FINAL DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR PROPOSED OPEN-WATER PLACEMENT OF DREDGED MATERIAL AT SITE 104

QUEEN ANNE'S COUNTY, MARYLAND

U.S. Army Corps of Engineers Baltimore District

Comments from W. Young Review of internal study team draft of Site 104 DEIS, December 29, 1998

Item	Page #	Line #	Comment
1	1-3	46-51	Text erroneously applies the same analysis for maximum placement potential to all placement options without consideration of significant differences between types of options and also treats annual and total maximums as the same. This oversimplification mischaracterizes the relationship between different types of options and effects of exceeding planned annual placements, erroneously implies increased environmental risk would be the only outcome, and erroneously implies that lifts in excess of optimal at HMI and CSX/Cox Creek would lead to water quality degradation. These statements, if not corrected, would result in public misperceptions that could seriously damage the dredging program and adversely affect permitting actions for containment facilities and open-water placement sites. In contrast to the text, certain sites could potentially be increased in size without causing significant environmental effects. High lifts at containment facilities does not result in water quality degradation, although it would make site and effluent management more difficult. Further, exceeding annual planned placements in open-water sites can potentially be accomplished without causing significant adverse environmental impacts or loss of placement capacity. This fact provides flexibility for the dredging program to respond to variations in annual placement needs. THE TEXT NEEDS TO BE REVISED FOR ACCURACY AND TO AVOID ADVERSE IMPACTS TO OTHER DREDGED MATERIAL PLACEMENT PROJECTS.
2	2-1 to 2-44		The text contains many errors and mischaracterizations and is incomplete in essential areas. THE TEXT SHOULD BE REPLACED WITH THE MARKUP PROVIDED BY W. YOUNG.
3	3-1	21-25	Oversimplification introduces inconsistency with DNPOP activities and publicly available DNPOP documentation. DELETE OFFENDING SENTENCE IN CHAPTER 3. REVISION OF SECTION 2 PROVIDED BY W. YOUNG FIXES PROBLEM.
3	3-2	64-67	This and other discussions of public involvement tend to blend USACE and MPA-sponsored public information and involvement activities together. The text needs to be clarified to distinguish between CENAB public involvement activities in formal compliance with NEPA and the MPA-sponsored activities which are separate from federal requirements, although for the purposes of NEPA, have supplementary effect. MODIFY PER W. YOUNG MARKUP WILL FIX PROBLEM AT THIS LOCATION IN THE TEXT.

4	4-1 to 4-2	36-38	As worded, the text does not require smoothing after each placement. Although smoothing may not be needed if elevations are below maximum height, smoothing after each cycle may be needed to satisfy the expectations of the MWA. Furthermore, there would be less potential for an additional tubidity event if the leveling was done immediately following each placement and because the material would not have settled and consolidated as much as if it were left alone until the end of final dredging cycle.. This later fact would also make it easier to conduct the leveling. The potential need for annual smoothing to insure proper elevations needs to be stated. Smoothing after each cycle to satisfy MWA expectations is not a technical requirement until the final placement, and should be handled outside of the EIS as a policy and management matter by CENAB and the MPA with incorporation into annual dredging contracts, if appropriate. ADDITIONS TO THE TEXT PER W. YOUNG MARKUP WILL CORRECT THIS PROBLEM.
5	4-2	44-46	As worded, the text does not preserve CENAB's management prerogatives for development of site management plans and ignores the role of the local sponsor. The text also implies that the USACE management responsibility is total, whereas the USACE authority is over the dredging contractor whereas it would appear that the State, as owner of the bottom, may also have some management responsibilities, for example, for use of the "property." MINOR REWORDING PER W. YOUNG MARKUP WILL FIX THIS SUBSECTION.

6	4-6 to 4-7	210-218	Serious problems exist with the monitoring text as written. The EIS attempts to become a site management and monitoring plan by making operational and management decisions. In particular, the text commits to extraordinary resource-intensive and costly monitoring requirements. These requirements should not be needed to achieve satisfactory results provided that the dredging contractor's vessel operators exercise diligence in their navigation and placement operations. The effect of the text is to take project management decisions out of the hands of the CENAB Operations Division and the MPA (as local sponsor). The EIS should state the need for monitoring but should only cite a non-inclusive range of monitoring alternatives and objectives here and refer the reader back to the monitoring framework in Section 9. Section 9 should provide a FRAMEWORK, not a definitive monitoring plan which should be developed separately and modified based on experienced gained with each placement. The EIS should not insert itself into operational decision making because such an insertion is made without the benefit of conditions actually existing during the placement cycle and will, as written, constrain the flexibility needed to respond to changing circumstances. Line 210: Use "continually" [sequential] rather than "continuously" [without interruption]. Continuous 24-hour monitoring of all activity would be incredible overkill. No commitment should be made to such a monitoring effort without a comprehensive capability and cost analysis to determine practicality, feasibility, cost implications and alternatives to achieve the same monitoring objectives at more reasonable expense. Once this information is available, then a major policy decision needs to be made with respect to practical management relative to determining what level of effort is needed to respond to public concerns about the adequacy of control of placement activity and how much public involvement is appropriate. SEE WY MARKUP. Lines 214-125: Text requires a continuous recording capability aboard each vessel involved in placement. As stated above, the EIS should not attempt to make operational decisions. It should provide a framework while leaving the actual plan for development and modification by CENAB Operations Division based on actual placement and monitoring needs during each dredging cycle. SEE WY MARKUP.

7	4-7	217-218	The EIS should not specify the format for position data. This is an operational decision that should be left to the discretion of the CENAB Operations Division and the contracting officer. An operational and cost assessment need to be performed prior to making this operational decision. SEE WY MARKUP.
8	4-7	221	The DEIS too often makes statements about exactly how CENAB will manage the project, especially with respect to monitoring. The DEIS should commit to effective management to achieve results identified in the DEIS but should limit the discussion to the range of management practices that are available for possible use and leave it up to CENAB Operations Division to manage the project consistent with USACE requirements and the findings presented in the DEIS. Use of the work "independent" could be taken to imply that CENAB has committed to funding an independent 3rd party to conduct the monitoring program. In fact, monitoring required to satisfy environmental requirements is a responsibility of CENAB that cannot be transferred to an "independent" party. Even if monitoring were to be contracted to an independent 3rd party, the USACE would still have the responsibility for insuring the adequacy of the monitoring effort and for final acceptance of the result. It may be desirable, or even necessary from a credibility perspective, to allow for independent 3rd party involvement to assure the public that the placement is being properly executed and monitored, but this is different than relying on the results of independent 3rd party monitoring as the management technique. RECOMMEND DELETION OF THE WORD "INDEPENDENT" AND ADDING THE WORD "REPRESENTATIVE" TO THE TEXT TO ALLOW CENAB THE FLEXIBILITY OF USING USACE STAFF OR CONTRACTORS. SEE WY MARKUP.
9	4-7	224	The availability of information should be guided by USACE policy and the Federal Freedom of Information Act (FOIA), not the DEIS. A statement in the DEIS regarding what information will be made available interferes with and could short-circuit and compromise USACE responsibilities under FOIA and compromise the FOIA process. RECOMMEND DELETE ALL TEXT THAT SPECIFIES WHAT INFORMATION WILL BE MADE AVAILABLE OUTSIDE OF USACE. SEE WY MARKUP.

10	4-7	240-246	Poorly worded text identifies excessively rigorous and expensive operational controls. The use on onboard inspectors for each unit would be an extraordinarily human-resource-intensive activity. Does CENAB have the resources to accomplish this? [It would probably be less resource intensive and more effective to set up a remote electronic tracking unit at Sandy Point and periodically collect the information.] REWORD TO MAKE MORE GENERIC WHICH WOULD STILL KEEP THE MORE EXTREME OPTIONS AVAILABLE IF CIRCUMSTANCES INDICATED THAT USE OF SOME OR A COMBINATION OF EXTREME TECHNIQUES WOULD BE PRUDENT. SEE WY MARKUP.

11	4-8	282-287	The Site 104 working group concept as stated in the text would be a radical departure from the DNPOP process. Lines 283-285: Inclusion of all "interested" parties would not necessarily contribute beneficially to the functioning of a technical working group, which is the principal focus of DNPOP working groups. For example, participation by political activists or the news media in working group meetings addressing politically charged issues could easily force discussions towards articulation of publicly held positions rather than allow for the frank give and take deliberations which have assisted DNPOP working group participants in seeking consensus-based solutions. The DNPOP working groups provide a cooperative forum for interaction by agency professional (management) representatives and representatives from organizations represented in the DNPOP Citizens Committee. Attendance at working group meetings is by invitation to interested DNPOP participants and to other individuals at the invitation of the Working Group facilitator in instances where such attendance is appropriate to the deliberations of the working group. Working group activities are not public meetings and are not open to the general public or the news media. Their role is to provide technical and advisory support to the management agencies for dredged material planning and management and to the DNPOP committees. As such, these activities are internal to the DNPOP program. SEE WY MARKUP. Line 285: Use of the Working Group as a public information medium would limit its usefulness and compromise its effectiveness as a management tool. Use of the existing DNPOP Site 104 Working Group for public involvement would have an adverse ripple effect on the functioning of other DNPOP working groups if such use resulted in opening of the working groups to the general public and the news media. CENAB should respond to its public involvement responsibility using other tools such as the MDOT-chartered Site 104 Public Outreach Committee (which is outside of the DNPOP program), CENAB Site 104 newsletters, and public meetings hosted by CENAB. SEE WY MARKUP.
12	5-43	824-826	The text incorrectly states that the 40% nutrient reduction goal is a component of the Chesapeake Bay Agreement. I believe that the goal is a separate target established in support of the Agreement. SEE WY MARKUP.

13	5-43	824	I don't believe that the Chesapeake Bay Agreement was signed by all "Bay jurisdictions," whatever that means. For example, are all counties, municipalities, and authorities signature to the agreement? I don't think so. NEEDS TO BE CHECKED AND BROUGHT INTO CONSISTENCY WITH THE AGREEMENT.
14	5-57 5-59 5-62 5-66 6-37 6-38	1107-1109 1147-1165 1254-1267 1324-1344 1134 1144-1146	The governing policy and guidance for assessing the quality of sediment relative to dredged material management is the EPA & USACE Inland Testing Manual which was published in final form in 1998. The ITM tiered process should be used in the EIS as the evaluation criteria for sediment quality. The ITM does not set numerical criteria for sediment for good reason - the character of sediment and the associated ecological and physical setting vary greatly by port region. Therefore, generic numerical criteria would not effectively or reliably respond to region-specific conditions. The existing text (except in the Section 9 monitoring framework) ignore the ITM tiered testing protocols and instead focused exclusively on the informal ER-L, ER-M, NOEL and PEL criteria. This focus has the effect of elevating these criteria above the ITM and establishing these criteria as de facto standards for dredged material management in the Chesapeake Bay. The use of these criteria poses a problem because of the tendency to focus on contaminants in the sediment and the associated characterization of all Bay sediments as contaminated by some scientists because of the presence of contaminants. However, when ITM tiered protocols are applied, the sediment planned for placement in Site 104 qualifies as "clean" or "uncontaminated" because the constituents in the sediments do not reach levels that would result in the sediment being categorized as contaminated. It may be acceptable to consider ER-L, etc. when performing tiered evaluation using the ITM. However, the ITM tiered evaluation requirement should be presented first because it is the testing manual that is prescribed for dredged material management by the EPA and USACE. All supporting analysis should then be conducted within the context of the ITM tiered evaluation. THE ITM NEEDS TO BE ADDED TO THE SEDIMENT ANALYSIS AS THE GOVERNING TESTING PROTOCOL. THE ER-L, ETC. WRITEUP NEEDS TO BE REVISED INTO THE CONTEXT OF ITM.

15	6-48	1596	The EIS should not commit to marking the transit routes. This is an operational decision that needs to consider physical conditions existing at the time of the placement event. Furthermore, placing and maintaining markers for navigational purposes must meet U.S. Coast Guard requirements. This could pose significant resource requirements on marking routes. The ability to maintain markers during winter operating conditions could be difficult, and could prove impossible at a practical tool if heavy ice conditions are encountered. SEE WY MARKUP FOR QUICK FIX.
16	7-2	53-56	Statement about the potential for water quality degradation at HMI is falacious and contrary to requirements of the SPDES permit for the facility and operational requirements, practices and procedures. CORRECT TEXT PER WY MARKUP.
17	7-2	87-89	The scenario postulated for Poplar Island filling is hypothetical and would not be allowed to occur, is not realistic, and not consistent with best management practices. FIX PER WY MARKUP.
18	7-2 7-3	89 90	The statement about adding elevated metals to local waters is inflamatory and incorrect. Only clean sediments are scheduled for placement at Poplar Island, therefore, even if material were discharged directly into local waters, contamination would not occur. In any event, the postulated scenario would be contrary to the Poplar Island EIS and would violate water quality certification requirements for the facility. SEE WY MARKUP
19	8-2	48	The text states that contaminated sediments would be placed in the Upper Bay Island Placement Site. The MPA has consistently stated publicly that there are no plans to place contaminated sediment at such a containment island. DELETE WORD 'CONTAMINATED."
20	8-3	126	Hydrodynamic modeling is in progress. RECOMMEND ADDING SENTENCE TO THIS EFFECT.
21	9-2	84-87	The EIS should present a monitoring framework but it should not attempt to become a monitoring plan. Monitoring planning cannot be completed without considering conditions that exist during the dredging window and without a serious assessment of monitoring needs, capabilities, and costs. Please refer to Items 4 through 10. RECOMMEND REVISE PER WY MARKUP.

22	9-3	129-130	The monitoring framework assumes precise predictive capabilities and results whereas the predictive tools that are available are neither precise nor complete. Therefore, the hypothesis to be testing cannot realistically be made more precise than the tools that are available to predict and measure results. The hypothesis throughout the framework need to be stated within the context of the predictions that are being testing, and should not state as a criteria a condition that would exceed the tolerances of predictive capabilities. At lines 129-130, the DEIS emphatically states that "placement of dredged material **will not deviate** [emphasis added] from these expected conditions. This hypothesis is a prescription for failure. It is not realistic to assume that some variation from predictions will occur. The issue is whether or not these variations are within the tolerances of the predictive tools that were applied. THE TEXT NEEDS TO BE REVISED TO REFLECT REALITY.
23	9-4	157-158 166-167	The hypothesis is flawed. It assumes that sedimentation rates will not be affected by any other physical condition, thereby placing the entire burden of no change in sedimentation on placements in Site 104. The hypothesis needs to be revised to address the potential for sedimentation from other sources such as a massive episodic storm and excessive sediment loading of the upper Bay from the Susquehanna. SEE WY MARKUP
24	9-5	205	The Inland Testing Manual is correctly referred to in this section. THE TEXT IN SECTIONS 5 AND 6 NEED TO BE BROUGHT INTO HARMONY WITH LINE 205
25	9-6	228	Same problem as Item 22. DELETE "WILL NOT DEVIATE" AND REPLACE WITH "REMAIN WITHIN THE"

26	9-7	274	The text incorrectly applies Chesapeake Bay Program parameters for assessing water quality. All assessment of water quality in Maryland needs to conform to parameters used by MDE because (1) MDE is the regulatory authority for water quality in Maryland (subject of course to EPA rules and regulations) , and (2) CBP guidelines, policies, etc., are voluntary guidelines unless incorporated into the official criteria of the regulatory authorities. The text has the effect of subjugating the regulatory role of MDE to the CBP. THE TEXT SHOULD USE WATER QUALITY REGULATION BY MDE AS THE CONTEXT FOR THIS SECTION, AND IF APPROPRIATE, SUPPLEMENT THOSE CRITERIA IF NEEDED BY ADDING ANY ADDITIONAL CRITERIA USED BY THE CBP.
27	9-8	348	MDE rather than the Chesapeake Bay Program is the regulatory authority responsible for water quality in the State of Maryland. If a reference station is selected, it should be one of MDE's stations, not the CBP's. The text has the effect of subjugating the regulatory role of MDE to the CBP.
28	10-1	26	Doesn't the USACE rather than Congress approve the EIS??????
29	11-5	187-190	There will be different monitoring regimes for Poplar Island and CSX/Cox Creek. Linking Poplar Island monitoring to the monitoring requirements at Hart-Miller implies contaminants. DELINK POPLAR FROM BOTH HMI AND CSX/COX CREEK.
30	11-5	215-216	Totally falacious. DELETE
31	12-18	803	EPA and USACE (1998) needs to be added to the References. ADD ITM

S~~S~~ection 1

Purpose and Need for the Action

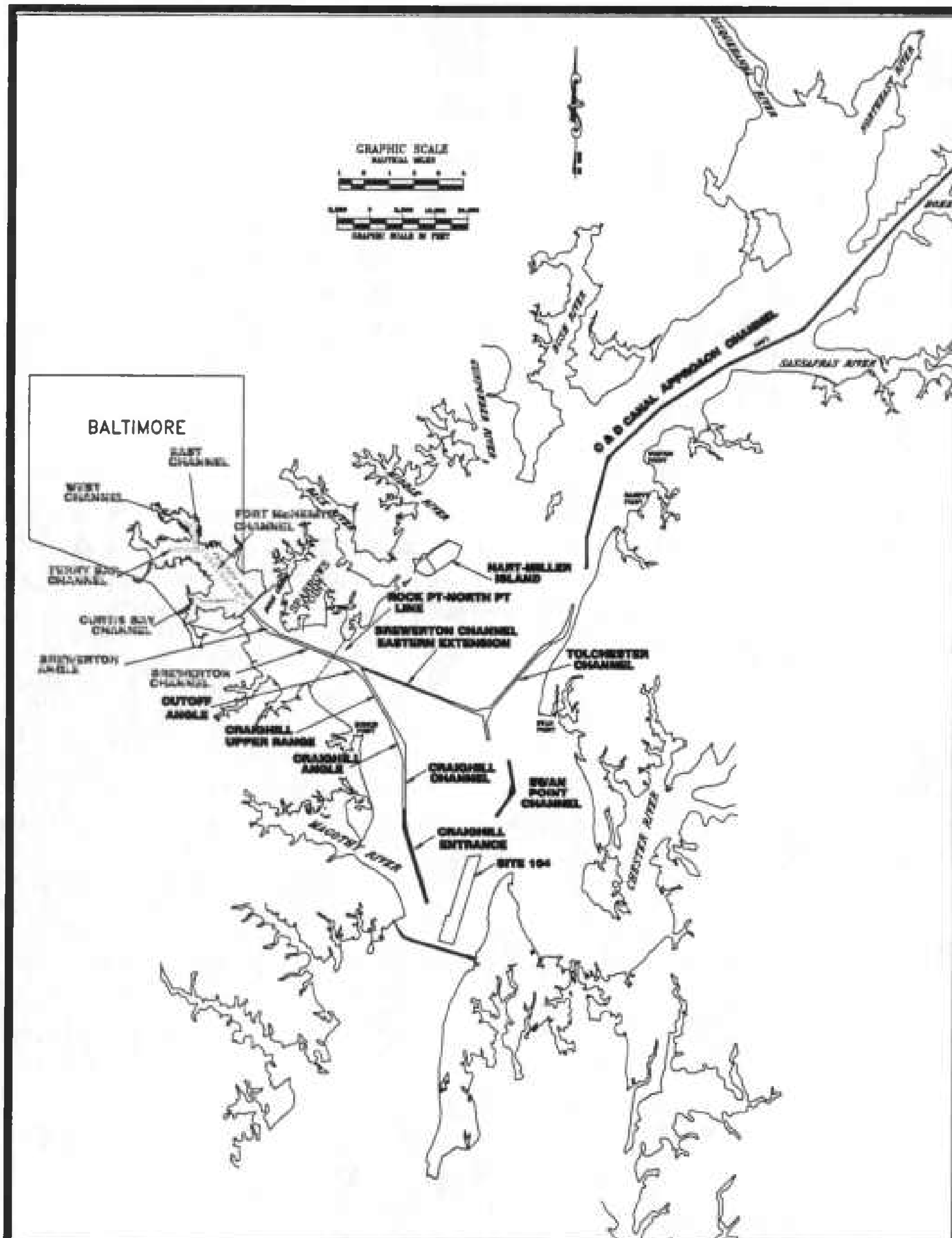
1.1 PURPOSE AND NEED

The Maryland Port Administration (MPA) and the U.S. Army Corps of Engineers (USACE) are responsible for maintaining, through periodic dredging, the 126 miles of Federal navigation channels that serve the Port of Baltimore. Continued maintenance dredging will be required to maintain the efficiency and safety of the approach channels to the Port of Baltimore. Of particular concern are the Chesapeake Bay ~~These~~ approach channels in Maryland, which include the Craighill Entrance, Craighill Channel, Craighill Angle, Craighill Upper Range, Cutoff Angle, Brewerton Channel Eastern Extension, Swan Point Channel, Tolchester Channel and the southern approach channel to the Chesapeake & Delaware (C&D) Canal (Figure 1-1). ~~This~~ ~~m~~Maintenance dredging of these channels requires the removal of approximately 3.2~~5~~ million cubic yards (mcy) of material per year. This total is exclusive of approximately 1.5 mcy of material that is dredged from the C&D Canal, ~~and~~ the northern approach channel to the C&D Canal, Virginia channels, and the Baltimore Harbor, and that is deposited in other placement sites. Several new-work dredging projects are currently proposed to ~~increase~~ improve navigation safety and efficiency for the Chesapeake Bay approach channels over the next several years. These new-work projects would require the removal of an additional 18 mcy of dredged material from the Chesapeake Bay approach channels in the next several years.

The management of dredged material is an ongoing concern for the MPA and USACE~~,~~ ~~Baltimore District (CENAB)~~. The Port of Baltimore ~~continues to~~has experienced difficulty in establishing placement sites with sufficient capacity to accommodate the dredging needed for navigation safety and to sustain port competitiveness.

Move the following paragraph to Section 2:
[In July 1990, a broad-based, multi-organizational task force was convened by the Governor of Maryland to review dredged material management options. The task force recommended a continuation of studies on the feasibility of using new open-water placement sites, with an emphasis on environmental considerations. Through its Dredging Needs and Placement Options Program (DNPOP), the MPA, in cooperation with the USACE, state and Federal agencies (FWS, EPA, MDDNR, MDE, and NOAA), and private interest groups (MWA, MCCA, CBE), ~~,~~ is developing alternative dredged material placement ~~areas~~ options to accommodate both current and future dredging projects for dredged material from the Baltimore Harbor, and the Baltimore Harbor and C&D Canal Approach Channels in Maryland. Results of the DNPOP program formed the basis of the 1996 State of Maryland's Strategic Plan for Dredged Material Management.]

The State of Maryland's 1996 Plan estimated that 40 mcy of sediment would have to be dredged over 10 years (1997 to 2007) for maintenance of the channels to the Port of Baltimore (MPA 1996). By 2012, maintenance dredging would generate an additional 20 mcy of sediment and by 2017 it would generate another 20 mcy of sediment. Currently scheduled new work would



MARYLAND PORT ADMINISTRATION

MARYLAND ENVIRONMENTAL SERVICE

US Army Corps of Engineers

BALTIMORE HARBOR AND APPROACH CHANNELS

FIGURE 1-1

J:\SITE104\SEP95.DWG

~~generate an additional 28 mcy of sediment by 2007. The 1996 Plan identified 18 mcy of material for placement in an open-water site, to fulfill near-term dredged material placement needs. This 18-mcy placement capacity is needed in addition to the placement volumes that are already~~

generate an additional 28 mcy of sediment by 2007. The 1996 Plan identified 18 mcy of material for placement in an open-water site, to fulfill near-term dredged material placement needs. This 18-mcy placement capacity is needed in addition to the placement volumes that are already committed to existing sites (Hart Miller Island and Pooles Island open water) and sites that are currently under development (CSX/Cox Creek and Poplar Island). The designed maximum ~~annual~~ placement capacities of the existing and developing sites would preclude their utilization beyond the volumes in the current Dredged Material Management Plans (DMMP) ~~without the risk of potential environmental impacts (e.g., water quality degradation adjacent to dredged material placement sites due to placing too much material too quickly).~~, without significantly reducing the sites' capacity by overfilling, which precludes proper drying and consolidation of the dredged material.

The purpose of this ~~Draft~~ Environmental Impact Statement (EIS) is to evaluate the proposed placement of up to 18 mcy of clean dredged material in a suitable placement area~~the open-water site, known as Site 104, located northeast of the William Preston Lane, Jr. Memorial Bridge (henceforth referred to as the Chesapeake Bay Bridge) as described in Section 1.6 and Section 2.1 (Proposed Action)~~. Due to a lack of immediately available capacity for maintenance and new work dredging projects, the Baltimore District and the MPA have a short-term need for additional dredged material placement capacity. Placement alternatives are~~Site 104 is~~ being considered as a solution to this need and would be expected to have an operational lifespan of 1-~~8~~9 years. Based on its prior use as a placement site from 1924 to 1975, its current available capacity, its geographic proximity to the approach channels, the potential for dredged material to improve environmental conditions at the site, and ~~MPA's~~ DNPOP program's evaluation of other ~~sites~~options, the MPA identified Site 104 ~~placement site has been identified by the MPA~~ as their preferred site to receive the 18 mcy of clean dredged material between 1999 to 200~~8~~4. Dredged material p~~P~~lacement alternatives ~~to Site 104~~ are discussed in Section 2.2 and~~, along with Site 104, are~~ evaluated further in this EIS.

1.2 STUDY AUTHORITY

Pursuant to Section 102 of the National Environmental Policy Act (NEPA), the Baltimore District will ~~will has~~ prepared and circulated an ~~n this draft~~ environmental impact statement for evaluation of the proposed ~~proposed placement of~~ dredged material placement alternatives~~at Site 104, Chesapeake Bay, Queen Anne's County, Maryland~~. The dredged material ~~to be placed at Site 104~~ would be clean material from Federal navigation channels in the main stem of the Chesapeake Bay leading to ~~Baltimore Harbor and~~ the Port of Baltimore. ~~Site 104 is located in the main stem of the Chesapeake Bay, north of the Chesapeake Bay Bridge, and west of Kent Island and encompasses approximately 1,800 acres.~~ The EIS will include descriptions of the existing site conditions, dredged material placement alternatives, probable impacts of dredged material placement, public involvement, and the recommended determination and/or activity. The Section 404(b)(1) evaluation will investigate the use of alternative placement locations~~,~~ and equipment and methods for the proposed placement of up to approximately 18 mcy of ~~additional~~ dredged material ~~in the deepestr parts of the site~~.

1.3 FEDERAL MAINTENANCE REQUIREMENTS

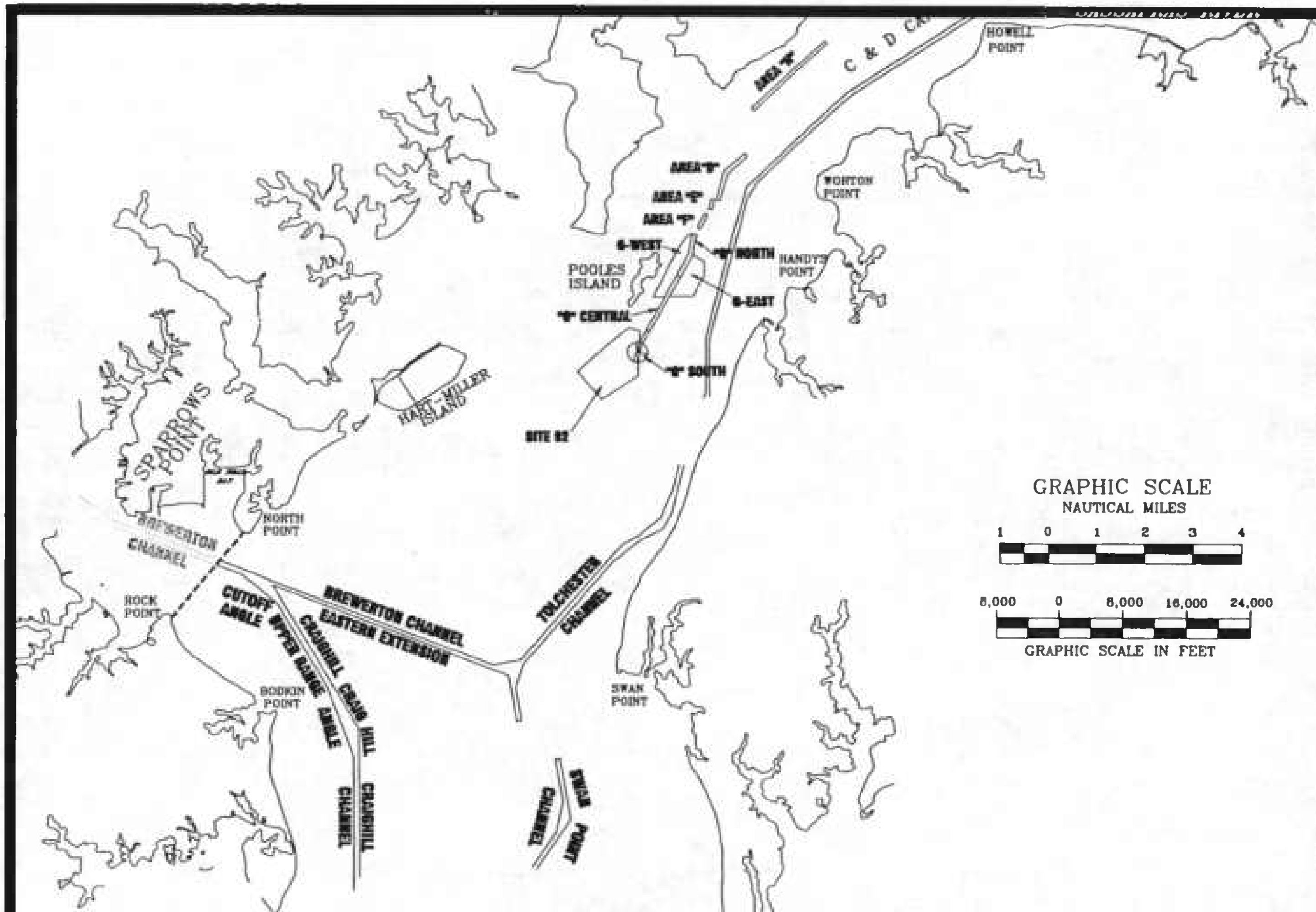
The Rivers and Harbor Act of July 3, 1958, authorized the deepening of the main approach channels to Baltimore Harbor from 39 ~~feet~~ft to 42 ~~feet~~ft and the deepening and widening of the connecting channels to the C&D Canal from 27 ~~feet~~ft to 35 ~~feet~~ft deep and from 400 ~~feet~~ft to 600 ~~feet~~ft wide. The connecting channels are comprised of the Brewerton Channel Eastern Extension and the Tolchester and Swan Point Channels. ~~The approximate length of the northern approach channels is 46 miles. The approximate length of the Brewerton Extension is 6 miles.~~ In addition, the project authorized maintenance of a 39-~~foot~~ft depth in the Northwest Branch, provided that local interests first deepen the channels to that depth. Deepening and maintenance of the Baltimore Harbor and southerly approach channels to a 50-~~foot~~ft depth were authorized under Section 101 of the Rivers and Harbor Act of 1970. ~~Under the 1958 and 1970 authorizations, USACE and the MPA are responsible for removing approximately 2.5 mcy per year for maintenance. Approximately 2.0 mcy of this annual need is in the upper Bay. The approximate length of northern approach channels is 25 miles. These projects are under the jurisdiction of USACE-Baltimore District (CENAB).~~ The Baltimore Harbor & Channels, MD & VA and Federal Navigation project is maintained annually by the U.S. Army Corps of Engineers, Baltimore District. As the non-Federal sponsor for the project, the Maryland Port Administration is responsible for identifying suitable dredged material placement areas for the material removed from the channels.

The authority for the Inland Waterway from the Delaware River to the Chesapeake Bay, Delaware and Maryland project, was adopted by House Document 63-196 in 1919 and modified several times to deepen and widen the C&D Canal and its approach channels. The latest modification was authorized by Senate Document 83-123 in 1954 that authorized in part, a channel 35 ~~feet~~ft deep and 450 ~~feet~~ft wide. This project is under the jurisdiction of USACE, Philadelphia District (CENAP). CENAP and the MPA are responsible for maintaining the Inland Waterway from the Delaware River to the Chesapeake Bay, Delaware and Maryland project.

~~If approved, Site 104 will only be used to receive dredged material from the Port of Baltimore approach channels and C&D Canal approach channels. Maintenance dredging from both sets of approach channels is estimated to generate 3.5 mcy per year. No material from within the Port of Baltimore (areas west of the North Point/Rock Point line) will be placed at Site 104 (Figure 1-2).~~

~~CENAP and the MPA are responsible for maintaining the Inland Waterway from the Delaware River to the Chesapeake Bay, Delaware and Maryland project.~~ This requires the dredging of approximately 1.5 mcy of material annually from the reaches between Pooles Island and the Sassafras River. This material ~~is usually~~has historically been placed in the Pooles Island open-water placement areas located west of the C&D Canal southern approach channel (Figure 1-2).

~~If approved, Site 104 will only be used to receive dredged material from the Chesapeake Bay approach channels to the Port of Baltimore and C&D Canal approach channels. Maintenance~~



MARYLAND ENVIRONMENTAL SERVICE

MARYLAND PORT ADMINISTRATION

US Army Corps of Engineers

POOLES ISLAND
OPEN WATER PLACEMENT SITES
FIGURE 1-2

~~dredging from both sets of approach channels is estimated to generate 3.5 mcy per year. No material from within the Port of Baltimore (areas west of the North Point/Rock Point line) will be placed at Site 104 (Figure 1-2).~~

These channels can be divided into several distinct geographical areas, the Virginia channels, the Maryland Bay channels, and the Baltimore Harbor channels, which comprise the Baltimore Harbor & Channels project; and the southern and northern approach channels to the Chesapeake and Delaware (C&D) Canal, and the C&D Canal which comprise the Inland Waterway from the Delaware River to the Chesapeake Bay, C&D Canal project.

The Virginia Channels are comprised of the Cape Henry, York Spit, and Rappahannock Shoal Channels. The channels are authorized to 50 ~~feet~~ft deep and are located in the Virginia Portion of the Chesapeake Bay. The Cape Henry and York Spit Channels are dredged periodically, removing an average of approximately 425,000 cubic yards annually. The Rappahannock Shoal Channel experiences little shoaling and has not been maintained since it was deepened to 50 ~~feet~~ft in 1987. Dredged material from the Cape Henry channel is placed at the Dam Neck Ocean placement area in the Atlantic Ocean. Dredged material from the York Spit Channel is placed at the Wolf Trap Alternate open water placement area in the Chesapeake Bay. Material previously dredged from the Rappahannock Shoal Channel was placed in the Rappahannock Deep Alternate placement area in the Chesapeake Bay. Since adequate dredged material placement capacity currently exists for these channels, this Environmental Impact Statement will not address these channels.

The Maryland Bay channels include the Craighill Entrance, Craighill Channel, Craighill Angle, Craighill Upper Range, and Cutoff Angle which are authorized to 50 ~~feet~~ft deep and extend from just north of the Chesapeake Bay Bridge to the entrance to the Patapsco River; and the Brewerton Channel Eastern Extension, Tolchester Channel, and Swan Point Channel, which are authorized to 35 ~~feet~~ft deep and extend from the Tolchester and Pooles Island areas to the mouth of the Patapsco River. Maintenance dredging is performed annually with approximately 2 million cubic yards of material being dredged from the channels. Shoaling rates and dredging frequencies vary from channel to channel. Material dredged from these channels over the past 15 years has been placed at either the Hart-Miller Island Containment Facility in Baltimore County, or at the Pooles Island open water placement areas in the Chesapeake Bay. The Poplar Island Habitat Restoration Project is currently being constructed to receive dredged material from these channels. Phase I, to construct 640 of the 1100-acre site is scheduled for completion by December 1999. Phase II is scheduled to start in the spring of 2000 and be completed by the fall of 2001.

The Baltimore Harbor Channels extend from the mouth of the Patapsco River into the Northwest and Middle Branches of the Patapsco River, Curtis Bay, and Curtis Creek. These channels are maintained annually, removing approximately 500,000 to 600,000 cubic yards of material. Shoaling rates and dredging frequencies vary from channel to channel. Material dredged from these channels over the past 15 years has been placed at the Hart-Miller Island Containment Facility, and is precluded from being placed in open waters of the Chesapeake Bay by State of Maryland law. Material dredged from these channels will continue to be placed in the Hart-

Miller Island Containment Facility and potentially in the proposed CSX/Cox Creek Containment Facility which is currently under study.

The southern approach channel to the Chesapeake and Delaware Canal extends from the Pooles Island Area to the Sassafras River. The northern approach channel extends form the Sassafras River to the entrance to the C&D Canal at Town Point. The C&D Canal extends from Town Point in the Chesapeake Bay to Reedy Point in the Delaware River. Maintenance dredging is performed annually in the channel areas maintained by the Philadelphia District, removing approximately 1.5 mcy of material, although not at reaches require dredging each year.

The material dredged from the southern approach channel to the C&D Canal (stations 250+000 to 163+000) has been deposited in five previously used open water placement areas designated as Pooles Island areas D, E, F, G, and H (Figure _). These sites are south of the Sassafras River and have been permitted for Corps use by the State of Maryland periodically since the 1970's. The Maryland Department of Natural Resources has allowed fill up to minus 8.5 ~~feet~~ft Mean Low Water (MLW) for area D, minus 11 ~~feet~~ft MLW for areas E, F, and G, minus 12 ~~feet~~ft MLW for area H, and minus 14 ~~feet~~ft MLW for Site 92. The annual quantity placed in open water (1977 to 1998) from this segment is approximately 1,200,000 cubic yards.

Based upon the amount of material that must be dredged from the Maryland portion of the project, approximately 4 mcy must be dredged annually to maintain the channels. This amounts to a dredging need of 80 mcy over a twenty-year dredging period.

In addition to maintenance dredging, there are several congressionally authorized new work projects and several new work projects in the planning or engineering and design phase. The following projects have been authorized for construction:

The Brewerton Channel Eastern Extension is authorized to 35 ~~feet~~ft deep and 600 ~~feet~~ft wide. The channel was deepened to 35 ~~feet~~ft in 1986 and widened to 450 ~~feet~~ft wide. The eastern nautical mile of the channel was widened to the authorized 600-~~foot~~ft width in 1989-90. Widening of the western five miles of channel requires the dredging and placement of 2.3 mcy of material. Congress has appropriate funds to complete this work in Fiscal Year (FY) 2000. Congress has directed the Corps to straighten the Tolchester Channel S-Turn. Straightening the Tolchester Channel S-Turn will require the dredging of 2.8 mcy of material. Congress appropriated a portion of the funds to initiate construction in FY 2000. Congress has also approved several improvements to under the Baltimore Harbor Anchorages and Channels project. These improvements will require the dredging of 4.5 mcy. Congress has not appropriated funds to initiate this work. The C&D Canal and approach channels area currently being studied to determine the Federal interest in deepening the channels beyond 35 ~~feet~~ft deep. Preliminary information indicates that approximately 10 mcy of material would have to be dredged to deepen the project to 40 ~~feet~~ft mean lower low water (MLLW). In addition, the State of Maryland currently proposes to construct a new 50-~~foot~~ft deep berth at either Dundalk or Seagirt Marine Terminals, and construct a new container facility at Masonville.

In order to accommodate the planned maintenance dredging and new work dredging over the next twenty years, an estimated 110 million cubic yards of material must be dredged in the upper Chesapeake Bay area.

1.4 SCOPE OF THE EIS

The decision of whether to accomplish the work proposed in this EIS will be based on an evaluation of the probable impact, including cumulative impacts, of the proposed work on ~~on in~~ the public interest. The decision will reflect the national concern for the protection and utilization of important resources. The benefits that may reasonably be expected to accrue from the proposed project must be balanced against its reasonably foreseeable detriments. This EIS documents and analyzes the potential environmental and socioeconomic effects associated with the action described in Section 2.1, "Proposed Action" and alternatives to the proposed action. The study area for this EIS includes the upper Chesapeake Bay ~~proposed Site 104~~ area and the potential region of influence (ROI) within the communities surrounding the proposed sites. ~~The ROI for this project consists of the Chesapeake Bay itself and Queen Anne's, Anne Arundel, and Kent Counties.~~

~~1.5 ALTERNATIVE PLACEMENT SITES~~

~~Placement alternatives to Site 104 are discussed in Section 2.2 and, along with Site 104, are evaluated further in this EIS.~~

1.5 ALTERNATIVE PLACEMENT SITES

Dredged material p~~P~~lacement alternatives ~~to Site 104~~ are discussed in Section 2.2 and~~, along with Site 104, are~~ evaluated ~~further~~ in this EIS.

MOVE THE FOLLOWING PARAGRAPHS TO SECTION 2:

1.6 STUDY AREA

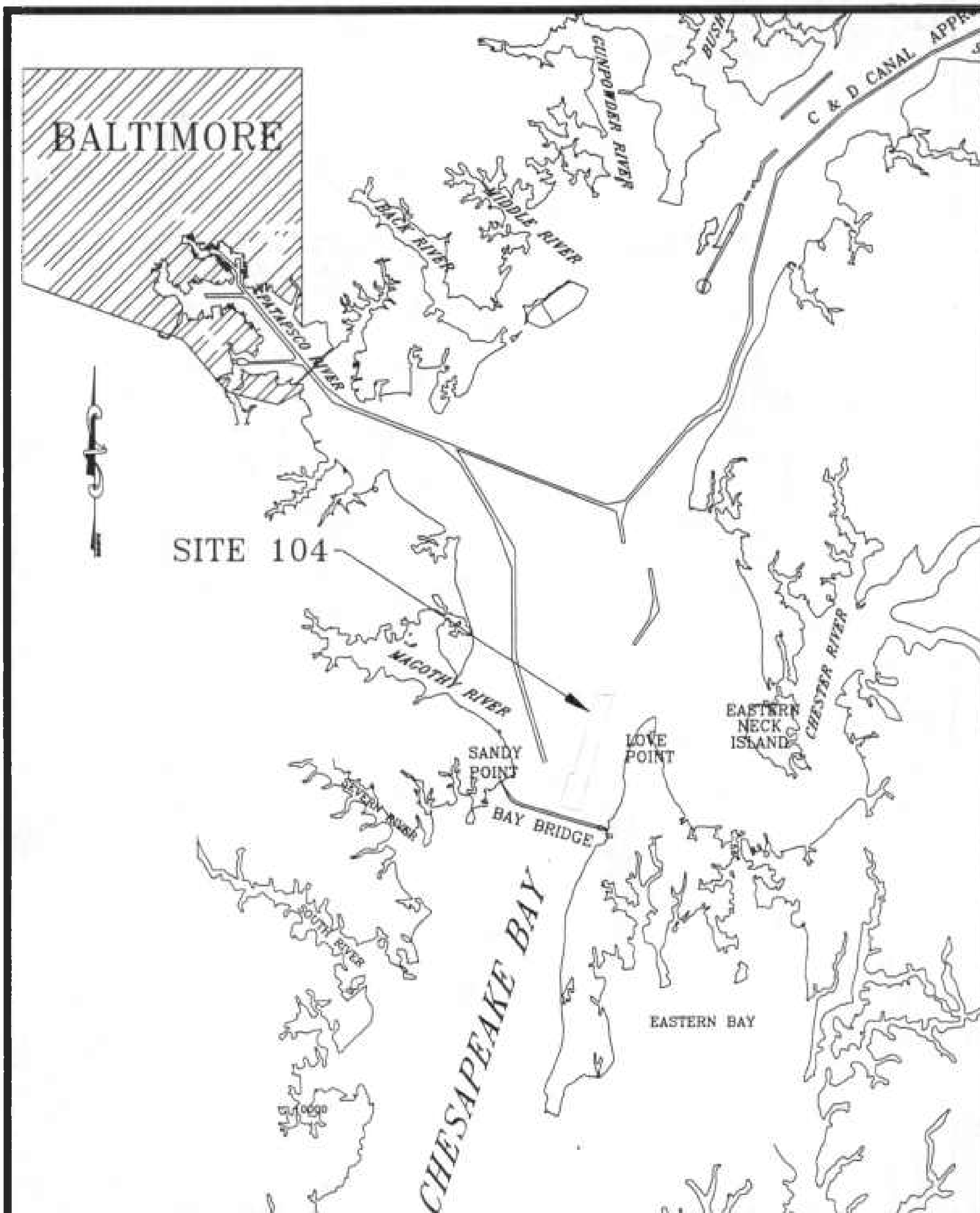
1.6.1 Site Location

Site 104 is a previously used 1,800-acre open-water placement site located approximately 2,000 ~~feet~~ft north of the Chesapeake Bay Bridge, ~~and~~ east of the Craighill navigational channel, and one mile west of Kent Island (Figure 1-3).

1.6.2 Site Description

The Site 104 placement area was established in 1924 by the U.S. Army Corps of Engineers, and was used for the placement of dredged material through 1975. The last known use of the site occurred in 1975, with the placement of approximately 850,000 cubic yards dredged from the inbound or eastern side of the ~~Brewerton cut-off~~Cut-off and Craighill ~~a~~Angles. Currently, the site is approximately 6.8 km (4.2 miles) long and 1.1 km (0.65 miles) wide. The depth ranges from

-12.8 to -23.3 ~~meters~~m (-42 to -7~~6~~8 ~~feet~~ft) mean lower low water (MLLW). Placement would be restricted to areas deeper than the -14 ~~meter~~m (-45 ~~foot~~ft) contour interval to achieve a final site elevation of not higher than -14 ~~meters~~m (-45 ~~feet~~ft) MLLW.



MARYLAND PORT ADMINISTRATION

MARYLAND ENVIRONMENTAL SERVICE

US Army Corps of Engineers

SITE 104
VICINITY MAP
FIGURE 1–3

Section 2

Alternatives Including the Proposed Action

The dredged material placement alternatives analyzed in this RDEIS are reviewed in this section. The proposed Site 104open-water placement project is described in Section 2.1.- _The criteria used to screen the placement alternatives placement options are described in Sections 2.2.1 and 2.2.2. Other placement options alternatives that have been considered are then described in Sections 2.2..3 and 2.2..4. Appendix xxAnnex E describes each of these placement options and their derivation in more detail and applies screening criteria (described in sSection 2.x.x) to determine which placement options were appropriate for consideration as alternatives in this RDEIS. As required by NEPA, the No Action alternative is included and evaluated in this document. The potential impacts of the proposed action are described in Section 6. Potential impacts of dredged material placement alternatives are described in Section 7.

2.1_ Proposed Action

Open-water placement is proposed for approximately 18 mcy of dredged material from the mainstem Chesapeake Bay channels in Maryland servingleading to the Port of Baltimore. The Maryland Port Administration (MPA) has recommended the use of Master Plan Site 104 (generally coinciding with the southern two-thirds of the site also known as "Kent Island Deep") for open-water placement of approximately 18 mcy of cleansuitable sediment beginning in 20001999 or as soon thereafter to fulfill the open-water placement element of the State of Maryland's Strategic Plan. The southern border of Site 104 is located in the Chesapeake Bay approximately one mile north of the Chesapeake Bay Bridge (Figure 1-3). Placement is not proposed for the northern portion of the Kent Island Deep which has depths of 45 feet or less. (This latter area generally coincides with Master Plan Site 105.)

Selection of Site 104open-water placement for NEPA investigation was based on a cooperative effort involving the U.S. Army Corps of Engineers (USACE), North Atlantic Division, Baltimore (CENAB); USACE, North Atlantic Division, Philadelphia District (CENAP); and the MPA, state and fFederal natural resource and regulatory agencies, local governments, and environmental and public interest groups. Site 104 was one of the preferred open-water alternatives resulting from multi-agency consultations during the Master Planning process (MPA, 1989, 1990) and was selected identified as athe most viable open-water optionalternative with through multiple levels of screening throughby participants in the MPA-sponsored Dredging Needs and Placement Options Program (DNPOP).

CENAB developed and appliedAdditional screening criteria were applied by CENAB in determining which of these options that was previously considered and which additional options would bewas suitable for inclusion and consideration.as alternatives in this DEIS in addition to Site 104, as discussed below.

2.1.1 Overview of the Proposed Site 104Open-Water Placement Project

Clean sSediment would be dredged from the Federally maintained navigation channels in the main stem of the Bay and placed in open waterSite 104, over a period of up to 1-9 years, depending upon the dredging sequence, dredging need and other factors. These channels include the Craighill Entrance, Craighill Channel, Craighill Angle, Craighill Upper Range, Cutoff Angle, Brewerton Channel Eastern Extension, Swan Point Channel, Tolchester Channel, and the southern approach channel to the C&D Canal. Dredged material from Baltimore Harbor channels (Figure 1-1) would not be placed in open waterat Site 104.

As set forth in Section 40 CFR § 230.11 (d) a determination must be made as to the degree to which dredged material will introduce, relocate, or increase contaminants within a placement area. The quality of estuarine sediment planned for dredging and placement is determined by applying the tiered testing protocol prescribed by the Environmental Protection Agency (EPA) in the Inland Testing Manual (EPA and USACE, 1998), as discussed in . Screening criteria have been developed by the Chesapeake Bay Program and will be used as the tool for satisfying the requirements of the ITM (Section 5.1.5.b). Sediments that are determined to be non-contaminated following the EPA protocol are characterized in this DEISreferred to as "clean" "suitable" to distinguish them from contaminated sediments.

As used in this DEIS, "unclean" "contaminated" dredged material means dredged material that would contain would be classified as contaminantscontaminated using the ITM protocols and would introduce, relocate, or increase these contaminants. Typically, these materials would be unacceptable for unconfined open-water placement in the Chesapeake Bay, although this material could potentially be placed in open-water and capped. "Unclean"The term "prohibited" also pertains to a legislative definition of dredged material that lies upstream of a line legislatively drawn across the mouth of the Patapsco River between Rock Point and North Point (Figure 1-2), and that is prohibited by State law from being placed in open waters of the Chesapeake Bay (Figure 1-2). By Code of Maryland Regulation, Title 8, Section 8-1602(a) "*A person may not ..deposit... in an unconfined manner spoil from Baltimore Harbor into or onto any portion of the water or bottomland of the Chesapeake Bay or of the tidewater portions of any of the Chesapeake Bay's tributaries outside of Baltimore Harbor.*"

Sediments proposed for placement in Site 104open water will be limited to sediments that have been determined to be suitable for open-water placement following the EPA testing protocol. ContaminatedProhibited sediments from Baltimore Harbor which are considered to be contaminated by sState law, cannot be placed in Site 104 or any other open-water site under the jurisdiction of the State of Maryland.

2.1.2 Proposed Use of Site 104 for Dredged Material Placement

The MPA designated and recommended Site 104 for investigation for open-water placement. Site 104 had been ranked highest among the open-water options that were identified and technically screened through the DNPOP program.

Open-water Pplacement proposed at Site 104 would be limited to areas deeper than the -45 ft MLLW contour interval to achieve a final site elevation of -45 ft MLLW and composed of

~~clean~~suitable ~~dredged material. Based on existing contours within the proposed site, placement would occur within the site in the area south of the lighted red-and-white buoy for Love Point (RW "LP" buoy [Figure 2-1]). Two concepts were originally advanced for placement at Site 104: placement with and without a berm.~~ **~~The latter was a proposal that a berm be constructed along the southern and western edge of the site~~ if needed ~~to~~ minimize the ~~potential for~~prevent ~~material drift~~ ~~to migrate from Site 104 after placement~~ into the area ~~defined by State legislation as the~~ Deep Trough. ~~Both~~ placement ~~approaches~~options ~~are discussed later in this chapter.~~**

~~2.1.23 Historical Use of Site 104 as a Dredged Material Placement Area~~

~~The Site 104 was established as a designated open-water dredged material placement area by the USACE in 1924. The site was used for that purpose from 1924 to 1975. The original site boundaries began at approximately 1.75 miles northwest of Love Point and extended 2.7 nautical miles south-southwestward along a natural deep channel to a position due east of Sandy Point Light. In 1950, the southern boundary was extended 1 nautical mile south to latitude 39°00' N. Then in 1960, the following changes were made (1) the southern boundary was extended another 2,500 ft south to a line running parallel to and 2,000 ft north of the Bay Bridge; (2) the southern 1.1 nautical miles of the site was widened to the west by an additional 1,000 ft; and (3) the depths along the original site axis were -70 ft to -73 ft MLLW and the added areas had depths to -95 ft MLLW.~~

~~Originally, it was intended that the site depths be raised to no higher than -50 ft MLLW; however, in September 1960 depths were raised to -40 ft MLLW in a portion of the site to provide additional placement capacity (CENAB 1997a). If Site 104 is found suitable for open-water placement, then bathymetric monitoring would be conducted to insure that the final elevation of the currently proposed placement would not increase the bottom elevation above the proposed -45 ft MLLW.~~

2.1.~~3~~4 SELECTION OF ~~Site 104~~ OPEN-WATER PLACEMENT AREA - PLANNING PROCESSES

The USACE, CENAB and CENAP, and the MPA have been involved in at least three major sState-sponsored and two USACE-sponsored dredged material placement planning efforts since 1986. These efforts have been conducted to identify suitable placement options and locations through screening level evaluations. Environmental, economic, and capacity needs were evaluated, and sites were rated or ranked to identify those that warranted further evaluation and study. The State-sponsored planning activities ~~occurred in succession, and~~ provided a conceptual framework and information resource for subsequent placement planning activities ~~that led to the current proposed placement action~~. These initiatives are summarized below and presented in more detail in ~~Appendix XX~~Annex E. The USACE dredged material management initiatives occurred concurrently with the State-sponsored efforts~~, which served as information resources~~. This planning process is depicted in Figure 2-1.

2.1.~~3~~14~~.a~~ MPA Master Plan – 1986

Initiative	Major Activities
MPA Master Plan, 1986	• 475 sites identified; 162 formally assessed • 31 sites remained after screening
Governors Task Force on Dredged Material Management 1990-1991	• Recommended integrated approach • Recommended continued evaluation of open-water placement, among other methods
DNPOP 1992-Present	• ? • ?
USACE Dredged Material Management Plans (Ongoing)	• Ongoing studies to identify 20-50 year placement capacity • Stress beneficial use
State of Maryland Strategic Plan for Dredged Material Management 1996 (Bay Enhancement ???)	• Formal statement of interagency cooperation • List 6 items for text • Further study of Site 104 recommended

Figure 2-1. Schematic History of Dredged Material Management Planning for Port of Baltimore.

~~. The Hart-Miller Island Dredged Material Containment Facility began receiving dredged materials in May 1984. The availability of this large-scale confined disposal facility (CDF) removed the immediate pressure for resolving long-term placement needs, and decision making on future options languished. In this regard, a case study by the National Research Council observed, as a lesson learned from the Hart-Miller Island experience, that "the availability of a large CDF can become a convenient excuse to delay or avoid making politically sensitive, difficult and controversial decisions to resolve critical dredging problems, shortening CDFR capacity for contaminated sediments in the process" (NRC, 1997). Nevertheless, efforts were continued to develop an acceptable long-term solution based on a cooperative, interdisciplinary process (Hamons, 1988); Hamons and Young, 1999).~~

The Master Plan effort was a multidisciplinary MPA-sponsored planning initiative that began in 1986 as a participatory process to resolve long-term dredged material placement needs. The goal was to develop a comprehensive, consensus-based, long-term plan for the management of dredged material. The initiative~~and~~ eventually involved representatives from a range of state and Federal resource and regulatory agencies, local USACE Districts, county and local governments, and public interest groups (Box 2-1) (Hamons~~,~~ 1988; Hamons and Young~~,~~ 1999).

During Phase I of the Master Plan, over 475 sites for dredged material placement were initially identified. Of the identified sites, all 475 were considered to have sufficient merit as to warrant preliminary formal screening. Of the 475,~~and~~ 162 ~~of these~~ were ~~given serious consideration~~formally assessed for potential dredged material placement based upon their potential feasibility in Phase II. The MPA prepared a summary report titled "*Port of Baltimore; Dredged Material Management Master Plan*" (MPA 1989, 1990), which recommended various dredged material placement options.

The Master Plan set forth a specific set of screening criteria that formed the conceptual basis for future dredged material site screening; it included both environmental and cost factors (Box 2-2). With the cooperation and input of key local and regional natural resource agencies (e.g.,

BOX 2-1
PARTICIPANTS IN MASTER PLAN DEVELOPMENT

Master Plan Regulatory Advisory Committee

- Maryland Department of the Environment
- Maryland Department of Natural Resources
- Chesapeake Bay Critical Areas Commission
- Environmental Protection Agency, Region III
- U.S. Army Corps of Engineers, Baltimore District
- U.S. Army Corps of Engineers, Philadelphia District
- U.S. Department of Commerce, National Marine Fisheries Service
- U.S. Department of Interior, U.S. Fish and Wildlife Service
- Regional Planning Council

Master Plan Citizens Advisory Committee

- Chesapeake Bay Foundation
- Citizens Advisory Committee to the Chesapeake Bay Program
- Coastal Resources Advisory Committee
- Maryland Wetlands Committee
- State Water Quality Advisory Committee
- Maryland Chamber of Commerce
- National Association of Dredging Contractors
- Upper Chesapeake Watershed Association, Inc.
- Baltimore City, Mayor's Office
- Baltimore County Executive
- Anne Arundel County Executive
- Harford County Commissioners
- Board of Cecil County Commissioners
- Board of Kent County Commissioners
- Board of Queen Anne's County Commissioners
- Hart-Miller Island Citizen's Oversight Committee
- Private Sector Port Advisory Committee

Source: MPA, 1990

MDE, USFWS, DNR, NOAA/NMFS, EPA) a suite of environmental factors of regional significance were identified. The factors considered included~~:~~ water quality, groundwater recharge areas, hydrology, shoreline erosion control, substrate, tidal and non-tidal wetlands, submerged aquatic vegetation, fisheries resources, shellfish, endangered species, forest resources, waterfowl use areas, archaeological and historical sites, and population centers. ~~Existing conditions i~~Information about existing conditions was gathered for each resource of concern at each of the 162 sites listed for ~~rigorous consideration~~formal assessment.

BOX 2-2
SCREENING CRITERIA FOR MPA MASTER PLAN

Process. Screening criteria were developed for preliminary screening in Phase I and comprehensive screening in Phase II.

Participants. Screening criteria were developed through a participatory process involving State and Federal dredged material management and natural resource agencies, counties and local governments, and public interest groups (see Box 2-~~2~~1). The U.S. Army Engineer Waterways Experiment Station provided technical advisory services.

Screening Criteria. The following screening factors were applied to placement categories (upland sites, land creation, overboard, shore stabilization/wetlands development)

Phase I ~~Screeing~~Screening Criteria	Phase II Screening Criteria
• distance from dredging area • minimum depth of water • maximum depth of water scow transport distance from dredging area mapped oyster bed • wildlife refuge • historical areas • parks • substantially built up area	**Environmental Screening Factors** Water Resources • Water quality • Ground water Physical Features • Hydrology • Erosion • Substrate Ecology • Tidal wetland • Nontidal wetland • Submerged aquatic vegetation • Finfish spawning or rearing area • Shellfish • Rare, threatened, or endangered species • Forest • Waterfowl use area Social/Public Welfare • Archaeology • History • Population center
	Cost Screening Factors • Pumping distance • Hauling distance • Water depth

Source: MPA, 1990

The environmental data, in conjunction with estimates of site development costs, were used to identify fatal flaws among the 162 listed sites.~~, resulting in a list of~~ Thirty-one ~~two 32~~ potential placement areas survived this rigorous evaluation process. ~~Based upon the environmental data, a score was assigned to each site reflecting the presence/absence and quality of the various resources; each resource was assigned an (agency negotiated) scoring factor that reflected the relative importance of various resources in the region. The sum of the scores allowed for a ranking of the site based upon environmental factors. Additionally, detailed costs were~~

~~developed for each of the 32 potential placement areas based upon a range of potential dredging options and placement scenarios. This allowed for a ranking of the potential placement options by cost.~~

The Master Plan initiative was discontinued as a ~~public~~ policy response to public controversy over the proposed use of the area known as the "Deep Trough" for open-water placement. Nevertheless, ~~T~~the Master Planning process was the foundation for resource agency consensus building with respect to selection of dredged material placement options within the ~~s~~State. Subsequent planning efforts (the Governor's Task Force, the DNPOP Program, and Maryland's Strategic Plan for Dredged Material ~~Placement~~Management) have all included multi-organizational working (advisory) groups and have utilized a similar multi-factor approach to placement site screening. Although some environmental factors have been added or changed since 1990, the basic multi-factor environmental screening approach has been the basis for all subsequent site selections and preliminary evaluations. ~~The 32 potential sites identified as part of this process were carried to the DNPOP program and analyzed more rigorously.~~

2.1.32~~4.b~~ Governor's Task Force on Dredged Material Management - 1990 to 1991

~~.~~To facilitate development of a broadly supported dredged material management plan, ~~placement options within the State,~~ Governor William Donald Schaefer convened a Task Force to provide a recommendeda~~tions for placement alternatives that used dredged sediments as a natural resource~~ approach as a replacement for the Master Plan. The membership of the task force was broadly based, representing state, Federal, and local governments, members of the academic community, groups concerned with protection of the environment, parties involved in maritime commerce, and parties whose livelihood is dependent upon the quality of Chesapeake Bay waters (Box 2-3). In a 1991 report, the Task Force recommended an integrated approach to dredged material management, with a desire to increase the beneficial uses of dredged material. It also recognized that the use of existing placement sites and creation or designation of new sites including containment sites, open-water placement sites, and upland placement sites would be required to accommodate both short- and long-term demand for placement of dredged materials.

The Task Force further recommended a continuation of studies on the feasibility of

BOX 2-3
GOVERNOR'S 1991 TASK FORCE PARTICIPATING ORGANIZATIONS

Association of Maryland Pilots
Baltimore County
Chesapeake Bay Commission
Chesapeake Bay Foundation
Environmental Protection Agency, Region III
John Hopkins University
Maryland Department of the Environment
Maryland Department of Natural Resources
Maryland Department of Transportation
Maryland Governor's Science Advisory Council
Maryland House of Delegates (3 delegates)
Maryland Saltwater Sportsfishermen's Association
Maryland Watermen's Association
National Marine Fisheries Service
Queen Anne's County Administration
Rukert Terminals
State Water Quality Advisory Committee
U.S. Army Corps of Engineers, Baltimore District
U.S. Army Corps of Engineers, Philadelphia District
U.S. Fish and Wildlife Service
W.J. Browning Company, Inc.

Source: MDOT, 1991

using new open-water placement sites with an emphasis on the environmental considerations.

2.1.~~3~~34~~.c~~ Dredging Needs and Placement Options Program (DNPOP) - 199~~3~~2 to Present

~~.~~The MPA is currently pursuing various options for the management of dredged material through its Dredging Needs and Placement Options Program (DNPOP). Like the Task Force, this is a multidisciplinary, interorganizational program that was formed by the MPA, with assistance from the Maryland Environmental Service (MES). The DNPOP program was specifically developed to implement the recommendations of the Governor's 1991 Task Force. Participants initiated their planning and advisory activities by focusing on identifying and evaluating beneficial use opportunities. Over 35 beneficial use options have been considered since 1992. The effort to find suitable placement sites included beneficial use, open-water, upland, and containment sites and innovative use opportunities. This effort was assisted by ~~F~~federal and ~~s~~State resource and regulatory agencies. In 1996, representatives of the natural resource agencies prepared a high value living resource area map covering the area north of the southern end of Kent Island. The map was intended to identify sites for within-Bay projects that would have the least impacts on living resources if used for the placement of dredged material (Crockett, circa 1996). The map was used as a resource in an effort to find new options and to perform preliminary screening of existing options. For example, the expansion of the Pooles Island open-water sites that have been implemented (Sites 92 and G-East) and Site 104 all lie in areas that were identified as having the least potential impact to living resources.

The DNPOP program includes Executive and Management Committees (Box 2-4), ~~and~~ Citizen's Committees (Box 2-5), and working groups. Moderator and staff support for the Committees and program management is coordinated by the MPA. Professional staff support for the working groups, facilitation and technical services for the DNPOP Program are provided by MES under arrangements with the MPA. The participating organizations ~~involved~~ included many of the state and Federal agencies involved in the development of the Master Plan as well as special interest and citizen's groups such as the Maryland Waterman's

BOX 2-4
DNPOP EXECUTIVE AND MANAGEMENT COMMITTEES

Executive Committee
- Maryland Department of the Environment
- Maryland Department of Natural Resources
- Maryland Department of Transportation
- U.S. Army Engineers, Baltimore District
- U.S. Army Corps of Engineers, Philadelphia District
- Maryland Port Administration (Executive Secretary)

Management Committee
- Aberdeen Proving Ground
- Association of Maryland Pilots
- Chesapeake Bay Commission
- Chesapeake Bay Foundation
- EPA Region III Chesapeake Bay Program
- Great Lakes Dredged & Dock Company
- Maryland Department of the Environment
- Maryland Department of Natural Resources
- Maryland Department of Transportation
- Maryland Environmental Service
- Maryland Port Administration
- National Marine Fisheries Service
- NOAA Chesapeake Bay Office
- Office of Congressman Wayne T. Gilchrest
- Ruekert Terminal
- State Water Quality Advisory Committee
- U.S. Fish and Wildlife Service

Source: MPA

Association, the Chesapeake Bay Foundation, ~~and~~ the Maryland Charterboat Captain's Association, and representatives of local governments.

The objective of the program is to identify and develop short-term to long-term dredged material placement options for the Port of Baltimore and its approach channels, seeking consensus whenever possible. ~~Many~~Some of the original ~~32~~ Master Plan sites have been considered under this program, and~~although some~~ ~~additional~~ other options were ~~also~~ added. ~~In all cases, t~~The program first identifies and distributes readily available information about the option~~.~~ The option is ~~and~~ then screened~~s placement options through~~ by a technical working group using local and expert knowledge and available information. The working group is comprised of individuals with relevant professional and local knowledge, called the Bay Enhancement Phase II (BEP II) Working Group. Site visits have been conducted and documented for certain sites in order to provide basic information needed for preliminary screening purposes.

The results of BEP II working group activities are reported to the Management and Citizen's Committees, and, where appropriate, to the Executive Committee. Multidisciplinary, interorganizational working groups are established, usually on a project- or area-specific basis, to provide technical and advisory support for pre-feasibility or feasibility studies, and where appropriate, for placement activities.

A broad-consensus on specific placement options proved to be elusive despite the dredging need and widespread interest and involvement in finding a solution to the placement problem. An intense effort was undertaken to implement the beneficial use recommendation of the Governor's 1991 Task Force, yet only the restoration of Poplar Island had achieved the necessary support to advance from concept to implementation. Describing this effort, Hamons and Young (1999) report that . . ."Linking the beneficial use concept to specific sites focuses attention on site-specific environmental, social and economic tradeoffs that, in most cases, work individually or collectively against project acceptability. Conversion of habitat from one form to another, especially fisheries habitat, has been a major factor in determining whether or not the environmental value that would be gained would in turn justify modifications to existing site conditions." By mid-1995, it became apparent that the beneficial use approach alone would not resolve the placement need, and that urgent action was needed to overcome an imminent large-scale deficit in placement capacity. This situation led to development of the State of Maryland Strategic Plan for Dredged Material Management,

BOX 2-5 **DNPOP CITIZENS COMMITTEE**
Anne Arundel County
Baltimore County Government
Baltimore County Watermen's Association
Baltimore Gas and Electric
Canal Bank Study Committee
Cecil County Government
Dorchester County Government
Essex-Middle River Civic Council
Kent County Government
Harford County Government
Hart-Miller Island Citizens Oversight Committee
Maryland Charter Boat Association
Maryland Saltwater Sportfishermen's Association
Maryland Watermen's Association
North Point Peninsula Community Coordination Council
Queen Anne's County
Upper Bay Charter Captains Association
Source: MPA

which is discussed in section 2.1.4.e (BEP II, 1995x; Hamons and Young, 1999).

2.1.34~~.d~~ USACE Dredged Material Management Plans

~~.~~The CENAP and CENAB are each working closely with MPA to develop multi-phased studies called Dredged Material Management Plans (DMMP)~~ for each District~~. These efforts are part of a USACE program to provide ~~a~~ more complete and consistent dredged material management planning nationwide for Federal navigation projects that require dredging. The objective of each study is to identify placement capacity for the next 20 to 50 years, as required by USACE policy. Plan formulation was initiated in Federal Fiscal Year 1995 and will include consideration of all dredging maintenance and construction of Federal projects, as well as state and private projects. The studies are planned to stress long-term solutions and ~~additional~~ beneficial uses of dredged material, insofar as practicable and consistent with the regulatory requirement for selection of the least cost, environmentally acceptable alternative (33 CFR **ADD CITATION**). ~~The prior and ongoing multi-disciplinary planning and broad-based interorganizational coordination for Federal navigation projects serving the Port of Baltimore and the Chesapeake and Delaware (C&D) Canal provide an invaluable resource to facilitate the development of USACE DMMPs, as does the environmental documentation and NEPA process for the placement action addressed by this DEIS. However, as dredging needs are continuing requirements, the proposed action must necessarily be considered prior to completion of t~~The USACE DMMPs are several years away from completion, thus necessitating interim solutions to the dredged material placement capacity deficit.~~.~~

2.1.35~~4.e~~ State of Maryland Strategic Plan for Dredged Material Management – 1996

~~.~~The results of the DNPOP activities formed the basis for and have been incorporated into the *State of Maryland Strategic Plan for Dredged Material Management* (MPA 1996). The Strategic Plan is supported by a formal statement of cooperation among several state and Federal agencies to assure full opportunity for review of each proposed dredged material placement site without pre-judgment and with recognition that each placement action would need to be considered in compliance with applicable laws and regulations (MDOT 1996a). Signatories that affirmed support for the State of Maryland's effort to establish a balanced, long-term, environmentally sound, dredged material placement plan included the U.S. Fish and Wildlife Service (USFWS)~~,~~; U.S. Environmental Protection Agency (EPA), Region III~~,~~; National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS)~~,~~; Maryland Department of the Environment (MDE)~~,~~; Maryland Department of Natural Resources (DNR)~~,~~; USACE (CENAB & CENAP), and Maryland Department of Transportation (MDOT).

The State of Maryland Strategic Plan contains the following elements:

- Expanded use of open-water placement sites in the immediate vicinity of Pooles Island.
- Raising the north cell dike system at the Hart-Miller Island Dredged Material Containment Facility.

- Restoring Poplar Island (Phase I: 640 acres) by beneficial use of dredged material.

- Reactivating the CSX and Cox Creek C~~c~~ontainment Facility cells.

- Establishing open-water sites for near-term placement of dredged material.

- Constructing a new upper Bay containment island with a beneficial use component.

All of the above elements are in the planning phase, construction phase, or have been completed.

The DNPOP Bay Enhancement Phase II Working Group (BEP II), in response to program management guidance from the Management and Executive Committees and the MPA, held a series of meetings in 1995 to evaluate and rate placement sites for consideration by the DNPOP Committees and the MPA (DNPOP~~,~~ 1995x,x,x,x,x). These deliberations included open-water placement options that were subsequently advanced as candidate sites to satisfy the open-water placement ~~option~~ component of the State of Maryland Strategic Plan for Dredged Material Management.

On March 15, 1995, the ~~multi-disciplinary and multi-organizational~~ BEP II ~~w~~Working Group recommended ~~to the Management Committee~~ further study of Site 104 and nine other options (BEP II, 1995x) to the Management Committee. On August 2, 1995, based on BEPII Working Group findings, the Management Committee determined that an accelerated program would be needed to address the impending dredged material placement deficit. The Management Committee also determined ~~and~~ that institutionally constrained options (e.g., raising the HMI dikes, Sparrows Point beneficial use project, use of the Deep Trough), needed to be reconsidered (MPA~~,~~ 1995x). The matter was referred to the Executive Committee that~~which~~, in response, initiated accelerated action that led to establishment of the State of Maryland's Strategic Plan for Dredged Material Management.

In December 1995, at the direction of the Executive Committee, the BEP II Working Group prepared a special report for further consideration of certain placement options. The BEP II Working Group~~that~~ provided consensus-based preliminary implementation plans including NEPA requirements for specific~~ed~~ placement options including the area defined as the Deep Trough and Site 104. The BEP II Working Group noted that CENAB was performing surveys to determine potential capacity of Site 104, and that an EIS would be necessary for implementation (BEP II, 1995x).

DNPOP activities, with respect to the open-water placement component of the State's plan, were subsequently directed away from the Deep Trough in response to a policy decision by the Governor. The BEP II Working Group then held a series of meetings to assist in the identification and ranking of open-water placement sites.

The BEP II Working Group recommended to the Management Committee in February 1996 that Site 104 merited ~~for~~ fast-track investigation due to the potentially available capacity and immediate need (BEP II, 1996x). The Working Group assisted with the scoping of necessary environmental studies for the EIS.

A meeting was held on April 22, 1996 to identify, characterize on the basis of technical merit, and conduct a prioritization of prospective upper Bay placement sites to meet the open-water component of the State's plan. The working group reviewed and updated the group's screening criteria, resulting in 21 ranking parameters that were used to estimate option suitability (Box 2-6). The Working Group identified the better of the available open-water sites and then ranked Site 104, along with Site 171 (Swan Point West) and Worton Point Open-water for further study. The working group recognized that the Worton Point open-water option did not have sufficient capacity, but ~~reluctantly~~ included it to provide a more complete frame of reference for comparing the merits of open-water sites. Because the Working Group was not able to develop a consensus recommendation, the group used a "forced ranking" technique to develop a numerical score that in turn was used to prioritize the three options. This approach and the results ~~were~~was reported to the Management Committee on April 24, 1996 (BEP II, 1996x, y).

The Management Committee ~~which~~ accepted Site 104 ~~as the preferred open-water alternative~~ (MPA, 1996x). On April 29, 1996, the Executive Committee accepted the Site 104 selection as the open-water placement option for the *State of Maryland Strategic Plan for Dredged Material Management*. ~~The MPA then requested that MES provide a detailed implementation plan for Site 104, including scoping for environmental documentation and studies.~~ The State's Strategic Plan for Dredged Material Management was formally announced by the Maryland Governor Parris Glendening in September 1996 (MDOT, 1996e).

2.1.6~~4~~.f Site 104 Public Outreach Committee

In March 1997, the Maryland Department of Transportation established the Site 104 Public Outreach Committee (Box 2-7). The objective was to provide an organized means to provide a forum for sharing information about the proposed used of Site 104 among State and Federal agencies, representatives of county governments, and public interest groups.

BOX 2-6

BAY ENHANCEMENT PHASE II WORKING GROUP PARAMETERS USED TO PRIORITIZE OPEN-WATER PLACEMENT SITES

The Working Group updated a list of screening factors that were then used as ranking parameters for prioritizing open-water placement sites which had been previously proposed and incorporated into the Phase II option list. The parameters were specifically chosen to include environmental factors that would need to be considered during the NEPA process.

Screening/Ranking Parameters

- [illegible]
- Geographic location relative to channel
- Bathymetry/hydrography relative to placement
- Hydrodynamic effects
- Geotechnical factors
- Construction materials
- Groundwater
- [illegible]
- Water quality
- Living resources: fisheries
- Living resources: benthics
- Living resources: wildlife
- Living resources: rare, threatened or endangered species
- Fishing activity – commercial and recreational
- Recreational activity (less fishing)
- Cultural resources
- Marine safety
- Institutional factors
- Public and community interests
- Placement and transportation costs
- Time required to implement

Source: MES, 1996

2.2 SELECTION OF ALTERNATIVES TO THE PROPOSED ACTION

A wide range of placement options are being considered ~~for the purposes of providing large-scale, near-term dredged material placement options~~ on the scale needed to meet the placement needs ~~of~~for the ~~State~~navigation ~~infrastructure~~channels in Maryland serving the Port of Baltimore. References used to gather information on the alternatives included, among others, the engineering report for the selection and preliminary design of a large-scale containment facility (Green and Trident, 1970), MPA Master Plan (MPA 1990), DNPOP meeting documentation from the BEP II Working Group, MES project files for supplemental reconnaissance work on several beneficial use options, ~~and~~ the MDOT-MPA Prefeasibility Study for the Upper Bay Island Placement Sites Long Term Placement Option, January 1998, and a case study of beneficial use in the upper Chesapeake Bay (Hamons and Young, 1999).

~~Placement options potentially available as alternatives to the proposed action are those which were included in the DEIS of February 1999 and site-specific options identified during the public comment period on the DEIS which ran from February 26, 1999 to July 31, 1999. The cutoff date for options that would be screened as possible alternatives was July 31, 1999, the effective closure date of the public comment period. It is possible that new or additional options may be identified in conjunction with ongoing dredged material management planning subsequent to the cutoff date for this DEIS. Consideration in this DEIS of new options would only serve to delay essential decision making on the important operational need and associated public policy issues that are addressed in this DEIS. The imminent placement crisis that necessitated the State's 1996 Strategy for Dredged Material Management resulted from the substitution of new approaches and new options for difficult decision making in the face of public controversy (Hamons, 1988; Hamons and Young, 1999; MDOT, 1996; NRC, 19XX). In this regard, the public comment period on the first DEIS yielded many comments to effect that not enough has been done to find placement options. In fact, extensive efforts have been made, as discussed and documented in this Chaptersection.~~

~~The public comment period also yielded various suggestions regarding placement concepts. However, placement concepts are not actual options, per se, and would not be considered as a possible alternative. The exception is when there is a site-specific option or there is specific work in progress to implement a concept for the navigation infrastructure in Maryland. In this DEIS, the innovative use of dredged material as an economic resource is one such option. Interest has been expressed by several private parties regarding the possibility of using certain commercial facilities or sites for dredged material management applications. To date, this interest has involved proprietary information. In general, CENAB and the MPA are precluded or constrained by their~~

BOX 2-7
SITE 104 PUBLIC OUTREACH COMMITTEE

Chesapeake Bay Foundation
Delegate Wheeler Baker
Delegate Ronald Guns
Delegate Mary Roe Walkup
Kent County Commissioners
Maryland Department of the Environment
Maryland Environmental Service
Maryland Department of Natural Resources
Maryland Port Administration
Maryland Watermen's Association
Office of Congressman Wayne T. Ggilchrest
Queen Anne's County Commissioners
State Senator Walter Baker
U.S. Army Corps of Engineers, Baltimore District

~~contractual regulations from publicly discussing certain contractual matters. Options in this latter category are not included as options for consideration as alternatives in this DEIS. However, such an option may be considered at a later date in the manner described in the next section.~~

~~New or additional options identified subsequent to the option cutoff date for this DEIS and concepts or existing options not selected as an alternative that subsequently are successfully brought to practical application would be considered on their own merits at that time. If an option in these categories were found to be feasible and analysis determines that the option could be the least cost, environmentally acceptable alternative relative to open-water placement, then the USACE can file a supplemental EIS. The USACE could take a similar action for if a higher cost, environmentally acceptable option is offered in substitution of open-water placement by the local sponsor with a commitment by the local sponsor to fund an appropriate share of incremental costs. The USACE also can make adjustments during operations in order to accommodate changed conditions, consistent with applicable rules and regulations, either to respond to information in a supplemental EIS or as is common practice with respect to changed operating conditions.~~

Alternatives for~~to~~ dredged material placement ~~at Site 104~~ of 18 million cubic yards of sediments dredged from the approach channels in the upper Bay are ~~presented~~summarized in the following sections and presented in detail in ~~Appendix XX~~Annex E. These alternatives include other open-water placement sites; upland placement; island creation/restoration; and beneficial uses that typically focus on habitat creation and restoration, recycling or construction use. In addition, placement options included combinations of viable smaller capacity options that (together) would meet the placement need within 9 years. The alternatives were generally derived from the results of the MPA Master Plan initiative (MPA 1990), the Governor's Task Force recommendations (MDOT 1991), various DNPOP documents, ~~and~~ the State of Maryland's Strategic Plan for Dredged Material Management (MDOT~~PA~~, 1996c), comments on the February 1999 DEIS, and CENAB's review of additional possible options, some of which are currently institutionally constrained.

2.2.1 Screening Criteria

Because the list of potential placement sites considered for short-term placement needs is so extensive, a screening process was developed to identify a range of potential viable options for in-depth consideration and impact analysis. ~~Primarily sites that were considered viable options in the succession of multi-agency dredged material management programs (including some options from the Master Plan process and DNPOP program) are considered here. These options were previously subjected to screening processes using criteria that were developed by Federal and state agency and citizen participants **(ADD CITATIONS)**. Several additional options that were identified during the course of NEPA documentation for this DEIS were also considered.~~

~~Each option which~~that ~~made it through the subsequent~~~~previous~~ ~~levels of screening was weighed against a list of carefully considered criteria developed specifically for this DEIS by CENAB.~~ These screening criteria were developed after review of recent NEPA documents pertaining to some other proposed actions including the Poplar Island restoration project, open-water placement sites G-East and Site 92, and the Oakland, California, deepening project. The screening approach that was used for selecting alternatives for the Oakland EIS (**CITATION**) provided a logic-based, straightforward approach that was adapted for use in this RDEIS. The criteria were chosen to identify viable options for placement of 18 mcy of material dredged from the Baltimore Harbor approach channelswhich options merited consideration as an alternative to Site 104;. tThe results of this analysis are summarized below. The criteria considered were developed based on CENAB's preliminary assessment of principal environmental and economic factors, dredging need, and implementation potential. Most screening criteria had to be met in order for a placement option to be considered as a realistic serious option (alternative) to provide the short-term need for the 18 mcy of placement capacity specified by the State of Maryland's Strategic Plan for Dredged Material Management for the projected deficit in capacity over the next 9 years. CENAB's estimate of the dredging need is presented in Section xxxxxxxx. Placement options included not only single sites but also combinations of viable smaller capacity options that (together) would meet the short-term placement need within 9 years. Placement is projected to occur in up to 5 years during this period. This variable time frame was selected because it is not possible to predict when the Congress will authorize and appropriate funds for new work dredging projects. Presently, four placement cycles are contemplated. The actual number of placement years may vary, and would be addressed during operations as necessary and appropriate for whatever alternative or alternatives are approved and implemented.

Screening Criteria:

1. **Dredging Need**—The proposed placement option (whether it be a single optionsite or combination of multiple smaller capacity optionssites) has the potential to provide approximately 109 to 18 mcy of placement capacity to meet at least half50 percent of the short-term placement deficit need to which the proposed action is directedbetween now and 20____.

2. **Real Estate**—The property owner is willing or has indicated a willingness to accept dredged material.

3. **Preliminary Environmental Suitability**—Preliminary evaluations, based upon existing information (outlined in Section 2.1.3), indicated that environmental impacts at the site are probably not significant enough to preclude the site from use.

4. **Infrastructure Considerations**—Infrastructure is in place, or expected to be in place, not later than October 15, 1999 in sufficient time to enable for the placement alternative to be available option to receive dredged material when the capacity is needed. Infrastructure includes dikes, docking facilities, access channels, and berms, where applicable. Alternatively, with regard to using a combination of sites, infrastructure for the first site to be used is in place or expected to be in place in sufficient time no later than 15 October 1999 to meet dredging needsfor the first placement site with infrastructure for subsequent sites expected to be in place prior to previously developed site or sites reaching capacity.

~~5.(a) The total cost for use of the placement alternative can be feasibly borne by the Federal and local project sponsors under existing rules, and regulations, and planned budgets to fund delivery, monitoring and management of the dredged material that is placed;~~

5. **Institutional Constraints**~~—OR (b)~~There is a reasonable prospect that any institutional constraint (e.g. statute preventing site development or placement, CERCLA liability, etc.) that would otherwise preclude use of a placement alternative could be resolved or removed as an impediment not later than six months prior to the first planned placement. This planning factor is necessary because of lead times required for dredging contracting. Alternatively, with regard to using a combination of sites, the institutional constraint for the first can be resolved or removed no later than six months prior to the first planned placement and the constraints for each subsequent site can be removed prior to the previous site reaching capacity.

6. **Economic Viability**—The cost for using the placement alternative can be feasibly borne by the Federal and local project sponsors under existing rules, and regulations, except that no option would be screened out solely on the basis of cost if screening factors 1 through 5 would otherwise result in the option being considered an alternative to the proposed action;

~~6.~~7. **Environmental Trade-Offs**~~—U~~Use of the placement alternative may either potentially provide a net environmental improvement with respect to existing conditions ~~and/~~or avoid or substantially reduce any of the significant environmental impacts of a potential placement activity.

2.2.2 Rationale for Screening Criteria.

2.2.2.a —Dredging Need. The placement action proposed by the MPA on behalf of the State of Maryland is based on the MPA's assessment of dredging needs. The MPA projection is updated at least annually and is based on historical averages for maintenance dredging and dredging engineering projections for sediments that would need to be dredged for improvements as modified based on prevailing conditions. Changes in need are reflected in the State's projections as ~~changes~~they occur. CENAB made its own assessment of projected needs, consistent with the fifty-year planning window used by the USACE, including contingencies to account for changes in excess of average conditions.

MPA-Dredged Material Planning. As reported by Hamons and Young (1999), "*The MPA uses a 20-year, forward-looking planning window for managing dredged material. . . . Planning data are continually updated to reflect changes in actual or projected dredging needs. The long-term planning approach allows for consideration of the magnitude of the dredging need; dredging needs beyond the 20-year window; time needed to advance placement projects from concept through implementation; prospective environmental conditions; changes in technology (for dredging, placement, ships, and intermodal transportation); and, associated implications to dredged material management, port infrastructure requirements and port competitiveness. A longer planning horizon moves beyond what can be reasonably managed, except for implementation options that begin within the 20-year window.*" The MPA planning approach acknowledges the potential for supplemental dredging needs but does not include a specific contingency for increased dredging requirements such as might result from abnormal shoaling resulting from episodic storms with long return periods. Because the MPA planning approach does not include a formal contingency, when additional maintenance dredging is required or an infrastructure need is identified, the MPA must increase the dredging need above that which has been previously projected~~. The MPA's dredging need projections are therefore by design conservative, although they have been questioned by opponents of specific placement projects, including comments received by CENAB in response to the DEIS issued n.~~

CENAB Dredging Need Projection. CENAB analyzed the State of Maryland's Strategy for Dredged Material Management and current dredging need projections provided by the MPA. CENAB then prepared ~~the District's~~an estimate of dredging needs over the USACE fifty-year planning window. CENAB's assessment included a 10 percent contingency to account for unanticipated dredging needs, such as ~~could~~may result from major storm events, per the following discussion and analysis.

Dredging need increased by XX percent in 1996 as a result of increased sediment loading caused by a combination of snow melt from major winter storms, rainfall which exacerbated snow melt and runoff, and resulting freshets from the Susquehanna River which transported the sediments to the upper Bay. Fifteen million tons of sediment were delivered to the Chesapeake Bay during the January 1996 flood event (one ton of sediment is approximately equivalent to one cubic yard of channel sediment). This is about 16 times the annual sediment loading of the Bay from the Susquehanna River (the scoured river basins would be filled in about 5 to 6 years){Langland, 1998). The actual quantity of sediment dredged from the southern half of the northern approach channels between the Sassafras River and Pooles Island increased by 60 percent, from a recent annual average of 1.2 mcy to 2.0 mcy (unpublished CENAP data). (The recent annual average has decreased somewhat from historical averages. Except for the 1996 flood event, this decrease is believed to be related to drought conditions which have resulted in lower than normal inflow from the Susquehanna River and fewer winter storms during the same period.) The actual quantity of sediment dredged from the Brewerton Extension increased from an annual average of **XX** mcy to **XX** mcy, an increase of **XX** percent (Unpublished CENAB data).

Although it is not possible to make a direct correlation between added sediment loads from the Susquehanna River and shoaling rates, the data do support an approximation of cause and effect. In the cited example, the overall increase in dredging need that occurred following the flood event was XX mcy, or approximately XX percent of the additional sediment loading. The decreasing holding capacity of the Conowingo Dam on the lower Susquehanna River has increased the potential for increased sedimentation from future events of similar or greater magnitude. Furthermore, on average, several million tons or more of sediment could flow annually into the upper Bay from the Susquehanna River once the basin behind the Conowingo Dam is at equilibrium, that is, once full sediment-storage capacity is reached. Equilibrium could occur as soon as 17 to 20 years (Langland~~,~~ 1998; Seay~~,~~ 1995). The magnitude of sediment discharge following equilibrium can only be roughly estimated, and would be affected by flood events as well as by effort to reduce erosion and sedimentation in the watershed (Seay~~,~~ 1995).

The annual loading will vary according to environmental conditions, and equilibrium could be delayed as the result of scouring from another major flood during the next 20 years. Substantially larger than average sediment loads could result from major flood events within the watershed (Langland~~,~~ 1998; Seay~~,~~ 1995). For example, Tropical Storm Agnes in June 1972 resulted in the discharge of 33 million ton~~m~~s of suspended sediment in a one-week period. This quantity was equivalent to the sediment input of 30 average years. Of this quantity, about 75 percent was deposited in the northernmost 28 miles of the Bay. The deposit averaged about 20 centimeters thick. Another 11 million tons of sediment were discharged as a result of Hurricane Eloise in September 1975 (SEAY~~,~~ 1995). Abnormally high sediment loadings resulting from flood events would increase the potential for shoaling of upper Bay shipping channels, including the Brewerton Extension which is especially prone to shoaling from freshets because of its perpendicular orientation relative to the current flow. Based on the preceding data and analysis, a contingency of 10 percent is reasonable to approximate prospective increased needs for which a precise prediction is not possible.

The CENAB analysis of dredging needs is included as Appendix **XY**. **[HERE INSERT A SUMMARY OF THE CENAB DREDGING NEED ASSESSMENT]** Based on CENAB's assessment of the need with contingency requirements, up to **XX** mcy could potentially ~~be~~ need to be dredged during the 9 year placement window considered in this RDEIS. Furthermore, any capacity not used ~~resulting from~~due to changes in new work or reduced maintenance dredging ~~projects~~ would still be needed within the 50-year USACE planning window.

In consideration of its dredging need assessment, CENAB determined that the MPA's projection of 18 mcy **[understates/approximates/overstates? – text depends upon CENAB needs analysis. Remaining text presumes an understated need]** the prospective dredging need. This conclusion is supported by the fact that MPA's projection does not include a contingency. Furthermore, the MPA's 1996 projection of an 18 mcy need did not include the quantity of suitable sediment that would have to be reprogrammed from placement at Hart-Miller Island to allow for improvements to berthing infrastructure needed to support the next generation of container ships. The MPA's current projection also do not include any allowance for increased sedimentation from the Susquehanna River, although the sediment basin behind the Conowingo Dam is likely to fill in during the period. CENAB also determined that more than one alternative might be needed to provide for the unmet dredging placement need over the next 9 years. In order to meet this need, a large-scale alternative or multi-option ~~combination of~~ alternative will be needed.

Based on the preceding analysis and the scale of the unmet placement need, the principal alternative (or combination of smaller options) should be capable of satisfying a major portion of that need. CENAB believes that in order to make a serious reduction in the placement deficit, at least 50 percent of the need should be accommodated by the principal alternative that is selected. In order to meet 100 percent of the 18 mcy need, a combination of alternatives may ultimately may be needed. ~~Furthermore,~~ Iin applying need criteria for screening purposes, consideration was given to the fact that, with respect to use ~~a~~of a specific placement site, the substitution of sediments dredged from one location for sediments dredged from another would not, by itself, reduce the deficit in placement capacity that is being addressed through this RDEIS.

2.2.2.b —Real Estate. The USACE requires that the local sponsor provide all real estate needed for placement projects. However, in order to determine whether or not a placement option is realistic as an alternative, it is necessary to make a preliminary determination as to whether or not sufficient real estate would be available so as to allow implementation of the alternative. Although condemnation of property is within the State's prerogatives, the CENAB does not assume that condemnation actions would be taken or successful.

2.2.2.c —Preliminary Environmental Suitability. Considerable information is available about certain placement options. A number of options have been subjected to one or more screening processes. Sufficient information is available to determine if there are specific environmental conditions that would make a specific option unacceptable.

2.2.2.d —Infrastructure Considerations. Infrastructure requirements vary significantly by type of placement option and project-specific conditions. Physical structures are required for many placement options, for example, the perimeter dike system at the Hart-Miller Island Dredged Material Containment Facility and the Poplar Island Environmental Restoration Project. The Hart-Miller Island project took **XX years** from concept to completion of construction. The Poplaer Island restoration project was conceived ~~by~~ prior to release of the final report of the Governor's Task Force on Dredged Material Management in February 1991 (MDOT, 1991). Formal planning for the project began in mid-1992. A prefeasibility report was completed in May 1994 (MES, 1994b). A comprehensive feasibility and design study was completed in **19XX (CITATION)**. Construction is projected for completion in 2001. Thus, a total of some 10 years will have passed from concept to completion of the island enclosure and full readiness to receive dredged sediments. Therefore, placement options need to be screened to determine whether or not the needed infrastructure can reasonably be expected to be completed in sufficient time to allow use of the option when needed.

~~**2.2.2.e Preliminary Economic Viability. The cost of placement alternatives varies greatly by type of project and location. USACE policy requires selection of the least cost, environmentally acceptable alternative. The local sponsor's cost share requirement can vary significantly depending upon alternative-specific conditions, location of the alternative, prospective funding sources, the "base plan" used by the USACE for cost-share calculations, and other factors. Currently, the highest overall cost option is Poplar Island at $xx.xx per cubic yard. For the purposes of determining whether an option is reasonable from a total cost perspective, an upper threshold of 250% of the current high cost option rounded up to the next dollar ($xx.xx) was used.**~~

2.2.2.e —Institutional Constraints. Various placement options have institutional constraints that may preclude their use. These constraints include certain State laws that are directed to specific placement options and locations, lack of remediation standards for unexploded ordnance, and liability issues also associated with unexploded ordnance. For the purposes of determining whether an option is realistic from an institutional constraint perspective, there is no indication that UXO institutional constraints would be resolved within the timeframe addressed by this RDEIS. Inasmuch as the State is considering a number of placement islands that lie within or partially within 5 miles of the Hart-Miller-Pleasure Island Chain, CENAB did not apply the State statute that prohibits construction of a containment facility within 5 miles of the chain in Baltimore County **(CITATION).** The State law that prohibits placement in the area defined as the "Deep Trough" was applied inasmuch as the Maryland General Assembly has given no indication of willingness to consider a modification to this statute **(CITATION).**

2.2.2.f —Preliminary Economic Viability. Cost is a fundamental, but not exclusive, component of federal decision making. The U.S. Code of Federal Regulations requires selection of the least cost, environmentally acceptable alternative [**CITATION**]. An exception can occur for higher cost, environmentally acceptable alternatives where the local sponsor is willing to fund all or a portion of the incremental costs in excess of the least cost, environmentally acceptable alternative, depending upon other applicable authorizations [**CITATION**]. The cost of placement alternatives varies greatly by type of project and location. The local sponsor's cost share requirement can vary significantly depending upon alternative-specific conditions, location of the alternative, prospective funding sources and funding criteria, the "base plan" used by the USACE for cost-share calculations, and other factors, including incremental costs that are solely the responsibility of the local sponsor.

For the purposes of determining whether an option is realistic from a cost perspective, both unit cost (that is, cost per cubic yard) and total cost are issues. However, unit cost provides a reasonable measure for comparative analysis among the various placement options, and was used for screening purposes. An upper threshold of 200% of the highest unit cost for an actual placement project for the Port of Baltimore, rounded up to the next dollar, was used. Currently, the highest unit cost option is Poplar Island at $11 per cubic yard. Therefore, the upper threshold used for screening purposes was calculated to be $22 [**CENAB PLEASE VERIFY**]. In applying this criteria, an option that would have been screened out solely on the basis of cost was nevertheless carried forward for consideration as an alternative if screening factors 1 through 5 would otherwise have resulted in its selection as an alternative.

2.2.2.g —Environmental Tradeoffs. The ~~sixth~~ seventh screening criteria was included to recognize potential benefits of a site that might compensate for environmental ~~other flaws~~ deficiencies identified. For example, a site may be deemed too costly for development under normal conditions but the potential benefits may compensate by providing significant habitat preservation, enhancement, or creation.

2.2.~~2~~3 Application of Screening Criteria to Alternatives

As the first step in the screening process of alternatives for this document, an analysis of each alternative was developed and is included in ~~Appendix xx~~Annex E. ~~t~~The screening criteria (identified above) were applied to each ~~site~~placement option. The results are summarized in Table 2-1 ~~{EA ADD TABLE}~~ and the criteria are keyed to the numbers presented in Section 2.2.1. Each site was assigned a designation of 0 (meets criteria), X (doesn't meet criteria). In many cases of site availability, the site was designated with a "P" indicating that the state would consider accepting material pending issuance of a water quality certification. The information used to derive the screening designation ~~are~~ is summarized in Table 2-2 ~~[EA ADD TABLE]~~ and detailed (by site) in Sections 2.2.3 and 2.2.4. All sites listed in Table 2-1 are ~~detailed~~ addressed in the following sections based upon their viability as an alternative ~~for Site 104~~. A series of locator maps displaying the site locations by placement type are available for reference (Figures 2-2 through Figure 2-7). Section 2.2.4.a.5 explores the option of combining several smaller sites to meet the 15 to 18 mcy ~~short-term~~ placement ~~need~~ quantity.

2.2.2~~3~~.a —Non-Viable Options. The following options are assessed in ~~Appendix XX~~Annex E and were found to be not viable as an alternative to the proposed action. However, options denoted by an asterisk had sufficient potential to be considered in combination with certain other options. Non-suitability of an option for consideration as an alternative in this RDEIS does not necessarily mean that a particular option is not or could not eventually become suitable at some future date. However, the screening that was performed in ~~Appendix XX~~Annex E resulted in a determination that they were not suitable as an alternative to the proposed action.

TABLE 2-1 NON-VIABLE OPTIONS

Beneficial Use

- APG Beneficial Use
- APG upland ~~upland~~ sites
- Artificial Reefs (small to medium scale)*
- Barren Island restoration
- Bodkin Island*
- Bodkin Point

~~C&D Canal Upland Sites~~

- Eastern Neck National Wildlife Refuge
- Davis Tract
- Grove Neck

~~Hawkins Point~~

- Holland Island (small-scale)*
- Holland Island (large-scale)
- Holly Neck Farm
- James Island
- Parsons Island*
- Poplar Island Phase I
- Poplar Island Phase II
- Queenstown
- Rocky Point
- Sollers Point

~~Sparrows Point~~

- Swan Point Peninsula
- Thoms Cove/Hawkins Point
- Worton Point Beneficial Use
- Innovative use of dredged material

Open Water

- Pooles Island Open Water
- ~~Deep Trough~~Site 170b
- Tolchester S-Turn Channel

Containments

- Bay Bridge Airport
- Hart-Miller Island north cell

~~Hart-Miller Island south cell~~

~~Cox Creek containment facility~~

- Masonville

The following non-viable options from the preceding list either received considerable attention in the public comments on the ~~first draft~~February 1999 DEIS, could potentially be environmentally acceptable but for an institutional constraint (denoted by a double asterisk), or both. They are discussed in the main text along with the reasons why they were found to be not suitable for consideration as an alternative to the proposed action or as a component of a multi-option alternative.

TABLE 2-2 NON-VIABLE OPTIONS WHICH RECEIVED SIGNIFICANT PUBLIC COMMENT—DEIS

- Hart-Miller Island south cell**
- Hart-Miller Island north cell**
- Cox Creek containment facility
- C&D Canal upland sites
- Beneficial Use (general concept)
- Poplar Island Phase I
- Poplar Island Phase II
- APG beneficial use**
- APG upland**
- Sparrows Point**
- Eastern Neck Wildlife Refuge
- James Island
- Innovative use of dredged material
- Pooles Island open water
- Deep Trough**

2.2.~~2~~3.b ~~Viable~~ Alternatives.- The options shown in the following categories survived the screening process that was applied in ~~Appendix XX~~Annex E and were ~~determined to be viable~~designated by CENAB as alternatives for consideration in this RDEIS:

- No action
- Open-water sites (Site 104, Site 171 open water, Worton Point open water, Shad Battery Shoal, Ocean Placement)
- Existing site (none – see preceding discussion)
- New containment options (~~Cox Creek,~~ Hart-Miller Island new cell)
- Beneficial use (Poplar Island wetland cell conversion to upland, Poplar Island footprint expansion, Holland Island~~, James Island~~)
- Island placement site (Pooles Island area, Tolchester West, Site 168, Site 170, Site 171)
- Combination of smaller ~~sites~~ options

2.2.3 NON-VIABLE OPTIONS~~Alternatives~~

[INSERT NUMBER] of placement options were considered in determining which were suitable for consideration as practicable alternatives for the placement of 18 mcy of dredged material. ~~Appendix XX~~Annex E presents detail about each of the options and applies the screening criteria and rationale described in Section 2.2.X. [INSERT NUMBER] of options passed through the initial screening and were carried forward to this chapter for characterization as alternatives. [INSERT NUMBER] of options did not screen successfully as options. Some of these received considerable attention in the public comments on the first draft EIS, could potentially be environmentally acceptable but for an institutional constraint, or both. Both categories are further discussed in this section in response to public interest in them or because they would have been considered alternatives had not institutional constraints made their further consideration impractical.

2.2.3.a ~~Small-Scale Placement Alternatives with Other Constraints. Many of the sites that have been considered as placement options have very limited capacity. Developed by themselves, limited capacity sites would not meet the short-term dredging need that necessitates consideration of Site 104 at this time. Several limited capacity sites together may be able to meet the short-term placement needs (Section 2.2.4 e). However, the development and transportation costs may be prohibitive and multiple sites could result in greater cumulative impacts (Section 7.1.5).~~

~~The sites that have limited capacity (those with a "X" in the first column of Table 2-1) may also have other constraints that would preclude them as viable placement alternatives at this time. Generally those other constraints are expectations for significant environmental impacts or institutional constraints (laws) that prohibit placement. Limited capacity sites that may not be available for placement immediately or that would probably involve a higher cost are considered separately (Section 2.2.3.b).~~

~~The sites that were not considered viable because of low capacity and other constraints are:~~

- ~~Queenstown~~
- ~~C&D Canal Upland Sites~~
- ~~Swan Point Peninsula~~
- ~~Grove Neck~~
- ~~APG Beneficial Use~~
- ~~Rocky Point~~
- ~~Worton Point Beneficial Use~~
- ~~Barren Island restoration~~
- ~~Bodkin Island~~
- ~~Parsons Island~~
- ~~Davis Tract~~
- ~~Holly Neck Farm~~
- ~~Tolchester S-Turn Channel~~

~~Shad Battery Shoal~~
~~Worton Point (Open-water)~~
~~Masonville~~
~~Sollers Point~~
~~Hawkins Point/Thoms Cove~~
~~Dredged Material Recycling~~

~~2.2.3.a.1 Queenstown (Upland Placement, Fastland Creation)~~

~~This site was proposed during the MDOT Master Plan process. There are 520 acres under consideration for placement, with a capacity of 9 mcy (Figure 2-4). There are tidal and non-tidal wetlands near and on the project, as well as forested areas. The exact amount of acreage of wetlands is approximately 9 acres. As a worst-case assessment, therefore, approximately 500 acres of forested area would be impacted. The site is adjacent to SAV beds. There is access from deep water and there are no known archeological or historical sites on or near the property. The site is far from both CENAB and CENAP channels which would add as much as $1.70 per cubic yard to the cost of placement (relative to Site 104) (Section 7). For these reasons the site is impracticable at the current time.~~

2.3.1 Hart-Miller Island Dredged Material Containment Facility

HMI is an existing state-owned and operated confined placement facility (Figure 2-6) Hart-Miller Island is located in the Upper Chesapeake Bay~~, at the entrance to the Back River~~. The site is approximately 14 miles due east of Baltimore City, near the mouth of Back River in Baltimore County. Initial construction of the placement site began in 1981 and was concluded in December of 1983. HMI covers 1140 acres and has approximately 6 miles of dike. It is oval shaped and is approximately 2 miles long by 1 mile wide.

-The facility has received maintenance sediments dredged annually from Baltimore Harbor and the approach channels since 1984. Sediments from the Inner Harbor area are considered to be contaminated and are required by the Code of Maryland Regulations (COMAR) to be placed in a containment facility, or within the Inner Harbor. The facility has also received sediments from the 50-foot channel deepening project, as well as smaller volumes of dredged sediments from state, local, and private channel maintenance projects.

~~Hart-Miller Island is located in the Upper Chesapeake Bay, north of the mouth of the Patapsco River. The site is approximately 14 miles due east of Baltimore City, near the mouth of Back River in Baltimore County. Initial construction of the placement site began in 1981 and was concluded in December of 1983. HMI covers 1140 acres and has approximately 6 miles of dike. It is oval shaped and is approximately 2 miles long by 1 mile wide.~~

The sand dikes were originally constructed to an elevation of +5.5 m (+18 ft) above MLW, a width of 164 ft at MLLW, with 3 horizontal (H) to 1 vertical (V) outer slopes, and 5H:1V inner slopes. The dike has a 20-foot-wide roadbed on top. The side slopes are protected by a revetment consisting of filter cloth on the sand dike, covered by a layer of gravel, which is in turn covered by a layer of riprap weighing up to 8,500 pounds per stone along the sides exposed to the Chesapeake Bay. The original +18 ft MLW high dikes were raised an additional 3.1 m (10 ft) to a height of +8.5 m (+28 ft) above MLW during the summer and fall of 1988 to provide additional capacity for the expedited completion of the 50-foot deepening project. The 1140-acre oval placement site holds approximately 62 mcy of dredged material to an elevation of 7.6 m (25 ft). The +8.5 m (+28 ft) raised portion of the dike has 2H:1V outer slopes, 3H:1V inner slopes, with a 10-ft-wide road bed on top. The site is divided into two cells, a North Cell (approximately 800 acres) and a South Cell (approximately 300 acres)..

2.3.1.a Hart-Miller Island South Cell Reconstruction and Reactivation

Use of the South Cell was discontinued in 1990 after it was filled to near capacity. The south cell is currently being developed for environmental restoration and passive recreation under a provision of Section 1135, Water Resources Development Act of **199X**. To facilitate habitat development in the 300-acre South Cell, the last 3.1 m (10 ft) of dredged material was suitable channel material from outside of the harbor. The south cell is under the day-to-day management of the Maryland Environmental Service, which is providing these services under the terms of an Interagency Agreement with the MPA in support of an intergovernmental agreement between the MPA and the Maryland Department of Natural Resources (MDNR). MDNR is responsible for habitat and recreational development of both cells.

The South Cell crust management and grading program has been underway since October 1990 to prepare a foundation for habitat and passive recreational development. Other actions taken to prepare the cell include management and discharge of rainwater to facilitate consolidation of the crust, phragmites eradication and control measures including controlled burns, and vegetative test plots. The 300-acre south cell is currently at +22 ft MLW average elevation.

Most of the sSouth cCell's upland tier dike was excavated for use in the north cell dike raising. Sand that had previously been placed within the South Cell and stockpiled was mined as a resource for reconstructing the North Cell dike to an elevation of +44 feet MLLW, discussed below. The nNorth cCell dike raising motivated legislation by the Maryland General Assembly that required substantial development of the south cell for recreation and habitat within 5 years. The law also prohibited the south cell from receiving any more dredged material. The same legislation mandated that the dike system could not be raised higher than +44 feet, that placement into the nNorth cCell must be completed by the end of calendar year 2009, and that the cell was to be substantially developed for recreation and habitat within 5 years of closure (Annotated code of the Public General Laws of Maryland, Environmental Article, § 16-202 (e)(1)(ii)).

The State requested that CENAB conduct a Section 1135. CENAB performed the study with the MPA as the local sponsor. The study has identified several approaches for providing ponds, wetlands and uplands that would provide important habitat for migratory birds (CITATIONS).

CENAB subsequently examined the south cell to determine if it could serve as an alternative to open-water placement. As discussed in Appendix **XX**, the south cell dike system could be reconstructed in stages to a final elevation of approximately **XX** feet. With optimal lifts of approximately XX mcy per annual dredging cycle and aggressive crust management, the cell could hold approximately XX mcy of dredged material. The cost of reconstructing the south cell and the cost of operating the south cell for placement of 18 mcy of sediments would be approximately $XXXX million, or about $X.XX per cubic yard. Inasmuch as Hart-Miller Island is a state facility, all reconstruction and operations costs would be the responsibility of the state.

Use of the south cell would result in nutrient releases at approximately the same rate as for an equivalent amount of sediment in the north cell (see Section X.X.X). Inasmuch as the facility already exists, there would be no conversion of Bay bottom. The existing vegetation in the cell, which has begun a natural transition from phragmites domination to various indigenous species, would be covered if the cell is returned to active placement operations. The State's and Federal investments in initial preparation of the cell for conversion would be lost.

The MPA is constrained from making the cell available for reconstruction because of a commitment made to the public by the Maryland Department of Transportation to accelerate the development of the south cell for habitat and recreation. Furthermore, it would be illegal for any party a State agency to reactivate the cell for placement because of the aforementioned sState law. The Maryland General Assembly, having only recently established this law, is unlikely to reverse itself. For this latter reason, reconstruction and reactivation of the south cell is not viable as an alternative to open-water placement.

2.3.1.b Use of Existing North Cell Capacity.

The approximately 800-acre north cell was increased in elevation to 14.6 meters (+44 ft) MLW by the MPA in 1997. With optimal crust management and consolidation, an estimated 24 mcy of capacity will remain following inflow operations during the 1998-1999 dredging cycle. Eventually, the entire site will be converted to habitat and passive recreation in compliance with State law after dredged material placement ceases in the year 2009. The 21 mcy of capacity that is still available in the north cell has been programmed to receive various maintenance and new work dredging projects over the remaining service life of the project. The potential capacity will be decreased during placement of up to 3.2 mcy during the October 1999-March 2000 dredging cycle. The potential remaining capacity following crust management during Summer 2000 would be approximately 19.5 mcy, depending upon environmental conditions.

CENAB subsequently examined the north cell to determine if it could serve as an alternative to open-water placement. As discussed in Appendix XX, the north cell dike system was reconstructed and increased in elevation to +44 feet MLLW. State law prohibits the dike from being increased above +44 feet in elevation. Although there is a limited potential to further increase the north cell dike elevation, this is not a viable option under existing state law. The Maryland General Assembly, having only recently established this law, is unlikely to reverse itself. In this regard, recent legislative sessions have seen continuing efforts to continue to impose additional constraints on placement options.

The north cell can only receive an annual maximum of 2.5 mcy without overburdening. The available capacity is being programmed for Harbor sediments that are unsuitable for open-water placement, insofar as practicable, consistent with other placement needs which have been programmed to HMI to correspond with dredging needs because other large-scale placement options are not yet available. CENAB's analysis of dredging needs indicates that there is no excess capacity available in the north cell. Diversion of material planned for open-water placement would not only be substituted for other existing needs, but would also result in a reduction in the north cell's ability to receive dredged material, as described below.

Operational records for the HMI facility document the ability to dewater and consolidate sediments in order to reduce sediment volume and regain a portion of used placement capacity. The operating history indicates that placement of quantities in excess 2.5 mcy would result in water being trapped between the crust prior to placement and the crust that forms following placement. This would have the effect of reducing the facility's overall capacity, because the state law that mandates a closure date does not allow time for a hiatus in placement operations to enable extended crust management operations to offset any overburdening. The prospective potential outcomes of overburdening the site would therefore be a shortened service life because the site would be filled more quickly, inadequate time available between placements for optimal dewatering and consolidation, and a reduction in the north cell's overall capacity. The resulting reduction in the north cell's optimal capacity would exacerbate the placement deficit that the proposed action under investigation by the DEIS is intended to relieve.

The diversion of additional sediments to HMI would therefore result in one or a combination of (1) substituting sediments dredged from one location for another without resolving the underlying placement need, (2) an increase rather than reduce the deficit in placement capacity through overburdening, and (3) deferral of planned dredging due to lack of capacity. In view of the preceding analysis, use of the existing capacity of the north cell is not viable as an alternative to open-water placement.

2.3.2 CSX/Cox Creek Dredged Material Containment Facility

The CSX/Cox Creek Dredged Material Containment Facility (DMCF) is located approximately 1 mile south of the Francis Scott Key Bridge, on the west bank of the Patapsco River, near Foreman's Corner in Anne Arundel County, Maryland (Figure 2-6). The two cells were originally constructed under contract to CENAB in the 1960's for the containment of dredged material from the deepening of the Baltimore Harbor Federal channels from -11.9 m (-39.0 ft) to -12.8 m (-42.0 ft). The MPA has acquired the cells and plans to renovate the facility for the placement of an additional 6 mcy of maintenance dredged material from the Inner Harbor channels.

Maintenance dredged material targeted for placement in open water will originate from the upper Bay channels located outside (east) of the North Point to Rock Point line. Placement of suitable dredged material from Bay Channels at CSX/Cox Creek would limit its further use for placement of contaminated dredged material from Inner Harbor channels. As placement options for sediments from Inner Harbor channels are much more limited, filling CSX/Cox Creek with clean Bay channel material is not a prudent commitment of resources. In addition, site

~~configuration will limit placement to a maximum of 500,000 cy per year to optimize its capacity over a planned 12-year service life.~~

~~The CSX containment cell was constructed in the early 1960s, and has been used periodically by non-Federal interests for dredged material placement throughout the 1970s. The site was purchased by the State of Maryland in July 1993. The cell was previously permitted for placement of material obtained from dredging operations in the Patapsco River and Baltimore Harbor areas. The area of the dredged material placement cell is 72 acres. Its dikes have been raised periodically throughout its use and presently have a height of +6.1 m (+20.0 ft) MLLW. The last reported use of the site for the placement of dredged material was in 1984; it has been part of the MPA's long term planning for dredged material management since 1979.~~

~~The Cox Creek containment cell, as it was formally known, is bordered on the west by the former Cox Creek Refining Company upland property (now owned by the MPA) and on the east by the Patapsco River. The cell is surrounded by dikes that are presently at a height of +4.9 m (+16.0 ft) MLLW. The site was originally developed in the mid-1960's. Although the cell has not been actively used as a placement site since that time, it has been part of the MPA's long-term planning for dredged material management since 1979. Roughly 15 acres of the Cox Creek containment cell is occupied by an existing pond that was determined not to be jurisdictional wetlands waters of the United States under Federal rules and regulations. The pond receives water in the form of precipitation and stormwater runoff from the Cox Creek upland adjacent to the pond property. The pond is not open to tidal interaction; it is served by a spillway that is passively discharging into the Patapsco River. The stormwater system has been rerouted so that it no longer discharges into the pond.~~

~~Harbor sediments may not be placed in open water, but may be placed in containment facilities. Currently, the Hart-Miller Island DMCF is the only facility that is able to receive contaminated sediments. The combined capacity of the Cox Creek cells and Hart-Miller (which also receives sediments from outside of the harbor for which other placement capacity is not available and which is prohibited by State law from receiving material after 2009) is not sufficient to accommodate all of the dredged material from the harbor during the next 20 years. For these reasons, the capacity at Cox Creek must be reserved for harbor sediments. This site is not suitable as an alternative to Site 104 due to the relatively low capacity and the need to dedicate the available capacity for Inner Harbor sediments.~~

~~2.3.3 C&D Canal Upland Sites~~ **[CENAB TO REVISE AND UPDATE THIS SECTION]**

~~There are currently 17 Federal upland sites designated along the C&D Canal for dredged material placement (Figure 2-6). These sites are strategically located to accommodate certain channel reaches within the C&D Canal and the northern portion of the approach channels. Periodic expansion of these sites has been necessary to accommodate maintenance needs of those channel reaches. Placement site capacity expansion is presently needed to accommodate existing C&D canal channels. The sites have limited capacity at present, and are in the process of being investigated for jurisdictional wetland delineation by CENAP. After this evaluation is complete, availability of these sites as placement options would not occur for 4-6 years. Use of these sites for the CENAB or CENAP southern reaches would reduce the long-term potential of these sites~~

~~for the channel reaches they now serve. Furthermore, the required pumping distances and elevations make use of these sites for reception of materials from the southern CENAB and CENAP reaches uneconomical and inefficient from both fiscal and engineering standpoints (MDOT 1996; MPA 1996).~~

2.3.2 Beneficial Use (General Concept)

A concept that has gained considerable popularity is the use of suitable dredged sediment as a natural and economic resource rather than as a byproduct of dredging that has traditionally been treated as a waste stream, although most dredged material does not classify as contaminated sediments (NRC~~;~~ 1989, 1994, 1997). The practical application of the beneficial use concept was introduced to the Chesapeake Bay as early as the mid-1970s by the USACE. A few small-scale marsh restoration and oyster reef creation projects were undertaken (Garbarino *et~~.~~ al.*~~,~~ 1994; NRC, 1994). The possibility of using dredged material as an economic resource was studied for application in the Port of Baltimore in 1974 (Weston~~,~~ 1974) and then again in the mid-1980s (Kidde Consultants~~;~~ 1984, 1986). Although these earlier initiatives proved impractical at the time, the concept of using dredged material as a resource has continued to be of interest to the USACE, MPA, natural resource agencies, and the public (Hamons and Young~~,~~ 1999). Expanding from small-scale demonstration projects to large-scale application was proposed as a way to resolve the Port of Baltimore's placement needs in a manner that would contribute to Chesapeake Bay restoration efforts (MDOT~~;~~ 1991). It was also thought that the beneficial use concept would help overcome longstanding controversy about dredged material management.

Moving the beneficial use concept into practical application for the navigation infrastructure serving the Port of Baltimore has proven very difficult, including the implementation of the Poplar Island restoration project. That project will have taken over **XX** years to advance from concept to completion of construction, which is projected for 2001. Over the past decade, over 35 beneficial use projects have been proposed for locations in the upper Bay that would use dredged material as a natural resource. With the exception of Poplar Island, none of these options has been capable of implementation. Hamons and Young (1999) documented the results of the continuing efforts to find beneficial use projects capable of obtaining the support necessary for implementation and identified reasons why more beneficial use projects have not been implemented.

> *Linking the beneficial use concept to specific sites focuses attention on site-specific environmental, social and economic tradeoffs that, in most cases, work individually or collectively against project acceptability. Conversion of habitat from one form to another, especially fisheries habitat, has been a major factor in determining whether or not the environmental value that would be gained would in turn justify modifications to existing site conditions* (Hamons and Young~~,~~ 1999).

A number of beneficial use options were screened as possible alternatives for this RDEIS, as discussed in section 2.2.2. Most were found to be not suitable as either standalone alternatives or as a component of a combined options alternative, as discussed in ~~Appendix XX~~Annex E and further discussed in the following subsections for specific beneficial use options. Some beneficial use options screened successfully as possible options to the proposed action, and were included as alternatives in Section 2.4. No options were screened out as possible alternatives solely on the basis of cost. Nevertheless, cost is a mandatory consideration in determining the least cost, environmentally acceptable option, as discussed in Section 2.2. Beneficial use projects are, in general, ~~not only more expensive per cubic yard utilized than~~ substantially more expensive than more traditional placement options~~, but have usually been substantially more expensive~~. The cost factor makes large-scale beneficial use projects extremely difficult to implement, because the federal beneficial use authority provided by Section 204 of the **XXXXX** is directed to small-scale projects. For example, despite widespread support for the Poplar Island project, it took special legislation by the U.S. Congress in order to obtain sufficient funding for the project, which greatly exceeded the $15 million annual national cap on normal funding of federal beneficial use projects. Except for the Poplar Island project, Section 204 funds have not been appropriated to the maximum annual amount and are competed for nationally. The beneficial use options that were screened as possible alternatives ranged in cost from tens of millions to hundreds of millions of dollars more than the proposed action, as discussed in ~~Appendix XX~~Annex E. Although the beneficial use concept continues to enjoy popular and institutional conceptual support, each beneficial use option was considered on its own merits as to whether or not it could serve as a practical alternative to the proposed action.

2.3.53 —Poplar Island Restoration Project

Island restoration sites using dredged material are placement areas created by constructing a physical structure to enclose an estuarine or marine area on the site of existing or previously existing islands. Poplar Island, like many islands in the Chesapeake Bay, has been severely eroded. It was determined that island restoration/creation could be an ideal solution to the dredged material management problem facing the Port of Baltimore. The group of islets known as Poplar Island are located in the upper middle Chesapeake Bay, approximately 34 nautical miles southeast of the Port of Baltimore and 2 miles northwest of Tilghman Island, Talbot County, Maryland (Figure 2-7).

Through the cooperative efforts of many state and Federal agencies, as well as private organizations, a project has been developed to reconstruct Poplar Island to its approximate size in 1847. This ~~will be~~is being accomplished using ~~clean~~ suitable dredged material from the approach channels that are part of the Baltimore Harbor and Channels Federal navigation project. Although Poplar Island is farther from some of the areas needing maintenance, the additional costs were offset by the significant beneficial use outputs of the project. The accepted restoration plan, when fully implemented, would create a 1,100-acre dredged material placement area within a 35,000-foot perimeter dike. The area would then be filled with ~~clean~~ suitable dredged material obtained from periodic maintenance dredging of Federal navigation approach channels that serve the Port of Baltimore. The site can then be developed into low and high marsh wetlands and uplands. The planned placement capacity of this island restoration is 38 mcy.

CENAB is considering the application of an innovative technique to prepare the restoration project to receive dredged material. The concept being considered is enhanced dewatering of the placement cells and drying and consolidation from the existing mud line up. This will involve continual pumping of the cell to keep it dry once initially dewatered. In theory, this approach could result in a reduction of pore water in the bottom sediments. The associated consolidation might nominally lower the bottom elevation, thereby increasing cell volume to a limited extent. Any increase in foundation strength that might result could potentially allow an increase in dike height. The principal reason for advance dewatering is to allow installation of underdrains in the cells to aid in the dewatering of the first several placements of dredged material. The underdrain system is anticipated to decrease markedly in capability following the first two placement cycles as the fine grained material clogs, and in effect, seals the underdrains. The additional capacity that might be gained cannot be effectively predicted. As the cell elevation is below the surrounding water level, the ability to keep it dewatered will depend upon environmental conditions encountered. Extremely wet conditions would reduce the potential effectiveness of this approach. Additionally, there have been additional requests for use of Poplar Island for the placement of suitable dredged material, including material from the proposed Wilson Bridge reconstruction project. Decisions on these requests are pending. Therefore, it is not clear whether any of the additional capacity that might be gained from the innovative approach discussed above would actually be available for sediments from the approach channels to the Port of Baltimore. For these reasons, the potential for increased capacity through enhanced dewatering techniques is not included in capacity estimates for Poplar Island Phases I and II. CENAB could address any substantial increase in capacity through a supplemental EIS, if circumstances warrant.

2.3.53.a Phase I. Construction of the Phase I Poplar Island project (670 acres, 19 mcy) began in mid-1998 and the dike system will be ready for inflow operations in ~~1999~~ 2000. The current placement capacity for the site has already been designated for uses other than those proposed for Site 104. Annual capacity at Poplar Island is limited because of it's environmental restoration, construction, and operation schedule. It is currently planned to accept 3 million cubic yards in the Year 2000 and 2 million cubic yards in Years 2001 and 2002. After that, it will be limited to 1.5 mcy annually. Because Poplar Island has an annual maximum designed placement capacity limit of 2 mcy (beyond which the site may not meet its environmental restoration specifications), additional materials cannot be placed in this site without adversely affect restoration objectives or reducing the potential capacity of the upland component of the project due to trapping of water in successive sediment layers. Consequently, Poplar Island can not provide the capacity for the near-term shortfall that necessitates considering the Proposed Action.

2.3.53.b Phase II. Construction of Phase II of the Poplar Island restoration project (450 acres, 19 mcy) is projected to begin in **19XX**. Two additional wetland cells are projected to be ready for inflow operations in **19XX**. It is anticipated that the Phase II wetland cells would be filled within three year of initial availability. The exterior dike for this cell is planned to remain open to the Bay for approximately **XX** years so as to serve as a sheltered harbor and staging area for filling of the Phase I and II wetland cells and the Phase I upland cell. The Phase II upland cell would not be available for use until the exterior dike is closed in approximately **19XX**. The Phase II upland cell capacity is estimated to be **XX** mcy. The actual capacity may vary from this estimate depending upon how much sand is excavated for dike construction. It is anticipated that there would be a more limited opportunity to increase capacity of the Phase II upland cell through enhanced dewatering because the depth and configuration of the excavated borrow area will likely inhibit the installation of an underdrain system throughout the cell. Once the upland cell is available, it would be capable or receiving an average annual inflow into it will be approximately **X.X mcy**. Higher inflow rates are anticipated during the first **X to Y years** of cell filling may be possible because the available volume of the borrow area provides substantially more capacity than had the cell not served as a borrow area. Once the sediment placed into the upland cell rises above the ambient Bay water level, the annual optimum placement potential will be reduced to a maximum of **X.X mcy**.

~~2.2.3.a.3 Swan Point Peninsula Restoration (Beneficial Use, Upland Placement, Fastland Creation)~~

~~Swan Point in Kent County has been severely eroded. Projects proposed as DNPOP placement options on Swan Point have included a beneficial use project or a containment project for clean dredged material. It is estimated that a beneficial use project would result in approximately 2 to 5 mcy of capacity. It is estimated that a dike system connected to Swan Point for containment could result in approximately 10 mcy of capacity. This area is known to provide fish nursery habitat, is a waterfowl use area, has viable oyster and clam bars in the immediate vicinity, and listed Rare, Threatened or Endangered species (eagles) have been preliminarily identified by resource agencies as present near or in the project area. Although time of year restrictions on placement may be sufficient to protect fisheries resources, the other natural resources at the site would still be vulnerable. The extent of wetland and forest acreage in the area has not yet been determined by studies performed to date. A conservative estimate would be that 18 acres of wetlands and forest would be lost to placement site development. Due to these constraints, the alternative was dropped from further consideration.~~

~~2.2.3.a.4 Grove Neck (Upland Placement)~~

~~Grove Neck is an upland site on the Eastern Shore of the Upper Bay in Cecil County (Figure 2-3). This site was first introduced as part of the Master Plan process, and was forwarded for consideration to the DNPOP Bay Enhancement Phase II Working Group for consideration. The site has an estimated 280 acres under consideration, with up to 5 mcy of placement capacity. It is a forested site at a high elevation along the Sassafras River. Up to 280 acres of forest could be lost to placement site development. The entire site would likely be within Maryland critical areas, in that it is located within 1,000 feet of the Chesapeake Bay and its tidal tributaries (Chesapeake Bay Critical Area Commission 1986). This adds increased logistical problems because there would be special requirements for land use, permitting, stormwater management, wetlands impacts and forest buffer impacts. Grove Neck is closer to CENAP channels than to CENAB channels which would add as much as $6.50 per cubic yard to the cost of placement (Section 7).~~

2.3.456 Aberdeen Proving Ground Beneficial Use Options

Given the large amount of shoreline controlled by Aberdeen Proving Ground (APG) on the western side of the upper Bay, CENAB, CENAP and the MPA have maintained a continuing interest in finding opportunities for the placement of dredged material at APG. ~~The DNPOP program has, since its inception, actively pursued identification and evaluation of upland placement sites within the boundaries of the U.S. Army, Aberdeen Proving Grounds (APG).~~ The APG-controlled area totals approximately 72,000 acres located on the northern ~~upper~~ Chesapeake Bay shoreline in Harford and Baltimore Counties. Approximately 40,000 acres consists of Bay waters and tributaries. Of the remaining 32,000 acres, a significant percentage is either in use for military missions or is wetlands or forested areas. ~~Alternatives being evaluated have the potential to provide material for beneficial use projects at APG such as shoreline stabilization, habitat restoration, and encapsulation of hazardous materials and unexploded ordnance (UXO). APG representatives are participating in the DNPOP, and continue to discuss the development of alternative placement options for APG.~~ CENAB, CENAP and the MPA have been involved in continuing efforts to establish placement sites within the APG area, as discussed in the following paragraphs. However, the interest in APG for dredged material management must be considered in the context of an active military installation with important national security missions that are the primary considerations for use of land and water areas controlled by the U.S. Army.

CENAB commissioned a major study of the potential for use of APG upland areas for the disposal of dredged material. The study began in 1984 and was completed in 1987 (Century Engineering~~,~~ 1987). Three technically feasible sites that would have the least environmental impacts were identified after detailed investigation of areas not affected by operating areas or critical military missions, areas with endangered species or historical attributes, water and land access, and areas with tidal wetlands. Detailed investigation was carried out for the most promising upland site which was located at the end of Abbey Point. The site had a potential capacity of 2.8 mcy. Deposition of dredged material would cover unexploded ordnance (UXO) to a depth of some 5 to 7 ~~feet~~ft. It was subsequently determined that ~~this~~ use of the site for dredged material placement ~~disposal~~ would severely restrict range and recovery operations. The ~~engineering consultant~~study ultimately concluded that ". . . there is no significant acceptable dredged material disposal area at Aberdeen Proving Ground" (Century Engineering~~,~~ 1987).

The MPA Master Plan initiative from 1986 to 1990 considered a number of potential placement sites in the APG-controlled water area. Potential sites were identified in the vicinity of Pooles Island, Cherry Tree Point, and Shad Battery Shoal. The Master Plan recommended use of the then existing open-water sites until their capacity was exhausted, with all dredged sediments designated for open-water disposal thereafter being placed in the Deep Trough (MPA~~,~~ 1990). In lieu of implementing the Master Plan recommendations, the Maryland Governor established a task force to develop another approach to dredged material management, as previously discussed.

The DNPOP program has, since its inception, continued the active pursuit of placement options within the boundaries of APG. Alternatives that have been identified and evaluated have the potential to provide material for beneficial use projects at APG such as shoreline stabilization, habitat restoration, and encapsulation of hazardous materials and unexploded ordnance (UXO). APG representatives are participating in the DNPOP, and continue to discuss the development of alternative placement options for APG.

The Maryland Environmental Service, at the request of the MPA, prepared a multi-objective screening of the potential of four beneficial use sites for dredged material placement in support of the C&D Deepening Study that was being performed by CENAP. Three of the sites – Weir Point, Spry Island Shoal, and Pooles Island were largely within the APG controlled area. The screening addressed endangered species, waterfowl, fisheries, benthos, wetlands, shallow water habitat, colonial waterbirds, submerged aquatic vegetation, ownership and jurisdiction, and institutional constraints (MES~~,~~ 1994). The report served as a technical resource for subsequent efforts to find suitable placement options at APG and identified various environmental factors and institutional constraints that would require further investigation. The possibility of encountering munitions was identified, but was not a factor that was specifically addressed during the environmental screening. The presence of UXO ~~as~~is a fatal flaw for projects at APG ~~became apparent as the results of subsequent efforts to find placement sites at APG~~, as discussed in a following paragraphs.

A DNPOP working group identified 5 areas (Carroll Island, Spry Island Shoal, Graces Quarters, Gunpowder Neck and Pooles Island) with 16 individual concepts for creating or restoring intertidal marshes. Most of these sites are within the perimeter of APG. Many areas of APG are in Harford County but within the five mile radius of Hart-Miller Island. Use of the sites may require a modification of the State law that prohibits establishment of a containment facility within 5 miles of the Hart-Miller-Pleasure Island Chain in Baltimore County. -APG, Federal and state natural resource agencies, and commercial fisherman expressed concerns regarding the environmental and economic issues related to each of the sites. Rare, threatened or endangered species (RTE) habitat, estuarine and palustrine wetlands, finfish nursery and spawning grounds, and CERCLA and UXO liability issues have all been part of the aquatic and terrestrial resources and environmental impacts discussed regarding use of APG sites for dredged material placement.

The most significant concerns voiced related to the safety, liability, and cleanup cost for use of a site that contains so much UXO and is currently on the National Priority List (NPL) of hazardous waste sites. EPA Region III advised the DNPOP program participants who were considering a demonstration project at J-Field on Gunpowder Neck that there is no national standard for remediation of -UXO. EPA ~~and~~ stated that there are no laws or regulations specifically addressing the liability of UXO. In the absence of definitive legal requirements, EPA Region III advised that DNPOP planning ~~should~~ use the CERCLA legal requirements and precedents as planning factors, including removal of UXO as the worse case remediation requirement Thus, any dredged material placement project might have to be removed in order to remediate UXO. Furthermore, any party which constructed a project that later required UXO remediation could be considered a Potentially Responsible Party by the EPA and, if so designated, would become liable for the cost of removing UXO. ~~Due to these concerns,~~ Neither the Army Corps of Engineers nor the Maryland Port Administration can accept the associated risk and liability. Therefore, active investigation of all potential sites and configurations within the APG boundary has been suspended from further evaluation. ~~, although the concepts will be reconsidered should conditions change. and therefore~~ APG sites are not suitable ~~as~~ alternatives ~~to the proposed open-water~~ for placement of dredged material (DNPOP~~,~~ 1995b).

~~Given the large amount of shoreline controlled by APG on the western side of the upper Bay, the DNPOP program has maintained a continuing interest in finding opportunities for the placement of dredged material. Many areas of APG are within the five mile radius of Hart-miller Island and are, therefore, unavailable for containment site development under current Maryland law. However, other smaller-scale concepts such as shoreline stabilization/beneficial use have been explored. Placement options involving APG have resulted in the inclusion of two APG-related alternatives to Site 104; Encapsulation of UXO using dredged material at two APG sites (J-Field [on Gunpowder Neck] and Graces Quarters) was actively pursued during 1994 and 1995 (Figure 2-7). One is a small-scale demonstration project combining waste encapsulation and shoreline stabilization, known as the J-Field project. This project concept is described below. The second is the expansion of Pooles Island in conjunction with development of a new island containment facility with an estimated capacity of 80 million cubic yards (mcy). Rare, threatened or endangered species (RTE) habitat, estuarine and palustrine wetlands, finfish nursery and spawning grounds, and CERCLA and UXO liability issues have all been part of the aquatic and terrestrial resources and environmental impacts discussed regarding use of APG sites for dredged material placement.~~ The Pooles Island dredged material island concepts are described and evaluated in Section 2.~~2.3.b.2~~.4.X.

~~J-Field Site~~

~~A small-scale demonstration project combining encapsulation and beneficial use was considered for J-Field, which is an APG Superfund site (Figure 2-7). The site also has a unique "floating marsh" that is in danger of being lost through shoreline erosion. In 1995, APG determined that incorporating the project into the facility's installation restoration program (IRP) was potentially feasible. The demonstration project would have had about 1.5 mcy capacity, and would have only provided a partial short-term solution for the C&D Canal southern approach channels. During the course of investigating the concept, it was learned that the shoreline and water reaches within the restricted area controlled by APG are contaminated by the presence of between 3 and 30 million rounds of UXO, creating significant concerns for safety. There is also substantial uncertainty about the degree to which the placement of dredged material would create exposure to future responsibility or costs if the encapsulated ordnance would need to be excavated or removed. There is also a technical limitation in locating UXO once buried in sediments. As a result, the proposed J-Field project to encapsulate UXO and to protect an eroding shoreline with a protective marsh has been indefinitely delayed and is not likely to be available to accommodate any of the near-term placement needs for the C&D Canal northern or southern approach channels.~~

~~Graces Quarters~~

~~Two beneficial use concepts were investigated for Graces Quarters, which is an APG Superfund site (Figure 2-7): (1) A 36-acre wetland creation and shore stabilization project with an approximate capacity of 400,000 cy and (2) a 36-acre encapsulation for shore protection with an approximate capacity of 400,000 to 824,000 cy, depending on fill elevation. Consideration of both concepts was discontinued due to: (1) the low capacity of the site, particularly if it had to be diked; (2) poor boat/scow access (very shallow water and poor truck access to most of the site;~~

~~(3) difficulties in getting the materials to the identified areas even with a hydraulic dredge; (4) the need for dewatered, consolidated materials to make the concept work; and (5) existence of prime tiger beetle (endangered species) habitat. The potential presence of UXO at this site (see above) would also indefinitely delay its use for accommodating any of the near-term placement needs for the C&D Canal northern or southern approach channels.~~

~~2.3.7 Sparrows Point Habitat Development~~

~~A 300-acre habitat development project was planned for the eastern end of Sparrows Point in Baltimore County (Figure 2-7). The project was planned to reclaim establish a habitat enhancement project contiguous to industrial shoreline by converting and enhance relatively poor bottom to aquatic and intertidal wetlands, high marsh, and upland nesting areas in order to benefit living resources. The habitat that would have been created was also envisioned as providing aesthetic relief for the entrance to the harbor. An estimated 10 mcy of capacity was projected. The MPA investigated use of this site, with preliminary conceptual designs and pre-feasibility environmental studies. Preliminary engineering determined that a project at the site was feasible. However, poor foundation conditions would necessitate highly specialized construction techniques in order to "float" a structure to enclose the site (GBA et al., 1992; Hamons and Young, 1999; MES and MPA, 1993). An environmental study determined that the area's biological productivity was similar to that of other areas inside the harbor, but less productive than the Bay (MES, 1995a).~~

~~Institutional difficulties exist from the prohibition in current state law for construction of a containment facility within a 5 mile radius of the Hart-Miller-Pleasure Island chain. Although the proposed project was intended to improve habitat, it nevertheless would have required the water area to be fully enclosed because of site-specific conditions. Public support would be required to change the current law in order to put a containment facility at this site. The campaign to change a law is expected to be long and potentially unsuccessful. Attempts on behalf of the MPA to secure citizen support for the beneficial use project and for a revision to the law were not successful. Local citizens, citing past filling of open-water in the area by Bethlehem Steel, objected to any further conversion of open-water in the area (Hamons and Young, 1999). Based on these factors, the site In the absence of support for removal of the institutional constraint associated with this project, habitat development has been maintained as a DNPOP option but efforts to implement the project have been suspended indefinitely put on hold indefinitely. The existing institutional constraint is considered a fatal flaw for this option, and it is not feasible or practicable as an alternative to the proposed action.~~

2.3.5 Eastern Neck Island National Wildlife Refuge

Eastern Neck Island National Wildlife Refuge is located on Maryland's Eastern Shore at the mouth of the Chester River. It encompasses all of Eastern Neck Island. The refuge is the responsibility of the U.S. Fish and Wildlife Service (USFWS). The refuge was previously the location of a small beneficial use project. The possibility of further beneficial use options at the refuge ~~are listed~~is considered as an option in the MPA's DNPOP Program. Use of Eastern Neck for beneficial use applications in lieu of the proposed open-water placement was advocated by a various public officials and private citizens. The potential of Eastern Neck Island for additional beneficial use applications was evaluated to determine whether it could serve as an alternative to the proposed open-water placement or as a component of a multi-option alternative.

