parameters. The objectives of the short-term fate assessment were to:

- **Determine the disposal foot-print geometry in terms of thickness and areal extent**: This data provides insight to the potential bathymetric impacts in the immediate vicinity of disposal.

- **Determine the distance that placed dredged material is displaced away from the point of release**: This parameter describes the ODMDS "buffer" which is needed to keep material within the disposal site boundary while the placed material is falling through the water column.

Short-term fate simulations were conducted for the disposal of dredged material from two types of hopper dredges: (A) a split-hull hopper dredge - *Newport*; and (B) a multiple bottom door hopper dredge - *Essayons*. Operating parameters for each dredge are shown below.

DREDGE	OVERALL DIMENSIONS length (ft)	beam (ft)	draft (ft) loaded/empty	WORKING CAPACITY average (cy)	VESSEL SPEED during disposal (knots)	DISPOSAL vessel type (# of doors/size of each)	DURATION placement of each load (minutes)
Newport	300	55	20/10	3,000	2 to 6	split-hull/ 200x30 ft	4 to 6
Essayons	350	68	27/15	4,500	2 to 8	bottom doors(12)/ 8x8 ft	6 to 12

Since 1990, about half of all dredging disposal at MCR ODMDSs has been performed by the *Essayons*. The *Newport* has performed about 30% of the MCR dredging disposal. The vessel speed during disposal was assumed to be 2 knots (3.5 ft/sec) for both dredges. The duration of placement for an individual load of dredged material was assumed to be 5 minutes for the *Newport* and 8 minutes for the *Essayons*. Short-term fate simulations were conducted for disposal water depths ranging from 40 to 200 ft. Three types of current conditions were also tested: No current, a 1 ft/sec current, and a 4 ft/sec current. Currents were modeled as being oriented 45° into the heading of the disposal vessel. The current regime at MCR ODMDSs ranges from 0.5 ft/sec to 5 ft/sec. The characteristics of sediment dredged from the MCR project and placed at ODMDSs are described previously on page 34, Section 2 of this report.

STFATE Results

As dredged material is released from a disposal vessel and falls through the water column, the material mixes with ambient environment and forms a plume. The dredged material plume slowly settles to the seabed under the influences of gravity and the ambient current environment. The time required for dredged material to fall to the seabed and completely settle out of suspension is largely dependent upon the water column environment and the material type placed at a given disposal site. At MCR ODMDSs, approximately 96% of dredged material placed is composed of sand and 4% is composed of fines (silt), on a per load basis. Based on STFATE results for typical MCR conditions, the **time** required for ***sand*** to completely settle out of the water column during dredged material disposal and deposit onto the seabed is approximately 200 seconds (after the completion of the disposal operation). The time required for ***silt*** to completely settle out of the water column and deposit onto the seabed is approximately 2,000 seconds (after the completion of the disposal operation). The above results were obtained for 100-foot water depth with no current. Short-term fate (STFATE) modeling results are summarized graphically in figures 22-23 and are described below for parameters governing mound height, mound width, and displacement distance.

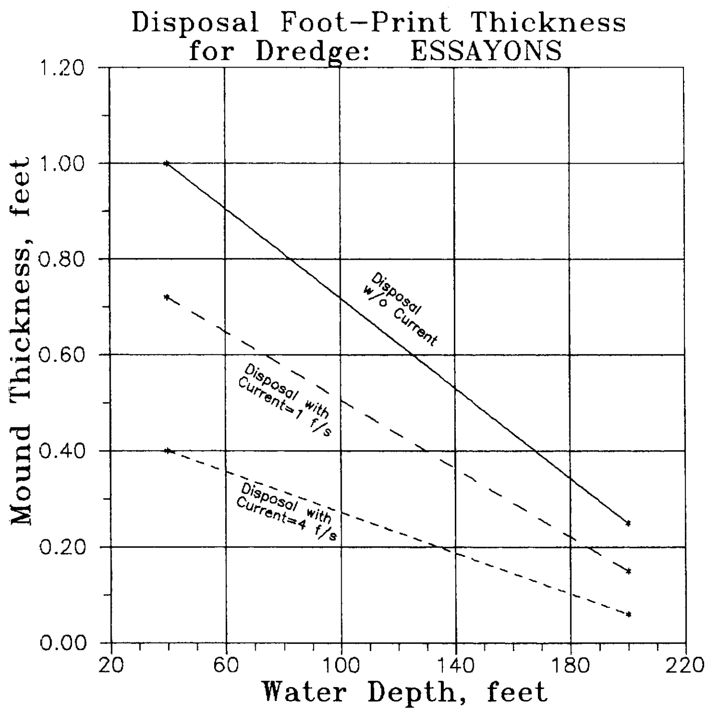
Mound length is directly related to disposal vessel ***speed*** and dump ***duration***. For normal operating conditions, the *Essayons* produces a dump foot-print 1,800-2,100 ft long for water depths ranging from 40 to 200 ft, respectively. The *Newport* produces a dump foot-print 1,200-1,500 ft long for water depths ranging from 40 to 200 ft, respectively.

For similar operating conditions (vessel speed, water depth, and currents), the larger the **disposal vessel** (hopper dredge) **capacity**, the thicker (higher) the resultant mound foot-print. For average operating conditions in 60 feet of water, without a current, the dredge *Essayons* will produce a deposition mound with maximum height of 0.9 ft . The *Newport* will produce a mound with maximum height of 1.2 ft.

The most significant parameter affecting ***mound geometry*** (width and height) ***is water depth.*** Increasing the ***water depth*** by a factor of 3 (60 ft to 180 ft) will decrease disposal ***mound height*** for a single dump by a factor of 2 for both hopper dredges. Increasing the water depth by a factor of 3 (60 ft to 180 ft) will increase disposal ***mound width*** for a single dump by a factor of 2.5 for both dredges. This applies to dredges disposing in all current conditions tested.

Increasing ***current speed*** from 1 to 4 ft/sec (in 60 ft of water) reduces mound height by a factor of 2 for both dredges. The presence of a current acts to displace placed dredged material away from the location of release, before the material impacts the seabed. For disposal in a water depth of 180 ft, a 1 ft/sec current will displace dredged material 400 ft from the site of disposal before most of the material hits the seabed. For the same water depth, a 4 ft/sec current will displace dredged material 2,000 ft from the site of disposal before most of the material hits the seabed.

The nominal configuration of a dredged material mound resulting from disposal of one load by the dredge *Newport* in 60 ft (and 160 ft) water depth with a current of 1 ft/sec is shown in figure 24. The estimated areal coverage of a mound resulting from a single load placed in 60 ft water depth is about 13 acres with maximum mound height of 0.8 ft, however, 90% of the mounded area is less than 0.33 ft. The estimated areal coverage of a



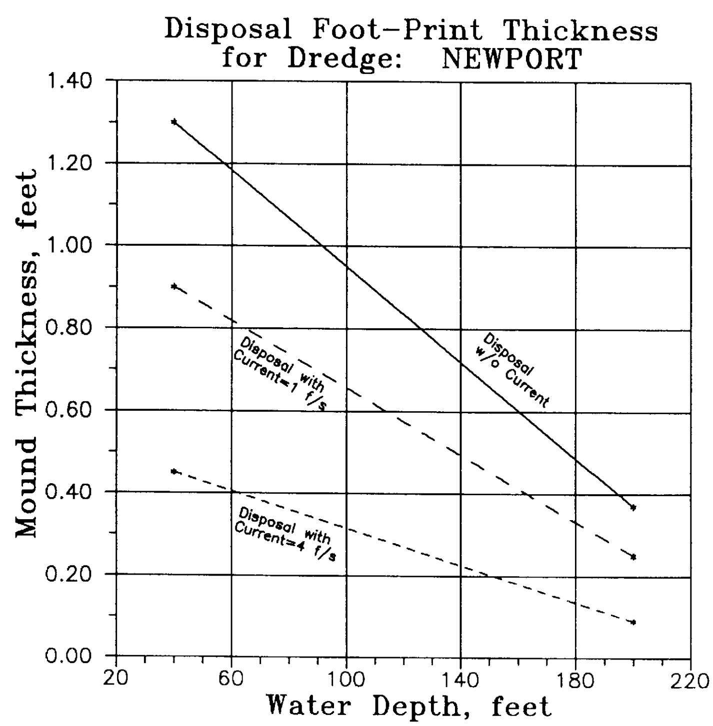
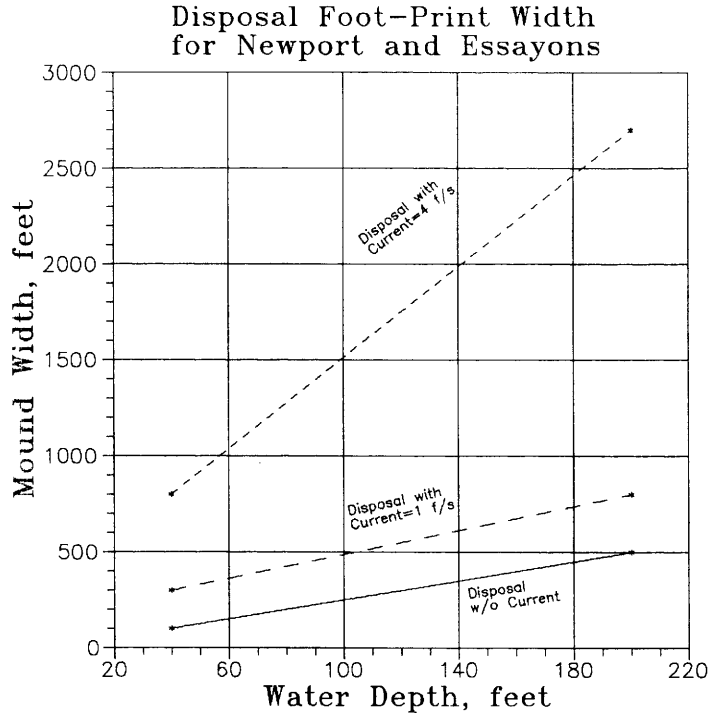


Figure 22. Predicted Thickness for Disposal Footprint for Two Types of Hopper Dredges: Essayons (top) and Newport (bottom).



