Section 2
ASSESSMENT OF FUTURE SITE CAPACITY FOR MCR ODMDS F

PRESENT STATUS OF ODMDS F

As cited in Section 1, the present MCR ODMDSs A, B, and E can accept only limited amounts of dredged material. Placement of dredged material at Site A has not occurred since 1995 and is currently restricted. Disposal at ODMDS B was limited to 2 million cy/yr for 1996 [Siipola and Braun 1995]. In 1997, disposal at Site B was revised down to 600,000 cy/yr, and may be further restricted beyond 1997. Dredged material disposal at site E is currently limited to less than 1 million cy/yr. Excluding ODMDS F, the total capacity of MCR ODMDSs was 3 million cy/yr for 1996, and may tail-off to 1 million cy/yr after 1997. The annual volume of sediment dredged from the MCR project and placed in ODMDSs varies from 4-5 million cy/yr (table 1).

Given the present capacity limitations on MCR ODMDSs, site F will be expected to receive as much as 4 million cy/yr after 1996. In order to confidently rely on ODMDS F to handle present and future MCR dredging disposal requirements, the capacity of site F (for 1996 and beyond) was assessed with respect to impacts on navigation. The following site assessment was conducted in June 1996. Figure 8 defines the region of interest: The dashed line refers to ODMDS F boundaries as expanded in 1992.

Within context of this report, adverse impacts to navigation are related to increased wave activity due to bathymetric changes (mounding). The threshold criteria used in this report for adverse navigation impacts was: Wave conditions at a given ODMDS should not be increased greater than 10% over the baseline condition wave environment (or prior to ODMDS use) due to dredged material mounding. The solid line in figure 8 refers to the bathymetric area surrounding site F, used for the RCPWAVE analysis of waves with respect to various predicted dredged material mound geometries. For this wave analysis, the 1995 survey was considered to represent the baseline condition at ODMDS F.

The present (1995) bathymetric condition of ODMDS F is the result of limited disposal operations conducted at this site since 1989. The bathymetric effects of dredged material disposal previously conducted at ODMDS F are shown in figures 9 -10 and summarized below.

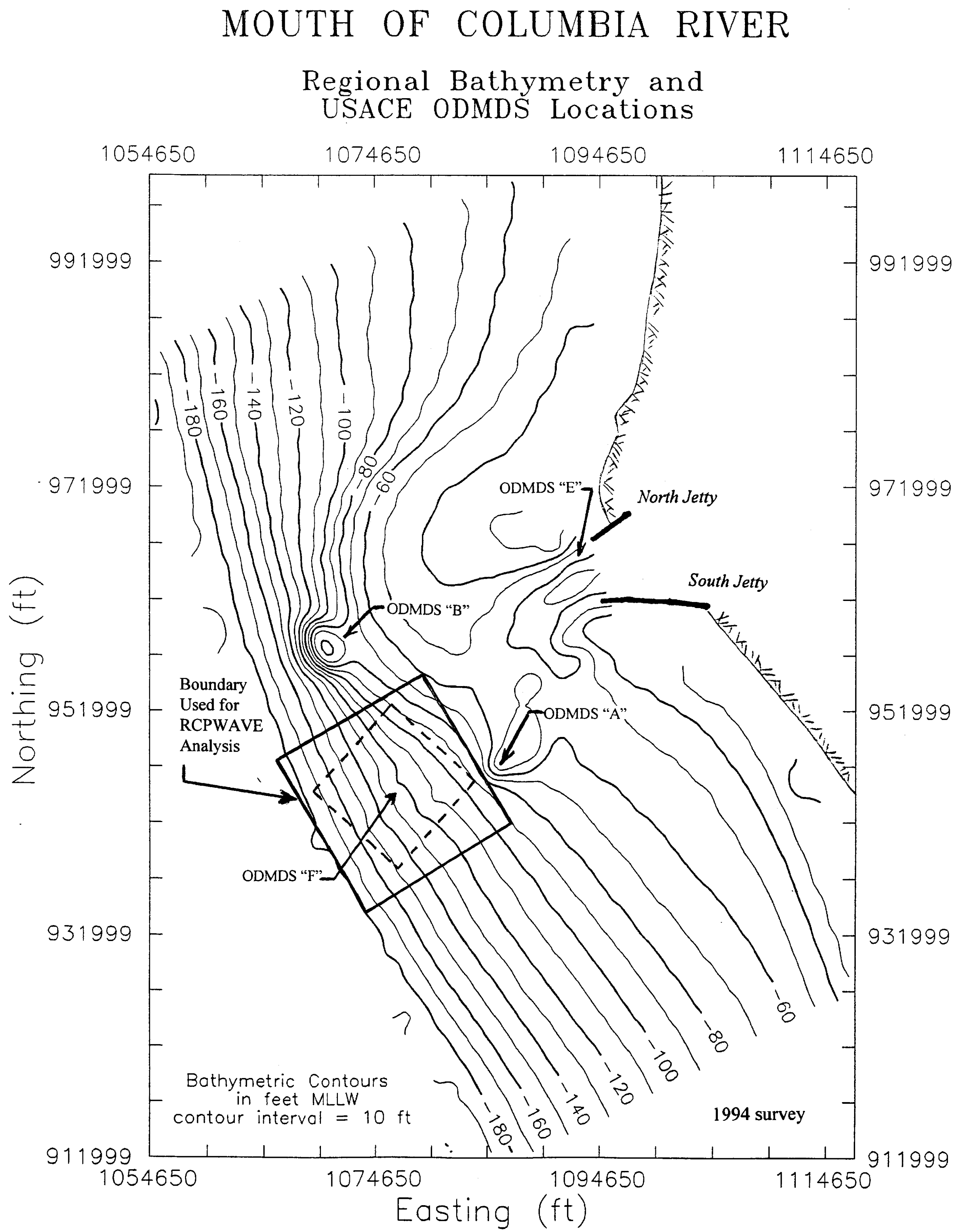
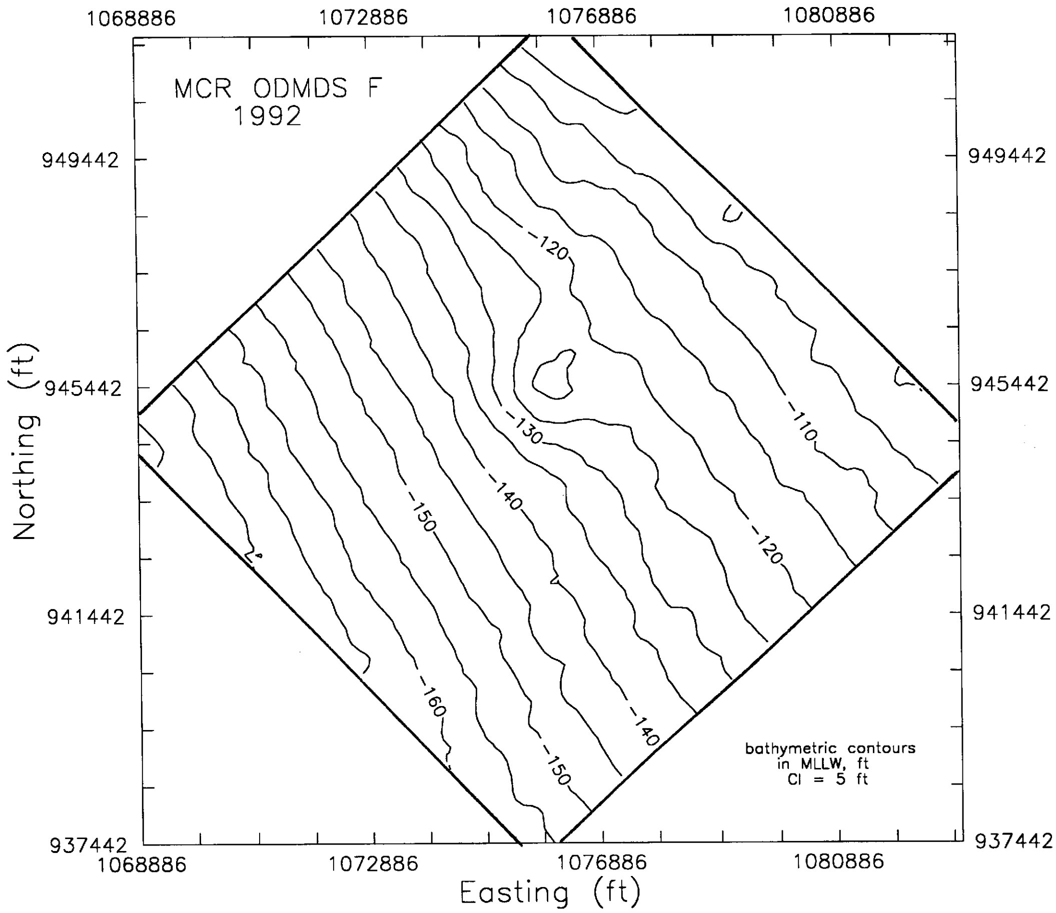


Figure 8. MCR Regional Bathymetry Used for ODMDS F Site Capacity Analyses.