The beneficial use application is an outgrowth of shore erosion and control measures for a portion of the island's western shoreline. The project was necessitated because the island was experiencing a significant loss of acreage due to shore erosion. Five stone segmented breakwaters were installed in 1992. The USFWS installed several sand-filled geotubes immediately southeast of the stone breakwaters, configuring them to extend the segemented breakwater system. After the geotubes were installed, CENAB deposited approximately 34,380 cubic yards of fine-grained sand between the tubes and the shoreline. About 77,000 wetlands plants were planted along the shoreline. The habitat value of the shallow water area between the breakwater system and the shoreline has subsequently improved significantly (Gill, *et. al.*, 1995; Hurt, 1995).

The BEP II working group considered the potential of Eastern Neck Island in 1995. The working group believed that although there was some potential for a small-scale beneficial use project at the refuge, large-scale placement options were needed to meet near-term needs. Eastern Neck Island was not considered a realistic option for meeting that need due to the limited potential for placement capacity. However, supplemental information was subsequently assembled for use in DNPOP planning and was available for this RDEIS.

The refuge provides habitat for nesting bald eagles, Ddelmarva fox squirrels, and migratory birds. There are also tidal wetlands, high value upland forest areas, diverse forage for fish, and agricultural fields. Cultural resources are believed to exist within the refuge boundaries. The southern portion of the western shoreline of the island is relatively low and dominated by fringe marsh. This portion of the shoreline is somewhat exposed, and minimal submerged vegetation (SAV) has been reported. Bottom conditions along the southern portion and immediately offshore of the western shoreline appear to be similar to conditions that ~~exisit~~exist in the vicinity of the segmented breakwaters. The success of the breakwater system and fill with fine-grained sand suggests that a similar result could be obtained from a similar project to the south. A segmented breakwater could be designed and installed, subject to suitable foundation conditions. Such a project would preserve the general character of the area. An estimated 50,000 cy of dredged sediments could be potentially be placed. Greater placement potential on the order of 100,000 to 200,000 cy would necessitate creating a closed dike system and constructing marshes or upland, thereby substantially changing the character of the shoreline. The shallow water areas along the eastern side of the island have historically supported considerable SAV and the shoreline has considerable tidal marshes (Orth, *et. al.*, 1997;, 1998). Informal coordination resulted in a finding that the USFWS is only willing to accept material that is mostly sand for a beneficial use project that would maintain the character of the area. Therefore, only the smaller-scale sand option would be considered by the agency.

The southwestern shore of Eastern Neck Island is 11 miles northeast of Site 104 by water. It is approximately 4 miles greater in distance from the CENAB channels that would be dredged than is Site 104. The increased transportation cost which would be borne by the State would be approximately $0.40 per cubic yard. There would be additional costs for environmental documentation, engineering design, site preparation/construction, mobilization and demobilization of equipment to Eastern Neck Island, and vegetation following completion of placement. The total cost of a beneficial use project to continue ~~the~~o extend the existing beneficial use project is estimated between $20 to $85 per cubic yard depending upon design, construction materials, foundation conditions, and other factors. Total costs could be on the order to $3 to $10 million. These costs are within the funding limits of Section 204, although funds from this source are competed for nationally.

Eastern Neck Island was not selected as an alternative to open-water placement because the ~~Since the~~ USFWS will only accept sandy material, and the materials from the channels to be dredged is primarily fine silts and clays, and there is no practical way to separate out a minor amount of sand that may be dredged. ~~I~~It is unlikely that the estimated 50,000 cubic yard capacity could be used, although this capacity would likely be available within the five-year planned placement window.

2.3.96 James Island

Although the Poplar Island restoration project is not yet constructed nor filled and vegetated, the prospect that the project will ultimately be successful has stimulated interest in the possibility of other large-scale island restoration projects. The potential for an island restoration project at James Island at the mouth of the Little Choptank River has been informally suggested to the MPA for possible inclusion as an option in the DNPOP program, and information is being assembled to provide a resource for consideration of the island's restoration potential and restoration options by the BEP II Working Group. During the course of the NEPA process for the proposed open-water placement which is the subject of this RDEIS, the possibility of restoring James Island was suggested as a possible alternative. The preliminary DNPOP information was made available to CENAB. Additional information was developed by CENAB to aid in determining whether or not restoration of James Island might effectively serve as an alternate.

The existing James Island Archipelago was formed as a result of natural processes of shoreline change that affect the Chesapeake Bay region. James Island is portrayed on 18th century maps as being connected to the mainland of Taylors Island by a marsh. By 1847, survey data indicated that connection was nearly breached. At that time, James Island consisted of about 1253 acres of upland and fringe marshes. By 1942, the two remnant islands were still connected but the connection to Taylors Island had been breached and consisted of open-water. By 1994, the remaining island was breached into two principal remnants consisting of a total of 106 acres. The islands today are estimated to be less than 100 acres. The southernmost island is separated from Taylors Island by about a mile of shallow open-water (Stevenson and Kearney~~,~~ 1996). The remaining remnants are privately held by different parties.

The shallow waters west and north of the existing remnants provide shallow water habitat for foraging. The area is exposed and does not currently support the growth of SAV (Orth *et~~.~~ al.~~,~~* 1997, 1998). The bathymetric break between the more shallow waters and the deeper waters that form the ancient bed of the Susquehanna River provide an edge that is exploited to some extent by sportsfishermen. There is a designated small natural oyster bar (14-6) of 16 acres size immediately southeast of the southernmost island remnant.

The progressive erosion of James Island is believed to have contributed to increased erosion of Dorchester County shorelines that were once in the shadow of the island complex. Oyster Cove, located at the northwest tip of Taylors Island, was once enclosed on the west by the peninsula that preceded the current James Island Archipelago. This area is one of the Dorchester County shorelines that has experienced increased erosion that appears to be associated with the progressive loss of the protection that had been provided by James Island.

Conceptually, James Island could potentially be restored either as an island or as a peninsula reconnected to Taylors Island. ~~Potentially,~~ tThe area could be restored in similar manner to Poplar Island with overall size of perhaps 1,000 to 1,200 acres and capacity also similar to that of the full Poplar Island restoration project, depending upon the project configuration. In order to be consistent with the historic footprint, the restoration would need to be on the west side of the Archipelago. Inasmuch as an upland island existed at this location, it is assumed that an upland island could be constructed to similar elevations planned for Poplar Island. Restorating the island with a reconnection to Taylors Island could potentially reduce physical energy affecting the east side of the James Island Archipelago and Oyster Cove, thereby improving conditions potentially favorable to colonization and growth of SAV.

Assuming that sufficient sand is available in deposits on site for dike construction, and that there would be no mitigation requirements, a planning estimate of the cost (with a standard contingency for unanticipated conditions) for a large-scale restoration is $20 per cubic yard. This planning estimate would increase if there were a need to import dike construction materials and if mitigation were required for the conversion of shallow water habitat (mitigation was not required for Poplar Island because the environmental benefits were assessed as greater than the environmental impacts resulting from construction). Whether or not a large-scale project can achieve the broad-based support necessary for implementation including special funding by the U.S. Congress and funding by the Maryland General Assembly of the local sponsor cost share is speculative in view of the legislative history of the Poplar Island restoration project. A small-scale restoration project on the order of 0.5 to 2.0 mcy within the Section 204 discretionary authority could cost on the order of $50 to $100 per cubic yard, depending upon site configuration, habitat types, and construction requirements. A small-scale restoration would be problematic on the west side of the Archipelago because the location is very exposed. A substantial armored dike system similar to the western dike of the Poplar Island project would be needed for either a large-scale or small-scale restoration.

The full developmental time frame for such a project would be at least as long as the Poplar Island restoration project which was fast-tracked, on the order of 10 to 14 years (the actual time frame will vary according to various factors including legislative schedules for consideration of funding authorizations). Based on the experience in building a consensus regarding the appropriateness of a large scale restoration project for Poplar Island, especially the environmental tradeoffs that were involved, it would take approximately 2 to 3 years to establish whether or to what extent a large-scale beneficial use project would be practicable at James Island. Although restoration of James Island is already under consideration as part of long term dredged material management planning, the ability to implement a project at this location is far from certain and would need to be developed on its own merits. Furthermore, the time frame for such development extends beyond the placement need addressed by the RDEIS. Therefore, restoration of James Island to accommodate 18 mcy of dredged material is not practical as an alternative to the proposed action, although it may prove to be suitable and acceptable as a beneficial use project at a future date.

2.3.~~10~~7 Innovative Use of Dredged Material

The concept of using dredged material as a non-traditional or economic resource (e.g., turning it back into soil products), a form of "beneficial use," has been widely discussed as a constructive approach to managing dredged material. For the purpose of this RDEIS, the concept of using dredged sediments ~~as an economic or non-traditional resource~~ for the production of products or for non-traditional end uses is referred to as "innovative use" to distinguish it from more traditional habitat enhancement and restoration applications. For example, innovative uses would include the concept of applying dredged sediments to farmlands, with or without the subsequent addition of amendments (Dalrymple~~,~~ 1997; Landin~~,~~ 1997; PIANC~~,~~ 1992; Price, *et~~.~~ a~~l~~l.~~,~~* 1997).~~ Indeed, t~~This concept has been used in small-scale farm applications in Maryland and elsewhere. Although reported to be successful, there currently is limited data to support general application in agriculture (Duff and Corletta~~,~~ 1997). Both the USACE and MPA are conducting applied research into potential soil applications. Applied research and development into the innovative use of dredged sediments is also being pursued elsewhere, including applications for New Jersey waters in the New York Harbor area [REVISE SO PUBLIC CAN UNDERSTAND]. This latter research involves federal funding through the Water Resources Development Acts of 1990, 1992 and 1996 ~~as well,~~and over $100 million in funding from the State of New Jersey in an effort to advance from concept to practical application (Jones~~,~~ *et al.~~,~~* 1999; McDonough~~,~~ *et al.~~,~~* 1999; Stern *et al.~~,~~* 1997, 1998a,b).

The innovative use of dredged sediments is not a new issue for the Port of Baltimore nor are the many suggestions that dredged material be recycled for the reclamation of mines and sand and gravel pits. The innovative use of dredged material for the production of various products including natural and synthetic aggregates, shells, bricks, mineral wools and other materials was previously studied for the Port of Baltimore. The manufacture of lightweight synthetic aggregates was assessed as feasible, but the potential market was not available. All other products were found to be unfeasible for a various technical and economic reasons (Weston~~,~~ 1974). A study was undertaken for the U.S. Department of Transportation and Baltimore City between 1984 and 1986 to examine the treatment of contaminated dredged materials (Kidde Consultants~~,~~ 1984, 1986). The facility now referred to as the Cox Creek DMCF was identified as the prospective location for a recycling facility. Conceptual designs, an economic analysis, and cost estimates were developed. However, the approach was not practical for implementation, because ~~. Neither~~either the containment cells nor a market were available.

Innovative use has more recently been addressed by the Maryland Port Administration in the form of conceptual options suggested through the DNPOP Program for which the MPA has sponsored research and has announced intentions to request proposals for innovative uses. Considering these developments, the use of dredged sediments was screened to determine whether or not a specific application or applications of the innovative use concept could serve as a practicable alternative for managing up to 18 mcy of dredged sediments for the Port of Baltimore. The state of practice in innovative use of dredged sediments is reviewed in ~~Appendix XX~~Annex E and summarized below.

Most research and development into the innovative use of dredged material has been directly related to initiatives intended to find solutions for the remediation of contaminated sediments. Development of pretreatment and treatment technologies have involved both low through high-technology solutions. ~~Inasmuch a~~As the national focus has been predominantly on contaminated sediments, the applications that have been tested have tended towards higher technologies. These have included thermal destruction technologies (incineration, pyrolysis, high-pressure oxidation, and vitrification), thermal desorption technologies (high-~~termperature~~temperature thermal processor, low-temperature thermal treatment system, proprietary thermal desorption systems, desorption and vaporization extraction systems, low-temperature thermal aeration systems, and anaerobic thermal processor systems), immobilization ~~technolgies~~technologies, extraction technologies (including soil washing), chemical treatment technologies (chelation processes, dechlorination processes, chemical dehalogenation treatment, base-catalyzed dechlorination, ultrasonically assisted detoxification, oxidation processes, and chemical and biological treatment), and bioremediation technologies (bioslurry processes, contained land treatment systems, composting, and contained treatment facilities). In general, research and testing have found that pyrolysis, oxidation, and bioslurry processes have performed within acceptable limits for both silts and clays, and soil washing, solvent extraction, composting, and contained treatment facility processes have performed within acceptable limits for silts (EPA~~,~~ 1994).

~~Technologically, t~~There have been significant advances in the technological capability to produce products and innovative end uses from dredged marine and estuarine sediments. Technologies and techniques that are under development include the manufacturing and blending to create soil products (Amiran~~,~~ *et al.*~~,~~ 1999; Graalum and Randall~~,~~ 1997; Palazzo~~,~~ *et al.*~~,~~ 1997; Sturgis~~,~~ *et al.*~~,~~ 1997a,b), soil washing (Amiran~~,~~ *et al.*~~,~~ 1999; Olin and Bowman~~,~~ 1997); conversion into lightweight construction aggregates (Weston~~,~~ 1974), use in landfill construction (MES~~,~~ 1995b), production of construction grade cements (Rehmat~~,~~ *et al.*~~,~~ 1999), forming cementitious products for mine reclamation (CTI~~,~~ 1998; McDonough~~,~~ *et al.*~~,~~ 1999; O'Donnel and Hennington~~,~~ 1999), manufacture of bricks (Cousins~~,~~ *et al.*~~,~~ 1997), production of commercial tiles (McLaughlin~~,~~ *et al.*~~,~~ 1999), and manufactured material using waste products such as automobile shredder byproduct and dredged sediments to produce structural and non-structural fill (McDonough~~,~~ *et al.*~~,~~ 1999; Willix and Graalum~~,~~ 1999). Most of these applications have been targeted towards contaminated sediments, primarily because these are the more difficult of dredged sediments for which to secure final ~~deposition~~placement. Other applications, such as farm applications, are intended to use suitable, uncontaminated dredged material (Corletta and Duff~~,~~ 1997; Dalyrmple~~,~~ 1997; Landin~~,~~ 1997; Price~~,~~ *et al.*~~,~~ 1997). Transforming these approaches into practicable applications requires that the technology be capable of adaptation to local sediment conditions, a particular need for contaminated sediments.

Certain specific innovative use applications involving the products have been demonstrated to be capable of pilot scale application on the order of 100 to 500 cubic yards. Some processes have ~~been demonstrated to be capable of~~ undergone demonstration or modest scale production on the order of 30,000 to 40,000 cubic yards and others are anticipated to go to this scale in the next year. For example, about 19,000 cy of contaminated sediments from Perth Amboy, New Jersey, were converted to a cementitious product and successfully placed at Bark Camp Mine in Pennsylvania as a strip mine remediation demonstration project at a cost of approximately $85 per cubic yard (CTI, 1998). The research program sponsored by the State of New Jersey is planning to advance selected processes from pilot scale (up to 30,000 cy) to full-scale commercial production of 100,000 cubic yards per year for the management of contaminated marine sediments. The goal is to develop a suite of marketable products and end uses that in combination would result in the annual conversion of up to 500,000 cy of contaminated sediments into marketable products or end uses. Implementation of the concept to date indicates that sufficient markets exist or could be developed in the New York and northern New Jersey metropolitan area (Amiran~~,~~ *et al.*~~,~~ 1999; McDonough~~,~~ *et al.*~~,~~ 1999; McLaughlin~~,~~ *et al.*~~,~~ 1999). However, market conditions, particular for soil products, is significantly different in Maryland where soil and fill material is readily available to meet existing demand. For this reason, the market for innovative products and end uses will need to be expanded or created in order for a technology...

The majority of testing has been performed at bench, pilot and demonstration test scales (Amiran~~,~~ *et al.*~~,~~ 1999; CTI~~,~~ 1998; EPA~~,~~ 1994; Jones~~,~~ *et al.*~~,~~ 1999; McLaughlin~~,~~ *et al.*~~,~~ 1999; Rehmat~~,~~ *et al.*~~,~~ 1999). The costs of treatment for remediation technologies for contaminated sediments range from about $45 per ton to over $500 per ton (EPA~~,~~ 1994, 1998a; McLaughlin~~,~~ *et al.*~~,~~ 1999). Although this RDEIS addresses suitable sediments, that is, those that can be characterized as clean, the technology for contaminated sediments can be applied to uncontaminated sediments as well. The high cost of remediation technologies detracts from their economic viability for innovative applications on a large scale, even for contaminated sediments. For example, the State of New Jersey's program to develop innovative use as an integral part of dredged material management has established a maximum of $35 per cubic yard as the amount the State is willing to pay for each cubic yard that is processed and removed from the dredged material management stream. Vendoers will be responsible for covering any costs in excess of this amount (State of New Jersey~~,~~ 1998). Research to date has resulted in prospective State costs of from $28 to $35 dollars. Gross costs (including the State's costs) are estimated to be in the $45 to $120 dollar range, exclusive of dredging costs and the cost of delivery of material to innovative use vendoers (Jones~~,~~ *et al.*~~,~~ 1999; McLaughlin~~,~~ *et al.* 1999; O'Donnell and Henningson~~,~~ 1999; Rehmat~~,~~ *et al.*~~,~~ 1999). The prospective high costs, however, have prompted efforts to find lower cost approaches for application to suitable sediments, such as the applied research efforts of the USACE and the MPA regarding soil products and farm applications.

Assuming that a technology or technique is viable, a fundamental determinant of success is the ability to establish adequate markets and end uses in order to complete the transition from dredged sediment to viable innovative products or end uses. A successful technology or technique would not become a successful application unless products produced from dredged material can be effectively utilized (including the development of markets for these products) or suitable end uses can be found on a scale that would make a meaningful contribution to dredged material management. High-technology applications generally result in specialty products that have small markets. Low-technology applications generally combine lesser production costs (relative to high-technology approaches) and flexibility for small through large-scale applications such as reclamation of sand and gravel pits and strip mines (use of deep mines has not been attempted), provided that suitable properties become available. In general, end uses rather than products appear to provide the potential for larger scale applications. Uses that require deposition at a specific site, such as a gravel pit, would require a site-specific environmental evaluation to determine the site's suitability to receive the material, and environmental documentation as appropriate. Engineering design would also be required. Pertinent regulatory requirements would ~~also~~ have to be met. An economic analysis would also have to be performed to determine economic feasibility. Implementation may require the installation of offloading facilities. Use of specific sites typically would involve contractual negotiations and proprietary information. There are a considerable number of additional implementation issues that would also need to be addressed (EPA~~,~~ 1994). Even if a specific site is offered for use and appears to merit consideration, contractual rules and regulations impose requirements on procurements that may preclude consideration of such a site in environmental documentation as a possible alternative to a proposed action.

As part of long-term planning for the management of dredged material, MPA has sponsored research of potential farm applications and has announced that the agency plans to issue a request for proposals for an innovative use system with initial focus on the management of harbor sediments. The MPA has publicly stated that the agency's goal is to progressively develop a capability to innovatively use dredged sediments at a meaningful scale. The MPA has set a conceptual goal of 500,000 cy annual throughput, to the extent that this proves feasible, practicable and cost effective. If the concept proves successful, the MPA would like to expand its application significantly over the next decade~~, insofar as practicable and cost-competitive~~ as a component of the overall dredged material management program (Hamons and Young~~,~~ 1999).

The objective of the MPA's agricultural applications research is to identify which soil amendments might be needed and to determine crop suitability. Bench scale testing is currently in progress to collect and assess leachate and soil quality changes over time from both untreated and amended sediments from approach channels outside of the harbor. The germination and production of various crops are also being studied. The results of the bench testing will be applied to assess geophysical conditions that would be suitable for the placement of sediments on agricultural lands. The results of the bench tests will also be used to guide the planting, monitoring and analysis of field test plots. Bench-scale testing is also being performed for industrial and agricultural residuals which could potentially be combined with dredged sediments to produce value-added agricultural products. If the results of these experiments is favorable, a field demonstration project would be undertaken, provided that a suitable location can be identified, is made available, and is capable of being permitted under applicable rules and regulations. A site-specific evaluation would be required, as would compliance with applicable rules and regulations. Whether or not a suitable test location can be found is assessed as problematic. (A private venture to apply dredged material to two farms in Kent County encountered substantial public opposition. The proposal was withdrawn [~~(~~Hamons and Young~~,~~ 1999]).

Preliminary unpublished results suggest that up to 500,000 cy per year could be placed in an environmentally acceptable manner on farmland. Sediments would be placed in thin layers, naturally dried, and amended, with the farm returned to active agricultural production thereafter. Although this approach has been successfully accomplished in Maryland on a very small scale (Corletta and Duff~~,~~ 1997), the large-scale approach is still experimental. Whether or not sufficient farmland would become available to enable annual placements is highly uncertain. Even if a 500,000 cy annual placement potential were realized, it would take 36 years to manage 18 mcy of dredged sediments. For these reasons, farm application is not a practicable alternative to the proposed open-water placement as either a standalone option or a component of a multi-option alternative. Should the farm application concept become viable at some future date, it could be reconsidered on its merits at that time.

In addition to the MPA's farm applications research, the MPA has indicated that the agency plans to issue a solicitation that would be intended to progressively develop a capability for the innovative use of dredged sediments. The upland property adjoining the Cox Creek Dredged Material Containment Facility has been identified as potentially suitable for the siting of an innovative use system. The MPA is hopeful that "perpetual" capacity might be achieved for the Cox Creek containment cell prior to it being filled to capacity. The Cox Creek site is also envisioned as a potential staging area for both contaminated and clean dredged sediments as resources for the innovative use system (Hamons and Young~~,~~ 1999). State procurement rules and regulations preclude the MPA from discussing the specific content of its solicitation prior to its public release. Based on similar initiatives for the Great Lakes (EPA~~,~~ 1994) and for the New York Harbor area, it can be anticipated that it would take several years for initial testing and evaluation to determine whether or not or to what extent innovative uses might become practicable for managing sediment from the Baltimore Harbor and its approach channels. Inasmuch as innovative use for the port is at the initial concept stage and in consideration of the uncertainty of the marketability for products or end uses, an estimate of the potential for innovative use as a viable component of dredged material management would be speculative. Innovative use systems would therefore not constitute an alternative to the proposed open water placement. Should a significant annual capability be developed at some future date, the capability could be considered on its merits at that time relative to the dredging program.

2.3.~~11~~8 Pooles Island Open-Water

The area immediately east of Pooles Island is a natural depression that has been used for many years for open-water placement of dredged sediments ~~was identified years ago as an important placement area within the upper Bay~~. There are ~~remaining and new placement capacity of the eight~~ eleven existing and two newly designated open-water placement sites in the Pooles Island area ~~were considered as possible alternatives to Site 104~~ (Figure 1-2). Although historical placement records are incomplete, an estimated 50-55 mcy of material has been dredged from the C&D Canal approach channels in the upper Bay since the approach channels were deepened to 27 ~~feet~~ft in the mid-1930s (**CITATION**). The areas have also been used for maintenance and new work dredging of the approach channels to Baltimore Harbor. Records prior to 1965 indicate open-water placement was within about 1,500 feet of the channels. All of the presently designated sites are further from the channel than 1,500 feet, and are not known to have received dredged material prior to 1965. During deepening of the approach channels in 1965-1968, much of the material was placed within open-water sites encompassed by currently designated sites. All open-water placement of maintenance dredging material ~~since~~ from 1977 until 1998 occurred within designated Areas D, E, F, G and H. ~~The status of the various placement areas is as follows:~~

~~Areas A, B, &C: Historical placement areas with unknown original capacities; filled~~

~~Area D: Filled to capacity.~~

~~Area E: Filled to capacity.~~

~~Area F: Filled to capacity.~~

~~Area G:~~
~~South Filled to near-capacity (further investigation needed prior to any further use), now partially designated as Site 92.~~
~~North Filled to capacity.~~
~~Central Removed from open-water placement designation due to high relief fisheries habitat.~~
~~West Filled to near-capacity during 1997/1998 dredging season; < 0.5 mcy of capacity left~~
~~East New site, 1.2 mcy capacity.~~

~~Area H: Dispersive site (not used).~~

~~Site 92: New site, 3.7 mcy capacity; planned for use during 1998/1999 dredging season.~~

~~The location and general configuration of these sites is depicted in Figure 1-2. Each of the sites has been designated for the open-water placement of dredged material.~~ Two new sites, one in area G (site G-East) and Site 92 (per its designation in the MPA Master Plan), have been designated for open-water placement for the purpose of implementing the Pooles Island open-water component of the State's Strategy for Dredged Material Management (MDOT~~,~~ 1996c). These sites are close to the C&D approach channels between the Sassafras River and the north end of the Tolchester S-Turn.

The NEPA documentation and the Environmental Assessment for this placement option was completed with a "finding of no significant impact" and released to the public (MES 1997a). Both sites have predicted short-term near field impacts from disturbance to the benthic community and turbidity in the water column during placement. An estimated combined capacity of approximately 4.9 mcy was ~~is~~ initially projected for G-East ~~(1.2 mcy)~~ and Site 92 ~~(3.7mcy)~~ with limited residual capacity in some of the other sites (G-West and G-South) following the 1997-1998 dredging cycle (MES 1997a). ~~The NEPA documentation and the Environmental Assessment EIS for this placement option have been finalized was completed with a "finding of no significant impact" and released to the public (MES, 1997). Site 92 is planned for placement to the -14 foot contour. G-East is planned for placement to the -16 foot contour. Both sites have predicted short-term (<2 year) near-field (within the placement area) impacts from disturbance to the benthic community and turbidity in the water column during placement. These sites are close to CENAP and CENAB the C&D approach channels between the Sassafras River and the north end of the Tolchester S-Turn.~~ The bathymetry for Site 92 was subsequently reassessed using more recent survey data. This resulted in a revised total estimated capacity of 6.0 mcy which was available prior to first use of the site, which occurred during the 1998-1999 dredging cycle. The placement capacity for the unfilled remaining Pooles Island open-water sites prior to the commencement of the 1999-2000 dredging cycle (G-West, G-East, G-South, and Site 92) is estimated at 4.9 mcy.

Over the past several dredging cycles, relatively low flow conditions from the Susquehanna River watershed and less severe winter conditions have resulted in a lower than average dredging need for the upper Bay approach channels to the C&D Canal. Consequently, the availability of the Pooles Island open-water placement sites may be extended for a year or so beyond initial projections if average conditions prevail over the next several years. Any such extension would help compensate to a small extent for delays experienced in implementing the placement deficit that is addressed by this RDEIS and the delay experienced in the construction of Phase I of the Poplar Island restoration project. However, flood events would likely result in abnormal shoaling and an associated increase in dredging need. With respect to placement planning, flood events that result in massive delivery of sediment to the Bay cannot be predicted beyond statistical analysis of return periods. Floods which resulted in such exceptional conditions occurred in 1972, 1975 and 1996. The average dredging need used in planning was based on typical low through high flow conditions and did not take into consideration extreme events. Whether another flood will occur during the remaining estimated service life of the Pooles Island ~~sites~~ open-water sites cannot be predicted. Therefore, it is not possible to precisely estimate actual placement needs. Should such conditions develop, they would most likely result in the available capacity being used quicker than projections that are based on average conditions. Variabilities of this type are normally accounted for by a contingency to accommodate uncertainty. However, a contingency to cover an extreme event would have to be very large relative to the remaining capacity and projected service, and would not be representative of prospective near-term needs. At the same time, the potential for flood-related shoaling cannot be ignored. Given the limited remaining service life, best management of the existing capacity is accomplished through operational adjustments to projected needs based on actual conditions that are experienced.

In view of the variability in shoaling rates and dredging need that have been experienced in recent years for the C&D approach channels, it cannot be assumed with confidence that any potential capacity at the Pooles Island sites in excess of the aforementioned capacity estimates could be substituted for a corresponding portion of the placement deficit addressed by this RDEIS. The additional capacity estimated by updated surveys may or may not be needed to respond to increased shoaling during the site's projected remaining service life. If so, the

USACE can reprogram this capacity to the extent available to compensate for delays in implementing the appropriate action to provide for the dredging need ~~addessed~~addressed by this RDEIS or to satisfy a portion of the placement deficit if not fully covered by the proposed action (or other alternative).

~~2.3.12 Deep Trough~~

~~An area referred to as the The Deep Trough (located south of the Bay Bridge) (Figure 2-2) has been considered several times as a potential open-water placement site (DNPOP, 1995a,c; Gucinski and Ecological Associates, 1984; MPA, 1990; Versar, 1990a,b). The area was reconsidered as part of this DEIS to determine whether or not the Deep Trough could serve as a practicable alternative to Site 104.~~

~~The Deep Trough is part of a trench of very deep water, up to 48.8 m (160 ft) in depth, that is generally aligned along a north-south axis in the eastern center of the main stem of the Chesapeake Bay. This trench is a remnant of the ancient Susquehanna River channel when this portion of the Bay was a riverine environment. The trench is approximately 32.2 km long (20 miles) beginning offshore of Kent Island, in the vicinity of the Bay Bridge, and extending south to the mouth of the Little Choptank River. It is an area encompassed by the -18.3 m (-60 ft) MLLW depth contour which extends 32.2 km (20 miles) south from the Chesapeake Bay Bridge to a shallower sill of a depth of -18.3 m to -21.3 m (-60 ft to -70 ft) MLLW opposite the mouth of the Little Choptank River (Versar 1990). Placement capacity at the Deep Trough is estimated to exceed 100 mcy depending upon the depth of placement.~~

~~Although this trench is broadly referred to as the Deep Trough, only a portion is legally defined using the term "Deep Trough." According to Title 8, Section 8-1601, subsection (a)(6) of the Annotated Code of Maryland,~~

> ~~*"Deep Trough" means any region that: (i) Is south of the Chesapeake Bay Bridge and north of a line extending westerly from Bloody Point; and (ii) Has a depth that exceeds 60 ft* [18.3 m]."~~

~~was investigated by DNPOP as a potential site for placement of dredged material from the Baltimore Harbor outer channels (Figure 2-2). It was specified in t A field study was undertaken by the Maryland Department of Natural Resources in 1984 to determine the ecological value of the Deep Trough in that portion of the trench that had depths between 80 and 175 feet. Although there were some uncertainties due to data limitations, the study results suggested that placement of approximately 20 mcy of sediments with an increase in bottom elevation of not more than 6 meters would probably result in short-term effects of limited duration to benthos and other living resources. The potential for long-term effects from protracted placements was not studied (Gucinski and Ecological Analysts, 1984).~~

~~The Deep Trough was included in the MPA Master Plan initiative and was assessed and subsequently selected as a principal option. A draft feasibility report and an impact assessment were sponsored by the Maryland Department of Natural Resources on behalf of the MPA~~

(Versar, 1990a,b). he draft environmental assessment (EA). The draft feasibility assessment considered a demonstration placement of sediment from the Craighill Channel. The sediment that would be placed was to have a larger grain size than material that had been naturally deposited at the proposed placement site. The draft assessment reported that use of the Deep Trough for bottom placement of clean material would have the advantages of containment within this natural bathymetric features that would form a barrier to sediment migration structure as well as the lower costs associated with open-water placement (Versar, 1990a). The EA for the proposed use of the Deep Trough was prepared as a draft technical report. Concerns that were identified related to potential nutrient releases, commercial fisheries, and benthic community impacts, as well as public nuisance concerns about the possible environmental effects,. combined to result in t Consideration of the site not being was discontinued when the Master Plan investigated further for placement after 1989. was not implemented (Section 2.1.4.a). The substantial public controversy that was associated with the proposed use of the Deep Trough promoted legislation by the Maryland General Assembly. In 1991, the State legislature amended Title 8, section 8-1602 of the Annotated Code of Maryland to prohibit the placement of dredged material in the Deep Trough. According to Title 8, Section 8-1602 subsection (d):

> *"Material excavated from Bay. - A person may not dump, deposit, or scatter any earth, rock, soil, waste matter, muck, or other material excavated or dredged from the Chesapeake Bay or its tidal tributaries into or onto the area of the bottomlands or waters of the Chesapeake known as the Deep Trough."*

Use of the site Deep Trough was reconsidered under the DNPOP program in 1995 as part of efforts to develop a consensus-based plan to overcome an imminent shortfall in placement capacity. The DNPOP Management Committee requested a review and compilation of the current technical status of the Deep Trough as a placement option. Representatives of the Federal and State resource and permitting agencies were consulted in order to provide additional information to assist decision makers in determining the technical merits of Deep Trough as an option prior to coordination with the Maryland General Assembly regarding the legal issues (DNPOP, 1995a). A consensus-based study approach consisting of studies and closely controlled and monitored test placements was developed at the request of the DNPOP Executive Committee by the Bay Enhancement Phase II Working Group (DNPOP, 1995c). Subsequently, the Deep Trough was not included in the State of Maryland Strategic Plan for Dredged Material Management due to the state law prohibiting placement in this area (see below) and in response to an environmental policy decision by the Governor Parris Glendening not to further reconsider use of the site.

The available studies are dated and nonconclusive with respect to the environmental acceptability of the Deep Trough as a long-term placement option. The available data suggest that use of the site would likely result in short-term, near-field effects. The site has more than ample capacity for 18 mcy. However, the institutional constraints that apply to the Deep Trough preclude its designation by the State as a placement site. The legal prohibition essentially prevents required participation by the local sponsor. In order for this the Deep Trough to be a viable alternative, public opinion would have to force a change in the current law, the aforementioned institutional constraints would need to be modified to enable. Then, the site investigations would have to be

~~completed, culminating in the preparation of an EIS the MPA to designate the site for placement as the local sponsor and request the USACE to evaluate the site in accordance with applicable rules and regulations. Prior to use, legal prohibitions on placement would need to be removed or waived by the Maryland General Assembly.~~

~~The Deep Trough is part of a trench of very deep water, up to 48.8 m (160 ft) in depth, that is generally aligned along a north-south axis in the eastern center of the main stem of the Chesapeake Bay. This trench is a remnant of the ancient Susquehanna River channel when this portion of the Bay was a riverine environment. The trench is approximately 32.2 km long (20 miles) beginning offshore of Kent Island, in the vicinity of the Bay Bridge, and extending south to the mouth of the Little Choptank River. It is an area encompassed by the -18.3 m (-60 ft) MLLW depth contour which extends 32.2 km (20 miles) south from the Chesapeake Bay Bridge to a shallower sill of a depth of -18.3 m to -21.3 m (-60 ft to -70 ft) MLLW opposite the mouth of the Little Choptank River (Versar 1990).~~

~~Although this trench is broadly referred to as the Deep Trough, only a portion is legally defined using the term "Deep Trough." According to Title 8, Section 8-1601, subsection (a)(6) of the Annotated Code of Maryland,~~

> ~~*"Deep Trough" means any region that: (i) Is south of the Chesapeake Bay Bridge and north of a line extending westerly from Bloody Point; and (ii) Has a depth that exceeds 60 ft* [18.3 m]."~~

~~In 1991, the State legislature amended Title 8, section 8-1602 of the Annotated Code of Maryland to prohibit the placement of dredged material in the Deep Trough. According to Title 8, Section 8-1602 subsection (d):~~

> ~~*"Material excavated from Bay. - A person may not dump, deposit, or scatter any earth, rock, soil, waste matter, muck, or other material excavated or dredged from the Chesapeake Bay or its tidal tributaries into or onto the area of the bottomlands or waters of the Chesapeake known as the Deep Trough."*~~

~~Any future proposals to place dredged material in the Deep Trough will be evaluated on a project-by-project basis in accordance with the Clean Water Act Section 404 (b)(1) Guidelines and other applicable laws and regulations. Although some previous reports suggest that placement of material at the Deep Trough is environmentally acceptable and is a cost-effective dredged material placement alternative, the existing state law essentially prohibits the required participation by the local sponsor. The legally defined Deep Trough was considered as an alternative to the use of Site 104. Placement capacity at the Deep Trough is estimated to exceed 100 mcy depending upon the depth of placement. The Deep Trough is not feasible for consideration as an alternative to Site 104 because of institutional constraints.~~

2.4 —ALTERNATIVES

[REVISED SECTION UNDER DEVELOPMENT]

2.4.1 No Action

2.4.2 Open-Water Sites

2.4.2a Site 104 (Proposed Action). Open-water placement is proposed for approximately 18 mcy of dredged material from the mainstem Chesapeake Bay channels in Maryland serving the Port of Baltimore. The Maryland Port Administration (MPA) has recommended the use of Master Plan Site 104 (generally coinciding with the southern two-thirds of the site known as "Kent Island Deep") for open-water placement of approximately 18 mcy of suitable sediment beginning in 2000 or as soon thereafter to fulfill the open-water placement element of the State of Maryland's Strategic Plan. The southern border of Site 104 is located in the Chesapeake Bay approximately 1 mile north of the Chesapeake Bay Bridge (Figure 1-3). Placement is not proposed for the northern portion of Kent Island Deep, which has depths of 45 ft or less. (This latter area generally coincides with Master Plan Site 105.)

Selection of open-water placement for this NEPA investigation was based on a cooperative effort involving the U.S. Army Corps of Engineers (USACE), Baltimore District (CENAB); USACE, Philadelphia District (CENAP); the MPA, state and Federal natural resource and regulatory agencies, local governments, and environmental and public interest groups. Site 104 was one of the open-water alternatives resulting from multi-agency consultations during the Master Planning process (MPA 1989, 1990) and was identified as the most viable open-water option through multiple levels of screening by participants in the MPA-sponsored Dredging Needs and Placement Options Program (DNPOP).

CENAB developed and applied screening criteria in determining which of the options that was previously considered and which additional options would be suitable for inclusion and consideration as alternatives in this RDEIS in addition to Site 104, as discussed below.

Overview of the Proposed Open-Water Placement Project

Sediment dredging is planned from the Federally maintained navigation channels in the mainstem of the Bay and placed in open water, over a period of up to 9 years, depending upon the dredging sequence, dredging need, and other factors. These channels include the Craighill Entrance, Craighill Channel, Craighill Angle, Craighill Upper Range, Cutoff Angle, Brewerton Channel Eastern Extension, Swan Point Channel, Tolchester Channel, and the southern approach channel to the C&D Canal. Dredged material from Baltimore Harbor channels (Figure 1-1) west of the [redacted] Point to [redacted] Point line would not be placed in open water.

As set forth in 40 CFR § 230.11 (d), a determination must be made as to the degree to which dredged material will introduce, relocate, or increase contaminants within a placement area. The quality of estuarine sediment planned for dredging and placement is determined by applying the tiered testing protocol prescribed by the Environmental Protection Agency (EPA) in the Inland Testing Manual (ITM) (EPA and USACE, 1998), as discussed in Section 5.1.5.b. Sediments that are determined to be non-contaminated following the EPA protocol are characterized in this

RDEIS as "suitable" to distinguish them from contaminated sediments. As used in this RDEIS, "contaminated" dredged material means dredged material that would be classified as contaminated using the ITM protocols. Typically, these materials would be unacceptable for unconfined open-water placement in the Chesapeake Bay, although this material could potentially be placed in open water and capped.

Dredged material that lies upstream of a line legislatively drawn across the mouth of the Patapsco River between Rock Point and North Point is considered to be prohibited by State law from being placed in open waters of the Chesapeake Bay (Figure 1-2). By Code of Maryland Regulation, Title 8, Section 8-1602(a) "*A person may not ..deposit... in an unconfined manner spoil from Baltimore Harbor into or onto any portion of the water or bottomland of the Chesapeake Bay or of the tidewater portions of any of the Chesapeake Bay's tributaries outside of Baltimore Harbor.*"

Sediments proposed for placement in open water will be limited to sediments that have been determined to be suitable for open-water placement following the EPA testing protocol. Prohibited sediments from Baltimore Harbor, which are considered to be contaminated by State law, cannot be placed in any other open-water site under the jurisdiction of the State of Maryland.

Proposed Use of Site 104 for Dredged Material Placement

The MPA designated and recommended Site 104 for investigation for open-water placement. Site 104 had been ranked highest among the open-water options that were identified and technically screened through the DNPOP program.

Open-water placement proposed at Site 104 would be limited to areas deeper than the -45 ft MLLW contour interval to achieve a final site elevation of -45 ft MLLW. Based on existing contours within the proposed site, placement would occur within the site in the area south of the lighted red-and-white buoy for Love Point (RW "LP" buoy [Figure 2-1]). Two concepts were originally advanced for placement at Site 104: placement with and without a berm. **The latter included a berm to be constructed along the southern and western edge of the site if needed to minimize the potential for material to migrate from Site 104 after placement into the area defined by State legislation as the Deep Trough. Both placement approaches are discussed in this chapter.**

Historical Use of Site 104 as a Dredged Material Placement Area

Site 104 was established as a designated open-water dredged material placement area by the USACE in 1924. The site was used for that purpose from 1924 to 1975. The original site boundaries began at approximately 1.75 miles northwest of Love Point and extended 2.7 nautical miles south-southwestward along a natural deep channel to a position due east of Sandy Point Light. In 1950, the southern boundary was extended 1 nautical mile south to latitude 39°00' N. Then in 1960, the following changes were made: (1) the southern boundary was extended another 2,500 ft south to a line running parallel to and 2,000 ft north of the Bay Bridge, and (2) the southern 1.1 nautical miles of the site was widened to the west by an additional 1,000 ft. The depths along the original site axis were -70 ft to -73 ft MLLW and the added areas had depths to -95 ft MLLW.

Originally, it was intended that the site depths be raised to no higher than -50 ft MLLW; however, in September 1960 depths were raised to -40 ft MLLW in a portion of the site to provide additional placement capacity (CENAB 1997a).

2.4.2.b Site 171 Open Water.

The open area of deep water immediately west of the Swan Point ship channel was designated as Site 171 in the MPA Master Plan initiative (Figure 2-2). This site was raised as a potential open-water placement site during both the 1990 Master Plan process and the DNPOP screening process. Factors considered in the screening process included natural and cultural resources, capacity, economic feasibility, navigation safety, institutional factors (Sstate restrictions on area and timing of placement), beneficial use opportunity and public and community interests. The screening process was conducted with all Sstate and Federal resource agencies, as well as commercial and recreational interests. As an open water site, it is estimated to be able to provide up to [ ] mcy of capacity. Site 171 is also being considered as a possible location for construction of a new island containment facility so the significant resource issues associated with this site have been detailed previously (Section 2.2.3.b.2). Site 171 is also being considered as a possible location for construction of a new island containment facility.

As part of the island creation this latter effort, the suitability of Site 171 is currently being investigated by MPA for construction of a containment facility or a submerged placement island with approximately 80 mcy80-mcy capacity. The submerged island plan would place material within an underwater containment area to a final elevation of -10 feet, with sand substrate used for capping. This submerged site is listed as an open-water site, although plans would be to cap it. It has also been noted in the pre-feasibility report (MPA 1998) that an improved water quality and bottom substrate habitat could result from capping. Water depths in this area are currently -24 to -26 feet. Although the existing benthic communities are stressed, the site supports some commercial fisheries harvests in winter. Hydrodynamic modeling of this site is currently being conducted to assess the potential impacts to regional current dynamics. Two potential concerns are that island construction could impact larval fish distributions and salinity. Concerns over potential impacts to ship handling in the adjacent channels have also been raised.

An open water site would be available after placement in the short-term (after permitting). The estimated time to complete the permitting for this site is 3-5 years. The costs associated with developing this option are [ ].

2.4.2.c Worton Point Open Water.

2.4.2.d Shad Battery Shoal.

2.4.2.e Ocean Placement.

2.4.2.f Deep Trough.

An area referred to as the Deep Trough (located south of the Bay Bridge) (Figure 2-2) has been considered several times as a potential open-water placement site (DNPOP 1995a,c; Gucinski and Ecological Associates 1984; MPA 1990; Versar 1990a,b). The area was reconsidered as part of this RDEIS to determine whether or not the Deep Trough could serve as a practicable alternative to Site 104.

The Deep Trough is part of a trench of very deep water, up to 48.8 m (160 ft) in depth, that is generally aligned along a north-south axis in the eastern center of the main stem of the Chesapeake Bay. This trench is a remnant of the ancient Susquehanna River channel when this portion of the Bay was a riverine environment. The trench is approximately 32.2 km long (20 miles) beginning offshore of Kent Island, in the vicinity of the Bay Bridge, and extending south to the mouth of the Little Choptank River. It is an area encompassed by the -18.3 m (-60 ft) MLLW depth contour which extends 32.2 km (20 miles) south from the Chesapeake Bay Bridge to a shallower sill of a depth of -18.3 m to -21.3 m (-60 ft to -70 ft) MLLW opposite the mouth of the Little Choptank River (Versar 1990). Placement capacity at the Deep Trough is estimated to exceed 100 mcy depending upon the depth of placement.

Although this trench is broadly referred to as the Deep Trough, only a portion is legally defined using the term "Deep Trough." According to Title 8, Section 8-1601, subsection (a)(6) of the Annotated Code of Maryland,

> *"Deep Trough" means any region that: (i) Is south of the Chesapeake Bay Bridge and north of a line extending westerly from Bloody Point; and (ii) Has a depth that exceeds 60 ft* [18.3 m]."

A field study was undertaken by the Maryland Department of Natural Resources in 1984 to determine the ecological value of the Deep Trough in that portion of the trench that had depths between 80 and 175 ft. Although there were some uncertainties due to data limitations, the study results suggested that placement of approximately 20 mcy of sediments with an increase in bottom elevation of not more than 6 m would probably result in short-term effects of limited duration to benthos and other living resources. The potential for long-term effects from protracted placements was not studied (Gucinski and Ecological Analysts 1984).

The Deep Trough was included in the MPA Master Plan initiative and was assessed and subsequently selected as a principal option. A draft feasibility report and an impact assessment were sponsored by the Maryland Department of Natural Resources on behalf of the MPA (Versar 1990a,b). The draft feasibility assessment considered a demonstration placement of sediment from the Craighill Channel. The sediment that would be placed was to have a larger grain size than material that had been naturally deposited at the proposed placement site. The draft assessment reported that use of the Deep Trough for bottom placement of clean material would have the advantages of natural bathymetric features that would form a barrier to sediment migration as well as the lower costs associated with open-water placement (Versar, 1990a).

Concerns that were identified related to potential nutrient releases, commercial fisheries, and benthic community impacts, as well as public concern about the possible environmental effects. Consideration of the site was discontinued when the Master Plan was not implemented (Section 2.1.4.a). The substantial public controversy that was associated with the proposed use of the Deep Trough promoted legislation by the Maryland General Assembly. In 1991, the State legislature amended Title 8, section 8-1602 of the Annotated Code of Maryland to prohibit the placement of dredged material in the Deep Trough. According to Title 8, Section 8-1602 subsection (d):

> *"Material excavated from Bay. - A person may not dump, deposit, or scatter any earth, rock, soil, waste matter, muck, or other material excavated or dredged from the Chesapeake Bay or its tidal tributaries into or onto the area of the bottomlands or waters of the Chesapeake known as the Deep Trough."*

Use of the Deep Trough was reconsidered under the DNPOP program in 1995 as part of efforts to develop a consensus-based plan to overcome an imminent shortfall in placement capacity. The DNPOP Management Committee requested a review and compilation of the current technical status of the Deep Trough as a placement option. Representatives of the Federal and State resource and permitting agencies were consulted in order to provide additional information to assist decision makers in determining the technical merits of the Deep Trough as an option prior to coordination with the Maryland General Assembly regarding the legal issues (DNPOP, 1995a). A consensus-based study approach consisting of studies and closely controlled and monitored test placements was developed at the request of the DNPOP Executive Committee by the Bay Enhancement Phase II Working Group (DNPOP 1995c). Subsequently, the Deep Trough was not included in the State of Maryland Strategic Plan for Dredged Material Management in response to an environmental policy decision by Governor Parris Glendening not to further reconsider use of the site.

The available studies are dated and nonconclusive with respect to the environmental acceptability of the Deep Trough as a long-term placement option. The available data suggest that use of the site would likely result in short-term, near-field effects. The site has more than ample capacity for 18 mcy. However, the institutional constraints that apply to the Deep Trough preclude its designation by the State as a placement site. The legal prohibition essentially prevents required participation by the MPA. In order for the Deep Trough to be a viable alternative, , the aforementioned institutional constraints would need to be modified to enable the MPA to designate the site for placement as the local sponsor and request the USACE to evaluate the site in accordance with applicable rules and regulations. Prior to use, legal prohibitions on placement would need to be removed or waived by the Maryland General Assembly.

Any future proposals to place dredged material in the Deep Trough will be evaluated on a project-by-project basis in accordance with the Clean Water Act Section 404 (b)(1) Guidelines and other applicable laws and regulations The Deep Trough is not feasible for consideration as an alternative to Site 104 because of institutional constraints.

1982-1983 Studies

The Deep Trough was extensively studied in the early 1980s as part of an assessment related to a proposal to place up to 25 million yards of dredged material from maintanence and deepening of the approach channels. Dissolved oxygen (DO) depletion was found to occur during the summer months throughout the Deep Trough. At depths between 30 and 60 ft, the waters would be considered oxygen stressed with concentrations < 5 ppm. The Deep Tough was found to become completely anoxic during the summer months at depths greater than 60 ft. The areas proposed for dredged material placement are in waters which are greater than 60 ft in depth. Material would be placed in an average thickness of 5 ft.

Stratification occurs during the summer months and little oxygen is transferred below the pycnocline (the boundary[something missing here]

Benthic community organisms are significantly affected by the summer low DO concentrations. During the 1982 studies, DO concentrations in bottom waters remained at 0.0 ppm. This resulted in near elimination of all benthic organisms during the summer period. Recolonization by pioneer species such as polychaete worms was noted by November, followed by a mollusk (*Mulinia lateralis*) in February. Total recovery to an expected normal diversity or density (when compared to shallow reference areas) never occurred.

Finfish populations were found to be moderately abundant during the winter months when both dissolved oxygen and availability of food organisms were favorable. The dominant juvenile species were Atlantic croaker and menhaden. The seasonal occurrence in the Deep Trough is is likely related to the timing of their migrations through the area and possible overwintering. In addition, blueback herring, alewife, and American eel use the general area during winter months. Spawning of Bay Anchovy occurred in the spring, but the Trough is not considered a significant spawning area for any finfish species. Utilization of the deepest waters occurred during the winter months when lower temperatures resulted in DO concentrations >5 ppm.

Most fish species, however, use the Trough as a migration route to more northern waters. The utilization of the Trough was found to be highly seasonal and limited in summer months by higher temperatures, low to non-existent dissolved oxygen, and lack of food source. Bottom fish were virtually absent during summer months. Fish abundance and diversity were very low in summer and significantly higher in winter. Commercial fish such as striped bass and white perch were present in the area but inconsistently from year to year. In the winter sampling of 1982-1983, virtually no striped bass or white perch were caught.

Blue crabs were found to be very low in number during most of the year, but lowest in summer. The Trough was found not to be a significant habitat for blue crabs.

The Deep Trough is not considered a significant habitat for either finfish or blue crabs. While winter utilization by finfish does occur, the overall ecological value is restricted to fall and winter and to only a limited number of species. It is also not considered a significant spawning area.

REFERENCES?? NEED MORE CURRENT ONES IF THEY EXIST.

Site Impacts

The environmental impacts of placement of dredged materials from the approach channels into the Deep Trough are both physical and chemical. Toxic effects are not expected due to the similarity of the channel sediments to those already in the site. Particle sizes and moisture content of the materials are virtually identical to those currently present in the Deep Trough. This comparison was made in the early 1980s and would be considered the same today. The main difference between the nature of the materials to be dredged today is that they are cleaner. The nutrient concentrations are expected to be similar. The direct physical effects would be smothering of existing benthic communities.

Winter Placement

If the placement occurred during the winter months, short-term impacts upon finfish and blue crabs would be expected. The smothering of that year's benthic community would also occur. Recovery of the community (to the limited extent that it would recover normally) would not occur until all placement had ceased. The Trough is not, however, considered a significant source of food for migrating fish at any time of the year.

Nutrient impacts would be expected to be minimal and potentiation of phytoplankton densities would be minimal because of low temperatures and limited migration of deep waters to the surface 10 m depths. Displacement of anoxic waters would be minimal since the winter DO concentrations are typically >7.0 ppm. Placement would decrease the average depth by 5 ft. No significant raising of the minimum depth of anoxic waters would be expected, therefore.

Summer Placement

Summer placement (which is not likely because of general restrictions on time of year placement throughout the Bay) would have little effect upon the benthic community since it is virtually eliminated anyway due to natural anoxia below 60 ft. Finfish and blue crab populations would not be significantly affected since they are not found in the deeper portions of the Trough during summer months. Short term nutrient effects above the pycnocline (the boundary, usually at 15-20 ft deep, formed by salinity and temperature gradients) might occur, although this would be expected to relate to dispersion of nutrients during initial dumping and not from movement from the bottom after placement. The depths of the Trough are such that there would be significant dispersion of nutrients released from anoxic sediments during the summer months when phytoplankton effects might be expected to occur. Some short-term increases in turbidity at the surface would reduce light penetration slightly and tend to inhibit phytoplankton growth. Some minor upwelling of deoxygenated water might occur on a very short-term basis when the dredged material displaced water at the bottom of the trough.

There would not be any environmentally significant long term effects of dredged material placement at the Deep Trough site.

2.4.3 Existing Sites

2.4.3.a South Cell of HMI.

Hart-Miller Island South Cell Reconstruction and Reactivation. Use of the South Cell was discontinued in 1990 after it was filled to near capacity. The south cell is currently being developed for environmental restoration and passive recreation under a provision of Section 1135, Water Resources Development Act of 1986. To facilitate habitat development in the 300-acre South Cell, the last 3.1 m (10 ft) of dredged material was suitable channel material from outside of the harbor. The south cell is under the day-to-day management of MES, which is providing these services under the terms of an Interagency Agreement with the MPA in support of an intergovernmental agreement between the MPA and the Maryland Department of Natural Resources (MDNR). MDNR is responsible for habitat and recreational development of both cells.

The South Cell crust management and grading program has been underway since October 1990 to prepare a foundation for habitat and passive recreational development. Other actions taken to prepare the cell include management and discharge of rainwater to facilitate consolidation of the crust, phragmites eradication and control measures including controlled burns, and vegetative test plots. The 300-acre south cell is currently at +22 ft MLW average elevation.

Most of the South Cell's upland tier dike was excavated for use in the north cell dike raising. Sand that had previously been placed within the South Cell and stockpiled was mined as a resource for reconstructing the North Cell dike to an elevation of +44 ft MLLW, discussed below. The North Cell dike raising motivated legislation by the Maryland General Assembly requiring substantial development of the south cell for recreation and habitat within 5 years. The law also prohibited the south cell from receiving any more dredged material. The same legislation mandated that the dike system could not be raised higher than +44 ft, that placement into the North Cell must be completed by the end of calendar year 2009, and that the cell was to be substantially developed for recreation and habitat within 5 years of closure (Annotated code of the Public General Laws of Maryland, Environmental Article, § 16-202 (e)(1)(ii)).

The State requested that CENAB conduct a Section 1135. CENAB performed the study with the MPA as the local sponsor. The study has identified several approaches for providing ponds, wetlands and uplands that would provide important habitat for migratory birds (CITATIONS).

CENAB subsequently examined the south cell to determine if it could serve as an alternative to open-water placement. As discussed in Annex E, the south cell dike system could be reconstructed in stages to a final elevation of approximately 44 ft. With optimal lifts of approximately 1.3 mcy3 per annual dredging cycle and aggressive crust management, the cell could hold approximately 14 mcy of dredged material

The cost of reconstructing the south cell and the cost of operating the south cell for placement of 18 mcy of sediments would be approximately $XXXX million, or about $X.XX per cubic yard.

Inasmuch as Hart-Miller Island is a state facility, all reconstruction and operations costs would be the responsibility of the state.

Use of the south cell would result in nutrient releases at approximately the same rate as for an equivalent amount of sediment in the north cell (see Section **X.X.X**). As the facility already exists, there would be no conversion of Bay bottom. The existing vegetation in the cell, which has begun a natural transition from phragmites domination to various indigenous species, would be covered if the cell is returned to active placement operations. The State and Federal investments in initial preparation of the cell for conversion to wildlife habitat and recreation would be lost.

The MPA is constrained from making the cell available for reconstruction because of a commitment made to the public by the Maryland Department of Transportation to accelerate the development of the south cell for habitat and recreation. Furthermore, it would be illegal for a State agency to reactivate the cell for placement because of the aforementioned State law. The Maryland General Assembly, having only recently established this law, is unlikely to reverse itself. For this latter reason, reconstruction and reactivation of the south cell is not viable as a dredged material placement alternative.

Use of Existing North Cell Capacity. The approximately 800-acre north cell was increased in elevation to 14.6 m (+44 ft) MLW by the MPA in 1997. With optimal crust management and consolidation, an estimated 24 mcy of capacity will remain following inflow operations during the 1998-1999 dredging cycle. Eventually, the entire site will be converted to habitat and passive recreation in compliance with State law after dredged material placement ceases in the year 2009. The 21 mcy of capacity that is still available in the north cell has been programmed to receive various maintenance and new work dredging projects over the remaining service life of the project. The potential remaining capacity following crust management during Summer 2000 would be approximately 19.5 mcy, depending upon environmental conditions.

CENAB examined the north cell to determine if it could serve as an alternative to open-water placement. As discussed in Annex E, the north cell dike system was reconstructed and increased in elevation to +44 ft MLLW. State law prohibits the dike from being increased above +44 ft in elevation. Although there is a limited potential to further increase the north cell dike elevation, this is not a viable option under existing state law. The Maryland General Assembly, having only recently established this law, is unlikely to reverse itself. In this regard, recent legislative sessions have seen continuing efforts to continue to impose additional constraints on placement options.

The north cell can only receive an annual maximum of 2.5 mcy without overburdening. The available capacity is being programmed for Harbor sediments that are unsuitable for open-water placement, insofar as practicable. However, other placement needs have been programmed to HMI to correspond with dredging needs . CENAB's analysis of dredging needs indicates that there is no excess capacity available in the north cell. Diversion of material planned for open-water placement would not only be substituted for other existing needs, but would also result in a reduction in the north cell's ability to receive dredged material, as described below.

Operational records for the HMI facility document the ability to dewater and consolidate sediments in order to reduce sediment volume and regain a portion of used placement capacity. The operating history indicates that placement of quantities in excess 2.5 mcy would result in water being trapped between the crust prior to placement and the crust that forms following placement. This would have the effect of reducing the facility's overall capacity, because the state law that mandates a closure date does not allow time for a hiatus in placement operations to enable extended crust management operations to offset any overburdening. The prospective potential outcomes of overburdening the site would therefore be a shortened service life because the site would be filled more quickly, inadequate time available between placements for optimal dewatering and consolidation, and a reduction in the north cell's overall capacity. The resulting reduction in the north cell's optimal capacity would exacerbate the placement deficit that the proposed action under investigation by the RDEIS is intended to relieve.

The diversion of additional sediments to HMI would therefore result in one or a combination of (1) substituting sediments dredged from one location for another without resolving the underlying placement need, (2) an increase in the placement capacity deficit through overburdening, and (3) deferral of planned dredging due to lack of capacity. In view of the preceding analysis, use of the existing capacity of the north cell is not a viable alternative.

2.4.3.b C&D Canal Upland Sites. **[CENAB TO REVISE AND UPDATE THIS SECTION]**

There are currently 17 Federal upland sites along the C&D Canal designated for dredged material placement (Figure 2-6). These sites are strategically located to accommodate certain channel reaches within the C&D Canal and the northern portion of the approach channels. Periodic expansion of these sites has been necessary to accommodate maintenance needs of those channel reaches. Placement site capacity expansion is presently needed to accommodate existing C&D canal channels. The sites have limited capacity at present, and are in the process of being investigated for jurisdictional wetland delineation by CENAP. After this evaluation is complete, availability of these sites as placement options would not occur for 4-6 years. Use of these sites for the CENAB or CENAP southern reaches would reduce the long-term potential of these sites for the channel reaches they now serve. Furthermore, the required pumping distances and elevations make use of these sites for reception of materials from the southern CENAB and CENAP reaches uneconomical and inefficient from both fiscal and engineering standpoints (MDOT 1996c; MPA 1996).

2.4.4 New Containment Options

2.4.4.a Hart-Miller Island Expansion.

Hart and Miller Island is an existing state-owned confined placement facility located at the mouth of Back River in the Upper Chesapeake Bay. The facility is currently utilized for dredged material placement from the Baltimore Harbor channels. The proposed alternative would involve the extension of the existing dikes either to the east or to the south to encompass approximately 700 acres. There are three basic options for expansion of the existing HMI facility.

Option 1 would involve extending the dikes to the east. This would result in an elongated cell or cells bounded on the west by the existing eastern dike of the existing facility and on the north, east, and south by new dikes. Average depths in the vicinity of the proposed new eastern dike alignment average between -15 and -18 feet MLW. The capacity would be increased by up to up to 20-mcy depending upon the area encompassed and the height of the dikes. The existing facility currently encompasses 1140 acres in two cells, with a projected final capacity of approximately 85-mcy. The north cell is at elevation +44 feet MLW, while the south cell is limited to +22 feet MLW. Any extension to the east would likely be restricted to the +22 feet unless the south cell restriction is modified by law. This option would incorporate the existing dike and would be adjacent to an area already affected by dredged material placement. It would not affect the view from the mainland, an issue raised with respect to the existing facility. Noise effects would be minimized since construction activities would be buffered by the existing facility. For all options, construction would be easier because of the presence of the existing dike, which would function as access and material transport. If the existing off loading facility could continue to be used, no additional access channel would be needed for movement of the dredged material to the facility.

Construction of Option 1 would eliminate existing clean Bay bottom and aquatic habitat. Reef effects presently related to the eastern dike of the existing facility would be temporarily lost during construction but would return once the new eastern dike had been completed.

Option 2 would be expansion to the south of the existing facility and would extend the dikes to Pleasure Island. This would be a longer and narrower configuration than Option 1, and would increase capacity up to 15-mcy. Average depths in the area are between +5 and –12 feet MLW. Depths along the eastern dike alignment are between –8 and –12 feet MLW. The actual capacity would vary depending upon the length of the expansion. It would, however, utilize the existing southern dike of the HMI facility and would utilize the upland of Pleasure as the footprint for the new western dike. This would be a more costly configuration than Option 1.

As with Option 1, the second option would eliminate existing clean Bay bottom and aquatic habitat. Reef effects presently related to the southern dike of the existing facility would be temporarily lost during construction but would return once the new southern dike had been completed. Existing recreation on Pleasure Island would be interrupted and modified. The existing flow through the channel between HMI and Pleasure Island would be eliminated. Since the major flow out of Back River is to the northeast on the west side of Pleasure Island, this should have minimal effect upon the flushing characteristics of Back River. Since a portion of Pleasure Island would be used for the base of the western dike, there would be losses of tidal wetlands and potentially terrestrial habitat. The upland habitat could be mitigated through the development of new habitat on the diked facility following completion of dredged material placement. The view from the mainland would be affected by this option since it would involve construction of a new dike along the eastern edge of Pleasure Island and between Pleasure and the existing HMI facility.

Option three would be the combination of Options 1 and 2, which would result in the greatest capacity, but also the greatest, relative impact. This combination would cover approximately 1100 acres, would result in up to 50-mcy capacity, and would be the most cost effective.

The construction of any of these options would increase the area for passive recreation and/or beneficial habitat development. It would eliminate recreational and commercial fishing in the area of construction, but these would be expected to shift to the east following completion of the dikes. I addition, any of the expansion options would be in violation of current agreements between the citizens and government of Baltimore County and MPA. This agreement states that no new island dredged material placement site shall be constructed within a five-mile radius of the existing HMI facility.

The cost for this option would range between $2 - $3 per cu. yd.

2.4.5 Beneficial Use

2.4.5.a Poplar Island Wetland Cell Conversion to Upland.

2.4.5.b
Modification of the Authorized Poplar Island Project

The project at Poplar Island could be modified to allow additional capacity. This could be accomplished by laterally expanding the island, elevating one or more of the upland cells, replacing one or more of the wetlands cells with upland cells, or a combination of all three.

Lateral expansion would involve the creation of a new cell(s) for containment of dredged material. Expansion to the north is limited by a poor foundation condition. Expansion to the west is limited by a natural oyster bar. Expansion to the east is limited by the potential for submerged aquatic vegetation. As part of the planning process for the Poplar Island project, a 1,340-acre alternative was investigated and eventually dropped due to cost considerations. This alternative is similar to the current project for Poplar Island, except that the southern portion of the project follows the –8-foot MLLW contour, expanding the island footprint by 230 acres. To maximize capacity, the expansion should be entirely upland. This yields an additional capacity of 12.7 mcy. Because the area of placement has increased, both the overall capacity and the optimum annual placement capacity will increase. An additional 14,000 lf of containment would be required, and this option is expected to cost approximately $75 million. The unit cost would be about $6/cyd.

A second option would be to raise the western upland dikes to allow additional capacity. The raising would be accomplished using sand obtained from a borrow site immediately south of the project on either side of the approach channel, or sand generated by channel dredging work. Current capacity in the two upland cells is about 32 million cubic yards. Each foot of elevation of the dikes will result in an additional 1.2 mcy of capacity. To meet the expected dredged material placement need of 18 mcy, the elevation of the two upland cells would have to be raised from +20 MLLW to +35 MLLW. Because the area of placement will not increase for this option, the overall capacity will increase, but the optimum annual placement capacity will remain the same. In other words, the additional capacity will be gained by extending the life of the project instead of increasing the amount that can be placed at the site in any given year. The cost to raise the dikes the initial 10 feet from +10 MLLW to +20 MLLW was estimated to be about $3.7 million. Raising them an additional 15 feet to +35 MLLW would cost about $5.6 million. Transportation costs for the 18 mcy of dredged material would be about $45 million. The total estimated cost for this option, $50.6 million, results in a unit cost of about $3/cyd.

A third option is to raise the dikes on one or more of the wetland cells. The total capacity for the four wetlands cells are about 6.3 mcy. Raising the dikes on the wetland cells from +8 MLLW to the presently proposed upland elevation of +20 MLLW will result in an additional 3.4 – 6.9 mcy of additional capacity. To meet the 18mcy capacity shortfall, all four dikes would have to be raised to +20 MLLW, providing additional capacity of just over 21 mcy. Raising the dikes to +20 MLLW is expected to cost about $4.5 million. The transportation cost for the 21 mcy of dredged material would be about $52.5 million. The total cost of about $57 million equates to a unit cost of about $3/cyd. Such an option would compromise the proposed wetland habitat. However, because the area of placement has increased, both the overall capacity and the optimum annual placement capacity will increase.

P:\Federal\DOD\ARMY\projects\6095793\NewDraft\Revised DEIS\Chapter_02\Poplar Island.doc

2.4.5.c Holland Island.

2.4.5.d Sparrows Point Habitat Development.

A 300-acre habitat development project was planned for the eastern end of Sparrows Point in Baltimore County (Figure 2-7). The project was planned to establish a habitat enhancement project contiguous to industrial shoreline by converting relatively poor bottom to aquatic and intertidal wetlands, high marsh, and upland nesting areas in order to benefit living resources. The habitat that would have been created was also envisioned as providing aesthetic relief for the entrance to the harbor. An estimated 10 mcy of capacity was projected. The MPA investigated use of this site, with preliminary conceptual designs and pre-feasibility environmental studies. Preliminary engineering determined that a project at the site was feasible. However, poor foundation conditions would necessitate highly specialized construction techniques in order to "float" a structure to enclose the site (GBA et al. 1992; Hamons and Young 1999; MES and MPA 1993). An environmental study determined that the area's biological productivity was similar to that of other areas inside the harbor, but less productive than the Bay (MES 1995a).

Institutional difficulties exist from the prohibition in current state law for construction of a containment facility within a 5 mile radius of the Hart-Miller-Pleasure Island chain. Although the proposed project was intended to improve habitat, it nevertheless would have required the water area to be fully enclosed because of site-specific conditions. Attempts on behalf of the

MPA to secure citizen support for the beneficial use project and for a revision to the law were not successful. Local citizens, citing past filling of open-water in the area by Bethlehem Steel, objected to any further conversion of open-water in the area (Hamons and Young 1999). In the absence of support for removal of the institutional constraint associated with this project, habitat development has been maintained as a DNPOP option but efforts to implement the project have been suspended indefinitely. The existing institutional constraint is considered a fatal flaw for this option, and it is not feasible or practicable as an alternative to the proposed action.

2.4.6 Island Placement Site

~~2.2.3.b.2 Proposed Upper Bay Island Long-Term Placement Site~~

The possibility of developing a new containment island was revisited under the DNPOP beginning in mid-1995. This possibility received additional emphasis as a result of the Joint Chairman's Report from the 1996 legislative session in Maryland, which required a report on the development of a plan for a dredged material placement island as a possible alternative to the second phase of the Poplar Island restoration project (MDOT 1996b). The Joint Chairman's Report required MDOT to "identify two or more sites in the Upper Chesapeake Bay for the development of artificial islands with sufficient capacity to meet the anticipated needs of the Port for at least 20 years (MDOT 1996b)."

The MPA, with technical and coordination assistance from the MES and advice of DNPOP participants, used its existing list of placement options to identify and conduct a preliminary multidisciplinary screening of possible island sites. Screening criteria included capacity, natural resources sensitivity, technical feasibility (based upon geotechnical and engineering evaluations), and practicability (based upon costs in association with engineering constraints). [Of the sites that were identified and screened by the DNPOP Bay Enhancement Phase II Working Group, all of the sites except Site 170 were advanced to prefeasibility studies by the MPA following presentation to the DNPOP Management, Citizens and Executive Committees. Site 170 was removed from short-term consideration due to concerns about prospective adverse hydrodynamic effects on circulation in the lower Patapsco River, Baltimore Harbor, Rock Creek, and Stony Creek. *CAN WE STILL SAY THIS????].* The goal of the upper Bay containment islandUpper Bay Containment Island is to provide between 50 and 100 mcy of placement capacity. The general locations of five potential areas for island creation are listed below and are presented in Figure 2-3:

- Tolchester West (vicinity of Gales Lumps)
- Site 168 (old placement site at the intersection of the Brewerton Extension and Tolchester Channels)
- Site 171 (Swan Point West)
- Pooles Island area
- Site 170 at the mouth of the Patapsco River - (evaluated but not advanced to prefeasibility phase study)

The information presented in the following sections was developed during the prefeasibility investigation of the above-listed sites by MPA in 1997 and 1998 (MPA 1998). Prefeasibility investigations were based largely on existing information, although some site-specific substrate and water quality information was collected. [Preliminary Hydrodynamic modeling was conducted for all sites, but in-depth hHydrodynamic investigations of all proposed island configurations are ongoing. Is this still true??]. All would involve dike construction construction, which that is a significant infrastructure constraint in the near-term.

All of the proposed sites lie north of the Bay Bridge but south of Worton Point. The Bay within this reach is oligohaline or mesohaline. Water quality from the two Chesapeake Bay Program stations within this reach (MCB3.1 and MCB2.2) indicate that anoxic or hypoxic conditions can be expected in the deeper areas of this reach during the warmer months. Similar to other deep areas of the Bay, nitrogen concentrations (particularly ammonium) tend to decrease with increasing temperature until anearobic nutrient cycling allows for increased releases to the water column. Phosphorus concentrations in this reach tend to peak in fall and early spring. These conditions can be expected in any of the deeper water areas considered for island construction. The shallower areas within this reach (i.e., those <2 meters) tend to remain oxygenated throughout the year and provide high value living resources habitat (for fish and shellfish) in the warmer months. Some deeper areas have been shown to be significant overwintering areas for resident and semi-anadromous fish species. Male blue crab overwintering can be expected in some of the deeper areas, but is more prevalent south of Swan Point. Site- specific engineering considerations and resource issues are detailed below.

~~Tolchester West Island Creation Site~~

~~This site was included in the DNPOP planning as a possible site for construction of an island containment facility and was subsequently advanced to the pre-feasibility study phase. The estimated capacity as a containment facility is approximately 80 my. This is among the shallower sites considered for island creation and is the site of a prehistoric island. The bottom substrates are sandy and the benthic community demonstrates little apparent signs of stress. The site is near a significant recreational fish haven (Gales Lump Reef). The site probably supports soft-shell clams. This site is currently within a 5-mile radius of Hart-Miller Island (HMI), and current sState law would thus preclude construction. This site is adjacent to the Tolchester Channel and concerns related to hydrodynamic impacts on channel traffic are being investigated in the pre-feasibility studies. It is expected that construction of this potential site, if sState law preclusions were removed, could take approximately 7 to14 years based upon whether or not an accelerated implementation process were feasible.~~

~~Site 168 Island Creation Site~~

~~The area immediately north of the Brewerton Extension at the intersection with the Tolchester Channel was previously used as a placement site for material dredged from the Brewerton Extension (Figure 2-3) and is being considered for dredged material placement. This general area was previously designated as Site 168 and was considered as a possible open-water placement site under the DNPOP program, but was dropped from consideration for open-water~~

~~placement because it had never been used, and there was no natural depression to aid in materials containment and the strong tidal currents in the area would likely move material into the adjacent channels. As an open-water site, it would have a relatively low capacity due to the average depths, and would lose the potential for island development. It is estimated to have about an 80 mcy80 mcy capacity if used as the location for a new containment island. Water depths in the area range from -4.9 to 8.5 meters (-16 to -28 feet) MLLW. There are weak foundation soils and a soft to very soft substrate that could make construction less practicable. No significant fisheries are known to exist in the project area. The existing benthic community is stressed due to periodic summer anoxia and poor substrate. This site provides significant commercial fishing opportunities in winter, although hypoxia makes it unsuitable as fish/crab habitat during most summers. This is considered a long-term site for dredged material placement that would take approximately 7 to 14 years based upon whether or not an accelerated implementation process was feasible.~~

~~Pooles Island Area Island Creation Site~~

~~There are currently three potential configurations at Pooles Island that are being evaluated as part of the Prefeasibility Study for Upper Bay Island Placement Sites. Two of these configurations are attached to the island, and one is removed and to the south. The two configurations that are attached to the island would be 825 to 1475 acres in size; the site which issite that is removed from Pooles Island ranges in size from 680 to 780 acres. The capacity of each site would be 80 mcy for the connected sites, and 40 mcy for the site that does not connect to the island. Water depths in the area under study range from -1.2 to -10.4 meters (-4 to -34 feet). Two of the configurations are completely removed from the APG designated area while one site does partially lie within the APG boundary.~~

~~The majority of the sites are underlain by soft substrates that would require removal and thus higher site development costs. Unexploded Ordnance (UXO) areis likely to be present in all sites. Dike construction over areas containing UXO would be a slow and costly process. If any UXO is buried or encapsulated by placement activities, there is a potential that it would have to be removed at a later time involving additional costs and uncertain responsibilities. Because APG is currently an National Priority List (NPL) site for hazardous wastes, any party that places dredged material placement in the area would likely be considered a potentially responsible party (PRP). This potentially implicates all parties that place material in the area to future hazardous waste mitigation actions under CERCLA.~~

~~The sites attached to the island have terrestrial, historical, and archeological resources of value and rare threatened, or endangeredRTE species on or near the project area that could potentially be impacted by placement activities. Although Pooles Island is south of the Sstate designated striped bass spawning grounds, areas near the island have been identified by APG and USFWS environmental managers as providing fish spawning and juvenile fish habitat, although a winter placement window could reduce the potential for impacts. Pooles Island also supports a heronry as well as nesting habitat for many other bird species. The area is also known to provide significant waterfowl habitat, particularly in fall/winter. It is anticipated that an island site near Pooles Island would take 7 to14 years to develop based upon whether or not an accelerated~~

implementation process was feasible.

Site 171 Island Creation Site

The open area of deep water immediately west of the Swan Point ship channel was designated as Site 171 in the MPA Master Plan initiative (Figure 2-3). Site 171 was included in DNPOP program planning as a possible site for construction of an island containment facility and was subsequently advanced to the prefeasibility study phase. As part of this latter effort, the suitability of Site 171 for construction of a submerged placement island is also being considered. The estimated capacity as a containment facility is approximately 80 mcy. Capacity as a submerged island of up to approximately 80 mcy has also been considered, with varying acreages. A submerged island is a partially contained mound of material that stops at -4 m (-12 ft); the concept may include a beneficial use component as the benthic environment is currently impacted by poor sediment quality and water quality due to seasonal anoxia. This site provides significant commercial fishing opportunities in winter, although hypoxia makes it unsuitable as fish/crab habitat during most summers. This site is not within a 5-mile radius of Hart-Miller Island (within which no dikes can currently be constructed under Sstate law), and would not currently be precluded by law for creation of a containment facility. Hydrodynamic modeling is being conducted on this site, and others, to determine if unacceptable hydrodynamic and water quality changes could result from construction of an island or a submerged island in this location. It is expected that further environmental study, permitting, funding funding, and construction of this site would take approximately 7 to14 years based upon whether or not an accelerated implementation process was feasible previous projects (HMI).

Site 170 Island Creation Site

Site 170, previously described, was considered as a possible location for a containment island under the DNPOP program (Figure 2-3). Use for containment is estimated to result in an approximate capacity of 80 mcy. This site was dropped from further consideration due to a combination of hydrodynamic concerns, as the site was seen as likely to reduce the cross-sectional area of Patapsco River and inhibit circulation in the Harbor and nearby tributaries. [Can we still say this?????]. The location could also affect navigation near the Harbor entrance.

2.4.6 Island Placement Site

The possibility of developing a new containment island was revisited under the DNPOP beginning in mid-1995. This possibility received additional emphasis as a result of the Joint Chairman's Report from the 1996 legislative session in Maryland, which required a report on the development of a plan for a dredged material placement island as a possible alternative to the second phase of the Poplar Island restoration project (MDOT 1996b). The Joint Chairman's Report required MDOT to "identify two or more sites in the Upper Chesapeake Bay for the development of artificial islands with sufficient capacity to meet the anticipated needs of the Port for at least 20 years (MDOT 1996b)."

The MPA, with technical and coordination assistance from the MES and advice of DNPOP participants, used its existing list of placement options to identify and conduct a preliminary multidisciplinary screening of possible island sites. Screening criteria included capacity, natural resources sensitivity, technical feasibility (based upon geotechnical and engineering evaluations) and practicability (based upon costs in association with engineering constraints). [Of the sites that were identified and screened by the DNPOP Bay Enhancement Phase II Working Group, all of the sites except Site 170 were advanced to prefeasibility studies by the MPA following presentation to the DNPOP Management, Citizens and Executive Committees. Site 170 was removed from short-term consideration due to concerns about prospective adverse hydrodynamic effects on circulation in the lower Patapsco River, Baltimore Harbor, Rock Creek, and Stony Creek. *CAN WE STILL SAY THIS????]*. The goal of the Upper Bay Containment Island is to provide between 50 and 100 mcy of placement capacity. The general locations of five potential areas for island creation are listed below and are presented in Figure 2-3:

- Tolchester West (vicinity of Gales Lumps)
- Site 168 (old placement site at the intersection of the Brewerton Extension and Tolchester Channels)
- Pooles Island Area
- Site 170 at the mouth of the Patapsco River - (evaluated but not advanced to prefeasibility phase study)
- Site 171 (Swan Point West)

The information presented in the following sections was developed during the prefeasibility investigation of the above-listed sites by MPA in 1997 and 1998 (MPA 1998). Prefeasibility investigations were based largely on existing information, although some site-specific substrate and water quality information was collected. Preliminary Hydrodynamic modeling was conducted for all sites, but in-depth hydrodynamic investigations of all proposed island configurations are ongoing. All would involve dike construction, which is a significant infrastructure constraint in the near-term.

All of the proposed sites lie north of the Bay Bridge but south of Worton Point. The Bay within this reach is oligohaline or mesohaline. Water quality from the two Chesapeake Bay Program stations within this reach (MCB3.1 and MCB2.2) indicate that anoxic or hypoxic conditions can be expected in the deeper areas of this reach during the warmer months. Similar to other deep areas of the Bay, nitrogen concentrations (particularly ammonium) tend to decrease with increasing temperature until anaerobic nutrient cycling allows for increased releases to the water column. Phosphorus concentrations in this reach tend to peak in fall and early spring. These conditions can be expected in any of the deeper water areas considered for island construction. The shallower areas within this reach (i.e. those <2 meters) tend to remain oxygenated throughout the year and provide high value living resources habitat (for fish and shellfish) in the warmer months. Some deeper areas have been shown to be significant overwintering areas for resident and semi-anadromous fish species. Male blue crab overwintering can be expected in some of the deeper areas, but is more prevalent south of Swan Point. Site specific engineering considerations and resource issues are detailed below.

2.4.6.a. Tolchester West Island Creation Site

This site was included in the DNPOP planning as a possible site for construction of an island containment facility and was subsequently advanced to the pre-feasibility study phase. The estimated capacity as a containment facility is approximately 80 my. This is among the shallower sites considered for island creation (10 to 16 feet) and is the site of a prehistoric island. Due to the shallow depths, the site has more living resources habitat value than deeper sites that can become anoxic during part of the year. Prelimenary results of the hydrodynamic investigations of this site indicated that it would cause the least overall changes in regional hydrodynamics of all options considered.

The bottom substrates are sandy and the benthic community is fairly diverse and demonstrates few apparent signs of stress. The site is near a significant recreational fish haven (Gales Lump Reef) . The site probably supports soft-shell clams. The proposed site is currently within a 5-mile radius of Hart-Miller Island (HMI), and current state law would thus preclude construction. This site is adjacent to the Tolchester Channel and concerns related to hydrodynamic impacts on channel traffic are being investigated in the pre-feasibility studies.

It is expected that construction of this potential site, if state law preclusions were removed, could take approximately 10 to14 years based upon whether or not an accelerated implementation process were feasible. Foundation materials in this area were among the best of all island sites considered which makes it among the most technically feasible of the island options. The total costs to develop construct this option are 62-70 million dollars. With transportation costs, his option would be 552 to 562 million dollars with an average cost per cubic yard of placement ranging from $7.91 to $7.05.

2.4.6.b. Site 168 Island Creation Site

The area immediately north of the Brewerton Extension at the intersection with the Tolchester Channel was previously used as a placement site for material dredged from the Brewerton Extension (Figure X-X) and is being considered for dredged material placement. This general area was previously designated as Site 168 and was considered as a possible open-water placement site under the DNPOP program. It was, however, dropped from consideration for open-water placement because it had never been used and there was no natural depression to aid in materials containment and the strong tidal currents in the area would likely move material into the adjacent channels. Prelimenary results of the hydrodynamic modeling of the islands indicated that this site would have the greatest potential to increase salinity in the upper reaches of the Bay. It also would create the greatest sheer stresses of all options which could be problematic for navigation and local erosion. As an open-water site, it would have a relatively low capacity due to the average depths, and would lose the potential for island development. It is estimated to have about an 80-mcy capacity if used as the location for a new containment island.

Water depths in the area range from –4.9 to 8.5 meters (-16 to -28 feet) MLLW. There are weak foundation soils and a soft to very soft substrate that could make construction less practicable. The existing benthic community is stressed due to periodic summer anoxia and poor substrate.

This site provides significant commercial fishing opportunities in winter, although hypoxia makes it unsuitable fish/crab habitat during most summers.

This is considered a long-term site for dredged material placement that would take approximately 10 to 14 years based upon whether or not an accelerated implementation process was feasible. Due to the foundation conditions, the estimated initial construction cost would be 184 to 199 million dollars. Within dredging and transport costs of 459 million dollars, the total cost to implement this option would be 669 to 685 million dollars (8.37 to 8.54 per cy).

2.4.6.c. Pooles Island Area Island Creation Site

There are currently three potential configurations at Pooles Island that are being evaluated as part of the Prefeasibility Study for Upper Bay Island Placement Sites. Two of these configurations are attached to the island, one is removed and to the south. The two configurations that are attached to the island would be 825 to 1475 acres in size; the site that is removed from Pooles Island ranges in size from 680 to 780 acres. The capacity of each site would be 80 mcy for the connected sites, and 40 mcy for the site that does not connect to the island. Water depths in the area under study range from –1.2 to –10.4 meters (-4 to -34 feet). Two of the configurations are completely removed from the APG designated area while one site does partially lie within the APG boundary. [Can we say anything about the hydrodynamics of the area?????]

The majority of the sites are underlain by soft substrates that would require removal and thus higher site development costs. Unexploded Ordnance (UXO) is likely to be present in all sites. Dike construction over areas containing UXO would be a slow and costly process. If any UXO is buried or encapsulated by placement activities, there is a potential that it would have to be removed at a later time involving additional costs and uncertain responsibilities. Because APG is currently a National Priority List (NPL) site for hazardous wastes, any party that places dredged material placement in the area would likely be considered a potentially responsible party. This potentially implicates all parties that place material in the area to future hazardous waste mitigation actions under CERCLA.

The sites attached to the island have terrestrial, historical, and archeological resources of value and rare threatened, or endangered species on or near the project area that could potentially be impacted by placement activities. Although Pooles Island is south of the state-designated striped bass spawning grounds, areas near the island have been identified by APG and USFWS environmental managers as providing fish spawning and juvenile fish habitat, although a winter placement window could reduce the potential for impacts. Pooles Island also supports a heronry as well as nesting habitat for many other bird species. The area is also known to provide significant waterfowl habitat, particularly in fall/winter. It is anticipated that an island site near Pooles Island would take 10 to14 years to develop based upon whether or not an accelerated implementation process was feasible.

Due to the substrates and depth of the water access, the two proposed island configurations would have moderate to high initial construction costs. Site 4A (east of Pooles Island) would cost approximately 283 to 316 million dollars to construct. With transportation costs, this option would total approximately 766 to 800 million dollars ($9.52 to $9.97 per cy). Costs for development and use of Site 4B (attached to the Southern portion of Pooles Island) would range from 165 to 213 million for construction with total costs of 663 to 712 million ($8.28 to 8.93 per cy). The smaller (40 mcy) configuration proposed for the area south of Pooles Island would have among the highest implementation costs of all options ($10.56 to 10.82 per cy).

2.4.6.d. Site 170 Island Creation Site

Site 170, previously described, was considered as a possible location for a containment island under the DNPOP program (Figure X-X). Use for containment is estimated to result in an approximate capacity of 80 mcy. This site was dropped from further consideration due to a combination of hydrodynamic concerns, as the site was seen as likely to reduce the cross-sectional area of Patapsco River and inhibit circulation in the Harbor and nearby tributaries. [Can we still say this?????]. The location could also affect navigation near the Harbor entrance.

MES to provide update......

2.4.6.e Site 171 Island Creation Site

The open area of deep water immediately west of the Swan Point ship channel was designated as Site 171 in the MPA Master Plan initiative (Figure X-X). Site 171 was included in DNPOP program planning as a possible site for construction of an island containment facility and was subsequently advanced to the prefeasibility study phase. As part of this latter effort, the suitability of Site 171 for construction of a submerged placement island is also being considered. The estimated capacity as a containment facility is approximately 80 mcy. Capacity as a submerged island of up to approximately 80 mcy has also been considered, with varying acreages. A submerged island is a partially contained mound of material that stops at –4 m (-12ft); the concept may include a beneficial use component as the benthic environment is currently impacted by poor sediment quality and water quality due to seasonal anoxia. This site provides significant commercial fishing opportunities in winter, although hypoxia makes it unsuitable fish/crab habitat during most summers. This site is not within a 5-mile radius of Hart-Miller Island (within which no dikes can currently be constructed under state law), and would not currently be precluded by law for creation of a containment facility. Preliminary results of the hydrodynamic modeling for this site indicates that it would create the largest decreases in salinity in the upper reaches of the Bay of all sites modeled

It is expected that further environmental study, permitting, funding and construction of this site would take approximately 10 to14 years based upon whether or not an accelerated implementation process was feasible previous projects (HMI). As an island option, this site would cost approximately 307 to 320 million dollars to construct. The estimated costs to implement this option as a containment island would be among the highest of all island options ($10.05 to 10.26 per cy). As a submerged island the construction costs would be relatively low (89 million dollars) an the total costs for implementation are estimated to be approximately $7.17 per cy.

2.4.7 Combination of Smaller Sites (Holland, Bodkin, Artifical Reefs, Parsons, Cox Creek)

[More Discussion Here]

Cox Creek Dredged Material Containment Facility

The Cox Creek Dredged Material Containment Facility (DMCF) is located approximately 1 mile south of the Francis Scott Key Bridge, on the west bank of the Patapsco River, near Foreman's Corner in Anne Arundel County, Maryland (Figure 2-6). The two cells were originally constructed under contract to CENAB in the 1960's for the containment of dredged material from the deepening of the Baltimore Harbor Federal channels from -11.9 m (-39.0 ft) to -12.8 m (-42.0 ft). The MPA has acquired the cells and plans to renovate the facility for the placement of an additional 6 mcy of maintenance dredged material from the Inner Harbor channels.

Maintenance dredged material targeted for placement in open water will originate from the upper Bay channels located outside (east) of the North Point to Rock Point line. Placement of suitable dredged material from Bay Channels at Cox Creek would limit its further use for placement of contaminated dredged material from Inner Harbor channels. As placement options for sediments from Inner Harbor channels are much more limited, filling Cox Creek with clean Bay channel material is not a prudent commitment of resources. In addition, site configuration will limit placement to a maximum of 500,000 cy per year to optimize its capacity over a planned 12-year service life.

The CSX containment cell was constructed in the early 1960s, and was used periodically by non-Federal interests for dredged material placement throughout the 1970s. The site was purchased by the State of Maryland in July 1993. The cell was previously permitted for placement of material obtained from dredging operations in the Patapsco River and Baltimore Harbor areas. The area of the dredged material placement cell is 72 acres. Its dikes have been raised periodically throughout its use and presently have a height of +6.1 m (+20.0 ft) MLLW. The last reported use of the site for the placement of dredged material was in 1984; it has been part of the MPA's long-term planning for dredged material management since 1979.

The Cox Creek containment cell, as it was formally known, is bordered on the west by the former Cox Creek Refining Company upland property (now owned by the MPA) and on the east by the Patapsco River. The cell is surrounded by dikes that are presently at a height of +4.9 m (+16.0 ft) MLLW. The site was originally developed in the mid-1960's. Although the cell has not been actively used as a placement site since that time, it has been part of the MPA's long-term planning for dredged material management since 1979. Roughly 15 acres of the Cox Creek containment cell is occupied by an existing pond that was determined not to be jurisdictional wetlands under Federal rules and regulations. The pond receives water in the form of precipitation and stormwater runoff from the Cox Creek upland adjacent to the pond property. The pond is not open to tidal interaction; it is served by a spillway that is passively discharging into the Patapsco River. The stormwater system has been rerouted so that it no longer discharges into the pond.

Harbor sediments may not be placed in open water, but may be placed in containment facilities. Currently, the Hart-Miller Island DMCF is the only facility that is able to receive contaminated sediments. The combined capacity of the CSX/Cox Creek cells and Hart-Miller (which also receives sediments from outside of the harbor for which other placement capacity is not available and which is prohibited by State law from receiving material after 2009) is not sufficient to accommodate all of the dredged material from the harbor during the next 20 years. For these reasons, the capacity at CSX/Cox Creek must be reserved for harbor sediments. This site is not suitable as an alternative due to the relatively low capacity and the need to dedicate the available capacity for Inner Harbor sediments.

Section 3

Decision Making Process

3.1 GENERAL SITE SELECTION PROCESS

Environmental evaluation is a preliminary decision making part of the NEPA process that must precede any decision concerning project selection by Federal agencies. CENAB has determined that the proposed action would constitute a major Federal action requiring preparation of an EIS. In addition to the evaluation being performed in this DEIS, CENAB and CENAP, and the MPA have been involved in at least three major state-sponsored dredged material placement area planning efforts since 1986. These efforts have been conducted to identify suitable placement options through screening level evaluations. In these processes, which were discussed in Section 2, environmental, technical, economic, and capacity needs have been evaluated to rate or rank sites that warrant further evaluation and study.

The MPA is currently pursuing various additional options for the continued management of dredged material through its DNPOP program. The program is a multidisciplinary, interorganizational program that was formed by MPA, with assistance from the MES, as a medium for implementing the 1991 Task Force recommendations. The objective of the program is to identify and develop short-term to long-term dredged material placement options for the Port of Baltimore and its approach channels. The DNPOP program is described in Section 2.

CENAP and CENAB are each working closely with the MPA to develop multiphased studies called DMMP for each District. The objective of each study is to identify placement capacity for the next 20 to 50 years. Plan formulation was initiated in Federal Fiscal Year 1995 and will include consideration of all dredging maintenance and construction of Federal projects, as well as state and private projects. The studies will stress long-term solutions and beneficial uses of dredged material rather than the short-term needs that could be satisfied by some of the sites evaluated in this EIS, and will take advantage of the prior planning and evaluations as a resource.

3.2 SECTION 404 GUIDELINES

Section 404(b)(1) guidelines indicate that no discharge of dredged or fill material will be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences. Further, for non-water dependent projects, a less damaging upland practicable alternative is presumed to exist, and it must be proven that such alternatives do not exist. Consequently, less damaging practicable alternatives that do not include placement of material within waters of the U.S. must be examined. An alternative is considered practicable if it is available and capable of being done after taking into consideration, cost, existing technology, and logistics in light of overall project purpose.

NEPA requires that the Federal government, in conjunction with assistance from the public and state agencies, identify those environmental, social and economic impacts that might occur should a proposed project be implemented. NEPA requires that USACE, as the implementing

Federal agency, rigorously explore and objectively evaluate reasonable alternatives. In addition, for each alternative that was eliminated from further detailed study, USACE is required to discuss the reason that the alternative was eliminated. NEPA requires the evaluation of the environmental impacts of all alternatives including the proposed action and any adverse consequences that cannot be avoided if the proposed action is implemented.

3.3 PUBLIC INTEREST REVIEW

Corps policy and guidance emphasize that opportunities for public involvement and agency coordination must be provided during the planning stages of a project. In addition, Corps guidance supports many Federal regulations requiring close coordination among all levels of government and natural resource management agencies. USACE public involvement activities are a distinct requirement; however, state-sponsored DNPOP activities were used as a resource. The purpose of USACE public involvement and agency coordination for the Site 104 project is to ensure that all factions of the public would have timely access to information about the project and be able to influence decisions about the study and, ultimately, the recommended plan. In conformity with these aims, a public involvement program was developed early in the Site 104 project to outline the program objectives, a tentative program schedule, and the products desired from the program. The program included a variety of public involvement techniques, such as newsletters, public meetings, and comment cards, and extensive agency coordination, including a Site 104 Working Group and other outreach groups sponsored by the MPA.

3.3.1 Working Group Meetings

The Site 104 Working Group was comprised of representatives from Federal, state, and local natural resource regulatory and management agencies and commercial and recreational fishing interests. Agencies represented include the U.S. Environmental Protection Agency (USEPA), U.S. Fish and Wildlife Service (USFWS), National Marine Fishing Service (NMFS), Maryland Department of the Environment (MDE), Maryland Department of Natural Resources (MDNR), Maryland Geological Survey (MGS), Chesapeake Bay Program (CBP), Maryland Waterman's Association (MWA), Upper Bay Charter Boat Captains Association (UBCBCA), Maryland Charter Boat Association (MCBA), and the Maryland Saltwater Sportfishing Association (MSSA), in addition to the MPA, MES, and the Baltimore and Philadelphia Districts of the Corps of Engineers.

The group met regularly and members served as points of contact for the agencies and organizations they represented. The purpose of the group was to provide input into the planning process from an agency and professional perspective. The meetings included discussions and presentations on the status of the study. In addition, the MPA and MES met with the commercial fisheries representatives in February 1997.

3.3.2 Public Notice

A Notice of Intent (NOI) to prepare as draft EIS was prepared for the project and published in the Federal Register on July 9, 1997. Prior to the NOI, a meeting notice was published in the Federal Register on July 1, 1997. In addition to the Federal Register publications, approximately 500 copies of the NOI were mailed to individuals, offices, and agencies on the USACE Baltimore District's mailing list. The NOI, as well as the meeting notice, included information about the study and about the scoping meetings that were held on July 15, 17, and 22 at Chestertown, Centreville, and Annapolis, Maryland, respectively.

3.3.3 Public Workshop Process

Public workshops were held at several stages of the study. At each stage of the study a set of three workshops was held in Queen Anne's, Kent, and Anne Arundel Counties in order to provide information about the study to residents throughout the area that would be most affected by the project, and to solicit input from the public. The meetings at each stage of the study were planned to be identical in format and information presented, however, the format of each meeting was modified to appropriately respond to the questions and concerns of meeting attendees. The numbers of attendees at the meetings was fairly small; however, each meeting produced numerous questions, comments, and suggestions.

Scoping meetings were held on July 15, 17, and 22, 1997, at Chestertown, Centreville, and Annapolis, Maryland, respectively. A separate scoping and information meeting with representatives of commercial and recreational fishing organizations was also held on July 28, 1997, at Centreville. A second set of meetings was held on March 24, 25, and 26, 1998, at Stevensville, Annapolis, and Chestertown, Maryland. The purpose of the March meetings was to present the results of field investigations and technical studies that were done to date to characterize the site and predict the potential effects of placing material at Site 104. Lists of the questions and comments made at the meetings are in Annex A.

3.3.4 NEPA Coordination

Coordination with Federal, state, and local agencies has proceeded in compliance with NEPA regulations and Corps policy. Early formal and informal coordination was completed at the project initiation and continued throughout the study. Copies of pertinent agency correspondence are included in Annex C.

3.4 COMPLIANCE TABLE

For a placement site to be environmentally acceptable, the location, plan and operation must be in compliance with a suite of environmental protection statutes and executive orders. As part of the NEPA process, the applicable environmental laws and statutes were reviewed relative to the proposed placement plan and are discussed in detail in Section 10.

Section 4

Description of Proposed Action

4.1 SITE 104

Site 104 is a previously used open water dredged material placement area located in the Chesapeake Bay, just north of the Chesapeake Bay Bridge. The recommended plan for reuse of Site 104 is described in this section along with recommended operational and monitoring requirements. These recommendations have been based upon the results of (1) a combination of literature search and review and (2) field, laboratory, and modeling studies developed specifically to analyze the existing conditions and potential impact of this proposed action.

The reuse of the Site 104 open water dredged material placement area would consist of the placement of approximately 18 mcy of sediments to be dredged from channels located outside Baltimore Harbor, east of the Rock Point/North Point line. The State of Maryland's Strategic Plan proposes 5 years of placement as shown in Table 4-1 (Depending on actual annual need, these volumes and timeframes may vary significantly from year to year; and may occur in non-successive years or may occur less or more than 5 years within the planned 1-9 year window).

It is anticipated that a Record of Decision (ROD) could be made regarding the proposed action in September 1999.

Dredged material placed at the site will only be taken from the Craighill Entrance Channel, the Craighill Channel, the Craighill Upper Reach, the Craighill Angle, the Cutoff Angle, the Brewerton Eastern Extension Channel, the Swan Point Channel, the Tolchester Channel, and the southern approach channels to the Chesapeake and Delaware Canal. No material will be taken to the site from channels within Baltimore Harbor. This Proposed Action does not include construction of a berm at the site (Section 2.2.4.g). The berm option was rejected as an alternative because researchers believed that the berm would not significantly improve off-site drift of materials and would be costly to construct (Section 6.1.3.1).

4.1.1 Site Design

Dredged material is to be placed no higher than a final elevation of -13.7 m (-45.0 ft) MLLW and completely within the site boundaries as defined in Section 5.1.1, "Setting." The contractors would be required to use a differential global positioning system (DGPS) to ensure that the material is placed in the intended area. If needed to improve bottom conditions for commercial fishing and elevation control, some smoothing or leveling of the Site 104 bottom contours by dragging a heavy metal bar is to be performed upon completion of the 5 years of planned placement at the site. Dragging may also be performed after the completion of annual placements if needed to ensure that the maximum elevation is not exceeded.

4.2 SITE MANAGEMENT

Table 4-1
Currently Proposed Dredged Material Placement Schedule

Placement Year	Volume
1	2.5 mcy
2	4.5 mcy
3	3 mcy
4	6 mcy
5	2 mcy
Total	**18 mcy**

If a decision is made to place dredged material at Site 104, a site management plan must be developed. This section presents information which will be used for developing site management guidelines for the designated operations. USACE will have management authority over the dredging contractor during placement of material at Site 104 and for some of the monitoring. The implemented site management plan will be developed in coordination with Federal and state resource and regulatory agencies, the local sponsor, and the public. The purpose of the site management plan is to ensure that project operations are conducted to minimize any potential impacts to the environment and to human use of the area. Additional information may be found in Section 4.2.3 Site Management Plan.

4.2.1 Dredging and Placement Methods

The following presents a description of the equipment and placement techniques, best management dredging, and material placement practices that are proposed for use on the action.

4.2.1.a Dredging Methods. Historically, contract specifications for maintenance dredging of the channels targeted for dredged material placement at Site 104 and other sites have not required specific methods for removal of sediments. Rather, equipment has been selected at the discretion of the dredging contractor. Mechanical dredging with a clamshell bucket has been the most common method for removal of material in these channels in recent years. Hopper dredges were used prior to 1975 and hydraulic pipeline dredges have also been used, but in limited circumstances. The selection of dredging equipment and the method used to perform the dredging depends on several factors including: the physical characteristics and quantities of the material to be dredged, the dredging depth, distance to the placement area, the physical environment of the dredging and placement areas (such as depth of water versus the draft of the dredge and/or scows), method of placement, production required, types of dredges available, and costs (EPA/USACE 1992).

Mechanical dredging will generally introduce less water into the material being dredged than hydraulic excavation. Stiffer material (less water content) is less likely to spread or be stripped during placement, subsequently resulting in less impact to the water column at the site. However, the eventual impact from placement of material at Site 104 is driven more by the method of placement employed at the site than by the initial material removal techniques. Conditions that vary significantly from site to site, such as project geometry, sediment types, and disposition play a more significant role in the selection of dredging methods. Therefore, it is not recommended that requirements for the dredging method be placed on the contractor unless there is a compelling reason to do so.

4.2.1.b Placement Methods. Dredged material is generally placed at open water placement locations by mechanical means via bottom- release scows or hopper dredges or through hydraulic placement means. All of these methods, including combinations of these methods, have been used for placement of material in the Chesapeake Bay in recent years. The selection of placement equipment and methods depends upon factors such as the distance between the dredging and placement areas, the characteristics of the placement site and the material to be placed, production requirements, equipment availability, potential environmental impacts, and costs. Modeling efforts performed by Waterways Experiment Station (WES) (1999) were designed to evaluate potential impacts resulting from both hydraulic and bottom-release placement of material at Site 104. The modeling studies focused on placement methods using bottom-release scows and hydraulic unloading of a barge or scow through a pipeline to a location close to the bottom surface to limit material dispersion.

Both techniques were found to be viable options for material placement at Site 104. Split-hull scow placement of material is a more common placement method and would likely yield a higher production rate, require less material handling, and be less costly than the alternate method of hydraulic unloading of a scow through a pipeline to a location close to the bottom surface. The hydraulic placement method, however, was found to result in less erosion in the model and would therefore result in less turbidity in the water column. Information concerning the results of the modeling of impacts from the two placement techniques described above are discussed in Section 6.1.3.g.

Mechanical and hydraulic methods for material placement at the site are described below. Placement locations and schedules have been evaluated through use of the modeling studies described in Section 6.1.3. The following sections provide descriptions of the various mechanical and hydraulic placement methods available.

Mechanical Dredging

Mechanical placement of material at Site 104 was modeled as placement from split hull scows. Scows and barges are large flat-bottomed container vessels pushed/pulled by tugboats; these vessels vary in size depending upon availability and location of the dredging operation. Dredged material scows likely to be used range in size from 3,000 to 6,000 cy. The 4,000 cy scow used for the modeling effort is a typical, medium sized scow that holds approximately 3,600 cy of dredged material (scows will not be filled to 100% to preclude overflow of material during loading, transporting, and unloading operations). The scows will be moved from the dredging sites to the placement site by tugs, which generally have on-board power of 1,500 horsepower (hp) to 3,000 hp. Multiple scows are assigned to service each dredge to minimize "down" time for the dredge. In other words, for maximum operational efficiency, as a full scow leaves the dredge, an empty scow should just have returned from the placement site. Loaded scows are to travel through designated channels to reach Site 104.

The total round trip, from the channels to the site and back, ranges from 2 to 70 nautical miles depending on what channel is being dredged. The rate of speed should range from 5-10 knots, depending upon the tugs, and scows utilized, vessel traffic, currents, and weather. Travel speeds of the tugs and associated scows are reduced to about 1 knot upon arrival at the designated placement location and during placement of the material. Round trip time would range from 1 to 10 hours. Additional equipment, which might typically be on site, would include a survey/crew boat, a fuel scow, a crane scow, and at least two tugs to move the dredge and scows.

Hydraulic Dredging

Hydraulic placement of dredged material at Site 104 was modeled as hydraulic pump out of a scow through a pipeline to locations near the site bottom. Use of this method would limit material dispersion during placement. This method is a much more expensive option with greater human safety concerns during operations, because it requires additional equipment to be stationed in or near Site 104 during the entire dredging operation, and the method is more human-resource-intensive.

Dredged material could also be brought to Site 104 in a scow and pumped into the site. Though rehandling of dredged material is inefficient, pumping dredged material from a scow is a possible option. The most common method used in the area is to use a hydraulic unloader, similar to a hydraulic dredge, to introduce slurry water from the Bay into the scow and pump the material out of the scows. Another method is to suspend a pump from a crane, place the suction end of the pump into the material in the scow and the discharge end into the site. This method requires that the material be slurried by the introduction of water into the scow sediment for transport, and offers only low production rates.

Some specialized equipment has been developed such as a smaller hydraulic marine excavator with pump out capability. The excavator backhoe transfers material from the scow to a pump intake onboard the dredge, where an automated water injection system slurries the material for pump transport to the site. The production capacity of this system is also relatively low, ranging from 100 to 300 yd^3 per hour.

It may also be possible to pump dredged materials directly to the site from the source. However, the distance from the dredging site to Site 104 restricts this method to the closer channels. Distances to Site 104 from some reaches of the southern approach channels of the C&D Canal may exceed 30 nautical miles. Pipeline transport of material from these distances is not economically feasible for most projects. Dredged material within a cost-effective pumping distance of Site 104, such as the Craighill Entrance Channel and Swan Point Channel, could be pumped directly to the site.

The hydraulic discharge pipe in either scenario could be a floating line that would be repositioned at a constant pace using a small boat or anchor lines to direct the discharge flow as desired. In some situations, however, a floating line could obstruct existing channels. A submerged line, or a line held neutrally buoyant at a specified depth above the bottom, could also be employed to minimize dispersion of sediments being placed at the site.

A diffuser can be installed on the end of the discharge pipe to reduce slurry velocity. Various diffuser configurations are available, but generally the dredged slurry is directed against a baffle plate or through a larger diameter pipe, or both. During hydraulic placement, it would be beneficial to direct the flow toward the bottom.

Any of these variations of hydraulic placement methods would be chosen to minimize resuspension and to prevent loss of material from the site boundaries while dredged material is pumped into the site.

4.2.2 Time-of-Year Restrictions

An annual placement window of approximately 15 October through 15 April has been identified for use of Site 104, in an attempt to limit the release of nutrients and to limit potential adverse impacts to aquatic and benthic organisms, and to the commercial and recreational fisheries within Site 104 and its surrounding environment. This window was set primarily to limit water quality impacts related to release of phosphorus during hypoxic water quality conditions. Table 4-2 presents a summary of the critical life stage periods of species that potentially occur in the Site 104 region and the use of the site by both commercial and recreational fisheries. Also depicted are the natural changes in salinity, water temperature, dissolved oxygen, phytoplankton blooms, and periods of hypoxia that could magnify impacts if material were placed during the placement period indicated. Each of these items was evaluated in depth. The details of these evaluations are presented in Section 5 and Section 6. Placement operations might also be affected by weather conditions. The annual window requires dredging and placement of dredged material at Site 104 during periods of harsh weather, particularly during the winter months when cold temperatures, ice, and Northeasters make towing difficult. Dredge captains and tug captains will have the final say as to whether they will risk continuing to dredge and make placement trips during adverse operating conditions, although the contracting officer's representative may direct against venturing out in rough water conditions.

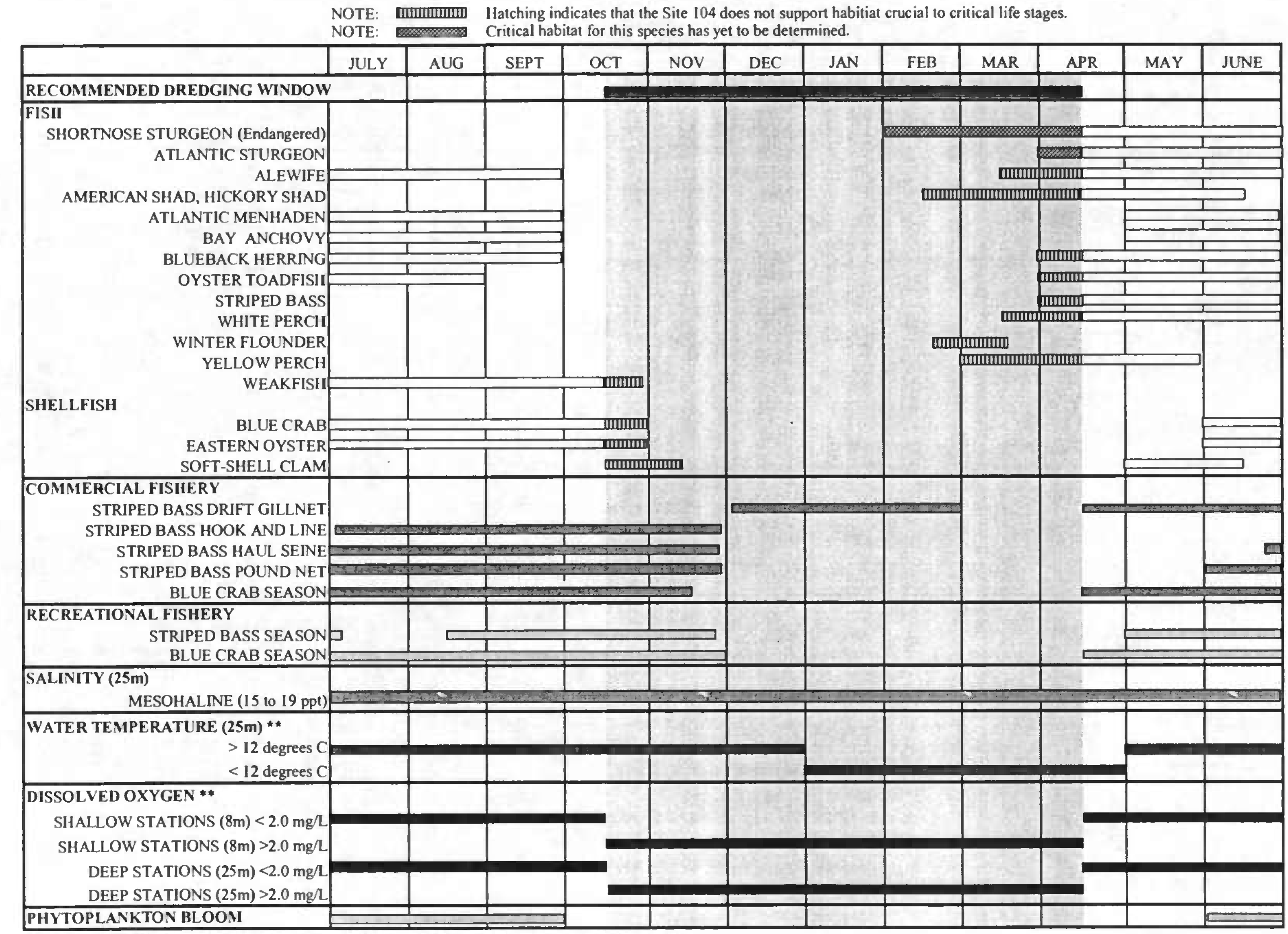
If approved, the 2000 Federal fiscal year dredging season could be targeted as the first year of material placement at Site 104.

4.2.3 Site Management Plan

Site management plans are developed to outline standard operating procedures specific to projects, helping to ensure safe and effective site operations. For the open-water placement of dredged materials at Site 104, the site management plan should: (1) provide guidelines for placement of material at the site, (2) specify operating requirements for circumstances where controls are necessary, (3) detail plans for meeting restrictions imposed by permits, (4) provide for monitoring of site performance, and (5) detail actions to be taken or respond to monitoring results.

Table 4-2: SITE 104 Open-Water Placement Area
Critical Life Stages, Fishing Seasons, and Pertinent Environmental Data

Overlaid with the Recommended Dredging Operations Window (Oct.15 - Apr. 15)



* Data from Habitat Requirements for Chesapeake Bay Living Resources (Funderburk *et al*, 1991) & Setzler-Hamilton 1987

** Data from MDE Chesapeake Bay Program Stations MCB3 3C,E and W 1984-1997

Site management plans usually require regular documentation of site operations. Through periodic review of site documentation and data, site management plans can be updated, revising procedures for better site performance. For Site 104, material placement during the first year would be planned conservatively for the center of the proposed site with actual data gathered during monitoring dictating the need and magnitude of operational controls during subsequent years of placement.

4.2.3.a. Material Placement Guidelines. Material placement guidelines will be designed to minimize resuspension and dispersion of sediment placed at the site, and to ensure that material is placed according to designated locations and depths within the placement site. Placement plans will be developed prior to each year's dredging based upon recent bathymetric and site condition surveys, and the results of past monitoring.

Sampling of the expected types of materials to be placed at the site will also play a role in the annual plan development. The physical characteristics of the material could influence the chosen method for placement, the placement locations within the site, and the placement timing including the placement year, time of year, and/or time of day. For example, since coarse-grain material is less erodible than fine-grained material, the contracting officer may choose to have the contractor place dredged material from certain locations which contain coarser-grained material by mechanical means. More fine-grained dredged material would be placed by hydraulic placement directly to the site bottom. The dredging operation will be monitored to ensure that specific minimum performance criteria are met. Those criteria will include, but will not necessarily be limited to, (1) verification of dredging and placement depth by periodic bathymetric soundings, (2) use of specified routes for travel between the dredging and placement sites, and (3) verification of dredging and placement location using data from electronic navigation systems. The first criteria will be performed by the Baltimore District or under contract. The second and third criteria will be incorporated into the dredging contract. The contractor will be required to provide the contracting officer with position data in a format and on a schedule specified for the dredging content.

It will be the responsibility of the dredging contractor to ensure that these criteria are satisfied. Verification of compliance with critical operating criteria by a designated representative or agent of the contracting officer through use of an electronic "silent" inspector will ensure that the project will proceed in a responsible manner. Results of these compliance reports will be documented in site operation reports.

Interim surveys of the work sites should be performed frequently by the USACE. These surveys would indicate the disposition of the placed material. Survey data will provide vital information to the contracting officer, will allow the opportunity for plan revisions, and will provide for the proper planning of future placement operations.

4.2.3.b Operational Controls. The principal objective of defining and implementing operational controls on the placement activities is to minimize the opportunity for sediment resuspension and dispersion during the placement process, while maximizing operational efficiency and safety. The specific control methods that are employed will depend on the dredging and placement techniques that are implemented. Control techniques specific to Site 104 may include: (1)

contractually requiring that the placement operations meet specific minimum environmental performance standards and environmental windows; (2) including, as part of the contract documents, the requirement for submittal and implementation of project specific plans: Accident *Prevention and Site Emergency Plan, Environmental Protection and Turbidity Control Plan, Dredging Equipment Plan & Schedule, Quality Control Plan, and Diving Plan*; (3) placing of marker buoys to identify routes or designated material placement locations, and (4) use of a Differential Global Positioning System (DGPS) with capability to identify and document location of material placement, (5) inspectors to verify placement location; (6) requiring the dredging contractor(s) to meet specific minimum competency and experience requirements; and (7) supplying notifications to U.S. Coast Guard, navagation, fishing, and boating interests of dredge and scow locations and movements.

Contract documents are used to clearly and equitably define the operational expectations and requirements as they pertain to the contractor. The contract documents will define the quantities, locations, types of materials to be dredged, and the water quality standards and other environmental requirements that must be met. The required location and elevations for the dredged material for placement at Site 104 will be clearly defined. Proper location, materials, and acceptable tolerances will be clearly defined in the specifications for this project.

The dredging contractor, under the terms of a performance-based contract, will execute the project. This means that the operation must satisfy specific performance standards during all operations. Dredged material placement must be performed to the specified lines and must be performed in such a manner as to control turbidity levels. If these criteria or standards are not achieved, the contracting officer will be obligated by contract to require the contractor to alter the method of operation or cease operations until the required standards are met.

4.2.3.c Monitoring Requirements. Monitoring will be undertaken to confirm predicted potential impacts to the surrounding environment and to assist in managing the site. Section 9 of this document presents details of the Monitoring Framework. It will be the responsibility of the contracting officer to implement and execute monitoring. The monitoring program will identify specific minimum performance criteria that must be satisfied to safely, effectively, and responsibly complete the required dredging and associated activities. Monitoring results will be compared with modeling predictions to more effectively plan for future placement at the site.

During dredged material placement operations and associated activities, the contractor will be observed by the contracting officer or his representative.

4.2.3.d Project Review and Oversight. As part of site management, regular meetings among the contracting officer, the contractor, monitoring groups, and designated review authorities will be held to review data collected, discuss project operations, and assess the general project progress. If warranted, adjustments will be made at this time to provide for improved site management and operations.

A Site 104 Working Group, composed of representatives of Federal and state resource and regulatory agencies and other pertinent parties, will be maintained during the operational life of the project. The group will promote the exchange of information between managers of the site and the disciplines and interests represented in the working group. Meetings will be held on an as-needed basis and are anticipated to be more frequent during the first year of placement than during the latter years of operations. Participants in the MPA-sponsored DNPOP program Executive, Management, and Citizen Committees will be informed about project performance at scheduled meetings. CENAB will schedule other public involvement activities as necessary and appropriate.

Section 5

Affected Environment/Existing Conditions

5.1 EXISTING RESOURCES

This section describes the existing conditions within and around Site 104 with respect to environmental, cultural, archaeological, socio-economic, aesthetics, and recreational resources. This information is necessary for NEPA compliance. The existing environmental resources are an important focus because, in this region of the Bay, these resources are an integral part of socio-economics and most recreational activities. The description provides a basis for measuring potential impacts associated with the placement of clean dredged material at Site 104. This material would be dredged from the Federally maintained navigation channels in the main stem of the Bay, including the Craighill Entrance, Craighill Channel, Craighill Angle, Craighill Upper Range, Cutoff Angle, Brewerton Channel Eastern Extension, Swan Point Channel, Tolchester Channel, and the southern approach channels to the C&D Canal. NEPA documentation has been prepared for the Federally maintained mainstem channels and will be updated as needed prior to dredging. Additionally, the Baltimore District characterizes sediment quality in all Federal channels scheduled for maintenance every ~~three~~ 3 years. New work projects will have sediment quality characterizations conducted prior to dredging operations.

5.1.1 Setting

Site 104 is a proposed open-water dredged material placement site located in the main stem of the Chesapeake Bay of Maryland. The site is a previously used 1,800-acre open-water placement site located approximately 0.61 kilometer (km) (2,000 ft) north of the Chesapeake Bay Bridge and 1.6 km (1 mile) west of Kent Island on the eastern shore, and approximately 3.2 km (2 miles) due east from Sandy Point on the western shore. The almost rectangular shape is approximately 6.8 km (4.2 miles) long and 1.1 km (0.65 miles) wide (Figure 2-1).

Site 104 was previously used as a placement area for dredged material from approximately 1924 to 1975. Prior to 1924, there are no records of placement at the site, though it is believed to have been used as a placement area (MDNR 1976). An estimated 70 mcy (55.5 mcm) of material was placed at the site between 1945 and 1975, although records are incomplete.

The boundaries of the area are as follows:

- Beginning at the western-most point at 38 59 43.19 N, 076 21 56.33 W
- Running thence to 39 00 44.37 N, 076 21 32.11 W
- Running thence to 39 00 42.40 N, 076 21 21.84 W
- Running thence to the northernmost point at 39 03 05.42 N, 076 20 24.65 W
- Running thence to 39 03 09.24 N, 076 19 44.72 W
- Running thence to the southernmost point at 38 59 33.13 N, 076 21 10.37 W
- Running thence to the point of the beginning

5.1.2 Physiography, Geology, and Hydrology

5.1.2.a Physiography. The topography within Site 104 is very flat, with slopes ranging from 100 horizontal feet to 1 vertical foot (100:1), to essentially flat (see Ssection 5.1.3.a). Prior to 1924, water depths at Site 104 ranged from 20 to 22 m (70 to 73 ft) in the northern three-fourths of the site to 26 to 28 m (86 to 95 ft) in the southern one-fourth of the site (MDNR 1976). The long dimension of the site (approximately north-northeast to south-southwest, oriented at about 17° relative to true north) is located along the Susquehanna River Paleochannel (Halka 1997—a or b?). This Paleochannel is the prehistoric channel of the Susquehanna River at the time when the sea level was lower; the Chesapeake Bay Estuary was created as sea level rose with the melting of the glaciers that began about 18,000 years ago (MES 1997—a, b, or c?). The site is located in a relatively narrow portion of the Bay, where the distance between the western shore at Sandy Point and Kent Island is about 6,000 m (20,000 ft). The site is in the deeper portions of this area. Outside of the site boundaries, the bottom rises to the east at a relatively steep 50:1 slope to the shoal area west of Kent Island; to the west, the bottom remains fairly flat for more than 2,500 m (8,000 ft) until it reaches the shoal areas east of Sandy Point.

5.1.2.b Geology. Site 104 lies within the Chesapeake Bay approximately 25 km (15 miles) to the east of the Fall Zone, in the Atlantic Coastal Plain Physiographic Province (USDA 1973). The Coastal Plain sediments form an east-southeastward thickening wedge consisting of sand, gravel, clay and sandy clay, of early Cretaceous to Holocene Age (MGS 1968).

The surficial materials of Site 104 (prior to placement of dredged sediments that began prior to 1924) consisted of fine-grained, unconsolidated sediments deposited in the Susquehanna River Paleochannel during the Holocene rise in sea level (i.e., during sea level rise over the past 18,000 years). Prior to sea level rise, this channel was incised into the Coastal Plain sediments of the site, removing portions of the sedimentary sequence in the area. At the current location of the Chesapeake Bay Bridge crossing, the Paleochannel was eroded to nearly 200 ft below mean sea level (Ryan 1953). In the process, sediments of the Pleistocene Age Kent Island (Talbot) Formation, and Tertiary Age Calvert, Piney Point, and Nanjemoy Formations were removed from the area (Colman and Halka 1989; Drummond 1988). As sea level rose and the Chesapeake Bay formed, fine-grained, organically rich estuarine muds were subsequently deposited into these eroded channels. An acoustic sub-bottom survey of Site 104 performed by the Maryland Geological Survey (MGS) in August 1997 indicates that soft, fine-grained, organically rich sediments occur throughout the site area which include, in part, the dredged material historically placed at the site as well as sediments naturally deposited at the site due to shoreline erosion, etc. The thickness of these sediments is a minimum of 10 to 15 m (30 to 45 ft), with mean thickness on the order of 20 to 30 m (60 to 90 ft) (Halka 1997).

Coastal Plain deposits in the Site 104 area immediately below the incised Paleochannel consist of the Aquia Formation, Hornerstown Sand, and Brightseat Formations (all of Paleocene Age) underlain by the Cretaceous Age Severn, Matawan and Magothy Formations and the Potomac Group (Drummond 1988). The Aquia Formation and the Hornerstown Sand together form the Aquia Aquifer, the source of most residential fresh water for residents of Kent Island. These units are predominantly sandy with abundant glauconite, some clay matrix and some calcite cementation. The Brightseat, Severn, and Matawan Formations are predominantly sandy clay with variable amounts of glauconite; they function as a lower confining bed to the Aquia Aquifer. The Magothy Formation lacks glauconite and is predominantly sandy with some clay-sized materials. The underlying Potomac Group consists of interbedded sands, silts, and clays. Below the Potomac Group is an undifferentiated crystalline bedrock, the surface of which dips to the southeast. Bedrock was reached at a depth of 763 m (2,504 ft) below sea level at the town of Chester, located on Kent Island (Mack 1983).

The U.S. Geological Survey (Halka 1998) reported the presence of a potential geologic fault in the Site 104 vicinity. The feature was described as a lineation (or linear ground feature observable on a high altitude, Landsat photo image) that extends from near Rock Hall (located about 11 km (7 mi) northeast of the northern border of Site 104), across the Chester River at Comegys Bight, across Spaniard's Neck north of the Corsica River, and continues east toward Delaware. A ground survey reviewed by the U.S. Geological Society (USGS) revealed that there was an elevation change across this feature. The USGS interpreted the feature to be the result of ground movement associated with a geologic fault. However, the MGS believes it is unlikely that the feature described is related to a surface expression of faulting (Halka 1998). The MGS notes that from an aerial perspective, numerous ground features can create lineations that may or

~~may not be associated with geologic faulting, and that features having elevation changes across them have been noted in numerous areas around the Chesapeake Bay and have been associated with periods of higher sea levels occurring between glacial periods. The investigations into these features, however, did not extend north of Talbot County in Maryland, and therefore did not include the Site 104 area and the lineation identified to the northeast of Site 104 (Annex C, Attachment E).~~

~~**5.1.2.c**~~ ~~Hydrology. The MGS completed a ground water study on Kent Island in the late 1980s (Drummond 1988). This study indicated that the Aquia Formation subcrops beneath the Chesapeake Bay and is at present hydraulically connected to the waters of the Bay. In locations where fine-grained sediments accumulate on the Bay bottom where the Aquia is present, they serve as a leaky confining bed for the aquifer. The density difference between the more saline Bay water and the fresh water of the aquifer probably results in the movement of Bay water into the lower portions of the Aquia matched by a corresponding outward movement of the overlying fresh water under normal conditions.~~

5.1.2.b Geology. The sediments that make up the Coastal Plain physiographic province in Maryland consist of unconsolidated clay, silt, sand and gravel beds, which dip gently to the southeast. These sediments crop out in a concentric band that lies parallel to the Fall Line. The Fall Line marks the western boundary of the Coastal Plain. The Coastal Plain sediments are underlain by Precambrian and Paleozoic gneiss, schist, and gabbroic rocks, which are usually referred to as "basement" rocks. The surface of the basement rocks underlying Southern Maryland has been downwarped into a structure termed the "Salisbury Embayment" (Chapelle and Drummond 1983).

The wedge of sediments that make up the Coastal Plain of Maryland consists of heds ranging from Cretaceous to Holocene in age. The location of a geologic cross section (A-B) near Site 104 is shown in Figure 5-1. The stratigraphic sequence is shown in Figure 5-2 and consists of the Severn Formation, overlain hy the Aquia Formation, which is overlain by Pleistocene organic-rich mud, gravel, and sand. The "Aquia Aquifer" as used in this report is defined as the sandy hydrogeologic unit above the lower confining bed and below the upper confining bed. This designation assigns three stratigraphic units to the Aquia Aquifer (in ascending order): The Hornerstown Sand, the Aquia Formation, and the Lower Eocene Sand. Although these sands have different ages, they are assumed to act as a single hydraulic unit, at least on a regional scale, and are thus designated as a single aquifer.

The Hornerstown Sand is the sandy layer directly overlying the lower confining bed, which is distinguishable throughout the study area. The Aquia Formation consists of medium to coarse-grained glauconitic quartz sand, silt, and clay. Although the Aquia is predominantly sand, some zones occur which contain significant quantities of clay and silt-sized particles. These low permeahility zones are not considered to be an aquifer. The sediments designated as Lower Eocene Sand directly overlie the Aquia Formation and were previously thought to be a part of the Aquia Formation due to lithologic similarity. However, core analysis for foraminifera assemblages (simple plant species) yielded an Early Eocene age for these sands; therefore, they are commonly referred to as the Lower Eocene Sands when distinguishing it from other sands in the Aquia Aquifer.

The Aquia Aquifer described above generally subcrops (is exposed below the water surface) beneath a thin veneer of Pleistocene sediments, but actually crops out as bluffs along the banks of rivers and creeks. It also subcrops beneath the Chesapeake Bay and the mouth of the Chester River where a paleochannel truncates the Aquia either partially or completely (Figure 5-2). The subcrop area trends southward down the Bay along the entire extent of Kent Island.

The Aquia Aquifer unconformably overlies the Severn Formation (lower confining bed), which is a sandy clay layer and functions as an impervious confining bed in the study area near Kent Island. The Aquia Aquifer is overlain by the upper confining bed which is defined by Drummond (1988) as a clayey layer which hydraulically separates the Aquia Aquifer from the overlying (usually) unconfined aquifer (Piney Point aquifer) or from the Chesapeake Bay, as in the study area. The upper confining bed includes the Nanjemoy and Calvert Formations, which generally separate the Aquia from the overlying unconfined aquifer and, in places, separate the Aquia from the Piney Point aquifer. The upper confining bed does not occur where the Aquia Aquifer subareally crops out or subcrops and there is direct contact between the Aquia and the unconfined aquifer. According to Drummond, the upper confining bed also includes the fine-grained, lower permeability bay-bottom sediments, which in places separate the Aquia from the Chesapeake Bay. In the paleochannel at Site 104, the Aquia is in contact with highly permeable channel deposits, which are then overlain by bay-bottom ooze as shown in Figure 5-2.

During Pleistocene time (about ten thousand to two million years before present), there were several periods of worldwide glaciation during which much of the water in the world was frozen in vast ice sheets. This caused a cyclic worldwide fluctuation of sea level. During periods of low sealevel stand, rivers cut deep channels into the existing Coastal Plain sediments. A river system developed which approached a sea level, which was 300 to 400 ft below the present sea level. During the periods between glaciations, the ice melted, sea level rose, and the channels were filled with sediments. At the end of Pleistocene time, the rising sea submerged much of this river system and the channels they had formed, creating the Chesapeake Bay estuary (Figure 5-3). The figure shows the distribution of paleochannels in the Kent Island area and identifies a major paleochannel near the shore, approximately following the present course of the Chesapeake Bay. The depth of the channel is reported to be up to 200 ft below sea level with sediment thickness between 66 and 126 ft. These paleochannels influence the hydrogeology of the Coastal Plain aquifer systems such as the Aquia Aquifer in the area of Site 104.

Because of the fluvial depositional environment of the Pleistocene channel-fill deposits, their lithology is highly variable. A generalized sequence consists of a fining-upward series of fluvial and estuarine deposits. Coarse fluvial lag gravel occurs at the base of this channel, grading upward into sand, silt, clay, and bay-bottom ooze at the top. The hydraulic properties of the channel-fill sediments are not well known because no laboratory or field hydraulic test results are available. Permeability of these sediments can be estimated from lithologic descriptions to within possibly several orders of magnitude. The extremely variable nature of channel-fill sediments makes it difficult to estimate hydraulic properties beyond the locations of sediment samples.

5.1.2.c Hydrogeology. The Kent Island area has undergone considerable residential and commercial development in the last few decades, which is expected to continue into the future. This development is accompanied by an increasing demand for freshwater. Virtually all of the freshwater is obtained from ground water, and most of that has been supplied by the Aquia Aquifer. Although not the sole ground-water source on Kent Island, the Aquia is relatively shallow, dependable, and produces water of drinking water quality throughout most of its extent. However, because it is shallow in the vicinity of the Chesapeake Bay and its tidal tributaries, and due to the presence of paleochannels incised into the Aquia Aquifer, the water supply is vulnerable to brackish-water intrusion. Water levels in the Aquia dropped from several feet above sea level in the mid-1950s to several feet below sea level in 1984. In addition, numerous wells screened in the Aquia near the Chesapeake Bay were reported to produce water of high chloride concentrations. These factors led to concern by State and county officials that brackish water was entering the Aquia Aquifer and that it was in danger of becoming irrevocably contaminated. A study was then undertaken by the Maryland Geological Survey to provide a better understanding of the hydrogeologic system (Drummond 1988). Much of the information in this report was obtained from that study.

Water level changes over time show the response of an aquifer system to various stresses (e.g., pumpage from wells, droughts, and rainfall) on the system. Seasonal water level changes in wells screened on Kent Island indicate that the seasonal trend is probably caused by seasonal fluctuations in evapotranspiration and precipitation. The correlation of water levels with evapotranspiration and precipitation suggests that the Aquia Aquifer is recharged locally, at least in part, and that there is a hydraulic connection with the unconfined aquifer.

The potentiometric surface of the Aquia Aquifer was measured in October 1984 and is shown in Figure 5-4. Ground-water elevations (heads) in the study area range from about 1 ft above sea level on the northern Kent Island to about 8 ft below sea level on the mainland Eastern Shore. The low heads are a result of heavy pumpage from the Easton area southeast of the study area, and of domestic pumpage throughout Kent Island. The direction of ground-water flow is perpendicular to the potentiometric contours, generally inland from northwest to southeast.

The Aquia Aquifer forms a flow system in which it gains water at its recharge zones, transmits water throughout its extent, and loses water at its discharge zones (Figure 5-5). Potential recharge and discharge zones include the subareal outcrop/subcrop area, leakage through the upper and lower confining beds, and the subcrop area beneath the Chesapeake Bay. Whether one of these sites acts as a recharge or discharge zone depends on the relative water pressures in the Aquia and the zone at that point. If the water pressure is greater in the zone than in the Aquia, the site will act as a recharge zone, and vice versa.

The Aquia Aquifer probably receives some recharge through the subaerial outcrop/subcrop area. Water can enter the Aquia directly where its sands are exposed, or through the overlying sediments where the Aquia is overlain by the unconfined aquifer. The subcrop of the Aquia Aquifer beneath the Chesapeake Bay, such as at Site 104, is an important zone for recharge and discharge to/from the aquifer. In Bay subcrop areas, where the freshwater head in the Aquia exceeds the head of brackish Bay water, freshwater will discharge into the Bay. In Bay subcrop areas where the freshwater head in the Aquia is less than the head of the bay water, brackish water will enter the Aquia as recharge. Before substantial pumpage from the Aquia began, water pressures in the Aquia probably exceeded those in the Bay everywhere, and the entire Aquia subcrop beneath the Bay was a discharge zone. However, since major Aquia pumpage began, Aquia heads have dropped below the head of the Bay water, and these areas have become recharge zones for brackish water.

Kent Island is experiencing a salt-water intrusion problem in the Aquia Aquifer due to brackish recharge from the Chesapeake Bay. This recharge from the bay is caused by pumping from the Aquia Aquifer in excess of the natural recharge from precipitation. Chloride distributions in 1983-1984 are shown in Figure 5-6. Brackish water is present in the Aquia along the Chesapeake Bay shore from the northernmost tip of the island (Love Point) to at least as far south as Prices Creek. In the northern part of the brackish-water zone, the entire vertical section contains brackish water. In the southern part of the brackish-water zone, the bottom of the Aquia contains brackish water, but the top contains freshwater. The northern and middle portions of the brackish water zone have increased in concentration over the last 20 years (Cooper 1999). The southern portions of the island, toward Kent Point, have remained relatively constant. As development and pumping quantities increase, this will probably change.

Based on ground-water flow and transport modeling (Drummond 1988), the brackish-water/freshwater interface has been calculated to move inland at approximately 21 ft per year. This calculation was based upon expected increases in pumping rates due to development. If all pumping from the Aquia were terminated, the brackish-water/freshwater interface would actually reverse direction and move towards the bay at a velocity of approximately 2 ft per year.

[NOTE: FIGURES 5-1 THRU 5-6 REQUESTED FROM MCKEE 9/22/99]

5.1.3 Hydrodynamics [THERE IS NEW DATA FOR THIS SECTION]

This section summarizes the following ~~S~~site conditions: ~~germane to the hydrology/hydrodynamics of Site 104 include~~ average water depths, ~~water levels,~~ astronomical tides, storm surge, water levels, wind conditions, wave conditions, tidal currents, and sedimentation~~, and wave conditions~~ for the part of the Chesapeake Bay near Site 104. A more in-depth discussion is presented in Annex F.

5.1.3.a Average Water Depths. Bathymetric data in the vicinity of Site 104 were obtained from National Oceanic Atmospheric Administration (NOAA) charts 12263, 12273~~, 12273~~, and 12278. ~~Hydrographic D~~data within Site 104 were obtained from the CENAB survey data collected in September 1997. ~~Vertical data are referenced to MLLW based upon the 1960 to 1978 tidal epoch, and horizontal data are referenced to the Maryland State Plane, North American Datum (NAD) 1983.~~

The bathymetry of the site is presented in Figure 2-1. Water depths at Site 104 range from -12.8 m (-42.0 ft) MLLW to -23.8 m (-78.0 ft) MLLW. As stated in Section 5.1.2.a, ~~the~~ slopes at Site 104 are very flat, with a range of 100:1 to flat. The typical slope where placement would occur in the site is about 100:1 to 400:1, in areas within Site 104 that are below -13.7 m (-45.0 ft) MLLW.

Over the northern portion of Site 104, the bottom depths range from -12.8 m (-42.0 ft) to -14.0 m (-46.0 ft) MLLW. From the northern end of the site, the bottom gently slopes downward towards the south. In the mid-section of the site, the downward slope increases, reaching a maximum depth of -23.8 m (-78.0 ft) MLLW at the southern boundary of the site.

The site slopes are steeper along the eastern edge, extending upward from -14.0 m (-46.0 ft) MLLW in the northern end and -23.8 m (–78.0 ft) MLLW in the southern end, to approximately -11.0 m (-36.0 ft) MLLW just east of the site. The bottom then continues to slope upwards towards the western shoreline of Kent Island.

