

2007 Annual Use Plan

Management of Open Water Dredged Material Disposal Sites

Mouth of the Columbia River, OR and WA

1. Purpose

The year-to-year management of open water dredged material disposal sites located at the mouth of the Columbia River (MCR) is controlled and documented through the preparation and adherence to an Annual Use Plan. This Annual Use Plan (AUP) serves as the primary mechanism for evaluating disposal site capacity and managing dredged material placement. The AUP is revised for each dredging and disposal season, as required by disposal site designation [USEPA 2005]. It is prepared by USACE and reviewed and approved by USEPA, Region 10.

This document is the 2007 AUP for utilizing ocean dredged material disposal sites (ODMDS) located offshore the mouth of the Columbia River. Only dredged material determined to be suitable for unconfined in-water disposal, through application of the current Dredged Material (Sediment) Evaluation Framework for the Pacific Northwest region, may be placed at the sites described within this AUP. The total volume of dredged material to be placed within MCR disposal sites during 2007 is expected to be 3-5 million cubic yards (MCY). During 2007, the dredged material that is to be placed within available MCR disposal sites will originate from the MCR channel navigation.

2. Background

Each year, the Corps of Engineers-Portland District dredges 3-5 MCY of sand at the mouth of the Columbia River (MCR) to maintain the inlet's 6-mile long deep draft navigation channel (figure 1). Most of the dredging occurs between river mile -2.0 and +2.5. The dredged material is fine-medium sand (0.19-0.25 mm) and fine-grained material (passing a 230 mesh sieve) content is 3% or less. The dredged sand is placed at two EPA designated ODMDS [USEPA 2005], or at sites available under Section 404 of the Clean Water Act (404 site). Due to the exposed ocean conditions at MCR, only ocean-going hopper dredges can perform dredging and disposal at MCR. Dredging is limited to June-November when wave conditions are favorable for working on the bar. Refer to Appendix A for additional information describing the MCR navigation project, dredged material disposal sites, and hopper dredge operating characteristics. Appendix B summarizes the use of MCR disposal site during 2006 in context to the bathymetry changes that have occurred during 1997-2007. The term "bathymetry" refers to topography of the seabed. Appendix B also summarizes special studies conducted during 2006, associated with MCR-ODMDS use and potential impacts.

During 2007, there is no Columbia River “new work” dredged material expected to be placed within the ocean disposal sites at the MCR. Refer to Appendix A for additional information describing the lower Columbia River (LCR) navigation project.

Available MCR Disposal Sites. MCR open water dredged material disposal sites available for use during 2007 are shown in figure 1 and 1a. As designated by USEPA-Region 10 in 2005, the Shallow Water Site (SWS) and Deep Water Site (DWS) can be used for the disposal of material dredged from either the MCR or the LCR. The North Jetty Site (NJS) is limited to MCR dredged material disposal. The SWS is of strategic importance to the region; its continual use has supplemented Peacock Spit with 74 million cy since 1973 (25 Mcy since 1997). Use of the SWS (formally site E) has maintained the littoral sediment budget north of MCR, protected the north jetty from scour and wave attack, and stabilized the MCR inlet. Figure 34 shows the recent bathymetry change of Peacock Spit in context of the SWS (green is erosion and red is deposition). Had the SWS not been used during 1997-2006, much of Peacock Spit would have lost significantly more sediment than is presently the case. It is USACE’s position that the SWS must continue to be used to maintain the MCR inlet and stabilize the sediment budget north of the MCR [Moritz et al 2007]. Use of the NJS protects the toe of the north jetty from excessive wave and current scour. The beneficial uses of dredged material placed at the nearshore sites (SWS and NJS) are preferred before dredged material is allocated to the DWS [USEPA 2005 and USACE/USEPA 1999, 2003, and 2005]. Priority will be given to utilize the available capacity of the nearshore sites to the fullest extent possible.

To control the long-term accumulation (mounding) of dredged material placed within the DWS and limit the areal deposition of material placed within the site, specific drop zones will be assigned within the DWS to direct the placement of dredged material, depending upon the material volume and origination. The MCR-07-DWS drop zone will be used for the disposal of MCR dredged material which can not be placed within nearshore sites. Note that the area within the DWS available for 2007 placement of MCR dredged material has been relocated from the area previously used during 2005-2006 (see figure 1). This DWS drop zone modification was needed to limit dredged material mounding within DWS, as specified in the (SMMP) Site Management and Monitoring Plan [EPA 2005]. Refer to Appendix A for additional information describing MCR dredged material disposal sites.

Due to safety restrictions at the SWS and NJS (which limits access to SWS and NJS to one dredge at a time), it may be necessary to intermittently use the DWS before the capacity of either the SWS or NJS is fully used (when two dredges would otherwise attempt simultaneous disposal within the SWS or NJS). Limiting the use of the SWS and NJS to one dredge also reduces the likelihood of mounding within each site (overloading of the site’s capacity to disperse placed dredged material). Utilization of MCR disposal sites will be coordinated to minimize use of the DWS, while capacity still remains within the SWS or NJ Site.

Management of an open water disposal site is predicated on the need to efficiently utilize the site's capacity while minimizing impacts to navigation and offsite environment and meeting statutory requirements. The capacity of an open water dredged material disposal site is defined by the volume (or height and area) of dredged material that can accumulate within a site's boundaries without unacceptable impacts to navigation or the environment. The potential for dredged material accumulation to have an effect upon waves (mound-induced wave shoaling) is an important site management consideration at MCR [USEPA 2005 and USACE 2005 & 2003].

2007 Dredging Year. Figure 1a shows the general location from which sediment is to be dredged from the MCR channel (between RM -2 and 2.5) during 2007. A spring 2007 survey of the MCR channel was unavailable during the preparation of this AUP. Given that the average volume annually dredged at MCR is about 4 MCY (Table B1, 1990-2006), the total volume of dredged material to be placed within MCR disposal sites during 2007 is expected to be 4 MCY. The USACE and USEPA have assigned a target capacity for each disposal site to be used during the 2007 dredging season. General utilization procedures and constraints for each disposal site are described in Appendix A. During 2007, two hopper dredges will be used to perform maintenance dredging at MCR: A government operated dredge (*Essayons*) and a contractor operated dredge, each with different capacities and operating characteristics.

Available Disposal Site Capacity. Bathymetry surveys were recently obtained for the SWS and the NJ Site, to assess the present capacity of these disposal sites and to support the preparation of this AUP. The present capacity estimate for the MCR-07-DWS is based on an August 2005 survey (2007 will be the first year that this area of the DWS will have been used). It is anticipated that the SWS and NJ site be surveyed again during April or May 2007 to improve planning for disposal site utilization during 2007, immediately prior to dredging/disposal operations. Immediately prior to commencing 2007 dredging, a pre-disposal survey will be obtained for the MCR channel to better quantify the volume and location of material to be dredged.

As of 5 March and 2 April 2007, the target (static) capacity of the SWS and NJ site was estimated to be 1.6 MCY and 0.2 MCY, respectively. A "static" capacity estimate *assumes* that the SWS and the NJ site experience NO sediment dispersion (transport of sediment out of each disposal site) during March (April) and the time when dredging-disposal operations commence (June), and that there is NO dispersion during the 2007 dredging season. Because 20-50% of the dredged material placed in each site during the dredging season is transported out of each respective site (Table B2), it is anticipated that the 2007 disposal capacity actually realized for the SWS and NJS will exceed the present estimates.

Based on the present target capacity estimates for SWS and NJS, the total MCR dredging requirement for 2007 (4 MCY, est.) is expected to exceed the present combined capacity of the SWS and NJ site by 1.2 MCY. As noted above, the capacity of the SWS and the NJ site will be fully utilized throughout the 2007 dredging-disposal, to minimize the volume of material placed within the DWS. MCR dredged material that can not be

placed within the nearshore sites, will be placed within the DWS (drop zone MCR-07-DWS). The present capacity of the MCR-07-DWS is estimated to be 10-12 MCY, which is sufficient to handle the disposal needs at MCR for 8-10 years out.

Timing of Site Use. The *contract* hopper dredge (to be determined in May 2007 via receipt of contract proposal/award) is expected to dredge up to 2.5 MCY from the MCR channel, and will begin dredging-disposal operation in June and continue (intermittently) through September. Based on present contract options and provisional capacity estimates for the SWS and NJ site, the contract hopper dredge may be able to place up to 1.5 MCY in the SWS, up to 0.2 MCY in the NJ site, and up to 0.5 MCY in MCR-07-DWS. The NJ site will not be used after 1 October. The contract hopper dredge will likely use the SWS and NJS in a concurrent manner, before utilizing the DWS.

The government dredge (*Essayons*) is expected to dredge up to 1.5 MCY from the MCR channel, and will begin utilizing MCR disposal sites in July and continue intermittently through October. Based on the provisional capacity estimates for the SWS and NJ site, the *Essayons* could be limited to placing less than 1.5 MCY in the SWS, and up to 1.5 MCY in MCR-07-DWS. The government hopper dredge will likely use the SWS and DWS in a concurrent manner.

To improve capacity utilization within the SWS during 2007, the SWS may not be used during periods of 1-2 weeks to allow waves and currents to “disperse” recently placed dredged material out of the site. If needed, other sites (DWS and NJ Site) may be used concurrently with the SWS to avoid overloading the SWS and extend the time for which the SWS can be used (increase the capacity of the SWS).

3. Annual Use Plan Objective

The objective of this *Annual Use Plan* for 2007 is to: A) Provide a decision framework that allows MCR dredging operations managers to manage open water disposal sites on a day to day basis, and B) Define a strategy to collect information (via monitoring or assessment of operational data) on a frequent basis, so that potential problems can be identified and corrective action can be undertaken.

The amount of dredged material that can be placed in an open water disposal site is limited by the site’s capacity to disperse or accumulate the material without adversely affecting the environment or navigation. ***The principal site management constraint for MCR is to avoid modification of a disposal site’s bathymetry (via dredged material mounding) that could potentially result in excessive wave amplification, due to wave shoaling over mounded dredged material.*** This AUP was developed to meet the requirement of the MCR ODMDS Site Management & Monitoring Plan [USEPA/USACE 2005]. As proposed, this *Annual Use Plan* is in place for the 2007 dredging season only. Elements of this annual use plan will be modified during the dredging season in accordance with adaptive site management.

The 2007 *Annual Use Plan* describes how each available MCR dredged material disposal site will be used and monitored. Two methods will be employed to monitor the placement of dredged material within each disposal site during 2007 and prevent mounding beyond the management target. The first monitoring method focuses on tracking the placement of dredged material within each disposal site on a daily basis, by plotting the location (dump track line) of each load placed. Frequent plotting of disposal locations will provide a continuous knowledge base of how placed dredged material is being deposited within a given site. During 2003-2006 daily tracking of hopper dredges (during dredged material disposal) significantly enhanced the management of dredged material disposal site capacity [USACE 2004]. The second monitoring method involves conducting frequent bathymetry surveys at active MCR disposal sites during the dredging season. Comparison of surveys to a site's baseline condition will quantify deposition of dredged material placed within a given site. Timely use of this information can be used to manage dredged material accumulation within a given disposal site.

The 2007 *Annual Use Plan* is based on adaptive management. This means that MCR disposal sites will be proactively managed: As sites are used, they are monitored to verify that the sites are being managed according to 2007 capacity targets. If a given disposal site is at or near its target capacity, then site management changes accordingly. The *Annual Use Plan* implements various recommendations made by a “*Federal Review Team*” [USACE/USEPA 2001] which was convened in September 2001 for the purpose of reviewing management practices at MCR dredged material disposal sites.

4. Site Management Criteria

The level to which any site can be used for dredged material disposal is related to the capacity available within the site and the efficiency to which the site's capacity is used. This means that the dredged material would be distributed throughout the entire site, both in space and time. Placement will use a regimented procedure to produce a uniform continuous deposition layer on the seabed, to avoid the formation of any localized mounding. Geometrically, the target capacity for a given disposal site is defined by the target height and area over which dredged material can accumulate (collectively referred to as a “target accumulation”), with respect to a baseline condition. The target capacity for a given disposal site defines a management condition for which an intermediate review action (decision point) occurs. At this point, the potential cumulative effects of additional disposal site utilization are assessed in conjunction with other physical processes. Use of an active disposal area may be discontinued upon reaching the specified target accumulation. The target accumulation is based on the need to manage dredged material accumulation such that mounded dredged material does not excessively amplify waves due to shoaling and refraction. The target accumulation may be different for each disposal site.

Target values for managing the accumulation of dredged material were obtained using the RCPWAVE model [Ebersole 1986] as discussed in USACE [1999, 2001, and 2002]. RCPWAVE is a numerical model that simulates the behavior of waves as they interact with spatially variable bathymetry (underwater mounds in this case). It must be noted

that wave height results obtained using RCPWAVE can be 10-50% higher than the actual case: RCPWAVE overestimates how waves interact with variable bathymetry (the model is conservative). The target mound heights given in table 1 are conservative and are intended to provide a safe operational limit to define an intermediate review action for site management.

A detailed analysis of various scenarios for dredged material placement (deposition and related wave effects) within the SWS was conducted by USEPA in 2003. The analysis concluded that the *target mound height* for dredged material accumulation, (the value presently being used for site management), is 2-3 ft below the level that would begin to affect waves passing over the SWS. The difference between the *target mound height* and the mound height that would actually begin to affect waves over the SWS, translates into a disposal volume of 1-2 MCY. This is the marginal capacity of the SWS that is not being realized in order to manage the site at a very safe operational limit.

Table 1 presents the target mound heights applicable for MCR disposal sites and Appendix A discusses site specific details concerning target mound heights, site utilization, and present disposal site capacity. Because of the need to assign capacity and concern for navigation safety, thresholds for increasing the level of monitoring intensity and management responses have been identified (see Section 5). The “target mound height” values shown in table 1 are intended to be used only as an ODMDS management guide (a screening tool to identify site management thresholds for concern). Dredged material disposal events that produce total accumulation levels less than or equal the “target mound height” throughout the site are acceptable. (Note: the values shown in Table 1 apply to a mound feature that occupies an area of 2,000 x 2,000 ft). Little or no wave amplification would be expected for smaller mound features that are equal to or marginally higher than the “target mound height” values in Table 1 [USACE 2002]. As dredged material accumulation approaches the “target mound height”, efforts are enacted to minimize additional dredged material accumulation within the affected area (dredged material would be placed uniformly within other areas of the disposal site).

The target mound height corresponding to the “**present**” site condition (March 2007 for the SWS) applies to the utilization of available disposal, sites at the beginning of the 2007 dredging-disposal season. The “present” target mound height will be redefined throughout the 2007 dredging-disposal season based on subsequent bathymetry surveys. Note that the bathymetry at several areas within a given disposal site will change since the establishment of the sites’ baseline condition. For example, the eastern area of the SWS is now deeper than it was in 1997 (baseline condition) while the western area of the site is shallower than in 1997 (see Appendix A and B). The “present” target mound heights shown in table 1 account for the change in site bathymetry that have occurred since the baseline condition.

Active disposal sites are monitored throughout the dredging disposal season to ascertain the level of mounding within each site and the corresponding management “action level” (see Section 5). Concern associated with dredged material mounding within a given disposal site, should arise only if the level of accumulation significantly exceeds the target height

and/or the area of accumulation exceeding the target value becomes greater than 2,000 x 2,000 ft. Detailed examination of wave amplification potential will be conducted if dredged material accumulates to levels that substantially exceed the “target mound height” and/or covers an area larger than 2,000 x 2,000 feet. Should this occur, the STWAVE model [Smith 2001] will be used to assess whether the area of accumulation may potentially affect waves in or near the disposal site. Although RCPWAVE is considered an appropriate model for establishing conservative target mound heights, STWAVE is more accurate and considered to be better suited for predicting actual conditions (see Appendix A).

Table 1. Target height of dredged material mounds, based on the RCPWAVE model. Values to be used for intermediate review of disposal site capacity.

Disposal Site	Target Mound Height (ft) with respect to		Drop Zone Area (acre)	Present Site Static Capacity Volume (CY)
	Baseline	Present		
SWS – East	5	5	190	1.2 M
SWS – West	5	3	100	0.4 M
NJ Site*	8	2	100	0.3 M
DWS – MCR	40	40	360	12.0 M

SWS = designated under section 102 of MPRSA, 1 April 2005 (40CFR, Part 228), formally ODMDS E

DWS = designated under section 102 of MPRSA, 1 April 2005 (40CFR, Part 228)

* = The NJ is not subject to the same target mound geometry criteria as unprotected sites. For initial assessment of 2005 dredging-disposal season, capacity of Site NJ has been set at 0.20 MCY to minimize potential transport to areas near the MCR channel.

Baseline = 1997 for SWS, 1999 for NJ Site, 2005 for MCR-DWS

5. Decision Framework for Site Threshold Management

Based on the above site management criteria, there are 6 action levels that will be used for managing dredged material placement within disposal sites at MCR.

Level 1. Normal Level = Dredged material accumulation is not close to the accumulation target. ACTION: Proceed as planned.

Level 2. Limited Capacity Level = Dredged material accumulates to within 1-2 ft of the threshold mound height in some part of the drop zone. ACTION: Minimize placement in affected location.

Level 3. Threshold Level = Dredged material accumulates to (or marginally exceeds) the target mound height within localized extent (less than 500 x 500 ft). ACTION: Assess accumulation in surrounding cells and overall site capacity. Avoid or minimize placement in the affected location of accumulation. Continue to use adjacent areas within site appropriately.

Level 4. Limited Management Level = Dredged material exceeds target mound height by 1-2 ft over an area greater than 500 x 500 ft. ACTION: Assess accumulation in surrounding cells and overall site capacity. Avoid or minimize placement in the affected location of accumulation and in adjacent areas. Continue to use areas not affected; adopt early exit strategy for site.

Level 5. Moderate Management Level = Dredged material exceeds target mound height by more than 2 ft over an area greater than 1,000 x 1,000 ft. ACTION: Assess accumulation in surrounding cells and overall site capacity. Stop using the area of the site exhibiting accumulation, until natural erosion has reduced accumulation (restored site capacity).

Level 6. General Management Level = Dredged material exceeds target mound height by more than 2 ft over an area greater than 2,000 x 2,000 ft. ACTION: Assess accumulation in surrounding cells and overall site capacity. Stop using the area of the site exhibiting accumulation. Assess potential wave impacts using STWAVE and determine appropriate action based on results.

6. Disposal Site Management Strategy

The goal of managing MCR disposal sites, particularly the SWS and NJ Site, is to fully utilize each available site, while limiting the average vertical accumulation of placed dredged material so as to minimize the potential for adversely affecting wave conditions at or near the site. To successfully manage each site throughout the dredging season, the capacity of each site must be frequently assessed.

As a general rule, capacity assessment for an *active* disposal site (one that is being used) will occur based upon the frequency at which a given site's bathymetry is surveyed. The frequency of conducting surveys will be directly related to the rate at which dredged material is placed within a given site. In this regard, the frequency for assessing active disposal sites will be based on the rate of volume of dredged material placed within the site. The Portland District (OP-NW and EC-CR) will, on a daily basis, collect operational dredging/disposal data at MCR (specifically, dump tracklines and beginning-ending coordinates). The data will be transferred to EC-HY/HR for compilation and plotting. Figure 2 shows the flow diagram describing the procedure of processing monitoring data and using the processed data to manage disposal site capacity. Improvements to the disposal plan will be identified and initiated within 1-2 days as necessary.

Coordination meetings will be conducted among different Portland District offices and EPA to discuss dredging and disposal management. Periodically, Portland District (OP-NW) will prepare a report that summarizes the volume of dredged material placed, relate this data to the changes in capacity for active MCR disposal sites, and make recommendations for utilizing each site. Active dredged material disposal sites will be assessed according to the management thresholds listed in Section 5 "Decision Framework for Site Threshold Management" and coordinated with EPA-Region 10. Periodically during the dredging season updates will be furnished via email to EPA-Region 10 and the members of the MCR Update Distribution List maintained by the MCR Channel O&M project manager (OP-NW).

Use of an active disposal site (or portion thereof) may be temporarily discontinued based on management indicators that show the potential for exceeding the target accumulation within the site, the status or location of the dredges and hydrosurvey vessels, priority use of sites, or other site use constraints. Weekly recommendations may address revision of monitoring needs (i.e. site bathymetry surveys) or the collection of additional operational

data to be used for the purpose of improving the assessment of disposal site capacity. Data required to monitor the progress of site utilization includes: bathymetry surveys; analysis of surveys (plotting, differencing, or other processing); tracking of disposal locations within each site; and other pertinent information provided by the dredge operators. See figure 2 for the flow diagram describing the work elements for monitoring and managing disposal site capacity.

Within the collective constraints of available MCR disposal sites, preference is given to using the Shallow Water Site (SWS) and the North Jetty (NJ) site. However, based on surveys conducted during March/April 2007, the SWS and the NJ site do not have sufficient capacity to meet the requirements for all MCR dredged material disposal during 2007. The Deep Water Site (DWS) will be used to supplement disposal site capacity for MCR dredging requirement during 2007 (refer to Section 8, fourth paragraph). It is intended that the contract dredge place up to 1.5 MCY of MCR material in SWS, up to 0.2 MCY of MCR material in the NJ site, and up to 0.5 MCY in the DWS (MCR-07-DWS drop zone). The government dredge is expected to place up to 1 MCY of MCR material in the SWS and up to 1.5 MCY in the DWS (MCR-07-DWS drop zone). Subsequent surveys of the SWS and NJ Site (during 2007) may show increased erosion within these areas, which may result in additional nearshore capacity for dredged material disposal. This would effectively reduce the volume of MCR dredged material that would be placed at the DWS (MCR-07-DWS).

If the SWS is to be used by both the government and contract hopper dredges for the disposal of MCR dredged material and does not have the capacity to allow both dredges to complete their respective MCR requirement, then both dredges may need to use the MCR-07-DWS.

The SWS requires focused monitoring during dredged material placement to ensure that the site is fully utilized without exceeding the site's management target. The SWS will be managed such that the site may be under-utilized, rather than attempting to achieve full utilization of the site at the risk of exceeding the site's capacity constraints. During 2005-2006, concurrent use of the NJ site, DWS, and SWS, reduced the rate at which material was placed within the SWS, yet allowed the site to fully disperse the material being placed within it. The cessation of SWS use during 2-week to 1-month periods gave the SWS a "holiday" to further disperse placed material (figure 16). More material was placed in the SWS throughout the 2005 and 2006 seasons by not over-using the site during a short time period. Intermittent use of the SWS had increased the dispersive capacity of the site (see Appendix B). Figures 3a-b show the flow diagram describing the procedure for assessing site capacity and directing the government and contractor dredges to specific MCR disposal sites.

A primary objective of this AUP is to leave the areas of the SWS, NJS, and DWS utilized during 2007 in a post-disposal condition which does not degrade navigation conditions or adversely affect other uses of the ocean within or adjacent to each disposal site.

7. Site Management and Monitoring – Routine and Special Studies

Monitoring of active ODMDSs at MCR is required based on the site designation statute of MPRSA. Both management and monitoring are described in the 2005 USEPA/USACE Site Management/Monitoring Plan (SMMP) for the Mouth of the Columbia River. Monitoring as described in the SMMP includes routine monitoring and when triggered special studies. Typically routine annual monitoring consists of bathymetric surveys of both the SWS and DWS. The intensity of these surveys is greater for the SWS than the DWS. For the DWS these would consist of a pre/post disposal survey of those areas proposed for placement of dredged material as well those portions of the site used the previous year. Placement of >500,000 CY at the DWS would trigger sediment physical characterization.

At the conclusion of the dredging season, USACE-USEPA will prepare a yearly report summarizing utilization of active MCR disposal sites (similar in scope to the first part of Appendix B and related figures). This report will be made available to MCR stakeholders and resource agencies within 3 months of the end of the dredging season.

USACE-USEPA will apply the STWAVE model at the conclusion of each MCR dredging-disposal season to assess the post disposal bathymetry of the SWS and Peacock Spit for wave amplification due to dredged material mounding within the SWS and regional bathymetry changes of Peacock Spit (figure 34). Wave amplification will be assessed with respect to the bathymetry changes that have occurred with respect to the SWS baseline condition (1997). The wave analysis will also included a characterization of the wave conditions that may pose navigation hazards. Present-condition bathymetry surveys will be conducted to describe the near post-disposal condition of Peacock Spit prior to the conclusion of the dredging season. This survey will be merged with other MCR surveys to describe the overall region of MCR for the purpose of assessing potential post-disposal wave amplification associated with utilization of the SWS and Peacock Spit bathymetry changes. If the post-disposal wave modeling indicates unacceptable mounding (as defined by 10% wave amplification relative to the 1997 baseline condition at the SWS), USACE will implement additional SWS monitoring actions and will coordinate with the US Coast Guard to issue a Notice to Mariners. Additional monitoring will include bathymetry surveys of the SWS obtained every 2 weeks (as weather/safety/scheduling conditions allow) until mounding is sufficiently dispersed. Additional wave modeling will be performed to assess the wave environment if mounding is not sufficiently dispersed after on month. Sediment transport modeling and/or other methods may be employed to estimate the time frame required for mounding to be sufficiently dispersed so that there is insignificant effect on the local wave environment.

Special studies are non-routine studies of specified duration that are intended to address specific questions or issues that are not covered by routine monitoring or that arise from questions or issues identified through routine monitoring. Designation of the SWS and DWS by USEPA in 2005, required additional disposal site monitoring/studies to be completed within 3 years of designation. These additional monitoring actions included biological as well as physical special studies. Proposals for ODMDS monitoring and special studies were submitted to EPA, Region 10 for review and approval. Special

studies for 2005 included sediment profile imaging, benthic infauna and physical sediment analysis, bottom trawls, detailed bathymetry surveys, modeling, and crab pot deployment. Sampling protocols were similar to those applied in 2002 for the DWS Biological Baseline survey but focused on the area of the 2005 placement with suitable reference areas. Results of the physical, biologic, and numerical modeling analyses conducted during 2005 are summarized in the 2006 AUP. The ARGUS beach monitoring system (ABMS) at North Head has been operational since 2004 and is used to verify that wave action on Peacock Spit is not negatively affected by the SWS (http://www.planetargus.com/north_head). Additional monitoring and physical analysis of the DWS benthos is required when more than 0.5 MCY of dredged material is placed within the DWS during a given year, or at the end of 10 years after designation regardless of level of use.

Monitoring and modeling activities for the SWS and DWS were conducted during 2006, to build on and complement the work performed in 2005. Additional investigations were also performed for the South Jetty Research Site during 2006, in preparation for phase II of the Columbia Nearshore Demonstration Project. A sediment tracer study was initiated at the SWS in September 2006 and is expected to be complete by June 2007. Results of the monitoring and modeling analyses conducted during 2006 are summarized in Appendix B of this AUP.

8. Survey Frequency for Monitoring Dredged Material Accumulation

Minimum site monitoring requirements for each active disposal site at MCR are a pre-disposal bathymetry survey (beginning of season), post-disposal survey (end of season) and a 2 x 2 mile area on Peacock Spit. Refer to figure 4 for survey coverage at MCR. Present operational strategy requires that the SWS and the NJ Site be surveyed at least once a month during the 2007 MCR dredging season. The drop zones of the DWS used during 2007 will be surveyed at the end of the dredging/disposal season. For active disposal sites, the survey frequency may differ from the minimum requirements, as specified in Table 2.

For all sites that are actually being used, an alternative Frequency for Site Monitoring (FSM) will be based on: The volumetric rate (∇) at which dredged material is begin placed, the area (A) over which the dredged material is being placed, and the vertical target (H) for dredged material accumulation. It is noted that as a given site (or portion thereof) is “filled” with dredged material, H will change (become less with time). The FSM may need to increase as a site is being filled. FSM will be re-assessed each time an active site is surveyed. An entire disposal area need not be surveyed during each survey; only the parts of the site receiving dredged material and adjacent areas (within approximately 1,000 ft of disposal activity). If the FSM becomes too frequent, then the disposal area may be considered “filled” and not used until sufficient dredged material dispersion occurs (as determined by site monitoring).

Equation 1 was used to estimate survey frequency for each site. Note that FSM (equation 1) assumes: The survey will be conducted at the midpoint of a site’s total remaining

capacity; dredged material is continuously placed at the site; and 20% of the site’s area is not used. Table 2 specifies the initial FSM for each site based on initial conditions for 2004 and other parameters as shown. Note that the FSMs in table 2 will require revision as the capacity (allowable accumulation height) of each site is reduced by dredged material disposal.

Frequency of Site Monitoring (FSM)

= (Target Height/2) x (Site Area*0.8/√volume placed per day) [Equation 1]

Example: Initial FSM for the Eastern half of SWS drop zone (DZ) for contract dredge is:
= (5/2) x (190*43560*0.8 /45,000*27) = 16 days.
...this is halfway thru the total time expected to fill the site.

Table 2. Values used to estimate Initial Frequency of Site Monitoring (FSM) for 2004.

Disposal Site	Target Mound	Area	Volume of DM Placed (√,CY/day)*		FSM**
	Height (H,ft)*		(A, acres)*	Government	
SWS – East DZ	5	190	55,000	or 45,000	11 or 14
SWS– West DZ	3	100	50,000	or 35,000	4 or 6
SWS DZ	4	290	52,000	or 40,000	14 or 18
NJ Site (west ½)	4	50		13,000	9
DWS (MCR DZ)	20	360	37,000		125

* = Based on present values; changes as a site is filled; may be redefined based on subsequent site surveys. Based on the need to distribute dredged material disposal over multiple sites, the daily rate of placement within the NJS will be 1/3 to ½ of normal rate.

**= time interval between FIRST successive surveys, assuming site in continuously used AND that dredged material is placed evenly throughout available disposal area. Frequency for Site Monitoring

♣= based on recent average production rates – values will be changed if 2007 production rates are higher

As a given disposal site is “used”, the interval between successive surveys will become smaller. Table 3 shows an estimated schedule for surveying MCR disposal sites during 2007 assuming that disposal occurs continuously in the site and that dredged material is placed uniformly within the available area. The values shown in () are the revised FSMs, following the initial value. An example of how to read table 3 is given for the SWS, and assumes that dredged material is continuously and evenly placed from day one using a government hopper dredge (production of 40,000 cy/day):

- 1) 18 days after commencement of the disposal operation, the site would be surveyed and remaining capacity assessed.
- 2) After 9 additional days, the site would be re-surveyed and re-assessed. The total time for disposal would be 27 days.
- 3) After 4 additional days, the site would be re-surveyed and re-assessed. The total time for disposal would be 31 days.
- 4) After 2 additional day, the site would be filled. The total time for disposal would be 33 days.

Table 3. Estimated successive frequency of site monitoring, based on contract (C) dredge and government (G) dredge production rates.

Disposal Site	Initial FSM	2 nd FSM	3 rd FSM	4 th FSM	5 th FSM
days, starting from when site is first used in 2007 (days from previous FSM)					
SWS (G)	18	27 (9)	31 (4)	33 (2)	80% Filled -1.3 MCY
NJ Site (C)	9	13 (4)	15 (2)		80% Filled - 190 KCY
DWS (C)	>120	Survey DWS at Beginning and End of Dredging Season**			

Values indicate cumulative time for which site has been used during 2007.

Values in () indicate successive FSM; or the time that the site can be used between successive surveys. When the FSM becomes less than 3 days, use of the site may be temporarily halted while site capacity is evaluated (see figures 2-3).

** Post-Survey of DWS occurs only if the site has been used in 2007.

9. Utilization of Active Disposal Sites during Monitoring and Contingencies

Under certain conditions, active disposal sites may be left alone and others will be used. This means that when the SWS is being surveyed to assess remaining site capacity, the government or contract dredge may use another disposal site until the SWS remaining capacity has been assessed. This will typically take 1-2 days. This may happen towards the end of the dredging season when the SWS is nearing its site capacity. During each site assessment period, the dredges may use the NJ site (if available) or the DWS. See figures 2 and 3a-b.