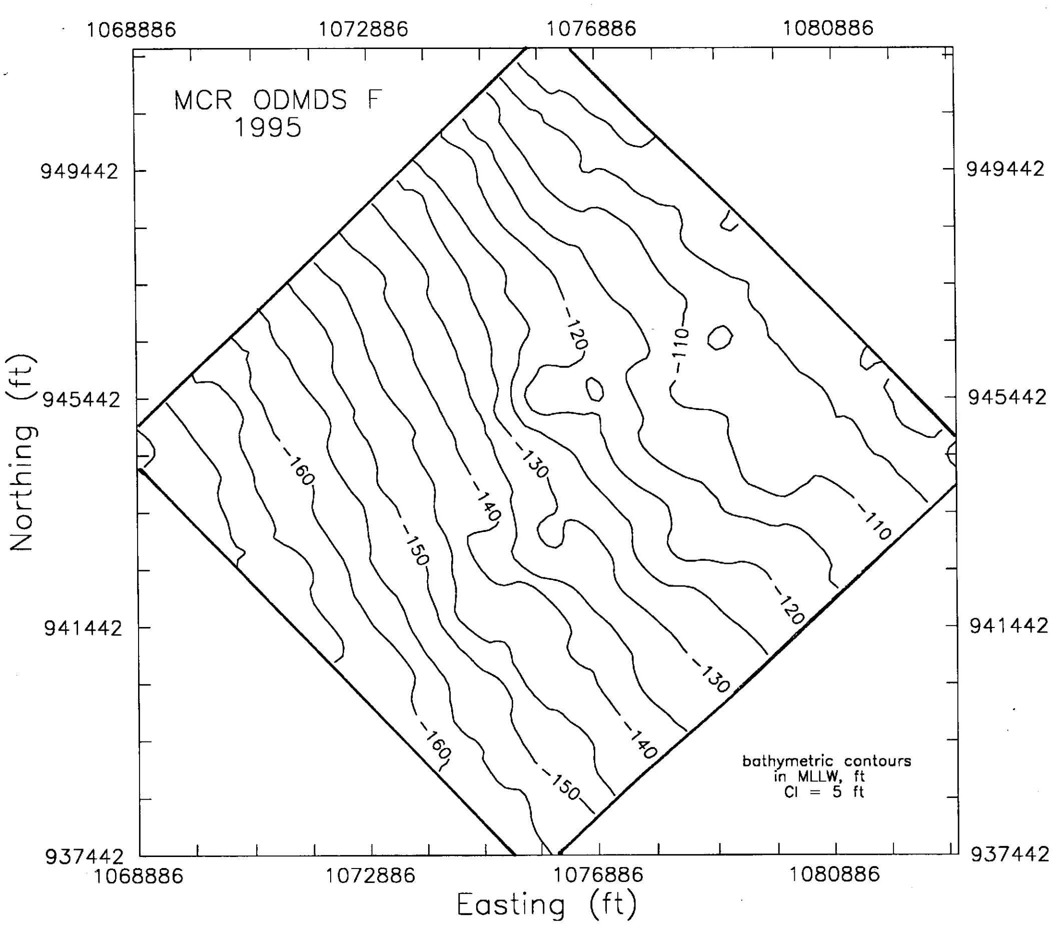


Figure 9. ODMDS F Bathymetry for 1992 (top) and 1995 (bottom).

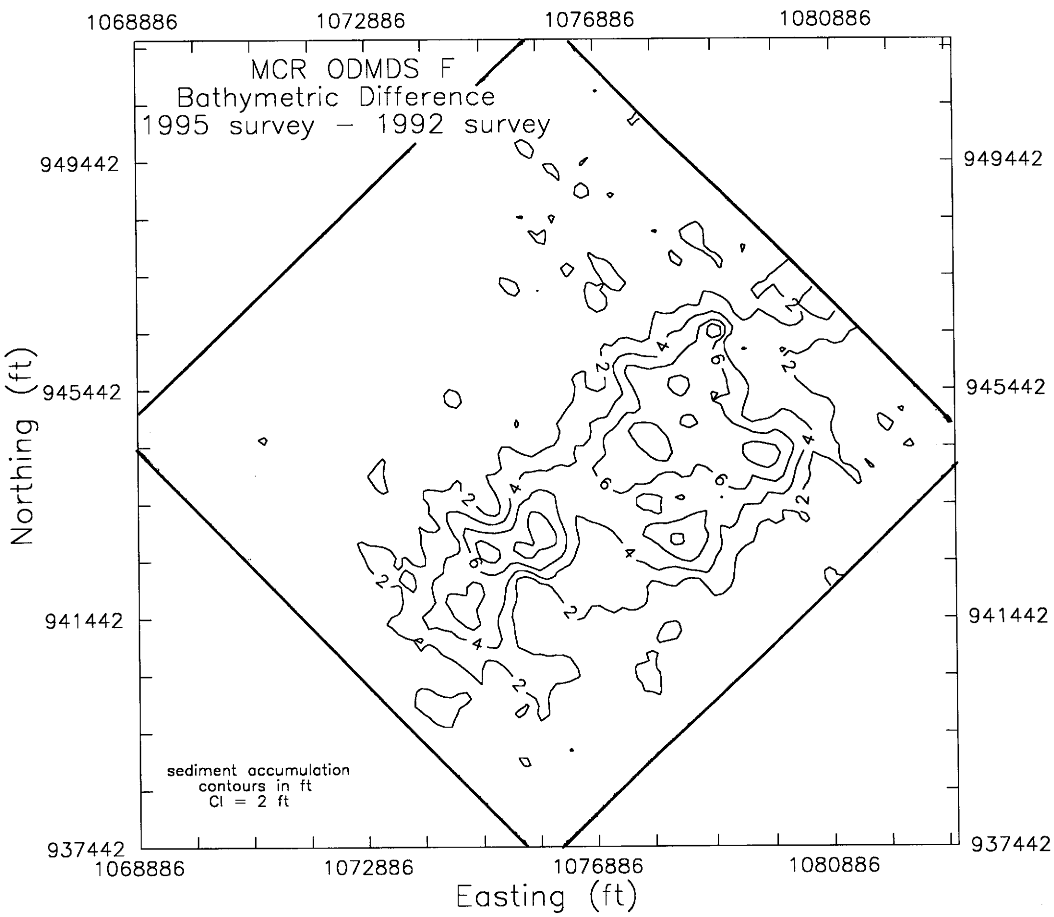


Figure 10. ODMDS F Bathymetric Difference for 1992-1995.

Previous Dredged Material Disposal Activities at ODMDS F
1989: 2.03 million cy of cohesive material (silty-clay) placed using split-hull scow. Material was placed near center of ODMDS F. A 12-foot high mound was formed with a 2500-foot base diameter. 1993: 2.29 million cy of fine-medium sand placed using split-hull hopper dredge (*Padre Island*). Material was distributed in southeastern half of expanded site F (cells 9-16). 1994: 1.5 million cy of fine-medium sand placed using bottom-door hopper dredge (*Essayons*). Material was distributed in southeastern half of ODMDS F (cells 9-16).

In figure 9, note the bathymetric change at ODMDS F between 1992 (top graphic) and 1995 (bottom graphic) resulting from the placement of 3.8 million cy of sand during 1993-1995. Obtaining a bathymetric difference between the 1992 and 1995 condition of site F resulted in figure 10, which shows multiple mounds 4-8 feet high distributed throughout southeasterern half of ODMDS F in cells 9-16 (see figure 11 for ODMDS F cell layout). The formation of these mounds has prompted the Portland District to examine how to maximize the use of ODMDS F capacity and determine the end-point at which site F should no longer be used for dredged material disposal. Note the 1000-foot "buffer zone" surrounding ODMDS F. To reduce the risk of dredged material being placed outside of the designated site boundaries, no dredged material disposal is permitted within the site's "buffer zone", although it is formally part of ODMDS F.