5.1.3.b Astronomical Tides. An astronomical tide is one that is caused by the attractive forces of the sun and moon. In the Chesapeake Bay, astronomical tides occur semi-diurnally, or twice a day. For Site 104, the mean tide level is between 0.22 and 0.26 m (0.73 and 0.84 ft) above MLLW; the mean tidal range is between 0.30 and 0.37 m (0.99 and 1.16 ft); and the spring tidal range is between 0.45 and 0.52 m (1.49 and 1.72 ft) (NOS 1996). Tidal datum characteristics for two locations in the upper Bay near Site 104 reported from National Ocean Service (NOS) are presented in Table 5-1. ~~76° 20.9' W).~~ These data were used to generate tidal current velocity characteristics for modeling of the fate and transport of placed dredged material (Section 6.1.3).

5.1.3.c~~b~~ Water Levels. Normal water level variations in the upper Bay are generally dominated by astronomical tides, although wind effects and freshwater discharge can be important influences. Depending on direction and duration, wind can force water into or out of rivers and

Table 5-1
Astronomical Tidal Datum Characteristics for Selected Chesapeake Bay Locations

Tidal Datum	Matapeake[1] [ms (ft)]	Love Point[2] [ms (ft)]
Mean Higher High Water (MHHW)	0.45 (1.49)	0.52 (1.72)
Mean High Water (MHW)	0.37 (1.22)	0.43 (1.42)
Mean Tide Level (MTL)	0.22 (0.73)	0.26 (0.84)
National Geodetic Vertical Datum (NGVD)	0.11 (0.35)	0.11 (0.35)
Mean Low Water (MLW)	0.07 (0.23)	0.08 (0.26)
Mean Lower Low Water (MLLW)	0.00 (0.00)	0.00 (0.00)

[1] Located on the western shore of Kent Island at latitude 38°57.4 ft north and longitude 76°21.3 ft west, 3 km (2 mi) south of Site 104.

[2] Located on the northeastern shore of Kent Island at 39°1.9 ft north and 76°18.1 ft west, 3 km (2 mi) east of the site.

embayments, subsequently causing a localized increase or decrease, respectively, of water level within the affected body of water. Relatively high occurrences of freshwater discharges from a river or stream can also locally raise water levels where it flows into the Bay. Extremely high water levels, on the other hand, are dictated by storm tides. A storm tide is a temporary rise in water level generated either by large-scale extra-tropical storms (nor'easters) or by hurricanes. The rise in water level results from wind action, the low pressure of the storm disturbance, and the Coriolis effect.

Long-term rise in sea level began about 18,000 years ago to create the Chesapeake Bay. In 1984, USACE reported that the rise in sea level was continuing at an average rate of about 0.001 to 0.002 m/yr (0.003 to 0.007 ft/yr) (USACE 1984). In 1987, the National Research Council (NRC) reported that sea level rise resulting from melting of the polar ice caps for the past century has been about 0.12 m (0.4 ft), resulting in a rise of approximately 0.0012 m/yr (0.004 ft/yr) (NRC 1987).

A recent hydrodynamics modeling study performed by Waterways Experiment Station (WES), for the proposed Delaware Bay deepening workproject, showed that an assumed sea level rise of 0.305 m (1.0 ft) at the mouth of the Chesapeake Bay would result in an increase in water depth of about 0.274 m (0.9 ft) at the Chesapeake Bay Bridge. Therefore, a rate of sea level rise in the oceans of 0.0012 m/yr (0.004 ft/yr) would equate to a potential water level rise at Site 104 of approximately 0.0011 m/yr (0.0036 ft/yr). At the time the model was run for the Delaware Bay deepening work, it had not yet been developed to include the C&D Canal and therefore may not adequately represent a predicted change in sea level rise in the area of Site 104. A model of both the Chesapeake Bay and Delaware Bay that includes the C&D Canal and extends out onto the Atlantic continental shelf would have to be developed tobe required to adequately address sea level rise in these areas (WES 1998).

5.1.3.c Astronomical Tides. An Aastronomical tides is one that is caused by the attractive forces of the sun and moon. iIn the Chesapeake Bay, astronomical tides areoccur semi-diurnally, or twice a day. For Site 104, the mean tide level is between 0.22 and 0.26 m (0.73 and 0.84 ft) above MLLW, the mean tidal range is between 0.30 and 0.37 m (0.99 and 1.16 ft), and the spring tidal range is between 0.45 and 0.52 m (1.49 and 1.72 ft) (NOS 1996). Tidal datum characteristics for two locations in the upper Bay near Site 104 reported from National Ocean Service (NOS) are presented in Table 5-1. Matapeake is located on the western shore of Kent Island at latitude 38° 57.4' N and longitude 76° 21.3' W, approximately 3 km (2 miles) south of the site. Love Point is located on the northeastern shore of Kent Island at latitude 39° 1.9' N and longitude 76° 18.1' W, approximately 3 k (2 miles) east of the site. The difference in elevation between MLLW and the national geodetic vertical datum (NGVD), or mean sea level, is approximately 0.35 ft. MLLW will serve as the datum for this project since it is the standard datum for nautical charts.

Tide and current data were also obtained from an extensive survey conducted by the NOS in the 1970s and 1980s (NOS 1988). The 1970s data were collected in a cooperative effort with USACE for use in the design of the physical model of the Bay. Two survey locations were in the vicinity of Site 104. The first was at Matapeake, and the ; tidal harmonic constants for tidal amplitude and phase were developed for this location. The second location was located within the boundaries of Site 104 (Station No. 175 in the survey at latitude 39° 0.2' N and longitude 76° 20.9' W); tidal harmonic constants for tidal currents (speed, direction, and phase) were developed for this station. Table 5-2 presents the tidal harmonic constants from these two locations. Thiese data wasere used to generate tidal current velocity characteristics for modeling of the fate and transport of placed dredged material (Section 6.1.3). Figures 5-1 and 5-2 present the predicted tidal heights for 1 year and 30 days, respectively, based upon the harmonic constants shown in Table 5-2. These figures show that maximum amplitude above and below mean tide level is almost 0.3 m (1.0 ft), compared to the spring tidal range of about 0.5 m (1.6 ft).

5.1.3.d Storm Surge. Extreme water levels are dominated by storm effects (i.e., storm surge and wave setup) in combination with astronomical tide. Wave setup describes the rise in water level due to wave breaking. Specifically, it refers to change in momentum that attends the breaking of waves propagating towards shore resultsing in a surf zone force, which raises water levels at the shoreline.

A comprehensive evaluation of storm-induced water levels for several Chesapeake Bay locations has been conducted by the Virginia Institute of Marine Science (1978) as part of the Federal Flood Insurance Program. Results of this study are summarized in Table 5-32 and shown as water-level versus frequency curves presented in Figure 5-37. The table provides water levels in meters above MLLW (NGVD) for various return periods. A return period is a statistical probability of occurrence for a given event (e.g., a 5-year return period has a 20 percent chance of occurring, a 50-year return period has a 2 percent chance of occurring, and a 100-year return period has a 1 percent chance of occurring at any given time). Data in Table 5-32 and Figure 5-37, for stations closest to Site 104, indicate that the storm tide elevation for a 10-year return period is 1.2 m (4.1 ft) MLLW and the 100-year water level for the project area is 2.3 m (7.7 ft) MLLW.

5.1.3.e Wind Conditions. Wind data from the National Oceanic and Atmospheric Administration (NOAA), National Climatic Data Center (NOS 1982) for Baltimore-Washington International (BWI) Airport, were used to estimate wind conditions at the project site. (Table 5-43). Data are presented as fastest mile winds, thatwhich are defined as the highest recorded wind speeds that last long enough to travel 1 mile, during a 24 hour recording period (NOS 1982). These winds were used to develop wind speed-–return period relationships based upon a Type I (Gumbel) statistical distribution.
The specific return periods examined were 5, 10, 15, 20, 25, 30, 35, 40, 50 and 100 years.

Table 5-53 shows that the wind speeds for a 5-year return period storm range from 14 m/s (32 mph) for winds from the east direction to 24 m/s (54 mph) for winds from the northwest direction. The wind speeds for a 100-year return period storm range from 29 m/s (65 mph) for winds from the east direction to 43 m/s (97 mph) for winds from the southwest direction. These wind speeds were used to estimate storm wave conditions for Site 104 (Section 5.1.3.fh).

Table 5-2~~3~~
Water Level Elevation per Return Period

Return Period (years)	Water Level [m (ft) MLLW]
5	1.2 (4.0)
10	1.2 (4.1)
15	1.3 (4.2)
20	1.4 (4.5)
25	1.5 (5.0)
30	1.6 (5.3)
35	1.7 (5.6)
40	1.9 (6.1)
50	2.0 (6.7)
100	2.3 (7.7)

Table 5-35
Fastest Mile Wind Speeds per Direction and Return Period (RP)

RP Year Year	N North		NE		E Northeast		SE		S East		SW		W Southeast		NW	
years	m/s	mph	m/s	mph	m/s	mph	m/s	mph	m/s	mph	m/s	mph	m/s	mph	m/s	mph
5	18	40	17	37	14	32	17	37	16	36	21	47	22	50	24	54
10	21	48	20	44	17	38	20	45	19	43	25	56	24	54	26	59
15	23	52	21	48	18	41	22	50	21	47	27	61	25	56	28	62
20	25	56	23	52	20	45	25	55	23	51	30	67	26	59	29	65
25	26	59	25	55	21	47	26	58	24	54	31	70	27	60	30	67
30	28	62	25	57	22	49	27	61	25	56	33	73	27	61	30	68
35	29	64	27	60	23	51	28	63	26	58	34	76	28	62	31	70
40	30	66	28	62	24	53	29	65	27	60	35	78	28	63	32	71
50	31	69	30	66	25	55	31	69	28	63	37	82	29	64	33	73
100	36	81	34	76	29	65	37	82	33	74	43	97	31	69	36	81

5.1.3.f Wave Conditions.

Average Wave Conditions

One year of hourly-averaged wind speed and directional data were obtained from the NOS for C-MAN station TPLM2, located at latitude 38° 58.5' N and longitude 76° 24' W, less than 1 mile southwest of Site 104. These data were used to generate an average wave height and period for the year using methods presented in the Shore Protection Manual (USACE 1984). The mean wave height was computed to be about 0.15 m (0.5 ft) and the mean wave period was computed to be about 1.5 seconds.

Extreme Wave Conditions

Site 104 is exposed to wind-generated waves approaching primarily from the north and south directions. The longest fetch distances (i.e., the area of the water over which a wind of constant direction and speed blows to generate waves) to which the site is exposed correspond to these two directions. In accordance with procedures recommended by the U.S. Army Shore Protection Manual (USACE 1984)., Wwave conditions were hindcast for each fetch direction for the winds adjusted appropriately for duration, water levels, and mean water depths along the fetch directions. The results are shown in Tables 5-54 and 5-65.

5.1.3.gf Tidal Currents. Vertical water movement associated with the rise and fall of the tide creates horizontal water movement called tidal currents. Tidal currents in the upper Chesapeake Bay are moderate to weak with an average maximum velocity of about 0.6 meters (m/s) per second (m/s) ([2 ft per second (ft/s)], NOS 1996). The Horn Point Environmental Laboratory (HPEL) of the University of Maryland, Center for Environmental Sciences (UMCES) conducted current velocity measurements for Site 104 using an Acoustic Doppler Current Profiler (ADCP), which was surveyed for one complete tidal cycle (about 13 hours) on 28 July 28, 1997 [UMCES 1997 (see Appendix F)]. Maximum ebb velocities were measured on the order of 0.45 to 0.6 m/s (1.5 to 2 ft/s), while maximum flood velocities were measured to be on the order of 0.3 to 0.45 m/s (1 to 1.5 ft/s).
Velocity vector plots for peak ebb and peak flood are shown in Figures 5-48 and 5-59, respectively (Moffatt and Nichol Engineers [M&N], 1998). This figure shows the peak ebb velocity distribution in and adjacent to the project area. These velocity measurements are similar to those resported in NOS (1996) for historic average conditions.

The tidal harmonic constants shown in Table 5-2 were used to generate predicted tidal current velocities for Site 104. Figures 5-6 and 5-7 present tidal current velocities over time for 1 year and 30 days, respectively. Maximum velocities are about 0.6 m/s (2 ft/s).

5.1.3.hg Sedimentation. The upper Chesapeake Bay is a region where a relatively large quantity of fine-grained sediment is deposited (MES 1995). The two primary sources of these fine-grained sediments are discharge from the Susquehanna River and adjacent shoreline erosion from within the upper Bay.

Susquehanna River Discharge

Table 5-46
Wave Height per Return Period

Fetch Direction	Return Period (years)									
	1 m (ft)	2 m (ft)	5 m (ft)	10 m (ft)	20 m (ft)	25 m (ft)	30 m (ft)	40 m (ft)	50 m (ft)	100 m (ft)
North	0.9 (3.0)	1.2 (3.9)	1.5 (4.8)	1.7 (5.7)	2.0 (6.6)	2.1 (6.9)	2.2 (7.2)	2.3 (7.7)	2.4 (8.0)	2.8 (9.3)
South	0.9 (3.0)	1.3 (4.2)	1.7 (5.5)	2.0 (6.5)	2.3 (7.7)	2.5 (8.1)	2.5 (8.3)	2.7 (8.9)	2.8 (9.3)	3.3 (10.7)

Table 5-57
Wave Period (seconds) per Return Period

Fetch Direction	Return Period (years)									
	1	**2**	**5**	**10**	**20**	**25**	**30**	**40**	**50**	**100**
North	3.7	4.1	4.5	4.8	5.1	5.2	5.3	5.5	5.6	5.9
South	3.9	4.4	5	5.4	5.8	5.9	6	6.1	6.3	6.7

The primary input of suspended sediment into the upper Chesapeake Bay is due to discharge from the Susquehanna River. ~~The Susquehanna River supplies more than 50 percent of the fresh water to the Bay and more than 90 percent of the fresh water to the upper Bay north of Baltimore (Magnien *et al.* 1993—"a" or "b"?). According to Biggs (1970) the Susquehanna River accounts for 96 percent of the total fresh water discharge to "Station VI," which is located at the northern limit of Site 104. Mean annual average discharge from the Susquehanna River (measured at the Conowingo Dam) between 1928 and 1975 was about 1,000 m^3/sec (36,000 ft^3/sec). The long-term mean discharge is approximately 1,099 m^3/sec (38,800 ft^3/sec); however, freshwater inflow to the upper Bay varies daily, weekly, monthly, and yearly, with relatively high discharge in the spring and low to moderate discharge in the summer and fall (Schubel and Pritchard 1987). Average flows in March and April exceeded 2,200 m^3/sec (78,000 ft^3/sec) between 1929 and 1984 (Schubel and Pritchard 1987); flows from 1984 through 1991 for February through April ranged from 1,100 to 2,100 m^3/sec [40,000 to 75,000 ft^3/sec (MES 1997—"a," "b," or "c"?)].~~

~~Previously, MDNR estimated that from 1928 through 1975, the discharge from the Susquehanna River provided an average of about 540,000 metric tons (600,000 tons) of sediment each year to the Bay (MDNR 1976). This estimate was based upon suspended sediment concentrations measured from the discharge of water through the Conowingo Dam. More r~~Recent data (1978–1993) indicate that the sediment load from the Susquehanna River (measured at Conowingo Dam) is approximately 1.3 million metric tons per year [1.4 million tons (MES 1995) and Panageotou *et al.* 1996]. During 1978–1993, the estimated annual total suspended load from the Susquehanna River varied from about 400,000 metric tons (440,000 tons) to 2.7 million metric tons (3 million tons). It is believed that a relatively small fraction of this sediment load actually reached the Site 104 area (Halka, personal communication), although occurrences of high-suspended sediment caused increased turbidity in the area (MDNR 1976). Biggs (1969) stated that more than 90 percent of the suspended sediment contributed by the Susquehanna River was deposited north ~~of Station VI (north~~ of Site 104~~)~~.

Sediment input to the Bay due to extreme weather events can be significant. In January 1996, record snowfall followed by a heavy rainfall and warm temperatures caused major flooding in the Chesapeake Bay watershed. During the January 1996 flood, the Susquehanna River discharged a total of about ~~9 billion m^3 (320 billion ft^3) of sediments at an average of 3,400 m^3/sec (120,000 ft^3/sec). This equates to approximately~~ 1.8 million metric tons (2 million tons) of sediment ~~carried~~ into the Bay ~~by the Susquehanna River~~ during this single event which is~~,~~ more than the average yearly input between the years 1978 and 1993 (USGS 1996).

Shoreline Erosion

Suspended sediment resulting from erosion of the shoreline from within the upper Bay is an additional significant source of material. Estimates of the quantity of material due to shoreline erosion in the upper Bay range from 300,000 metric tons (330,000 tons) (Biggs 1970) to 390,000 metric tons per year (430,000 tons [Kerhin *et al.* 1988]). The fine-grained fraction of this material is estimated to range from 110,000 metric tons (120,000 tons [Biggs 1970]) to 180,000 metric tons (200,000 tons [Kerhin *et al.* 1988]) per year.

Total Sedimentation

Based upon a review of the data presented above, the total quantity of sediment supplied to the upper Bay averages from approximately 1.6 to 1.7 million metric tons (1.8 to 1.9 million tons)., per year. In addition, according tousing suspended sediments concentration data collected at various locations throughout the upper Bay, Biggs (1969) estimated that about 4 percent of the annual supply of material to the upper Bay is transported south of Station VI (the northern limit of Site 104). Based upon this estimate, a mean of approximately 60,000 to 70,000 metric tons (66,000 to 77,000 tons) is supplied annually to the Site 104 area and south. This sediment is deposited over a large area of the Bay, including an estimated small percentage at Site 104. Most of this
remaining material is deposited north of the mouth of the Potomac River (Officer *et al.* 1984,; Donoghue 1990,; Colman *et al.* 1992,; Hobbs *et al.* 1992).

Sedimentation at Site 104

Sedimentation at Site 104 corresponds primarily to sediment particle size and classification and is influenced by particle settling velocity, density throughout the water column, and current velocity. Typical fine-grained, naturally- occurring sediment suspended in the waters of the upper Bay are approximately 0.010 to 0.015 mm (0.0004 to 0.0006 in.) in diameter, with settling (falling) velocities in the range of 0.004 cm/sec (1.5×10^{-4} ft/sec, MDNR 1976). Samples collected by E2Si (1997) and MGS (1997) add MGS 1997 to ref. list in Site 104 contained material with particle sizes ranging from 0.005 to 0.1 mm (0.0002 to 0.004 in.), with a mean of 0.02 mm (0.0008 in.). Settling velocity for a 0.02 mm (0.0008 in.) particle is approximately 0.06 cm/sec (0.002 ft/sec). Due to these relatively slow-settling velocities, this suspended material can be transported over large distances by tidal currents, and some material may never settle to the bottom. In addition, wave-forced resuspension of deposited material is an important factor influencing the transport of material (Sanford 1994).

Biggs (1970) estimated that sedimentation in the area around Site 104 is approximately 1.1 mm/yr (0.04 in./yr). This estimate assumes a uniform distribution of 303,000 metric tons (334,016 U.S. tons) of particulate matter spread evenly over the bottom of this region. The amount of material being deposited is based upon the difference in suspended matter measured at the designated upstream and downstream stations from 1 February 1996, through 31 January 1997. Eskin *et al.* (1996) estimates that the sedimentation rate in the area is about 1.2 to 10 mm/yr (0.05 to 0.4 in./yr) as a result of lead-210 analyses of core samples collected at stations in and around Site 104.

Sedimentation rates in the deeper portions of the Chesapeake Bay are generally higher than in the surrounding shallower waters, due in part to lower current velocities and lessened effects from wave action. The deeper channels are relict features incised during times of lower sea level by the Susquehanna River and its tributaries, and are now filling relatively rapidly with sediments (Colman *et al.* 1992). It is estimated that over more than a 10,000 year period, the long-term average rate of sediment accumulation in the vicinity of Site 104 has been approximately 0.003 m/yr (0.12 in./yr) (Colman and& Halka 1990). Pollen -dating techniques applied to three recent sediment cores collected in the vicinity of Site 104 indicate that a rate of sediment accumulation since the time of European occupation has averaged approximately 0.004 m/yr (0.156 in./yr Brush 1990; Brush *et al.* 1997). Although these cores were not located within the Site 104 boundaries, and extrapolation of sedimentation rates from specific core locations is questionable, the results corroborate the long-term average (Halka 1998). Higher sedimentation rates [0.01 to 0.03 m/yr (0.396 to 1.176 in./yr)] have been calculated from radionuclide dating of two cores collected from the deep water areas to the south of Kent Island (Goldberg *et al.* 1978). Assuming a surface sediment bulk density of 1.25 grams per cubic centimeter (g/cc) in Site 104, Halka (1998) calculated the sedimentation rate of 0.004 m/yr (0.156 in./yr), which would result in a sediment mass accumulation rate of 1,600 $g/m^2/yr$.

Table 5-56 shows estimated sedimentation rates at or near Site 104 as determined by a variety of methods. The estimates range from 1mm/yr to 4 mm/yr. These estimates are much lower than Goldberg's estimated of 10-30 mm/yr for deeper waters swouth of Kent Island. Sedimentation rates in deeper portions of the Chesapeake Bay are generally higher due to lower current velocities and lessened effects from wave action.

5.1.3.h Wave Conditions

Average Wave Conditions

One year of hourly-averaged wind speed and directional data were obtained from the NOS for C-MAN station TPLM2, located at latitude 38° 58.5' N and longitude 76° 24' W, less than 1 mile southwest of Site 104. These data were used to generate an average wave height and period for the year using methods presented in the Shore Protection Manual (USACE 1984). Figures 5-810 and 5-911 present the hourly-averaged wave heights and periods for 1 year, respectively, using the TPLM2 data. The figures show the variability of the wave heights and periods for the year. The mean wave height and period for the year were computed from the above analysis output. The mean wave height was computed to be about 0.15 m (0.5 ft) and the mean wave period was computed to be about 1.5 seconds.

Extreme Wave Conditions

Site 104 is exposed to wind-generated waves approaching primarily from the north and south directions. The longest fetch distances (i.e., the area of the water over which a wind of constant direction and speed blows to generate waves) to which the site is exposed correspond to these two directions. In accordance with procedures recommended by the U.S. Army Shore Protection Manual (USACE 1984), a radially averaged fetch distance was computed for the two directions. The radially averaged fetch distances for the north and south directions are shown in Figures 5-1012 and 5-1113, respectively. Wave conditions were hindcast for each fetch direction for the winds (Table 5-54) adjusted appropriately for duration, water levels (Table 5-32), and mean water depths along the fetch directions (Figure 5-37). The results are shown in Tables 5-65 and 5-76.

A sea state is normally composed of a spectrum of waves with varying heights and periods that may range from relatively long waves to short ripples. In order to summarize the spectral characteristics of a sea state, it is customary to represent that wave spectrum in terms of a distribution of wave energy over a range of wave periods. Having made this distribution, known as a wave spectrum, it is convenient to represent the wave spectrum for Site 104 by a single representative wave height and period. The wave conditions reported in Tables 5-6 and 5-7 are

Table 5-6
Estimated Sedimentation Rates in the Vicinity of Site 104

Source	Location	Estimated Rate	Method of Estimation
Goldberg et al 1978	Deep water areas south of Kent Island	10 to 30 mm/yr	Radionuclide dating of cores
Biggs 1970	Site 104 vicinity	1.1mm/yr	Based upon difference in suspended matter measure upstream and downstream
Eskin 1996	Site 104 vicinity	1.2-10 mm/yr	Lead 210 core analyses
Colman and Halka 1990	Site 104	3mm/yr	10,000year long term average
Brush 1990; Brush etal 1997	Site 104 vicinity	4mm/yr	Pollen dating post European occupation

the significant wave height, H_s, and the peak spectral wave period, T_p. The significant wave height, H_s, is defined as the average of the highest one-third of the waves in the spectrum. Depending on the duration of the storm condition represented by the wave spectrum, maximum wave heights may be as high as 1.8 to 2 times the significant wave height computed above. The peak spectral period, T_p, is the wave period that corresponds to the maximum wave energy level in the wave spectrum. Higher return periods for both wave height and periods lead to a greater potential for storm-induced resuspension of sediments from the bottom.

5.1.4 Water Quality

~~Summary~~ Introduction

Existing water quality conditions at Site 104 are described in the context of this region of the Bay ecosystem. The findings from several data collection efforts are summarized to characterize the water quality ~~in~~ at Site 104. The data collection efforts undertaken for this document included water column studies that sampled and analyzed water quality at three depths within the water column; sediment studies that characterized nutrient levels in the sediments and the sediment characteristics ~~of the sediments~~ that could influence water quality; and nutrient-related and sediment nutrient flux studies that measured fluxes of nutrients and oxygen to and from the sediments ~~now~~ existing ~~in~~ at Site 104.

The results of these studies were within expected ranges and were similar to other studies of waters of similar depth and salinity in the Bay. The area of the Bay in which Site 104 is located has ~~a mesohaline~~mesohaline salinity, generally from 5 to 13 ppt (Lippson 1973). Th~~is~~e salinity changes with depth, with bottom water being more saline. The water column generally shows less salinity stratification in the autumn through early spring, and shows greater stratification in the May to October period (MDE 1998a;~~,~~ Lippson 1973).

Salinity, water depths, and nutrient-rich sediments in Site 104 combine to ~~result in~~cause seasonal deep water hypoxia (low dissolved oxygen) or anoxia (no dissolved oxygen) ~~resulting from~~due to enhanced microbial growth in the sediments as the water temperatures warm up in the spring. This anoxia and resulting anaerobic microbial metabolism in turn cause increased rates of nitrogen and phosphorus release to the water column overlying the sediments. Studies performed by UMCES indicate that increased phosphorus and ammonium fluxes resulted in higher concentrations of these nutrients in the near-bottom waters of Site 104 in the warmer months of 1996, but this did not appear to result in more frequent or larger algal blooms (Boynton *et al.* 1998). This could be due to the large volume of water in this area, relative to the ~~loadings~~loading from the sediment. In addition, when salinity stratification exists, the waters with higher nutrient concentrations would remain in the deeper waters of Site 104, below the photic zone where increased phytoplankton production would occur. At some point, these higher concentrations of nutrients are thought to become mixed with waters above the pycnocline and to result in increased phytoplankton productivity. Details of this mixing in the Chesapeake Bay system are not well understood at this time (Boynton *et al.* 1998).

Pore water and sediment water interactions were also studied in the navigation channels in order to compare channel sediment conditions to those in Site 104 (Cornwell and Boynton 1998). While water quality conditions and grain size distributions in the deep channels were similar to those ~~of~~~~in~~ at Site 104, the sediments in the channels were less likely to flux phosphorus to the water column than were Site 104 sediments. This is thought to be due to the ~~because of the higher levels of~~ easily decomposed, phytoplankton-based organic material associated with the Site 104 sediments versus a more terrestrial nature of the nutrients associated with the channel sediments. Ammonium fluxes were lower in the more southerly CENAB channels than in the northern C&D Canal approach channels, perhaps because of higher rates of organic matter deposition in the northern channels. These observations are discussed in further detail in later sections.

5.1.4.a Water Column Studies.

Introduction

Estuaries, such as the Bay, have been experiencing water quality problems related to the worldwide growth of the human population, specifically in coastal areas (Dennison *et al.* 19943). Water quality is a significant contributor to the health of an aquatic ecosystem and can affect the distribution and abundance of living organisms within the ecosystem. Significant research on water quality has been conducted in the Bay in an effort to restore and protect the Bay ecosystem and resources. These initiatives were formalized by Federal, state, and local agencies in the 1980's (Magnien *et al.* 1993).

Water quality is influenced by a variety of factors including natural precipitation, point and non-point sources of runoff, physical mixing, natural seasonal processes, tidal cycles, and temperatures (Magnien *et al.* 1993b). Water quality in the Bay is also influenced by the magnitude and timing of freshwater flow events (Boicourt 1992). In the upper Bbay near Site 104, freshwater flows originate almost exclusively from the Susquehanna River. Water quality in the relatively broad, shallow estuary of the upper Bay is also strongly influenced by sediment oxygen consumption and sediment nutrient exchange rates, which are related to and regulated by external nutrient supplies, (including freshwater flows, and water temperature (Boynton *et al.* 1990;, Boynton *et al.* 1998).

Water quality is typically monitored by gathering a variety of chemical and physical data and by evaluating abundance and diversity of resident critical species (Dennison *et al.* 19933). Water quality data typically monitored includes: spatial location, depth, temperature, salinity, conductivity, turbidity, total suspended solids (TSS), secchi depth, pH, dissolved oxygen (DO), chlorophyll-a and nutrients such as nitrogen, phosphorus, carbon and silica species, and other components that are important to ecosystem function (Magnien *et al.* 1993).

There are significant studies on-going in the Bay, including water quality, physiochemical processes monitoring, and biological and living resources monitoring (Heasly *et al.* 1989). These studies are part of the Chesapeake Bay Basin Monitoring Program, which is funded and supported by the Federal and state governments. The monitoring subcommittee, which oversees the monitoring program, includes representatives from the EPA, USFWS, USGS, NOAA, USACE, and representatives from Maryland, Virginia, Delaware, Pennsylvania, and the District of Columbia. The water quality monitoring portion of this program, which monitors chemical and physical components, has been ongoing in Maryland since 1984.

Data from this a comprehensive water quality study (Heasly *et al.* 1989) and other studies undertaken in the upper Bay region for specific dredged material placement projects (Austin *et al.* 1991; Boynton *et al.* 1992; Boynton *et al.* 1993; Boynton *et al.* 1994; Boynton *et al.* 1995;

Boynton *et al.* 1996a and b; Boynton *et al.* 1997; Boynton *et al.* 1998; MDE 1996e; MDE 1997; MDE 1998a~~,~~ and b; Michael *et al.* 1991) have indicated that water quality in the Bay varies spatially, temporally, and seasonally, and that year-to-year variability is often significant.

MDE conducted seasonal water quality studies for this project, including ~~a~~ data collection ~~effort~~ beginning in October 1996 at stations located within and outside of Site 104, as well as an evaluation of data from two Chesapeake Bay Water Quality Monitoring Stations, MCB3.3C and MCB3.3E, which are located in the southern and eastern vicinity of Site 104, respectively (Figure 5-14~~2~~). ~~The~~ MDE provided seasonal ~~means~~ average data from the two aforementioned monitoring stations from 1985 to 1995, and compared these data to data collected beginning in October 1996 in the vicinity of Site 104. The Chesapeake Biological Laboratory (CBL) also performed a study of bottom-water quality in the Site 104 area (Figure 5-15~~3~~) over the period of May-September 1996 (Boynton *et al.* 1998).

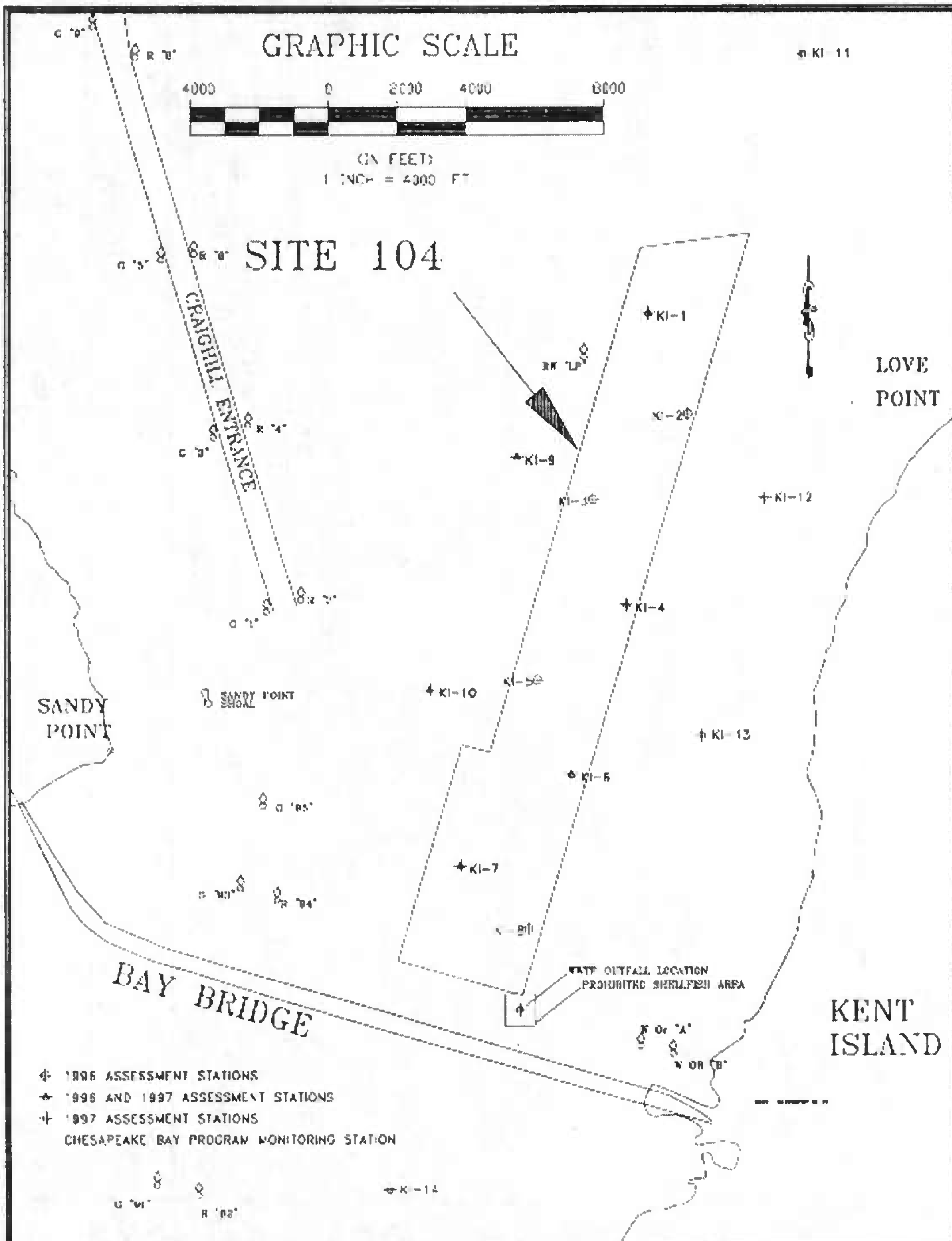
–Data from the MDE and CBL studies are discussed in the following sections. ~~Both~~All reports can be found in Appendix C.

~~**Seasonal Trends**~~

Data results indicate that water quality was influenced by seasonally varying levels of precipitation in the watershed and freshwater entering the upper Bay. A wetter than average fall in 1996 resulted in low salinities in the vicinity of Site 104 during October 1996, followed by a gradual increase through October 1997 and a slight decline in December 1997 (MDE 1998a). Surface waters were well oxygenated throughout the year, but low DO was observed in summer 1996 at depth (Boynton *et al.* 1998) and in the summer of 1997 (MDE 1998a). Water quality sampling was conducted at 10 stations in October and December 1996 (KI-1 to 10) and in April, July, October, and December 1997 (KI-1, KI-4, KI-6, KI-7, and KI-9 to KI-14) by MDE (1998a) (Figure 5-14~~2~~). Four new stations were added for the 1997 work (KI-11 to 14) in order to make the sampling stations more representative of Site 104 as a whole, and in exchange, four of the stations sampled in 1996 were not included in the 1997 sampling regime- (KI-2, KI-3, KI-5 and KI-8). - Water depths sampled ranged from -13 m (-42 ft) to -24.5 m (-80 ft) MLLW. Typically, three water quality samples were collected per station (surface, mid, and bottom) per sampling event. Mid-layer samples were collected at a site-specific calculated mid-depth. Exceptions to the three-layer sampling occurred at KI-1, KI-3, and KI-4, where mid-layer sampling was omitted because the depths were slightly shallower than at the other stations. Furthermore, at KI-12 and KI-13, where sampling depths ranged from 1.5 m (4.9 ft) to 4.1 m (13.5 ft), every sample was collected at mid-depth (MDE 1998a).

In-situ sampling was performed by MDE and analytical analysis was performed by CBL utilizing standard EPA/CBP techniques (MDE 1998a) for parameters listed in Table 5-7~~8~~.

Table 5-8~~9~~ provides a summary of the means and ranges of salinity, temperature, pH, TSS, turbidity and DO for Site 104, by sample depth and by season. A summary of the means and

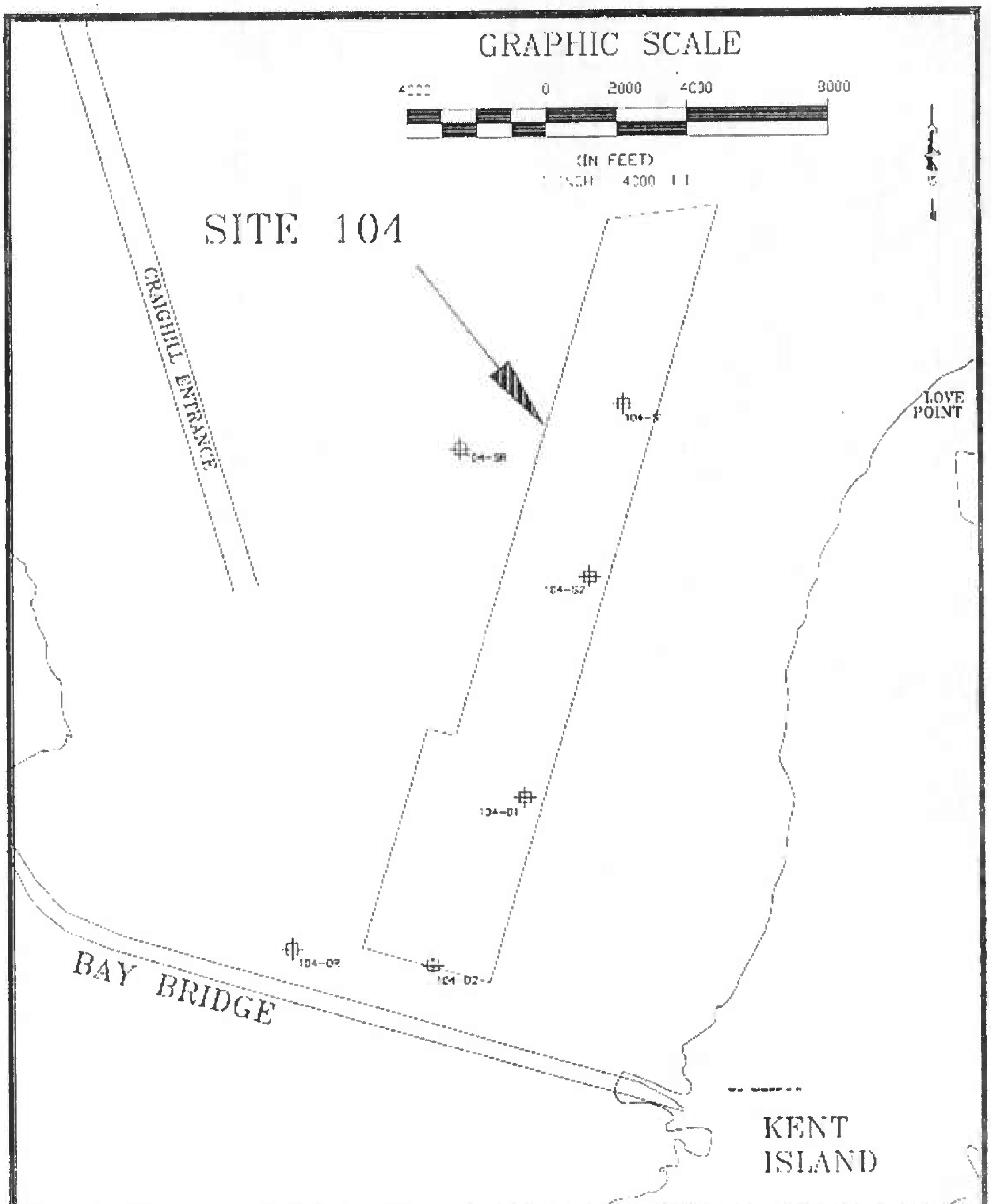


MARYLAND ENVIRONMENTAL SERVICE

MARYLAND PORT ADMINISTRATION

US Army Corps of Engineers

SITE 104
WATER QUALITY & BENTHIC
COMMUNITY ASSESSMENET STATIONS
FIGURE 5-14



MARYLAND PORT ADMINISTRATION

MARYLAND ENVIRONMENTAL SERVICE

US Army Corps of Engineers

SITE 104
SEDIMENT NUTRIENT FLUX &
PORE WATER SAMPLING STATIONS
FIGURE 5-15

Table 5-78~~G-1~~

Water Quality Parameters Measured, Units, Analysis Location, and Field Equipment or Analytical Method Utilized

Parameter	Unit	Type of Sample	Equipment/Method Utilized
Temperature	C	*in-situ*	Linear thermistor network, Hydrolab
Dissolved Oxygen (DO)	mg/L	*in-situ*	Au/Ag polarographic cell, Hydrolab
Conductivity	mmhos/cm	*in-situ*	Temperature compensated six electrode cell, Hydrolab
pH	pH units	*in-situ*	Glass Electrode, Hydrolab
Secchi Depth	M	*in-situ*	20-cm diameter disk
Depth	M	*in-situ*	Hydrolab
Turbidity	NTU	*in-situ*	Hach 2000P Turbidimeter
Total Organic Carbon	mg/L as C	analytical	EPA 1979, Method 415.2 (Infrared)
Dissolved Organic Carbon, filtered	mg/L as C	analytical	EPA 1979, Method 415.1 and 415.2 (Infrared)
Particulate Carbon	mg/L as C	analytical	Perkin Elmer Corp.
Total Suspended Solids	mg/L	analytical	Standard Methods, sect. 209D, p. 94 (Gravimetric)
Total Persulfate Nitrogen, filtered	mg/L as N	analytical	D'Elia *et al.* 1977, Valderma 1981, EPA 1979, Method 353.2
Particulate Nitrogen, filtered	mg/L as N	analytical	Perkin Elmer Corp.
Ammonia	mg/L as N	analytical	EPA 1979, Method 350.1
Nitrate & Nitrite, filtered	mg/L as N	analytical	EPA 1979, Method 353.2
Nitrite, filtered	mg/L as N	analytical	EPA 1979, Method 353.2
Total Phosphorus	mg/L as P	analytical	EPA 1979, Method 365.1
Dissolved Phosphorus	mg/L as P	analytical	EPA 1979, Method 365.1
Orthophosphate	mg/L as P	analytical	EPA 1979, Method 365.1
Particulate Phosphorus	mg/L as P	analytical	Aspila *et al.* 1976, EPA Method 160.2-1
Chlorophyll-a	µg/L	analytical	Standard Methods, sect. 1002G, pp. g50-g54
Pheophytin-a	µg/L	analytical	Standard Methods, sect. 1002G, pp. g50-g54

Source: MDE 1998a

Table 5-89G-2

Means and Ranges of Physical Parameters, by Sample Depth and Sampling Event for Site 104

Sampling Event		Salinity (ppt)	Temp (C)	pH (units)	Turbidity (NTU)	TSS (mg/L)	DO (mg/L)
Oct. 1996	Surface	7.7 (7.1-8.0)	17.4 (16.9-18.4)	8.3 (8.2-8.4)	NA	4.7 (3.0-7.3)	10.4 (9.5-11.0)
	Mid	9.9 (9.1-10.6)	17.8 (17.5-18.0)	7.7 (7.7-7.8)	NA	4.0 (2.8-5.2)	6.7 (6.2-7.2)
	Bottom	10.7 (9.8-11.6)	18.1 (17.8-18.4)	7.6 (7.6-7.7)	NA	8.3 (5.0-12.7)	6.3 (5.4-8.6)
Oct 1996 Average	Mean Range	9.4 (7.1-11.6)	17.8 (16.9-18.4)	7.9 (7.6-8.4)	NA	5.7 (2.8-12.7)	7.8 (5.4-11.0)
Dec. 1996	Surface	3.0 (2.4-3.2)	4.3 (4.2-4.4)	7.6 (7.5-7.6)	NA	12.0 (10.0-14.3)	11.9 (11.6-12.1)
	Mid	4.0 (0.0-6.4)	4.7 (0.0-5.1)	7.5 (0.0-7.6)	NA	10.7 (0.0-12.2)	NA
	Bottom	7.6 (5.3-9.5)	6.5 (5.7-7.0)	7.3 (7.0-7.4)	NA	21.1 (12.2-29.8)	9.2 (6.2-9.9)
Dec 1996 Average	Mean Range	4.9 (0.0-9.5)	5.2 (0.0-7.0)	7.5 (0.0-7.6)	NA	14.6 (0.0-29.8)	10.6 (6.2-12.1)
April 1997	Surface	5.3 (4.8-5.9)	11.1 (10.8-11.5)	8.0 (7.8-8.3)	18.1 (15.5-26.0)	6.3 (5.3-7.4)	10.9 (10.2-11.8)
	Mid	8.2 (6.0-10.1)	10.4 (10.2-10.6)	7.6 (7.5-7.7)	18.1 (16.0-22.0)	5.7 (3.4-8.6)	8.3 (7.0-9.9)
	Bottom	14.4 (13.1-16.1)	10.0 (10.0-10.0)	7.3 (7.3-7.3)	20.7 (14.8-34.0)	27.8 (11.0-65.7)	4.1 (3.0-4.8)
April 1997 Average	Mean Range	9.3 (4.8-16.1)	10.5 (10.0-11.5)	7.6 (7.3-8.3)	19.0 (14.8-34.0)	13.3 (3.4-65.7)	7.8 (3.0-11.8)
July 1997	Surface	9.0 (8.5-9.2)	26.8 (26.6-27.0)	8.2 (8.1-8.3)	2.9 (2.5-3.3)	4.6 (2.8-5.8)	7.7 (6.9-8.4)
	Mid	10.7 (9.0-12.6)	24.8 (22.5-26.6)	7.5 (7.1-8.1)	2.4 (1.9-2.8)	3.6 (2.2-6.0)	3.7 (0.4-7.0)
	Bottom	16.6 (15.3-18.0)	20.0 (19.0-21.0)	7.3 (7.2-7.3)	4.7 (2.5-7.6)	7.5 (4.0-14.2)	0.13 (0.1-0.15)
July 1997 Average	Mean Range	12.1 (8.5-18.0)	23.9 (19.0-27.0)	7.7 (7.1-8.3)	3.3 (1.9-7.6)	5.2 (2.2-14.2)	3.8 (0.1-8.4)
Oct. 1997	Surface	14.6 (13.6-15.0)	17.3 (16.9-17.6)	7.6 (7.5-7.7)	2.2 (2.0-2.4)	1.9 (1.5-2.8)	7.7 (7.5-8.0)
	Mid	15.6 (14.1-16.9)	17.7 (16.8-18.5)	7.6 (7.6-7.7)	2.3 (1.6-2.8)	6.3 (1.5-40)	7.0 (5.9-8.1)
	Bottom	17.8 (16.9-18.8)	19.2 (18.6-19.8)	7.5 (7.2-7.6)	7.2 (2.5-11.0)	9.3 (3.2-15.4)	4.9 (3.8-6.1)
Oct 1997 Average	Mean Range	16.0 (13.6-18.8)	18.1 (16.6-19.8)	7.6 (7.2-7.7)	3.9 (1.6-11.0)	5.8 (1.5-40)	6.5 (3.8-8.1)
Dec. 1997	Surface	9.9 (9.7-10.1)	5.6 (5.4-5.8)	7.8 (7.6-8.0)	2.1 (2.0-2.4)	2.0 (1.5-3.2)	10.2 (10.0-10.4)
	Mid	15.1 (9.8-17.3)	7.7 (5.4-8.5)	7.7 (7.5-7.8)	2.5 (2.0-3.2)	3.6 (1.5-6.0)	7.6 (6.6-10.7)
	Bottom	17.0 (16.7-17.5)	8.6 (8.5-8.6)	7.6 (7.3-7.7)	6.3 (3.5-10.9)	10.0 (5.3-16.0)	6.4 (6.2-6.6)
Dec. 1997 Average	Mean Range	14.0 (9.7-17.5)	7.3 (5.4-8.6)	7.7 (7.3-8.0)	3.6 (2.0-10.9)	5.2 (1.5-16.0)	8.1 (6.2-10.7)

Source: MDE 1998a

Note: NA - data not available for that parameter or depth for that sampling period. Turbidity measurements were not made prior to the April 1997 collection.

Surface, mid and bottom samples were not collected for all stations at each sampling event. Therefore, the mean for each parameter and each event is determined based upon a varying sample size.

ranges of chlorophyll-a (chl a) and nitrogen species, including total dissolved nitrogen (TDN), total nitrogen (TN), ammonia (NH_4), nitrite (NO_2), nitrite+nitrate (NO_{2+3}), particulate nitrogen (PN), and dissolved inorganic nitrogen (DIN) for Site 104 is provided for the period October 1996 through December 1997 in Table 5-9~~10~~. Table 5-10~~11~~ includes a summary of the means and ranges of phosphorus species.

Above-normal precipitation in fall 1996 resulted in slightly lower salinity readings in the vicinity of Site 104 during October 1996. Salinities were also relatively low in December 1996 and increased to substantially higher levels in April, July, and October 1997 before decreasing slightly again in December 1997 (Figure 5-16~~14~~). Water temperature (Table 5-8~~9~~) and dissolved oxygen concentrations (Figure 5-17~~15~~) followed seasonal weather patterns. TSS and pH values were within the normal range for this area of the Bay (Table 5-8~~9~~).

The CBL study indicated that DO concentrations in the bottom layer were below 2.0 mg/L at deep water Site 104 sampling stations in June, July, and August 1996, and at shallow water Site 104 sampling stations (Figure 5-15~~13~~) in July and August 1996 (Boynton *et al.* 1998) (Table 5-11~~12~~). Shallow water and deep water reference stations near Site 104 had DO concentrations below 2.0 mg/L in July, August, and September 1996. DO levels (Table 5-8~~9~~) in October 1996 (MDE 1998a) reflected a rebound from summer hypoxic conditions observed earlier in 1996 (Table 5-11~~12~~, Boynton *et al.* 1998]). In December 1996, the water column was well mixed and typical to the region and the season. Mean DO in the bottom layers was as high as 9 mg/L during December 1996, but then dropped to anoxic conditions (<2 mg/L) at deeper stations in July 1997 (MDE 1998a); these anoxic conditions are typical of the area during the summer (Boynton *et al.* 1997, 1998). By October 1997, ~~mean~~ DO concentrations in the bottom layers had reached a mean of 4.9 mg/L, and continued to increase in December 1997, reaching a mean of 6.4 mg/L (MDE 1998a). Physical parameters in spring 1997 reflected a relatively dry period prior to the April 1997 sampling event (MDE 1998a). Strong vertical stratification was observed in July 1997 and some parameters (ammonia nitrogen, orthophosphate, and salinity) were slightly elevated in bottom waters due to a protracted dry period in early 1997, and reflected sediment-to-water nutrient flux (MDE 1998a). The deeper sampling stations in Site 104 exhibited anoxia in bottom waters during July 1997 (MDE 1998a). Surface water samples were well oxygenated throughout the year; mid-depth samples showed a decline in DO in the summer, remaining on average above 3.5 mg/L (although mid-depth DO concentrations at two individual sampling locations dropped below 2.0 mg/L during July 1997) (MDE 1998a). Similar patterns were observed yearly at the background stations (MDE 1998a), and represent a natural water quality phenomenon in the deeper waters of the Maryland mainstream Chesapeake Bay (Maryland Sea Grant 1992).

~~Spatial Trends~~

Spatial variations in water quality parameters between stations inside Site 104 compared to outside Site 104 were minimal and followed no clear pattern during the period from May 1996

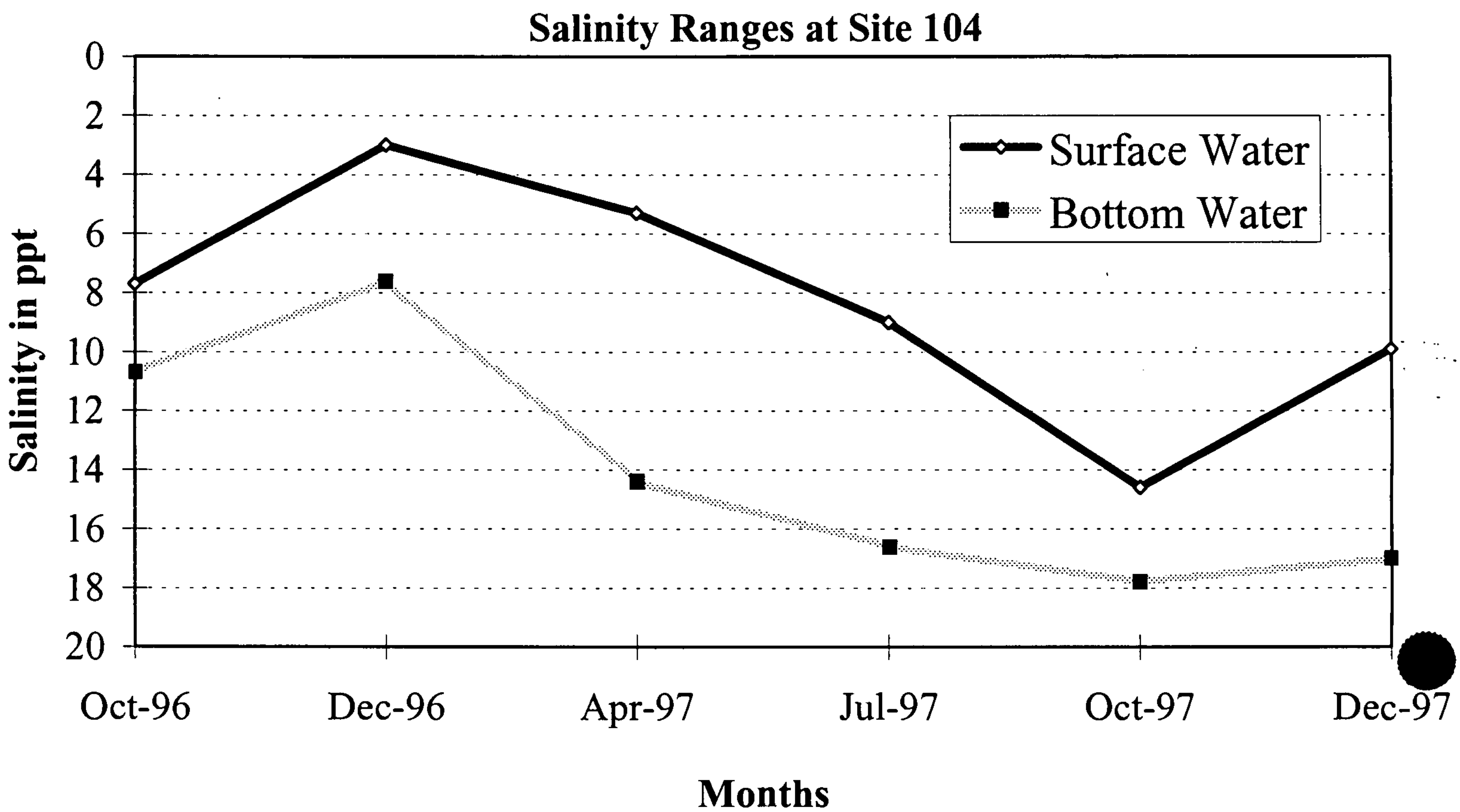


Figure 5-16~~14~~. Salinity Ranges at Site 104 (Source: MDE 1998a).

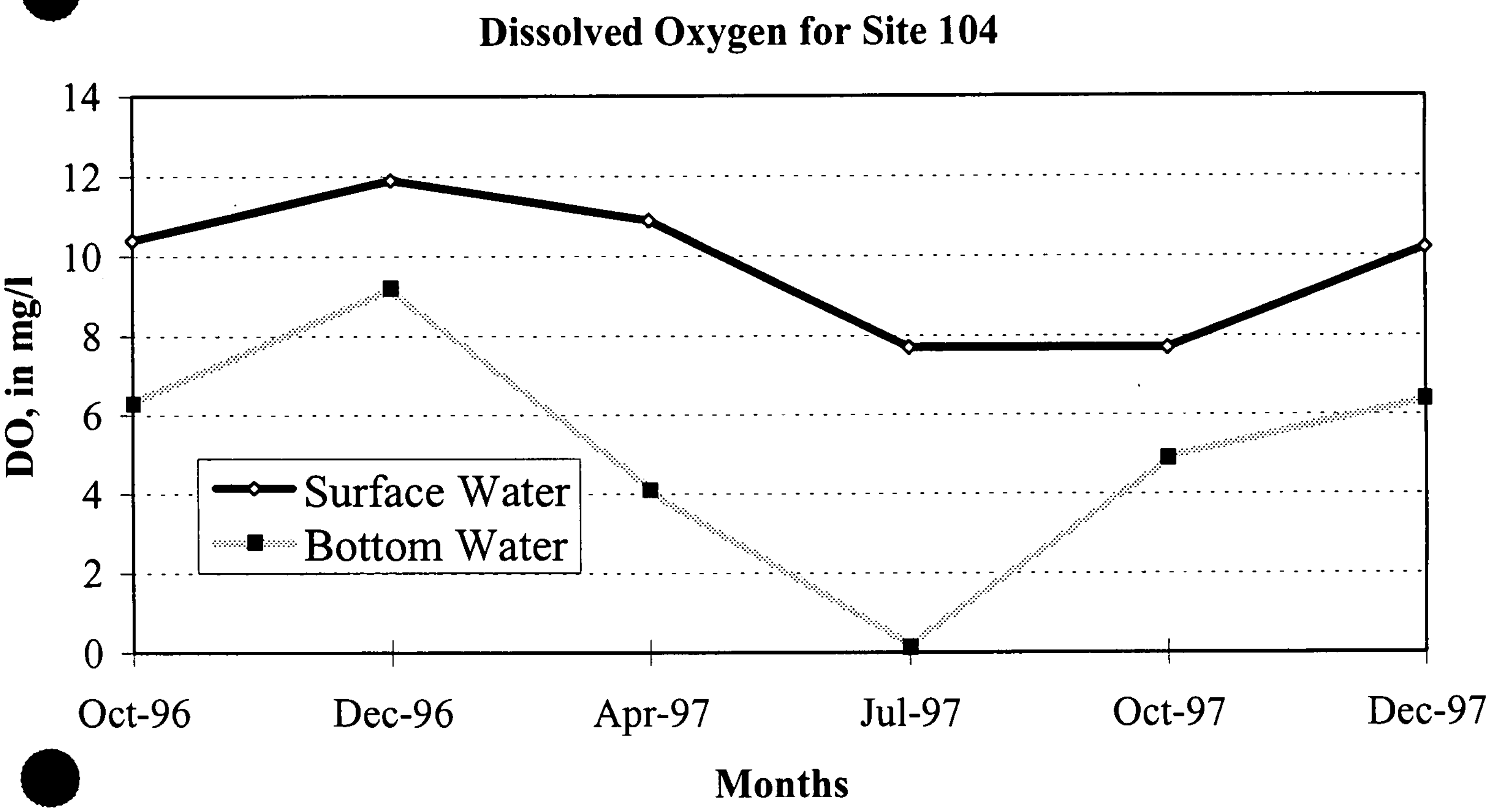


Figure 5-17~~15G-4~~. Dissolved Oxygen for Site 104 (Source: MDE 1998a).

Table 5-9~~10~~~~G-3~~

Means and Ranges of Chlorophyll-a and Nitrogen Species, by Sample Depth and Sampling Event (October 1996 - December 1997) for Site 104

Sampling Event		Chl_a (ug/L)	TDN (mg/L)	TN (mg/L)	NH_4 (mg/L)	NO_2 (mg/L)	NO_{2+3} (mg/L)	PN (mg/L)	DIN (mg/L)
Oct. 1996	Surface	19.1 (11.7-31.7)	0.57 (0.51-0.62)	0.87 (0.76-0.96)	0.003 (0.003)	NA	0.23 (0.18-0.27)	0.30 (0.22-0.42)	0.23 (0.18-0.27)
	Mid	7.6 (5.4-9.0)	0.60 (0.56-0.69)	0.75 (0.70-0.82)	0.034 (0.028-0.042)	NA	0.23 (0.22-0.24)	0.15 (0.11-0.18)	0.27 (0.25-0.28)
	Bottom	4.7 (2.4-7.8)	0.63 (0.58-0.65)	0.78 (0.71-0.84)	0.048 (0.044-0.057)	NA	0.24 (0.22-0.25)	0.16 (0.11-0.19)	0.28 (0.27-0.29)
Oct 1996 Average	Mean Range	10.5 (2.4-31.7)	0.60 (0.51-0.69)	0.80 (0.70-0.96)	0.028 (0.003-0.057)	NA	0.23 (0.18-0.27)	0.20 (0.11-0.42)	0.26 (0.18-0.29)
Dec. 1996	Surface	9.1 (4.5-16.2)	1.28 (1.20-1.36)	1.43 (1.37-1.52)	0.071 (0.062-0.078)	NA	1.02 (0.87-1.03)	0.16 (0.10-0.25)	1.09 (0.94-1.11)
	Mid	3.4 (0.0-10.5)	1.26 (0.00-1.32)	1.36 (0.00-1.53)	0.084 (0.000-0.097)	NA	0.99 (0.00-1.03)	0.10 (0.00-0.21)	1.08 (0.00-1.11)
	Bottom	2.2 (1.8-3.0)	1.01 (0.66-1.15)	1.13 (0.91-1.23)	0.108 (0.100-0.115)	NA	0.68 (0.18-0.86)	0.13 (0.08-0.17)	0.79 (0.33-0.97)
Dec 1996 Average	Mean Range	4.9 (0.0-16.2)	1.18 (0.00-1.36)	1.31 (0.00-1.53)	0.088 (0.000-0.115)	NA	0.90 (0.00-1.03)	0.13 (0.00-0.25)	0.99 (0.00-1.11)
April 1997	Surface	NA	1.06 (1.00-1.12)	NA	0.042 (0.009-0.066)	0.010 (0.009-0.011)	0.83 (0.81-0.84)	0.17 (0.11-0.28)	NA
	Mid	NA	0.97 (0.93-1.04)	NA	0.108 (0.054-0.147)	0.011 (0.010-0.011)	0.68 (0.55-0.79)	0.14 (0.10-0.24)	NA
	Bottom	NA	0.85 (0.79-0.92)	NA	0.260 (0.200-0.299)	0.014 (0.013-0.015)	0.37 (0.30-0.41)	0.21 (0.13-0.42)	NA
April 1997 Average	Mean Range	NA	0.96 (0.79-1.12)	NA	0.137 (0.009-0.299)	0.012 (0.009-0.015)	0.63 (0.30-0.84)	0.17 (0.10-0.42)	NA

Source: MDE 1998a

Note:

1. NA - data not available for that parameter or depth for that sampling period.
2. Surface, mid and bottom samples were not collected for all stations at each sampling event. Therefore, the mean for each parameter and each event is determined based upon a varying sample size.

Table 5-9~~10~~~~G-3~~ (continued)

Sampling Event		Chl_a (ug/L)	TDN (mg/L)	TN (mg/L)	NH_4 (mg/L)	NO_2 (mg/L)	NO_{2+3} (mg/L)	PN (mg/L)	DIN (mg/L)
July 1997	Surface	9.1 (5.7-11.1)	0.31 (0.27-0.34)	0.58 (0.53-0.65)	0.013 (0.003-0.031)	0.001 (0.001-0.002)	0.008 (0.003-0.014)	0.28 (0.22-0.33)	NA
	Mid	5.0 (3.0-8.7)	0.35 (0.24-0.42)	0.52 (0.43-0.60	0.089 (0.011-0.156)	0.002 (0.001-0.003)	0.009 (0.003-0.012)	0.17 (0.12-0.27)	NA
	Bottom	4.1 (2.7-5.1)	0.66 (0.61-0.71)	0.80 (0.74-0.85)	0.400 (0.335-0.427)	0.001 (0.001-0.002)	0.004 (0.002-0.008)	0.14 (0.10-0.19)	NA
July 1997 Average	Mean Range	6.1 (2.7-11.1)	0.44 (0.24-0.71)	0.63 (0.43-0.85)	0.167 (0.003-0.427)	0.001 (0.001-0.003)	0.007 (0.002-0.014)	0.20 (0.10-0.33)	NA
Oct. 1997	Surface	5.8 (4.5-7.5)	0.46 (0.43-0.53)	0.58 (0.54-0.64)	0.039 (0.034-0.046)	0.008 (0.008-0.009)	0.15 (0.014-0.18)	0.11 (0.09-0.13)	NA
	Mid	3.6 (2.1-6.6)	0.41 (0.38-0.44)	0.51 (0.46-0.55)	0.040 (0.031-0.051)	0.009 (0.007-0.012)	0.12 (0.09-0.15)	0.09 (0.06-0.12)	NA
	Bottom	1.8 (1.2-3.0)	0.45 (0.4-0.54)	0.54 (0.48-0.61)	0.073 (0.051-0.094)	0.019 (0.013-0.024)	0.09 (0.07-0.10)	0.10 (0.07-0.15)	NA
Oct 1997 Average	Mean Range	3.7 (1.2-7.5)	0.44 (0.38-.054)	0.54 (0.46-0.61)	0.051 (0.031-0.094)	0.012 (0.007-0.024)	0.12 (0.07-0.18)	0.10 (0.06-0.15)	NA
Dec. 1997	Surface	3.6 (3.0-3.9)	0.94 (0.87-0.98)	1.05 (0.96-1.12)	0.107 (0.090-0.121)	0.007 (0.006-0.007)	0.58 (0.55-0.59)	0.11 (0.09-0.12)	NA
	Mid	6.8 (2.7-9.9)	0.61 (0.42-0.95)	0.74 (0.60-1.04)	0.096 (0.088-0.107)	0.006 (0.005-0.007)	0.20 (0.05-0.057)	0.14 (0.09-0.19)	NA
	Bottom	10.2 (7.8-15.0)	0.51 (0.46-0.58)	0.71 (0.65-0.76)	0.104 (0.094-0.114)	0.006 (0.005-0.006)	0.07 (0.05-0.09)	0.20 (0.16-0.26)	NA
Dec. 1997 Average	Mean Range	6.9 (2.7-15.0)	0.69 (0.42-0.98)	0.84 (0.61-1.09)	0.102 (0.088-0.121)	0.006 (0.005-0.007)	0.28 (.05-0.59)	0.15 (0.09-0.26)	NA

Source: MDE 1998a

Note:

1. NA - data not available for that parameter or depth for that sampling period.
2. Surface, mid and bottom samples were not collected for all stations at each sampling event. Therefore, the mean for each parameter and each event is determined based upon a varying sample size.

TDP = Total Dissolved Phosphorus
TP = Total Phosphorus
PP = Particulate Phosphorus

Table 5-10~~11G-4~~

Means and Ranges of Phosphorus Species, by Sample Depth and Sampling Event for Site 104

Sampling Event		PO_4 (mg/L)	TDP (mg/L)	TP (mg/L)	PP (mg/L)
Oct. 1996	Surface	0.004 (0.001-0.006)	0.017 (0.014-0.022)	0.043 (0.034-0.059)	0.026 (0.019-0.038)
	Mid	0.011 (0.008-0.014)	0.022 (0.017-0.026)	0.038 (0.035-0.043)	0.016 (0.013-0.019)
	Bottom	0.017 (0.015-0.019)	0.026 (0.023-0.029)	0.047 (0.039-0.056)	0.021 (0.015-0.030)
Oct 1996 Average	Mean Range	0.011 (0.001-0.019)	0.022 (0.014-0.029)	0.043 (0.034-0.059)	0.021 (0.013-0.038)
Dec. 1996	Surface	0.017 (0.015-0.021)	0.024 (0.022-0.026)	0.049 (0.044-0.052)	0.024 (0.022-0.026)
	Mid	0.018 (0.000-0.019)	0.025 (0.000-0.026)	0.050 (0.000-0.052)	0.025 (0.000-0.026)
	Bottom	0.017 (0.013-0.019)	0.023 (0.019-0.024)	0.046 (0.043-0.049)	0.023 (0.022-0.024)
Dec 1996 Average	Mean Range	0.017 (0.000-0.021)	0.024 (0.000-0.026)	0.048 (0.000-0.052)	0.024 (0.000-0.026)
April 1997	Surface	0.002 (0.001-0.003)	0.008 (0.007-0.010)	0.043 (0.020-0.148)	NA
	Mid	0.004 (0.001-0.006)	0.010 (0.008-0.013)	0.024 (0.018-0.032)	NA
	Bottom	0.014 (0.012-0.016)	0.020 (0.017-0.022)	0.057 (0.034-0.103)	NA
April 1997 Average	Mean Range	0.007 (0.001-0.016)	0.013 (0.007-0.022)	0.041 (0.018-0.148)	NA
July 1997	Surface	0.006 (0.004-0.010)	0.015 (0.013-0.017)	0.039 (0.034-0.043)	0.024 (0.020-0.026)
	Mid	0.004 (0.003-0.005)	0.013 (0.011-0.016)	0.031 (0.027-0.037)	0.019 (0.016-0.022)
	Bottom	0.044 (0.030-0.054)	0.055 (0.039-0.069)	0.086 (0.064-0.101)	0.031 (0.023-0.041)
July 1997 Average	Mean Range	0.018 (0.003-0.054)	0.028 (0.011-0.069)	0.052 (0.027-0.101)	0.025 (0.016-0.041)
Oct. 1997	Surface	0.025 (0.023-0.027)	0.034 (0.030-0.037)	0.042 (0.038-0.045)	0.008 (0.008-0.009)
	Mid	0.020 (0.015-0.024)	0.029 (0.023-0.033)	0.035 (0.030-0.042)	0.007 (0.005-0.011)
	Bottom	0.018 (0.016-0.022)	0.026 (0.021-0.031)	0.038 (0.031-0.050)	0.014 (0.007-0.023)
Oct 1997 Average	Mean Range	0.021 (0.015-0.027)	0.030 (0.021-0.037)	0.038 (0.030-0.050)	0.010 (0.005-0.023)
Dec. 1997	Surface	0.007 (0.005-0.009)	0.014 (0.012-0.019)	0.016 (0.013-0.020)	0.001 (0.001-0.001)
	Mid	0.004 (0.003-0.006)	0.012 (0.011-0.013)	0.014 (0.013-0.015)	0.001 (0.001-0.002)
	Bottom	0.004 (0.003-0.005)	0.013 (0.011-0.016)	0.016 (0.013-0.019)	0.002 (0.002-0.003)
Dec. 1997 Average	Mean Range	0.005 (0.003-0.009)	0.013 (0.011-0.019)	0.015 (0.013-0.020)	0.002 (0.001-0.003)

Source: MDE 1998a

Note:

1. NA - data not available for that parameter or depth for that sampling period.
2. Surface, mid and bottom samples were not collected for all stations at each sampling event. Therefore, the mean for each parameter and each event is determined based upon a varying sample size.

TDP =Total Dissolved Phosphorus TP = Total Phosphorus PP =Particulate Phosphorus

Table 5-11~~12G-5~~

Physical Parameters Measured in Bottom Water Layers in the Vicinity of Site 104 During Summer 1996

Station	Date	Time	Total Depth (m)	Sample Depth (m)	Bottom Water Measurements			
					Temp. (C)	Salinity (ppt)	DO (mg/L)	DO Sat (%)
Shallow Water Stations: 12 - 15 Ms								
Shallow Water Reference Station: Average Depth 13.5 Ms								
104-SR	14-May-96	1708	14.5	14.0	13.8	10.6	3.07	31.6
104-SR	10-Jun-96	1620	14.5	14.0	18.2	12.0	2.07	23.6
104-SR	17-Jul-96	801	14.0	13.5	21.8	14.5	0.09	1.1
104-SR	15-Aug-96	745	14.3	14.0	24.5	16.8	0.16	2.1
104-SR	11-Sep-96	820	12.0	12.0	25.1	NA	1.96	24.4
Shallow Water Sampling Station #1: Average Depth 13.3 Ms								
104-S1	14-May-96	1145	14.5	13.5	14.0	9.9	3.27	33.7
104-S1	10-Jun-96	1100	14.5	14.0	19.4	8.4	4.09	46.6
104-S1	16-Jul-96	1415	13.5	13.0	24.0	8.8	3.53	44.1
104-S1	12-Aug-96	1440	13.5	13.0	24.3	15.6	0.15	2.0
104-S1	9-Sep-96	1355	14.0	13.0	25.6	11.7	3.32	43.4
Shallow Water Sampling Station #2: Average Depth 15.7 Ms								
104-S2	14-May-96	1400	17.0	16.0	13.9	10.2	3.15	32.4
104-S2	10-Jun-96	1335	16.5	15.5	17.2	14.6	0.47	5.3
104-S2	16-Jul-96	1618	15.5	15.0	23.0	10.4	1.64	20.3
104-S2	12-Aug-96	1735	17.0	16.0	24.3	16.4	0.14	1.8
104-S2	9-Sep-96	1600	17.0	16.0	25.5	12.3	2.95	38.6
Deep Water Stations: 16 - 25 Ms								
Deep Water Reference Station: Average Depth 17.6 Ms								
104-DR	15-May-96	1302	18.0	17.5	14.1	9.1	3.56	36.5
104-DR	11-Jun-96	1145	18.0	17.0	19.5	9.9	3.63	41.9
104-DR	22-Jul-96	1118	18.0	17.5	22.1	15.1	0.20	2.5
104-DR	14-Aug-96	1420	18.5	18.0	24.5	17.6	0.21	2.8
104-DR	10-Sep-96	800	18.0	18.0	25.1	14.9	0.49	6.5
Deep Water Sampling Station #1: Average Depth 18.3 Ms								
104-D1	15-May-96	815	20.0	19.5	13.3	11.3	2.51	25.7
104-D1	11-Jun-96	835	19.5	19.0	18.0	12.7	1.66	18.9
104-D1	22-Jul-96	830	18.5	18.0	22.2	14.9	0.18	2.3
104-D1	14-Aug-96	815	18.5	18.0	24.4	18.0	0.16	2.1
104-D1	10-Sep-96	1025	18.5	17.0	25.5	13.0	1.98	26.0
Deep Water Sampling Station #2: Average Depth 24.1 Ms								
104-D2	15-May-96	1102	25.0	24.5	13.9	10.1	3.24	33.3
104-D2	11-Jun-96	1445	25.0	23.5	16.9	16.4	0.08	0.9
104-D2	22-Jul-96	1504	25.0	24.0	22.0	15.4	0.20	2.5
104-D2	14-Aug-96	1035	25.0	24.5	24.4	18.1	0.15	2.0
104-D2	10-Sep-96	1400	27.0	24.0	25.4	14.9	0.13	1.7

Source: Boynton *et al.* 1998

Note: NA indicates data were not available.

through December 1997. Spatial variations were less apparent than the seasonal trends previously discussed.

In order to compare physical and chemical water quality parameters inside the previously used placement area (Site 104) to parameters outside the site, the stations were grouped by location and depth. -This enabled comparison of stations at similar locations and depths. The major categories were deep inside stations, consisting of stations KI-1 through KI-8 (Figure 5-14~~12~~), all inside Site 104 and all in water ranging from 12.5 m (41 ft) to 19.5 m (64.3 ft) deep; deep outside stations, including stations KI-9, KI-10, and KI-11, all outside Site 104; and shallow outside stations, that included stations KI-12 and KI-13, outside Site 104 and in waters less than 4.1 m (13.5 ft) deep. Station KI-14, outside Site 104 to the south of the Bay Bridge, was not included because its depth is >25m (82 ft). No shallow stations [less than 4.6 m (15 ft)] exist inside Site 104.

For each water quality parameter, the occurrence, direction, and magnitude of statistical significance with respect to background data from EPA's Chesapeake Bay Program monitoring stations (MCB3.3C and MCB3.3E) were calculated (Appendix C). Water quality conditions at Site 104 were within typical ranges for this region of the Bay and conditions in Site 104 were similar to the nearby CBP monitoring stations from October 1996 to July 1997 (MDE 1998a).

Minimal spatial variations were observed between the water quality assessment stations inside and outside the boundaries of Site 104 in summer 1996 (Table 5-12~~13~~) (Boynton *et al.* 1998) and during the October 1996 through December 1997 sampling period (MDE 1998a). During summer 1996, no clear spatial trends emerged in physical parameters in surface or bottom water layers, either when comparing shallow stations inside Site 104 and shallow reference stations outside the site (Figure 5-15~~13~~), or comparing deep stations inside and outside Site 104 (Table 5-12~~13~~). DO levels declined below 2.0 mg/L in June 1996 at the deep stations inside Site 104, while the deep reference station remained above hypoxic levels (Boynton *et al.* 1998). However, the stations inside Site 104 were deeper than the corresponding reference stations. In July and August 1996 nutrient concentrations in bottom waters in the vicinity of Site 104 -(Table 5-13~~14~~) followed no discernible spatial trends among the deep and shallow Site 104 stations and reference stations, although clear seasonal trends were evident for nitrate and nitrite. Nitrite+nitrate concentrations in the bottom layers were somewhat lower at the deep stations at Site 104 than at the corresponding reference station or the shallow stations in June 1996; nitrite+nitrate concentrations continued to be lower at all deep stations than at shallow stations in July 1996.

Differences in bottom water nutrient concentrations among the stations were less apparent than seasonal trends (Boynton *et al.* 1998). Deviations in the observed patterns among chemical and nutrient parameters from those seen in the background data could be attributed to heavy precipitation and runoff in fall and early winter of 1996, followed by an extended dry spell during spring and summer of 1997 (MDE 1998a).

~~Kent Island Waste Water Treatment Plant Outfall~~

Table 5-12~~13G-6~~

Physical Parameters in the Vicinity of Site 104 in Summer 1996, by Sampling Date, Depth, and Location

		May 1996				June 1996			
Level	**Station**	**Depth (m)**	**Salinity (ppt)**	**Temp (C)**	**DO (mg/L)**	**Depth (m)**	**Salinity (ppt)**	**Temp (C)**	**DO (mg/L)**
Surface	Mean of S1, S2	0.5,0.5	2.2	16.2	10.36	0.5,0.5	5.7	22.2	7.83
	SR	0.5	1.8	17.5	10.65	0.5	6	22.5	8.34
	Mean of D1, D2	0.5,0.5	3.2	15.4	9.2	0.5,0.5	6	22.2	7.2
	DR	0.5	3	15.7	9.27	0.5	5.8	22.3	7.7
Middle	Mean of S1, S2	6,6	6.3	14.7	5.81	6,6	6.1	21.3	6.78
	SR	6	7.2	14.5	5.7	6	6.4	21.4	6.95
	Mean of D1, D2	6,6	4.7	15.2	7.67	6,6	6.5	22.1	7.51
	DR	6	3.2	15.4	8.68	6	5.8	22.2	7.42
Bottom	Mean of S1, S2	13.5, 16	10.1	14	3.21	14,15.5	11.5	18.3	2.28
	SR	14	10.6	13.8	3.07	14	12	18.2	2.07
	Mean of D1, D2	19.5,24.5	10.7	13.6	2.88	19,23.5	14.6	17.5	0.87
	DR	17.5	9.1	14.1	3.56	17	9.9	19.5	3.63

Source: Boynton *et al.* 1998

Note: S1, S2: shallow stations inside Site 104.
SR: shallow reference station.
D1, D2: deep stations inside Site 104.
DR: deep reference station.

Table 5-1213G-6 (continued)

Physical Parameters in the Vicinity of Site 104 in Summer 1996, by Sampling Date, Depth, and Location

		July 1996				August 1996				September 1996			
Level	**Station**	**Depth (m)**	**Salinity (ppt)**	**Temp (C)**	**DO (mg/L)**	**Depth (m)**	**Salinity (ppt)**	**Temp (C)**	**DO (mg/L)**	**Depth (m)**	**Salinity (ppt)**	**Temp (C)**	**DO (mg/L)**
Surface	Mean of S1, S2	0.5,0.5	6.1	27.3	11.2	0.5,0.5	7.2	25.3	6.68	0.5,0.5	9.5	26.9	11.87
	SR	0.5	6.9	25.4	7.1	0.5	5.6	24.3	7.66	0.5	8.6	26.3	9.22
	Mean of D1, D2	0.5,0.5	5.6	25.2	9.5	0.5,0.5	6.2	23.9	6.87	0.5,0.5	8.7	27.0	12.54
	DR	0.5	6	25.1	9.2	0.5	6.2	24.9	7.28	0.5	8.6	25.9	8.41
Middle	Mean of S1, S2	6,6	7.2	25.1	5.9	6,6	8.1	25.4	5.14	6,6	10.6	25.8	5.17
	SR	6	7.5	24.8	5.6	6	9.2	24.4	4.03	6	10.6	25.6	4.02
	Mean of D1, D2	6,6	9	24.3	3.1	6,6	11.3	24.3	2.71	6,6	10.1	25.8	5.08
	DR	6	7.9	24.6	4.8	6	11.1	24.5	2.66	6	10.1	25.9	6.23
Bottom	Mean of S1, S2	13,15	9.6	23.5	2.6	13,16	16	24.3	0.15	13,16	12.0	25.6	3.14
	SR	13.5	14.5	12.8	0.1	14	16.8	24.5	0.16	12	NA	25.1	1.96
	Mean of D1, D2	18,24	15.2	22.1	0.2	18, 24.5	18.1	24.4	0.16	17,24	8.7	25.5	1.06
	DR	17.5	15.1	22.1	0.2	18	17.6	24.5	0.21	18	14.9	25.1	0.49

Source: Boynton *et al.* 1998

Note: S1, S2: shallow stations inside Site 104.
SR: shallow reference station.
D1, D2: deep stations inside Site 104.
DR: deep reference station.

Note: NA indicates data were not available.1996, differences in bottom DO levels between deep reference and deep Site 104 stations were negligible (Boynton *et al.* 1998)

Table 5-13~~14~~~~G-7~~

Nutrients in Bottom Water Layers in the Vicinity of Site 104 in Summer 1996, by Sampling Date and Location

Station	Depth (m)	NH_4 (uM)	NO_2 (uM)	NO_{2+3} (uM)	DIP (uM)
May 1996					
Mean of S1, S2	13.5, 16	24.2	2.45	41.4	0.53
SR		23	2.41	40	0.5
Mean of D1, D2	19.5, 24.5	22.9	2.45	38.45	0.47
DR		24.6	2.46	43.3	0.64
June 1996					
Mean of S1, S2	14, 15.5	15.1	0.97	16.87	0.1
SR	14	16.1	0.8	12.7	0.1
Mean of D1, D2	19, 23.5	19.8	0.49	5.71	0.34
DR	17	11.6	0.98	21.4	0.11
July 1996					
Mean of S1, S2	13, 15	25.9	0.5	6.32	0.7
SR	13.5	33.4	0.24	0.75	1.54
Mean of D1, D2	18,24	38	0.07	0.15	3.05
DR	17.5	35.7	0.08	0.15	2.52
August 1996					
Mean of S1, S2	13,16	29.5	0.05	0.16	2.78
SR	14	23.8	0.05	0.12	2.69
Mean of D1, D2	18,24.5	20.8	0.05	0.13	4.1
DR	18	22.1	0.08	0.14	2.28
September 1996					
Mean of S1, S2	13,16	20.4	0.23	0.8	1.75
SR	12	21.1	0.18	0.59	1.88
Mean of D1, D2	17,24	23.4	0.15	0.42	2.08
DR	18	25.8	0.04	0.2	2.55

Source: Boynton *et al.* 1998

Note:	S1, S2:	shallow stations inside Site 104.
	SR:	shallow reference station. .
	D1, D2:	deep stations inside Site 104.
	DR:	deep reference station.

The outfall for the Kent Island Waste Water Treatment Plant (WWTP) extends from the Kent Island shoreline to a point approximately adjacent to the southeastern corner of Site 104 (Figure 5-14). A diffuser is located on the Bay bottom at the end of a submerged pipe that releases effluent at consistent points, not just at the end. Physical and chemical water quality of the treatment plant effluent is monitored periodically by plant personnel at a sampling point on the WWTP property upstream of the submerged discharge pipe. Effluent water quality records for the period 1990 through February 1997 were obtained and compared to nutrient levels at Site 104. Nutrient levels in the treatment plant effluent at the plant prior to discharge were generally similar to or higher than those observed in surface waters at Site 104; no discernable increase in nutrient levels at Site 104 sampling locations closest to the outfall were noted (MDE 1998a).

It is likely that ambient Chesapeake Bay waters in the mixing zone adjacent to the plant outfall dilute any elevated nutrient concentrations in the treatment plant effluent.

Conclusions - —Water Quality Data Collection

Site 104 lies in the mesohaline portion of the middle Chesapeake Bay. Physical and chemical water quality parameters observed throughout this ~~assessment~~ study were largely within expected ranges observed in this area of the Bay. The time frame encompassing the ~~assessment~~ study included extended periods of unusual meteorological conditions. The year 1996 was wetter than average in the Bay region, while an extended dry spell occurred during the spring and summer of 1997. The signatures of these events are evident in data collected during the ~~assessment~~ study. Salinity data from Site 104, when compared with background data from 1985-1996, highlights these episodic events (MDE 1998a).

Hypoxic to anoxic conditions were observed in summer 1997 at the bottom layers of all but the shallowest stations in the vicinity of Site 104. Site 104 lies within the portion of the Bay routinely subjected to oxygen depletion in deeper water during the summer months. The background data collected by the ~~Chesapeake Bay Program~~CBP at station MCB3.3C and MCB3.3E also exhibited similar trends (MDE 1998a).

Dissolved nutrient regimes at Site 104 generally followed seasonally-_expected patterns, with minor perturbations probably ~~owing~~ due to meteorologic ~~al variations~~variability. A prominent feature was the relatively high concentration of both ammonia and orthophosphate in bottom waters during summer 1997. These concentrations were similar to those seen in the background data set, and indicate nutrient flux from sediments to the overlying water column during periods of low oxygen concentrations (MDE 1998a).

Particulate nutrient fractions, as well as measures of water clarity, appear to have been more immediately influenced by precipitation and runoff. A sharp spike in these parameters in the bottom water layer at Station KI-6 in April 1997 may be the result of localized disturbance of the B~~b~~ay floor~~.~~ (MDE 1998a).

Water quality at sampling stations outside and inside the boundaries of the proposed site generally did not exhibit significant spatial variation (Boynton *et al.* 1998; MDE 1998a). Where such variation did occur, it usually was attributable to differing sampling depths. Stations KI-12 and KI-13, for example, exhibited apparent differences from other mid-layer samples. However, the mid-layer at these two stations was only 1 to 1.5 m (3 to 5 ft) deep, and when compared with water samples from that depth, differences in most parameters were no longer evident (MDE 1998a).

The most serious degradation of water quality in this area of the Bay occurred during the summer months when DO levels approach zero at bottom depths~~,~~ and the concentrations of orthophosphate and ammonia nitrogen exhibited sharp increases indicative of nutrient fluxes (MDE 1998a).

5.1.4.b Sediment Nutrient Interactions in Site 104.

Summary

The sediments in the middle and upper Bay can serve as the predominant source of nutrients, which can flux~~es~~ to the overlying water column (Boynton *et al.* 1998) under certain conditions. Sediment water interactions at Site 104 were studied to characterize the existing relationship of water quality and sediment ~~interactions~~. Sediments within Site 104 are rich in organic material and nutrients (Boynton *et al.* 1998). Annual deposition of organic materials in Site 104 fuels the ~~seasonal~~ summer anoxia and high rates of ammonium and phosphorus release to the bottom waters in the area. At least temporarily, the ~~seasonal~~ summer pycnocline that develops as a result of freshwater runoff and solar warming of the surface keeps waters with higher nutrient concentrations at the bottom. Over a period of time, these nutrients move upward through the pycnocline into the waters of the photic zone. This process likely occurs by the time the pycnocline decreases in strength with winter cooling of the surface layers, but the mechanism is not fully described or understood as of yet (Boynton *et al.* 1998). The results of sediment/nutrient flux studies at Site 104 were similar to other deep mesohaline waters of the Chesapeake Bay.

Introduction to Sediment Nutrient Interactions

The Chesapeake Bay is a relatively shallow ecosystem with limited flushing. Because of this, the sediments act as the dominant storage site for nutrients and organic matter. Sediments have a significant influence on water quality conditions, due to the following: (1) microbes in the sediments utilize DO from the overlying water column, resulting in hypoxic or anoxic conditions in deep water; and (2) sediments release essential nutrients that support phytoplankton growth; this phytoplankton growth is followed by deposition and decay on the sediment surface that fuels the depletion of DO in deep water and the resulting hypoxia and anoxia (Boynton *et al.* 1998). A considerable portion of the total primary production (10-50 percent) and organic matter are deposited in the sediments. At depths greater than 20.1 m (66 ft), the percentage of primary production deposition often exceeds 40 percent of total primary production (Roden *et al.* 1995). This high rate of organic matter deposition typically leads to a predominance of anaerobic pathways for sediment metabolism (Roden *et al.* 1995) associated with hypoxic or anoxic conditions.

In order to evaluate the Bay's overall health and to facilitate changes that would improve the ecosystem, it is necessary to monitor nutrient levels in the water column and sediments, as well as the exchange between the two components, referred to as sediment nutrient flux, in addition to the phytoplankton production in the estuary. As discussed above, these components, as well as others, are interdependent, and a significant~~,~~ ~~far-field~~ change in one factor could result in significant changes throughout the ecosystem.

In support of the Chesapeake Bay Agreement, which was signed by parties from the Bay jurisdictions,~~.-~~ ~~T~~the ~~Chesapeake Bay Program~~CBP has established a goal of achieving a 40 percent reduction of nutrients entering the Bay by the year 2000 (MDE *et al.* 1995). As part of this strategy, there has been a movement to address the nutrient inputs to the Bay at their source, referred to as the Tributary Strategies Program (MDE *et al.* 1995). The majority of nutrient loading to the Bay is from external sources at the head of the estuary, typically riverine sources and major wastewater treatment plants (Magnien *et al.* 1992). In addition, within the mainstem Bay, the oligohaline and upper mesohaline portions are sites of considerable internal recycling of nutrients to surface waters, and the sedimentation load (containing significant nutrients) from the upper reaches of the Bay is considered the major source of these recycled nutrients (Magnien *et al.* 1992).

As part of the Maryland Chesapeake Bay Water Quality Monitoring Program (Heasly *et al.* 1989) the Sediment Oxygen and Nutrient Exchanges (SONE) monitoring program has been initiated by UMCES. This program monitors the nutrient levels in the water column and sediments, and studies sediment nutrient flux. Results from this program are discussed below.

Sediment Nutrients—Study Description and Related Studies

In order to evaluate the existing sediment nutrient flux conditions at Site 104, the UMCES, CBL, and Horn Point Environmental Laboratory (HPEL) conducted sediment carbon, oxygen and nutrient flux analysis (Boynton *et al.* 1998) and pore water/solid phase analysis (Cornwell and Owens 1998) for the Site 104 area. Included in the data collection effort were stations located within and adjacent to the project area. For the sediment carbon, oxygen, and nutrient flux study, CBL also evaluated available data from the Deep Trough study (Boynton and Garber 1989), from other nearby stations which are part of the SONE program, and from studies completed in the Pooles Island area (Boynton *et al.* 1992, 1993, 1994, 1995, 1996, 1997) to provide a comparison base to determine whether the data for Site 104 ~~is~~ similar to or unique from other areas of the upper Bay.

Findings from sediment nutrient flux studies at two stations from the SONE program and four stations within the Deep Trough were evaluated and compared to the findings from the Site 104 data collection. Site 104 ~~conditions~~ nutrient flux relationships were similar to those found in the Deep Trough study conducted in 1989, and in 10 years of data collection at two SONE stations in relatively deep waters. The Deep Trough study (Boynton and Garber 1989) conducted in 1989 revealed higher rates of ammonium fluxes and dissolved inorganic phosphate fluxes from the sediments to the water column than those observed at Site 104, but the ranges were similar.

Sediment~~,~~ Carbon, Oxygen, and Nutrient Flux Analysis

Sediment carbon, oxygen, and nutrient flux sampling occurred at six stations, three in shallow water (104-SR, 104-S1, and 104-S2) and three in deep waters (104-DR, 104-D1, and 104-D2) (Figure 5-15~~13~~). Sampling was conducted by CBL during May, June, July, August, and September 1996 -(Boynton *et al.* 1998). A total of five sets of measurements were made per station (vertical water column profiles of temperature, salinity, and DO;~~,~~ water column samples;~~,~~ and sediment core samples). The sampling was scheduled for the period of the year when water temperatures are above 15°C (59°F). This temperature was selected because previous investigations have revealed that sediment-water carbon, oxygen, and nutrient exchanges are most active during the warmer months, and sediment-water fluxes (particularly phosphorus) are greatest during hypoxic or anoxic periods in the warmer months (Boynton *et al.* 1998). This phenomenon is attributed to microbial mediation. Microorganisms in the sediments, which are most active during the warm months, decompose organic matter to obtain energy. This decomposition process results in a release of dissolved inorganic forms of the nutrients to the water column (Day *et al.* 1989).

The water column samples were analyzed for ammonium, nitrite, nitrite+nitrate, dissolved inorganic phosphorus (DIP) corrected for salinity, and ~~silicious~~siliceous acid (Table 5-14~~15~~). The sediment cores were used to measure oxidation-reduction potential (Eh) of the sediments at 1 cm (0.4 in.) intervals for the top 10 cm (4 in.), particulate carbon, particulate nitrogen, particulate phosphorus total and active chlorophyll-a (Table 5-15~~16~~), and net exchanges of carbon, oxygen and dissolved nutrients between sediments and overlying waters (Table 5-16~~17~~). In addition, water samples from the overlying waters of the cores that were used for the net exchange analysis were analyzed for ammonium, nitrite, nitrite+nitrate, dissolved inorganic phosphorus, ~~siliceous~~siliceous acid, and total carbon dioxide.

As outlined in the sediment oxygen and nutrient exchange report for Site 104 (Boynton *et al.* 1998), a characterization of average input (river flow) from the Susquehanna River into the upper Bay is required to calculate sediment oxygen, carbon, and nutrient flux rates. In the study, 1993, 1994, and 1996 were considered high-~~-~~flow years and 1992 and 1995 were considered low-flow years. The high flows in 1996 are attributed to high winter and spring flows whereas the high-spiked flows of 1993 and 1994 occurred only in spring.

Research in the Bay has shown that the intra-annual and inter-annual time scales are important in governing relationships between nutrient loading rates and sediment-water carbon, nutrient, and oxygen exchange rates in the Bay. The Susquehanna River is a significant source of nutrients to the upper Bay due to runoff within the upper Bay drainage basin. Depending on the amount of riverine input, the quantity of nutrients and fresh water coming into the upper Bay will vary, resulting in these inter-annual and seasonal differences.

Table 5-14~~15G-8~~

Summary of Site Assessment Study Sediment Nutrient Parameters: Ammonium (NH_4^+), Nitrite (NO_2^-), Nitrite+nitrate ($NO_2^- + NO_3^-$), Dissolved Inorganic Phosphorus (DIP), and Silicate [$SI(OH)_4$] at Site 104 Open Water Placement Area.

Station	Date	TOTAL DEPTH (m)	SAMPLE DEPTH (m)	DISSOLVED NUTRIENTS				
				NH_4 (µM)	NO_2 (µM)	NO_{2+3} (µM)	CORR DIP (µM)	SILICATE (µM)
Shallow Water Stations: 12 - 15 Ms								
Shallow Water Reference Station: Average Depth 13.5 Ms								
104-SR	14-May-96	14.5	14.0	23.00	2.41	40.00	0.50	13.40
104-SR	10-Jun-96	14.5	14.0	16.10	0.80	12.70	0.10	26.50
104-SR	17-Jul-96	14.0	13.5	33.40	0.24	0.75	1.54	43.90
104-SR	15-Aug-96	14.3	14.0	23.80	0.05	0.12	2.69	37.90
104-SR	11-Sep-96	12.0	12.0	21.10	0.18	0.59	1.88	45.50
Shallow Water Sampling Station #1: Average Depth 13.3 Ms								
104-S1	14-May-96	14.5	13.5	24.10	2.31	41.80	0.52	14.00
104-S1	10-Jun-96	14.5	14.0	11.10	1.26	24.10	0.07	26.00
104-S1	16-Jul-96	13.5	13.0	22.50	0.52	7.27	0.56	33.50
104-S1	12-Aug-96	13.5	13.0	30.20	0.05	0.20	2.94	47.20
104-S1	9-Sep-96	14.0	13.0	20.70	0.18	0.73	1.83	45.70
Shallow Water Sampling Station #2: Average Depth 15.7 Ms								
104-S2	14-May-96	17.0	16.0	24.30	2.59	41.00	0.54	13.20
104-S2	10-Jun-96	16.5	15.5	19.10	0.68	9.63	0.12	26.10
104-S2	16-Jul-96	15.5	15.0	29.20	0.48	5.36	0.83	36.50
104-S2	12-Aug-96	17.0	16.0	28.80	0.04	0.12	2.61	46.90
104-S2	9-Sep-96	17.0	16.0	20.00	0.28	0.86	1.66	46.10
Deep Water Stations: 16 - 25 Ms								
Deep Water Reference Station: Average Depth 17.6 Ms								
104-DR	15-May-96	18.0	17.5	24.70	2.46	43.30	0.64	18.40
104-DR	11-Jun-96	18.0	17.0	11.60	0.98	21.40	0.11	28.10
104-DR	22-Jul-96	18.0	17.5	35.70	0.08	0.15	2.52	48.40
104-DR	14-Aug-96	18.5	18.0	22.10	0.08	0.14	2.28	37.70
104-DR	10-Sep-96	18.0	18.0	25.80	0.04	0.20	2.55	48.40
Deep Water Sampling Station #1: Average Depth 18.3 Ms								
104-D1	15-May-96	20.0	19.5	22.60	2.50	36.50	0.45	13.90
104-D1	11-Jun-96	19.5	19.0	18.40	0.60	9.02	0.10	26.40
104-D1	22-Jul-96	18.5	18.0	36.90	0.06	0.17	2.81	48.60
104-D1	14-Aug-96	18.5	18.0	21.50	0.06	0.14	2.08	38.30
104-D1	10-Sep-96	18.5	17.0	22.80	0.21	0.61	1.88	46.80
Deep Water Sampling Station #2: Average Depth 24.1 Ms								
104-D2	15-May-96	25.0	24.5	23.20	2.40	40.40	0.49	14.40
104-D2	11-Jun-96	25.0	23.5	21.10	0.38	2.39	0.58	26.10
104-D2	22-Jul-96	25.0	24.0	39.10	0.07	0.12	3.29	51.00
104-D2	14-Aug-96	25.0	24.5	20.10	0.04	0.11	2.02	34.90
104-D2	10-Sep-96	27.0	24.0	23.90	0.09	0.22	2.27	47.60

Source: Boynton *et al.* 1998.

Note: NA indicates data were not available.

Table 5-15~~16G-9~~

Summary of Site Assessment Study Sediment Particulate Parameters: Eh, Particulate Carbon (SED PC), Particulate Nitrogen (SED PN), Particulate Phosphorus (SED PP), and Total and Active Chlorophyll-a (SED CHLa), at Site 104 Open Water Placement Area.

STATION	DATE	TIME	EH CORE DEPTH (cm)	Eh CORR (mV)	CORE DEPTH (cm)	SURFICIAL SEDIMENT PARTICULATES				
						SED PC %(wt)	SED PN %(wt)	SED PP %(wt)	SED CHLa TOTAL (mg m^{-2})	SED CHLa ACTIVE (mg m^{-2})
Shallow Water Stations: 12 - 15 Ms										
Shallow Water Reference Station: Average Depth 13.5 Ms										
104-SR	14-May-96	1641	0.0	359	-1.0	4.13	0.280	0.099	304.8	154.4
104-SR	10-Jun-96	1700	0.0	110	-1.0	4.43	0.550	0.131	540.9	440.8
104-SR	17-Jul-96	726	0.0	227	-1.0	3.57	0.400	0.132	459.5	334.6
104-SR	15-Aug-96	703	0.0	331	-1.0	3.28	0.400	0.080	359.8	285.0
104-SR	11-Sep-96	748	0.0	336	-1.0	3.42	0.410	0.070	196.0	146.0
Shallow Water Sampling Station #1: Average Depth 13.3 Ms										
104-S1	14-May-96	1118	0.0	326	-1.0	4.80	0.250	0.074	189.2	79.7
104-S1	10-Jun-96	1045	0.0	333	-1.0	4.16	0.510	0.142	287.2	162.7
104-S1	16-Jul-96	1238	0.0	209	-1.0	3.85	0.510	0.154	243.7	153.5
104-S1	12-Aug-96	1308	0.0	299	-1.0	3.03	0.350	0.090	143.1	100.8
104-S1	9-Sep-96	1252	0.0	-50	-1.0	4.04	0.560	0.150	209.2	147.7
Shallow Water Sampling Station #2: Average Depth 15.7 Ms										
104-S2	14-May-96	1320	0.0	361	-1.0	4.13	0.280	0.099	273.7	124.1
104-S2	10-Jun-96	1512	0.0	249	-1.0	4.73	0.620	0.150	535.4	428.4
104-S2	16-Jul-96	1535	0.0	329	-1.0	3.84	0.530	0.097	372.7	279.8
104-S2	12-Aug-96	1602	0.0	215	-1.0	3.36	0.330	0.070	205.8	176.9
104-S2	9-Sep-96	1521	0.0	351	-1.0	3.09	0.390	0.110	171.1	135.5
Deep Water Stations: 16 - 25 Ms										
Deep Water Reference Station: Average Depth 17.6 Ms										
104-DR	15-May-96	1242	0.0	341	-1.0	4.80	0.250	0.074	339.6	201.8
104-DR	11-Jun-96	1121	0.0	80	-1.0	4.32	0.590	0.141	368.6	261.0
104-DR	22-Jul-96	1022	0.0	255	-1.0	1.92	0.240	0.053	115.7	63.3
104-DR	14-Aug-96	1332	0.0	180	-1.0	1.76	0.220	0.040	100.1	53.1
104-DR	10-Sep-96	730	0.0	351	-1.0	3.11	0.360	0.070	240.6	171.3
Deep Water Sampling Station #1: Average Depth 18.3 Ms										
104-D1	15-May-96	752	0.0	355	-1.0	4.13	0.280	0.099	322.9	214.0
104-D1	11-Jun-96	849	0.0	298	-1.0	4.54	0.620	0.141	364.9	226.5
104-D1	22-Jul-96	730	0.0	332	-1.0	3.59	0.470	0.085	308.2	219.2
104-D1	14-Aug-96	653	0.0	68	-1.0	2.94	0.360	0.070	123.5	75.2
104-D1	10-Sep-96	1045	0.0	351	-1.0	2.94	0.330	0.060	178.8	112.0
Deep Water Sampling Station #2: Average Depth 24.1 Ms										
104-D2	15-May-96	1035	0.0	349	-1.0	4.80	0.250	0.074	138.9	47.2
104-D2	11-Jun-96	1510	0.0	334	-1.0	3.48	0.440	0.091	237.7	99.2
104-D2	22-Jul-96	1409	0.0	-8	-1.0	3.30	0.400	0.080	227.6	128.4
104-D2	14-Aug-96	944	0.0	170	-1.0	2.99	0.380	0.050	116.4	72.4
104-D2	10-Sep-96	1332	0.0	348	-1.0	4.01	0.550	0.080	249.1	178.8

Source: Boynton *et al.* 1998.

Note: NA indicates data were not available.

Table 5-16~~17G-10~~

Summary of Site Assessment Study Flux Measurements: Ammonium (NH_4^+), Nitrite (NO_2^-), Nitrite + Nitrate ($NO_2^- + NO_3^-$), Phosphate (DIP), Silicate [$SI(OH_4)$] and Total Inorganic Carbon (TCO_2), at Site 104 Open Water Placement Area.

Station	Date	MEAN FLUX						
		SOC (gO^2/m^2 day)	NH_4 (µM N/(m^2 hr)	NO_2 (µM N/(m^2 hr)	NO_{2+3} (µM N/(m^2 hr)	DIP (µM P/(m^2.hr)	SILICATE (µM Si/(m^2.hr)	TCO_2 (µM C/(m^2.hr)
Shallow Water Stations: 12 - 15 Ms								
Shallow Water Reference Station: Average Depth 13.5 Ms								
104-SR	14-May-96	-0.78	206.05	3.82	-136.01	-0.50	223.89	2137.27
104-SR	10-Jun-96	-0.61	229.84	-6.53	-154.26	0.63	399.50	2740.71
104-SR	17-Jul-96	-0.18	256.32	-2.84	-4.72	16.04	212.67	2922.18
104-SR	15-Aug-96	-0.01	209.72	0.00	0.00	49.34	240.46	1944.03
104-SR	11-Sep-96	-0.54	102.9	5.17	4.47	0.47	189.95	0.00
Shallow Water Sampling Station #1: Average Depth 13.3 Ms								
104-S1	14-May-96	-0.92	439.10	8.16	-207.05	7.98	262.97	3316.75
104-S1	10-Jun-96	-0.94	214.47	0.00	-148.25	4.09	195.69	2288.13
104-S1	16-Jul-96	-0.77	496.59	3.34	-35.96	8.24	298.23	4401.98
104-S1	12-Aug-96	0.00	185.62	0.00	0.00	34.37	154.10	1530.32
104-S1	9-Sep-96	-0.79	198.00	4.92	4.47	2.94	205.84	0.00
Shallow Water Sampling Station #2: Average Depth 15.7 Ms								
104-S2	14-May-96	-0.53	149.10	4.57	-121.86	1.69	253.51	966.40
104-S2	10-Jun-96	-0.25	262.57	-5.54	-79.73	1.82	351.66	1677.28
104-S2	16-Jul-96	-0.50	255.11	-1.34	-34.00	-4.10	202.61	1510.73
104-S2	12-Aug-96	0.00	194.67	0.00	0.00	36.65	264.82	1151.46
104-S2	9-Sep-96	-0.68	188.90	4.39	5.92	-0.50	230.33	0.00
Deep Water Stations: 16 - 25 Ms								
Deep Water Reference Station: Average Depth 17.6 Ms								
104-DR	15-May-96	-0.91	192.26	2.17	-169.49	-4.95	189.76	1753.93
104-DR	11-Jun-96	-0.92	161.58	-2.76	-151.62	0.17	230.10	1855.40
104-DR	22-Jul-96	0.00	122.87	0.00	0.00	8.87	198.30	1549.51
104-DR	14-Aug-96	0.00	133.37	0.36	0.00	17.99	319.68	1280.67
104-DR	10-Sep-96	-0.18	53.30	0.00	0.00	8.76	146.67	0.00
Deep Water Sampling Station #1: Average Depth 18.3 Ms								
104-D1	15-May-96	-0.47	216.20	2.75	-92.80	5.72	388.71	1980.28
104-D1	11-Jun-96	-0.40	272.50	-2.50	-93.37	33.49	385.66	2711.15
104-D1	22-Jul-96	-0.02	203.35	-0.43	0.00	51.58	281.87	2793.05
104-D1	14-Aug-96	-0.02	134.32	-0.24	5.48	32.48	218.81	1951.42
104-D1	10-Sep-96	-0.80	362.70	-1.44	-1.55	42.30	323.06	0.00
Deep Water Sampling Station #2: Average Depth 24.1 Ms								
104-D2	15-May-96	-0.66	812.80	9.70	-104.79	49.70	186.95	3779.50
104-D2	11-Jun-96	-0.11	395.59	-0.74	-24.68	54.77	273.59	3770.14
104-D2	22-Jul-96	0.00	311.80	3.08	0.00	47.76	186.62	2052.70
104-D2	14-Aug-96	-0.01	264.53	0.00	0.00	35.14	186.55	2275.73
104-D2	10-Sep-96	-0.23	352.10	0.00	2.15	50.61	219.23	0.00

Source: Boynton *et al.* 1998.

Note: NA indicates data were not available.

Bottom water temperature at Site 104 was within expected ranges for summer: 13.78-C (56.8-F) to 25.57-C (78-F) in shallow water (depth range: 12-17 m) and 13.33-C (56-F) to 25.48-C (77.8-F) in deep water (depth range: 18-27 m) and the vertical temperature difference was less than 2-C (Table 5-11~~12~~) (Boynton *et. al* 1998). Data from the nearby SONE station R-64 shows a historical trend during low-flow years (1992 and 1995) of increasing temperature from spring to summer and decreasing temperature from summer to fall/winter. SONE station R-64 is located at 38°33.517'N, 76°25.583'W, in the mainstem Chesapeake Bay near the mouth of the Little Choptank River.

Similarly, long-term (1984-1997~~8~~) bottom water temperature observations at the Chesapeake Bay Program (CBP) Station MCB3.3C show gradually increasing temperatures from late March through late June (Figure 5-18~~16~~) with relatively little year-to-year variations in the rate of increase, and peak bottom water temperatures in mid- to late-August (Figure 5-19~~17~~), followed by a steady decline in temperature into December.

Bottom water salinity generally increased from May to August 1996 due to decreasing river flows and decreased from August to September 1996 due to increased river flows. Salinity ranged from 8.4 ~~ppt~~ to 16.8 ppt in the shallow water sites and from 9.1 ~~ppt~~ to 18.1 ppt in the deep water sites. Data from the nearby SONE station R-64 shows a historical trend of decreasing salinity from spring to summer and increasing salinity from summer to fall/winter during 1992 and 1995 (low flow years). During high-flow years (1993, 1994, and 1996), there was an increase in salinity from spring to summer and a decrease from summer to fall/winter at the nearby SONE station R-64.

Bottom water DO at the shallow water sites in the vicinity of Site 104 ranged from 0.1 ~~mg/L~~ to 4.1 mg/L and at the deep water sites it ranged from 0.1 ~~mg/L~~ to 3.6 mg/L. At Site 104, hypoxic conditions were generally present in near-bottom waters from June to September 1996. Over the period 1984-1997, bottom water DO concentrations at CBP station MCB3.3C generally fell below 2.0 mg/L in the mid-April to mid-May period, although the onset of less than 2.0 mg/L DO concentrations occurred as soon as early April and as late as early June (Figure 5-20~~18~~). Bottom water DO generally remained below 2.0 mg/L at MCB3.3C until early September to mid-October (Figure 5-21~~19~~).

Information from the nearby SONE station R-64 shows that historically there are similar trends in both low- and high-flow years to those found at Site 104 in 1996. Data from the SONE station R-64 also indicated that in October, from 1985 to 1994, there was an average DO concentration of 5.4 mg/L and a range of 4.0 to 7.3 mg/L. During 1992, a low-flow year, DO concentrations in October were measured at 5.4 mg/L and during high-flow years such as 1993 and 1994, DO concentrations in October were measured at 4.7 and 6.8 mg/L, respectively.

Therefore, there appears to be a historical trend of an increase in DO levels that generally begins during the September to October period in the Site 104 area. However, there is significant inter-annual variability of the duration of hypoxic conditions, which is directly related to the magnitude of winter-spring river flows.

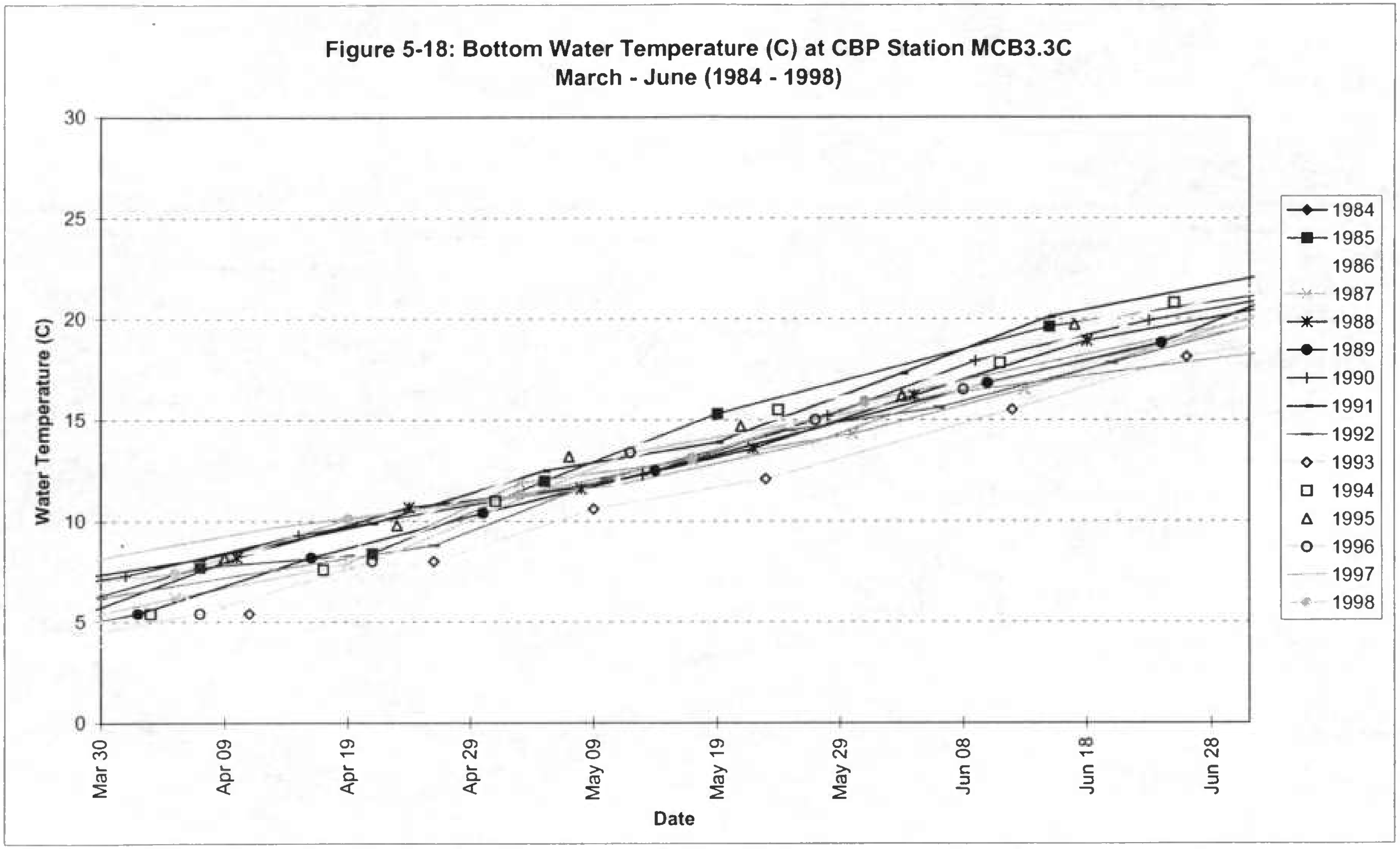


Figure 5-18: Bottom Water Temperature (C) at CBP Station MCB3.3C
March - June (1984 - 1998)
Water Temperature (C)
30
25
20
15
10
5
0
Mar 30
Apr 09
Apr 19
Apr 29
May 09
May 19
May 29
Jun 08
Jun 18
Jun 28
Date
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998

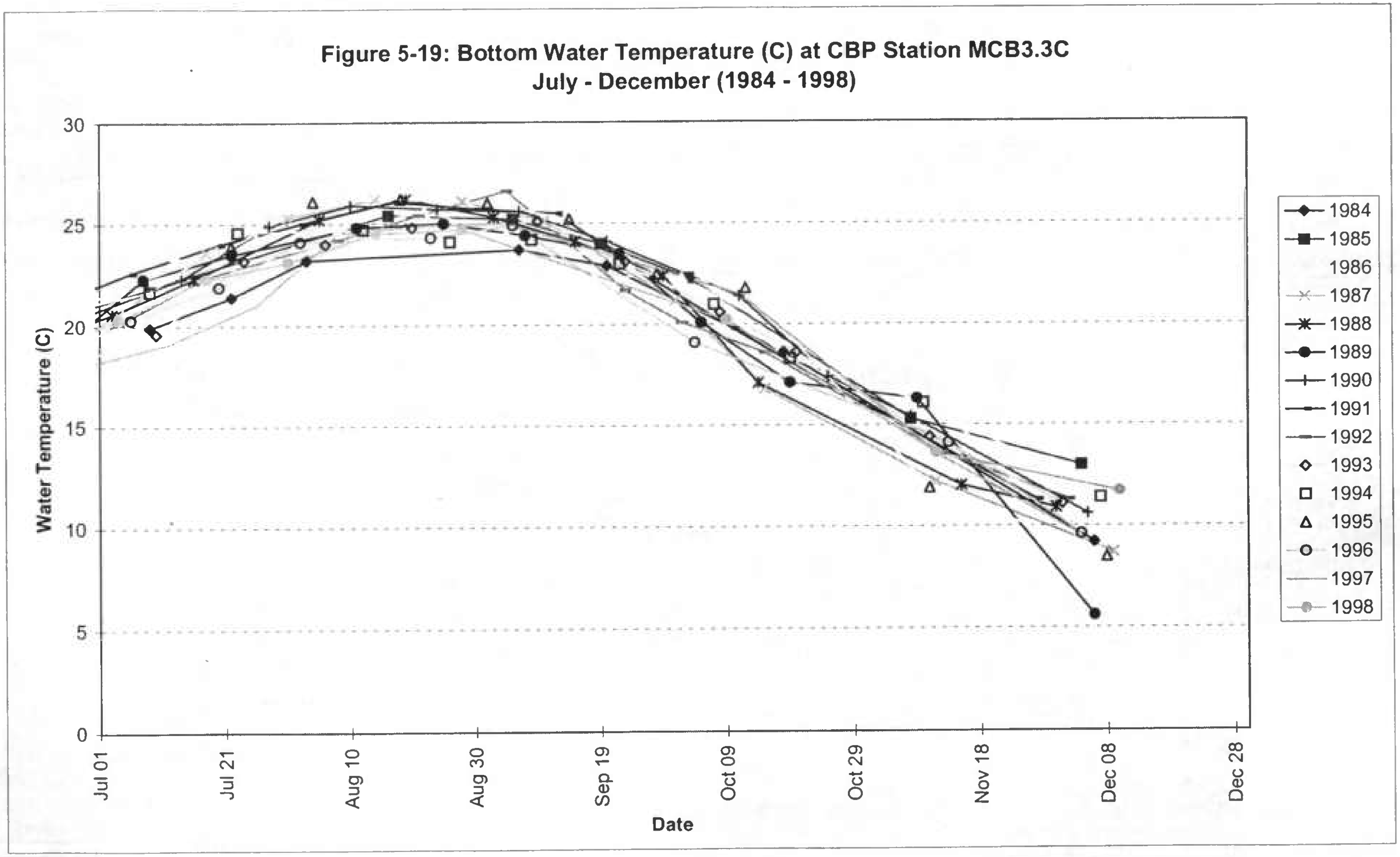


Figure 5-19: Bottom Water Temperature (C) at CBP Station MCB3.3C
July - December (1984 - 1998)
Water Temperature (C)
30
25
20
15
10
5
0
Jul 01
Jul 21
Aug 10
Aug 30
Sep 19
Oct 09
Oct 29
Nov 18
Dec 08
Dec 28
Date
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998

Figure 5-20: Bottom Water Dissolved Oxygen Concentration (mg/L) at CBP Station MCB3.3C March - June (1984 - 1998)

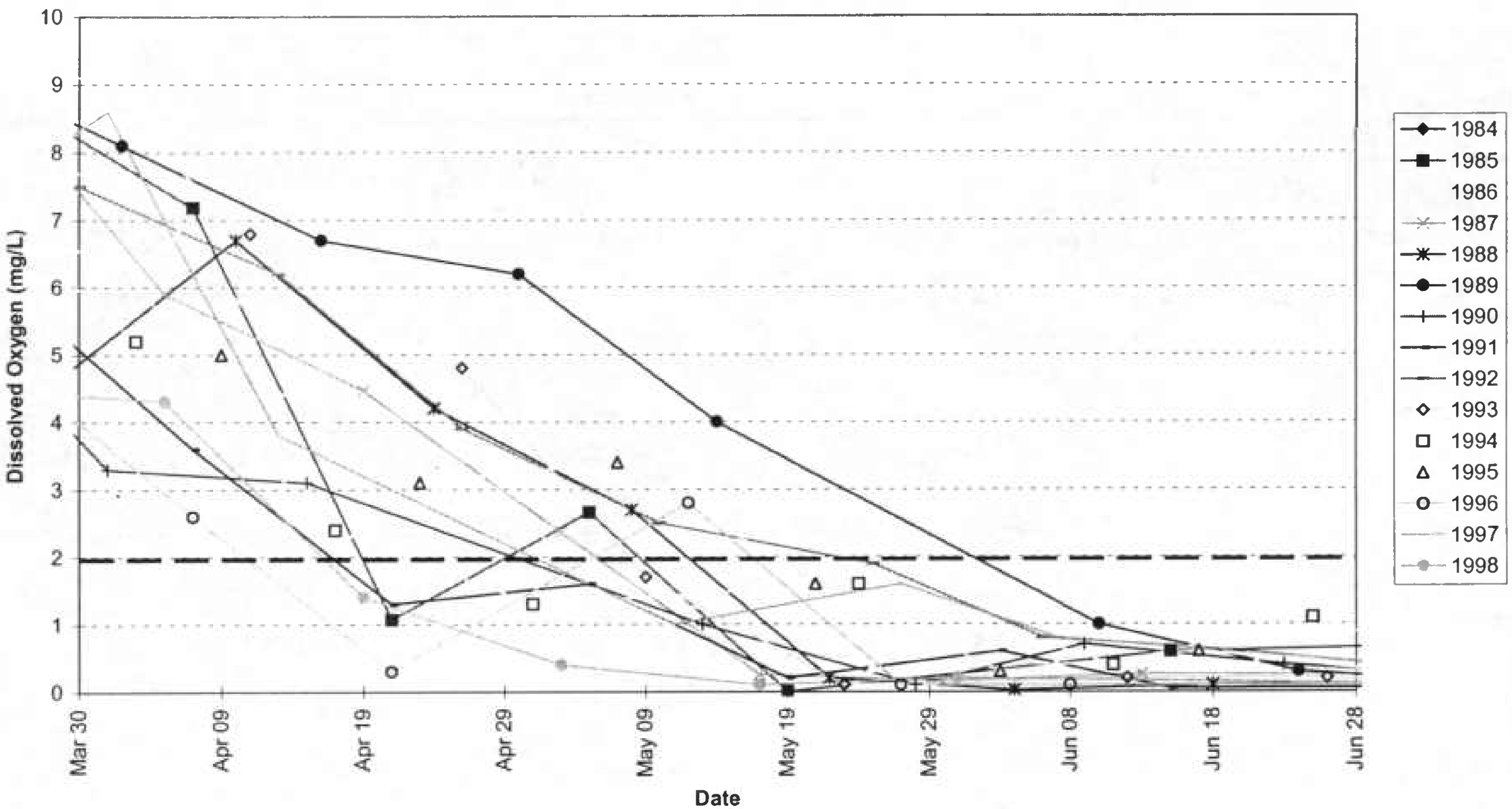
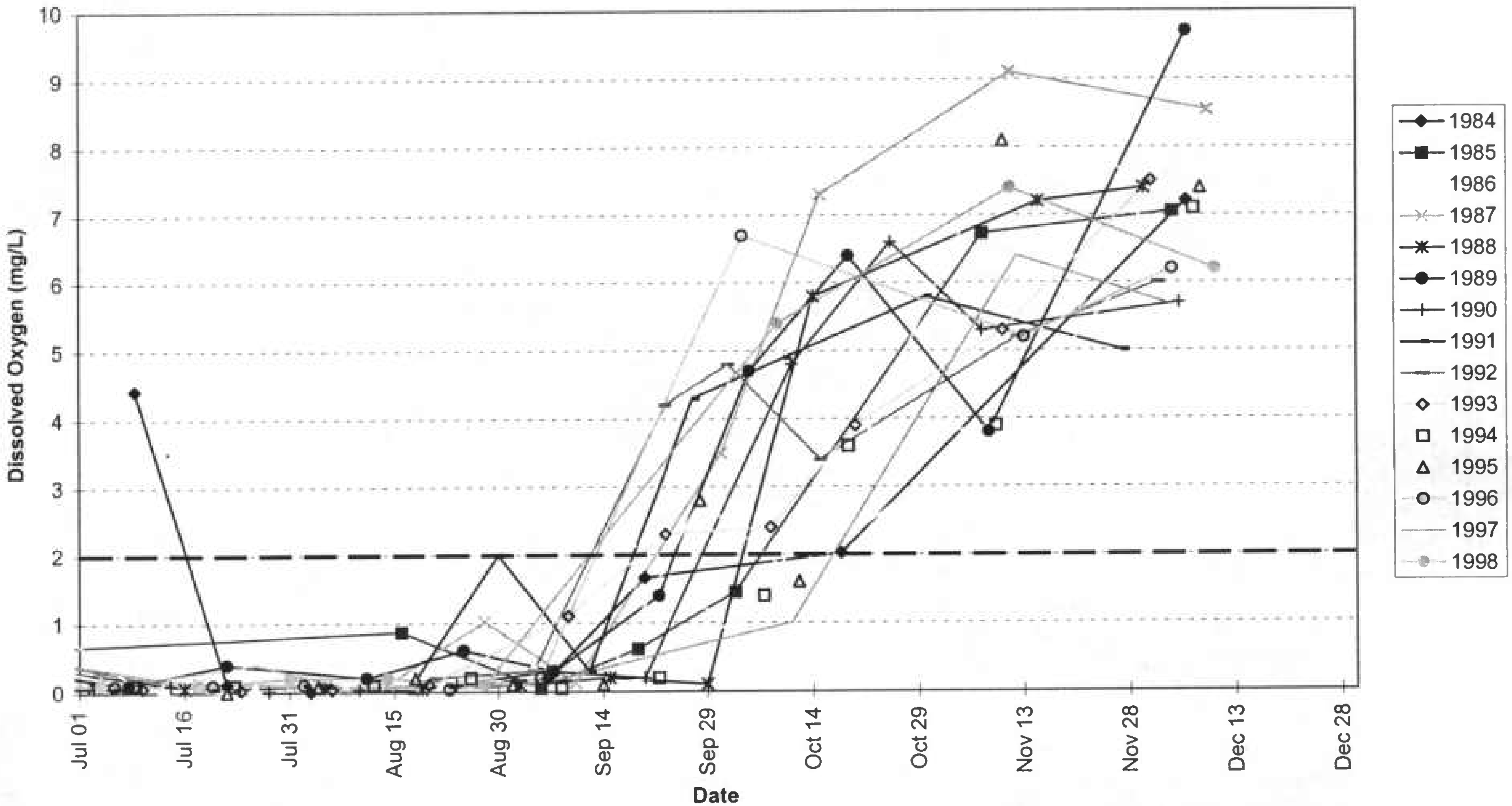


Figure 5-21: Bottom Water Dissolved Oxygen Concentration (mg/L) at CBP Station MCB3.3C July - December (1984 - 1998)



Sediment Fluxes

Sediments in Site 104 were rich in organic matter and nitrogen that resulted from phytoplankton deposition. Phosphorus was relatively abundant in the sediments but most of it ~~is~~ was bound to sediment particles and would not, therefore, be available to the biological community until hypoxic (low oxygen) sediment conditions ~~exist~~occur. The sediment oxygen consumption (SOC) rates were modest during the spring, increased during early summer due to increased temperatures, and were followed by a decline due to a lack of oxygen in the overlying water in mid to late summer.

Ammonium fluxes in Site 104 and at deep water reference sites were high (>200 µmol N m^{-2} hr^{-1}) relative to other, shallower regions of the Bay. This is ~~, probably from~~thought to be due to the high rate of organic matter being deposited, followed by the decomposition of the organic matter and release of ammonium from the organic matter. This was also reflected in the sediment organic carbon and nitrogen concentrations. Nitrate fluxes were high and generally directed into the sediments from the water column. This is typical of deep water areas of the Bay that experience oxygen depletion (hypoxia) during the summer. Nitrate fluxes from the sediments to the water column in areas such as this throughout the Bay are rare. Phosphate fluxes were also generally large in Site 104 and adjacent deep water sites (30--60 µmol N m^{-2} hr^{-1}) during the summer hypoxic period. Smaller fluxes are associated with well-oxygenated areas of the Bay that do not experience hypoxic conditions.

Although Site 104 experiences hypoxia, existing sediments at the site are still considered active sites for organic matter consumption and nutrient release. This ongoing metabolism during the summer months is expected to continues to be elevated as long as the rate of organic matter deposition is elevated.

In summation, nutrient levels in the Site 104 area were subject to intra-annual and inter-annual variability due to Susquehanna River input to the upper Bay. Hypoxia occurred during the summer months (July to September in 1996) in bottom waters, organic matter deposition was high, and nutrient and sediment nutrient flux levels were within expected ranges for a deep water area that experiences summer hypoxia.

Pore Water and Solid Phase Analysis

These analyses were conducted by ~~Horn Point Environmental Laboratory (~~HPEL~~)~~ in 1996 to ~~determine~~ study and describe the mechanism of nitrogen and phosphorus release from sediments in and adjacent to Site 104. The sediment carbon, oxygen, and nutrient flux study (previously discussed) analyzed conditions just above the sediment surface, while the pore water and solid phase study analyzed conditions in the upper layers (0.8---3 in.) of the sediments. Pore water and solid phase sampling occurred at the same six sites that were used for the sediment carbon, oxygen, and nutrient flux study (Figure 5-15~~13~~). Vertical cores were collected in June and August 1996 for surficial solid phase and pore water analyses, and in July 1996 for surficial solid phase analysis. The top 8 cm (3 in.) of each core was used for analysis in June 1996 and the top 2 cm (0.8 in.) in July and August 1996.

The study found considerable spatial and temporal variability in the pore water (water between individual sediment particles) and solid phase data. The variability noted at Site 104 is similar to other ~~seasonally anoxic~~ areas of the Bay that experience summer anoxia. This variability suggests high rates of nutrient remineralization (or recycling) of nutrients to the water column as a result of organic matter decomposition ~~offrom organic matter~~.

Overall, data from the pore water and solid phase study supported the findings of the sediment carbon, oxygen, and nutrient flux study. The site receives a significant load of organic matter and has high rates of nitrogen and phosphorus remineralization. In summation, this site is similar to other deep water sites that experience summer anoxia.

5.1.4.c Pore Water/Solid Phase Analysis and Sediment Nutrient Interactions in the Channels ~~Summary~~. [JEFF C'S DATA TO BE ADDED]

Introduction

Pore water and solid phase nutrient analyses were performed on sediment core samples taken from both ~~in~~ navigation channels and ~~in~~ Site 104 in September 1999. The reason for performing these analyses was to gain an understanding of the chemical and probable biological conditions existing in sediments at the time of measurement. Measuring these conditions ~~helps us to~~ improves the understanding of the potential types and flux rates ~~of fluxes~~ of nutrients and other elements from sediments, and improves the ability to estimate the storage or "bank account" of nutrients and other materials in sediments. This information can also be used to compare sediments in one area to another. A detailed discussion of these analyses is presented in Annex G and summarized below.

[Sections to be written after Jeff Cornwell data becomes available.]

Pore water and solid phase testing of sediments from Site 104 were conducted by Horn Point Environmental Laboratories in Cambridge, Maryland. Solid phase testing refers to measurements of various constituents in the actual solids or particulates that comprise the sediments near the surface of the bottom. Pore water is the interstitial water that surrounds sediment particles (i.e. water between the sediment grains). Pore water is separated from the solid phase (particles) with a centrifuge. Nutrient concentrations were determined for both pore water and solid phase elements of the sediment. This information is used to determine whether nutrients are bound to particulates (solids) or whether they are released into the interstitial waters. The solid phase and pore water studies are integral to determining the sediment-nutrient interactions and the potential availability of nutrients to the water column.

Remineralization refers to the rate of change of particulate and dissolved organic forms of nitrogen and phosphorus into ammonium, nitrite, nitrate and phosphate, which are available for reuse in the aquatic system by phytoplankton and microbes. Also important is the fate of nutrients, in particular phosphorus, which is sorbed to sediment particles. This linkage of phosphorus to sediment particles is important because such bound phosphorus is generally unavailable for biological uptake unless low oxygen conditions in the water occur. Under these conditions phosphorus can be rapidly (days to weeks) released from sediment particles and is then available for reuse in the aquatic system by phytoplankton and other microorganisms.

Pore water/solid phase analysis and an analysis of sediment/water nutrient interactions in several Chesapeake Bay Federal navigation channels and adjacent shoal areas were conducted in August ~~of~~ 1997 by HPEL and CBL (Cornwell and Boynton 1998). The Fort McHenry, Brewerton, Brewerton Channel Eastern Extension, Craighill, and Northern C&D Canal approach channel were studied (Figure 1-2), along with adjacent shoal areas for comparison. The Fort McHenry Channel and Brewerton Channel results are included here, but these sediments will not be placed at Site 104 as they are from the Inner Harbor. These studies showed that the waters and sediments in the channels are subject to conditions similar to those at Site 104. The waters in the channels are of higher salinity, lower temperature, and lower DO concentrations than waters in shoal areas near the channels.

Ammonium and dissolved inorganic phosphorus concentrations are higher in the deep waters of the channels than in shallow waters adjacent to the channels. Ammonium fluxes in the channel, however, were similar to shoal sediments nearby, with the exception of the northern Bay channel, where ammonium fluxes were higher than nearby shoal sediments. Ammonium fluxes were similar in the channels to those observed in Site 104, although considerable variability exists in the channels. Ammonium fluxes would generally be expected to be higher in the channels, which are generally characterized by DO levels lower than in adjacent shoals, and which are depositional areas where fresh supplies of organic material would tend to enhance flux rates. Ammonium fluxes were smallest in the Craighill Channel, which is the most southern channel, and highest at the northern C&D Canal approach channel, which is the most northern channel.

Fluxes of dissolved inorganic phosphorus were directed into the sediments in the Brewerton Eastern Extension and in the Craighill Channels. Small positive fluxes from the sediment to the water column were measured in the Brewerton and in the Fort McHenry channels. A larger flux to the water column was present in the northern C&D Canal approach channel. All dissolved inorganic phosphorus fluxes in the channels in August ~~of~~ 1997 were smaller than those measured in Site 104 in August ~~of~~ 1996. In particular, the deeper stations at Site 104 showed much higher dissolved inorganic phosphorus fluxes than those observed in the channels. Based upon these findings, it would appear that conditions in the sediments of the channels are ~~very~~ somewhat different from those at Site 104, even though water quality conditions are similar in the two environments. Additional ~~S~~studies are planned ~~incomplete~~ to more fully characterize the differences, but it has been speculated that the source of the channel sediments may ~~result from~~ ~~a~~be more land-based in characteristic, versus the phytoplankton-based organic matter in areas such as Site 104 and the Deep Trough. This terrestrial -based sediment appears to contain higher percentages of inorganic and more complex or non-refractory organic matter inputs ~~or~~ which are newer than those deposited in Site 104, and thus result in lower phosphorus fluxes.

Conclusions

Hypoxic to anoxic conditions were observed in summer of 1996 and 1997 in the bottom layers of the deeper stations in the vicinity of Site 104. Relatively high concentrations of ammonia and orthophosphate were observed in water column samples during the summer months. The ~~seasonal~~ summer anoxic conditions enhanced release of nitrogen and phosphorus from the sediments into the water column. Depositional rates of organic matter in the vicinity of Site 104 were high and associated with deposition of phytoplankton. Sediments at Site 104 are rich in organic carbon and nitrogen; phosphorus is also relatively abundant, but the majority is bound to sediment particles and unavailable for biological uptake until hypoxic sediment conditions exist. Remineralization rates in the sediments are also high, resulting in the observed flux rates of nitrogen and phosphorus.

NOT UPDATED

5.1.5 Sediment

Sources of sediments in the central portions of the Chesapeake Bay include Susquehanna River flows, erosion of bay banks and shorelines, and resuspension of existing bay sediments. Another source of sediments in the vicinity of Site 104 is historic dredged material placement that occurred at the site from prior to 1924 until 1975 (MDNR 1976). Much of this deposited material would be expected to have remained substantially in place because Site 104 is located in the main stem of the Chesapeake Bay, which is generally considered to be a depositional area with deposition rates ranging from 0.0012 to 0.01 m/yr (0.047 to 0.393 in./yr)(Eskin *et al.* 1996). Once deposited in the bay in the vicinity of Site 104, sediments can act as a source or sink for chemical constituents that have been introduced into the aquatic system from natural or anthropogenic (man-made) sources.

5.1.5.a Sediment Composition. A geotechnical field and laboratory investigation was conducted by Earth Engineering and Sciences, Inc. (E2Si 1997) and the Maryland Geological Survey (MGS 1997) to evaluate sediment characteristics within the Site 104 project area (see Appendix D). E2Si collected sediment samples from six borings that were drilled using a hollow stem auger. Each boring was approximately 12.2 m (40 ft) in depth. MGS obtained nine piston core samples having lengths ranging from approximately 2.4 to 4.3 m (8 to 14 ft). Boring and piston core locations are shown in Figure 5-20.

Data obtained from the investigation indicate that the Site 104 area consists primarily of very soft to soft gray silty clay containing localized pockets of silty sand and red-brown silty clay. The Standard Penetration Test (SPT) resistance of the sediment at Site 104 is typically the "weight of the rod" (WOR), i.e., the coring device moves through the sediment under its own weight because the sediment has a low bearing capacity. The liquid limit ranges from 38 to 139 percent, and the plastic limit has a mean of 36.6 percent. The data show that several samples collected from the borings and analyzed in the laboratory contain water contents greater than the liquid limit, indicating that the soil-water system is in a suspension. The water contents ranged from 25 to 377.5 percent.

Grain size distribution measured from eight samples indicated that sediment composition was 0.6 percent gravel, 15.3 percent sand, 50.5 percent silt, and 33.6 percent clay. Organic content is approximately 9.0 percent. Unit weight of the material ranged from 1300 to 1800 kg/m^3 (82 to 115 pcf). Specific gravity ranges from 2.63 to 2.77, with a mean of 2.69. Sheer stress is low, ranging from 0 kg/m^2 (0 psf) at the mudline, 600 kg/m^2 (120 psf) at 3 m (10 ft) below the mudline, 900 kg/m^2 (180 psf) at 6 m (20 ft) below the mudline, 1100 kg/m^2 (220 psf) at 9 m (30 ft) below the mudline, 1750 kg/m^2 (350 psf) at 12 m (40 ft) below the mudline, and 2500 kg/m^2 (500 psf) at 15 m (50 ft) below the mudline. The angle of internal friction (f) is zero.