During periods of rough bar conditions, the SWS or the NJ Site may not be available for use; in which case the DWS may be used. At times during the 2007 dredging season, both contract and government dredges may relocate to other work areas.

10. Optimization of Site Capacity

During 1997-2006, SWS has been the principal disposal site for MCR project maintenance dredged material; 64% of all MCR dredged material (sand) was placed in the SWS. Approximately 88% of the material placed within the SWS drop zone during 1997-2006 has been dispersed by waves and currents, in a north-northwesterly direction onto Peacock Spit (Table B2). Less than 10% of the dredged material placed at the SWS has been transported southward into the MCR navigation channel. Continued use of SWS as a primary disposal site is of strategic importance to the MCR federal project and environment [USACE 2003]. The western half of the SWS drop zone has been slowly accumulating dredged material, since its initial use in 1997; approximately 2 MCY (see figure 18). Management of the SWS has taken this into account by preferentially using the highly dispersive eastern half of the site, and minimizing the additional accumulation within the western half of the site. The net result is to achieve uniform accumulation throughout the site with respect to the baseline condition (1997) without exceeding the

site's target height of accumulation; by placing dredged material accordingly to match the site's dispersive and depositional nature. Refer to figure 17 for utilization plans implemented for the SWS during 2006.

The level to which the SWS can be used for dredged material disposal is related to the capacity available within the site and the efficiency to which the site's capacity is used. Regardless of the capacity available within the site, full utilization of SWS capacity can be achieved by promoting even deposition of dredged material throughout the site's drop zone, with respect the baseline condition. This means that the dredged material would be placed though out the entire site, both in space and time, using a regimented procedure to produce a uniform continuous layer on the seabed, avoiding the formation of any localized mounding.

SWS and NJ Site. To promote even and controlled deposition of dredged material within SWS and NJ Site the sites were partitioned into a system of cells (83 cells @ 500 x 500 ft for the SWS and 40 cells @ 250 x 500 ft for the NJ Site) as shown in figure 1a. Initial dump assignments are made for each cell within a given site based on the target mound heights (elevations) for dredged material accumulation. The cell assignments (dumps per cell) are periodically refined as a given site is "filled". As areas of a site become filled; the filled cells are either minimally used or are restricted from use. To facilitate coordination of site assessment, the same placement grid will be used by the contractor and government dredges. Figures 5 and 6 show initial cell assignments for the SWS and NJ Site and constitute the initial (provisional) disposal plan for each site for 2007. It is noted here and elsewhere in this AUP that these disposal plans may be updated using survey data obtained immediately before commencement of the dredging-disposal season.

During 2007, placement of dredged material within either SWS or the NJ Site will be conducted according to the following specification. The SWS and NJ Site shall be filled uniformly with no more than one load difference between any two cells: All cells must be filled with one load before placing a second load in any cell; all cells designated for two loads must be filled before placing a third load in any cell, etc. When recording the placement location, material shall be credited to the cell in which the disposal operation is started regardless of the number of cells disposed in. Each load shall be distributed across no less than 3 cells. No more than 35% of a hopper dredge load shall be placed within any given grid cell. Additional measures may be exercised to maximize capacity within the eastern half of the SWS. The filling of cells may be preferentially weighted toward the eastern half of the site.

Deep Water Site. Dredged material placement within the active drop zone of the DWS will be conducted in manner similar to the SWS. See figure 1 and 7(a) for the DWS drop zone to be used during 2007. The intent is to confine the aerial dispersal of dredged material placed within each "drop zone" of the DWS without promoting excessive vertical accumulation of placed dredged material. The outcome will achieve pin-point dumping without negative effects. Appendix A describes how a cell-based assignment can be used for the DWS to effectively achieve a concentrated accumulation on the bottom. Figures 7a show initial cell assignments for the drop zones to be used within the

DWS and constitute the initial disposal plan for each site for 2007. The present vertical limit for dredged material accumulation (on the seabed) within the MCR-06-DWS is approaching 20 ft. Deposition of dredged material placed within the MCR drop zone during 2007 is not expected to exceed 10 ft of additional accumulation. Drop zones within the DWS shall be used uniformly with no more than 5 loads difference between any two cells. When recording the placement location within each drop zone, material shall be credited to the cell in which the disposal operation is started regardless of the number of cells disposed in. Each load shall be distributed across no less than 1 cell. It is noted that after 2006, dredged material accumulation with the MCR-06-DWS drop zone was expected to reach 30 ft with respect to the 2004 baseline elevation. Based on this expectation, a new MCR-DWS drop zone was selected for 2007 (MCR-07-DWS) to limit mounding within MCR-06-DWS.

11. Data Reporting Requirements

Field Data to be Provided to NWP: Portland District will conduct an internal briefing every week, during the active MCR dredging-disposal season. The Portland Resident Office (EC-R) and Waterways Contracts (OP-NWC) will retrieve digital information describing the contract and government hopper dredge disposal operation (tracklines and beginning-ending dump coordinates). EC-R will verify the integrity of the disposal data. The previous day's verified disposal data will be provided to EC-HY/HR digitally every day while the dredges are working at MCR. Weekly compilation of disposal tracklines (in digital form) will be provided to EC-HY/HR and EPA-Region 10 weekly. Other data may be transferred to OP-NW and EC-HY/HR, as adaptive site management requirements dictate. EC-HY will review disposal data to verify that the active disposal sites are being used as intended and compare to hydrographic survey results. OP-NWH should provide hydrographic survey information (MCR channel and all MCR disposal sites) to EC-HY in a timely format.

EC-HY will compile survey information, update disposal plans when needed, and disseminate value-added products according to the flow diagram in figure 2. These data will be coordinated with EPA.

Updates from NWP to Public: The Portland District (MCR project manager) will provide updates to collaborating agencies and interested stakeholders periodically – normally every week. Other data may be sent, as adaptive site management requirements dictate.

12. Coordination of Dredging Activities during the Dredging Season

Steps that are taken to increase awareness of dredge locations and disposal management throughout the dredging season include:

1. **Public Coordination:** The EPA- Region 10 approved Annual Use Plan is coordinated with State Agencies and the public via email and an informational meeting conducted in the local area (Ilwaco/Astoria) prior to start of dredging. The approved Annual Use Plan is also posted on the Corps' website. A press release is issued to newspapers and radio stations in the local area prior to start of dredging and disposal

activities. Key crab fisherman who fish in the area of the Shallow Water Site and the North Jetty Site are notified via telephone two weeks in advance of the dredge starting work in these sites.

2. The Coast Guard is informed of when the work will start and they include this information in their Notice to Mariners. As Dredge Orders are prepared for the Federal dredges, a copy is furnished to the Coast Guard via email for posting in the Notice to Mariners.
3. If two dredges are scheduled to concurrently work the MCR project, a meeting is held (at the beginning of the dredging season) between the Captains of each vessel to discuss communication and coordination. If a contract dredge is assigned use the SWS or NJS for dredged material disposal, an extensive briefing and tutorial is given to the bridge crew of the contract dredge by NWP to ensure that the contract dredge performs dredging and dredged material disposal according to the requirements set forth in the dredging contract plans and specifications. The plans and specifications for the dredging contract dealing with dredged material disposal at MCR, are based on AUP requirements.
4. Hopper dredges are required by the Coast Guard to employ an intermittent blast from the ship's horn during foggy and low visibility conditions. Hopper dredges are also required by the Coast Guard to display the "ball-diamond-ball" pattern atop her bridge to symbolize her limited ability to maneuver within a navigation channel.
5. Hopper dredges are required by the Coast Guard to display of automated identification systems (AIS) information, which indicates the position, heading, speed, ship length, beam, and type.
6. Nighttime dredging operations require Coast Guard navigation lights mounted at each cardinal location of a dredge.
7. Local newspapers, radio, and media propel public awareness of dredging activity within the area.

APPENDIX A

Mouth of the Columbia River Navigation Project

The mouth of the Columbia River (MCR) is the ocean gateway for maritime navigation to/from the Columbia – Snake River navigation system. The U. S. Army Corps of Engineers is responsible for the operation and maintenance (O&M) of the federal deep-draft navigation channel at the Mouth of the Columbia River (MCR). The MCR navigation channel lies between Columbia River Mile (RM) –3 to +3. The federal navigation project at the MCR is authorized by Rivers and Harbors Act of 1884, 1905, 1954, and Public Law 98-63. The authorized project provides for a 2640-ft wide deep-draft navigation channel across the Columbia River bar. The northerly 2,000 ft of the channel is maintained at –55 ft MLLW (plus 5 ft for over dredging), and the southerly 640 ft of the channel is maintained at –48 ft MLLW (plus 5 ft for over dredging). To achieve the 5 foot of advanced maintenance, in some locations 1-2 feet of material may be disturbed or removed during the dredging process.

The Corps of Engineers-Portland District annually dredges about 4 million cubic yards (MCY) of sand at MCR to maintain the 6-mile long deep draft navigation channel (Table B1). Most of the dredging occurs between RM –2 and +2 and is executed during the summer season. The dredged material is fine-medium sand (0.19-0.25 mm) and fine-grained material content is less than 3%. Due to the exposed ocean conditions at MCR, only ocean-going hopper dredges can perform dredging and disposal at MCR; dredging is limited to summer when wave conditions are favorable for working on the bar. Two hopper dredges are normally used to perform maintenance dredging at MCR: A government operated dredge and a contractor operated dredge, each with different capacities and operating characteristics.

Columbia River and Lower Willamette River Navigation Project

Since 1962, the Columbia and Lower Willamette Rivers federal navigation channel has been maintained at a depth of 40 feet and width of 600 feet, from RM 3.0 to 106.5. This channel configuration was authorized by River and Harbor Act 1962, PL 87-874. Much of the sediment that was dredged from RM 3 to 29 has been placed within estuarine disposal sites. Due to projected capacity limitations of estuarine disposal sites to accept additional dredged material (sand), long-term plans have identified material as far upstream as RM 29.0 as potentially being placed in the ocean, at designated disposal sites [USCE 1998]. Annual maintenance quantities projected to go to designated MCR ocean disposal sites, beginning in 2010-2012, were estimated to average 0.4 MCY per year. Sediment located within the Lower Columbia River (LCR) channel is classified as fine-medium sand (0.20-0.28 mm, with less than 3% silt-clay) and is suitable for placement within the ocean.

In December 1999, Congress authorized the deepening of the Columbia River segment of the Columbia and Lower Willamette Rivers federal navigation channel to 43 feet [Section 101(b)(13) of the Water Resource development Act of 1999]. The existing 600-foot-

wide, 40-foot-deep navigation channel would be deepened to -43 feet Columbia River datum (CRD), from RM 3 to RM 106.5. The construction phase of the LCR channel deepening includes advanced maintenance dredging for over-width and over-depth, in the reaches where this practice is currently performed in the present maintenance program. It is likely that the LCR deepening project will be completed in 4-6 phases: The construction (new work) of the 3-ft channel deepening project for the Columbia River is dependent on Federal appropriations, and at this point it is difficult to assess the completion date. During the construction phase of the 3-foot channel deepening, it was estimated that 6 mcy (4 mcy new work; plus 2 mcy for 40-foot O&M) from RM 3-29 could go to MCR ocean disposal sites [USACE 1999]. Similar to long-term planning conducted for the 40-foot project, future maintenance material from RM 3-29 (associated with the deepened channel @ -43 ft) is expected to go to the ocean, when estuarine disposal sites reach capacity. If the material dredged from RM 3-29 is to be placed in the ocean, the dredging could be accomplished using either a hopper dredge or a clamshell/barge disposal operation.

In 2005, work (dredging) began to deepen the 600-ft wide navigation channel within the lower Columbia River from -40 ft to a newly authorized depth of -43 ft CRD (-45 ft to -48 ft when considering advanced maintenance). During 2005 (phase I of LCR channel deepening), approximately 1.3 MCY of the “new work” sediment was dredged from the LCR channel via hopper dredge, between river mile (RM) 5 and 21, and was placed within the Deepwater Site (DWS). The DWS is located 7 miles offshore the mouth of the Columbia River. In 2006 (phase II), approximately 1.1 MCY of “new work” LCR material was dredged between RM 21 and 29 and placed within the DWS using a hopper dredge. During 2007, there is no Columbia River “new work” dredged material expected to be placed within the DWS.

The Hopper Dredge

A hydraulic hopper dredge is a self-propelled seagoing ship with sections of its hull compartmented into one or more holds or “hoppers”. It is normally configured with two drag arms, one on each side of the dredge. During dredging, bottom sediment is sucked into the drag arm by hydraulic pumps and deposited into the dredge’s hoppers. The dredged material enters the hoppers in slurry form and settles to the bottom as excess water flows over the top of the hoppers. Once the hoppers are full, the drag arms are lifted, and the dredge transits to the disposal area where the dredged material is usually dumped thru doors located on the bottom of the ship (hoppers). In some cases, the hopper dredge can use its pump to discharge the dredged material directly overboard or thru a pipeline to a disposal site not reachable by the hopper dredge (i.e. beach, upland, or nearshore locations). The operating parameters for several dredges that have been used at MCR are shown below.

Table A-1. Operating parameters for hopper dredges commonly used at MCR

DREDGE	OVERALL DIMENSIONS			CAPACITY load-average (cy)	VESSEL type	TIME TO PLACE	
	length (ft)	beam (ft)	draft(ft) loaded/empty			open water dump (minutes, per load)	pump-out
<i>Newport(Cntr)</i>	300	55	20/10	3,000	split-hull	4 to 8	N/A
<i>Padre Island(Cntr)</i>	281	52	19/8	2,700	split-hull	4 to 8	N/A
<i>Essayons(Gvt)</i>	350	68	30/15	5,400	bottom doors	6 to 15	120 to 140*
<i>Stuyvesant(Cntr)</i>	372	72	29/17	8,000	bottom doors	6 to 15	130 to 160

* may have pump-out capability in 2008

Hopper dredges are used mainly for dredging in wave exposed or high current areas where traffic and operating conditions preclude the use of more stationary dredges and their attendant pipeline or dump scows. Hopper dredges are effective working offshore and in entrances where sea and weather conditions preclude the use of extensive dredge pipe (associated with pipe-line or cutter-head/hydraulic dredges). Most hopper dredges are capable of operating in ocean swell 8-10 ft high which is required for ocean inlet dredging and accessing disposal sites many miles from the dredging location. The government hopper dredge (*Essayons*) utilizes a series of “doors” located on the hull bottom to release each load of dredged material. The bottom doors are sequentially opened during disposal until the entire load of dredged material is released from the vessel resulting in a gradual release of dredged material from the vessel. Contractor hopper dredges typically employ a split-hull design. A split-hull hopper dredge releases its load of dredged material by opening (splitting) the entire hull of the vessel. The split-hull method of disposal is more rapid (time-efficient) than bottom-door hopper dredges. While the use of split-hull hopper dredges reduces the time required for material disposal, split-hull dredges reduce the horizontal dispersal of dumped dredged material on the seabed while increasing the vertical extent of accumulation per dump.

MCR Disposal Site Utilization: Procedures and Governing Constraints

Both the Shallow Water (SWS) and Deep Water Sites (DWS) were configured based on hopper dredge operating characteristics. The Deep Water Site is large enough that barge-disposal of material would not be a problem. At the Shallow Water Site, dredged material placed using a barge/scow would likely not erode and disperse as readily as material placed by a hopper dredge. Due to less control and maneuverings limitations of a barge and tow, placement of material in the SWS by this equipment may not be possible. *Before any non-hopper dredged material may be discharged at the Shallow Water Site, a specific evaluation (potentially including sophisticated modeling) must be completed and submitted for approval by the USEPA [USACE 2005].*

Disposal Site Terminology: The **Placement Area** of a disposal site defines the extent of sea bottom that will be occupied by disposed dredged material released at the water surface on an annual use basis, and/or over the anticipated life of the disposal site. A **drop zone** is a defined area at the water surface within the placement area and within which dredged material discharge may occur. The drop zone for the SWS and the DWS are shown in figure 1 (dashed black line). The Drop Zone may be further subdivided into “cells” for more specific placement control (i.e. area MCR-07 within the DWS). A **Buffer** is that area of the sea bottom between the defined limit of the placement area and the disposal site boundary. Direct disposal into the buffer is prohibited. Consult the SMMP for additional information [USACE/USEPA 2005].

Shallow Water Site (formally ODMDS E): The entire SWS occupies a trapezoidal area of 3,100 to 5,600 ft wide x 11,500 ft long and lies within 2 miles offshore from MCR in a water depth of 45 ft to 75 ft (see figure 1 and 8). The SWS drop zone is 1,054 ft to 3,600 ft wide by 10,000 ft long (and is equivalent to the former Section 103 ODMDS E). The SWS was designated in 2005, under the Section 102 of the MPRSA as described in USEPA [2005]. The SWS is of strategic importance to the region; its continual use has supplemented Peacock Spit with 74 million cy since 1973, maintained the littoral sediment budget north of MCR, protected the north jetty from scour and wave attack, and stabilized the MCR inlet. It is USACE’s position that the SWS must be continued to be used to maintain the MCR inlet and stabilize the sediment budget north of the MCR (see Appendix B). Prior to 2007, approximately 25 MCY of MCR dredged sand had been placed within the SWS (during 1997-2006). As of 5 March 2007 approximately 2.2 MCY of this material remain within the SWS drop zone, with respect to the site’s 1997 baseline condition (figure 9 and 10). Results obtained from extensive analysis of the SWS indicate that the site can accommodate 4-6 MCY of accumulation within the drop zone baseline bathymetry without creating hazardous wave conditions, provided that the dredged material deposition is uniform throughout the drop zone [USACE 2003]. The SWS is configured so that the site is large enough to allow for the temporary storage of placed dredged material as it is naturally dispersed into the littoral zone during the dredging season avoiding the creation of conditions that could interfere with navigation safety.

Figure 11 shows the *target contour elevations* for the SWS: These contours account for a 5-ft accumulation added onto the site’s baseline (1997) bathymetry (compare to figure 9). As of 5 March 2007, the SWS present *static* target capacity is 1.6 MCY; this is the static volume that can be realistically placed within the SWS drop zone (figure 12). The static target capacity is what would be achieved if there were no dispersion of placed dredged material during the dredging season. The western half of the site is typically less dispersive than the eastern half of the site. Figure 12 shows the *contour heights* at which dredged material can accumulate within the SWS, without exceeding the site’s management target (with respect to May 1997), based on the 5 March 2007 survey. As of 5 March, the average height of accumulation that can be achieved during 2007 without exceeding the target contour elevations for the eastern and western areas of SWS is 5 ft and 3 ft, respectively.

Note that as of 5 March 2007, the *effective* target capacity within the Shallow Water Site (SWS) for the 2007 dredging season was estimated to be 2.1 MCY. The effective target capacity assumes that dredged material accumulates to the present target level within the site's drop zone and accounts for the dredged material side slope and the dispersive potential of the SWS. Between 20-50% of the material placed within the SWS is dispersed out of site's drop zone during the dredging season (June-October), based on site monitoring during 1998-2006 (see Table B-2). Refer to Appendix B for additional information concerning dredged material deposition within the SWS. The effective target capacity within the SWS drop zone can increase or decrease, depending upon prevailing wave-current conditions. Active monitoring of the SWS bathymetry during the dredging season is conducted to evaluate the current capacity of the SWS.

To avoid exceeding the management target for dredged material accumulation within the SWS (with respect to the baseline condition- May 1997), dredged material will be placed such that it accumulates uniformly throughout the site, both in space and time. This means that the entire site will be utilized, to the maximum extent practicable.

North Jetty Site (NJS): The NJS is located approximately 200 ft south of the MCR north jetty and occupies an area of 1,000 ft x 5,000 ft (figures 1 and 13). The average water depth within the NJ Site is 35 ft to 55 ft, below MLLW. The NJS overall site boundaries are coincident with the site's drop zone boundary and placement area boundary. The NJS was selected in 1999, under Section 404 of CWA, for the purpose of allowing the placement of MCR dredged material along the toe of the north jetty. Placing dredged material along the north jetty toe is needed to reduce severe undermining of the jetty by wave and current scour. Approximately 3.9 MCY were placed within the NJS during 1999-2006. As of 2 April 2007, 1.1 MCY remained within the NJS. It is acknowledged that some of the dredged material placed at the NJS is transported toward the navigation channel. So long as the amount transported from the NJS to the channel per year is small (less than 30% of the amount placed), the value of reducing scour along the north jetty outweighs the cost of re-handling the dredged material placed at the NJS. In consideration of the above, use of the NJS is curtailed from previous levels (0.5 MCY/yr).

As of 2 April 2007, the *effective* target capacity of the NJS was estimated to be 0.3 MCY, assuming that 70% of the NJS is permitted to accumulate dredged material to a height of 8 ft (with respect to the site's baseline 1999 condition). Refer to figure 14. The present target capacity for the NJS does not account for any dispersion of dredged material placed within the site. Due to the relatively shallow water depths thru the NJS, care will be taken to place dredged material such that it accumulates evenly within the site and the entire site should be utilized, to the maximum extent practicable. Placement of dredged material within the eastern half of the site is restricted during 2007 to prevent additional accumulation within that part of the site.

Deep Water Site: The entire DWS occupies an area of 17,000 x 23,000 ft and lies 6 miles offshore from MCR in a water depth of 190 ft to 300 ft (see figure 1). The DWS has a defined placement area, which is inscribed within the overall site boundary by a 3,000 ft

buffer zone, separating the DWS boundary from the DWS placement area (see figure 7). The DWS placement area is 11,000 ft x 17,000 ft. The DWS was designated in 2005, under the Section 102 of the MPRSA as described in USEPA [2005], to provide sufficient capacity for the disposal of dredged materials to meet current and anticipated future ocean disposal needs at the MCR. Placement of dredged material within the DWS will be limited to specific drop zones, which will be inscribed within the DWS placement zone. The intent is to confine the aerial dispersal of dredged material placed within the “drop zone” of the DWS without promoting excessive vertical accumulation of placed dredged material. Use of the DWS is expected to occur ONLY when the nearshore disposal sites have been used to the maximum extent practicable or when inclement weather conditions or operational constraints temporarily preclude the safe use of the other disposal sites.

One (1) DWS drop zone is available for use during 2007. The MCR-07-DWS drop zone is 4,000 X 4,000 foot (367 acres) and resides in a water depth of 220-235 ft. The MCR-07-DWS drop zone can accommodate approximately 12 MCY total deposition with an overall target mound height of 20-30 ft. During 2007, only sediment dredged from the MCR will be placed within the MCR-07-DWS. Figure 7a shows the initial 2007 placement plan for the MCR-07-DWS.

In 2003, part of the DWS was available for use for the first time (as a Section 103 site). It was not used that year as it was a below average shoaling year and there was adequate capacity in the SWS and NJS. In 2004, part of the DWS was used for the first time (as a Section 103 site) for the disposal of 1.7 MCY of sand dredged from the MCR channel. The DWS area used in 2005-2006 was the same as the drop zone used in 2004 (figure 24). During the 2006, the government hopper dredge *Essayons* placed 1.3 MCY of dredged sand using a cell-based plan very similar to what was used for the MCR-DWS in 2004-05. The resultant distribution of dumps through the MCR-06-DWS was almost uniform (figure 30), while the deposition on the seabed was confined similar to a pin-point disposal operation (figure 31). As of May 2006, the maximum height of dredged material accumulation within MCR-06-DWS was 18 ft. Approximately 64% of the dredged material placed within the 3,000 X 3,000 foot drop zone of the MCR-06-DWS during 2004 and 2005 could be accounted for as deposition on the seabed. To limit the mounding within MCR-06-DWS to 20-30 ft, a new DWS “drop zone” was selected for use in 2007. Refer to Appendix B for additional information concerning dredged material deposition within the DWS. Based on the results of the 2004-2006 disposal action with the MCR-DWS, it is assumed that a cell-based plan of disposal within DWS drop zones for 2007 will result in a confined (pin-point) accumulation of dredged material on the seabed allowed by the safety and operational constraints of a hopper dredge. Note that hopper dredges must remain moving during the disposal phase of the operation.

Previously Used Disposal Sites: The de-designation of ODMDSSs previously used at MCR is described in USEPA [2005]. The MPRSA Section 103 part of ODMDSSs A, B, and F (as expanded in 1993) expired in Fall 2002, leaving the original 1986 EPA-designated areas (Section 102) of ODMDSSs A, B, and F. In April 2005, EPA de-designated the original ODMDSSs A, B, and F. USEPA (Region 10) designation also

voided the Corps' selected Section 103 ODMDS E. Refer to Table B-1 for a summary of MCR open water disposal site use during 1956-2006.

Wave Model Application for Assessing Dredged Material Mounding at MCR

Numerical models (solved by computer) can be used to simulate the behavior of waves (wind waves and swell) as the waves approach the shore and become modified by limiting water depth, wind, and currents. In this capacity, numerical wave models can be used to evaluate the effects of waves interacting with dredged material mounding. Utilization of the SWS is predicted upon limiting dredged material accumulation within the site so as to avoid negatively affecting waves passing through the site. Numerical wave modeling has been used to ensure that SWS utilization complies this wave-related operational requirement.

RCPWAVE is a monochromatic wave model used to simulate modification of nearshore waves associated with shoaling (wave height change due to water depth change) and refraction (wave height and direction change due to spatial variation in water depth change). Because RCPWAVE is a monochromatic wave model (all waves are assumed to be identical in period, height, and direction), it can overestimate nearshore wave evolution by as much as 50%. Since RCPWAVE tends to over estimate nearshore wave height, it was used to establish a conservative target level for dredged material mounding (described in Section 4 of the AUP). Due to the inherent nature of RCPWAVE to over predict nearshore wave height, it is no longer used by USACE to quantify nearshore wave evolution where engineering applications require accurate determination of wave parameters needed to achieve optimized (least cost) coastal design.

STWAVE is a steady-state spectral wave model developed for simulating nearshore wave transformation and is presently the standard USACE wave model for estimating wave refraction and shoaling. STWAVE uses the wave action conservation equation, solved in the frequency domain using phase averaging to simulate wave propagation and estimate wave height, period, and direction at a given location (x,y). Time-varying information describing the changes in wave phase and superposition of waves having different phases is not presented. Phase-averaging limits this model from directly solving for wave diffraction and reflection caused by very steeply-sloped bathymetric features and surface piercing structures. However, approximation methods have been incorporated into STWAVE to indirectly account for wave diffraction and reflection [Smith 2003]. STWAVE has been extensively applied, calibrated, and verified throughout the US and the world. Refer to Moritz et al (2006) for a discussion of STWAVE application at MCR. The physics affecting waves in the nearshore area of Peacock Spit, including the SWS, are limited to shoaling and refraction; processes for which the STWAVE model was developed to simulate [USACE-USEPA 2003]. There are essentially no diffraction or reflection effects occurring within the SWS or nearshore areas of Peacock Spit, west of the offshore of the MCR jetties. In this regard, the STWAVE model is appropriate for assessing wave modification on Peacock Spit and within the SWS due to mounding of placed dredged material. The gradual varying bottom gradient (slope) of the bathymetry and mounding within SWS is consistent with the

formulation of STWAVE; i.e. the bottom gradient with the SWS is not so rapidly changing as to be invalid for STWAVE application.

Should mounding within the SWS exceed specified management thresholds, as described in Section 5 of this AUP, the STWAVE model will be used to evaluate the effects of dredged material (mounding) upon the wave environment of Peacock Spit. Beginning in 2007, the STWAVE model will be used at the conclusion of each MCR dredging-disposal season to assess the post disposal bathymetry of the SWS and Peacock Spit for wave amplification due to dredged material mounding within the SWS. Refer to Section 7 of the AUP for a discussion of post-disposal wave modeling for MCR.

APPENDIX B

Utilization of MCR Disposal Sites During 2006

During 2006, approximately 3.4 million cy of sand was dredged from 6-mile long MCR deep draft navigation channel. Approximately 1.8 million cy was placed within the SWS, 0.2 million cy was placed within the NJ Site, and 1.3 million cy was placed within the MCR-06-DWS. Approximately 1.1 million cy of LCR “new work” sand (dredged from the Channel Improvement project) was placed within the CR-06-DWS during 2006.

Figure 15 highlights the distribution of dredged material placed at MCR during 1956-2006, in terms of nearshore (north and south of the entrance) and deepwater (greater than 55 ft depth) locations. Note that during 1956-1996, most of the material dredged at MCR was placed in the nearshore, with equal distribution to the north and south of MCR. During 1997-2005, about 75 % of the sediment dredged at MCR was placed within the nearshore area north of the entrance. In an effort to re-initiate the balance in nearshore placement at MCR (north and south distribution), 34,000 cy was placed within the South Jetty Research Site in 2005.

Figure 16 shows the distribution and timing of MCR disposal site use during 2006. Note the times when the SWS was used (and not used). Non-use of the SWS during several 10-day periods (end of July, beginning of August, end of September) allowed time for the material placed within the site during 2006 to be dispersed out of the site (renewing site capacity), before the site was again used. The SWS was used most heavily during late August to early September, when the large displacement contract hopper dredge *Stuyvesant* placed 0.8 MCY within the SWS during a 16-day period. Approximately 37% of the material placed within the SWS during 2006 was dispersed out of the site’s drop zone during the 2006 dredging season. To reduce the rate of material placed within the SWS and NJS (and increase dispersion of placed material), dredged material disposal was distributed between the SWS and the NJS (or DWS) based on a daily 70%-30% split. During 2007, opportunities will be sought to allow cessation of disposal within the SWS and daily distribution of dredged material to available site to achieve the dispersal of dredged material observed during the 2006 dredging season.

SWS: Utilization of the SWS during 2006 is illustrated in figures 17-25. Figure 18 shows the level of sediment accumulation within the SWS at the beginning of the 2006 dredging season (June 2006) with respect to 1997; maximum accumulation was 5 ft. Figure 17 shows the 9 dump plans that were used to manage dredged material placement within the SWS during 2006. Note the instances (plans 1-4 and 8) when dredged material placement was restricted through much of the site’s western half to ensure that accumulation did not exceed management threshold (Section 5 of the AUP). Figures 19-26 show how dredged material accumulated within the SWS during 2006, in response to the contract dredge and government dredge using the site. Figure 19 shows the total accumulation of dredged material placed within the SWS during 2006 season (July-October), with respect to June 2006. Figure 19 demonstrates the overall attempt to utilize

available capacity within the SWS during 2006. Dredged material placement was managed around areas of prior accumulation so that total accumulation at the end of 2006 would not exceed 5 ft with respect to the 1997 baseline condition (compare to figures 18 and 19).

Figures 20-21 illustrate effectiveness of the government hopper dredge (*Essayons*) at distributing 0.49 MCY of dredged material within the SWS during 1 July – 9 August 2006. Localized deposition of dredged material placed within the SWS (by the *Essayons*) was 1-2 ft high, with most of the material placed and depositing within the eastern ½ of the site. Note how the western half of the SWS was not used; with some erosion of the seabed during June-August 2006.