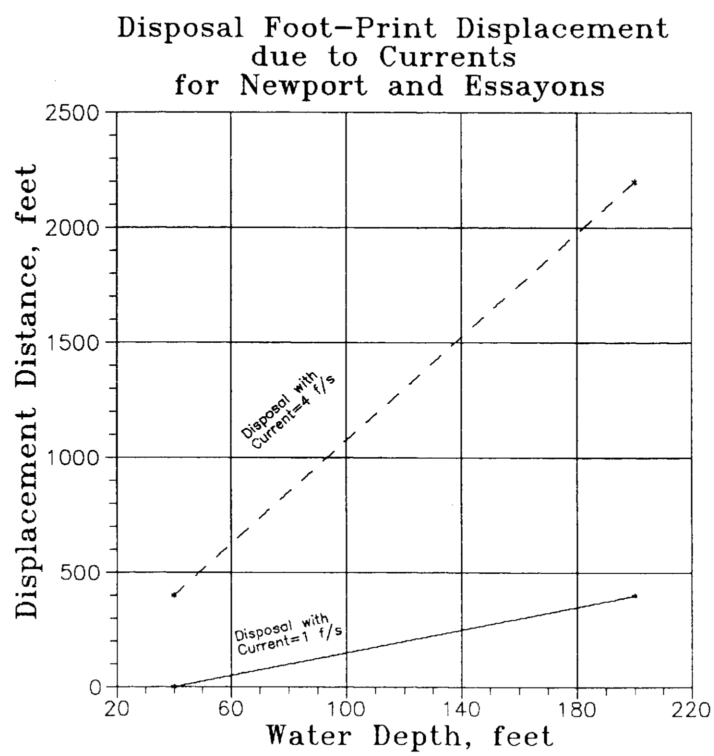


Figure 23. Predicted Geometry for Disposal Footprint for Two Types of Hopper Dredges. Top caption describes dump foot-print width in terms of disposal water depth and current. Bottom caption describes displacement distance (offset) of dump foot-print due to current.

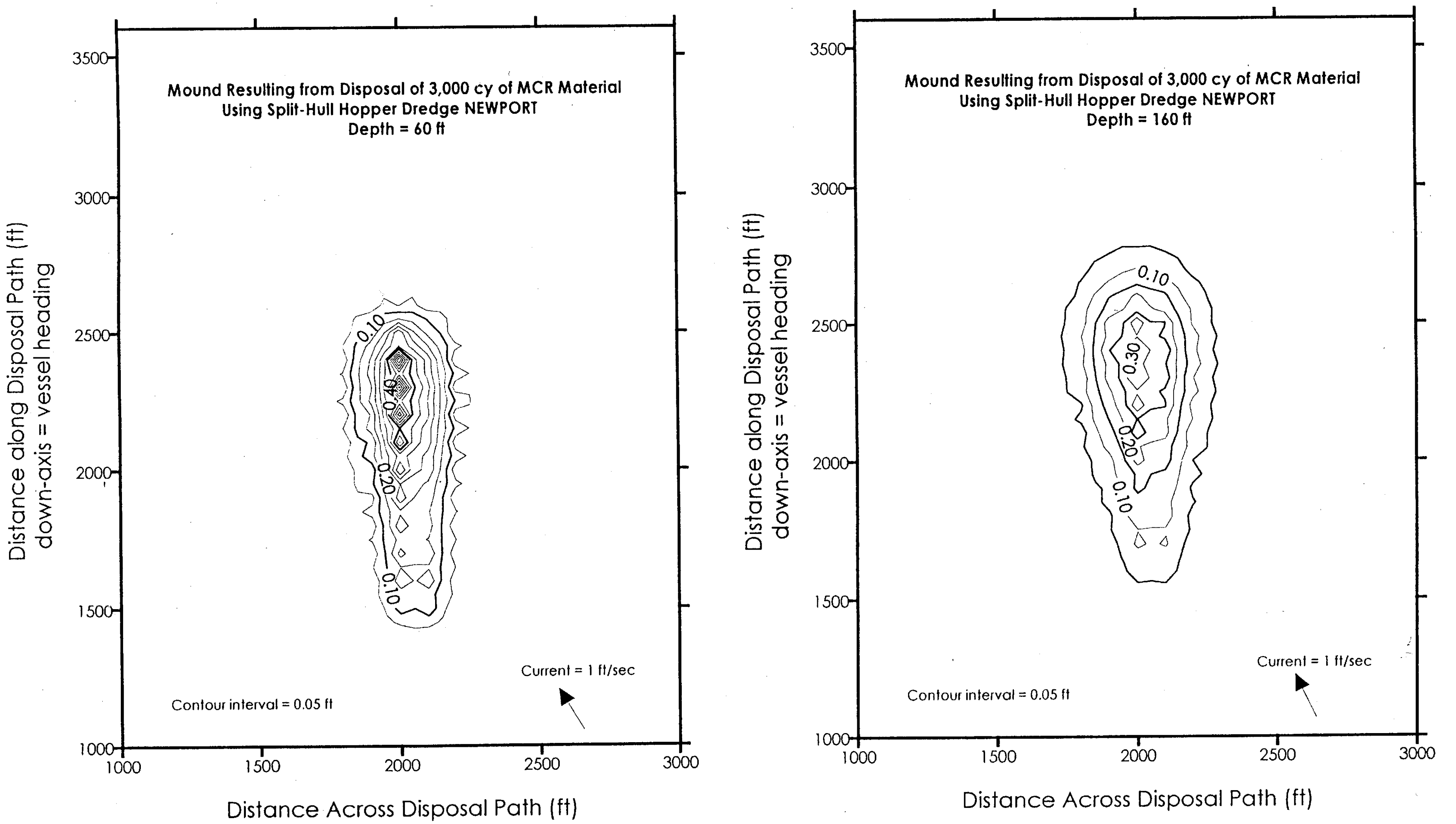


Figure 24. Predicted Footprint for Mound Resulting from One Dump by the Dredge *Newport*. Left Caption Applies for Dredged Material Placement in 60-foot Water Depth. Right Caption is for Placement in 160-foot Depth.

mound resulting from a single load placed in 160 ft water depth is about 26 acres with a maximum mound height of 0.4 ft, however, 98% of the mounded area is less than 0.33 ft.

For typical conditions at expanded ***ODMDS B***, the mound resulting from an ***individual dump*** could be expected to have the following configuration:

Mound Length: 1,300 - 2,100 ft
Mound Width: 400 - 800 ft
Mound Thickness: 0.2 - 0.8 ft
Displacement of Mound during Disposal: 100 - 400 ft

For typical conditions at expanded ***ODMDS E***, the mound resulting from an ***individual dump*** could be expected to have the following configuration:

Mound Length: 1,200 - 1,600 ft
Mound Width: 800 - 1,500 ft
Mound Thickness: 0.2 - 0.6 ft
Displacement of Mound during Disposal: 400 - 1,200 ft

Sediment Transport Assessment: Long-Term Fate Modeling

The long-term fate of dredged material which is expected to be placed within expanded ODMDSs B and E was assessed using the MDFATE model [Moritz 1995]. Transport of sediment "off" of the dredged material mounds (mound geometry described in pages 44-47) was simulated for a period of one year. Figures 20 and 25 shows the expanded ODMDSs B and E with an expected configuration for dredged material mounds.

The dredged material parameters and current regimes used in the MDFATE model were that same as those used for the short-term fate analysis, shown in pages 34 and 49 of this report. Wave conditions were generated using a WIS-III correlation coefficient matrix [Borgman 1991 and Jenson 1989]. Long-term fate simulations were run separately for expanded ODMDSs B and E. Each year-long simulation was divided into oceanographic seasons, based on changes in the seasonal residual current.

Results from the long-term fate simulations for ***ODMDS B*** are summarized below in terms of applicable residual current seasons:

April - June = no net movement of mound dredged material (sediment)

July - October = very little (17,000 cy) movement of sediment to the SW, mound height reduction was less than 0.5-foot.

November - March = appreciable sediment movement (1,465,000 cy or 8% of the total mound volume) to the NW, maximum mound height erosion was 2 ft for the 16-foot high deep-water mound and 6 feet for the 8-foot high shallow-water mound. Net aggregate mound movement was about 250 ft to the NW.