5.1.5.b Sediment Quality. The sediment quality study prepared by EA Engineering, Science, and Technology in November 1997 (EA 1997) was performed to provide information on the chemical and physical characteristics of sediments at Site 104. An earlier study (EA 1996) included sediment elutriate samples from several main stem Chesapeake Bay approach channels, and was intended to characterize the sediments in the approach channels, as well as in certain reference areas and potential placement sites. The results of these studies can be used to fulfill the requirements of Tier I and Tier II evaluations as described by the EPA and USACE manual "Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. – Testing Manual" (EPA/USACE 1998), commonly referred to as the Inland Testing Manual, for placement of sediments from approach channels at Site 104. Tier I is a literature review of existing reference documents detailing sediment chemistry studies in the project area, and Tier II consists of sediment sampling and analysis in the projected dredging area.

The Tier I literature review included a review of previous dredged material placement at the site (MDNR 1976), and a review of sediment characteristics from nearby locations in the upper Chesapeake Bay (E2Si *et al.* 1997, MES 1997), and from mainstem Chesapeake Bay locations (Eskin *et al.* 1996). Available data for sediment metal concentrations in those areas to be dredged for disposal at Site 104 (e.g., main stem Chesapeake Bay approach channels) were compared to sediment quality guidelines implemented by NOAA and EPA. Finally, existing sediment elutriate data collected in late 1995 at several main stem Chesapeake Bay approach channels (EA 1996) were compared to Maryland water quality standards for estuarine and salt water.

The Tier II evaluation compared the results of sediment testing at Site 104 (EA 1997) to available criteria, standards or regulations governing sediment quality, and described whether or not the sediments collected in the sample area would meet the objectives for the area. Inasmuch as standardized numerical sediment quality criteria are not available, this Tier II analysis compared bulk sediment quality at Site 104 with sediment quality guidelines implemented by NOAA and EPA to protect environmental health, and with EPA Region III's Risk-Based Concentrations (RBCs) for chemical screening of soils to protect human health. The details of this Tier II evaluation are included in the sections which follow.

Sediment quality in the vicinity of Site 104 is influenced by the nature of the source materials and by the hydrodynamic processes that control sediment transport and deposition. A site-specific sediment sampling report prepared by EA Engineering, Science, and Technology in January 1998 (EA 1998) is included as an appendix. This report contains information on sampling methodology and analytical tests.

Studies indicate that sediment priority pollutant organic compound concentrations in existing sediments sampled at Site 104 are generally below detection limits (EA 1997) or are near or below sediment quality guidelines (Eskin *et al.* 1996, EPA 1998). Organic compounds found at concentrations above sediment quality guidelines include anthracene and phenanthrene at KI-7 (higher than the No Observable Effect Level [NOEL] but less than the Probable Effects Level [PEL]), and naphthalene at KI-3 (slightly higher than the NOEL but less than the PEL) (Figure 5-21). Further details of sediment organic compound distributions at Site 104 are discussed in the following Organic Analysis section. Sediment metal concentrations at Site 104 are generally similar to concentrations measured at other nearby locations, including Site 3 of the upper Bay Island Placement Sites study, northwest of the Swan Point Channel (E2Si *et al.* 1997), and mainstem Chesapeake Bay locations (Eskin *et al.* 1996). Further details of sediment metal concentrations at Site 104 are discussed in the Metals Analysis section. Sediment metals concentrations at Station KI-7 at Site 104, however, are higher than at nearby locations. Sediment metal concentrations at Site 104 (exclusive of KI-7) are generally higher than (but within an order of magnitude of) concentrations at a reference station near Pooles Island (MES

1997). Environmental effects, including effects on fish and wildlife, associated with existing sediments at Site 104, exclusive of KI-7, would therefore be expected to be higher than but within the range of those observed at an upper Chesapeake Bay reference station. Human health effects are unlikely both because sediment concentrations are generally below human health-based guidelines (EPA 1998) and because extended exposure is unlikely.

Water Column Effects

The Tier I evaluation of existing data included an analysis of sediment elutriate data collected during October and November 1995 in several approach channels to Baltimore Harbor in the main stem of the Chesapeake Bay (EA 1996). Sediments for the elutriate tests were collected using a Van Veen grab sampler to collect surface sediments. At two locations (Tolchester Channel and Brewerton Channel Eastern Extension), additional sediments were collected using a gravity corer to sample the consolidated sediments beneath the sediment surface. The sediment elutriate test data were compared to Maryland water quality standards for estuarine and salt water to determine if potential water column effects might result from open water placement of the dredged material from these approach channels (Table 5-18).

Human Health

The potential for the general public health risk associated with contaminant levels in sediments at Site 104 can be evaluated on a screening level by comparing ambient sediment concentrations with U.S. EPA Region III Risk-Based Concentrations (RBCs [U.S. EPA 1998]). RBCs are screening level tools that are set at levels low enough that humans exposed to these concentrations in industrial or residential soils will not experience unacceptable risk levels related to increased incidence of cancer or other non-carcinogenic human health endpoints. In the case of the residential soil RBC, the assumption is that exposure will occur over a longer period of time than for exposure to soil in an industrial scenario.

It is unlikely that humans will come in direct contact with the sediments at Site 104 or in the channels to be dredged and placed at Site 104. Dredging contractors may be more likely than the general public to come in direct contact with the sediments dredged from channels to be placed at Site 104, but their exposure would be sporadic. Dredging contractors are unlikely to come in contact with existing sediments at Site 104. Environmental sampling personnel contracted to collect samples in the channels to be dredged or at Site 104 have the potential for exposure to sediments during the sample collection procedure, but standard protocol requires that sampling personnel utilize personal protective equipment (PPE) which prevents direct dermal contact with the sediments. If ambient concentrations in these sediments are less than RBCs, it is reasonable to assume that human health risks from other exposure pathways (e.g., ingestion of fish or shellfish which were exposed to sediments) should be even lower, and should also result in acceptable risk levels.

Field Sampling

Sediment sampling was conducted on 23 September 1997 in the vicinity of Site 104 by EA Engineering, Science, and Technology, Inc. under contract to CENAB. Analyses of the sediment samples were performed by EA (organics and inorganics), the University of Maryland's HPEL (nutrients), and E2Si (grain size and Atterberg limit tests) (EA 1997). The results of this final data report are summarized in this section, and the entire report is included in Appendix D.1.

Sediment samples were collected at eight locations: four inside the boundaries of Site 104 and four outside (Figure 5-21). Most of these sediment sampling locations corresponded with stations monitored for water quality (MDE 1998a Section 5.1.4) and benthic community analyses (MDE 1998b) (Section 5.1.6.c) (Figure 5-21). Two sediment sampling locations (KI-15 and KI-16) were newly established for this September 1997 sediment collection. Depths at the sampling locations inside Site 104 ranged from -12.5 m (-41 ft) to -18 m (-61 ft); depths at the four reference locations ranged from -12 m (-40 ft) to -24 m (-80 ft).

Physical Conditions

Sediments in the vicinity of Site 104 were predominantly silts and clays, with trace amounts of sand, although up to 24 percent sand was present at two locations (KI-5 and KI-7). Sediments collected at location KI-7 were visibly different from the sediment collected at the other seven stations. Field sampling personnel noted that only the sediments from KI-7 were characterized by an oily smell. The sediments at KI-7 were described as a "dark gray tacky substance at approximately 8 in. depth (20 cm), surface layer very black, tar-like consistency, oil sheen" (EA 1997). Sediments at KI-7 were 23.5 percent sand and 1 percent gravel, the highest sand and gravel content for this group of samples (EA 1997).

Piston core samples collected by MGS in September 1997 at nearby stations in the southern, deeper part of Site 104 were also characterized by "a variety of fairly firm, stiff light grey and pink clays," with admixtures of sands and small gravel sized sediments in a mud matrix (Halka 1997). Sediments with physical characteristics similar to those observed at these stations nearby KI-7 are not normally encountered in deeper waters of the Chesapeake Bay, and are likely the result of sediments originally dredged in the Baltimore Harbor area (Halka 1997) and deposited at Site 104 during its active period, 1924-1975 (Halka 1998). These former Harbor sediments might be buried by sediments ranging in depth from 22 to 73 cm, assuming an approximate deposition rate of 1 cm/yr (Eskin *et al.* 1996, Halka 1998), and a possible placement date between 1924 and 1975.

Organic Analysis

Organic analyses included volatile organic compounds, semi-volatile organic compounds, semi-volatile polycyclic aromatic hydrocarbons (PAHs), pesticides, and polychlorinated biphenyls (PCBs). Volatile organic compounds were below detection limits at all sediment sampling locations. Detection limits were established by the analytical laboratory for each sample and analysis, based upon the sample quantitation limit, corrected for sample dilution (if any) and percent moisture. As shown in the tables in Appendix D.1, 49 semi-volatile organic compounds were tested at each of the 8 sample sites. With only 4 exceptions out of 392 sampled analytes, semi-volatile organic compounds (other than PAHs) were also below detection limits at all locations. Two semi-volatile organic compounds, bis(2-ethylhexyl)phthalate and 2-methylphenol, were detected at concentrations equal to their detection limits at locations KI-1 and KI-11, respectively. A semi-volatile organic compound, 3+4-methylphenol, was detected at locations KI-7 and KI-15. The majority of the sixteen typically detected PAHs were found at the sediment sampling locations; details of ambient concentrations and implications are discussed in the next two sections.

Most pesticides and PCBs were below detection limits at the sediment sampling stations, with limited exceptions. Exceptions included location KI-7, at which five pesticides (1,1-dichloro-2,2-bis(p-chlorophenyl)ethylene (DDE), aldrin, endosulfan I, endrin aldehyde, and heptachlor epoxide) and two aroclors (1254 and 1260) were detected. Heptachlor epoxide was detected at three of the eight sampling locations, but was also detected in the field blank, suggesting the possibility of contamination in the field. Three pesticides (endrin, endrin aldehyde, and methoxychlor) were detected at the reference location KI-14. Details of ambient concentrations of pesticides and PCBs, and implications of these concentrations are discussed in the next two sections.

Environmental Health Effects

All sediment PAH concentrations were less than the PELs (Table 5-19). With the exception of napthalene at KI-3 and anthracene and phenanthrene at KI-7, none of the PAH concentrations exceeded the NOELs. Because PAH concentrations were less than PELs in all cases, and less than NOELs in most cases, adverse biological effects to aquatic organisms at Site 104 due to sediment concentrations of PAHs would not be likely. PAHs are widely found throughout the Bay.

The pesticide DDE concentration at KI-7 was well below the PEL, and only slightly higher than the NOEL; NOELs and PELs were not available for the other pesticides detected at KI-7. PELs are not also available for the three pesticides detected at reference location KI-14. Because most pesticides and PCBs were either below detection limits or below available PELs and only slightly higher than NOEL, adverse biological effects to aquatic organisms are not expected.

Human Health Effects

Concentrations of PAHs at Site 104 were less than residential soil RBCs for all PAHs except benzo[a]pyrene (BAP), for which the sediment concentration at KI-7 exceeded the RBC by less than 7 percent. BAP concentrations at KI-7 were substantially lower than the industrial soil RBC. The BAP RBC is based upon increased incidence of cancer upon exposure to soils. Based upon the relatively small degree of exceedence of the residential soil RBC, and the fact that the sediments did not exceed the industrial soil RBC, little incremental human health risk is anticipated, given the unlikelihood of human exposure extended (greater than 8 hours/day) to BAP in sediments present at Site 104.

Concentrations of pesticides and PCBs at Site 104 were substantially lower than the RBCs for residential and industrial soil exposure. Therefore, there is little likelihood of increased risk to human health due to potential exposure to pesticides and PCBs in Site 104 sediments.

Metals Analysis

With the exception of metals at location KI-7, sediment concentrations of most metals (arsenic, chromium, copper, lead, mercury, nickel and zinc) at Site 104 (Table 5-20), were similar to concentrations reported in clean sediments from the navigation channels in the main stem of the Chesapeake Bay (EA 1996) (Table 5-21). Cadmium concentrations in Site 104 sediments, however, were higher than the maximum cadmium concentrations reported in these clean sediments (Table 5-21). Sediment metal concentrations (arsenic, cadmium, copper, lead, mercury, nickel, and zinc) at location KI-7 (Table 5-21) were higher than the maximum reported in clean sediments, except for nickel. Nickel concentrations at KI-7 were similar to those found in the channel and at other Site 104 locations. Details of sediment metals concentrations at Site 104 compared to quality guidelines and other Chesapeake Bay sediments are discussed in the following two sections.

Environmental Health Effects

With the exception of chromium, sediment metal concentrations were generally higher than NOELs at most sediment sampling locations (both in-site and reference) in the vicinity of Site 104 (Table 5-21). Chromium was detected at concentrations below the NOEL at three of the eight sampling locations (two within the site and one reference station). Sediment metal concentrations were generally less than the PELs at most stations; however, metal concentrations at KI-7 exceeded PELs for all metals for which PELs were available, except chromium. Cadmium concentrations exceeded the PEL at all locations at Site 104 (both in-site and reference).

The Tier I evaluation of available data on sediment metal concentrations compared to sediment guidelines indicated that maximum sediment metal concentrations at areas to be dredged for disposal at Site 104 (main stem Chesapeake Bay channels) were higher than NOELs but were less than PELs, except for zinc, for which the maximum zinc concentration was higher than the PELs. Mean concentrations of sediment metals in the main channels were all less than PELs.

Sediment metal concentrations greater than NOELs but less than PELs would imply that adverse effects, such as increased mortality rates in benthic organisms may be possible but are not probable. Effects of the exceedences of these sediment quality guidelines at KI-7 were reflected in benthic species diversity indices at KI-7 in September 1997 which was lower than all other locations except the deep location KI-14 (MDE 1998b Section 5.1.6.c). However, overall abundance of benthic organisms at KI-7 ranked fourth highest of the 10 locations sampled in September 1997. The benthic index of biotic integrity at KI-7 in September 1997 also ranked fourth of 10 locations (MDE 1998b Section 5.1.6.c). These mixed results probably reflect the conservative derivation of the NOEL and PEL thresholds and demonstrate how exceedences of the PEL do not always infer effects.

Human Health Effects

Sediment metal concentrations in the vicinity of Site 104 were less than the residential soil RBCs for all metals except arsenic. Arsenic concentrations at all eight sediment quality stations in the vicinity of Site 104 exceeded the RBCs (both residential and industrial soil) for arsenic. The arsenic RBC is based upon increased cancer incidence upon exposure to soils.

Maximum metal concentrations in the clean sediments of the navigational channels in the main stem of the Chesapeake Bay near Baltimore (Table 5-21) were substantially lower than the industrial soil RBCs for all metals except arsenic (no RBC is available for lead). Mean and maximum sediment arsenic concentrations in the navigational channels are substantially lower than arsenic concentrations inside Site 104 (especially KI-7), but still exceeded both the residential and industrial soil RBCs. However, because humans are not expected to be directly exposed to sediments in the navigational channels or in the vicinity of Site 104, little additional human health risk associated with exposure to these sediments is expected. Burial of existing sediments inside Site 104 with sediments from the navigational channels would lower the mean arsenic concentrations in surficial sediments at Site 104.

Summary

In summary, sediment concentrations of most organic and inorganic constituents in the vicinity of Site 104 were well below levels that would likely cause adverse biological effects to aquatic organisms or, if found in residential soils, might result in unacceptable human health risks. Sediment metal concentrations at KI-7 were higher than at nearby locations, and exceeded PELs, but these exceedences were not necessarily reflected in lower benthic abundances. BAP and arsenic concentrations in the sediments in the vicinity of Site 104 were higher than residential RBCs, suggesting that unacceptable human health risks could result if humans were exposed to these sediments to the same extent that they would be exposed to soils around their homes. Arsenic in clean sediments from the navigational channels of the main stem Chesapeake Bay near Baltimore, on average, were substantially lower than those at Site 104, but also exceeded the residential arsenic RBC. Because sustained human exposure to these sediments is unlikely, unacceptable human health risks from exposure to metals in the sediments are not expected.

5.1.5. Sediment

5.1.5.~~1~~a. General Overview of Physical Behavior of Dredged Material at Aquatic Sites.

Aquatic placement in conjunction with site selection and management techniques and dredged material testing procedures to ensure environmentally sound placement is the most widely used management option for uncontaminated dredged material in the United States and around the world. To properly use these management tools, it is important to recognize the behavior of dredged material at aquatic placement sites and how that behavior affects the potential for environmental consequences.

This summary, taken from a much more detailed discussion in MES (1999), describes the typical distribution of deposited dredged material around the release point, and the distance-time-concentration relationships typical of suspended sediments around aquatic dredged material placement sites.

When dredged material is released from a vessel, the vast majority of the material falls quickly to the bottom. The size and configuration of the deposit are determined by many factors. Both suspended and deposited sediments have potential ecological ramifications. Deposited sediments inevitably bury the existing seafloor and any benthic (bottom-dwelling) organisms living in or on it. Sediment that remains in suspension after the moment of discharge will settle out of the water column or become so diffused that the concentration cannot be distinguished from background levels.

This summary should not be construed as predictive of conditions likely to result from any specific dredged material placement operation, but indicate the limits within which most operations would typically be expected to fall.

Sediment deposits tend to be thickest at the point of release, and become thinner with distance from the release point. Dredged material that is clumped in the barge tends to form thick deposits with less lateral spread, while slurried material tends to form thinner deposits with more lateral spread. Deposits of slurried dredged material may be several feet thick at the center, and may spread laterally over hundreds of feet. Deposits of slurried material tend to be very low relief, with side slopes on the order of 1/100 or 2/100. Barge position at the time of release can be controlled to influence the thickness and lateral spread of the overall deposit resulting from the complete project. Sediment is shifted and redeposited by natural processes like storms, but to a lesser degree than by dredged material placement.

Suspended sediment concentrations tend to be highest at the point and time of release, and decrease with distance and time from the release. Suspended sediment concentrations tend to be lower in the upper water column, and higher closer to the bottom. Suspended sediment concentrations in the upper water column may have a maximum value on the order of a few hundred mg/l (parts per million – ppm) near the release point at aquatic placement sites. Suspended sediment concentrations near the bottom at aquatic placement operations may have a maximum value on the order of several hundreds of mg/l. Suspended sediment concentrations tend to dissipate to approximately background conditions within distances on the order of 800 to 1400 meters from the release point. Suspended sediment concentrations near aquatic placement operations tend to dissipate to approximately background conditions within less than an hour after release in many cases. Dissolved constituents in the discharge tend to follow time and space patterns of distribution roughly similar to suspended sediments.

Sediment is suspended by dredged material placement and by natural processes like wind, waves and currents. Suspended sediment concentrations from dredging operations tend to be on the same general order as natural maximum suspended sediment concentrations. Naturally elevated suspended sediment concentrations tend to cover large areas and persist continuously for perhaps a few days. Suspended sediment (and dissolved constituents) from aquatic placement of mechanically dredged material tend to cover relatively small areas and persist for perhaps a few hours, but to be repeated several times a day for periods of weeks or months.

The potential ecological implications of dredged material distribution can be accurately assessed only in the context of the major factors that control the overall effect of any environmental stress. Important among these are:

- **Concentration**: Other things being equal, the farther any parameter is from normal values the more stressful it becomes to organisms that experience it.

- **Time**: Other things being equal, the longer any parameter deviates from normal values the more stressful it becomes to organisms that experience it.

- **Area**: Other things being equal, the larger an area in which any parameter deviates from normal values the more organisms will experience it, and the greater the potential for the population as a whole to be affected.

5.1.5.~~2.~~b Tiered Evaluation.—Discussion of tiered approach, what is evaluated in which tier.

The U. S. Environmental Protection Agency's (EPA) Guidelines for Specification of Disposal Sites for Dredged or Fill Material implementing Section 404(b)(1) of the Clean Water Act are published in the Code of Federal Regulations at 40 CFR Part 230. The technical evaluation of potential effects of contaminants that may be associated with dredged material is to be conducted in accordance with 40 CFR 230.60 and 230.61. The EPA and U. S. Army Corps of Engineers (USACE) have jointly published a Testing Manual (U.S. EPA 1998c) describing testing and evaluation in accordance with 40 CFR 230.60 and 230.61 of dredged material proposed for placement in waters of the United States.

The testing manual (U.S. EPA 1998c) uses a tiered approach to testing. The initial tier (Tier I) uses readily available existing information, and if this is inadequate to support a decision, testing proceeds through subsequent tiers of successively more extensive and specific testing until sufficient information to support a decision is generated. It is necessary to proceed through the tiers only until information on each topic sufficient to make the required factual determinations has been obtained. If the existing information compiled in Tier I is complete and comparable to that which would be sufficient to make a decision in higher tiers, factual determinations can be made without more testing in the higher tiers (U.S. EPA 1998c). In such cases, the existing (Tier

I) information for each type of data is evaluated in relation to the guidance for that type of data presented in Tier II or III in the manual (U.S. EPA 1998c).

The manual (U.S. EPA 1998c) specifies that potential effects both in the water column and from deposited dredged material be evaluated, as summarized below. An action may be disapproved if there are unacceptable adverse effects to either the water column or from deposited dredged material; it may be approved only if both water column and deposited dredged material effects are acceptable.

- **Water column effects** address the chemical quality of the water, and thus potential effects on water-column organisms. Water column effects are evaluated by comparison of elutriate test results to water quality criteria and standards, considering the mixing that will occur at the site.

- **Deposited dredged material effects** are the emphasis of the evaluation because organisms can be exposed to deposited dredged material for extended periods. Two aspects of deposited dredged material are evaluated:

  - **Bioaccumulation** or the accumulation of chemical constituents from the dredged material in the tissues of organisms. If biologically adverse constituents were accumulated to sufficiently high levels both the organisms themselves and their predators, including humans, could potentially be affected. Bioaccumulation is evaluated by comparing dredged material test results to (1) bioaccumulation from a reference sediment, and (2) potentially adverse levels documented in the scientific literature. *(I ASSUME THE REFERENCE SEDIMENT CONCEPT HAS BEEN EXPLAINED ELSEWHERE)*

  - **Toxicity** is evaluated by comparing toxicity of dredged material to toxicity of reference sediment.

Spatial considerations are important in evaluating test data. Sedentary organisms (e.g., clams) may spend their entire life at the dredged material placement site, resulting in elevated body burdens (bioaccumulation) of some constituents from the dredged material in individuals on the site. This same site may constitute only a small proportion of the feeding range of a mobile predator (e.g., fish). Such a site typically provides only a small proportion of the prey of such a predator, unless something about the site is peculiarly attractive to the predator. Therefore, the site may contribute only a small proportion of the total diet, and the predator may receive a relatively small dose of the constituent bioaccumulated by the prey from the site. The net result may be that the site is of relatively little consequence to the predator.

Potential human health evaluations focus on determination of potential effects on individuals. In contrast, ecological evaluations focus more on effects that might threaten stable, self-perpetuating local populations and communities than about risks to individual organisms. This generalization does not apply when endangered species are of potential concern.

5.1.5.~~2~~b.1. Tier I

Tier I consists of compiling the readily available existing information and evaluating that information to determine whether it provides a sufficient basis for making the factual determinations required by 40 CFR 230.

5.1.5.~~2~~b.1.1. Presentation of existing information

[EXISTING SITE 104 AND CHANNEL DATA TO BE UPDATED]

5.1.5.~~2~~b.1.2. Tier I conclusions

According to the manual (U.S. EPA 1998c), after consideration of all available Tier I information, one of the following conclusions is reached.

1. Existing information does not provide a sufficient basis for making factual determinations. In this case, further evaluation in higher tiers is appropriate.

2. Existing information provides a sufficient basis for making factual determinations. In this case, one of the following decisions is reached:

   ~~(a)~~a. The material meets the criteria for exclusion from testing

   ~~(b)~~b. The material does not meet the criteria for exclusion from testing, but information concerning the potential impact of the material is sufficient to make factual determinations.

The existing Site 104 information presented in Section 5.1.5.2.1.1 leads to conclusion 2(b), because it provides a sufficient basis for making factual determinations and indicates that the dredged material does not meet the criteria for exclusion from testing. The existing information includes data on potential water column and deposited sediment effects, and addresses both toxicity and bioaccumulation. It is complete and comparable to that which would be sufficient to make a decision in higher tiers (i.e., Tier II for water quality and bioaccumulation data and Tier III for toxicity data). Therefore, the existing data will be evaluated according to the guidance (U.S. EPA1998c) in the appropriate tier for each type of data.

5.1.5.~~2~~b.2. Tier II

5.1.5.~~2~~b.2.1. Water quality evaluation

Analytical chemistry data for the elutriate samples collected in 1995 and 1998 were evaluated for a large group of analytes collected from six sample locations: Swan Point Channel, Craighill Entrance / Craighill, Craighill Angle, Craighill Upper Range/Cutoff Angle, Tolchester, and Brewerton Eastern Extension. The following chemical suites were analyzed: volatile organics, semi-volatile organics, pesticides and PCBs, metals and general water chemistry parameters.

Tables 1-1 and 1-2 summarize the results of the analytical characterizations and present all of the analytes with values which were equal to or greater than the reported analytical detection limit. The table does not present the data qualifiers, which may be important to the interpretation of the analytical results (e.g., J= estimated value; B= chemical measured in blank; E- estimated concentration). These qualifiers are discussed in the text below if they are important for a particular analyte.

For those analytes which were detected, Tables 1-1 and 1-2 present the range of the reported elutriate sample concentrations. These undiluted elutriate concentration values are then compared to specific regulatory criteria which are applicable to estuarine / saltwater conditions:

- T~~t~~he saltwater acute and chronic aquatic life criteria from U.S. EPA's (1998c) National Recommended Water Quality Criteria [63 Federal Register 68354 - 68364], and Maryland Department of the Environment's ambient water quality criteria [COMAR 26.08.02.03-2G]; and

- U.S. EPA's and MDE's criteria for the protection of human health from the consumption of contaminated aquatic organisms [63 Federal Register 68354 - 68364; and COMAR 26.08.02.03-2G].

Few of the more than 145 analytes analyzed in the samples were detected in the elutriate samples. For each of the detected analytes where a measured concentration exceeded a criterion, the required maximum dilution factor is calculated (maximum elutriate concentration / most restrictive criterion). Dilution modeling using the U.S. Army Corps of Engineers' STFATE model was conducted for both peak ebb and slack water tidal conditions by Moffatt and Nichol Engineers (30 September 1999- Draft). Each elutriate analyte with an undiluted concentration which exceeded a numerical criterion is discussed below.

1. ~~1.1~~ Evaluation of the 1995 Elutriate Dataset

Of the 145 analytes evaluated in 1995, only six had elutriate concentrations which exceeded any applicable numeric water quality criteria for saltwater. Each is presented in Table 1-1 and discussed below.

a. ~~1.1.1~~ Copper

Copper was detected in elutriates from each of the six stations at concentrations ranging from 1.7-3.5 µg/L. As shown in Table 1-1, the concentration measured in elutriates from three of the stations are slightly higher than U.S. EPA's (1998c) saltwater chronic aquatic life criterion, which is 3.1 µg/L (dissolved). However, the criterion would not be exceeded because the U.S. EPA's chronic criterion is a 4-day average concentration (U.S. EPA 1993), and modeling has shown that the elutriate concentration would be diluted to a concentration below the 4-day chronic criterion in less than five minutes under absolute worst case (slack water) conditions. Note also that the highest measured elutriate concentration (3.5 µg/L) is below MDE's estuarine criterion of 6.1 µg/L. Thus, because of the transient nature of the dredged material release and the rapid dilution, ambient water quality criteria for copper should not be exceeded at the site.

b. ~~1.1.2~~ Manganese

Manganese was measured in elutriates from each of the six stations at concentrations ranging from 589 - 9,960 µg/L. U.S. EPA's ambient water quality criterion for the protection of human health is 100 µg/L, was published in the Agency's (1976) Red Book, and was intended "*to protect against a possible health hazard to humans by manganese accumulation in shellfish*" (U.S. EPA 1993, p. 158).

The assumptions upon which U.S. EPA's manganese criterion is based are not consistent with the water column exposure that will occur at the proposed dredged material disposal site. Specifically:

- The transient and short duration in the water column will not allow mollusks to achieve a steady-state bioaccumulation factor, and therefore not accumulate manganese to high concentrations in their edible tissues. STFATE modeling for the site has shown that manganese concentrations are diluted by more than 100-fold under peak ebb flow within 60 minutes, and by approximately 80-fold under slack water conditions. Within hours, therefore, manganese concentrations are expected to be below U.S. EPA's 100 µg/L human health criterion.

- The manganese human health criterion is based on humans consuming the contaminated aquatic life on a regular basis for a **long duration (e.g., 6.5 grams per day for a 70 year lifetime)???** Because the proposed site will be closed to commercial fishing, it is highly unlikely that anyone could consume aquatic species collected from the site on a daily basis throughout their lifetime.

- EPA's criteria document states that "*very large doses of manganese can cause some diseases and liver damage, but these are not known to occur in the United States. Only a few manganese toxicity problems have been found throughout the world, and these have occurred under unique circumstances (i.e., a well in Japan near a deposit of buried batteries)*" (U.S. EPA 1993, p. 157).

Therefore, based on the environmental fate and exposure that would occur at the proposed site, environmental concerns based on exposure to manganese are very unlikely.

c. ~~1.1.3~~ Mercury

Total mercury was "detected" in 5 of the 6 undiluted elutriate samples in the 1995 dataset. Of these, 4 of the 5 were reported to be at concentrations $\leq$ 0.18 µg/L. The remaining value was 1.8 µg/L total mercury (Swan Point Channel), had an N-qualifier (MS outside of control limits). Comparisons of these concentrations with aquatic life and human health criteria are presented in Table 1-1, and discussed below.

Acute Criteria Comparisons

The highest elutriate concentration measured (1.8 μg/L) is numerically equivalent to U.S. EPA's (1998c) acute aquatic life criterion of 1.8 μg/L (dissolved). However, U.S. EPA's acute criterion is a 1-hour average exposure concentration, and the STFATE modeling has demonstrated that the highest measured elutriate concentration will be below the acute criterion in less than 5 minutes under worst-case slack water conditions.

Chronic Aquatic Life Comparisons

As shown in Table 1-1, U.S. EPA's (1998c) and MDE's chronic criteria differ substantially (0.94 μg/L versus 0.025 μg/L, respectively) because MDE's value is based upon U.S. EPA's (1986) Gold Book value which was substantially revised during U.S. EPA's promulgation of revised water quality standards for the state of California [62 Federal Register 42194 (5 Aug 97); and 63 Federal Register 68357 (10 Dec 98)]. As a result, U.S. EPA's revised value (0.94 μg/L- dissolved) is considered to be the most scientifically valid chronic criterion for the protection of saltwater aquatic life. Based on this updated criterion, only the highest elutriate value (1.8 μg/L) exceeds EPA's 4-day average chronic criterion (0.94 μg/L) by a factor of two. STFATE modeling has demonstrated that the highest measured elutriate concentration will be below EPA's chronic criterion in less than 5 minutes under worst-case slack water conditions. Thus, U.S. EPA's chronic criterion would not be exceeded at the proposed site. Similarly, STFATE modeling shows that MDE's 4-day average chronic criterion of 0.025 μg/L would be met within several hours under slack water conditions, and in less than 1 hour under peak ebb conditions.

Human Health Criteria Comparisons

Concentrations measured in undiluted elutriates from the four stations exceed U.S. EPA's and MDE's human health criteria by factors of 35 and 12, respectively. As discussed above, MDE's value is based upon U.S. EPA's (1986) Gold Book value which was substantially revised during U.S. EPA's promulgation of revised water quality standards for the state of California [62 Federal Register 42194 (5 Aug 97); and 63 Federal Register 68357 (10 Dec 98)]. As a result, U.S. EPA's (1998c) more stringent value (0.051 μg/L) is considered to be the most scientifically valid criterion for the protection of human health from the consumption of contaminated organisms. The transient and short duration in the water column will not allow aquatic species to achieve a steady-state bioaccumulation factor, and therefore not accumulate mercury to high concentrations in their edible tissues. STFATE modeling for the site has shown that mercury concentrations are diluted by more than 100-fold during peak ebb flow within 60 minutes, and by approximately 80-fold under slack water conditions. In less than one hour, therefore, mercury concentrations are expected to be below

U.S. EPA's human health criterion. As stated by U.S. EPA (1980) the mercury criterion should be interpreted "*as a time-weighted average concentration covering a period of 2 months or so. In other words it should not be regarded as an instantaneous value that should never be exceeded even for brief periods of time*" (p. C-106). Finally, because the proposed site will be closed to commercial fishing, it is highly unlikely that consumers could obtain and eat aquatic species collected from the site on a daily basis throughout their lifetime, **which is an assumption of the criterion.**

d. ~~1.1.4~~ Nickel

Nickel was detected in elutriates from each of the six stations at concentrations ranging from 3.3-41.3 µg/L. The concentration measured in elutriates from four of the stations are higher than U.S. EPA's (1998c) and MDE's saltwater chronic aquatic life criterion (8.2 µg/L-dissolved). However, the criterion would not be exceeded because the nickel chronic criterion is a 4-day average concentration (U.S. EPA 1993), and STFATE modeling has shown that the highest elutriate concentration (41.3 µg/L) would be diluted to a concentration below the 4-day chronic criterion in less than 15 minutes under absolute worst case (slack water) conditions. Thus, because of the transient nature of the release, ambient water quality criteria for nickel should not be exceeded at the site.

e. ~~1.1.5~~ Silver

Silver was detected in elutriates from two of the stations sampled in 1995 at concentrations of 4 and 5 µg/L (data qualified as between the IDL and CRDL). As shown in Table 1-1, these concentrations exceed the values in U.S. EPA's (1998c) and MDE's saltwater acute criteria for the protection of aquatic life. However, the criteria are 1-hour average concentrations (U.S. EPA 1993), and the STFATE modeling has demonstrated that the highest measured elutriate concentration will be diluted to below the EPA and MDE acute criteria in less than 5 minutes under worst-case slack water conditions, and quicker under ebb tide conditions. Thus, ambient water quality criteria for silver should not be exceeded at the site.

f. ~~1.1.6~~ Ammonia

Ammonia was detected in elutriate samples from each of the six sites in concentrations ranging from 1.4 to 10.8 mg/L total ammonia (as nitrogen). U.S. EPA's (1993) total ammonia criteria vary with pH, temperature and salinity (which were assumed for this analysis to be 7.4, 20° and 10 g/kg, respectively). As shown in Table 1-1, elutriate samples from five of the six stations exceeded U.S. EPA's (1993) saltwater criterion of 3.0 mg/L total ammonia (as nitrogen). The highest elutriate value (10.8 mg/L) is 3.6 times higher than the 4-day average chronic criterion. Based on STFATE modeling, however, the highest elutriate concentration would be diluted to below U.S. EPA's 4-day average criterion in less that 15 minutes under worst case slack water conditions, and less than 5 minutes under ebb flow. Therefore, ambient ammonia criteria will not be exceeded.

~~1.2~~2. Evaluation of the 1998 Elutriate Dataset

Of the 162 analytes evaluated in the 1998 sampling program, only six had elutriate concentrations which exceeded any applicable numeric criteria for saltwater. Each is presented in Table 1-2 and discussed below.

a. ~~1.2.1~~ Heptachlor

Heptachlor was detected at very low concentrations in elutriates from each of the six stations in 1998. The six samples ranged from 0.009 to 0.022 μg/L, which are near the reported instrument detection limit of 0.006 μg/L. U.S. EPA's (1998c) ambient criterion for the protection of human health from the consumption of contaminated aquatic life is 0.00021 μg/L, 29 times lower than the instrument detection limit. As discussed in U.S. EPA water quality criteria documents (e.g., EPA 1993, Appendix C) the Agency's criterion is based upon the following *assumptions*:

- T~~t~~he criterion is the exposure concentration that is estimated to cause a lifetime carcinogenic risk of 10^{-6} (i.e., causing one additional cancer out of one million exposed persons),
- "~~c~~*Continuous exposure to the compound*" throughout a 70 year human lifespan, which would require daily consumption of contaminated organisms from the site for 70 years,
- T~~t~~he consumed organisms are exposed to the chemical for a sufficient duration that they reach a maximum steady state tissue concentration, and
- A continuously exposed population of edible contaminated organisms from the site that is sufficient to feed a population on a daily basis for 70 years.

The assumptions upon which U.S. EPA's heptachlor criterion is based are not consistent with the water column exposure that will occur at the proposed dredged material disposal site. Further, a dilution factor of 105 would reduce the highest of the heptachlor concentrations below EPA's ambient water quality criterion. STFATE modeling has demonstrated that this amount of dilution would occur within a few hours under slack or ebb tide conditions. Therefore, measured elutriate concentrations of heptachlor would not have adverse effects to human health.

b. ~~1.2.2~~ Heptachlor epoxide

Heptachlor epoxide was detected at very low concentrations in elutriates from each of the six stations in 1998. The six samples ranged from 0.0027 to 0.0076 μg/L, and each value has important laboratory qualifiers (i.e., five of the six reported heptachlor epoxide in the blank, and the remaining sample was "estimated"). U.S. EPA's (1998c) ambient criterion for the protection of human health from the consumption of contaminated aquatic life is 0.00011 μg/L, 9 times lower than the instrument detection limit (0.001 μg/L). The discussion immediately above for heptachlor also applies for heptachlor epoxide; except the required dilution factor of 69 (see Table 1-2) would be achieved slightly quicker.

c. ~~1.2.3~~ Manganese

Manganese was measured in elutriates from each of the five stations at concentrations ranging from 746 - 11,200 μg/L. U.S. EPA's ambient water quality criterion for the protection of human health is 100 μg/L, was published in the Agency's (1976) Red Book, and was intended "*to protect against a possible health hazard to humans by manganese accumulation in shellfish*" (U.S. EPA 1993, p. 158).

As discussed for the 1995 manganese dataset (above), the assumptions upon which U.S. EPA's manganese criterion are based are not consistent with the water column exposure which will occur at the proposed dredged material disposal site. Specifically, the transient and short duration in the water column will not allow resident mollusks to achieve a steady-state bioaccumulation factor, and therefore not accumulate manganese to high concentrations in their edible tissues for long-term human consumption. STFATE modeling for the site has shown that manganese concentrations are diluted by more than 100-fold under peak ebb flow within 60 minutes, and by approximately 80-fold under slack water conditions. With a maximum required dilution factor of 112 (see Table 1-2), manganese concentrations are expected to be below U.S. EPA's 100 μg/L human health criterion within several hours. Therefore, based on the environmental fate and exposure that would occur at the proposed site, environmental concerns based on exposure to manganese are very unlikely.

d. ~~1.2.4~~ Mercury

Total mercury was "detected" in 3 of the 5 undiluted elutriate samples in the 1998 dataset at concentrations ranging from 0.12 to 0.97 μg/L. Each of the three had a data qualifier noting the concentration reported was greater than the Instrument Detection Limit (IDL) but less that the Reporting Limit (RL). Comparisons of these concentrations with aquatic life and human health criteria are presented in Table 1-2, and discussed below.

Chronic Aquatic Life Comparisons

As shown in Table 1-2, U.S. EPA's (1998c) and MDE's chronic criteria differ substantially (0.94 μg/L versus 0.025 μg/L, respectively) because MDE's value is based upon U.S. EPA's (1986) Gold Book value which was substantially revised during U.S. EPA's promulgation of revised water quality standards for the state of California [62 Federal Register 42194 (5 Aug 97); and 63 Federal Register 68357 (10 Dec 98)]. As a result, U.S. EPA's revised value (0.94 μg/L- dissolved) is considered to be the most scientifically valid chronic criterion for the protection of saltwater aquatic life. Based on this updated criterion, the highest elutriate value (0.97 µg/L) exceeds EPA's 4-day average chronic criterion (0.94 µg/L) by only 3 percent. STFATE modeling has demonstrated that the highest measured elutriate concentration will be below EPA's chronic criterion in less than 5 minutes under worst-case slack water conditions. Thus, U.S. EPA's chronic criterion would not be exceeded at the proposed site. Similarly, STFATE modeling shows that MDE's 4-day average chronic criterion of 0.025 µg/L would be met within several hours under slack water conditions, and in less than 30 minutes under peak ebb conditions.

Human Health Criteria Comparisons

Concentrations measured in undiluted elutriates from the three stations exceed U.S. EPA's and MDE's human health criteria by factors of 19 and 6.6, respectively. As discussed above, MDE's value is based upon U.S. EPA's (1986) Gold Book value which was substantially revised during U.S. EPA's promulgation of revised water quality standards for the state of California [62 Federal Register 42194 (5 Aug 97); and 63 Federal Register 68357 (10 Dec 98)]. As a result, U.S. EPA's (1998c) more stringent value (0.051 µg/L) is considered to be the most scientifically valid criterion for the protection of human health from the consumption of contaminated organisms. The transient and short duration in the water column will not allow aquatic species to achieve a steady-state bioaccumulation factor, and therefore not accumulate mercury to high concentrations in their edible tissues. STFATE modeling for the site has shown that mercury concentrations are diluted by more than 100-fold during peak ebb flow within 60 minutes, and by approximately 80-fold under slack water conditions. In less than one hour, therefore, mercury concentrations are expected to be below U.S. EPA's human health criterion. As stated by U.S. EPA (1980) the mercury criterion should be interpreted "*as a time-weighted average concentration covering a period of 2 months or so. In other words it should not be regarded as an instantaneous value that should never be exceeded even for brief periods of time*" (p. C-106). Finally, because the proposed site will be closed to commercial fishing, it is highly unlikely that consumers could obtain and eat aquatic species collected from the site on a daily basis throughout their lifetime, **which is an assumption of the criterion**.

Silver was detected in elutriates from three of the five stations samples in 1998 at concentrations ranging from 1.6 to 2.1 µg/L (data qualified as between the IDL and RL). As shown in Table 1-2, the highest concentration exceed U.S. EPA's (1998c) saltwater acute aquatic life criterion (1.9 µg/L-dissolved) by 10 percent. However, the criteria are 1-hour average concentrations (U.S. EPA 1993), and the STFATE modeling has demonstrated that the highest measured elutriate concentration will be diluted to below the EPA acute criterion in less than 5 minutes under worst-case slack water conditions, and quicker under ebb tide conditions. Thus, because of the transient nature of the release, ambient water quality criteria for silver should not be exceeded at the site.

e. ~~1.2.5~~ Ammonia

Ammonia was detected in elutriate samples from each of the six sites in concentrations ranging from 1.7 to 8.8 mg/L total ammonia (as nitrogen). U.S. EPA's (1993) total ammonia criteria vary with pH, temperature and salinity (which were assumed for this analysis to be 7.4, 20° and 10 g/kg, respectively). As shown in Table 1-2, elutriate samples from five of the six stations exceeded U.S. EPA's (1993) saltwater criterion of 3.0 mg/L total ammonia (as nitrogen). The highest elutriate value (8.8 mg/L) is 2.9 times higher than the 4-day average chronic criterion. Based on STFATE modeling, however, the highest elutriate concentration would be diluted to below U.S. EPA's 4-day average criterion in less that 15 minutes under worst case slack water conditions, and less than 5 minutes under ebb flow. Therefore, given the transient nature of the release, ambient ammonia criteria will not be exceeded.

5.1.5.~~2~~b.2.2~~.~~ Water quality conclusions

According to the manual (U.S. EPA 1998c), after consideration of the Tier II water quality data, one of two possible conclusions is reached regarding the potential water column impact of the proposed dredged material:

1. The available water quality requirements are met. Further information on water column toxicity must be evaluated in Tier III when there are contaminants of concern for which applicable water quality criteria or standards are not available or where interactive effects are of concern.

2. Concentrations of one or more of the dissolved contaminants of concern, after allowance for mixing, exceeds applicable water quality criteria or standards beyond the boundaries of the mixing zone. In this case, the proposed discharge of dredged material does not comply with the water quality criteria or standards.

The preceding discussion of the data demonstrates that the available water quality requirements are met. Most dissolved contaminants of concern in the discharge are predicted to be below the applicable water quality criteria or standards. Those that exceed the applicable water quality criteria or standards do so by relatively small margins. Mixing and dispersion at Site 104 will bring them into compliance with the applicable criteria or standards within a matter of minutes and hundreds of yards of the discharge point, which will be at least 1000 yards inside the site boundary.

5.1.5.~~2~~b.2.3~~.~~ Bioaccumulation (TBP for each COC in relation to reference, Corps' Environmental Residue-Effects Database (ERED), and human exposure via consumption.

5.1.5.b.2.3.1 Basis for evaluation

Environmental Residue-Effects Database. The Environmental Residue-Effects Database (ERED) is a compilation of data relating bioaccumulation of individual chemicals to specific biological changes in particular species. ERED is maintained by the EPA and USACE and is updated regularly. The biological changes or endpoints in ERED include any endpoints reported in the peer-reviewed scientific literature in conjunction with appropriate bioaccumulation data. Some of these studies involve important physiological processes, but measure specific biological endpoints whose consequences, if any, at the organism or ecosystem level are not at all clear (e.g., reduced glucose content of the coelomic fluid). Other endpoints are of clear importance at the level of the organism (e.g., survival, growth) or ecosystem (e.g., various measures of reproduction). Because of the diversity of species and chemical constituents reported in the literature, ERED may contain relatively few data for the exact species and chemical tested for any particular project. However, data for related species and chemicals are useful in evaluating bioaccumulation. For evaluation of this project, if ERED data were not available for *Neanthes* species, data for any annelid were considered potentially useful substitutes. If ERED data were not available for *Macoma* species, data for any bivalve mollusk were considered potentially useful substitutes. If ERED data were not available for individual pesticides or polychlorinated biphenyls (PCB), data for any chlorinated hydrocarbon were considered potentially useful for evaluating bioaccumulation. No substitutions were made for metals. PAH were evaluated by the critical body residue approach discussed below. The measurement in the ERED considered most useful for this evaluation was "no observed effect dose" (NOED), since this indicates the effects under study were not observed at a bioaccumulation level at least that high, and therefore the NOED is presumably a "safe" level in terms of those effects. If NOED data were not available, "lowest observed effects dose" (LOED) data were used. This is the lowest bioaccumulation level studied at which the effects under study were observed, and implies that the effects may occur at a level lower by some unknown margin.

[TABLES NEED TO BE ADDED]

The complete ERED information for all relevant constituents is presented in Table 5.1.5.2.2.3.1-N for *Neanthes virens*, and in Table 5.1.5.2.2.3.1-M for *Macoma nasuta*. All data in the ERED are presented in mg/kg wet weight, and this reporting basis is used in Tables 5 and 6. Because the Site 104 TBP bioaccumulation data (Table ? from Section 5.1.5.2.1.1) are presented in units of mg/kg, ug/kg and ng/kg wet weight for various compounds, the data from ERED summarized in Table 5.1.5.2.2.3.2-ERED have been converted to the same units as the Site 104 data for ease of comparison.

Critical Body Residue. The critical body residue (CBR) approach is based upon PAH primary mode of lethality, which is narcosis (causing unconsciousness, immobility, or death). Studies have shown that narcosis occurs when the concentration of total PAH in tissues exceeds a critical threshold (McCarty and Mackay 1993). The CBR is the sum of the tissue concentrations of PAH on a umol/g wet weight basis. The CBR threshold for chronic narcosis is in the range of 0.2 to 0.8 umol/g wet weight for aquatic invertebrates (McCarty and Mackay 1993). That is, if the CBR is less than the threshold of 0.2 to 0.8 umol/g wet weight, chronic narcosis is not expected from the total PAH body burden in the organism. The CBR threshold for acute narcosis is much higher, in the range of 2 to 8 umol/g wet weight for aquatic invertebrates (McCarty and Mackay 1993), and is not considered in this evaluation.

5.1.5.b.2.3.2 Evaluation of data

For every analyte Table 5.1.5.2.2.3.2-ERED presents the maximum TBP calculated for any sediment sample representing dredged material potentially proposed for placement at Site 104. The table also presents the TBP for the reference sediment for each analyte, and the ERED data on body burdens associated with biological responses. The critical body residue (CBR) based on TBP of PAH for each sediment sample representing dredged material potentially proposed for placement at Site 104 is shown in Table 5.1.5.2.2.3.2-CBR. This table also shows the CBR as a percent of the threshold for chronic effects (0.2 umol/g wet weight). The following discussion of each analyte is based on the information summarized in these two tables.

4,4'-DDD. (a discussion like the following will be inserted for every pesticide/PCB)

1-methylnaphthalene and 2-methylnaphthalene. The TBP of these compounds was not calculated for the reference sediment. The maximum TBP of these compounds from any of the samples was 210.91 ug/kg dry weight. There are no relevant ERED data for these compounds in *Macoma* or *Neanthes*, nor in any other bivalve mollusk or annelid. The maximum CBR of all PAH for any sediment sample representing dredged material potentially proposed for placement at Site 104 was 0.006055 umol/g wet weight from sample CR3 (Table 5.1.5.2.2.3.2-CBR). This value is only 3.03 percent of the CBR threshold for chronic effects (Table 5.1.5.2.2.3.2-CBR). In other words, the critical body residue of all PAH, of which 1-methylnaphthalene and 2-methylnaphthalene are components, would have to have been 33 times higher before chronic effects might have been a concern in the sample with the highest TBP values for PAH. Because of this, the low TBP values, and the lack of evidence in ERED of potential effects, bioaccumulation of 1-methylnaphthalene and 2-methylnaphthalene to an environmentally important level by *Macoma* and *Neanthes* from any sediment sample representing dredged material potentially proposed for placement at Site 104 does not appear likely.

Acenaphthene. The TBP of acenaphthene from the reference sediment was 25.60 ug/kg dry weight. The maximum TBP of this compound from any of the sediment samples representing dredged material potentially proposed for placement at Site 104 was 143.82 ug/kg dry weight. The TBP from the highest sample was 118.22 ug/kg (parts per billion – ppb) wet weight (5.6 times) higher than from the reference sediment. There are no relevant ERED data for acenaphthene in *Macoma* or *Neanthes*, nor in any other bivalve mollusk or annelid. The maximum CBR of all PAH for any sediment sample representing dredged material potentially proposed for placement at Site 104 was 0.006055 umol/g wet weight from sample CR3 (Table 5.1.5.2.2.3.2-CBR). This value is only 3.03 percent of the CBR threshold for chronic effects (Table 5.1.5.2.2.3.2-CBR). In other words, the critical body residue of all PAH, of which acenaphthene is a component, would have to have been 33 times higher before chronic effects might have been a concern in the sample with the highest TBP values for PAH. Because of this, the low TBP value, the small increase in the sample compared to the reference, and the lack of evidence in ERED of potential effects, bioaccumulation of acenaphthene to an environmentally important level by *Macoma* and *Neanthes* from any sediment sample representing dredged material potentially proposed for placement at Site 104 does not appear likely.

Other PAH. (a discussion like the preceding will be inserted for every PAH)

5.1.5.2b.2.4. Bioaccumulation conclusions

According to the manual (U.S. EPA 1998c), after consideration of the Tier II bioaccumulation data, one of the following conclusions is reached based upon comparison between the theoretical bioaccumulation potential (TBP) for the dredged material and for the same contaminants in the reference sediment:

1. The TBP for the non-polar organic contaminants of concern in the dredged material does not exceed the TBP for the reference sediment, and therefore, the dredged material is predicted not to result in benthic bioaccumulation of the measured non-polar organic compounds.

2. The TBP for the non-polar organic contaminants of concern in the dredged material exceeds the TBP for the reference sediment. In this case, the information is not sufficient to predict whether the dredged material will result in benthic bioaccumulation of the measured non-polar organic compounds, and further evaluation of bioaccumulation in Tier III is necessary to furnish information to make determinations under the guidelines.

5.1.5.2b.3. Tier III

5.1.5.2b.3.1. Benthic toxicity evaluation (Old Versar data & space-holder for data now being generated.)

5.1.5.2b.3.2. Benthic toxicity conclusions

According to the manual (U.S. EPA 1998c), benthic toxicity testing of contaminants in the dredged material in Tier III will result in one of the following possible conclusions:

1. Mortality in the dredged material is not statistically greater than in the reference sediment, or does not exceed mortality in the reference sediment by at least 10 percentage points (or 20 percentage points for amphipods). Therefore, the dredged material is predicted not to be acutely toxic to benthic organisms.

2. Mortality in the dredged material is statistically greater than in the reference sediment and exceeds mortality in the reference sediment by at least 10 percentage points (or 20 percentage points for amphipods). In this case, the dredged material is predicted to be acutely toxic to benthic organisms.

5.1.5.3c. Summary and ~~conclusions~~ conclusions.

5.1.6 Aquatic Resources

5.1.6.a Plankton. Phytoplankton are microscopic plants found throughout aquatic systems ~~and~~that generally form the basis of aquatic system food webs. Phytoplankton production, accumulation, and subsequent decomposition, govern ~~the~~ productivity at higher trophic levels, as well as nutrient and dissolved oxygen concentrations in the Bay and its tributaries (Sellner 1993). Zooplankton, which are microscopic animals that feed directly upon phytoplankton, are also an essential link in the food web and provide the bulk of the forage prey for most larval and juvenile fish as well as many other estuarine organisms (Birdsong and Buchanan 1993).

Phytoplankton

Phytoplankton serve as an integral link in the aquatic food chain, produce life-sustaining oxygen for aquatic organisms, and assimilate nutrients (nitrogen, phosphorus, and silicon) that flow into the Bay. Light, temperature, nutrients, and zooplankton abundance regulate the distribution and abundance of phytoplankton in any estuarine ecosystem (Lippson 1973). Maximum phytoplankton productivity generally occurs in the mainstem of the Chesapeake Bay between the Chesapeake Bay Bridge and the Potomac River, where water clarity, nutrient concentrations, and mixing in the water column create optimal conditions (Tuttle *et~~.~~ al.* 1985 and Sellner 1987). Site 104 is located in the maximum phytoplankton production area of the B~~b~~ay.

The annual cycle of phytoplankton production in the Chesapeake Bay is characterized in~~by two~~ phases. There is a spring biomass maximum in April-May supported by increased light penetration and high riverine nutrient inputs. ~~And~~This is followed by a summer productivity maximum supported by ~~benthic~~ nutrient re~~generation~~lease from bottom sediment organic matter decomposition (Conley and Malone 1992). Recent work by Fisher~~,~~ *et ~~.~~al.* (1992, 1999)~~,~~ and Malone~~, *et.al.*~~ *et al.* (1996) ~~and Fisher, *et.al.* (1992)~~ have more fully described the nature of these phytoplankton productivity cycles and the seasonal factors ~~which~~that limit phytoplankton productivity. These findings have led to a better understanding of the nature of nutrient limitations and the seasonal changes in water quality conditions which then control phytoplankton growth.

The factors ~~which~~that control phytoplankton growth include temperature, light, salinity, and nutrients. Nutrients that control phytoplankton growth include nitrogen and phosphorus and in some cases, silica. Prior to recent studies in the Chesapeake Bay, the Bay was thought to be nitrogen-limited for phytoplankton growth. That is, the phytoplankton would only grow to the extent that nitrogen was available as a nutrient;~~,~~ when nitrogen was no longer available, phytoplankton growth would stop. The studies by Fisher~~,~~ *et ~~.~~al.*~~,~~ (1992 and 1999) and Malone~~,~~ *et ~~t~~.al.*, (1996) have further refined that theory. ~~What t~~These studies have found ~~is~~ that nitrogen in fact limits phytoplankton growth in the summer, but in the spring, phosphorus is the limiting factor (for diatoms, a kind of phytoplankton with a silicate skeleton, silica becomes limiting in the spring).

~~The reasoning behind t~~This change in limiting factors is due to the changing environmental conditions in the estuary. The late winter to spring period in the Chesapeake Bay is characterized by large freshwater runoff, with higher ratios of nitrogen loadings compared to phosphorus in the runoff. During this time period, as sunlight is also increasing, there is more nitrogen available than can be utilized by the phytoplankton, when compared to phosphorus. Under these conditions, phosphorus then becomes the limiting nutrient – the phytoplankton only grow to the extent that phosphorus is available as a nutrient. During the summer this dynamic changes. With a decrease in nitrogen loading as freshwater runoff declines and plants in the watershed begin to grow and tie up the nutrients, the source of nutrients to the water column switches to the nutrients being recycled from organic matter decomposition in the sediment. The increasing water temperatures in the bottom waters begin a process of microbial activity. These microbes break down the organic matter that has fallen to the bottom of the ~~b~~Bay, and in the process, nutrients are "remineralized,"~~;~~ or recycled to the water column. When this happens, the sediments become the main source of nutrients to fuel phytoplankton growth. Under these conditions, the Bay is now producing higher ratios of phosphorus, and phytoplankton only grow to the extent that nitrogen is available as a nutrient.

The Chesapeake Bay Water Quality Program (CBWQP) determines the standing crop (biomass) of phytoplankton by indirectly measuring concentrations of chlorophyll-a (the primary photosynthetic pigment in all plants). Chlorophyll-a has been measured seasonally from 1984 to 1996 by the CBWQP at MCB3.3C, a fixed sampling station located in the southern portion of Site 104 north of the Chesapeake Bay Bridge, and various other fixed stations within the Bay (Figure 5-14~~12~~). Chlorophyll-a concentrations were found to have generally increased in the mainstem of the Bay from 1985 to ~~-~~1996. This increased trend was largely attributed to productivity during the summer months (Lacouture *et al.* 1993). In the context of water quality, increased chlorophyll-a concentrations would be an indicator of deteriorating conditions. However, in the context of nutrient and suspended sediments trends, increases in chlorophyll-a are actually a positive sign that the ecosystem is becoming more balanced. Lacouture *et~~.~~ al.* (~~1997~~1998) postulated that the chlorophyll-a concentrations would have to increase, then stabilize, and finally decrease to be in the necessary range for a balanced ecosystem.

Diatoms, dinoflagellates, golden brown algae, green algae, and blue-green algae represent dominant major phytoplankton taxonomic groups found within the Chesapeake Bay estuary. Studies performed by the CBWQP have found that diatoms generally dominate the spring phytoplankton biomass initially, followed by a large contribution of dinoflagellates. These dinoflagellates continue to dominate the productivity maximum in the summer (Lacouture *et al.* 1993). Studies have also shown that dinoflagellates have a higher light optima, shorter generation times, and are motile [EXPLAIN SO PUBLIC CAN UNDERSTAND], whereas diatoms have a lower light optima, longer generation times, and a greater capacity for energy storage, but require mixing to remain suspended (Lacouture *et al.* 1993). Generally, phytoplankton in the Bay are considered to be extremely productive when compared to the open ocean flora (EA 1997). Phytoplankton densities, pigment levels, and productivity decrease in the open ocean due to limited nutrient availability and higher salinity levels.

Zooplankton

Zooplankton, the animal component of the planktonic community, provide an important pathway by which phytoplankton and bacterial biomass moves up through the food chain to higher trophic levels. Grazing by zooplankton regulates phytoplankton and bacteria populations, and excretion by zooplankton transports nutrients to the benthos (Brownlee and Jacobs 1987). Zooplankton includes crustaceans such as copepods, fishes in egg and larval stages (ichthyoplankton), and other pelagic microscopic animals that are at the mercy of water currents. These free swimming selective feeders are capable of consuming large quantities of phytoplankton and detritus and the enormous abundance of zooplankton constitute a primary source of food for larval stages of fishes and other planktonic feeders. Zooplankton have been monitored B~~b~~ay-wide at a network of stations in the Chesapeake Bay since 1984 by the CBWQP. Station MCB3.3C is located north of the Chesapeake Bay Bridge and is located in the southern portion of the site (Figure 5-14~~12~~).

Calanoid copepods have dominated mesozooplankton collections in the Maryland and Virginia portions of the Chesapeake Bay since 1984 (Brownlee and Jacobs 1987). Species distributions tend to vary seasonally and by salinity. In mesohaline salinities (5-18 ppt), such as the Site 104 area, *Acartia spp.* dominate mesozooplankton communities in the summer and fall; and *Eurytemora affinis* predominate in the winter months (Brownlee and Jacobs 1987). It has been indicated that *E. affinis,* when fed to striped bass larvae, produces optimum growth and survival (Jacobs 1995). Brownlee and Jacobs noted that mesohaline stations in the mainstem of the Bay (including MCB3.3C) generally yielded fewer copepod species overall than freshwater and oligohaline zones in the Bay. In addition to calanoid copepods, polychaete larvae and barnacle nauplii were also collected in the mesohaline region of the Bay. Polychaete larvae were collected in winter and summer in pulses while the barnacle nauplii were collected in spring in highest densities. During the summer months, comb jellies (ctenophores), such as the sea walnut (*Mnemeopsis leidyi*) were found to be abundant in the mesozooplankton samples in mesohaline and polyhaline waters (Brownlee and Jacobs 1987).

Rotifers, largely *Synchaeta spp.*, dominated microzooplankton collections at mesohaline stations (including MCB3.3C) within the Chesapeake Bay (Brownlee and Jacobs 1987). Major abundance and biomass peaks (1984 to 1996) occurred in late summer-early fall, with minor peaks in winter and spring. Other species collected were *Copepod nauplii* and *Tintinnines*. The overall status of microzooplankton in the Bay is considered fair (Lacouture *et al.* ~~1997~~1998).

Hypotrich ciliates [EXPLAIN] have been identified as microaerophiles (species who tolerate low oxygen conditions) and are frequently found in hypoxic or anoxic waters (Sellner and Brownlee 1995). These populations have been proposed as excellent indicators of recurring summer hypoxia and anoxia in the deep bottom waters of the Chesapeake Bay. Hypotrich ciliates, such *as Euplotes spp.*, have been shown to grow most rapidly at oxygen concentrations from 6-8% saturation. For the period 1984-1994 hypotrich ciliate abundances were compared to bottom DO concentrations for six CBPWQ stations including MCB3.3C. Densities of hypotrich ciliates were found to be strongly associated with bottom DO levels (Sellner and Brownlee 1995). Station MCB3.3C was found to support a summer maximum for stress tolerant organisms that have been shown to survive long periods of low dissolved oxygen concentrations.

5.1.6.b Fisheries.

Introduction

Historically, the Chesapeake Bay has been among the most productive estuaries in the world for fish and shellfish, supporting commercial and recreational fisheries for as many as 50 commercial species throughout Maryland and Virginia (Rothschild *et al.* 1981). In the past two decades, populations of some fish species (e.g., American shad [*Alosa sapidissim*] and river herring [*Alosa* spp.]) have declined significantly (Richkus *et al.* 1992), whereas other species such as striped bass (*Morone saxatilis*-rockfish) are showing signs of recovery after years of record low abundances (CBP 1995b).

The habitat requirements of individual fish species are numerous and complex. They include abiotic and biotic environmental conditions. The two major determining abiotic conditions are salinity and depth. Biotic conditions are governed by variables such as vegetative cover, quality and quantity of prey species, predation, and competition. Habitat types in the Bay range from deep open-water habitats in the mainstem to expansive saltwater marshes in the southeastern areas. Salinity zones in the Bay can be classified as tidal fresh, oligohaline, mesohaline, or polyhaline. Water depths within Site 104 vary from deep (-23.8 m [-78 ft] MLLW) to shallow (-12.8 m [-42 ft] MLLW) habitat types. It is common for the deeper water habitats of Site 104 to go hypoxic (dissolved oxygen less than 4 to 5 mg/L) to anoxic (dissolved oxygen 0 mg/L) in the bottom layers during the summer (Section 5.1.4). Dissolved oxygen concentrations associated with hypoxic to anoxic conditions are potentially harmful to aquatic life. [MES will provide temperature data here to answer the thermal refuge question in the UMCES white paper].

Murdy *et al.* (1997) cataloged 267 species of fish that inhabited the Chesapeake Bay during a portion of their life history. However, only 32 species are classified as year-round residents. Of the 267 species present in the Bay, a significant number require high salinities and are, therefore, restricted to the lower portion of the Bay. The upper Bay supports a maximum diversity of 100 species of fish, for at least a portion of their lifecycle, and these species are distributed primarily based upon their tolerance to salinity, available habitat, and annual migratory cycles (Lippson *et al.* 1979; Lippson and Lippson 1984). Site 104 is located in the mesohaline portion of the upper Bay. Species present in this region of the Bay must be able to tolerate salinity concentrations that vary from 5 to 13 ppt (Lippson 1973).

Fish species that occur in the upper Bay mainstem (which includes Site 104) of the Chesapeake Bay can be divided into two dominant groups based upon utilization of the area: permanent residents and migratory species. The permanent residents consist of species that spend their entire life cycle in the upper Bay (CBP 1995b). The bay anchovy (*Anchoa mitchilli*) is an example of a resident species. This species has a life expectancy of 1 year and is an important link in the Bay's food web (Miller 1998). Migratory fish are categorized based upon their utilization of the Bay. Migratory fish include both species that regularly (seasonally) utilize the area for some period of their life cycles as well as many that are only occasional transients of the fish community (Setzler-Hamilton 1987). Migratory fish can be further divided on the basis of spawning behavior: anadromous fish, which migrate from the ocean to spawn in the Bay or its tributaries, and catadromous fish, which migrate from Bay waters to spawn in the ocean (CBP 1995b). True anadromous fish include alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*), American shad (*Alosa sapidissima*), hickory shad (*Alosa mediocris*), striped bass (*Morone saxatilis*), shortnose sturgeon (*Acipenser brevistrum*), and Atlantic sturgeon (*Acipenser oxyrinchus*). Semi-anadromous fish, which migrate from the lower estuary to upper estuary freshwaters to spawn, include white perch (*Morone americanus*), gizzard shad (*Dorosoma cepedianum*), yellow perch (*Perca flavescens*), and estuarine populations of threadfin shad (*Dorosoma petenense*). Eels (*Anguilla rostrata*) are the only true catadromous species in the Chesapeake Bay (CBP 1995b). Although eels live in the Chesapeake for long periods, they eventually migrate to open waters in the Sargasso Sea to spawn.

Other fish, mostly marine species, utilize the Bay not for spawning purposes but for successful completion of a portion of their life cycle (e.g., as larvae or juvenile life stages) (Setzler-Hamilton 1987). Examples of marine fish that spend some portion of their life cycle in the Bay include Atlantic menhaden (*Brevoortia tyrannus*) and bluefish *(Pomotomus saltatrix)*[May want to include EFH discussion here]. Some marine fishes that utilize the Bay, if given the opportunity, may survive equally as well in coastal or oceanic waters during these life stages (e.g., Tautog and harvestfish) (Setzler-Hamilton 1987).

An inventory of fishes commonly known to occur in the mesohaline portion of the upper Bay from the Chesapeake Bay Bridge to the Pooles Island area was derived from a variety of literature sources and is included in Table 5-21 (Miller 1998). Table 5-22 provides a synopsis of general distribution and life history information for these upper Bay species (Miller 1998; Setzler-Hamilton 1987; Jordan *et al.* 1991).

Commercially Important Species

Two species of fish, striped bass and white perch, support an extensive fishery in the NOAA025 region (Chesapeake Bay Bridge to Pooles Island) of the Bay (Section 5.3.5.e). Site 104 is included in this region.

The striped bass is an anadromous fish that occurs from Canada to the Florida peninsula (Murdy *et al.* 1997). However, the majority of spawning occurs in a few areas, with the Hudson River and the Chesapeake Bay accounting for nearly all stocks (Setzler-Hamilton and Hall 1991). In the Chesapeake Bay, spawning occurs from early April to late May in the tidal freshwater areas, and during times of peak abundance, fish spawned in the Bay may contribute as much as 90 percent of the coastal migratory stocks (Miller 1998; Setzler-Hamilton and Hall 1991). During summer and fall (June-November), commercial fishermen take striped bass in pound nets (MDNR 1999d). These fixed nets are set typically in <6.1 m (<20 ft) of water along shorelines to intercept fish as they move. Miller (1998) documented that because of the offshore location of Site 104, pound netting was not commonly practiced within its boundaries. Commercial fishermen use drift gill nets during the winter (December-February). Commercial fisherman from Rock Hall that were interviewed by Miller (1998) indicated that most drift nets are

Table 5-21

Scientific and Common Names of Fishes that are Known to Occur in the Mesohaline Portion of the Upper Bay.

Common Name	Scientific Name
Family Species	Family *Species*
Freshwater Eels	Anguillidae
American eel	*Anguilla rostrata*
Herrings	Clupeidae
Blueback herring	*Alosa aesitvalis*
Hickory shad	*Alosa mediocris*
Alewife	*Alosa pseudoharengus*
American shad	*Alosa sapidissima*
Atlantic menhaden	*Brevoortia tyrannus*
Gizzard shad	*Dorosoma cepedianum*
Threadfin shad	*Dorosoma petenense*
Anchovies	Engraulidae
Bay anchovy	*Anchoa mitchelli*
Minnows	Cyprinidae
Common carp	*Cyprinus carpio*
North American Catfish	Ictaluridae
Channel catfish	*Ictalurus punctatus*
Brown bullhead	*Ictalurus nebulosus*
Yellow bullhead	*Ictalurus natalis*
Toadfish	Batrachoididae
Oyster toadfish	*Opsanus tau*
Killifishes	Cyprinodontidae
Mummichog	*Fundulus heteroclitus*
Silverside	Atherinidae
Atlantic silverside	*Menidia menidia*
Temperate Basses	Percicthyidae
White perch	*Morone americanus*
Striped bass	*Morone saxatilis*
Perch	Percidae
Yellow perch	*Perca flavescens*
Bluefishes	Pomotomidae
Bluefish	*Pomotomus saltatrix*
Drums	Sciaenidae
Weakfish	*Cynoscion regalis*
Spot	*Leiostomus xanthurus*
Atlantic croaker	*Micropogonias undulatus*
Gobies	Gobiidae
Naked goby	*Gobiosoma bosci*
Right Eye Flounders	Plueronectidae
Winter flounder	*Pleuronectes americanus*
Soles	Soleidae
Hogchoker	*Trinectes maculatus*

1 **Source: Miller 1998**

Table 5-22

General Distribution and Life History Information for Fishes Found in the Mesohaline Portion of the Upper Bay

Species	Spawning Season and Locations	Habitat Eggs	Habitat Larvae	Habitat Juveniles	Occurrences of Larvae/Juveniles
Herrings					
Blueback herring *Alosa aestivalis*	Fresh and brackish waters not far above tidewater; April-June	Essentially pelagic	Fresh. O.	Leave nursery grounds ~ 50 mm mid Sept.-Oct; O, M, P	Larvae, April-June. Juveniles May-Nov; James R., downstream migration almost complete by Nov. Some overwintering in Del. and Chesapeake Bay
Hickory shad *Alosa mediocris*	Tidal freshwater late April early June	Demersal or pelagic	Fresh. O.	Leave nursery areas early summer. O, M, P	Juveniles of age group I found sporadically throughout most of year, Chesapeake Bay and tributaries
Alewife *Alosa pseudoharengus*	Ascend freshwater streams further than blueback herring; late March-mid May	Essentially pelagic	Freshwater; form schools at <10 mm	Pass slowly down Ches. Drainage system. O, M, P	Juveniles main seaward migration, fall.
American shad *Alosa sapidissima*	Tidal freshwater April-July	Demersal or pelagic; absent at <5 ppm DO	Fresh. O. Most abundant at surface	Form schools 20-20 mm. O, M, P	Juveniles gradually move downstream; some remain in Chesapeake Bay for first year
Atlantic menhaden *Brevoortia tyrannus*	During northward spring and southem fall migration	Pelagic, mostly offshore; P (July-Aug.)	Pelagic, enter estuary ~10 mm P, M, few O	O, tidal freshwater	Larvae lower Bay, Feb., April-May, Aug.; upper Bay May-June, Nov. Juveniles, spring-summer; migrate south in fall, some overwinter
Gizzard shad *Dorosoma cepedianum*	Freshwater, near surface; April-June	Demersal, adhesive	Smallest larvae most abundant at surface; freshwater. Largest larvae surface day; midwater night	Greatest abundance well upstream from brackish water	Juveniles < 70 mm only in freshwater
Threadfin shad *Dorosoma petenense*	Freshwater or O; April-July	Demersal, attached	Freshwater; diel migration inshore	Prefer < 15 ppt.; most common <5 ppt. O, M	no information

Note: O = Oligohaline (0.5 - 5.0 ppt.) M = Mesohaline (5.1—20.0 ppt.) P = Polyhaline (> 20.00 ppt.)

Sources: Setzler-Hamilton 1982 and Jordan *et al.* 1991

Table 5-22 (Continued)

Species	Spawning Season and Locations	Habitat: Eggs	Habitat: Larvae	Habitat: Juveniles	Occurrences of Larvae/Juveniles
Anchovies					
Bay anchovy *Anchoa mitchelli*	Late April-late Sept. (peak July) throughout mid and lower Ches. Bay O, M, P; most > 9 ppt.; peak 13-15 ppt. (though eggs most abundant in most saline portion of lower Bay)	Pelagic, congregate at surface. M, P	O, M, P surface waters	O, M, P, euryhaline, ascend rivers to freshwater	Larvae early May-mid Oct; greatest abundance 3-7 ppt. Juveniles most abundant brackish water near salt-fresh interface June-Sept.; deeper waters Oct-March
Minnows					
Common Carp *Cyprinus carpio*	Shallow marshes and flats, tidal freshwater, May-June	Demersal, attached	Freshwater O; in vegetation	In vegetation	Tidal tributaries of Chesapeake Bay
North American Catfish					
Channel catfish *Ictalurus punctatus*	May-June; tidal freshwater, in nests, depressions or other protected areas	Demersal, adhesive	Guarded by male 2-5 days after hatching Freshwater. O	Freshwater, O, M	Larvae upper salinity tolerance ~ 8 ppt; Juveniles grow at salinities < 11 ppt. at 5-6 mo.
Brown bullhead *Ictalurus nebulosus*	May-June; tidal freshwater	Demersal, adhesive, aerated by parents		School throughout summer. O	Early juveniles herded about in schools by one or more parents
Toadfish					
Oyster toadfishes *Opsanus tau*	April-July or Aug.; cavities among shells or rocks, tin cans, broken bottles, etc. in nests. M, P and coastal waters	Demersal, attached; guarded by male	Yolk-sac larvae remain attached to substrate of nest site until yolk absorbed; cared for by male. M, P	Demersal; become free swimming between 16-18 mm	Juveniles, summer
Killifishes					
Mummichog *Fundulus heteroclitus*;	Chesapeake Bay, April-Aug; Delaware Bay, May-mid Aug. Several peaks at or near new moon high tide; shallow areas with sparse to dense vegetation. Upper tidal marsh among *Spartina* roots; freshwater O, M, P	Demersal; filamented eggs attached; eggs with reduced filaments, inside vertically oriented ribbed mussel shells	Remain off bottom; attracted to light; 0	Among eelgrass, shallow pools and ditches; O, M, P	no information

Note: O = Oligohaline (0.5 - 5.0 ppt.) M = Mesohaline (5.1—20.0 ppt.) P = Polyhaline (> 20.00 ppt.)
Sources: Setzler-Hamilton 1982 and Jordan *et al.* 1991

Table 5-22 (Continued)

Species	Spawning Season and Locations	Habitat Eggs	Habitat Larvae	Habitat Juveniles	Occurrences of Larvae/Juveniles
Silverside					
Atlantic silverside *Menidia menidia*	March-July, Chesapeake region; May-Nov, Chesapeake Bay; intertidal zone or shallows waters; estuarine areas O, M, P (mostly M and P)	Demersal, attached	Shallow water near shore; school at 8-10 mm TL; O, M, P	Chesapeake Bay, O, M; 1-14 ppt; mode = 7 ppt. Also P	Larvae and Juveniles schools at surface, follow incoming and outgoing tides
Temperate Basses					
White perch *Morone americana*	Freshwater or O; late March-early June	Demersal, attached	Freshwater O; downstream movement with development	Estuarine populations move toward more brackish water, Aug-Nov. O (most), M	Larvae freshwater to at least 8 ppt.; greatest abundances at mid depths in water column (day). Juveniles ~ 20-25 mm, move inshore shoal areas
Striped Bass *Morone saxatilis*	Tidal freshwater April-early June; peak Chesapeake Bay last half April-first week May	Pelagic	Freshwater O, move inshore to shoal area ~ 17 mm	Schools, more abundant areas with pronounced current. O, M	Larvae April-early June; concentrate at bottom; Juveniles general downstream movement late May
Perch					
Yellow perch *Perca flavescens*	March-April; tidal freshwater; O (max. salinity 2.5 ppt.)	Attached; long flat demersal, semibuoyant or rarely floating band or ribbons	Pelagic, phototrophic, O	Large schools initially pelagic, then demersal; O, M	Larvae, end of March-mid May; Potomac and Patuxent estuaries Juvenile salinity range to 9.5 ppt.
Bluefishes					
Bluefish *Pomotomus saltatrix*	June-Aug. (possibly May)	Pelagic, offshore; few mouth of Bay	Pelagic, offshore; few mouth of Bay	Coastal waters. P, M, O, tidal freshwater	Juveniles, summer and fall
Drums					
Weakfish *Cynoscion regalis*	Late spring and summer; two peaks, June and July, Delaware Bay	Initially buoyant, M, P	Sink to bottom by 8-10 mm. M, P	Soft, muddy bottoms, low salinity areas, O, M, P	Larvae, May-Aug., Chesapeake Bay. Juveniles, Mar-Oct; may remain Nov-Dec; most seek warmer offshore waters; upper York R. most abundant July; migrating downstream Sept-Nov.

Note: O = Oligohaline (0.5 - 5.0 ppt.) M = Mesohaline (5.1—20.0 ppt.) P = Polyhaline (> 20.00 ppt.)
Sources: Setzler-Hamilton 1982 and Jordan *et al.* 1991

Table 5-22 (Continued)

Species	Spawning Season and Locations	Habitat: Eggs	Habitat: Larvae	Habitat: Juveniles	Occurrences of Larvae/Juveniles
Drums Cont'd					
Spot *Leiostomus xanthurus*	Late fall, winter	Pelagic, well offshore	Most frequently at bottom coastal waters	Enter Bay ~ 4 mo. P, M, O (smaller juv)	no information
Atlantic croaker *Micropogonias undulatus*	Offshore over wide area; extends some distance offshore, Aug-Dec; peak Aug-Sept; VA may occur in all months. spring-fall peaks	no information	O, M	Conc. At ~ 18 ppt; bottom waters of relatively deep channels. M, P	Larvae taken during winter; Juveniles, spring and summer. Croaker larvae and juveniles upper Bay 0-21 ppt; 0-24°C
Gobies					
Naked goby *Gobiosoma bosci*	May-mid Nov; upper Chesapeake Bay, clam and oyster shells; M, P, 10-30 ppt.	Demersal, attached, guarded by male	Day, mid-depth and near bottom; nearer surface at night. O, M	Benthic, O, M	Larvae, upriver or in waters <18.5 ppt; appear in Patuxent first week of May, and in Potomac mid-May; York River, May-Oct.
Right Eye Flounders					
Winter flounder *Pleuronectes americanus*	Mid Dec-May; peak March estuaries, sandy bottoms, 1.8-3.6 m; 11.4-33 ppt. M, P. 1-10°C; peak 2-5°C	Demersal	Pelagic, strongly bottom oriented before metamorphosis; O, M, P	Benthic - remain in estuaries 2 + yrs; inshore except for temperature extremes	Larvae 3.5-27.7 ppt; peak abundance 6-15 ppt. Juveniles 4-30 ppt; normal growth at 20 but not 30 ppt; 0-25°C, normal growth 12-16°C
Soles					
Hogchoker *Trinectes maculatus*	May-Sept. primarily n estuaries; 0-24 ppt. peak 10-16 ppt. O, M, P	Near surface, higher salinities; near bottom, lower salinities	Move into low salinity waters. O	Shore zone, move upstream to 240 km inland; over-winter in bays. O, M	Larvae concentrate near salt-freshwater

Note: O = Oligohaline (0.5 - 5.0 ppt.) M = Mesohaline (5.1—20.0 ppt.) P = Polyhaline (> 20.00 ppt.)
Sources: Setzler-Hamilton 1982 and Jordan *et al.* 1991

deployed north of the "RWLP" [NEED MAP SHOWING WHERE THIS IS] buoy (Figure2-1) within and around Site 104. This is north of the area planned for dredged material placement.

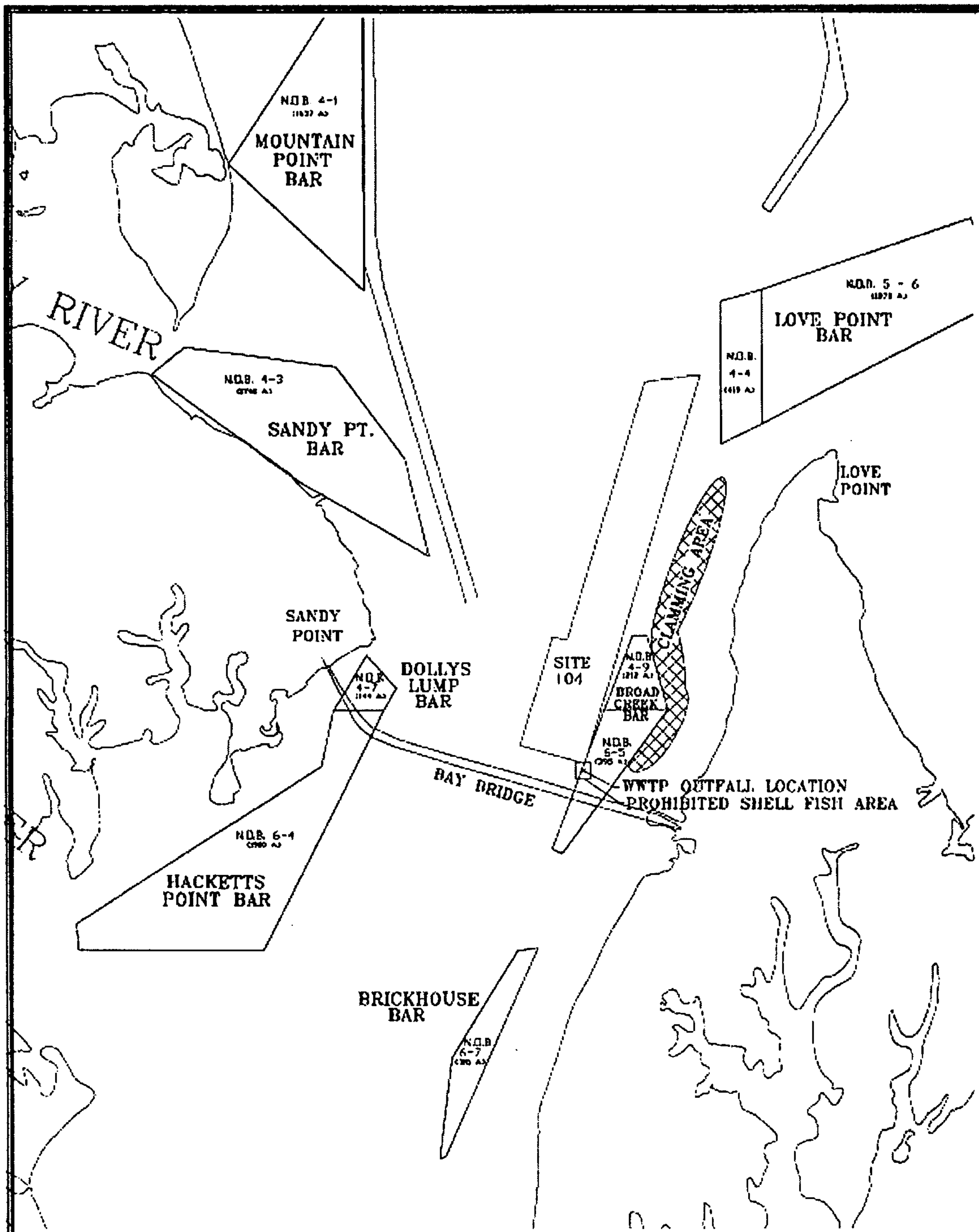
White perch is one of the most abundant fish in the Bay (Miller 1998). Within the Bay, white perch migrate in the spring from regions of polyhaline to freshwater to spawn. Spawning migrations begin in March. Following spawning, adults move back downstream to higher salinity regions. Drift gill nets and pound nets are the two principal fishing gears deployed in the NOAA025 region for this species (Miller and McCraken 1997). During summer and fall (August-November), white perch are taken in pound nets set close to shore. No pound nets are set within the boundaries of Site 104 (Miller 1998). Drift gill nets are used by commercial fishermen during the winter (December-April) above the "RWLP" buoy within and around Site 104 (Miller 1998).

Three invertebrate species of commercial importance occur near to Site 104: soft shell clam (*Mya arenaria*), oyster (*Crassostrea virginica*), and blue crab (*Callinectes sapidus*). Of these, only blue crab inhabits Site 104. Peak densities of soft shell clams along the Eastern Shore of the Bay are found from the Eastern Bay to Pocomoke Sound, particularly at depths of less than 5.2 m (17 ft) along the shoreline (Baker and Mann 1991). The shallowest depth at Site 104 is -12.8 m (-42 ft).

For hundreds of years, eastern oysters were among the most abundant bivalves and the most commercially important fishery resource in the Bay (Richkus *et al.* 1992). Harvests throughout the Bay have been declining for decades for a variety of reasons, leading to a near collapse of the industry in recent years (CPB 1995b). Oysters provide the only available hard substrate in many areas of the Bay, and oyster bars provide physical habitat for a wide variety of Bay species (Kennedy 1991). Most oysters in the Bay occur in waters between 2.4 and 7.6 m (8 and 25 ft) deep (Lippson 1973). Seasonal deficiencies in dissolved oxygen prevent their establishment in most waters over 10.7 m (35 ft) deep (Lippson 1973).

There are seven oyster bars (Broad Creek, Love Point, Mountain Point, Sandy Point, Dolly's Lump, Hacketts Point, and Brickhouse Bar) that are known to exist in the vicinity of Site 104 (Figure 5-24). The boundaries of the oyster bars depicted in this figure are of historic nature and do not necessarily reflect the areas currently considered viable [BY WHOM]. The Love Point oyster bar is located approximately 1.1 km (0.7 miles) northeast of the northern edge of Site 104. Mountain and Sandy Point bars are both located approximately 5.1 km (3.2 miles) northwest and west, respectively, of Site 104. Hacketts Point Bar and Dolly's Lump are located south-southeast of Sandy Point State Park and are approximately 2.4 km (1.5 miles) from the southwest boundary of Site 104. Brickhouse Bar is located approximately 3.2 km (2.1 miles) south of Site 104. Broad Creek is the closest oyster bar to Site 104 (just southeast of the southern end of Site 104). However, a portion of the Broad Creek oyster bar is prohibited to shellfish harvesting due to the presence of the Kent Island Waste Water Treatment Plant outfall (Figure 5-24).

MDNR's Oyster Propagation Program (1999f) reported that 1998 was a low year (four spat per bushel) for average oyster spat sets on both natural bars and on State designated seed areas in the Bay. According to MDNR (1999f), Sandy Point, Dolly's Lump, and Hacketts Point are the most



MARYLAND ENVIRONMENTAL SERVICE

MARYLAND PORT ADMINISTRATION

US Army Corps of Engineers

HISTORIC OYSTER BAR LOCATION MAP

FIGURE 5-24

heavily commercially harvested oyster bars in the vicinity of Site 104. Broad Creek is actively harvested, although it is not naturally reproducing (i.e., 0 spat per bushel), and requires annual seeding by MDNR. MDNR reported that most of the harvesting takes place in 16 to 22 ft (4.9 to 6.7 m) of water at this bar (MDNR 1999g).

The blue crab is widely distributed along the Atlantic and Gulf coasts, but is most abundant and perhaps best known from the Chesapeake Bay. Blue crabs utilize nearly every habitat type in the Bay during some stage of their lifecycles. Mating occurs from June to October generally in shallow water (<3 m, <9.8 ft) in the middle and upper Bay and its tributaries (Lippson 1973). The peak mating period is usually during July and August. After mating, most of the females migrate toward the lower Bay to the higher-salinity areas, not to return until the following spring, while the majority of males remain in the fresher waters, most overwintering at depths >9 m (>29.5 ft) in the muddy bottom of deeper channel waters. Blue crab density is widely distributed (i.e., at a variety of depths); however, concentrations of blue crabs are higher in shallow water areas. Shallow water areas, particularly those with SAV or other suitable cover, are important refuges for older juveniles and soft crabs (Van Heukelem 1991). Crabs are taken commercially by pots, trotlines, dip nets, and in limited areas by crab traps (Section 5.3.5.f).

The Winter Dredge Survey conducted by MDNR annually monitors random stations within the Bay for blue crab densities during the winter months (Volstad et al. 1994; Rothschild and Sharov 1997). Data collection during December to February of 1995 to 1997 found that Site 104 is mostly utilized by adult males who are overwintering during the winter months (MDNR 1998b). While in fewer numbers, females were also captured at Site 104 during these sampling periods. The Chesapeake Bay Winter Dredge Survey results indicate that hibernating blue crab densities are lower in waters deeper than -12.2 m (40 ft) than in shallower areas of the Bay (MDNR 1998a). [Estimates of crab densities at the site indicate that Site 104 has low crab densities (59.9/1000 m^2) relative to other areas of the upper Bay (88.95/1000 m^2) and the average for Maryland portions of the Bay (101.10/1000 m^2)]-Waiting for Information from Glen Davis of MDNR-].

The commercial crab pot fishery is used as an indicator to track female blue crab migration to the lower Bay. From 1990 to 1998, total combined yields were highest in September and October (approximately 3 to 8 million). These were the highest pot catches of female blue crabs in Maryland waters. By November, total combined pot catches of female blue crabs in Maryland waters had decreased significantly to approximately 1 to 2 million (MDNR 1999e).

Commercial harvesting of blue crabs occurs throughout the upper Bay, including Site 104. However, crab pots are usually set in the shallower areas (less than 12 m [<40 ft]) because of potential gear conflict with water traffic (MDNR 1998b). All of Site 104 is deeper than 12 m (40 ft).

Site 104 Finfish Survey

Introduction

Fish abundances and distributions in the upper Bay are highly dynamic and can vary seasonally, dielly, interannually, and in response to changes in temperature, salinity, and oxygen conditions in the water column (Brandt *et al.* 1994). To account for these fluctuations and to identify the fish species specifically using the Site 104 area, a four-season sampling program was conducted by University of Maryland Chesapeake Biological Laboratory and Buffalo State College Great Lakes Center during the day and night at varying depths from July 1996 to April 1997. Nearby reference areas A and B were established as controls and sampled to help separate natural seasonal and interannual variability in fish abundances (Weimer *et al.* 1996) (Figure 5-25). In addition to the use of gill nets, fish density, size, and species composition were evaluated using underwater fish acoustics, mid-water trawls, and bottom trawls within Site 104 and the two reference areas.

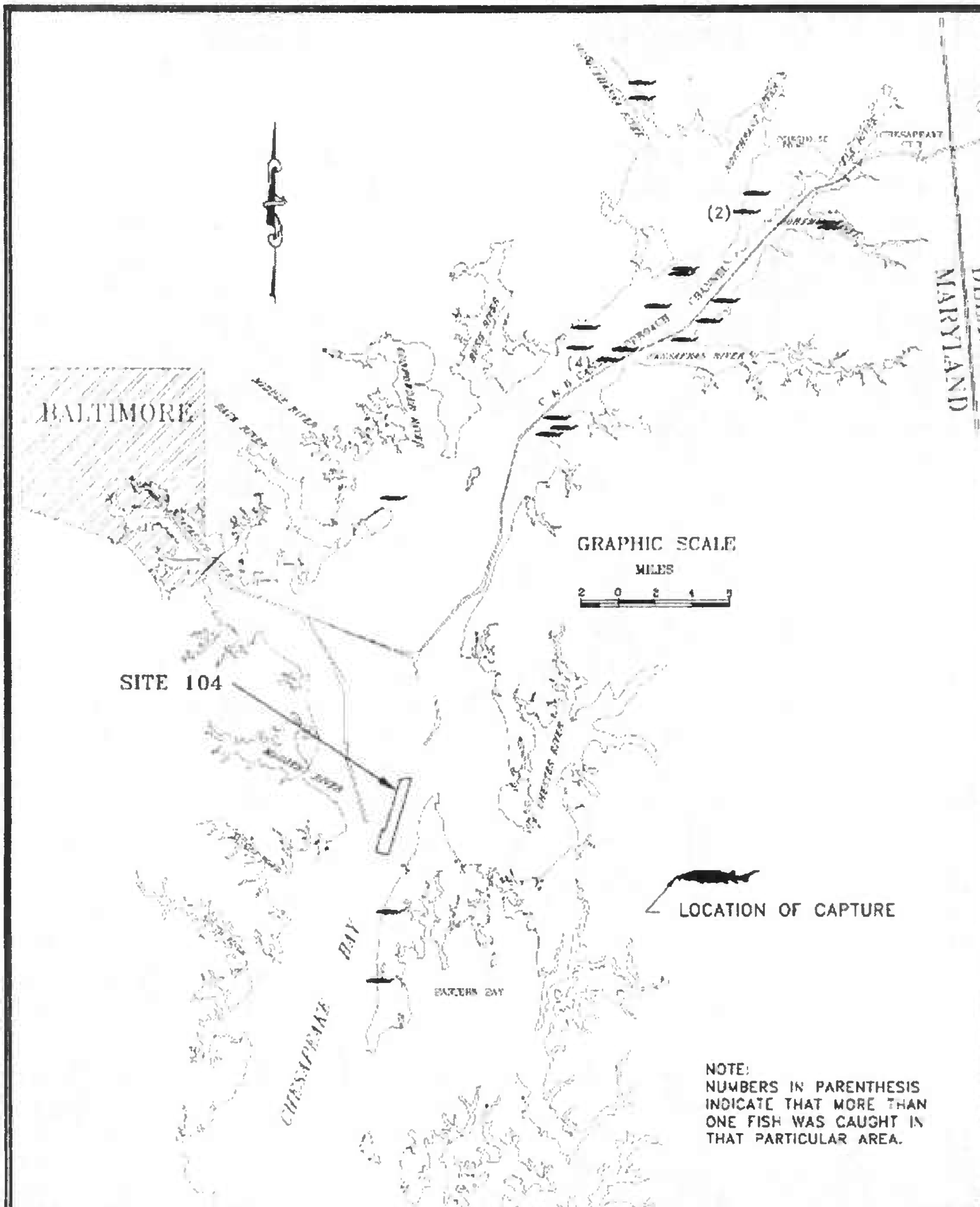
The fisheries cruises were conducted during the months of June/July, October, and December 1996 and April 1997. A total of 28 deployments of multi-panel anchor-set gill nets, 96 acoustic transects, 128 bottom trawls, and 24 mid-water trawls were performed to determine the composition of the fish community within and around Site 104. Summaries of the gillnet, acoustic, and trawl studies are discussed below. Additional information can be found in Appendix B.

Fish community structure during 1996-1997 varied among sampling periods and sampling areas. Fish collection methods yielded a total of 21 species representing 14 families. Of these 21 species, none are listed as rare, threatened, or endangered species. All together, white perch dominated gill net and acoustic/trawl sampling in all seasons sampled. However, mid-water and bottom trawl sampling in October revealed a peak in catch of bay anchovy and Atlantic croaker. Species diversity was lowest in June irrespective of gear type. All estimates of total fish abundance were lowest in October.

Bottom and Mid-Water Trawl and Fish Acoustic Results (Reference Areas A & B and Site 104)

Seasonal Comparison of Bottom Trawls

In all areas sampled, species diversity in bottom trawls (day and night combined) varied from a low of 4 in June (Area A and B) to a maximum of 12 during April (Area A). In Site 104, species diversity was greatest during April 1997 (10), and lowest during June 1996 (5). In Area A, 10 to 12 fish species were collected during each sampling period except in June 1996 when only 4 species were caught. In Area B, the number of fish species almost doubled from 4 in June 1996 to 7 during October and December 1996. White perch were caught in all sampling areas during each sampling period. Atlantic croaker and gizzard shad were not captured during June 1996. Striped bass were not caught during October 1996 and bay anchovy were not captured during December 1996. Hogchoker were captured in Area A during October and December 1996 and



MARYLAND PORT ADMINISTRATION

MARYLAND ENVIRONMENTAL SERVICE

US Army Corps of Engineers

SHORTNOSE STURGEON LANDINGS
IN CHESAPEAKE BAY AND TRIBUTARIES
4/96 TO 7/98
FIGURE 5-25

April 1997 (Weimer et al. 1996). Mean catch per unit effort (CPUE=#fish/trawl) also varied across all seasons in all areas during day and night. During the day, CPUE was highest for all species in all areas during December. At night, mean total catch was highest during October and December in Site 104, during October in Area A, and during December in Area B. Mean total catch was lowest during June in all areas during the day and night.

Among individual species, CPUE of white perch varied across seasons in all areas during both day and night. During the day, the largest catches of white perch occurred during December for all three areas. White perch were also relatively abundant during April in Site 104 and Area B. Mean CPUE of white perch during the day was lowest during June and October for all areas. At night, CPUE of white perch was also highest during December for all areas.

Striped bass catches were small in all sampling areas. During the day, mean CPUE of striped bass peaked during December and April in all three areas. At night, CPUE of striped bass was highest during April in Site 104 and Area A, but did not differ among seasons in Area B.

Mean CPUE of bay anchovy was variable among seasons and time of day in all areas. During the day, bay anchovy were most abundant during April in Site 104 and Area A, and during October and April in Area B. At night, highest catches of bay anchovy occurred during October in all areas. Bay anchovy were also relatively common at night during April in Site 104 and Area B. Few bay anchovy were collected during June and December in any area.

Mean CPUE of Atlantic croaker varied among seasons during the day and night in all areas. Atlantic croaker numbers were low during June, increased during October (night) and December (day), and decreased during April (day and night).

Seasonal Comparison of Mid-Water Trawls

The species diversity in midwater trawls ranged from a minimum of 1 (Site 104 and Area B in December, Area A in April) to a maximum of 6 (Area A in June). Species diversity in each area was greatest during June 1996, and lowest (1 or 2 species) during December 1996 and April 1997.

Total midwater trawl catches were greatest during June, decreased through October and December, and increased during April. Mean CPUE peaked during June at Site 104 due to some very large catches. During June, midwater trawl catches were dominated by white perch, with some bay anchovy and some herring species present. In contrast, bay anchovy accounted for the majority of the mid-water catch during October, with some herring species present. White perch were not caught in mid-water trawls during October, December, or April.

Seasonal Comparison of Acoustic Data

During the day, acoustic estimates of numeric fish densities generally ranged between 0.04 and 0.6 fish$\cdot m^{-3}$. During the day, peak densities (approximately 0.5 fish$\cdot m^{-3}$) occurred at different seasons among areas: during June in Site 104, during April in Area A, and during October in

Area B. At night, fish numeric density peaked during December (0.7 to 2 fish$\cdot m^{-3}$) and was lowest during June (<0.1 fish$\cdot m^{-3}$) in all three areas. In Site 104 and Area A, numeric densities were similar at night during October and April; however, biomass density was higher in October compared to April in Area B. Based upon trawl data, the high numeric densities of fish during December at night were related to large numbers of white perch and Atlantic croaker in the area.

Fish biomass density during the day was greatest during October in all areas (>40 g$\cdot m^{-3}$). This high density was attributed to the presence of larger size class fish, including weakfish, white perch, and gizzard shad. Fish biomass densities were also relatively high during the day in June in Site 104 and Area B (about 9 g$\cdot m^{-3}$). At night, fish biomass density peaked during October and December in Site 104 (about 11 to 13 g$\cdot m^{-3}$), and during December in Areas A and B (about 3 to 6 g$\cdot m^{-3}$).

Mean total length of fish during the day was highest during June and October in all areas (>40 mm). At night in Site 104, fish length was similar during June, October, and December (about 100 to 130 mm), but lower during April (about 50 mm). In Areas A and B at night, fish length peaked during June (about 106 to 115 mm), and was lowest in April (about 45 to 57 mm).

Summary of Gill Net Sampling Results

Species diversity and abundance differed greatly between seasons. A total of 610 fish from 6 species were collected from 28 anchored gillnet deployments in Site 104 and 2 reference areas. Of this total, 36 fish were caught in July, October, and December combined as compared to 574 fish caught in April 1997. Miller (1998) attributed this peak primarily to white perch and other anadromous fish that were present because of annual spawning migrations through the area. Species diversity varied from a low of 1 species (Site 104 during July and October and Area A during July and December) to 5 species during April (Areas A and B). The low sample sizes in July, October, and December 1996 precluded a detailed description of community composition during these periods.

<u>July 1996</u>

A total of 7 fish (6 striped bass and 1 white perch) were captured in July 1996 from the 7 anchored gillnet deployments. Of these, two striped bass were caught at Site 104. All the remaining fish came from the two reference areas. All fish were caught in 3 or 4 inch panels.

<u>October 1996</u>

A total of 15 fish (5 Atlantic menhaden, 7 gizzard shad, 1 striped bass, and 2 weakfish) were captured in October 1996 from the 7 anchored gillnet deployments. Of this total, only one fish, a weakfish, came from Site 104. The majority of fish captured came from Area B.

<u>December 1996</u>

No sampling was possible in Area B in December 1996 because of commercial drift nets in the area (Miller 1998). The survey gill nets could not be deployed because of the risk of destroying the commercial fishermen nets. From the 6 deployments performed at Site 104 and Area A, 14 fish (3 gizzard shad, 3 striped bass, and 8 white perch) were captured. Two of the three striped bass came from Site 104.

<u>April 1997</u>

A total of 574 fish from 5 species (98 Atlantic menhaden, 2 gizzard shad, 14 striped bass, 457 white perch, and 1 shad *sp.*) were collected in all areas combined from the 8 anchored gillnet deployments. Of this total, 402 fish were collected at Site 104, 116 fish were collected in Area A and 56 fish were collected in Area B. Estimated CPUE was highest at Site 104 and declined for both reference areas A and B, respectively. The most abundant species captured was white perch. Striped bass, Atlantic menhaden, gizzard shad, and other shads (both blueback herring and hickory shad) were also collected. The majority of striped bass were caught in reference areas A and B.

5.1.6.c Benthic Community.

Community Composition

Benthic macroinvertebrates are ~~organisms~~ animals that live on or in the bottom substrates of water bodies for all or part of their lives (Versar 1992). Benthos are an important link in the ecology of the Chesapeake Bay because they are secondary consumers of detritus and bacteria from the bottom and are in turn an important food source for fish, crustaceans, and waterfowl. Conditions which control benthic macroinvertebrate species diversity and distribution include salinity, sediment type, dissolved oxygen levels, water temperature, and hydrodynamics. Benthic macroinvertebrate species diversity and distribution are lower in the upper Bay than in areas further south due to salinity and temperature fluctuations (Rogers and Rogers 1986; Diaz and Schaffner 1990; Ruddy 1990). In addition, diversity of benthic communities (number of species present) is theoretically lowest in environments with salinities of approximately 7 ppt, and increases progressively in more and less salty waters (Gosner 1971). Studies in the upper Bay have shown that benthic species diversity is typically highest in spring and fall (MDE 1996~~a~~b).

The substrate in the upper Bay is predominantly silty clay, to clayey silt (mud) (MDE 1996b~~a~~; MDE 1996~~b~~c; MDNR 1996). Because of this, the upper Bay is dominated by macroinvertebrates that prefer mud substrates and that can survive in a low-mesohaline to oligohaline environment with wide fluctuations in salinity and temperature. Studies conducted by Diaz and Schaffner (1990) have shown that habitats dominated by mud substrate exhibit the lowest productivity, compared to mixed mud and sand substrate habitats, although the highest productivity for mud substrate habitats occurs in the low-mesohaline to oligohaline zones. The bottom substrate at Site 104 is comprised of predominantly silty clay substrate (Table 5-23~~24~~) and the site is located in a predominantly mesohaline region (Table 5-~~9~~8; Section 5.1.4).

Environmental factors such as substrate type, temperature, salinity, and dissolved oxygen dictate that the Site 104 region be dominated by stress-tolerant, opportunistic species that are less sensitive to environmental fluctuations and stresses and that can re-colonize rapidly. It is generally accepted that the upper Bay is a naturally unstable environment that precludes the establishment of a benthic community dominated by equilibrium species. Equilibrium species are those benthic taxa that require a setting characterized by relatively constant, rather than variable, physical environmental ~~Variables~~conditions.~~,~~ ~~and~~This equates to a reduced level of environmental stressors such as extremes of temperature, salinity, dissolved oxygen, or ambient water or sediment concentrations of chemical contaminants (Cronin *et al.* 1970; MDE 1996~~a~~b; MDE 1996c~~b~~).

Seasonal Trends

~~The~~ MDE performed sampling at Site 104 and at nearby locations selected as reference stations on six dates during the period October 1996 through December 1997. Benthic samples were collected at locations KI-1 through KI-10 in October 1996 (Figure 5-14~~12~~). Subsequent to the

Table 5-2324

Percent Composition of Substrate and Depth of Stations in the Vicinity of Site 104 by Station and Sampling Event

Stations	Station Number	October 1996		March 1997		May 1997		July 1997		September 1997		December 1997	
		Depth	Composition	Depth	Composition	Depth	Composition	Depth	Composition	Depth	Composition	Depth	Composition
Site 104	KI-1	13.0 m (42.6 ft)	1% detritus 1% shell 98% silty clay	13.5 m (44.3 ft)	100% silty clay	13.3 m (43.6 ft)	100% silty clay	12.5 m (41.0 ft)	100% silty clay	12.7 m (41.7 ft)	99% silty clay 1% shell	12.7 m (41.7 ft.)	100% silty clay
	KI-2	14.6 m (47.9 ft)	2% detritus 1% shell 97% silty clay										
	KI-3	13.8 m (45.3 ft)	1% detritus 99% silty clay										
	KI-4	14.2 m (46.6 ft)	2% detritus 1% shell 97% silty clay	14.7 m (48.2 ft)	100% silty clay	15.3 m (50.2 ft)	100% silty clay	14.5 m (47.6 ft)	100% silty clay	14.8 m (48.5 ft)	99% silty clay 1% shell	14.8 m (48.5 ft.)	100% silty clay
	KI-5	15.3 m (50.1 ft)	10% detritus 10% sand 5% shell 75% silty clay										
	KI-6	17.1 m (56.1 ft)	1% detritus 99% silty clay	17.9 m (58.7 ft)	5% sand 95% silty clay	17.3 m (56.7 ft)	75% sand 25% silty clay	17.0 m (55.8 ft)	100% silty clay	17.7 m (58.1 ft)	100% silty clay	17.7 m (58.1 ft.)	100% silty clay
	KI-7	18.6 m (61.0 ft)	50% detritus 50% silty clay	19.3 m (63.3 ft)	95% sand 5% silty clay	19.5 m (64.3 ft)	25% sand 5% shell 70% silty clay	19.0 m (62.3 ft)	100% silty clay	19.2 m (63.0 ft)	65% gravel, 35% silty clay	19.2 m (63.0 ft.)	60% silty clay 40% gravel
	KI-8	18.0 m (59.0 ft)	1% detritus 1% shell 98% silty clay	18.0 m (59.0 ft)									
Ref.	KI-9	14.0 m (45.9 ft)	1% detritus 25% shell 74% silty clay	14.9 m (48.9 ft)	15% gravel 85% silty clay	13.8 m (45.3 ft)	20% gravel 40% sand 20% silty clay	17.0 m (55.8 ft)	10% gravel 10% sand 80% silty clay	13.5 m (44.3 ft)	10% gravel 35% sand, 55% silty clay	13.5 m (44.3 ft.)	86% silty clay 10% sand 4% shell
	KI-10	17.2 m (56.4 ft)	10% detritus 10% gravel 20% sand 10% shell 50% silty clay	18.3 m (60.0 ft)		17.5 m (57.4 ft)	20% gravel 80% sand	14.0 m (45.9 ft)	100% silty clay	17.0 m (55.8 ft)	100% silty clay	17.0 m (55.8 ft.)	95% silty clay 5% sand
	KI-11			13.8 m (45.3 ft)	100% silty clay	13.2 m (43.3 ft)	100% silty clay	12.5 m (41.0 ft)	100% silty clay	12.6 m (41.3 ft)	100% silty clay	12.6 m (41.3 ft.)	90% silty clay 10% sand
	KI-12			4.1 m (13.5 ft)	100% sand	2.6 m (8.50 ft)	100% sand	1.5 m (4.90 ft)	100% sand	2.0 m (6.60 ft)	100% sand	2.0 m (6.6 ft.)	100% sand
	KI-13			3.4 m (11.2 ft)	100% sand	3.6 m (11.8 ft)	100% sand	2.5 m (8.20 ft)	100% sand	2.9 m (9.50 ft)	100% sand	2.9 m (9.5 ft.)	100% sand
	KI-14			25.3 m (83.0 ft)	100% silty clay	25.8 m (84.6 ft)	100% silty clay	25.0 m (82.0 ft)	100% silty clay	25.0 m (82.0 ft)	100% silty clay	25.0 m (82.0 ft.)	100% silty clay

Source: MDE 1998b

October 1996 sampling period, certain benthic (and water quality) sampling stations were revised to better represent the benthic community at Site 104 (Figure 5-1412, Table 5-2324).

Benthic organism collection at Site 104 from October 1996 to December 1997 has shown that the area is generally dominated by mollusk, annelid, and arthropod species typical of much of the Bay (Table 5-2425). This table also provides a listing of all species found during the benthic community assessment at Site 104 and at the reference locations, for each of the sampling events. Dominant species found at Site 104 included: the mollusks *Macoma balthica* and *Mulina lateralis;* the polychaetes *Marenzelleria viridis*, *Streblospio benedicti*, and *Neanthes succinea*; the oligochaete *Tubificoides* sp.; and the arthropod *Leptocheirus plumulosus*.

Data gathered for the benthic community assessment at all sampling locations both inside and outside Site 104 were used to determine a number of variables that together were used to calculate the Benthic Index of Biotic Integrity (B-IBI) for the Site 104 vicinity as a whole. Benthic invertebrates are used extensively as indicators of estuarine environmental stress and trends; the B-IBI provides a uniform scale for comparing the quality of benthic assemblages across varying habitats (Weisberg *et al.* 1997). The B-IBI assigns a score to each of several attributes (overall abundance, abundance of opportunistic and equilibrium species, Shannon Diversity Index, abundance of carnivores and omnivores) that describe benthic communities (MDE 1998b).

The first of several attributes used in the calculation of B-IBI scores was total abundance. Total abundance was calculated as total number of organisms per square meter (#/m^2). Other benthic community attributes, including abundance of equilibrium and opportunistic taxa, and abundance of carnivores and omnivores, were calculated as the percentages of total abundance, and were also used in calculating the B-IBI.

Equilibrium taxa are generally large, relatively long-lived organisms that often dominate community biomass in undisturbed or unstressed habitats (Warwick 1986). In contrast, the relatively short-lived, opportunistic taxa have a relatively high reproductive and recruitment potential. Opportunistic taxa typically dominate disturbed or stressed habitats (Boesch 1973; Rhoades *et al.* 1978). Consequently, high percentages of opportunistic species and low percentages of equilibrium species could be expected in a degraded habitat.

The Shannon Diversity Index (H) is related primarily to species richness [EXPLAIN TO PUBLIC] and distribution of individuals among the species (Weber 1973). The index was used to show hierarchical species diversity and to calculate the B-IBI. Higher diversity index values suggest greater numbers of species and a more even representation of the taxa present.

From October 1996 to March 1997 based upon the mean of all stations sampled during the study at all study stations, there was an increase in the B-IBI, number of taxa, overall abundance (Table 5-2526), and percent of equilibrium species present (Table 5-26)7) based upon the mean of all stations sampled during the study. Similarly, there was a decrease in the carnivore/omnivore abundance and the percent of opportunistic species present, and a slight decrease in the Shannon -Diversity Index.

Table 5-2425

Species of Benthic Invertebrates Collected in the Vicinity of Site 104, October 1996 through December 1997.

	October	March	May	July	September	December
CNIDARIA						
Actinaria					X	X
NEMERTINEA	X	X	X	X		
MOLLUSCA						
Macoma balthica	X	X	X	X	X	
Macoma mitchelli		X	X	X	X	X
Mulina lateralis	X	X	X	X	X	X
Mya arenaria		X	X			X
Opisthobranchia	X	X	X			
Rangia cuneata		X		X		X
ANNELIDA						
POLYCHAETA						
Boccardiella ligerica	X			X		
Capitellidae			X			X
Capitella sp.		X	X	X	X	X
Glycera sp.			X	X		X
Hypereteone heteropoda	X	X	X	X	X	X
Leitoscoloplos fragilis	X	X				
Marenzelleria viridis	X	X	X	X	X	X
Neanthes succinea	X	X	X	X	X	X
Pectinaria gouldii		X	X	X		X
Polydora cornuta	X	X	X			X
Sabellariidae						X
Sabellaria vulgaris						X
Streblospio benedicti	X	X	X	X	X	X
OLIGOCHAETA						
Tubificidae			X			
Tubificoides sp.	X	X	X	X	X	X
ARTHROPODA						
Americoludes sp.		X	X	X	X	
Chiridotea almyra	X	X	X	X	X	X
Chiridotea caeca			X			
Corophium lacustre	X	X	X			X
Cyathura polita	X		X	X	X	
Cyclaspis varians			X			
Gammarus sp.			X			
Gammarus daiberi	X	X	X			
Gammarus palustris		X	X			
Gammarus tigrinus		X	X			
Haustoriidae		X	X	X	X	X
Leptocheirus plumulosus	X	X	X	X		X
Neomysis americana					X	X
INSECTA						
Chironomus sp.	X	X				
Coelotanypus sp.		X				
Cricotopus/Orthocladius	X					
Eukeifferiella sp.	X		X			
Orthocladinae			X			
Procladius sp.	X					
Rheotanytarsus sp.	X		X			

Source: MDE 1998b

Table 5-25~~26~~

Benthic Community Assessment Summary of B-IBI, Shannon Diversity Index and Abundance Parameters by Sampling Event for Locations in the Vicinity of Site 104

Sampling Event	B-IBI	Number of Taxa		Shannon Diversity Index		Carnivore /Omnivore Abundance	Overall Abundance
	Mean	Mean (Range)	Std. Dev.	Mean (Range)	Std. Dev.	Percent	Mean (#/m^2)
Oct. 1996	1.85	5.5 (3-7)	1.43	1.63 (1.39-1.85)	1.43	26.5	1766.6
March 1997	2.7	10.1 (7-16)	3.14	1.62 (0.45-2.38)	3.14	9.8	6422.6
May 1997	2.56	10.1 (6-15)	2.69	2.19 (0.82-3.07)	2.69	12.2	3325.9
July 1997	2.05	9.1 (7-11)	1.20	1.50 (0.76-2.15)	0.33	3.70	6310.6
Sept. 1997	1.51	4.1 (1-8)	2.08	1.24 (0-2.57)	0.72	4.32	1733.3
Dec. 1997	2.16	5.3 (3-9)	1.9	1.37 (0.61-1.92)	0.46	11.8	2537.3
Net change - Oct. 1996 to March 1997	+0.85	+4.6		-0.01		-16.7	+4656
Net change - March 1997 to May 1997	-0.14	0		+0.57		+2.4	-3097
Net change - May 1997 to July 1997	-0.51	-1		-0.69		-8.5	+2985
Net change - July 1997 to Sept. 1997	-0.54	-5		-0.26		+0.62	-4577
Net change - Sept. 1997 to Dec. 1997	+0.65	+1.2		+0.13		+7.48	+804

Source: MDE 1998b

Table 5-2627

Benthic Community Assessment: Percent Opportunistic Species Abundance and Percent Equilibrium Species Abundance by Sampling Event for Locations in the Vicinity of Site 104

Sampling Event	% Opportunistic Species Abundance		% Equilibrium Species Abundance	
	Mean (Range)	Std. Dev.	Mean (Range)	Std. Dev.
Oct. 1996	49.9 (27.2-73.3)	15.5	0.8 (0.0-2.9)	1.0
March 1997	18.5 (0.3-64.2)	19.5	63.4 (26.7-96.7)	25.0
May 1997	40.3 (0.8-96.6)	28.8	32.9 (1.2-81.1)	25.1
July 1997	63.7 (2.2-91.1)	33.2	12.0 (2.9-64.2)	18.5
Sept. 1997	56.2 (2.1-96.9)	34.8	6.4 (0-22.3)	9.6
Dec. 1997	53.6 (2.8-92.4)	32.8	9.5 (0.03-42.3)	13.5
Net change - Oct. 1996 to March 1997	-31.4		+62.6	
Net change - March 1997 to May 1997	+21.8		-30.5	
Net change - May 1997 to July 1997	+23.4		-20.9	
Net change - July 1997 to Sept. 1997	-7.5		-5.6	
Net change - Sept. 1997 to Dec. 1997	-2.6		+3.1	

Source: MDE 1998b

From March 1997 to May 1997, there was a decrease in the B-IBI (Table 5-~~26~~25), and decrease in the overall abundance and the percent of equilibrium species present, based upon the mean of all stations (Table 5-~~27~~26). At the same group of stations, there was an increase in the Shannon Diversity Index, carnivore/omnivore abundance, and the percent of opportunistic species present. The number of taxa present remained steady from March to May 1997.

From May 1997 to July 1997, there was a decrease in the mean B-IBI, number of taxa, the Shannon Diversity Index, the carnivore/omnivore abundance, and the percent of equilibrium species present. Overall abundance and the percent of opportunistic species present increased during the same period.

From July 1997 to September 1997~~,~~ based upon the mean of all stations sampled, all calculated indices decreased, with the exception of the carnivore/omnivore abundance index, which increased slightly. In contrast, from September to December 1997, all calculated indices increased, except the percentage of opportunistic species, which decreased slightly.

The general trends in the benthic community appeared to follow the bottom dissolved oxygen concentrations in the overlying water column (Table 5-~~28~~27). As the dissolved oxygen increased from October 1996 to March 1997, the benthic community improved (Tables 5-~~26~~ 25 and 5-~~27~~26), but as the dissolved oxygen levels decreased in May and July (Table 5-~~28~~27), there was a decline in the benthic community. This decline was further evident during September 1997. The increase in dissolved oxygen concentrations in December 1997 compared to the previous collection was reflected in the generally improving trend in benthic population indices in December 1997 compared to September 1997.

Spatial Trends

For comparison purposes, sampling locations were grouped into categories based upon their location (inside or outside of Site 104) and depth. Stations categorized as deep-~~-~~water locations inside Site 104 included KI-1 through KI-8 during October 1996, and KI-1, KI-4, KI-6, and KI-7 thereafter (Figure 5-~~12~~14). ~~Deep water~~Deep-water locations outside Station 104 (reference stations) included KI-9 and KI-10 during October 1996, and KI-9, KI-~~10,~~10 and KI-11 thereafter. Locations KI-12 and KI-13 (sampled ~~only~~ after October 1996) were classified as shallow stations outside Site 104. Location KI-14 (also sampled ~~only~~ subsequent to October 1996) was a very deep station outside Site 104. Be~~; be~~cause the water depth at KI-14 was substantially greater than the depth of the other reference stations outside Site 104, KI-14 was not grouped with the other deep outer stations, but rather was categorized as its own group of one station.

The mean B-IBI (Table 5-~~29~~28) and the mean number of taxa at locations inside the previously used dredged material placement area at Site 104 were equal to or higher than locations outside Site 104 in four of the six sampling periods~~;~~. The ratios of inside to outside station B-IBI indices during these four periods ranged from 1 to 1.29. The Shannon Diversity Index was higher at deep outside stations compared to deep inside stations on five of the six sampling dates; ratios of outside to inside stations on these five dates ranged from 1.0~~5~~6 to 1.50. Overall abundance was

Table 5-2728

Water Quality Parameters at the MDE Benthic Sampling Stations in the Vicinity of Site 104

		Station	Temp (C)	pH	DO (mg/L)	Salinity (ppt)	Conductivity (mS/cm)
October 1996	Deep Inner	K1-1	16.8	7.3	5.3	10.8	18600
		K1-2	16.9	7.4	5.2	11.3	19400
		K1-3	17	7.3	5	11.7	19900
		K1-4	17	7.4	5	11.7	19900
		K1-5	17.2	7.3	5.2	11.6	19900
		K1-6	17.1	7.3	5.2	11.1	19000
		K1-7	17.2	7.3	4.6	12.2	20700
		K1-8	17.1	7.3	4.9	11.5	19800
	Deep Outer	K1-9	17	7.3	5.1	11.4	19500
		K1-10	17.1	7.3	4.9	11.7	20100
March 1997	Deep Inner	K1-1	6.1	7.4	8.6	10.3	17900
		K1-4	6	7.4	8.6	10.7	18600
		K1-6	6	7.3	8.1	11	18700
		K1-7	6	7.3	8.1	11.5	19900
	Deep Outer	K1-9	6.2	7.4	8.1	10.9	18700
		K1-10	6.1	7.3	8.6	11.6	19800
		K1-11	6.1	7.4	8.3	10.6	18200
	Shallow Outer	K1-12	6.5	7.7	11.8	4.5	8670
		K1-13	6.5	7.7	11.6	4.8	9080
	KI - 14	K1-14	6.1	7.3	7.8	8.2	21200
May 1997	Deep Inner	K1-1	12	7.3	3.9	12.3	21100
		K1-4	11.7	7.2	3.2	12.5	22100
		K1-6	11.8	7.2	3.3	12.7	21800
		K1-7	11.7	7.2	3.2	13.8	23300
	Deep Outer	K1-9	12.3	7.4	4.4	11.6	19600
		K1-10	12	7.4	3.5	12.5	21200
		K1-11	12.2	7.4	4.1	11.5	20100
	Shallow Outer	K1-12	14.1	7.9	9.3	6.8	12410
		K1-13	13.7	7.7	8.4	7.7	13840
	KI - 14	K1-14	11.5	7.1	2.9	14.5	24500

		Station	Temp (C)	pH	DO (mg/L)	Salinity (ppt)	Conductivity (mS/cm)
July 1997	Deep Inner	K1-1	20.8	7.6	1.4	13.4	22400
		K1-4	19.2	7.5	2.1	15.8	26000
		K1-6	18.8	7.5	0.31	16.7	27300
		K1-7	18.9	7.5	0.36	16.8	27400
	Deep Outer	K1-9	19.3	7.6	0.3	16.2	26400
		K1-10	20	7.8	0.3	14.9	24500
		KI-11	21.3	7.6	0.8	12.4	21100
	Shallow Outer	K1-12	25.7	8.1	14	8	13890
		KI-13	24.9	7.9	9.1	8.6	15100
	KI - 14	K1-14	18.2	7.4	0.21	18.2	29400
September 1997	Deep Inner	K1-1	24.1	7.19	2.14	16.1	26500
		K1-4	24.2	7.21	1.88	16.8	27600
		K1-6	24.2	7.21	1.81	16.8	27600
		K1-7	24.3	7.21	1.5	17.7	28800
	Deep Outer	K1-9	23.9	7.18	2.9	15.1	25100
		K1-10	24.1	7.2	2.49	16.0	26400
		K1-11	23.9	7.2	1.82	14.8	24500
	Shallow Outer	KI-12	23.9	7.68	6.92	12	20500
		K1-13	23.9	7.65	6.27	13.1	22100
	KI - 14	K1-14	24.4	7.16	1.4	16.6	27300
December 1997	Deep Inner	K1-1	8.8	7.6	6.4	16.6	27200
		K1-4	8.8	7.6	6.3	16.7	27300
		K1-6	9.0	7.8	6.0	17.0	27800
		K1-7	9.3	7.7	5.5	17.6	28700
	Deep Outer	K1-9	8.8	7.6	6.3	16.6	27100
		K1-10	9.0	7.8	6.0	17.0	27600
		K1-11	8.7	7.6	6.4	16.4	26900
	Shallow Outer	K1-12	6.1	7.7	10.3	11.5	19500
		K1-13	6.9	7.9	9.1	12.8	21400
	KI - 14	K1-14	9.3	7.8	5.6	17.7	28800

Source: MDE 1998b

Table 5-~~29~~28
Benthic Community Indices by Sampling Date and Stations Categorized by Depth, Location, and Ratio of B-IBI Indices

Overall Abundance (No./m2)	Deep Inner	Deep Outer	Ratio Out/In	Ratio In/Out	Shallow Outer	KI-14
October 1996	1480	2910	1.97	0.51	NA	NA
March 1997	9520	5750	0.60	1.66	3310	2300
May 1997	3980	1790	0.45	2.22	1630	8700
July 1997	7270	8180	1.13	0.89	2580	4340
September 1997	1360	3640	2.68	0.37	474	10
December 1997	4312	2064	0.48	2.09	222	1490
Max.			2.68	2.22		
Min.			0.45	0.37		
Number of Taxa						
October 1996	5.25	6.5	1.24	0.81	NA	NA
March 1997	11	11	1.00	1.00	8.5	7
May 1997	12.5	9.67	0.77	1.29	6.5	9
July 1997	9	9	1.00	1.00	9	10
September 1997	3.75	3.66	0.98	1.02	7	1
December 1997	5.5	6.7	1.22	0.82	3	5
Shannon Diversity Index						
October 1996	1.61	1.7	1.06	0.95	NA	NA
March 1997	1.49	2.24	1.50	0.67	0.68	2.11
May 1997	2.7	2.56	0.95	1.05	1.32	0.82
July 1997	1.04	1.44	1.38	0.72	1.71	0.76
September 1997	0.813	1.1	1.35	0.74	2.09	0
December 1997	1.37	1.57	1.15	0.87	1.46	0.61
Max.			1.50	1.05		
Min.			0.95	0.67		
B-IBI						
October 1996	1.94	1.5	0.77	1.29	NA	NA
March 1997	2.5	2.33	0.93	1.07	3.75	2.5
May 1997	2.6	2.6	1.00	1.00	3.2	1
July 1997	1.2	2.6	2.17	0.46	3.25	1.4
September 1997	1.3	1.13	0.87	1.15	2.75	1
December 1997	2.0	2.3	1.15	0.87	2.5	1.7
Max.			2.17	1.29		
Min.			0.77	0.46		
Opportunistic Taxa Abundance (%)						
October 1996	54.2	32.8	0.61	1.65	NA	NA
March 1997	12.0	23.8	1.98	0.50	0.75	64.2
May 1997	45.0	41.4	0.92	1.09	0.91	96.6
July 1997	78.8	72.2	0.92	1.09	5.8	93.8
September 1997	68.0	59.4	0.87	1.14	5.8	100
December 1997	66.7	56.5	0.85	1.18	3.3	92.4
Equilibrium Taxa Abundance (%)						
October 1996	0.74	1.05	1.42	0.70	NA	NA
March 1997	69.0	48.5	0.70	1.42	93.0	26.7
May 1997	29.4	19.1	0.65	1.54	76.3	1.19
July 1997	5.74	6.49	1.13	0.88	37.1	3.23
September 1997	1.4	0.03	0.02	46.67	20.0	0
December 1997	4.82	2.5	0.52	1.93	33.3	2.01

Source: MDE 1998b
Note: NA – Locations in this category were not sampled during this month

higher at deep stations outside Site 104 compared to deep stations inside Site 104 on three of the six sampling dates; ratios of outside to inside overall abundance ranged from 1.13~~2~~ to 2.6~~7~~8 on these three dates.

Opportunistic taxa abundance was higher at stations inside Site 104 on five of the six sampling trips, but the differences were minimal in most cases. Equilibrium taxa abundance was similar at stations inside Site 104 compared to outside Site 104 on three of the six sampling dates. On two dates (March and May 1997) equilibrium taxa abundance appeared to be slightly higher at deep stations inside Site 104 than at similar depths outside Site 104.

Summary

Overall, the benthic community was within expected ranges for this area and there were few substantial differences between areas of similar depth outside Site 104 and areas within the boundaries of Site 104. Spatial comparisons revealed no generalized pattern in the relationship between stations inside and outside Site 104 at similar depths. Spatial location appeared to have minimal affect on the benthic community; differences were much more apparent when comparing locations of different depth. Site 104 is located in a section of the Chesapeake Bay that is prone to summer hypoxia below the pycnocline. The depth of the water column exacerbates this condition. Hypoxic/anoxic conditions during the summer months resulted in reduced number of benthic taxa, low B-IBI scores, and low diversity indices relative to other times of the year (MDE 1998b).

The Chesapeake Restoration Goals Index (RGI) is an evaluation criteria which has been developed as a target for benthic community restoration. To achieve a "restored" or healthy condition, a score of ~~4.0~~ 3.0 or more on the B-IBI must be achieved.

~~Only one deep station sampled inside or outside of Site 104 achieved this goal during the study. This was Station KI-1, which is at 42.6 feet of water in the northern end of Site 104, it achieved a B-IBI of 4 in October, 1996. Otherwise, all deep water stations in all seasons had B-IBI's of less than 4, indicating a generally poor quality benthic environment.~~

Within the Site 104 stations sampled (deep inner stations; depths ranging from approximately 42 to 63 ft.), the mean B-IBI never achieved the RGI of 3.0. The highest mean B-IBI for the Site 104 stations sampled was 2.5 in May 1997. The only individual stations to achieve or exceed the RGI of 3.0 were stations K1-1 and K1-4 (Figure 5-14~~12~~). Station K1-1 is the northernmost station in the site with depths approximating 42 ft. Station K1-4 is located on the eastern edge at approximately the middle of the site. Depths at this site are approximately 48 ft. The RGI of 3.0 was only achieved or surpassed at station K1-1 in October 1996 (4.0) and May 1997 (3.0) and at station K1-4 in March (3.0) and May 1997 (3.0).

During the study, the deep ~~outer~~ stations outside of Site 104 (K1-9, 10 and 11; depths ranging from approximately 41 to 60 ft.) and the deep outlier station, K1-14 (depth approximately 83 ft.), never achieved the RGI of 3.0. The highest B-IBI at the deep ~~outer~~ stations outside of Site 104 was 2.6 in May and July 1997. The highest B-IBI at station K1-14 was 2.5 in March 1997.

However, the mean B-IBI at the shallow ~~outer~~ stations outside of Site 104 (K-12 and 13; depths ranging from approximately 8 to 10 ft~~.~~) achieved the RGI during the March, May and July 1997 sampling event. The mean B-IBI at these stations ranged from 3.3 to 3.8 over this period.

The low mean B-IBI scores within Site 104 (deep inner), the deep ~~outer~~ stations outside of Site 104 and the deepest outlier station, ~~is~~are an indication of the poor quality benthic habitat in deeper areas of th~~e~~is region of the Bay. The mean B-IBI scores at the shallow ~~outer~~ stations outside of Site 104 indicate the generally better habitat available to the benthic community in the shallow waters in the vicinity of Site 104.
This is probably due to a combination of better, sandy substrate, as well as better oxygenation of the bottom environment in the spring, summer, and fall in the more shallow waters.

5.1.6.d Submerged Aquatic Vegetation (SAV). SAV ~~(submerged aquatic vegetation)~~ is an important component of the Chesapeake Bay ecosystem. SAV communities can contribute much to the primary and secondary productivity of an estuary. They provide food and nursery habitat for many species and help to consolidate sediment and reduce turbidity by decreasing wave energy. They also absorb nutrients and produce oxygen (Batiuk *et al.* 1992;; Hurley 1990;; Hurley 1991). Because SAV have specific habitat requirements, their presence can be used to help evaluate the water quality of a given area (Dennison *et al.* 1994). These habitat requirements can be profoundly affected by land use since agricultural, residential, and urban ~~land~~ uses ~~practices~~ influence loadings of nutrients and sediment (Hurley 1990). Increases in nutrients stimulate algae growth in the water column and on the SAV. This limits the ability of SAV to utilize available sunlight. Also, increased sedimentation from shoreline erosion, etc. reduces available sunlight and covers the plants with sediments.

Historically, expansive communities of SAV contributed significantly to the high productivity of the Bay, and were indicative of good water quality. ~~But~~ However, dramatic SAV declines in the late 1960s and the 1970s ~~have~~ resulted from degradation of the Bay's water quality at that time. Baywide SAV coverage and density has, however, increased in recent years (Orth *et al.* 1995;; Blankenship 1997). However, the rates of recovery are not constant throughout the Bay. Certain tributaries and areas of the Bay have not attained sufficient water quality to support SAV growth (Orth *et al.* 1994).

Because of light availability requirements, SAV in the Chesapeake Bay is limited to shallow waters, generally less than 2 m (6.6 ft) in depth (Batiuk *et al.* 1992). No SAV have been found in Site 104 because the area is too deep to support them due to insufficient light. Three ephemeral or short-term beds have been documented within 2.5 nautical miles of Site 104 in the past few years. In 1996, an ephemeral bed was documented approximately 2.5 nautical miles to the southwest of Site 104 in Goose Pond, just north of Hackett Point (Orth *et al.* 1996). In 1997, two ephemeral beds were documented in coves located approximately 1 nautical mile southeast of Site 104, just to the north and south of the Bay Bridge (Orth *et al.* 1997). None of the three ephemeral beds were observed before or after their respective ~~sitings~~sighting in 1996 or 1997. In the vicinity of Site 104, it is very common to have ephemeral beds occur due to the recruitment of seed sprouts. Most of the ephemeral beds in the area are composed of widgeon grass (Orth 1999).

The nearest significant SAV beds to Site 104 (documented in 1997) are ~~over~~more than 4 nautical miles away along the southern shoreline of the Magothy River and along the northern shoreline of the Chester River mouth. The Magothy River bed, which consists primarily of [illegible], is located approximately 5 nautical miles away, along the western shoreline of the mouth of Deep Creek. The bed along the northern shore of the Chester River mouth is located approximately 4 nautical miles from Site 104 in the area between Eastern Neck and Eastern Neck Island. This SAV bed is rather large, covering an area approximately 5,000 ~~meters~~ long and 2,250 ~~meters~~ wide and consisting of [illegible]. Additional beds are also located intermittently along the eastern shore of Eastern Neck Island approximately 6 nautical miles from Site 104 (Orth *et al.* 1997).

The closest documented SAV is approximately 4.0 km (2.5 miles) southeast of Site 104, in Goose Pond (north of Hackett Point)(Orth *et al.* 1996), but it is isolated from the site by Kent Island. The nearest beds that are along the mainstem are 4 miles away (mouth of the Magothy River) and 5 miles away (north shore of the Chester River mouth). One ephemeral SAV bed was found on the Eastern Shore adjacent to the Bay Bridge in 1997 but was not found prior or since.

5.1.7 Avian/Terrestrial Resources

5.1.7.a Terrestrial Resources. Site 104 is an open-water placement area located 1.6 km (1 mile) from the Kent Island shoreline; therefore, there are no terrestrial resources within the project area.

5.1.7.b Avian Resources. There are three categories of avian resources that could potentially occur within the Site 104 open-water placement area;~~,~~ these are (1) raptor species, (2) waterfowl, and (3) sea birds including gulls, terns, etc. The USFWS stated that because colonial wading birds prefer areas less than 1 m (3.3 ft) in depth, they would not be present at Site 104, which ranges from -12.8 to -23.8 m (-42 to -78 ft) MLLW in depth (~~Doug~~ Forsell 1997). The USFWS performed limited aerial surveys that estimated the numbers of all waterbirds in the area of ~~proposed~~ Site 104. Consultation with USFWS indicated that except for the occasional transient, no Federally listed, or proposed for listing, endangered avian species are known to exist at Site 104 (Forsell 1997;~~,~~ Annex C). The Wildlife and Heritage Division (W&HD) of DNR stated in a letter dated 9 May ~~9,~~ 1997~~,~~ that they have no records for Federal or state rare, threatened, or endangered plants or animals within Site 104 (Slattery 1997;~~,~~ Annex C). However, the W&HD and Environmental Review Division (ERD) of MDNR indicated that the Department has designated a site on the ~~shoreline on the~~ western side of Kent Island immediately north of the Bay Bridge as a ~~is adjacent to h~~ Historic ~~w~~Waterfowl C~~e~~oncentration ~~a~~Areas. This area extends westward from the Kent Island shoreline approximately 5,000 feet and northward from the westbound span of the Bay Bridge approximately 6,000 feet, and includes a buffer area. This area is designated by the Department as being outside the Site 104 boundaries (MDNR 1999a~~,~~; Annex C).

Raptor species common to the Bay region include bald eagle (*Haliaeetus leucocephalus*) and osprey (*Pandion haliaetus*). Bald eagles prefer large trees for nesting, roosting, and perching, in areas with limited human activity. They feed on a variety of prey species and are considered an opportunistic predator-scavenger. Ospreys prefer to nest over or near water (within 150 m [~~(~~492 ft]~~)~~) or on man-made structures isolated from animal predation and away from human activity. They feed on fish caught from the nearby waterway (Funderburk *et al.* 1991). There are no structures within the proposed placement area to provide nesting habitat for the osprey, and the site is located 1.6 km (1 mile) from the Kent Island shoreline.

According to MDNR, there are no raptor species inhabiting Site 104. There are peregrine falcons (*Falco peregrinus*), a raptor species that is not considered common to the Bay region, that nest on the mainspan of the Bay Bridge; however, they do not utilize Site 104 as a primary feeding area and their use of the area for feeding habitat is characterized as intermittent (~~Glenn~~ Therres 1997). The peregrine falcon ~~is~~ has been removed from the Federal Endangered Species List ~~presently designated as~~but is still considered -endangered by the ~~Federal and~~ Sstate ~~entities,~~. ~~while~~ Tthe bald eagle is considered threatened by Federal ~~entities~~ and ~~endangered by~~ state entities. Although the peregrine falcon and the bald eagle are presently designated endangered and/or threatened, consultation with Federal and state agencies has determined that the proposed project will not have an adverse impact on either species.