Figures 22-23 show the effectiveness of the contract hopper dredge (*Stuyvesant*) at distributing dredged material within the SWS during 21 August to 11 September 2006, during which time the *Stuyvesant* placed 0.84 MCY within the SWS. It must be noted that the contract dredge was severely challenged with at working MCR and placing dredged material within the SWS/NJS. The *Stuyvesant* is the largest hopper dredge to have worked at MCR, and she is based out of the Gulf coast and was not accustomed to a structured QC work plan for dredging and disposal operations. Through intensive teaming between the *Stuyvesant* crew and Portland District personnel, the objective of performing MCR dredging and disposal according the contract plans and specifications was realized. The distribution of *Stuyvesant* dredged material disposal (beginning-ending coordinates, figure 22) suggests an arc-like pattern of disposal through the middle and northern half of the SWS. On several occasions, the *Stuyvesant* was requested by USACE to avoid repeating the same disposal track through the SWS. Another competing issue is that a large hopper dredge like the *Stuyvesant* can have a very high dredging production (disposal) rate. On several days during 26 August – 7 September, the *Stuyvesant* placed more than 65,000 cy/day within the SWS. This is significantly higher than what normally occurs at the SWS and occurred when splitting the daily disposal volume between the SWS and NJS (70% and 30%). Had the *Stuyvesant* not used the NJS concurrently with the SWS, there would have been several days where 80,000 to 90,000 cy/day would have been placed within the SWS; possibly leading to excessive mounding. Figure 23 shows the resultant bathymetry change (deposition) within the SWS during 9 August – 11 September (and captures the time period when the *Stuyvesant* was placing dredged material within the SWS). Note the arc of deposition (1 to 3 ft) within the middle and northern half of the site.

Figures 24-25 illustrate effectiveness of the government hopper dredge (*Essayons*) at distributing 0.54 MCY of dredged material within the SWS during 12 September – 14 October 2006. Localized deposition of dredged material placed within the SWS (by the *Essayons*) was 1 ft or less, with most of the material being placed along the southern margin of the site, while the material appeared to deposit through the center of the site. Note how the western half of the SWS was not used; yet some deposition occurred during September-October 2006. It is likely that material which has deposited within the eastern area and southern margin of the SWS was being transported to the west and north during July-October 2006. Although both dredges were “effective” at distributing dredged

material within the SWS during 2006; the *Essayons* had achieved better dispersal of dredged material.

As of October 2006, maximum accumulation of sediment within the SWS had reached 6 ft with respect to 1997 (covering an area of 500 ft x 800 ft). By the end of the 2006 dredging season, the SWS was at a “level 4” status (acceptable) in terms of the site’s Decision Framework for Site Management (see Section 5 of the AUP).

DWS: Utilization of the DWS during 2006 is summarized in figure 30-33. The dredge *Essayons* used the MCR-06-DWS (1.3 MCY) and the dredge *Stuyvesant* used the CR-06-DWS (1.1 MCY). The disposal locations shown in figure 30 document the distribution (beginning and ending coordinates for each load) of dredged material placed within the MCR-06-DWS during 2006. Figure 31 shows the accumulation of dredged material placed within the MCR-DWS since 2004. Although an attempt has been made to distribute dredged material placement within MCR-DWS, bottom accumulation of dredged material has been concentrated near the center of the site, due to the crossing of disposal tracks within the relatively small site. The maximum value of dredged material deposition within the MCR_DWS (during 2004 to 2006) is 17 ft. Figure 32 shows the distribution of dredged material disposal within the CR-06-DWS as performed by the dredge *Stuyvesant* during 2006. Note that only LCR (new work) material was placed within the CR-06-DWS during 2006.

NJ Site: Utilization of the NJ Site during 2006 is summarized in figures 13 and 33. The dredge *Stuyvesant* used the NJ Site during 2006 for a limited volume of dredged material placement (243, 000 cy). Some accumulation of sediment was observed to have occurred within the center of the NJ Site during 2006 (see figures 13-14). This localized accumulation is assumed to be dredged material placed within the NJS during 2006. Use of the NJ site during 2007 will be limited to 200,000 cy due to the persistent accumulation within the center of the site. It is noted that sediment has been accumulating within the eastern end of the NJS since 1999. This material is believed to have originated from sand that had been transported through the north jetty (from Benson Beach) during intense winter storm activity (refer to the next section for details).

Special Studies Conducted During 2006

Several studies were conducted during 2006 to assess the potential effects of dredged material placement within MCR disposal sites, as required by the SMMP and other regulatory frameworks. In summary, these activities included continued development of the ARGUS beach monitoring system (ABMS) at North Head, Multibeam bathymetry (collected at SWS), Circulation and Sediment Transport modeling at the SWS/DWS, and a second phase of study to assess the viability of nearshore dredged material south of the MCR south jetty. Results obtained from the 2006 special studies are summarized in figures 35-46. A biological special study (for assessing potential dredged material disposal impacts) was conducted in 2006.

ABMS at North Head: The ARGUS beach monitoring system (ABMS) at North Head has been operational since 2004 and is used to verify that wave action on Peacock Spit is not negatively affected by the SWS (http://www.planetargus.com/north_head). Figure 35 highlights the utility of the ABMS to monitor wave action along the southern extent of Peacock Spit (including the SWS). The bottom panel of figure 35 shows merged images from the 8 ABMS video cameras installed within the North Head lighthouse, view is to the south (7 Feb 2005). The SWS boundary is shown as a yellow line element in each image (bottom panel). Note the breaking waves that appear to boarder the northern boundary of the SWS. The top panel of figure 35 shows the rectified imagery (planimetrically correct) obtained from the bottom panel. The blue line shown within the top panel is the SWS drop zone, view is to the east. Note the location of wave breaking shown in the top panel; the waves are breaking 1 km north of the SWS. The North Head ABMS system continually updates the video imagery of Benson Beach and Peacock Spit every hour; the imagery is available to the public and can be accessed at the above website. Improved functionality has recently been added to the ABMS to monitor and convey real time wave action within the SWS using an hourly-updated “map”. If wave breaking is observed within the SWS, the Portland District will assess the severity of the situation, potential causes, and inform EPA and stakeholders of the situation. The North Head ABMS is also used to assess the stability of Peacock Spit and Benson Beach, in context to littoral sediment transport, SWS use, and morphology change (figure 36).

SWS Multi-beam Survey: Figures 37-42 describe two multibeam surveys obtained within the SWS during 23 August- 7 September 2006. The multibeam (MB) surveys were conducted to observe changes in bedform activity of the seabed (and transport of placed dredged material) along the northern boundary of the SWS drop zone. The two MB surveys show that sand waves 2-3 ft high were observed to migrate toward the northwest. Approximately 600,000 cy of dredged material was placed within the SWS during 23 Aug – 7 Sept. Figure 37 shows the coverage area of the two MB surveys with the SWS (along the northern perimeter of the drop zone). Figure 37 shows the deployment zone for a sediment tracer study, conducted within the SWS during 2006-2007 (see below). Figures 38-39 show the MB surveys for Aug and Sept 2006, respectively (note the location of cross-sections A-A’ and B-B’). Recent deposited dredged material can be seen to be moving out of the SWS, in a Northwest direction (indicated by the darker areas as sand waves within the figures). Figures 40 and 41 show close up views of the SWS MB surveys (figure 40 shows the eastern area of SWS and figure 41 shows the western area); note the orientation of the sand waves on the seabed indicating northwest transport of sediment out of the SWS. In both figure 40 and 41 the sand waves appear to have migrated further toward the northwest during Aug and September. Figure 42 shows the change in seabed elevation along cross-sections A-A’ and B-B’. Along Section A-A’ the sand waves tend to diminish at a distance of 1,600 ft along the section alignment, and at about 1,400 ft along Section B-B’. A higher degree of sand wave activity can be seen in each cross section in Sept as compared to Aug. These figure show that the dredged material placed within the SWS is actively being transported immediately after deposition on the seabed in a northwesterly direction, onto Peacock Spit. The active sand waves indicate a transport direction to the NW for sediment within

the eastern half of the SWS and WNW for sediment within the western half of the site, which is consistent with the 2005 MB SWS survey (see AUP for 2006).

Sediment Tracer Study at SWS: In September 2006 Portland District (NWP) initiated a sediment tracer study at the SWS. Moffatt & Nichol Inc was contracted by NWP to perform study with assistance from Evans-Hamilton, Inc and Environmental Tracing Systems, Ltd. The fieldwork for phase I of the tracer study spanned from September to December 2006 and focused on the SWS with a sediment tracer release site north of the SWS drop zone (figure 37 and 43-mid panel). The sediment tracer was designed to ‘behave’ in the same way (in terms of sediment transport) as the dredged sediment placed in the disposal site during dredge operations. The tracer would be transported (or become suspended) by waves and currents along with the dredged material. The ultimate goal of the tracer study is to verify whether dredged sediment placed within the SWS would become part of the littoral budget and provide direct measurement of the transport pathways on Peacock Spit. On 1 October 2006, approximately 1,200 Kg of tracer (or 150 billion tracer particles having equivalent gradation and density as MCR sand) was mixed 1:1 with MCR sand and placed on the seabed, via 120-20 Kg dissolving (starch) bags. Figure 43 (mid panel) shows the distribution of tracer release (bags) within the drop zone (bags dissolved within 10 minutes of release). On 3 October, the seabed near the tracer release site was sampled (first tracer sampling event) to verify that the tracer was on the seabed and determine if there had been any dispersion during the preceding 2 days. The sediment tracer is identified from native sand by fluorescence illumination (see bottom panel of figure 43). Results of the first tracer sampling event are shown in figure 44. Note that the sediment tracer had been dispersed to areas beyond the deployment release points. Results of the second tracer sampling event (4 Dec 2006, 63 days after release) are shown in figure 45 and 46. Note the extent to which the tracer had been dispersed to the NW and northward onto Benson Beach. Based on figure 45-46, there is strong and consistent evidence that the tracer was mobile and transported in a north or northwest direction in line with alongshore transport at SWS. It appears that sediment placed within the SWS is transported onto Peacock Spit and is incorporated into the littoral budget of WA. Additional findings and details are described in the draft report “Sediment Tracer Study, Ocean Dredged Material Disposal Site, Mouth of Columbia River”, prepared by Moffatt and Nichol Engineers. A spring 2007 tracer sampling (third) event is planned which will include all of Peacock Spit and an area north of North Head.

South Jetty Research Site (SJRS), Phase II Evaluation: The placement of dredged material within the nearshore region south of MCR is of strategic importance to bring balance back to the MCR regional sediment budget. SJRS-Phase II was conducted as a series of collaborative modeling tasks during 2006 to determine the feasibility of using MCR dredged material, deposited to form a large accretion feature (LAF), to protect the south jetty from storm wave action and augment the littoral budget south of the south jetty. Various “berm” geometries were evaluated using wave models for wave attenuation/impacts and several circulation models were applied to assess sediment transport off the LAF. Phase II was a highly successful collaboration between Oregon State University, USGS, ERDC-CHL, WDOE, nearshore stakeholders, and federal/state regulatory agencies. Phase II results are pending final reporting.

Table B1 Disposal of Dredged Material at Mouth of the Columbia River ODMSs (1956-2006) (MCR & CR & Tongue Point Dredged Material Deposited at Cited Disposal Areas)											
Disposal Site	A	B	C/NJ Site*	D *	E/SWS	F \$*	DWS_MCR	DWC_CR***	SJ Site	G	Total
											cubic yards
Fiscal Year	cy	cy	cy	cy	cy	cy	cy	cy	cy	cy	cy
1956	12,096,000	1,296,000	504,000	504,000	0	0				0	14,400,000
1957	1,605,643	1,221,307	422,071	838,428	0	0				0	4,087,449
1958	6,135	2,274,704	0	326,753	0	0				0	2,607,592
1959	0	1,914,964	0	661,021	0	0				0	2,575,985
1960	0	1,927,208	0	612,636	0	0				0	2,539,844
1961	0	1,837,879	0	297,066	0	0				0	2,134,945
1962	0	2,322,256	2,838	632,618	0	0				0	2,957,712
1963	0	1,725,851	724,630	234,735	0	0				0	2,685,216
1964	0	514,900	1,459,186	683,151	0	0				0	2,657,237
1965	0	675,921	1,205,090	1,606,671	0	0				0	3,487,682
1966	0	2,010,673	29,891	2,437,451	0	215,002				0	4,693,017
1967	0	1,463,573	1,067	354,700	0	422,066				0	2,241,406
1968	0	1,919,199	0	109,592	0	0				0	2,028,791
1969	0	2,021,562	0	89,042	0	0				0	2,110,604
1970	0	1,489,795	0	3,060	0	0				0	1,492,855
1971	51,047	1,439,042	13,818	241,689	0	0				0	1,745,596
1972	12,995	2,579,688	0	287,646	0	1,886				0	2,882,215
1973	0	3,051,662	0	409,640	291,439	3,060				0	3,755,801
1974	0	994,059	0	506,711	2,168,543	29,123				0	3,698,436
1975	0	333,462	0	895,594	4,886,792	27,539				0	6,143,387
1976	2,574	1,017,100	0	758,743	4,257,150	53,250				602,895	6,691,712
1977	2,867,393	1,868,579	0	710,373	3,678,429	0				0	9,124,774
1978	3,060	187,704	0	312,635	3,925,986	0				0	4,429,385
1979	0	116,502	0	158,466	4,930,840	0				0	5,205,808
1980	11,142	118,686	0	0	2,675,722	0				0	2,805,550
1981	2,254,321	9,180	0	0	3,042,896	0				0	5,306,397
1982	971,209	12,240	0	0	3,086,514	0				0	4,069,963
1983	1,124,466	199,969	0	0	606,218	0				0	1,930,653
1984	4,060,853	3,864,247	0	0	989,600	0				0	8,914,700
1985	1,326,150	2,068,927	0	0	4,126,429	0				0	7,521,506
1986	2,037,455	3,387,376	0	0	2,926,412	0				0	8,351,243
1987	1,593,550	1,209,358	0	0	1,183,050	0				0	3,985,958
1988	1,447,240	4,533,756	0	0	478,864	0				0	6,459,860
1989	647,458	3,456,285	0	0	568,522	2,030,954				0	6,703,219
1990	2,729,358	1,119,663	0	0	507,201	0				0	4,356,222
1991	1,486,938	1,956,570	0	0	380,142	0				0	3,823,650
1992	874,700	2,888,028	0	0	796,198	0				0	4,558,926
1993	0	1,629,208	0	0	988,208	2,288,431				0	4,905,847
1994	408,924	1,002,668	0	0	397,621	1,500,407				0	3,309,620
1995	0	2,480,664	0	0	988,547	0				0	3,469,211
1996	0	1,693,145	0	0	726,336	2,205,113				0	4,624,594
1997	0	326,824	0	0	1,071,246	174,883				0	1,572,953
1998	0	0	0	0	3,444,656	820,722				0	4,265,378
1999	0	0	1,050,000	0	3,750,000	262,000				0	5,062,000
2000	0	0	504,000	0	2,896,000	465,500				0	3,865,500
2001	0	0	498,000	0	2,176,000	1,390,000				0	4,064,000
2002**	0	0	498,800	0	1,503,800	2,270,668				0	4,273,268
2003	0	0	447,000	0	2,847,000	0				0	3,294,000
2004	0	0	506,000	0	2,960,000	0	1,715,283			0	5,181,283
2005	0	0	227,000	0	2,629,000	0	1,041,000	1,318,000	34,254	0	3,931,254
2006	0	0	243,900	0	1,832,860	0	1,395,330	1,056,000		0	3,472,090
Totals	37,618,611	68,160,384	8,337,291	13,672,421	73,718,221	14,160,604	4,151,613	2,374,000	34,254	602,895	220,456,294
Volume of sediment placed in Ocean Dredged Material Disposal Sites for 1956-2006 (cy)											
Annual Avg	North Jetty		SWS		ODMS F	MCR_DWS	CR_DWS	SJ Site	MCR Annual avg. for		
1997-2006	496,838		2,511,056		897,296	1,383,871	1,187,000		1990-2006	4,001,753	
									1986-1989	6,375,070	
									1977-1985	5,478,748	
									1956-1976	3,696,071	
Note 1 : ODMSs receive <i>Interim</i> designation in 1977 . Final designation of ODMSs in 1986											
Note 2 : 1999, NJ site used. Final designation of ODMSs in 1986 . In 2005; Sites A,B,F,E de-listed; SWS and DWS designated											
Note 3 : * Estuarine disposal site.; ** 43,500 cy placed on Benson Beach, *** used for Columbia River material, **\$ Tongue Pt. material 199											

Table B2 Summary of SWS ODMDS utilization and dispersive properties of site.

YEAR	VOLUME PLACED IN SWS ODMDS % of MCR dredging	SPECIFICIED PLACEMENT METHOD ^ C=contractor G=government	MAXIMUM MOUND HEIGHT @ END OF DREDGING SEASON *	EFFECTIVENESS OF USING ENTIRE SW SITE TO DISPERSE DREDGED MATERIAL	TRANSPORT DURING DREDGING SEASON (CY) **	TRANSPORT DURING WINTER (CY) **	NET ANNUAL TRANSPORT OF SEDIMENT OUT OF SW SITE (CY) **
1997	1.0 MCY 68%	None (C)	2-3 ft peak = 5 ft	20% of the Site Was Used	-400,000 (40%)	+614,000 60%	+214,000 20% accumulated
1998	3.5 MCY 81%	Grid Cells (C) Uniformly (G)	5-6 ft peak = 6 ft	70% of the Site Was Used	-2,100,000 (60%)	-1,216,000 (35%)	-3,315,000 (95% eroded)
1999	3.8 MCY 74%	Grid Cells(C) Uniformly(G)	6-7 ft Peak = 7 ft	80% of the Site Was Used	-1,520,000 (40%)	-1,091,000 (30%)	-2,611,000 (70% eroded)
2000	2.9 MCY 75%	Grid Cells(C) Uniformly(G)	6-8 ft Peak = 8 ft	60% of the Site Was Used	-1,160,000 (40%)	-739,000 (25%)	-1,899,000 (65% eroded)
2001	2.2 MCY 54%	Disposal Lanes(C) Uniformly(G)	6-7 ft Peak = 9 ft	70% of the Site Was Used	-1,200,000 (50%)	-1,752,000 (73%)	-2,952,000 (123% eroded)
2002	1.5 MCY 32%	Disposal Lanes(C)	6-7 ft Peak = 8 ft	50% of the Site Was Used	-300,000 (20%)	-1,710,000 (113%)	-2,010,000 (134% eroded)
2003	2.8 MCY 86%	Grid Cells (C) Grid Cells (G)	2-4 ft Peak = 5 ft	>90% of the Site Was Used	-900,000 (32%)	-575,000 (21%)	-1,475,000 (52% eroded)
2004	2.9 MCY 57%	Grid Cells (C) Grid Cells (G)	2-5 ft Peak = 5 ft	>90% of the Site Was Used	-1,000,000 (34%)	-1,000,000 (34%)	-2,000,000 (68% eroded)
2005	2.6 MCY 67%	Grid Cells (C) Grid Cells (G)	2-6 ft Peak = 7 ft	>90% of the Site Was Used	-900,000 (35%)	-1,900,000 (73%)	-2,800,000 (107% eroded)
2006	1.8 MCY 53%	Grid Cells (C) Grid Cells (G)	2-6 ft Peak = 6 ft	>75% of the Site Was Used	-680,000 (37%)	-730,000 (40%)	-1,410,000 (77% eroded)
	2.8 MCY 64%	AVERAGE VALUES	5-6 ft Peak = 9 ft	70%	39%	49%	88%

^ = method used to distribute dredged material within SWS ODMDS during seasonal placement. Assigning disposal events Grid Cells is used to enhance the uniform distribution of dredged material placed through out the site; the release point of each dump is assigned to a given grid cell, the end point of the dump lies 500-1,500 ft away from the release point. Each grid cell is assigned a finite number of dumps. Disposal lanes thru the SWS were assigned a limiting elevation, above which accumulation of placed dredged material was restricted. The use of Grid Cells to minimize the vertical accumulation of dredged material placed with the SWS is considered superior to disposal lanes.

* = peak value for maximum vertical accumulation of dredged material (mound height) may have occurred before the end of the dredging season. Values reported based on accumulation with respect to baseline condition (May 1997)

** = percentage of dredged material transported (out of SWS ODMDS) is based on the volume "placed" during a given year. Transport greater than 100% indicates that the SWS experienced net erosion. 1997 not included in winter and net dispersal statistics due to El Niño related deposition that occurred within western half of the site.

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Mouth of the Columbia River - Bathymetry and 2007 Dredged Material Placement Sites

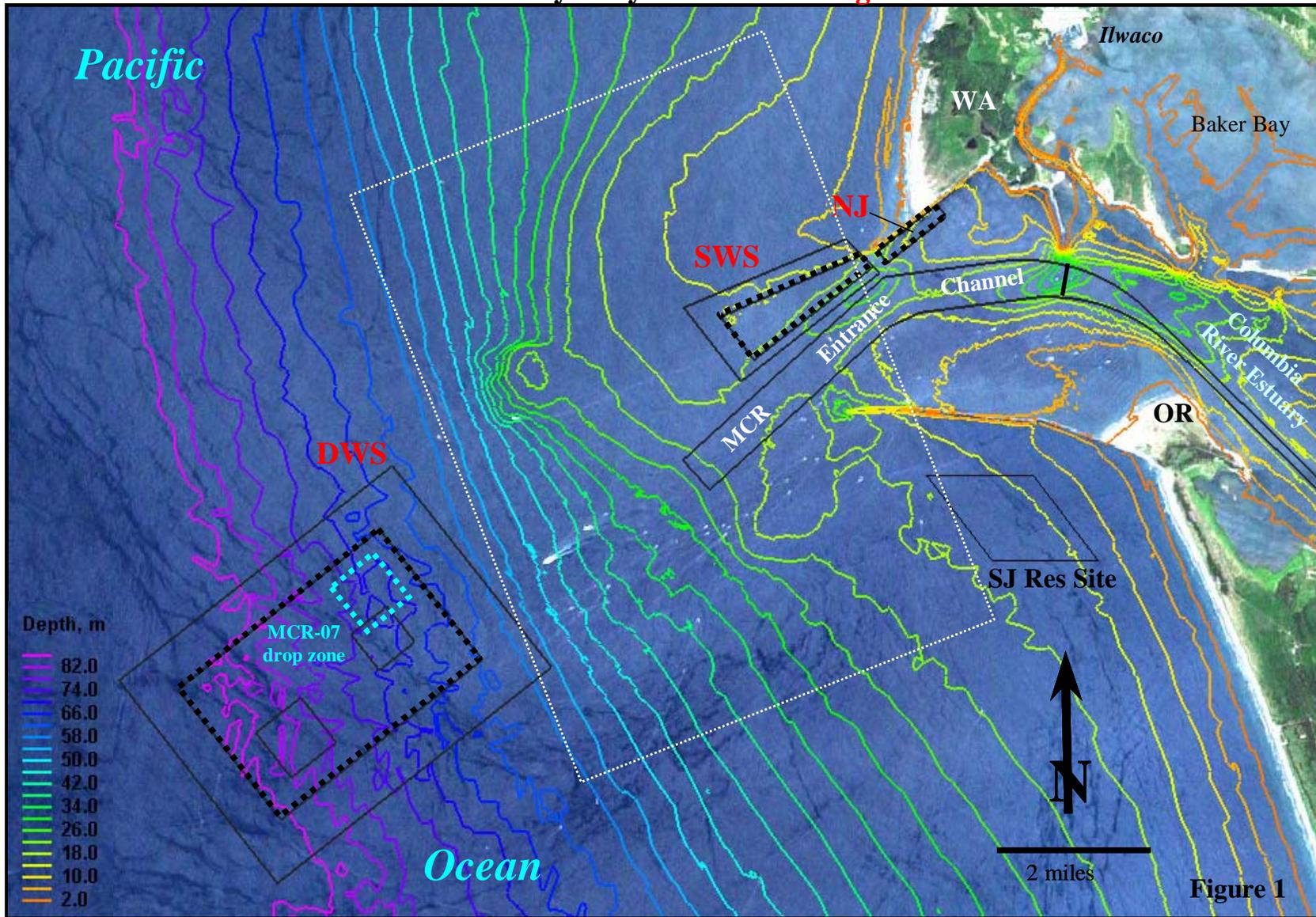


Figure 1

DWS= Deep Water Site, 102 MPRSA
 SWS= Shallow Water Site, 102 MPRSA

NJ Site = North Jetty disposal site, 404 CWA
 White Box = Bathymetry change shown in Fig 34

SJ Res. Site = South Jetty research site, restricted use by EPA permit

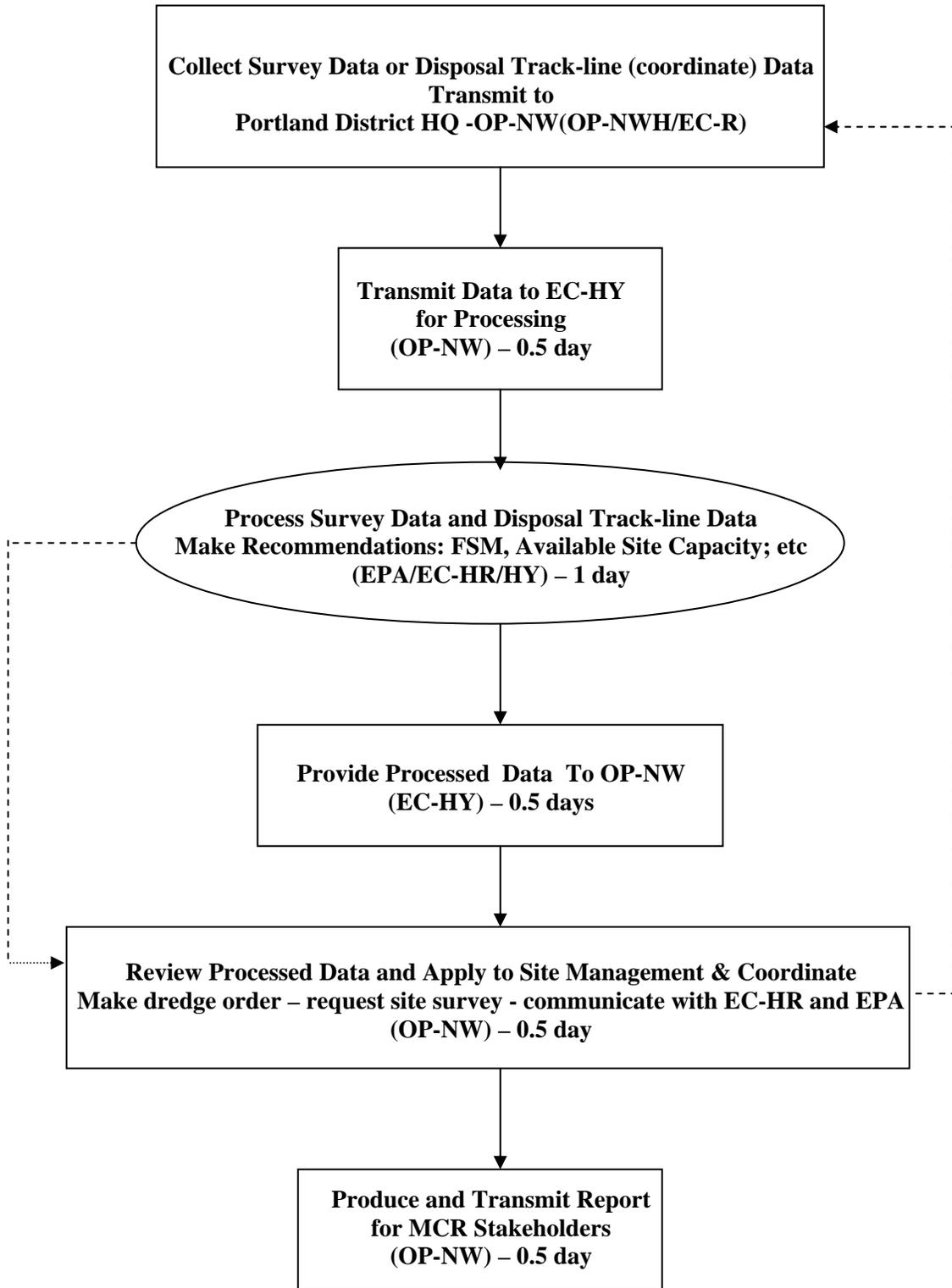


Figure 2. Flow diagram describing the procedure of processing monitoring data and using the processed data to manage disposal site capacity, at a frequency of 1 week or greater. Offices shown in () are assigned responsibility for task; expected duration of task is specified. FSM = Frequency for Site Monitoring.

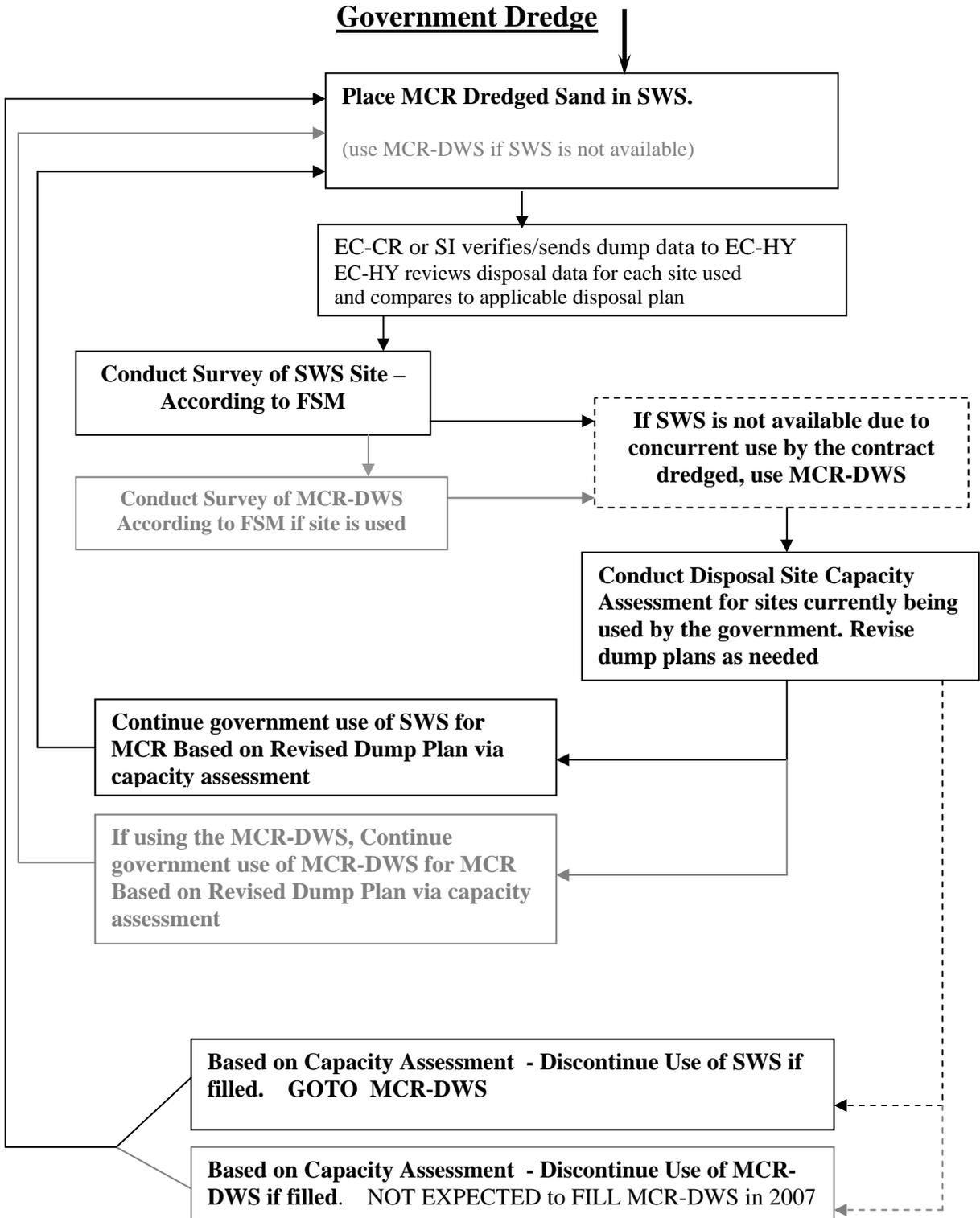


Figure 3a. Flow Diagram describing Action events for government dredge *Essayons* during dredging-disposal at MCR for 2007.