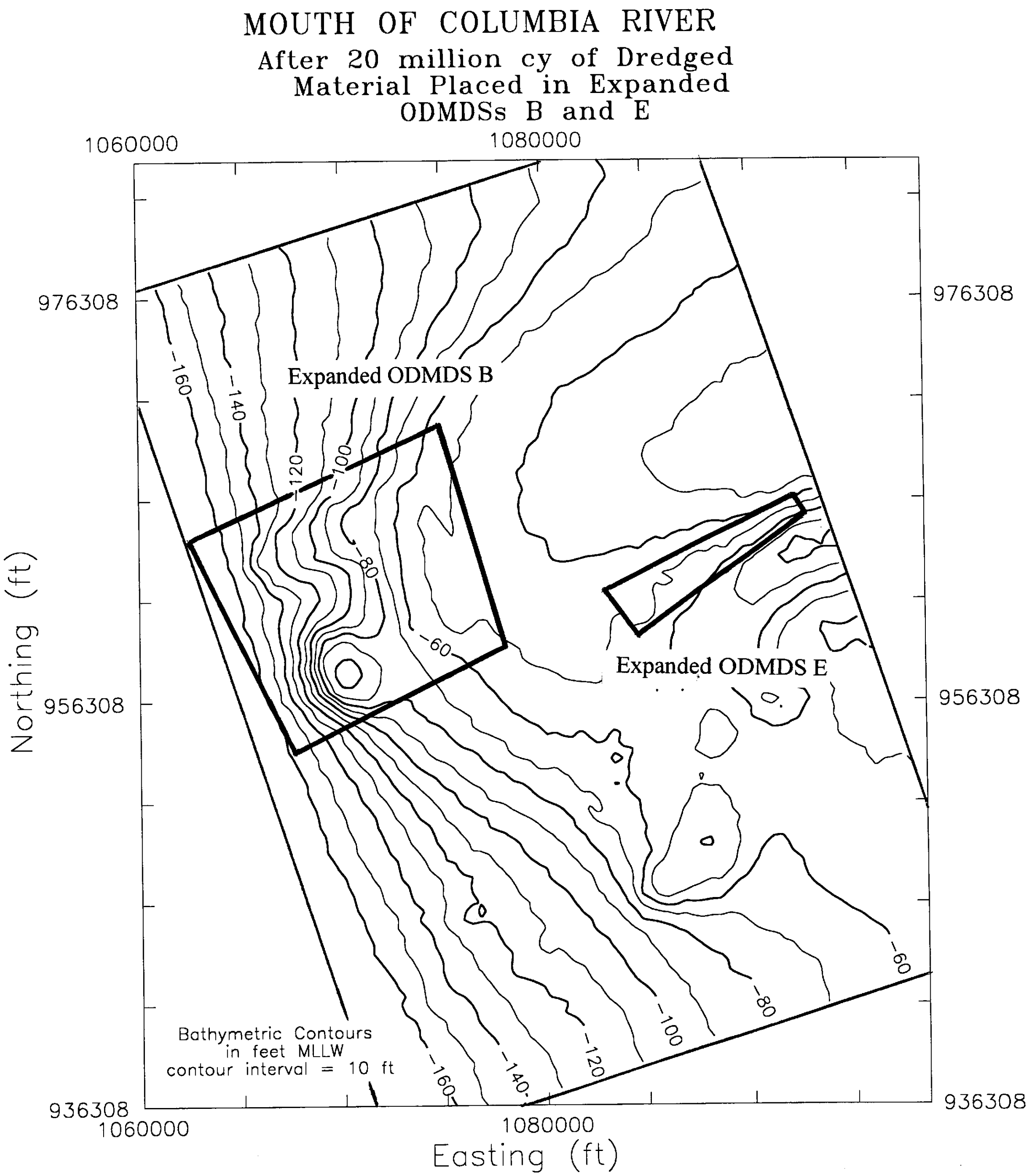


Figure 25. Regional View for Predicted Mound Bathymetry for Expanded ODMDSs B and E.

Long-term fate simulation results for expanded ODMDS B indicate that the spring and summer seasons produce little sediment transport or mound movement. The winter storm season produces appreciable sediment transport on dredged material mounds at site B. The largest changes in mound geometry apply to the shallow water area of the site, where mound height erosion was 6 ft (entire mound was initially 8 ft) in some locations. Based on the simulation results, the shallow water area of expanded site B has favorable potential for dispersing placed dredged material and re-introducing dredged sediments into the littoral zone.

Results from the long-term fate simulations for ***ODMDS E*** are summarized below in terms of applicable residual current seasons:

July - October = movement of sediment (160,000 cy of the 1 million cy simulated) was to the SW, mound height erosion 2 feet for the 4-foot high mound, net aggregate mound movement of 1,000 ft toward the SW.

November - June = significant sediment movement (660,000 cy of the 1 million cy simulated) to the N, mound height erosion 3.5 feet, net aggregate mound movement of 700 ft toward the N.

Long-term fate results for expanded site E clearly indicate that this site is dispersive in terms of transport of dredged material placed on the seabed. Given the amount of sediment transport predicted for 1 year, it appears that 1 million cy of dredged material could be dispersed annually at this site. Based on the above results, the direction of sediment transport during the summer is toward the southwest (SW).

A SW transport direction would disperse placed dredged material back into the navigation channel: An unacceptable outcome. This trend concurs with field experience at ODMDS E. Dredged material is not placed at site E during early to later summer, due to migration of the material into the MCR navigation channel. During the Winter and Spring season, a 4-foot high dredged material mound at site E would be dispersed toward the north, away from the navigation channel and onto Peacock spit: A highly desirable result assuming that dispersed dredged material does not re-accumulate in a manner which hazards navigation.

Wave Assessment for Dredged Material Placed at Expanded ODMDSs

Changes in wave height at MCR due to bathymetric changes at the expanded ODMDSs (formation of dredged material mounds described previously) were estimated using the RCPWAVE model. RCPWAVE is a 2 dimensional numerical model which simulates behavior of waves as they are refracted and diffracted by the bathymetry that the waves pass over.

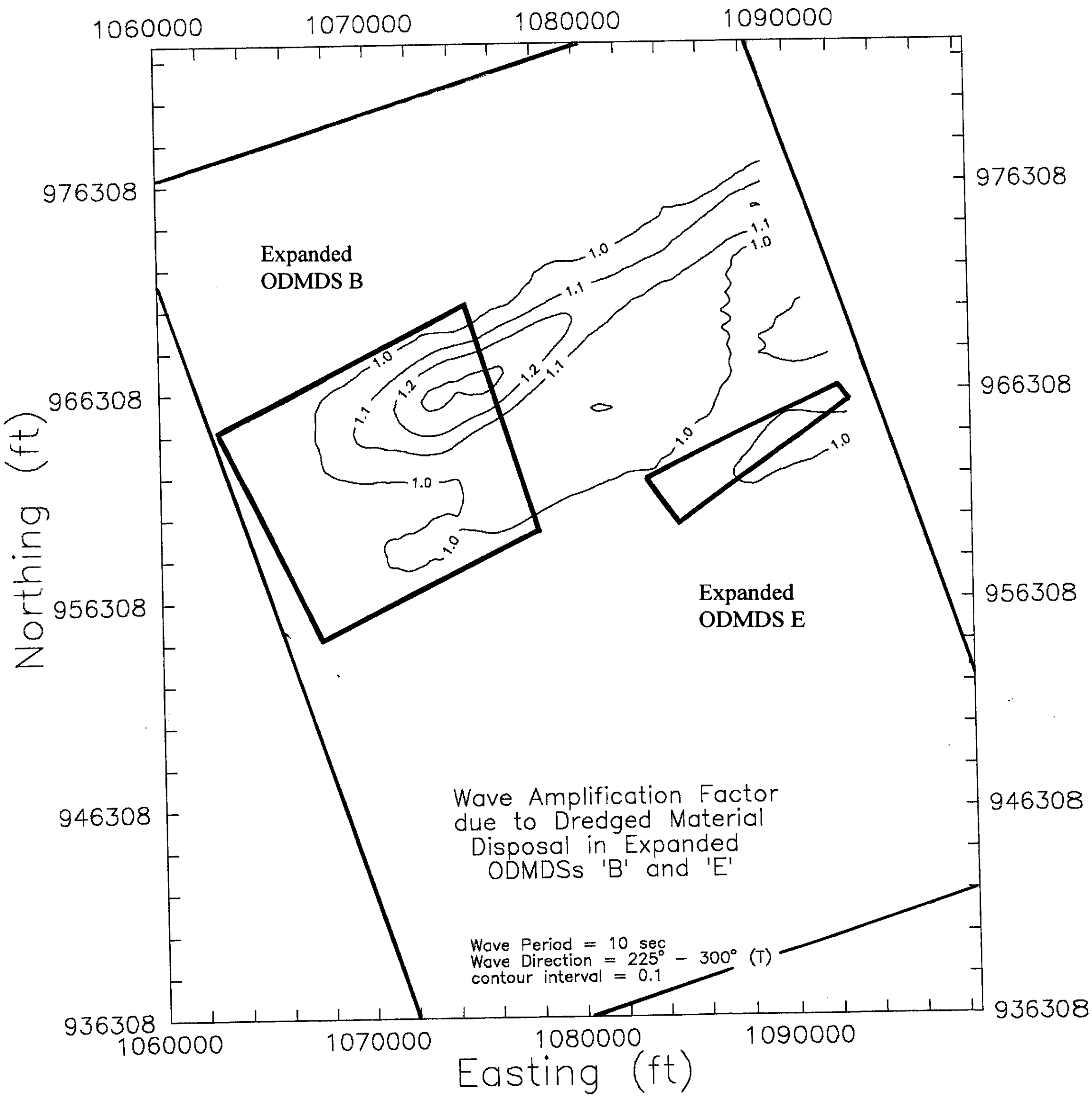


Figure 26. Wave Analysis Results for 10 second Wave Period over Mounded Bathymetry.