There are numerous waterfowl species common to the Chesapeake Bay region including wood duck (*Aix sponsa*), American black duck (*Anas rubripes*), canvasback (*Aythya valisineria*), lesser scaup (*Aythya affinis*), bufflehead (*Bucephala albeola*), common goldeneye (*Bucephala clangula*), and redhead (*Aythya americana*). Wood ducks remain in the Bay region in all but the coldest months. They are considered omnivores, prefer a variety of freshwater wetland habitats, typically nest in tree cavities, and are unlikely to be at Site 104. Black ducks typically remain in inland and emergent wetlands throughout the Bay region. They are also considered omnivores. Canvasbacks, scaup, goldeneye, and buffleheads are diving ducks that prefer inland and coastal habitats. They prefer shoal-water habitats with extensive submerged aquatic vegetation (SAV) beds and small bivalves. They are considered predominantly herbivores and feed primarily on sago pondweed and wild celery. The Bay provides an important overwintering habitat for canvasbacks. Redheads are also diving ducks that are considered sporadic fall and spring migrants to the Bay region. They are almost exclusively herbivores and feed mainly on SAV. Waterfowl concentration studies conducted in the Bay region by USFWS were used to determine whether a significant waterfowl population was present at Site 104 (USFWS 1994). USFWS studies included limited surveys of Site 104, and the majority of the waterfowl sightings were to the north and west of Site 104. Species of ducks that were observed by the USFWS in the vicinity of Site 104 include lesser scaup, bufflehead, and goldeneye. Based upon these studies and the fact that water depths are too great to support SAV (see Section 5.1.7.d), it was determined that Site 104 does not support a significant waterfowl population.

Sea birds that are common to the Chesapeake Bay region include various species of terns, gulls, and sea ducks. Sea ducks are grouped separately from other ducks because of their preference for open bay and inshore coastal water habitation. Sea ducks observed by the USFWS in the Site 104 vicinity include oldsquaw (*Clangula hyemalis*) and white-winged scoter (*Melanitta fusca*). Gulls that were observed by USFWS in the vicinity of Site 104 include the herring gull (*Larus argentatus*), ring-billed gull (*Larus delawarensis*), black-backed gull (*Larus marinus*), and bonaparte's gull (*Larus philadelphia*). No terns were observed in the vicinity of Site 104. In addition, through discussion with the MDNR and USFWS, it was determined that seabirds such as terns, gulls, and sea ducks used the area only for occasional foraging. Consultation with Mr. Forsell (USFWS) on 10 April ~~10,~~ 1997 determined that Site 104 does not appear to support a significant seabird population.

5.1.8 Rare, Threatened, and Endangered (RTE) Species

5.1.8.a Introduction. Certain species of plants and animals are protected by Federal and ~~state~~ State regulations under the Endangered Species Act (ESA) of 1973 and the Maryland Nongame and Endangered Species Conservation Act of 1975. Under (Section 7[a]) of the ESA, Federal agencies are required to consult with the USFWS and NMFS (where appropriate) if a prospective permit or license applicant or the implementing agency of Federal actions or Federal projects has reason to believe that rare, threatened, or endangered species (RTE) may be affected by a proposed project. The Maryland Nongame and Endangered Species Conservation Act has a similar consultation requirement regarding protected species that may be potentially affected.

5.1.8.b Coordination. In fulfillment of Federal and ~~state~~ State requirements, consultation was conducted with the USFWS Ecological Services Office in Annapolis, Maryland; the Habitat and Protected Resources Division of the NMFS in Oxford, Maryland; and MDNR's Fish, Heritage, and Wildlife Administration located in Annapolis, Maryland. Information requested from these agencies included Federal and ~~state~~ State listed ~~rare, threatened, and endangered~~RTE species, designated or proposed critical habitat, and candidate taxa occurring in the project area.

The State of Maryland RTE response letter (Slattery 1997; Attachment E) received from MDNR stated that their agency has no records of state listed ~~rare, threatened or endangered~~RTE plants or animals within the project site.

The response letter from the USFWS (Wolfin 1997; Attachment E) stated that shortnose sturgeon (*Acipenser brevirostrum*), a Federally listed endangered species, had been documented off western Kent Island in May 1996 by USFWS. USFWS also cited wild Atlantic sturgeon (*Acipenser oxyrhynchus*), which has been recorded in the area as a species of concern.

The Atlantic sturgeon is not currently listed Federally for purposes of the ESA. ~~However, its future listing status is uncertain at this time.~~ The summary statement provided by USFWS indicates that, except for occasional transient individuals, no other Federally listed or proposed for listing endangered or threatened species are known to exist in the project impact area, and therefore, no further Section 7 Consultation was required with the USFWS. However, USFWS recommended contacting NMFS because they are the lead Federal agency for formal Section 7 requirements for the shortnose sturgeon.

The Federal response letter from the NMFS (Rosenberg 1997a; Attachment E) stated that while their agency is responsible for a number of endangered and threatened species, including sea turtles and several marine mammals, in the upper Chesapeake Bay, NMFS believes it unlikely that the proposed action would adversely affect these species. Nevertheless, the NMFS stated that their agency could not accurately determine the current status of the shortnose sturgeon (SNS).

Beginning in the fall of 1997, SNS catches in the Chesapeake Bay have been under review by NMFS due to the results of a bounty program administered by the USFWS since 1996. This program has resulted in the reporting and documentation of SNS as incidental bycatch in the pound nets, hoop nets, and gill nets of watermen in the Chesapeake Bay. With the documented incidence of more than an occasional transient, NMFS has requested an Informal Section 7 Consultation under the ESA of 1973 and Biological Assessments of proposed actions by the Baltimore and Philadelphia Corps Districts in open-water in the Chesapeake Bay (Rosenberg 1997b and 1997c; Annex A). This consultation is underway, with both Baltimore and Philadelphia Districts participating.

An interim B~~b~~iological A~~a~~ssessment is being prepared by the Baltimore District and will be distributed to NMFS at the time of the public release of this draft EIS [MCKEE-CURRENT STATUS?]. This interim Biological Assessment (BA) will include all field data available at this time. Although a final BA will not be completed until 2000, after 2 years of field data have been collected, the District will request a biological opinion from NMFS on this action based upon the data contained in the interim BA. ~~Preliminary assessment of SNS have indicated that most specimens were genetically similar to the Delaware Bay population which is currently stable.~~

The NMFS encouraged collection of information to determine whether or not SNS in the Chesapeake Bay constitute a geographically and genetically distinct population from the Delaware Bay. If a distinct shortnose population exists in the Chesapeake Bay, then more stringent protection requirements could be required by NMFS because of the unique nature of the population.

5.1.8.c Shortnose Sturgeon (SNS) History, Biology, and Current Status.

History and Current Status of SNS in the Chesapeake Bay

~~Shortnose sturgeon (~~SNS~~)~~ has been documented in the Chesapeake Bay since the 1600s, when settlers first colonized America. Historical records indicate that SNS were~~as~~ commonly found to inhabit the Potomac River in Maryland in the 1800s (Uhler and Lugger 1876). Few sturgeon have been reported in the Chesapeake Bay since the last known resident populations were thought to have been extirpated in the 1970s (Dadswell *et al.* 1984). There is, however, a documented resident population in the Delaware River (Hastings *et al.* 1987).

When shortnose sturgeon were found in the Bay over the last 20 years, it was generally believed that they were infrequent transient, non-resident adults that~~which~~ had traveled through the Inland Waterway, or C&D Canal, from the Delaware Bay into the Chesapeake Bay. Prior to 1997, ~~N~~no juveniles or spawning activity have~~s~~ been observed in the Chesapeake Bay for decades, leading to the assumption that a distinct population segment, or resident population, did not exist in the Chesapeake Bay.

Speculation has been that overfishing, losses of habitat, and spawning impediments such as the Conowingo Dam have contributed to their decline. At present, the continued existence of SNS as a distinct genetic population in the Chesapeake Bay remains uncertain. However, preliminary assessment of SNS have indicated that most specimens were genetically similar to the Delaware Bay population which is currently stable (NMFS 1999).

Biology of the Shortnose Sturgeon (SNS)

The life history of SNS is not fully understood to date. SNS~~hortnose sturgeon~~ populations have been documented by Dadswell *et al.* (1984) to occur in rivers, estuaries, and nearshore marine waters. ~~Shortnose sturgeons~~SNS are anadromous, migrating to fresh water to spawn. Movement of SNS is usually restricted within their natal river or estuary. Most of the year SNS are found at or below the fresh-saline water interface until the spawning migration begins, at which time they move into freshwater reaches of the Bay.

Freshets, substrate character, and flows are all documented factors influencing SNS spawning (Gilbert~~,~~ 1989). ~~Shortnose sturgeon~~SNS spawn mostly once a year between February and May depending on latitude and longitude (Dadswell *et al.*~~,~~ 1979).

Temperature is also a major factor in determining spring migration. Spawning generally occurs between 9°C and 12°C in freshwater areas. After spawning, the adults move to deep overwintering sites that are sometimes adjacent to the spawning grounds (Dadswell *et al.*~~,~~ 1979).

Fertilized eggs of SNS stick to the bottom (Baine 1997). SNS eggs ~~and~~ hatch in 8 days at approximately 17°C. After 2 days, the yolk-sac fry seek concealment and avoid light. ~~Beginning t~~Twelve days after hatching, the yolk sac is completely absorbed and the fry start feeding on zooplankton (Buckley and Kynard 1981). ~~Washburn and Gillis Associates (1981) found that f~~Fertilized eggs strongly adhere to rough-surfaced substrata within 1 minute ~~after~~ of fertilization ~~occurs~~ (Washburn and Gillis Assoc. 1981). SNS~~turgeon~~ eggs begin hatching 12 days after fertilization with some individuals still emerging on the 16th day.

Early growth of SNS is rapid. Young SNS begin to resemble adults by the time they are 20-30 mm in length~~, approximately 1 year of age [~~(Dadswell *et al.* 1984~~]~~), but ~~. T~~they remain juveniles until they are 45-55 cm Fork Length (FL) ~~(approximately 3 years of age for males and up to 6 years of age for females),~~ depending on the latitude. Males may mature in 2-3 years in ~~the southern part of the range (~~Georgia~~)~~ and up to 10-11 years in the northernmost part of their range.

Females require longer to mature, as their range moves northward, ~~from~~ 6 years in the south~~ernmost parts of the range~~ to 13 years in the north~~ernmost~~ (Gilbert 1989).

Suitable and/or critical habitat for the SNS in the Chesapeake Bay is currently unknown, due to their infrequent detection in the ~~Chesapeake~~ Bay. Spawning habitat has not been identified in the Chesapeake Bay. ~~, but i~~If this habitat is consistent with the preferred substrate and water quality conditions in other East Coast populations, spawning habitat would consist of relatively fresh water high up in a river system that has a ~~with~~ relatively high velocity and gravelly to gravelly-sand and sandy mud substrates (MES 1998a).

5.1.8.d Atlantic Sturgeon History, Biology, and Current Status.

History and Current Status of the Atlantic Sturgeon in the Chesapeake Bay

An abundant and economically important population of Atlantic sturgeon (*Acipenser oxyrinchus*) once inhabited the Chesapeake Bay. During the late 19th century, the Chesapeake Bay supported the third greatest caviar fishery in the Eastern United States (Secor and Houde 1997). An 1876 Maryland fisheries manual (Uhler and Lugger 1876) describes the Atlantic sturgeon as populating the Susquehanna and Potomac Rivers.

In the early 1900's, the Atlantic sturgeon population collapsed. In Maryland, fishery landings declined from 74,500 kg in 1904 to 320 kg in 1920 (Hildebrand and Schroeder 1928). Atlantic sturgeon has not recovered from this decline in the Chesapeake Bay. No spawning activity has been observed in the Chesapeake Bay for two decades, leading to the assumption that any remnant population of Atlantic sturgeon in the Bay may be incapable of a resurgence. The last fish legally harvested in the Chesapeake Bay, a mature female, was captured in 1970 from the Potomac River. Secor and Houde (1997) reported that the spawning population of Atlantic sturgeon may have been extirpated. Speculation has been that overfishing, losses of habitat, hypoxia, and spawning impediments such as the Conowingo Dam have contributed to their decline or extirpation in the Bay (Secor and Houde 1997). At present, the continued existence of Atlantic sturgeon in the Chesapeake Bay remains uncertain.

Biology of the Atlantic Sturgeon

The life history of Atlantic sturgeon, like the shortnose sturgeon, is not fully understood to date. Atlantic sturgeon populations have been documented by Bain (1997) to occur in rivers to river mouths, estuaries, and marine waters.

Atlantic sturgeon are anadromous and spawn generally once a year between April and May depending on latitude and longitude (Gilbert 1989). Little is known about temperature, salinity, or dissolved oxygen requirements for spawning. Borodin (1925) reported that Atlantic sturgeon spawning occurred in the Delaware River at depths of 11 to 13 m (36-42 ft.) over a hard clay bottom at water temperatures of 13.3-17.8 °C (55.9-64 F).

Fertilized eggs of Atlantic sturgeon are adhesive and remain on the bottom in deep channel habitats. Sturgeon embryos and larvae have a limited salt tolerance, so their habitat must be well upstream of the salt front. No additional information is available on egg and larval development of the Atlantic sturgeon. Baine (1997) reported the transition from larva to juveniles occurs at about 30 mm total length based upon Hudson River specimens.

After spawning, the adults move to marine waters (either all year or seasonally) for feeding and further development. Little is known about their behavior in marine waters. Available information suggests that juvenile Atlantic sturgeon may make oceanic excursions. Despite their extensive oceanic migrations, these fish are believed to be highly ~~site~~ site-specific and apparently return to the same river and even the same general hatching area to spawn (Gilbert 1989).

Suitable and/or critical habitat for the Atlantic sturgeon in the Chesapeake Bay is currently unknown. Spawning habitat also has not been identified in the Chesapeake Bay.

5.1.8.e Shortnose and Atlantic Sturgeon Studies. Due to their believed extirpation from the Chesapeake Bay, few studies have been conducted of the shortnose and Atlantic sturgeon in the area until very recently. The following paragraphs list and discuss aquatic sampling in and around dredged material placement sites conducted in the Chesapeake Bay.

Previous Aquatic Studies in and around Dredged Material Placement Sites in the Upper Bay

Fish Population Characterizations Conducted Before, During, and After Open-~~water~~ Water Dredged Material Placement in the Upper Bay.

Eight fish characterization studies have been performed in the Pooles Island area on proposed and existing dredged material placement sites and reference areas to collect baseline data for planned actions and to monitor placement actions. The studies conducted since 1992 have included midwater and bottom trawls along with acoustic surveys in four quarters each year (MES 1997c). In addition to~~Along with~~ the above-mentioned annual studies, anchor set gill nets were used in several sites in four quarters from July ~~of~~ 1996 to April ~~of~~ 1997. The nets were generally set in the daytime tide, and consisted of 150 ft length with a 3-4-5-6-7-and 8-inch mesh.

A charter boat angling survey was also conducted in the summer and fall of 1996. The objectives of the angling and the fish characterization studies were to characterize the abundances, diversity, and changing community structure and seasonal abundances of the fish populations in planned and actual placement sites and nearby reference areas. Data collected w~~as~~ere used to calculate catch per unit effort, length frequency distributions, diel changes in use of sites and depths of water at the sites, as well as changes in these parameters over time if placement was implemented at the study sites.

No SN~~Shortnose sturgeon~~ were captured during the eight studies (166 hours of gill netting, 79 hours of bottom trawl and 38 hours of mid-water trawl sampling) conducted to characterize the upper Bay reference areas and proposed and actual placement sites since 1992. One Atlantic sturgeon was captured during the 1996/1997 gill netting study. This wild Atlantic sturgeon was captured in the July 1996 gill net setting in a reference area between Pooles Island and Fairlee Creek. It was 870 mm long and weighed 4,173 grams (9.2 lb). According to Bain (1997), the corresponding age range would be from 6- to 11 years and the individual would be considered a late juvenile. ~~This individual was considered~~ At the time of capture, ~~a~~ late juvenile of this size class according to Bain (1997) ~~and~~would not be of spawning age. ~~at the time of capture.~~

Fish Population Characterization Conducted ~~in~~ In and ~~around~~ Around Site 104.

Fish abundances and distributions were evaluated at Site 104 and two reference areas during a four-season sampling program conducted during the day and night, during different seasons of the year (July 1996 to April 1997) and at varying depths [Finfish Survey in Section 5.1.6.b]. The fisheries cruises were conducted during the months of June/July, October, December 1996 and April 1997. A total of 28 deployments of multi-panel anchor-set gill nets, 24 midwater trawls, and 128 bottom trawls were performed to determine the composition of the fish community within and around Site 104 (Figure 5-~~23~~25). The gill nets were generally set during the daytime tide, and consisted of 150 ft length with a 3-4-5-6-7- and 8-inch mesh. Bottom trawls consisted of a 7.9-m headrope, 3.8-cm stretch mesh netting, and a ~~13-~~13-mm stretch mesh liner to retain small samples.

-No shortnose or Atlantic sturgeon were captured during the study by either method in Site 104 or in reference areas A and B during July 1996 to April 1997. ~~No sturgeon were collected during the Poplar Island fish studies in 1995.~~

Current Shortnose and Atlantic Sturgeon Studies

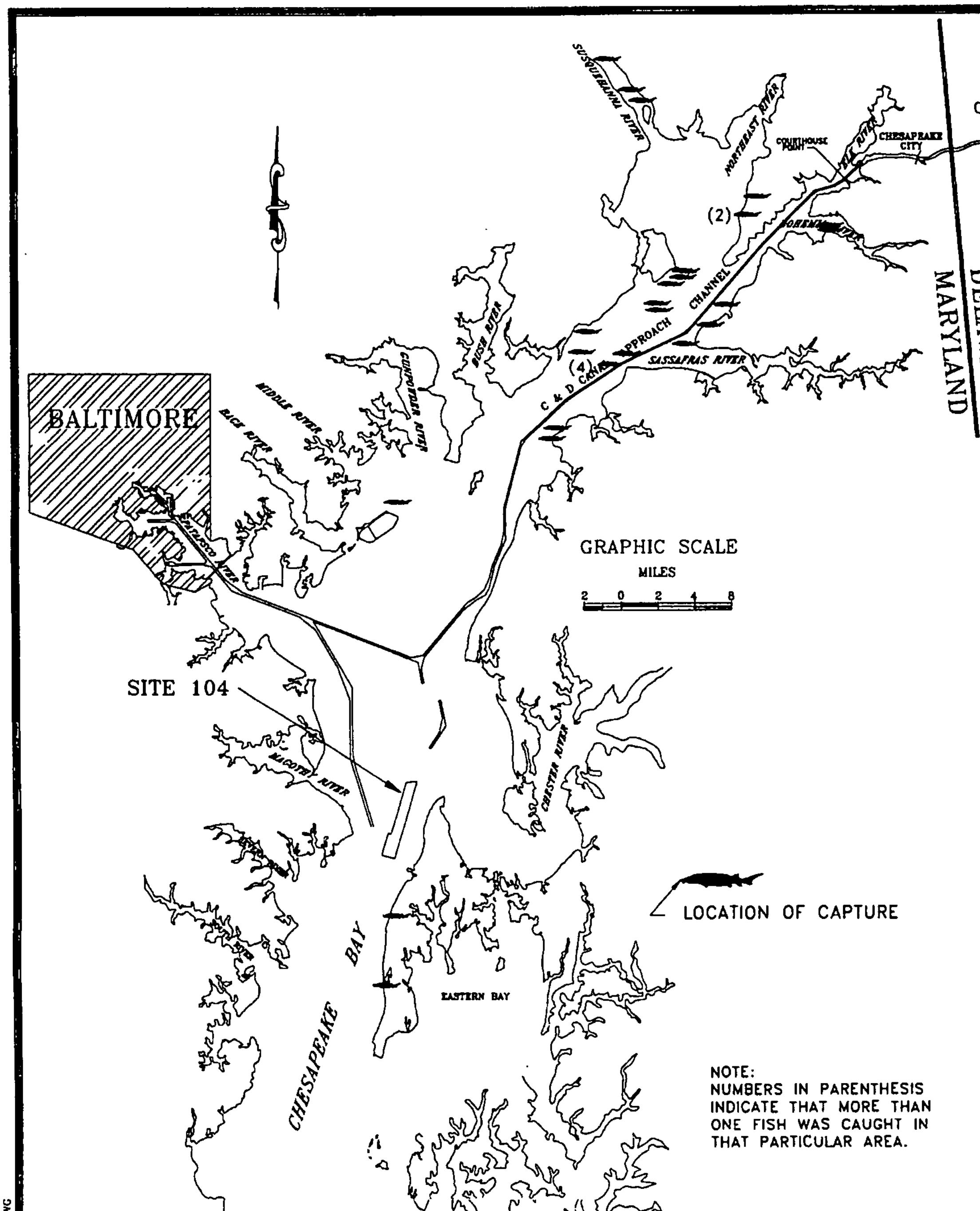
Aberdeen Proving Ground Study.

The USFWS is currently conducting a field study with the U. S Army Aberdeen Proving Ground (APG). ~~No sturgeon have been collected as of January 1999.~~ Data collection has been underway since early summer of 1997. While no published data are available yet, studies have used gill nets set in 3.7-6.1 m (12-20 ft) of water in the mainstem of the Bay around Pooles Island and in the Gunpowder River. The nets have generally been set as~~in~~ day~~time slack tide~~ and overnight sets year round, and consist of 300-ft~~.~~ (91.4-m) and 400-ft (122-m)~~182.9-m 300- and 600-ft~~ lengths with 4,5,-6- and 8-inch mesh. ~~A few data collections have occurred using nets that have been set overnight. Nets have been set every 2-3 weeks for 4-12 hours each time.~~ No shortnose sturgeon have been collected in approximately 593 hours of gillnetting to date (USFWS 1999a)]. ~~The~~ APG is performing this study to fulfill their responsibility to document and manage any rare, threatened, or endangered species that exist within their boundaries.

USFWS Atlantic and Shortnose Sturgeon Bounty Program.

The USFWS is currently conducting a field study of Atlantic and shortnose sturgeon populations in the Chesapeake Bay through a bounty program. This program is offering a reward of $25 for each live Atlantic sturgeon and $100 for each live SNS~~Shortnose sturgeon~~ reported and documented as incidental bycatch by commercial or recreational watermen.

The study has documented ~~29~~ 32 shortnose caught between 4 April 4~~,~~ 1996~~,~~ and 24 September ~~July 1~~24~~,~~ 199~~8~~9 (Figure 5-~~24~~26). Most of the fish were caught in relatively shallow water, using pound nets (11~~0~~ fish), gill nets (13~~1~~ fish), fyke nets (4 fish), catfish traps (2 fish), a hoop net (1 fish)~~,~~ and a~~n~~ eel pot (1 fish)~~ and a catfish trap (2 fish)~~. Of the 32~~29~~ fish captured, 12~~7~~ were captured~~ught~~ in the winter~~1996~~ (December-February~~April, May, and June~~), 18~~0~~ in the Spring~~were caught in 1997~~ (March-May~~January, April, and December~~), 2 in the Summer ~~and 12~~



MARYLAND PORT ADMINISTRATION

MARYLAND ENVIRONMENTAL SERVICE

US Army Corps of Engineers

SHORTNOSE STURGEON LANDINGS IN CHESAPEAKE BAY AND TRIBUTARIES 4/96 TO 10/99

Figure 5-26

J:\SITE104\TMP\FIG5-20.DWG

~~were caught in 1998~~ (June- August~~January - April~~) and none in the Fall (September-October). ~~None have been captured since the original bounty program ended July 1, 1998. The bounty program started up again on 11 December 1998 and no new captures have been made. Of the fish caught to date, 24~~ Twenty--three of the fish were caught in the far upper Chesapeake Bay~~;~~, ~~20~~ from near the ~~between the~~ Sassafras River and into the Susquehanna Rivers~~.~~ ~~; t~~The other nine SNS ~~four~~ were captured in various other locations such as the Potomac River, Nanticoke River, Barren Island, and Hart--Miller Island. ~~between Hart Miller Island and Worton Point.~~ To date no SNS have been found within Site 104. ~~The remaining 5 were caught elsewhere in the Bay: 2 south of the Bay Bridge, 1 off Barren Island, and 2 in the Potomac River. Compared to the overall capture mean of 762 - 914 mm (2.5 - 3 ft), 7 of the 29 fish were considered small in size. These small fish were captured in the far upper Bay in the Bohemia River, off Worton Point, and off Aberdeen during February, March and April of 1998. Their sizes ranged from 381 mm (1.3 ft) to 527 mm (1.7 ft) However, 2~~Two SNS were captured along the Kent Island shoreline south of the Chesapeake Bay Bridge in May 1996.

As with the SNS~~shortnose sturgeon~~, most of the wild Atlantic sturgeon were also caught in relatively shallow water, using pound nets ~~(23 fish)~~, gill nets ~~(27 fish)~~, crab pot ~~(1)~~ and trawls ~~(1)~~. Of the 395~~211~~ captured, 95~~3~~ percent were captured below the Chesapeake Bay Bridge. ~~in the lower Bay below the Choptank River)~~. No wild Atlantic sturgeon were captured within Site 104 boundaries. However~~, although~~ 2 fish were located [OR CAPTURED? REVISE]along the shoreline of Kent Island, east of Site 104 in May 1997 (Figure 5-~~25~~27).

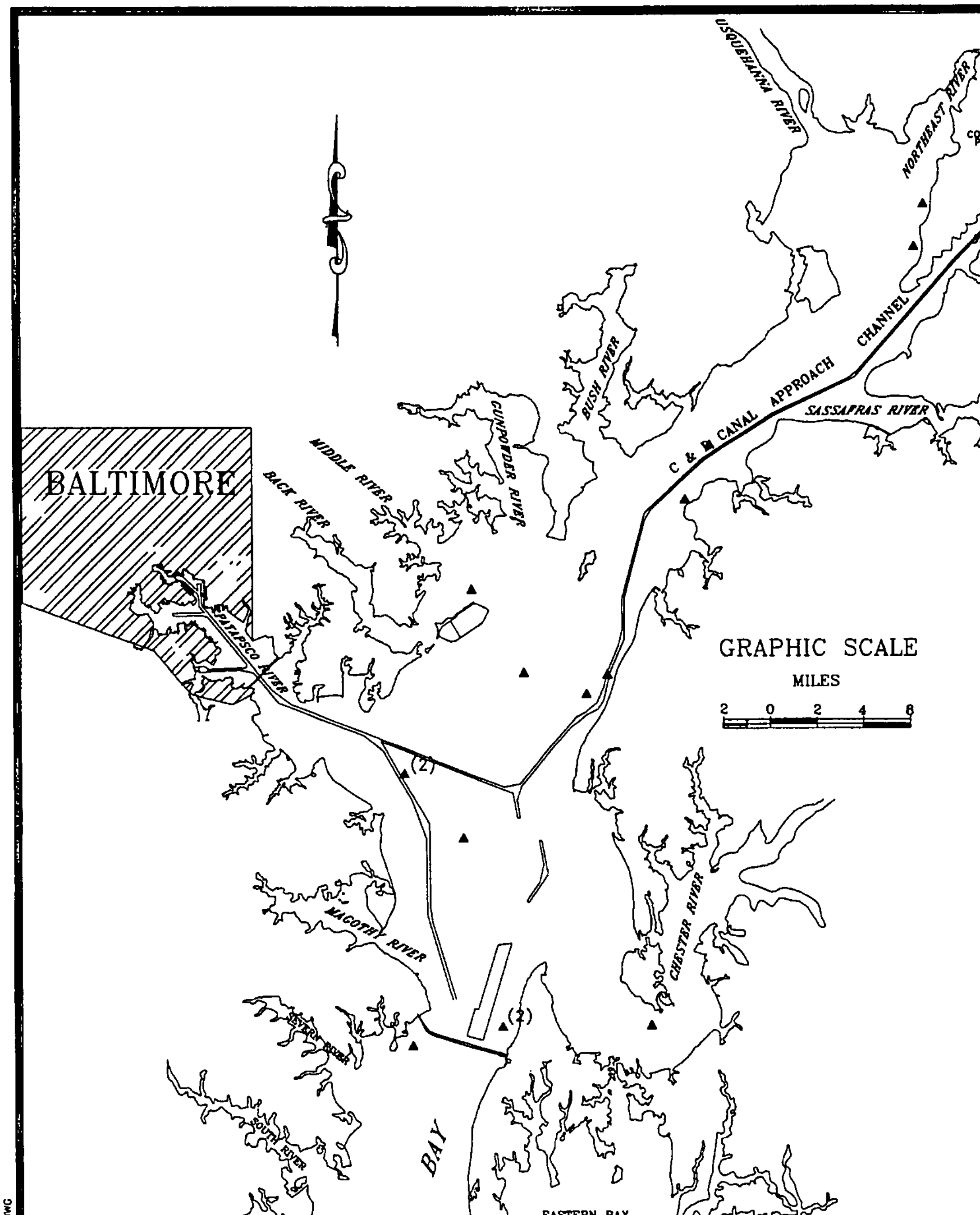
Hatchery Raised Atlantic Sturgeon Population Studies in the Chesapeake Bay.

In order to assess the potential for reestablishing spawning populations of Atlantic sturgeon in the Chesapeake Bay, a team, comprised of scientists from USFWS, University of Maryland, and the Chesapeake Bay Program, released more than 3,000 hatchery-raised (Hudson River brood stock) and tagged juvenile Atlantic sturgeon in the Nanticoke River in July 1996 ~~to address the feasibility of sturgeon restoration~~ (Miller 1998).

Of the total number stocked, 460~~49~~ ~~non-multiple~~were re-captured~~s occurred as a result of the USFWS Bounty Program~~ Bay-wide between October 1996 and 29~~4~~ September ~~24,~~ 1999 ~~December 1998~~. ~~Of the 449 hatchery Atlantic sturgeon recaptured, 93 percent were found in the Bay south of the Chesapeake Bay Bridge. Of the 449 Atlantic Sturgeon recaptured only 1 percent were recaptured within or around Site 104. The methods used to evaluate the objectives outlined above include use of anchored gill nets, telemetry, genetic testing, and water quality assessments~~. The majority of these fish were landed below the Chesapeake Bay Bridge~~)~~.

Determining the Status of SNS in the Chesapeake Bay

As part of the Section 7 Consultation process to determine the status of the shortnose and Atlantic sturgeon within the Chesapeake Bay, a ~~two~~2-year sampling program was developed by the USFWS in consultation with the NMFS and funded by the Baltimore and Philadelphia Corps Districts.



J:\SITE104\TMP\FIG5-21.DWG

MARYLAND ENVIRONMENTAL SERVICE

US Army Corps of Engineers

Wild Atlantic Sturgeon In Chesapeake Bay and Tributaries 4/96 - 10/99

Figure 5-27

The main objectives of the ~~two~~2-year study are to:

- Determine whether the Chesapeake Bay supports a resident SNS population, or if the SNS found in the Chesapeake Bay are transients from the Delaware River via the C&D Canal;
- Assess the genetic composition of the Chesapeake Bay SNS with the Delaware River and Hudson River stock; and
- Determine the Atlantic and SNS use of the shipping channels and the proposed and existing dredged material placement sites.

The methods used to evaluate the objectives outlined above include anchored gill nets, telemetry, genetic testing, and water quality assessments. Field sampling for this study was initiated in March ~~of~~ 1998 in the Chesapeake Bay and the Delaware River, using anchored experimental gill nets (4, 5, and 6-inch mesh) set during daytime and overnight in 19 sample locations. The 19 sample locations were determined by the NMFS based on proposed dredged material placement sites and shipping channels. ~~Proposed dredged material placement sites are s~~Sampl~~ed~~ing is performed on a rotating schedule ~~biweekly with four nets at a time~~ during the fall, winter, and spring for both shortnose and Atlantic sturgeon. [Summer sampling is performed in areas that do not become hypoxic/anoxic during the summer months. The larger sites, such as Site 104, are subdivided based upon their size and other ecological features. Shipping channels are also divided into sampling sections and sampled similarly to the ~~above~~ above-mentioned proposed placement sites Waiting for call from Mike Mangold to determine if and when they stopped sampling within the proposed placement sites. Also want to include a total number of gill netting hours in Site 104 and overall].

Sonic tags will be fitted on up to 30 shortnose sturgeon captured from the Delaware River and the Chesapeake Bay. Once fitted, the sonic tags will allow USFWS personnel to track SNS movements in the Chesapeake Bay biweekly using a portable hydrophone. In addition, movement of SNS between the Chesapeake Bay and the Delaware River via the C&D Canal is monitored by stationary continuous automatic sonic tag loggers located at Chesapeake City and Reedy Point.

In order to determine whether a distinct population of SNS exists within the Chesapeake Bay, a small tissue sample is clipped from the caudal fin of each tagged shortnose sturgeon upon capture. DNA analysis will be performed on these tissue samples and will be compared to Hudson, Delaware, and Savannah River tissue samples.

Preliminary Results

~~Data collected from this 2-year study will be used to prepare an interim biological assessment and will be distributed to NMFS at the time of the public release of this draft EIS. This interim biological assessment will include all field data available at this time. A final biological assessment will not be completed until 2000, after 2 years of field data have been collected.~~

~~Preliminary genetic analysis indicates that of the 17 Chesapeake Bay SNS sampled so far there were 7 different haplotypes of which 6 were found in the Delaware Bay indicating a similarity among the populations.~~

On 26 January ~~26,~~ 1999, NMFS issued a Biological Opinion (BO) concerning impacts to shortnose sturgeon from maintenance dredging of the C&D Canal and Northern Approach Channel to the C&D Canal in Maryland and Delaware.

Based on their review of available data and the CENAP Break Out Biological Assessment, NMFS concluded that the project was not likely to jeopardize the continued existence of shortnose sturgeon that inhabit the project area in the Upper Chesapeake Bay. The NMFS authorized an incidental take allowance of three shortnose sturgeon for this project.

Since the initiation of the sampling program, some preliminary conclusions about the seasonal distribution of the SNS in the Upper Chesapeake Bay due to investigations and results of the USFWS reward program have been made by USFWS (1999b) and NMFS (1999). NMFS (1999) reported in the BO that it is likely that SNS spawn in the Potomac River and, possibly, below the Conowingo Dam in the Susquehanna River. NMFS drew this conclusion based on the occurrence of SNS within freshwater reaches of the Potomac River, the capture of adult SNS below the Conowingo Dam in mid to late April, and the capture of six juvenile shortnose sturgeon in the Upper Bay.

Eight SNS were captured during the winter (1997/1998) in relatively deep regions of the Upper Bay near Howell and Grove Points. SNS are known to overwinter in deep, channel sections of Rivers. Thus, it is probable that the Howell to Grove Point section of the Upper Bay provides overwintering habitat for SNS. The extent to which SNS use the shipping channel in this region is unknown. Additional data in the area may provide additional information on the use of this region.

Telemetry information from five sturgeon tracked in the Upper Bay from the early feeding season~~,~~ indicates SNS use of the Worton Point to Howell Point section of the Upper Bay. Four fish were tracked south and southeast of Pooles Island in water depths of approximately 20 ~~feet~~. Based on foraging patterns exhibited by SNS in other northeast river systems, SNS in this system are likely to be widely dispersed and actively feeding during the summer. Productive reaches of the Upper Bay (e.g., near the saltwater/freshwater interface and channel areas bordering mud flats or emergent macrophytes) are potential feeding areas (NMFS 1999).

The USFWS tracked one SNS in the C&D Canal in July (1998), indicating that the sturgeon may move between the Delaware River and Chesapeake Bay, possibly to access productive feeding areas in either the Chesapeake or Delaware Bay.

Preliminary genetic analysis performed by Dr. Ike Wirgn of the New York Medical School under contract to USFWS indicates that of the 18 Chesapeake Bay SNS genetically sampled to date, there were 7 different haplotypes of which 6 were found in the Delaware Bay. Several reasons may account for why all 7 haplotypes in the species sampled did not occur in the Delaware Bay.

First, the individual sampled may be of a rare genotype found in either the Delaware or Chesapeake Bays and so rare that it does not match the other genotypes in the sample set. Secondly, the fish could represent a Chesapeake Bay stock prior to the opening of the C&D canal. Lastly, the fish could have been from somewhere else.

Continued Coordination

Data collected from this 2-year study will be used to prepare an interim Biological Assessment and will be distributed to NMFS at the time of the public release of this draft EIS.

This interim Biological Assessment will include all field data available ~~at this time~~. A final Biological Assessment will ~~not~~ be completed ~~until~~in 2000, after 2 years of field data have been collected.

5.1.9 Air Quality

As required by the Federal Clean Air Act, the State of Maryland monitors six air pollutant criteria: ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, lead, and particulate matter. The Environmental Protection Agency has established the National Ambient Air Quality Standards (NAAQS), which sets acceptable limits for the six parameters listed above. These national standards provide a benchmark to which air pollutant levels can be compared. Areas are classified as either in attainment of the NAAQS~~;~~ or, if they do not meet the standards, they are classified as nonattainment areas.

In Maryland, the MDE, Air and Radiation Management -Administration is responsible for monitoring the state's air quality. In the most recent Maryland Air Quality Data Report (MDE 1995), it was reported that the State of Maryland is meeting all of the air quality standards with the exception of ozone. Maryland as a whole is classified as a nonattainment area for the National Ozone S~~s~~tandard. Also, Maryland is part of the Northeast Ozone Transport Region. This region includes 12 states concerned with the transport of ozone between states. Individual states, as well as regional efforts, are concluding that ozone nonattainment areas cannot demonstrate attainment simply through the implementation of control measures within a nonattainment area. ~~; s~~Significant ~~ozone and precursor concentration~~ reductions at the boundary of a nonattainment area will be necessary, together with volatile organic compounds (VOC) and/or nitrogen oxides (NOx) reductions within the nonattainment areas, in order to demonstrate modeled attainment.

No air quality monitoring was conducted at the Site 104 project area~~, since~~ and there are no monitoring stations in the vicinity. Consequently, the information is regional in nature. Site 104 is adjacent to Kent Island, the Bay Bridge, and Sandy Point State Park. The northern end of Kent Island (the closest landmass to the proposed placement site) has little industry and its land use is ~~primarily consists of~~mainly residential and agricultural~~ land use~~. Sandy Point State Park is located to the west and is surrounded by mostly~~predominately~~ residential and agricultural areas. The most significant determinant of air quality in the vicinity of Site 104 is the vehicular traffic on the Bay Bridge. Air quality in the channels and at Site 104 is typical of adjacent B~~b~~ay areas. Because Site 104 is an open water area, it does not adversely contribute to air quality in the immediate vicinity other than through commercial and recreational boating activity.

5.1.10 Noise

Open water areas generally have very few natural noise sources; most noise is generated by natural occurrences. Noise levels at Site 104 have not been measured, but background noise can be attributed to natural processes such as wave action, wind, and any wildlife that may frequent the areas. In addition to natural noise sources, Site 104 experiences man-caused noise pollution as well. Vehicular traffic on the Bay Bridge (approximately 0.61 km ([2,000 ft)] south), commercial, and recreational boat traffic in and around the site, and noise from small planes using the small Bay Bridge airport on Kent Island are the primary contributors to the noise levels in the area.

5.1.11 Hazardous, Toxic, and Radioactive Substances

Site 104 is not designated as a Superfund site on the National Priorities List (NPL) under the Comprehensive Environmental Response, Compensation, and Liability Act (40 CFR 300, Annex A: NPL List). Site 104; and is not listed for further action under the Comprehensive Environmental Response, Compensation, and Liability Information System (CERLIS). ; and tThere are no known hazardous materials in the proposed placement area.

USACE regulations require documentation of the existence of CERCLIS and NPL sites within the boundaries of a proposed project that could impact, or be impacted by, the presence of Hazardous, Toxic, or Radioactive Substances (HTRS) contamination. USACE regulation ER 1162-2-132 provides that dredged material and sediments beneath navigable waters proposed for dredging qualify as HTRS only if they are within the boundaries of a site designated by the EPA or a state for a response action, such as removal or remediation under CERCLA. Site 104 is not a designated CERCLA site.

The Resource Conservation and Recovery Act of 1976 (RCRA) established the Federal program regulating solid and hazardous waste management. RCRA is a comprehensive amendment of earlier legislation, the Solid Waste Disposal Act of 1965. Subtitle C of RCRA created the hazardous waste management program. RCRA specifically excludes materials covered under certain other legislation, including the Clean Water Act, covering discharges to navigable waters, and the Marine Protection, Research, and Sanctuaries Act, which applies to ocean placement. Dredged material placement is regulated by the Corps of Engineers under one or more of these acts, and is not regulated by RCRA.

Site 104 (previously known as the Kent Island Deep placement site) was used for placement of approximately 70 million cubic yards of dredged material between 1924 and 1975. Records for the period are incomplete, and although the approximate quantities of dredged sediments are known, there are no records of the sediment characteristics, nor are there records of where the material came from. It appears that some quantity of dredged maintenance material from Baltimore Harbor was placed at the site in the early 1960s. This was the last time that Site 104 received material from the Baltimore Harbor.

In 1975, the final year of placement, the origin and quantities of dredged material were recorded. In addition, environmental monitoring was performed in 1975 before, during, and after placement. No adverse impacts were noted on oysters, clams, and other benthic organisms. The approximately 860,000 cubic yards of sediments that were placed originated from the Baltimore Harbor approach channels including the Craighill Channel and the Brewerton Extension. The material placed was clean, uncontaminated sediment.

Some new work and maintenance material dredged from Baltimore Harbor was placed in Kent Island Deep (Site 104) during the period from 1924 to the early 1960's. Sediments which may have been originally dredged from the Baltimore Harbor area were noted during surficial sediment and subsurface sediment sampling at Site 104 in 1997, as discussed in the Physical Conditions section under Section 5.1.5.b. These sediments were dissimilar different in appearance and chemical composition from other surficial sediment samples collected

~~concurrently~~at the same time, and may have been buried under a layer of sediment deposited since placement at Site 104 ceased in 1975. It is clear, however, that the material placed at Kent Island from the mid 1960s to 1970s did not originate from Baltimore Harbor. _Environmental monitoring which was performed before, during, and after the final placement in 1975, addressed a wide array of environmental parameters. The monitoring results disclosed no significant impacts._ These findings support the conclusion that Site 104 (Kent Island Deep) is not a source of hazardous, toxic, or radioactive wastes.

5.2 CULTURAL AND ARCHAEOLOGICAL RESOURCES

The Maryland Historical Trust (MHT) was consulted to identify and evaluate any potential historic, cultural, or archaeological resources in the Site 104 area, as per the National Historic Preservation Act of 1966, as amended, and its implementing regulations, 36 CFR Part 800.

5.2.1 Historical Use of Site 104 Dredged Material Placement Area

Site 104 is a previously used 1,800-acre open-water placement site located approximately 0.61 km (2,000 ft) north of the Chesapeake Bay Bridge and 1.6 km (1 mile) west of Kent Island. The site is approximately 7.2 km (4.5 miles) long and 0.8 km (0.5 mile) wide. Beginning in 1924, the site was used for dredged material placement, though records are incomplete (MDNR 1976). It is estimated that a total of 70 mcy (53.5 mcm) of sediment were placed at the site during the period 1924 to 1975 (CENAB 1997—"a" or "b"?). In the early 1960s it was reported that some operations and maintenance material from the Baltimore Harbor was also placed in the site. Subsequent placement of sediments from the Federal approach channels and from new work dredging of the Federal channels in the 1960's and 1970's occurred in Site 104. New work dredging usually produces coarser grained material because the area has not been dredged before, as compared to maintenance dredging of existing channels that have been previously shoaled. The last placement of sediment occurred in 1975 and totaled approximately 850,000 cubic yards of material.

5.2.2 Existing Archaeological, Cultural, and Historic Resources

Coordination with the MHT was initiated in June 1997. The MHT has stated that the site is considered disturbed due to historical placement in the area, which would have buried any potential resources under several meters of material. The MHT stated that there are no archaeological, historical, or cultural issues related to the Site 104 area (see Attachment E). Therefore, marine surveys for archaeological or historic resources in the Site 104 area were not considered necessary.

5.3 SOCIOECONOMIC RESOURCES

Site 104 and the surrounding area form an integral part of the socioeconomic framework of Queen Anne's, Anne Arundel, and Kent Counties. The socio-economics of the Site 104 region are tied to commercial and recreational activities associated with the Chesapeake Bay and the Port of Baltimore. Demographics, land and water use, fishing activity, employment, and industry are discussed in the following sections.

5.3.1 Identification of Socioeconomic Resources

Socioeconomic resources were identified through coordination with the MPA-DNPOP Site 104 Working Group; the Site 104 Public Outreach Committee; county representatives, and representatives of commercial and recreational fishing interests; review of information gathered at public scoping meetings; and literature search and review.

5.3.2 Water Use

Commercial use of waters around Site 104 is mainly centered around transportation and commercial fishing. The waters of Site 104 are part of an active fairway corridor between the Bay Bridge and the Swan Point Channel. Commercial vessels, tugs, and barges with drafts of 10.7 m or less (35 ft or less) use this route (35 ft or less) when transiting directly to and from the C&D Canal and ports south of Baltimore. Vessels calling on the Port of Baltimore through the C &-D Canal occasionally use this route if they can-not use the Brewerton Channel Eastern Extension. Vessels with drafts to 12.2 m (40 ft) can be expected to use this route if the C&D Canal and its approach channels are deepened to 12.2 m (40 ft). This navigation network is a critical component of the regional economy in the mid-Atlantic area. Recreational use of the waters of Site 104 include sailing and power boating, wind surfing, personal water craft, and recreational fishing.

During most of the year, Site 104 provides a suitable natural environment for commercial crabbing and fishing. In the summer months, the distribution of aquatic life may be limited due to anoxic conditions within the deeper waters of Site 104. Nonetheless, commercial crabbing and fishing resources contributes significantly to the economic well-being of the region. As a result of the seasonal nature of these species, waters in the northern portion of the site are utilized virtually year round. Commercial fishermen concentrate gillnetting efforts north of the RWLP buoy in areas shallower than 13.7 m (45 ft) (Figure 2-1). Recreational fishermen and charter boat captains fish the shallower edges [< 12.2 m (<40 ft)] east of the site. **[May want to update this line after the meeting with the Recreational Fishers]** Commercial fishing activities within Site 104 and the surrounding areas are discussed further in Ssection 5.3.5.d.

5.3.3 Land Use

There are no land masses within the Site 104 boundaries. The nearest land mass to the east (approximately 1.6 km [1 mile] away) is Kent Island in Queen Anne's County. The nearest land mass to the west is the Anne Arundel County mainland (4.0 km [(2.5 miles]) to the west). Land use in sensitive coastal areas, also known as the Chesapeake Bay Critical Area, is heavily regulated by Queen Anne's County (QAC) oOrdinances (a 1,000-ft buffer is required) to protect water quality and crucial habitat areas (QAC 1996).

The western side of Kent Island north of the Bay Bridge is largely rural, except at the northern extremity (Love Point), which is suburban with non-public facilities. The western shoreline north of the Chesapeake Bay Bridge is lightly populated. Single-family residences are widely dispersed. The Route 50 corridor across Kent Island is heavily commercialized. The Stevensville area also hosts light manufacturing facilities. The eastern shoreline area south (approximately 3.2 km [(2 miles])) of the Bay Bridge is mostly suburban with some public facilities. There is a marina immediately southeast of the bridge. Further south, the shoreline is interspersed with rural areas and suburban areas with non-public facilities, except for a small suburban area with public facilities about 9.7 km (6 miles) south of the bridge (QAC 1993).

The Anne Arundel County shoreline, immediately north and northwest of the Bay Bridge for approximately 4.8 km (3 miles), consists of Sandy Point State Park. Sandy Point State Park is heavily used seasonally as a land and water recreation site. The facility includes a small boat harbor, the entrance to which is immediately north of and adjacent to the Bay Bridge. The shoreline northwest of the State Park consists of suburban residential areas. The shoreline at Sandy Point breaks towards the northwest until the mouth of the Magothy River is reached immediately south of Gibson Island. The southern shoreline at the river mouth is approximately the same latitude as the northernmost boundary of Site 104.

The Anne Arundel County shoreline immediately south of the Chesapeake Bay Bridge is categorized as light industrial. South of this small industrial area; is the entrance to Whitehead Bay, which is dominated by Holly Neck Farm. This farm is privately owned and is zoned for agricultural use. The U.S. Naval Ship Research and Development Center is located on the shoreline between the southwest side of the entrance to Whitehead Bay and the Severn River. The largest urban center in the proximity of Site 104 is Annapolis.

5.3.4 Demographics

The counties surrounding Site 104 are mostly rural in nature with low density population. The closest county to the east of Site 104 is Queen Anne's County. Most of the development in Queen Anne's County is associated with Route 50, the main artery to and from the Eastern Shore. The most recent census data revealed that in 1990, approximately 33,953 individuals resided in Queen Anne's County (U.S. Bureau of Census 1990). Projections of population growth indicate the 1995 population to be 37,350 (U.S. Bureau of Census 1990). This shows a projected absolute growth of 8.6 percent over the 5-year period. The projected population for 2005 is 44,900. This shows an absolute growth of 32.2 percent over the 15-year period. The minority population in Queen Anne's County in 1990 was 3,993 individuals. The number of individuals with income below the poverty level in 1989 totaled 2,235 individuals (U.S. Bureau of Census 1990). Minority individuals with incomes below the poverty level in 1989 wereas approximately 2 percent of the total county population while the percent of white individuals with incomes below the poverty level in 1989 was approximately 4 percent of the total county population. Kent Island is the closest community located in proximity to Site 104 with a 1990 population of 12,829 (Maryland Department of Economic and Employment Development [MDEED] 1996b). Recreational activities associated with tourism as well as sailing and power boating contribute significantly to the local economy in the southern portion of Kent Island. For instance, the Bay Bridge brings more than 20 million visitors through Queen Anne's County each year (MDEED 1996a).

The closest county to the west of Site 104 is Anne Arundel County. According to the U. S. Bureau of Census, approximately 427,239 individuals resided in Anne Arundel County in 1990. Projections of population growth indicate the 1995 population to be 459,700. This ~~shows~~ indicates an absolute growth of 7.5 percent over the 5-year period. Projections of population growth indicate the 2005 population to be 501,000. This indicates an absolute growth of 17.3 percent over the 15-year period. The minority population in Anne Arundel County in 1990 was 61,634 individuals. The number of individuals with income below the poverty level in 1989 totaled 18,391 individuals (U.S. Bureau of Census 1990). Minority individuals with incomes below the poverty level in 1989 ~~was~~ were approximately 2 percent of the total county population while the percent of white individuals with incomes below the poverty level in 1989 was approximately 3 percent of the total county population. The largest urban center relative to Site 104 is Annapolis, with a 1990 population of 33,187. It is important to note that the Sandy Point State Park to the west and Annapolis Harbor and Severn River to the southwest all experience significant seasonal increases in visitor populations during the spring through fall. Recreational activities associated with tourism as well as sailing and power boating contribute significantly to the local economy in these areas.

Kent County is located to the northeast of Site 104, north of Queen Anne's County. In 1990, approximately 17,842 individuals resided in Kent County. Projections of population growth indicate the 1995 population to be 18,300. This ~~shows~~ indicates an absolute growth of 2.5 percent over the 5-year period. Projections of population growth indicate the 2005 population to be 19,800 (U.S. Bureau of Census 1990). This ~~shows~~ indicates an absolute growth of 11.0 percent over the 15-year period. The minority population in Kent County in 1990 was 3,649 individuals. The number of individuals with income below the poverty level in 1989 totaled 1,943 individuals (U.S. Bureau of Census 1990). Minority individuals with incomes below the poverty level in 1989 ~~was~~ were approximately 4 percent of the total county population while the percent of white individuals with incomes below the poverty level in 1989 was approximately 7 percent of the total county population. Recreational activities associated with tourism as well as sailing and power boating contribute significantly to the local economy of Kent County.

It is assumed that low income or minority populations use the Site 104 area to some extent~~,~~. ~~although t~~The exact number of users is unknown but is expected to be small. Published information on the use of the Site 104 water area by specific populations was not found. There is potential that some area commercial and recreational fishermen are members of low income or minority populations.

5.3.5 Employment and Industry

5.3.5.a Queen Anne's County. The median income per household in Queen Anne's County in 1990 was $42,800 (U.S. Bureau of Census). The majority of individuals in Queen Anne's County (31 percent) were reported in the 1990 Census ~~to be~~as employed in technical, sales, or administrative support occupations. Another 29 percent were reported ~~to be~~as employed in service occupations. A further breakdown of the employment statistics reveal that approximately 861 individuals, or 5 percent of the work force, were reported ~~to be~~as employed in trades associated with fisheries, agriculture, or forestry. The exact number of individuals actively engaging in fishing activities is not published for Queen Anne's County.

Kent Island is located on the western edge of Queen Anne's County and is the closest body of land relative to Site 104. The principal employment on Kent Island is service industries for tourism and recreation. Traditionally, Kent Island has been a residential retreat from more populated and developed areas on the western shore of the Chesapeake Bay.

5.3.5.b Anne Arundel County. The median household income for Anne Arundel County in 1990 was $55,342. The majority of individuals in Anne Arundel County (35 percent) were reported in the 1990 Census ~~to be~~as employed in technical, sales, or administrative support occupations. Another 32 percent were reported ~~to be~~ employed in the managerial and professional specialty occupations. A further breakdown of the employment statistics reveal that approximately 2,097 individuals, or 1 percent of the work force, were employed in trades associated with fisheries, agriculture, or forestry. The exact number of individuals actively engaging in fishing activities is unknown for Anne Arundel County.

5.3.5.c Kent County. The median income per household for Kent County in 1990 was $35,231. The majority of individuals in Kent County (46 percent) were reported in the 1990 Census ~~to be~~as employed in managerial, professional, technical, sales, or administrative support occupations. Another 45 percent were reported ~~to be~~as employed in the service, operators, fabricators, precision production, or laborer industries. A further breakdown of the employment statistics reveal that approximately 881 individuals, or 10 percent of the work force, were reported ~~to be~~as employed in trades associated with fisheries, agriculture, or forestry. The exact number of individuals actively engaging in fishing activities is not published for Kent County. Traditionally, Kent County has been a residential retreat from more populated and developed areas on the western shore of the Chesapeake Bay.

5.3.5.d Fishing Activity. Commercial fishing in the Chesapeake Bay primarily involves small-scale operators. In the entire Chesapeake Bay in 1998~~6~~, approximately 833~~78~~ commercial fisherman reported actively fishing for crabs in crab-pots, 552~~656~~ reported actively fishing for finfish with gill nets, and 1,707~~620~~ oyster harvesters reported oyster catches using a variety of techniques (Lewis 1999).

Gill nets and pound nets are the two principal fishing gears deployed in the Site 104 region. Commercial fishermen ~~revealed~~ indicated that gill-netting effort is concentrated to the upper half of Site 104 north of the RWLP buoy. Commercial fishermen also reported that the area below the RWLP buoy is avoided during non-slack tidal periods because of reported snags and other bottom obstructions that foul gill nets. Pound nets are typically set in less than 6.1 m (20 ft) of water along shorelines to intercept fish as they move. Due to the depth of Site 104, no pound nets are set within the boundaries of the site (Miller 1998).

5.3.5.e Finfish Fishery. The economic value of aquatic resources obtained by commercial fishing from within the site and immediate surrounding waters are difficult to estimate because of the way landings are tracked by the Maryland Department of Natural Resources. Landings are grouped and reported yearly as sales from specific sub-regions based upon commercially important harvestable fish. The sub-region containing Site 104, termed the NOAA025 area, is considered to contain waters from the Bay Bridge north to Pooles Island. Table 5-~~30~~29 presents weight and dollar value of selected commercial fisheries landings for the NOAA025 portion of the Chesapeake Bay, by year, from 1980 to 1998~~6~~ (MDNR 1999b~~8~~). The portion of income derived specifically from Site 104 and the immediate surrounding area cannot be extracted from these data.

~~Of finfish, s~~Striped bass were caught in the greatest quantity (240,352~~179,752~~ lbs~~.~~ average yearly catch between 1990 and 1998~~6~~) and they have also been the most monetarily important finfish species
(\$531~~691~~,863~~698~~ in 1998~~6~~). More recent data for striped bass ~~was~~ were unavailable [REVISE?]; however, an increase in both landings and dollar value would be expected because of the easing of restrictions associated with a 5-year moratorium (lifted in 1996) that limited or completely restricted harvest of striped bass in an effort to replenish reproductive stocks. Other important commercial fish species caught within this region of the Chesapeake Bay include white perch, Atlantic menhaden, summer flounder, and bluefish. The total monetary contribution (\$82,492 in 1998) for ~~of each of~~ these finfish species and others listed in Table 5-29~~30~~, however, is significantly less than striped bass. It is important to note that seasonal abundances and market conditions can affect the monetary value of any species on a seasonal or yearly basis.

5.3.5.f Blue Crab Fishery. Blue crabs provide the most significant income-producing resource for most Chesapeake Bay regions. Landings and the monetary value associated with those landings exceed every other harvestable resource within the Chesapeake Bay waters (2,867,936~~4,745,500~~ lbs~~.~~ worth \$3,161~~229~~,995~~107~~ in 1998~~6~~). In addition, total crab catches exceed catches of every other commercially important species combined (Table 5-~~30~~29). In 199~~6~~8, 79~~85~~ percent of the total landings of selected commercial species in the NOAA025 area consisted of blue crabs.

In recent years, increasing pressure has been placed on the blue crab fishery as catches increase with the introduction of more efficient gear and an increasing demand. Stricter regulations on commercial and recreational crabbing were instituted in 1997. For example, commercial crabbers must obey area closures, time restrictions, and undetermined waiting periods for licenses. Recreational crabbers may not harvest on Wednesdays and commercial crabbers may not harvest on either Sunday or Monday. In addition, the 1998~~6~~ season was closed on 30 November ~~30~~, compared to the normal season closing (31 December). Commercial harvesting

Table 5-2930

Weight and Dollar Value of Selected Commercial Fisheries Landings for the NOAA025 Portion of the Chesapeake Bay From 1980 - 1996.

	Species									
	Blue Crab (sum of hard and soft)		Blue Fish		Menhaden		Oyster		River Herring	
Year	Pounds	$ Value	Pounds	$ Value	Pounds	$ Value	Pounds	$ Value	Pounds	$ Value
1980	2,185,807	549,669	116,041	9,503	530,335	28,884	112,820	158,429	10,133	828
1981	8,374,838	2,242,133	140,781	15,443	688,890	40,990	105,870	154,181	2,856	287
1982	5,359,292	1,777,819	99,871	15,003	1,694,327	101,567	110,726	175,393	5,786	1,377
1983	4,316,630	1,502,329	20,673	3,283	459,751	22,988	115,439	227,286	2,807	685
1984	5,663,072	2,056,469	5,010	578	173,752	10,765	24,665	58,301	1,337	168
1985	12,358,778	4,690,066	75,918	12,927	422,346	25,749	28,457	52,858	35,719	4,674
1986	6,215,196	2,694,662	120,122	25,531	358,587	25,733	148,731	454,654	3,622	409
1987	5,207,240	2,556,782	9,128	1,807	248,859	16,364	132,558	475,529	56	6
1988	4,092,420	1,878,396	5,935	818	37,084	2,228	117,750	396,647	2,616	247
1989	4,088,320	2,039,609	11,349	1,968	153,250	11,680	88,120	298,246	135	18
1990	4,284,279	18,234,253	16,554	3,947	132,240	12,014	130,749	482,386	96	16
1991	5,065,860	2,128,023	1,608	414	210,065	20,667	121,442	374,300	2,109	195
1992	3,279,221	1,800,777	10,358	3,834	241,117	23,153	129,831	443,734	2,875	639
1993	6,024,740	3,477,756	138	83	4,000	415	62,266	180,493	800	95
1994	4,945,510	4,206,405	971	274	34,320	5,299	49,988	159,075	770	42
1995	5,185,213	4,783,633	192	120	84,390	9,035	118,264	318,338	150	8
1996	4,745,500	3,229,107	50	36	42,550	4,294	20,882	68,583	-0-	-0-
1997	3,573,187	3,169,550	136	43	6,080	595	101,704	338,047	222	44
1998	2,867,936	3,161,995	471	125	20,252	1,850	91,861	305,686	90	10

Table 5-2930 (Continued)

	Species									
	Soft Clam		Striped Bass (sum of large, med., and small)		Summ Flounder		Weakfish		White Perch	
Year	Pounds	$ Value	Pounds	$ Value	Pounds	$ Value	Pounds	$ Value	Pounds	$ Value
1980	280,440	634,797	1,076,244	897,541	45	21	1,658	502	282,747	101,913
1981	316,392	644,018	780,100	767,715	1,003	548	13,812	6,400	125,146	52,146
1982	392,322	827,987	219,645	361,107	-0-	-0-	7,724	4,360	119,090	65,995
1983	579,952	1,313,912	87,019	163,154	278	155	186	120	49,398	29,575
1984	226,818	578,311	114,218	192,700	106	112	48	22	52,397	24,468
1985	136,734	374,799	-0-	-0-	31,121	42,797	81,506	45,728	35,215	13,441
1986	109,242	311,846	-0-	-0-	370	576	38,385	39,810	51,171	22,887
1987	845,916	1,544,498	-0-	-0-	320	364	1,029	808	18,895	10,675
1988	1,665,324	3,427,094	-0-	-0-	136	254	360	386	53,665	28,162
1989	1,754,862	4,244,568	-0-	-0-	1,374	3,208	9,902	9,142	55,013	34,920
1990	701,085	2,941,801	4,148	8,393	78	137	150	169	58,060	31,011
1991	366,387	1,238,288	15,135	29,921	-0-	-0-	422	361	19,063	12,279
1992	157,437	906,308	130,973	194,117	615	920	337	532	80,126	148,040
1993	395,148	1,814,640	156,558	288,858	-0-	-0-	-0-	-0-	107,169	78,192
1994	211,581	1,427,891	225,374	374,368	56	79	1,298	943	165,302	133,630
1995	188,898	1,024,183	288,438	434,860	631	1,031	9,531	10,61	211,926	169,028
1996	116,820	605,550	437,642	691,699	15	35	12	12	232,049	136,914
1997	106,320	751,481	481,672	694,137	8	16	1,055	440	246,404	98,720
1998	81,820	547,407	423,227	531,863	20	42	600	344	140,740	80,121

Source: MDNR 19998

within Site 104 is concentrated on the eastern edge of the sSite 104 and is limited to the shallower areas less than 12.2 m (<40 ft) because of potential gear conflict with water traffic (Site 104 Open-Water Placement Area Commercial and Recreational Fishermen Meeting Summary July, 28 1997).

5.3.5.g Oyster Fishery. The average yearly catch of oysters harvested in the NOAA025 area from 1980 to 19986 was 95,375209 lbs with an approximate monetary value of $26993,588437 (Table 5-3029). It is not possible to determine from the available data which portion of the total catch came from waters adjacent to Site 104 (there are no oyster bars in Site 104). In years past, oysters were dredged from the deeper waters of the Bay by sailboats, but most beds now are found in the shallows along the shore and in Bay tributaries where sediments are firmer and where the supply of dissolved oxygen is more reliable (Kennedy 1991).

There are six seven oyster bars (Broad Creek, Love Point, Mountain Point, Sandy Point, Dolly's Lump, Hacketts Point, and Brickhouse Barand Broad Creek) that are known to exist in the vicinity of the Site 104 (Figure 5-2224). The boundaries of the oyster bars depicted in this figure are of historic nature and do not necessarily reflect the areas currently considered viable. The Love Point oyster bar is located approximately 1.1 km (0.7 miles) northeast of the northern edge of Site 104. Mountain and Sandy Point bars are both located approximately 5.1 km (3.2 miles) northwest and west, respectively, of Site 104. Hacketts Point Bar and Dolly's Lump areis located south-southeast of Sandy Point State Park and areis approximately 2.4 km (1.5 miles) from the southwest boundary of Site 104. Broad Creek is the closest oyster bar to Site 104 (just southeast of the southern end of Site 104). However, a portion of the Broad Creek oyster bar is prohibited to shellfish harvesting due to the presence of the Kent Island Waste Water Treatment Plant outfall (Figure 5-242218). According to MDNR (1999), Sandy Point, Dolly's Lump, and Hacketts Point are the most heavily commercially worked oyster bars in the vicinity of Site 104.

The Maryland Department of Transportation and MDNR have established a program to provide supplemental funding for MDNR's Oyster Recovery Program to account for transportation-related introduction and re-circulation of potentially harmful nutrients and/or pollutants in the Bay. This topic is further discussed in Section 6.3.2.b.

5.3.5.h Soft Clam Fishery. The distribution of soft shell clams in the Chesapeake Bay is restricted by several variables, particularly salinity, sediment type, anoxia, and predation. Populations persist mainly in shallow areas of the Bay, particularly in areas of less than 5.2 m (17 ft) (Baker and Mann 1991). Optimal areas for soft shell clams are found on the Eastern Shore of the Pocomoke Sound to Eastern Bay and on the western side from the Rappahanock River to the Severn River.

Over the last 197 years, soft clam landings in the NOAA025 area have fluctuated widely. A 197 year (1980-19986) mean of 45496,395785 lb. with an approximate average annual monetary value of $1,324403,178558 for the region from the Bay Bridge to Pooles Island was determined by MDNR (Table 5-3019). Soft clam populations fluctuate on a yearly basis, depending on reproductive success. It is difficult to determine what percentage of the soft clam harvest came from the vicinity of near Site 104 specifically. MDNR (1999) reported that most of the soft clamming commercial activity occurs in shallower depths north of the Broad Creek Oyster Bar. ~~Soft clamming activity was documented to occur near the boundaries of Site 104.~~ However, clamming in parts of Site 104 is prohibited because it is near a closure zone around the Kent Island Waste Water Treatment Plant~~WWTP~~ outfall. No soft clams are harvested within the Site 104 boundaries because most of the site is too deep to support the resource.

5.4 AESTHETICS AND RECREATIONAL RESOURCES

The upper Chesapeake Bay, which encompasses Site 104, is a recreational and aesthetic resource enjoyed by many different individuals in a variety of pursuits. The upper Bay region, in its entirety, offers a number of seasonal recreational activities including water sports such as boating, sail boating, and fishing. An aesthetically pleasing environment is an integral part of these seasonal recreational activities.

5.4.1 Aesthetics

Over 20 million people, whether commuting or vacationing, enjoy a panoramic view of the upper-Bay while traveling across the Chesapeake Bay Bridge each year (Maryland Department of Business & Economic Development 1997). Most of this traffic occurs in times of warmer weather rather than during the winter months when placement would occur. Sandy Point State Park, which is 4.0 km (2.5 miles) west of the proposed placement site, consists of several public beaches and many natural protected areas that provide scenic vistas to both the shoreline observer and the boater. To the east of the proposed placement site are the rural shorelines of Kent Island.

5.4.1.a Odors. Because Site 104 is an open water placement site approximately 1.6 km (1 mile) from the nearest shoreline, it is generally not subject to anthropogenic (manmade) sources of odor. Brief odors could be experienced which are associated with automobile traffic on the Bay Bridge and marine traffic. Distances from industrial sources of odor are generally great enough to prevent odors from reaching the area. Baseline odors at Site 104 have not been measured;, however, there are no permanent sources of odor at the site, and only natural odors common to open water areas of the Bay should be detectable.

5.4.2 Recreation

A variety of recreational activities occur around Site 104 depending on the season and on weather conditions. The most popular recreational activities in the area are fishing activity and boating. -Marina and boat launching facilities are available on Kent Island. Sandy Point State Park on the western shore provides many recreational opportunities such as beaches, boat docks, boat launching facilities, and picnic pavilions.

5.4.2.a Fishing. Fishing is likely the most common recreational activity that occurs in the waters surrounding Site 104. Fishing for several species, including striped bass and white perch, is especially popular during spring migration periods. There is a "trophy" striped bass season in the spring (23 April 234-31 May.June 3114 in 19998) with a minimum size of 28 in. and a subsequent summer/fall season with a smaller size limit whichlimit, which extends from 14 June 14mid-August to 30 November 30late November (MDNR 1999c). The white perch fishing season is typically open year round with no minimum size restrictions.

Representatives from the Maryland Waterman's Association (MWA), Maryland Charter Boat Association (MCBA), Upper Bay Charter Boat Captains Association (UBCBCA), Maryland

Saltwater Sportfishermen's Association (MSSA), and Kent, Anne Arundel, and Queen Anne's Counties were contacted to discuss the current use of Site 104 by recreational and commercial fishermen. [CENAB to Update after latest meeting with recreational fishers]. Two meetings were also held in February and July 1997. ~~In July~~At the July meeting, the recreational fishermen stated that they fish on the northern edge of the site in shallow areas (~~Site 104 Open Water Placement Area Commercial and Recreational Fishermen Meeting Summary July, 28 1997~~MES 1997d). Personal communication with Russell Green, President of the MCBA, on 18 November ~~18~~, 1997 verified that recreational fishermen and charter boat captains fish the shallower edges (< 12.2 m ~~(~~[<40 ft])) east of ~~the~~ Site 104. A Kent County representative and the Charter Boat Captains stated that the RW "LP" buoy, which is located 0.4 km (0.4 mile) west of the northern portion of the proposed site, is the southern cut-off point for recreational fishing activities (~~Site 104 Open Water Placement Area Commercial and Recreational Fishermen Meeting Summary July, 28 1997~~MES 1997d).

5.4.2.b Boating. Boating is central to many Bay activities, including recreational pursuits. In the Chesapeake Bay, power boaters, water-skiers, and sailboaters all utilize portions of the Bay waters. Commonly, boats passing through Site 104 are in transit to and from either Baltimore Harbor, Sandy Point State Park, Chester River, other northern areas along the eastern shore, marinas on the western shore of Kent Island, or points south of the Bay Bridge. There are four major access points for boats entering or exiting the Bay just south of the Bay Bridge on the eastern edge of Kent Island. Traveler Marine, Chesapeake Bay Bridge, and Pier 1 Marinas are located just south of the Bay Bridge and north of Broad Creek in Stevensville. The Traveler Marine, Chesapeake Bay Bridge, and Pier 1 Marinas are full service yards offering a wide array of services and facilities for recreational boaters. The Matapeake Terminal and State Park, located south of the Bay Bridge, is not a full service yard, but does offer a launching ramp for recreational boaters. Adjacent to the west side of Site 104 is the Craighill Entrance, which is the principal access to the Port of Baltimore for shipping.

Section 6

Potential Environmental Impacts of the Proposed Action

6.1 IMPACTS OF THE PROPOSED ACTION

The NEPA process requires the evaluation of potential impacts of the proposed project to area resources at Site 104. The following section analyzes the impacts of the placement of dredged material on various resources identified in Section 5. The specific issues associated with Site 104, as well as Bay-wide concerns, and the analysis of these parameters relative to the use of Site 104 for dredged material placement are discussed. The impacts of the alternatives presented in Section 2 are discussed in Section 7.

Short-term impacts are defined as impacts that occur during dredged material placement activities and subside and return to normal shortly after placement ends. Long-term impacts are defined as impacts that occur as a direct result of placement activities, and remain and do not diminish after placement ceases. Both short-term and long-term impacts can be minimized by time-of-year restrictions on site use and by modification of placement strategies. A summary of impacts for the proposed action is provided in Table 6-1. Potential negative impacts that are expected to be minimized by the implementation of time-of-year restrictions and/or by the modification of placement strategies are also designated within Table 6-1.

The dredging of the channels has been addressed in other NEPA documentation. This documentation will be updated as appropriate prior to the dredging of individual channels. The channels are dredged based upon shoaling surveys performed by ~~the~~ USACE. In general, the Federal channels are dredged every year. The dredging frequency of the various channel reaches varies from every other year to every few years depending upon shoaling rates. Prior to dredging, a public notice is distributed and a water quality certification is applied for from MDE.

6.1.1 Setting

Site 104 is a previously used 1,800-acre open-water placement site. The proposed dredged material placement activities would occur inside the existing site boundaries as defined in Section 5.1.1. Therefore, use of the site for dredged material placement will not alter the physical boundaries or the existing setting of the site. Other than temporary visual impacts during placement activities, there will be no visible change within the project area other than the anticipated changes in underwater relief.

6.1.2 Physiography, Geology, and Hydrology

6.1.2.a Physiography. The use of Site 104 as an open-water dredged material placement area is not anticipated to significantly change the current physiography of the area. The site was previously used for dredged material placement from 1924 through 1975; consequently, the area is relatively flat with slopes on the order of 100 horizontal to 1 vertical (100H:1V) or flatter, and

Table 6-1.
Summary of Impacts for the Proposed Action

Resource	No Impact	Positive Impact		Negative Impact		
		Short-term	Long-term	Short-term	Long-term	Minimize[a]
Environmental Resources						
Setting	✔					
Physiography, Geology, Hydrology	✔					
Groundwater	✔					
Hydrodynamics [b]				✔		✔
Water Quality			✔	✔		✔
Sediment Quality			✔			
Aquatic Resources						
Plankton Communities				✔		✔
Finfish Communities			✔	✔		✔
Shellfish Communities				✔		✔
Benthic Communities			✔	✔		✔
Submerged Aquatic Vegetation (SAV)	✔					
Terrestrial / Avian Resources	✔					
Rare, Threatened & Endangered Species	✔ [c]					
Air Quality				✔		✔
Noise				✔		✔
Hazardous, Toxic, & Radioactive Substances	✔					
Cultural and Archaeological Resources						
Cultural Resources	✔					
Archaeological Resources	✔					
Socioeconomic Resources						
Aquatic Resources			✔	✔		✔
Commercial Fisheries			✔	✔		✔
Regional Economics			✔			
Aesthetic Resources						
Aesthetics				✔		✔
Odors				✔		✔
Recreational Resources						
Fishing			✔	✔		✔
Boating				✔		✔

(a) Material placement and site management practices were chosen to minimize impacts to resources of concern.
(b) See Table 6-3 for detailed summary of hydrodynamics impacts
(c) Assumed. Shortnose sturgeon study not finalized. Current results show no impact. Pending biological determination from NMFS.

contains soft, fine-grained material (MDNR 1976; CENAB 1996—ADD TO REF. LIST; Halka 1997—a or b?; ~~and~~ E2Si 1997). Future use of the site for dredged material placement will maintain these flat slopes and soft sediment composition. Placement of dredged material could potentially cover up and eliminate fishing net snags in the bottom areas where material is placed.

6.1.2.b Geology. The use of Site 104 as an open-water dredged material placement area will not change the underlying geology of the area. The presence of the lineation (or linear ground feature observable on a high altitude, Landsat photo image) identified in the vicinity of Site 104 and described in Section 5.1.2.b of this document is insignificant to the proposed action. Maryland is ranked in the lowest category of potential for ground acceleration (FEMA 1994—ADD TO REF. LIST), and is ranked in the second lowest risk category based on the USGS National Seismic Hazard Mapping project. The possibility of a major earthquake occurring in Maryland is relatively low, and even a large scale event would likely have little effect on the soft sediments in the bottom of the Chesapeake Bay, including those deposited within the Site 104 area (Halka 1998). The soft sediments, both naturally deposited in the Bay and placed dredged material, would effectively absorb and dissipate any relatively minor motion of the underlying earth such that no impact would be expected to occur.

6.1.2.c Hydrology. Placement of sediment in Site 104 will likely have little effect on the overall movement of water from the Bay into the lower portions of the Aquia Aquifer in the Kent Island area, or the corresponding outward movement of the overlying fresh water. Using calculated velocities for current inland movement (21 feet per year), the advective travel time of water from Site 104 would require over 400 years to reach the closest wells on Kent Island. Since any alleged solute from the dredged material would be subject to retardation, this estimated travel time would actually be larger, based on the respective retardation of the alleged contaminant. In addition, the hydraulic conductivity of the dredge material is considerably lower than both the paleochannel and Aquia Aquifer (Section 5.1.2c). This would have the effect of thickening the clay seal at the bottom of the current channel, thus decreasing the velocity at which water will enter the aquifer. In other words, disposing of dredge material at Site 104 may actually decrease the current rate of salt-water intrusion (Halka 1997). ~~Placement of dredged material at Site 104 will result in a greater thickness of fine-grained sediments between the Bay waters and the sediments of the Aquia. The movement of Bay water from the Bay to the aquifer will tend to be inhibited by placement of additional sediments (Halka 1997).~~ The fine-grained material is not expected to move beyond the placement area into the aquifer.

6.1.3 Hydrodynamics [NEED UPDATED INFO. FROM SAIC/WES]

6.1.3.a Introduction. Computer models were run by Moffatt & Nichol Engineers (M&N) and the U.S. Army Corps of Engineers Waterways Experiment Station (WES) to simulate potential hydrodynamic changes due to placement of dredged material at Site 104. Models simulated the motion of the water (hydrodynamics) flowing through Site 104 and the resulting potential for erosion and movement of placed dredged material using both controlled hydraulic bottom pipeline placement and bottom-release scow placement methods. The erosion models also provided information on potential annual changes in water depths. Laboratory testing was conducted by WES to characterize the erodability of the dredged materials proposed for placement at Site 104. The information gained from the laboratory testing was ultimately used in

Table 6-2
Five Year Placement Plan for Site 104

Year	Volume (m^3) / (cy)	Modeled Placement Days
1	1,913,265 / 2,500,000	140
2	3,443,878 / 4,500,000	140
3	2,295,918 / 3,000,000	168
4	4,591,837 / 6,000,000	168
5	1,530,612 / 2,000,000	140
Total	**13,775,510 / 18,000,000**	

Table 6-3
Summary of impacts to hydrodynamic processes in the vicinity of Site 104

Hydrodynamics	No Impact	No Significant Impact	Impact
Average Depth			✔
Water Level	✔		
Astronomical Tides	✔		
Extreme Water Levels	✔		
Wind Conditions	✔		
Tidal Currents		✔	
Sedimentation Rates		✔	
Sediment Erodability			✔
Material Spreading			✔
Potential Sediment Transport			✔
Wave Conditions		✔	

the modeling of the potential erosion and movement of placed dredged material. The annual placement plans were developed using the MDFATE model in accordance with the following criteria: _minimize loss of material during placement; minimize loss of material following placement due to erosion; minimize mounding of the material at each placement location (which subsequently serves to minimize erosion); prevent material from mounding above elevation –13.7 meters (-45 feet); place material in the deeper portions of the site to achieve as uniform a depth as possible throughout the site; and maximize capacity. The quantities of material to be placed originated from the State of Maryland's Strategic Plan for Dredged Material Management (Table 6-2). In the model, 2,755 m^3 (3,600 cy) of material (holding capacity of one barge) was placed during each placement event. The number of placement events in any one day or placement season depended upon the total amount of dredged material to be placed in that year. A placement window from 1 November into March was utilized.

6.1.3.b Summary. A summary of potential impacts to hydrodynamic processes is provided in Table 6-3. Water levels, astronomical tides, extreme water levels, and wind conditions will not be impacted by the proposed action. The changes in the depth-averaged currents due to a decrease in the water depths at Site 104 from dredged material placement were determined to be small (less than 2%). _Changes in the resulting bottom forces that could move the bottom sediments varied by ±15% depending upon where and in what order material was placed. Based on the assumptions and the material placement plan used for the erosion model studies, the modeled results indicated a worst-case potential for 16.9% of the material placed by bottom-release scow to leave the site boundary and a potential for 6.2% of the material placed by controlled hydraulic pipeline bottom placement to leave the site boundary. Available models of the Chesapeake Bay are not able to predict sediment transport. It is, therefore, unknown exactly where material potentially leaving the site boundaries will end up, although smaller particles will tend to travel farther than larger ones. The hydraulic placement modeling simulated the hydraulic unloading of individual barges by pump-out through a pipeline and diffuser, to locations within about 2 meters (6.0 feet) of the Site 104 bottom. Most of the predicted erosion is anticipated to take place during the material placement period (WES 1998). These predicted sediment losses are thought to be higher than what actually would be expected to occur, since the model doesn't take into account any material that leaves the site and is then carried back into the site by tidal action. The losses could vary for either of the placement methodologies under actual conditions (WES 1998).

Sedimentation rates are controlled by the physical characteristics of the sediments and surrounding water and the hydrodynamics of the area. Since the hydrodynamics models revealed that the variations in tidal currents through the site area would not change significantly (WES 1998), it is anticipated that natural sedimentation rates within Site 104 will not be significantly impacted by the proposed action. _Physical analysis of sediments proposed for placement at Site 104, indicated that the particle sizes of material to be placed at the site are similar to the sediments that currently exist at the site. _The majority of sediment proposed for placement consists of silt and clay particles. _Analysis of sediments from the Craighill Angle, the Cutoff Angle, the Brewerton Channel Eastern Extension, the Tolchester Channel, and the Swan Point Channel indicated that the mean sediment particle size was 10.88×10^{-6} meters (3.57×10^{-5} feet). Existing sediments in the Site 104 area consist primarily of very soft to soft gray silty clay with localized pockets of silty sand and red-brown silty clay (E2Si 1997~~,~~; MGS 1997—ADD TO REF. LIST~~,~~; EA 1998).

The water quality model developed by WES and described ~~below~~ in Annex F was run using a tracer concentration that indicated the long-term movement of water over the Site 104 bottom to be to the north, indicating that sediments remaining in suspension over multiple tidal cycles would ultimately move in a northerly direction. However, it should be noted that the suspended sediments that will remain in the water column over tidal cycles will be low.

This northward movement is not expected to interfere with the turbidity maximum zone in the upper Bay or with planktonic transport associated with the movement of the turbidity maximum zone. Impacts to recreational and commercial fishing, due to the northerly movement of the suspended sediment, will be minimal due to the time-of-year that placement will occur and the small amount that will likely be transported. In addition, northerly movement is not expected to impact clam beds adjacent to the site because the movement will be restricted to the deeper areas that are located west of the clam beds.

6.1.3.c Model Descriptions. Preliminary investigations into the hydrodynamics of Site 104 and the development of dredged material placement plans to minimize the potential for erosion were performed by M&N using the following models: FASTTABS, STFATE, SURGE, MDFATE, LTFATE. More detailed investigations of the Site 104 hydrodynamics, potential sediment erosion and transport, and placement plan development were performed by WES using the following models: CH3D-WES, STFATE, SURGE, MDFATE, LTFATE, CEQUAL-ICM. Each of these models is state-of-the-art, is utilized both nationwide and internationally, and is the best tool available for making respective predictions for areas within the Chesapeake Bay. A joint effort by M&N and WES was made to compute the initial footprint generated by hydraulically placed material based on work by Thevenot *et al.* 1992. Reports on both modeling studies are located in Appendix F. Validation and calibration of the models and a discussion of the assumptions for each model are also included in these reports. Brief descriptions of each model utilized are provided in ~~the following sections~~Annex F.

~~FASTTABS is the personal computer version of the main-frame based TABS-2 model (Thomas and McAnally 1985) developed by the USACE. It was used to simulate existing depth-averaged tidal current velocities in and around Site 104. Predicted depth-averaged current velocities were used as inputs to the MD FATE model that was used for development of a dredged material placement plan to be utilized in the WES modeling studies. The FASTTABS model encompasses an area of the Chesapeake Bay from the Susquehanna River and C&D Canal to near the southern tip of Calvert County in the south and was refined in the area of Site 104 to provide greater detail. The model requires that the estuarial system be represented by a network of nodal points (i.e. points defined by coordinates in the horizontal plane and water depth) and elements (i.e. areas made up by connecting adjacent nodal points). The nodes were connected to form quadrilateral and triangular two-dimensional elements. The resulting nodal/element network is commonly called a finite element mesh and provides a computerized representation of the estuarial geometry and bathymetry. The site bathymetry modeled was provided by CENAB from a survey conducted in September 1997 (Appendix F.3, M&N 1998).~~

The CH3D-WES (Curvilinear Hydrodynamics in Three Dimensions) model was developed jointly through funding by the USACE, EPA, and the State of Maryland, with oversight provided by the Chesapeake Bay Program. This model simulates the hydrodynamics, salinity, and temperature of the entire Chesapeake Bay system in three dimensions (WES 1998). The principal model extends from the mouth of the Chesapeake Bay in the south to the Susquehanna River and C&D Canal in the north. A version of this model was developed for simulations within the upper Bay to provide more detailed predictions within the upper Bay, including Site 104, with relatively short model run times. The boundary conditions of the upper Bay model were initially driven by the full-Bay model, but were then changed to utilize data. Both models contain layers of cells that are five feet thick, with the exception of the top layer, which varies with the tides.

The modeling study conducted for the proposed action used data collected during the year 1993 for specifying conditions at the model boundaries. 1993 was a high fresh water flow year into the Bay and it was deemed that modeling with these flows would provide a worst case for the project area hydrodynamics resulting in a higher estimate of potential sediment losses, since higher flow rates generate higher forces that are able to dislodge more sediments from the estuary bottom than the forces produced by average flow conditions. During the period of time being simulated, the CH3D-WES model generated depth-averaged current velocities and bottom shear stresses. The bottom shear stresses result in forces along the bottom of the study area resulting from the varying movement of water over the sediments and control whether or not the sediments will move off of the bottom. These depth-averaged current velocities and the bottom shear stresses computed by CH3D-WES were applied in the MDFATE modeling. The CH3D model was rerun at the end of each simulated placement year to produce the new depth-averaged current velocities and bottom shear stresses based on the changed bathymetry produced by MDFATE from dredged material placement. Therefore, the results account for any changes in the area currents caused by decreased depths from dredged material placement in the previous model year (Appendix F.2, WES 1998).

The earliest version of the STFATE (Short Term FATE) model was developed by the U.S. Environmental Protection Agency (Koh and Chang, 1973) to predict the behavior of dredged material placement in open water. This model was later modified and refined by WES to predict the behavior of discrete discharges of dredged material from hoppers or barges. The model computes the fate of the placed material during its descent through the water column, its spread over the bottom, and finally the transport and diffusion of material remaining in suspension.

The STFATE model grid for Site 104 covered most of the site with the exception of the shallow water areas to the north that are planned to receive very little dredged material. The model utilizes input data describing characteristics of the planned placement vessel (i.e. bottom-release scow or hopper dredge), dredged material being placed, and the placement site (Site 104). STFATE modeling for Site 104 computed the fate of dredged material placed with a bottom-release scow as the material falls through the water column and then impacts with the bottom. It also computed the movement of the suspended sediments stripped from the main mass during material descent until this stripped material reaches the site boundary; therefore, predicting the quantity of material potentially leaving the site during this phase of placement.

The model output provided the following information: 1) the amount of placed dredged material that is stripped; 2) the potential horizontal movement of the material until it reaches the edge of the site boundary while in suspension; 3) the footprint on the Bay floor resulting from the material placed within the site; and 4) the dynamics when the material encounters the site bottom. This output was used in determining material placement set-backs within the site boundaries in order to minimize the potential for material movement outside of the site. A limitation in the application of STFATE and in the model used to evaluate the spreading of hydraulically-placed material is that both models assume that the bottom being impacted by the dredged material is essentially flat. To compensate for this limitation, the extent of material spreading on bottom slopes was evaluated using the SURGE model (Appendix F.3 & F.2, M&N 1998 and WES 1998).

SURGE modeling provided a basic analysis of the extent of material mass movement from the moment it impacts the site bottom until it comes to rest. The model was run for various slopes expected to be found at Site 104. SURGE uses output from the STFATE model including the velocity and diameter of the material cloud just before impact and a description of the bottom slopes expected to be encountered during placement. The energy stored (potential energy) in the falling cloud is converted to active energy (kinetic energy) by the SURGE model to establish the extent of potential material mass movement along the bottom slope (Appendix F.3 & F.2, M&N 1998 and WES 1998). These results can also be used for determining set-backs from the site boundaries for material placement that will minimize the amount of placed material leaving Site 104.

The MDFATE (Multiple Dump FATE) and LTFATE (Long-Term FATE) models were used to evaluate the extent of long-term movement of dredged material that has been placed on the bottom when subjected to the forces produced by the CH3D model described earlier. A version of STFATE is a component of MDFATE which models the descent and spreading of each placement load. The MDFATE/LTFATE evaluation considers potential erosion of material after it has settled to the bottom and remained in place for a relatively long period of time which is specific to the simulation being performed and can range from hours to years after the initial placement of material. For the Site 104 study, a period of one calendar year from 1 November to 31 October was used for each material placement year evaluated, since at the time the modeling was being performed, it was thought that the placement window would begin with 1 November. Multiple placement plans were assessed to devise an optimal placement location and timing sequence to minimize material losses during the simulated placement of dredged materials at Site 104 over a five-year period. This optimal placement plan was then input to the model. Physical characteristics of the dredged material proposed for placement at Site 104 were determined through laboratory analyses and were also used as input in the model. During the model runs, only the material that was being placed for the year was evaluated. Thus, the model scenario was set up so that existing sediment as well as the previous year's material could not erode since material that remains at the site longer than one year would be minimally susceptible to erosion compared to the year being evaluated. The object of the modeling was to determine the lost quantities of the material placed during the modeled year. This was done by assessing the model output of the mass remaining on the site bottom following the model run and comparing it with the mass of dredged material placed at the beginning of that modeled year (Appendices F.4 & F.3, M&N 1998 and WES 1998).

~~CEQUAL-ICM (Corps of Engineers Quality - Integrated Compartment Model) is a three dimensional model of the entire Bay developed (Cerco and Cole 1994) to be used in conjunction with the CH3D-WES hydrodynamics model to evaluate water quality and compute the fate of water quality constituents. CH3D-WES provides 3-D velocities and diffusion coefficients to CEQUAL-ICM that contains a database of sediment characteristics measured throughout the Bay. Since no model has been developed to track sediment transport throughout the Chesapeake Bay, CEQUAL-ICM was used to track a tracer concentration released in the bottom model cell which covers Site 104 and to provide an indication of where in the Bay the fraction of suspended sediment leaving Site 104 that remains in the water column over multiple tide cycles may end up. It must be noted, however, that this model does not simulate the true physical behavior of sediments and cannot therefore provide information on the final destination of the sediments that might leave Site 104. These computations primarily provided insight into the effect of bottom residual currents near Site 104 (Appendix F.2, WES 1998).~~

~~The formation of a footprint of material resulting from hydraulic placement of dredged material at Site 104 was computed based upon the USACE & USEPA (1992) approach. For the simulations run for the Site 104 study, it was assumed that the estuary bottom was horizontal, the viscosity (or thickness of the slurried material) was constant, the overlying flow exerted negligible shear stress on the underflow, and the spreading of the placed material was radially-outward around the discharge end of the pipe. The assumptions chosen were those that fit the conditions most likely to be encountered during this type of placement at Site 104. The model assumptions simulated the hydraulic unloading of an individual barge holding 2,755 m^3 (3,600 cy) of dredged material that was pumped out through a pipeline and diffuser and placed within 2 meters (6.6 feet) of the site bottom. These assumptions were used because they minimized water column losses (Appendix F.3 and F.2, M&N 1998 and WES 1998). Hydraulic placement, with the discharge pipe positioned just under the water surface, would maximize material exposure to the currents in the -14 to -24 meter (-45 to -78 feet) water column, and would result in a larger bottom footprint, with more erosion than mechanical placement. The characteristics of the dredged material being placed were based on laboratory analyses of the channel sediments proposed for placement. The output of the computation is a footprint of placed material providing its predicted radius and thickness. The resulting material footprint data were input into a modified version of the MDFATE model by WES to determine the potential for erosion. The results of the models are discussed in the following subsections.~~

6.1.3.d Average Depths. Average depths at Site 104 will be directly impacted by the proposed action since placement of dredged materials would cause the depths to become shallower. Existing water depths at Site 104 range from –12.8 to –23.8 meters (-42.0 to -78.0 feet). Proposed placement of dredged material at Site 104 would reduce the water depths from a maximum of –23.8 meters (-78.0 feet) MLLW to a current design depth of –13.7 meters (-45.0 feet). Areas where water depths are currently at or shallower than –13.7 meters (-45.0 ft) are not targeted for material placement. A minimum depth of -12.2 meters (-40.0 feet) MLLW should be maintained throughout the Site 104 area to promote navigational access to the Swan Point Channel. Average depths are discussed further in Annex F.

The most recent bathymetric surveys performed by CENAB in 1997 indicate that the bottom depths at the proposed placement Site 104 range between -12.8 meters (-42 feet) MLLW and -23.8 meters (-78 feet) MLLW. Although dredged material was placed at the site for over 50 years, the material was not consistently placed to a particular depth at all locations to achieve a consistent bottom contour. The proposed action would raise the deeper areas within the site to -13.7 meters (-45 feet) MLLW and will not affect the areas that are shallower than -13.7 meters (-45 feet) MLLW. Bathymetric studies would be required before, during, and after placement to ensure that the placement is limited to approved depths. The proposed action at Site 104 is not expected to significantly affect the surrounding bathymetry outside of the site.

The modeling of hydraulic placement (hydraulic unloading of individual barges by pump-out through a pipeline and diffuser to locations within 2 meters (6.6 feet) of the site bottom) of 3,600 cy of dredged material from one barge resulted in a footprint with a thickness of 7.8 cm (3.1 in) and a radius of 129 meters (423 feet). This footprint was used in the MDFATE modeling for each hydraulic placement event and resulted in changes in bathymetry similar to the stacking of disks or pancakes. Although this does not accurately represent what is expected to occur under actual conditions, it was the closest representation that could be modeled. The modeled footprint of material placed by bottom-release scow varies with each placement and depends on the depth of the water column through which the material is placed and the ambient current at the time of placement. In both placement scenarios, the cumulative height of mounded material above the surrounding bathymetry was attempted to be kept below 3.1 to 4.6 m (10 to 15 ft) and the exposed surface area of newly placed material minimized. This was done in an attempt to minimize material exposure to erosive forces and thus minimize material erosion.

Changes to water depths within the site would vary from year to year. The water depth changes will depend upon the quantities and locations of material placed in any one year, and the equipment and methods used for placement (i.e. bottom hydraulic placement vs. bottom-release scow or hopper dredge placement). The proposed action would raise the deeper areas within the site to -13.7 meters (-45 feet) MLLW and will not affect the areas that are shallower than -13.7 meters (-45 feet) MLLW. Figures 6-1 through 6-5 and Figures 6-6 through 6-10 show predicted cumulative changes to the bathymetry following each year of placement resulting from the MDFATE modeling for both bottom-release scow and hydraulic bottom placement, respectively. At the end of the fifth year, slopes range from basically flat throughout the majority of the site with steep slopes between 20:1 and 35:1 at the southern portion of the western boundary and at the southern boundary where material accumulation above the existing depths is greatest. The steeper slopes would be formed in an attempt to maximize the capacity of the site. The same placement plan was used for each of the modeled placement scenarios discussed above and allowed for a 152.4 meters (500 feet) buffer along the site perimeter. The placement plan for the modeling was developed to place an estimated 13.8 million m^3 (18 mcy) of dredged material at Site 104. The bathymetry at the end of the fifth year of placement is shown in Figures 6-5 and 6-10. However, these average water depths will increase over time due to consolidation of the placed material. This consolidation will occur due to the overlying weight of the newly placed dredged material. It is anticipated that areas where 9.1 meters (30.0 feet) of dredged material are placed will consolidate by up to 1.1 meters (3.5 feet). In areas with less placed material, less consolidation should be seen. Fifty percent of the consolidation has been calculated to occur

~~within the first eight years following placement. The remaining consolidation should occur more gradually over the next three to four decades (E2Si 1998).~~

6.1.3.e Water Levels. Placement of dredged material at Site 104 would not affect extreme high water levels resulting from storm tides that are predominantly driven by wind forces and atmospheric pressure forces. Long-term sea level rise will cause higher average water levels. However, long-term sea level rise is a small percentage (less than one percent) of the existing normal water level variations as discussed in Section 5.1.3.c, and it is not anticipated to be affected by the proposed action.

6.1.3.f Astronomical Tides. Astronomical tides in the Chesapeake Bay and the Site 104 area would also not be impacted by the proposed action. Astronomical tides result from gravitational forces of the moon and the sun on the earth and from the earth's rotation and are influenced, in part, by the three-dimensional shape of the estuary. Decreasing the water depth at Site 104 would not affect the magnitude of tidal height at Site 104.

6.1.3.g Extreme Water Levels (Storm Surge and Wave Setup). Extreme water levels would not be impacted by the proposed action as they are dominated by storm effects (i.e., storm surge and wave setup) in combination with astronomical tide. Storm surge is a temporary rise in water level from wind stress generated either by large-scale extra-tropical storms known as northeasters, or by hurricanes. The rise in water level results from wind action, the low pressure of the storm disturbance, and the Coriolis force. Wave setup is a term used to describe the rise in water level due to wave breaking. Specifically, change in momentum that attends the breaking of waves propagating toward shore results in a surf zone force that raises water levels at the shoreline. Decreasing the water depth at Site 104 has no effect on these forces, and the area of Site 104 where the estuary bottom will be raised is a small percentage of the entire upper Bay. The storm surge at the site itself will not be higher due to the decrease in water depth.

Storm surge would indirectly affect the changed conditions at Site 104 as a factor in the development of extreme wave conditions: higher storm surge would allow for higher waves, longer wave periods and longer wavelengths. For a given water depth, the longer the wavelength, the greater the erosional effect of the wave energy on the bottom. Based on the LTFATE modeling conducted, a 25-year storm event would not effect the bottom below –13.7 meters (-45.0 feet) which is the current design elevation to which dredged material is proposed to be placed at Site 104. Storms greater than 25-year events would increasingly affect the bottom. For storms greater than a 25-year event, significant erosion and turbidity will occur in shallow waters east and north of the site, before Site 104 is affected. The 100-year storm event modeled using LTFATE predicts about 0.3 meters (1.0 feet) erosion for a bottom at elevation –13.7 meters (-45.0 feet) (Moffatt & Nichol 1998—ADD TO REF. LIST). Similar erosion rates for these storm events would be expected for the same type of sediments found at depths of -13.7 meters (-45.0 feet) in the areas of the Bay in the vicinity of Site 104. Due to placement activities, the Site 104 area would be more susceptible to erosion from storm events occurring less frequently than the 25-year storm.

6.1.3.h Wind Conditions. Wind conditions on the earth are ultimately caused by energy from the sun and rotation of the planet. Subsurface placement of dredged material at Site 104 would have no effect on wind conditions. Wind would have an effect only on the surface of the water where waves would be generated. Section 6.1.3.k (Wave Conditions) discusses the potential impacts on wave conditions caused by wind, whereas Section 6.1.3.g (Extreme Water Levels) discussed the effects of extreme wind/wave conditions.

6.1.3.i Tidal Currents. Placement of dredged material at Site 104 and subsequent decrease in water depth would theoretically cause a slight increase in tidal current velocity directly proportional to the decrease in water depth. Hydrodynamic model results indicated a slight increase for some depth-averaged velocity points as material was placed at the site~~,~~; however, the magnitude of this change from year to year was negligible~~ (see Figures 6-11 through 6-15)~~. Changes measured in the model are practically imperceptible (from zero to a maximum of two percent increase in velocity from year to year) for the three observation points within the Site 104 project area (i.e., different elevations in the water column; one near the southern end of the site, one near the center of the site, and one further to the north of the site) (Appendix F.3). Tidal currents are discussed further in Annex F.

~~Note that although the boundary forcings from the 1993 data remain the same for each simulated year, the CH3D-WES model was rerun after each year of proposed placement using the changed bathymetry from the previous placement year (See Figures 6-1 to 6-10). The reruns resulted in changes to bottom shear stresses that were input to the subsequent years of MDFATE modeling. Therefore, any minor changes in currents that were predicted to occur due to the decreased depths associated with dredged material placement, were taken into consideration during the erosion modeling.~~

~~Residual currents in the upper Bay would not be appreciably impacted with placement of material at the site. Existing residual current flow is toward the north. The tracer concentration studies show that the long-term movement of water over the site bottom is to the north due to gravitational circulation (WES 1998). Therefore, if material or nutrients remain in suspension for long periods of time, it is likely that some of the material or nutrients carried through the southern boundary of the site during an ebb flow could be carried back into the site during the subsequent flood cycle, with the net drift being to the north.~~

6.1.3.j Sedimentation. Sedimentation rates are controlled by the physical characteristics of the sediments and the hydrodynamics of the area. The hydrodynamic modeling revealed that variations in depth-averaged current velocities through the site area would change as little as zero to two percent and would not change significantly (WES 1998). Based on these results, it is anticipated that natural sedimentation rates within the Site 104 area will not be significantly impacted by the proposed action. Sedimentation is discussed further in Annex F.

~~Sedimentation and the potential for material movement at Site 104 due to placement of dredged material is dependent on: 1) the physical sediment characteristics of the placed material; 2) the physical characteristics of the water through which the material is being placed (i.e., temperature, salinity, and density which are not anticipated to significantly change following the proposed action); 3) the created and existing bottom geometry; and 4) the hydrodynamics on the surrounding area. Based on grain size analyses, the majority of the dredged material proposed to be placed at Site 104 (± 95%) is made up of fine-grained silts and clays that typically would take~~

~~a long period of time to settle as individual particles. Placement using bottom-release scows or hoppers causes the material to settle *en masse*, allowing it to reach the bottom faster than if individual particles were released. This is particularly true of cohesive sediments such as those proposed for placement at Site 104. A portion of the mass, however, does become removed (or stripped) from the cloud of placed material as it descends and remains in the water column. The duration of time that this material remains in the water column depends on factors such as grain size and surrounding hydrodynamics. The STFATE model run for Site 104 indicated that < 1% of material placed using bottom-release scows was stripped during descent and dispersed throughout the water column. This loss is not seen in bottom hydraulic placement since the material being placed is contained within the pipeline during descent and the discharge end of the pipeline is normally located within a few feet of the estuary bottom.~~

~~When a load of mechanically placed dredged material (either placed with a bottom-release scow or a hopper dredge) reaches the site bottom and collapses, a portion of the material's clay fraction remains in suspension in the water column above the bottom surface. Modeling conducted for Site 104 using this placement technique indicated that loss of this suspended clay material would account for another 3.3% of the total of the mechanically placed material. It was assumed during the modeling that all of the hydraulically placed material settles to the bottom before erosive forces act on it. No portion of the hydraulically placed material will experience the collapse phase to which mechanically placed material is subjected because the material will be pumped to the bottom through a pipeline. A combination of both mechanical (bottom-release scow) and controlled hydraulic pipeline bottom placement will likely be used for dredged material placement at Site 104.~~

6.1.3.j.1 Sediment Erodability

To characterize the erodability of both in-place and dredged maintenance material currently proposed for placement at Site 104, sediment samples were obtained by ~~Maryland Geological Survey (~~MGS~~)~~ and provided to WES for laboratory erosion experiments described below. One sediment core was collected from each of the following channels with the exception of the Brewerton Channel Eastern Extension from which two samples were collected (one was collected at each end of the channel): Craighill Angle, Cutoff Angle, Tolchester, and Swan Point. The cores were collected in shoaling areas and are representative of the material proposed for placement at Site 104. Other channels proposed for maintenance dredging were not sampled because the channels had already been dredged for the season at the time of sampling. Previous sediment characterization studies in these channels (EA 1996) indicate that the physical characteristics of sediments in the non-sampled channels are similar to those of the cores collected for the erosion experiments. Generally, the sediments proposed for maintenance dredging are primarily comprised of silt/clay particles. Section 6.1.5.a provides a description of the core samples' physical characteristics. Annex F provides a detailed discussion of sediment erodability.

~~Results from the erosion tests were used to provide erosion parameters such as critical shear stresses for the modeling of material placement and potential erosion of the material placed both hydraulically and by bottom-release scow. This modeling was subsequently performed using MDFATE. The experiments tested both original channel sediments and sediments mixed with~~

Table 6-4
Dredged Material Erosion from the Bottom Surface by Placement Year

Year	Mechanical (bottom-release scow)	Hydraulic (controlled bottom pipeline placement)
1	16.0%	6.3%
2	9.5%	4.0%
3	18.9%	10.4%
4	9.5%	4.7%
5	15.6%	9.2%
Weighted 5-Year Average	12.6%	6.2%

Source: WES 1998

Table 6-5
Total Dredged Material Erosion as a Five Year Average

Erosion	Mechanical (bottom-release scow)	Hydraulic (controlled bottom pipeline placement)
Water Column	4.3%	0.0%
Bottom	12.6%	6.2%
Total	16.9%	6.2%

Source: WES 1998

~~water from Site 104 (which had a constant and uniform density which is representative of the waters 12.0 meters (39.4 feet) below the surface, within 3.0 meters (9.8 feet) of the sediments at Site 104). The sediment samples were placed in the 11.75 cm (4.63 in) diameter test cylinder, covered with 12.7 cm (5.0 in) of additional water from Site 104, and allowed to settle over specified increments of time between one and eight days prior to testing. The original sediments were representative of the material as it exists in the channels. The sediments mixed with water and allowed to settle were representative of material dredged and placed. A mechanical oscillating disk moved water over the surface of the sediments in the test cylinder at various rates equivalent to shear stresses of 0.1, 0.2, 0.3, 0.4, and 0.5 Pascals (allowing 30 minutes at each step) to simulate movement of water over sediments in Site 104 at various velocities. The mass of sediments eroded from the test bed at each rate was measured to determine erosion rates and critical shear stresses to be used in the FATE modeling along with the shear stresses generated by the CH3D modeling for each year of placement. The effects of water pressure and gravitational forces were not simulated directly since these experiments simulated the impact on material erosion of a range of shear stresses acting on the bottom sediments. How those shear stresses are created in the real world is not considered by the model, (e.g., the total shear stress at Site 104 is influenced by tidal circulation). However, it is not each individual component of the shear stress that is important, but the total stress acting on the bottom which could potentially dislodge the sediments (Appendix F.2, WES 1998).~~

Potential Erosion of Placed Dredged Material

The MDFATE model was run as explained in the beginning of Section 6.1.3 under "Model Descriptions" and in the study report located in Appendix F.3 for both bottom-release scow and bottom hydraulic placement scenarios to predict the percentages of material potentially lost from the site during placement. Long-term erosion losses as a ~~five~~5-year, weighted average were predicted to be 12.6% for placement with a bottom-release scow and 6.2% for hydraulic pump-out of individual barges. The weighted averages were determined by multiplying the annual predicted percent losses by the placement quantity for that year and then adding the resulting quantities and dividing them by the total quantity to be placed over the ~~five~~ 5-year time period. Predicted percent losses for bottom-release scow and hydraulic pump-out of individual barges by placement year and the five-year averages are provided ~~below~~ in Tables 6-4 and 6-5, respectively. Percentages vary from year to year based primarily on the total quantities of material placed and the placement locations. The greater the exposed surface area of new material and closer the placement location is to the site boundaries, the more likely it is that placed material will erode and move outside of those boundaries.

~~As discussed earlier in Section 6.1.3.j, t~~The bottom-release scow methodology was predicted to lose an additional 4.3% into the water column between the time the material left the barge and settled on the site bottom. It was assumed that all of the hydraulically placed material settles to the bottom before erosional forces act on it, since no portion of this material experiences water column stripping or the collapse phase to which mechanically-placed material is subjected. Therefore, the total predicted worst-case losses were 16.9% for bottom-release scow and 6.2% for hydraulic placement (Table 6-5). However, these predicted losses are thought to be higher than will be experienced under actual conditions because the model could not predict the return of sediments back into the site effectively (WES 1998). As previously discussed, some sediment may leave the site during ebb tide and be transported back to the site during flood tide. The model can only predict the portion of material that has the potential to leave the site, not the portion that would be expected to return.

For each placement method scenario, a representative year-long run was made for each year of proposed placement. The major impacts on the model results are the erosion parameters discussed above, the size of the material footprint from each placement event, and the bottom shear stresses generated from the CH3D-WES model for each simulated year of placement. Since the erosion parameters and the bottom shear stresses were the same for both placement scenarios, the controlling factor for material losses due to erosion was the footprint. ~~As discussed in Section 6.1.3.d, t~~The footprint generated from the hydraulic placement modeling was smaller than the footprints generated from the bottom-release scow modeling. Reasons why a single barge pump-out results in a smaller footprint size and less erosion than a bottom-release scow include:

- Hydraulic pump-out will result in material reaching the bottom at a higher concentration and thus with a lower total volume than a barge release

- Hydraulic pump-out results in a spreading layer that is of more limited height, is thicker, and has a smooth flow over a short distance from the discharge point, whereas, bottom release is turbulent and continues to pick up water as it spreads over the bottom

- Hydraulically placed material spreads closer to the bottom surface and is, therefore, less affected by currents

- Hydraulic pump-out will result in a spreading layer which will get denser more rapidly than a barge release and, due to the limited volume being pumped, will not spread as far from the release point as a barge release does (WES 1998).

Therefore, as shown in Table 6-4, the bottom erosion for mechanical placement is predicted to be greater than hydraulic placement for each placement year. However, results would be different if hydraulic placement were conducted with a continuous flow instead of pump-out of individual barges. In this case, the hydraulic placement footprint would be larger and thus subject to greater erosion.

6.1.3.j.2 Material Spreading

One aspect of dredged material placement that is not considered by STFATE, MDFATE, and hydraulic footprint modeling is the spread of material on a slope. SURGE modeling was performed to evaluate distances that placed material could travel along the bottom from the location at which the material reaches the site bottom. The modeling was performed using data from the STFATE modeling of bottom-release dredged material placement at the deepest part of the site (i.e., near the southern boundary since bottom slopes are greater there). Although not specifically modeled (since no model exists that can do so), hydraulically placed material should also be expected to spread further on slopes versus a flat bottom. Typical slopes anticipated to be encountered at Site 104 were between 0.0% and 1.5%. Typical slopes were measured from existing bathymetry and modeling calculations determined the post-shearing angles that result from "slumping" of placed material, as described in the study report in Appendix F.3. Predicted dredged material spreading over the slopes ranged from approximately 220 ~~meters~~ (720 ~~feet~~) to 920 ~~meters~~ (3,020 ~~feet~~). The model assumes that the slopes are continuous, whereas in reality, opposing slopes could be encountered, therefore reducing the amount of material spreading. A SURGE model run was made on a 1.5% slope with a created 6 ~~meters~~ (20 ~~feet~~) high opposing slope of approximately 7H:1V placed approximately 305 ~~meters~~ (1,000 ~~feet~~) away. The results of the model run indicated that the surge produced from placement on the 1.5% slope would not have enough energy to overtop the opposing slope. The results of the SURGE model should be viewed with caution, since actual surge data for placement operations at Site 104 do not exist to verify the model. Also, some input parameters for the Site 104 modeling had to be obtained from what were thought to be similar projects for which these data were available (WES 1998).

6.1.3.j.3 Potential Sediment Transport

It should be noted that a portion of the predicted losses is comprised of material that leaves the boundaries of the MDFATE model to the south during an ebb tide or to the north during a flood tide and could potentially re-enter the site boundaries during a flood tide or ebb tide, respectively. The model does not track sediments once they leave the model boundaries. The site boundaries are rectangular and were established to include the bottom two-thirds of the Site 104 project area, and extend approximately ~~915~~ an additional 915 ~~meters~~ (3,000 ~~feet~~) to the south and 610 ~~meters~~ (2,000 ~~feet~~) on both the east and west sides of the southern portion of the site. In reality, material in suspension is influenced by the tidal cycles and, therefore, material that moves from the site due to tidal fluctuations could be brought back into the site boundaries on the next opposing tide (i.e., what leaves with the ebb tide could return with the flood tide). In addition, material that left the northern model boundary could still be in the northern third of Site 104. These "losses", therefore, would not truly be lost from the site. This dynamic process will continue over a period of time. Sediment will consolidate and movement will eventually approach or equal the normal sediment redistribution patterns in the upper Bay.

The tracer studies conducted using the CEQUAL-ICM model to evaluate net long-term movement of suspended material within the Site 104 area indicated that the net residual current is directed northward. Material that remains in suspension would thus have a tendency to be transported northwards. Material placement at Site 104 is proposed for the southern deeper portions of the site where depths are currently greater than –13.7 ~~meters~~ (–45 ~~feet~~) MLLW. This equates to approximately the lower two-thirds of the site. Material would not be placed in the northern portion of the site in depths shallower than –13.7 ~~meters~~ (-45 ~~feet~~) MLLW (approximately the northern one-third of the site). No model of the Chesapeake Bay exists that can quantifiably track potential sediment movement throughout the Bay. Therefore, the final destination of the material that was predicted to leave the site remains unknown. Based on typical settling rates, however, it is believed that any material placed at Site 104 that is suspended in the bottom currents will settle out over a short distance and depending on the location of the placement will most-likely stay within the site boundaries unless further erosion takes place.

6.1.3.k Wave Conditions. Average and extreme wave conditions for Site 104 are dependent on wind conditions within the Chesapeake Bay region. As stated in Section 6.1.3.g above, wind conditions would not be affected by the proposed action and, subsequently, placement of dredged material at Site 104 would not affect wave conditions at the site. Average depths at the site will not change to the extent that normal wave conditions would have an effect on the increased bottom elevations. Effects from extreme wave conditions due to storms were discussed earlier in Section 6.1.3.e. The proposed action is not expected to change the characteristics of surficial waves at the site. For storm events greater than or equal to a 25-year storm event, however, sub-surface waves will impact the bottom.

6.1.3.l Effects of a Berm on Flow Field and Dredged Material Placement

If a berm is built at the southern boundary of Site 104, there could be two impacts relative to the proposed placement of dredged material at the site. The first impact (probably the most significant) is related to the possibility of the berm stopping bottom density surges containing suspended sediment. These surges result from the encounter of the placement material striking the bottom. The second is the impact on erosion of deposited placement material.

When the placement material descends through the water column as a cloud or jet it entrains ambient water and grows. At the moment of bottom encounter, the jet or cloud of material possesses a certain amount of energy which is the sum of its potential and kinetic energy. An outward flow of the suspended sediment and water mixture then occurs along the sea floor. This is referred to as the bottom surge. This outward movement of suspended sediment and water mixture continues until the energy possessed by the surge is dissipated. Dissipation of its kinetic energy occurs due to frictional effects. Potential energy is converted to kinetic energy and is also lost due to the fact that as the surge looses energy and slows down suspended material is deposited on the bottom, resulting in a decrease of the surge's density.

Whether placement occurs on a flat bottom, a down slope or an up slope all of the processes described above occur. However, if a down slope is encountered, the surge also gains energy due to the gravitational force accelerating the surge down the slope. Likewise, when the surge attempts to move up a slope, the kinetic energy of the surge decreases due to the resisting gravitational force.

The behavior described above has been incorporated into the model called SURGE. A simulation of the placement by bottom scow release in a water depth of 21.3 meters (70 ft) at Site 104 that occurs 304.8 meters (1,000 ft) in front of a 6.0 meters (20 ft) high berm with an angle of repose of 8 degrees has been made with SURGE. The model predicted that the energy of the bottom surge would be dissipated before the surge over topped the berm. Of course, these results should be viewed with caution since results are dependent on parameters such as the rate of dissipation and the rate of conversion of potential energy to kinetic energy. However, depending on the characteristics of the placement material, the placement process, and the placement bathymetry, berms can obviously be used to control the spreading of placement material contained in bottom surges.

The second impact of constructing a berm at the southern boundary of Site 104 relates to changes in erosion of deposited material that might occur due to changes in the flow field caused by the berm. These impacts will be very localized and relatively insignificant. The impact on the flow field will be determined by the magnitude of the ambient flow and the height of the berm. In any case, the impact away from the berm should not extend more than ~~2-3~~two to three times the height of the berm. Thus, changes in erosion rates will only be seen within perhaps 50-100 ft of the location of the berm.

6.1.4 ~~6.1.4~~ Water Quality

Projected water quality effects are described here by type of impact and by time scale of impact. The types of water quality impacts ~~which~~that have been investigated include turbidity, salinity, contaminant and nutrient releases which could be associated with dredged material placement at Site 104. The time scale for potential impacts is divided into the following: those which are expected in short--term time scales, essentially during and just after placement events; those water quality impacts which could be expected within a year of placement; and longer term impacts which could endure longer than ~~one~~1 year after placement.

6.1.4.a Impacts During Placement.

~~Summary. Both placement methods are expected to cause short-term nutrient water quality impacts during placement activities. However, the~~A primary water quality impact expected during placement is turbidity. The extent and behavior of turbidity plumes for both controlled pipeline placement and bottom-release scow have been studied by the MGS, MDE, and WES. For water quality impact prediction at Site 104~~In this study~~, two types of placement actions are considered. ~~w~~Water column turbidity was modeled for placement by ~~a~~ bottom-release scow~~;~~, while ~~but~~ it was assumed that water column turbidity would be~~to be~~ nonexistent (other than near the bottom) for the pump--out method of placement. ~~Some increase in t~~The release of ~~the nutrient~~nitrogen, in the form of~~s~~ ammoni~~uma~~a was ~~exhibited during modeled placement~~predicted~~found~~ during placement using studies of channel sediment nutrient~~s~~ conditions, as well as projections of ~~and likely~~ releases~~-~~ during lab studies and modeling ~~activities~~ which simulated dredging and placement. Water quality ~~M~~modeling and studies of sediment/water nutrient interactions have not predicted significant negative ~~impacts~~effects at Site 104 or either upstream or downstream of Site 104 due to changes in nutrient concentrations in the waters of Site 104 resulting from placement by either method (Cerco~~WES,~~ 1999). To minimize impacts, placement of dredged material at Site 104 is scheduled for the fall and winter quarters. During these periods, water temperature, salinity, and dissolved oxygen conditions are not conducive to negative water quality impacts from phytoplankton blooms ~~in the event~~ resulting from enhanced nutrient concentrations ~~are enhanced~~ during placement. In addition, biological resources are less prevalent and less active at the site during these periods. ~~No significant turbidity-associated impacts are expected at the time of placement.~~

Short-term near-field water quality impacts from turbidity are expected at the time of placement. These impacts are expected to be of relatively short duration, lasting less than an hour after material is released to the site. In the event of near-bottom hydraulic placement, turbidity is expected to impact near-bottom waters only. In the event of bottom release scow placement, turbidity plumes are expected to last less than 20-40 minutes after each release.

Short-term near-field increases in nitrogen concentrations in the water column and near--bottom waters are expected at the time of placement. These increases were not found to have negative water quality outcomes, using the water quality module of the CH3D Chesapeake Bay Hydrodynamic model.

Salinity changes due to placement of dredged material at Site 104 are not expected.

Contaminant concentrations in the water column were modeled using the sediment quality of material from the channels, ~~and~~ modeling the concentrations of contaminants in the water column after release. Toxic effects levels are not expected to be exceeded based on the model results. [Leave room for a more full description of Tier II and III]

Turbidity Impacts During Placement

Hydraulic Placement

The assumption in the hydrodynamic modeling conducted by WES was that no water column turbidity would result from hydraulic placement, if non-continuous pumping is performed, with pipeline placement directed to near the bottom (WES 1998). Some near-bottom turbidity releases are expected, but were not modeled.

Bottom-Release Scow Placement

For bottom-release scow placement, approximately <1% of the material was predicted to be lost to the water column before the material reached the bottom. An additional maximum 3.3% is predicted to re-enter~~be lost to~~ the water column when the material actually strikes the bottom. Some of this material is expected to settle back to the bottom over a relatively short time frame of minutes to hours, but the existing model capabilities do not allow a calculation. –

Discussion

Studies performed on other open--water placement actions in the Chesapeake Bay have ~~all~~ been conducted under ~~differ~~varying conditions. In the upper Bay, in relatively shallow water (<25 ft), monitoring of continuous hydraulic placement has shown the placed sediments typically descend to the bottom as a slurry (Panageotou and Halka 1990). The MGS study of Pooles Island Area D found a small portion of material dispersed as a turbidity plume extended no farther than 0.5 k~~ilometers~~ (1,641 f~~ee~~t) down current during periods of strong current velocities (Panageotou and Halka 1990).

Acoustic monitoring studies performed by Versar (1994) of hydraulic placement in 1991 and 1992, again in shallower waters in the upper Bay, found that turbidity plumes~~,~~ from continuous hydraulic placement with the pipeline located approximately 2 m~~eters~~ below the surface of the water, were larger than from bottom-release scow placement. (Bottom-release scows operate by moving over a placement area, with the assistance of a tug. The bottom doors of the scow then open, allowing the dredged material to fall out of the scow and through the water column to the bottom). Specifically, hydraulic plumes extended ~~to~~ for greater than 3 k~~ilometers~~ (9,843 f~~ee~~t) and controlled bottom- release plumes extended less than 0.7 k~~ilometers~~ (2,297 f~~ee~~t). The turbidity plume from bottom-release scow placement was nearly 2.5 times shorter in length than the continuous hydraulic placement turbidity plume, though they were similar in width. Though no measurements were made of the hydraulic placement area, the total suspended solids concentrations in the bottom-release scow area returned to ambient levels within 20 to 40 minutes.

In addition, in the bottom-release scow area, the total suspended solids concentrations of the plumes represented approximately 1 to 5% of the total sediment deposited. The Versar (1994) studies confirmed that hydraulic placement had a near-field, short-term impact to water quality from increased suspended sediment concentrations. Hydraulic pump-out of single barges at a time is expected to significantly reduce the water column turbidity compared to continuous hydraulic dredging and placement just below the water surface. During placement activities proposed for Site 104, the pipeline will be approximately 2 meters (6.0 feet) from the bottom. Barge pump-out will entrain less water in the dredged material, and placement targeted close to the bottom will reduce the area of the water column which experiences increased turbidity. It is expected that any turbidity impacts resulting from placement at Site 104 would be transitory, localized, and not environmentally significant.

Nutrient Impacts During Placement

The potential for nutrient-related water quality effects during placement were investigated in several ways. Nutrient-related water quality effects could occur from enhanced concentrations of nutrients in the water column. The source of these nutrients would be the nutrients existing as part of organic or inorganic matter in the dredged sediments. Adding nutrients to the water column could theoretically increase the fuel for phytoplankton blooms, which could result in increased organic matter production, leading to increased organic matter decomposition when the algae die. This leads to decreased dissolved oxygen as the organic matter decomposes. Low dissolved oxygen concentrations in the water column cause fish mortality, and low dissolved oxygen in bottom waters kills the benthic animals living in the sediments. Low dissolved oxygen in the sediments results in even greater nutrient releases when it results in the process of anaerobic decomposition ~~,~~ (from a change in the type of microbes which live in the sediments when there is no oxygen), and this in turn releases large amounts of dissolved inorganic phosphorus and nitrogen from the sediments.

These potential effects were investigated using laboratory studies of channel sediments, using the recommended tiered testing protocol in the Inland Testing Manual, and using three-dimensional hydrodynamic and water quality modeling.

Laboratory testing of the channel sediments and Site 104 sediments was performed to characterize the sediments and to enable predictions of changes if channel sediments were moved to Site 104. The laboratory testing was also used to provide data to perform the three-dimensional and Tiered testing modeling.

The water quality model of Chesapeake Bay (CEQUAL-ICM) was run to assist in the prediction of potential impacts to water quality from the placement of dredged material at Site 104 (Cerco 1999; WES 1998~~, WES, 1999~~). ~~Insignificant impacts to water quality are expected from interaction of the Kent Island Waste Water Treatment Plant (WWTP) discharges and any nutrients released during or after placement of dredged material. Water quality sampling within Site 104 did not find any increased nutrient discharges at the sampling point closest to the Kent Island WWTP discharge point. The large volume of water in the Bay, combined with the minor change in water quality modeled from placement, are not expected to cause detectable changes in~~

water quality or contribute to negative water quality impacts such as enhanced algal blooms or increased anoxia.

ThreeOriginally, Ttwo potential cases were modeled, in an attempt to cover a range of environmental conditions which could result from placement of dredged material at Site 104 according to the proposed plan. oOne case was when thefor surface channel sediment to be was completely mixed with water, with all dissolved and bound nutrients released completely to the water column at the time of placement. For, and onethe second case, withmodeling was performed allowing -no mixing of surface sediments with water, and all nutrients remaining in deposited in the sediments deposited on the bottom at Site 104. This could make the nutrients subject to release during the first season of anoxia after placement. Water quality impacts were firstthen reviewed under these two "worst case" sets of scenarios. A third scenario was modeled after the completion of Dr. Jeff Cornwell's findings of pore water ammoniuma releases and higher ammonium concentrations at depth from dredged material channel sedimentsplacement. This third scenario used Dr. Cornwell's values of 0.13 lb of N (nitrogen) per cubic yard of dredged material placed, with no additional P (phosphorus) release at the time of placement. No additional P (phosphorus) release was assumed for this scenario due to Dr. Cornwell's finding that the oxidized condition of the sediment and water, combined with the exposure of multiple binding sites for phosphate during movement of the dredged material would essentially lock up all available P (phosphorus) during the dredging and placement process.

In the first, complete mixing and release scenario, increased releasesconcentrations of phosphorus were noted at the bottom during placement seasons, but not at other times. The increased phosphorus had no detectable impact to chlorophyll levels or dissolved oxygen (DO) concentrations during the fall and winter seasons of placement, or thereafter,. but a slight stimulatory effect on the spring algal blooms was observed. There iswas no apparent effect on summer chlorophyll levels. It is thought the effect doeswould not last until the summer because the phosphorus released iswould be dispersed before the summer algal blooms begin. The releases from elutriation of ammonium, nitrate or Chemical Oxygen Demand (COD) are minor and no influence on water column nitrogen or oxygen were predicted by the model.

Nutrient releases from mixing of higher concentrations of nutrients from dredged sediment pore water have been studied during previous open water placement events in the Chesapeake Bay. Water quality studies performed during and after the open water placement of dredged materials in the upper Chesapeake Bay have included multi-year 12 month data collection efforts, with analysis of water samples at the surface, mid-depth and bottom for nutrients, chlorophyll, turbidity and total suspended solids. These studies have not detected increased nutrient concentrations or increased phytoplankton productivity in the water column during placement (MES 1997, 1997b). This is thought to be due to a combination of factors. The actual volume of water associated with the transport of dredged material only results in a very small increase in nutrient concentrations in the total water column. The receiving water volume is huge (thousands of gallons of water associated with the dredged material vs. billions of gallons in the Bay in the mainstem). In addition, losses at the point of dredging could result in smaller pore water contributions at the placement site.

Under ~~the~~ the second no elutriation scenario (no mixing, all nutrients deposited ~~in~~with the sediment), water quality impacts from increased nutrient concentrations would not be observed during placement, according to the scenario used~~WES model~~. A slight stimulatory effect on the spring algal blooms was observed. There was no apparent effect on summer chlorophyll levels. It is thought that the enhanced phytoplankton growth effect is not found to last until the summer because the released phosphorus would be dispersed before the summer algal blooms begin. The modeled releases from elutriation of ammonium, nitrate, or Chemical Oxygen Demand (COD) are minor and no influence on water column nitrogen or oxygen were predicted by the model.

Under the third scenario, with 0.13 lb of nitrogen per cubic yard of dredged material released as ammonium at the time of placement, no water quality impacts were observed at the time of placement. This is probably due to the cold water temperatures and lack of sunlight during the recommended placement window of 15 October to 15 April.

Nutrient releases from mixing of higher concentrations of nutrients from dredged sediment pore water have been studied during previous open--water placement events in the Chesapeake Bay. Water quality studies performed during and after the open--water placement of dredged materials in the upper Chesapeake Bay have included multi-year 12--month data collection efforts, with analysis of water samples at the surface, mid-depth, and bottom for nutrients, chlorophyll, turbidity, and total suspended solids. These studies have not detected increased nutrient concentrations or increased phytoplankton productivity in the water column during placement (MES 1997c~~, 1997b~~). This is thought to be due to a combination of factors. The actual volume of water associated with the transport of dredged material only results in a very small increase in nutrient concentrations in the total water column. The receiving water volume is huge (thousands of gallons of water associated with the dredged material vs. billions of gallons in the Bay in the mainstem). In addition, losses at the point of dredging could result in smaller pore water contributions at the placement site. The timing of placement during winter months also contributes to less likelihood of increased phytoplankton production.

Nutrient concentrations were also modeled for the Tiered Testing protocol in the Inland Testing Manual (EPA/USACE 1998). Concentrations of nutrients in the water column were found to be [put in M&N information]

In order to minimize water quality impacts from possible releases in nutrient concentrations at the time of placement, Site 104 is scheduled for placement 15 October to 15 April, when water temperature, salinity, and dissolved oxygen conditions are not conducive to negative water quality impacts from phytoplankton blooms. According to Dr. Cornwell's studies, ~~T~~this should limit the immediate release of phosphorus, in particular, which would strip from the sediment particles ~~as~~if they entered anoxic waters.
~~Nutrient releases from newly placed sediments are predicted when anoxic conditions occur in the no mixing scenario. These releases are predicted to be higher than that of the background sediments, but should be limited to the top 10 cm of the placed sediment, and would only occur for the first season of anoxia after each year's placement. Section 6.1.4.b describes potential long-term impacts likely to result from purposed dredged material placement.~~

There were differences in the background water quality and sediment nutrient flux data collected during field studies and the background values used by the model. This is thought to be due to the differences in the years when data was collected for the model (1985-1987) and the depth-averaging of the cell in which Site 104 is found in the model. The model results were verified and found to be correct for the conditions under which the model ran the water quality impact module. Due to the differences, however, additional sampling will be performed as part of the Site 104 monitoring to ascertain and verify the projected impacts.

It must be noted that the complete mixing and no mixing scenarios modeled for Site 104 arewere both worst-case scenarios, which were used to bound and define the extent of negative impacts to water quality from nutrient releases from the sediments. No negative water quality effects were predicted by the model during or just after placement using these scenarios. These scenarios are considered worst-case because neither case is expected to exclusively occurThe third scenario is the expected scenario for conditions of nutrient release, albeit it is conservative in that it probably over-estimates nitrogen release,. and Nno short--term water quality impacts were detected under this scenario. , but rather some combination of the two is expected. In either case, impacts were found to be limited in duration and aerial extent. Mitigation efforts, such as limiting the timing of placement to avoid anoxia, should further limit negative impacts.

Insignificant impacts to water quality are expected from interaction of the Kent Island Waste Water Treatment Plant (WWTP) discharges and any nutrients released during or after placement of dredged material. Water quality sampling within Site 104 did not find any increased nutrient discharges at the sampling point closest to the Kent Island WWTP discharge point. The large volume of water in the Bay, combined with the minor change in water quality modeled from placement, are not expected to cause detectable changes in water quality or contribute to negative water quality impacts such as enhanced algal blooms or increased anoxia.

Contaminant Impacts at the Time of Placement

No contaminant-related water quality impactseffects are expected at the time of placement. are expected. Sediment analysis offound sediment quality in the channel sediments was performed according to the new tiered testing protocol in the Inland Testing Manual. to be generally good, and similar to sediments in Site 104. Sediment quality in the channels was generally similar to that expected in most of the Chesapeake Bay. No water quality effects at the time of placement are expected from placement of these sediments at Site 104. [Needs a greater discussion of Tiered protocol]

One area of Site 104 was found to have Some contaminants were found to be present in higher levels than in most of the other sediments the sediments existing at the placement site. There is a potential that these sediments could be disturbed during placement, creating short-term increases in concentrations of these contaminants in near-bottom waters. These contaminated sediments are expected to bewill be covered by the placed sediments and are not predicted to result in significant water quality impacts.– Placement is planned to be designed to minimize disturbance of these sediments and to cover them with channel sediments, which are cleaner. Placement techniques to achieve this will be developed.

A Tiered ~~I~~ Testing evaluation (using guidelines provided in EPA/USACE 1998) of sediment elutriate data from the channels proposed for dredging indicated that trace metal -and organic compounds in the elutriates were all less than the Maryland acute water quality criteria (see Section 5.1.5). Therefore, it is not anticipated that trace metals or organic compounds suspended in the water column from placement of sediment will adversely impact aquatic organisms. This statement is valid for all metals and organic compounds for which state water quality criteria exist. [must be modified with M&N data and Peddicord evaluation]

Both placement scenarios, bottom-release scow and hydraulic pump-out with controlled pipeline placement, have been designed to minimize turbidity and sediment movement. Placement methods will be controlled to reduce the potential for disturbances of sediment from Site 104 into the water column during placement. Additional care may need to be taken under the hydraulic pump-out scenarios to avoid scouring the bottom during placement, with the potential re-suspension of sediments from the bottom. -Overall, the existing contaminated sediments will be covered (capp~~ing~~ed) with clean material and ~~no~~ re-suspension of contaminated material is not expected to cause significant impacts.[Must be updated with EA, M&N and Peddicord data]

Salinity Impacts at the Time of Placement

There are no salinity impacts predicted at the time of placement. The location (or origin) of the source material is in the upper Bay in the same region and salinity regime as Site 104. Therefore, there will be no significant difference between the salt content in the dredged material and the water column.

6.1.4.b Impacts Within 1 Year After Placement.

~~Summary.~~ Impacts occurring up to ~~one~~ 1 year after placement were modeled using the WES CH3D Chesapeake Bay Model, with the Water Quality Module (CEQUAL-ICM). Impacts were found to be limited in nature. Under a worst-case scenario of complete mixing and release of all nitrogen and phosphorus nutrients, a slight stimulatory effect on the spring algal concentrations was observed, but this effect did not continue into the summer. In the expected scenario of nitrogen release at the time of placement, and summer nitrogen and phosphorus release continuing at pre-placement levels, no water quality effects were detected using the model~~ed~~. In addition, no impacts within ~~one~~1 year ~~from~~ resulting from elevated turbidity are expected, as turbidity impacts are expected to be very short term in nature~~.~~.

Turbidity Impacts Within 1 Year of Placement

Modeling of the short- and long-term fate of dredged material placed at Site 104 by either bottom-release scow or pipeline placement found that no long-term environmentally significant turbidity impacts are predicted after placement. Modeling was conducted with a combination of the WES CH3D model, which is a three-dimensional model of the Chesapeake Bay, along with MDFATE, STFATE and SURGE, which are WES models ~~which~~that track the short- and long-term fate of material deposited. These models were run, as appropriate, to mimic conditions occurring after bottom-release scow placement and after directed pipeline hydraulic placement to the bottom at Site 104. [Needs a review after SAIC report is done]

Monitoring of open water placement at Pooles Island areas G-South and G-North (see Figure 1-2) revealed the greatest local (affecting the water column in and near the placement site) short-term impacts from the bottom-release scow placement to be increases in phosphorus and turbidity concentrations in the immediate vicinity (Austin *et al.* 1991; MES 1997c). MGS also studied placement in G-South (Halka *et al.* 1994) and found that post-placement, the elevated (bottom) suspended sediment concentrations were localized in time (<7 months) and space, and there was no evidence of elevated background concentrations.

Water column turbidity levels would be elevated during placement, for approximately 20-30 minutes during and after each placement event. This effect would be more distributed in the water column for controlled bottom-release scow placement than for a pump-out barge, which would confine the material within a pipeline directed to the bottom, and place the material just above the bottom. These intermittent increases in turbidity would last each year for the duration of the placement activities. The total duration would depend upon how long each placement action took. The recommended placement duration each year is ~~six~~ 6 months. Therefore, intermittent periods of localized turbidity could occur during a ~~six~~ 6-month placement period, but localized turbidity would not be continuously elevated at the site for a ~~six~~ 6-month duration.

Monitoring of dredged material placement in the Pooles Island Open Water Placement Area G-West by MGS has shown significant turbidity associated with placement activities. The turbidity values, however, return~~s~~ to ambient levels within 40 to 45 minutes after a placement event, and turbidity concentrations outside the plume never exceed levels that naturally occur in the Bay (Halka *et al.* 1995).

Based on these studies, dredged material placement at Site 104 is expected to result in elevated total suspended solids concentrations and turbidity plumes during placement events, but the turbidity plumes are expected to dissipate in a short time-frame, and settle out within a short distance of the placement locations. ~~and t~~The elevated total suspended solids concentrations would be localized, intermittent, and short-term in nature.

Nutrient Impacts Within 1 Year of Placement

Water quality impacts from placement of dredged material at Site 104 were modeled over a ~~five~~5- year placement period. Using the complete mixing scenario, all water quality impacts would be short-term, lasting only for the duration of each placement action. These impacts were discussed in the previous section.

For the no mixing scenario, ~~increased~~ sediment releases of all bound and unbound nitrogen and phosphorus compounds contained in the dredged material ~~over background rates~~ were modeled~~predicted~~ ~~for~~during the first season of anoxia after each placement event. _This impact was predicted using values for ambient and channel sediment nutrient concentrations which existed in the model. Under the no elutriation scenario (no mixing, all nutrients deposited in the sediment), a slight stimulatory effect on the spring algal blooms was observed. There was no apparent effect on summer chlorophyll levels. It is thought that the enhanced phytoplankton growth effect is not found to last until the summer because the released phosphorus would be dispersed before the summer algal blooms begin.

Studies performed in the field at Site 104 found different sediment nutrient release rates ~~than~~compared to those used in the model as background conditions. This is thought to be due to the size of the cells used in the water quality model, and an inability to distinguish between relatively small-scale changes in bottom conditions, as well as inter-annual variations which are observed in the Chesapeake Bay. Additional sediment-nutrient flux studies are recommended during and after- placement to verify and further calibrate the model.

For the expected nitrogen release at the time of placement scenario, using Dr. Cornwell's findings of immediate large--scale ammonium releases and no phosphorus releases at the time of placement, -no long--term water quality impacts were observed in the model. Water quality ~~I~~impacts were not observed at Site 104 or in any other parts of the Chesapeake Bay during any time scale. This model assumed that sediment nutrient flux rates were unchanged over background rates in Site 104 after placement of dredged sediments. It has been speculated that the terrestrial nature of the channel sediments, and higher bound phosphorus concentrations, could result in larger sediment nutrient fluxes after organic matter deposition in the spring and the onset of hypoxia and anoxia in Site 104. This is a potential outcome, but is not predicted. This is not predicted based on further studies performed by Dr. Cornwell under anoxic conditions, where organic matter was added to simulate conditions after placement in Site 104. Organic matter additions had no impact on the flux rates. [Verify after Dr. Cornwell completes studies].

Discussion

Sediment-nutrient flux studies conducted by Dr. Walter Boynton of Chesapeake Biological Laboratory (Boynton *et al.* 1998) found that elevated nitrogen and phosphorus nutrient releases occur from the top 10 cm of the sediments during May to September in the Site 104 area of the Bay. This time period is dependent upon water temperature in the spring and available organic matter carbon in the fall. For this reason, the time period proposed for placement at Site 104 does not include the May to September time period when anoxic conditions and enhanced sediment-nutrient fluxes occur. Phosphorus within the sediment would ~~can~~ be released into the water column during periods of anoxia. Nutrient releases outside the May to September time period are expected to be small due to the relatively low water temperatures and available dissolved oxygen.