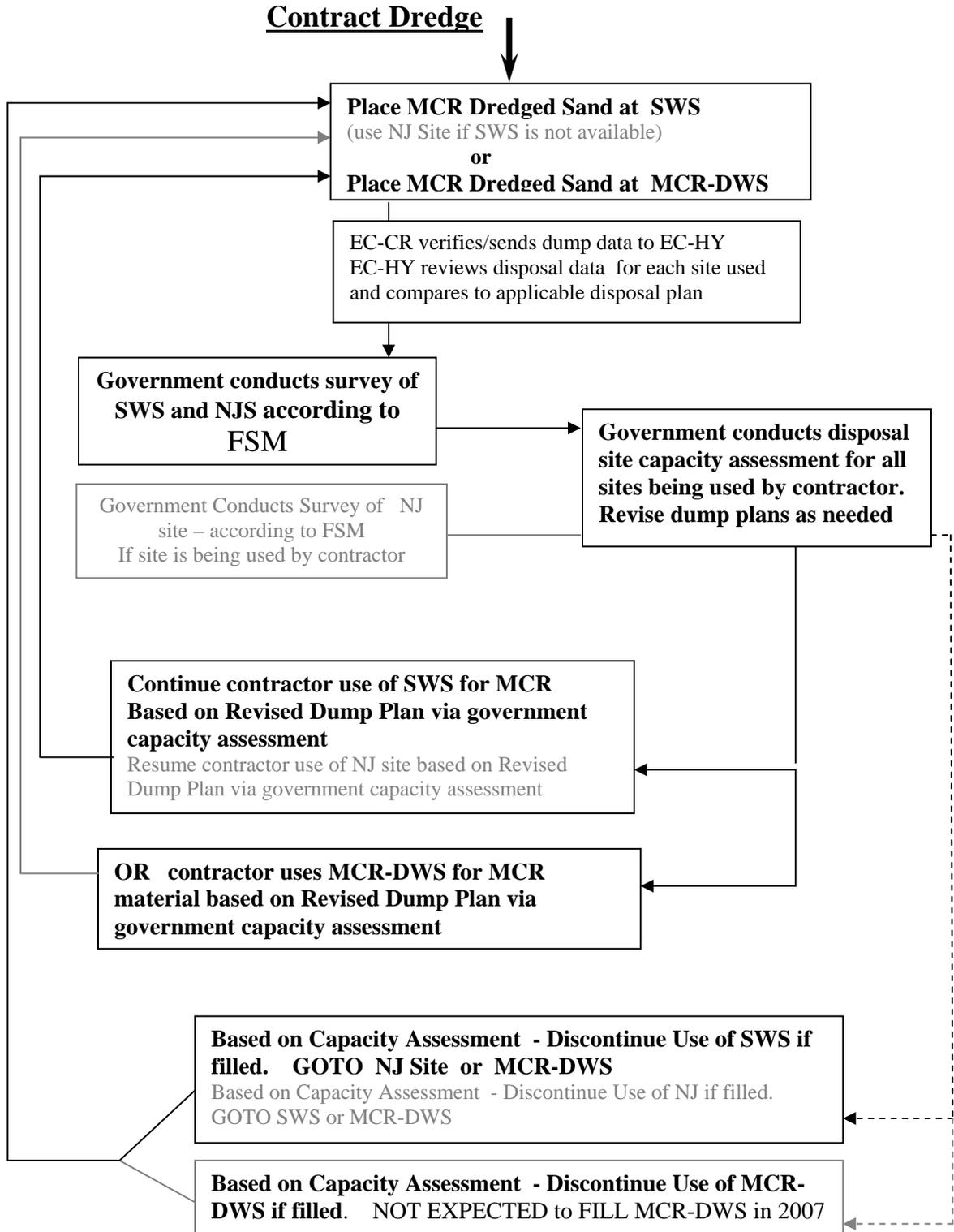
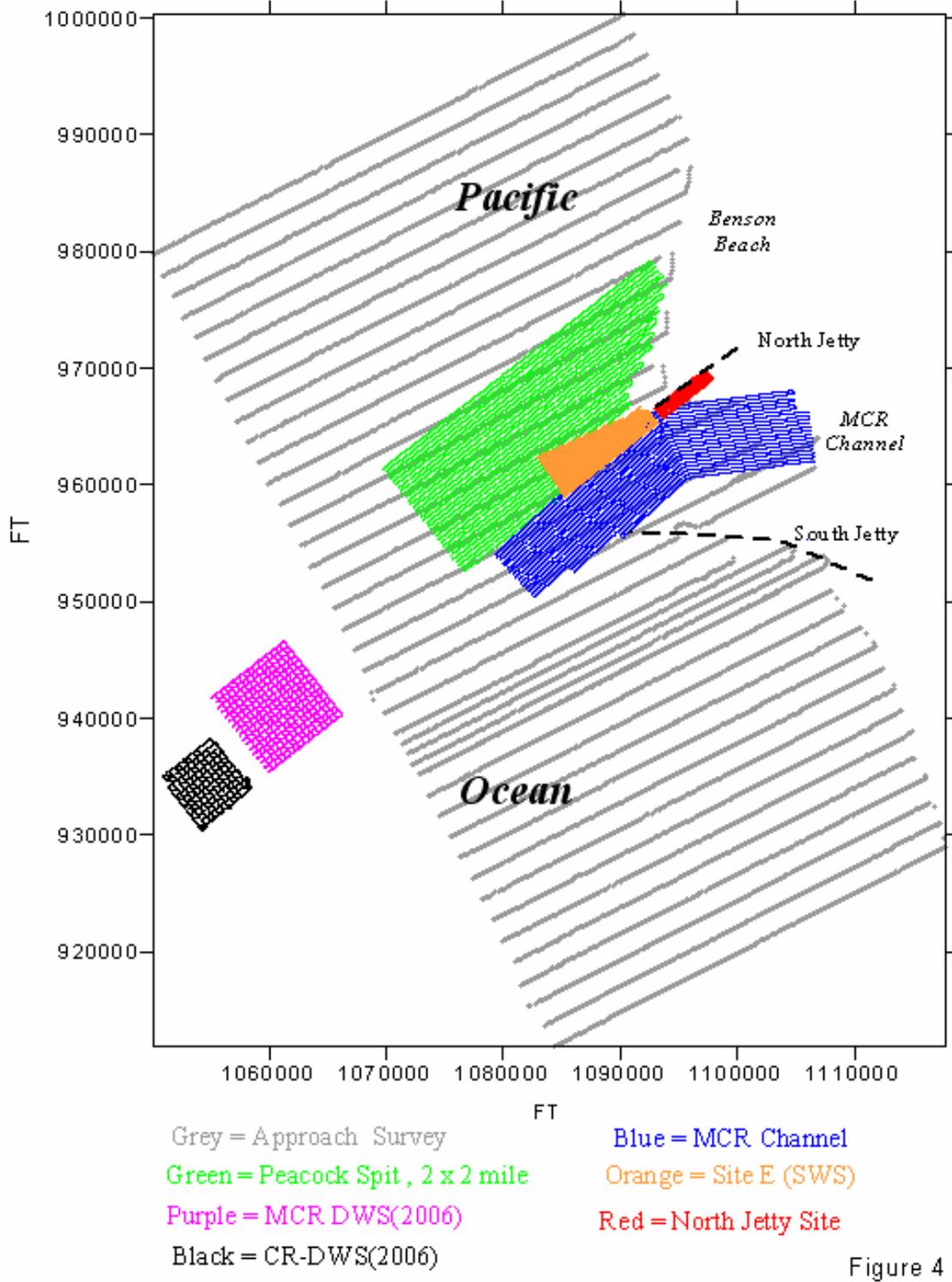


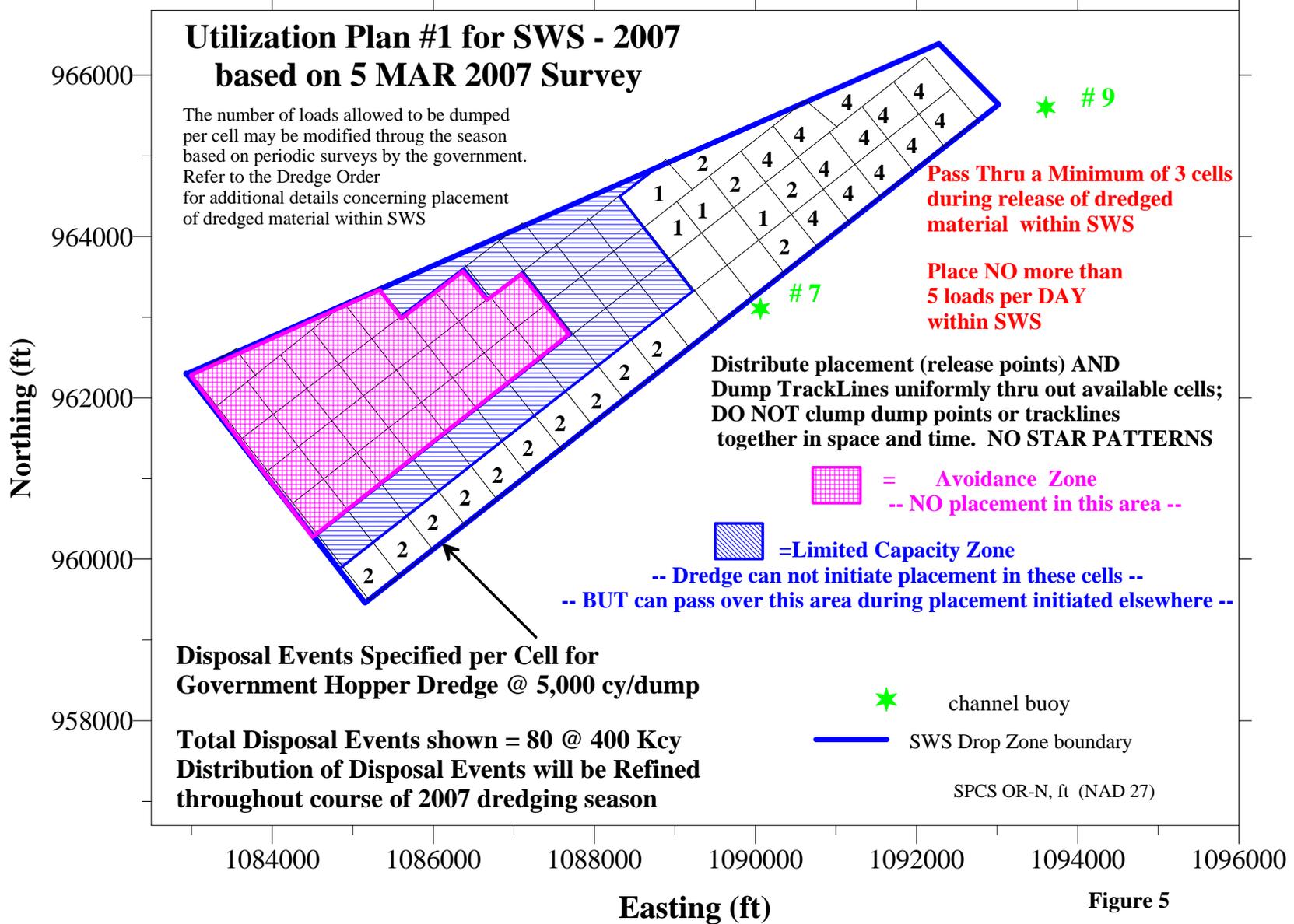
Figure 3b. Flow Diagram describing Action events for contract dredge during dredging-disposal at MCR for 2007.

MCR SURVEY DATA - COVERAGE - 2006



Site Use Sequence = Atl 1:

Once the dredge has placed the specified number of dumps in a cell, that cell shall become a Limited Capacity Zone



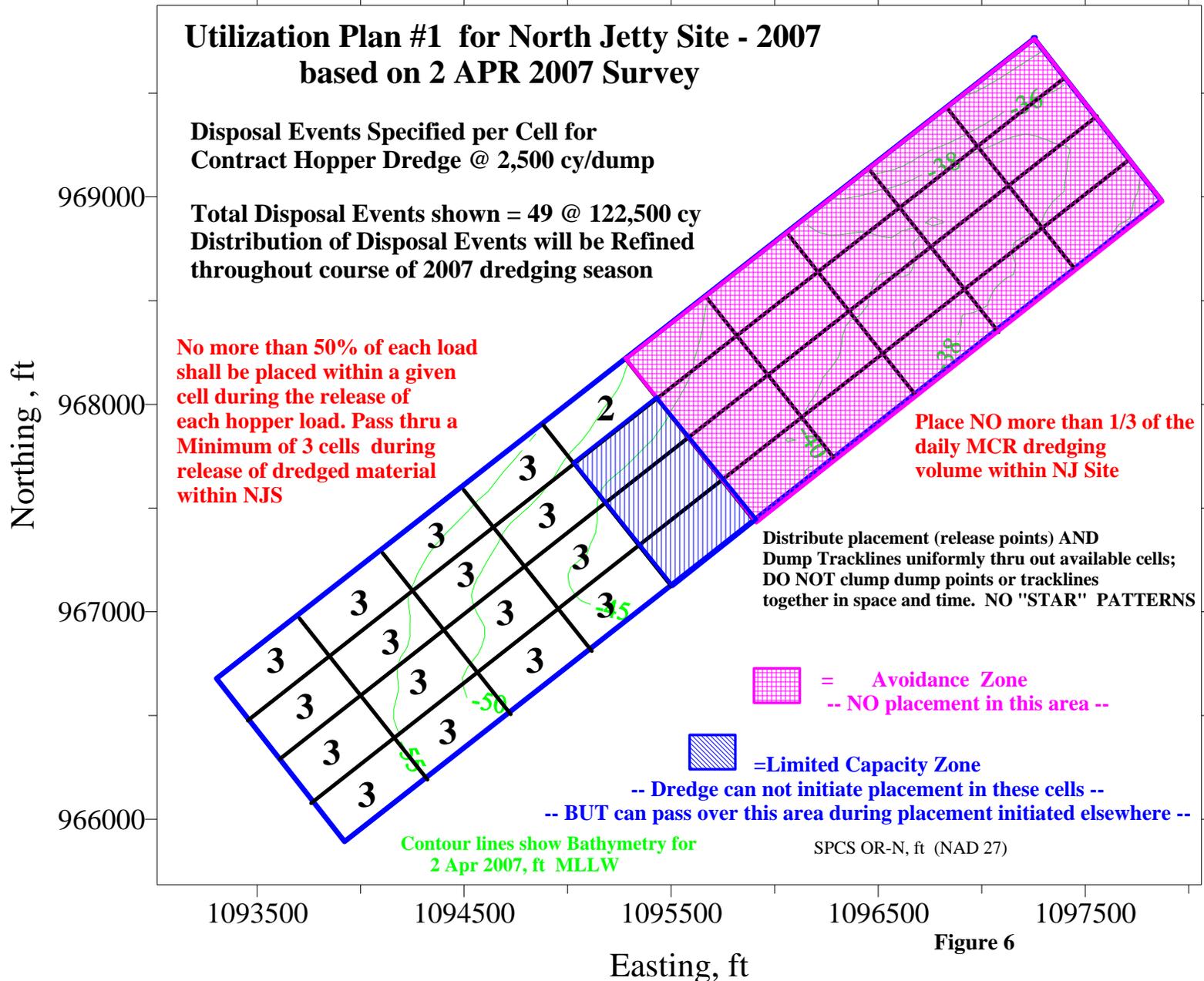


Figure 6

Easting, ft

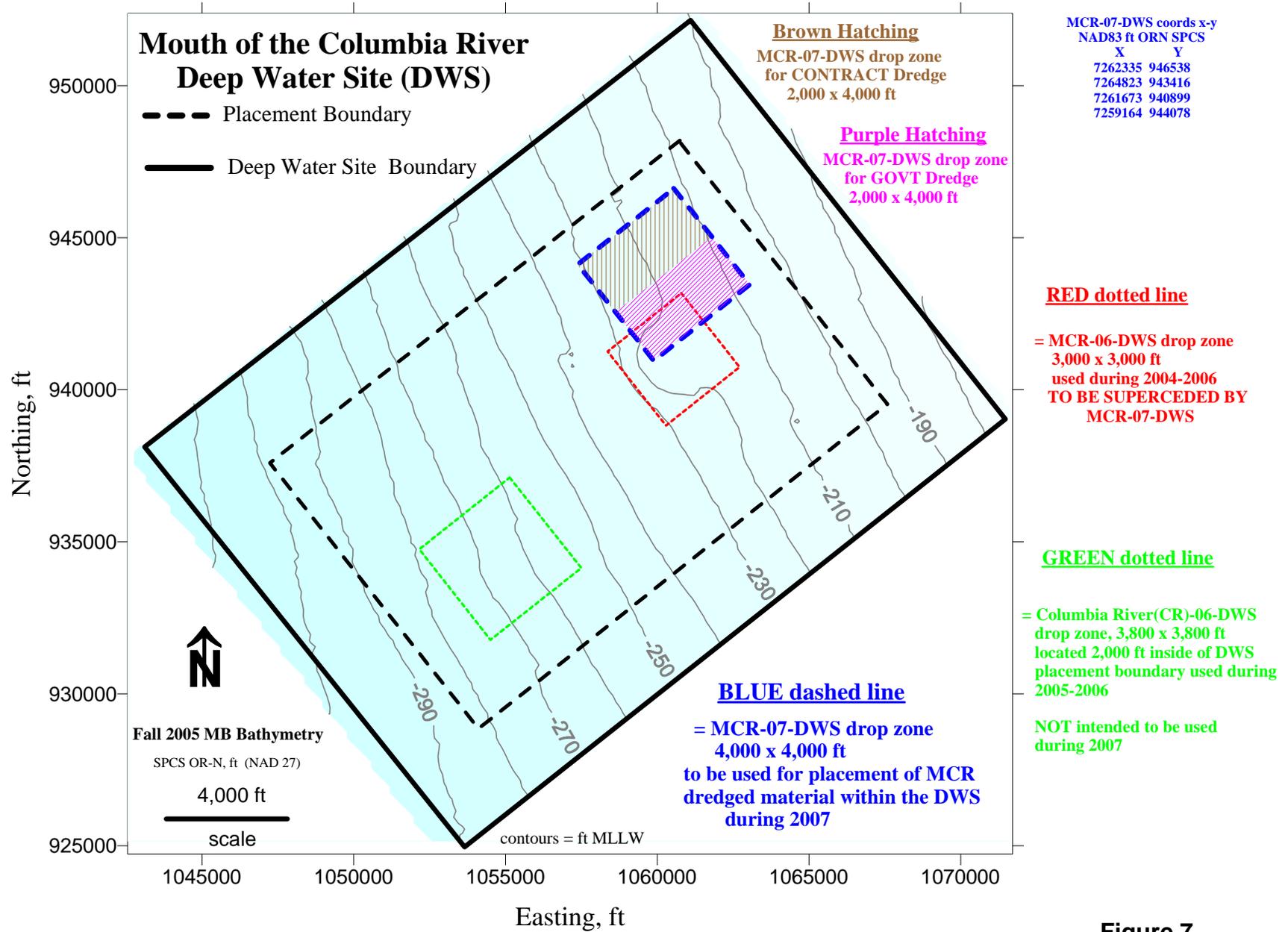


Figure 7

Mouth of the Columbia River Deep Water Site (MCR-07-DWS)

Utilization Plan #1 for MCR DWS: 2007

dashed blue line = "MCR-07-DWS"
Site drop zone is 4,000 x 4,000 ft

BROWN cell assignments = 200 loads
CONTRACT dredge loads/cell
at 2,500 cy/load = 0.5 MCY

PURPLE cell assignments = 300 loads
GOVERNMENT dredge loads/cell
at 5,000 cy/load = 1.5 MCY

Red Lines = grid (cells) used to control
the placement of dredged
material within the MCR
DWS area - 1,000 x 1,000 ft ea.

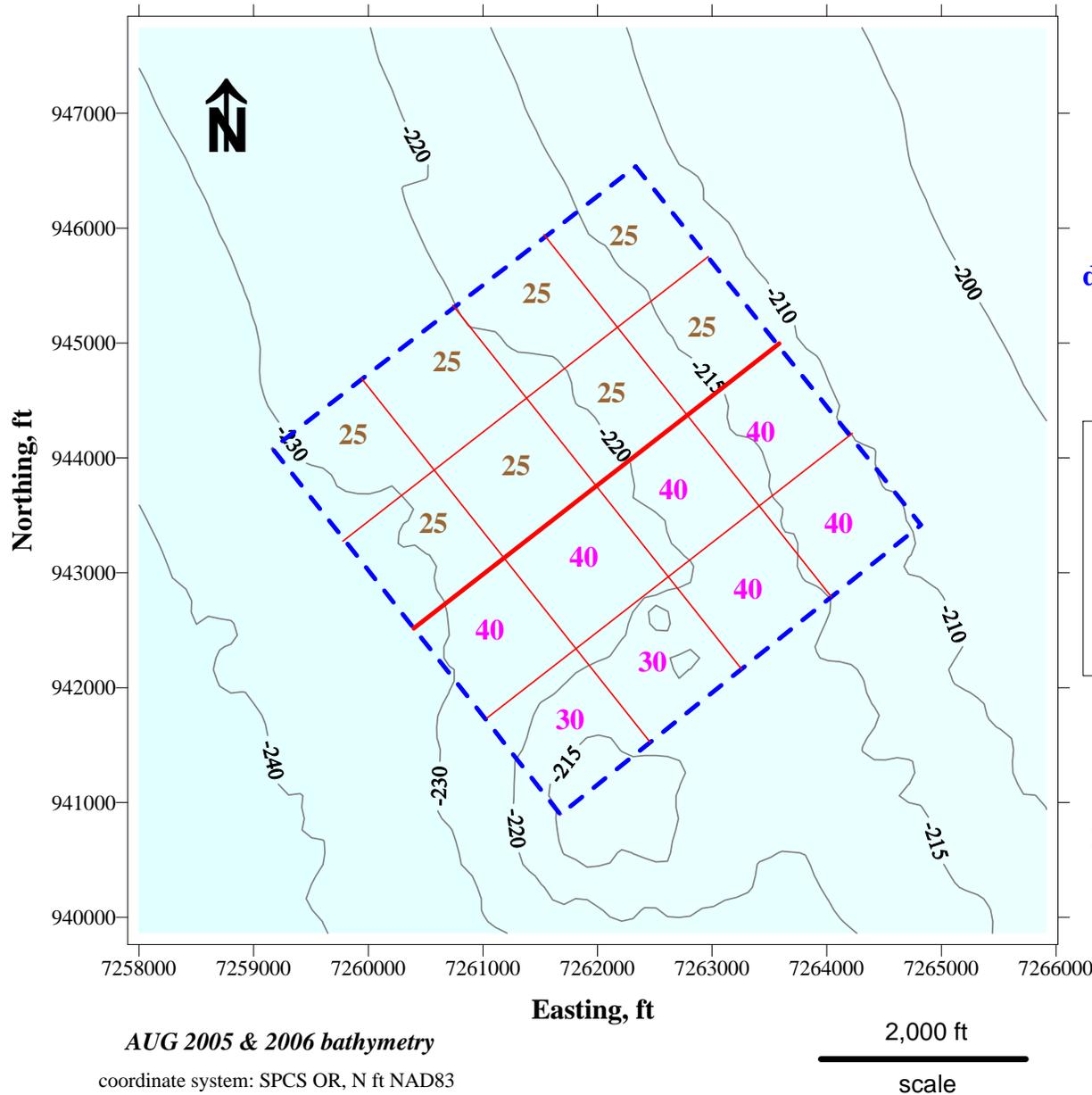
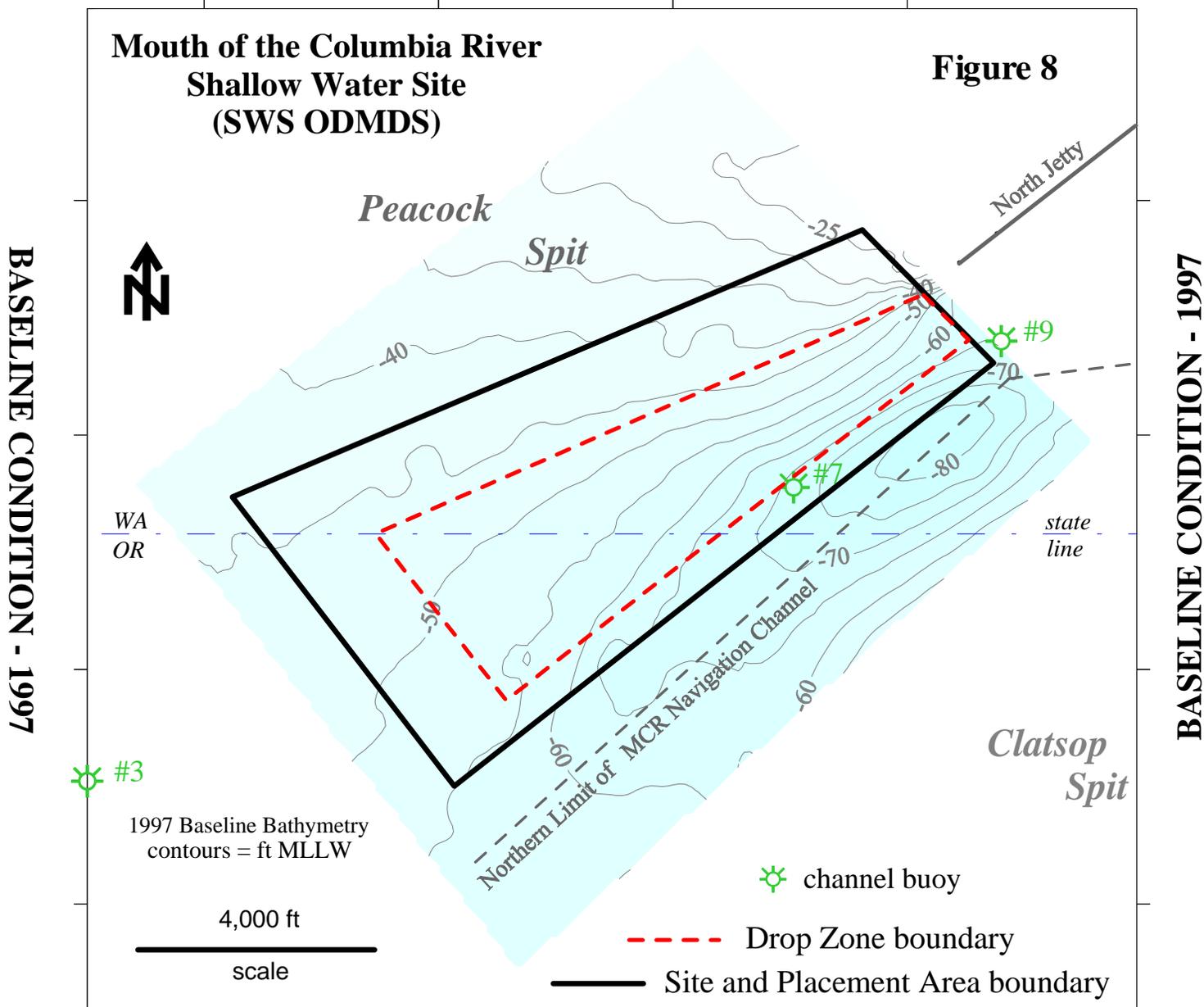
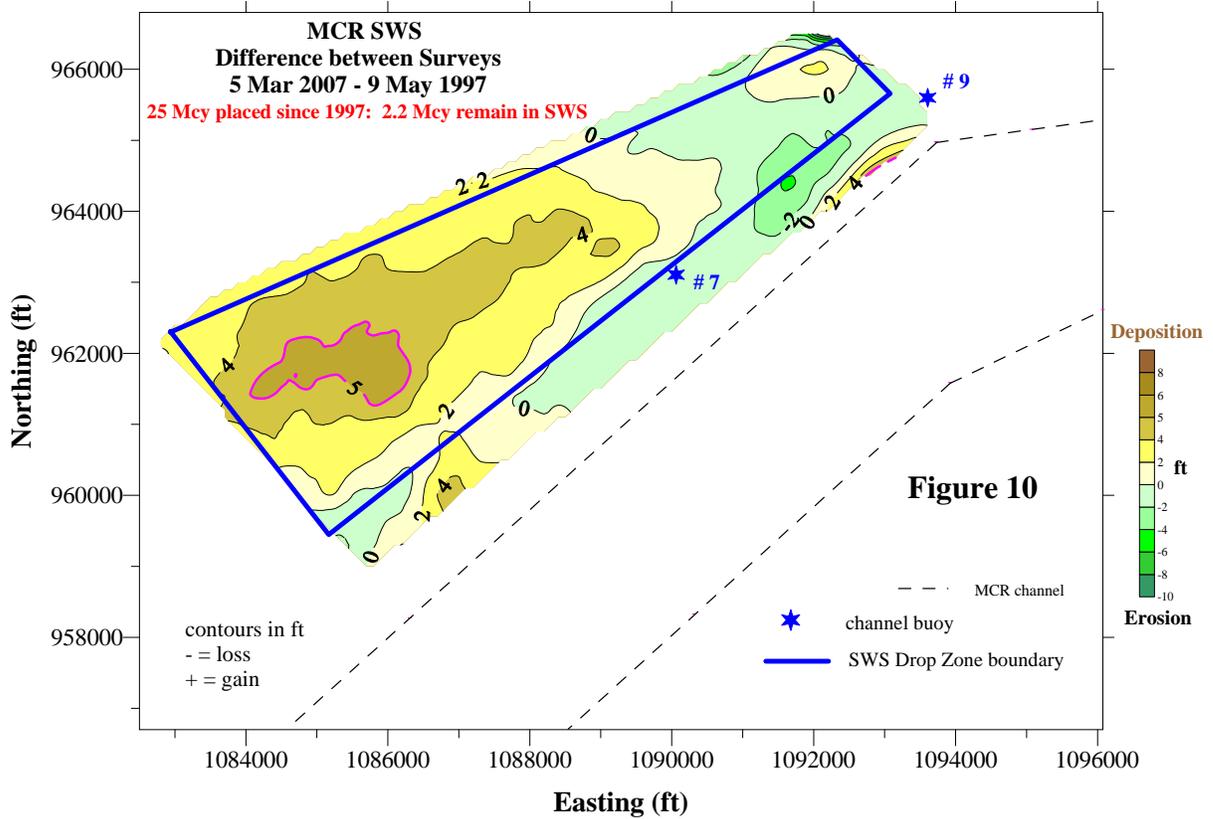
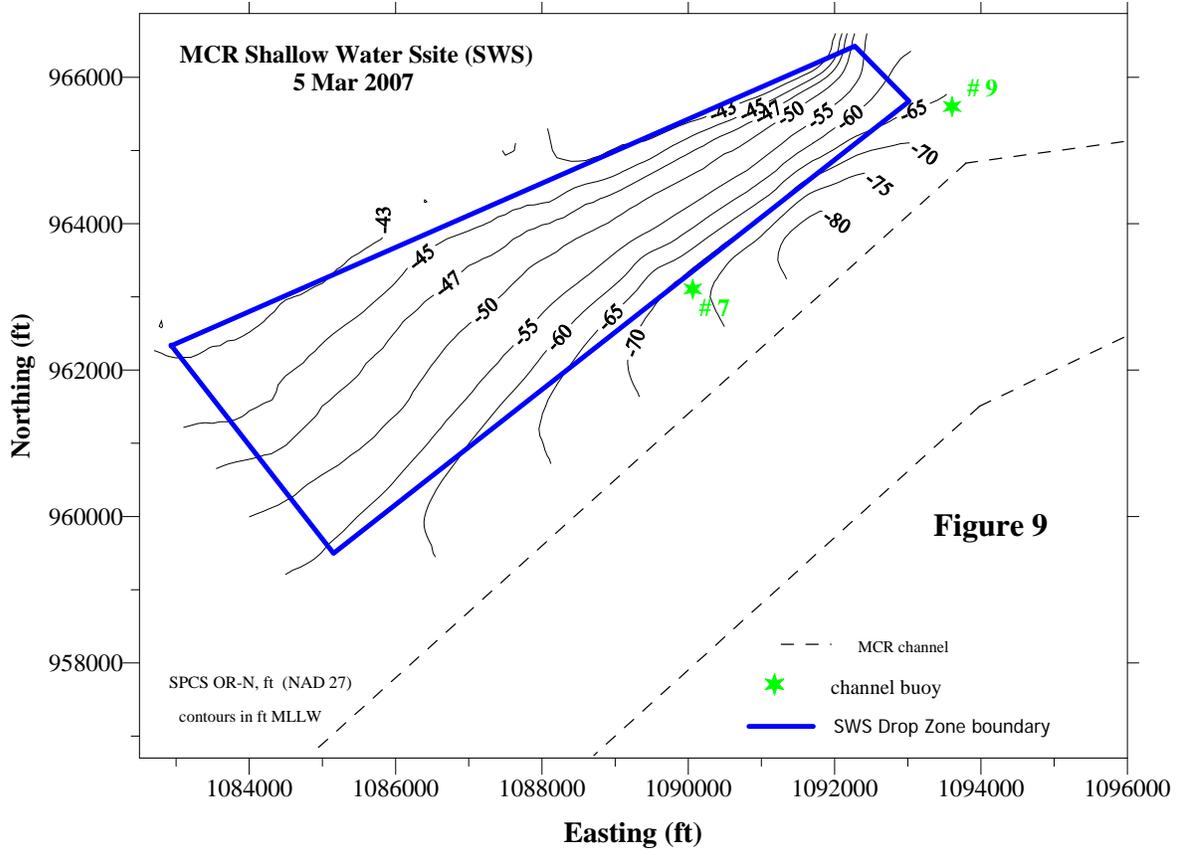