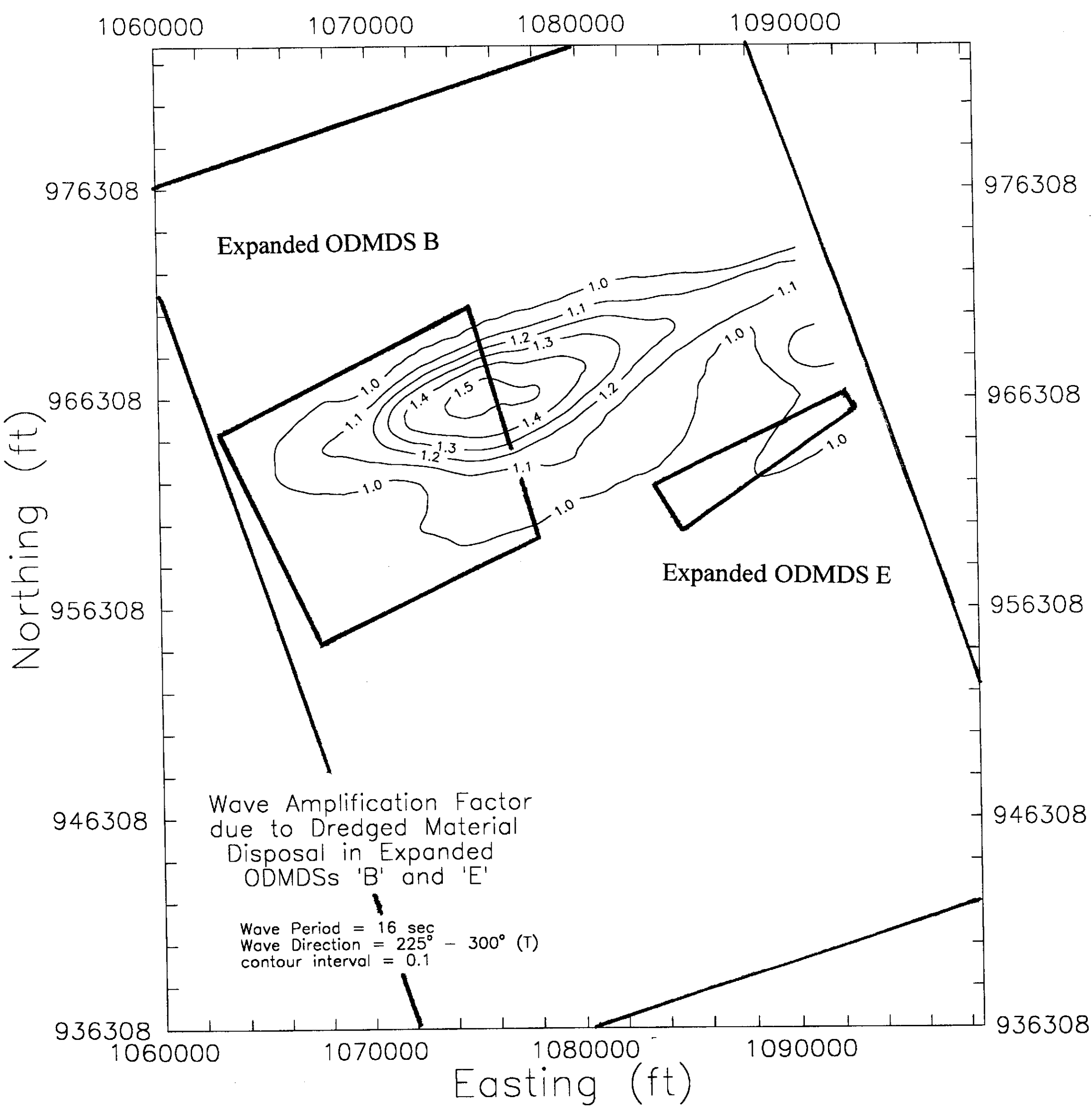


Figure 27. Wave Analysis Results for 16 second Wave Period over Mounded Bathymetry.

For this section of the report, ***two*** MCR bathymetry data sets were assessed using RCPWAVE. The two bathymetry data sets describe the same geographic area. The "baseline" condition (figure 18) documents the MCR bathymetry before disposal is conducted in the expanded ODMDSs. The "mounded" configuration (figure25) accounts for 20 million cubic yards of dredged material placed within expanded ODMDSs B and E. For both bathymetry configurations, waves were transformed from offshore through the area of interest (boxed region common to both figures 18 and 25). The RCPWAVE simulation was performed for:

> Offshore wave direction: between 225° to 300°.
> Wave period of 10 seconds and 16 seconds
> Unit wave height (H=1 ft)

The increase in waves (amplification) from the "baseline" bathymetric condition to the "mounded" condition was the focus of this wave assessment. Amplification of wave height greater than 10% over the "baseline" bathymetric condition was considered unacceptable. Wave amplification results are shown in figures 26 and 27, for wave periods of 10 and 16 seconds, respectively. The results were calculated in terms of ("mounded" wave height) / ("baseline" wave height). For both 10 second and 16 second period waves, the 10% criterion is expected to be exceeded within the expanded ODMDS B by the "mounded" bathymetry configuration shown in figure 25. Both the deep-water and shallow-water mounds (16-foot and 8-foot high, respectively) within ODMDS B contribute to exceedence of the wave criterion. The 4-foot high mound within ODMDS E does not significantly affect the wave environment at MCR.

Based on the above wave analysis results, it is recommended that 20 million cubic yards of dredged material ***not*** be placed (over a 5 year time span) within the expanded boundaries of ODMDS B as initially proposed in this report (shown in figure 25).

RECOMMENDED CONFIGURATION AND USE OF EXPANDED ODMDSs B AND E

In order to meet the 10% wave amplification criterion at ODMDS B, the total volume of dredged material to be placed within the expanded configuration shown in figure 25 must be reduced to 5-7 million cubic yards (1-1.5 million cy/yr for 5 years). In addition, the placement of dredged material must be done in such a way as to avoid forming dredged material mounds higher than 4 feet in the shallow-water area (50-70 ft) of expanded site B. This will require thin-layer disposal of dredged material: Disposal vessels would place material while underway to maximize dispersal rather than releasing material at a slow speed (point-dump). Within the deeper area (90-160 ft) of expanded site B, formation dredged material mounds higher that 8 ft should be avoided in order to prevent exceeding the 10% wave criterion.

As initially proposed, utilization of expanded ODMDS E avoids exceedence of the 10% wave criterion as long as dredged material mounds are not allowed to exceed 4 ft in height with respect to the present bathymetry.

The boundaries of expanded ODMS E, as shown in figure 25, are considered adequate for utilizing site E in a fully dispersive manner: Dredged material mounds higher than 4 ft would not be permitted to form within the site. In addition, expanded site E would be utilized in manner that would prevent dredged material from volume accumulation greater than 1 million cy from one disposal season to the next (1 year).

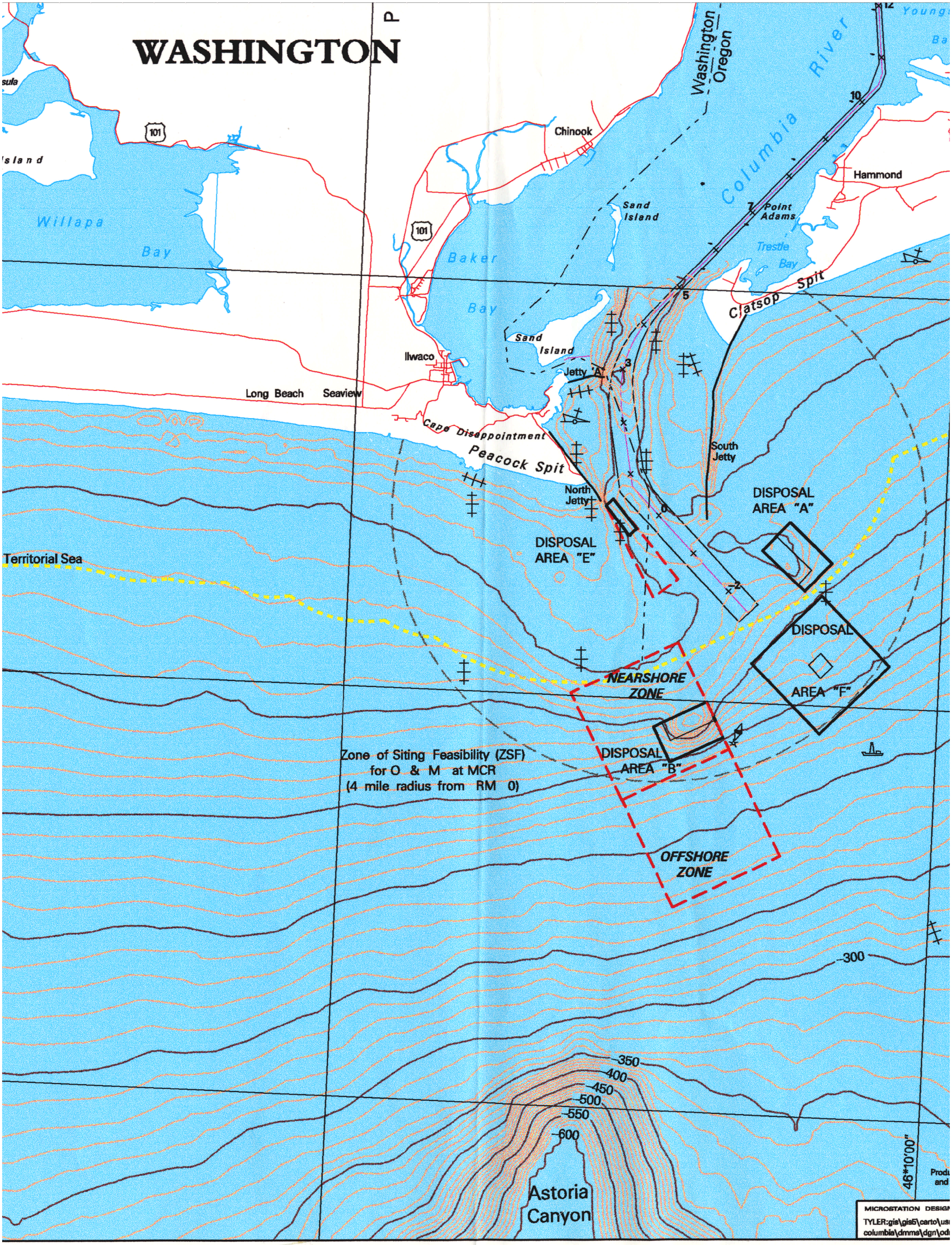
Revised Configuration for Expanded ODMDS B