PROPOSED DREDGED MATERIAL DISPOSAL AT ODMDS F: OPTIONS FOR 1996 AND FUTURE USE

Two scenarios were examined to assess the remaining capacity of ODMDS F. In both disposal scenarios, it was anticipated that site F would handle all MCR dredged material disposal in excess of what is currently expected to be placed in ODMDS E (1 million cy/yr). Scenario 1 represented a lower bound for site F use based on one year disposal of 3 million cy (4 million cy total MCR dredging disposal). Scenario 2 represented an upper bound based on 2 years disposal of 4 million cy/yr (5 million cy total MCR dredging disposal per year). Future dredged material disposal at ODMDS F will not be permitted to degrade (increase) the wave environment by more than 10% over the 1995 condition.

Disposal Scenario 1 – Lower Bound for 1 Year of Disposal

The feasibility of placing ***3 million cubic yards*** of dredged material in the southeastern half of ODMDS F ***for one year***, was assessed in terms of predicted bathymetric change at the site and related impacts upon the wave environment. The disposal operation conforming to scenario 1 is defined below:

1) The southeastern half of site "F" (cells #'s 9-16, with overall dimensions = 4,000 ft x 8,000 ft) was divided into 8 disposal lanes (figure 11). Each disposal lane was 500 ft wide x 8,000 ft long and was oriented NE-SW. Dredged material was placed randomly within each lane based upon a 400 ft radius. To accurately account for operational reality, each randomly-selected dump location was "weighted" toward the direction from which the dredge was approaching the disposal site.

2) Dredged material disposal at site F was expected to occur during July to October, during which 3 million cy of material would be equally distributed along the 8 disposal lanes, as stated above. Longterm fate predictions were made for sediment transport at site "F" during November (1996) - June (1997).

3) The impact of the predicted dredged material mound at site "F" upon the wave environment was assessed for wave periods of 10 seconds and 16 seconds. Wave approach direction included all angles for which offshore waves are incident to the Northern Oregon coast and ranged from 225° (SW) to 300° True (NW).

Disposal Scenario 2 - Upper Bound for 2 Years of Disposal

The feasibility of placing ***4 million cy/year*** of dredged material in the southeastern half of ODMDS F, ***for two consecutive years***, was assessed in terms of predicted bathymetric change at the site and related impacts upon the wave environment. The disposal operation conforming to scenario 2 is defined below:

1) The southeastern half of site "F" was divided into 8 - cells (#'s 9-16), each 2,000 x 2,000 ft. Dredged material was placed randomly about the centroid of each cell based upon a 900 ft radius (figure 14). Dump location was "weighted" toward the direction from which the dredged was approaching the disposal site.

2) Dredged material disposal at site F was expected to occur during July to October, during which 4 million cy of material was equally distributed in the 8 dump cells, as stated above. Longterm fate predictions were made for sediment transport at site "F" during November - June. Dredged material disposal was simulated for 1996 and 1997.

3) The impact of the predicted dredged material mound at site "F" upon the wave environment was assessed for wave periods of 10 seconds and 16 seconds. Wave approach direction ranged from 225° to 300° T.

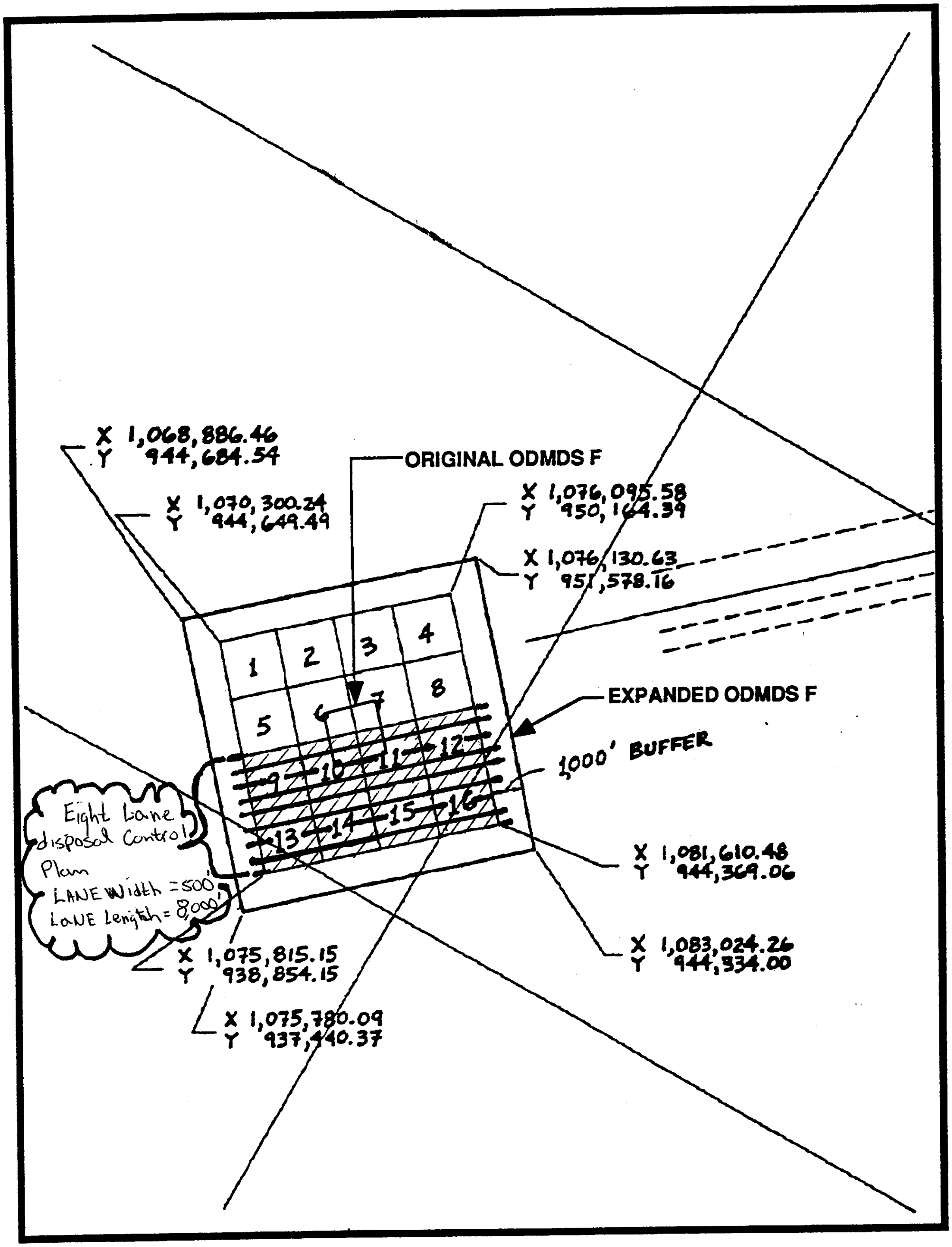
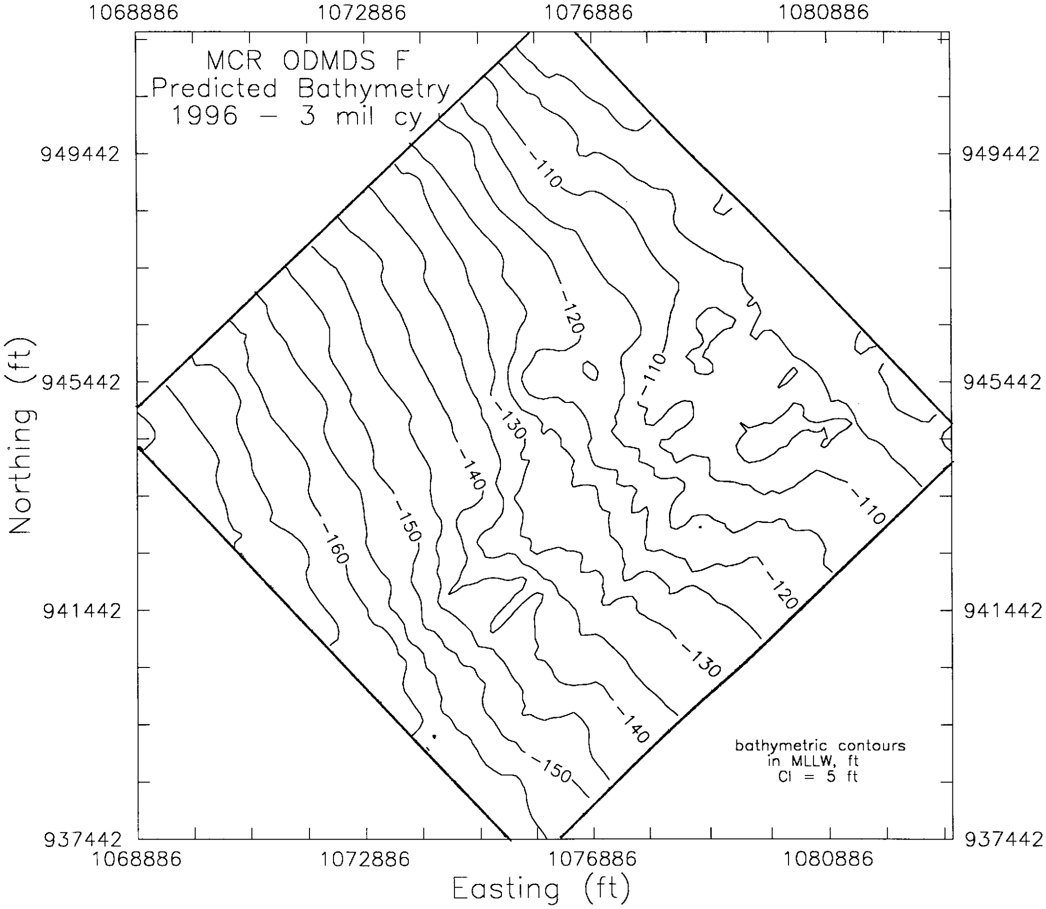


Figure 11. Disposal Control Plan for ODMDS F Disposal Scenario 1.