Figure 7a





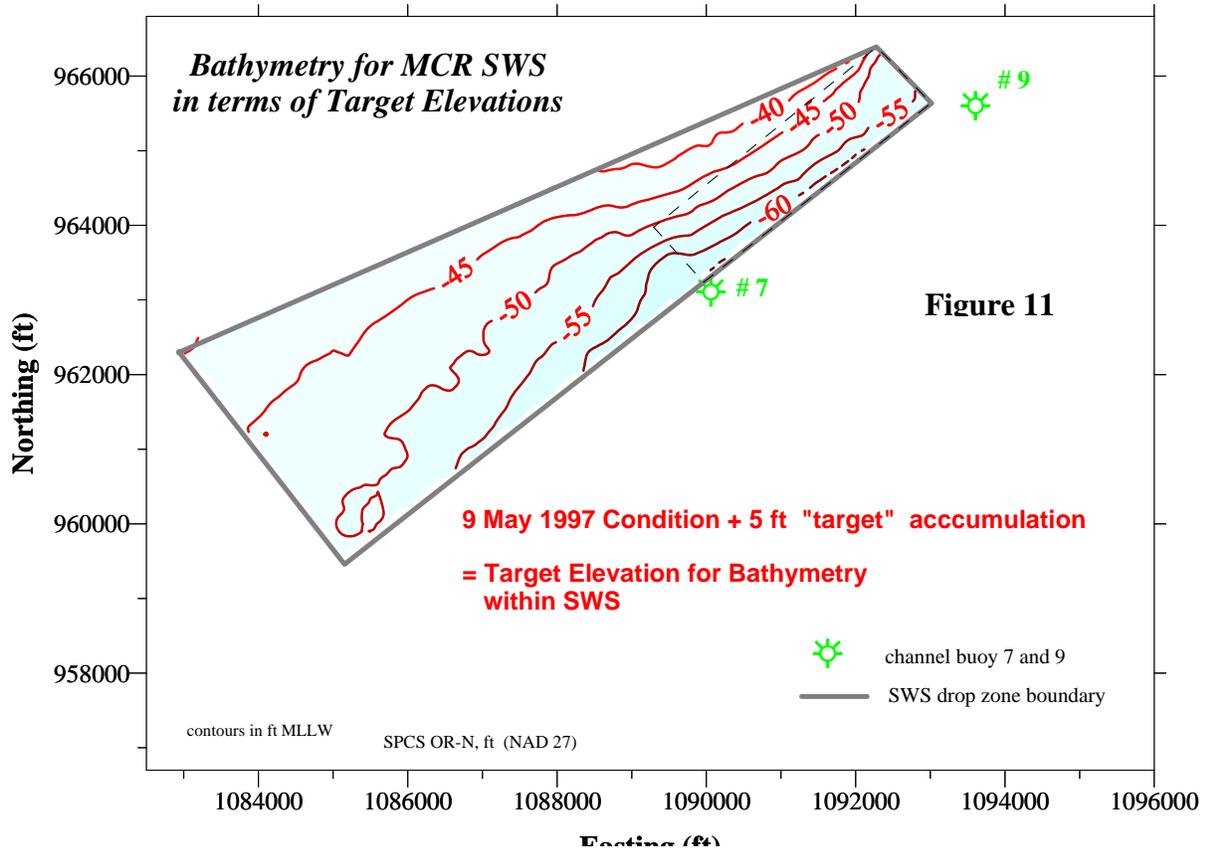


Figure 11

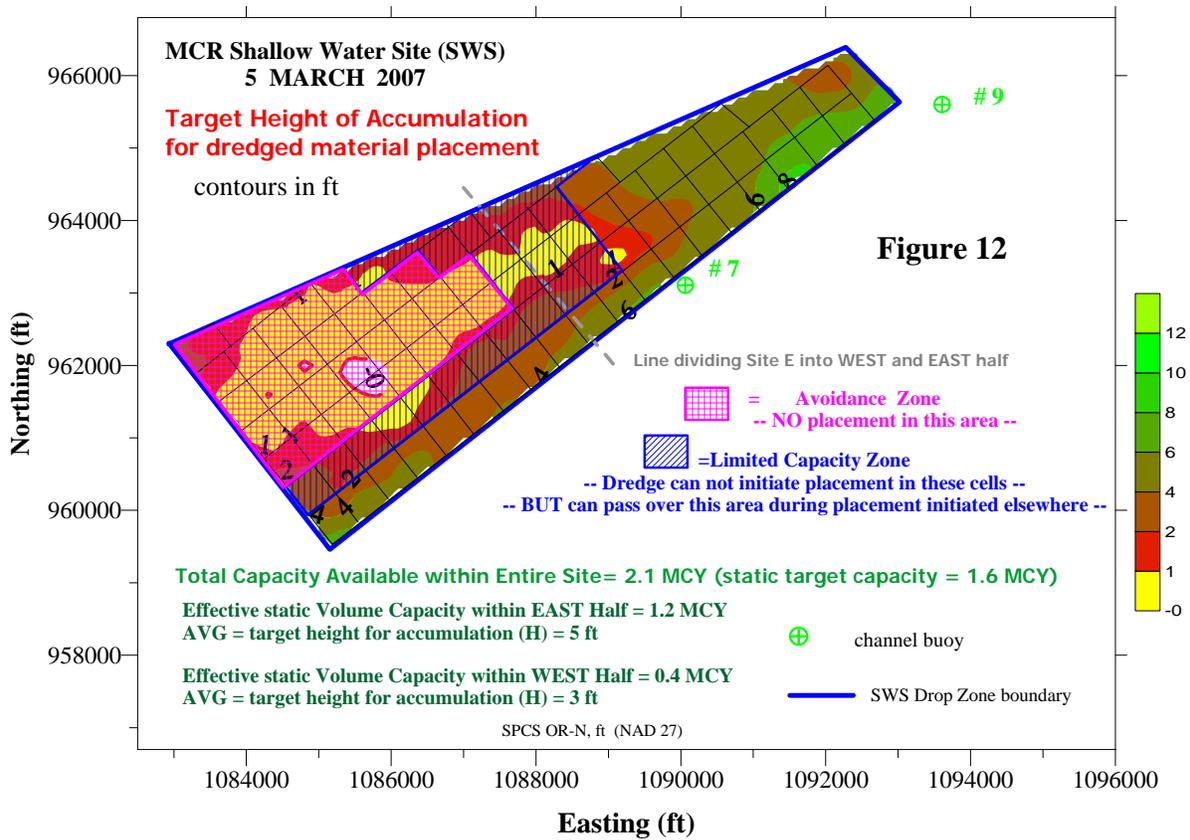
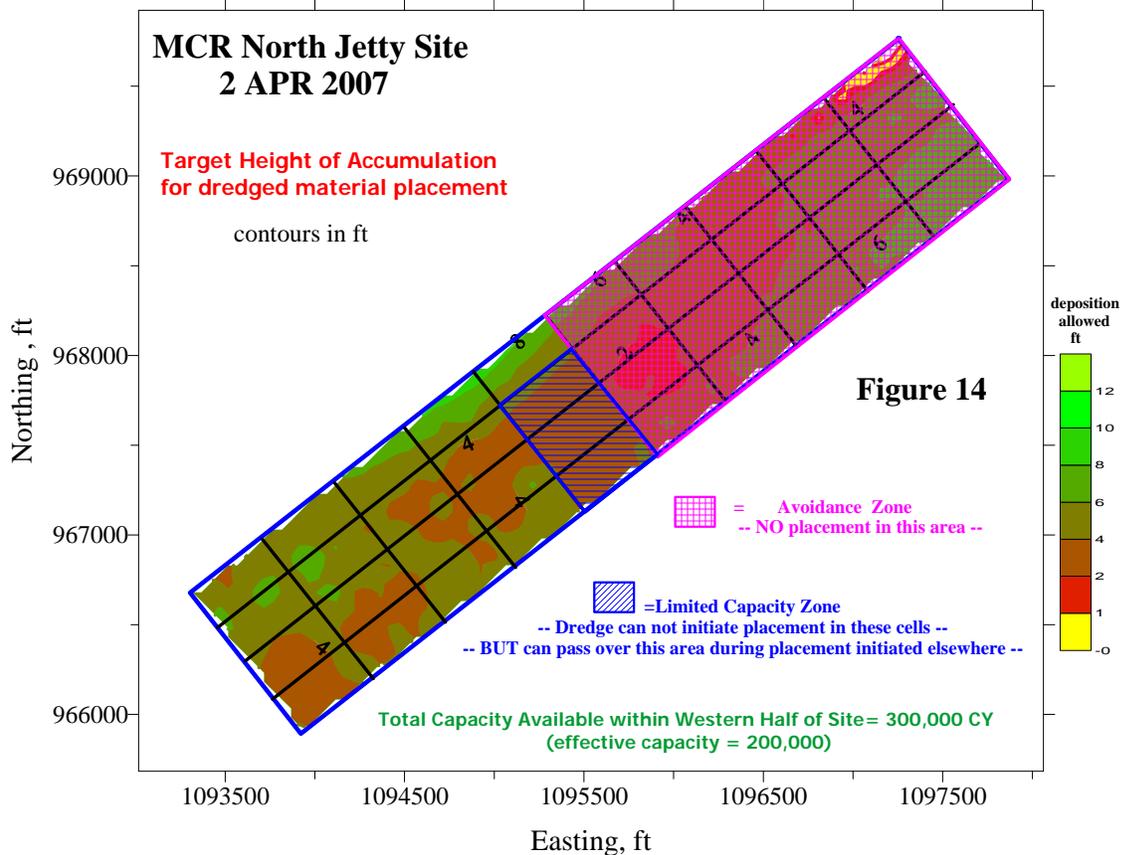
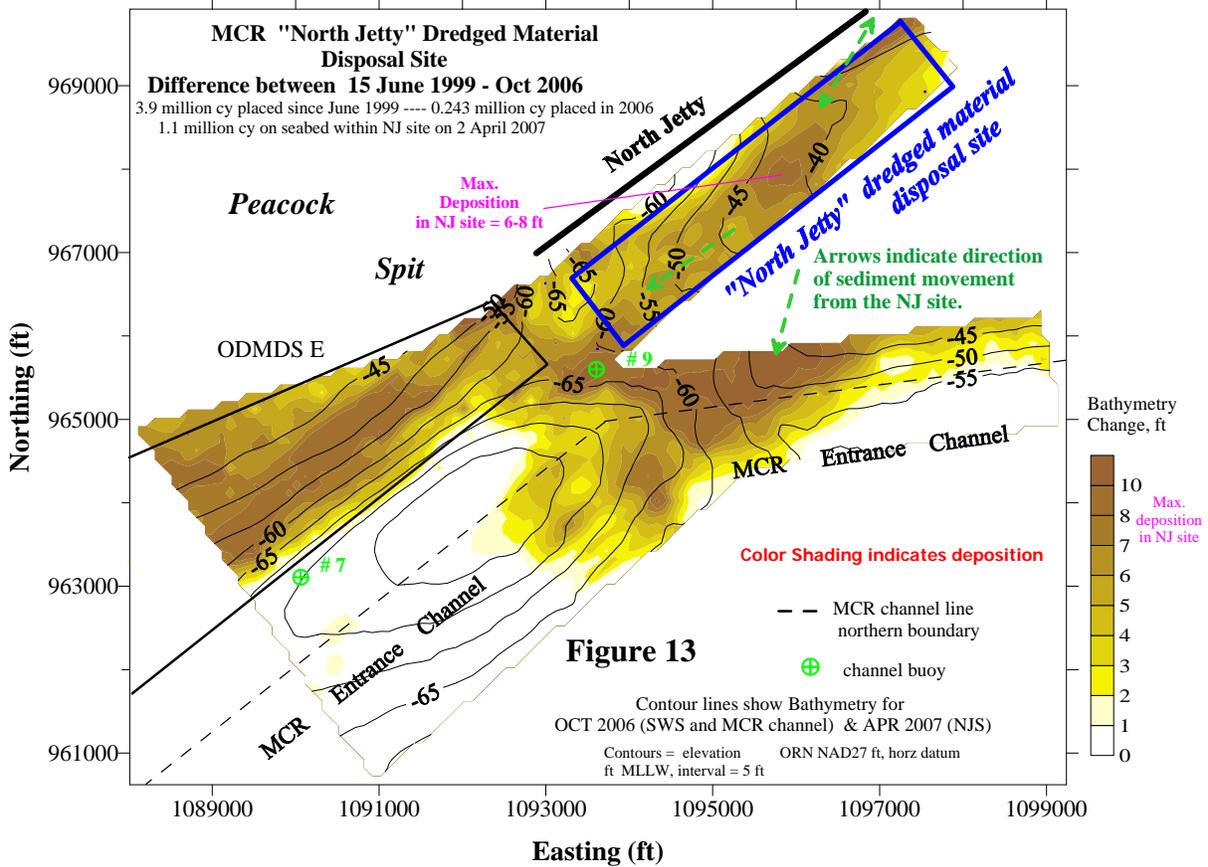
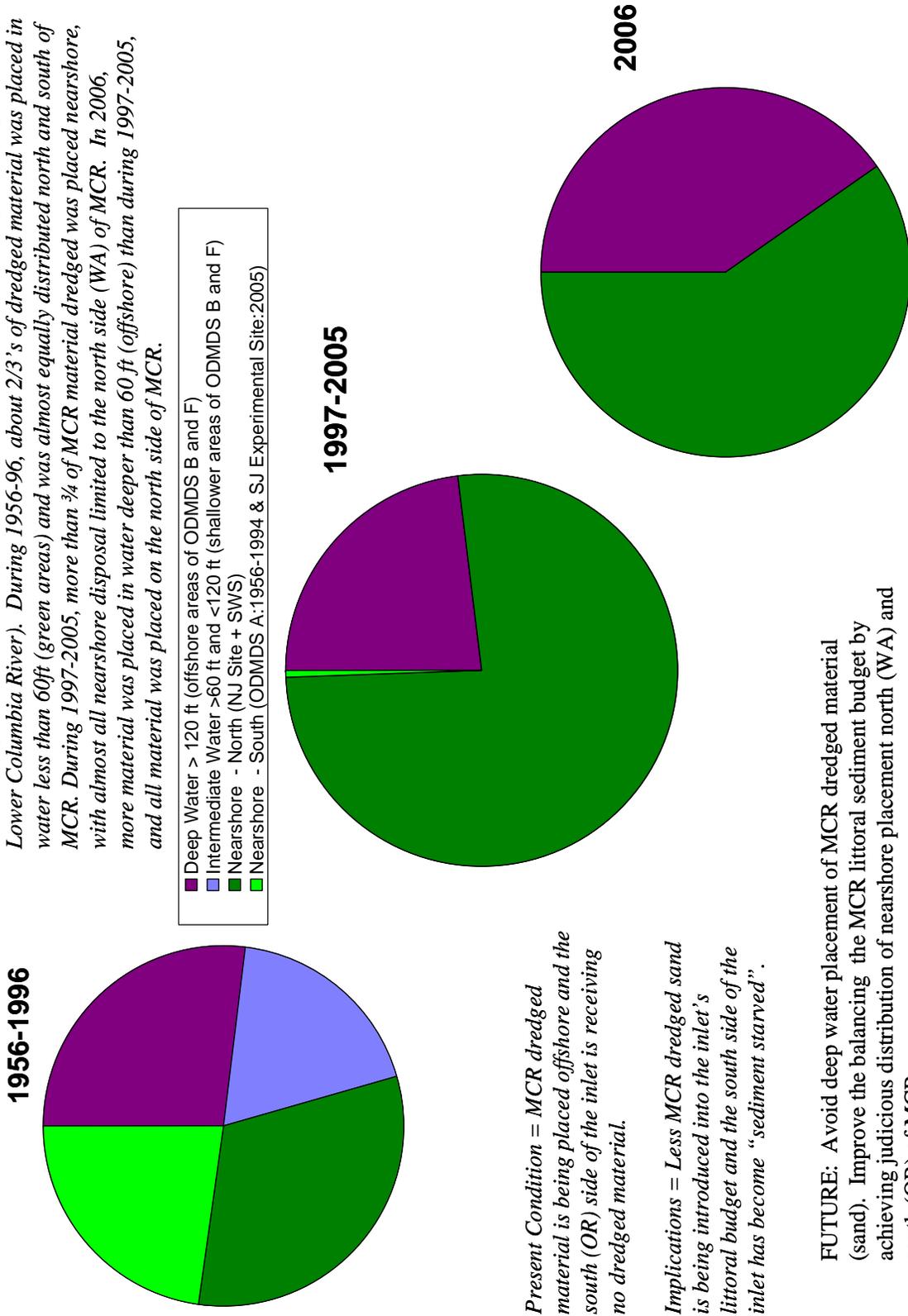


Figure 12



MCR Dredged Material Placement through time (includes material from Tongue Pt and Lower Columbia River). During 1956-96, about 2/3's of dredged material was placed in water less than 60ft (green areas) and was almost equally distributed north and south of MCR. During 1997-2005, more than 3/4 of MCR material dredged was placed nearshore, with almost all nearshore disposal limited to the north side (WA) of MCR. In 2006, more material was placed in water deeper than 60 ft (offshore) than during 1997-2005, and all material was placed on the north side of MCR.

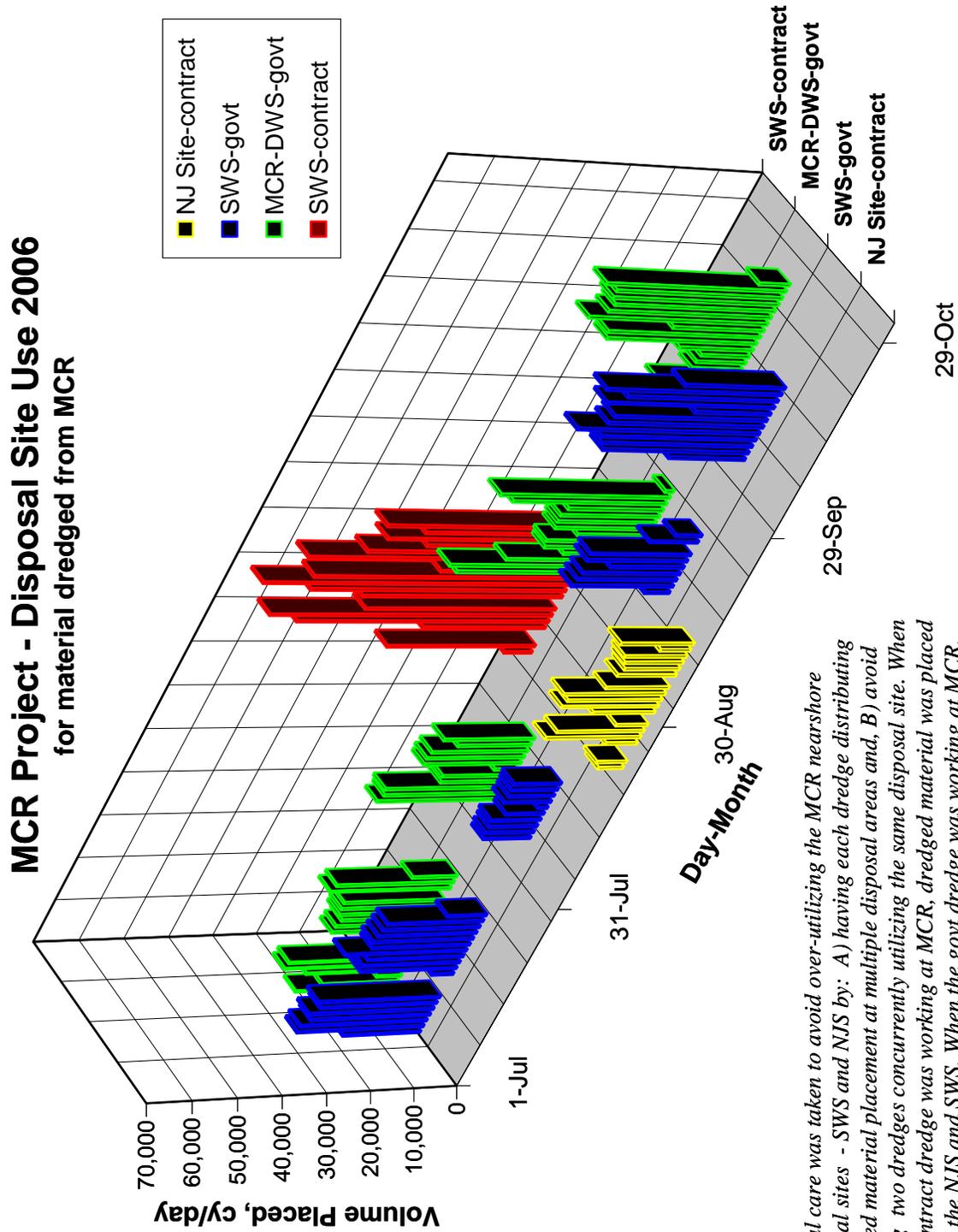


Present Condition = MCR dredged material is being placed offshore and the south (OR) side of the inlet is receiving no dredged material.

Implications = Less MCR dredged sand is being introduced into the inlet's littoral budget and the south side of the inlet has become "sediment starved".

FUTURE: Avoid deep water placement of MCR dredged material (sand). Improve the balancing the MCR littoral sediment budget by achieving judicious distribution of nearshore placement north (WA) and south (OR) of MCR.

Figure 15



Special care was taken to avoid over-utilizing the MCR nearshore disposal sites - SWS and NJS by: A) having each dredge distributing dredged material placement at multiple disposal areas and, B) avoid having two dredges concurrently utilizing the same disposal site. When the contract dredge was working at MCR, dredged material was placed within the NJS and SWS. When the govt dredge was working at MCR, dredged material was placed within the SWS and MCR-DWS.