To permit disposal of 20 million cubic yards of dredged material in ODMDS B without negatively affecting the wave environment (due to mounding), the site's boundaries must be expanded beyond the initially proposed configuration shown in figure 25. The optimal configuration for ODMDS B would be to additionally expand the site seaward in the same similar as was initially proposed for the landward expansion. To ease the description of boundary geometry for site B, the easternmost boundary of this site was "straightened". The **"final" proposed expanded configuration for both ODMDSs B and E is shown in *figure 28*** (expanded ODMDSs are shown in dashed lines).

The expanded site B (shown in figure 28) would be composed of two distinct zones: An ***offshore zone*** situated in water depth 160-220 ft, and a ***nearshore zone*** situated in water depth 50-160 ft. To facilitate improved management of dredged material placement and enhanced response monitoring (bathymetric change and benthos sampling, if needed), each zone would be divided into a specific number of cells. The offshore zone would be divided into four (4) 6,000 ft x 6,000 ft cells. The nearshore zone would be composed of only one (1) cell with dimensions of 4,000 ft x 10,000 ft. A 1,000 ft buffer zone would be maintained within the perimeter of the entire expanded ODMDS B. To prevent dredged material placement outside of the site boundaries, disposal of dredged material would be prohibited within the buffer zone. Figure 29 describes the cellular layout proposed for expanded ODMDS B. The cellular partition of expanded site B (for both nearshore and offshore zones) would also be used to restrict dredged material disposal in areas of potential "siting conflict".

Avoidance of the MCR "Mud-Hole"

One such "siting conflict" area is located immediately north-northwest of the existing ODMDS B. This area is referred to as "the mud-hole", due to the high percentage of fine material (passing the #230 sieve or grain size smaller than 0.0625 mm) present in the bottom sediments of this area [Sternburg 1977 and Siipola 1994]. Figure 30 characterizes the fines content of bottom sediments throughout the MCR approach area and shows the location of the "mud hole". The "mud hole" is in vicinity of the 40% fines contour shown in figure 30.



WASHINGTON
Washington
Oregon
Columbia River
Willapa Bay
Baker Bay
Chinook
Sand Island
Point Adams
Hammond
Trestle Bay
Clatsop Spit
Ilwaco
Long Beach
Seaview
Cape Disappointment
Peacock Spit
Jetty "A"
North Jetty
South Jetty
DISPOSAL AREA "A"
DISPOSAL AREA "E"
DISPOSAL AREA "F"
DISPOSAL AREA "B"
Territorial Sea
NEARSHORE ZONE
OFFSHORE ZONE
Zone of Siting Feasibility (ZSF)
for O & M at MCR
(4 mile radius from RM 0)
-300
-350
-400
-450
-500
-550
-600
Astoria Canyon
46°10'00"

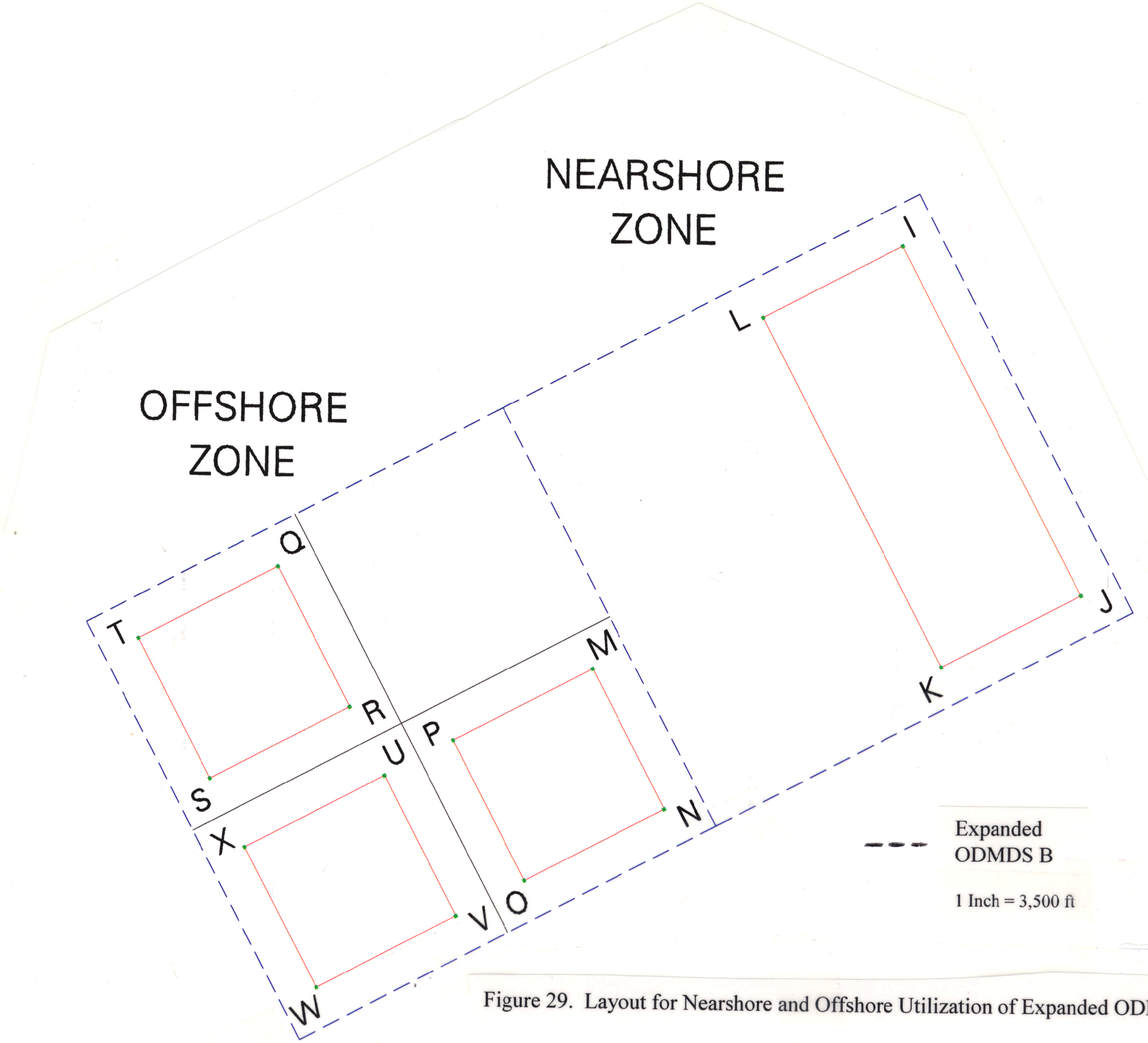


Figure 29. Layout for Nearshore and Offshore Utilization of Expanded ODMDS B.