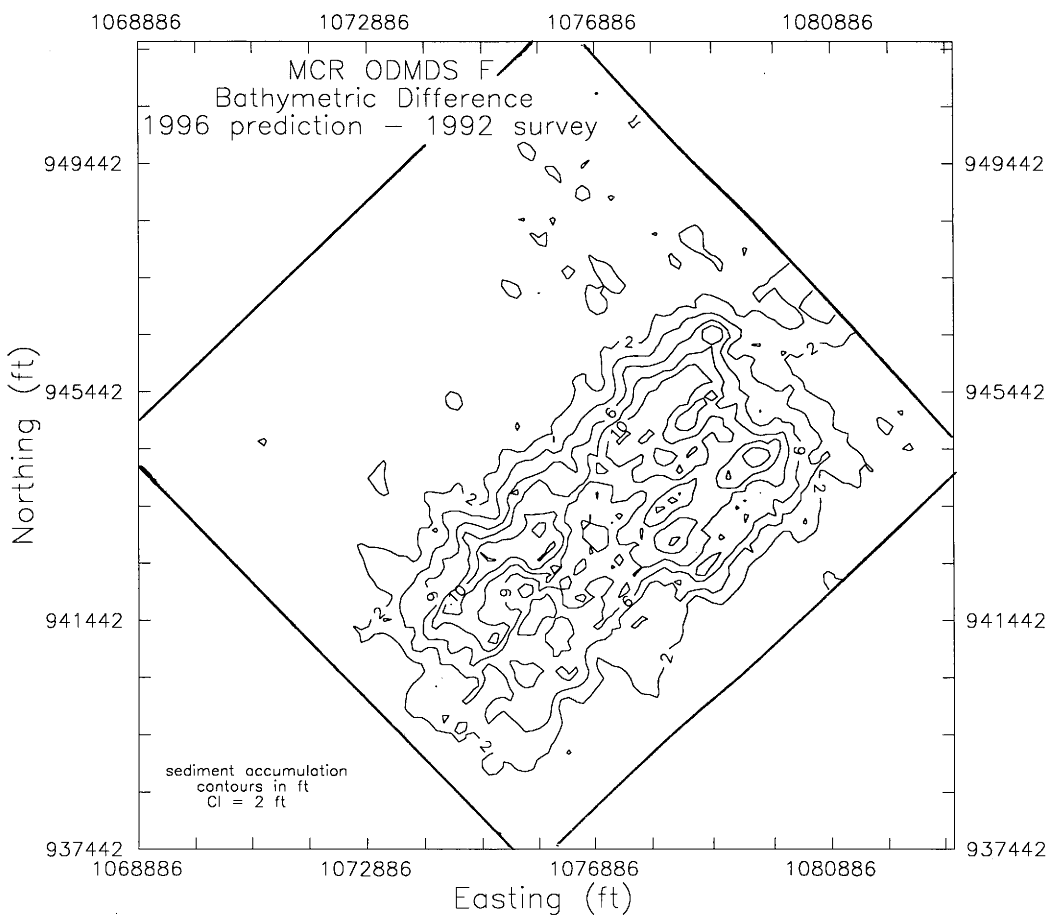


Figure 12. Predicted Bathymetry for Disposal Scenario 1 (1996) and Bathymetric Difference.

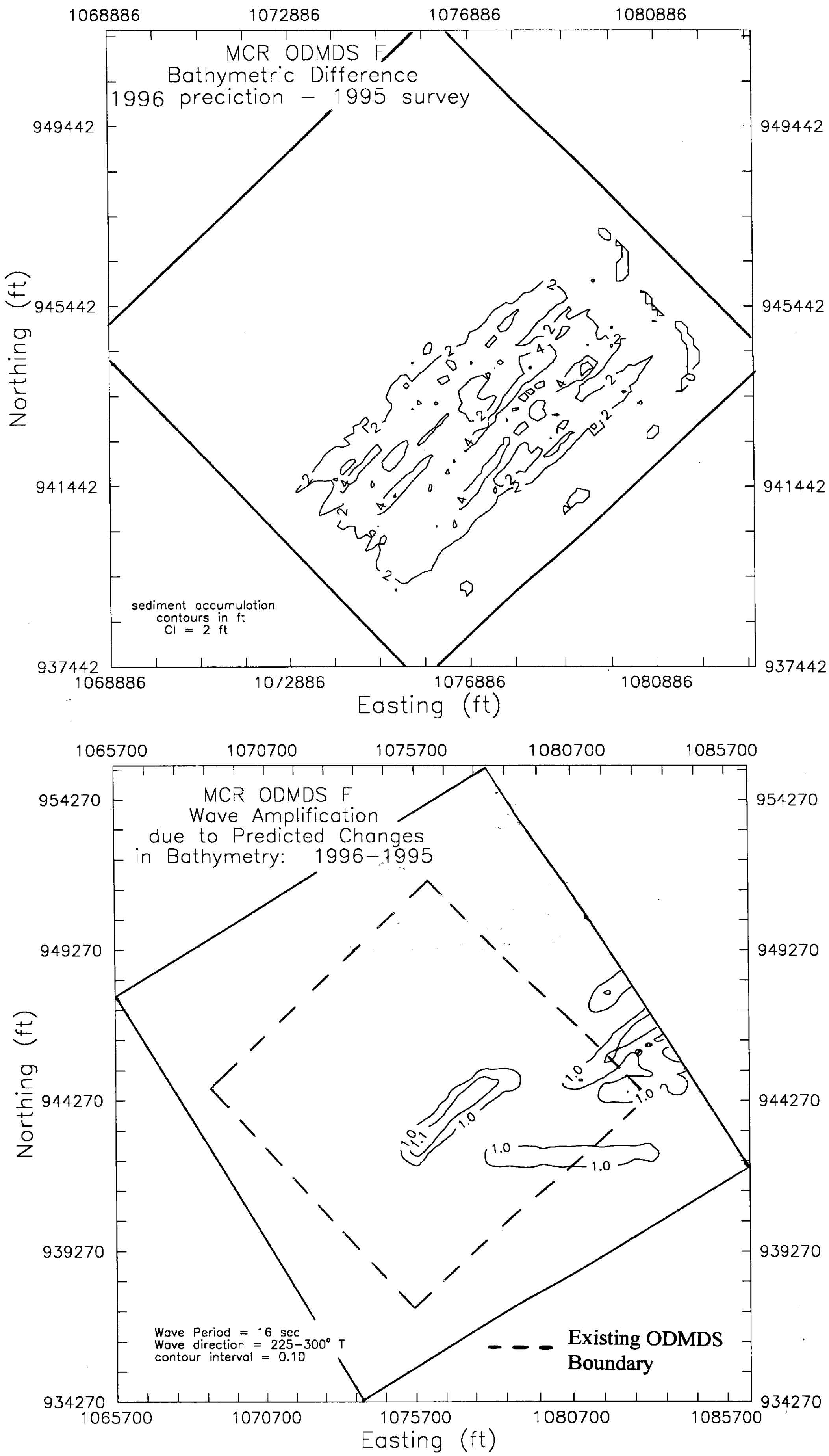


Figure 13. Scenario 1 - Predicted Bathymetry Difference and Affected Wave Environment.