Figure 16

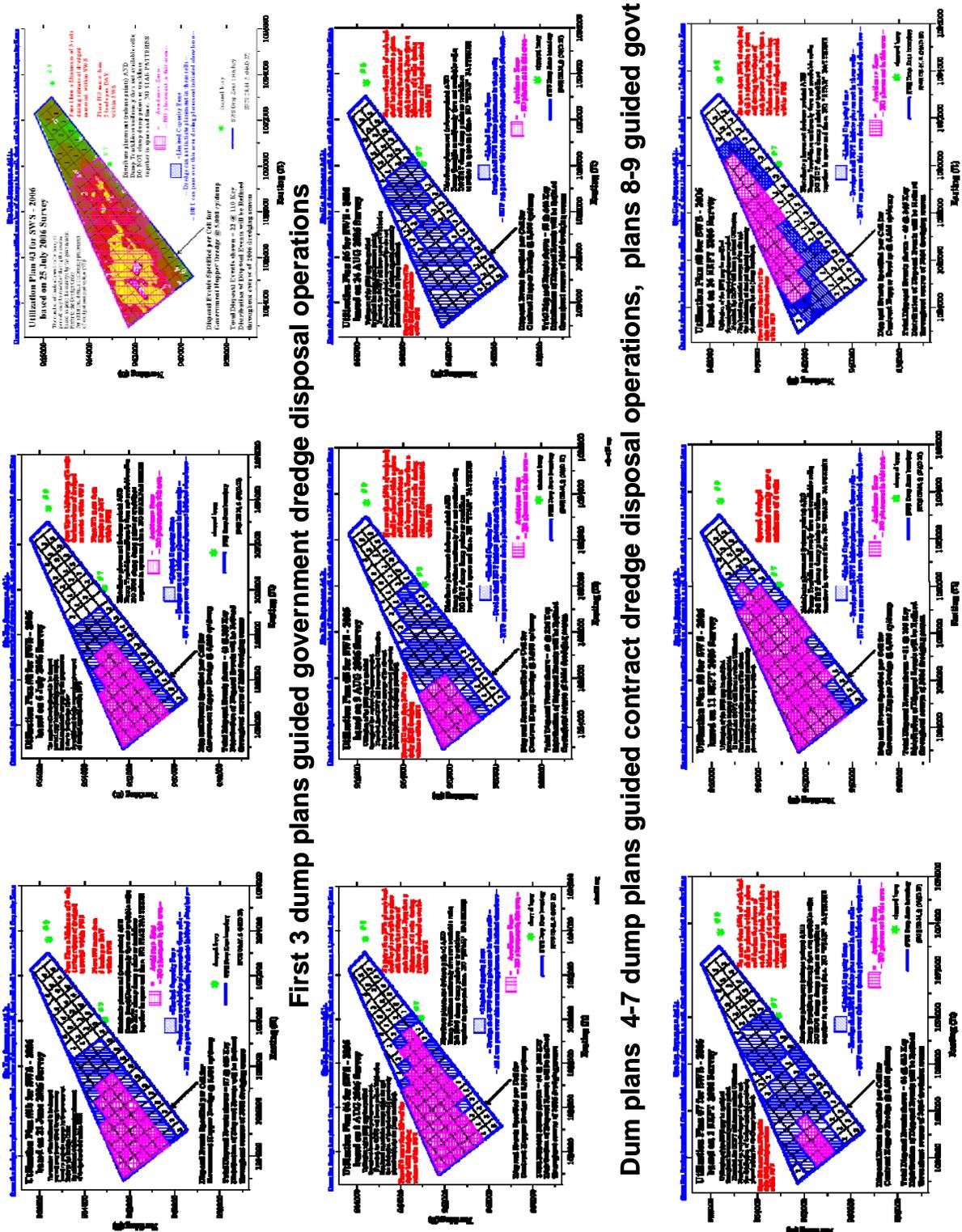
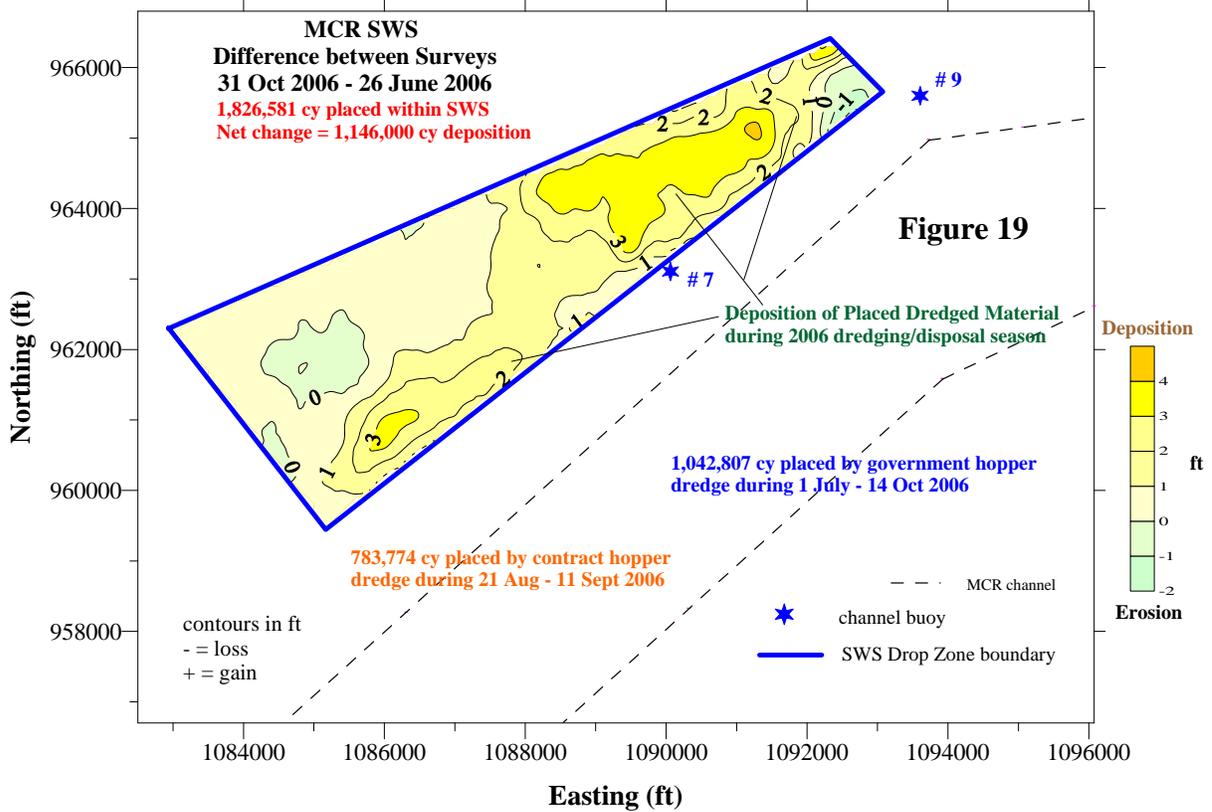
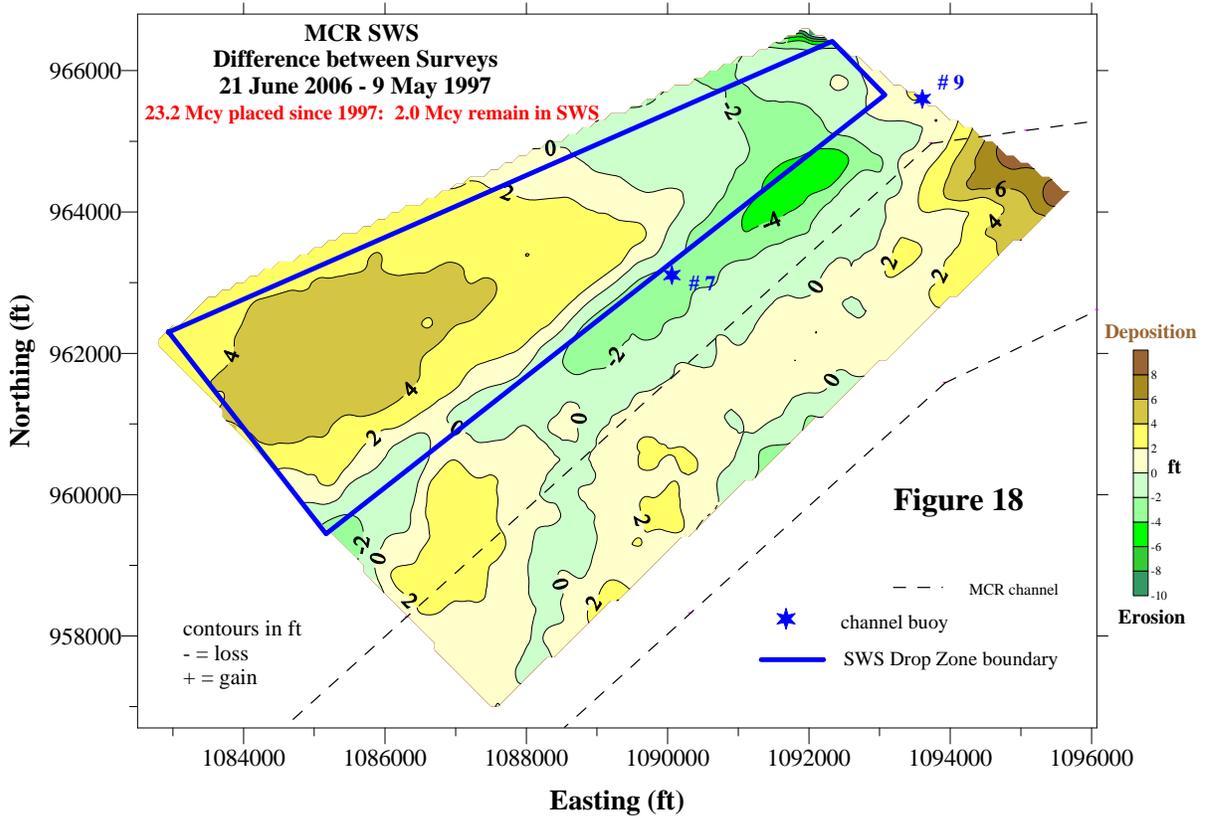
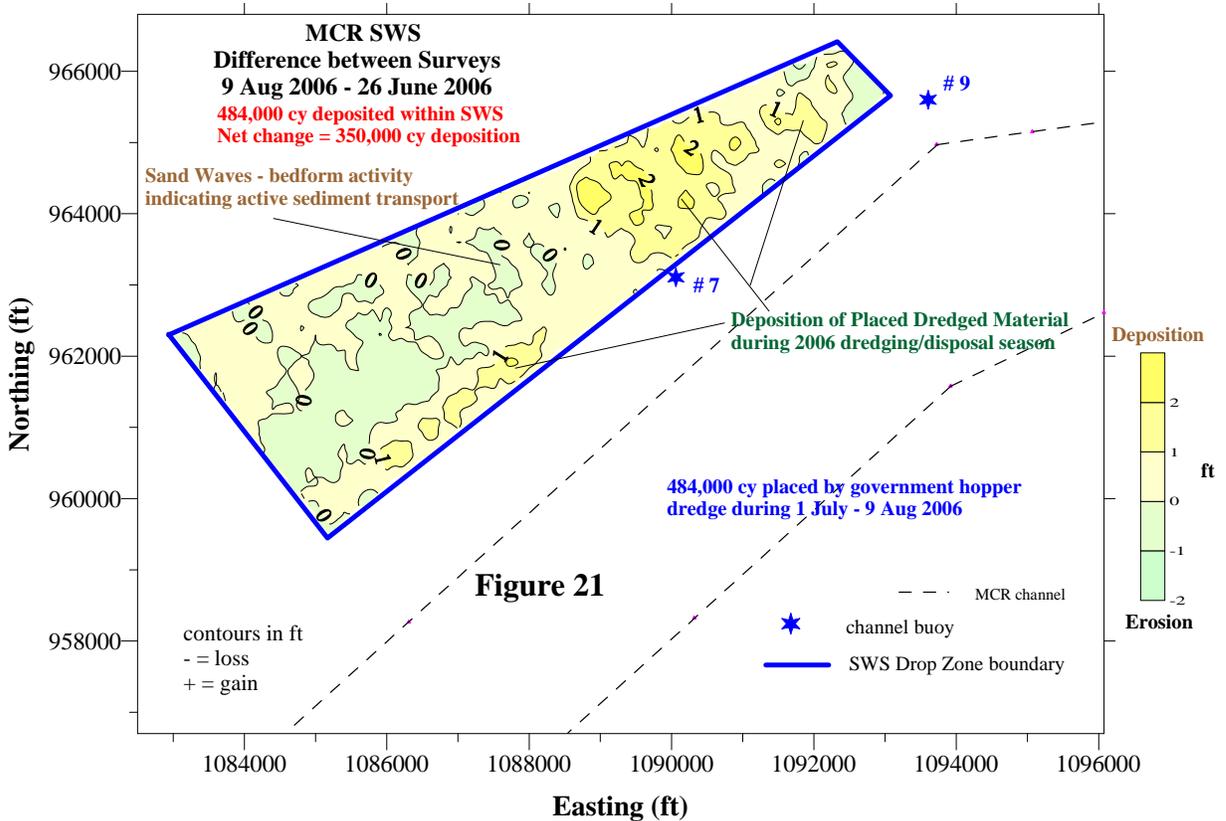
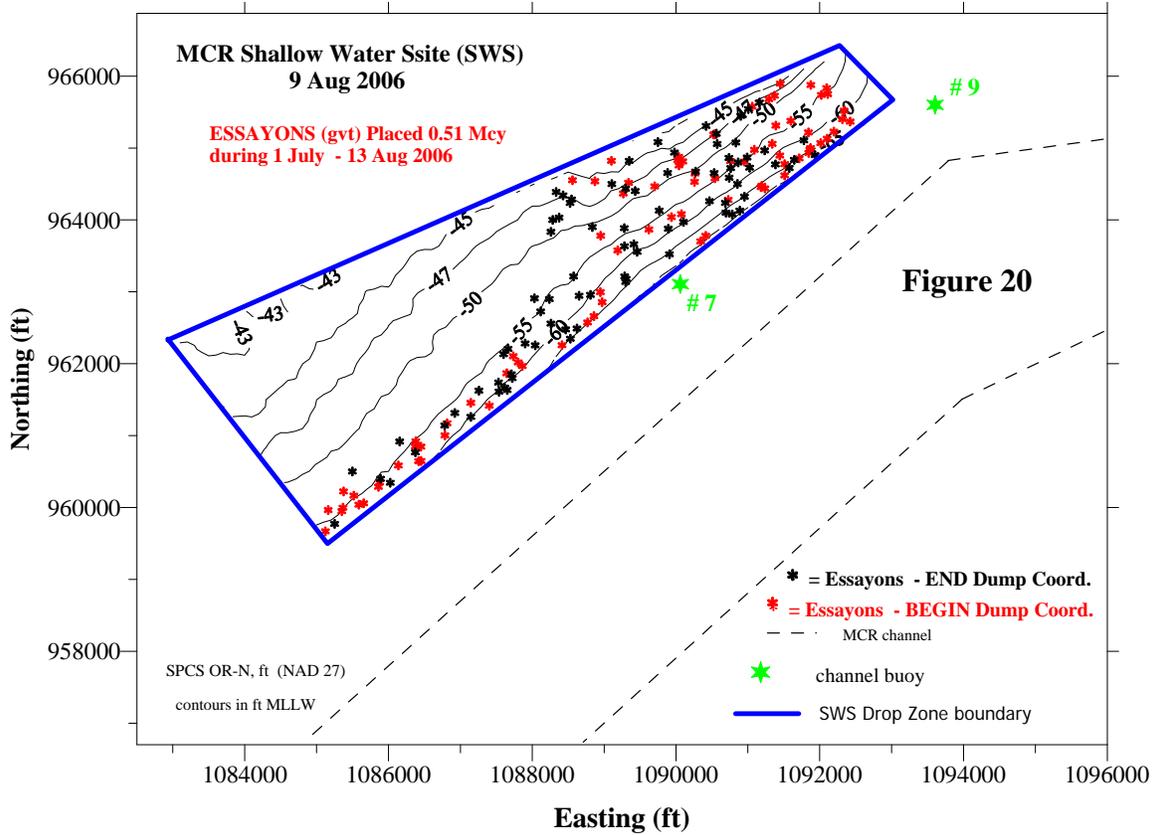
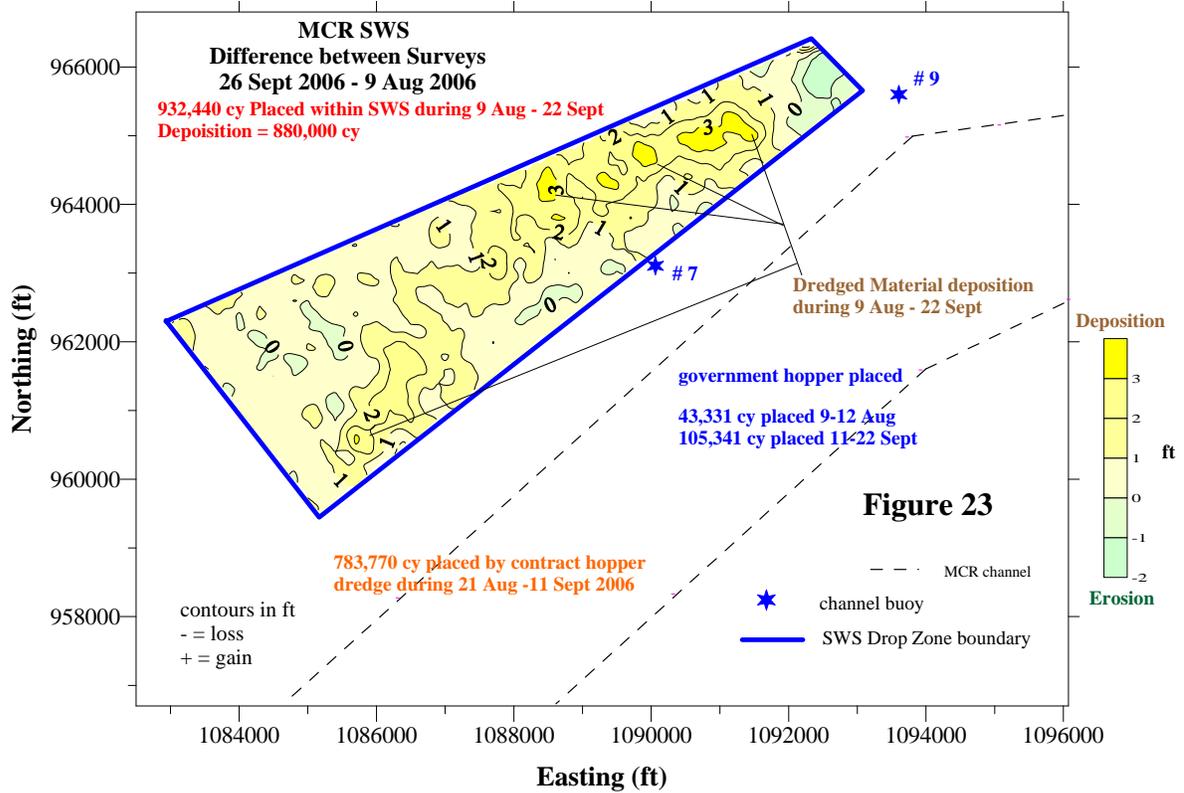
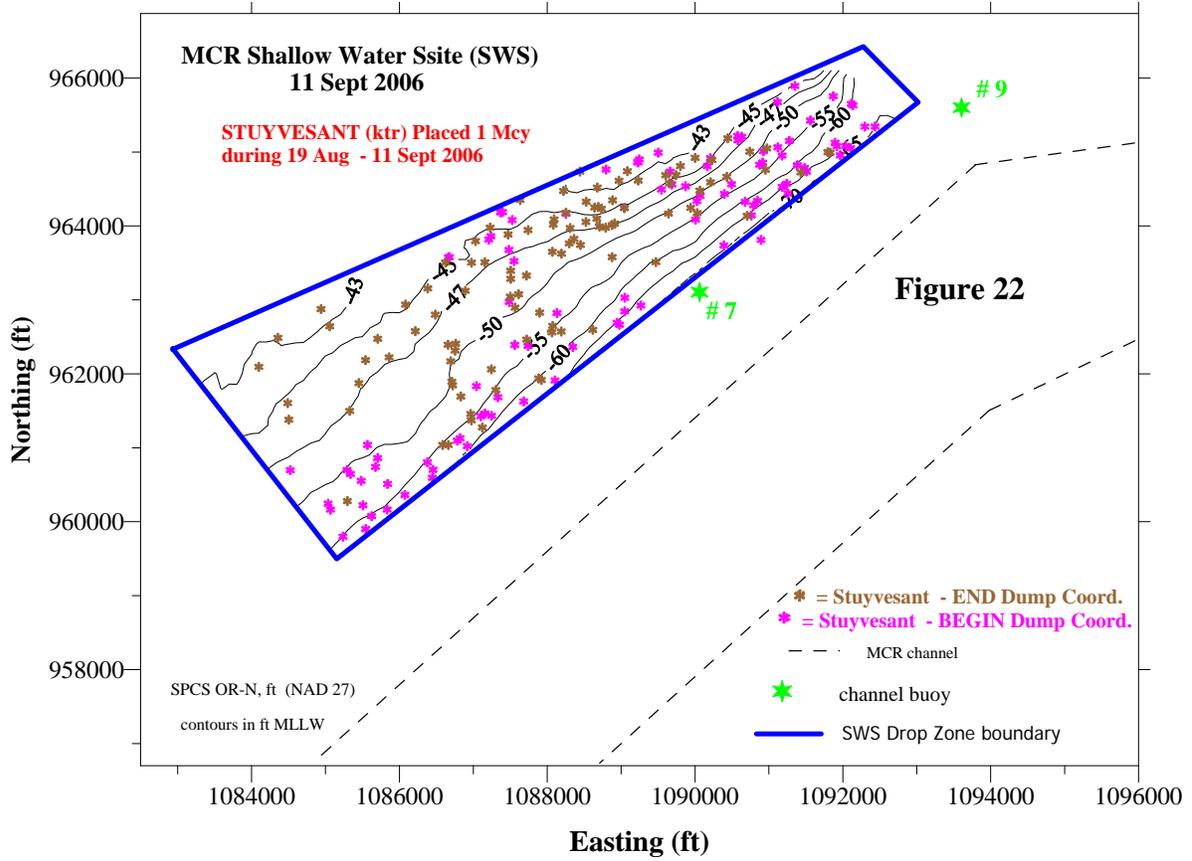
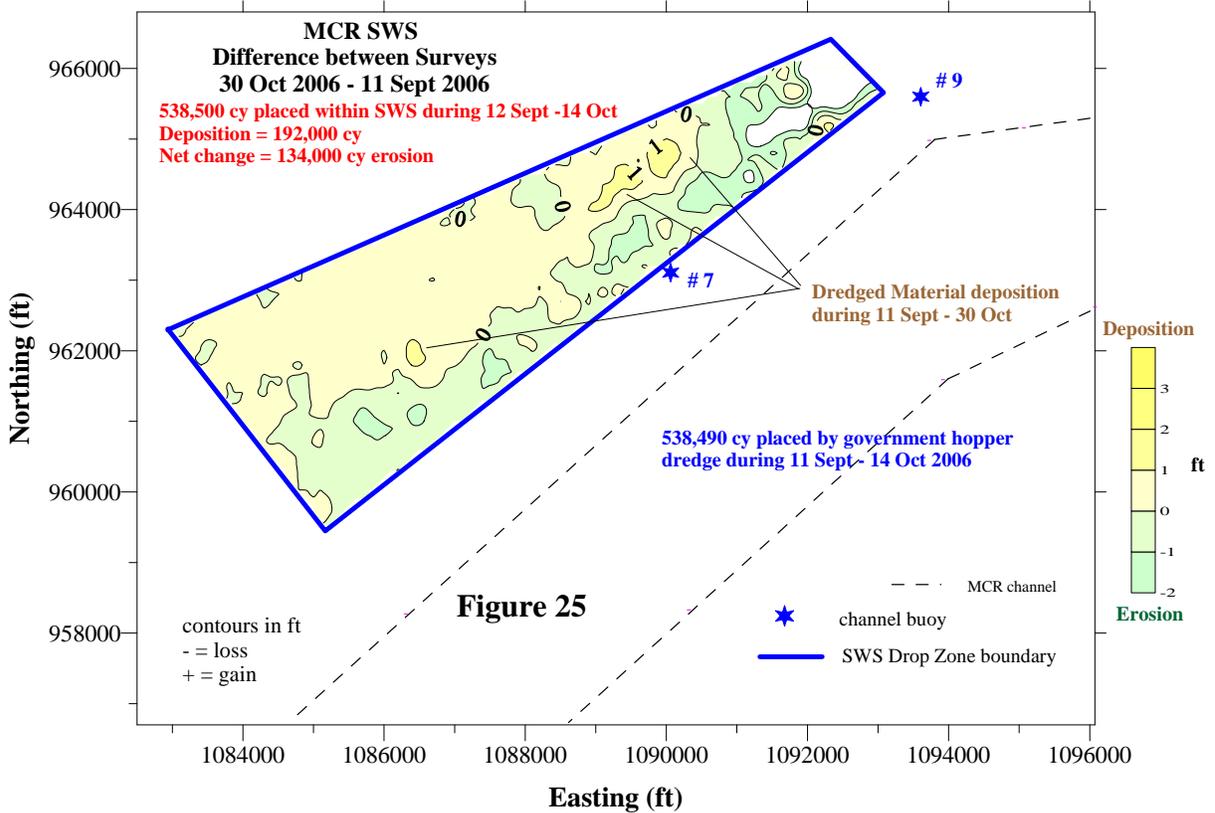
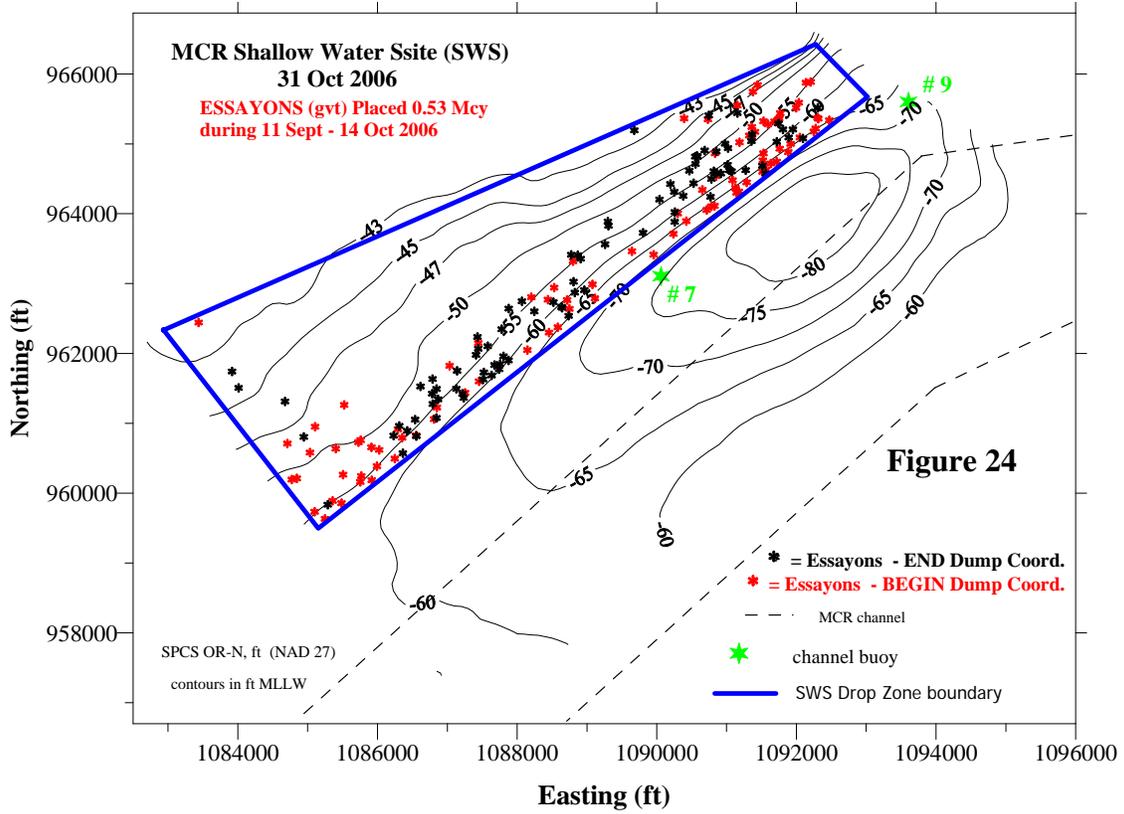


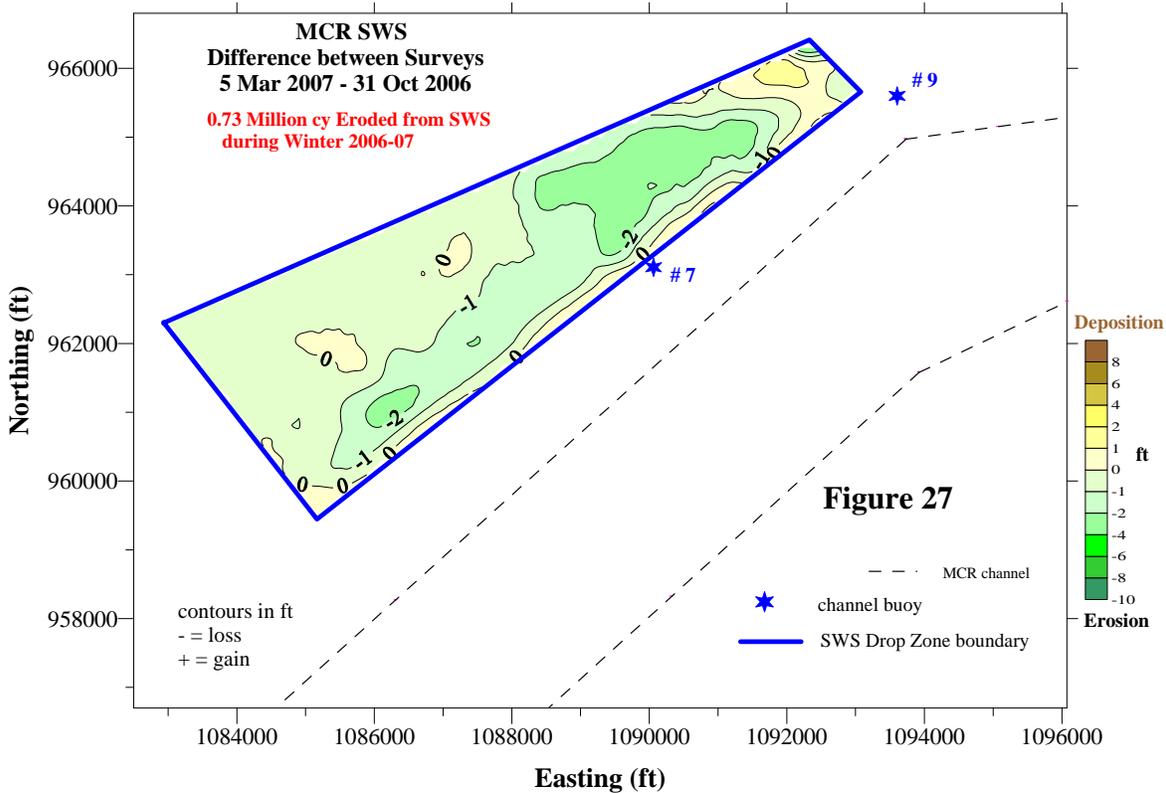
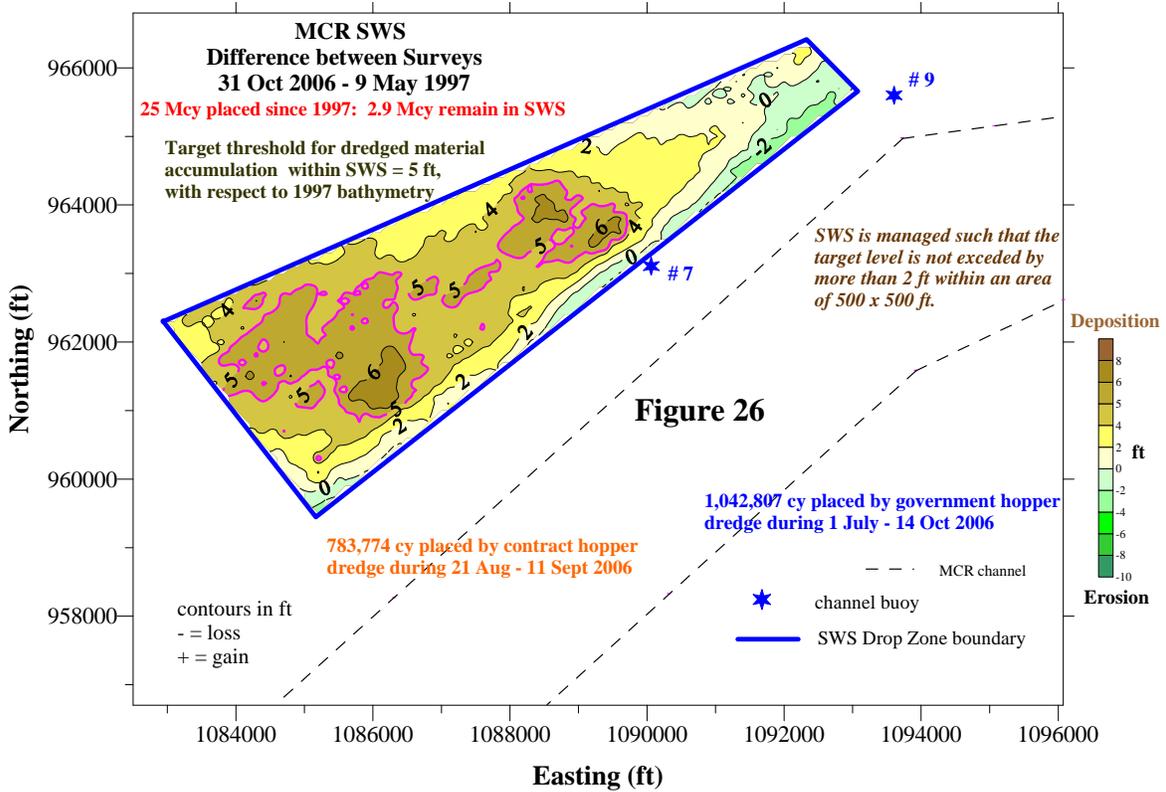
Figure 17

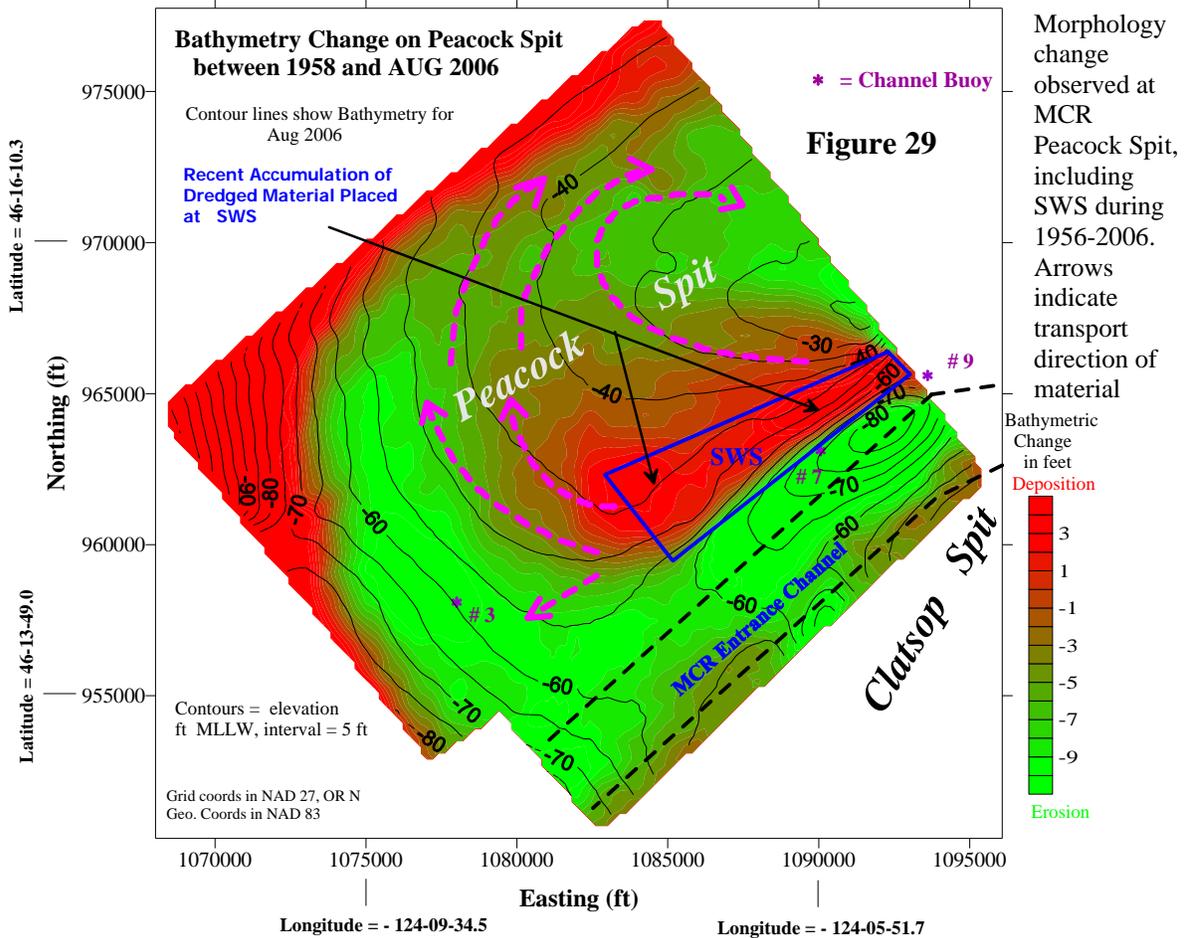
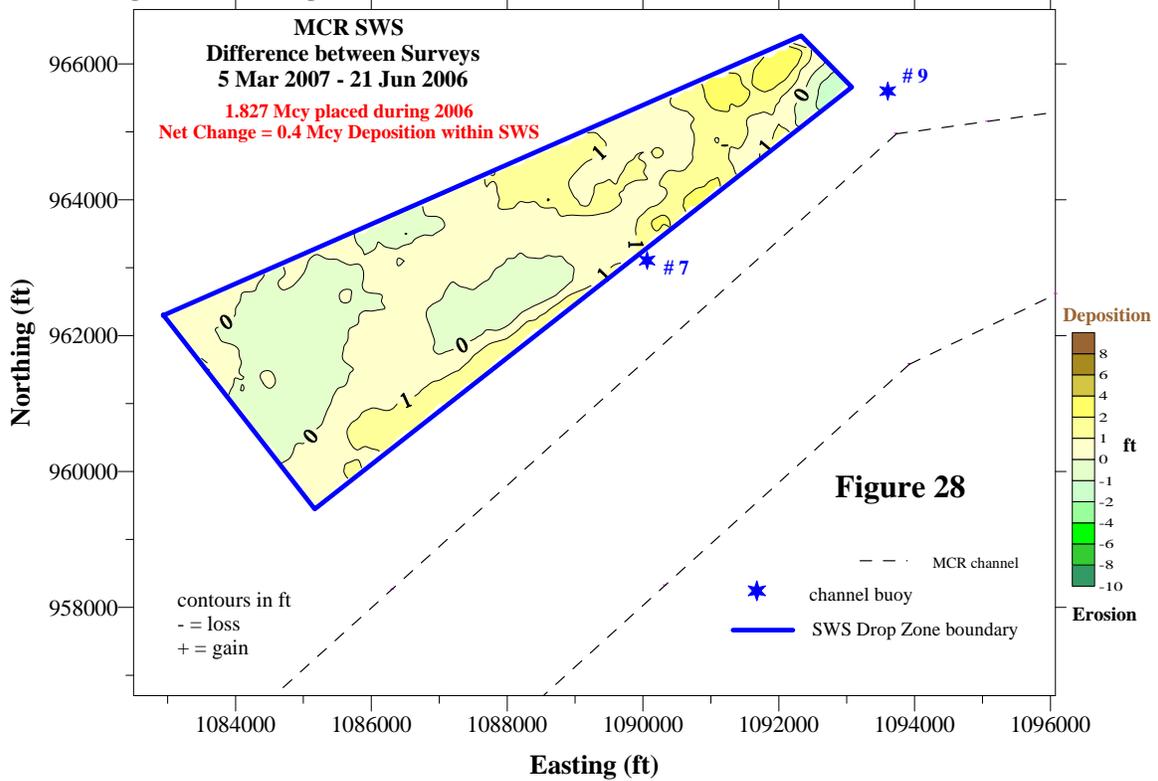