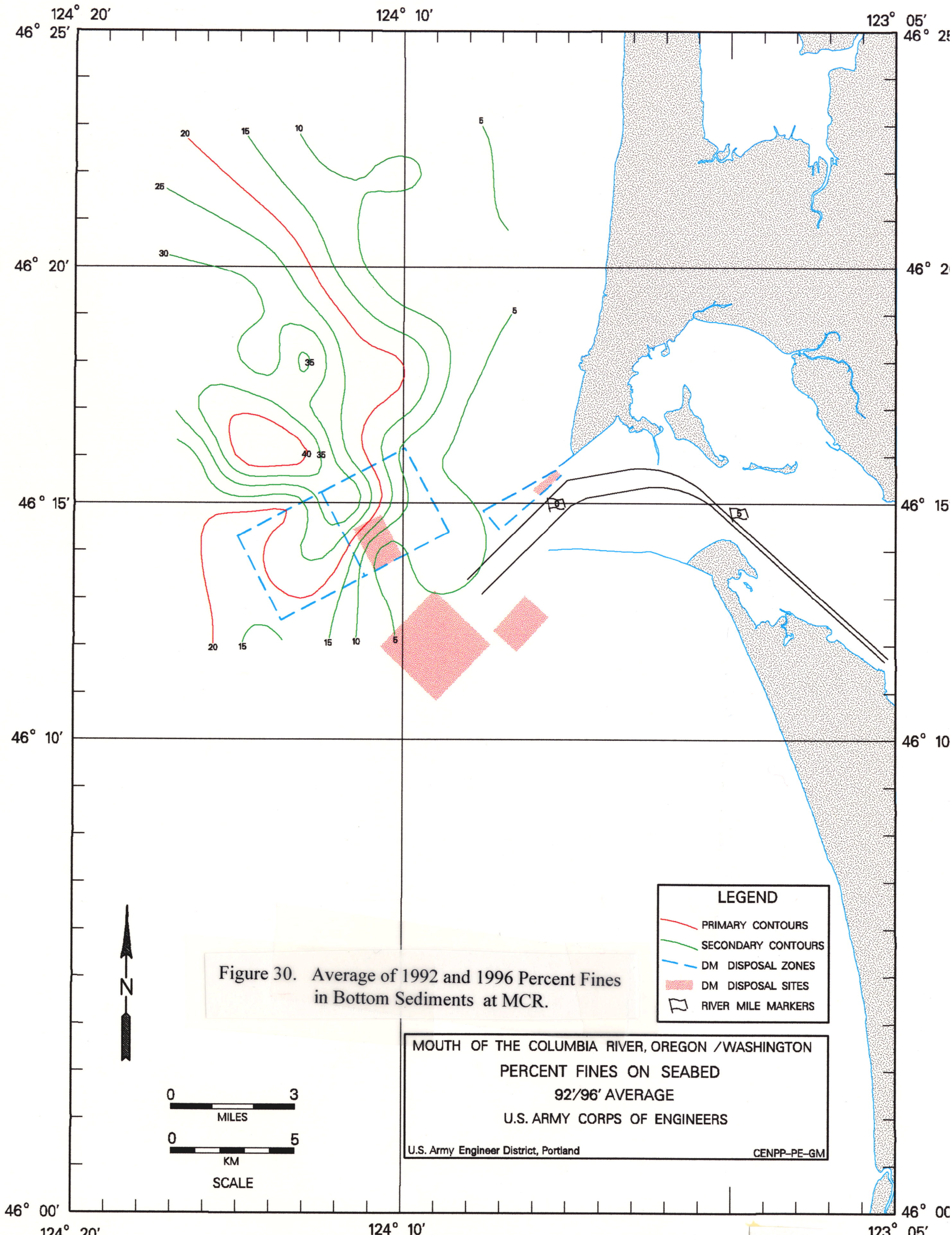


Figure 30. Average of 1992 and 1996 Percent Fines in Bottom Sediments at MCR.

Figure 30 was compiled from data collected by the National Marine Fisheries Service [Emmett and Hinton 1992-1996 and Siipola 1994] for the Portland District as part of the district's present MCR ODMDS monitoring program. The reason why the "mud hole" is present at this location is not entirely known, but it is most likely the result of the Columbia River plume releasing suspended sediment as the plume water is enacted upon by the coastal current.

Regardless of how it was formed, the "mud hole" represents a unique benthic feature with special biologic conditions likely to be associated with it. Open water disposal of dredged material which is significantly dissimilar with the ambient sediments of a candidate ODMDS is generally prohibited [Siipola 1994]. MCR dredged material (medium-fine sand) is not similar to "mud hole" material (silt), MCR dredged material will not be placed within the "mud hole". For purposes of ODMDS management, benthic areas in vicinity of the "mud hole" with fines content greater than 25% are considered part of the "mud hole" feature. To prevent dredged material disposal within the "mud hole" feature, only the following cells within expanded ODMDS B should be used for placement of dredged material (refer to figure 29):

- The three (3) cells within the *offshore zone* defined by corner points *MNOP*, *QRST*, and *UVXY*
- The cell within the *nearshore zone* defined by *IJKL*.

Revised Use of Expanded Site B

Limited volumes of dredged material (0.5-1.0 million cy/yr) would be placed in the ***nearshore zone*** of expanded ODMDS B to: A) Enhance littoral transport of dredged material, while minimizing the wave-related impacts; and B) Minimize impacts to sensitive benthic biota (crab fishery) associated with disposal of larger volumes of dredged material. Thin-layer disposal techniques would be used for this purpose. Placed dredged material would ***not*** be permitted to accumulate higher than 4 ft over the pre-disposal (1997) baseline condition. Bathymetric monitoring of the nearshore zone would be conducted to determine that most of the preceding year's disposal volume (mound) had been transported out of the site before a subsequent disposal operation was allowed to commence.

Simulation of Placed Dredged Material in the Nearshore Zone

Dredged material placement was simulated within the 4,000 ft x 10,000 ft ***nearshore zone*** of site B to assess the areal and vertical extent of mounding which may occur during a 1 million cy disposal operation. The MDFATE model was used for this purpose. The *Essayons* was the dredge used in the simulation (parameters are shown on page 51, each load = 4,500 cy). Uniform thin-layer placement of dredged material was accomplished by using a grid of 160 - 500 ft x 500 ft cells to "control" the release point for each load

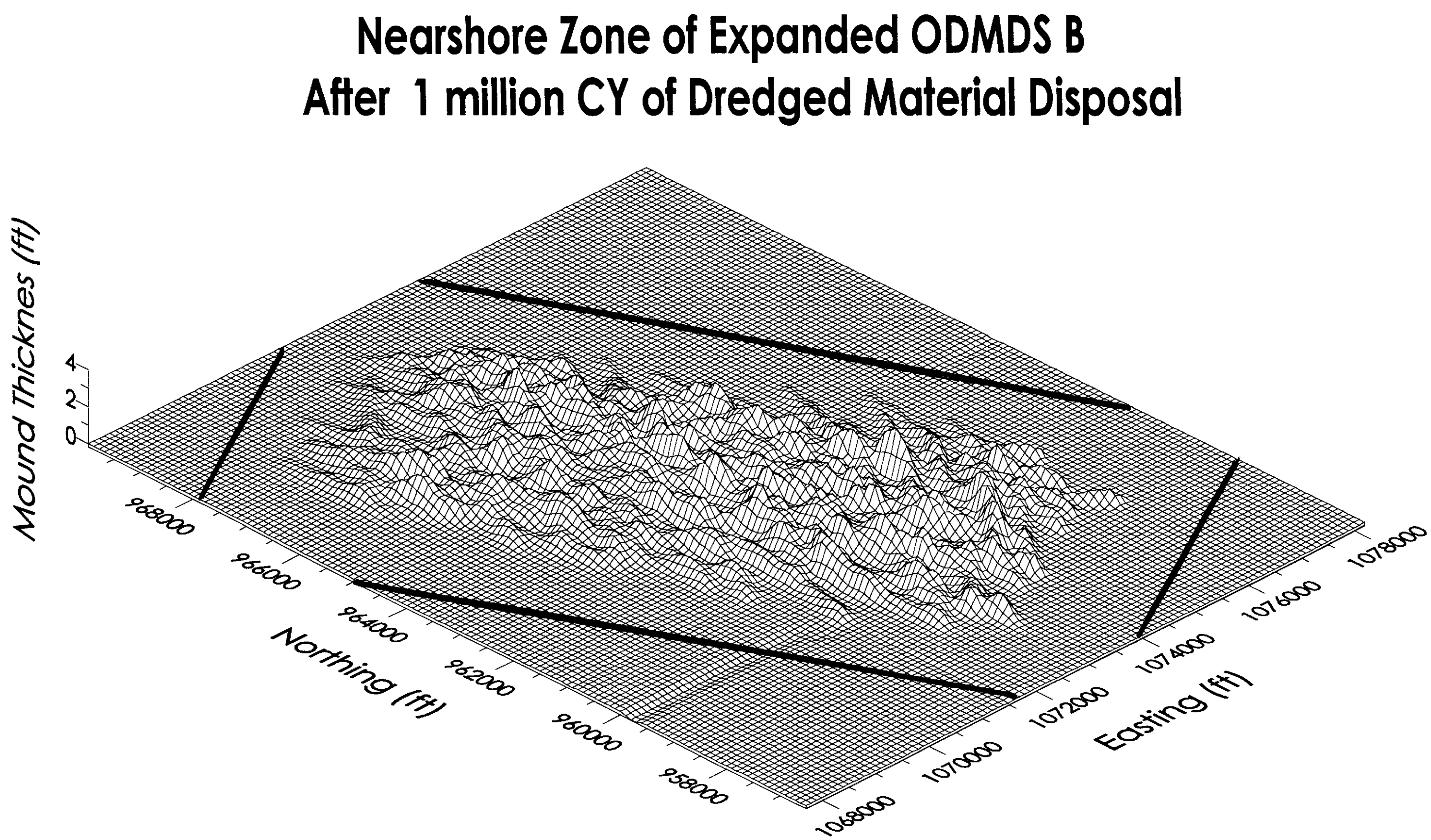
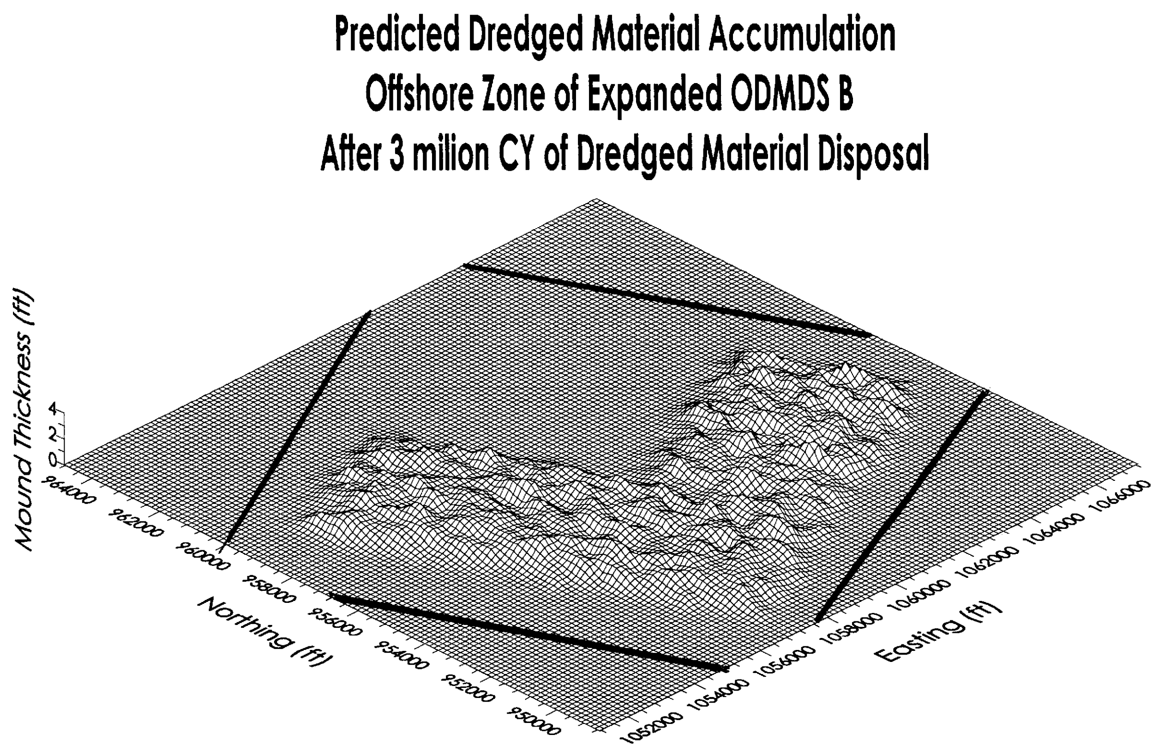