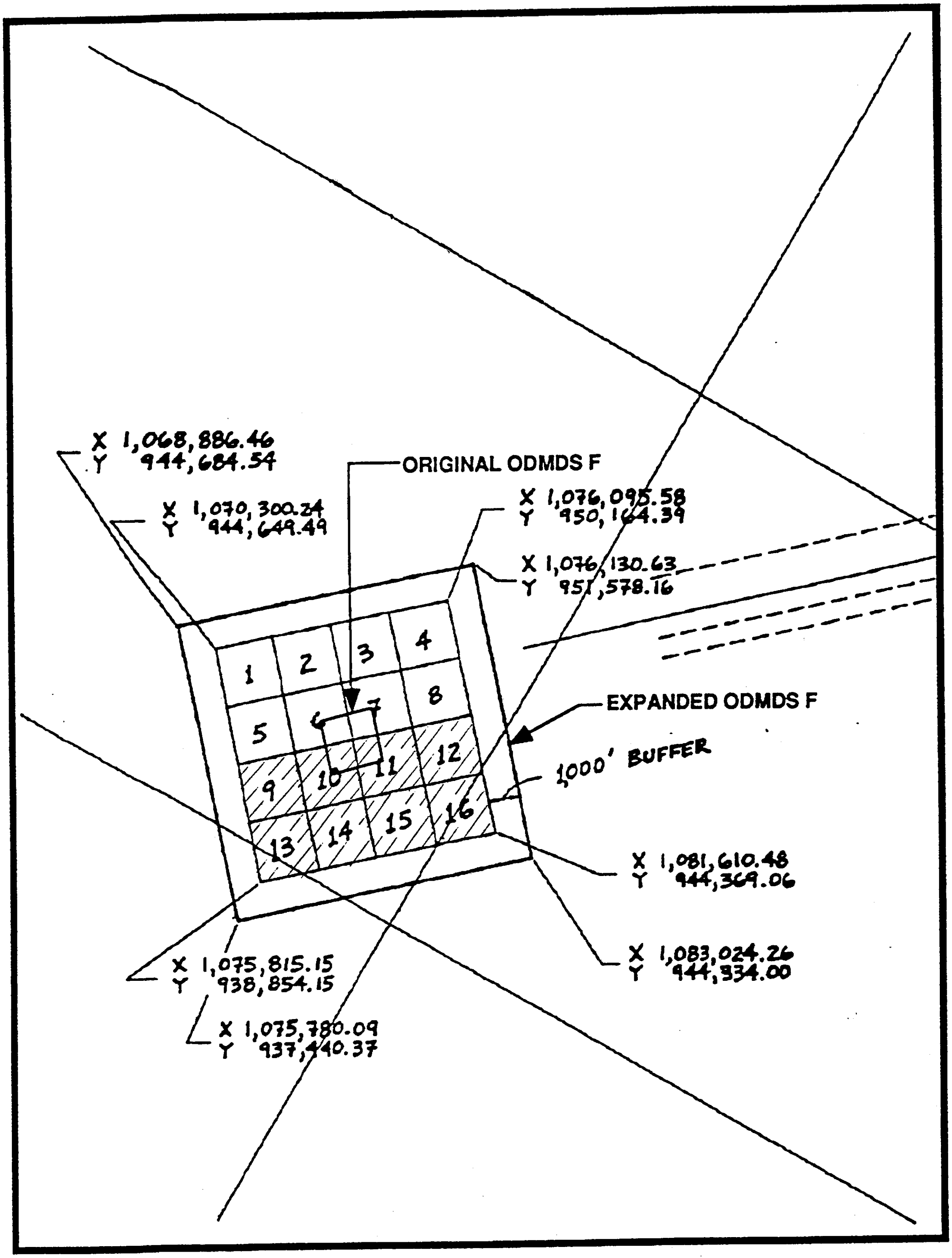
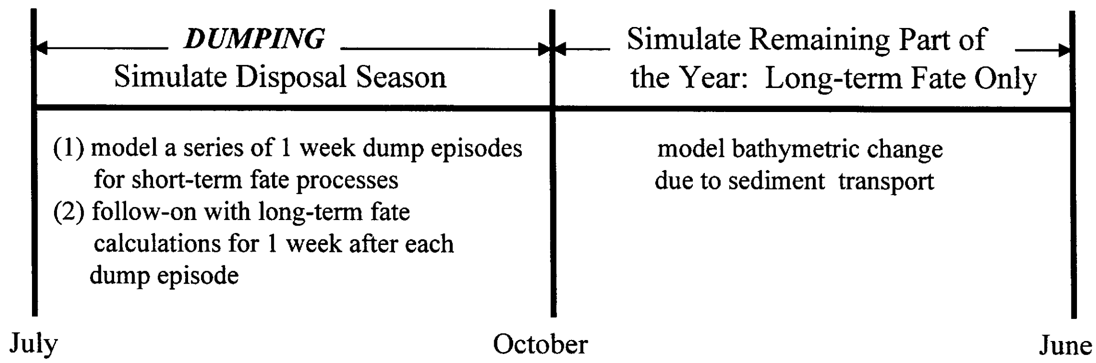


Figure 14. Disposal Control Plan for ODMDS F Disposal Scenario 2.

Simulation of Dredged Material Behavior and Wave Conditions

The MDFATE sediment transport model and RCPWAVE wave transformation model were used for the ODMDS F assessment. The method used to apply the models is summarized below. The schematic shown below describes how the MDFATE model was applied to simulate dredged material disposal at ODMDS F.



For both disposal scenarios, the Essayons was assumed to be the operating dredge dumping at:

4,500 cy/dump capacity
- -total of 666 dumps for one year for scenario 1
- -total of 888 dumps per year for 2 years for scenario 2

Approaching the disposal site from the northeast (aligned with the MCR navigation channel)
Dumping while underway at 3.5 ft/sec
Duration of active disposal per dump estimated at 10 minutes.

Dredged material parameters were: [Paxton 1990 and Hough 1957]

Dredged material type = fine sand, SP
D_{50} material dredged from MCR = 0.20 mm
Fines content (D<0.0625 mm) = 4 % (silt)
S.G. of dredged material solids = 2.71
Cs(disposal) = concentration of solids by volume in the disposal vessel = 0.485
ed = depositional void ratio = 1.062
φs = subaqueous shearing angle = 1.8°
φps = subaqueous post-shearing angle = 1.5°
Baseline predisposal bathymetry at ODMDS F for this analysis = Summer 1995

Waves and currents used:

Time series for waves = WIS-III station 22 [Jensen 1989]
Time series for tidal currents = ADCIRC constituents [Hench 1994]
Residual currents for ODMDS F (and ODMDS B) [Sternberg 1977 and USNHO 1954,1960]:
Spring (April-June) = 0.09 ft/sec @ 320°(True), maximum 2.1 ft/sec@315°(True)
Summer (July-October) = 0.60 ft/sec @ 213°(T), maximum 2.9 ft/sec @251°(T)
Winter (November -March) = 0.96 ft/sec @ 294°(T), maximum 2.4 ft/sec @ 284°(T)
Total effective current at ODMDS F = tidal current + residual current

Results - Scenario 1

Predicted *mound formation* after **one year** of disposal at the southeastern half of ODMDS F (3 million cy for one year):

- A fairly uniform mound covering the southeastern half of site F was predicted to be added onto the existing bathymetry (1995), after 1 year of dredged material disposal (1996). Results for the 1996 predicted bathymetry at site F are shown in figure 12 (top).

- Total bathymetric change within the southeastern half of ODMDS F from 1992 to 1996 (including predicted accumulation for 1996) is expected to be +12 ft. Results for predicted bathymetric change (difference) between 1996-1992 are shown in figure 12 (bottom graphic). Note that the simulation was performed for only for one year: The 1996 dredging season.

Disposal of 3 million cubic yards (for one year) in the southeastern half of ODMDS F is expected to add a fairly uniform 3-6 foot high mound in that area of site F, on top of the existing 1995 bathymetry (figure 13, top graphic).

Predicted *changes in wave height* at ODMDS F due to mound formation during 1996 using 1995 as the baseline condition are described below (disposal scenario 1):

- ♦**For average wave conditions** (10-sec period waves, all applicable directions of wave approach), the predicted mound is not expected to affect wave height in the southeastern half of ODMDS F.

- ♦**For large swell wave conditions** (16-sec period waves, all applicable directions of wave approach), the predicted mounds are expected to increase wave height by no more than +10% in the southeastern half of ODMDS F. Results for predicted wave increase between 1995 (present "baseline" condition) and 1996 are shown in figure 13 (bottom graphic).

It was predicted that the wave environment at site F will be minimally impacted by a 12-foot high mound (total height relative to the 1992 bathymetry). Following disposal scenario 1, waves at the affected part of site F are expected to be no greater than 10% of the 1995 baseline condition.