The no mixing scenario found nutrient impacts in the spring were restricted to bottom waters immediately over the sediments. The only noticeable change was an increase in dissolved inorganic phosphorus in the near bottom waters. At the time of year and at the water depths where this will occur, this enhanced phosphorus should not contribute to phytoplankton blooms because it is outside of the normal mid-April to mid-October bloom period, and is below the photic zone. The photic zone is the depth to which light sufficiently penetrates the water column where photosynthetic activity can take place.

Anoxic conditions~~,~~ that occur during the summer months~~,~~ stimulate phosphorus releases from the sediments. After placement of dredged material, these bottom releases are not expected to increase beyond the normal summer anoxic periods that currently exist at the site. Sediment-nutrient flux studies conducted on sediments within the channels proposed for dredging indicated that the release of phosphorus from the channel sediments is actually lower than the release from existing sediments at Site 104. This may be due, in part, to the origin of the actual sediment particles. Sediments from land-based erosion are the primary source of sediments deposited in the channels. Sediments deposited in mainstem areas of the Bay (such as in Site 104) are typically organic-rich depositional materials.

Nutrients have not been identified as causing direct effects to fish or crabs in "Habitat Requirements of Chesapeake Bay Living Resources" (Funderburk *et al.* 1991). Ammonia is a known toxin, but was not shown to have detectable enhanced concentrations in the no elutriation or complete elutriation results. Elutriation is the process of mixing, settling, and decanting. In this case, sediment and water are mixed and settled, and the decanted water is tested for dissolved nutrients.

The model also found vertical stratification which tended to trap the additional phosphorus in bottom waters below the photic zone so little or no stimulation of algae in surface waters was expected in the summer (WES 1998). Some speculation has occurred that there will be some northward movement of the bottom waters from Site 104, with eventual mixing with surface waters at some point(s) remote from Site 104. The water quality model did find some northward migration of a dissolved tracer placed in the bottom waters of Site 104. The model showed gradual dispersion of this tracer, with some movement northeast, but more movement in the northwest direction, indicating a potential tendency to follow the channels and on into the Patapsco River. Overall, increased concentrations appeared negligible. Monitoring at the time of placement is recommended to verify the model predictions.

The no~~complete~~ mixing scenario found the spring algal bloom was slightly enhanced due to enhanced phosphorus remaining in the water column. This effect did not last until the summer phytoplankton blooms. No effect was predicted from elutriation of ammonium, nitrates, or COD.

~~As was stated before, the complete mixing and no mixing scenarios modeled for Site 104 are both worst-case scenarios, which were used to bound and define the extent of negative impacts to water quality from nutrient releases from the sediments. Neither case is expected to occur, rather, some combination of the two is expected, dependent upon the selected placement type and conditions that occur at the time of placement.~~ In ~~ei~~all modeled~~ther~~ ~~case~~scenarios, impacts were found to be limited in duration and aerial extent. _Mitigation efforts, such as limiting the timing of placement to avoid anoxia, should further limit negative impacts.

Water quality impacts from increased nutrient concentrations resulting from placement of dredged material have also been found to be temporary in nature in the open water placement sites in the upper Bay. Monitoring of placement in Pooles Island Area G-West for ~~four~~ 4 years has shown no long-term or regional water quality impacts in the surface or bottom waters associated with placement (MES 1997c). The open water placement sites in the Pooles Island area do not experience seasonal anoxia, have lower salinities, and are shallower than Site 104; therefore, these sites were not used as a model for Site 104. _The long-term information gained from the monitoring of these sites, however, was used to create the data collection effort for Site 104 and will be used to define the monitoring requirements for this site.

In addition, some of the findings in the upper Bay studies support some of the findings in these studies. For example, measured phosphorus fluxes in the placed sediments in Pooles Island were negative, with phosphorus moving from the water to be bound by the sediments. -This supports the finding that under oxidized conditions, phosphorus releases will not be enhanced when sediments are dredged. It also supports the theory that dredging of the sediment will tie up any pore water phosphorus by exposing it to more iron oxide binding sites on the sediment particles.

In the upper Bay, as is expected for Site 104, significant seasonal and annual fluctuations in water quality associated with the Susquehanna River flow and shoreline erosion were found to impact sediment conditions and fluxes.

The use of Site 104 for placement is expected to have short-term and localized impacts on water quality, primarily through increased turbidity at the time of placement, total suspended solids, and nutrient concentrations. These short-term impacts are expected to last only until the summer season after the last placement event. After these short-term impacts cease~~,~~ ~~the site will likely experience~~there is a potential for ~~a~~ longer-term positive impacts ~~of~~from shorter hypoxia and anoxia events. _Decreasing the depth ~~will~~could limit the intrusion of low oxygen bottom water during the summer months. Hypoxia and anoxia are typical in deep water areas of the Bay, including Site 104, during the summer months.

Salinity Impacts Within 1 Year of Placement

There are no ~~short-term~~ salinity impacts predicted within ~~one~~1 year of~~during or immediately after~~ placement. _The location (or origin) of the source material is in the upper Bay in the same region and salinity regime as Site 104. Therefore, there will be no significant difference between the salt content in the dredged material and the water column.

6.1.4.c Sediment-Nutrient Flux Changes. As discussed in Section 5.1.5, sediments have a significant influence on overlying water quality~~;~~, specifically in utilization of dissolved oxygen from the overlying water column and recycling of nutrients in the ecosystem. Deep areas in the Chesapeake Bay, such as Site 104, experience very different cycles when compared to shallower areas of the Bay, due, in part, to anoxic or hypoxic conditions during the summer months.

As with other areas of the upper Bay, Site 104 is subject to inter-annual and intra-annual variability due to input from the Susquehanna River. Bottom waters in the area were hypoxic during the summer (July to September 1996) and organic matter deposition rates were generally high. Sediment-nutrient fluxes in the Site 104 area were found to be within expected ranges for an area experiencing summer hypoxia (Boynton *et al.* 1998).

The impact of dredged material open-water placement on sediment-nutrient fluxes has been studied extensively in the Pooles Island open-water placement areas. This area has typical depths between -5 and -7 m~~eters~~ (16 to 23 f~~eet~~) and does not experience seasonal hypoxia or anoxia due to the shallower depths and well-mixed water column (MES 1997a). Studies on the effects of dredged material placement on sediment-nutrient fluxes in deep water sites experiencing seasonal hypoxia or anoxia are limited or non-existent. The on-going monitoring at the Pooles Island open-water placement areas is the first extensive monitoring of an open-water placement site~~s~~ in the Maryland portion of the Bay including sediment-nutrient flux measurements. The monitoring at the Pooles Island sites was used to design the NEPA data collection effort at Site 104 and will also be used to design the monitoring of placement at this site.

Historically, Site 104 was the only open-water placement site in deep water in Maryland with any monitoring records until recent years, when extensive monitoring has been performed at the Pooles Island sites. The last placement action in Site 104, which occurred in 1975, was monitored, including~~:~~ the accumulation and dispersal of the placed material; the biological effects of placement on clams and oyster; and the impacts to the commercial shellfish stocks and predominant benthic organisms (MDNR 1976).

As presented in the most recent monitoring report (MES 1997~~b~~c), pre-placement monitoring at the Pooles Island G-West area has shown that natural sediments in the G-West area represent a modest internal source of nitrogen and an important internal source of phosphorus to the overlying water column. For ~~one~~ 1 year after placement, the sediments represented an important source of nitrogen and a loss of phosphorus. The studies could not fully explain why the results were different for nitrogen and phosphorus fluxes. It could be due to a loss of phosphorus from pore water during placement, whereupon the silt and clay particles tend to strip phosphorus from the water column until a similar equilibrium is achieved. These conditions are controlled by the fluxes from the newly placed sediments, and it has been estimated that these fluxes occur in the top 10 cm of the sediment only. By the third year post-placement, the sediment-nutrient flux rates had returned to baseline conditions. The changes in flux rates from the second to third year post-placement was attributed to consolidation of the placed sediments.

In addition to studying the effects of open-water placement, the G-West monitoring effort studied the effect of placement technique on sediment-nutrient flux rates (bottom-release scow versus continuous hydraulic placement). These studies were performed by collecting and incubating sediment samples from areas of controlled bottom-release scow placement and from continuous hydraulic placement areas each year, measuring the flux rates to the overlying water column, and comparing these concentrations to background sediments which were incubated in the same way. Samples were collected from June to August, which is the period for enhanced fluxes in the upper Bay near Pooles Island. The enhanced ammonium fluxes observed from the sediments lasted less than ~~one~~ 1 year for the hydraulic placement areas and did not exceed ~~one~~ 1 year for the bottom-release scow areas.

In summary, nutrient loading observed at G-West over the monitoring period (from 1993 to 1996) was found to be a locally important, short-term impact (<1 year) and to represent a modest source of nutrients when compared to external sources, predominantly Susquehanna River input (Boynton *et al.* 1997). The impacts were found to be locally important, versus regionally important due to the magnitude of the source compared to the magnitude of other sources, and due to the fact that enhanced water column concentrations of nutrients or chlorophyll were not observed in areas remote from the placement areas.

Based on studies conducted at other open--water placement sites (Pooles Island)~~,~~ it has been speculated that several sources cumulatively contribute to localized nutrient concentrations at a placement area: (1) water column concentrations occurring at the point of dredging; (2) the short-term concentrations released at the time of placement; and (3) longer term releases or fluxes from the sediment during -the first season after placement. Ongoing ~~Further~~ stud~~ies~~y of placement ~~are being~~ would be planned to ~~conducted to attempt to~~ better quantify these amounts. No studies performed to date have detected increased anoxia or hypoxia, or enhanced phytoplankton blooms at the placement sites (G-West near Pooles Island) as a result of placement.

When comparing sediment-nutrient flux rates from Pooles Island (G-West) to Site 104 it is apparent that the greater depth at Site 104 and the seasonal hypoxia have a significant effect on the magnitude of the fluxes. The studies conducted at Site 104 in 1996 found the region to have high rates of organic matter deposition, and sediment-nutrient fluxes in this area are significant contributors to the poor water quality conditions and high primary production. This is typical of deep areas, such as Site 104, which undergo seasonal hypoxia or anoxia.

When compared to external nutrient loadings (primarily the Susquehanna River), the existing conditions at Site 104 ~~area~~ contribute a modest amount of ammonium but a large amount of phosphorus in the upper Bay region, due to the effect of hypoxic conditions on phosphorus fluxes (Boynton *et al.* 1998). This large phosphorus input contributes significantly to the high primary productivity and resultant algal blooms that further deplete dissolved oxygen from the water column. The timing, degree, and extent of phytoplankton blooms are dependent upon the ratio of nitrogen and phosphorus in the water column and the time of year that these releases are observed. Both nutrients are required for primary production (phytoplankton growth). Nitrogen-phosphorus (N:P) ratios have been studied; ~~and~~ southern areas of the Bay have been found to be generally nitrogen-limited, and northern areas phosphorus-limited for phytoplankton blooms.

The annual cycle of phytoplankton production in the Chesapeake Bay is characterized by two phases. There is a spring biomass maximum in April-May supported by increased light penetration and high riverine nutrient inputs. This is followed by a summer productivity maximum supported by benthic nutrient regeneration from bottom sediment organic matter decomposition (Conley and Malone 1992). Recent work by Fisher~~,~~ *et ~~.~~al.* (1992, 1999), and Malone, *et~~.~~ al.* (1996) ~~and Fisher, *et.al.* (1992)~~ have more fully described the nature of these phytoplankton productivity cycles and the seasonal factors which limit phytoplankton productivity. These findings have led to a better understanding of the nature of nutrient limitations and the seasonal changes in water quality conditions which then control phytoplankton growth. What these studies have found is that nitrogen in fact limits phytoplankton growth in the summer, but in the spring, phosphorus is the limiting factor.

The reasoning behind this change in limiting factors is due to the changing environmental conditions in the estuary. The late winter to spring period in the Chesapeake Bay is characterized by large freshwater runoff, with higher ratios of nitrogen loadings compared to phosphorus in the runoff. During this time period, as sunlight is also increasing, there is more nitrogen available than can be utilized by the phytoplankton, when compared to phosphorus. Under these conditions, phosphorus then becomes the limiting nutrient – the phytoplankton only grow to the extent that phosphorus is available as a nutrient. During the summer this dynamic changes. With a decrease in nitrogen loading as freshwater runoff declines and plants in the watershed begin to grow and tie up the nutrients, the source of nutrients to the water column switches to the nutrients being recycled from organic matter decomposition in the sediment. The increasing water temperatures in the bottom waters begin a process of microbial activity. These microbes break down the organic matter that has fallen to the bottom of the Bay, and in the process, nutrients are "remineralized,"~~,~~ or recycled to the water column. When this happens, the sediments become the main source of nutrients to fuel phytoplankton growth. Under these conditions, the Bay is now producing higher ratios of phosphorus, and phytoplankton only grow to the extent that nitrogen is available as a nutrient.

From the above studies, it has been determined that ~~P~~primary productivity at Site 104 would be primarily phosphorus-limited in the spring and nitrogen-limited in the summer. Water quality modeling ~~of the complete elutriation or no elutriation scenarios found slightly enhanced dissolved phosphorus concentrations at Site 104 after placement. This was found to have a slight stimulatory effect on the spring algal bloom under the no-mixing scenario, but no impact on phytoplankton blooms in the complete mixing scenario.~~found no impacts on chlorophyll-a production (which is a measure of phytoplankton growth) under the expected-case scenario. Under the scenario which released all of the available phosphorus during seasonal anoxia, a slight stimulatory effect was observed on phytoplankton growth, but this did not last into the summer.

The monitoring of the effects of dredged material placement on sediment-nutrient flux at the G-West area near Pooles Island have shown placement to have a short-term local impact on the flux rates. A similar~~The same~~ magnitude and duration of impacts would be~~are~~ expected in the Site 104 area. Additional studies are currently being conducted on nutrient fluxes from the sediments in the deep water (50-f~~oo~~t) channels that would be dredged and placed in Site 104. Studies performed in 1997 ~~7~~ by Horn Point Environmental Laboratories found nutrient fluxes and water quality conditions in the channels to be similar to those in Site 104, leading to the conclusion that overall net changes should be small when sediments are moved from the channels to Site 104.

Further study was performed as part of the water quality modeling aspect of this EIS. Using the complete mixing scenario, all water quality impacts would be short-term, lasting only for the duration of each placement action. For the no mixing scenario, increased releases of nitrogen and phosphorus compounds from the sediment were predicted for the first spring season of anoxia after each placement event. This impact was predicted using values for ambient and channel sediment nutrient concentrations which exist in the model. These values were entered into the model after field sampling from 1985-1987, and were verified as accurate after the model runs for Site 104. These values differed from the results of the field study of Site 104 in 1996, but these differences are thought to result from the different time periods when sampling occurred, and from the depth-averaged nature of the model's conditions for the Site 104 cell. The expected--case scenario found no changes to water quality conditions after placement of dredged sediment with large ammonium releases as the time of placement.

It is projected that after placement has ended, natural annual sediment deposition would become the source of sediment-nutrient fluxes and conditions would be expected to return to ambient levels. This is projected based on the knowledge of sediment depositional processes in the Bay, on the multi-year study of nutrient fluxes which occur from these sediments, and from the findings of monitoring at the Pooles Island sites in the upper Bay.

As stated before, the ~~complete mixing and no mixing~~ scenarios modeled for Site 104 are ~~both~~ worst-case scenarios, used to bound and define the extent of negative impacts to water quality from nutrient releases from the sediments. ~~Neither case is expected to occur, rather, some combination of the two is expected, dependent upon the selected placement type and conditions that occur at the time of placement.~~ In ~~either~~all cases, nutrient impacts were found to be limited in duration and aerial extent. Mitigation efforts, such as limiting the timing of placement to avoid anoxia, should further minimize negative impacts.

Overall, the impacts to sediment-nutrient flux at Site 104 from dredged material placement are expected to be short-term and local in nature, as has also been observed at the Pooles Island open-water placement areas (MES 1997~~b~~c). Monitoring of placement activities at Site 104 will include sediment-nutrient flux studies and water quality studies to verify this.

6.1.4.d Long-term Impacts to Water Quality. In the long-term, water quality in the bottom waters at Site 104 is expected to be unchanged, or to possibly ~~could~~ improve. Decreasing the depth at the site (by placement of dredged material) ~~sh~~could minimize the extent and distribution of hypoxic and anoxic bottom waters in the site. The saltier, hypoxic and anoxic waters will be restricted to deeper water areas adjacent to the site. Therefore, post-placement, water quality in the filled area could be better for supporting aquatic communities.

There are no predicted long-term adverse impacts to water quality from placing dredged material at Site 104. Nutrient releases from the sediments under worst case conditions of either complete mixing or no mixing of nutrients with the water column during placement are predicted to result in a return to ambient conditions within ~~six~~ 6 months of placement. It is important to note that because placement will occur during the 15 October to 15 April placement window, by the time nutrient levels are expected to return to ambient conditions (~~six~~ 6 months post-placement), a new placement event may or will have likely occurred. Thus, nutrients in bottom waters at the site in the winter will be slightly to moderately elevated throughout the ~~1- to 9-year~~ placement period. Nutrient impacts to water quality are not expected~~will be localized and seasonal~~, and food-chain-effects, although not modeled, are not expected to be significant.

Changes to salinity conditions upstream of Site 104 were modeled by the CH3D model in response to concerns related to the impacts of reduced water depths on the ability of the salt wedge to move up the Bay. These conditions were modeled as long-term impacts only, assuming near-complete filling of Site 104 to the -45 f~~oo~~t MLLW contour. The study performed by WES (1998) found a mean decrease in salinity of < 0.1 ppt to pre-placement conditions at the Chesapeake Bay Program MCB3.2 station (due east of the Patapsco River, north of Site 104) after ~~four~~ 4 of ~~five~~ 5 years of placement at Site 104.

Smaller net changes in salinity were observed, when compared to background at the other MCB stations that extend up the Bay to Pooles Island and beyond. Mean changes in the more northern station appeared to be less than 0.05 ppt. In some cases, salinities increased, for unknown reasons. Changes were concentrated in the time periods before and after calendar days 100 to 150, during that period, and essentially no change was predicted by the model. These days would correspond to the spring freshet, when it is assumed that fresh water from the Susquehanna pushes higher salinity waters further down the Bay and results in essentially fresh water for most of the upper Bay. This timing would indicate no impacts from enhanced salinities to anadromous fish spawning concentrations. Natural inter-annual variability in salinity from one year to the next is generally much greater than the 0.05 to 0.1 change predicted at the times before and after calendar days 100 to 150, -so limited impacts are expected from this potential change. The ecosystem of the Chesapeake Bay is adapted to respond to widely varying fluctuations in salinity due to impacts from drought and excessive rainfall. These fluctuations can span a change~~s~~ of 10 ppt from the surface to the bottom of deep water in the Bay, and can change the salinity by 5 to 10 ppt over a period of days of heavy rainfall. -For these reasons, the small changes in salinity which have been modeled for this proposed action are not projected to result in negative impacts.

There will be no long-term turbidity impacts. Elevated levels of water column turbidity will be short-term and localized during placement. Bottom turbidity will remain slightly elevated while the material consolidates and settles. While depth and water quality conditions are different at Site 104, when compared to the extensively studied Pooles Island sites, these impacts are similar to impacts observed at other open--water placement areas in the upper Bay.

6.1.5 Sediment

6.1.5.a Sediment Composition. Maintenance sediments from the following channels were collected through piston cores taken by MGS in January 1998 and analyzed by WES for use in the modeling studies (WES 1998): Craighill Angle, Cutoff Angle, Brewerton Channel Eastern Extension, Tolchester, and Swan Point. These samples represent approximately 85% of the maintenance material targeted for placement at Site 104 and are typical of the majority of maintenance material likely to be placed. The other 15% of material will originate from approaches to the C&D Canal and the upper Tolchester Channel and is likely to be similar in composition to the sediments used in the modeling studies. Results from an analysis of a composite made from the core samples revealed a water content of 67.44% and an organic content of 10.1%. The sediment particle size was follows: mean of 10.88×10^{-6} meters (3.57×10^{-5} feet), median of 6.02×10^{-6} meters (1.98×10^{-5} feet), and standard deviation of 14.2×10^{-6} meters (4.66×10^{-5} feet). Silt and clay are defined as particle sizes $< 50 \times 10^{-6}$ meters (15.10×10^{-5} feet). The majority of sediment proposed for dredging is primarily comprised of silt and clay particles. All sediments to be placed at Site 104 have been tested or will be tested prior to placement at the site.

Based on data obtained from Site 104 (see Section 5.1.5.a), sediments in the Site 104 area consist primarily of very soft to soft gray silty clay with localized pockets of silty sand and red-brown silty clay (E2Si 1997, MGS 1997, EA 1998). The proposed action will not change the physical characteristics of the sediment in the area because the sediments proposed for placement are primarily silt and clay particles.

6.1.5.b Sediment Quality Impacts. Based on chemical analysis of the existing sediments at Site 104 and Tier II evaluations (EPA/USACE 1998), the sediment quality at Site 104 is expected to improve as the result of placement activities. A review of the relative priority pollutant concentrations in existing Site 104 sediments was compared to channel sediments proposed for placement. Metals concentrations for this comparison are presented in Table 5-~~20~~16, along with the NOEL and PEL values for each metal. This table shows that mean metals concentrations in existing Site 104 sediments, excluding sample site KI-7, are similar but somewhat higher than the metals concentrations in the channel sediments which are proposed for placement at Site 104. Sample KI-7 in Site 104 had metals concentrations at least 10 times higher for almost all metals than those in the channels proposed for placement in Site 104, and when this sample is added to the mean sediment quality at Site 104, all values except nickel exceeded the channel means. As was discussed in Section 5, the finding of some unclean sediments within Site 104 could be due to the placement of unclean inner harbor sediments in Site 104 from actions starting in 1924 and continuing to the 1970s.

While both the channel sediments and Site 104 sediments had a majority of mean metals concentrations which exceeded the NOEL values, all channel sediments had mean values less than the PELs. Most of the mean channel sediment concentrations of heavy metals were less than that of Site 104, indicating a potential improvement in sediment quality for benthic organisms if channel sediments cover or "cap" the in-place sediments at Site 104. This improved sediment quality for benthic organisms could help the benthic populations, although the anoxia which occurs annually only allows limited repopulation in the fall and spring. The risk of potential human health impacts due to exposure to arsenic that exceeds the soil RBCs will be reduced if channel sediments cover existing sediments at Site 104.

The physical composition of sediment at Site 104 will not be impacted by placement activities. A review of the sediment composition from samples in the channels and samples collected in Site 104 shows very similar particle sizes, with sediments in both Site 104 and in the channels consisting of predominantly silty clays to clayey silts. Therefore, the physical composition (i.e. particle size) of the sediments is not expected to change.

Overall, no negative impacts related to sediment quality are predicted, and a potential positive long-term impact would result from capping the contaminated sediments that exist at KI-7 within Site 104 with cleaner channel sediments.

6.1.6 Aquatic Resources

6.1.6.a Plankton. In the short-term, increases in turbidity associated with dredged material placement by controlled bottom-release scow could suppress light penetration into the water column and, therefore, locally depress the phytoplankton community. The proposed placement schedule (mid-October through mid-April) should minimize potential effects on the phytoplankton population because the primary phytoplankton productivity is already depressed due to the decreased daylight and temperatures. Turbidity associated with dredged material placement by hydraulic pump-out placement is not expected to have short-term or long-term effects on the phytoplankton population because there would be no turbidity occurring in the photic zone.

For mechanical placement by bottom-release scow, there will be some direct mortality to phytoplankton and zooplankton as the result of entrainment in the turbidity plume during placement events. This mortality is not expected to significantly impact or be detrimental to local phytoplankton or zooplankton populations.

Effects from enhanced nutrient release were modeled. Under a worst-case scenario of complete mixing and release of nutrients at the time of placement, a slight stimulatory effect on spring algal concentrations was observed, but this effect did not continue into the summer. Under a scenario of no mixing with releases in the next summer after placement, no impacts on phytoplankton populations were projected.

Overall, the short-term effects on the phytoplankton are~~,~~ expected to be negligible. As a result, zooplankton communities that are dependent on phytoplankton densities are not expected to be limited by food availability. Effects on photosensitive zooplankton species due to localized light penetration are expected to be short lived due to current exchanges and rapid settling of most of the materials. Short-term impacts to zooplankton would be temporarily significant; however, no medium or long-term impacts are expected. Temporary significant impacts would include inability to forage and potential loss of organisms in the water column that are entrained in the turbidity plume. It is important to note that Site 104 is within the southern portion of the turbidity maximum area and therefore already experiences significant turbidity events from discharge from the Susquehanna and other nearby river systems. Long-term impacts to phytoplankton productivity due to nutrient releases are also expected to be negligible. Although nutrient concentrations at the site will be slightly elevated throughout the 1- to 9-year placement period, effects to phytoplankton communities, although not modeled, are not expected to be significant. Seasonal placement is also expected to be planned for seasons of the year when phytoplankton activity -and zooplankton populations are depressed, thus~~,~~ minimizing any impact to larger populations that would occur during the -warmer months.

~~**6.1.6.b** Fisheries.~~

~~**Potential Impacts to Finfish**~~

~~Adverse impacts to the resident finfish communities will be short-term and minimal. Due to their mobility, finfish are affected by placement operations much less than benthic~~

~~macroinvertebrates. However, larval and juvenile life stages are less mobile than adults are. As such, placement operations should be avoided during peak reproductive periods. Table 6-6 shows critical life stages of target species and harvest seasons overlaid with the placement operations window. Critical life stages of target species were chosen based on spawning, larval and juvenile development intervals. Habitat requirements of these target species were outlined and discussed in Section 5.1.6.b. The dredged material placement window shown in Table 6-6 avoids significant impacts to commercially and recreationally valuable fish species during their critical life stages. In addition, most commercial and recreational fishing effort takes place north of the "RWLP" buoy (Figure 2-1) and along the shallows east of Site 104 . The hatched bars in Table 6-6 indicate that the habitat necessary for the critical life stages development takes place outside of Site 104. Table 6-6 also shows recreational and commercial fishery seasons overlaid with the recommended dredging operations window for Site 104.~~

~~More mobile members of the pelagic (e.g., menhaden, striped bass) and demersal fish community (e.g., flounders, oyster toadfish) are expected to move out of or generally avoid the area during placement. The fishes most affected would be the smaller, less mobile resident species and young fish that may utilize the area for staging between nursery areas and overwintering areas. Increased turbidity may cause migrating fish to alter their course to avoid the plume.~~

~~Two species of fish, striped bass and white perch, support an extensive fishery in Maryland and are known to inhabit the waters of Site 104 (Section 5.1.6.b). The proposed placement is not expected to significantly impact the striped bass population because Site 104 does not support conditions necessary for critical life stages. The proposed placement is also not expected to negatively impact the white perch population because spawning takes place in tributaries and along shorelines. In addition, the existing abiotic water quality conditions (e.g., salinity ranges) at Site 104 are not suitable for the development of eggs and larvae. Overall, placement is not expected to negatively effect the striped bass and white perch commercial and recreational fishing industry because most fishing effort takes place north of the "RWLP" buoy.~~

~~No impact is anticipated for alewife, American shad, weakfish, hickory shad, white perch and yellow perch because spawning and early life stages occur outside of the Site 104 area in tributaries of the Bay. The critical life stages of winter flounder are also not anticipated to be impacted because spawning takes place in shallow water during the winter. Known winter flounder spawning areas include the Patapsco, Sassafras and Chester Rivers.~~

~~Potential impacts to shortnose sturgeon, a federally endangered species, are not known at this time. However, use of Site 104 should not impact spawning activities since spawning would occur in the tributaries. An interim Biological Assessment will integrate information collected from the two-year sturgeon monitoring program and will assess potential placement impacts. The proposed project cannot proceed unless NMFS decides that the interim Biological Assessment provides sufficient data to issue an opinion on the potential impacts of open-water placement on shortnose sturgeon, prior to the completion of the 2-year study being conducted by the Baltimore and Philadelphia Districts (Section 5.1.8).~~

~~The burial of benthic macroinvertebrates (further discussed in Section 6.1.6.c Impacts to Benthics) temporarily reduces the size of the benthic population available for consumption by finfish. (See Section 6.1.6.c for more information on Benthics). This may impact benthic-feeding finfish populations that use these areas as feeding grounds in the winter. Atlantic croaker was the most abundant bottom-feeding fish that was observed in the winter months at Site 104.~~

~~While most fish experience reduced metabolism and reduced need for food in the winter, the loss of benthic organisms during placement years could result in fish moving to nearby unimpacted areas to feed and possible increased competition for benthic food resources in other areas. Placement is not projected to result in a long-term change in the benthic community which currently exists at Site 104, as the site is expected to be re-colonized within 18 months after cessation of all placement activities based on studies conducted by the MDE (1998b). The temporary reduction in benthic populations will last for the 1- to 9-year placement duration. These studies generally indicated rapid re-colonization by pioneer species and the eventual re-colonization by a climax benthic community. Some studies have indicated that the re-colonization by long-lived species takes much longer. This is not a factor in Site 104 because of the annual die-off of benthic organisms due to low-oxygen conditions in the late spring and summer which limits long-lived benthics at the site (Section 6.1.6.c).~~

~~Fish habitat is anticipated to change from waters of a maximum depth of -23.8 meters (-78 feet) MLLW to waters of -13.7 meters (-45 feet) MLLW in Site 104. The impact of these changes is not anticipated to be significant, because the existing bathymetry in Site 104 does not provide a substantial amount of features considered important for fish habitat. Important habitats include: rocks or shell reefs that provide protection from predators and feeding areas; overwintering areas; shallow-water areas that are used as nursery grounds for newly-hatched fish (generally, depths less than 1.8 meters (6 feet); and hard bottom substrates (used by some species for spawning). No fish habitat structures have been located by bathymetry surveys and side-scan sonar studies within Site 104. No fish habitat structures are expected to be impacted by the placement activities.~~

~~Finfish and sensitive spawning periods are not expected to be affected by elevated turbidity in the water column or by nutrient releases from the bottom sediments. Finfish in the Bay are generally used to and tolerant of turbid water quality. It is expected that finfish in the vicinity of Site 104 will leave the site during placement events. In addition, no placement will occur during spawning season. Turbidity levels at the site are expected to be elevated for approximately 20-30 minutes during and after each placement event. This effect would be more distributed in the water column for controlled bottom-release scow placement than for a pump-out barge, which would confine the material within a pipeline directed to the bottom, and place the material just above the bottom. These intermittent increases in turbidity would last each year for the duration of the placement events. The total duration would depend upon how long each placement action took. The recommended placement duration each year is six months. Therefore, intermittent periods of localized turbidity could occur during a six month placement period, but localized turbidity would not be continuously elevated at the site for a six month period. It is expected that demersal (bottom dwelling) species would potentially be more impacted by placement activities than pelagic (water column) species.~~

Nutrient releases that could potentially occur post-placement are not expected to impact sensitive lifestages or spawning activities because nutrient releases during spawning periods are expected to be very small due to low water temperatures.

In the long-term, finfish communities in the Site 104 area may be positively impacted as a result of placement activities. The depth change at the site will improve water quality and change the water column dynamics from a deep water area to a mid-depth water area. As a result, although not modeled, primary productivity in the immediate vicinity could increase, thus fueling the bottom of the food chain (at a localized level). Generally, shallow water areas are considered to be more valuable and productive habitat for aquatic organisms. Directly after placement there may be a lack of benthic food resources for finfish. After the benthic communities begin to re-establish, however, the communities may actually be more prolific and provide more abundant food resources for bottom-feeding fish than pre-placement, if the duration and extent of anoxia is reduced. Thus, in the long-term, it is possible that placement activities at Site 104 will actually enhance the fish habitat and food resources in the immediate vicinity of the Site.

Potential Impacts to Shellfish

Oysters are not known to occur within Site 104. The closest oyster bar that has been harvested in recent years is the Broad Creek Bar which is located at the southeastern side of Site 104 (Scott 1998). Broad Creek is adjacent to the proposed placement area. No impacts are anticipated for this bar because it is outside of the placement area, and models have predicted that sediment transport will be predominantly to the north (Section 6.1.3.g).

Peak densities of softshell clams along the eastern shore of the Chesapeake are found from the Eastern Bay to Pocomoke Sound, particularly at depths of less than 5.2 meters (17 feet) along the shoreline (Baker and Mann 1991). The proposed placement activity is not expected to adversely effect softshell clam densities because the minimum depth at Site 104 is -12.8 meters (-42 feet).

Blue crabs utilize nearly every habitat type in the Bay during some stage of their lifecycle. During the fall, female crabs begin their migration to the lower Bay and adult males migrate to deeper waters from the Bay tributaries to overwinter. Although the Chesapeake Bay Winter Dredge Surveys performed by MDNR have found overwintering males in Site 104 boundaries during the proposed placement window, the survey indicates that hibernating blue crab densities are generally lower in areas greater than -12.2 meters (-40 feet) (Alexi Sharov MDNR 1998). The blue crabs present in water greater than -12.8 meters (-45 feet) MLLW within the portion of Site 104 where placement would occur, would likely be covered by material. The impact to crab densities should be minimal since the densities are lower at these greater depths and it is primarily the male crab that would be impacted. Also, estimates of crab densities at the site indicate that Site 104 has low crab densities (59.9/1000 m^2) relative to other areas of the upper Bay (88.95/1000 m^2) and the average for Maryland portions of the Bay (101.10/1000 m^2). Impact to populations and migratory patterns of the blue crab, therefore, is not anticipated because female migration to the lower Bay will be completed before the placement activities begin each year, and females will migrate north to lower salinities after placement activities cease each year.

In summary, it is expected that the proposed dredged material placement at Site 104 would have a short-term negative effect on the shellfish community and a long term positive effect. These results would be consistent with observations made in conjunction with the placement of dredged material in the Pooles Island open-water placement sites.

6.1.6.c Benthic Community. The upper Bay is considered a naturally unstable environment with a benthic community dominated by opportunistic species (refer to Section 5.1.6.c). This environment is considered unstable due to the fluctuating salinity, seasonal anoxia in deep water areas, and periods of high turbidity during high inflows from the Susquehanna. Proposed dredged material placement would permanently raise the bottom in this area to -13.7 meters (-45 feet) from the current elevations, which range from -12.8 meters (-42 feet) to 23.8 meters (-78 feet). This is not projected to result in a long-term change in the benthic community that currently exists at Site 104. Mortality due to placement is considered a significant, but temporary short-term impact in an already unstable environment. The site is expected to be recolonized within 18 months after cessation of all placement events, based on studies conducted by MDE and others (e.g., Cronin 1970, Gross *et al.* 1976). Recolonization occurs both through in-place survival of a portion of the populations, and by an influx of individuals from adjacent unaffected areas. A key component of the temporary nature of the projected impacts is that the dredged material composition is similar to the existing substrate composition allowing for rapid recolonization of similar species (Cronin *et al.* 1970). The substrate in Site 104 is predominantly a silty clay composition similar to the upper Bay. The material dredged from the channels would have a similar composition because it is from shoaling of sediment that is flushed into the upper Bay from the Susquehanna River and shoreline erosion.

Research has shown that benthic communities in dredged material placement areas are completely disrupted during and immediately after placement, but that they are recolonized within twelve to eighteen months after the end of placement (Ruddy 1990; Cronin *et al.* 1970; MDE *et al.* 1996). Research by Cronin *et al.* (1970) indicated that immediately after placement there was a 71% decrease in the average number of individuals per sample within a dredged material placement area and an 11% increase in stations outside the placement area. The increase in stations outside the placement area was partially attributed to hydrologic pushing or migration of individuals out of the placement area during or after placement. The increase in the number of individuals outside of the area may have also contributed to the rapid recolonization of the area as the opportunistic benthic macroinvertebrates typical to the upper Bay rapidly reproduced or relocated in response to the decrease in abundance. Long-lived species such as bivalves are slower to recolonize. In addition to this research, Cronin *et al.* (1970) recommended that placement occur from late fall to early spring to avoid the period of high species diversity and organism distribution and thereby, cause the least amount of impact to the benthic community. The proposed dredged material placement window for Site 104 would be from 15 October and 15 April each dredging year.

Overall, the benthic communities at the site will return to pre-placement conditions after all placement activities cease. Some partial recolonization is expected to occur after each placement event. However, theses communities are expected to die off by naturally-occurring summer anoxia events that are likely to occur between yearly placement windows. Thus, benthic production will be repressed in the area throughout the 1- to 9-year placement period.

As discussed in Section 5.1.6.c, the low mesohaline mud substrate portions of the Bay are considered areas that have high macroinvertebrate productivity when compared to areas further south. Therefore, temporary impacts to the benthic community from placement during a period of low species diversity and organism distribution would not have a long-term impact on an area that already has high macroinvertebrate productivity. In support of this concept, Cronin *et al.* (1970) observed no gross effect of dredged material placement on phytoplankton primary productivity, zooplankton, fish eggs and larvae, and fish immediately after placement, all of which are populations that would have been directly affected by changes in the benthic community.

Benthic assemblage studies in Pooles Island areas G-Central, D, E and F (see Figure 1-2), after dredged material placement of similar volumes and types proposed for Site 104, indicated that the benthic assemblages recover from localized placement effects within nine to eleven months after placement (Ranasinghe and Richkus 1993). Versar (1994) found a more rapid recovery in the aforementioned areas as well as in G-South than in Areas G-West, A and B. The lack of immediate recovery in G-West has been attributed to the continuous placement of dredged material annually and the lack of sufficient time (twelve to eighteen months post-placement) without placement activities occurring for the area to recover (MES 1997). Some repopulation of the benthic population at Site 104 would be expected to occur from areas inside the site not utilized for placement operations during a given year, even under the projected placement schedule at Site 104 which calls for placement on an annual basis. Versar (1994) also found that areas of bottom-release scow placement of dredged material had lower species diversity and lower total abundance in the first eight months post-placement than hydraulic placement areas. While exact reasons for this are unknown, it has been speculated that the increased density of bottom-release scow material results in longer periods before recolonization, compared to the less dense hydraulically placed material. Hydraulically placed material can also be placed in thinner lifts. These thinner lifts may allow some benthic organisms an opportunity to move up and out of the dredged material, rather than experiencing mortality through burial.

MDE (1996) conducted a study at G-South prior to 1996/1997 placement activities to verify the recovery of the resident benthic community subsequent to earlier placement of dredged material in 1993. The results of the study suggested that the benthic community at the G-South site was healthy and met the Chesapeake Bay Benthic Restoration Goals and the Chesapeake Bay Benthic Index of Biotic Integrity. Scores of three or greater were considered as meeting the Chesapeake Bay restoration goal. The benthic community in G-South met or exceeded RGI and B-IBI goals for the upper Chesapeake Bay within approximately 3-years post-placement and there was no notable difference between the sampling stations and reference station.

Although there will be short-term, localized adverse impacts to the benthic communities at Site 104, in the long-term, benthic communities in the site may be positively impacted as a result of placement activities. The depth change at the site will improve water quality and change the water column dynamics from a deep water area to a mid-depth water area. Generally, shallower water areas are considered to be more valuable and productive habitat for aquatic organisms. In addition, the extent and duration of seasonal hypoxia and anoxia is expected to be reduced in the area after placement occurs. This will provide the benthic communities a longer growing season.

~~The improved sediment quality, created by covering the existing contaminated sediment, will also enhance the benthic environment. The changes in depth, water quality, and sediment quality will provide a long-term positive effect on the local benthic communities.~~

~~In summation, it is expected that, as has been seen in other dredged material placement areas, placement in Site 104 would have a short-term, near-field effect on the benthic community. This is not expected to significantly impact the benthic community or their predators due to the existing annual benthic die off during the seasonal anoxia in the bottom waters. The benthic community is expected to remain of poor quality when compared to Chesapeake Bay restoration goals, but would be expected to recover to pre-placement conditions within twelve to eighteen months after all placement was completed. In addition, the improved water quality and sediment quality at the site post-placement will provide a more favorable environment for benthic productivity.~~

6.1.6.b Fisheries.

Potential Impacts to Finfish

Adverse impacts to the resident finfish communities will be short-term and minimal. Due to their mobility, finfish are affected by placement operations much less than benthic macroinvertebrates. However, larval and juvenile life stages are less mobile than adults are. As such, placement operations should be avoided during peak reproductive periods. Table 6-6 shows critical life stages of target species and harvest seasons overlaid with the placement operations window. Critical life stages of target species were chosen based on spawning, larval and juvenile development intervals. Habitat requirements of these target species were outlined and discussed in Section 5.1.6.b. Note that critcal habitat for shortnose sturgeon and Atlantic sturgeon have yet to be determined in the Chesapeake Bay. Potential impacts to these species are discussed in detail in Section 6.1.8. The dredged material placement window [If it is decided to shorten this window from March to April because of the White Paper we should reduce the window in Table 6-6 to reflect this change] shown in Table 6-6 avoids significant impacts to commercially and recreationally valuable fish species during their critical life stages. In addition, most commercial and recreational fishing effort takes place north

Table 6-6 Critical Life Stages and Fishing Seasons Overlaid with the Recommended Dredging Operations Window for Site 104.

ENVIRONMENTAL FACTOR	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE
CRITICAL LIFE STAGE												
SHORTNOSE STURGEON												
ATLANTIC STURGEON												
ALEWIFE												
AMERICAN SHAD, HICKORY SHAD												
ATLANTIC MENHADEN												
BAY ANCHOVY												
BLUEBACK HERRING												
SUMMER FLOUNDER												
BLUEFISH												
OYSTER TOADFISH												
STRIPED BASS												
WHITE PERCH												
WINTER FLOUNDER												
YELLOW PERCH												
WEAKFISH												
BLUE CRAB												
EASTERN OYSTER												
SOFT-SHELL CLAM												
RECREATIONAL FISHERY												
STRIPED BASS SEASON*												
BLUE CRAB SEASON*												
COMMERCIAL FISHERY												
STRIPED BASS DRIFT GILL NET SEASON*												
STRIPED BASS HOOK AND LINE*												
STRIPED BASS POUND NET*												
BLUE CRAB SEASON*												

*= Seasons fluctuate annually based on Management Effort and Total Harvest.

Note: Critical life stages of other species are not presented in this table because their critical life stages do not overlap with the typical dredging window.

Cross-hatching indicates that Site 104 does not support habitat crucial to critical life stages. Critical Habitat for this species has yet to be determined by NMFS.

Sources: Critical life stages adapted from information presented in the Chesapeake Bay Program's *Habitat Requirements for Chesapeake Bay Living Resources* and Setzler-Hamilton 1987 of the "RWLP" buoy (Figure 2-1) and along the shallows east of Site 104-[Update with information from Recreational Fish meeting]. The hatched bars in Table 6-6 indicate that the habitat necessary for the critical life stages development takes place outside of Site 104. Table 6-6 also shows recreational and commercial fishery seasons overlaid with the recommended dredging operations window for Site 104.

More mobile members of the pelagic (e.g., menhaden, striped bass) and demersal fish community (e.g., flounders, oyster toadfish) are expected to move out of or generally avoid the area during placement. The fishes most affected would be the smaller, less mobile resident species and young fish that may utilize the area for staging between nursery areas and overwintering areas. Increased turbidity may cause migrating fish to alter their course to avoid the plume.

Two species of fish, striped bass and white perch, support an extensive fishery in Maryland and are known to inhabit the waters of Site 104 (Section 5.1.6.b). The proposed placement is not expected to significantly impact the striped bass population because Site 104 does not support conditions necessary for critical life stages. The proposed placement is also not expected to negatively impact the white perch population because spawning takes place in tributaries and along shorelines. In addition, the existing abiotic water quality conditions (e.g., salinity ranges) at Site 104 are not suitable for the development of eggs and larvae. Overall, placement is not expected to negatively effect the striped bass and white perch commercial and recreational fishing industry because most fishing effort takes place north of the "RWLP" buoy [Update with findings from Recreational Fishers Meeting].

No impact is anticipated for alewife, American shad, weakfish, hickory shad~~, white perch~~ and yellow perch because spawning and early life stages occur outside of the Site 104 area in tributaries of the Bay. Potential impacts to shortnose sturgeon, a federally endangered species, are discussed in Section 6.1.8.

The Magnuson-Stevens Fisheries Conservation and Management Act (MSFCMA) (16 USC 1801) requires that federal agencies consult with NMFS regarding any action or proposed action authorized, under, or undertaken by the agency that may adversely affect Essential Fish Habitat (EFH) identified under the Act. EFH that could potentially be impacted by placement activities at Site 104 are bluefish, winter flounder and summer flounder habitats. An analysis of impacts on each species follows. [PLEASE NOTE: the following paragraphs were generated from text written by Mark Mendelsohn for the EFH consultation; we NEED CITES and verification for the information presented in the THE FOLLOWING PARAGRAPHS]

No impacts to spawning, egg or larvae habitat of the bluefish are projected because spawning does not occur in the Chesapeake Bay and the eggs and larvae do not occur in the Site 104 area. There are no impacts expected for adult and juvenile bluefish because the proposed placement window occurs during a time in their lifecycle when they are overwintering off of the southeastern coast of Florida. According to the proposed dredged material placement window placement activities would be ending before bluefish begin their migration into the Chesapeake Bay. Adults are not typically bottom feeders and are strong swimmers that can easily avoid turbid conditions. Juveniles prefer shallower waters [Need a definition of shallow water habitat in this case from Mark Mendelsohn] than that found in Site 104. Therefore, no significant impacts are expected to adults or juveniles during the proposed placement activities. [THIS PARAGRPAH NEED CITES FROM MARK MENDELSOHN]

Adult summer flounder would not likely be in the project area during the proposed placement window because they overwinter in the Ocean. Juveniles prefer shallower waters [NEED A DEFINITION OF SHALLOW WATER HABITAT IN THIS CASE FROM MARK MENDELSOHN'S RESEARCH] than what is presently found at Site 104. Therefore, no significant impacts are expected to adults or juveniles during the proposed placement activities. No impacts to spawning or summer flounder eggs are projected because spawning occurs during the offshore ocean migration which is not located in the Chesapeake Bay and the eggs do not occur in the Site 104 area. Larvae could be present in the project area because they begin to migrate into the Bay in October. However, because of the timing of the placement window the larvae that could potentially use the shallow water areas near Site 104 would not be in great enough numbers to cause a significant impact. [THIS PARAGRPAH NEED CITES FROM MARK MENDELSOHN]

Winter flounder adults and juveniles are in the bay during the time of the year (winter) when Site 104 contains enough dissolved oxygen to support a benthic community. Some food sources (benthics) may be lost during material placement. Site 104 is not considered to be a significant resource for the winter flounder because of the annual depression of benthic species in the area due to yearly severe anoxic events. Some food sources for the juveniles may be lost, however, juveniles are expected to occur more frequently in more shallow water. [THIS PARAGRPAH NEED CITES FROM MARK MENDELSOHN]

The critical life stages of winter flounder are not anticipated to be impacted because spawning takes place from mid-February to mid-March in shallow waters [NEED A DEFINITION OF SHALLOW WATER HABITAT IN THIS CASE FROM MARK MENDELSOHN'S RESEARCH] during the winter. Known winter flounder spawning areas include the Patapsco, Sassafras and Chester Rivers. Winter flounder eggs stick to the bottom and are not transported out of the shallows. The winter flounder larvae is strongly attracted to the bottom (demersal) so its is unlikely that it would reach Site 104 during placement window. If larvae are transported to the site by currents it is unlikely likely that larvae would survive. However, the amount of larvae that could be in the site is considered very small and would not contribute significantly to the decline of the overall population if lost. [THIS PARAGRPAH NEED CITES FROM MARK MENDELSOHN]

~~The critical life stages of winter flounder are also not anticipated to be impacted because spawning takes place in shallow water during the winter. Known winter flounder spawning areas include the Patapsco, Sassafras and Chester Rivers.~~

~~Potential impacts to shortnose sturgeon, a federally endangered species, are not known at this time. However, use of Site 104 should not impact spawning activities since spawning would occur in the tributaries. An interim Biological Assessment will integrate information collected from the two-year sturgeon monitoring program and will assess potential placement impacts. The proposed project cannot proceed unless NMFS decides that the interim Biological~~

~~Assessment provides sufficient data to issue an opinion on the potential impacts of open water placement on shortnose sturgeon, prior to the completion of the 2-year study being conducted by the Baltimore and Philadelphia Districts (Section 5.1.8).~~

The burial of benthic macroinvertebrates (further discussed in Section 6.1.6.c Impacts to Benthics) temporarily reduces the size of the benthic population available for consumption by finfish. (See Section 6.1.6.c for more information on Benthics). This may impact benthic-feeding finfish populations such as winter flounder that use these areas as feeding grounds in the winter. -However during the seasonal fisheries study at Site 104, Miller (1998) documented no winter flounder in or around Site 104 as a result of his sampling program.~~Atlantic croaker was the most abundant bottom feeding fish that was observed in the winter months at Site 104.~~

While most fish experience reduced metabolism and reduced need for food in the winter, the loss of benthic organisms during placement years could result in fish moving to nearby unimpacted areas to feed and possible increased competition for benthic food resources in other areas. Placement is not projected to result in a long-term change [may want to adjust this sentence if the placement timeframe is 9 years] in the benthic community which currently exists at Site 104, as the site is expected to be re-colonized within 18 months after cessation of all placement activities based on studies conducted by the MDE (1998~~b~~). The temporary reduction in benthic populations will last for the [1- to 9-year placement duration]. These studies generally indicated rapid re-colonization by pioneer species and the eventual re-colonization by a climax benthic community. Some studies have indicated that the re-colonization by long-lived species takes much longer. This is not a factor in Site 104 because of the annual die-off of benthic organisms due to low oxygen conditions in the late spring and summer which limits long lived benthics at the site (Section 6.1.6.c).

Blue fish are voracious predators. They are sight feeders throughout the water column, with smaller individuals feeding on a wide variety of fishes and invertebrates and with large bluefish feeding almost exclusively on fishes, particularly menhaden, bay anchovies and Atlantic silversides. Impacts to bluefish prey are not anticipated because species such as bay anchovy, menhaden and Atlantic silversides are not found in depths that are characteristic of Site 104. They are more likely to occur in shallower waters in depths below 25 meters. [MARK MENDELSOHN VERIFY THIS WITH CITE] Since these species are found in shallower waters their critical life stages are believed to be supported by habitat found within Site 104. In addition, Site 104 is not considered a unique or important source of plankton on which these species feed. [THIS PARAGRPAH NEED CITES FROM MARK MENDELSOHN]

Fish habitat is anticipated to change from waters of a maximum depth of -23.8 meters (-78 feet) MLLW to waters of -13.7 meters (-45 feet) MLLW in Site 104. The impact of these changes is not anticipated to be significant, because the existing bathymetry in Site 104 does not provide a substantial amount of features considered important for fish habitat. Important habitats include: rocks or shell reefs that provide protection from predators and feeding areas; overwintering areas; shallow water areas that are used as nursery grounds for newly-hatched fish (generally, depths less than 1.8 meters (6 feet); and hard bottom substrates (used by some species for spawning). No fish habitat structures have been located by bathymetry surveys and side-scan sonar studies

[NEED TO VERIFY WITH MOST RECENT CORPS SURVEY] within Site 104. No fish habitat structures are expected to be impacted by the placement activities.

Site 104 contains deep water habitat in the lower portion of the site. Deep water habitat is considered unique if it provides a warmer water habitat when compared to shallower surrounding waters. These warm habitats are considered important to fish because they provide a thermal refuge during the winter months (overwintering habitat). To evaluate the potential that the deep waters at Site 104 provide unique warm water habitat, two long term Chesapeake Bay Monitoring Program (CBMP) stations, MCB3.1 and MCB3.3C, were analyzed [(Figure 6-?, 6-?)]. Station MCB3.1 is 41 feet deep and is located off of Fairlee Creek in the Upper Bay. Station MCB3.3C is 77 feet deep and is located in the southern end of Site 104. From 1990 to 1998, winter surface water temperatures at the deeper CBMP station, MCB3.3C, ranged from 0.7 to 6.2 °C and the bottom water temperatures ranged from 0.5 to 7.6 °C. The difference in temperatures in any given year ranged from +0.2 to +5 °C between the surface and bottom water at this deep-water station. In comparison, from 1990 to 1998, winter temperatures in the shallower CBMP station, MCB3.1, ranged from 0.7 to 5 °C and the bottom water temperatures ranged from 0.7 to 7.3 °C. The temperatures in any given year ranged from no difference in temperature to a difference of + 4.3 °C between the surface and bottom water at this shallow station. The long-term temperature differences observed between these sites in addition to the water quality monitoring performed by MDE does not indicate that the deep water in Site 104 provides a unique thermal refuge for fish when compared to other surrounding waters in the Bay. It also doesn't indicate a unique thermal refuge in Site 104 when compared to the depths of waters expected in Site 104 after the proposed placement. [PLEASE NOTE THESE ARE PRELIMINARY FINDINGS. MES NEEDS TO QC & VERIFY THIS DATA AND RESULTS THEN DISCUSS WITH TOM MILLER (UMCES)].

Finfish and sensitive spawning periods are not expected to be affected by elevated turbidity in the water column or by nutrient releases from the bottom sediments. Finfish in the Bay are generally used to and tolerant of turbid water quality. It is expected that finfish in the vicinity of Site 104 will leave the site during placement events. In addition, no placement will occur during spawning season. Turbidity levels at the site are expected to be elevated for approximately 20-30 minutes during and after each placement event. [This effect would be more distributed in the water column for controlled bottom-release scow placement than for a pump-out barge, which would confine the material within a pipeline directed to the bottom, and place the material just above the bottom CENAB NEEDS TO DETERMINE PLACEMENT METHOD]. These intermittent increases in turbidity would last each year for the duration of the placement events. [The total duration would depend upon how long each placement action took. The recommended placement duration each year is six months. Therefore, intermittent periods of localized turbidity could occur during a six month placement period, but localized turbidity would not be continuously elevated at the site for a six month period CENAB NEEDS TO DETERMINE LENGTH OF PLACEMENT WINDOW]. It is expected that demersal (bottom dwelling) species would potentially be more impacted by placement activities than pelagic (water column) species.

After April, we expect negligable ~~N~~nutrient concentrations when compared to background conditions. ~~R~~Nurtirent releases that could potentially occur ~~post-placement~~during this period are not expected to impact sensitive lifestages or spawning activities because nutrient releases during spawning periods (after April) are expected to be very small ~~due~~ because of~~to~~ low water temperatures.~~,~~

In the long-term, finfish communities in the Site 104 area may be positively impacted as a result of placement activities. The depth change at the site ~~will~~ may slightly improve water quality and change the water column dynamics from a deep water area (78 feet) to a mid-depth water area (approximately 45 feet in the southern portion of the site). ~~As a result, although not modeled, primary productivity in the immediate vicinity could increase, thus fueling the bottom of the food chain (at a localized level).~~ Generally, shallow water areas are considered to be more valuable and productive habitat for aquatic organisms. Directly after placement there may be a lack of benthic food resources for finfish. After the benthic communities begin to re-establish and could be subject to more intermittent and less severe seasonal hypoxia~~, however,~~ the communities may actually be more prolific and provide more abundant food resources for bottom-feeding fish than pre-placement~~, if the duration and extent of anoxia is reduced.~~ Thus, in the long-term, there is a potential ~~it is possible~~ that placement activities at Site 104 ~~will~~ could ~~actually~~ contribute to enhanced ~~the fish habitat and~~ food resources in the immediate vicinity of the Site.

Potential Impacts to Shellfish

Oysters are not known to occur within Site 104. The closest oyster bar that has been harvested in recent years is the Broad Creek Bar which is located at the southeastern side of Site 104 (Scott 1998). Broad Creek is adjacent to the proposed placement area. No impacts are anticipated for this bar because it is outside of the placement area in shallower depths (between 8 and 25 feet), and models have predicted that sediment transport will be predominantly to the north and along the bottom in deeper water (Section 6.1.3.~~g~~i). Using monitoring from open water placement areas including monitoring of Site 104 and the Pooles Island Area (MES 1991-1997, MDNR 197) it is also expected that any sediment transport would be restricted to areas close to the placement area and impacts to the Broad Creek and the Love Point bar (north of Site 104) are not expected.

Peak densities of softshell clams along the eastern shore of the Chesapeake are found from the Eastern Bay to Pocomoke Sound, particularly at depths of less than 5.2 meters (17 feet) along the shoreline (Baker and Mann 1991). The proposed placement activity is not expected to adversely effect softshell clam densities because the minimum depth at Site 104 is -12.8 meters (-42 feet) and any potential sediment transport would be restricted to areas close to the placement area.

Blue crabs utilize nearly every habitat type in the Bay during some stage of their lifecycle. During the fall, female crabs begin their migration to the lower Bay and adult males migrate to deeper waters from the Bay tributaries to overwinter. Although the Chesapeake Bay Winter Dredge Surveys performed by MDNR have found overwintering males in Site 104 boundaries during the proposed placement window, the survey indicates that hibernating blue crab densities are generally lower in areas greater than –12.2 meters (-40 feet) (~~Alexi Sharov~~ MDNR 1998). The blue crabs present in water greater than -12.8 meters (-45 feet) MLLW within the portion of Site 104 where placement would occur, would likely be covered by material. The impact to crab densities should be minimal since the densities are lower at these greater depths and it is primarily the male crab that would be impacted. Also, estimates of crab densities at the site indicate that Site 104 has low crab densities ~~(59.9/1000 m^2)~~ relative to other areas of the upper Bay ~~(88.95/1000 m^2)~~ and the average for Maryland portions of the Bay ~~(101.10/1000 m^2)~~ [MES will need to update this with information from Glen Davis]. Impact to populations and migratory patterns of the blue crab, therefore, is not anticipated because female migration to the lower Bay will be completed before the placement activities begin each year, and females will migrate north to lower salinities after placement activities cease each year.

In summary, it is expected that the proposed dredged material placement at Site 104 would have a short-term negative effect on the ~~shellfish~~ benthic community. There is a potential for ~~and~~ a long term positive effect on the quality of habitat as a result of placement if the benthic habitat is subject to more intermittent and less severe seasonal hypoxia duration. There is no impact expected to shellfish. Overall, ~~T~~these results would be consistent with observations made in conjunction with the placement of dredged material in the Pooles Island open-water placement sites and past monitoring at Site 104.

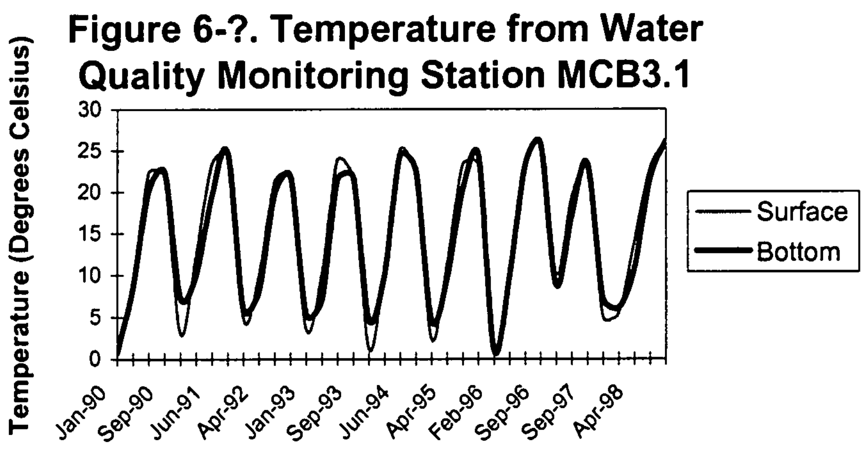
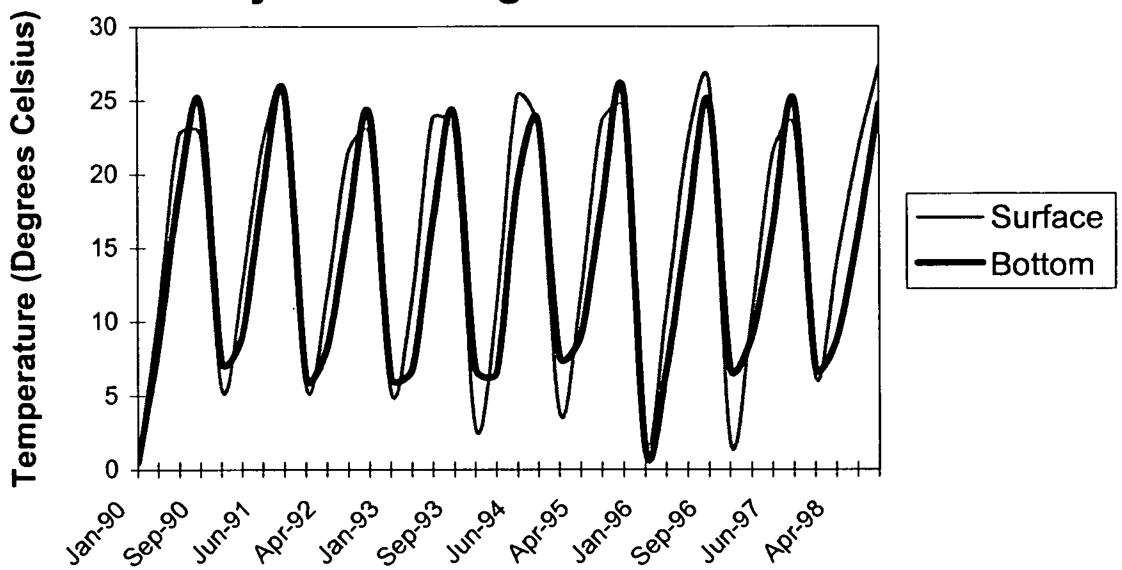


Figure 6-?. Temperature from Water Quality Monitoring Station MCB3.1
Temperature (Degrees Celsius)
30
25
20
15
10
5
0
Jan-90
Sep-90
Jun-91
Apr-92
Jan-93
Sep-93
Jun-94
Apr-95
Feb-96
Sep-96
Sep-97
Apr-98
Surface
Bottom

Figure 6-?. Temperature from Water Quality Monitoring Station MCB3.3C



6.1.6 Aquatic Resources

6.1.6.a Plankton. In the short-term, increases in turbidity associated with dredged material placement by controlled bottom-release scow could suppress light penetration into the water column and, therefore, locally depress the phytoplankton community. The proposed placement schedule (mid-October through mid-April) should minimize potential effects on the phytoplankton population because the primary phytoplankton productivity is already depressed due to the decreased daylight and temperatures. Turbidity associated with dredged material placement by hydraulic pump-out placement is not expected to have short-term or long-term effects on the phytoplankton population because there would be no turbidity occurring in the photic zone. —

For mechanical placement by bottom-release scow, there will be some direct mortality to phytoplankton and zooplankton as the result of entrainment in the turbidity plume during placement events. This mortality is not expected to significantly impact or be detrimental to local phytoplankton or zooplankton populations.

Effects from enhanced nutrient release were modeled. Under a worst-case scenario of complete mixing and release of nutrients at the time of placement, a slight stimulatory effect on spring algal concentrations was observed, but this effect did not continue into the summer. Under a scenario of no mixing with releases in the next summer after placement, no impacts on phytoplankton populations were projected.

Overall, the short-term effects on the phytoplankton are, expected to be negligible. As a result, zooplankton communities that are dependent on phytoplankton densities are not expected to be limited by food availability. Effects on photosensitive zooplankton species due to localized light penetration are expected to be short lived due to current exchanges and rapid settling of most of the materials. Short-term impacts to zooplankton would be temporarily significant; however, no medium or long-term impacts are expected. Temporary significant impacts would include inability to forage and potential loss of organisms in the water column that are entrained in the turbidity plume. It is important to note that Site 104 is within the southern portion of the turbidity maximum area and therefore already experiences significant turbidity events from discharge from the Susquehanna and other nearby river systems. Long-term impacts to phytoplankton productivity due to nutrient releases are also expected to be negligible. Although nutrient concentrations at the site will be slightly elevated throughout the 1- to 9-year placement period, effects to phytoplankton communities, although not modeled, are not expected to be significant. Seasonal placement is also expected to be planned for seasons of the year when phytoplankton activity and zooplankton populations are depressed, thus, minimizing any impact to larger populations that would occur during the warmer months.

6.1.6.b Fisheries.

Potential Impacts to Finfish

Adverse impacts to the resident finfish communities will be short-term and minimal. Due to their mobility, finfish are affected by placement operations much less than benthic macroinvertebrates. However, larval and juvenile life stages are less mobile than adults are. As such, placement operations should be avoided during peak reproductive periods. Table 6-6 shows critical life stages of target species and harvest seasons overlaid with the placement operations window. Critical life stages of target species were chosen based on spawning, larval and juvenile development intervals. Habitat requirements of these target species were outlined and discussed in Section 5.1.6.b. The dredged material placement window shown in Table 6-6 avoids significant impacts to commercially and recreationally valuable fish species during their critical life stages. In addition, most commercial and recreational fishing effort takes place north of the "RWLP" buoy (Figure 2-1) and along the shallows east of Site 104. The hatched bars in Table 6-6 indicate that the habitat necessary for the critical life stages development takes place outside of Site 104. Table 6-6 also shows recreational and commercial fishery seasons overlaid with the recommended dredging operations window for Site 104.

More mobile members of the pelagic (e.g., menhaden, striped bass) and demersal fish community (e.g., flounders, oyster toadfish) are expected to move out of or generally avoid the area during placement. The fishes most affected would be the smaller, less mobile resident species and young fish that may utilize the area for staging between nursery areas and overwintering areas. Increased turbidity may cause migrating fish to alter their course to avoid the plume.

Two species of fish, striped bass and white perch, support an extensive fishery in Maryland and are known to inhabit the waters of Site 104 (Section 5.1.6.b). The proposed placement is not expected to significantly impact the striped bass population because Site 104 does not support conditions necessary for critical life stages. The proposed placement is also not expected to negatively impact the white perch population because spawning takes place in tributaries and along shorelines. In addition, the existing abiotic water quality conditions (e.g., salinity ranges) at Site 104 are not suitable for the development of eggs and larvae. Overall, placement is not expected to negatively effect the striped bass and white perch commercial and recreational fishing industry because most fishing effort takes place north of the "RWLP" buoy.

No impact is anticipated for alewife, American shad, weakfish, hickory shad, white perch and yellow perch because spawning and early life stages occur outside of the Site 104 area in tributaries of the Bay. The critical life stages of winter flounder are also not anticipated to be impacted because spawning takes place in shallow water during the winter. Known winter flounder spawning areas include the Patapsco, Sassafras and Chester Rivers.

Potential impacts to shortnose sturgeon, a federally endangered species, are not known at this time. However, use of Site 104 should not impact spawning activities since spawning would occur in the tributaries. An interim Biological Assessment will integrate information collected from the two-year sturgeon monitoring program and will assess potential placement impacts. The proposed project cannot proceed unless NMFS decides that the interim Biological Assessment provides sufficient data to issue an opinion on the potential impacts of open water placement on shortnose sturgeon, prior to the completion of the 2-year study being conducted by the Baltimore and Philadelphia Districts (Section 5.1.8).

The burial of benthic macroinvertebrates (further discussed in Section 6.1.6.c Impacts to Benthics) temporarily reduces the size of the benthic population available for consumption by finfish. (See Section 6.1.6.c for more information on Benthics). This may impact benthic-feeding finfish populations that use these areas as feeding grounds in the winter. Atlantic croaker was the most abundant bottom feeding fish that was observed in the winter months at Site 104.

While most fish experience reduced metabolism and reduced need for food in the winter, the loss of benthic organisms during placement years could result in fish moving to nearby unimpacted areas to feed and possible increased competition for benthic food resources in other areas. Placement is not projected to result in a long-term change in the benthic community which currently exists at Site 104, as the site is expected to be re-colonized within 18 months after cessation of all placement activities based on studies conducted by the MDE (1998b). The temporary reduction in benthic populations will last for the 1- to 9-year placement duration. These studies generally indicated rapid re-colonization by pioneer species and the eventual re-colonization by a climax benthic community. Some studies have indicated that the re-colonization by long-lived species takes much longer. This is not a factor in Site 104 because of the annual die-off of benthic organisms due to low oxygen conditions in the late spring and summer which limits long-lived benthics at the site (Section 6.1.6.c).

Fish habitat is anticipated to change from waters of a maximum depth of -23.8 meters (-78 feet) MLLW to waters of -13.7 meters (-45 feet) MLLW in Site 104. The impact of these changes is not anticipated to be significant, because the existing bathymetry in Site 104 does not provide a substantial amount of features considered important for fish habitat. Important habitats include: rocks or shell reefs that provide protection from predators and feeding areas; overwintering areas; shallow water areas that are used as nursery grounds for newly hatched fish (generally, depths less than 1.8 meters (6 feet); and hard bottom substrates (used by some species for spawning). No fish habitat structures have been located by bathymetry surveys and side-scan sonar studies within Site 104. No fish habitat structures are expected to be impacted by the placement activities.

Finfish and sensitive spawning periods are not expected to be affected by elevated turbidity in the water column or by nutrient releases from the bottom sediments. Finfish in the Bay are generally used to and tolerant of turbid water quality. It is expected that finfish in the vicinity of Site 104 will leave the site during placement events. In addition, no placement will occur during spawning season. Turbidity levels at the site are expected to be elevated for approximately 20-30 minutes during and after each placement event. This effect would be more distributed in the water column for controlled bottom-release scow placement than for a pump-out barge, which would confine the material within a pipeline directed to the bottom, and place the material just above the bottom. These intermittent increases in turbidity would last each year for the duration of the placement events. The total duration would depend upon how long each placement action took. The recommended placement duration each year is six months. Therefore, intermittent periods of localized turbidity could occur during a six month placement period, but localized turbidity would not be continuously elevated at the site for a six month period. It is expected that demersal (bottom dwelling) species would potentially be more impacted by placement activities than pelagic (water column) species.

Nutrient releases that could potentially occur post-placement are not expected to impact sensitive lifestages or spawning activities because nutrient releases during spawning periods are expected to be very small due to low water temperatures.

In the long-term, finfish communities in the Site 104 area may be positively impacted as a result of placement activities. The depth change at the site will improve water quality and change the water column dynamics from a deep water area to a mid-depth water area. As a result, although not modeled, primary productivity in the immediate vicinity could increase, thus fueling the bottom of the food chain (at a localized level). Generally, shallow water areas are considered to be more valuable and productive habitat for aquatic organisms. Directly after placement there may be a lack of benthic food resources for finfish. After the benthic communities begin to re-establish, however, the communities may actually be more prolific and provide more abundant food resources for bottom-feeding fish than pre-placement, if the duration and extent of anoxia is reduced. Thus, in the long-term, it is possible that placement activities at Site 104 will actually enhance the fish habitat and food resources in the immediate vicinity of the Site.

Potential Impacts to Shellfish

Oysters are not known to occur within Site 104. The closest oyster bar that has been harvested in recent years is the Broad Creek Bar which is located at the southeastern side of Site 104 (Scott 1998). Broad Creek is adjacent to the proposed placement area. No impacts are anticipated for this bar because it is outside of the placement area, and models have predicted that sediment transport will be predominantly to the north (Section 6.1.3.g).

Peak densities of softshell clams along the eastern shore of the Chesapeake are found from the Eastern Bay to Pocomoke Sound, particularly at depths of less than 5.2 meters (17 feet) along the shoreline (Baker and Mann 1991). The proposed placement activity is not expected to adversely effect softshell clam densities because the minimum depth at Site 104 is -12.8 meters (-42 feet).

Blue crabs utilize nearly every habitat type in the Bay during some stage of their lifecycle. During the fall, female crabs begin their migration to the lower Bay and adult males migrate to deeper waters from the Bay tributaries to overwinter. Although the Chesapeake Bay Winter Dredge Surveys performed by MDNR have found overwintering males in Site 104 boundaries during the proposed placement window, the survey indicates that hibernating blue crab densities are generally lower in areas greater than -12.2 meters (-40 feet) (Alexi Sharov MDNR 1998). The blue crabs present in water greater than -12.8 meters (-45 feet) MLLW within the portion of Site 104 where placement would occur, would likely be covered by material. The impact to crab densities should be minimal since the densities are lower at these greater depths and it is primarily the male crab that would be impacted. Also, estimates of crab densities at the site indicate that Site 104 has low crab densities (59.9/1000 m^2) relative to other areas of the upper Bay (88.95/1000 m^2) and the average for Maryland portions of the Bay (101.10/1000 m^2). Impact to populations and migratory patterns of the blue crab, therefore, is not anticipated because female migration to the lower Bay will be completed before the placement activities begin each year, and females will migrate north to lower salinities after placement activities cease each year.

~~In summary, it is expected that the proposed dredged material placement at Site 104 would have a short-term negative effect on the shellfish community and a long-term positive effect. These results would be consistent with observations made in conjunction with the placement of dredged material in the Pooles Island open-water placement sites.~~

6.1.6.c Benthic Community. The upper Bay is considered a naturally unstable environment with a benthic community dominated by opportunistic species (refer to Section 5.1.6.c). This environment is considered unstable due to the fluctuating salinity, seasonal anoxia in deep-water areas, and periods of high turbidity during high inflows from the Susquehanna. Proposed dredged material placement would permanently raise the bottom in this area to -13.7 ~~meters~~ (-45 ~~feet~~) from the current elevations, which range from -12.8 ~~meters~~ (-42 ~~feet~~) to 23.8 ~~meters~~ (-78 ~~feet~~). This is not projected to result in a long-term change in the benthic community that currently exists at Site 104. Mortality due to placement is considered a significant, but temporary short-term impact in an already unstable environment. The site is expected to be recolonized within 18 months after cessation of all placement events, based on studies conducted by MDE and others (e.g., Cronin 1970~~,~~; Gross *et al.* 1976). Recolonization occurs both through in-place survival of a portion of the populations, and by an influx of individuals from adjacent unaffected areas. A key component of the temporary nature of the projected impacts is that the dredged material composition is similar to the existing substrate composition allowing for rapid recolonization of similar species (Cronin *et al.* 1970). The substrate in Site 104 is predominantly a silty clay composition similar to the upper Bay. The material dredged from the channels would have a similar composition because it is from shoaling of sediment that is flushed into the upper Bay from the Susquehanna River and shoreline erosion.

Research has shown that benthic communities in dredged material placement areas are completely disrupted during and immediately after placement, but that they are recolonized within ~~twelve~~ 12 to ~~eighteen~~ 18 months after the end of placement (Ruddy 1990; Cronin *et al.* 1970; MDE *et al.* 199~~6~~5). Research by Cronin *et al.* (1970) indicated that immediately after placement, there was a 71% decrease in the average number of individuals per sample within a dredged material placement area and an 11% increase in stations outside the placement area. The increase in stations outside the placement area was partially attributed to hydrologic pushing or migration of individuals out of the placement area during or after placement. The increase in the number of individuals outside of the area may have also contributed to the rapid recolonization of the area as the opportunistic benthic macroinvertebrates typical to the upper Bay rapidly reproduced or relocated in response to the decrease in abundance. Long-lived species such as bivalves are slower to recolonize. In addition to this research, Cronin *et al.* (1970) recommended that placement occur from late fall to early spring to avoid the period of high species diversity and organism distribution and, thereby, cause the least amount of impact to the benthic community. The proposed dredged material placement window for Site 104 would be from 15 October and 15 April each dredging year.

Overall, the benthic communities at the site will return to pre-placement conditions after all placement activities cease. Some partial recolonization is expected to occur after each placement event. However, theses communities are expected to die off by naturally-occurring summer anoxia events that are likely to occur between yearly placement windows. Thus, benthic production will be repressed in the area throughout the 1- to 9-year placement period.

As discussed in Section 5.1.6.c, the low mesohaline mud substrate portions of the Bay are considered areas that have high macroinvertebrate productivity when compared to areas further south. Therefore, temporary impacts to the benthic community from placement during a period of low species diversity and organism distribution would not have a long-term impact on an area that already has high macroinvertebrate productivity. In support of this concept, Cronin *et al.* (1970) observed no gross effect of dredged material placement on phytoplankton primary productivity, zooplankton, fish eggs and larvae, and fish immediately after placement, all of which are populations that would have been directly affected by changes in the benthic community.

Benthic assemblage studies in Pooles Island areas G-Central, D, E and F (see Figure 1-2), after dredged material placement of similar volumes and types proposed for Site 104, indicated that the benthic assemblages recover from localized placement effects within ~~nine~~ 9 to ~~eleven~~ 11 months after placement (Ranasinghe and Richkus 1993). Versar (1994) found a more rapid recovery in the aforementioned areas as well as in G-South than in Areas G-West, A and B. The lack of immediate recovery in G-West has been attributed to the continuous placement of dredged material annually and the lack of sufficient time (~~twelve~~ 12 to ~~eighteen~~ 18 months post-placement) without placement activities occurring for the area to recover (MES 1997—a, b, or c?). Some repopulation of the benthic population at Site 104 would be expected to occur from areas inside the site not utilized for placement operations during a given year, even under the projected placement schedule at Site 104 which calls for placement on an annual basis. Versar (1994) also found that areas of bottom-release scow placement of dredged material had lower species diversity and lower total abundance in the first ~~eight~~ 8 months post-placement than hydraulic placement areas. While exact reasons for this are unknown, it has been speculated that the increased density of bottom-release scow material results in longer periods before recolonization, compared to the less dense hydraulically placed material. Hydraulically placed material can also be placed in thinner lifts. These thinner lifts may allow some benthic organisms an opportunity to move up and out of the dredged material, rather than experiencing mortality through burial.

MDE (1996d) conducted a study at G-South prior to 1996/1997 placement activities to verify the recovery of the resident benthic community subsequent to earlier placement of dredged material in 1993. The results of the study suggested that the benthic community at the G-South site was healthy and met the Chesapeake Bay Benthic Restoration Goals and the Chesapeake Bay Benthic Index of Biotic Integrity. Scores of three or greater were considered as meeting the Chesapeake Bay restoration goal. The benthic community in G-South met or exceeded RGI and B-IBI goals for the upper Chesapeake Bay within approximately 3-years post-placement and there was no notable difference between the sampling stations and reference station.

Although there will be short-term, localized adverse impacts to the benthic communities at Site 104, in the long-term, benthic communities in the site may be positively impacted as a result of placement activities. The depth change at the site will improve water quality and change the water column dynamics from a deep--water area to a mid-depth--water area. Generally, shallower water areas are considered to be more valuable and productive habitat for aquatic organisms. In addition, the extent and duration of seasonal hypoxia and anoxia is expected to be reduced in the area after placement occurs. This will provide the benthic communities a longer growing season. The improved sediment quality, created by covering the existing contaminated sediment, will also enhance the benthic environment. –The changes in depth, water quality, and sediment quality will provide a long-term positive effect on the local benthic communities.

In summation, it is expected that, as has been seen in other dredged material placement areas, placement in Site 104 would have a short-term, near-field effect on the benthic community. This is not expected to significantly impact the benthic community or their predators due to the existing annual benthic die off during the seasonal anoxia in the bottom waters. The benthic community is expected to remain of poor quality when compared to Chesapeake Bay restoration goals, but would be expected to recover to pre-placement conditions within ~~twelve~~ 12 to ~~eighteen~~ 18 months after all placement was completed. In addition, the improved water quality and sediment quality at the site post-placement will provide a more favorable environment for benthic productivity.

6.1.6.d Submerged Aquatic Vegetation (SAV). SAV is not generally viable in the Chesapeake Bay at depths greater than 2 m~~eters~~ (6.6 f~~eet~~) due to natural light limitations (Hurley 1990; Batiuk *et al.* 1992). The existing depths at Site 104 range between -12.8 m~~eters~~ (-42 f~~eet~~) and -23.2 m~~eters~~ (-78 f~~eet~~) MLLW and therefore, do not support SAV. It is proposed that placement occur in the site up to -13.7 m~~eters~~ (-45 f~~eet~~) MLLW. At this proposed elevation the site would still not support SAV, due to lack of light.

Although there are no SAV beds in Site 104, the following SAV issues were considered: (1) proximity of the proposed placement action to historically documented SAV beds, (2) resulting turbidity plumes from placement activities that may adversely effect SAV in the area, and (3) timing of the placement action in relation to SAV critical life stages. Potential impacts associated with the proposed placement of dredged material at Site 104 have been considered according to the *Guidance for Protecting Submerged Aquatic Vegetation in Chesapeake Bay from Physical Disruption* (CBP 1995), and are discussed below.

The Chesapeake Bay Program's (CBP''s) suggested undisturbed buffer width around SAV beds is 500 yards (CBP 1995). There are no documented SAV beds within the 500 yard buffer (Orth 1996). The closest potential SAV habitat is the shallow water on the western shore of Kent Island. Although most of these potential habitat areas are greater than 500 yards away from Site 104, there ~~are some~~ are some potential habitats ~~potential habitat areas~~ within this suggested buffer area. However, the shallow waters west of Kent Island are quite exposed and unsuitable for SAV growth (Orth 1994). In addition, there is no historical documentation of SAV growth on the shoals of the western shore of Kent Island (field surveys - Orth 1994).

Three ~~One~~ ephemeral SAV beds were~~as~~ identified within 2.5 miles of Site 104 in the past few years. This includes 1 bed in Goose Pond (2.5 nautical miles southwest of Site 104 in 1996) and two beds approximately 1 mile southeast of Site 104 (just above and below the Bay Bridge in 1997). None of the three ephemeral beds were observed before or after their respective siting in 1996 or 1997 (Orth 1996, 1997). ~~near the Bay Bridge in 1997 but was not found before or since. The proposed action is not anticipated to impact the potential SAV habitat areas along the western shoreline of Kent Island.~~ The nearest significant SAV beds to Site 104 are over 4 miles away along the southern shoreline of the Magothy River (Deep Creek mouth) and along the northern shoreline of the Chester River mouth (between Eastern Neck and Eastern Neck Island) (Orth 1997).

The proposed action is not anticipated to impact the potential SAV habitat areas or existing beds. ~~closest SAV habitat on the western shore of the Bay is located near the mouth of the Little Magothy River approximately four miles west of the site (VIMS and USGS 1998). The closest SAV is southeast of the site in Goose Pond (north Hackett Point). This area is enclosed and isolated from the site of the proposed action.~~ Measurements and modeling of the currents flowing through Site 104 (See ~~s~~Sections 5.1.3 and 6.1.3) indicate that the currents run in a predominately north-south pattern with a net movement to the north. Therefore, if a turbidity plume was created during placement activities, it is expected to dissipate very quickly and ~~it~~ should not effect potential SAV habitat to the east, the ephemeral beds to the southeast or southwest, or the existing beds in the Magothy and Chester River areas. ~~located to the east of the site.~~ Any sediment transport is also expected to occur near the bottom of the placement area in deeper waters, not in the shallow, near-shore waters where SAV are located. ~~Several small SAV beds exist in shallow waters near the mouth of the Chester River (VIMS and USGS 1998) (approximately 5 miles away). These beds, however, are not expected to be impacted by placement activities because they are in shallow, near-shore waters.~~ In addition, dredging activities will take place during typical dormant periods for SAV.

6.1.7 Avian/Terrestrial Resources

6.1.7.a Terrestrial Resources. Site 104 is an open-water placement area located 1.6 km (1 mile) from the Kent Island shoreline. There are no terrestrial resources within the project area;~~:~~ therefore there are no impacts to terrestrial resources within the project area.

6.1.7.b Avian Resources. There are three categories of avian resources that could potentially occur within the Site 104 open-water placement area; these are raptor species, waterfowl and seabirds.

Raptor species common to the Bay region include bald eagle (*Haliaeetus leucocephalus*) and osprey (*Pandion haliaetus*). Coordination with MDNR was conducted regarding potential raptor species within the vicinity of Site 104. MDNR stated that no raptor species are known to utilize Site 104 (~~Glen~~-Therres 1997). Both ~~B~~bald eagle and ~~P~~peregrine falcons (*Falco peregrinus*~~),~~) have been identified in the upper Bay region. Peregrine falcons, raptors that are not common to the Bay region, nest on the mainspan of the Bay Bridge. These birds do not, however, utilize Site 104 as a primary feeding area, and their use of the area for feeding habitat is characterized as intermittent (~~Glenn~~-Therres 1997). In addition, there is abundant comparable habitat within the region. There are no expected impacts to the peregrine falcons residing on the Chesapeake Bay Bridge or to other raptor species common to the Chesapeake Bay region.

There are numerous waterfowl species common to the Chesapeake Bay region including wood duck (*Aix sponsa*), American black duck (*Anas rubripes*), canvasback (*Aythya valisineria*), lesser scaup (*Aythya affinis*), bufflehead (*Bucephala albeola*), common goldeneye (*Bucephala clangula*) and redhead (*Aythya americana*). Waterfowl concentration studies that had been conducted in the Bay region by USFWS were used to determine if a significant waterfowl population was present in Site 104. The USFWS studies included limited surveys of the Site 104 vicinity and indicated that majority of the waterfowl sightings were to the north and west of Site 104 (~~Doug~~-Forsell 1997). Some waterfowl species such as canvasback and redhead feed on SAV. Based on the above studies and the fact that water depths are greater than those required to support SAV (see Sections 5.1.6.d and 6.1.6.d), it was determined that Site 104 does not appear to support a significant waterfowl population (~~Doug~~-Forsell 1997). Coordination was also completed with the Environmental Review Division of MDNR concerning the Historic Waterfowl Concentration Area in the vicinity of Site 104 [(MDNR~~,~~ 1999; Annex C)]. This area extends westward from the Kent Island shoreline approximately 5,000 feet and northward from the westbound span of the Bay Bridge approximately 6,000 feet and included a buffer area. MDNR indicated that because the Concentration Area was outside the designated boundaries of Site 104, they did not anticipate any disturbance impacts from the proposed use of Site 104 to wintering waterfowl within the designated Concentration Area. Therefore, there are no expected impacts to waterfowl from the proposed project.

Sea birds that are common to the Chesapeake Bay region include various species of terns, gulls, and sea ducks. Sea ducks are grouped separately from other ducks because of their preference for open bay and inshore coastal water habitation. Sea ducks observed by the USFWS in the Site 104 vicinity include oldsquaw (*Clangula hyemalis*) and white-winged scoter (*Melanitta fusca*). Gulls that were observed by USFWS in the vicinity of Site 104 include the herring gull (*Larus* *argentatus*), ring-billed gull (*Larus delawarensis*), black-backed gull (*Larus marinus*) and bonaparte's gull (*Larus philadelphia*). There were no terns observed by USFWS surveys in the vicinity of Site 104. Consultation with Mr. Forsell on 10 April ~~10,~~ 1998 determined that Site 104 does not appear to support a significant seabird population. Therefore there are no expected impacts to seabirds from the proposed project. The placement of dredged material is expected to attract scavengers such as herring gulls to the water surface as material is introduced into the water column. Thus the placement may provide a slight increase in feeding opportunities for gulls, but it is not expected to be significant.

6.1.8 Rare, Threatened, and Endangered (RTE) Species

Coordination with USFWS and MDNR has verified that, other shortnose sturgeon (SNS) and transient individuals, no threatened or endangered species under their jurisdiction are documented as occurring in the proposed placement areas or relying on them for habitat needs (Rosenberg 1997a and b;; Wolfin 1997;; Slattery 1997; Attachment E).

Few studies have been conducted on dredging and placement related impacts to SNS. However, potential impacts that could occur from dredging and placement include: (1) physical injury or death to sturgeon due to entrainment by a hydraulic pipeline or hopper dredges, (2) burial from dredged material placement, (3) injury to larvae or juveniles from dredging operations, (4) the disruption of migrations due to physical disturbances and noise, (5) the settling of suspended material on the spawning ground or foraging locations, and (6) if the material is contaminated, toxin uptake by sturgeon. It has been suggested by Hastings (1983) that dredging in some river systems produces a residual beneficial impact on sturgeon by creating or maintaining deeper channel regions which both juveniles and adults seem to prefer.

Maintenance dredging of Federal navigation channels can adversely affect or jeopardize SNS populations. In particular, hydraulic dredges (e.g., hopper) can lethally harm sturgeon by sucking fish up through dredge dragarms and impeller pumps. In addition to the direct effects of dredging operations, SNS may potentially be impacted by the destruction of benthic feeding areas, disruption of spawning migrations, and deposition of resuspended fine sediments in spawning habitat as a result of dredge operations. Potential impacts from hydraulic dredge operations may be avoided by imposing work restrictions during sensitive time periods (i.e., spawning, migration, feeding) when sturgeon are most vulnerable to mortalities from dredging activity. To avoid jeopardy to the critical life stages in other river systems from projects in the past, the NMFS has recommended that the USACE use alternative dredge types (i.e., clamshell, and hydraulic pipeline) and/or reschedule the project after sturgeon were likely to have moved away from the project area (USACE 1997).

On January 26, 1999 a Biological Opinion (BO) was issued to the USACE by the NMFS concerning impacts to endangered shortnose sturgeon from maintenance dredging (Hopper Dredge) of the C&D Canal and the Northern Approach Channel to the C&D Canal in Maryland and Delaware. NMFS based their BO on the review of the available data from the USFWS sturgeon study in addition to the CENAP Break Out Biological Assessment. In this BO, the NMFS concluded that the project was not likely to jeopardize the continued existence of shortnose sturgeon that inhabit the project area in the Upper Chesapeake Bay. The NMFS authorized an incidental take allowance of three shortnose sturgeon for this project.

Sturgeon eggs and larvae could potentially be subject to burial during bottom release scow or hydraulic placement actions. Since no sturgeon eggs or larvae have been found in the Chesapeake Bay including Site 104 in at least 20 years, impacts to sturgeon eggs and larvae from the placement of material at Site 104 is unlikely. [Larval data possibly inserted from UMCES].

Spawning habitat could potentially be subject to burial during the settling of dredged material from placement actions. However, the time period for dredging and placement of material at Site 104 and the salinity levels do not correlate with reported water temperatures (9-12 °C) and other water quality parameters required for sturgeon spawning and larval development (Kynard 1997). The fine-grained sediment currently found at Site 104 in addition to what is proposed for placement from the Federal channels are not the type of sediments typically found used by sturgeon eggs or larvae historically. In addition, the NMFS (1999) stated that based on the distribution and timing of capture data from the USFWS survey, it is likely that SNS spawn in the Potomac River and possibly, below the Conowingo Dam in the Susquehanna River. Based on these observations, impacts of siltation on spawning areas are unlikely because SNS spawning areas would be found much further upstream in freshwater areas.

Another potential impact is burial of SNS under deposited material or displacement from overwintering habitats. However, according to the NMFS (1999), review of the most current information on SNS, overwintering habitat of SNS is likely to be between Howell and Grove Points. This overwintering habitat is approximately 25 nautical miles away from Site 104. Therefore, no impact from burial or displacement from overwintering habitat to the SNS is projected from proposed placement at Site 104.

[Toxin uptake from SNS is not considered a potential impact because contaminant levels in channel sediments were not found to be present in levels that are expected to affect state water quality criteria during the proposed action-EA TO VERIFY]. In addition, sediment quality investigations within Site 104 found one area of contaminated sediments which could produce toxic effects to benthics organisms, this area would be covered during the proposed action. [EA may want to add a blurb from the most recent data analysis here].

~~Coordination with USFWS and MDNR has verified that, other than transient individuals, no threatened or endangered species under their jurisdiction are documented as occurring in the proposed placement areas or relying on them for habitat needs (Rosenberg 1997a and b, Wolfin 1997, Slattery 1997; Attachment E). Therefore, there will be no impact to threatened or endangered species from the proposed dredged material placement in Site 104.~~
From review of the USFWS study results to date it is anticipated that the short and temporary nature of the placement operations would not have any impacts to larval, young-of-the year or juvenile sturgeon due to the location of Site 104 with respect to NMFS observation of habitat location.
However, ~~the USFWS and NMFS have stated that further coordination is necessary on the shortnose sturgeon. P~~per the request of NMFS (Rosenberg 1997; Attachment E), formal consultation under Section 7 (c) of the Endangered Species Act of 1973, as amended, has been initiated by the Baltimore and Philadelphia Districts of the COE with the NMFS. ~~Studies conducted by USFWS for the Baltimore and Philadelphia Districts began in 1997. No shortnose sturgeon have been reported in Site 104.~~ To further ensure that the placement action will not jeopardize or alter designated critical habitat for the shortnose sturgeon, ~~A~~a Biological Assessment (BA) is currently underway. ~~to address issues raised by NMFS such as ensuring that the proposed placement action does not jeopardize or alter designated critical habitat for the shortnose sturgeon.~~ This BA will include the full results of the two year study currently being conducted by the USFWS for the Baltimore and Philadelphia Districts. ~~study is expected to be completed by the year 2000.~~ ~~An~~ In the meantime an interim BA will be submitted to NMFS at the time of distribution of this DEIS. ~~Preliminary assessment of SNS have indicated that most specimens were genetically similar to the Delaware Bay population which is currently stable.~~

6.1.9 Air Quality Impacts

The increase in air pollution emissions from proposed dredged material placement activities at Site 104 are expected to be small and temporary in nature and should not adversely effect air quality in the surrounding area. The increase would be from tugboats ~~boats~~ transporting scows to and from the site. The use of controlled hydraulic pipeline placement would increase air quality impacts further because hydraulic pump-out equipment would be stationed at Site 104 during the entire dredging period. Dredged material placement activities will take place during the late fall and winter and, therefore, equipment emissions are not likely to contribute to high levels of ozone. Consultation with ~~the~~ MDE has confirmed that the proposed dredged material placement activities at Site 104 will be in compliance with the Maryland State Implementation Plan of the Clean Air Act (~~Diane~~ Franks 1997).

6.1.10 Noise

Sources of noise from the proposed action would include tugboats transporting scows to and from the site and hydraulic pumps if controlled bottom pipeline placement is used. The hydraulic pumping would likely cause the largest increase in local noise levels. Noise impacts associated with the placement of dredged material in Site 104 are expected to be insignificant due to the distance of the site from the surrounding shoreline (approximately 1.6 km ~~(~~[1 mile~~)~~]). Placement will occur during the winter months of the year. The lower temperatures generally make it necessary for residential doors and windows to be shut, further precluding any noise detection. Also, there are fewer recreational boaters at this time of year that will experience the increased noise levels associated with dredged material placement operations. Placement at Site 104 will not increase vehicular traffic on the Bay Bridge, which is considered one of the primary contributors to the noise levels in the area. Communication with MDE verified that no noise related impacts are expected in the surrounding communities (~~Dave~~ Jarinko 1997). Furthermore, there are no known noise ordinances for which compliance is necessary that are applicable to the proposed placement activities (~~John~~ Nickerson 1997).

6.1.11 Hazardous, Toxic, and Radioactive Substances

The proposed project will not involve the use, storage, or transport of hazardous, toxic, or radioactive materials during or after placement. None of the originating locations for the material to be placed at Site 104 are listed as CERCLIS or NPL sites and therefore are not considered to be a potential source of hazardous, toxic, or radioactive substances. Placement of uncontaminated sediment at Site 104 would tend to further bury or cap any existing sediment which remains from the previous dredged material placement activities. Dredged material placement is specifically excluded from regulation under RCRA, because dredged material management regulations are authorized under the Clean Water Act and under the Marine Protection, Research, and Sanctuaries Act.

6.2 CULTURAL AND ARCHAEOLOGICAL RESOURCES

Dredged material placement at Site 104 is not expected to impact cultural or historic resources in the area. Coordination with the MHT was initiated in June 1997 (Banta 1997; Attachment E).

MHT stated that the site is considered to be a disturbed area as a result of previous dredged material placement. Therefore, it is "unlikely that placement of dredged material will affect historic properties" (Langley 1997; Attachment E). If any "unanticipated cultural resources" are discovered during the course of the proposed action or if there is any disturbance of the bottom, such as dredging, further coordination with the MHT will be conducted.

6.3 IMPACTS TO SOCIOECONOMIC RESOURCES

Impacts on the socioeconomic resources directly associated with use of Site 104 for the open-water placement of dredged material will depend, in part, on the ~~manner~~ placement method and timing of placement. Impacts ~~are~~ would also be related to the employment of commercial users of Site 104 resources, accessibility of the site for placement, effects on income-producing aquatic organisms in and near the project area, and public perception of the health and safety of harvestable resources within and in proximity to the affected environment.

Under the proposed project design, water depths in Site 104 would be reduced and the bottom leveled. [VERIFY AFTER FINAL DECISION ON SMOOTHING AND RELIEF.] The extent to which the change in bottom elevation and placement activities would affect socioeconomic resources is evaluated in the following paragraphs.

The potential for employment of area residents and commercial fishermen is unlikely to change significantly, because the scope of dredging and placement activity associated with use of Site 104 will be confined to the portion of the site which is not currently used by commercial fishermen. The contour of 13.7 m~~eters~~ (45 f~~ee~~t) was also deliberately chosen so as not to have an impact to ~~commercial~~ shipping vessels in transit to and from the C&D Canal approach channels which require a 45-ft depth for navigation. In addition, placement operations are not anticipated to impede the navigation of ~~commercial~~ fishing vessels because they currently utilize the northern portion of the site where placement will not occur. [VERIFY AFTER CORPS COORD W/ REC FISHERS] Use of Site 104 for placement activities will have no significant impact on minority or low income populations. If minority or low income watermen find fewer commercial fishing gear conflicts after the completion of bottom conditioning at the site, gear maintenance cost will decrease, producing a net increase in income. However, it is not known at this time the extent of contouring that will occur and if snags can be eliminated. [VERIFY AFTER FINAL DEICISION ON SMOTHING AND RELIEF]

The schedule of use for Site 104 is an important consideration in determining socioeconomic impacts to the project area and the region. Barge traffic, dredging activities, and operational access would potentially have an impact on watermen fishing in and in proximity to Site 104 and recreational boaters transiting the site. In particular, representatives of the Maryland Watermen's Association (MWA) and members of the Site 104 Public Outreach Committee have identified a potential for gear conflicts because of tugs and barges transiting to and from the placement site and have requested appropriate routing and monitoring arrangements if the site is used. In order to minimize impacts, ~~T~~tugboat routes will be designated, marked as necessary, and monitored to ensure dredged material placement vessel access to the site through designated routes only.

Charter boat and sportfishing activities in proximity to the site could potentially be affected by placement activities. Barge traffic and vessels associated with placement activities could interfere with normal fishing boat transit and operations. In addition, fish are likely to avoid areas of high activity and turbidity. Fishing effort in the general area, however, ~~is~~ has been reported as most intense during the summer months when the weather is suitable for smaller vessels ~~and when fish abundance is generally higher~~. Therefore, placement activities at Site 104 will be designed and timed to avoid potentially negative impacts to living resources, shipping, commercial and recreational fishing activity, and recreational boating. These potential impacts are described in the following sections.

6.3.1 Scope of the Project

The project placement schedule is an important determinant when considering socioeconomic impacts to the project area and region. Barge traffic and placement activities could potentially affect commercial and recreational activities in the project area, even with coordination and appropriate routing and monitoring arrangements. Under the proposed project design, all placement of dredged material will be within the existing Site 104 boundaries. The water depth in the lower two-thirds of Site 104 ~~in Site 104~~ would be reduced to -13.7 meters (-45 feet) MLLW. The reduction in depth and leveling of the bottom within site boundaries would change the physical character of this deep-water area. Although there is some indication of sediment contamination at the site from earlier placements of sediments from within ~~the~~ Baltimore Harbor, the proposed placements c~~w~~ould provide a cap of clean material from the approach channels over the Baltimore Harbor materials at Site 104. [CAPPING AND RELIEF NEED FINAL DETERMINATION AFTER DECISIONS ON PLACEMENT TYPE, SMOTHING AND RELIEF]

Best management practices (i.e., placement during time-of-year when aquatic species would be least impacted, limiting barge traffic to marked channels, compliance with placement protocols, and quickly and efficiently completing placement activities) will be utilized during placement operations to avoid or minimize impacts to aquatic resources, marine traffic, and, consequently, impacts to socioeconomic resources.

6.3.2 Economic Impact to Aquatic Resources

The current project alignment, which is within the charted boundaries of this previously used placement area, would impact approximately 1,200 acres of Bay bottom (approximately the southern ~~2/3~~two-thirds of the site). Presently, this charted area contributes a portion of the total landings for finfish and blue crab fisheries in the Chesapeake Bay, which in turn~~,~~ contributes to the economic well-being of Queen Anne's, Kent, and Anne Arundel Counties and surrounding communities. Sportfishing areas along the western shore of Kent Island and northwest of the site (the Belvedere Shoal) contribute to the sportfishing catch of the region.

Under the proposed project design, deep-water areas would be increased in elevation from depths of -23.8 meters (-78 feet) MLLW to approximately -13.7 meters (-45 feet) MLLW. Upon completion of placement activities, the affected bottom would be graded or leveled using appropriate techniques (Section 4.2) [VERIFY]. The decrease in depth would change the physical character of this deep-water area by covering existing snags or other low-lying obstructions on the bottom.

–Historically, placement of sediments at Site 104 included some material that originated from inside ~~the~~ Baltimore Harbor. Because of this, there is an ~~preliminary~~ indication of contamination at one location sampled in the site (Sections 5.1.5 and 6.1.5). The proposed placement of ~~clean~~ suitable dredged material from the outer channels ~~w~~could provide additional capping of previously placed sediments. ~~It has been proposed that~~There is a potential outcome that the decrease in depth may reduce the duration of hypoxic and anoxic conditions that occur in the site during summer months (Section 6.1.4). _This ~~sh~~could produce a benefit to the ecosystem by providing a longer growing season for benthic organisms, which ~~will~~ could also provide additional food resources for fish and crabs.

6.3.2.a Economic Value of Aquatic Resources. Studies have been conducted to determine the monetary value of the early life stages of aquatic resources that are killed as the result of -power plant projects throughout the East Coast. However, these studies involve estimates of impingement and entrainment that can be more directly correlated. Methods are not available to calculation ~~E~~economic losses resulting from dredging and open-water placement ~~have never been calculated~~ or correlat~~ed~~ion ~~with~~to impacts to sensitive life stages of economically important resources. Because of this, it is difficult to assign a monetary value to impacts to non-harvestable life stages of aquatic resources that contribute to overall recruitment in a much larger area ~~are difficult to assign a monetary value~~. Unlike power plant operations, dredging and associated open-water placement operations can be controlled and impacts minimized by timing events to coincide with periods when sensitive life stages are not present or present in minimal numbers.

Harvestable resources in the Chesapeake Bay region are reported annually by commercial watermen to ~~the Maryland Department of Natural Resources (~~MDNR~~)~~. Prices for harvestable resources fluctuate on a yearly and seasonal basis. Assigning a standard value to any one resource is difficult, because of the many factors that affect market prices. Information on the monetary value of harvestable resources collected from the NOAA 025 region (Bay Bridge north to Pooles Island) is discussed below. It should be noted that past prices often have no correlation with future market prices for any harvestable resources. Furthermore, the fishing productivity of specific sub-locations within an MDNR sub-region can vary significantly annually and between seasons. For these reasons, predicting the socioeconomic value of future harvestable resources in and around Site 104 cannot be calculated with any precision and could be significantly different in any given year.

Finfish Fishery [FINFISH USAGE IN WINTER?]

Site 104 is not known to be a nursery or spawning area for any commercially important fish species, including striped bass. Therefore, long-term adverse impacts from project-related activities on local finfish landings are not anticipated. Impacts to critical lifestages are discussed in detail in Section 6.1.6.b. It is difficult to determine direct impacts from habitat loss caused by dredged material placement. Survey results of existing conditions indicate that fish utilization of Site 104 is greatest in the spring and summer [VERIFY] (Miller 1998). Some impacts on harvestable fish could be minimized by timing placement activities during periods of lower fish activity (Sections 5.1.6.b and 6.1.6.b). Generally, finfish will avoid localized areas with elevated turbidity concentrations. Elevated turbidity will be short-term and will not affect critical finfish lifestages. It is also assumed that most fish would avoid the bottom waters of Site 104 during the seasonal anoxia/hypoxia which occurs in the late spring and summer to early fall [BUT WE ARE NOT PLACING THEN].

Commercial and recreational watermen that actively use the Site 104 area have indicated that fishing is concentrated on the northeastern edge of the site in the shallower waters. [VERIFY THROUGH CORPS COORDINATION] Although placement would not occur in these more productive areas, there may be some temporary impacts, due to elevated levels of bottom turbidity that may result in a reduction in catch and income during placement and consolidation of dredged material. Turbidity impacts are expected to be short-term. No significant long-term adverse impacts to the finfish fishery are expected as the result of temporary increases in water column turbidity, increases in bottom turbidity, or as the result of slightly elevated nutrient concentrations. A minimization of short-term impacts by timing placement activities to occur within winter months during periods of low utilization by commercially important species and commercial and recreational fishermen would limit disruption to the aquatic environment and the socioeconomic well-being of the region.

Decreasing the depth at Site 104 from a maximum of –23.8 m~~eters~~ (–78 f~~eet~~) to approximately 13.7 m~~eters~~ (–45 f~~eet~~) MLLW ~~will~~ could potentially improve some water quality conditions and finfish utilization and enhance commercial and recreational fishing in the area. Shallower habitat, combined with more abundant benthic food resources and shorter duration of hypoxia or anoxia, could potentially improve finfish habitat at Site 104 over the long-term. Both outcomes are uncertain. Currently, the majority of commercial fishing activity, primarily gill netting, is reported to occurs in the northern portion of the site in shallower~~, more productive~~ habitats where material placement will not occur. Improving finfish habitat and foraging areas at Site 104 ~~will~~ could potentially improve the commercial fishing efforts in the region. ~~In addition, t~~The shallower depths and smoothed bottom after placement ~~will~~ would facilitate use of gill netting in the area. [VERIFY AFTER DECISIONS ON SMOOTHING AND RELIEF]

Impacts of the project on the socioeconomic resources associated with the crabbing industry are expected to be minimal. Due to the depth, the area is not highly utilized by commercial crabbers. In addition, the commercial crabbing season usually runs from April through November [CHECK THIS], closing earlier in some years as directed by MDNR. The proposed placement window is from mid-October to mid-April, the primary period during which the fishery is closed. The blue crabs present in water greater than -12.8 m~~eters~~ (-45 f~~eet~~) MLLW within the portion of Site 104 where placement would occur would likely be covered by material. The crabs residing in this area are overwintering males. [MES NEEDS TO GET #S FOR THIS] The quantity of crabs that would be directly smothered by material placement would be insignificant to the health and prosperity of the overall fishery because crab densities at the site were low relative to both upper-Bay and Bay-wide densities. In addition, this impact to crab densities should be minimal as the densities are lower at these greater depths. Impact to migratory patterns and populations ~~of the~~ is not anticipated because female migration to the lower Bay is completed before the placement activities are planned to begin and return after placement activities cease.

[NEED TO ADD A BLUE CRAB SECTION]

Soft Clam Fishery

Peak densities of softshell clams along the Eastern Shore of the Chesapeake are found from the Eastern Bay to Pocomoke Sound, particularly at depths of less than 5.2 m~~eters~~ (17 f~~eet~~) along the shoreline (Baker and Mann 1991). A soft shell clam bed is located east of Site 104 in shallow water (___ m [___ ft]). Placement in Site 104 is not expected to effect the clam bed, which at its closest point is located _____ miles from the placement area. Because the minimum depth at Site 104 is -12.8 m~~eters~~ (-42 f~~eet~~), and it does not contain unique habitat for the softshell clam, the proposed placement activity is not expected to adversely effect softshell clam densities. [DNR 76 REPORT SHOWED NO IMPACTS TO BAR—SEE DNR 1976 REPORT FOR APPROPRIATE TEXT]

Oyster Fishery

Live harvests of oysters have not been found within Site 104, and the closest oyster bar~~,~~ that has been harvested in recent years~~,~~ is the Broad Creek Bar, which is located on the southeastern side of Site 104 (Scott~~, R MDNR~~ 1998). The Broad Creek Bar is not currently a self-sustaining oyster bar. It is seeded yearly by DNR. Minimal socioeconomic impacts are anticipated for this bar because it is outside of the placement area and therefore would not be directly impacted. Any short-term impacts from turbidity plumes would be expected to be minimal because net movement is to the north, not to the south. Precautions, such as time-of-year restrictions and modifications to placement strategies as appropriate, will be implemented to minimize impacts to the Broad Creek Bar and to ensure survival for future growth and expansion of the viable beds on the bar. The 1975 placement monitoring at Site 104 detected no impacts to this bar.

There are no known oyster bars within Site 104. Placement during the winter avoids impact to the critical life stage of the Eastern Oyster. There would be no spawning during placement; therefore, no larval or egg stages could be impacted. There is a time-of-year restriction for hydraulic dredging within 500 yards of an oyster bar from 1 June ~~1~~ to 30 September ~~30~~. Placement would not be ongoing ~~on~~ during that period, and dredging in this area is not being performed.

Placement of dredged material at Site 104 could provide a direct, positive long-term impact to the oyster fishery of the Bay through MDNR's Oyster Recovery Program. The program benefits are discussed in the following section.

6.3.2.b MDOT and MDNR Chesapeake Bay Enhancement Program (Oyster Recovery). The proposed use of Site 104 for the placement of clean dredged material is not anticipated to directly impact oyster beds and the oyster fishery. However, placement of dredged material at Site 104 could indirectly provide a positive long-term impact to the Bay's oyster fishery. On 1 September ~~1,~~ 1996, MDOT and MDNR executed a cooperative agreement with ~~the Maryland Watermen's Association (~~MWA~~)~~ to devise programs that would enhance the Bay and concurrently sustain economic growth opportunities associated with Bay resources.

The purpose of MDNR's Oyster Recovery Program is ". . . restore the oyster population of the Chesapeake Bay to a sustainable economic foundation for the oyster industry as well as to a viable ecological foundation for the Bay ecosystem" (MDOT and MDNR~~,~~ 1996). Recognizing that a healthy and prosperous oyster population improves water quality by the filtration of excess nutrients, and that there was a need to expand MDNR's oyster recovery program, MDOT agreed to provide supplemental funding with a net value of $17.7 million over the life of the agreement. This funding is directly related to the quantity of dredged sediments placed in open water sites. The agreement is in effect for ~~six~~ 6 years beginning in State Fiscal Year 1997 and ending at the close of State Fiscal Year 2002, and is subject to the availability of appropriated funds and the actual placement of dredged material in open water, among its various provisions. The agreement automatically terminates ". . . if after any two consecutive years, no dredged material has been placed in open water sites . . ." (MDOT and MDNR~~,~~ 1996).

If dredged material is placed at Site 104, it could provide an ancillary environmental benefit accounting for up to 70 percent ($12.4 million) of the prospective MDOT supplemental funding to the Oyster Recovery Program. The agreement between MDOT and MDNR is based on the first use of a new open water site in State Fiscal Year 1999 (MDOT and MDNR~~,~~ 1997). [CHECK W/MPA ON WHAT HAPPENS WHEN FY99 WASN'T MET] The target capacity of Site 104 is 18 mcy (13.8 mcm) under the State of Maryland's Strategy for Dredged Material Management. Site 104 appears to be the only open-water site with sufficient capacity under investigation or able to be -authorized for placement within the next 1 to 4 years by the pertinent state and Federal regulatory agencies. As is reviewed in Section 7, other open-water sites with sufficient placement capacity are not currently under active investigation due to various impediments to implementation. If Site 104 is used for dredged material placement, it could provide an ancillary positive economic impact to the Oyster Recovery Program, and thus a positive impact to the oyster fishery.

6.3.3 Impacts to Commercial Fishing

Site 104 is currently used only to a limited extent by commercial fishermen in the southern portion of the site where placement is planned. The presence of snags or other obstructions on the bottom in this area severely limits the opportunity for commercial fishing with drift nets; the only authorized open-water commercial fishing technique for finfish. Representatives of the MWA have stated that, although they object to open-water placement generally, they would not oppose placement in Site 104 if bottom conditions could be improved (Site 104 Open-Water Placement Area Commercial and Recreational Fishers Meeting Summary July, 28 1997 - Attachment C). ~~Some material drift is expected near the bottom at the northern site boundary which could impact commercial netting during the period when the site is actively being used (1-9 years).~~ Consultation with MWA representatives resulted in a determination that the placement of dredged material could be managed to minimize or avoid impacts with fishing activity in any given fishing season (Sections 5.1.6.b and 6.1.6.b). This would involve sequencing and timing placements in coordination with the MWA, the Upper Bay Charter Captains Association (UBCCA), and the Maryland Charter Boat Association (MCBA), as well as the establishment of strict transportation routing requirements for tugs and barges to avoid vessel conflicts with fishing gear. ~~In the long-term, commercial fishing activities are expected to be positively~~

~~impacted by placement activities. Covering of snags and raising the bottom elevation will facilitate gillnetting in the area.~~[CONSULTATIONS ONGOING]

6.3.4 Socioeconomic Impacts to the Site 104 Region

The potential for additional employment related to dredging activity is limited. Dredging and placement activity associated with use of Site 104 is generally within the scope and scale of existing annual maintenance dredging and is not anticipated to result in any appreciable changes in employment opportunities. New work dredging, which is the deepening or widening of channels rather than maintaining existing channels at their current authorized dimensions, would increase the level of dredging activity above that which is associated with maintenance dredging. The possibility for an economic benefit within the local region by using the local workforce would depend upon the dredging contractors and the sources they use for employees and subcontracted services.

Dredging of the approach channels to the Port of Baltimore will ensure future economic growth and success of port-related industry. -Maintenance of the channels is necessary for the viability of the Port. Placement of dredged material at Site 104 will provide long-term benefits to the regional economy through continued viability of the Port of Baltimore.

In summary, regional socioeconomic impacts resulting from the project are closely related to impacts on commercially important species that are harvested from the area. Some short-term adverse impacts can be expected within the project area as a result of the placement activities. Long-term adverse socioeconomic impacts are not anticipated. Short-term impacts will be minimized by timing disruptive activities to occur within periods of low utilization by commercially important species. Placement during a period of low utilization will limit disruption to the aquatic environment and the socioeconomic well-being of the region. In the long-term, placement of material at Site 104 will provide benefits ~~to~~ through the Oyster Recovery Program and to the regional economy through the viability and success of port-related business and industry.

6.4 AESTHETICS AND RECREATIONAL RESOURCES

Impacts to aesthetics and recreational resources as a result of the proposed placement at Site 104 will be short-term in nature and primarily associated with the placement phase of the project. Upon completion of placement, both aesthetic values and recreational utilization are expected to return to pre-placement conditions.

6.4.1 Aesthetics

The proposed placement of dredged material is not expected to have a long-term effect on the aesthetics of Site 104. Aesthetically, Site 104 would experience a short-term impact due to the presence of dredged material placement equipment, such as barges and tugboats during the placement phase of the proposed project. If bottom-dump scow placement is used, tugs and scows would periodically travel to the site, spend a few minutes depositing material, and then leave. If controlled bottom placement with hydraulic pipeline is used, a hydraulic unloader would be stationed at the site for the entire dredging period, and tugs and scows would spend approximately 1 hour at the site while the scows are pumped out. The equipment would be visible to individuals commuting across the Bay Bridge and to commercial fishermen and to recreational fishermen and boaters ~~that~~ who transit the area. However, dredging is not expected to occur during the summer season, when the bridge is used heavily and when recreational boating and fishing activities are at a peak. Sandy Point State Park is approximately 2 miles west of Site 104. Consequently, it is not expected that placement activities will be noticeable from the park. No sedimentation impacts to the park are expected based on hydrodynamic modeling (Section 6.1.3). The water clarity at the placement sites is expected to be temporarily reduced by sediment plumes during placement operations. This aesthetic impact is expected to be short-term in nature.

6.4.1.a Odors. Historically, there have been no complaints about odors produced by open water dredged material placement operations. The material will be transported to the site by barge and since it will be placed underwater, potential odors from the dredged material would be quickly contained. Also, odor impacts associated with the placement of dredged material at Site 104 are expected to be insignificant due to the distance of the site from the surrounding shoreline ~~[~~(approximately 1.6 km ~~(~~[1 mile~~)~~]~~]~~). This distance is generally sufficient to make most odors undetectable (~~Mike~~ Caughlin 1997). It is possible that recreational boaters or recreational fishermen ~~that~~who transit the area during placement activities could detect an odor from material exposed to air on the barges before or during the pump-out or bottom-release events. There will be no odor from the material after it is placed underwater, however. In addition, the filled barges will not remain stationary on the site for an extended period of time. Any odors that are created by the placement of dredged material ~~is~~ are expected to be short-lived and will not be chronic in nature. Also, the variability of weather patterns and prevailing winds will decrease the potential of odors adversely impacting any one area persistently.

Odor issues related to the placement of dredged material at Site 104 fall under the Code of Maryland Regulation (COMAR) 26.11.06, Sections .08 and .09 (~~Mike~~ Caughlin 1997). If odors are determined to be offensive and persistent, then compliance with COMAR would become an issue. COMAR 26.11.06.08 states: *"Nuisance. An Installation or Premise may not be operated or maintained in such a manner that a nuisance or air pollution is created. Nothing in this regulation relating to the control of emissions may in any manner be construed as authorizing or permitting the creation of, or maintenance of, nuisance or air pollution."* COMAR 26.11.06.09 states: *"Odors. A person may not cause or permit the discharge into the atmosphere of gases, vapors, or odors beyond the property line in such a manner that a nuisance or air pollution is created."* Odors resulting from the placement of dredged material at Site 104 are not expected to create a nuisance to surrounding communities. In the unlikely event odors are detected, they are not expected to be persistent in nature.

6.4.2 Recreation

The proposed placement of dredged material is not expected to have a long-term effect on the recreational activities at Site 104. Recreational activities, such as boating and fishing, are expected to be minimally impacted during the proposed placement of dredged material within Site 104. These impacts will primarily be associated with increased vessel traffic (barges and tugboats) during placement operations and a moored hydraulic pump-out facility if controlled hydraulic bottom placement is used. Channels will be established and marked in the area to minimize potential navigational hazards to recreational boaters or commercial fishermen caused by an increased volume of vessel traffic associated with placement activities. Placement will be timed to occur during the late fall and winter seasons when recreational boating activities are minimal.

6.4.2.a Fishing. [NEED TO UPDATE WITH COE/FISHERMEN CONSULTATION DATA] Recreational fishing activities within Site 104 are concentrated in shallow areas (-12.2 m~~eters~~ ~~(~~[-40 f~~eet)~~]) north of the RW "LP" buoy and along the eastern edge of Site 104 (Site 104 Open-Water Placement Area Commercial and Recreational Fishers Meeting Summary July, 28 1997-- Appendix E). Therefore, recreational impacts will be minimal, since the proposed placement action will occur in areas below the -13 m~~eter~~ (-45 f~~oo~~t) contour interval. The proposed action will raise the contours of the remainder of the site up to -13.7 m~~eters~~ (-45 f~~ee~~t). Decreasing the depth may improve recreational fishing in the area, and may decrease the extent, distribution, and duration of hypoxic or anoxic conditions allowing a longer growing season for benthic organisms. Thus, in the long-term recreational fishing success in the area may be enhanced as the result of placement activities.

6.4.2.b Boating. Existing levels of boating activity are usually confined to boats passing through the Site 104 area in transition to or from either ~~the~~ Baltimore Harbor, Sandy Point State Park, Matapeake State Park, or points further south of the Bay Bridge during the spring, summer, and fall months of the year. Use of the Bay waters and the Site 104 area diminishes in the winter due to inclement weather. Proposed placement of dredged material at Site 104 is expected to have a minimal impact on boating activities as the placement window is slated for the 15 October to 15 April time period. During the placement activity, recreational boaters can avoid inconveniences due to the tugboats and barges in the area by modifying their direction to avoid the boats. This will not require an extensive change in course or require considerable additional time and expense. As stated previously, tugs will be required to follow a marked course to minimize effects on recreation and commercial boaters.

6.5 IRRETRIEVABLE COMMITMENT OF RESOURCES

During construction of a project, resources may be expended or impacted. If the resource is not renewable, it may be considered irretrievable. Resources can come from on-site or off-site sources.

Currently, the only off-site resources to be utilized for "construction" would be the fuel used for the dredged material placement equipment and the sediment dredged from the channels.

Currently, fuel is not considered an irretrievable resource and placement at Site 104 is not expected to use enough of this resource to significantly deplete available sources of the fuel.

Dredging of the channels is necessary to maintain navigation throughout the Bay. The sediment that shoals in the channels and results in the need for the dredging is from external sources, predominantly the Susquehanna River and shoreline erosion, and is a consistent input to the upper Bay (Kerhin *et al.* 1988; Panageotou *et al.* 1996). In addition, the sediment is just being relocated within the upper Bay and is not being lost. Therefore, the sediment dredged from the channels is not considered an irretrievable resource.

The most significant on-site irretrievable resource to be affected by the proposed project is the change in depth of the deep--water (>-45 feet MLLW) habitat and the burial of potential snags that may provide deep--water fish habitat. These losses are considered among the impacts. The depths would be reduced to -13.7 meters (-45 feet) MLLW in the portion of Site 104 that is currently greater than -13.7 meters (-45 feet) deep (Figure 2-1). Generally, shallower areas are more highly utilized by aquatic organisms and are considered to be more valuable habitat areas than are deep--water areas (greater than –13.7 meters ([-45 feet]). Primary productivity is higher in shallow water areas, and this productivity fuels the food chain. The loss of deep--water habitat at Site 104 is offset by the potential increase in value and usability of the site for the commercial and recreational fishermen. The "smoothing" of the bottom and covering of the snags by placing material will facilitate gill netting in the area. The depth change could also potentially reduce the duration and extent of hypoxic or anoxic conditions, leading to an localized increase in -benthic abundance and thus to an increase in the food sources for bottom foraging fish species.

[NEED TO ADD BENTHICS/BLUE CRAB INFO. WHEN AVAILABLE]

6.6 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The use of Placement Site 104 will be short-term. Placement of up to 18 mcy of dredged material is expected to occur over a projected 1- to 9-year period. When the capacity of the site is filled, placement activities will cease. -The short-term use of the site will result in long-term overall benefits to the local environment and natural resources associated with the site. Placement of clean dredged material will cap the existing contaminated sediment that originated from placement activities that occurred at the site decades ago. This capping will provide long-term environmental benefits by creating a more favorable habitat for aquatic organisms that may potentially support more diverse aquatic communities. In addition, placement of material will decrease the depth at the site. This decrease will essentially change the existing deep--water habitat to more productive mid-depth--water habitat. In the long-term, the post-placement habitat at the site will support enhanced primary productivity, food resources, and aquatic communities.

DRAFT: To be completed after decision regarding final alternatives is made.

Section 7

Alternatives Impacts

Section 404(b)(1) guidelines require that no discharge of dredged material into waters of the U.S. will be permitted if another practicable alternative exists with fewer impacts to the aquatic ecosystem unless the alternative itself has other significant environmental impacts. Consequently, less environmentally damaging practicable alternatives are required to be evaluated that do not include placement of material in waters of the U.S. The alternatives analysis must demonstrate that an open water alternative is the least damaging practicable alternative, based upon economics, technology, logistics, and environmental considerations. The impacts of dredged material placement alternatives are analyzed in this section. Impacts from other placement options, which have been considered as part of several Corps and Port of Baltimore initiatives, are described.

The site screening process (detailed in Section 2 and Annex E) reduced the numbers of potentially viable sites by identifying significant environmental impacts, access problems, or costs/institutional constraints that would preclude the site from being developed, particularly in the near term (1-9 years). Details on non-viable alternatives are addressed in Annex E and only potentially viable alternatives are considered in this section. Based upon the site screening process (Annex E) and the Alternatives analysis (Section 2), the following alternatives were identified which could potentially meet the Port's short-term placement needs either individually or in combination. In accordance with NEPA, the "No Action Alternative" (assuming that no project is developed) is also analyzed.

[This is the list as it currently stands in Chapter 2; I have added text to some and annotated thoughts to others]

- No action
- Open-water sites:
  - Site 104
  - Site 171 open water,
  - Worton Point open water
  - Shad Battery Shoal
  - Ocean Placement
  - Deep Trough
- Existing site:
  - South Cell Of Hart & Miller Island
  - C&D Canal Sites
- New containment options
  - Hart-Miller Island new cell)
- Beneficial use
  - Poplar Island wetland cell conversion to upland
  - Poplar Island footprint expansion
  - Holland Island
  - Sparrow's Point
- Island placement site:
  - Pooles Island area

- Tolchester West
- Site 168
- Site 171
- Site 171

- Combination of smaller options
  (Holland Island, Bodkin Island, Artificial Reefs, Parson's Island, Cox Creek)

7.1 No action

Without sites to accept dredged sediment, dredging of the federally-maintained navigation channels to authorized project depths would have to be severely curtailed or delayed until sufficient placement capacity is identified, delineated, assessed and permitted. Annually, 4 mcy of capacity is needed for maintenance dredging with additional capacity for new work projects. If this annual capacity is not met, then channel currently scheduled for maintenance or upgrades may not be maintained. This would then inhibit access by deep-draft vessels that currently use these routes and would increase risk to navigation safety unless there is a corresponding reduction in cargo-carrying capacity in order to reduce vessel draft. In the extreme, some deep draft vessels that currently use the Baltimore Harbor and C&D Canal might not be able to access the Harbor or Canal at all, due to inadequate draft or difficult handling in shallow water associated with minimum under-keel clearance requirements coordinated by the U.S. Coast Guard and Association of Maryland Pilots.

A No Action Alternative is comparable with not maintaining authorized depths in the Federal channels. Furthermore, the Port of Baltimore directly and indirectly contributes in excess of $2 billion per year to the State of Maryland's economy and contributes a significant amount to the Eastern Seaboard regional economy (MPA 1996). It is likely that some of this shipping and associated business activity would be lost to the Port of Baltimore and would be shifted to other ports. It is in the national interest to maintain the navigation infrastructures necessary for a productive Port of Baltimore. Therefore, the No Action Alternative is unacceptable.

7.2 Open-water sites:

Open-water placement sites were included the Port and USACE planning process because they can provide a large amount of capacity that can be made available relatively quickly. Most open-water options are more cost effective than comparably-sized containment islands or upland options both in terms of development costs and placement costs. There are trade-offs with any placement option. Any option that involves placement within a waterbody invariably includes the potential for some impacts to the aquatic ecosystem. Open-water sites have predominantly short-term impacts but the placement areas generally recover over time and remain productive components of the aquatic environment. In some cases, dredged material placement can improve the conditions of a placement site by decreasing depths in an area that experiences anoxia or by improving the composition or quality of the sediments in the area.

7.2.1 Site 104

Site 104 (also known as "Kent Island Deep") is the preferred alternative for the open-water placement of 18 mcy (13.8 mcm) of clean sediment beginning in 2000. Placement would occur over a period of 1 to 9 years (2000 to 2008), depending upon the dredging sequence, dredging need and other factors (Figure 1-2). Clean sediment would be dredged from the Federally maintained navigation channels in the main stem of the Bay. These include the Craighill Entrance, Craighill Channel, Craighill Angle, Craighill Upper Range, Cutoff Angle, Brewerton Channel Eastern Extension, Swan Point Channel, Tolchester Channel and the southern approach channel to the C&D Canal. This site is not proposed for placement of sediment from the Baltimore Harbor Channels (those channels that lie to the west of the line between North Point in Baltimore County and Rock Point in Anne Arundel County).

Placement would be limited to areas deeper than the -13.7 m (-45 ft) MLLW contour interval to achieve a final site elevation of -45 ft MLLW. Based on existing contours within the proposed site, placement would occur in the area south of the lighted, red and white buoy for Love Point (RW "LP" buoy) (Figure 2-1).

The impacts and cumulative impacts of the preferred alternative are detailed in Sections 6 and 8 (consecutively) and are only abstracted here. No impacts are predicted for the following resources: setting; physiography, geology, and hydrology; groundwater; submerged aquatic vegetation; terrestrial/avian resources; rare, threatened and endangered species (pending biological determination from NMFS); hazardous, toxic, and radioactive substances; cultural resources, and archaeological resources. Several resources are expected to be impacted only during placement and, thus would be very short-term. These include impacts: air quality, noise, aesthetics, odors, and recreational boating.

Negative impacts to water quality and the benthic community are expected to be short-term in nature. Capping of poorer quality bottom sediments and decreases in water depth (after placement) are expected to have long-term positive impacts on benthics and site water quality. The short-term water quality impacts are projected to include turbidity impacts during placement, and some impacts related to the release of nutrients from the dredged material at the time of placement and possibly into the spring after placement. The extent and duration of turbidity impacts are dependent upon placement type, with bottom release scow likely to result in water column release of 4 % or less. [WE NEED A DECISION OF WHETHER THIS IS STILL THE PARTY LINE: Controlled bottom pipeline placement to just above the bottom should result in minimal release other than limited flow of sediments along the bottom of Site 104]. [NEED TO CONFIRM THIS WHEN ANALYSES ARE COMPLETE: Release of nutrients during mixing at the time of placement was also modeled and was found to result in few impacts over either the short or long term when analyzed with hydrodynamic modeling. The estimated nitrogen releases at Site 104 would be 2.3 pounds. The measured phosphorus releases were negligible and resulted in predicted loading of zero. If no mixing occurs, nutrient release from placed sediments was modeled to result in a slight enhancement of the spring phytoplankton bloom due to higher phosphorus concentrations, but this effect did not extend into the summer bloom period due to rapid dissipation. This effect was also limited to the area directly over Site 104. Dissipation occurred relatively rapidly after material placement, so that no far field impacts were projected to occur. Under the complete mixing scenario, no impacts to phytoplankton blooms were predicted due to rapid dissipation in the colder months of placement, when blooms do not occur].

Placement would be limited to the cold weather months, beginning after October 15 when vertical mixing of the water column has begun in response to cooler air temperatures. The placement window would continue until before or on April 15, when increasing water temperatures begin to cause the development of hypoxia in the bottom waters of Site 104. Limiting placement to these colder temperatures and to conditions when the bottom waters are relatively well oxygenated will reduce the potential for short-term impacts from the release of phosphorus, which would otherwise be stripped from the sediments as they entered anoxic or hypoxic waters.

Changes to salinity conditions upstream of Site 104 were modeled to address concerns related to the impacts of reduced water depths on the ability of the salt wedge to move up the Bay. Limited study of changes to salinities after four years of placement at Site 104 found some evidence of a mean decrease in salinity of less than 0.1 ppt. This was modeled at the Chesapeake Bay Program monitoring station MCB3.2 due north of Site 104 and due east of the Patapsco River. Smaller changes were identified by modeling as the stations extended up the Bay to Pooles Island and beyond. Mean changes in the more northern station were modeled to be less than 0.05 ppt. Changes were predicted by the model during the periods before and after model calendar days 100 and 150. Within this interval, however, no changes were predicted. The timing of these reduced salinities (before and after the spring freshet, but not during) should avoid impacts to anadromous fish spawning. Natural interannual, spatial and temporal salinity variations in the bay are generally much greater than this, and the bay ecosystem is adapted to this, so limited impacts are expected. Modeling indicated small, almost subtle changes in mean salinity. These changes would be significantly smaller than natural daily or seasonal variations in Bay water salinity. With sea level continually rising (and pushing more saline waters farther into the Bay), these slight decreases in salinity will be negligible.

Impacts to the benthic community from placement of clean dredged sediments in Site 104 would occur. The benthic community naturally dies off each spring and summer in Site 104, with some recruitment occurring in the late fall and winter. Placement of dredged material in the winter would reduce the potential for recruitment in the placement areas. This effect would be expected to continue in the areas of Site 104 where dredged material is placed until placement has ended. This effect should be limited each year to the area impacted by dredged material placement. Benthic monitoring at other sites in the Chesapeake Bay and the U.S. have shown benthic community recovery within 18 months after all placement has ended. These other sites, however, did not experience the seasonal anoxia that has been observed at Site 104 to cause seasonal benthic die-off. These conditions have been observed at sites in the Bay with different conditions, but similar results are expected due to the stress-tolerant nature of the benthic community in this portion of the estuary.

The potential annual burial of the benthic community at Site 104 during dredged material placement in the fall and winter when the benthic community is normally reestablishing itself could negatively impact benthic feeding fish populations which may use these areas as feeding grounds in the winter. While most fish show reduced metabolism and reduced need for food in the winter, the loss of benthics in this area could result in fish moving to nearby unimpacted areas to feed, resulting in possible increased competition for benthic food resources in other areas. Potential negative impacts to fisheries resources are, therefore, expected to be very short-term. It is predicted that the improved quality of the benthic community and site water quality over time will have a net positive impact on fisheries resources of on the site. Recreational and commercial fishing is, therefore, expected to improve over time. The potential covering of snags on the site will make the site more accessible to commercial netters which is expected to have a positive impact on area commercial fishing and economics.

Some short-term shellfish impacts are predicted. Because a small portion of the Bay blue crab population overwinters in deeper areas of the Bay (like Site 104), burial of some crabs is expected during placement. The small loss of blue crabs that is predicted is not expected to substantially impact the Bay blue crab population or productivity and will only occur in the years during placement. Other shellfish resources should be unaffected by placement activities. The oyster bar immediately east-southeast of Site 104 is in shallow water and any material drift from the site is predicted to be in a northerly direction. No soft-clam resources occur on or immediately adjacent to the site.

Hydrologic modeling was conducted to identify potential effects of sediment losses during and after the placement operations at Site 104. A worst-case potential for 16.9% of the placed material to move out of the site boundaries was determined from the modeling of controlled bottom release scow placement. A worst-case potential for 6.2% of the placed material to move out of the site boundaries after hydraulic placement near the bottom was also determined from the modeling exercise. Available models of the Chesapeake Bay are not able to predict sediment transport. Conservative tracer studies found that the net movement from the site was northward, following the higher salinity tidal flow. While movement of sediment could not be fully modeled, when settling velocities were assigned to particles at Site 104, settling was found to occur very quickly. It is assumed that some of the material that was defined by the model as leaving the site would re-deposit during the next ebb tide, but the model could not accurately depict this. All modeling was performed using conservative factors, such as the use of 1993 hydrodynamic forcings in the CH3D-WES model. These factors included using the highest freshwater inflows to the Bay in the years that are available to model.

7.2.2 Site 171 open water

-Higher nutrient releases is all capacity is used
-Comparable aquatic resource conditions, perhaps a little better fishing
-a target islanddevelopment site

7.2.3 Worton Point open water

-smaller capcity.
-lower nutrient releases
-significant finfish nursery area; commercial fishing area
-significant waterfowl area

7.2.4 Shad Battery Shoal

[No datasheet yet]
-smaller capacity
-lower nutrient releases

7.2.5 Ocean Placement

-Higher transportation costs

DRAFT: To be completed after decision regarding final alternatives is made.

-No nutrient releases within Bay

7.2.6 Deep Trough

-Institutional constraints
-Higher nutrient releases than Site 104
-Poorer overall ecological value (due to depths and nearby resources) than Site 104

7.3 Existing sites

7.3.1 South Cell Of Hart & Miller Island

[THIS IS THE OLD HMI TEXT.]....Hart-Miller Island Dredged Material Management Facility is the only major placement facility that is currently receiving dredged material. The facility has an optimum annual efficient operating capacity of 2.5 mcy for dewatering and crust management. Placement beyond the 2.5 mcy efficient operating capacity would not allow for effective use of site as greater lifts (layers) of material would greatly inhibit evaporative drying potential. Placement beyond the efficient operating capacity would also not effectively use the site's capacity which has been designated for other maintenance and improvements dredging projects and should be retained for unclean Harbor sediments (particularly since CSX/Cox Creek has a small capacity). Hart Miller Island alone cannot meet the current annual maintenance dredging needs (approximately 4 mcy), and the site would not be able to provide the 18 mcy of capacity provided by the Site 104 option. For these reasons, Hart Miller Island was rejected as an alternative to Site 104.

Jane's thought: I don't think HMI belongs here. The only thing that I see as viable would be to use some of the currently annual capacity as part of a combination of smaller sites.

7.3.2 C&D Canal Sites

-No nutrient releases to Bay
-Far from channels
-Already designated sites
[Have not had opportunity to read datasheets]

7.4 New containment options

-Point out that any new containment option is going to involve significant time delays.

7.4.1 Hart-Miller Island (new cell)

-Moderate nutrient releases
-Would have to be permitted; may not happen
-finfish area
-recreational area
-waterfowl area

7.5 Beneficial use

-Point out that beneficial uses may have short-term impacts but are ultimately beneficial to the region
-Some are very small scale
-Can take a long time to permit and implement

DRAFT: To be completed after decision regarding final alternatives is made.

7.5.1 Poplar Island

Poplar Island is currently under construction and will be ready to receive material during the 1999-2000 dredging season. The designed maximum annual capacity for the site is 2-3 mcy. Placement beyond designed capacity could result in discharge of poorer quality water relative to design specifications (if dewatering must be done too quickly); poorer quality releases of water could impact natural resources by adding elevated nutrients and metals concentrations to the local waters. Exceeding maximum design capacity could also impact the designed wetland creation at the site.

The capacity that will become available by 2000 has already been designated for other maintenance and improvement projects and would not be available to offset the short-term need for 18 mcy of placement capacity. One option considered for Poplar Island is to convert one or more of the wetland cells to uplands. Another possibility considered was to raise the upland dikes to provide more capacity. The final possibility would be to expand the footprint to include more placement capacity. Potential impacts of these alternatives are detailed below.

7.5.1.a. Poplar Island: wetland cell conversion to upland

- Loss of some wetland habitat which is a significant benefit of the current project.

7.5.1.b. Poplar Island: raising upland dikes

- Adds capacity without impacting more shallow water habitat
- Minimal incremental nutrient releases
- Change of the original design that may have aesthetic impacts

7.5.1.c Poplar Island: footprint expansion

-Would covert more shallow open water to uplands
-low nutrient releases
-High value living resource area
-Not available immediately

7.5.2 Holland Island

-Very low capacity
-low nutrient releases
-significant terrestrial and avian resources
-soft clam and oyster bars

7.5.3 Sparrow's Point

-Within 5 mile of HMI
-Some avian resources
-Within spawning area of some anandromous fish species
-[Need nutrient informtion]

7.6 Island placement site

[I think that this should include a generic discussion of the impacts of Island placement sites versus open water and upland with some detail about the range of implementation costs and nutrient releases. I have left the discussion of 171 in and added the nutrient information. My concern is that the environmental trade-offs and nutrient release information is fairly redundant. This goes back to the idea that we should be elevating the Upper Bay island as a concept and not as viable individual alternatives.]