Figure 31. Three-dimensional View of Predicted Bottom Accumulation (mound) Resulting from 1 million cy Of Dredged Sediment Placement in the ***Nearshore Zone*** (4,000 ft x 10,000 ft) of Expanded ODMDS B. See Figure 29 for Cell Layout Description.



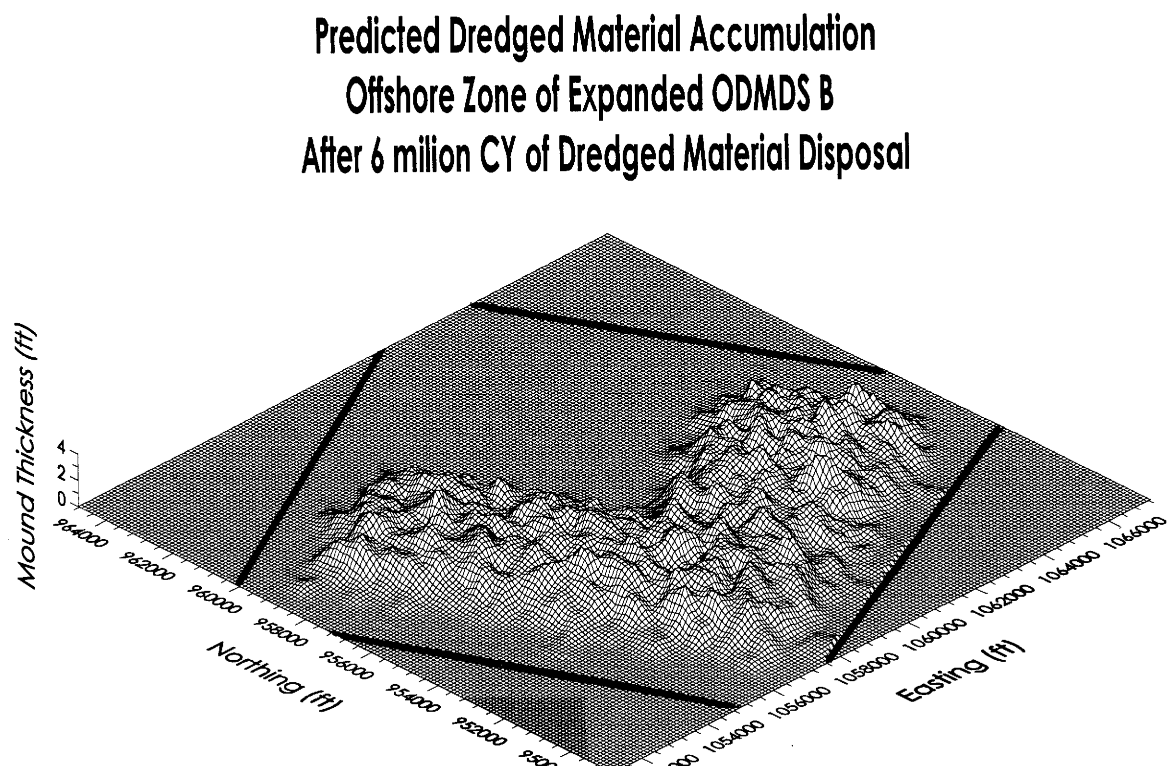


Figure 32. Three-dimensional View of Predicted Bottom Accumulation (mound) within the ***Offshore Zone*** (12,000 f x 12,000 ft) of Expanded ODMDS B. Top Caption is Predicted Result from 3 million cy of Dredged Sediment Placement. Bottom Caption is Predicted Result from 6 million cy of Dredged Sediment Placement. See Figure 29 for Cell Layout Description.

of dredged material. Only 1-2 dumps per grid cell were needed to place 1,000,000 cy of dredged material within the site. The selection of each simulated dump location was chosen randomly based on a 500-foot radius from the center coordinate for each cell. Results of the simulated dredged material disposal are shown in figure 31. The highest point on the dredged material mound was predicted to be about 2.5 ft, the average mound height was about 1 ft. The mound shown in figure 31 should not affect the present wave environment within the nearshore zone of expanded ODMDS B. Within 1 year after placement of the dredged material, at least 250,000 cy (25% of the total placed) is predicted to be eroded off of the mound. This transport rate is expected to decrease with time as the mound relief is eroded.

It is recommended that no more than 250,000 cy per year be placed within the nearshore zone of expanded site B, if that area is to be used on a continual year to year operational plan. If the nearshore zone is to be used every other year, then 500,000 cy could be placed per disposal event. Likewise, 1 million cy could be placed in the nearshore zone during a given disposal event if no other disposal occurs in this area for 3 years thereafter. If the nearshore zone of expanded ODMDS B is used for disposal of dredged material, the site will be surveyed before and after each disposal event (dredging season) to ensure that mound formation does not exceed 4 ft with respect to the baseline condition (1997 bathymetrry).

Simulation of Placed Dredged Material in the Offshore Zone

Larger volumes of dredged material (3.5-4 million cy/yr) would be placed in three of the four 6,000 ft x 6,000 ft cells of the ***offshore zone***: Where the benthic biota is considered to be not as sensitive, dredged material is dispersed more rapidly during disposal in deeper water (producing a thinner accumulation per dump), and waves are not sensitive to dredged material mound accumulation.

Dredged material placement was simulated within the offshore zone of site B to assess the areal and vertical extent of mounding which may result from the disposal of 3 million cy/yr over a two year period. The MDFATE model was used for this purpose. The *Newport* was the dredge used in the simulation (parameters are shown on page 51, each load = 3,000 cy). Uniform placement of dredged material was accomplished by using a grid of about 300 - 500 ft x 500 ft cells to "control" the release point for each load of dredged material. Only 3-4 dumps per grid cell were needed to place 3,000,000 cy of dredged material within the site. The selection of each dump location was chosen randomly based on a 500-foot radius from the center coordinate for each cell. Results after 1 and 2 years of dredged material disposal are shown in figure 32. The highest point on the dredged material mound after 1 (2) years was predicted to be about 3 (5) ft, the average mound height was about 1.5 (2.5) ft. Within 1 year after placement of the dredged material, about 20,000 cy (less than 0.5% of the total placed) is predicted to be eroded off of the mound.

If 3 million cy/yr were placed within the offshore zone of expanded ODMDS B for 5 consecutive years, the maximum estimated mound height resulting from dredged material accumulation would be about 12 ft; the average mound height would be about 8 ft relative to the 1997 baseline bathymetry. Based on the 160-220 ft water depths at the offshore zone, a mound 8-12 ft high would not affect present wave conditions with the site.