Scenario 1 would result in a mound that is at or below the threshhold limit in terms of affecting the wave environment at the southeastern half of ODMDS F. Additional future disposal at the southeastern half of site F will result in increased wave heights at the site and probable exceedance of the 10% threshold criteria.

Results-Scenario 2

The area of ODMDS F to be used during disposal scenario 2 is shown in figure 14. Predicted *mound formation* after two years of disposal at the southeastern half of ODMDS F (4 million cy/year for two years) is described below:

- Two elongated mounds (berms) covering the southeastern half of site F are predicted to be added onto the existing bathymetry (1995), after 2 years of dredged material disposal (1997). Results for the 1997 predicted bathymetry at site F are shown in the top graphic of figure 15.

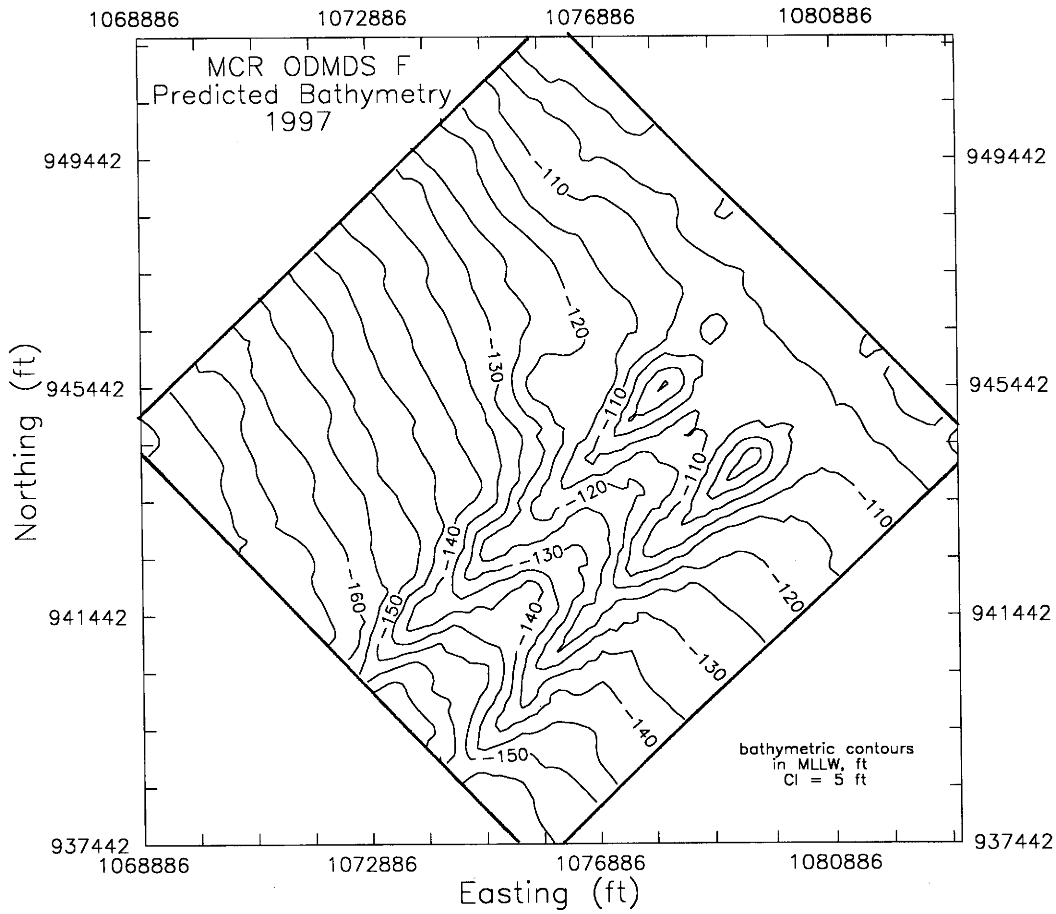
- Total bathymetric change (accumulation) since 1992 is expected to be +22 ft, within the southeastern half of site F. Results for predicted bathymetric change between 1997-1992 are shown in figure 15 (bottom graphic).

Disposal of 4 million cy/yr (for two consecutive years) in the southeastern half of ODMDS F is expected to create 12-18 foot high mound(s) in that area of site F, on top of the existing 1995 bathymetry. Simulated results for 1997-1995 are shown in the bottom graphic of figure 16. Actual bathymetric change for 1992-1995 is shown in the top of figure 16 for comparison purposes. The "regularity" of the predicted mound features shown in figure 16 (bottom) is due to the small radius used to control the placement of dredged material within each "dump cell".

The scenario 2 result is not trivial. Dump scenario 2 reproduced a similar bathymetric trend as was observed at ODMDSs A and B during 1986-94 when dredged material disposal was confined within small placement areas. The "random" radius that used in scenario 2 to place dredged material (in cells 9-16) varied between 0-900 ft. Random placement was achieved using a uniform distribution: The mean value for the random dump radius was about 450 ft. Since each dump cell is 2,000 ft/side (or about 1,000 ft radius), most of scenario 2 placement was confined to areas 450 ft from the center of each dump cell. The alignment of cells 9-16 combined with the dredging vessel approach heading (NE to SW) during disposal, resulted in a narrow two-lane disposal control plan. Given this result, disposal scenario 1 (8 lanes) is much more effective at dispersing placed dredged material than scenario 2 (2 lanes).

Predicted *changes in wave height* at site F in 1997 due to mound formation since the 1995 baseline condition are described (disposal scenario 2):

- ♦**For average wave conditions** (10-sec period waves, all applicable directions of wave approach), the predicted mounds are expected to increase wave height by 10-20% in the southeastern half of ODMDS F. Results for predicted wave increase between 1995 ("baseline" condition) and 1997 are shown in figure 17.