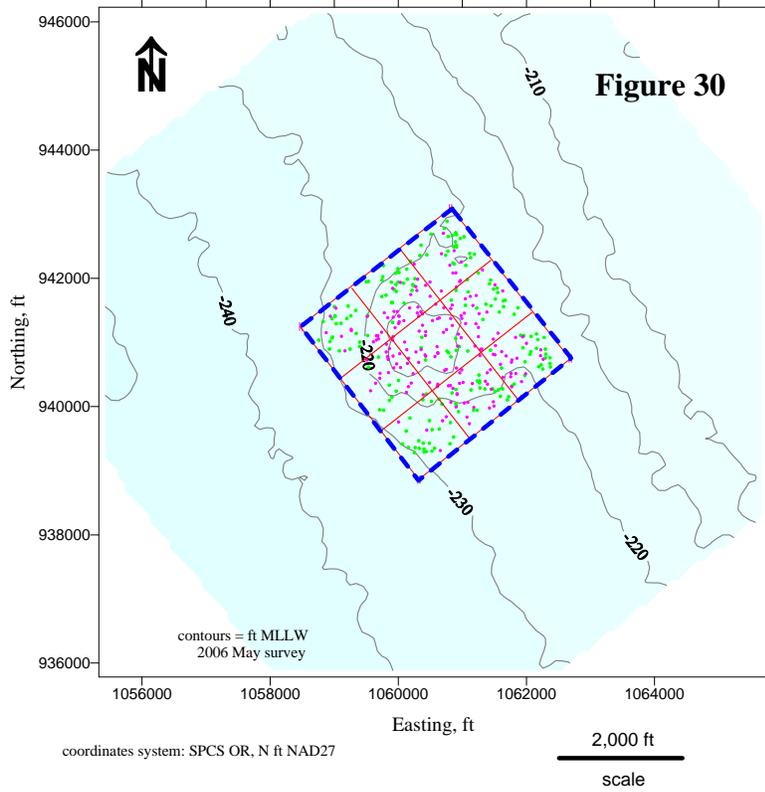












**Mouth of the Columbia River
Deep Water Site
(MCR-06-DWS)**

May 2006

Volume of MCR dredged material placed during 2004-2005 = 2.8 million cy

dashed blue line = "MCR-06-DWS"
Site drop zone is 3,000 x 3,000 ft

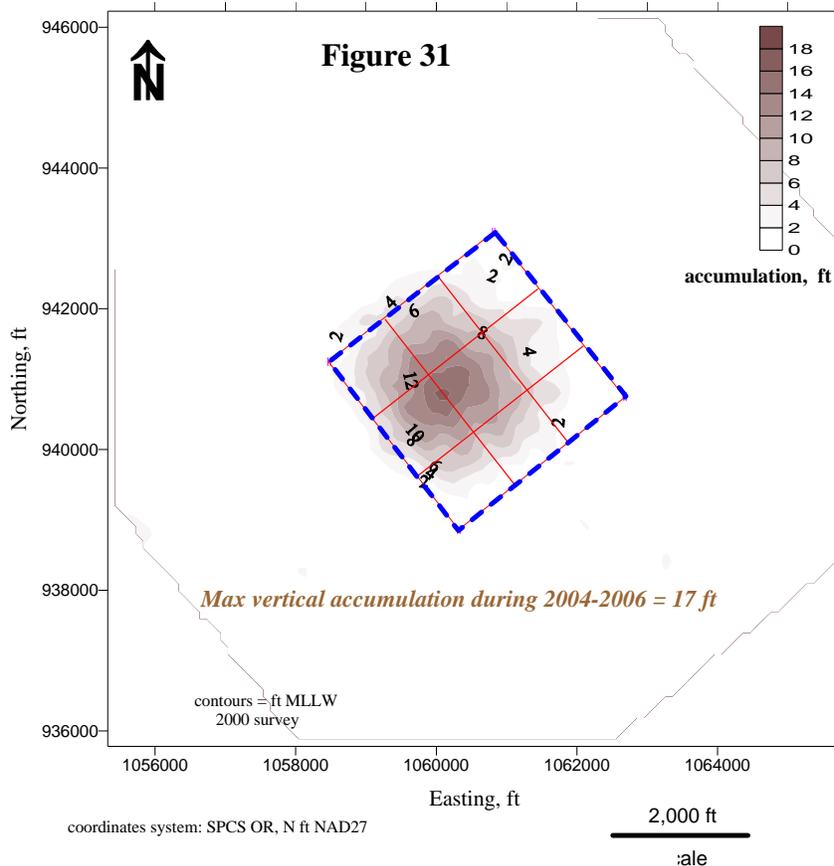
Red Lines = grid (cells) used to control the placement of dredged material within the MCR DWS area - 1,000 x 1,000 ft ea.

• = Beginning dump coord. - Essaysons

• = Ending dump coord. - Essaysons

Volume of MCR dredged material placed during July - Oct 06 = 1.39 million cy

Deposition due to 2006 disposal is not shown here



**Mouth of the Columbia River
Deep Water Site
(MCR-06-DWS)**

*Difference Between Suveys
29 June 2004 - 31 May 2006*

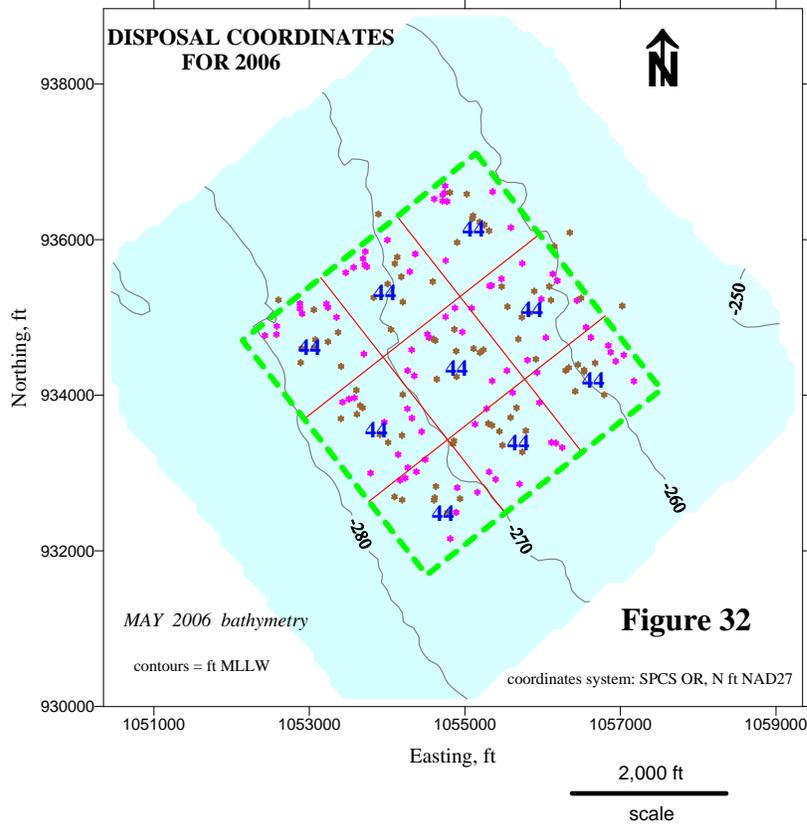
Volume of dredged material placed during 2004-05 = 2.8 million cy

Bathymetric change does not include effects due to 2006 dredged material disposal

Volume of deposition = 1.8 million cy

Red Lines = grid (cells) used to control the placement of dredged material within the DWS 103 area - 1,000 x 1,000 ft ea.

dashed blue line = "MCR-06-DWS"
Site drop zone is 3,000 x 3,000 ft



**Columbia River
 Deep Water Site
 (CR-06-DWS)**

**Utilization Plan #1
 for CR DWS: 2006**

blue cell assignments =
 CONTRACT dredge loads/cell
 at 2,500 cy/load = 1 MCY

dashed GREEN line
 = Columbia River 2006 DWS drop zone
 3,800 x 3,800 ft

Red Lines = grid (cells) used to control
 the placement of dredged
 material within the CR-06-DWS
 placement area - 1,270 x 1,270 ft ea.

* = Stuyvesant - END Dump Coord.

* = Stuyvesant - BEGIN Dump Coord.

1.06 MCY of CRCI material placed
 with the CR-06-DWS during 2006

1.32 MCY of CRCI material placed
 with the CR-05-DWS during 2005

Figure 32

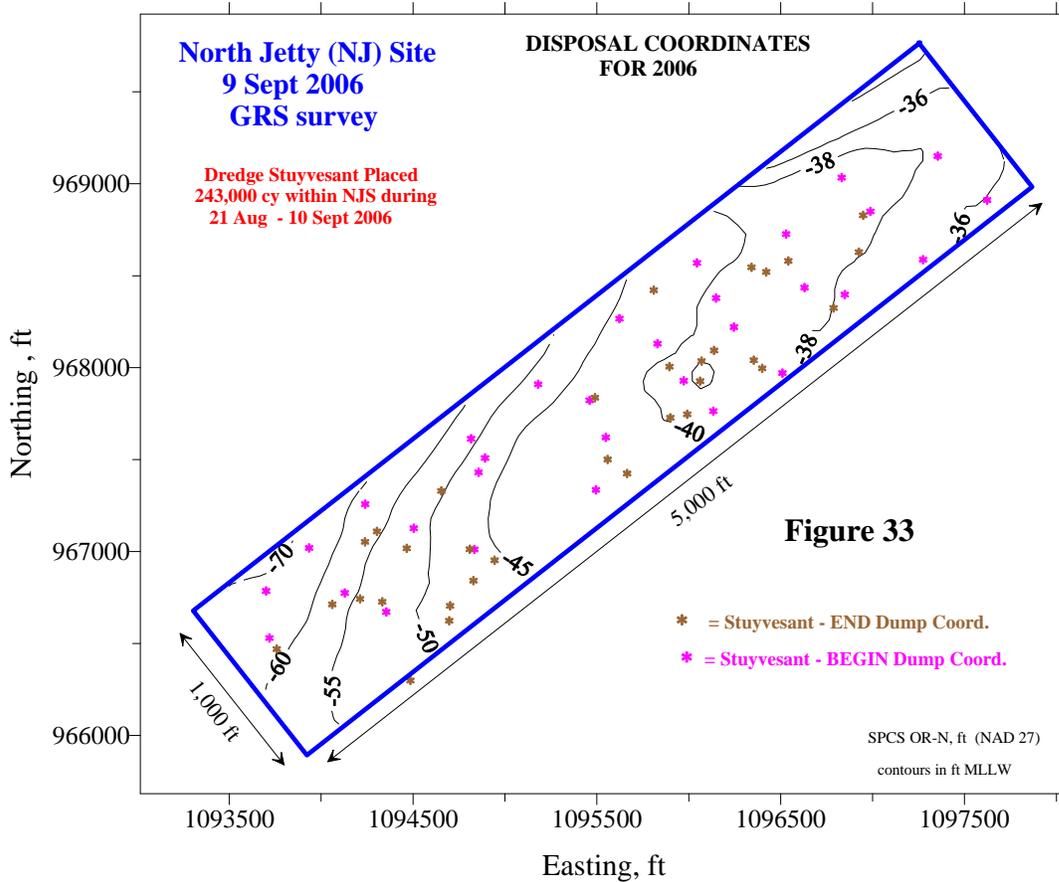
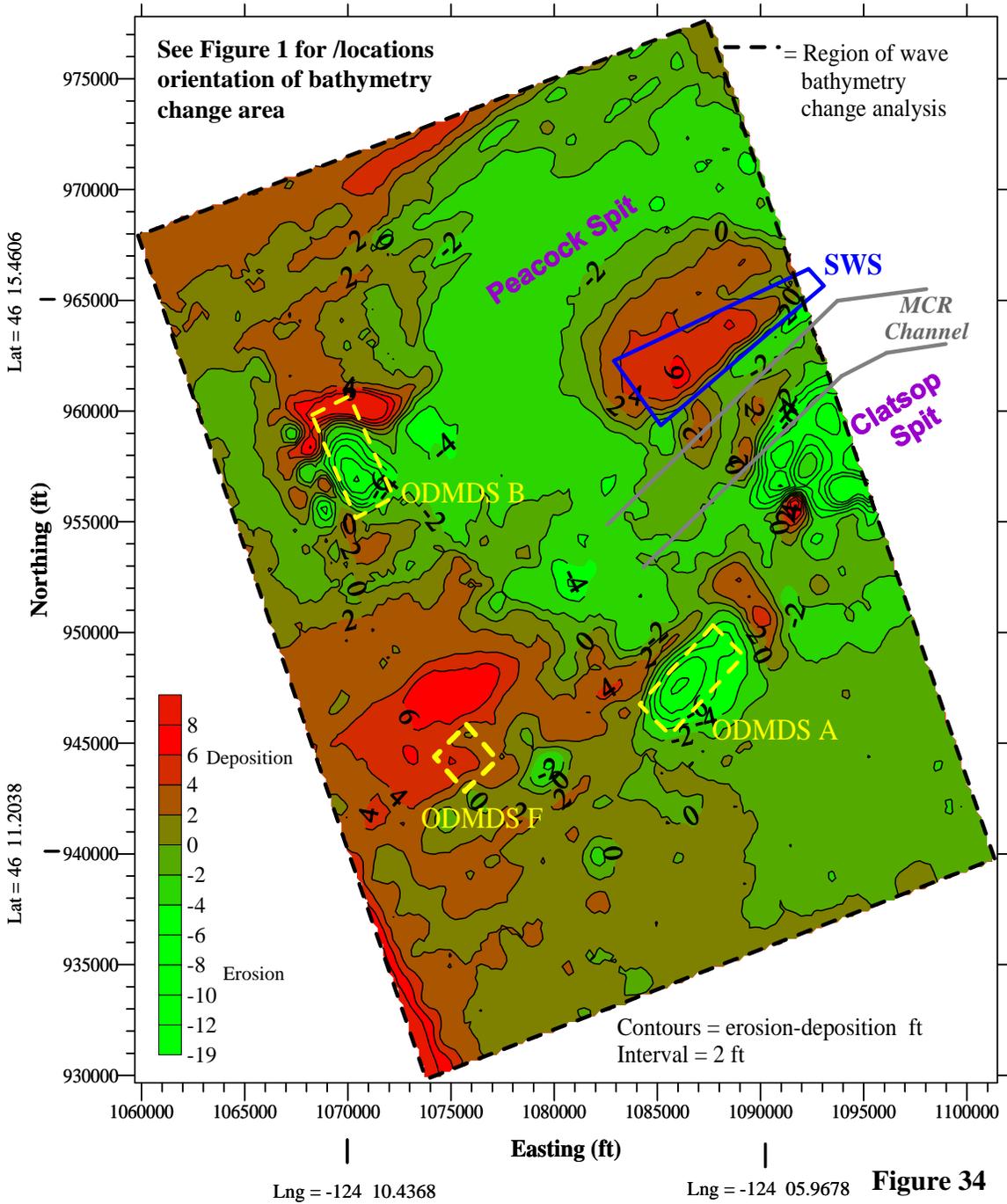


Figure 33

* = Stuyvesant - END Dump Coord.

* = Stuyvesant - BEGIN Dump Coord.

MCR Bathymetry Difference: 1997 -2006



1139328000.Tue.Feb.07_16_00_00.GMT.2006.nrthhead.cx.plan.mat

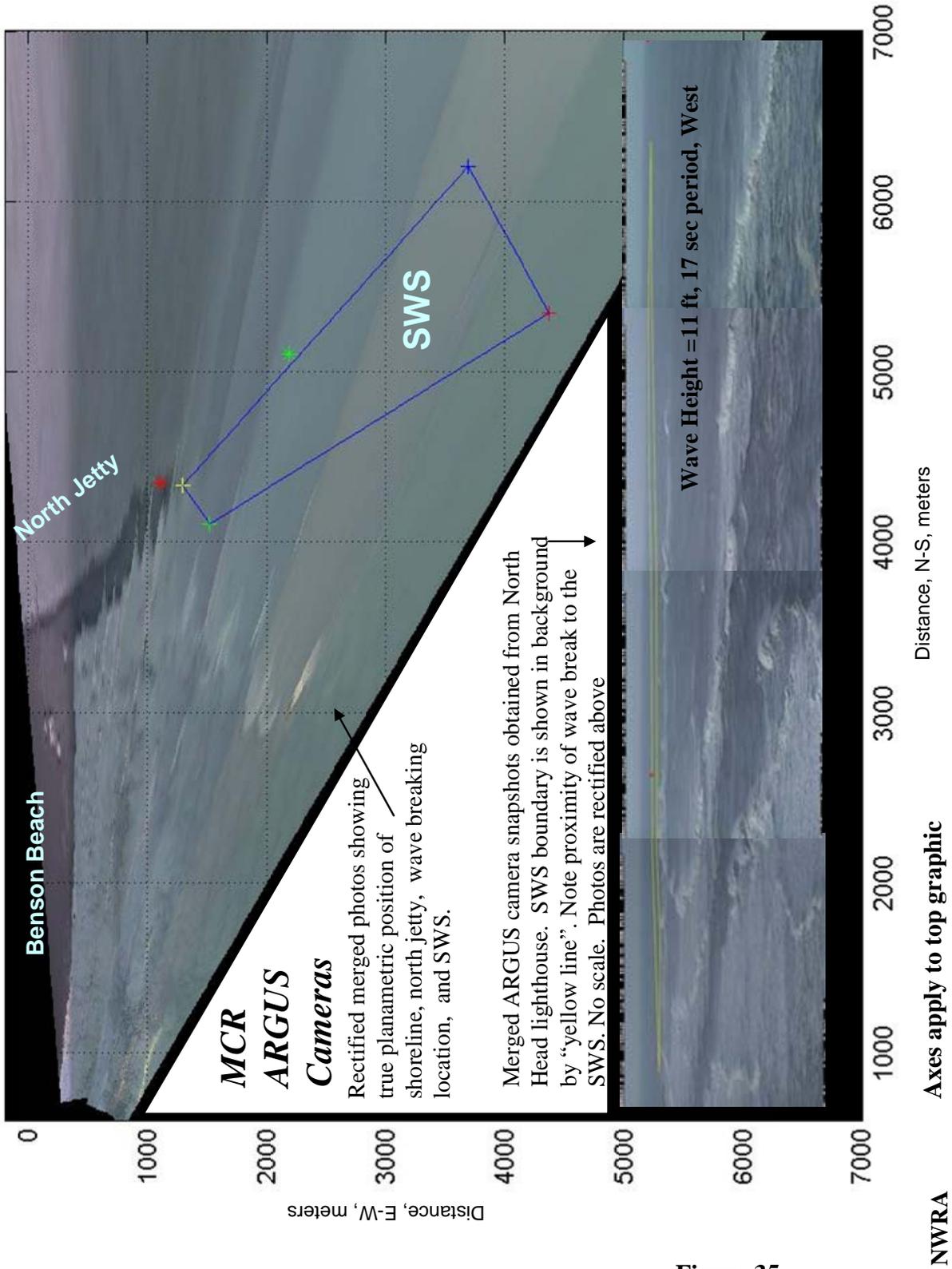
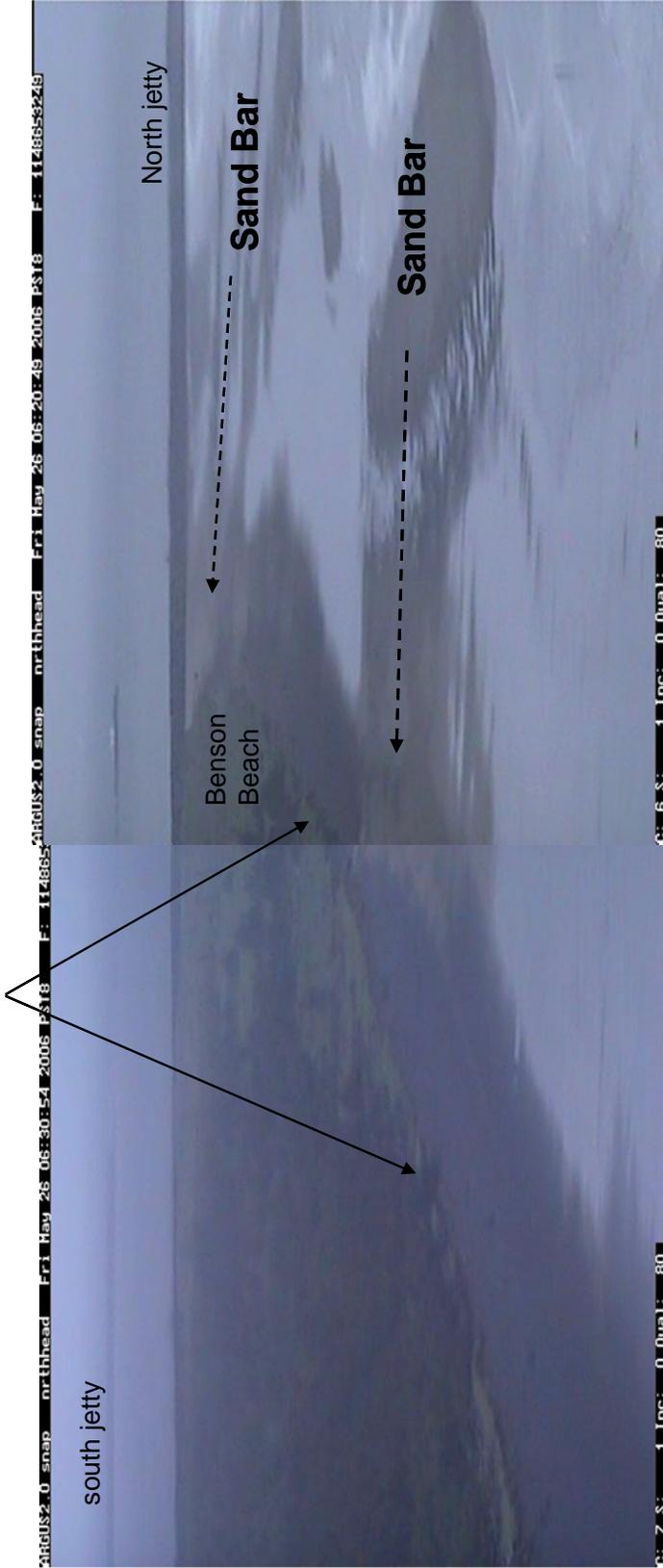


Figure 35

26 MAY 2006 ARGUS Beach Monitoring System at North Head cameras 5 & 6

Additional Erosion (cutting) of Beach Scarp during winter '05-'06



Sand from “Sand Bars” being transported onshore

Note lighter color of sand migrating shoreward from sand bars covering darker sands

The darker color sands contain hematite and other heavy minerals. The darker sands are more dense and less mobile than the lighter color sands, and tend to stay on the beach during the winter wave season. The dredged sediment placed at the SWS has likely contributed to the sand supply of Peacock Spit. The lighter color sands may have come from the dredged sand placed at the SWS.

Figure 36

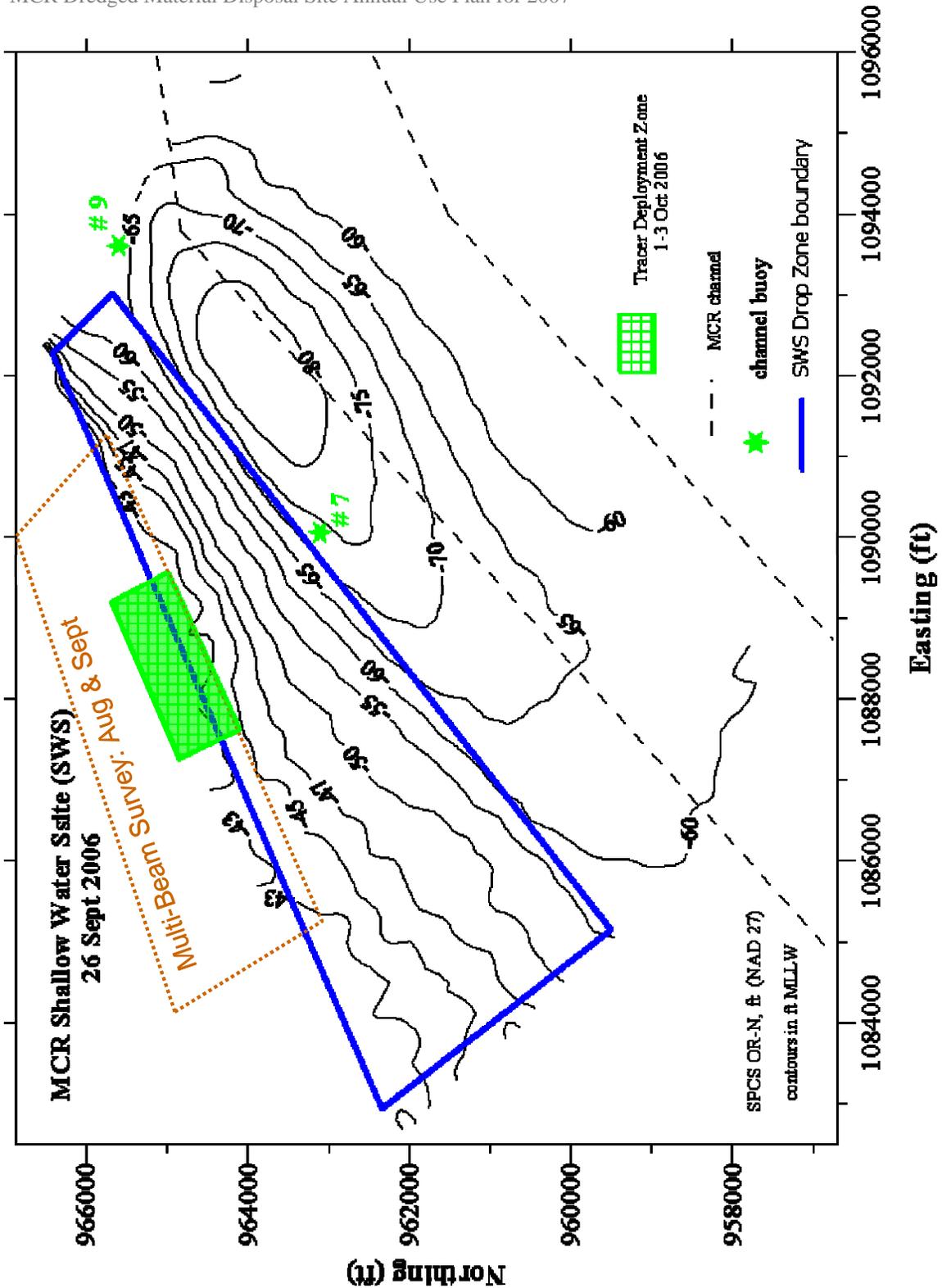


Figure 37. Bathymetry of the SWS on 26 Sept 2006. Location of SWS multibeam survey conducted on 23-24 Aug and 6-7 Sept 2006, and location of sediment tracer deployment zone (tracer released 1 Oct 2006).