7.6.1 Pooles Island area

7.6.2 Tolchester West

7.6.3 Site 168

7.6.4 Site 170

7.6.5 Site 171

Site 171 is under investigation as the possible location for a new containment island (Figure 2-2). As part of that investigation, the possible construction of a submerged island is also being considered. Potential environmental impacts at the site would include short term impacts investigated at other open water placement sites, including turbidity in the water column during placement, hydrodynamic impacts, benthic community impacts and fisheries impacts. Nutrient releases may also be of concern as this area is in relatively deeper water and would experience anoxia during some of the warmer months. Modeling of the nutrient releases of this option indicated that up to 10 pounds of nitrogen would be released as a result of placement (as a submerged option). This is nearly 5 times the release projected for Site 104 (2.3 pounds of nitrogen). As a containment (emergent island), the nitrogen releases would be slightly higher than those projected for site 104 (3.6 pounds of N), but would also include some release of Phosphorus (0.09 pounds).

If developed as an island, this site would not be available for approximately 10 to 14 years (which is an estimate of the time needed for feasibility studies, design work, permitting, and construction based upon the HMI experience). This option would, therefore, not meet the immediate need short term (1-9 year) placement need in the State of Maryland's Strategic Plan. Prefeasibility investigations for the Upper Bay Island Placement Sites (EA 1998) indicated that commercial fishermen utilize parts of the site, particularly in winter. Site 171 does appear to be utilized more than Site 104 for commercial fishing based upon interviews with area watermen. For these reasons, Site 171 was eliminated from consideration as an alternative to Site 104 at this time.

7.7 Combination of smaller options (Holland Island, Bodkin Island, Artificial Reefs, Parson's Island, Cox Creek)

Multiple limited capacity options were considered as alternatives to the Proposed Action. Within the multiple limited capacity alternatives, several sites would be selected which could be used in combination to match the required 18 million cubic yards of capacity identified at Site 104. In addition to the alternatives listed in Section 7.0, a combination of smaller capacity sites was considered as an alternative to Site 104 (Section 2.4.7). [Old text that needs to be updated when the alternatives analysis for this option is completed....It was concluded from the analysis that a combination of suitable smaller sites into a multi-site alternative offers limited potential and

DRAFT: To be completed after decision regarding final alternatives is made.

insufficient capacity (between approximately XX and XX MCY). Concerns were also raised as to whether or not all of the capacity projected for these sites would actually become available or could be effectively utilized is uncertain. Use of some or all of the viable small-scale sites would result in a significant increase in dredging costs.]

To completely evaluate this alternative, partial use of Site 104 would be needed to accommodate the full 18 MCY capacity requirement and/or sites with known or expected environmental, cost, development time or institutional constraints would have to be considered in combination. There is, however, an economy of scale related to dredging and placement. It is far more economical to use one large site because this reduces the cost for mobilization and demobilization of equipment as well as additional costs related to logistics, design and environmental studies. Additionally, travel distances from dredged channels to a site can significantly increase costs. Table 7-1 summarizes the distances from various proposed placement sites to the channels scheduled for maintenance or improvement over the next several years. Many of the smaller capacity sites (for example, Holland Island, Bodkin Island, Parson's Island) are 2 to 10 times further from the approach channels than the preferred alternative. Longer travel distances would translate into significantly higher placement costs per cubic yard of material because the average transportation cost is approximately $0.10 per cubic yard per mile.

In conclusion, although it is conceivable that many small sites could be combined to accommodate the 18 MCY of material that is proposed for placement in Site 104 over the next 5 years, it would be difficult because of increased costs, logistical problems, and increased environmental impacts. It would be less desirable to use a combination of many of the smaller sites because of the significant potential for environmental impacts to valuable habitat at some of the sites and because of the significantly higher cost per cubic yard of placement. This alternative is, therefore, rejected.

[Old Text: Cox

CSX/Cox Creek is an existing site that has been evaluated and rejected as an alternative to Site 104. This site is within Baltimore Harbor and as such is designated for contaminated sediments originating from within the harbor. Therefore, if CSX/Cox Creek were used for clean materials, it would not be available for the anticipated contaminated materials placement needs over the next 10 to 15 years. The annual maximum capacity at CSX/Cox Creek is also very low (approximately 0.5 mcy/year) and it would, therefore, not be a viable alternative for the placement need that necessitated consideration of Site 104 at this time].

Think this should be retained:

??????? **Man-O-War Shoals**

Potential environmental impacts at the Man-O-War Shoals (Figure 2-2) would include short term impacts investigated at other open water placement sites, including turbidity in the water column during placement, hydrodynamics impacts, benthic community impacts and fisheries impacts.

DRAFT: To be completed after decision regarding final alternatives is made.

Because of it's location within the striped bass spawning area and a relatively narrowed part of the Bay, it is believed that the potential for hydrodynamic and fisheries impacts would be greater than those at Site 104. Man-O-War Shoals was rejected due to concerns related to striped bass habitat and potential impediments to navigation. Prefeasibility investigations for the Upper Bay Island Placement Sites (EA 1998) indicated that commercial fishermen utilize parts of the site, particularly in winter. These resource issues would indicate a higher potential for impacts from placement at this site relative to Site 104.

Table 7-1
Distance Measured from Designated Channels to Site 104 and Alternatives

Sites	Channels																	
	Craighill Entrance		Craighill Channel		Craighill Angle		Craighill Upper Range		Cuttoff Angle		Brewerton Eastern Extension		Swan Point		Tolchester		C&D Canal Approach	
	Km	N Mi	Km	N Mi	Km	N Mi	Km	N Mi	Km	N Mi	Km	N Mi	Km	N Mi	Km	N Mi	Km	N Mi
Davis Tract Marsh	78	42	73	39	69	38	66	36	65	35	61	33	59	32	45	24	12	7
Grove Neck	64	34	58	31	55	30	52	28	51	27	46	25	45	24	30	16	1	0
Aberdeen Proving	47	25	41	22	38	21	34	19	34	18	29	16	27	15	13	7	5	2
Shad Battery Shoal	46	25	41	22	38	20	34	18	33	18	29	16	27	15	13	7	<1	<1
Rocky Point	52	28	46	25	43	23	39	21	38	21	34	18	32	17	18	10	2	1
Worton Point	42	23	37	20	34	18	30	16	29	16	25	14	23	13	9	5	0	0
Pooles Island	42	23	37	20	34	18	30	16	29	16	25	14	23	13	9	5	2	1
Hart-Miller Island	22	12	16	9	14	7	10	5	9	5	9	5	15	8	9	5	9	5
Masonville	29	15	23	13	20	11	17	9	15	8	16	9	30	16	26	14	39	21
Sparrows Point	20	11	15	8	12	7	9	5	7	4	8	4	22	12	18	10	31	17
Tolchester S-Turn	28	15	23	12	20	11	16	9	15	8	6	3	9	5	<1	<1	3	2
CSX/Cox Creek	22	12	16	9	13	7	10	5	8	4	9	5	23	12	19	10	32	17
Man-O-War Shoals	13	7	8	4	5	3	1	1	<1	<1	<1	<1	4	2	0	0	12	6
Site 168	26	14	21	11	17	9	14	7	13	7	4	2	7	4	1	0	12	6
Site 170	12	6	7	4	4	2	16	8	<1	<1	1	0	14	8	11	6	24	13
Swan Point	26	14	21	11	18	10	14	8	13	7	5	2	3	2	2	1	11	6
Site 171	6	3	5	3	6	3	9	5	11	6	5	3	2	1	6	3	19	10
Site 104	1	0	5	3	10	5	13	7	16	9	12	7	3	2	12	7	26	14
Queenstown	18	10	19	10	24	13	27	14	30	16	24	13	14	8	23	13	36	20
Deep Trough	3	2	9	5	14	8	17	9	21	11	20	11	11	6	20	11	33	18
Holly Neck Farm	4	2	10	6	16	8	18	10	22	12	22	12	12	7	21	12	34	18
Parsons Island	34	18	40	21	45	24	48	26	51	28	51	27	41	22	50	27	63	34
Bodkin Island	30	16	37	20	42	23	45	24	48	26	48	26	38	21	47	26	60	32
Poplar Island	27	15	34	18	39	21	41	22	45	24	45	24	35	19	44	24	57	31
Artificial Reefs	18	10	24	13	30	16	32	17	36	19	35	19	26	14	35	19	48	26
Bay Bridge Airport	0	2	8	4	13	7	16	9	20	11	16	8	6	3	15	8	29	15
Eastern Neck	2	12	24	13	29	16	32	17	36	19	29	16	20	11	29	16	42	23
Smith Island	119	64	125	68	130	70	133	72	137	74	136	74	127	68	136	73	149	80
Holland Island	108	58	114	62	120	65	122	66	126	68	125	68	116	63	125	68	138	74
Barren Island	79	42	85	46	90	49	93	50	96	52	96	52	86	47	95	52	108	58

* Distance measured from closest point in channel to closest point in site following relevant channels.

Section 8

Cumulative Impacts

Cumulative impacts are impacts that are additive and/or synergistic in nature. Cumulative impacts may result from a single project or from multiple projects that occur concurrently or successively within a defined area or region. Although impacts caused by a single project may not be environmentally significant, the combined impacts of multiple, concurrent, or successive projects could result in significant cumulative environmental impacts.

The Region of Influence (ROI) for the proposed action is the mainstem of the Chesapeake Bay extending from Pooles Island south to Kent Point (the southernmost portion of Kent Island). This region encompasses an area of the mainstem Bay that is approximately 56 kilometers (35 miles) in length.

Open water placement of dredged material at Site 104 by itself has both negative and positive environmental impacts. The majority of cumulative negative effects are short-term, temporary and of minimal environmental significance. Future projects in the upper Bay could compound the hydrodynamic effects in the region, and additional studies prior to future construction or placement projects would be required to determine the potential impacts. The cumulative positive effects and overall benefits of the project are long-term. The long-term net environmental and socioeconomic benefits outweigh the short-term adverse environmental impacts. The project could not adversely impact setting, physiography, geology, hydrology, groundwater, sediment quality, SAV, terrestrial or avian resources, cultural resources or archaeological resources in the region. In addition, the proposed project will not involve the use, storage or transport of hazardous, toxic or radioactive materials during or after placement. Pending a biological determination from NMFS, the project is not expected to impact shortnose sturgeon. In the long-term, the project could positively impact water quality, sediment quality, and socioeconomics associated with the Oyster Recovery Program, commercial and recreational fisheries, and port-related industry. The long-term cumulative impacts related to hydrodynamics have not been studied. Open water placement at Site 104 provides a short-term solution to the existing placement deficit for dredged material, while causing minimal site-specific or cumulative regional adverse environmental impacts and providing long-term benefits to aquatic and socioeconomic resources.

8.1 PAST, PRESENT, AND FUTURE DREDGING-RELATED ACTIVITIES IN THE UPPER-BAY AND BAY-WIDE

Approximately 4 mcy of material must be dredged annually from the upper Bay shipping channels to the Port of Baltimore in order to keep the port viable. There is a possibility that additional shipping lines will move to Baltimore. This will require more dredging of inner harbor material that would need to be placed at HMI. Past, present, and future placement areas for dredged material from these channels are geographically concentrated in the upper Chesapeake Bay region (north of the Bay Bridge) to minimize costs associated with transporting the material to placement facilities/areas. Past and present placement activities for the navigational channels include (but are not limited to): historic placement at Site 104 (1924 through 1975), at Man O'War Shoal (1900s-1950s), and at Shad Battery Shoal (prior to 1968); contained upland placement at Cox Creek (1960s -1970s); open water placement north and east of Pooles Island (1940-1960 and 1977-present); and placement of contaminated sediments at Masonville (1970s to early 1990s) and Hart-Miller Island (1984 to present). On a more Bay-wide basis, future long-term placement activities include beneficial use of clean material to restore Poplar Island and the proposed construction of an upper Bay containment island to accommodate the future demand for placement of dredged sediments.

Existing dredged material placement areas for the navigational channels in the upper Bay region encompass more than 10,000 acres of enclosed, open water, or shoreline area. In addition, there 17 upland placement areas and numerous other county placement areas have been used for smaller projects. On a Bay-wide scale, there are few other regions in the Bay that have such a dense concentration of dredging-related activities that impact Bay bottom. The concentration of open water placement and dredging activities in the upper Bay could potentially contribute to cumulative environmental impacts associated with the proposed open water placement at Site 104.

8.2 CUMULATIVE NEGATIVE IMPACTS

Potential negative short-term impacts to hydrodynamics, water quality, aquatic communities, air quality, noise, socioecomonic resources, aesthetics, and recreational resources have been identified and are discussed in detail in Chapter 6. Potential cumulative impacts to each resource component are described in the following sections. Under each section, an overview of Site 104 specific impacts is provided followed by a description and discussion of the anticipated cumulative effects that may result from other activities in the region.

8.2.1 Hydrodynamics

8.2.1.a Salinity. Site-specific alterations in hydrodynamics of the area, caused by decreasing the depth, could potentially impact salinity in the immediate region. A slight average decrease in salinity north of the site (0.05 to 0.1 ppt) could occur due to less up-estuary movement of the salt wedge. This decrease would most likely be observed during the summer months, but not during springtime migration and spawning periods for anadromous fish. The slight decrease in salinity should be insignificant to resident aquatic organisms that are adapted to much wider salinity ranges. Estuarine organisms, especially those in the upper Bay, are resilient to annual variability in physical parameters caused by natural events (i.e. drought, floods, etc.). Greater salinity fluctuations are observed annually, than those that will be observed or created by placement of material at Site 104.

Within the ROI, cumulative impacts of other future dredging-related projects in the upper Bay could compound hydrodynamic changes associated with movement of the salt wedge. The proposed deepening of the C&D Canal is expected to create a slight increase in salinity in the northern Bay (CENAP 1996). In addition, the construction of an upper Bay containment island could change regional hydrodynamic properties and could potentially affect the northward movement of the salt wedge (EA 1997). The net change in salinity distribution to the upper Bay as a cumulative impact of the present and future projects has not been studied, and additional future studies would be required to determine the environmental significance of impacts of future proposed projects.

8.2.1.b Material Loss and Erosion. In addition to potential changes in regional salinity, site-specific hydrodynamic processes will influence the movement of dredged material from the placement site. Hydrodynamic modeling conducted to date indicates that depth-averaged tidal currents in the region of Site 104 will increase proportionally to the decrease in water depth. This increase (approximately 0-2% year to year) is relatively minor, will be gradual, is not expected to affect natural sedimentation rates, and is not expected to adversely affect aquatic organisms or boat navigation in the area. Site specific changes in bottom shear stress (±15% depending upon where and in what order material is placed) will influence movement of bottom sediment at the site. Erosion modeling has indicated a worst-case potential loss of 16.9% and 6.2% of material placed by bottom-release scow and controlled hydraulic pipeline methods, respectively (5-year average). The majority of erosion will be short-term and take place during the placement period (WES 1998). Current models cannot predict the destination and cumulative impact of material that moves off of the site. Following completion of all placement activities, losses are expected to stabilize and the additive effects related to other planned dredged material management activities are expected to be minimal.

Based on modeling studies, it is also anticipated that water column losses of fine-grained suspended clay will amount to 4.3% of the total mechanically placed (bottom-release scow) material. A portion of the fine-grained material may be transported in the bottom waters and could potentially be deposited on adjacent Bay bottom. This transport and deposition is not expected to be environmentally significant. Shallow water areas along the Kent Island shoreline are not expected to be impacted. Studies conducted by WES indicate that the net long-term movement of water over the site bottom is to the north due to gravitational circulation (WES 1998). Nutrients or particulates suspended in bottom waters will be transported south of the site during ebb flows and back-into the site and north of the site during flood flows, with a net movement to the north. It is not anticipated that northward bottom movement of suspended sediment or nutrients will impact waters of the Chester River, as natural shoals will prohibit the movement of bottom waters into the river mouth.

Cumulative impacts related to other dredging–related projects proposed for the upper Bay could result in further changes or disruptions to hydrodynamic properties and influence erosional and depositional processes at or near Site 104. Construction of an upper Bay containment island (EA 1997) north of Site 104 and the proposed deepening of the C&D Canal (CENAP 1996) could result in some potential additional changes in hydrodynamic processes in the area. The cumulative changes to hydrodynamics in the region as a result of multiple projects could potentially influence erosion and sedimentation or create navigational hazards. Directional or velocity changes to tidal currents could cause changes in erosion and sedimentation rates in nearby shoreline areas. In addition, changes in tidal currents and velocity could potentially impact normal navigation patterns and manuverability of large cargo vessels approaching to and departing from the Port of Baltimore. Additional studies and modeling would be required to quantify and predict the cumulative changes associated with future projects. Preliminary hydrodynamic modeling on the potential navigation effects is being performed by the USACE-WES under sponsorship of the MPA.

8.2.2 Water Quality

Minor site-specific water quality impacts are expected to occur during placement activities at Site 104. These include localized increases in turbidity and total suspended solids (TSS) during placement periods but these will be short-term, temporary and not environmentally significant. Studies conducted during open water placement at Pooles Island revealed that turbidity and TSS values subside and return to background levels within 20-40 minutes after scow releases (Versar 1994). Similar turbidity and TSS values and short-term changes are expected during open water placement at Site 104. The localized turbidity impacts will occur every dredging season over a projected 1- to 9-year period but will not be additive in nature. Cumulative effects of other activities in the upper Bay that could potentially create temporary localized increases in turbidity include placement activities at Pooles Island, maintenance dredging activities in the approach channels to Baltimore Harbor and new work dredging projects. Because turbidity associated with the majority of these activities is short-term and localized in nature, it is not expected that water quality impacts from successive or concurrent dredging-related projects will be cumulative or exceed the normal range of values for the upper Bay region.

In addition to localized turbidity increases, it is anticipated that nutrients (phosphorus and nitrogen) in the project area are expected to be slightly elevated throughout the 1- to 9-year placement period. These slightly elevated nutrient concentrations will be localized and seasonal and will be primarily associated with bottom waters at the site. These nutrients are expected to dissipate quickly after all placement activities cease and are not expected to enhance algal blooms or anoxic conditions on a Bay-wide scale. In order to minimize the potential for localized nutrient impacts, placement at Site 104 will only occur during the fall, winter, and early spring months, when algal populations are naturally significantly depressed. Based upon studies conducted after open water placement at Pooles Island, the nutrient loadings originating from dredged material placement will be locally important, but short-term. Water quality modeling indicated a worst-case potential for slight, localized increases in phytoplankton production fueled by phosphorus releases from the recently deposited sediments during the spring following winter placement. Although not modeled, if placement occurs every 15 October to 15 April over a projected 1- to 9-year period, the worst-case result could be be a slight localized increase in phytoplankton production for each consecutive spring period. Typically, maximum phytoplankton productivity in the Chesapeake Bay occurs in the Bay Bridge region. In this region, water clarity, nutrient concentrations, and water column mixing can create optimal conditions for phytoplankton production (Sellner 1987). In comparison to the annual loadings from external sources (predominantly the Susquehanna River), the quantity of nutrients released by placement, however, is modest (Boynton et al. 1997). After placement activities cease, springtime phytoplankton production in the local region of the placement site are expected to return to within normal ranges.

The slight increase in springtime phytoplankton production is not expected to result in significant phytoplankton blooms or increased severity/duration of anoxia in the local region or Bay-wide. At the local level, increased phytoplankton growth could arise from nutrients released at the point of dredging, nutrients released during placement, and nutrients released during the first season post-placement. Studies to quantify the additive impact of these activities are not feasible. Cumulative impacts, however, are expected to be short-lived. No studies have quantified the additive impact potential of these activities, but they are expected to be short-lived. It is not expected that the localized nutrient releases or increases in phytoplankton production at Site 104 will combine with similar effects from other placement projects to produce an additive or synergistic effect on the Bay system.

8.2.3 Aquatic Organisms

8.2.3.a Phytoplankton and Zooplankton. Site specific phytoplankton and zooplankton communities may be impacted by placement activities. Both controlled hydraulic pipeline placement (directed to the bottom) or bottom-release scow placement could displace or bury phytoplankton and zooplankton in the water column. Because the controlled hydraulic pipeline placement will be directed to within 2 m (6.0 ft) of the bottom, the impact to organisms in the water column will be minimal. Material placed by bottom-release scow will be released at approximately 20 feet or descend through the water column and create a more significant impact. These losses will be short-term, temporary, and environmentally insignificant on a Bay-wide scale. Mortality impacts to zooplankton will be minimal during the 15 October to 15 April placement events when densities are typically depressed by temperature and food resources. Localized increases in turbidity and total suspended solids may suppress light penetration in the water column resulting in repressed phytoplankton densities and may inhibit zooplankton foraging ability. These impacts will be short-term, temporary in nature (lasting as long as the turbidity events), and environmentally insignificant. Nutrients are expected to be slightly elevated throughout the placement period, but will be localized and seasonal, and food-chain effects, although not modeled, are not expected to be significant. Nutrient releases during or after placement may result in phytoplankton potentiation in the springtime, but long-term adverse cumulative effects are not expected. Impacts to phytoplankton and zooplankton communities as a result of maintenance dredging, placement activities at Pooles Island, and other new dredging projects are not expected to be cumulative. Additive impacts from upper Bay dredging activities and placement projects will also be short-term and localized in nature and will not result in significant cumulative environmental impacts on a regional or Bay-wide scale.

8.2.3.b Finfish Communities. While finfish are an important commercial and recreational resource in the Chesapeake Bay, they are much less directly affected by dredged material placement activities than benthic macroinvertebrates because they are mobile. Studies indicate that the area in the vicinity of Site 104 is utilized by a variety of fish species, including commercial species such as striped bass and white perch. Placement activities at Site 104 will occur during the period of 15 October through 15 April to avoid peak spawning and migration periods for commercially important species. In addition, the fish will likely avoid the region during the short-term periods of elevated turbidity. The commercial and recreational fishery for striped bass and white perch is not expected to be impacted by placement, because the majority of fishing effort takes place north of the site, in shallower water. Scow and tug traffic may create short-term congestion in the fishing areas via transit to and from the site, but the impact to the fishery will be negligible. Burial of the existing benthic communities at Site 104 will temporarily reduce local food resources for demersal fish species in the area. Sufficient food resources should be available in areas adjacent to the site. Due to the depth at the site and annual summer hypoxia/anoxia events, it is not likely that the site is actively used for summer foraging or serves as an important foraging area or critical habitat for Bay species. Cumulative impacts to the finfish fishery in the upper Bay from maintenance dredging, open water placement at Pooles Island, and other upper Bay projects are expected to be minor due to the availability of comparable habitat in the region.

8.2.3.c Shellfish. Commercial shellfish that are important to the upper Bay region include oysters, softshell clams, and blue crabs. Oysters and softshell clams are not expected to be directly impacted by placement at Site 104 because oyster and softshell clam habitats do not exist within the Site 104 boundaries. The closest viable oyster bar is the Broad Creek Bar located at the southeastern end of Site 104 (Scott 1998). Although not directly impacted by placement of dredged material at Site 104, the bar could potentially be affected by residual turbidity plumes and sediment deposition. Impacts from turbidity plumes are expected to be minimal (although deposition outside of the site has not been modeled) and environmentally insignificant. Time of year restrictions will minimize potential impacts to larval or juvenile lifestages. Few viable oyster bars remain in the Bay today, so that adverse impacts to any viable bar are considered significant on both a regional and Bay-wide scale. Historical overharvesting, disease, and habitat destruction have cumulatively impacted the Chesapeake Bay oyster fishery. Any potential adverse impact to viable oyster bars would add to the existing pressure on this resource and would be environmentally significant.

Overwintering male blue crabs within the site boundary will be directly impacted by placement activities. Both controlled hydraulic pipeline placement to the bottom and bottom-release scow placement will bury overwintering male crabs within the project area. These males only represent a sub-set of the total overwintering population in the upper Bay. Based on Winter Dredge Surveys conducted by MDNR (Sharov 1998), the density of male crabs overwintering in water deeper than –13.7 meters (-45 feet) is reduced compared to shallower locations of the site. Blue crab densities within the site were low compared both to the upper-Bay and Bay-wide densities. Placement impacts to blue crabs would, therefore, be locally significant (at the site), but short-term and temporary. The direct mortality may minimally impact recruitment on a year-to-year basis but is not expected to have impacts on the Bay-wide population. The site specific placement activities will not impact female blue crabs because they overwinter in higher salinity areas near the mouth of the Bay.

On a Bay-wide scale, the impact to the blue crab fishery is expected to be insignificant due to the availability of comparable overwintering habitat in the upper Bay. Little significant cumulative impact to the blue crab fishery is expected on a regional or Bay-wide scale, because, on a regional level, few other planned dredging or placement activities will occur concurrently with dredged material placement at Site 104.

8.2.3.d Benthic Communities. Benthic communities in the Site 104 boundary will be significantly impacted by the direct placement of dredged material on Bay bottom. The existing communities in the immediate area are dominated by opportunistic species that re-colonize each successive year after summer anoxia events. Based on benthic community studies conducted at other open water placement sites similar to Site 104, the communities are expected to re-establish to pre-placement conditions within 18 months following cessation of all placement activities. This scenario will be valid for locations within the site that are annually used during all nine potential placement years. Placement, however, is expected to occur at various locations throughout the site, with only a few areas being used continuously throughout the life of the project. Overall, impacts to the community will be short-term (approximately 1 to 9 years in duration), and environmentally insignificant on a Bay-wide scale.

Other dredging –related activities in the upper Bay that could disrupt regional benthic communities include placement at Pooles Island, maintenance dredging, and new dredging projects. Overall, the net cumulative impacts to benthic communities in the upper Bay will be short-term, temporary, and environmentally insignificant. In addition, the majority of communities that will be impacted by dredging or placement activities are not diverse equilibrium communities, already exhibit signs of stress from naturally occurring hypoxia events, or have been disturbed by previous placement activities. These areas are already stressed by naturally occurring conditions or by previous dredging or placement events, and are not undisturbed pristine communities. It is possible that a more diverse benthic community may eventually become established due to shallower depths and shorter duration of summer hypoxia events after placement at the site ceases.

8.2.4 Air Quality

Localized increases in air pollutant emissions from placement equipment and vessels will be short-term and environmentally insignificant. The emissions generated at the placement site are not expected to cumulatively impact air quality or contribute to high ozone levels in the region.

8.2.5 Noise

Noise generated by placement equipment and marine vessels will be short-term, localized, and non-disruptive to residents of the adjacent shorelines. The noise generated by several different on-site sources will not be cumulative. Because no other noise-generating activities or noise sources are anticipated in the immediate area, no adverse cumulative noise impacts are expected.

8.2.6 Socioeconomics

Adverse impacts to socioeconomics associated with aquatic resources and fisheries of the region will be short-term and temporary. Finfish, blue crabs, and oysters are not expected to be significantly impacted by placement activities. Commercial and recreational finfish catches from the vicinity of the site may potentially be depressed during placement activities, but are expected to return to normal levels after placement ceases. Mortality of overwintering blue crabs in the site is not expected to significantly impact blue crab recruitment or the blue crab fishery on a Bay-wide scale. On a regional level, the site is not highly utilized by commercial crabbers, and the majority of placement activities will take place outside of the commercial crabbing season. There are no oyster beds within the site, and placement activities are not expected to adversely impact oyster beds adjacent to the site. Economics associated with recreational use in the region are not expected to be impacted by placement activities (see Section 8.2.8). Overall, short-term economic impacts to fisheries and commercial watermen will be minor on a regional level, and will be insignificant on a Bay-wide scale. If multiple dredging-related projects are implemented concurrently in the upper Bay, there could be a net adverse impact to the overall fishery landings and recreational use for the region. Additional socioeconomic evaluations would be necessary to determine the potential cumulative impacts to fisheries of the region prior to implementation of future projects. Each individual new dredging project in the upper Bay region will be evaluated for potential impacts to commercial fisheries prior to implementation.

8.2.7 Aesthetics

There will be no long-term adverse impacts to the aesthetic quality of the region. Placement equipment, such as scows and tugboats, will disrupt the visual aesthetics of the area only during placement activities, as will turbidity plumes. These impacts will be short-term and temporary, lasting only as long as the placement activities continue. No physical changes above the water will occur at the site as the result of placement activities. Therefore, there will be no cumulative impact to the aesthetics of the area.

8.2.8 Recreational Resources

Recreational fishing and boating in the site-specific area will be temporarily impacted during placement events. Increased scow and tugboat traffic will potentially disrupt recreational boating and fishing activities, and localized, short-term increases in water column turbidity could potentially disrupt recreational fishing success in the vicinity of the placement site. Because placement has been planned for periods when recreational activities are minimal, these impacts should be insignificant. Vessel traffic in the area of Site 104 should return to normal levels after placement ceases, and turbidity levels are expected to subside to background values within a short period of time after each placement event. Therefore, no cumulative adverse impacts to the recreational resources of the area are expected from the project.

Other dredging–related activities proposed for the upper Bay, could adversely impact recreational resources in the region. The majority of currently proposed projects should, however, only create temporary disruptions to the recreational resources of the upper Bay. Cumulative impacts to the recreational resources in the upper Bay from maintenance dredging, open water placement at Pooles Island, and other upper Bay projects are expected to be minor due to the availability of comparable recreational boating and fishing areas in the region.

8.3 CUMULATIVE POSITIVE IMPACTS

Positive effects of the project are long-term and are discussed in detail in Chapter 6. Major long-term benefits of the project include improvement to water quality, sediment quality, and aquatic resource habitat, and increased economic prosperity to the local commercial fisheries and to the Port of Baltimore.

8.3.1 Water Quality

Despite site-specific short-term, localized increases in turbidity, total suspended solids, and nutrient concentrations, placing dredged material at Site 104 could have a long-term positive impact on water quality in the region. Water column stratification, hypoxia, and anoxia commonly occur in the deep central portions of the Bay during the summer months. Typically, these areas support little aquatic life or are limited to communities composed of organisms adapted to low dissolved oxygen conditions. Decreasing the depth from a maximum of -23.8

meters (–78 feet) to approximately –13.7 meters (–45 feet) MLLW could reduce the duration and severity of regional hypoxic and anoxic conditions during the summer months in the vicinity of Site 104. Shorter duration of hypoxia and anoxia would allow a longer annual recovery period for benthic communities and a longer foraging period for finfish that inhabit the area. Improvement to the available habitat would be reflected in healthier benthic and finfish communities. Combined with other water quality restoration efforts in the upper Bay watershed, changes in the distribution and duration of anoxic conditions would provide a net benefit to the area on a regional level.

8.3.2 Sediment Quality

The quality of surficial sediments at Site 104 will improve by placing dredged material at the site. The sediment to be placed at Site 104 will be non-contaminated material dredged from the Chesapeake Bay approach channels to the Port of Baltimore Harbor. Sediment studies (EA 1998) for the approach channels indicate that quality of these materials is good. Physical characteristics of the sediments currently at Site 104 are comparable to the physical characteristics of sediments proposed for placement at the site. Chemical characterizations, however, revealed that concentrations of trace metals in existing sediments at Site 104 were up to ten times greater than sediments from the channels proposed for dredging. It is suspected that the high concentrations of trace metals at Site 104 are the result of historic placement of contaminated sediment from Baltimore Harbor. Future placement of clean dredged material at Site 104 will provide a capping effect and will improve site specific surficial sediment quality for the resident benthic communities. Sediment quality improvement could be manifested by enhanced benthic and finfish production on a regional level.

Proposed future dredged material placement activities will further ensure that no contaminated sediments will be placed in open water sites.

8.3.3 Aquatic Resource Habitat and Commercial Fisheries

8.3.3.a Finfish. Decreasing the depth at Site 104 from a maximum of -23.8 meters (–78 feet) to approximately -13.7 meters (–45 feet) MLLW will potentially improve finfish utilization and enhance commercial and recreational fishing in the area. Shallower habitat, combined with more abundant benthic food resources and shorter duration of hypoxia or anoxia will improve finfish habitat at Site 104 over the long-term. Currently, the majority of commercial fishing activity, primarily gill netting, occurs in the northern portion of the site in shallower, more productive habitats where material placement will not occur. Improving finfish habitat and foraging areas at Site 104 will potentially improve the commercial fishing efforts in the region. Representatives from MWA have stated that, although they object to open-water placement in general, they would not oppose placement in Site 104 if bottom conditions could be improved. The shallower depths and smoothed bottom after placement will facilitate use of gill netting in the area by commercial fishermen.

8.3.3.b Shellfish. In addition to potential long-term improvement to the regional finfish fishery, open water placement activities at Site 104 could provide an ancillary benefit to MDNR's Oyster Recovery Program and watermen. MDOT and MDNR have executed a cooperative agreement with the MWA to develop and fund programs that will enhance Bay resources and sustain economic growth. In a six-year funding agreement (1997-2002), MDOT has agreed to provide a maximum of $17.7 million to DNR's Oyster Recovery Program. The program is designed to "...restore the oyster population of the Chesapeake Bay to a sustainable economic foundation for the oyster industry as well as to a viable ecological foundation for the Bay ecosystem" (MDOT and MDNR 1996). Funding is directly proportional to the quantity of dredged material that is placed in open water sites. If dredged material is placed at Site 104, it would provide a secondary environmental benefit to the oyster fishery of the Bay. Open water placement of 18 mcy of dredged material at Site 104 could fund up to $12.4 million for the Oyster Recovery Program. When combined with open water placement at Pooles Island, the cumulative benefit to the Oyster Recovery Program is substantial.

8.3.4 Regional Socioeconomics

Placement of dredged material at Site 104 will provide long-term economic benefits to the state, the Port of Baltimore, and to industries that depend upon the viability of the Port. Regional economic benefits of the project could include employment by local dredging companies and increased value of the local commercial fisheries landings as a result of improved habitat quality. Because the project will provide funding to the Oyster Recovery Program, the oyster fishery will be enhanced both ecologically and economically.

Maintenance dredging and placement activities must take place in order to assure safe navigational access to and from the Port. The potential capacity at Site 104 (18 mcy) will accommodate placement needs for clean material for approximately one to nine years. This short-term solution will allow time for completion of the Poplar Island facility and will allow for continued evaluation of future placement options. Open water placement at Pooles Island and Site 104, maintenance dredging, and new work dredging projects throughout the upper Bay will cumulatively contribute to a net economic benefit for local watermen, the Port, and the upper Bay region.

8.4 CUMULATIVE IMPACTS SUMMARY

Open water placement of dredged material at Site 104 will not adversely impact the regional setting, physiography, geology, hydrology, groundwater, sediment quality, SAV, terrestrial or avian resources, cultural resources or archaeological resources in the region. In addition, the proposed project will not involve the use, storage or transport of hazardous, toxic or radioactive materials during or after placement. Pending a biological determination from NMFS, the project is not expected to impact the endangered shortnose sturgeon. Although some short-term adverse impacts are anticipated for air quality, noise, socioeconomics, aesthetics, and recreational resources, adverse cumulative impacts to these resources are not expected.

Overall, cumulative negative effects of open water placement at Site 104 are of minimal environmental significance. Increases in turbidity, TSS, and nutrient concentrations will be site specific, short-term, and localized. Potential cumulative effects upon regional salinity will be negligible and will not adversely impact resident organisms. Due to the abundance of comparable habitat in the region, the project will have little adverse impact on a Bay-wide scale. The majority of hydrodynamic impacts will be short-term and temporary. Depths at the site will be permanently changed, and some sediment erosion, sediment transport, and material spreading will occur. The potential cumulative impacts to regional hydrodynamics as the result of multiple upper Bay projects have not been studied. Additional studies and modeling of regional hydrodynamics would be required to determine the potential adverse cumulative impacts.

Overall, the cumulative positive effects of the project outweigh the short-term negative impacts. Improvements to water quality, sediment quality, and fishery habitat are environmentally significant at a local level. In addition, representatives of the MWA have stated that, although they object to open-water placement generally, they would not oppose placement in Site 104 if bottom conditions could be improved (Site 104 Open-Water Placement Area Commercial and Recreational Fishers Meeting Summary July, 28 1997-Attachment C). In addition, the potential reduction in anoxia in the area and the contributions to the Oyster Recovery Program may be environmentally significant at a regional level. Combined with other on-going restoration projects in the Bay, the positive impacts contribute to cumulative improvements to the Bay resources and ecosystem. Dredged material placement at Site 104 is an economically significant project for the Port of Baltimore. As an ancillary benefit any enhancement or improvement of the Bay's oyster fishery will provide improvements in the health of the Bay and help support future economic prosperity of the Bay's watermen.

Section 9

SITE 104 MONITORING FRAMEWORK

9.1 PURPOSE

Monitoring for the Site 104 placement operations will be performed as part of regulatory compliance, to ensure that performance criteria are met, to confirm and to limit the predicted potential impacts, and to provide information to further assist in the management of the site. Results of the Site 104 monitoring framework can be used to verify assumptions and predictions or to provide a basis for modifying the site management process. This monitoring framework was developed with the objective of providing the information needed by regulatory and resource agencies to meet their operational requirements and data needs, and serves as a template for developing the monitoring plan. The monitoring framework will be submitted by CENAB to MDE for approval as part of the Water Quality Certification requirements for this project should a favorable Record of Decision be issued for use of Site 104 for placement of dredged material.

9.2 INTRODUCTION

This monitoring framework, like the study process and project design, is the result of a collaborative effort. It has been developed to provide a multi-disciplinary monitoring program that meets the regulatory and resource agencies requirements for the Site 104 open-water placement project. Monitoring needs have been identified in a collaborative manner by a multi-disciplinary group of state and Federal regulatory and resource agencies for similar sites throughout the upper Bay (e.g., Hart-Miller Island, Pooles Island sites, and Poplar Island).

~~Agencies providing expertise and information on Region III and CBP monitoring elements will include NMFS, USFWS, MDNR, MGS, MPA, MDE, MES, EPA, USACE, UMCES HPEL and CBL. A collaborative, multi-disciplinary team will participate in the development of the monitoring framework in order to contain costs, to ensure comprehensive monitoring, and to provide concurrent peer review of the monitoring effort.~~

The development of the monitoring approach is a dynamic process, and monitoring elements will evolve to fit changing conditions and findings. The specifics of each monitoring element will be controlled by the final project details. Changes will continue to be presented to the agency team for their review and comment. Monitoring is intended to be flexible in order to meet the needs of the project and the requirements of the resource and regulatory agencies over time. Each element will be evaluated at the end of each monitoring year, and the monitoring team will decide upon appropriate changes as necessary.

These monitoring needs require that data be collected before, during, and after placement at Site 104. The baseline data include information previously collected for the NEPA process to document existing conditions in or around Site 104. Data collected would be used to compare and assess future conditions both during and after placement occurs. Baseline data collection was initiated in the spring of 1996.

The use of fish (demersal and pelagic) and crustaceans such as crabs to directly monitor the impacts of the placement operations is not appropriate. They move into and out of the Site 104 area, which makes it impossible to determine how representative they would be in assessing the impacts of placement operations in Site 104. Also, the direct effects of dredged material placement in open waters on the behavior and long-term physiological response of fish and crabs is poorly understood. There are no indices or coefficients (such as toxicity tests) that allow the direct exposure effects on predators to be quantified.

Although not included in this framework, a ~~two~~ 2-year monitoring program for the shortnose and Atlantic sturgeon was developed by the NMFS, USFWS, and USACE and implemented by the USFWS and funded by CENAB and CENAP. An interim Biological Assessment (BA) is being prepared by the Baltimore District and will be provided to NMFS at the time of the public release of this draft EIS. This interim BA will include all sturgeon-related field data available at that time. In addition to the data collected during this sturgeon monitoring program, the interim BA will include data collected during the USFWS Bounty Program.

9.3 MONITORING ELEMENTS

9.3.1 Site Management

~~The objectives of this monitoring element are as follows:~~

~~1.To provide guidelines for placement of material at Site 104;~~

~~2.To specify operational criteria where controls are necessary;~~

~~3.To provide detailed plans for meeting restrictions imposed by certification; and~~

~~4.To provide monitoring of site performance.~~

~~The following methodologies will be used to achieve the above objectives:~~

Guidelines for material placement would be designed to minimize resuspension and dispersion of sediment, and to ensure that material is placed in accordance with pre-designated locations and depths within the placement site. Placement plans will be developed prior to each year's dredging and will be developed based on pre-placement surveys performed to verify the capacity of the Site 104 area. The specific minimum performance criteria may include, but are not necessarily limited to: (1) verification of dredging and placement depth by bathymetric surveys, (2) use of specified routes for travel between the dredging and placement sites, and (3) verification of dredging and placement locations using data from electronic navigation systems.

~~Implementing operational controls on the placement activities would minimize the opportunity for sediment resuspension and dispersion during the placement process while maximizing operational efficiency and safety. Control techniques may include, but are not limited to: (1) contractually requiring that the placement operations meet specific minimum environmental performance~~

~~standards and environmental windows; (2) contractually requiring submittal and implementation of project specific plans; (3) placement of marker buoys to identify routes or the designated material placement locations; (4) use of a Global Positioning System with onboard recording capability to identify and document the location of material placement and/or requirements for inspectors to verify placement locations; (5) requiring the dredging contractor(s) to meet specific minimum competency and experience standards; and (6) notifications to fishing and boating interests of dredge and scow movements and schedules.~~

CENAB will submit a finalized Site Management Plan to MDE to ensure coordination of all parties involved and will obtain approval for use of Site 104 prior to commencement of any placement activity. The Site Management Plan will include estimates of placement capacity and coordinates of the designated grid area in which all placement will occur. This will include the placement sequence of material and the designated locations and volumes. The operations plan to be used by the contractor for dredged material placement will also be appended to the Site Management Plan.

~~Study Endpoint:~~

The study endpoint of this monitoring element will be determined within a window to be defined following the last placement action. This window will be clarified based upon information collected following the completion of all placement activities.

9.3.2 Consolidation and Erosion

~~The objectives of this monitoring element are as follows:~~

~~1. To determine the initial capacity of the Site 104 area before and the remaining capacity after each placement season;~~

~~2. To measure and evaluate changes in the material placed within and around the Site 104 area due to erosion and consolidation of sediments;~~

~~3. To evaluate the monitoring data and suggest modifications as necessary in the monitoring program design and in site management.~~

~~The hypothesis being evaluated is as follows:~~

> ~~Dredged sediment is subject to predictable forces after placement which result in relatively standard rates of consolidation and erosion, based on the type of material, the method of placement and the placement location. Placement of dredged material will not materially deviate from these expected conditions.~~

Observations of consolidation and erosion in the Site 104 area would be determined through sample collection, laboratory analysis, and data processing and synthesis. Existing sediments in the Site 104 location would be collected and analyzed before dredging and placement operations begin. Bathymetric surveys of the placement area would also be performed prior to placement to evaluate changes in capacity of the placement area over time. At the conclusion of the proposed placement activities and at the end of the monitoring period, core samples would be collected from the placement area to provide a baseline for evaluating changes in the deposited sediments over time. Selected samples would be subjected to grain size and bulk property analyses. These data would be analyzed to determine volumetric changes due to consolidation of the foundation sediments.

~~Study Endpoint:~~

Monitoring would be performed each year that placement occurs within the Site 104 area, and up to ~~one~~ 1 year after placement is completed to document consolidation and erosion.

9.3.3 Shellfish Bed Sedimentation

The objective of this monitoring element would be to provide information on the change in sedimentation rates on nearby charted oyster bars (State of Maryland Natural Oyster Bars [N.O.B.] 6-5 and 4-8), otherwise known as Broad Creek and the Bear Creek Bar, respectively) and at adjacent reference sites.

~~The hypothesis being evaluated is:~~

~~There is no discernable increase in sedimentation rates on the charted oyster bars during placement when compared to sedimentation rates prior to placement activities, adjusted to reflect seasonal and annual variations in sedimentation.~~

~~To test this hypothesis, t~~The baseline sedimentation rate within the oyster bar ~~must~~ would first be determined and then compared to rates obtained during placement operations. This will be accomplished using bathymetric surveying combined with a side-sonar survey and acoustic bottom classification. The baseline accumulation rates will be determined by measurements made at predefined locations within the oyster bar for a specified period prior to initiation of placement operations. The rates will be adjusted to reflect seasonal and annual variations to enable an appropriate comparison. The specific approach will be developed prior to submission of the monitoring framework.

If it is determined that sedimentation within the oyster bar has increased due to placement of the dredged materials, operations will be discontinued until the placement methods can be re-evaluated and refined.

~~Study Endpoint:~~

Evaluations would continue annually to determine whether monitoring should continue.

9.3.4 Sediment Quality Monitoring

~~The objectives of this monitoring element are as follows:~~

~~1.To characterize the chemical composition of the sediments in the channels to be placed at Site 104;~~

~~2.To track the quality of sediments placed at Site 104; and~~

~~3.To distinguish the anticipated improvement of the sediment quality at station KI-7 (which had the highest levels of contaminants).~~

~~The hypotheses being evaluated are as follows:~~

~~1.The priority pollutant organic compound concentrations in sediments taken from the channels and placed at Site 104 will be below detection limits or below the appropriate criteria for these constituents.~~

~~2.The metal concentrations in sediments placed at Site 104 will be below appropriate criteria for these constituents; and~~

~~3.After one year of placement at KI-7, the concentrations of metals and organics will be below the appropriate sediment criteria for these constituents.~~

Sediment samples would be collected both inside and outside the boundaries of Site 104 every ~~three~~ 3 years -at the same locations as in the baseline sampling ~~(Figure 5-13)~~. Sediment samples would be analyzed for organics, inorganics, nutrients, and grain size (including the Atterberg limit tests).

Samples would be collected from the Chesapeake Bay approach channels and analyzed using field and laboratory methods as defined by the Chesapeake Bay Program to support the Inland Testing Manual guidelines (EPA and USACE~~,~~ 1998). The results of these samples are used to define the materials dredged during channel maintenance operations.

After ~~one~~ 1 year of placement, sediments at station KI-7 would be analyzed to verify equal or improved sediment quality over baseline conditions.

~~Study Endpoint:~~

The study endpoint of this monitoring element will be the final monitoring following the last proposed placement action at Site 104.

9.3.5 Sediment Nutrient Flux

~~The objectives of this monitoring element are as follows:~~

~~1.To characterize nutrient loading in and around Site 104; and~~

~~2.To verify that placement at Site 104 will have no long term impact on nutrient flux rates and, therefore, water quality (short term impacts are expected).~~

~~The hypothesis being evaluated is as follows:~~

> ~~Sediment nutrient flux rates will remain within the expected ranges for a similar area that experiences summer hypoxia.~~

~~In order to evaluate this hypothesis, s~~Stations in and around Site 104 would be monitored each year during hypoxic/anoxic periods (May--September) at a time when microbial activities and potential nutrient releases are highest. Sediment carbon, oxygen, and nutrient flux sampling would take place during May, June, July, August, and September following placement each season. A total of five sets of measurements would be made at each station (vertical water column profiles of temperature, salinity and DO, water column samples, and sediment core samples). The water column samples would be analyzed for ammonium, nitrite, nitrite+nitrate, dissolved inorganic phosphorus (DIP) corrected for salinity, and silicious acid. The sediment cores would be used to measure oxidation-reduction potential (Eh) of the sediments at 1-cm intervals for the top 10 cm, particulate carbon, particulate nitrogen, particulate phosphorus, total and active chlorophyll-a, and net exchanges of carbon, oxygen, and dissolved nutrients between sediments and overlying waters.

~~Study Endpoint:~~

When sediment nutrient flux rates return to within expected ranges for the area, or are predictable in nature based upon data collected over a minimum of ~~three~~ 3 years, the study team will determine whether monitoring should continue.

9.3.6 Water Quality Monitoring

~~The objectives of this monitoring element are as follows:~~

1. ~~To characterize water quality in and around Site 104 to evaluate whether long-term water quality changes have resulted from the proposed action (short-term water quality impacts are expected);~~

2. ~~To monitor turbidity resulting from placement activities at the edge of the mixing zone; and~~

3. ~~To comply with the Water Quality Certificate requirements during placement.~~

~~The hypotheses being evaluated are as follows:~~

1. ~~There will be no significant long-term change in water quality conditions at Site 104 (a slight short-term change in turbidity is expected immediately after placement operations within the boundaries of Site 104); and~~

2. ~~Turbidity levels outside the defined mixing zone will remain in compliance with the Water Quality Certification limitations during and after placement activities.~~

~~In order to evaluate these hypotheses, s~~Stations within and outside of Site 104, including the Chesapeake Bay Program Water Quality Monitoring (CBP) stations, would be monitored seasonally during placement. Typically three water quality samples would be taken per station (surface, mid, and bottom). The same parameters would be used for water quality testing as are evaluated in the Chesapeake Bay Program (spatial location, depth, temperature, salinity, conductivity, turbidity, total suspended solids [~~(~~TSS~~)~~], secchi depth, pH, dissolved oxygen, chlorophyll-a, and nutrients such as nitrogen, phosphorus, carbon, and silica species). The CBP approach is specific to the Bay and will function as the tool to satisfy the ITM guidelines. In addition, data from CBP stations would be evaluated for use as a historical comparison for baseline data sets.

TSS and nutrient samples would be collected upstream, in and downstream of the turbidity plume. Samples would be collected at three depths in the water column including surface, mid, and bottom layers. This would be repeated during each placement year.

Compliance turbidity monitoring is not defined as yet. It would depend upon the mixing zone, which has yet to be developed. Turbidity monitoring would be required during placement since compliance limits would be set in the Water Quality Certification issued by the Maryland Department of the Environment.

~~Study Endpoint:~~

Evaluations would be made by the monitoring team annually on whether the monitoring should be continued.

9.3.7 3-D Water Quality Modeling of Sediment Nutrient Flux Impacts on Water Quality

~~The objective of this monitoring element is as follows:~~

~~To provide data to evaluate potential water quality impacts from sediment nutrient fluxes and to substantiate the model predictions under actual placement conditions at Site 104.~~

~~The hypothesis being evaluated is as follows:~~

~~1. The use of Site 104 for placement is expected to have a short-term and localized impact on water quality, primarily through increased turbidity, total suspended solids and nutrient concentrations at the time of placement;~~

~~2. Placement of dredged material at Site 104 will provide a moderate increase in dissolved oxygen concentrations in bottom waters due to decreasing water depth;~~

~~3. Salinity concentrations in the upper Bay will not change more than 0.1 ppt; and~~

~~4. No long-term impacts to water quality are expected.~~

~~In order to evaluate these hypotheses, w~~Water quality data from Site 104 during the first, second, and third year of placement would be collected. These data would be used to re-run the water quality module of the WES CH3D Chesapeake Bay Model to assist in the verification of predicted impacts to water quality from the placement of dredged material at Site 104.

~~Study Endpoint:~~

Evaluations would continue annually by the study team to determine whether monitoring should continue.

9.3.8 Benthics Monitoring

~~The objectives of this monitoring element are as follows:~~

~~To verify re-establishment of the benthic community and to compare the results of sampling with established Chesapeake Bay benchmarks, including the B-IBI, to evaluate benthic community conditions at Site 104;~~

~~The hypotheses being evaluated are as follows:~~

~~1. The benthos at Site 104 will show no long term loss in terms of the multi-metric Benthic Index of Biotic Integrity (B-IBI) within a specified time period after all placement has ceased; and~~

~~2. The elevation of the site depths may potentially embellish benthic colony establishment (due to reductions in low oxygen events) and may promote non-opportunistic species colonization.~~

~~In order to evaluate these hypotheses, b~~Benthic stations would be monitored once in the summer, fall, winter, and spring beginning ~~one~~ 1 year after placement of material has ceased. Three replicate samples per station would be collected. Reference stations would be established outside the area of impact for comparison purposes. The Chesapeake Bay Program's Benthic Monitoring Program and baseline data would provide useful data for comparison. The ~~Benthic Index of Biotic Integrity (~~B-IBI~~)~~ would be used to compare the benthos at the active placement site to the benthos at the reference sites. Appropriate depth stations would be compared. At least one of the reference stations would be a Chesapeake Bay Program Benthic Monitoring Program Site.

~~Study Endpoint:~~

The study endpoint of this monitoring element is ~~eighteen~~ 18 months after the last placement action at Site 104.

Section 10

Compliance with Applicable Laws, Regulations and Executive Orders

As part of the NEPA process, the applicable environmental laws and statutes were reviewed relative to the proposed placement plan. For a placement site to be environmentally acceptable, the location, plan, and operation must be in compliance with a suite of environmental protection statutes and executive orders. The placement plan is expected to comply with all pertinent regulations, as summarized in Table 10-1. Table 10-1 outlines the statutes and executive orders that are potentially applicable to the project, including the level of compliance. The multiple organizations involved in the project, the ongoing and open communication surrounding the placement site, the identification process, and site evaluation and decisions have helped assure complete compliance with potentially applicable statutes and regulations.

The plan is expected to be in compliance with the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). The plan is in compliance with the National Historic Preservation Act.

The technical impact assessment documented in this report demonstrates that the project complies with applicable components of the Anadromous Fish Conservation Act; Clean Air Act, Coastal Zone Management Act, Estuary Protection Act, Marine Mammal Protection Act, Archaeological and Historic Preservation Act, National Historical Preservation Act, and the Rivers and Harbors Act. The proposed action would be in full compliance with the Clean Water Act if the State of Maryland issues a Water Quality Certification (WQC). The proposed action would also be in full compliance with the Endangered Species Act when the NMFS issues a Biological Opinion for shortnose sturgeon based upon activities associated with this project.

The project complies with all components of NEPA. Through the coordination process, the project complies with the Fish and Wildlife Coordination Act.

A number of executive orders are applicable to the project. The impact evaluation process demonstrates that the project complies with Executive Orders number 11593 Protection and Enhancement of Cultural Environment, number 11990 Protection of Wetlands and number 12962 Protection of Recreational Fisheries.

The project will have no disproportionate impact on minority or low-income communities, and complies with Executive Order number 12893, Environmental Justice. Through USACE public involvement and Outreach Committee meetings and public scoping meetings, the residents of Queen Annes, Anne Arundel, and Kent Counties have been involved in the decision making process.

Table 10-1

COMPLIANCE OF THE PROPOSED ACTION WITH ENVIRONMENTAL PROTECTION STATUTES AND EXECUTIVE ORDERS

FEDERAL STATUTES	COMPLIANCE
Anadromous Fish Conservation Act	Full
Archaeological and Historic Preservation Act	Full
Clean Air Act	Full
Clean Water Act	Partial
Coastal Zone Management Act	Partial
Comp. Envir. Response, Compensation and Liability Act	Full
Endangered Species Act	Partial
Estuary Protection Act	Full
Federal Water Project Recreation Act	Full
Fish and Wildlife Coordination Act	Full
Land and Water Conservation Fund Act	Full
Marine Mammal Protection Act	Full
National Historic Preservation Act	Full
National Environmental Policy Act	Full
Resource Conservation and Recovery Act	Full
River and Harbor Act	Full
Watershed Protection and Flood Prevention Act	Full
Wild and Scenic Rivers Act	N/A
The Magnuson Stevens Fishery Conservation and Management Act	Full
EXECUTIVE ORDERS (E.O.), MEMORANDA, ETC.	**COMPLIANCE**
Protection and Enhancement of Cultural Environment (E.O. 11593)	Full
Recreational Fisheries (E.O. 12962)	Full
Env. Effects of Major Federal Actions (E.O. 12114)	Full
Floodplain Management (E.O. 11988)	N/A
Protection of Wetlands (E.O. 11990)	Full
Prime and Unique Farmlands (CEQ Memorandum, 11 Aug 80)	N/A
Environmental Justice (E.O. 12893)	Full

All applicable laws and regulations listed will be fully complied upon completion of the environmental review, obtaining State water quality certification, and a Biological Opinion for the Endangered Species Act.

Note:

Full Compliance (Full):	Having met all requirements of the statute, E.O. or other equivalent requirements for the current stage of planning.
Non-Compliance (NC):	Violation of a requirement of the statute, E.O.
Partial Compliance (Partial):	Not having completed some of the requirements that must be met prior to undertaking the Action
Not Applicable (N/A):	No requirements for the statute, E.O. or other environmental requirement for the Current stage of planning

Section 11

Relative Costs of Placement Site Alternatives

The costs related to the use of any placement alternative must be balanced against the benefits inherent in its use. As part of the NEPA process, the economic considerations of the preferred alternative (i.e., the Proposed Action) must be analyzed and balanced against the environmental impacts. The NEPA process also requires that the economics of any viable options be considered and weighed against the economics of the Proposed Action. This section summarizes the relative costs of the various viable placement alternatives considered in Sections 2 and 7.

11.1 PLACEMENT ALTERNATIVES

The placement alternatives considered for the 18 mcy short-term placement need were screened from hundreds of potential candidate sites (Section 2). The screening process considered sites with several different placement strategies. The placement strategies and sites that were considered viable after the screening process are detailed below.

11.1.1 Types of Placement Alternatives

Dredged material placement sites are generally categorized by the type of containment that is provided. The costs to develop and operate a site are directly dependent upon the type of placement involved. Generally speaking, placement sites are either on uplands or within/along bodies of water (shoreline stabilization/marsh reconstruction). Upland sites are generally contained and include some type of berm or retaining wall to help to keep materials in place. Shoreline stabilization sites or marsh/island reconstruction sites (along water bodies) are generally "semi-contained," a berm, breakwater, or bulkhead may be constructed to help stabilize material initially, but it may be designed to be temporary in low physical energy settings. Materials used for shoreline stabilization or marsh construction (i.e., beneficial use options) are generally expected to interact with the adjacent water body. Sites that lie completely within a waterbody tend to be one of two basic types: (1) island creation (usually completely or mostly diked/contained); or (2) open water (either with or without a berm).

Because all of these operations differ in the type and degree of materials contained and the necessary construction, the costs for development and operation will vary considerably.

11.1.2 Alternatives Considered

The screening process to identify the most appropriate type of placement and placement site for the 18 mcy short-term dredging need is detailed in Section 2. The analysis yielded the following list of viable alternatives:

- Site 104
- Hart Miller Island
- CSX/COX Creek
- Pooles Island Open Water

- Poplar Island (Phase I&II)
- Site 171 (as open-water site)
- Man-O-War Shoals
- Combination of Potentially Implementable Small Scale Projects
- No Action Alternative

Sections 2 and 7 detail the site-specific reasons that these sites remained as viable alternatives for the short-term placement need, relative to the hundreds of sites initially considered throughout the Bay region. Details on the economic and environmental considerations that resulted in Site 104 becoming the preferred alternative (and Proposed Action) are also found in Sections 2 and 7. The remainder of this section is meant to clarify some of the economic considerations for the selection of Site 104.

11.1.3 No Action Alternative

The no action alternative is not the lowest cost alternative. If a placement option or site is not used, dredging cannot proceed. The cost to the Port would be potential loss of bulk and container carriers due to the inability to navigate the channels, increased costs to lighter ships calling on the Port, and increased transportation costs resulting from light loading of vessels. This would result in irretrievable losses of revenue as well as jobs. The ultimate cost would be the demise of Baltimore as a viable Port for modern seagoing ships. Since this would not be a realistic situation, the No Action Alternative would not be acceptable.

11.2 PLACEMENT COSTS

The type of placement facility and area where materials are placed will dictate the costs of placement. Costs can vary greatly from site to site, even within one type of placement. The main reasons for this variability includes: distance from dredging project to placement site/facility, accessibility of facility to barges/scows, land acquisition constraints and costs, monitoring costs, and site-specific engineering constraints. There are, however, some generalizations that can be made within and between placement types. These are outlined in the following sections with site-specific examples, as available.

11.2.1 Costs of Dredging and Transportation of Dredged Materials

One of the significant factors that is utilized to make comparisons among alternatives is the estimation of the cost for dredging and transportation of the dredged material to any specific alternative location. While the least expensive alternative is not always preferred, the difference in cost provides a useful tool with which to judge the merits of each alternative. As a general rule, the costs of the actual dredging of the channels will not vary much among the placement alternatives.

The most significant cost factor in the actual dredging operation is the distance over which the dredged material must be transported. Current estimates of transportation costs for this region are $0.10/cubic yard per mile of distance. Section 7 includes an analysis of distances from the channels scheduled for maintenance/improvement relative to all of the sites considered to accommodate the short-term placement need (Table 7-1). Sites 171, Man-O-War Shoals, and Site 104 have the lowest transportation distances of any of the currently viable placement alternatives. Although increased transportation costs will not, of themselves, preclude a site from being economically viable, it remains as one of the key considerations in assessing placement costs in this region.

11.2.2 Dredged Material Placement Costs

Dredged material placement costs are a function of several factors: (1) the type of dredging necessary for the project; (2) the type of transportation necessary for the type of dredging used; and (3) the type of placement implied by the type of dredging and placement facility type. In the Bay, materials are generally dredged either mechanically (with a large bucket that scoops material onto a barge/scow) or hydraulically (where material is either cut or suctioned into/onto a scow or pumped directly to a placement site).

Upon arrival at a site, the way the material is placed is dependent upon the type of site. For upland or contained sites, material must either be mechanically placed (i.e., scooped) onto the site or pumped onto the site. Mechanical placement is more time consuming and, therefore, costly. For open water sites, the placement occurs either by hydraulically pumping sediments directly onto the site from nearby channels, pumping materials from a scow (controlled pipeline), or allowing the materials to drop from the bottom of a scow (bottom release scow) or hopper dredge. In this instance, the mechanical placement (bottom release scow) is the least costly alternative for open-water and the least costly of any placement type. Although the process of hydraulic placement is similar for both open-water and contained/semi-contained sites, vessel access to open-water sites is generally easier, making this process slightly less costly at open-water sites. Placement in open water sites (such as Site 104, Man-O-War Shoals, and Site 171) tend to be the least costly placement processes.

11.2.3 Real Estate Costs

The relative costs of real estate required for each of the placement site types are dependent upon whether the alternative is an upland vs. in-water (open water, shoreline) site. In-water placement sites will not require purchase of real estate unless a connection to shore is required. The State of Maryland, as the owner of the Bay bottom, already owns the placement sites for all open-water sites. All upland sites and shoreline sites must be acquired or leased, or an easement must be obtained from the current owners prior to use if not already under State or Federal ownership. This generally results in significant cost and can take a very long time in negotiation. For example, the land required for the CSX/Cox Creek Site took more than 6 years to acquire. Because most upland and shoreline sites are of moderate or low capacity, development of multiple sites would be required to meet the 18-mcy short-term need. Multiple sites will cost significantly more per acre to negotiate and acquire than a single site large enough to handle the required 18 MCY.

Sites that are already owned or acquired, and are either permitted (HMI, Pooles Island) or in the process of construction or permitting (Poplar Island, CSX/Cox Creek) would not involve any new real estate costs. Therefore, these would be comparable to open water sites in terms of real estate costs (at the present time). However, all of the aforementioned sites have maximum annual capacity constraints and are currently scheduled for materials other than the 18 mcy that are necessitating the consideration of Site 104 at this time.

11.2.4 Site Development Costs

Site development costs are a function of the amount of construction needed. Confined sites (that require dike construction) are the most costly to develop. Upland or shoreline sites that require some kind of stabilizing structure (bulkhead, retaining wall, berm) would be less costly than a completely contained facility, but certainly more costly to develop than an open water site. The costs are incurred not only from the need to construct containment structures, but also from the need to construct infrastructure (e.g., developing access roads, dredging service channels, development of docking/mooring facilities). For example, CSX/COX Creek will require significant renovation and improvements prior to full-scale operation.

All of the new confined or upland alternatives would, therefore, require significant site development. There would be planning, design, and construction costs associated with each of these alternatives that are much greater than at either of the existing sites or open water options. Open water sites require little, if any, containment construction or infrastructure development. Some open water alternatives may require construction of underwater berms to adequately confine the dredged material; underwater berms would be an additional cost at an open-water site, and would be comparable in costs to similar containment structures on land. None of the development cost would be incurred at Site 104.

Beneficial use sites with habitat components, such as Poplar Island, would have the added cost of habitat reconstruction. Although this is not strictly a construction cost, it must be acknowledged as a cost of site development.

11.2.5 Site Operation Costs

Site operation costs are a direct function of the type of placement and facility. Engineered (contained) facilities require a certain amount of continual maintenance to ensure that dikes and spillways are properly maintained and that material de-watering and consolidation proceed as planned. Therefore, site operation costs for a facility like CSX/COX Creek are expected to be somewhat more expensive than the current operating costs at HMI. Upland and shoreline sites may require less maintenance than containment sites, although some grading and spreading generally is required. Of course, site operation costs for multiple upland/shoreline sites would be expected to be significantly higher than for any single site with capacity for 18 mcy, and significantly higher than open water sites. Open water sites require little to no site operation other than monitoring (see below). Grading is required for some open water sites, and grading may be required for Site 104.

11.2.6 Site Monitoring Costs

Site monitoring costs will vary both among and within placement types, due primarily to the resources of concern in the area and the nature of the placement activity. All contained sites are required to monitor the quality of the water that is released from the site as well as the condition of the aquatic resources in the vicinity of the site. The use of HMI would not result in additional monitoring costs since monitoring is already an integral part of site operations and will occur regardless of the source of the material. The other confined site, CSX\COX Creek, is expected to have similar monitoring requirements to HMI. In the case of Poplar Island, monitoring of aquatic resources may be required because the area has significant fisheries resources and monitoring of wetlands development will be required. This would be in addition to the water quality monitoring required by the NPDES discharge permit.

Upland sites would not necessarily have any aquatic monitoring requirements but would have effluent monitoring requirements. Monitoring of the health and recovery of plant communities within, and adjacent to, the placement area may require monitoring. Shoreline stabilization and marsh reconstruction sites would likely have to monitor water quality and the condition of the aquatic biota in proximity to the site. In beneficial use cases such as Poplar Island (where habitat reconstruction is an integral part of the site development and operation) additional costs of monitoring the success of the habitat reconstruction will occur.

Open water sites generally require more monitoring than most other options and would, therefore, incur additional expense. In addition to the water quality and natural resource monitoring, open water sites require bathymetric surveys to verify that placement occurred correctly. Site 104 will require significant monitoring which will cost approximately the same as other open water options (e.g., Site 171, Man-O-War Shoals). Monitoring at confined sites will generally not require the more extensive bottom monitoring and phosphorous flux evaluations that would be necessary at deeper sites, such as Site 104. A combination of small scale projects will be significantly more costly since each site will require effluent monitoring and perhaps some other natural resource monitoring.

11.2.7 Permitting Costs and Considerations

All placement alternatives require a certain amount of investigation prior to site development/utilization. In most cases, environmental assessments and/or environmental impact statements must be prepared. The costs associated with this required documentation are a function of: (1) the size of the site; (2) the natural resources within the potential influence of the alternative; and (3) the type of material to be placed at the site. In general, the more environmental documentation and negotiations that are necessary, the more costly the alternative will be.

In-water options (open water, shoreline stabilization, island construction sites) have special permits and certifications that are required. In addition to the water quality certification, projects that involve shallow water, wetlands, and other shoreline areas require additional approvals and permits under state and Federal law. The more permits and approvals required, the more complex and costly the process. Existing sites that have already been through the process would not require additional permitting/documentation costs. Open water sites tend to be of moderate cost to permit. Although they generally do not involve wetlands, they do require water quality certifications, and documentation tends to involve more costly (boat-based) field studies. Upland sites tend to be the least costly to study and permit.

11.3 CONCLUSIONS

Placement costs are a direct function of the placement type for most cost factors, with the exception of transportation costs. Containment (confined) facilities tend to be the most costly to build and operate, although monitoring costs are lower. Upland sites and shoreline stabilization sites are relatively inexpensive to develop and maintain, but many tend to be low capacity. When the costs of developing several low-capacity sites are factored together, the option can be cost prohibitive. Open water sites are the least costly to develop and maintain. Even though the initial environmental documentation, permitting, and monitoring may be among the most costly of any placement type, these costs are relatively low compared to site development and operation costs. Open water sites, such as Site 104, are the most cost-effective placement options currently available in the Bay region.

NOT UPDATED — COE

Section 12

List of Preparers

Carol Anderson-Austra	Landscape Architect USACE, Baltimore District
Tammy Rose Banta	Senior Environmental Specialist Maryland Environmental Service
Jane Boraczek	Aquatic/Fisheries Scientist EA Engineering, Science, and Technology
Mark Cohoon	CADD Technician Maryland Environmental Service
Robert M. Corletta	Environmental Specialist Maryland Environmental Service
Peggy Derrick	Aquatic Scientist EA Engineering, Science, and Technology
Cecelia L. Donovan	Senior Environmental Scientist Maryland Environmental Service
Jennifer L. S. Duff	Environmental Specialist Maryland Environmental Service
Cherry Janiczewski	Water Resources Assistant
Vanessa Jones	Civil Engineer Maryland Environmental Service
Suzanne M. Kelly	Environmental Specialist Maryland Environmental Service
Stacey Kemper	Marketing Services Supervisor EA Engineering, Science, and Technology
Anwar Khan	Water Quality Specialist EA Engineering, Science, and Technology
Alex Knab	Administrative Support Maryland Environmental Service

NOT UPDATED

Pete Kotulak	Professional Engineer Moffatt & Nichols Engineers
Charles Leasure	Project Scientist EA Engineering, Science, and Technology
Jia Liu	Administrative Support Maryland Environmental Service
Jeffrey A. McKee	Ecologist USACE, Baltimore District
Matthew T. McKnight	Environmental Specialist Maryland Environmental Service
Mark Mendelsohn	Biologist USACE, Baltimore District
Christopher E. Norris	Graphics Specialist Maryland Environmental Service
Frank Pine, Ph.D.	Senior Project Manager/Senior Scientist EA Engineering, Science, and Technology
Stephen Storms, Ph.D.	Environmental Specialist Maryland Environmental Service
Maria De la Torre	USACE, Baltimore District
Brian Walls	Civil Engineer USACE, Baltimore District
Wayne Young	Senior Environmental Planner Maryland Environmental Service

Section 13

Public Involvement and Agency Coordination

13.1 PURPOSE OF THE PUBLIC INVOLVEMENT PROGRAM

The Baltimore District, U.S. Army Corps of Engineers has prepared this Draft Environmental Impact Statement (EIS) for the placement of 18 mcy of dredged material at Site 104 at the request of the Maryland Port Administration (MPA). Corps policy and guidance emphasizes that opportunities for public involvement must be provided during the planning stages of a project. Public involvement and agency coordination were especially important for the Site 104 project because of the high degree of public interest in dredged material placement in the upper Bay area. For these reasons, as well as the need to satisfy National Environmental Policy Act (NEPA) requirements for Federal projects, public involvement and agency coordination were designed to be an integral part of the planning process for this project.

The purposes of the public involvement program for the Site 104 study included the following:

- Introducing the public to the study team and planning process;
- Informing the public and decision makers about the study;
- Gathering information;
- Coordinating with citizens, interest groups, and agencies;
- Assessing support for the project;
- Providing a mechanism for citizen input to the planning process; and
- Explaining the use of tax dollars to the taxpaying public.

13.2 PARTICIPANTS

Many factions of the public were represented in the public involvement and agency coordination process for the Site 104 study. In addition to the MPA and MES, the different groups included natural resource management, regulatory, and planning agencies, the port community, citizen and interest groups, and the general public. A Site 104 DNPOP Working Group, comprised of study team members, representatives of commercial fishing interests, and natural resource management and regulatory agencies, also met on an as needed basis to provide input during the planning process. In addition, on-going public involvement and agency coordination activities conducted by the MPA, such as the DNPOP Executive, Management, and Citizen's Committee meetings and the Public Outreach Committee meeting, provided opportunities to incorporate citizen and agency input into navigation and dredged material placement activities. Coordination activities with natural resources management and regulatory agencies included communicating with the Maryland Department of Natural Resources (MDNR), National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) for rare, threatened, and endangered species and with the Maryland Historic Trust for historical and cultural resources.

For public involvement purposes on this study, the term "public" refers to any person, group, or agency that is not the Corps of Engineers. In addition to individuals, key participants in this study included the following:

- Federal natural resource management and regulatory agencies, such as Environmental Protection Agency Region III, NOAA/National Marine Fisheries Service, and U.S. Fish and Wildlife Service;

- State agencies, including the Maryland Department of the Environment, Maryland Geological Survey, Maryland Historical Trust, and Department of Natural Resources;

- Local agencies and offices, such as the Commissioners of Kent and Queen Anne's Counties;

- Commercial and recreational fishing groups - Maryland Waterman's Association, Maryland Charterboat Association, Upper Bay Charter Boat Captains Association, and the Maryland Saltwater Sportfishermen's Association;

- Environmental interest groups, such as the Chesapeake Bay Foundation, Haztrak Coalition, Alliance for Chesapeake Bay, and Chester River Association.

A number of public involvement activities were accomplished as part of an earlier site selection process for the State of Maryland's Strategic Plan for Dredged Material Management, prepared by the Maryland Port Administration (MPA) in 1996. The Citizens Committee for the Dredging Needs and Placement Options Program is comprised of representatives of county governments, commercial fishing groups, the Hart Miller Island Citizen's Committee and other pertinent parties. A Management Committee, which includes representatives from the Chesapeake Bay Foundation and the Alliance for the Chesapeake Bay, also provides input for navigation dredging and placement issues. Both of these groups continue to assist in the evaluation of alternative placement sites in the Bay and contribute to implementation of the State of Maryland's Strategic Plan. Information from the groups was incorporated into the Site 104 EIS.

13.2.1 Program Structure and Relationship to Planning Process

The public involvement program for the Site 104 study was organized into several stages. The stages were linked to the stages and tasks of other study activities. The public involvement stages included Project Initiation, Data Gathering, Data Analysis and Development of Recommended Plan, and Conclusion of Planning Study. Each stage provided different opportunities for public participation and agency coordination, including formal and informal meetings, correspondence, newsletters, and conversations, and each stage resulted in specific products.

13.2.1.a Stage 1 - Project Initiation Stage

The objectives of the Project Initiation Stage of the study were to develop a public involvement program; identify potential study participants and prepare a mailing list; notify the public and agencies about the study and the public involvement process; conduct public scoping meetings; and define data needs. The product of these activities was an extensive list of the citizens, groups, and agencies that would be involved in the study and the comments, ideas, concerns, and issues that were identified as important to incorporate into the planning process.

In June 1997, a notice was prepared and mailed to approximately 500 individuals, agencies, and offices announcing the intent of the Corps to prepare a draft Environmental Impact Statement (DEIS) that would evaluate the proposed placement of dredged material at Site 104. The notice also announced scoping meetings to be held on July 15, 17, and 22, 1997. The same information appeared in a Meeting Notice and a Notice of Intent published in the Federal Register and in advertisements and legal notices published in several newspapers in Queen Anne's, Kent, and Anne Arundel Counties.

The purpose of the scoping meetings was to present preliminary information about the study to the public and to identify the ideas, values, and concerns of the public. Three scoping meetings were held at Centreville (Queen Anne's County), Chestertown (Kent County), and Annapolis (Anne Arundel County) in order to meet with citizens in each of the three counties adjacent to Site 104. The same agenda and information were presented at each of the three locations. A fourth meeting was held in Centreville on July 28 to discuss the study with representatives of commercial fishing interests in the Bay, including the Maryland Watermen's Association and the Maryland Charter Boat Association. Although attendance was modest in numbers, the product of the four meetings was an extensive list of the concerns, thoughts, and ideas of the attendees. Annex A includes attendance lists for the four meetings, as well as a list of questions and comments from each of the July meetings.

In August 1997, a newsletter was distributed to addresses on the mailing list. The newsletter provided a discussion of the study progress and responded to ideas, questions, and comments received at the scoping meetings and by phone and mail. The comments and questions fell into several general categories, including the following: existing conditions at the site; fishing use of the site; field testing, monitoring, and modeling studies; potential impacts to the site, the upper Bay area, and the region; the effectiveness/ineffectiveness of public participation in the study and the credibility/lack of credibility of project proponents; the need for the project and/or other placement options; and the design, construction and maintenance of the project.

13.2.1.b Stage 2 - Data Gathering Stage. The objectives of this stage were to collect data on existing conditions at the site to serve as a baseline for possible impacts, to conduct modeling studies on different placement, methods, and locations, and to continue agency coordination activities. The product of this stage was preliminary technical data and continued coordination with natural resource management and regulatory agencies. Following the scoping meetings, data gathering needs were finalized and although most of the studies were already underway, some tests and studies were modified in order to incorporate the concerns identified in the scoping meeting comments and questions. The studies that were described in the newsletter included bathymetric surveys; studies on sediment nutrient flux and pore water/solid phase characteristics; water quality; sediment quality and foundation testing; fishing activity; wildlife, including the identification of rare, threatened, and endangered species; and studies of the groundwater, air quality, noise and odors, and hazardous, toxic, and radioactive materials at the site; a benthic community and fish abundance, size, and composition survey; and a cultural and archaeological resources survey. Other studies included hydrodynamic modeling for sediment transport, fate, and erosion as an evaluation tool for the effects of different placement techniques and to predict water quality impacts of the project. In response to specific questions about the possible impacts of the project on groundwater in the area, the Maryland Geological Survey (MGS) provided data on aquifers, as well as possible tectonic faults near the site. Finally, a comprehensive summary of the impacts of using Site 104 was addressed in a study of the Cumulative Impacts.

A summary of the studies conducted for the project was part of the August 1997 newsletter, included in Annex A.

Following the initiation of studies to characterize site conditions and potential impacts of the project, coordination with NMFS and USFWS identified new or anticipated studies on Chesapeake Bay sturgeon populations. A study focusing on the endangered shortnose sturgeon had been initiated and USFWS reported that Bay populations of Atlantic sturgeon were being considered for listing, which would require studies on their presence and habits in the Bay. The result of this coordination was initiation of a study on the Atlantic sturgeon, to be tied to the study and future dredging and navigation activity in the upper Bay.

13.2.1.c Stage 3 - Data Analysis and Development of Recommended Plan. Following the Data Gathering Stage of the public involvement and agency coordination program, analysis was begun on the preliminary monitoring and study findings. The objectives were to determine a scenario for use of the site that would result in the least negative environmental impacts of dredged material placement. Public involvement activities during this stage included a second newsletter, distributed in March 1998, and a second series of public meetings. The purpose of the newsletter was to provide information on the project status, report on the preliminary findings, and announce the March 1998 public information meetings.

The second series of public meetings was held following the receipt and preliminary analysis of draft reports on the monitoring and study results. The meetings were again held at three locations - in Stevensville, Annapolis, and Chestertown - in order to provide information to residents of each of the counties adjacent to the project site. A summary of the study findings was presented at each of the meetings, followed by a question and comment period. A number of the questions asked and comments made addressed topics similar to those received at the July 1997 meetings, however, a new topic - sturgeon populations in the Bay - was also addressed. The first March meeting, held in Stevensville on March 24, had the largest attendance (approximately 100 people) and the liveliest discussion. About 20 people attended each of the meetings in Annapolis and Chestertown. A list of the questions and comments received at the March 1997 series of meetings are in Annex A of this report.

13.2.1.d Stage 4 - Conclusion of Planning Study. Following the analysis of study findings, the impacts of placing dredged material at Site 104 are being evaluated and a decision will be made on whether to recommend the proposed action. The draft EIS being submitted for public and agency review includes information from these studies. Copies of the DEIS will be available for public review at several public libraries in Queen Anne's, Kent, and Anne Arundel Counties, as

NOT UPDATED

well as at local government offices. In addition, copies will be available electronically and by mail if requested.

A series of public hearings is scheduled to follow distribution of the draft EIS. The hearings will be held in the three counties adjacent to the project site. The purpose of the public hearing will be to receive comments on the DEIS an during the official 45-day public review and comment period. A summary and copies of official letters, questions and comments made about the study, and records of other communications are included in Annex A.

The formats of each of the meetings will be identical; however, prior to the Kent Island public hearing, a workshop will be held to review the project with interested citizens and representatives of agencies, offices, and organizations. The workshop will provide an opportunity for attendees to ask questions to technical investigators and to make written or taped comments on the EIS.

13.2.2 Public Meetings and Newsletters

The following table shows the dates and locations of public meetings held as part of the study. Notices announcing the meetings were sent to addresses on the study mailing list and placed as paid advertisements in local newspapers several weeks prior to the meeting dates.

DATE	LOCATION	COUNTY	PURPOSE	# ATTENDEES
15 July 1997	Chestertown, MD	Kent	Scoping	
17 July 1997	Centreville, MD	Queen Anne's	Scoping	
22 July 1997	Annapolis, MD	Anne Arundel	Scoping	
28 July 1997	Centreville, MD	Queen Anne's	Scoping	
24 March 1998	Stevensville, MD	Queen Anne's	Information	
25 March 1998	Annapolis, MD	Anne Arundel	Information	
26 March 1998	Chestertown, MD	Kent	Information	
March 1999	*Stevensville, MD*	*Queen Anne's*	*Info. Workshop*	To be determined
March 1999	*Stevensville, MD*	*Queen Anne's*	*Public Hearing*	To be determined
March 1999	*Chestertown, MD*	*Kent*	*Public Hearing*	To be determined
March 1999	*Annapolis, MD*	*Anne Arundel*	*Public Hearing*	To be determined

Two editions of a study newsletter were also mailed to approximately 500 individuals and offices. The first newsletter was sent in August 1997. The August newsletter reviewed the July public scoping meetings and included a project overview and information on the questions and comments received at the scoping meetings. The second newsletter was sent in March 1998, prior to the second set of public meetings. The March newsletter announced the second set of public meetings and reported on the technical studies and modeling being conducted for the EIS.

13.2.3 Evaluation of Program

The public involvement program developed for the Site 104 study included a number of communication techniques. The public scoping and information meetings provided an

NOT UPDATED

opportunity for citizens to interact with the study team, to discuss their ideas and concerns, to ask questions, and to make comments. At each of the meetings, numerous comments were made and questions asked. Project newsletters mailed to approximately 500 agencies, organizations, businesses, interest groups, and citizens provided a way to report on the study status and to answer questions that were asked several times. Comment cards were distributed at meetings and in the newsletters. Most of the cards returned included requests for inclusion on the mailing list, rather than comments. Extensive comments were included in several letters, however.

Section 14

References

American Public Health Association. 1981. Standard methods for the examination of water and wastewater, 15th. ed.

Amiran, M.C., C.L. Wilde, R.L. Haltmeier, J.D. Pauling, and J.G. Sontag, Jr. 1999. Advanced Sediment Washing for Decontamination of New York/New Jersey Harbor Dredged Materials, pp. 567-574. In: Proceedings of the Western Dredging Association Nineteenth Technical Conference and Thirty-First Texas A&M Dredging Seminar, May 15-18, 1999, Louisville, Kentucky (R.E. Randall, ed.). CDS Report No. 371. College Station, Texas: Center for Dredging Studies, Texas A&M University.

Aspila, I., H. Agemian and A.S.Y. Chau. 1976. A semi-automated method for the determination of inorganic, organic and total phosphate in sediments. *Analyst* 101:187-197.

Austin, D.K.L, R.E. Magnien and B.D. Michael. 1991. Water Quality Monitoring Assessment of Pooles Island Dredged Sediment Disposal Site. Final Report. Maryland Department of the Environment. May ~~1991~~.

Baine M.B. 1995. Sturgeon Notes. Cornell University. Sponsored by the Hudson River Foundation. June ~~1995~~.

Baine M.B. 1996. Sturgeon Notes. Cornell University. Sponsored by the Hudson River Foundation. July ~~1996~~.

Baine, M.B. 1997. Atlantic and shortnose sturgeons of the Hudson River: C~~c~~ommon and divergent life history attributes. *Env. Bio. Of Fishes.* ~~Vol.~~ 48:~~., pp.~~ 347-358.

Baker, P.K., and R. Mann. 1991. Soft Shell Clam; *Mya arenaria*. In: *Habitat Requirements for Chesapeake Bay Living Resources*. Second Edition. Funderburk, S.L., S.J. Jordan, J.A. Mihursky and D. Riley (eds.). Chesapeake Research Consortium, Solomons, Maryland.

Bates, R.L., and J.A. Jackson, eds. 1984. *Dictionary of Geological Terms*. Third edition. Prepared by the American Geological Institute. Anchor Press/Doubleday, Garden City, New York.

Batiuk, R.A., R.J. Orth, K.A. Moore, W.C. Dennison, J.C. Stevenson, L.W. Staver, V. Carter, N.B. Rybicki, R.E. Hickman, S. Kollar, S. Bieber, and P. Heasley. 1992. *Chesapeake Bay Submerged Aquatic Vegetation Habitat Requirements and Restoration Targets: A Technical Synthesis.* USEPA, Chesapeake Bay Program (CBP), Annapolis, Maryland.

Biggs, R.B. 1969. Biological and geological research on the effects of dredging and spoil disposal in the upper Chesapeake Bay – geology and hydrography (mimeo). Chesapeake Biological Laboratory, 69:23.

Biggs, R.B. 1970. Sources and Distribution of Suspended Sediment in Northern Chesapeake Bay. *Marine Geology*~~,~~ 9 ~~(1970)~~:-173-186.

Birdsong, R.S. and C. Buchanan. 1993. Zooplankton, pp. 45-50. Chesapeake Bay Strategy for the Restoration and Protection of Ecologically Valuable Species. Published by Maryland DNR CBRM for The Chesapeake Bay Program. CBP/TRS 113/94.

Blankenship, K. 1996. From Shipping Lanes to Shorelines. Alliance for the Chesapeake Bay, Bay Journal 6. Baltimore, Maryland.

Blankenship, K. 1997. Bay grasses increased in 1996 despite adverse conditions. Bay Journal ~~(7)~~ 2(7):-1,4.

Boesch, D.F. 1973. Classification and community structure of macrobenthos in the Hampton Roads area, Virginia. *Marine Biology* 21:-226-244.

Boicourt, W. 1992. Influences of Circulation Processes on Dissolved Oxygen in the Chesapeake Bay. In: D.E. Smith, M. Leffler, and G. Mackiernan (eds.), Oxygen Dynamics in the Chesapeake Bay: A Synthesis of Recent Research. Maryland Sea Grant, College Park, MD. Pp 7-59.

Borodin, N. 1925. Biological Observations on the Atlantic Sturgeon (*Acipenser sturio*). *Trans. Am. Fish. Soc.* 55:184-190.

Boynton, W.R., and J.H. Garber. 1989. Sediment-Water Oxygen and Nutrient Exchanges in Chesapeake Bay: Deep Trough Dredge Disposal Areas, Summer 1989. Final Report. Prepared for Versar Inc., Columbia, MD.

Boynton, W.R., J.H. Garber, W.M. Kemp, J.M. Barnes, L.L. Matteson, J.L. Watts, S.E. Stammerjohn, and F.M. Rohland. 1990. Ecosystem Processes Component Level 1 Interpretive Report No. 7. Chesapeake Biological Laboratory (CBL), University of Maryland, Solomons, MD. [UMCEES] CBL Ref. No. 90-062.

Boynton, W.R., W.M. Kemp, J.M. Barnes, L.L. Matteson, J.L. Watts, S.E. Stammerjohn, D.A. Jasinski, F.M. Rohland, and G.H. Garber. 1992. Pooles Island and Upper Chesapeake Bay Special Report: Sediment Oxygen and Nutrient Exchanges. March, 1992; Data and Progress Report: August 1980 - December 1991. Prepared for Maryland Department of the Environment.

Boynton, W.R., J.M. Barnes, L.L. Matteson, F.M. Rohland, and H.L. Kimble. 1993.

Pooles Island Dredge Survey Program. Final Report. June - August 1992, June – August 1993. Prepared for Maryland Environmental Service. October 1993.

Boynton, W.R., J.M. Barnes, L.L. Matteson, F.M. Rohland, L.L. Magdeburger, and B.J. Weaver. 1994. G-West Berm Monitoring Study. Interim Report (June - July 1994); September 1994. Prepared for Maryland Environmental Service.

Boynton, W.R., J.M. Barnes, L.L. Matteson, F.M. Rohland, L.L. Magdeburger, and B.J. Weaver. 1995. Sediment Oxygen and Nutrient Exchanges - G-West Hydraulic Placement Monitoring Study. Final Report (June - August 1995); November 1995. Prepared for Maryland Environmental Service.

Boynton, W.R., J.M. Barnes, F.M. Rohland, L.L. Matteson, J. Frank, and M.M. Weir. 1996a. G-East and Site 92 Subaqueous Placement Baseline Study: Sediment Oxygen and Nutrient Exchanges. November; Chesapeake Biological Laboratory Ref. No. 96-149; Final Report (June-August 1996).

Boynton, W.R., J.M. Barnes, F.M. Rohland, L.L. Matteson, J. Frank, and M.M. Weir. 1996b. G-West Hydraulic Placement Monitoring Study. Final Report. Chesapeake Biological Laboratory (CBL), University of Maryland System, Solomons, MD 20688-0038. [UMCEES] CBL Ref. No. 96-167.

Boynton, W.R., J.M. Barnes, F.M. Rohland, J. Frank, and M.M. Weir. 1997. Sediment Oxygen and Nutrient Exchanges, G-West Hydraulic Placement Monitoring Study. Final Report (June - August 1997). January 1997.

Boynton, W.R., J.M. Barnes, F.M. Rohland, J. Frank, and M.M. Weir. 1998. Sediment Carbon, Oxygen and Nutrient Flux Analysis at Site 104 Open Water Placement Area (May - September 1996). Chesapeake Biological Laboratory Ref. No. 96-150a.

Brandt, S.B., D. Bailey, and J. Kirsch. 1994. Fish Abundance, Size and Species Composition in the G-West Area Near Pooles Island. Final Report. Prepared for: Maryland Environmental Service.

Brandt, S.B., D.J. Bailey, and J. Kirsch. 1995. Fish Abundance, Size, and Species Composition Near Worton Point.

Brinker, Dave. 1998. MDNR. Personal Communication. 10 March 10, 1998.

Brower, J.E., and J.H. Zar. 1984. Field and Laboratory Methods for General Ecology, Second Edition. William C. Brown Publishers, Dubuque, IA.

Brownlee, D.C., and F. Jacobs. 1987. Mesozooplankton and microzooplankton in the Chesapeake Bay, Iin: Contaminant Problems and Management of Living

Chesapeake Bay Resources (S.K. Majumbar, L.W. Hall and H.M. Austin, eds.), pp. 217-269. The Penn. Acad. of Science.

Brundage, H.M., III, and R.E. Meadows. 1982. The Atlantic sturgeon, *Acipenser oxyrhynchus*, in the Delaware River estuary. *Fishery Bulletin* 80:-337-343.

Brush, G. 1990. Sedimentation Rates in the Chesapeake Bay, Final Report Submitted to the U.S. Environmental Protection Agency.

Brush, G., J.M. Hill, and M. Unger. 1997. Pollution History of the Chesapeake Bay: Final Report Submitted to NOAA Project NA27OA0450.

Buckley, J., and Boyd Kynard. 1981. Spawning and Rearing of Shortnose Sturgeon from the Connecticut River. *Prog. Fish-Cult.* 43:-74-76.

Caughlin, M. ~~March~~ 1997. Maryland Department of the Environment. Personal Communication. March.

CENAP. 1996. Chesapeake And Delaware Canal-Baltimore Harbor Connecting Channels (Deepening) Delaware and Maryland. Draft Feasibility Study and Environmental Impact Statement. January 1996. Philadelphia, Pennsylvania.

Century Engineering. 1987. Report on Dredged Material Disposal Site Selection Study at Aberdeen Proving Ground Maryland. Contract report prepared for Baltimore District, U.S. Army Corps of Engineers. Towson, Maryland.

Cerco, C.F. 1999. Additional Water Quality Model Examinations at Site 104. Draft Report. Waterways Experiment Station, Corps of Engineers. Prepared for Maryland Environmental Service. May.

Chapelle, F.H., and Drummond, D. D. 1983. Hydrogeology, Digital Simulation, and Geochemistry of the Aquia and Piney Point-Nanjemoy Aquifer System in Southern Maryland, Report of Investigations, No. 38, Maryland Geological Survey.

Chesapeake Bay Program (CBP). 1995a. Guidance for Protecting Submerged Aquatic Vegetation in Chesapeake Bay from Physical Disruption. USEPA, Chesapeake Bay Program (CBP), Annapolis, Maryland.

Chesapeake Bay Program (CBP). 1995b. Living Resources and Biological Communities pp. 16-22. In: ~~K. Reschetiloff (Ed.)~~ Chesapeake Bay, Introduction to an Ecosystem (K. Reschetiloff, ed.). US. Environmental Protection Agency.

Coastal Design and Construction. 1994. Parson's Island: Shoreline Management Proposal, January 19, 1994. Baltimore, Maryland: Parson's Island Enterprises.

Colman, S.M., and J.P. Halka. 1989. Maps showing Quaternary geology of the northern Maryland portion of the Chesapeake Bay. U.S. Geological Survey MF-1948-D, 3 sheets.

Colman, S.M., and J.P. Halka. 1990. Maps Showing Quaternary Geology of the Northern Maryland Portion of the Chesapeake Bay: U.S. Geological Survey MF-1948-D.

Colman, S.M., ~~and~~ J.P. Halka, and C.H. Hobbs III. 1992. Patterns and Rates of Sediment Accumulation in the Chesapeake Bay During the Holocene Rise in Sea Level; In: Quaternary Coastal Systems of the United States, S.E.P.M. Special Publication No. 48; eds. Fletcher, C. and J.F. Wehmiller.

Conley, D.J., and T.C. Malone. 1992. Annual cycle of dissolved silicate in Chesapeake Bay: implications for the production and fate of phytoplankton biomass. *Marine Ecology Progress Series*~~.~~ ~~Vol.~~ 81:-121-128.

Cooper, B. F., 1999. Data From Observation Well Network Monitoring Brackish-Water Intrusion of the Aquia Aquifer, Kent Island, Queen Anne's County, Maryland, Maryland Geological Survey.

Corletta, R., and J.L.S. Duff. 1997. Beneficial Uses of Dredged Material: Agricultural Use, pp. 100-101. In: Proceedings: International Workshop on Dredged Material Beneficial Uses, Baltimore, Maryland, July 28 – August 1, 1997 (M.C. Landin, ed.). Baltimore, Maryland and Washington, D.C.: Baltimore District, U. S. Army Corps of Engineers and U. S. Environmental Protection Agency.

Cornwell, J., and M. Owens. 1998~~a~~. Sediment Biogeochemistry at Site 104 Open Water Placement Area (June through August 1996). Draft Final Report. UMCES/HPL.

Cornwell, J., and W.R. Boynton. 1998~~b~~. Nutrient Chemistry of Sediment Dredging: Sediment Nutrient Inventories and Fluxes. 1997 Studies Including Channel Nutrient Inventories, Fluxes from Channel Sediments, and Controls on Sediment Nutrient Fluxes. Draft Progress Report. Univ. of Maryland Center for Environmental Science.

Correll, D.L. 1987. Nutrients in Chesapeake Bay. In: Majumdar, S.K., L.W. Hall, Jr. and H.M. Austin (ed.). Contaminant Problems and Management of Living Chesapeake Bay Resources. Pennsylvania Academy of Science.

Cousins, L., F. Beason, and J. Shuman. 1997. Brick Manufacture From Dredged Material, A Reality? P. 141. In: Proceedings: International Workshop on Dredged Material Beneficial Uses, Baltimore, Maryland, July 28 – August 1, 1997 (M.C. Landin, ed.). Baltimore, Maryland and Washington, D.C.: Baltimore District, U.S. Army Corps of Engineers and U. S. Environmental Protection Agency.

Cronin, L.E. 1971. A Biological Study of Baltimore Harbor. N.R.I. Reference No. 71-76. Natural Resources Institute, University of Maryland, Chesapeake Biological Laboratory, Solomons, Maryland. September.

Cronin, L.E., R.B. Biggs, D.A. Flemer, H.T. Pfitzenmeyer, F. Goodwyn, W.L. Dovel, and D.E. Ritchie. 1970. Gross Physical and Biological Effects of Overboard Spoil in Upper Chesapeake Bay. Solomons; Natural Resources Institute, University of Maryland. 1965-1968.

Cronin, W.B., M.G. Gross, J.A. Boggs, H.D. Palmer, J.L. Nolder, and D.G. Wilson. 1975. Accumulation and Dispersal of Dredged Materials Kent Island Disposal Site. Chesapeake Bay Institute, Johns Hopkins University. 8 December 8, 1975.

Consolidated Technologies, Inc. (CTI). 1998. Summary Report: Pilot Project for Dredging City of Perth Amboy Municipal Marina, City of Perth Amboy, Middlesex County, NJ. and Beneficial Use of Dredged Sediment for Mine Reclamation at Bark Camp Mine Facility, Huston Township, Clearfield County, PA. Report prepared for Pennsylvania Department of Environmental Protection, New Jersey Department of Commerce and Economic Development, City of Perth Amboy, and New York/New Jersey Clean Ocean and Shore Trust. Blue Hill, Pennsylvania.

Cusick, Melvin. 1997. Talbot County Government. Personal Communication.

D'Elia, C.F., P.A. Steudler, and N. Corwin. 1977. Determination of total nitrogen in aqueous samples using persulfate digestion. *Limnol. Oceanogr.* 22:-760-764.

Dadswell, M.J. 1979. Biology and population characteristics of the shortnose sturgeon, *Acipenser brevirostrum* LeSueur 1818 (Osteichthyes: Acipenseridae), in the Saint John River estuary, New Brunswick, Canada. Canadian Journal of Zoology 57:2186-2210.

Dadswell, M.J., B.D. Taubert, T.S. Squires. D. Marchette, and J. Buckley. 1984. Synopsis of biological data on shortnose sturgeon, *Acipenser brevirostrum* LeSueur 1818. NOAA/NMFS Tech. Rep. 14. Washington, D.C.

Dalyrmple, K. 1997. Use of Dredged Material as a Soil Amendment, p. 99. In: Proceedings: International Workshop on Dredged Material Beneficial Uses, Baltimore, Maryland, July 28 – August 1, 1997 (M.C. Landin, ed.). Baltimore, Maryland and Washington, D.C.: Baltimore District, U.S. Army Corps of Engineers and U.S. Environmental Protection Agency.

Day, J.W., C.S. Hall, W.M. Kemp, and A. Yanez-Arancibia. 1989. *Estuarine Ecology*. John Wiley & Sons, Inc.

Dennison, W.C., K.A. Moore, R.J. Orth, J.C. Stevenson, S. Kollar, P.W. Bergstrom, and R.A. Batiuk. 1994. Assessing Water Quality with Submersed Aquatic Vegetation: Habitat Requirements as Barometers of Chesapeake Bay Health. *Bioscience* 43(2):-86-94.

Diaz, R.J., and L.C. Schaffner. 1990. The Functional Role of Estuarine Benthos. In: Perspectives on the Chesapeake Bay 1990. *Advances in Estuarine Science*, ed. M. Haire. April ~~1990~~.

DNPOP. 1995a. Composite Summary Results of Interagency Discussions About Deep Trough Placement Options Issues. Report prepared by W. Young for the Management Committee, Dredging Needs and Placement Options Program, November 1995. Annapolis, Maryland: Maryland Environmental Service.

DNPOP. 1995b. Report to the Management Committee, Dredging Needs and Placement Options Program (DNPOP), Aberdeen Proving Grounds Placement Options prepared by W. Young and G. Savage, August, 1995. Annapolis, Maryland: Maryland Environmental Service.

DNPOP. 1995c. Special Report to the Executive Committee, December 20, 1995. Report prepared by W. Young for Bay Enhancement Phase II Working Group, Dredging Needs and Placement Options Program (DNPOP). Annapolis, Maryland: Maryland Environmental Service.

Donoghue, J.F., 1990, Trends in Chesapeake Bay sedimentation rates during the Late Holocene. ~~,~~ *Quaternary Research*, ~~v.~~ 34: ~~, pp.~~ 33-46.

Drummond, D.D. 1988. Hydrogeology, Brackish-Water Occurrence, and Simulation of Flow and Brackish-Water Movement in the Aquia Aquifer in the Kent Island Area, Maryland. Maryland Geological Survey, Report of Investigations No. 51, 131 pp.

EA Engineering, Science, and Technology. 1996. Final Data Report. FY1995 Sediment Sampling and Chemical Analysis for Baltimore Harbor and Chesapeake Bay, Maryland. Volume I: Data Report and Appendices A and B. Prepared for CENAB. September ~~1996~~.

EA Engineering, Science, and Technology. 1997. Sediment Sampling and Chemical Analysis for Placement Site 104, Queen Anne's County, Maryland: Draft Data Report. Prepared for CENAB. Report No. 60957.26. November.

EA Engineering, Science, and Technology. 1998. Sediment Sampling and Chemical Analysis for Placement Site 104, Queen Anne's County, Maryland: Final Data Report. Prepared for CENAB. Report No. 60957.26. January ~~1998~~.

Earth Engineering Sciences Inc., EA Engineering, Science, and Technology, Inc., Gahagan & Bryant Associates, Inc., and Moffatt & Nichol Engineers. 1997. Draft Consolidated Report. Prefeasibility Study for Upper Bay Island Placement Sites. Geotechnical, Coastal, Dredging & Site Engineering, and Environmental Investigations. Prepared for Maryland Port Administration. 18 December ~~18, 1997~~.

Earth Engineering & Sciences, Inc. (E2Si). 1997. Geotechnical Investigation, Site 104, Chesapeake Bay, Maryland.

EPA/USACE. 1998. Evaluation of D~~d~~redged ~~m~~Material ~~p~~Proposed for ~~d~~Discharge in ~~w~~Waters of the U.S. - Testing manual. EPA-823-B-98-004~~.~~, Washington, D.C. February.

Eskin, R.A., K.H. Rowland, and D.Y. Alegre. 1996. Contaminants in Chesapeake Bay Sediments, 1984-1991. U.S. EPA Chesapeake Bay Program. Report No. CBP/TRS 145/96. May ~~1996~~.

Fisher, T.R., E. R. Peele, J.W. Ammerman and L.W. Harding, Jr. 1992. Nutrient Limitation of Phytoplankton in Chesapeake Bay. *Mar. Eco. Prog. Ser.* 82:51-63.

Fisher, T.R., A.B. Gustafson, K. Sellner, R. Lacouture, L. W. Haas, R.L. Wetzel, R. Magnien, D. Everitt, B. Michaels, and R. Karrh. 1999. Spatial and Temporal Variation of Resource Limitation in Chesapeake Bay. *Marine Biology* 111:763-778.

Forsell, Doug. 1997. U.S. Fish and Wildlife Service. Personal Communications January through April ~~1997~~.

Forsell, Doug. 1998. U.S. Fish and Wildlife Service. Personal Communications January through April ~~1998~~.

Franks, Diane. 1997. Personal Communication. MDE, Air and Radiation Management Administration, Baltimore, Maryland. Phone Conversation – 21 November ~~21, 1997~~.

Funderburk, S.L., S.J. Jordan, J.A. Mihursky and D. Riley (eds.). 1991. Habitat Requirements for Chesapeake Bay Living Resources. Second Edition. Prepared for Chesapeake Bay Program. June ~~1991~~.

Gahagan and Bryant Associates (GBA) and EA Engineering, Science, and Technology, Inc. (EA). 1989. Port of Baltimore, Dredged Material Management Master Plan (Draft). Prepared for Maryland Port Administration. July ~~1989~~.

Gahagan and Bryant Associates (GBA). 1999. Conceptual Dredging and Site Analysis for Site 170. Contract report prepared for the Maryland Environmental Service in response to a request from the Maryland Port Administration. Baltimore, Maryland.

Gahagan and Bryant Associates (GBA), Earth Engineering and Sciences, Inc.(E2SI), and Environmental Concern, Inc. (ECI). 1992. Feasibility Evaluation of Bethlehem Steel Shoreline Enhancement Project. Contract report prepared for Maryland Port Administration, November, 1992. Baltimore, Maryland.

Garbarino, S.D., R. Blama, M.C. Landin, T.R. Patin, and S.R. Maynord. 1994. Environmental Restoration and Enhancement Using Dredged Material in Chesapeake Bay, Maryland, pp. 384-393. In: Dredging 94: Proceedings of the Second International Conference on Dredging and Dredged Material Placement. New York, New York: American Society of Civil Engineers.

Gardner, Gus. 1997. Queen Anne's County Government. Personal Communication.

Gebert, Jeff. 1991. Summary of Findings on Historical Dredging and Disposal Practice, Approach Channel to the C&D Canal. Personal communication. U.S. Army Corps of Engineers, Philadelphia District.

Gilbert, C.R. 1989. Species profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Mid-Atlantic Bight) Atlantic and Shortnose Sturgeons. U.S. Fish and Wildlife Service Biological Report 82 (11.122) U.S. Army Corps of Engineers TR EL-82-4.

Gill, J.W., P. McGowan, and L.E. Gerlich. 1995. Monitoring Study, Eastern Neck Island National Wildlife Refuge. Technical Report WRP-RE-12. Vicksburg, Mississippi: U.S. Army Engineer Waters Experiment Station.

Goldberg, E.D., V. Hodge, M. Kiode, J. Griffin, E. Gamble, O.P. Bricker, G. Matisoff, G.R. Holden, and R. Braun. 1978. A Pollution History of the Chesapeake Bay. *Geochem. Cosmochem. Acta.* 42:1413-1425.

Gosner, K.L. 1971. *Guide to Identification of Marine and Estuarine Invertebrates.* Cape Hatteras to the Bay of Fundy. New York John Wiley & Sons, Inc.

Graalum, S.J., and R. E. Randall. 1997. Feasibility of Manufacturing Soil from Texas Gulf Intracoastal Waterway Dredged Material, pp. 46-47. In: Proceedings: International Workshop on Dredged Material Beneficial Uses, Baltimore, Maryland, July 28 – August 1, 1997 (M.C. Landin, ed.). Baltimore, Maryland and Washington, D.C.: Baltimore District, U. S. Army Corps of Engineers and U. S. Environmental Protection Agency.

Green and Trident. 1970. Selection and Preliminary Design of Dike Disposal Areas for Dredged Spoil from Baltimore Harbor. Contract report prepared for the Maryland

Department of General Services. Three volumes. Baltimore and Annapolis Maryland: Green Associates and Trident Engineering Associates.

Gross, M.G., W.R. Taylor, R.C. Whaley, E.O. Hartwig, and W.B. Cronin. 1976. Environmental Effects of Dredging and Dredged Material Disposal, Approaches to Chesapeake and Delaware Canal, Northern Chesapeake Bay. Final Report. Chesapeake Bay Institute, The Johns Hopkins University, Baltimore, Maryland. Revised 30 November ~~30~~.

Gucinski, H., and Ecological Analysts. 1984. Deep Trough Study of the Chesapeake Bay. Contract report number TWA-CRD 1-84 prepared for Coastal Resources Division, Tidewater Administration, Maryland Department of Natural Resources. Arnold, Maryland and Sparks, Maryland: Anne Arundel Community College and Ecological Analysts, Inc.

~~Gucinski, H. and Ecological Analysts, Inc. (EAI). 1984. Deep Trough Study of the Chesapeake Bay. Prepared for Coastal Resources Division, MDNR. August 1984.~~

Hach. 1997. Hach 2100P Users Manual, Hach Company, Loveland, Colorado.

Halka, J., and Panageotou, B. 1986. Evaluation of Sediment Movement from the Patapsco River Extended Disposal Site. Maryland Geological Survey, Coastal Geology Program. File Report #47, 46p.

Halka, J., and W. Panageotou. 1992. Capacity Determinations for Overboard Disposal Areas in the Pooles Island Vicinity. Coastal and Estuarine Geology Open File Report No. 11.

Halka, J., L. Sanford, and R.A. Ortt. 1994. Resuspension Studies Conducted on Dredged Sediments Placed in Area G-South. Coastal and Estuarine Geology File Report No. 94-3.

Halka, J., W. Panageotou, R. Ortt, and J. Shadid. 1995. Consolidation and Erosion of the Sediment Berm Created at G-West Open-Water Placement Site. January - September 1994. Coastal and Estuarine Geology File No. 95-3.

Halka, J. 1997a. Site 104 Piston and Gravity Coring, Maryland Geological Survey, Trip Report, September 23, 1997. Memo to V. Jones, Maryland Environmental Service.

Halka, J.P. 1997b. Acoustic Sub-Bottom Survey of Site 104, Upper Chesapeake Bay. File Report No. 97-4.

Halka, J. 1998. Personal communication: phone conversation with Jeffrey Halka, Maryland Geological Survey, 27 January ~~27, 1998~~.

Hamons, F.L. 1988. Port of Baltimore: Dredged Material Management Master Plan. Pp. 112-118 in Proceedings of the International Seminar on Environmental Impact Assessment of Port Development. London, England: International Maritime Organization.

Hamons, F.L., and W. Young. 1999. Beneficial Use of Dredged Material: Upper Chesapeake Bay Case Study, pp. 405-427. In: Proceedings of the Western Dredging Association Nineteenth Technical Conference and Thirty-first Texas A&M Dredging Seminar, May 15-18, 1999, Louisville, Kentucky (R.E. Randall, ed.). CDS Report No. 371. College Station, Texas: Center for Dredging Studies, Texas A&M University.

Hamons, F., D. Bibo, M. Hart, W. Young, C. Donovan, M. Vargo and L. Walsh. 1997. Hart-Miller Island: From Remnant Island through Containment Facility to Park and Natural Resources Area. In: Proceedings: International Workshop on Dredged Material Beneficial Uses. 28 July~~-28-~~1 August ~~1,~~ 1997.

Hastings, R.W. 1983. A study of the shortnose sturgeon (*Acipenser brevirostrum*) population in the upper tidal Delaware River: assessment of impacts of maintenance dredging. Final Report to the USACE, Philadelphia, Pennsylvania. 129 pp.~~ages~~

Hastings, R.W., J.C. O'Herron, K. Schick, and M.A. Lazzari. 1987. Occurrence and Distribution of Shortnose Sturgeon, *Acipenser brevirostrum*, in the Upper Tidal Delaware River. *Estuaries* 10:337-341.

Heasly, P., S. Pultz, and R.A. Batiuk. 1989. Chesapeake Bay Basin Monitoring Program Atlas, Volume I, Water Quality and Other Physiochemical Monitoring Programs. USEPA Chesapeake Bay Program. August ~~1989~~.

Hildebrand, S.F., and W.C. Schroeder. 1928. Fishes of Chesapeake Bay. *U.S. Bur. Fish. Fish. Bull.* 43 (Part I). 366 pp.

Hobbs, C.H. III, J.P. Halka, R.T. Kerhin, and M.J. Carron~~,~~. 1992~~,~~. Chesapeake Bay Sediment Budget. *Journal of Coastal Research*~~,~~ ~~v.~~ 8:~~, pp.~~ 292-300.

Hurley, L.M. 1990. Field Guide to the Submerged Aquatic Vegetation of Chesapeake Bay. USFWS, Chesapeake Bay Estuary Program, Annapolis, Maryland.

Hurley, L.M. 1991. Submerged Aquatic Vegetation. In Habitat Requirements for Chesapeake Bay Living Resources. Second Edition (Funderburk *et al.*, eds.) Prepared for Chesapeake Bay Program.

Hurt, S. 1995. Shore Stabilization: Shoreline Enhancement at Eastern Neck. Land and Water: May/June 1995.

Hydrolab. 1984. Hydrolab Manual, Hydrolab Corporation, June 1984.

Jacobs, F. 1995. Development of Zooplankton Community Environmental Indicators for Chesapeake Bay: A final report on the project's results through June 1995: Food limitations of Striped Bass Larvae in spring. Interstate Commission on the Potomac River Basin

Jarinko, Dave. 1997. Personal Communication. MDE, Baltimore Maryland. Phone Conversation – 21 November~~21, 1997~~.

Jones, K.W., A.J. Guadagni, E.A. Stern, K.R. Donato, and N.L. Clesceri. 1998. Commercialization of Dredged-Material Decontamination Technologies, pp. 43-54. In: Remediation/Spring 1998. John Wiley and Sons, New York.

Jordan, S.J., J.A. Mihursky, and S.L. Funderburk. 1991. Introduction pp. 1.1-1.5. In: S.L. Funderburk, J.A. Mihursky, S.L. Nelson, and D.A. Riley. *Habitat Requirements for Chesapeake Bay Living Resources*. Chesapeake Research Consortium, Solomons Maryland.

Judy, Chris. 1999. Maryland Department of Natural Resources. Fisheries Service Hatcheries and Special Projects. Personal Communication.

Kennedy, V.S. 1991. Eastern Oyster. In: Habitat Requirements for Chesapeake Bay Living Resources. Second Edition (Funderburk *et al.*, eds.) Prepared for Chesapeake Bay Program.

Kerhin, R.T., J.P. Halka, D.V. Wells, E.L. Hennessee, P.J. Blakeslee, N. Zoltan, and R.H. Cuthbertson. 1988. The surficial sediments of Chesapeake Bay, Maryland: Physical Characteristics and Sediment Budget. Maryland Geological Survey Report of Investigations No. 48.

Kidde Consultants. 1984. Feasibility Study Phase I: Recycling, Reusing and/or Rehandling Dredged Materials. Contract report prepared for U.S. Department of Transportation, Federal Highway Administration and Interstate Division of Baltimore City.

Kidde Consultants. 1986. Feasibility Study Phase III: Recycling, Reusing and/or Rehandling Dredged Materials. Contract report prepared for U.S. Department of Transportation, Federal Highway Administration and Interstate Division of Baltimore City.

Kynard, B. 1997. Life history, latitudinal patterns, and status of the SNS, *Acipenser brevirostrum*. *Env. Bio. Of Fishes* 48:319-334.

Lacouture, R.V, J.H. Sniezek Jr., and K.G. Sellner. 1993. Maryland Chesapeake Bay Water Quality Program: Phytoplankton and Microzooplankton Component Draft Report. The Academy of Natural Sciences Benedict Estuarine Research Laboratory.

Lacouture, R.V., S. Sellner, R. Matos, and J. Gronefeld. 199~~7~~8. Draft: Long Term Trends and Current Status of Phytoplankton and Microzooplankton for the Chesapeake Bay and Potomac, Patuxent and Choptank Rivers from 1985-1996. The Academy of Natural Sciences (Draft).

Landin, M.C. 1997. Current Agricultural Applications of Dredged Material in Washington, New Jersey, South Carolina, and Mississippi, pp. 101-102. In: Proceedings: International Workshop on Dredged Material Beneficial Uses, Baltimore, Maryland, July 28 – August 1, 1997 (M.C. Landin, ed.). Baltimore, Maryland and Washington, D.C.: Baltimore District, U. S. Army Corps of Engineers and U. S. Environmental Protection Agency.

Leatherman, S.P., R. Chalfont, E.C. Pendleton, T.L. McCandless, and S. Funderburk. 1995. Vanishing Lands: Sea Level, Society and Chesapeake Bay. College Park, Maryland.

Lewis, Connie. 1999. Maryland Department of Natural Resources. Fisheries Statistician. Personal Communication.

Lippson, A. J., ed. 1973. *The Chesapeake Bay in Maryland: An Atlas of Natural Resources*. The Johns Hopkins University Press, Baltimore, Maryland.

Lippson, A.J, M.S. Haire, A.F. Holland, F. Jacobs, J. Jensen, R.L. Moran-Johnson, T.T. Polgar, and W.A. Richkus. 1979. Environmental Atlas of the Potomac Estuary. Prepared for Power Plant Siting Program, Maryland Department of Natural Resources.

Lippson and Lippson. 1984. *Life in the Chesapeake Bay*. Johns Hopkins University Press, Baltimore, MD

Long, E.R. and L.G. Morgan. 1990. The Potential for Biological Effects of Sediment-sorbed Contaminants Tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52. Seattle, WA.

MacDonald, D.D. 1993. Development of an Approach to the Assessment of Sediment Quality in Florida Coastal Waters. Florida Department of Environmental Regulation.

Mack, F.K. 1983. Preliminary analysis of geohydrologic data from test wells drilled near Chester on Kent Island, Queen Anne's County, Maryland. Maryland Geological Survey, Open File Report No. USGS 82-854, 31 pp.

Magnien, R.E., R.M. Summers, K.G. Sellner. 1992. External Nutrient Sources, Internal Nutrient Pooles, and Phytoplankton Production in Chesapeake Bay. *Estuaries*~~,~~ ~~Vol.~~ 15(~~, No. 4~~):~~, p.~~ 497-516. December ~~1992~~.

Magnien, R.E, D.K. Austin, and B.D. Michael. 1993a. Chemical/Physical Properties Component, Level I Data Report (1984-1991). Volume I. May ~~1993~~.

Magnien, R.E., D.K. Austin, and B.D. Michael. 1993b. Chesapeake Bay Water Quality Monitoring Program, Chemical/Physical Properties Component, Level I Data Report (1984-1991). Maryland Department of the Environment; Baltimore, Maryland.

Malone, T. C., D.J. Conley, T.R. Fisher, P.M. Glibert, L.W. Harding and K.G. Sellner. 1996. Scales of Nutrient-Limited Phytoplankton Productivity in Chesapeake Bay. *Estuaries* 19(2B):371-385.

Maryland Department of Business & Economic Development. 1997. Census Pamphlet. Queen Anne's County Economic Development Commission. Centreville, MD.

Maryland Department of Economic and Employment Development (MDEED). 1996a. Queen Anne's County: Brief Economic Facts. 4 pp.

Maryland Department of Economic and Employment Development (MDEED). 1996b. Anne Arundel County: Brief Economic Facts. 4 pp.

Maryland Department of the Environment (MDE). 1994. Maryland Water Quality Inventory, 1991-1993. Technical Report #94-002. August ~~1994~~.

Maryland Department of the Environment (MDE), Maryland Department of Natural Resources (DNR), Maryland Department of Agriculture, Maryland Office of State Planning, Maryland Governor's Office and University of Maryland. 1995. Maryland's Tributary Strategies for Nutrient Reduction: A Statewide Summary. March ~~1995~~.

Maryland Department of the Environment (MDE). 1996a. Maryland Air Quality Data Report 1995. The Air and Radiation Management Administration, MDE. Baltimore Maryland.

Maryland Department of the Environment (MDE). 1996b. Benthic Community Assessment of Courthouse Point Upland Dredged Material Placement Site, Cecil County, Maryland: Pre-Placement Analysis - Phase I Study. Maryland Department of the Environment. June ~~1996~~.

Maryland Department of the Environment (MDE). 1996c. Benthic Community Assessment of G-West Open-Water Dredged Material Placement Site, Maryland: 2nd Year Monitoring. June~~1996~~.

Maryland Department of the Environment (MDE). 1996d. Benthic Community Assessment of G-South Open-Water Dredged Material Placement Site, Maryland. V. Dalal, C. Poukish, C. Montgomery and L. Habicht, principal investigators.

Maryland Department of the Environment (MDE). 1996e. Water Quality Assessment of G-West Open-Water Dredged Material Placement Site, Maryland. June 1996. 2nd Year Monitoring. Maryland Department of the Environment.

Maryland Department of the Environment. 1997. 1996 Water Quality Assessment of G-West Open-Water Placement Site, Pooles Island Complex, Maryland. April~~1997~~. Maryland Department of the Environment.

Maryland Department of the Environment (MDE). 1998a. Final Water Quality Assessment Report, Proposed Site 104 Placement Area, Queen Anne's County, Maryland. Maryland Department of the Environment, Technical and Regulatory Services Administration. MDE/TARSA Technical Report No. 98-01. January ~~1998~~.

Maryland Department of the Environment (MDE). 1998b. Final Benthic Community Assessment Report, Proposed Site 104 Placement Area, Queen Anne's County, Maryland. Maryland Department of the Environment, Technical and Regulatory Services Administration. MDE/TARSA Technical Report No. 98-02. January ~~1998~~.

Maryland Department of Natural Resources (MDNR). 1976. Monitoring of Open Water Dredge Material Disposal Operations at Kent Island Disposal Site and Survey of Associated Environmental Impacts. Final Report to the Maryland Department of Natural Resources, Water Resources Administration and Maryland Department of Transportation, Maryland Port Administration. February~~1976~~.

Maryland Department of Natural Resources (MDNR). 1996. Chesapeake Bay Basin Monitoring Program Long-Term Benthic Site 026 Data. Unpublished raw data.

Maryland Department of Natural Resources (MDNR). 1998a. Personal Communication with Alexi Sharov, Fisheries Section. 12 February.

Maryland Department of Natural Resources (MDNR). 1998b. Personal Communication with Glen Davis, Fisheries Section. 2 March.

~~b~~Maryland Department of Natural Resources (MDNR) 1999a. Further MDNR Coordination Letter-Historic Waterfowl

Maryland Department of Natural Resources (MDNR). 1999b. Chesapeake Bay Commercial Landing NOAA025 Data. Unpublished raw data.

Maryland Department of Natural Resources (MDNR). 1999c. Maryland Tidal Recreational Fisheries Regulations for 1999. Maryland Register, Code of Maryland Regulations and Natural Resources Article of the Annotated Code of Maryland.

Maryland Department of Natural Resources (MDNR). 1999d. Maryland Commercial Fish Regulations for 1999. Code of Maryland Regulations.

Maryland Department of Natural Resources (MDNR). 1999e. Maryland Commercial Fish Landings for 1990-1998. Raw Unpublished Data.

Maryland Department of Natural Resources (MDNR). 1999f. Personal Communication with Chris Judy, Oyster Propagation Program, Fisheries Service. 23 September.

Maryland Department of Natural Resources (MDNR). 1999g. Personal Communication with John Hess, Oyster Propagation Program, Deal Island Hatchery. 27 September-.

Maryland Department of Transportation (MDOT). 1991. Recommendations of Governor William Donald Schaefer's Task Force on Dredged Material Management. February ~~1991~~.

Maryland Department of Transportation (MDOT). 1996a. Statement of Cooperation Regarding Use and Placement of Dredged Material in the Maryland Portion of the Chesapeake Bay. 5 September 5~~, 1996~~.

Maryland Department of Transportation (MDOT). 1996b. A Report to the Maryland General Assembly Senate Budget and Taxation Committed and House Appropriations Committee Regarding The Governor's Strategic Plan for Dredged Material Management (JCR pages 85 and 86). September ~~1996~~.

Maryland Department of Transportation (MDOT). 1996. State of Maryland's Strategic Plan for Dredged Material Management. September 5, 1996. Baltimore-Washington International Airport, Maryland.

Maryland Department of Transportation (MDOT) and MDNR. 1996e. Agreement Between the Maryland Department of Transportation and the Maryland Department of Natural Resources for the Chesapeake Bay Enhancement Program (Oyster Recovery). Baltimore Washington International Airport and Annapolis, Maryland: Maryland Department of Transportation (MDOT) and Maryland Department of Natural Resources (MDNR).

Maryland Department of Transportation (MDOT) and MDNR. 1997. Amendment 1 to the Agreement Between the Maryland Department of Transportation and the Maryland Department of Natural Resources for the Chesapeake Bay Enhancement Program (Oyster Recovery). Baltimore Washington International Airport and Annapolis, Maryland: Maryland Department of Transportation (MDOT) and Maryland Department of Natural Resources (MDNR).

Maryland Environmental Service (MES). 1994a. Initial and Multi-Objective Screening of Four Proposed Dredged Material Placement Sites in the Upper Chesapeake Bay. Contract report prepared for the Maryland Port Administration. Annapolis, Maryland.

~~Maryland Environmental Service (MES). 1994. Initial and Multi-Objective Screening of Four Proposed Dredged Material Placement Sites in the Upper Chesapeake Bay. Contract report prepared for Maryland Port Administration (MPA). Baltimore, Maryland: MPA.~~

Maryland Environmental Service (MES). 1994b. Prefeasibility Report for the Poplar Island Restoration Project. Contract Report prepared for the Maryland Port Administration. Annapolis, Maryland.

Maryland Environmental Service (MES). 1995. Pooles Island G-West Berm Monitoring Final Report. July~~1995~~.

Maryland Environmental Service (MES). 1995a. Sparrows Point Shoreline Reclamation Project: Assessment of Biological Productivity. Contract report prepared for the Maryland Port Administration. Annapolis, Maryland.

Maryland Environmental Service (MES). 1995b. Use of Dredge Material as a Drainage Layer at Midshore Regional Solid Waste Facility. Contract report prepared for the Maryland Port Administration. Annapolis, Maryland.

Maryland Environmental Service (MES). 1996. Finfish Data Compilation for Six Selected Sites in the Upper Chesapeake Bay: Main Report. Contract Report DACW61-95-H-0005 prepared for U.S. Army Corps of Engineers, Philadelphia District (CENAP). Philadelphia, Pennsylvania: CENAP.

Maryland Environmental Service (MES). 1997a. Final Environmental Assessment. Designation of Aquatic Dredged Material Placement Areas G-East and Site 92 for Maintenance Dredging, Inland Waterway Delaware River to Chesapeake Bay, Delaware and Maryland Northern Approach Channel. Prepared for the U.S. Army Corps of Engineers, Philadelphia District, and Maryland Port Administration. August~~1997~~.

Maryland Environmental Service (MES). 1997b. Investigation and Literature Search and Review of Land Application of Dredged Material. July~~1997~~.

Maryland Environmental Service (MES). 1997c. Pooles Island G-West 1995/1996 Comprehensive Monitoring Final Report. Prepared for: U.S. Army Corps of Engineers, Philadelphia District and Maryland Port Administration. October 1997.

Maryland Environmental Service. 1997d. Site 104 Open-Water Placement Area Commercial and Recreational Fishermen Meeting Summary. 28 July 1997.

Maryland Environmental Service (MES). 1998a. Break Out Biological Assessment for Hopper Dredging of a Portion of the C&D Canal and Northern Approach Channels. Prepared for: the Philadelphia District. February., 1998

Maryland Environmental Services (MES). 1998b. Preliminary Sections of the EIS for the proposed Site 104 Placement. Prepared for the U.S. Army Corps of Engineers, Baltimore District. Unpublished.

Maryland Environmental Services (MES). 1999. Overview of Aquatic Placement of Dredged Material. Maryland Environmental Service. Contract Report prepared by Dick Peddicord & Company, Inc., 1 March 1999.

Maryland Environmental Service (MES) and Maryland Port Administration (MPA). 1993. Sparrows Point Shoreline Reclamation: Briefing, Spring 1993. Annapolis and Baltimore, Maryland.

Maryland General Assembly (MGA). 1996. Joint Chairman's Report, 1996 Legislative Session. Annapolis, Maryland: MGA.

Maryland Geological Survey (MGS). 1968. Geologic Map of Maryland.

Maryland Port Administration (MPA). 1989. Master Plan (draft). Draft technical report. Baltimore, Maryland.

Maryland Port Administration (MPA),. 1990. Port of Baltimore: Dredged Material Management Master Plan. Report prepared for MPA by Gahagan and Bryant Associates and EA Engineering, Science and Technology, Inc. Unpublished.

Maryland Port Administration (MPA). 1996. State of Maryland's Strategic Plan for Dredged Material Management. 5 September 5, 1996.

Maryland Port Administration (MPA). 1998. Prefeasibility Study for Upper Bay Island Placement Sites - Final Consolidated Report. Report prepared for MPA by Earth Engineering and Sciences, Inc., EA Engineering Science and Technology, Inc., Gahagan and Bryant Associates, Inc. and Moffat and Nichol Engineersing.

Maryland Sea Grant. 1992. Dissolved Oxygen in the Chesapeake Bay: A Scientific Consensus. Publication Number UM-SG-TS-92-03. 18 pp.

Maynord, S.T., M.C. Landin, J.W. McCormick, J.E. Davis, R.A. Evans, and D.F. Hayes. 1992. Design of Habitat Restoration Using Dredged Material at Bodkin Island, Chesapeake Bay, Maryland. Wetlands Research program Technical Report WRP-RE-3. Vicksburg, Mississippi: U.S. Army Engineer Waterways Experiment Station.

McCarty, L.S., and D. Mackay. 1993. Enhancing ecotoxicological modeling and assessment. *Environmental Science and Technology* 27:1719-1728.

McDonough, F.M., G.A. Boehm, and W.S. Douglas. 1999. Dredged Material Management in New Jersey: A Multifaceted Approach for Meeting Statewide Dredging Needs in the 21st Century, pp. 349-368. In: Proceedings of the Western Dredging Association Nineteenth Technical Conference and Thirty-first Texas A&M Dredging Seminar, May 15-18, 1999, Louisville, Kentucky (R.E. Randall, ed.). CDS Report No. 371. College Station, Texas: Center for Dredging Studies, Texas A&M University.

McLaughlin, D.F., S.V. Dighe, D.L. Keairns, and N.H. Ulerich. 1999. Decontamination and Beneficial Use of Dredged Estuarine Sediment: The Westinghouse Plasma Vitrification Process, pp.533-554. In: Proceedings of the Western Dredging Association Nineteenth Technical Conference and Thirty-first Texas A&M Dredging Seminar, May 15-18, 1999, Louisville, Kentucky (R.E. Randall, ed.). CDS Report No. 371. College Station, Texas: Center for Dredging Studies, Texas A&M University.

McKee, J. 1998. U.S. Army Corps of Engineers, Baltimore District, Operations Division. Personal Communication.

Michael, B.D., D. Austin, and R.E. Magnien. 1991. Water Quality Monitoring Assessment of Pooles Island Dredged Sediment Disposal Site. Technical Report 116. Maryland Department of the Environment.

Miller, T.J., and J. McCraken. 1997. Assessment of fishing activity near Pooles Island. Report to Maryland Environmental Service. Chesapeake Biological Laboratory Ref. [UMCEES] CBL 97-011A.

Miller, T. 1998. Assessment of Fish Community Structure Within and Near Site 104 Final Report. Report to Maryland Environmental Service. Chesapeake Biological Laboratory Ref. [UMCEES] CBL 97-123.

Millero, F.J., and M. Sohn. 1992. *Chemical Oceanography*. CRC Press. Boca Raton, Florida. 20 pp.

Moffatt & Nichol Engineers. 1999. Site 104 STFATE Modeling Results. Draft. 30 September 1999.

Morris, Christopher, ed. 1992. *Academic Press Dictionary of Science and Technology*. Academic Press. 2,432 pp.

Murdy, E.O., R.S. Birdsong, and J.A. Musick. 1997. *Fishes of Chesapeake Bay*. Smithsonian Institution Press. Washington D.C. 324 p.

National Marine Fisheries Service (NMFS). 1999. Section 7 consultation Biological Opinion for the Dredging Activities Wwithin the Philadelphia District. Conducted by: National Marine Fisheries Service. Prepared for U.S. Department of the Army, Philadelphia District.

National Ocean Service (NOS). 1982. U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA). Historical Extreme Winds for the United States - Atlantic and Gulf of Mexico Coastlines. Rockville, MD.

National Ocean Service (NOS). 1988. U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA). Tide and Tidal Currents in the Chesapeake Bay. NOAA Technical Report NOS OMA 3. Rockville, MD.

National Ocean Service (NOS). 1996. U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA). Tidal Currents 1996. Rockville, MD.

National Ocean Service (NOS). 1997. U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA). Tide Datums for Selected Stations.

National Research Council (NRC). 1987. Responding to Changes in Sea Level: Engineering Implications. Marine Board, Commission on Engineering and Technical Systems. Washington, D.C.: National Academy Press.

National Research Council (NRC). 1989. Contaminated Marine Sediments: Assessment and Remediation. Marine Board, National Research Council (NRC). National Academy Press, Washington, D.C.

National Research Council (NRC). 1992. Restoring and Protecting Marine Habitat: The Role of Engineering and Technology. Washington, D.C.: National Academy Press.

National Research Council (NRC). 1994. Restoring and Protecting Marine Habitat: The Role of Engineering and Technology. Marine Board, National Research Council (NRC). National Academy Press, Washington, D.C.

National Research Council (NRC). 1997. Contaminated Sediments in Ports and Waterways: Cleanup Strategies and Technologies. Marine Board, National Research Council (NRC). National Academy Press, Washington, D.C.

Nickerson, John. 1997. Personal Communication. Director of Environmental Health for Queen Anne's County, Maryland. Phone Conversation – 21 November 21, ~~1997~~.

O'Donnel, S., and J. Henningson. 1999. The Beneficial Use of Dredged Material to Mitigate Acid Mine Drainage, pp. 499-512. In: Proceedings of the Western Dredging Association Nineteenth Technical Conference and Thirty-first Texas A&M Dredging Seminar, May 15-18, 1999, Louisville, Kentucky (R.E. Randall, ed.). CDS Report No. 371. College Station, Texas: Center for Dredging Studies, Texas A&M University.

Officer, C.B., Lynch, D.R., Setlock, G.H., and Helz, G.R., 1984. Recent Sedimentation Rates in Chesapeake Bay. In: ~~V.S. Kennedy, ed.,~~ *The Estuary as a Filter* (V.S. Kennedy, ed.), Academic Press, N.Y., pp. 131-157.

Olin, T. J., and D.W. Bowman. 1997. Soil Washing Potential at Confined Disposal Facilities, p. 139. In: Proceedings: International Workshop on Dredged Material Beneficial Uses, Baltimore, Maryland, July 28 – August 1, 1997 (M.C. Landin, ed.). Baltimore, Maryland and Washington, D.C.: Baltimore District, U. S. Army Corps of Engineers and U. S. Environmental Protection Agency.

Orth, R., R. Batiuk, and J. Nowak. 1994. Trends in the Distribution, Abundance, and Habitat Quality of Submerged Aquatic Vegetation in Chesapeake Bay and its Tidal Tributaries: 1971-1991. USEPA, Chesapeake Bay Program (CBP) Annapolis, Maryland.

Orth, R.J, J.F. Nowak, D.J. Wilcox, J.R. Whiting, and L.S. Nagey. 1995. 1995 Distribution of Submerged Aquatic Vegetation In the Chesapeake Bay. Virginia Institute of Marine Science. USEPA, Chesapeake Bay Program (CBP) Annapolis, Maryland.

~~Orth *et al.* 1995. 1995 Distribution of Submerged Aquatic Vegetation In the Chesapeake Bay. Virginia Institute of Marine Science. USEPA, Chesapeake Bay Program (CBP) Annapolis, Maryland.~~

Orth, R.J, J.F. Nowak, D.J. Wilcox, J.R. Whiting, and L.S. Nagey. 1996. 1996 Distribution of Submerged Aquatic Vegetation In the Chesapeake Bay. Virginia Institute of Marine Science. USEPA, Chesapeake Bay Program (CBP) Annapolis, Maryland.

~~Orth *et al.* 1996. 1996 Distribution of Submerged Aquatic Vegetation In the Chesapeake Bay. Virginia Institute of Marine Science. USEPA, Chesapeake Bay Program (CBP) Annapolis, Maryland.~~

Orth, R.J, J.F. Nowak, D.J. Wilcox, J.R. Whiting, and L.S. Nagey. 1997. 1997 Distribution of Submerged Aquatic Vegetation In the Chesapeake Bay. Virginia Institute of Marine Science. USEPA, Chesapeake Bay Program (CBP) Annapolis, Maryland.

Orth, R.J., J.F. Nowak, D.J. Wilcox, J.R. Whiting, and L.S. Nagey. 1998. Distribution of Submerged Aquatic Vegetation in the Chesapeake Bay and Tributaries and the Coastal Bays – 1997. Report prepared for the U.S. Environmental Protection Agency, Chesapeake Bay Program Office (EPA-CBPO). Annapolis, Maryland: (EPA-CBPO).

Orth, R.J. 1999. Personal Communication Virginia Institute of Marine Science. 14 September 1999.

Palazzo, A.J., C.R. Lee, T.C. Sturgis, and P. Zang. 1997. Manufactured Soil Concept in the Rehabilitation of Housing Demolition Soil and Military Training Land, pp. 48-49. In: Proceedings: International Workshop on Dredged Material Beneficial Uses, Baltimore, Maryland, July 28 – August 1, 1997 (M.C. Landin, ed.). Baltimore, Maryland and Washington, D.C.: Baltimore District, U. S. Army Corps of Engineers and U. S. Environmental Protection Agency.

Panageotou, W. and J. Halka. _1990. _Monitoring of Sediments Dredged from the Approach Channel to the Chesapeake and Delaware Canal. October 1989 - March 1990 and from the Brewerton Channel Eastern Extension, May 1990 - April 1991. Maryland Geological Survey, Open File Report No. 12.

Panageotou, W., R.A. Ortt, Jr., and J.P. Halka. _1996. _Placement, Consolidation and Erosion Studies of Sediments Dredged from the Approach Channels to the Chesapeake and Delaware Canal: November 1994-January 1995. Maryland Geological Survey, File Report No. 96-1.

Perkin Elmer Corporation. Undated. 240b Elemental Analyzer Manual.

Permanent International Association of Navigation Congresses (PIANC). 1992. Beneficial Uses of Dredged Material: A Practical Guide. Report of PIANCE Working Group 19. Brussels, Belgium.

Price, R.A., P.R. Schroeder, L.E. Banks, J.G. Sanders, and D.R. Johnson. 197. Agricultural Use of Yazoo River Dredged Material ,p. 100. In: Proceedings: International Workshop on Dredged Material Beneficial Uses, Baltimore, Maryland, July 28 – August 1, 1997 (M.C. Landin, ed.). Baltimore, Maryland and Washington, D.C.: Baltimore District, U. S. Army Corps of Engineers and U. S. Environmental Protection Agency.

Pushkar, D.J. 1975. Baltimore Harbor: An Assessment of the Capacity of Discontinued Spoil Disposal Areas. Report prepared by the Water Quality Services Division, Water Resources Administration. Annapolis, Maryland: Maryland Department of Natural Resources.

Quagliano, James. 1964. *Chemistry*. Prentice-Hall, Inc.

Queen Anne's County (QAC). 1993. Comprehensive Plan Map. Centreville, Maryland: QAC.

Queen Anne's County (QAC). 1996. Queen Anne's County Chesapeake Bay Critical Area Program. Centreville, Maryland: QAC.

Ranasinghe, J.A., and W.A. Richkus. 1993. Dredged Material Placement at Pooles Island: Evaluation of the Effects of Unconfined Placement on Benthic Assemblages (June 1991-July 1993). Prepared for: Maryland Environmental Service, Maryland Department of Natural Resources and Maryland Department of the Environment. October ~~1993~~.

Reger, James P. 1993 (revised 1994). A User's Guide to the Maryland Coordinate System. Fact Sheet No. 8. Maryland Geological Survey.