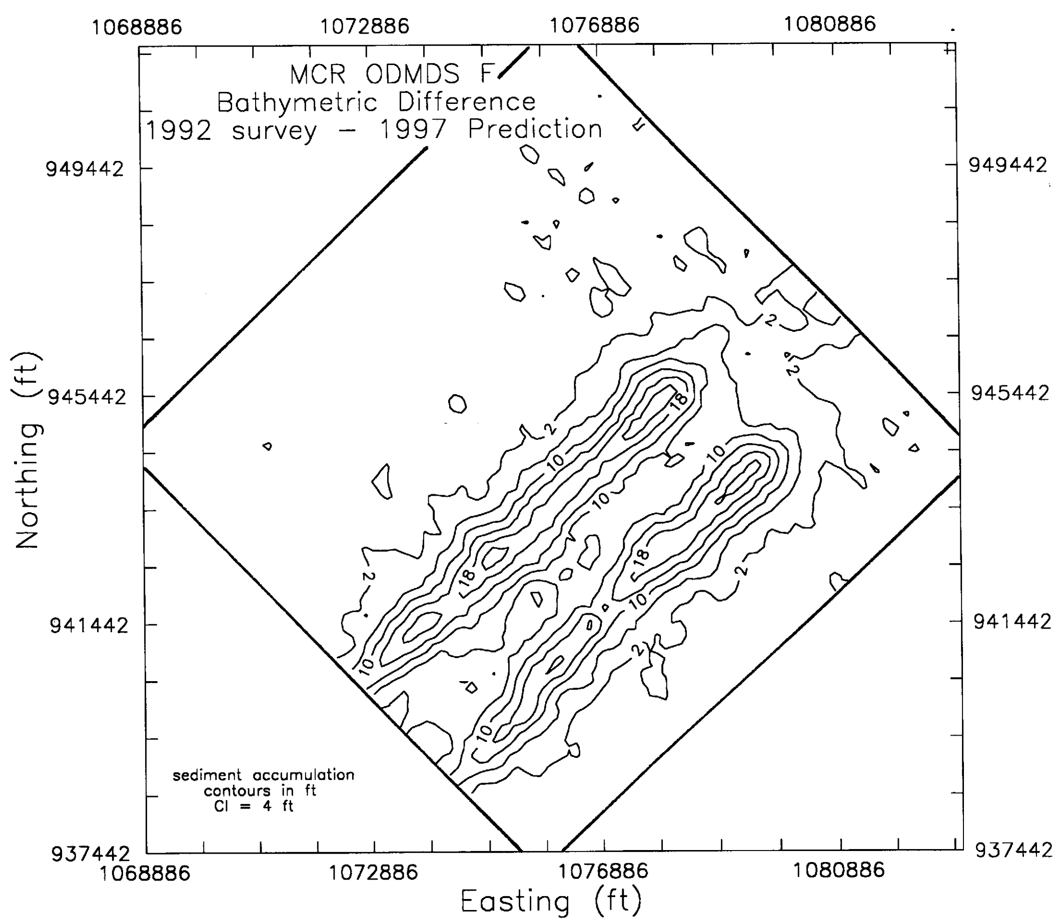
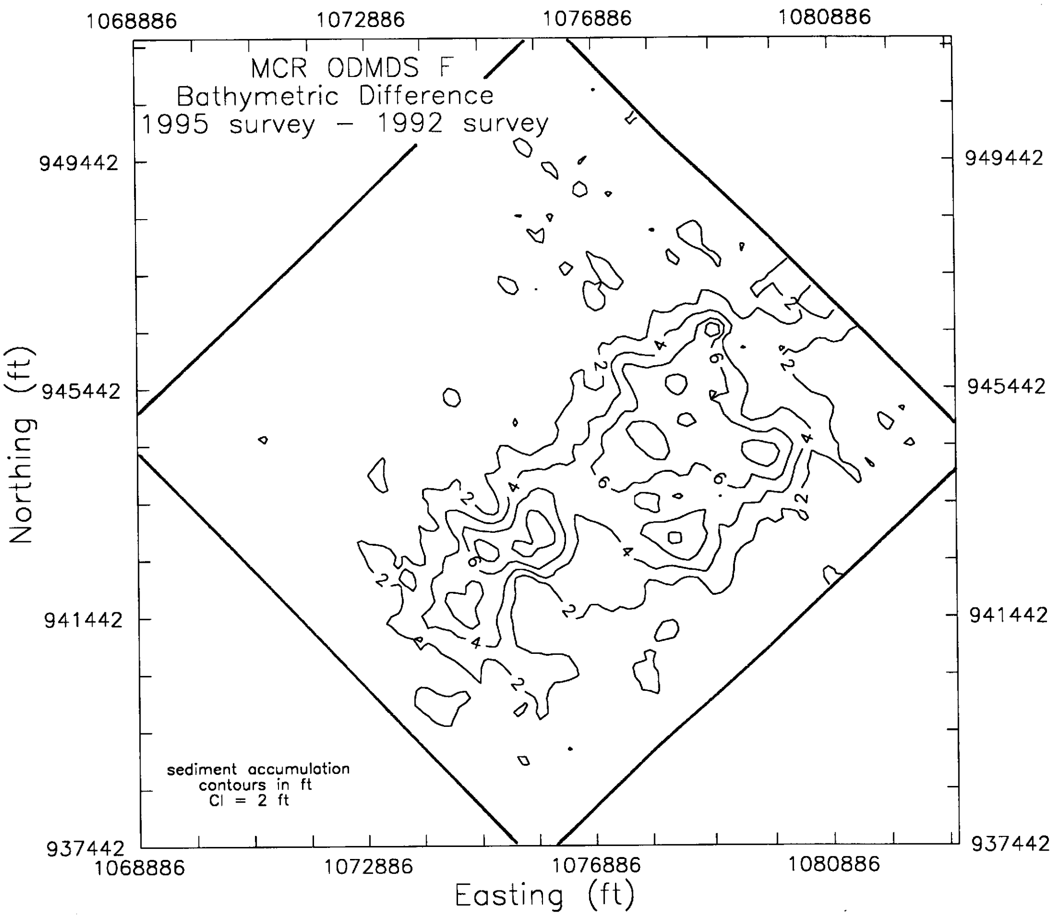


Figure 15. Predicted Bathymetry for Scenario 2 (1997) and Bathymetric Difference.



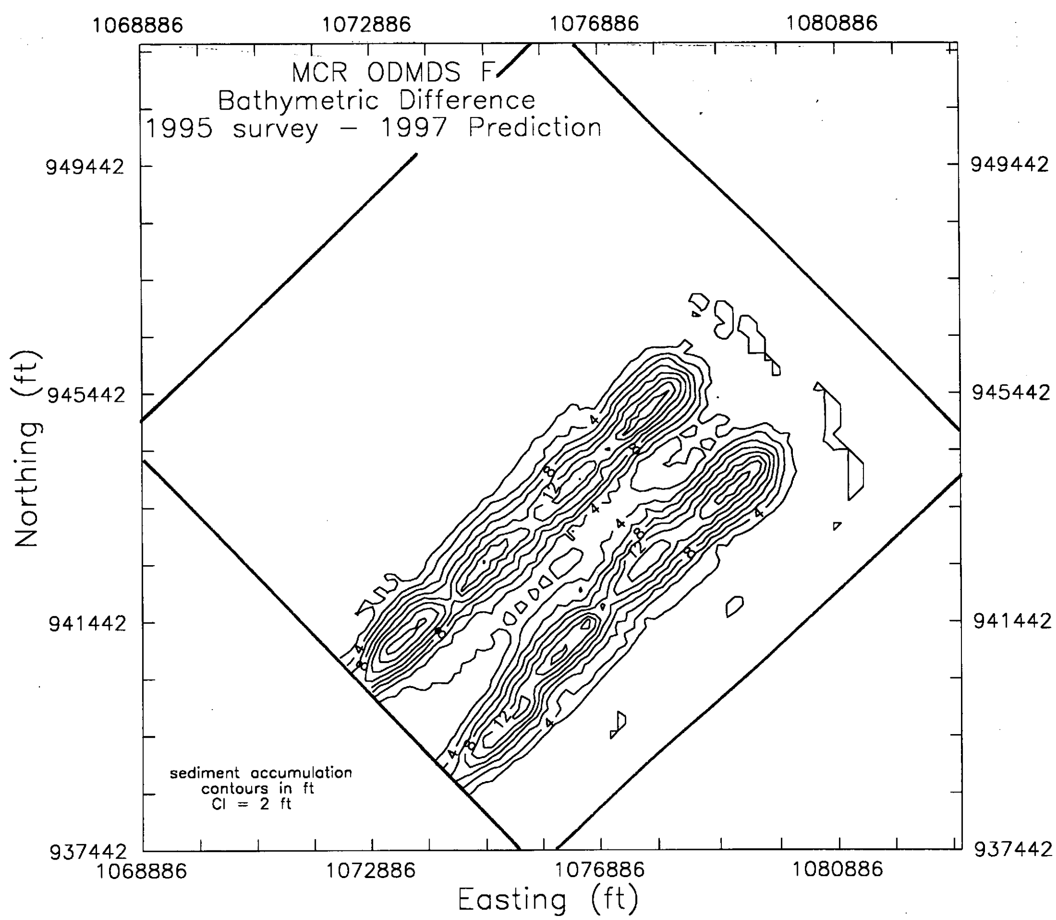
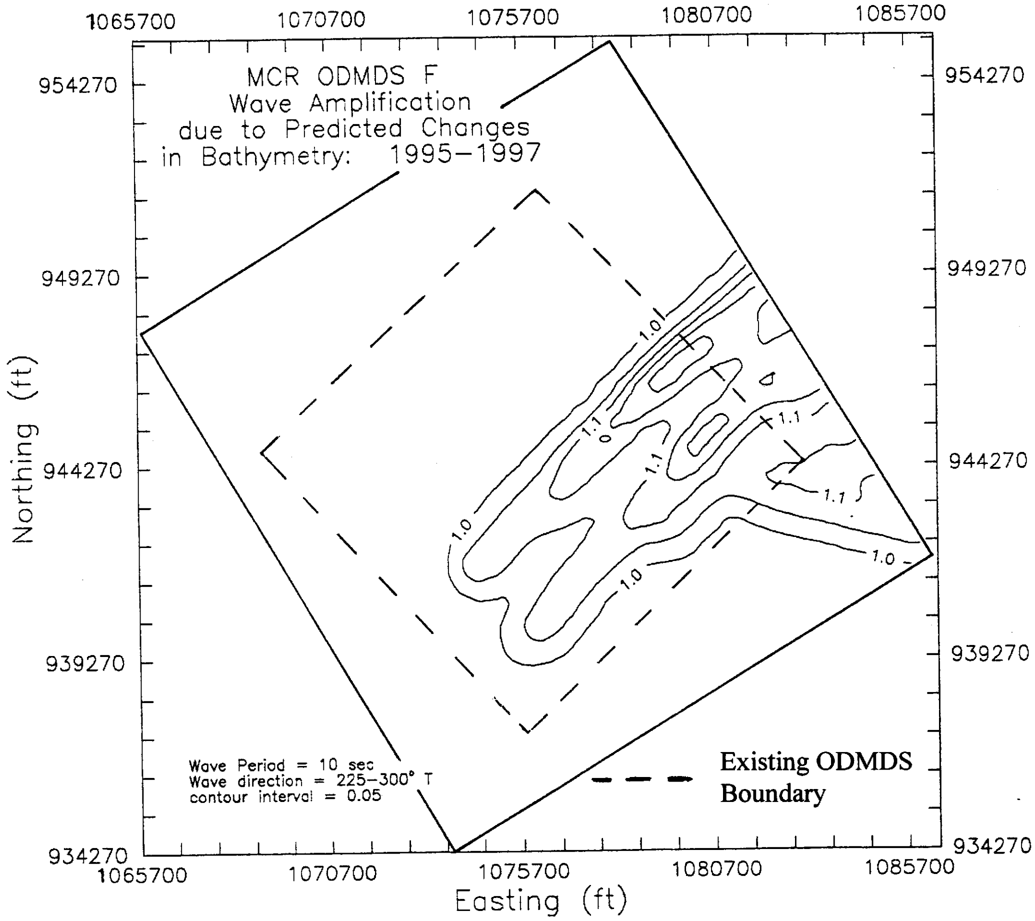


Figure 16. Actual and Simulated Bathymetry Difference for Scenario 2.