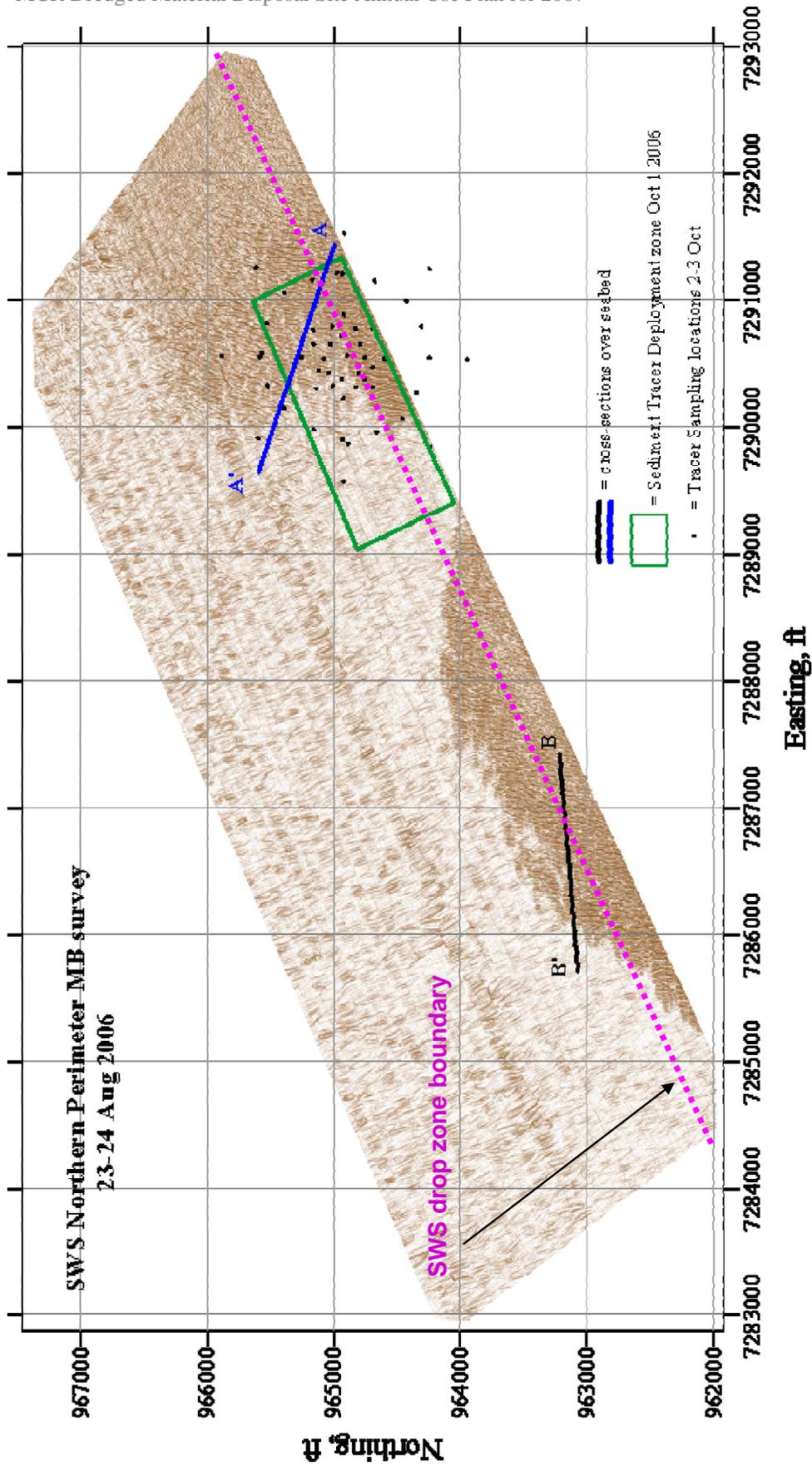


Figure 38. Multibeam survey of the SWS during 23-24 Aug 2006. Active transport of dredged material placed within the SWS is indicated by the darker areas, which show sand waves 1-3 ft high

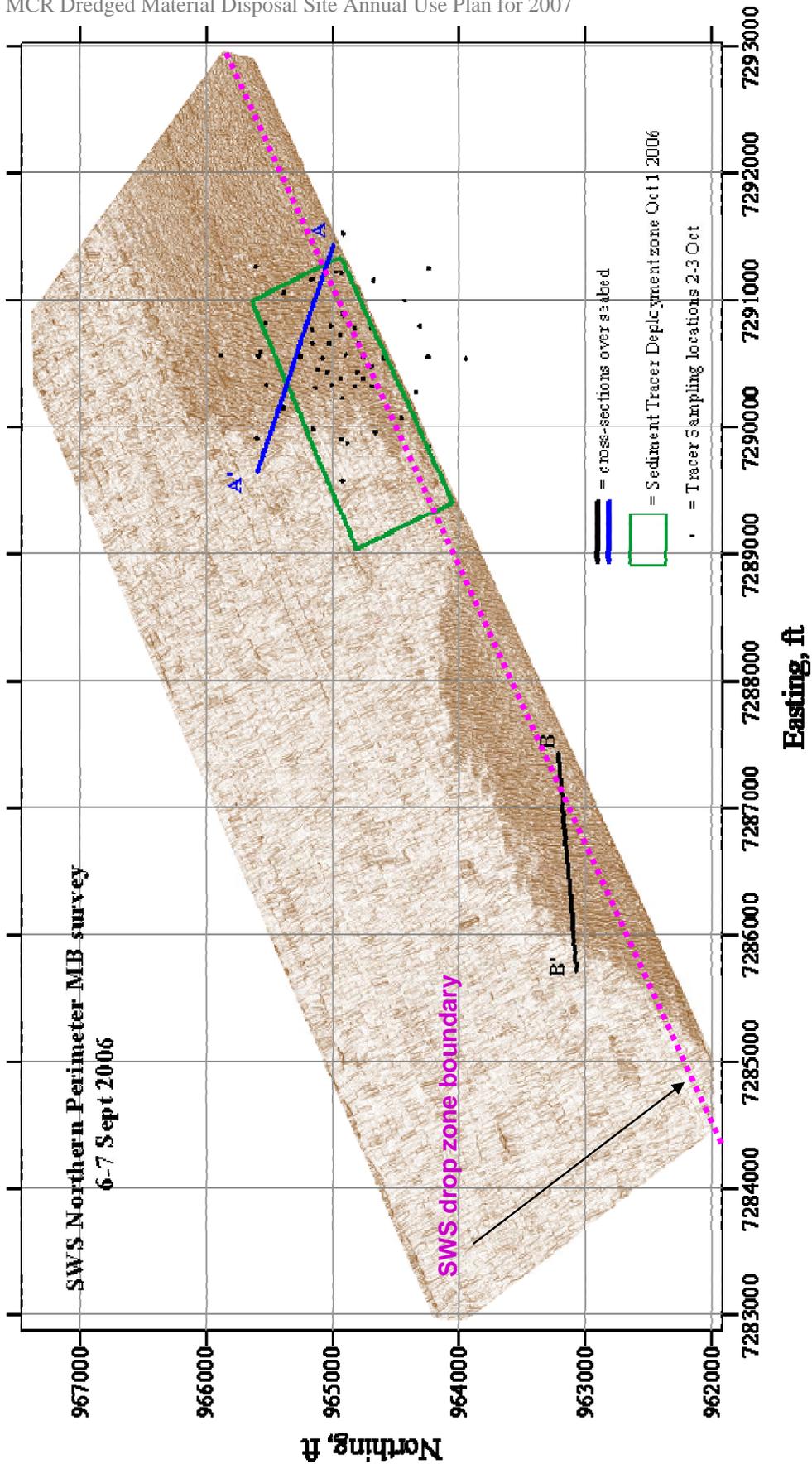


Figure 39. Multibeam survey of the SWS during 6-7 Sept 2006. Active transport of dredged material placed within the SWS is indicated by the darker areas, which show sand waves 1-3 ft high

Figure 40. Close-up in view of SWS multibeam survey conducted Aug and Sept 2006, showing sandwaves of dredged material moving along seabed in a Northwest direction. Note location of cross section A-A', which is shown in figure 38-39. Seabed variation along A-A' during Aug-Sept is shown in figure 42.

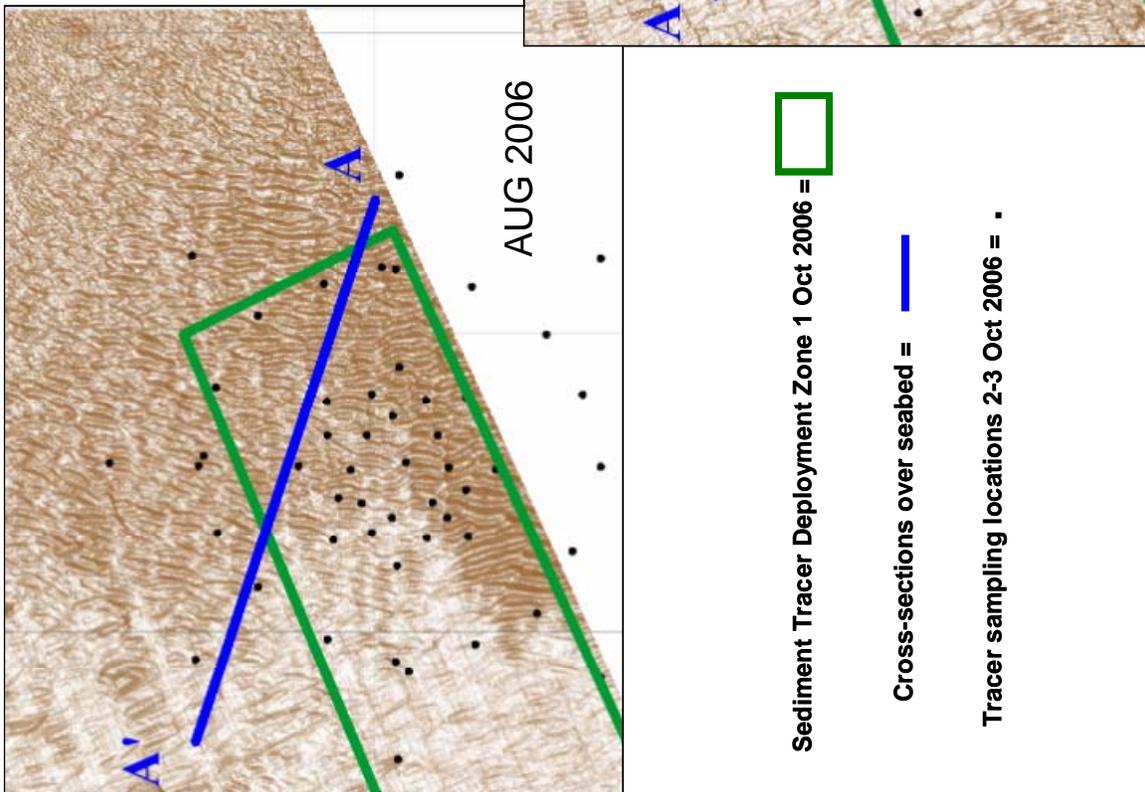


Figure 41. Zoom-ed in view of SWS multibeam survey conducted Aug and Sept 2006, showing sandwaves of dredged material moving along seabed in a Northwest direction. . Note location of cross section B-B', which is shown in figure 38-39. Seabed variation along B-B' during Aug-Sept is shown in figure 42.

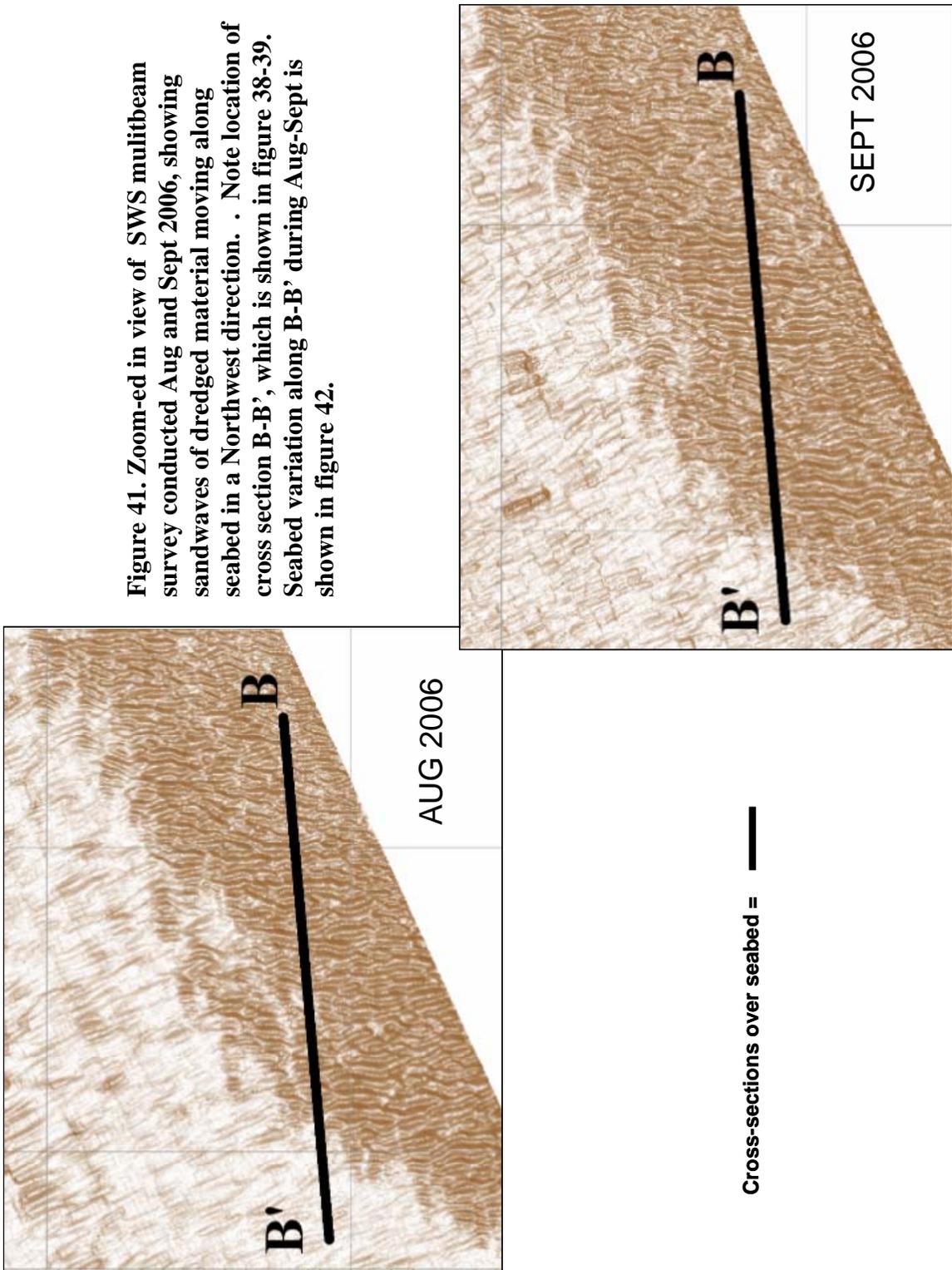
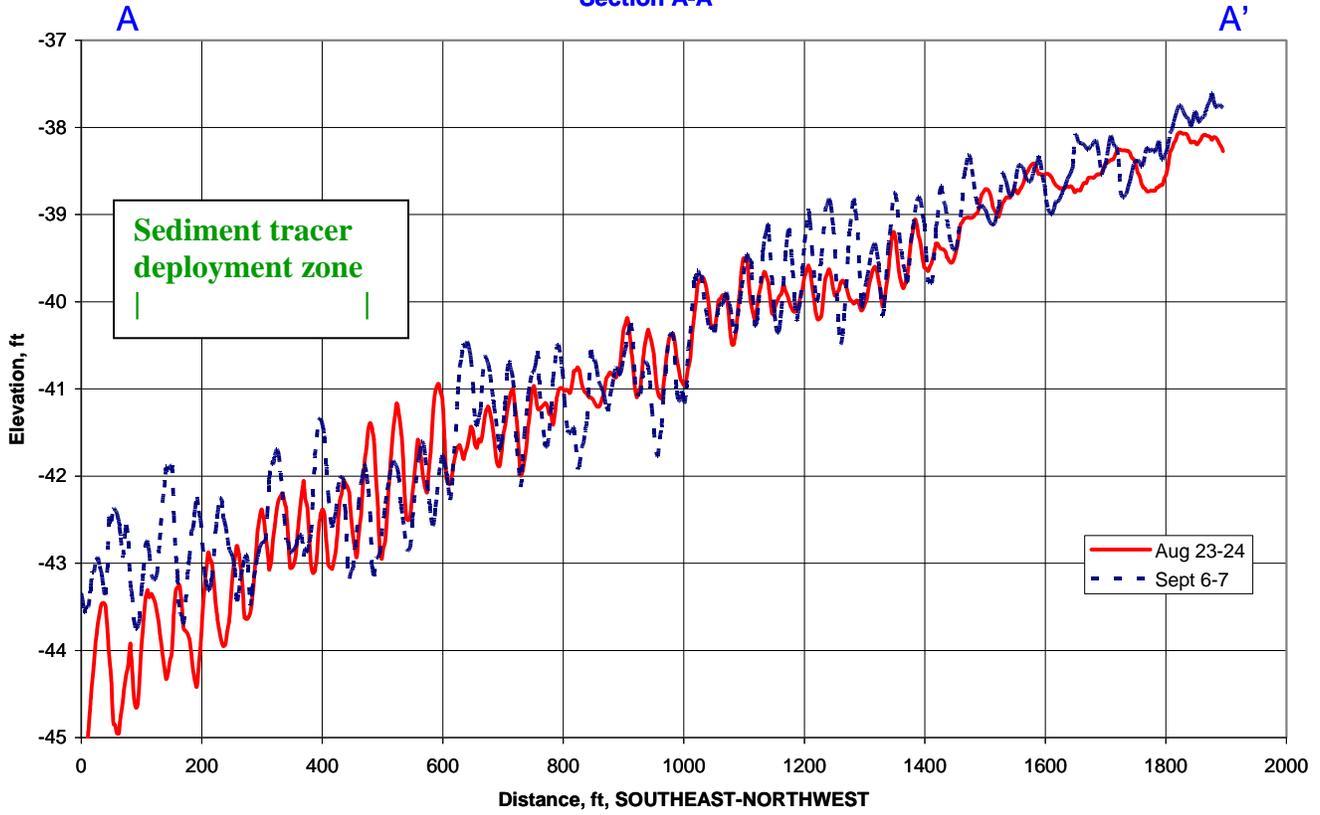


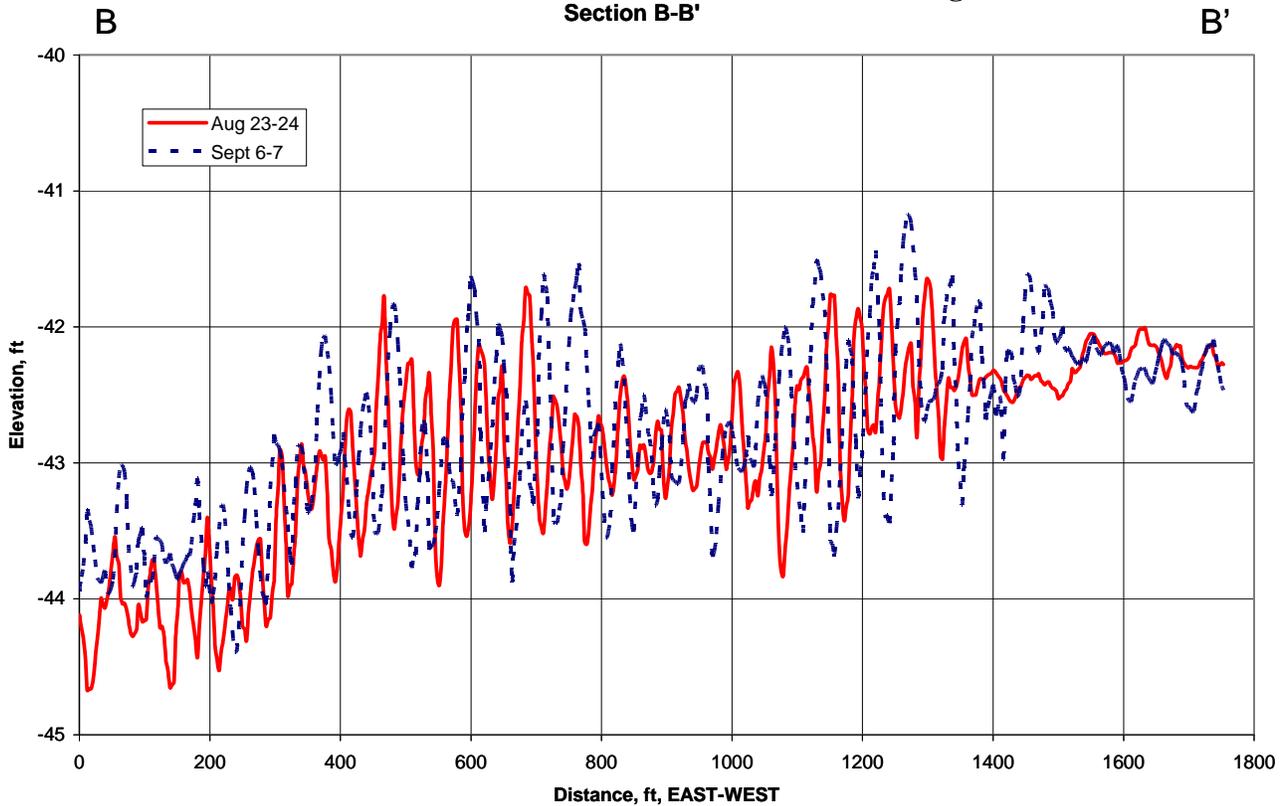
Figure 41

**Cross-section Along SWS Seabed
Section A-A'**



**Cross-section Along SWS Seabed
Section B-B'**

Figure 42





Sediment tracer was mixed with sand (1:1) during 1 October 2006 release from RV Forerunner. 2,400 Kg of tracer:sand mix was placed using 210-20 kg starch bags. Bags dissolved on seabed within 10 minutes.

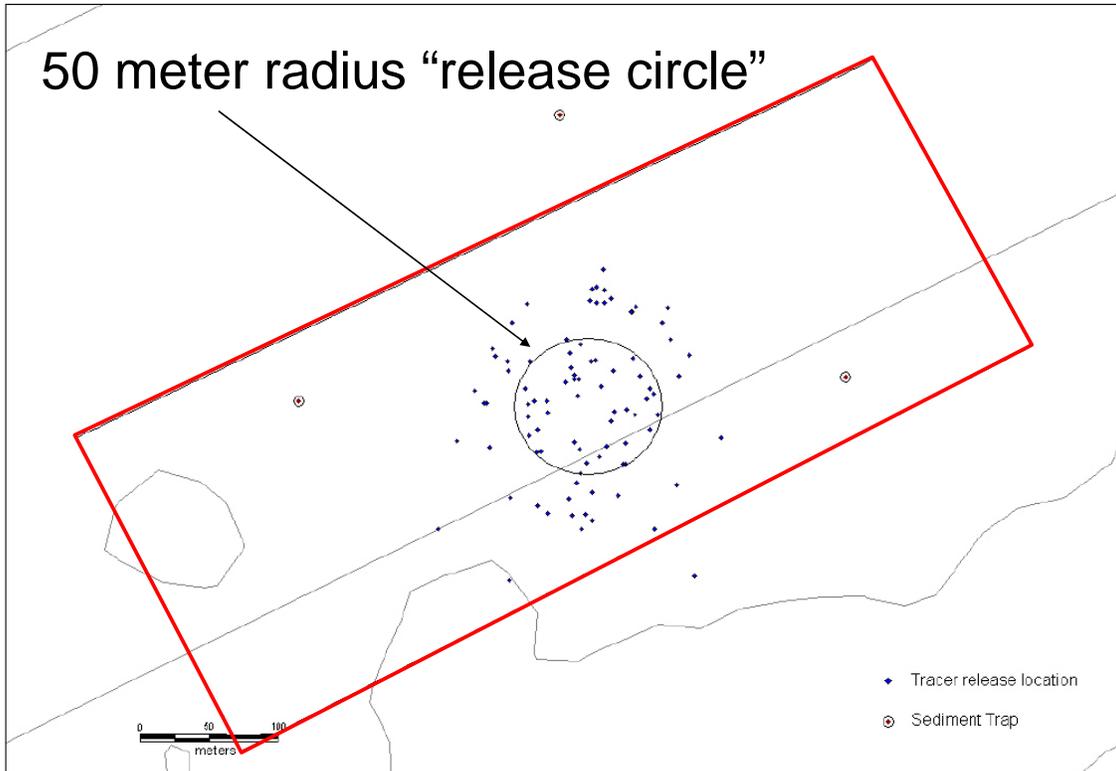
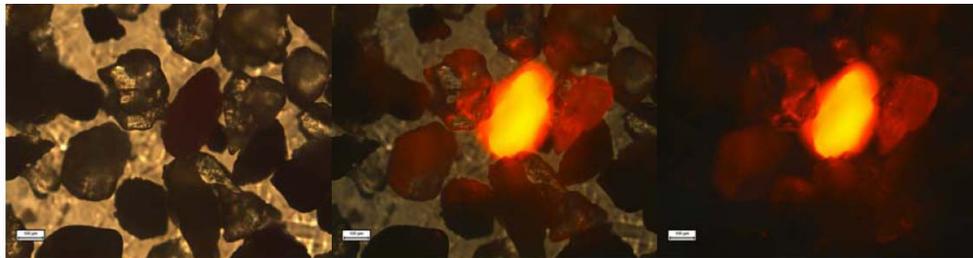


Figure 3.4: Map showing locations of sediment deployments relative to the main tracer release area and individual tracer placements.



Tracer particle in native sand
white light only, no
fluorescence illumination.

Tracer particle in native sand
White light and fluorescence
illumination

Tracer particle in native sand
No white light, fluorescence
illumination only.

Figure 2.5: Fluorescence micrographs of an MCR tracer particle

Figure 43

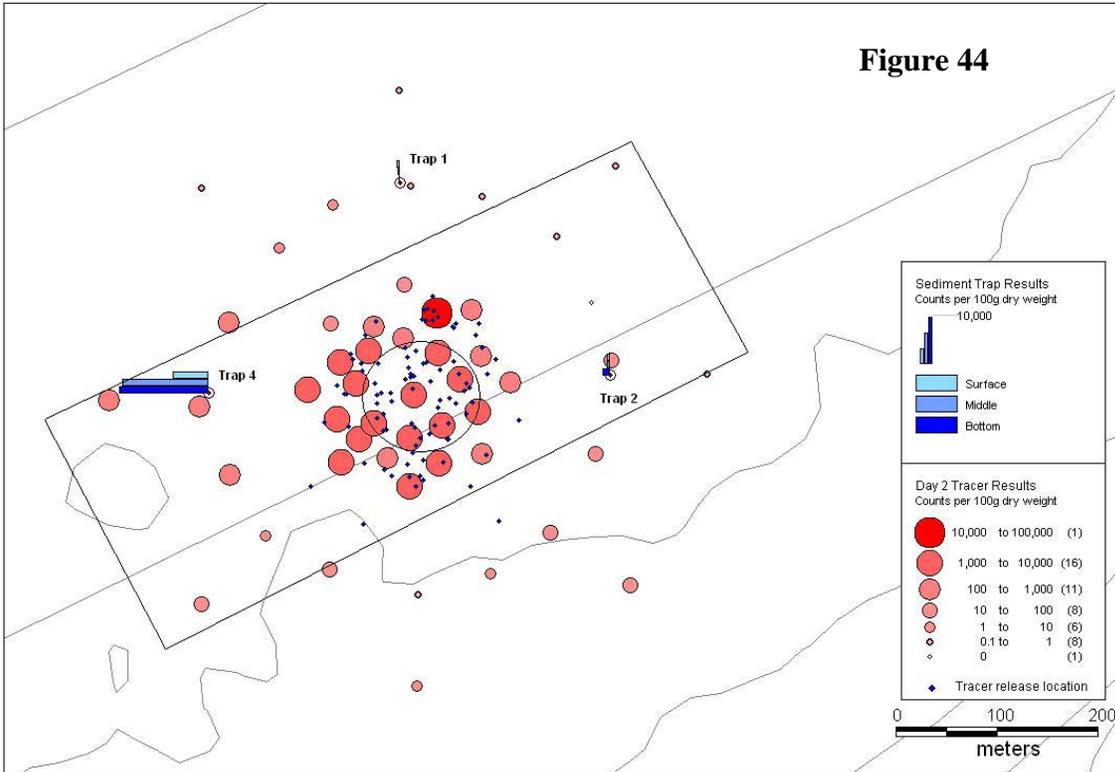


Figure 4.3: Tracer recover from grab samples and sediment traps obtained 2 days after release 3rd October

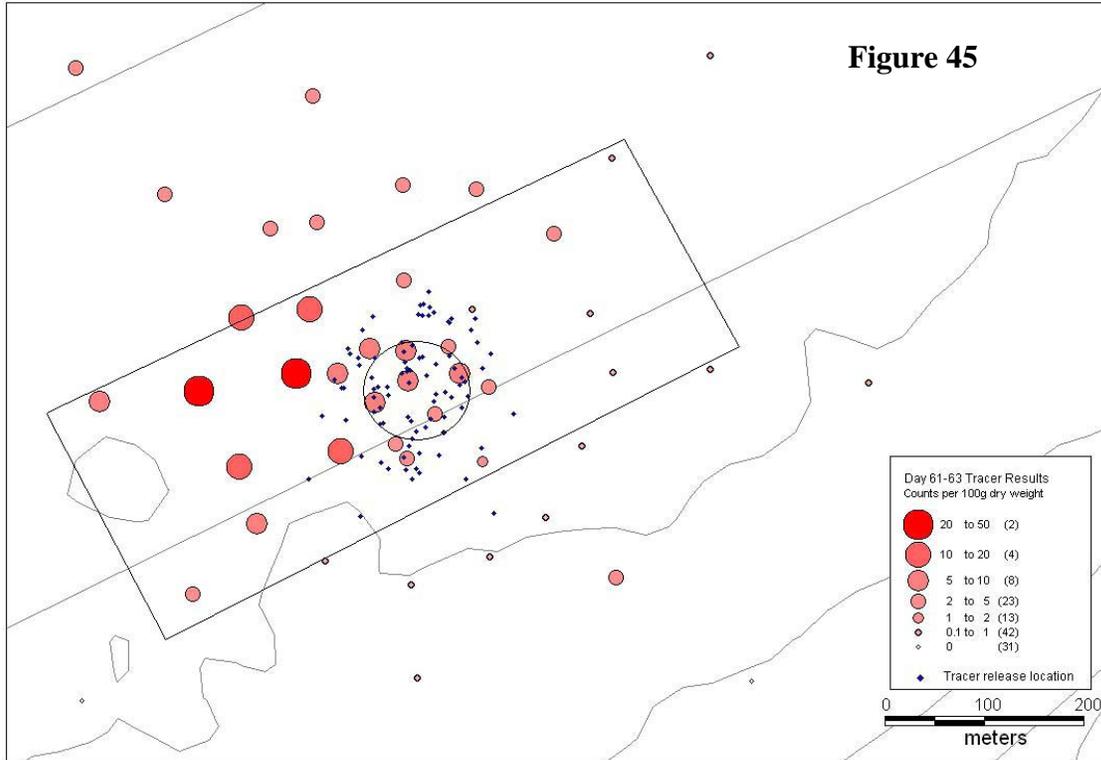


Figure 4.4: Tracer concentrations measured in grab samples collected Day 61–63 (around the tracer release area). Note different tracer concentration scales from Figure 4.3

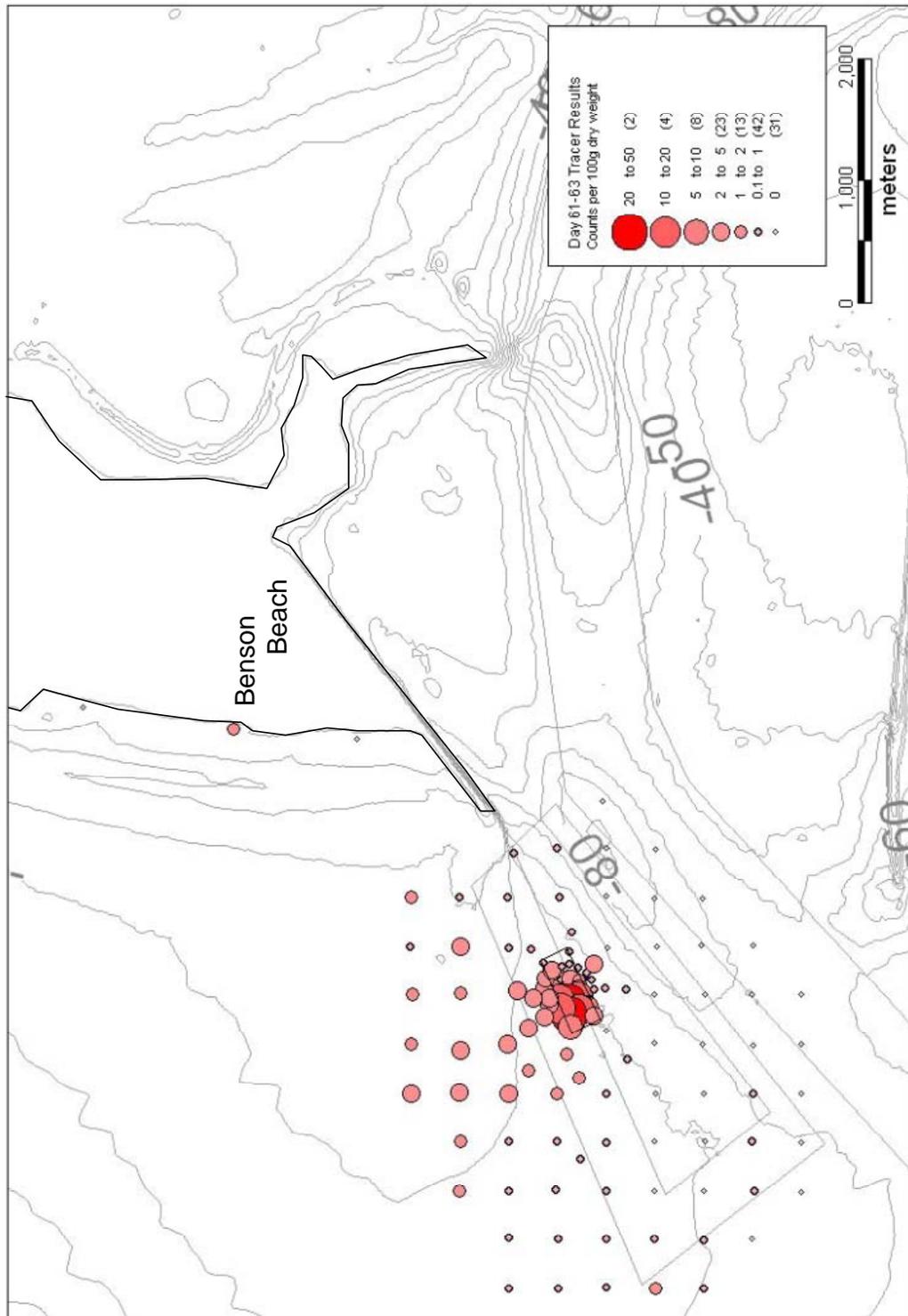


Figure 4.5: Tracer concentrations measured in grab samples collected Day 61–63 including Benson Beach

Figure 46