SUMMARY RECOMMENDATION FOR EXPANDED ODMDSs B AND E

Utilization of both nearshore and offshore zones of expanded ODMDS B and expanded ODMDS E would facilitate optimal consideration of: Dredging disposal haul distance within the MCR ZSF (minimize); Interference of dredging disposal vessels with inbound/outbound MCR vessel traffic (minimize); Impacts of dredge material mounding with ambient wave conditions (minimize); Impacts to the benthic biota (minimize); and Re-introduction of placed dredged material into the littoral zone (maximize). The total site capacity available from expanded ODMDSs B and E, for a five year duration, is estimated to be at least 20 million cubic yards. Based on the findings presented in this report, the ***revised*** dimensions and corner coordinates recommended for temporary expansion of ODMDSs B and E are listed below and shown in figure 28:

Expanded ODMDS "B": *(see figure 28)*

dimensions = 12,000 ft x 24,000 ft, azimuth of longitudinal axis = 62°,
average depth = 150 ft, 1995 elevation variation = -50 MLLW to -220 MLLW

State Plane Coordinates (OR north zone NAD27)

Northwest corner - Easting=1,051,147 ft, Northing=959,676 ft
Northeast corner: - Easting=1,073,123 ft, Northing=970,017 ft
Southwest corner: - Easting=1,056,318 ft, Northing=948,688 ft
Southeast corner: - Easting=1,078,294 ft, Northing=959,029 ft

Geographic Coordinates (NAD83)

Northwest corner - Latitude = 46° 14' 18" N, Longitude =124° 15' 07" W
Northeast corner - Latitude = 46° 16' 10" N, Longitude =124° 10' 01" W
Southwest corner - Latitude = 46° 15' 31" N, Longitude =124° 13' 46" W
Southeast corner - Latitude = 46° 14' 23" N, Longitude =124° 08' 40" W

Expanded ODMDS "E": *(see figure 28)*

dimensions = 2,000 ft x 10,000 ft, azimuth = 229°, average depth = 55 ft
1994 elevation variation = -75 MLLW to -46 MLLW

State Plane Coordinates (OR north zone NAD27)

Northwest corner - Easting=1,082,928 ft, Northing=962,314 ft
Northeast corner: - Easting=1,092,272 ft, Northing=966,392 ft
Southwest corner: - Easting=1,085,149 ft, Northing=959,481 ft
Southeast corner: - Easting=1,093,020 ft, Northing=965,649 ft

Geographic Coordinates (NAD83)

Northwest corner - Latitude = 46° 14' 58" N, Longitude =124° 07' 37" W
Northeast corner - Latitude = 46° 15' 42" N, Longitude =124° 05' 26" W
Southwest corner - Latitude = 46° 14' 31" N, Longitude =124° 07' 03" W
Southeast corner - Latitude = 46° 15' 35" N, Longitude =124° 05' 15" W

Section 4
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Section 5
ADDENDUM

Comparison of ODMDS F Bathymetric Prediction to Survey Results

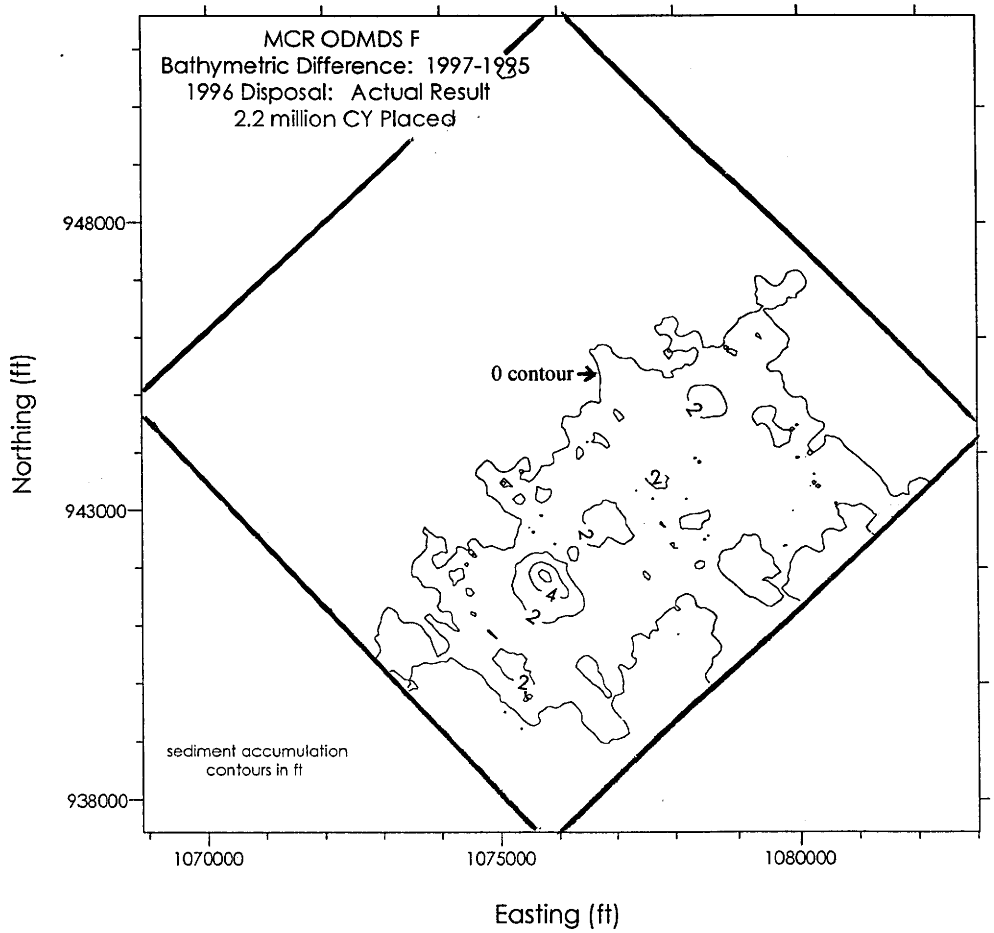
The ***top graphic*** of plate 1 describes the *measured* bathymetric difference between a 1995 survey (pre-1996 disposal) and a 1997 survey (post-1996 disposal). The contours describe measured bathymetric accumulation (dredged material thickness) in response to dredged material disposal during 1996. The contours in the top graphic of plate 1 vary from 0 to 5 ft. The Essayons placed approximately 2.2 million cy at ODMDS F during 1996.

The ***bottom graphic*** of plate 1 describes the *predicted* bathymetric difference at ODMDS F in response to 3.0 million cy of dredged material disposal. The bottom graphic represents the same result as scenario 1 shown in figure 13 of this report. The contours in the bottom graphic vary from 0 to 5 ft.

The measured (top graphic) and predicted (bottom graphic) results compare favorably. The areal extent of the bottom accumulation of dredged material (0 contour) for the two cases is about the same. The maximum bottom accumulation (5 ft) for both the measured and predicted cases is consistent. The only difference between the two cases is the average accumulation: Predicted average accumulation is about 2 ft, whereas the measured results indicate a 1-foot or less average accumulation. There are two likely reasons for the "average" discrepancy.

- Only 2.2 million cy of dredged material was *actually* placed at site F (top graphic) whereas 3.0 million cy was *assumed* to be placed at the site for the prediction (bottom graphic). The 27% difference in volume "placed" would make the average thickness in the *predicted* case higher than the *actual* case.

- The ability of bathymetric surveys to fully detect material accumulation of 1 to 2 feet in 130-foot water depths is <u>at</u> the threshold of survey resolution (accuracy and precision). The inability of surveys to detect small bathymetric changes would explain the discrepancy in measured average accumulation in the top graphic.



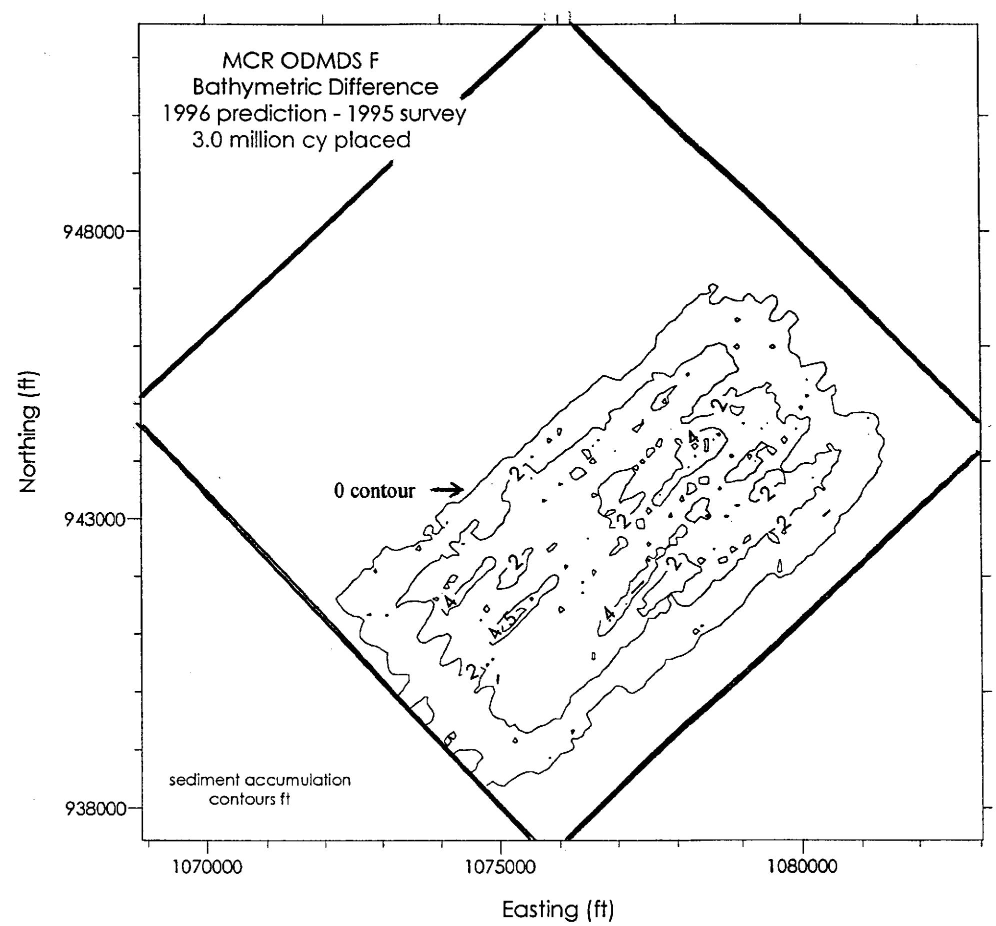


Plate 1. Comparison of Measured to Predicted Results for Bathymetric Accumulation at MCR ODMDS F in Response to 1996 Dredged Material Disposal.