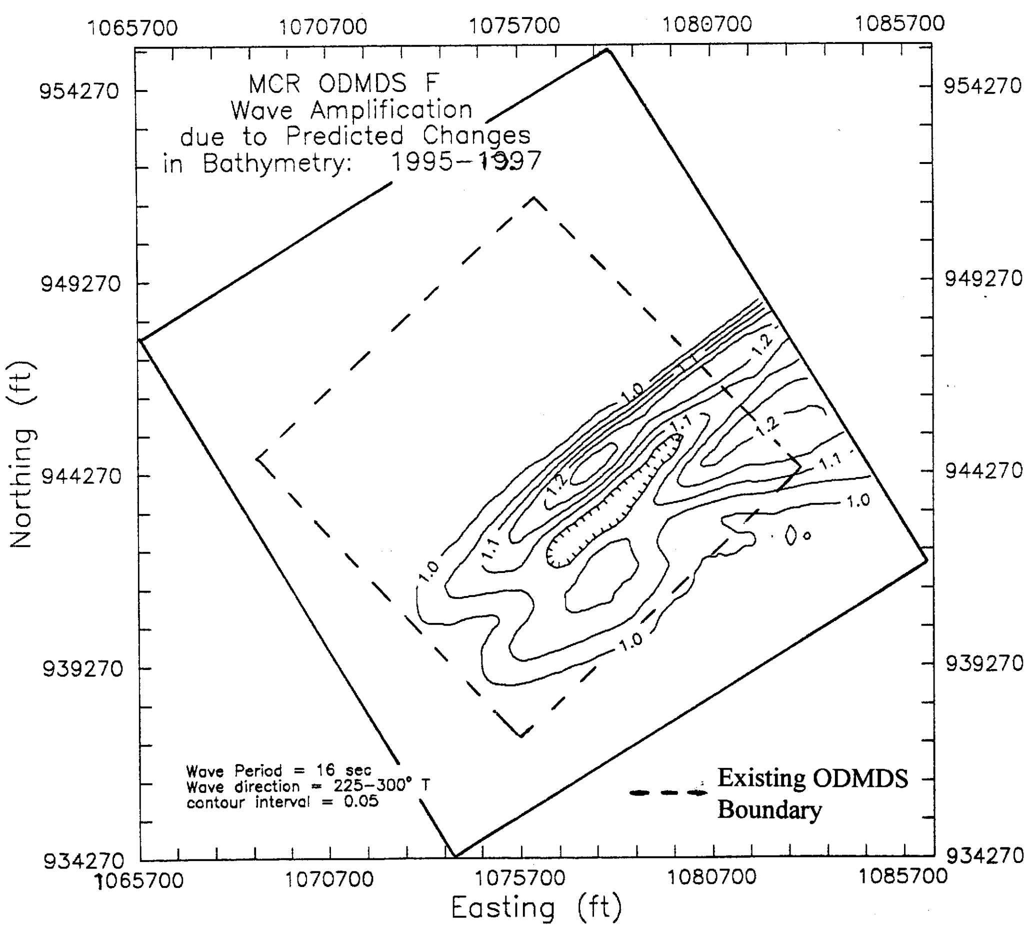


Figure 17. Scenario 2 - Affected Wave Environment.

♦**For large swell wave conditions** (16-sec period waves, all applicable directions of wave approach), the predicted mounds are expected to increase wave height by 10-30% in the southeastern half of ODMDS F.

Following disposal scenario 2, the wave environment at site F were predicted to be be significantly impacted by a 18-20 foot high mound: Waves could be 10-30% higher than at present. Scenario 2 would result in a mound that exceeds the threshold limit in terms of affecting the wave environment at the southeastern half of ODMDS F**. A disposal sequence conforming to scenario 2 would be unacceptable from the standpoint of navigation impacts.**

ODMDS F CAPACITY: GENERAL CONCLUSIONS AND RECOMMENDATIONS

At the beginning of the 1996 dredging season, the remaining capacity for the *southeastern* half of ODMDS F was approximately 3 million cubic yards: A disposal sequence conforming to scenario 1 would "fill" the southeastern half of site F. After 1996, the total volume of dredged material placed in the southeastern half of site F was expected to be 8.9 million cubic yards (from 1989-1996, assuming 3 million cy is added in 1996).

Conducting dredged material disposal in the southeastern half of ODMDS F in excess of 3 million cubic yards (total, beginning with 1996 disposal) would likely result in increased wave conditions (above the 10% criteria).

Dredged material placed in ambient water depths at ODMDS F (-100 to -180 ft MLLW) does not significantly disperse in the longterm time-frame. Material placed within site F stays: This was concluded from long-term fate calculations for dredged material behavior at ODMDS F. USACE can not risk negatively impacting navigation at or near ODMDS F. The water depths at this location would preclude any dredge from re-working placed dredged material to mitigate for inadvertent mounding problems caused by dredging disposal.

ODMDS F is in the direct line of approach to the MCR entrance channel. Bar pilots use the area as a staging location for transferring pilots to vessels of commerce. ODMDSs A and B have been used to an extent at which safe navigation is presently impaired at or near these sites, due to significant mounding and related wave conditions. If similar conditions were created at ODMDS F, overall navigation at MCR would be impaired. Recommendations for future use of ODMDS F are:

- **Total cumulative mound height at ODMDS F should be kept under 13 feet** (as compared to 1992 bathymetry) **in order to avoid adverse navigation impacts due to wave amplification.**

•After an additional 3 million cubic yards of dredged material has been placed in the southeastern half of ODMDS F (beginning in 1996), **no more material should be placed in this area of site F.**

•For future dredged material disposal at ODMDS F, only the northwestern half of the site should be used in order to minimize mounding and associated impacts to the local wave environment.

•Avoid placing dredged material in a concentrated manner at ODMDS F. Dredged material should not be placed "within" a small number of cells. Use a multi-lane (lanes spaced 500 ft or closer) **disposal control plan to ensure uniform dispersal of dredged material across all applicable dump cells.**

•The estimated capacity remaining within the northwestern half of ODMDS F (given that the southeastern half will be effectively filled by 1997) **is approximately 10 million cy, assuming that the dredged material is optimally distributed. If dredged material is <u>not</u> optimally distributed, the remaining capacity in site F is about 8 million cubic yards.**

•The remaining capacity in ODMDS F will facilitate 2 - 3 years of MCR dredged material disposal, assuming all material in excess of 1 million cy/yr is placed at site F.

•The northwestern half of OMDS F is directly in line with the inbound and outbound shipping lanes for MCR navigation. Bar pilots and shippers have expressed concern for hopper dredges interfering with navigation while dumping at ODMDS F, even during episodic disposal operations at the site. Continual use of this area for dredged material disposal during an entire dredging season may require enhanced operational coordination.

•While some dredged material could be placed in ODMDS F during a given year (1 million cy/yr, providing capacity is not exceeded)**, other ODMDSs must be found** (or existing ODMDSs expanded) **to avoid using site F on a continual basis.**

•Assuming that 1 million cy/yr could be placed within ODMDS F (for 8-10 years) **and 1 million cy/yr continues to be placed in ODMDS E, the required capacity needed from new or expanded MCR ODMDSs would be at least 3 million cy/yr** (5 mcy/yr dredged at MCR – 1 mcy/yr placed at ODMDS E – 1 mcy/yr placed at ODMDS F = 3 mcy/yr).

•If ODMDS F is not used and site E is used for 1 million cy/yr disposal**, the required capacity needed from new or expanded MCR ODMDSs would be 4 million cy/yr.**

The *measured* bathymertic change at ODMDS F due to the actual 1996 disposal operation is compared to the scenario 1 *prediction*. The comparison results are shown in <u>Section 5</u> of this report. Overall, the scenario 1 prediction agrees with the measured (survey-based) result.