Rehmat, A., A. lee, A. Goyal, and M.C. Messinger. 1999. Construction-Grade Cement Production from Contaminated Sediments Using CEMENT-LOCK™ Technology, pp. 555-566. In: Proceedings of the Western Dredging Association Nineteenth Technical Conference and Thirty-first Texas A&M Dredging Seminar, May 15-18, 1999, Louisville, Kentucky (R.E. Randall, ed.). CDS Report No. 371. College Station, Texas: Center for Dredging Studies, Texas A&M University.

Rhoades, D.C., P.L. McCall, and J.Y. Yingst. 1978. Disturbance and production on the estuarine sea floor. *Am. Scientist*. 66: 577-586.

Richkus, W.A., H.M. Austin, and S.J. Nelson. 1992. Fisheries assessment and management synthesis: lessons for Chesapeake Bay, in Perspectives on Chesapeake Bay, 1992: Advances in Estuarine Sciences. Chesapeake Research Consortium Publication No. 143.

Ringler, Robert. 1992. The Birds of Hart-Miller Island.

Roden, E.E., J.E. Tuttle, W.R. Boynton, and W.M. Kemp. 1995. Carbon cycling in mesohaline Chesapeake Bay sediments 1: POC deposition rates and mineralization pathways. *Journal of Marine Research*. 53: 799-819.

Rogers, G., and H Rogers. 1986. Chesapeake and Delaware Canal Data Consolidation Report. Prepared for the U.S. Army Corps of Engineers, Philadelphia District. December ~~1986~~.

Rosenberg. 1997. NMFS Consultation letter.

Rothschild, B.J., P.W. Jones and J.S. Wilson. 1981. Trends in Chesapeake Bay Fisheries. In Transactions of the 46th North American Wildlife and Natural

Resources Conference. Published by the Wildlife Management Institute, Washington D.C.

Rothschild, B.J. and A.F. Sharov. 1997. Abundance estimation and population dynamics of the Blue Crab in the Chesapeake Bay. Submitted to MDNR. Prepared by: University of Massachusetts, Center for Marine Science and Technology North Dartmouth, Mass.

Ruddy, G. 1990. Baseline Biological Conditions and Preliminary Biological Impacts: Chesapeake and Delaware Canal Reconnaissance Study. January ~~1990~~.

Ryan, D.J. 1953. The sediments of Chesapeake Bay, Maryland. Maryland Department of Geology, Mines and Water Resources, Bulletin 12, 120 pp.

Sanford, L.P. 1994. Wave-Forced Resuspension of Upper Chesapeake Bay Muds. *Estuaries*~~,~~ ~~Vol.~~ 17(~~, No.~~ 1B):~~, pp.~~ 148-165.

Sauls, Beverly. 1997. Maryland Department of Natural Resources. Personal Communication.

Scarpulla, Eugene. 1997. Hart-Miller Island: Avian Utilization of an Operating Dredged Material Containment Facility, presented at International Workshop on Dredged Material Beneficial Uses, Baltimore, MD. 29 July ~~29-~~ 1 August~~1, 1997~~.

Schubel, J.R. and D.W. Pritchard. 1987. A Brief Physical Description of the Chesapeake Bay. Contaminant Problems and Management of Living Chesapeake Bay Resources. The Philadelphia Academy of Science.

Scott, Roy. ~~March 10,~~ 1998. Maryland Department of Natural Resources. Personal Communication. 10 March.

Seay, E.E. 1995. Managing Sediments and Nutrients in the Susquehanna River Basin: Final Report. Report prepared for Susquehanna River Basin Commission, Publication Number 164. Harrisburg, Pennsylvania: Susquehanna River Basin Commission.

Secor, D.H. 1995. Chesapeake Bay Atlantic Sturgeon: Current Status and Future Recovery. Summary of findings and recommendations for the Chesapeake Bay Atlantic Sturgeon. Chesapeake Biological Laboratory Workshop held the 8 of November 1994.

Secor, D.H. and E.D. Houde. 1997. Effects of Hypoxia and Temperature on Growth, Survival, and Respiration of Juvenile Atlantic Sturgeon. Report to Chesapeake Bay and Watershed Programs. Chesapeake Biological Laboratory Ref. [UMCEES] CBL 97-025.

Sellner, Kevin G. 1987. Phytoplankton in Chesapeake Bay: Role in carbon, oxygen and nutrient dynamics, ~~i~~In: Contaminant Problems and Living Resources (S.K. Majumbar, L.W. Hall and H.M. Austin, eds.), pp. 134-157. The Penn. Acad. of Science.

Sellner, K. 1993. Phytoplankton: Maryland Perspective, pp. 35-39. Chesapeake Bay Strategy for the Restoration and Protection of Ecologically Valuable Species. Published by Maryland DNR CBRM for The Chesapeake Bay Program. CBP/TRS 113/94

Sellner, K.G., and S.G. Brownlee. 1995. Development of Zooplankton Community Environmental Indicators for Chesapeake Bay: A final report on the project's results through June 1995: Microzooplankton as Indicators of Bottom Water Hypoxia/Anoxia. Interstate Commission on the Potomac River Basin

Setzler-Hamilton, E.M. 1987. Utilization of Chesapeake Bay by early life history stages of fishes. pp. 64-93. In: ~~S.K. Majumdar, L.W. Hall and H.M. Austin (Eds.).~~ *Contamination Problems and Management of Living Chesapeake Bay Resources* (S.K. Majumdar, L.W. Hall and H.M. Austin, eds.). American Association for the Advancement of Science.

Setzler-Hamilton, E.M. and L. Hall, Jr. 1991. Striped bass. In S.L. Funderburk, J.A. Mihursky, S.L. Nelson, and D.A. Riley. Habitat Requirements for Chesapeake Bay Living Resources. Chesapeake Research Consortium, Solomons, Maryland.

Slattery. 1997. MDNR Coordination Letter-State RTE Avian

Southall, B. 1997. Port: Making All the Right Moves. The Daily Record, No. 244, 213:1A, 29A.

Spier, H., and T. O'Connel. 1996. Status of Atlantic sturgeon in Maryland's Chesapeake Bay. Tidal Fisheries Technical Report Series, No. 17, pp. 2

State of New Jersey. 1998. Bid Documents: Sediment Decontamination Demonstration Project. Bid Number 98-X-99999. Two volumes. Issued by the State Department of the Treasury, Department of Commerce and Economic Development, and the Office of New Jersey Maritime Resources. 4 March.

Stern, E.A., K.R. Donato, N.L. Clesceri, and K.W. Jones. 1997. Integrated Sediment Decontamination for the New York-New Jersey Harbor, pp. 71-81. In: Proceedings of the National Conference on Management and Treatment of Contaminated Sediments, Cincinnati, Ohio, May 13-14, 1997. Report Number EPA/625/R-98/001. Washington, D.C.: Environmental Protection Agency.

Stern, E.A., K.W. Jones, K. Donato, and N.L. Clesceri. 1998a. Processing Contaminated Dredged Material from the Port of New York-New Jersey. *Estuaries* 21(4A):646-651.

Stern, E.A., K. Jones, K. Donato, J.D. Pauling, N.L. Clesceri, M.C. Mensinger, and C.L. Wilde. 1998b. Maintaining Access to America's Intermodal Ports/Technologies for Decontamination of Dredged Sediment: New York/New Jersey Harbor. Technical Paper Number 8007 presented at 1998 S.A.M.E. National Conference, New York City, New York. West Chester, Pennsylvania: Roy F. Weston, Inc.

Stevenson, J.C., and M.S. Kearney. 1996. Shoreline dynamics on the windward and leeward shores of a large temperate estuary, pp. 233-259. In: Estuarine Shores: Evolution, Environments and Human Alternations (: K.F. Nordstrom and C. T. Roman, eds.). John Wiley and Sons, Ltd., New York.

Sturgis, T.C., C.R. Lee, and P. Langan. 1997a. Manufactured Soil from Mobile Harbor Dredged Material, p. 46. In: Proceedings: International Workshop on Dredged Material Beneficial Uses, Baltimore, Maryland, July 28 – August 1, 1997 (M.C. Landin, ed.). Baltimore, Maryland and Washington, D.C.: Baltimore District, U. S. Army Corps of Engineers and U. S. Environmental Protection Agency.

Sturgis, T.C., C.R. Lee, and K.A. Taplin. 1997b. Manufactured Soil from St. Lucie Muck, p. 48. In: Proceedings: International Workshop on Dredged Material Beneficial Uses, Baltimore, Maryland, July 28 – August 1, 1997 (M.C. Landin, ed.). Baltimore, Maryland and Washington, D.C.: Baltimore District, U. S. Army Corps of Engineers and U. S. Environmental Protection Agency.

Tawes, Scott. 1997. U.S. Army Corps of Engineers, CENAP. Personal Communication.

Terres, John K. 1991. *The Audubon Society Encyclopedia o~~O~~f North American Birds.* ~~1991.~~

Therres, Glenn. 1997. Maryland Department of Natural Resources. Personal Communication._ January ~~1997~~.

Tuttle, J.H., T.C. Malone, R.B. Jonas, H.W. Ducklow, and D.G. Cargo. 1985. Nutrient-Dissolved Oxygen Dynamics in Chesapeake Bay: The Roles of Phytoplankton and Micro-Heterotrophs Under Summer Conditions. US Environmental Protection Agency. CBP/TRS 3/87.

Uhler, P.R., and Otto Lugger. 1876. List of Fishes of Maryland. Report of the Commissioners of Fisheries of Maryland. John F. Wiley, Printer. Annapolis, MD.

U.S. Army Corps of Engineers (USACE), Baltimore District (CENAB). 1981. General Design Memorandum – Baltimore Harbor Anchorages and Channels, Maryland and Virginia.

U.S. Army Corps of Engineers (USACE), Waterways Experiment Station (WES), Coastal Engineering Research Center (CERC). 1984. Shore Protection Manual, Volumes I and II. Fourth Edition. U.S. Government Printing Office.

U.S. Army Corps of Engineers (USACE). 1989. Managing Dredged Material: Evaluation of Disposal Alternative in the New York - New Jersey Metropolitan Region. New York, NY; USACE, New York District.

U.S. Army Corps of Engineers (USACE) and U.S. Environmental Protection Agency (EPA). 1992. Evaluating Environmental Effects of Dredged Material Management Alternatives - A Technical Framework, EPA842-B-92-008. Washington, D.C.: USEPA.

U.S. Army Corps of Engineers, Philadelphia District (CENAP). 1995. Raw data of placement quantities from surveys of G-West and Area E&F.

U.S. Army Corps of Engineers (USACE), Baltimore District (CENAB). 1996. September bathymetric survey data of Site 104.

U.S. Army Corps of Engineers (USACE) and Maryland Port Administration (MPA). 1996. Poplar Island, Maryland Environmental Restoration Project Integrated Feasibility Report and Environmental Impact Statement. February ~~1996~~.

U.S. Army Corps of Engineers, New England Division. 1997. Biological Assessment for SNS in the Kennebec River, in Bath, Maine. Submitted to National Marine Fisheries Service.

U.S. Army Corps of Engineers, CENAB (CENAB). 1997a. Baltimore Harbor Anchorages and Channels, Maryland and Virginia - Integrated Feasibility Report and Environmental Impact Statement. March ~~1997~~.

U. S. Army Corps of Engineers, Baltimore District (CENAB). 1997b. Proposed New Work Dredging Baltimore Harbor and Channels Maryland 42-foot Project - Brewerton Channel Eastern Extension, Final Environmental Assessment, August ~~1997~~.

U.S. Army Corps of Engineers, Philadelphia District (CENAP). 1997. Raw data of placement quantities from 1995/1996 PCOE surveys of G-West and Area F. Personal Communication. W. Panageotou. Maryland Department of Natural Resources, Maryland Geological Survey. 6 February ~~6, 1997~~.

U.S. Bureau of Census. 1990. Census of the United States. U.S. Government Printing Office. Washington, DC.

U.S. Department of Agriculture (USDA), Soil Conservation Service (SCS). 1973. Soil Survey of Anne Arundel County, Maryland.

U.S. Environmental Protection Agency (EPA). 1979. Chemical Analysis of Water and Wastes. USEPA-600/4-79-020.

U.S. Environmental Protection Agency (EPA). 1980. Ambient Water Quality Criteria for Mercury. U.S. EPA Office of Water, Criteria and Standards Division. Washington D.C. EPA 449/5-80-058.

U.S. Environmental Protection Agency (EPA). 1986. Quality Criteria for Water 1986. Prepared by U.S. EPA's Office of Water, Regulations and Standards Group. Washington, D.C. EPA 440/5-86-001.

U.S. Environmental Protection Agency (EPA). 1992. Evaluating Environmental Effects of Dredged Material Management Alternatives. USEPA-842-B-92-00. November 1982.

U.S. Environmental Protection Agency (EPA). 1993. Quality Criteria for Water 1993. Prepared by U.S. EPA's Health and Ecological Criteria Division, Office of Water. Washington, D.C.

U.S. Environmental Protection Agency (EPA). 1994. Assessment and Remediation of Contaminated Sediments (ARS) Program: Remediation Guidance Document. EPA 905-B94-003. Chicago, Illinois: Environmental Protection Agency (EPA) Great Lakes National Program Office.

U.S. Environmental Protection Agency (EPA). 1997. Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California; Proposed Rule. 62 Federal Register 42160-42208; 5 August 97.

U.S. Environmental Protection Agency (EPA). 1998a. Costs of Remediation at Mine Sites. Washington, D.C.: U.S. Environmental Protection Service (EPA), Office of Solid Waste.

U.S. Environmental Protection Agency (EPA). 1998b. Risk-Based Concentration Table. Memo from Jennifer Hubbard, Toxicologist, Superfund Technical Support Section (3HS41), U.S. EPA Region III. 1 April~~1~~.

U.S. Environmental Protection Agency (EPA) 1998c. National Recommended Water Quality Criteria. 63 Federal Register 68354-68364, 10 December 1999.

U.S. Fish and Wildlife Service. 1994. Chesapeake Bay Waterbird Database. Unpublished data 1996.

U.S. Fish and Wildlife Service (USFWS). 1999a. Personal Communication with Mike Mangold. 23 September ~~1999~~.

U.S. Fish and Wildlife Service (USFWS). 1999b. Progress report on sturgeon research in the Chesapeake Bay. Unpublished. 27 July ~~1999~~.

Uhler, P.R., and Otto Lugger. 1876. List of Fishes of Maryland. Report of the Commissioners of Fisheries of Maryland. John F. Wiley, Printer. Annapolis, MD.

University of Maryland ~~(UM)~~, Center for Environmental Science (UMCES). 1997. Acoustic Doppler Current Profiler (ADCP) velocity data output and Conductivity, Temperature, and Turbidity vs. Depth data.

Valderma, J.C. 1981. The simultaneous analysis of total nitrogen phosphorus in natural waters. *Mar. Chem.* 10:-109-122.

Van Heukelem, W.F. 1991. Blue Crab *Callinectes sapidus*. In: *Habitat Requirements for Chesapeake Bay Living Resources* (S.L. Funderburk, J.A. Mihursky, S.L. Nelson, and D.A. Riley, eds.). Chesapeake Research Consortium, Solomons, Maryland.

Versar, Inc. 1990. Impact Assessment of Craighill Channel Dredged Material Placement in the Deep Trough. Prepared for Power Plant & Environmental Review Division, MDNR. March ~~1990~~.

Versar. 1990a. Assessment of the Feasibility of Utilizing the Deep Trough as a Dredge Disposal Site. Contract report prepared for the Power Plant and Environmental Review Division, Maryland Department of Natural Resources in response to a request from the Maryland Port Administration. Columbia, Maryland.

Versar. 1990b. Impact Assessment of Craighill Channel Dredged Material Placement in the Deep Trough. Contract report prepared for the Power Plant and Environmental Review Division, Maryland Department of Natural Resources in response to a request from the Maryland Port Administration. Columbia, Maryland.

Versar, Inc. 1992. Summary of Pre-Placement Monitoring Conducted for the Pooles Island Unconfined Placement Study. Prepared for Maryland Environmental Service. Prepared by Versar, Inc. August ~~1992~~.

Versar, Inc. 1994. Pooles Island Unconfined Placement Study. Final Assessment Report. Funded by: Maryland Port Administration. Prepared for: Maryland Environmental Service. February ~~1994~~.

Virginia Institute of Marine Science (VIMS). 1978. Storm Surge Height-Frequency Analysis and Model Prediction for Chesapeake Bay. Special Report No. 189 in Applied Marine Science and Ocean.

Virginia Institute of Marine Science (VIMS) and U.S. Geological Survey (USGS). 1998. Submerged Aquatic Vegetation Mapping for 1997 (Preliminary). Langford Creek, Queenstown, and Gibson Island, Maryland USGS quad sheets. VIMS SAV Mapping Lab. Downloaded from VIMS website 18 January 1999. http://www.vims.edu/bio/sav/sav97/quads/.

Volstad J.H., ~~and~~ B.J. Rothschild, and T. Maurer. 1994. Abundance estimation and population dynamics of the Blue Crab in the Chesapeake Bay. UMCES. Ref [UMCEES] CBL 94-014.

Warwick, R.M. 1986. A new method for detecting pollution effects on marine macrobenthic communities. *Marine Biology* 92:-557-562.

Washburn and Gillis Associates LTD. 1981. Studies of the Early Life History of the Shortnose Sturgeon (*Acipenser brevirostrum*). Final Report to the Northeast Utilities Service Company. 120 pp.

Waterways Experiment Station (WES). 1998. Modeling the Fate and Water Quality Impact of Dredged Material Placed at Site 104. Draft Report, April 1998. Waterways Experiment Station, Corps of Engineers. Prepared for Maryland Environmental Service.

Weber, C.I. 1973. Biological field and laboratory methods for measuring the quality of surface waters and effluents. United States Environmental Protection Agency, Cincinnati, Ohio.

Webster's New Twentieth Century Dictionary of the English Language. 1983. Unabridged. Simon and Schuster, New York.

Weimer, M., S. Brandt, K. Hartman, J. Jech, and K. Barry. 1996. Fish abundance, size and species composition in the G-West and reference areas near Pooles Island. Prepared for Maryland Environmental Service.

Weisberg, S.B., J.A. Ranasinghe, D.M. Dauer, L.C. Schaffner, R.J. Diaz, and J.B. Frithsen. 1997. An estuarine benthic index of biotic integrity (B-IBI) for Chesapeake Bay. *Estuaries* 20:-149-158.

Weston. 1974. The Technical and Economic Feasibility of Producing Beneficial Products from Baltimore Harbor Dredged Spoil. Contract report prepared number W.O. 1086-1 for the Maryland Environmental Service. West Chester, Pennsylvania.

Wolfin. 1997. USFWS Consultation Letter.

~~Waterways Experiment Station (WES). 1998. Modeling the Fate and Water Quality Impact of Dredged Material Placed at Site 104. Draft Report, April 1998.~~

Waterways Experiment Station. Corps of Engineers. Prepared for Maryland Environmental Service.

Section 15

Terms and Acronyms

°C	Degrees Celsius
°F	Degrees Fahrenheit
µM	See µmol.
µMOL	Micromole. A solution that contains 1 gram molecular weight (1 gram mole) of a solute, dissolved in 1 liter of solution, is known as a 1 molar solution. A micromolar solution contains 1 gram mole of a solute dissolved in 1,000,000 liters of solution. Concentrations can be expressed on a mole-volume basis because all chemical reactions occur according to a fixed ratio of the gram molecular weights of the reactants (Quagliano 1964).
ABIOTIC	Non-biological; factors independent of living organisms.
ADCP	Acoustic Doppler Current Profiler
AEROBIC	Requires atmospheric oxygen to survive.
ALGAE	Aquatic organisms that contain chlorophyll and other pigments and can photosynthesize; includes microscopic single-celled organisms as well as large multi-cellular structures, including seaweed.
ALGAE BLOOM	An unusually large concentration of algae in or on a body of water.
AMBIENT	Of or relating to an environmental condition, such as temperature or pressure.
AMPLITUDE	The size, range, or extent of something.
ANADROMOUS	Fish that live most of their lives in the ocean, but migrate to freshwater streams to spawn.
ANAEROBIC	Occurring with little or no oxygen.
ANNELID	A class of animals including earthworms and leeches.
ANOXIA/ANOXIC	Without dissolved oxygen or in oxygen deficit. Dissolved oxygen concentrations of 0 mg/l (MDE 1994).

APG	Aberdeen Proving Ground~~.~~
AQUIFER	Rock that has sufficient permeability to allow ground water to flow through it, and which can provide significant amounts of water to wells and springs.
ASTRONOMICAL TIDE	A tide caused by the attractive forces of the sun and moon, as opposed to a meteorological tide caused mainly by wind and atmospheric pressure.
BA	Biological Assessment
BASEMENT ROCK	Rocks that underlie the rocks of interest in an area; often sedimentary (i.e., rocks that pertain to or contain sediment, or were formed by its deposition).
BATHYMETRY	Information gathered by measuring the depths of bodies of water.
BAY BRIDGE	W~~M~~illiam Preston Lane Jr. Memorial Bridge, ~~.~~ ~~L~~located between Kent Island and Cape St. Clair Maryland.
BENCHMARK	A measurement or standard against which similar units can be compared.
BENTHIC	Living in, on, or in close association with the bottom of a body of water.
BEP II	Bay Enhancement Phase II. A working group of the DNPOP.
BERM	A bench-like earthen structure used for stabilization.
B-IBI	Benthic Index of Biotic Integrity. A technique to assess the health of a benthic community. Scores are assigned based upon a number of variables. Generally in the Chesapeake Bay, a B-IBI score of 3 or greater is considered equal to or above restoration goals and a score of less than three is below the restoration goals.
BIOMASS	Refers to the entire population of living organisms, both plant and animal, of a given habitat.
BIOTIC	Ecological factors due to the interactions of living organisms.
BIVALVE	An organism that has a two-part shell.
BO	Biological Opinion

BRACKISH	Water with a salt content between that of sea water and fresh water.
BWI	Baltimore-Washington International
C&D	Chesapeake and Delaware
CALANOID	One of the major suborders of the Order Copejcoda, which are microscopic planktonic crustaceans, relatives of the crabs.
CARBON MONOXIDE	A colorless, almost odorless, highly poisonous, and flammable gas that is an exhaust product from automobile engines, and occurs when a carbon-containing fuel is burned with an insufficient amount of oxygen.
CATADROMOUS	Fish that live in fresh water but migrate downriver and spawn at sea.
CBL	Chesapeake Biological Laboratory. Part of the University of Maryland, Center for Environmental Science.
CBP	U.S. Environmental Protection Agency Chesapeake Bay Program
CBWQP	The Chesapeake Water Quality Program
cc	Cubic centimeters
CENAB	U.S. Army Corps of Engineers, Baltimore District
CENAP	U.S. Army Corps of Engineers, Philadelphia District
CEQUAL-ICM	Corps of Engineers Quality-Integrated Compartment model
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980. This act regulates the release, threat of release, investigations, remedial action and removal of any hazardous substance, pollutant or contaminant (as defined in the Federal Water Pollution Control Act, the Solid Waste Disposal Act, the Toxic Substances Control Act, CERCLA and the Clean Air Act) which is considered detrimental to the environment or is an imminent or substantial danger to public health or welfare. Amended by the Superfund Amendments and Reauthorization Act of 1986. Sites designated under CERCLA/Superfund are

	considered contaminated areas under the aforementioned guidelines.
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System~~.~~
CFR	Code of Federal Regulations
CH3D-WES	Curvilinear Hydrodynamics in Three Dimensions model
CHLOROPHYLL-A (Chl a)	A photosynthetic pigment found in plants, including phytoplankton. Frequently utilized as an estimate of plant or phytoplankton standing crop.
CLAY	An extremely small fragment of rock or mineral with a diameter less than 0.0039 millimeter.
cm	Centimeter(s)
COASTAL PLAIN	A low, broad plain that has its margin on the ocean shore, and which gently slopes towards the water.
COD	Chemical Oxygen Demand
COMAR	Code of Maryland Regulations
CONFINING BED	Material that is impermeable or distinctly less permeable located adjacent to an aquifer(s).
COPEPOD	A microscopic crustacean.
CORE SAMPLE	A piece of rock or soil that is extracted by drilling and used for analysis.
CORIOLIS EFFECT	The deflection of air or water as a result of the earth's eastward rotation. In the northern hemisphere~~;~~, this results in a deflection to the right.
CPUE	Catch Per Unit Effort
CRUSTACEAN	A class of animals including crabs, lobsters, shrimps, crayfish, and barnacles, among others.
CWA	Clean Water Act~~.~~
CY or cy	Cubic ~~Y~~yards. A common measure for dredged material.
DDE	Dichlorodiphenyltrichloroethylene or 1,1-dichloro-2,2-bis(p-chlorophenyl)ethylene, a degradation product of the pesticide DDT.

DDT	Dichlorodiphenyltrichloroethane, or 1,1-trichloro-2,2-bis(p-chlorophenyl)ethane, a pesticide.
DEIS	Draft Environmental Impact Statement
DEMOGRAPHICS	The characteristics of a population, such as average age, life expectancy, etc.
DENSITY	The concentration of items in a given area; measured as the ratio of mass to volume.
DETRITUS	Loose rock or organic material produced by decay of a substance or tissue.
DIATOM	A type of microscopic algae.
DIFFUSER	A duct used to convert a fast-moving stream of fluid to a slow-moving stream of fluid.
DIKE	A ridge of earth used to hold water in place or protect against flooding.
DIN	Dissolved inorganic nitrogen
DINOFLAGELLATE	A type of zooplankton.
DIP	~~Disorganized~~ Dissolved inorganic phosphorus
DIVERSITY	A measure of the number of species coexisting in a community.
DMCF	Dredged Material Containment Facility
DMMP	Dredged Material Management Plans
DNPOP	Dredging Needs and Placement Options Program; sponsored by MPA and facilitated by MES; established to address channel placement needs of the Port of Baltimore and associated channel systems in Maryland.
DNR	(Maryland) Department of Natural Resources
DO	Dissolved oxygen
DRAFT	The vertical distance from the waterline to the bottom of a vessel's keel (i.e., the main beam running the length of a vessel's bottom.
E2Si	Earth Engineering Sciences Inc.
~~EA~~	~~Environmental Assessment. A brief document required by NEPA which provides sufficient information to the District Commander on potential environmental effects of the proposed~~

	~~action and its alternatives to determine if an EIS or FONSI is required.~~
EA	EA Engineering, Science, and Technology, Inc.
EAI	Ecological Analysts, Inc.
EBB	The flowing back of the tide as water returns to the sea.
Eh	Oxidation-reduction potential. A measure of the chemical environment (oxidizing or reducing) at a specific depth in the sediment column measured relative to a calomel electrode.
EIS	Environmental Impact Statement. Required by NEPA for actions that could result in significant environmental impacts or for projects that are not eligible for an Environmental Assessment and FONSI. Results in a Record of Decision from the District Commander.
ELUTRIATION	Process for separating into sized fractions finely divided particles in accordance with their rate of gravitation relative to a rising stream of fluid.
ENVIRONMENTAL ASSESSMENT	A brief document required by NEPA which provides sufficient information to the District Commander on potential environmental effects of the proposed action and its alternatives to determine if an EIS or FONSI is required.
EOCENE	Includes geologic time and rocks after the Paleozoic time period and before the Oligocene time period; part of the early Tertiary (i.e.. between 65 million and 2million years ago) time period.
EPA	Environmental Protection Agency~~.~~
EQUILIBRIUM SPECIES	Generally large organisms that are long-lived and dominate communities in undisturbed or unstressed habitats.
ERD	Environmental Review Division
ER-L	Effects Range – Low~~.~~
ER-M	Effects Range – Medium~~.~~
EROSION	Processes such as wind and water which cause materials on the earth's surface to loosen, dissolve, or wear away, and be transported from one place to another.

ESA	Endangered Species Act of 1973.
ESTUARY	An area of the sea at the mouth of, or the drowned mouth of, a river, where the tide meets the river current.
EURYHALINE	Organisms capable of withstanding widely varying saltwater concentrations in the environment.
EVAPOTRANSPIRTATION	The portion of precipitation that is returned to the atmosphere by evaporation (i.e., the conversion of liquid to vapor by heating) and transpiration (i.e., evaporation from a plant's surface of water absorbed by the plant's roots).
EXTIRPATE	To make extinct.
FALL LINE	An imaginary line that connects the waterfalls of nearly parallel rivers. More specifically, the Fall Line marking the boundary between the Piedmont Plateau and the Atlantic Coastal Plain.
FETCH	An area of water over which a wind of constant direction and speed blows to generate waves.
FL	Fork Length
FLORA	Plant life that is present in a particular habitat.
FLUVIAL	Of or pertaining to a stream or river.
FONSI	Finding of No Significant Impact~~.~~ Authorization to initiate a project once an Environmental Assessment has been completed and an EIS was determined ~~to~~ not to be necessary to fulfill the requirements of the NEPA.
FOOTPRINT	The outline and surface area.
FORAMINIFER	A protozoan (i.e., a single-celled organism), usually marine.
FRESHET	Discharge of a large volume of fresh water resulting from ice melts and spring rains.
~~F~~ft~~.~~	Foot/feet~~.~~
g	Grams
GABBROIC	Basaltic (Basalt is an igneous rock [i.e., solidified from molten or partially molten material (magma)]).

GILL NET	A mesh net that is suspended from a fishing boat; catches fish by snaring their gill covers.
GNEISS	A metamorphic (i.e., derived from pre-existing rocks by changes in temperature, pressure, shearing ~~strees~~stress, and chemical environment) rock.
GPS	Global Positioning System~~.~~
HEAD	The elevation that water rises to at a given point due to reservoir pressure.
HERBIVORE	An organism that eats plants.
HMI	Hart-Miller Island~~.~~
HOPPER	A vessel with sloping sides that discharges material through a valve-like opening in the bottom.
HP or hp	Horsepower~~.~~
HPEL	Horn Point Environmental Laboratory. Part of the University of Maryland, Center for Environmental Science.
hr	Hour(s)
HTRS	Hazardous, Toxic, or Radioactive Substances
HYDROGEOLOGIC UNIT	An area with similar subsurface waters and related geologic aspects of surface water.
HYDROLOGY	The science of water (liquid and solid), its properties, circulation, and distribution, both on and below the earth's surface and in the atmosphere.
HYPOTRICH CILIATES	Benthic ciliated protozoa (microzooplankton) that have been shown to survive long periods of low dissolved oxygen concentrations in aquatic systems.
HYPOXIA/ANOXIA	Deficiencies in the concentration of dissolved oxygen in aquatic systems.
HYPOXIC/HYPOXIA	Having dissolved oxygen concentrations less than 4 to 5 mg/l (MDE 1994).
IBI	Index of Biological Integrity
in.	Inches
IN-SITU	Latin term meaning 'in place,' especially in natural or original position. In research, this

	typically refers to data collection or analysis that occurs at the location where sampling occurs, versus taking samples then shipping them elsewhere for data collection or analysis.
IRP	Installation Restoration Program~~.~~
~~K~~km	Kilometers~~.~~
L	Liter(s)
LAG GRAVEL	Coarse rock fragments that accumulate on a surface after the finer material has been blown away by wind.
lb	Pound(s)
LITHOLOGIC	Of lithology, the description of rocks based on characteristics such as color, mineral composition, and grain (i.e., particle) size.
LTFATE	Long Term FATE model
~~M~~m	Meters~~.~~
M&N	Moffatt and Nichol Engineers
MACROINVERTEBRATE	Organisms greater than 0.5 mm, possessing no internal skeleton.
MAINTENANCE	Dredging process that involves maintaining a channel at an existing depth, rather than dredging to greater depths.
MAINTENANCE DREDGING	Dredging necessary to keep the channels serving the Port of Baltimore and the C&D Canal at their nominal authorized depth and width.
MCBA	Maryland Charter Boat Association
MCM or mcm	Million cubic meters.
MCY or mcy	Million cubic yards~~.~~
MDE	Maryland Department of the Environment~~.~~
MDEED	Maryland Department of Economic and Employment Development
MDFATE	Multiple Dump FATE model
MDNR	Maryland Department of Natural Resources
MDOT	Maryland Department of Transportation~~.~~
MEAN	Average; the sum of all data values divided by

	the total number of values.
MEAN TIDE LEVEL	The reference plane halfway between mean high water and mean low water.
MES	Maryland Environmental Service.
MESOHALINE	Salinity of 5.0 to 18.0 parts per thousand (ppt). Waters containing from 3.0 to 16.5 ppt. dissolved salts.
MESOZOOPLANKTON	An assemblage of zooplankton organisms greater than 200 µm.
METABOLISM	The chemical and physical processes occurring within a living organism.
~~MI~~	~~Mile~~
mg	Milligram(s)
MGS	Maryland Geological Survey
MHW	Mean High Water. The average height of all high waters at a given place, usually over a period of 19 years.
MHHW	Mean Higher High Water. The average height of all the daily higher high waters at a given place, usually over a period of 19 years.
MHT	Maryland Historical Trust
MI	Mile
MICROAEROPHILES	Organisms that are specialized in the use of gases.
MICROBE	A microorganism, such as bacteria, protozoa, and fungi.
MICROZOOPLANKTON	An assemblage of zooplankton organisms less than 200µm.
MLW	Mean Low Water. The average height of all low waters at a given place, usually over a period of 19 years.
MLLW	Mean Lower Low Water. The average height of all the daily lower low waters at a given place, usually over a period of 19 years.
~~MLLW~~	~~Mean lower low water.~~
mm	Millimeters
MOTILE	Capable of spontaneous movement.
MOUTH	The outfall of a river, stream, or bay into another body of water.

MPA	Maryland Port Administration.
mph	Miles per hour
MSSA	Maryland Saltwater Sportfishermen's Association.
MWA	Maryland Waterman's Association.
NAAQS	National Ambient Air Quality Standards
NAD	North American Datum. A surface to which horizontal positions in the United States, Canada, Mexico, and Central America are accurately surveyed and referenced.
NAUPLII	Free-swimming larvae of most marine crustaceans, having a single eye, two pairs of antennae, and one pair of mandibles.
NEPA	National Environmental Policy Act. Refers to the Act of 1969 and all Amendments.
NEW WORK DREDGING	Dredging needed to widen and deepen channels below existing conditions. Virgin material would be dredged to allow larger ships to safely gain access to Baltimore and the C&D Canal.
NGVD	National Geodetic Vertical Datum., or mean sea level. Derived from the average sea level over a period of many years at 26 tide stations along the Atlantic, Gulf of Mexico, and Pacific Coast. Does not necessarily represent local mean sea level at a particular place.
NH_4	Ammonia.
NITROGEN DIOXIDE	A brown gas or yellow liquid used as a catalyst in the production of nitric acid and as an oxidizer for rocket fuels.
NMFS	National Marine Fisheries Service.
NO_2	Nitrite
NO_{2+3}	Nitrite + nitrate
NOAA	National Oceanic and Atmospheric Administration.
N.O.B.	Natural Oyster Bed
NOEL	No Observable Effect Level.
~~NO_2~~	~~Nitrite.~~
~~NO_{2+3}~~	~~Nitrite + nitrate.~~

NOI	Notice of Intent~~.~~
NON-POINT SOURCE	A non-specific source, such as runoff from a large field.
NOS	National Ocean Survey
NO_x	Nitrogen oxides~~.~~
NPL	National Priorities List~~.~~
NRC	National ~~Resource~~ Research Council
NUTRIENT	A substance that provides nourishment.

OLIGOHALINE	Salinity of 0.5 to 5.0 ppt~~.~~ _Waters containing from 0.5 to 3.0 ppt~~.~~ dissolved salts.
OMNIVORE	An organism that eats both plants and animals.
OPPORTUNISTIC SPECIES	Generally small organisms that are short-lived and reproduce rapidly. They generally dominate communities in disturbed or stressed habitats.
OUTCROP	The part of a geologic formation appearing exposed and visible at the earth'"s surface.
OVERWINTER	To remain alive through the winter.
OZONE	A form of oxygen that is an ingredient of smog in the lower atmosphere.

PAH	Polycyclic ~~A~~aromatic ~~H~~hydrocarbon~~.~~
PALEOCHANNEL	The remains of a river or stream channel carved in older rocks, which has filled with or been buried by sediments of younger rocks.
PALEOZOIC	Includes geologic time and rocks from the end of the Precambrian time period to the beginning of the Mesozoic time period; from about 570 to 225 million years ago.
PALUSTRINE	Of or relating to a marshy habitat.
PARAMETER	A variable quantity or value.
PARTICULATE MATTER	Matter composed of particles that are not bound together (e.g., sand or dust).
PASCALS	A unit of measure equal to the pressure of a force of one newton (i.e., the amount of force needed to produce an acceleration of one meter per second per second in a mass of one kilogram) per square meter.

PCB	Polychlorinated biphenyl
PEL	Probable Effects Level
PELAGIC	Pertaining to the open ocean.
PERMEABILITY	The ability of a porous rock, sediment, or soil to transmit fluid.
PHASE	A particular stage or aspect of something.
PHOTIC ZONE	The upper water layer down to the depth of effective light penetration where photosynthesis balances respiration.
PHYSIOGRAPHIC PROVICE	A region whose parts have similar geology and climate.
PHYSIOGRAPHY	The description and origin of landforms.
PHYTOPLANKTON	Microscopic plants (primary producers) found throughout aquatic systems.
PLANKTON	Small floating or feebly swimming plants and animals.
PN	Particulate nitrogen
POINT SOURCE	A specific source, such as an outfall pipe.
POLYHALINE	Waters containing from 16.5 to 30.0 ppt. dissolved salts.
POLYCHAETE	A class of marine worms.
PORE WATER STUDY	Study of the interstitial water. Pore water chemistry studies provides information on (1) the predominant chemical redox regime within the sediment (i.e., whether the system is anoxic, sulfidic, etc.); and (2) the upward gradients and upward fluxes of solutes within sediments, providing an indication of rates of organic matter oxidation.
ppm	Parts per million
ppt	Parts per thousand
PRECAMBRIAN	Includes geologic time and rocks before the beginning of the Paleozoic time period; approximately 90% of geologic time.
PRIMARY PRODUCTION	The rate at which organisms such as plants store of energy as carbohydrates to be consumed by other organisms.
PRP	~~Partially~~ Potentially Responsible Party
~~PPT~~	~~Parts Per Thousand.~~

PYCNOCLINE	A water layer that shows a marked change in density with increasing depth.
QAC	Queen Anne's County
RCRA	Resource Conservation and Recovery Act
REMINERALIZATION	A portion of a cyclic process in which organic materials are decomposed, releasing mineral elements (i.e., nitrogen, phosphorus) as inorganic ions.
RGI	Restoration Goals Index
RIVERINE	Found in or near a river.
ROD	Record of Decision
ROI	Region of Influence
ROTIFERS	Microscopic members of he Phylum Rotifera, many of which are planktonic.
RTE	Rare, Threatened, or Endangered Species
RUNOFF	Precipitation that flows over land (i.e., runs off) and into a body of water.
RW "LP"	Red and white buoy.
s	Second
SALINITY	The ratio of dissolved salts to water.
SARGASSO SEA	Located in the North Atlantic Ocean, northeast of the West Indies; has unusually calm waters and large areas of free-floating marine plants.
SAV	Submerged Aquatic Vegetation
SCHIST	A crystalline metamorphic (i.e., derived from pre-existing rocks by changes in temperature, pressure, shearing stress, and chemical environment) rock.
SCOW	A large, flat-bottomed boat with square ends, usually pulled by a tug boat.
SECCHI DISK	A white disk used to measure clarity of water; the disk is lowered into the water until it can no longer be seen, and the depth to the disk is measured.
SET-BACK	A recessed area.

SEDIMENT	Material that is transported by, suspended in, or deposited by wind, water, or ice, and then accumulates in layers.
SHANNON DIVERSITY INDEX	Typically used to show the hierarchical species diversity and one of the parameters used to calculate the B-IBI. Formula is: $H' = \Sigma(n_i/N) \log(n_i/N)$ where n_i = number of individuals of a given species and N = total number of individuals in each sample (Brower and Zar 1984).
SHOAL	A area of submerged accumulation of sediments in shallow water.
SHOALING AREA	An area of initial decrease in wave height, followed by a rapid increase in wave height before the wave breaks.
SILICEOUS	Consisting of, containing, or resembling silica (a mineral).
SILT	Sediment that is suspended in water; smaller than a very fine grain of sand and larger than coarse clay, ranging in diameter from 0.002 to 0.06 millimeter.
SNS	Shortnose Sturgeon
SOC	Sediment oxygen consumption.
SOLID PHASE PROFILES	Study of the sediments. Solid phase profiles of biogeochemical redox components provide information on the chemical forms of phosphorus, carbon, sulfur and iron in sediments.
SONE	Sediment Oxygen Nutrient Exchange Program. An element under the Maryland Chesapeake Bay Water Quality Monitoring Program that has been conducted since 1984. Stations are located throughout the mainstem Bay and in each major tributary.
STFATE	Short Term FATE model
STORM SURGE	An exceptionally high water caused by high winds on the convergence of wind-driven currents; may also include the effect of a drop in atmospheric pressure caused by hurricane winds.
STRATIFICATION	A process by which sediment is formed, accumulates, or is deposited in layers.

SUBAERIAL	Formed, situated, or occurring in contact with the open air, directly ~~adjaeen~~adjacent to or on the land ~~sufaee~~suffice.
SUBCROP	Subsurface layers of rock that are in contact with the underneath of a younger layer of rock, marked by an obvious overstep (i.e., an overlap).
SUBSTRATE	Material that underlies cover material.
SULFUR DIOXIDE	A toxic, colorless gas that is an oxidizing and reducing agent and a dangerous constituent of smog.
SUMMER MAXIMUM	Refers to highest taxa abundance.
TDN	Total dissolved ~~oxygen~~nitrogen~~.~~
TIDAL	Of or relating to tides; a tidal marsh is an area of land along a coast that is usually flooded at high tide.
TIDAL HARMONIC CONSTANTS	The observed tide is the sum of a number of components, each of whose periods corresponds to one of the relative astronomical motions between the earth, sun, and moon. The tidal harmonic constants are the period-, amplitude, and phase angle (epoch) for each of the tidal components.
TN	Total nitrogen~~.~~
TOPOGRAPHY	The configuration of a land surface; includes relief (i.e., elevation) and position of both natural and man-made features.
TRAWL	A baglike net that is towed beneath a vessel to catch marine life.
TROPHIC	Having to do with nutrition.
TSS	Total suspended solids~~.~~
TURBIDITY	A cloudy or hazy appearance in a naturally clear liquid caused by the suspension of fine solids in the liquid.
UBCBCA	Upper Bay Charter Boat Captains Association~~.~~
UMCES	University of Maryland, Center for Environmental Science~~.~~
UNCONFORMABLY	Layers of rock that do not succeed underlying rocks in order of age or parallel position; not part of a continuous whole.

USACE	U.S. Army Corps of Engineers.
USFWS	U.S. Fish and Wildlife Service.
USGS	U.S. Geological Survey.
UXO	Unexploded ordinance; ammunition that has been fired and has contacted ground without detonating. In the Chesapeake Bay region, this ordnance is typically buried and is therefore not an explosive danger until it is disturbed by activities such as dredging or placement.
VOC	Volatile organic compound
VISCOSITY	The internal friction of a fluid; i.e., a fluid's resistance to flow.
W&HD	Wildlife and Heritage Division
WAVE PERIOD	The time between the passage of adjacent points of equal phase through a fixed point in space.
WAVE SETUP	An increase in mean water level between the zone of wave break and shore, caused by the momentum of the waves.
WES	Waterways Experiment Station.
WETLANDS	Low-lying areas that are periodically submerged or whose soil contains a lot of moisture.
WWTP	Waste Water Treatment Plant.
yr	Year
ZOOPLANKTON	Microscopic animals that live suspended in the water column and move passively in relation to water currents.

ADDITION TO
ANNEX B
ATTACHMENT C

Site 104 Open-Water Placement Area
Commercial and Recreational Fishers Meeting Summary

July 28, 1997

Attendees:

Mark Mendelsohn	CENAB	Tammy Banta	MES
Jeff McKee	CENAB	Jennifer Duff	MES
Carol Anderson-Austra	CENAB	Emory Edwards	MWA
George Crosby	MCBA	Joey Sadler	MWA
Russell Green	MCBA	Larry Simns	MWA
Greg Jetton	MCBA	Del. Baker	QA Cty
Roland Limpert	MDNR	Commissioner O'Donnell	QA Cty
Richard Schaefer	MDNR	Commissioner Fithian	Kent Cty
Wayne Young	MES		

Date and Location:

Monday, July 28, 1997, 7pm at Queen Anne's County Office Building, Centreville.

1. Opening Remarks

Ms. Anderson-Austra presented the opening remarks. She stated that the meeting was being held to discuss with the commercial and recreational fishers their concerns regarding placement in Site 104, and the locations of snags and important fishing spots within the site.

2. Study Update

Mr. McKee presented an update on the status of the project. He stated that the current schedule was for completion of a draft Environmental Impact Statement (EIS) by January, 1998. The proposed action would be to place 18 mcy of clean dredged material up to the -45-foot MLLW contour. CENAB is currently evaluating environmental concerns as well as fishing seasons to determine the most appropriate placement schedule.

3. Open Discussion

Mr. Simns opened the discussion by addressing the commercial fishers' concerns regarding placement at Site 104. He stated that the commercial fishers want the areas where placement will occur to be clearly marked and for placement to start at the southern end and move north. Mr. McKee verified that "southern end" actually equates to approximately midway down the site at roughly the -45-foot contour. Mr. Simns also stated that the fishers' want the barge/construction equipment traffic to stay within the marked channels to prevent destruction of fishing gear outside the channels.

Mr. Simns stated that the southern end of the site is useless due to the snags throughout the area. The fishers' want the site "smoothed" out to enable use of the area for drift netting.

Mr. Fithian stated that the LP buoy is the southern cut-off point for gillnet fishing. He agreed with Mr. Simns, that placement should begin below the LP buoy. Mr. McKee stated again that placement would be in the areas below the -45-foot contour; therefore, placement would not occur north of the LP buoy.

Mr. Simns inquired into the distance between the southern end of the site and the Bay Bridge. It was determined through open discussion that the area between the southern end of the site and the Bridge was not used for commercial fishing but that drift netting did occur below the bridge and sometimes began just north of the bridge, but south of the site, and drift through the bridge pilings.

Mr. Fithian inquired into what was meant by filling to the -45-foot contour with 18 mcy of material. Mr. McKee explained that placement would slope back from the edges to maintain placement within the area and would meet the -45-foot contour in the north. It has been estimated that this would total 18 mcy of placement. This does not mean that the entire site will be filled to -45 feet MLLW. Mr. McKee also stated that the site could be dragged after placement to help "flatten" it out. Mr. McKee then explained what "dragging" the bottom meant and how it was done.

Mr. Simns explained that the some of the snags may only be a foot or two out of the bottom but what happens is that the snags catch the bottom of the net and then drag the top down. The fishers want something flatter than 1 foot contours. The nets will catch on mounds as well as actual protrusions from the bottom.

Mr. Simns stated that he was concerned because they cannot smooth out clay materials. Mr. McKee stated that dredging operations could be scheduled so that clays could be placed first and then capped with fine-textured materials to facilitate smoothing the surface. Mr. Simns then stated that it was OK if some snags were missed because the fishers know that it would be impossible to flatten the entire site. He just wants everyone to do what they say they will do at the site.

Commissioner O'Donnell expressed concern that they will not be able to smooth the site but stated that if they could they would gain significant public trust. Mr. McKee stated that hydraulic placement would create a smoother area but that the unloader would have to remain on location for several months, which would create additional noise in the area, and may make it more difficult to retain material in the site. The fishers stated that they could work around the unloaders if they knew where they were.

Mr. Fithian inquired into the impacts associated with dredged material placement. Recreational fishers stated that they fish on the northern side of Site 104 above the LP buoy. They also stated that they are concerned with the shallower edges of the site and bad oxygen levels in the water chasing fish away. They are also concerned with the plume, turbidity and phosphorus levels. He stated that the fishers use the site north of LP buoy from May to November. Mr. McKee stated that it would be unlikely placement would occur from June 1 to October 15 because of anoxic conditions at the site. He stated again that material would be placed below the -45-foot contour.

Commissioner O'Donnell raised concerns about the Aquia Aquifer located below Kent Island and Site 104. Bay City has problems with saltwater intrusion and Commissioner O'Donnell is concerned that by filling Site 104, the opening to the Aquia Aquifer that could be in the deeper portions of the site could be blocked with material. He stated that Kent Island has to draw water from the Magothy Aquifer. Mr. McKee stated that they are coordinating with MGS regarding groundwater issues.

Mr. Simns stated that the commercial fishers want the barges to remain within the shipping channels until they are close to the site then run straight to the site and place the material. The channels should be clearly marked. He offered to assist CENAB with laying out the routes for the barges. Mr. McKee stated that CENAB could designate in the specs. that the barges stay within the channels and there be GPS tracking of the barges. Mr. Simns also stated that he would recommend that CENAB have contractors put up a bond to repair and replace fishing equipment damaged during placement.

Delegate Baker stated that he wants a representative from Queen Anne's County to review the trackings weekly or monthly to verify that the contractors stayed within the channels. Ms. Austra stated that they could set up monthly meetings with a citizen's committee to discuss project issues. It as also suggested that some of the money from the $18 million for the Oyster Recovery Program might be used to fund citizen monitoring of the contractor. The fishers agreed that they would set up reviewers and work on a possible stipend.

Mr. Fithian stated that he is frustrated with how the money is being distributed from the Oyster Recovery Program.

Commissioner O'Donnell stated that they should place material in Aberdeen Proving Ground (APG) and that if he was on the committee he would get access to APG within two weeks.

Mr. Simns stated that he was concerned that they want to straighten the Tolchester Channel and fill in the old channel. He is concerned that they are going to use up the sites they have. Mr. McKee stated that they are no longer discussing placing the material into the old channel.

Mr. Fithian wanted to know how long the Corps was going to spend money to maintain the channels, how long the Port of Baltimore would be viable, and if the Port of Baltimore would eventually be a tug boat port only. Mr. McKee stated that there is a $12 to $13 million budget for Baltimore Corps to maintain the approach channels to the Port and a comparable budget for the Philadelphia Corps to maintain the C&D Canal and the southern approach channels. The C&D Canal Deepening would be a 75% Corps and 25% State cost-share. Delegate Baker inquired as to where the Port of Baltimore ranked nationwide for maintenance costs. Mr. McKee stated due to the distance from the ocean, it cost more to maintain channels. Mr. McKee stated that placement at Site 104 would be approximately $2.25 to $2.50 per cubic yard.

Mr. Simns wanted to know if small harbors could place material in Site 104. He stated that Broad Creek Marina would be dredging soon and that it was a private job. Mr. Young stated that Hart-Miller Island is required by COMAR to accept county jobs and some private owners based upon dredging. Mr. O'Donnell stated that he would recommend investigating this if Site 104 is used. Mr. McKee stated that they would address this issue in the cumulative impacts section of the document. They would specify a generic yardage and specify criteria to be met. Mr. Simns questioned how they would address the issue if a county such as Dorchester wanted to place in Site 104 and could afford to get it to the site; would they be permitted to place? It was agreed that it would be reasonable to allow the counties closest to and potentially most affected by dredged material placement at Site 104 to use the site for material placement.

At this time, the meeting was adjourned.

ADDITION TO

ANNEX B

ATTACHMENT D ?

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Chesapeake Bay Field Office
177 Admiral Cochrane Drive
Annapolis, MD 21401

April 1, 1997

Mr. Robert Smith
Maryland Environmental Service
2011 Commerce Park Drive
Annapolis, MD 21401

Re: Site 104 Dredged Placement Area Near Kent Island, Queen Anne's County, MD

Dear Mr. Smith:

This responds to your March 12, 1997, request for information on the presence of species which are Federally listed or proposed for listing as endangered or threatened in the project area. We have reviewed the information you enclosed and are providing comments in accordance with Section 7 of the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*).

One Federally listed species, the Shortnose sturgeon (*Acipenser brevirostrum*) occurs in the proposed spoil placement area. Shortnose sturgeon were documented off western Kent Island in May 1996, by the U.S. Fish and Wildlife Service's Maryland Fisheries Resources office. A second species of concern (not Federally listed), the Atlantic sturgeon (*Acipenser oxyrhynchus*) is also found in the project area in significant numbers. You may wish to contact the Maryland Fisheries Resources office at (410) 573-4506 for additional information and survey recommendations for these species. Because National Marine Fisheries Service had lead for the endangered Shortnose sturgeon, they should be contacted for formal Section 7 requirements.

Except for occasional transient individuals, no other Federally listed or proposed endangered or threatened species are known to exist in the project impact area. Therefore, no further Section 7 Consultation with the U.S. Fish and Wildlife Service is required. Should project plans change, or if additional information on the distribution of listed or proposed species becomes available, this determination may be reconsidered. This response relates only to endangered species under our jurisdiction For information on other rare species, you should contact Ms. Lynn Davidson of the Maryland Natural Heritage Program at (410) 974-3195.

Sincerely,

Ms. Tammy Banta
Project Manager
Environmental Dredging

Mr. John S. Nichols
Fishery Biologist
National Marine Fisheries Service

TRB:smk

c: Mr. David Bibo, MPA
Mr. Mark Mendelsohn, CENAB
Mr. Brian Walls, CENAB
Mr. Jeff McKee, CENAB
Dr. Thomas Miller, UMCES
Ms. Sue Kelly, MES

MARYLAND
ENVIRONMENTAL
SERVICE

Parris N. Glendening
Governor

James W. Peck
Director

January 16, 1998

Mr. John S. Nichols
Fishery Biologist
US Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Habitat and Protected Resources Division
Oxford, Maryland 21654

Reference: Site 104 Open-Water Placement Area
Sturgeon Coordination

Dear Mr. Nichols:

The Maryland Environmental Service (MES) is writing, on behalf of the Maryland Port Administration, regarding the National Marine Fisheries Services' response to a request by Dr. Thomas Miller, University of Maryland Center of Environmental Science, for literature on the fish community and fisheries occurring at and in the vicinity of the proposed Site 104 dredged disposal site in the Chesapeake Bay, west of the northern tip of Kent Island.

In a letter dated July 31, 1997, NMFS stated that "2 shortnose sturgeon have been taken within the proposed site during 1996 and 1997." As per your conversation with Ms. Sue Kelly, a member of our staff, on January 16, 1998 you verified that the 2 shortnose sturgeon landings were not found within Site 104, but were south of the Bay Bridge off the western shore of Kent Island. Further examination of information available from USF&WS shows that no recorded shortnose sturgeon landings have been documented to date within Site 104 boundaries.

If you concur with the information presented above please sign below and return this letter as soon as possible to MES. Thank you for your timely response to this request.

2011 Commerce Park Drive • Annapolis, Maryland 21401 • 410/974/7281 • Fax 410/974/7267

Service comments on this project under the Fish and Wildlife Coordination Act and the National Environmental Policy Act (NEPA) will be provided through future comments during the NEPA process.

Thank you for your interest in fish and wildlife issues. If you have any questions or need further assistance, please contact Andy Moser at (410) 573-4537.

Sincerely,

for John P. Wolflin
Supervisor
Chesapeake Bay Field Office

cc: Jorgen Skjeveland, MD FRO
Laurie Silva, NMFS, Gloucester, MA
MD Heritage

ADDITION TO

ANNEX C

Parris N. Glendening
Governor

Maryland Department of Natural Resources
ENVIRONMENTAL REVIEW
Tawes State Office Building
Annapolis, Maryland 21401

John R. Griffin
Secretary

Carolyn D. Davis
Deputy Secretary

March 16, 1999

RECEIVED MAR 18 1999 M.E.S. WASTE MGT.

Wayne Young
Maryland Environmental Service
2001 Commerce Drive
Annapolis, MD 21401

Dear Mr. Young:

We writing in response to your question regarding potential impacts from the proposed use of Site 104 as an open water disposal site on wintering waterfowl. The Department has designated a site on the western side of Kent Island immediately north of the Bay Bridge as a Historic Waterfowl Concentration Area. This area extends westward from the Kent Island shoreline approximately 5,000 feet and northward from the westbound span of the Bay Bridge approximately 6,000 feet and includes a buffer area. Based on the dimensions for Site 104 presented in the Draft Environmental Impact Statement (Figure 2-1); the area designated by the Department as a Historic Waterfowl Concentration Area is outside of the boundaries for Site 104. We do not anticipate any disturbance impacts from the proposed use of Site 104 to wintering waterfowl within the area designated as a Historic Waterfowl Concentration Area.

If you have any questions regarding these comments, please feel free to contact Roland Limpert of my staff at (410) 260-8330.

Sincerely,

Ray C. Dintaman, Jr.

Ray C. Dintaman, Jr.
Director

Telephone:______________
DNR TTY for the Deaf: (410) 974-3683

Annex E

Selection of Alternatives with Supporting Data and Analysis

This annex applies screening criteria from Section 2 to a wide range of placement options that were identified through dredged material management planning activities specific to development of the DEIS which this annex supports as well as through prior and ongoing planning through the State-sponsored Dredging Needs and Placement Options Program. The screening criteria are described. The criteria are then applied to placement options that are organized by categories of placement types. A supporting analysis and data sheets are provided for each option.

1.0 Screening Criteria

The following criteria were developed by the Baltimore District, U.S. Army Corps of Engineers (CENAB) to provide a rationale for determining which of the various placement options were practical for consideration as alternatives by this DEIS, consistent with the requirements of the National Environmental Policy Act (NEPA) and NEPA regulations promulgated by the Council on Environmental Quality. In some cases, applicable Federal requirements necessitated the consideration as alternatives of placement options that are institutionally constrained by State statutes, as discussed in pertinent sections of this Annex. The rationale for these criteria are presented in Section 2 and are not repeated here.

Primary Screening Criteria:

Screening Criteria Number 1: The proposed placement option (whether it be a single options or combination of multiple smaller capacity options) has the potential to provide approximately 9 to 18 mcy of placement capacity to meet at least 50 percent of the placement deficit need to which the proposed action is directed.

Screening Criteria Number 2: The property owner is willing or has indicated a willingness to accept dredged material.

Screening Criteria Number 3: Preliminary evaluations, based upon existing information (outlined in Section 2.1.3), indicated that environmental impacts at the site are probably not significant enough to preclude the site from use.

Screening Criteria Number 4: Infrastructure is in place, or expected to be in place, in sufficient time to enable the placement option to receive dredged material when the capacity is needed. Infrastructure includes dikes, docking facilities, access channels, and berms, where applicable. Alternatively, with regard to using a combination of sites, infrastructure for the first site to be used is in place or expected to be in place in sufficient time to meet dredging needs with infrastructure for subsequent sites expected to be in place prior to previously developed site or sites reaching capacity.

Secondary Screening Criteria:

Screening Criteria Number 5: There is a reasonable prospect that any institutional constraint (e.g. statute preventing site development or placement, CERCLA liability, etc.) that would otherwise preclude use of a placement alternative could be resolved or removed as an impediment not later than six months prior to the first planned placement. This planning factor is necessary because of lead times required for dredging contracting. Alternatively, with regard to using a combination of sites, the institutional constraint for the first can be resolved or removed no later than six months prior to the first planned placement and the constraints for each subsequent site can be removed prior to the previous site reaching capacity.

Screening Criteria Number 6: The cost for using the placement alternative can be feasibly borne by the Federal and local project sponsors under existing rules, and regulations, except that no option would be screened out solely on the basis of cost if screening factors 1 through 5 would otherwise result in the option being considered an alternative to the proposed action;

Screening Criteria Number 7: Use of the placement alternative may either potentially provide a net environmental improvement with respect to existing conditions or avoid or substantially reduce any of the significant environmental impacts of a potential placement activity.

1.2 Screening Criteria.

At the minimum, in order to be selected as an alternative for the action under investigation by this DEIS, an option had to satisfy the primary screening criteria (1 through 4), except as otherwise noted. The secondary criteria (5 through 7) were applied to determine if there were any option-specific factors that would make a particular option unreasonable (e.g., insurmountable institutional constraint) or might make the option more competitive (e.g., high cost but high environmental benefit). No options were screened out as possible alternatives solely on the basis of either legislated prohibitions or cost or both if the primary criteria were satisfied. The following parameters were used in applying the screening criteria.

1.2.1 Dredging Need (Screening Criteria Number 1)

A dredged material placement deficit of 18 mcy was identified by CENAB and used as a baseline in applying Screening Criteria Number 1, as follows:

- An option that was capable of providing new or added capacity for at least 50 percent of the deficit in dredged material placement need was eligible for consideration as an alternative.

- Options that did not individually provide new or added capacity for at least 50 percent of the deficit but which satisfied criteria 2 through 4 were assembled into a combined options alternative.

- An option that reprogrammed sediments from one placement option to another without providing new or added capacity for at least 50 percent of the deficit was not eligible for selection as an alternative.

1.2.2 Real Estate (Screening Criteria Number 2)

- If sufficient real estate were available for use with owner concurrence or prospective concurrence, the option was eligible for consideration as an alternative.

- Except as noted in the next bullet, if a property owner objected to use of the real estate or was not capable of authorizing use of the real estate, the option was not eligible for consideration as an alternative.

- If there was a legislated prohibition on the use of property needed to implement the option, then screening criteria number 5 was applied in lieu of screening criteria number 2.

1.2.3 Preliminary Environmental Suitability (Screening Criteria Number 3)

- An option which had no specific environmental conditions that would make it unacceptable was eligible for consideration as an alternative.

1.2.4 Infrastructure Considerations (Screening Criteria Number 4)

- If the needed infrastructure can reasonably be expected to be available or completed in sufficient time to allow use of the option when needed, the option was eligible for consideration as an alternative.

- For small-scale options satisfying criteria 1 through 3, an option was considered to be eligible for considerations as part of a multi-option alternative if infrastructure could reasonably be expected to be available or completed in approximately 2 years from the time implementation commenced.

1.2.5 Institutional Constraints (Screening Criteria Number 5)

- If there is a reasonable prospect that any institutional constraint that would otherwise preclude use of a placement option could be resolved or removed as an impediment not later than six months prior to the first planned placement, then the option was eligible for consideration as an alternative.

- Without prejudice to the legislative process and in compliance with NEPA regulations, if an option satisfied screening criteria 1 through 4 but was legislatively prohibited from use, the site was eligible for consideration as an alternative.

- Without prejudice to the legislative process and in compliance with NEPA regulations, an option was considered eligible for consideration as a component of a multi-option alternative if the prohibition were legislatively imposed and could be resolved or removed as an impediment not later than six months prior to the first use of the option.

1.2.6 Preliminary Economic Viability (Screening Criteria Number 6)

- If the unit cost per cubic yard of a proposed option was not more than 200% of the highest unit cost for an actual placement project for the Port of Baltimore, rounded up to the next dollar ($22 per cubic yard), then the option was considered eligible for consideration as an alternative or as a component of a multi-option alternative.

- If an option that would have been screened out solely on the basis of cost, it was nevertheless eligible for consideration as an alternative or component of a multi-option alternative if screening factors 1 through 4 would otherwise have resulted in its selection as an alternative.

1.2.7 Environmental Tradeoffs.

- If a placement option satisfied Screening Criteria Numbers 1 through 4 but did not satisfy Screening Criteria Number 6, it was nevertheless eligible for consideration as an alternative if it might either potentially provide a net environmental improvement with respect to existing conditions or avoid or substantially reduce any of the significant environmental impacts of a potential placement activity.

2.0 Results of Screening Process

The screening criteria identified in Section 1 of this annex are applied to a variety of placement options in Section 3. The results of the screening process are summarized below.

2.1 Overall Results of Screening

The screening criteria (identified in section 1.2 above) were applied to each placement option and are summarized in Table **X-1** [EA ADD TABLE]. Each site was assigned a designation of 0 (meets criteria), X (doesn't meet criteria). In many cases of site availability, the site was designated with a "P" indicating that the state would consider accepting material pending issuance of a water quality certification. The information used to derive the screening designation are summarized in Table **X-2** [EA ADD TABLE] and detailed. All sites listed in Table **X-1** are addressed in the following sections based upon their viability as an alternative for Site 104. A series of locator maps displaying the site locations by placement type are available for reference in Section 2 (Figures 2-2 through Figure 2-7). Non-selection of an option as an alternative does not necessarily mean that a particular option is not or could not eventually become suitable at some future date.

2.2 Options Selected as Alternatives

The options shown in the following categories survived the screening process that was applied in this annex and were designated by CENAB as alternatives for consideration in this EIS:

- No action (required by NEPA regulations)
- Open-water sites (Deep Trough, Ocean Placement, Shad Battery Shoal. Site 104, Site 170 open water, Site 171 open water, Worton Point open water)
- Existing site: (Hart-Miller Island South Cell)
- New containment options (Hart-Miller Island new cell)
- Beneficial use (Poplar Island wetland cell conversion to upland, Poplar Island Increase in

Elevation; Poplar Island footprint expansion)

- Island placement site (Pooles Island area, Tolchester West, Site 168, Site 170, Site 171)
- Combination of smaller options (Artificial Reef off Thomas Point, Bodkin Island, Holland Island, Parsons Island).

3.0 Application of Screening Criteria and Option Characterization.

The following section of this Annex applies the screening criteria described in above and in Section 2 of the DEIS to a wide range of placement alternatives.

3.1 No Action.

As required by NEPA, the option of taking no action included as an alternative. The option was screened using the screening criteria for consistency purposes only.

Box XX-1
Screening of No Action

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: No capacity provided.
2. Site Availability: Not applicable.
3. Environmental Suitability: No primary environmental effects would be caused by taking no action. The ancillary environmental implications are discussed in the DEIS and, as applicable, to individual placement options insofar as they would be affected.
4. Infrastructure Readiness: The no-action option would necessitate reprogramming of sediments to existing placement sites or sites that are being constructed. Each of the existing sites and sites that are under construction or reconstructed are addressed as a separate option and screening accordingly.
5. Institutional Feasibility: No institutional constraints.
6. Prospective Affordability: No direct cost. Secondary economic effects are addressed in Section 2.
7. Potential for Environmental Improvements: None.

Results of Screening: Option required by NEPA to be considered as an alternative.

3.1.1a Location. Not applicable.

3.1.1b Type of Placement Option. Under the no-action option, dredging would need to be performed within the capacity available from existing placement sites and sites that are under construction (Poplar Island) or reconstruction (Cox Creek).

3.1.1c Potential Placement Capacity. No additional capacity would be provided. Under the no-action option, dredged sediment would be reprogrammed to existing sites and to sites that are under construction or reconstruction (Poplar Island and Cox Creek). Use of any of these sites would have the effect of reducing their service life through use of capacity earlier than current projected and potentially through filling at rates in excess of capabilities to effectively dewater and/or consolidate the sediment that is placed.

3.1.1d Bathymetry/Topography. Not applicable.

3.1.1e Environmental Characteristics. No primary environmental effects are caused by taking no action. However, there are ancillary environmental implications relative to marine transportation and other placement options. Future options to compensate for the capacity not provided would likely have environmental effects. These implications are discussed, as applicable, for individual placement options addressed in this annex, insofar as they would be affected.

3.1.1f Implementation Factors. No action maintains the status quo but would not resolve the placement deficit. Therefore, it can be anticipated that efforts would continue to implement one or more placement option. Future options to compensate for the capacity not provided as the result of no action may have construction requirements and also have variable implementation time frames.

3.1.1g Institutional Constraints. None. There are institutional constraints associated with certain other options either would or could potentially be used that may affect their availability, which are discussed later in this annex.

3.1.1h Estimated Costs. No direct costs. Ancillary costs would accrue as a result of a need to continue action to find placement options. There are economic implications with respect to the ability to maintain the marine navigation infrastructure and economic effects of potentially significant proportion that would need to be addressed.

3.1.1i Other Factors. Selection of the no-action would necessitate future action to provide capacity matched to dredging needs, would have the effect of delaying decision-making to resolve the deficit in placement capacity, and would result in the shortening of the service life of sites used to cover the capacity requirement of the proposed action.

3.1.1j Option Summary. The no-action option is required to be considered as an alternative by CEQ's NEPA regulations. Although there would be no direct effects from not taking action, there would be secondary effects that could be significant that would need to be assessed.

3.1.1k Option Data Sheet. **[ADD DATA SHEET]**

3.2 Open-Water Sites

The following open-water placement sites are examined in this subsection.

- Deep Trough
- Ocean Placement
- Pooles Island open-water
- Shad Battery Shoal
- Site 104
- Site 170 open-water
- Site 171 open water
- Worton Point open water

3.2.1 Deep Trough

The area known as the Deep Trough was screening (Box XX-2) and determined to be reasonable for consideration as an alternative to the proposed action.

Box XX-2
Screening of Deep Trough

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Capacity adequate to serve as alternative (>100 mcy).
2. Site Availability: Criteria #2 waived; Criteria #5 applies. Local sponsor cannot designate as a placement site because use of the site is prohibited by State law.
3. Environmental Suitability: No specific environmental characteristics are known that would preclude consideration of the Deep Trough as an alternative.
4. Infrastructure Readiness: Site could be prepared for use when needed.
5. Institutional Feasibility: Institutional constraints could be removed by the legislature of the State of Maryland and the Governor of Maryland in sufficient time to enable use of the site when needed.
6. Prospective Affordability: Estimated unit cost ($__) is less than maximum screening threshold.
7. Potential for Environmental Improvements: Modest potential for segregation of nutrients. Phosphorus deposited at the site would be buried, thereby preventing communication of all but the top ___cm with the water column.

Results of Screening: Option reasonable for consideration as an alternative.

3.2.1a. Location. An very deep trench in the center of the Chesapeake Bay has been previously considered as a placement option. A specific portion of this trench, referred to as the Deep Trough (located south of the Bay Bridge) (Figure 2-2), has been considered several times as a potential open-water placement site (DNPOP, 1995a,c; Gucinski and Ecological Associates, 1984; MPA, 1990; Versar, 1990a,b. Although the trench is broadly referred to as the Deep Trough, only a portion is legally defined using the term "Deep Trough." According to Title 8, Section 8-1601, subsection (a)(6) of the Annotated Code of Maryland,

> *"Deep Trough" means any region that: (i) Is south of the Chesapeake Bay Bridge and north of a line extending westerly from Bloody Point; and (ii) Has a depth that exceeds 60 ft* [18.3 m].

3.2.1b Type of Placement Option. Use of the Deep Trough would result in open-water placement. Controlled bottom placement could be conducted using either hydraulic placement means or by bottom-release scows.

3.2.1c Potential Placement Capacity. Placement capacity at the Deep Trough is estimated to exceed 100 mcy depending upon the depth of placement and the acreage used.

3.2.1d. Bathymetry. The Deep Trough is part of a trench of very deep water, up to 48.8 m (160 ft) in depth, that is generally aligned along a north-south axis in the eastern center of the main stem of the Chesapeake Bay. This trench is a remnant of the ancient Susquehanna River channel when this portion of the Bay was a riverine environment. The trench is approximately 32.2 km long (20 miles) beginning offshore of Kent Island, in the vicinity of the Bay Bridge, and extending south to the mouth of the Little Choptank River. It is an area encompassed by the -18.3 m (-60 ft) MLLW depth contour which extends 32.2 km (20 miles) south from the Chesapeake Bay Bridge to a shallower sill of a depth of -18.3 m to -21.3 m (-60 ft to -70 ft) MLLW opposite the mouth of the Little Choptank River (Versar 1990).

3.2.1e Environmental Characteristics. The available studies are dated and inconclusive with respect to the environmental acceptability of the Deep Trough as a long-term placement option. The studies that were undertaken did not reveal any insurmountable environmental conditions. The environmental characteristics of the Deep Trough are presented in the Deep Trough Option Data Sheet, and generally summarized below.

Living Resources. The available data suggest that use of the site would likely result in short-term, near-field effects. Although there were some uncertainties due to data limitations, the study results suggested that placement of approximately 20 mcy of sediments with an increase in bottom elevation of not more than 6 meters would probably result in short-term effects of limited duration to benthos and other living resources. The potential for long-term effects from protracted placements was not studied (Gucinski and Ecological Analysts, 1984). A draft feasibility study and impact assessment are available. They was sponsored by the Maryland Department of Natural Resources (MDNR) on behalf of the Maryland Port Administration (MPA). Concerns that were identified related to potential nutrient releases, commercial fisheries, and benthic community impacts, as well as public concern about the possible environmental effects (Versar, 1990a,b).

Water Quality. [XXXX]

Hydrodynamics. [XXXX]

Rare, Threatened or Endangered (RTE) Species. [XXXX]

Fishing Activity. [XXXX}

Recreational Activity. [XXXX]

Historical/Archeological. [XXXX]

Groundwater: [XXXX]

View Shed. Open-water placement would result in an increase in marine operations between the Chesapeake Bay Bridge on the north and Bloody Point to the south. This increased activity would involve tug and barge activity and would temporarily affect the view shed during the placement period.

3.2.1f Implementation Factors.

Construction Considerations. Placement of dredged material in the Deep Trough would not be expected to require any construction activities. The previously discussed draft feasibility assessment considered a demonstration placement of sediment from the Craighill Channel. The sediment that would be placed was to have a larger grain size than material that had been naturally deposited at the proposed placement site. The draft assessment reported that use of the Deep Trough for bottom placement of clean material would have the advantages of natural bathymetric features that would form a barrier to sediment migration as well as the lower costs associated with open-water placement (Versar, 1990a).

Implementation Time Frame. Should the State of Maryland remove the restrictions on the use of the Deep Trough, it is estimated that approximately 2 to 3 years of study and environmental documentation would be needed prior to the first placement. In order to prove the feasibility of using the Deep Trough, a phased approach of test placements separated by study periods as well as an extensive environmental monitoring regime was developed through the DNPOP program. The approach consisted of 3 test placement sequences covering about 9 years (CTITATION). Although this approach was not implemented, it presents a practical approach that could be used for validating the results of environmental studies. If this approach were adopted, it would take about 10 to 12 years to move from initial placements to full-scale use of the Deep Trough.

3.2.1g Institutional Constraints.

In 1991, the State legislature amended Title 8, section 8-1602 of the Annotated Code of Maryland to prohibit the placement of dredged material in the Deep Trough. According to Title 8, Section 8-1602 subsection (d):

> *Material excavated from Bay. - A person may not dump, deposit, or scatter any earth, rock, soil, waste matter, muck, or other material excavated or dredged from the Chesapeake Bay or its tidal tributaries into or onto the area of the bottomlands or waters of the Chesapeake known as the Deep Trough.*

Use of the Deep Trough was reconsidered under the MPA-sponsored Dredging Needs and Placement Options Program (DNPOP) in 1995 as part of efforts to develop a consensus-based plan to overcome an imminent shortfall in placement capacity. At the request of the DNPOP Management Committee, the technical status of the Deep Trough as a placement option was reviewed and compiled. Representatives of the Federal and State resource and permitting agencies were consulted in order to provide additional information to assist decision makers in determining the technical merits of Deep Trough as an option prior to anticipated coordination with the Maryland General Assembly regarding the legal issues (DNPOP, 1995a). A consensus-based study approach consisting of studies and closely controlled and monitored test placements was developed at the request of the DNPOP Executive Committee by the program's Bay Enhancement Phase II Working Group (DNPOP, 1995c). Subsequently, the Deep Trough was not included in the State of Maryland Strategic Plan for Dredged Material in response to an environmental policy decision by Governor Parris Glendening not to further reconsider use of the site.

The existing institutional constraints could be removed by the legislature of the State of Maryland in sufficient time to enable use when needed.

3.2.1h Estimated Cost. [XXXX]

3.2.1i Oher Factors. None identified.

3.2.1j Option Summary. The Deep Trough has more than ample capacity for 18 mcy. No environmental factors have been identified that would make consideration of the option unreasonable. However, the institutional constraints that apply to the Deep Trough preclude its designation by the State as a placement site and required participation by the local sponsor. In order for the Deep Trough to be designated by the local sponsor, the Legislature of the State of Maryland would have to remove or waive the prohibition on the use of the site and the Governor of Maryland would have to sign the legislation. The institutional constraint notwithstanding, the Deep Trough is reasonable for consideration as an alternative within the scope of the NEPA regulations published by the Council on Environmental Quality.

3.2.1k Option Data Sheet. [**ADD DATA SHEET**]

~~2.2.3.b.5~~ Deep Trough

The Deep Trough (located south of the Bay Bridge) was investigated by DNPOP as a potential site for placement of dredged material from the Baltimore Harbor outer channels (Figure 2-2). It was specified in the draft environmental assessment ~~(EA)~~ that use of the Deep Trough for bottom placement of clean material would have the advantages of containment within this natural structure and the low costs associated with open-water placement.

The ~~EA~~ environmental assessment for the proposed use of the Deep Trough was prepared as a draft technical report. Concerns related to potential nutrient releases, commercial fisheries, and benthic community impacts, as well as public nuisance concerns, combined to result in the site not being investigated further for placement after 1989. Use of the site was reconsidered under the DNPOP program in 1995, but was not included in the State of Maryland Strategic Plan for Dredged Material Management due to the ~~s~~State law prohibiting placement in this area (see below) and an environmental policy decision by the Governor not to reconsider use of the site. In order for this to be a viable alternative, public opinion would have to force a change in the current law. Then, the site investigations would have to be completed, culminating in the preparation of an environmental impact statement (EIS).

The Deep Trough is part of a trench of very deep water, up to 48.8 m (160 ft) in depth, that is generally aligned along a north-south axis in the eastern center of the main-stem of the Chesapeake Bay. This trench is a remnant of the ancient Susquehanna River channel when this portion of the Bay was a riverine environment. The trench is approximately 32.2 km long (20 miles) beginning offshore of Kent Island, in the vicinity of the Bay Bridge, and extending south to the mouth of the Little Choptank River. It is an area encompassed by the -18.3 m (-60 ft) MLLW depth contour which extends 32.2 km (20 miles) south from the Chesapeake Bay Bridge to a shallower sill of a depth of -18.3 ~~m~~ to -21.3 m (-60 ~~ft~~ to -70 ft) MLLW opposite the mouth of the Little Choptank River (Versar 1990).

Although this trench is broadly referred to as the Deep Trough, only a portion is legally defined using the term "Deep Trough." According to Title 8, Section 8-1601, subsection (a)(6) of the Annotated Code of Maryland,

> *"Deep Trough" means any region that: (i) Is south of the Chesapeake Bay Bridge and north of a line extending westerly from Bloody Point; and (ii) Has a depth that exceeds 60 ft* [18.3 m]."

In 1991, the State legislature amended Title 8, S~~s~~ection 8-1602 of the Annotated Code of Maryland to prohibit the placement of dredged material in the Deep Trough. According to Title 8, Section 8-1602 subsection (d):

> *"Material excavated from Bay. - A person may not dump, deposit, or scatter any earth, rock, soil, waste matter, muck, or other material excavated or dredged from the Chesapeake Bay or its tidal tributaries into or onto the area of the bottomlands or waters of the Chesapeake known as the Deep Trough."*

Any future proposals to place dredged material in the Deep Trough will be evaluated on a project-by-project basis in accordance with the Clean Water Act Section 404 (b)(1) Guidelines and other applicable laws and regulations. Although some previous reports suggest that placement of material at the Deep Trough is environmentally acceptable and is a cost-effective dredged material placement alternative, the existing S~~s~~tate law essentially prohibits the required participation by the local sponsor. The legally defined Deep Trough was considered as an alternative to the use of Site 104. Placement capacity at the Deep Trough is estimated to exceed 100 mcy depending upon the depth of placement.

1982-1983 Studies

The Deep Trough was extensively studied~~s~~ in the early 1980~~'~~s as part of an assessment related to a proposal to place up to 25 million yards of dredged material from maintanence and deepening of the approach channels. Dissolved ~~O~~oxygen (DO) depletion was found to occur during the summer months throughout the Deep Trough. At depths between 30 and 60 f~~eet~~, the waters would be considered oxygen stressed with concentrations < 5 ppm. The Deep Tough was found to become completely anoxic during the summer months at depths greater than 60 f~~eet~~. The areas proposed for dredged material placement are in waters which are greater than 60 f~~eet~~ in depth. Material would be placed in an average thickness of 5 f~~eet~~.

Stratification occurs during the summer months and little oxygen is transferred below the pycnocline (the boundary-[something missing here]

Benthic community organisms are significantly affected by the summer low DO concentrations. During the 1982 studies, DO concentrations in bottom waters remained at 0.0 ppm. This resulted in near elimination of all benthic organisms during the summer period. -Recolonization by pioneer species such as polychaete worms was noted by November, followed by a mollusk (*Mulinia lateralis*) in February. Total recovery to an expected normal diversity or density (when compared to shallow reference areas) never occurred.

Finfish populations were found to be moderately abundant during the winter months when both dissolved oxygen and availability of food organisms were favorable.– The dominant juvenile species were Atlantic croaker and menhaden. - The seasonal occurrence in the Deep Trough is is likely related to the timing of their migrations through the area and possible overwintering.- In addition, blueback herring, alewife, and American eel use the general area during winter months. Spawning of Bay Anchovy occurred in the spring, but the Trough is not considered a significant spawning area for any finfish species. - Utilization of the deepest waters occurred during the winter months when lower temperatures resulted in DO concentrations >5 ppm.

Most fish species, however, use the Trough as a migration route to more northern waters. The utilization of the Trough was found to be highly seasonal and limited in summer months by higher temperatures, low to non-existent dissolved oxygen, and lack of food source. Bottom fish were virtually absent during summer months. Fish abundance and diversity were very low in summer and significantly higher in winter. Commercial fish such as striped bass and white perch were present in the area but inconsistently from year to year. In the winter sampling of 1982-1983, virtually no striped bass or white perch were caught.

Blue crabs were found to be very low in number during most of the year, but lowest in summer. The Trough was found not to be a significant habitat for blue crabs.

The Deep Trough is not considered a significant habitat for either finfish or blue crabs. While winter utilization by finfish does occur, the overall ecological value is restricted to ~~to~~ fall and winter and to only a limited number of species. It is also not considered a significant spawning area.

REFERENCES?? NEED MORE CURRENT ONES IF THEY EXIST.

Site Impacts

The environmental impacts of placement of dredged materials from the approach channels into the Deep Trough are both physical and chemical. - Toxic effects are not expected due to the similarity of the channel sediments to those already in the site. Particle sizes and moisture content of the materials are virtually identical to those currently present in the Deep Trough. This comparison was made in the early 1980's and would be considered the same today. – The main difference between the nature of the materials to be dredged today is that they are cleaner. The nutrient concentrations are expected to be similar. The direct physical effects would be smothering of existing benthic communities.

Winter Placement

-If the placement occurred during the winter months, short--term impacts upon finfish and blue crabs would be expected. - The smothering of that year's benthic community would also occur. Recovery of the community (to the limited extent that it would recover normally) would not occur until all placement had ceased. The Trough is not, however, considered a significant source of food for migrating fish at any time of the year.

Nutrient impacts would be expected to be minimal and potentiation of phytoplankton densities would be minimal because of low temperatures and limited migration of deep waters to the surface 10 meter depths. - Displacement of anoxic waters would be minimal since the winter DO concentrations are typically >7.0 ppm. - Placement would decrease the average depth by 5 feet. - No significant raising of the minimum depth of anoxic waters would be expected, therefore.

Summer Placement

Summer placement (which is not likely because of general restrictions on time of year placement throughout the Bay) would have little effect upon the benthic community since it is virtually eliminated anyway due to natural anoxia below ~~the~~ 60 feet. - Finfish and blue crab populations would not be significantly affected since they are not found in the deeper portions of the Trough during summer months.- Short term nutrient effects above the pycnocline (the boundary, usually at 15-20 feet deep, formed by salinity and temperature gradients) might occur, although this would be expected to relate to dispersion of nutrients during initial dumping and not from movement from the bottom after placement. The depths of the Trough are such that there would be significant dispersion of nutrients released from anoxic sediments during the summer months when phytoplankton effects might be expected to occur. - Some short-term increases in turbidity at the surface would reduce light penetration slightly and tend to inhibit phytoplankton growth. - Some minor upwelling of deoxygenated water might occur on a very short-term basis when the dredged material displaced water at the bottom of the trough.

There would not be any environmentally significant long term effects of dredged material placement at the Deep Trough site.

~~P:\Federal\DOD\ARMY\projects\6095793\NewDraft\Working pieces\DeepTrough\SITE 104 DRAFT EIS REWRITE.doc~~

P:\Federal\DOD\ARMY\projects\6095793\NewDraft\Revised DEIS\Chapter_02\Deep Trough.doc

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title
Deep Trough

Type:
Open Water

Location:

Located south of the Bay Bridge and approximately 1 mile west of Kent Island. It runs from approximately ½ mile south of the bridge to south of Bloody Point.

Size: Approximately ½ mile wide by 9 miles long. Actual proposed usable area is about 2600 acres filled to an average thickness of 5 feet in waters > *90 feet in depth.*

Potential Capacity: Approximately 26 mcy (could be more if a larger area or greater thickness of placement were used).

Availability:

State owned waters.

Nutrients: Some release would be expected. Effects would depend upon the time of year that the placement occurred. Depths are sufficiently great that effects would be minimal for placement near the bottom. Bottom dump from scows would result in somewhat greater effects.

Infrastructure Required to Implement:

None

Institutional Issues:

The site has been restricted from use for dredged material placement by state law.

Costs:

Total Unit Costs Per Cubic Yard: **[NEED!]** *Approximately $4 - $6 per cu. yd.*

Development & Implementation Costs: **No** development or implementation costs would be required for placement. *Monitoring costs would need to be defined*

COMMENTS:
Ecological value is restricted to fall through spring.
Benthic community is severely impacted during summer months by low to 0 dissolved oxygen concentrations.
Fisheries are limited. Potential winter use for passage.
Limited drift gill netting in winter and spring
Not an important spawning area.
Possible short term upwelling of deoxygenated water might occur during summer placement.

DRAFT DRAFT DRAFT DRAFT

TITLE: Deep Trough **PROJECT TYPE**: Open Water

Existing Conditions	**Presence***	**Potential***	**Unknown***	**N/A***
Physical and Chemical Characteristics				
Substrate		X		
High Relief Area				X
Suspended Particulates, Turbidity		X		
Water Quality		X		
Hydrodynamics				X
Tidal Fluctuations				X
Salinity Gradients				X
Sediment Quality		X		
HTRS				X
Biological Characteristics				
RTE-Bald Eagle				X
Aquatic Organisms				
Benthic Communities		X		
Fisheries		X		
Designated Spawning Area				X
Larval Habitat Area				X
Crabs		X		
Mollusks				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife				X
Avian Wildlife				
Waterfowl concentration area				X
Land and/or Waterbirds				X
Special Aquatic Sites				
Sanctuaries and Refuges				X
SAV				X
Wetlands				
Tidal Wetlands				X
Non-tidal Wetlands				X
Human Use Characteristics				
Groundwater			X	
Water Related Recreation			X	
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars-NAB1-1				X
Crabs				X
Recreationally important fisheries				X
Commercially important fisheries		X		
Aesthetics				
Air Quality				X
Noise				X
Critical Areas				X
Forested Areas				X
Cultural Resources				X
Archaeological Resources				X
Potential for Benefit			X	
Potential to Minimize Adverse Effects		X		

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A** (Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Living Resources Maps
MDNR Historic Oyster Bar Maps
MGS Tidal Wetland Maps
MGS Non-Tidal Wetland Maps
Lee Crockett Living Resource Map of the Upper Bay
MDNR Report on the Deep Trough of the Chesapeake Bay: An Assessment of the Fisheries Value and Suitability for Dredged Spoil Disposal. 1984.

3.2.2 Ocean Placement

Ocean placement was screened (Box XX-3) and determined to be reasonable for consideration as an alternative to the proposed action.

Box XX-3
Screening of Ocean Placement

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Capacity adequate to serve as alternative (>100 mcy).
2. Site Availability: An ocean placement site has been designated off of Cape Henry for use in disposing of sediments from channels serving the Port of Hampton Roads. The site is available and could potentially be designated for use for disposing of sediments from approach channels to the Port of Baltimore. The site is considered to be available for planning purposes.
3. Environmental Suitability: No specific environmental characteristics are known that would preclude consideration of ocean placement as an alternative.
4. Infrastructure Readiness: Site could be prepared for use when needed.
5. Institutional Feasibility: The site potentially can be designated for use in support of the Port of Baltimore under existing federal regulations that are applicable to ocean placement.
6. Prospective Affordability: The estimated unit cost ($__) is near and potentially could exceed the maximum screening threshold, depending upon transportation costs. However, the option is otherwise reasonable for consideration as an alternative.
7. Potential for Environmental Improvements: None.

Results of Screening: Option reasonable for consideration as an alternative.

3.2.2a Location. Currently, ocean placement is used for the placement of dredged material by a number of USACE Districts including the Norfolk District. The Norfolk Placement Site is located off the Virginia Capes approximately 17 miles from the mouth of the Chesapeake Bay. The EPA has previously designated and permitted the site for use by tidewater Virginia ports.

3.2.2b Type of Placement Option. Use of the ocean placement site would result in open-water placement. Controlled bottom placement would be conducted using bottom-release scows and tugboats suitable for offshore operations during winter operating conditions.

3.2.2c Potential Placement Capacity. The ocean disposal site can accommodate large quantities of dredged material and has more than adequate potential for the proposed action.

3.2.2d Bathymetry/Topography. [XXXX]

3.2.2e Environmental Characteristics [CENAB PROVIDE DATA FROM NORFOLK DISTRICT EIS]

3.2.2e Environmental Characteristics. [CENAB PROVIDE DATA FROM NORFOLK DISTRICT EIS]

Living Resources. [XXXX] Ocean substrates near the mouth of the Bay tend to be larger grained in nature than the northern Chesapeake Bay sediments, which are mostly fine grained and typically have high organic matter contents and nutrients. The placement of these fine grained sediments in areas of larger grained sediments could result in benthic community impacts and water quality impacts due to changes in the benthic substrate.

Water Quality. [XXXX]

Hydrodynamics. [XXXX]

Rare, Threatened or Endangered (RTE) Species. [XXXX]

Fishing Activity. [XXXX}

Recreational Activity. [XXXX]

Historical/Archeological. [XXXX]

Groundwater: [XXXX]

View Shed. Open-water placement would result in an increase in marine operations between the channels being dredged and the ocean placement site. This increased activity would involve tug and barge transit activity that would be similar to existing marine traffic.

3.2.2f Implementation Factors. [CENAB PROVIDE REQUIREMENTS FROM NORFOLK DISTRICT EIS]

Construction Considerations.???????

Implementation Time Frame.

3.2.2g Institutional Constraints The site is currently not designated for use for the Port of Baltimore. The site potentially can be designated for use in support of the Port of Baltimore under existing federal regulations that are applicable to ocean placement. Ocean placement from Chesapeake Bay channels would require the designation for use by the Port of Baltimore (including permitting from state and Federal agencies)

3.2.2h Estimated Costs. [XXXX]

. and transport to the ocean via the southern approach channels through Virginia waters.

The average distance from the centroid of the Harbor approach channels to the ocean is approximately 162 nautical miles. The added distance from the Preferred Actions (Site 104) is 154 nautical miles. Estimated costs for transport are $0.10/cy per mile resulting in costs of approximately $16.20 per cubic yard for this option. Typically transportation costs range from $1 to $4 per yard for sites within 10 to 40 nautical miles of the channels. This alternative is not practicable due to transportation costs.

3.2.2i Other Factors. [XXXX]

3.2.2j Option Summary. [XXXX]

3.2.2k Option Data Sheet. [ADD DATA SHEET]

3.2.3 Pooles Island Open-Water

Use of the existing open-water placement sites in the vicinity of Pooles Island was screened (Box XX-4) and determined to be unsuitable as an alternative to the proposed action as indicated by the analysis.

Box XX-4
Screening of Pooles Island Open-Water Placement Sites

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Insufficient capacity to serve as either an alternative or as a component of a multi-option alternative. The remaining capacity as of October 1999 (≅ 4.9 mcy). All of this capacity is already programmed for dredging needs other than the deficit addressed in this annex.
2. Availability: Sites are already in use and would be available if there were reserve capacity.
3. Environmental Suitability: Existing sites are environmental acceptable for placement.
4. Infrastructure Readiness: Sites could be ready for use when needed.
5. Institutional Feasibility: There are no institutional constraints that would restrict use of the sites.
6. Prospective Affordability: The estimated unit cost ($__) would be comparable with current costs of open-water placement at the sites and would be well below the maximum screening threshold.
7. Potential for Environmental Improvements: None.

Results of Screening: Use of the Pooles Island open-water placement sites is not suitable for consideration as an alternative because all remaining capacity is already allocated for placement needs other than the deficit addressed by this annex.

3.2.3a Location. The area immediately east of Pooles Island is a natural depression that has been used for many years for open-water placement of dredged sediments . There are eleven existing and two newly designated open-water placement sites in the Pooles Island area (Figure 1-2). These sites are close to the C&D approach channels between the Sassafras River and the north end of the Tolchester S-Turn that are managed by the Philadephia District, U.S. Army Corps of Engineers (CENAP).

3.2.3b Type of Placement Option. Placement at the Pooles Island open-water placement sites has involved controlled bottom placement using bottom release scows or hydraulic placement, or both.

3.2.3c Potential Placement Capacity. Although historical placement records are incomplete, an estimated 50-55 mcy of material has been dredged from the C&D Canal approach channels in the upper Bay since the approach channels were deepened to 27 feet in the mid-1930s (**CITATION**). The areas have also been used for maintenance and new work dredging of the approach channels to Baltimore Harbor. Records prior to 1965 indicate open-water placement was within about

1500 feet of the channels. All of the presently designated sites are further from the channel than 1500 feet, and are not known to have received dredged material prior to 1965. During deepening of the approach channels in 1965-1968, much of the material was placed within open-water sites encompassed by currently designated sites. All open-water placement of maintenance dredging material from 1977 until 1998 occurred within designated Areas D, E, F, G and H. Two new sites, one in area G (site G-East) and Site 92 (per its designation in the MPA Master Plan), have been designated for open-water placement for the purpose of implementing the Pooles Island open-water component of the State's Strategy for Dredged Material Management (MDOT, 1996).

An estimated combined capacity of approximately 4.9 mcy was nitially projected for G-East and Site 92 with limited residual capacity in some of the other sites (G-West and G-South) following the 1997-1998 dredging cycle (MES 1997a). The NEPA documentation and the Environmental Assessment for this placement option was completed with a "finding of no significant impact" and released to the public (MES, 1997). The bathymetry for Site 92 was subsequently reassessed using more recent survey data. This resulted in a revised total estimated capacity of 6.0 mcy was available prior to first use of the site, which occurred during the 1998-1999 dredging cycle. The placement capacity for the unfilled remaining Pooles Island open-water sites prior to the commencement of the 1999-2000 dredging cycle (G-West, G-East, G-South, and Site 92) is estimated at 4.9 mcy.

3.2.3d Bathymetry/Topography. High relief bottom exists in the vicinity that is used for foraging by striped bass and other fish species. The placement sites currently available for use have been configured to take advantage of existing modest depressions that are lower in elevation than nearly high relief areas. The placement sites have been further designed to avoid the high relief areas.

3.2.3e Environmental Characteristics.

Living Resources. There is no submerged aquatic vegetation (SAV) in or near the Pooles Island placement sites. Previous environmental assessments of the Pooles Island sites have predicted short-term near field impacts from disturbance to the benthic community and turbidity in the water column during placement. These predictions have been confirmed through environmental monitoring. Various fisheries studies have been performed to determine species diversity and density in the Pooles Island area. Striped bass and other fishes use the Pooles Island high relief areas for foraging. Finfish transit the waters above the depressions east and southeast of Pooles Island while enroute to other areas (**CITATIONS**). Placement activities have been designed to avoid high relief areas and have been timed to minimize the effect on finfish (**CITATIONS**).

Water Quality. **[XXXX]**

Hydrodynamics. **[XXXX]**

Rare, Threatened or Endangered (RTE) Species. **[XXXX]**

Fishing Activity. A fishing study were previously conducted to ascertain productivity of placement areas G-East and Site 92 and control sites in response to concerns expressed by charter boat captains who fished the Pooles Island area (**CITATION**). The findings of the study resulted in a reconfiguration of Site G-East in order to avoid an impacting bottom area used for foraging by finfish **(CITATION)**.

Recreational Activity. The high relief shoal areas east, northeast and southeast of Pooles Island is used seasonally for recreational and charter boat fishing activity. The depressions between Pooles Island and these shoals are rarely fished because they are not productive **(CITATION)**.

Historical/Archeological. **[XXXX]**

Groundwater: **[XXXX]**

View Shed. If dredged material were reprogrammed from other locations to the Pooles Island open-water sites, it would result in a substitution of one dredging need for another. There would be virtually no change in the level of dredged material placement operations that is already associated with use of the sites.

3.2.3f Implementation Factors. The sites are already in use. Water quality certification is required prior to use. No factors were identified that would inhibit water quality certification.

3.2.3g Institutional Constraints. No institutional constraints were identified.

3.2.3h Estimated Costs. **[XXXX]**

3.2.3i Other Factors.

Sedimentation Rates. Over the past several dredging cycles, relatively low flow conditions from the Susquehanna River watershed and less severe winter conditions have resulted in a lower than average dredging need for the upper Bay approach channels to the C&D Canal. Consequently, the availability of the Pooles Island open-water placement sites may be extended for a year or so beyond initial projections if average conditions prevail over the next several years. Any such extension would help compensate to a small extent for delays experienced in implementing the placement deficit that is addressed by this annex and the delay experienced in the construction of Phase I of the Poplar Island restoration project.

Flood events would likely result in abnormal shoaling and an associated increase in dredging need. With respect to placement planning, flood events that result in massive delivery of sediment to the Bay cannot be predicted beyond statistical analysis of return periods. Floods which resulted in such exceptional conditions occurred in 1972, 1975 and 1996 **(CITATION)**. The average dredging need used in planning was based on typical low through high flow conditions and did not take into consideration extreme events. Whether another flood will occur during the remaining estimated service life of the Pooles Island sites open-water cannot be predicted. Therefore, it is not possible to precisely estimate actual placement needs. Should such conditions develop, they would most likely result in the available capacity being used quicker than projections that are based on average conditions. Variables of this type are normally accounted for by a contingency to accommodate uncertainty. However, a contingency to cover an extreme event would have to be very large relative to the remaining capacity and projected service, and would not be representative of prospective near-term needs. At the same time, the potential for flood-related shoaling cannot be ignored. Given the limited remaining service life, best management of the existing capacity is accomplished through operational adjustments to projected needs based on actual conditions that are experienced.

Site Management. Use of the Pooles Island open-water sites had been accomplished without incident until the 1997-1998 winter dredging cycle for approach channels to the C&D Canal. During that period, procedural errors resulted in placement of some of the material too close to the perimeter of site G-West for prevailing conditions. About 26 percent of the material migrated just outside of the site boundary. The situation was identified during environmental monitoring of the site by the Maryland Geological Survey. The finding was reported to the Maryland Department of the Environment, CENAP, and the MPA (as local sponsor) as required under the environmental monitoring regime for the site. Lessons learned from this experience were subsequently incorporated into an enhanced regulatory oversight and monitoring requirement for use of the site. Subsequent placement during the 1998-1999 dredging cycle was accomplished according to plan (**CITATION**).

3.2.3j Option Summary. All capacity remaining in the Pooles Island open-water placement sites has been allocated to placement needs other than the placement deficit addressed in this annex. In view of the variable shoaling rates and associated dredging need over the past several years for the C&D approach channels, it cannot be assumed with confidence that any potential capacity at the Pooles Island sites in excess of the aforementioned capacity estimates could be substituted for a corresponding portion of the placement deficit addressed by this annex. The additional capacity estimated by updated surveys may or may not be needed to respond to an increase in shoaling during the site's projected remaining service life. If so, the USACE could reprogram this capacity to the extent available to compensate for delays in implementing the appropriate action to provide for the dredging need addressed in this annex or to satisfy a portion of the placement deficit if not fully covered by the proposed action.

3.2.3k Option Data Sheet. **[ADD DATA SHEET]**

3.2.4 Shad Battery Shoal

Use of the area in the vicinity of Shad battery Shoal for open-water placement was screened (Box XX-5) and determined to be suitable as an alternative to the proposed action as indicated by the analysis.

Box XX-5
Screening of Shad Battery Shoal

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Less than 50% of the dredging need. However, the site could potential serve in conjunction with other open-water sites to provide the needed capacity..
2. Availability: Some of the area is within the boundary of APG. Although APG has opposed use of the site on the basis of military missions and environmental effects, it is anticipated that use of the site for open-water placement could not be reasonably withheld if determined to be in the best interests of the federal government and the State of Maryland.
3. Environmental Suitability: Use of the site could result in environmental impacts to fisheries habitat that could potentially impact high relief areas. The site is also within the legally designated spawning area for striped bass.
4. Infrastructure Readiness: Sites could be ready for use when needed.
5. Institutional Feasibility: Use of the site could potentially involve the covering of unexploded ordnance (UXO) at APG. The extent of UXO contamination would need to be assessed to determine if this posed an institutional barrier to use of the site.
6. Prospective Affordability: The estimated unit cost ($__) would be comparable with current costs of open-water placement at the sites and would be well below the maximum screening threshold, provided that removal of UXO were not required.
7. Potential for Environmental Improvements: None identified.

Results of Screening: Use of the Shad Battery Shoal area for open-water placement sites is not suitable for consideration as a standalone alternative due to insufficient capacity. There is also a potential for significant environmental effects and for institutional constraints (military missions and UXO). However, the site potentially could be used in combination with other open-water sites to provide the target capacity. For this reason, Shad Battery Shoal was included as an alternative.

3.2.4a Location.

3.2.4b Type of Placement Option.

3.2.4c Potential Placement Capacity.

3.2.4d Bathymetry/Topography.

3.2.4e Environmental Characteristics

3.2.4e Environmental Characteristics.

Living Resources.

Water Quality.

Hydrodynamics.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.2.4f Implementation Factors.

Construction Considerations.

Implementation Time Frame.

3.2.4g Institutional Constraints.

3.2.4h Estimated Costs.

3.2.4i Other Factors.

3.2.4j Option Summary.

3.2.4k Option Data Sheet. [ADD DATA SHEET]

3.2.5 Site 104

Site 104 was designated by the Maryland Port Administration as the placement site to resolve a placement deficit of 18 mcy. Use of the site for open-water placement was screened (Box XX-6) and determined to be suitable as an alternative as indicated by the analysis.

Box XX-6
Screening of Site 104

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide 14 to 18 mcy.
2. Availability: The site consists of State-owned bottom that has been made available for open-water placement.
3. Environmental Suitability:
4. Infrastructure Readiness: Sites could be ready for use when needed.
5. Institutional Feasibility: There are no institutional constraints to using the site.
6. Prospective Affordability: The estimated unit cost ($__) would be comparable with current costs of open-water placement, well below the maximum screening threshold.
7. Potential for Environmental Improvements:

Results of Screening: Use of Site 104 for open-water placement sites is suitable for consideration as an alternative.

3.2.5a Location.

3.2.5b Type of Placement Option.

3.2.5c Potential Placement Capacity.

3.2.5d Bathymetry/Topography.

3.2.5e Environmental Characteristics

3.2.5e Environmental Characteristics.

Living Resources.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.2.5f Construction Factors.

3.2.5g Institutional Constraints.

3.2.5h Estimated Costs.

3.2.5i Other Factors.

3.2.5j Option Summary.

3.2.5k Option Data Sheet. [ADD DATA SHEET]

3.2.6 Site 170B/Patapsco River Mouth (Open Water)

Site 170 is located at the mouth of the Patapsco River. The western portion of Site 170 was previously considered during the MPA Master Plan Initiative (as Site 97) for estuarine overboard placement. It was not short-listed for further consideration at that time (MPA, 1990). The area, redesignated at Site 170, was included as Option #1 of 55 in the Bay Enhancement Phase II component of the MPA's Dredging Needs and Placement Options Program (DNPOP). The DNPOP Program documentation uses Site 170A as the option designation for a constructed island and Site 170B as the option designation for open-water placement. The DNPOP option designations are used in this annex to refer to specific options whereas the term "Site 170" applies to the area in general. Site is irregularly shaped (Figure X-____). It is approximately 1 mile wide and 2.5 miles long, comprising approximately 1,600 acres. This size is consistent with the approximate acreage that would be needed for a large-scale constructed island placement site.

Use of the site for open-water placement was screened (Box XX-6) and determined to be unsuitable as an alternative to the proposed action as indicated by the analysis.

Box XX-7
Screening of Site 170B/Patapsco River Mouth (Open Water)

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over 50 percent of the target placement need.
2. Availability: The site consists of State-owned bottom that could be made available for open-water placement.
3. Environmental Suitability: Migration of sediment from the site was reported during the most recent placement (1983). Further use of the site for open-water placement is expected to result in environmental impacts due to a significant potential for disturbance of bottom sediments during storm events with waves from the northeast. It is expected that significant quantities of sediment would be dispersed from the site to nearby shallow water areas, tributaries and beaches. Some material could potentially also migrate back into the channels.
4. Infrastructure Readiness: Sites could be ready for use when needed.
5. Institutional Feasibility: There are no institutional constraints to using the site. Prior use of the site resulted in material migrating to nearby beaches and associated public concern.
6. Prospective Affordability: The estimated unit cost ($__) would be comparable with current costs of open-water placement at the sites and would be well below the maximum screening threshold.
7. Potential for Environmental Improvements: None identified.

Results of Screening: Use of the Patapsco River Mouth for open-water placement sites is not suitable for consideration as an alternative due to the significant potential for migration of material from the site and associated environmental impacts to nearby shorelines and tributaries.

3.2.6a Location.

Site 170 is located at the mouth of the Patapsco River between the shipping channels and the north shore of Anne Arundel County. The northeastern edge is adjacent to and immediately south of the Brewerton angle and is configured to generally parallel the channels. The northwestern side of the site is immediately east of a line between Rock Point in Anne Arundel County and North Point in Baltimore County (referred to as the Rock Point - North Point line). The southeastern side is north of the Frankie Point at the mouth of Bodkin Creek. The reconfigured site approaches to about ½ mile of the northeastern Anne Arundel County shoreline at its closest point.

Immediately west of the western end of Site 170 is a discontinued disposal area. The eastern end of the old disposal area is due north of Rock Point. This area is west of the Rock Point - North Point line. It was included and short-listed as Site 123 for island creation in the MPA Master Plan (MPA, 1990). The shallow-water disposal areas that were used by the Baltimore District for open-water placement consisted of Sites 123 and 97.

3.2.6b Type of Placement Option. Open water placement.

3.2.6c Potential Placement Capacity. XX mcy.

3.2.6d Bathymetry/Topography.

3.2.6e Environmental Characteristics

3.2.6e Environmental Characteristics.

Living Resources.

Water Quality/Hydrodynamics.

Between 1975 and 1983, almost 6 mcy of material dredged during the maintenance of approach channels to Baltimore Harbor were placed in Sites 123 and 97. Changes to the Code of Maryland Regulations (COMAR Subsection 8-1602.a) enacted in 1976 prohibited the placement of dredged material from channels west of the Rock Point - North Point line into waters of the Chesapeake Bay (Figure 1-2). Consequently, no further dredged material from the Baltimore Harbor has been placed at Site 97. Subsequently, all material placed at Site 97 was dredged from the Craighill Channel and the Brewerton Channel east of the North Point - Rock Point line.

Site 97 was used for open-water placement between 1975 and 1983. About one third of the sediment placed at the site was dredged hydraulically and discharged at the site as a slurry. Material placed hydraulically was down-shunted to the bottom and was placed closer to the center of the site in order to minimize loss of material from the site. However, some of the sediment may have been lost to the water column during placement or may have been re-suspended and carried from the site by wind-driven currents and wave action such as occur during winter storms. Although not proven, it has been suggested by some resource managers that the think relatively clean surficial layer of sediments in the lower reaches of the Patapsco River near the Francis Scott Key Memorial Bridge may have originated from the Site 97 placement area. Further, it is possible that the reported temporary deposition of fine grained sediment in nearshore areas in northern Anne Arundel County may have resulted from placement of dredged material at Site 97.

Use of Site 97 for placement of dredged material ended in 1983. A study performed on Site 97 after it was used in 1983 found that, because of the relatively exposed position of the site and the shallow depths before and after placement, some material could be lost from the site under certain wind and current conditions (Halka and Panageotou, 1986). Due to the relatively shallow depths at the site, the material had the potential to impact adjacent shorelines, shellfish bends, and shallow water habitats.

Site 97/170B was found to be a poor location for overboard placement option as discussed above. This evaluation was reaffirmed in both the Master Plan and DNPOP planning processes. Use of Site 170B for open-water placement was estimated to result in an approximately capacity of 9 to 10 mcy. Existing water depths are -14 to -17 feet MLLW. The proposed elevation after placement would be approximately -10 feet MLLW. The interorganizational, interdisciplinary Bay Enhancement Phase II Working Group of the DNPOP program, drawing on technical advice from the Maryland Geological Survey, found that the site is exposed to winter storm conditions, especially Nor'easters. which would result in the resuspension of sediments because of wave turbulence and shallow depths of about 15 to 17 feet. The site was considered by as unsuitable for overboard placement without construction of a protective breakwater, which would be similar to a perimeter dike for a constructed island **(CITATION)**.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.2.6f Implementation Factors.

Implementation Time Frame.

3.2.6g Institutional Constraints.

3.2.6h Estimated Costs.

3.2.6i Other Factors.

3.2.6j Option Summary. Because of the potential for some fine-grained material to move off the site and the associated potential for environmental effects, Site 170B is not considered suitable for open-water placement of fine-grained sediments.

3.2.6k Option Data Sheet. [ADD DATA SHEET]

3.2.7 Tolchester S-Turn Channel

Box XX-8
Screening of XXX

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX..

3.2.7a Location.

3.2.7b Type of Placement Option.

3.2.7c Potential Placement Capacity.

3.2.7d Bathymetry/Topography.

3.2.7e Environmental Characteristics

3.2.7e Environmental Characteristics.

Living Resources.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.2.7f Construction Factors.

3.2.7g Institutional Constraints.

3.2.7h Estimated Costs.

3.2.7i Other Factors.

3.2.7j Option Summary.

3.2.7k Option Data Sheet. [ADD DATA SHEET]

3.2.8 Worton Point Open Water

Box XX-9
Screening of XXX

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX..

3.2.8a Location.

3.2.8b Type of Placement Option.

3.2.8c Potential Placement Capacity.

3.2.8d Bathymetry/Topography.

3.2.8e Environmental Characteristics

3.2.8e Environmental Characteristics.

Living Resources.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.2.8f Construction Factors.

3.2.8g Institutional Constraints.

3.2.8h Estimated Costs.

3.2.8i Other Factors.

3.2.8j Option Summary.

3.2.8k Option Data Sheet. [ADD DATA SHEET]

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title:
Worton Point

Type:
Open Water

Location:

Located in the Chesapeake Bay, southwest of Worton Point and to the east of the C&D Canal Approach Channel.

Size:

700 to 1150 acres

Potential Capacity:

Approximately 6 mcy

Availability:

State owned

Nutrients: [NEED INFO!]

Infrastructure Required to Implement:
Site may require a berm to minimize material erosion because of strong currents on eastern side of Bay. Depending on berm needs would require additional time and costs for material other than dredged material.

Institutional Issues:

Permitting required for construction in shallow water habitat.
Permitting required for open water placement.

Costs:

Total Unit Costs Per Cubic Yard:

[NEED!]

Development & Implementation Costs:

[NEED!]

COMMENTS:
Site lies within finfish nursery area of the upper Bay
Near significant waterfowl use, waterfowl use the area during typical dredging window
Supports a small recreational finfish fishery area
Some year's conditions may support striped bass spawning areas, in the area of striped bass spawning rivers.
Waters off shore is used for commercial fishing

DRAFT DRAFT DRAFT DRAFT

TITLE: WORTON POINT **PROJECT TYPE:** OPEN-WATER

Existing Conditions	Presence*	Potential*	Unknown*	N/A*
Physical and Chemical Characteristics				
Substrate	X			
High Relief Area	X			
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics	X			
Tidal Fluctuations		X		
Salinity Gradients –Low salinity Regime	X			
Sediment Quality		X		
HTRS			X	
Biological Characteristics				
RTE-Bald Eagle	X			
Aquatic Organisms				
Benthic Communities	X			
Fisheries	X			
Designated Spawning Area	X			
Larval Habitat Area	X			
Crabs	X			
Mollusks				
Soft shell clams				X
Hard shell clams				X
Oyster bars	X			
Terrestrial Wildlife				X
Avian Wildlife				
Waterfowl concentration area		X		
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges				X
SAV				X
Wetlands				
Tidal Wetlands				X
Non-tidal Wetlands				X
Human Use Characteristics				
Groundwater				X
Water Related Recreation	X			
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars-NOB1-1	X			
Crabs	X			
Recreationally important fisheries	X			
Commercially important fisheries	X			
Aesthetics				
Air Quality				X
Noise		X		
Critical Areas				X
Forested Areas				X
Cultural Resources			X	
Archaeological Resources			X	
Potential for Benefit	X			
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A** (Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Chesapeake Bay Program. 1996. High Value Living Resource Map of the Upper Bay. In a memo prepared for the Bay Enhancement Phase II Working Group.

Funderburk, S.L., S.J. Jordan, J.A. Mihursky and D. Riley. 1991. Habitat Requirements for Chesapeake Bay Living Resources. Second Edition. Chesapeake Bay Program

Maryland Department of Natural Resources. 1989. Natural Oyster Bar Maps. Prepared by Coast and Geodetic Survey for the Maryland Department of Natural Resources.

Maryland Geological Survey. 1971. Maryland Tidal Wetlands and Critical Area Inventory Maps. Based on County maps 1:2,400 scale organized by.

US Fish and Wildlife Service. 1979. National Wetland Inventory Maps. Non-Tidal Wetlands Maps. Prepared by Office of Biological Services. Based on USGS 7.5 minute topographic quadrangle map series.

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title

Worton Point

Type:

Open Water

Location:

Located in the Chesapeake Bay, southwest of Worton Point and to the west of the C&D Canal Approach Channel.

Size:

700 to 1150 acres

Potential Capacity:

Approximately 6 mcy

Availability:

State owned

Infrastructure Required to Implement:

Site may require a berm to minimize material erosion because of strong currents on eastern side of Bay, placement of berm would require additional time and costs.

Institutional Issues:

Permitting required for construction in shallow water habitat.
Permitting required for open water placement.

Costs:

Total Unit Costs Per Cubic Yard:

[NEED!]

Development & Implementation Costs:

[NEED!]

COMMENTS:

Site lies within finfish nursery area of the upper Bay
Near significant waterfowl use, waterfowl use the area during typical dredging window
Supports a small recreational finfish fishery area
Some year's conditions may support striped bass spawning areas, in the area of striped bass spawning rivers.

DRAFT DRAFT DRAFT DRAFT

TITLE: WORTON POINT **PROJECT TYPE:** OPEN-WATER

Existing Conditions	**Presence***	**Potential***	**Unknown***	**N/A***
Physical and Chemical Characteristics				
Substrate	X			
High Relief Area	X			
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics	X			
Tidal Fluctuations		X		
Salinity Gradients –Low salinity Regime	X			
Sediment Quality		X		
HTRS			X	
Biological Characteristics				
RTE-Bald Eagle	X			
Aquatic Organisms				
Benthic Communities	X			
Fisheries	X			
Designated Spawning Area	X			
Larval Habitat Area	X			
Crabs	X			
Mollusks				
Soft shell clams				X
Hard shell clams				X
Oyster bars	X			
Terrestrial Wildlife				X
Avian Wildlife				
Waterfowl concentration area		X		
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges				X
SAV				X
Wetlands				
Tidal Wetlands				X
Non-tidal Wetlands				X
Human Use Characteristics				
Groundwater				X
Water Related Recreation	X			
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars-NAB1-1	X			
Crabs	X			
Recreationally important fisheries	X			
Commercially important fisheries	X			
Aesthetics				
Air Quality				X
Noise		X		
Critical Areas				X
Forested Areas				X
Cultural Resources			X	
Archaeological Resources			X	
Potential for Benefit	X			
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A** (Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Living Resources Maps
MDNR Historic Oyster Bar Maps
MGS Tidal Wetland Maps
MGS Non-Tidal Wetland Maps
Lee Crockett Living Resource Map of the Upper Bay

3.3 Existing Placement Options (Less Open Water)

3.3.1 C&D Canal Upland Sites [CENAB TO REVISE AND UPDATE THIS SECTION. A DECISION IS NEEDED REGARDING WHETHER THERE SHOULD BE A BLANKET SCREEING OR WHETHER OR NOT INDIVIDUAL SITES NEED TO BE SCREENED. A SCREENING OF SELECTED SITES IS SUGGESTED FOR CONSISTENCY WITH THE REST OF THIS ANNEX.]

Box XX-10
Screening of C&D Canal Upland Sites

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX..

3.3.1a Location. There are currently 17 Federal upland sites designated along the C&D Canal for dredged material placement (Figure 2-6). The C&D Canal upland placement sites are strategically located to accommodate certain channel reaches within the C&D Canal and the northern portion of the approach channels.

3.3.1b Type of Placement Option. Upland placement in confined disposal facilities.

3.3.1c Potential Placement Capacity. Periodic expansion of the C&D upland confined disposal sites has been necessary to accommodate maintenance needs of those channel reaches. Placement site capacity expansion is presently needed to accommodate dredging needs for the existing C&D Canal channels and approach channels. The sites have limited capacity at present, and are in the process of being investigated for jurisdictional wetland delineation by CENAP. After this evaluation is complete, it would take approximately 4 to 6 years to redevelop the sites to extend their service life. Use of these sites for placement from the CENAB-maintained channels or CENAP-maintained southern reaches to the C&D Canal would reduce the long-term potential of these sites for the channel reaches they now serve. It would be virtually impossible to replace this diverted capacity without acquiring private or public lands with riparian access. The redirection of sediment from the channels south of the Sassafras River would substitute a long-term deficit for a near-term deficit, transfer the burden of the long-term deficit to a different geographic area, and impose the burden of the unresolved placement deficit upon the constituencies interested in dredged material management for the C&D Canal.

3.3.1d Bathymetry/Topography.

3.3.1e Environmental Characteristics

3.3.1e Environmental Characteristics.

Living Resources.

Water Quality.

Hydrodynamics.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.3.1f Implementation Factors.

Construction Considerations.

Implementation Time Frame.

3.3.1g Institutional Constraints.

3.2.1h Estimated Costs. [The required pumping distances and elevations make use of these sites for reception of materials from the southern CENAB and CENAP reaches uneconomical and inefficient from both fiscal and engineering standpoints (MDOT 1996; MPA 1996).]

3.3.1i Other Factors.

3.3.1j Option Summary.

3.3.1k Option Data Sheet. [ADD DATA SHEET]

3.3.2 Cox Creek Dredged Material Containment Facility

Box XX-11
Screening of Cox Creek Containment Cell

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX..

3.3.2a Location.

The Cox Creek Dredged Material Containment Facility (DMCF) is located approximately 1 mile south of the Francis Scott Key Bridge, on the west bank of the Patapsco River, near Foreman's Corner in Anne Arundel County, Maryland (Figure 2-6). The two cells were originally constructed under contract to CENAB in the 1960's for the containment of dredged material from the deepening of the Baltimore Harbor Federal channels from -11.9 m (-39.0 ft) to -12.8 m (-42.0 ft). The MPA has acquired the cells and plans to renovate the facility for the placement of an additional 6 mcy of maintenance dredged material from the Inner Harbor channels.

3.3.2b Type of Placement Option.

3.3.2c Potential Placement Capacity.

Maintenance dredged material targeted for placement in open water will originate from the upper Bay channels located outside (east) of the North Point to Rock Point line. The combined capacity of the two existing containment cells at Cox Creek and Hart-Miller (which also receives sediments from outside of the harbor for which other placement capacity is not available and which is prohibited by State law from receiving material after 2009) is not sufficient to accommodate all of the dredged material from the harbor during the next 20 years. Site configuration will limit placement to a maximum of 500,000 cy per year to optimize cell capacity over a planned 12-year service life. Also, placement at Cox Creek of dredged material that is suitable for open-water placement would limit the facility's utilization for the placement of contaminated dredged material from Inner Harbor channels. Consequently, the capacity at Cox

Creek must be reserved for harbor sediments.

3.3.2d Bathymetry/Topography. [XXXX]

3.3.2e Environmental Characteristics.

Living Resources. [XXXX]

Water Quality.[XXXX]

Hydrodynamics. Not applicable.

Rare, Threatened or Endangered (RTE) Species. None have been observed at the facility.

Fishing Activity. Reconstruction of the facility will involve impacts to shallow water habitat. This issue is being addressed through a separate environmental regulatory process.

Recreational Activity. None.

Historical/Archeological. None.

Groundwater: No impacts (**CITATION**).

View Shed. The dike system is scheduled for an increase in elevation. View shed impacts would be minimal.

3.3.2f Implementation Factors.

Construction Considerations.

The Cox Creek containment cell, as it was formally known, is bordered on the west by the former Cox Creek Refining Company upland property (now owned by the MPA) and on the east by the Patapsco River. The cell is surrounded by dikes that are presently at a height of +4.9 m (+16.0 ft) MLLW. The site was originally developed in the mid-1960's. Although the cell has not been actively used as a placement site since that time, it has been part of the MPA's long-term planning for dredged material management since 1979. Roughly 15 acres of the Cox Creek containment cell is occupied by an existing pond that was determined not to be jurisdictional wetlands under Federal rules and regulations. The pond receives water in the form of precipitation and stormwater runoff from the Cox Creek upland adjacent to the pond property. The pond is not open to tidal interaction; it is served by a spillway that is passively discharging into the Patapsco River. The stormwater system that discharged into the cell has been rerouted so that it no longer discharges into the pond.

The CSX containment cell was constructed in the early 1960s, and has been used periodically by non-Federal interests for dredged material placement throughout the 1970s. The site was purchased by the State of Maryland in July 1993. The cell was previously permitted for placement of material obtained from dredging operations in the Patapsco River and Baltimore Harbor areas. The area of the dredged material placement cell is 72 acres. Its dikes have been raised periodically throughout its use and presently have a height of +6.1 m (+20.0 ft) MLLW. The last reported use of the site for the placement of dredged material was in 1984; it has been part of the MPA's long-term planning for dredged material management since 1979.

The two existing cells are planned for conversion in a single cell. There will be a phased dike construction program in order to progressively surcharge and increase the strength of underlying sediments. [ADD HERE WHETHER IT MIGHT BE POSSIBLE TO RAISE THE DIKES HIGHER THAN CURRENTLY PLANNED AND THE PROSPECTIVE FINAL HEIGHT.] (CITATION).

Implementation Time Frame. [XXXX]

3.3.2g Institutional Constraints.

Harbor sediments may not be placed in open water, but may be placed in containment facilities. Currently, the Hart-Miller Island DMCF is the only facility that is able to receive contaminated sedimentsThis site is not suitable as an alternative to Site 104 due to the relatively low capacity and the need to dedicate the available capacity for Inner Harbor sediments.

3.3.2h Estimated Costs. [XXXX]

3.3.2i Other Factors. [XXXX]

3.3.2j Option Summary. [XXXX]

3.3.2k Option Data Sheet. [ADD DATA SHEET]

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title: Cox Creek Dredged Material Containment Facility (DMCF)

Type: Upland Placement. Concept is to use site for Inner Harbor channel material

Location:
Site located approximately 1 mile south of the Francis Scott Key Bridge, on the west bank of the Patapsco River in Anne Arundel County.

Size: 133 Acres

Potential Capacity: Approximately 6 mcy. Site configuration will limit placement to a maximum of .5 mcy per year over a 12 year period.

Availability: State owned

Nutrients: [Need info]

Infrastructure Required to Implement: Already developed

Institutional Issues:
State Law requires dredged material from the Baltimore Harbor's Patapsco River west of the North Point-Rock Point Line to be placed within the line or in a containment facility. This site is currently being renovated for placement of Inner Harbor dredged materials.

Costs:

Total Unit Costs Per Cubic Yard: $1.93/cy

Development & Implementation Costs:

COMMENTS:
Waterfowl in the area from November to April, thus a restriction on water side construction may be imposed.
Wetlands to the north and south of the site. South cell contains 59.3 acres of non-tidal and open water wetlands. North cell contains 50.6 acres of non-tidal and open water wetlands.
Site previously used for contaminated dredged material placement.
Avian wildlife includes herring gulls, song sparrows, red-winged blackbirds, great blue herons, green herons, Carolina wren, American crow, starling, common grackle, house sparrow, slate colored junco, and white throated sparrow.
East of site is a historic waterfowl staging area.
Terrestrial wildlife includes muskrat, raccoon, eastern cottontail, gray squirrel, deer mouse, red fox, meadow vole, white tailed deer, green frog, southern pickerel frog, black rat snake, American toad and fowlers toad.

DRAFT DRAFT DRAFT DRAFT

TITLE: Cox Creek DMCF **PROJECT TYPE**: Upland Containment Facility

Existing Conditions	Presence*	Potential*	Unknown*	N/A*
Physical and Chemical Characteristics				
Substrate				X
High Relief Area				X
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics				X
Tidal Fluctuations				X
Salinity Gradients				X
Sediment Quality				X
HTRS	X			
Biological Characteristics				
RTE-				X
Aquatic Organisms				
Benthic Communities	X			
Fisheries				X
Designated Spawning Area-anadromous fish		X		
Larval Habitat Area-anadromous fish		X		
Crabs		X		
Mollusks				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife	X			
Avian Wildlife				
Waterfowl concentration area	X			
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges				X
SAV				X
Wetlands				
Tidal Wetlands	X			
Non-tidal Wetlands	X			
Human Use Characteristics				
Groundwater				X
Water Related Recreation				X
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Crabs		X		
Recreationally important fisheries		X		
Commercially important fisheries				X
Aesthetics				
Air Quality		X		
Noise		X		
Critical Areas	X			
Forested Areas		X		
Cultural Resources		X		
Archaeological Resources		X		
Potential for Benefit	X			
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A** (Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Chesapeake Bay Program. 1996. High Value Living Resource Map of the Upper Bay. In a memo prepared for the Bay Enhancement Phase II Working Group.

Woodward-Clyde 1992. Environmental and Geotechnical Characterization Study. Prepared for CSX Realty. December 23, 1992.

Funderburk, S.L., S.J. Jordan, J.A. Mihursky and D. Riley. 1991. Habitat Requirements for Chesapeake Bay Living Resources. Second Edition. Chesapeake Bay Program

Maryland Department of Natural Resources. 1989. Natural Oyster Bar Maps. Prepared by Coast and Geodetic Survey for the Maryland Department of Natural Resources.

Maryland Geological Survey. 1971. Maryland Tidal Wetlands and Critical Area Inventory Maps. Based on County maps 1:2,400 scale organized.

US Fish and Wildlife Service. 1979. National Wetland Inventory Maps. Non-Tidal Wetlands Maps. Prepared by Office of Biological Services. Based on USGS 7.5 minute topographic quadrangle map series.

Vogel, J. K. 1998. Value Engineering Study: Dredged Material Containment Facility, CSX/Cox Creek Maryland. Prepared for USACE, Baltimore District by Project Management Services, Inc. October 1998.

3.3.3 Hart-Miller Island Dredged Material Containment Facility

HMI is an existing state-owned and operated confined placement facility (Figure 2-6) Hart-Miller Island is located in the Upper Chesapeake Bay. The site is approximately 14 miles due east of Baltimore City, near the mouth of Back River in Baltimore County. Initial construction of the placement site began in 1981 and was concluded in December of 1983. HMI covers 1140 acres and has approximately 6 miles of dike. It is oval shaped and is approximately 2 miles long by 1 mile wide.

The facility has received maintenance sediments dredged annually from Baltimore Harbor and the approach channels since 1984. Sediments from the Inner Harbor area are considered to be contaminated and are required by the Code of Maryland Regulations (COMAR) to be placed in a containment facility, or within the Inner Harbor. The facility has also received sediments from the 50-foot channel deepening project, as well as smaller volumes of dredged sediments from state, local, and private channel maintenance projects.

The sand dikes were originally constructed to an elevation of +5.5 m (+18 ft) above MLW, a width of 164 ft at MLLW, with 3 horizontal (H) to 1 vertical (V) outer slopes, and 5H:1V inner slopes. The dike has a 20-foot-wide roadbed on top. The side slopes are protected by a revetment consisting of filter cloth on the sand dike, covered by a layer of gravel, which is in turn covered by a layer of riprap weighing up to 8,500 pounds per stone along the sides exposed to the Chesapeake Bay. The original +18 ft MLW high dikes were raised an additional 3.1 m (10 ft) to a height of +8.5 m (+28 ft) above MLW during the summer and fall of 1988 to provide additional capacity for the expedited completion of the 50-foot deepening project. The 1140-acre oval placement site holds approximately 62 mcy of dredged material to an elevation of 7.6 m (25 ft). The +8.5 m (+28 ft) raised portion of the dike has 2H:1V outer slopes, 3H:1V inner slopes, with a 10-ft-wide road bed on top. The site is divided into two cells, a North Cell (approximately 800 acres) and a South Cell (approximately 300 acres).

3.3.4 Hart-Miller Island South Cell Reconstruction and Reactivation

Use of the South Cell was discontinued in 1990 after it was filled to near capacity. The south cell is currently being developed for environmental restoration and passive recreation under a provision of Section 1135, Water Resources Development Act of 199**X**. To facilitate habitat development in the 300-acre South Cell, the last 3.1 m (10 ft) of dredged material was suitable channel material from outside of the harbor. The south cell is under the day-to-day management of the Maryland Environmental Service, which is providing these services under the terms of an Interagency Agreement with the MPA in support of an intergovernmental agreement between the MPA and the Maryland Department of Natural Resources (MDNR). MDNR is ultimately responsible for the habitat and recreational development of both cells.

CENAB subsequently examined the south cell to determine if it could serve as an alternative to open-water placement.

Box XX-12
Screening of hart-Miller South Cell Reconstruction and Reactivation

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX.

3.3.4a Location.

See paragraph 3.3.3.

3.3.4b Type of Placement Option.

The State requested that CENAB conduct a Section 1135. CENAB performed the study with the MPA as the local sponsor. The study has identified several approaches for providing ponds, wetlands and uplands that would provide important habitat for migratory birds (CITATIONS).

3.3.4c Potential Placement Capacity.

The South Cell crust management and grading program has been underway since October 1990 to prepare a foundation for habitat and passive recreational development. Other actions taken to prepare the cell include management and discharge of rainwater to facilitate consolidation of the crust, phragmites eradication and control measures including controlled burns, and vegetative test plots. The 300-acre south cell is currently at +22 ft MLW average elevation.

The south cell dike system could be reconstructed in stages to a final elevation of approximately **XX** feet. With optimal lifts of approximately **XX** mcy per annual dredging cycle and aggressive crust management, the cell could hold approximately **XX** mcy of dredged material. Inasmuch as the south cell is less than half the acreage of the north cell, it would not be possible to place as much material annually as in the north cell without trapping water in the sediments. The annual optimal placement potential is approximately **XX** mcy. Therefore, even if reconstructed and reactivated, the south cell would not be capable of providing all of the capacity needed within the required time frame. Thus, it would be necessary to use the south cell in conjunction with another placement option in order to accommodate the near term need.

3.3.4d Bathymetry/Topography.

Most of the South Cell's upland tier dike was excavated for use in the north cell dike raising. Sand that had previously been placed within the South Cell and stockpiled was mined as a resource for reconstructing the North Cell dike to an elevation of +44 feet MLLW.

3.3.4e Environmental Characteristics.

Living Resources. Inasmuch as the facility already exists, there would be no conversion of Bay bottom. The existing vegetation in the cell, which has begun a natural transition from phragmites domination to various indigenous species, would be covered if the cell is returned to active placement operations. The State and Federal investments in initial preparation of the cell for conversion would be lost.

Water Quality. Use of the south cell would result in nutrient releases at approximately the same rate as for an equivalent amount of sediment in the north cell (see Section **X.X.X**).

Hydrodynamics. No effects.

Rare, Threatened or Endangered (RTE) Species. None.

Fishing Activity. No effects.

Recreational Activity. Conversion of the south cell for passive recreation would be delayed by approximately 12 to 15 years of longer, assuming that the closure plan for the cell continued to call for a combination of conversion for habitat and passive recreation.

Historical/Archeological. No effects.

Groundwater: No effects.

View Shed. The second tier dike was removed as a borrow source for construction of the +44 foot north cell dike system. The lowering of the south cell dike system was viewed by residents in nearby communities as part of a long-awaited lowering of the dike system that was required by the State Wetlands License which authorized the construction of the second tier (+28 foot) dike. Reconstruction of the south cell dike system would significantly alter the view shed as seen from the Millers Island community by increasing the dike elevation from +18 feet MLLW up to +44 feet MLLW.

3.3.4f Implementation Factors.

Construction Considerations. **[CENAB ADD HERE GEOTECHNICAL FACTORS, DIKE QUALITY MATERIAL REQUIREMENTS AND SOURCES, QUANTITY OF MATERIAL REQUIRED FOR DIKE CONSTRUCTION, AND OTHER CONSTRUCTION CONSIDERATIONS.]**

Implementation Time Frame.

3.3.4g Institutional Constraints.

The North Cell dike raising motivated legislation by the Maryland General Assembly that required substantial development of the south cell for recreation and habitat within 5 years. The law also prohibited the south cell from receiving any more dredged material. The same legislation mandated that the dike system could not be raised higher than +44 feet, that placement into the North Cell must be completed by the end of calendar year 2009, and that the cell was to be substantially developed for recreation and habitat within 5 years of closure (Annotated code of the Public General Laws of Maryland, Environmental Article, § 16-202 (e)(1)(ii)).

The MPA is constrained from making the cell available for reconstruction because of a commitment made to the public by the Maryland Department of Transportation to accelerate the development of the south cell for habitat and recreation. Furthermore, it would be illegal for a State agency to reactivate the cell for placement because of the aforementioned State law. The Maryland General Assembly, having only recently established this law, is unlikely to reverse itself.

3.3.4h Estimated Costs.

The cost of reconstructing the south cell and the cost of operating the south cell for placement of 18 mcy of sediments would be approximately **$XXXX** million, or about **$X.XX** per cubic yard. Inasmuch as Hart-Miller Island is a state facility, all reconstruction and operations costs would be the responsibility of the state. Inasmuch as the south cell could not accommodate all of the placement need within the required time frame, it use could potentially increase dredging costs if multiple mobilizations are required to enable placement at other locations, if not required for other placement needs.

3.3.4i Other Factors. [XXXX]

3.3.4j Option Summary.

Reconstruction and reactivation of the south cell could provide sufficient capacity within the time fame needed with minimal environmental effects. Although the State's investment to date in a 10-year effort to prepare the south cell for permanent conversion to habitat and passive recreational use would be lost, there would be an environmental benefit in the form of increased "interim" habitat for migratory waterfowl. There would be an increase in the release of nutrients by returning the cell to active operation, however, this release would be somewhat less than for open-water placement. Reconstruction and reactivation of the south cell is prohibited by State law. State law also requires expedited conversion of the south cell for habitat and passive recreation. The cost of reactivation is within the cost screening criteria. But for the State law, reactivation of the south cell would be an environmentally acceptable alternative. Therefore, in accordance with the NEPA regulations, use of the south cell is considered an alternative to open-water placement.

3.3.4k Option Data Sheet. [ADD DATA SHEET]

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title:
Hart-Miller Island: South Cell Dike Raising

Type:
Dredged Material Containment Facility

Location:

Chesapeake Bay in Baltimore County, east of the mouth of Back River.

Size:
The south cell is 300 acres and at an elevation of +22 feet MLW. This project would raise the dikes at the south cell to +44 feet, consistent with the 800-acre north cell.

Potential Capacity: Approximately 14.0 mcy

Availability:
Currently owned by the State of Maryland.

Nutrients: [Need info]

Infrastructure Required to Implement:
Infrastructure will be on site for the existing project.

Institutional Issues:
The south cell is prohibited from receiving any more dredged material by the Annotated Code of the Public General Laws of Maryland, Environmental Article, § 16-202 (e)(1)(ii).

Costs: [Still working on costs]

Total Unit Costs Per Cubic Yard: [Need]

Development & Implementation Costs: [Not sure what this is]

COMMENTS:

This is a very viable option save for the institutional constraint.

DRAFT DRAFT DRAFT DRAFT

TITLE: Hart-Miller Island: South Cell Dike Raising

PROJECT TYPE: Dredged Material Containment Facility

Existing Conditions	**Presence***	**Potential***	**Unknown***	**N/A***
Physical and Chemical Characteristics				
Substrate	X			
High Relief Area				X
Suspended Particulates, Turbidity				X
Water Quality				X
Hydrodynamics				X
Tidal Fluctuations				X
Salinity Gradients				X
Sediment Quality	X			
HTRS				X
Biological Characteristics				
RTE-Bald Eagle				X
Aquatic Organisms				
Benthic Communities				X
Fisheries				X
Designated Spawning Area				X
Larval Habitat Area				X
Crabs				X
Mollusks				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife				X
Avian Wildlife				
Waterfowl concentration area	X			
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges		X		
SAV				X
Wetlands				
Tidal Wetlands				X
Non-tidal Wetlands		X		
Human Use Characteristics				
Groundwater				X
Water Related Recreation		X		
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Crabs				X
Recreationally important fisheries				X
Commercially important fisheries				X
Aesthetics				
Air Quality			X	
Noise		X		
Critical Areas				X
Forested Areas				X
Cultural Resources				X
Archaeological Resources				X
Potential for Benefit	X			
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for

impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A** (Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title:
Hart-Miller Island: South Cell Dike Raising

Type:
Dredged Material Containment Facility

Location:

Chesapeake Bay in Baltimore County, east of the mouth of Back River.

Size:
The south cell is 300 acres and at an elevation of +22 feet MLW. This project would raise the dikes at the south cell to +44 feet, consistent with the 800-acre north cell.

Potential Capacity: Approximately 8.1 mcy

Availability:
Currently owned by the State of Maryland.

Nutrients: [Need info]

Infrastructure Required to Implement:
Infrastructure will be on site for the existing project.

Institutional Issues:
The south cell is prohibited from receiving any more dredged material by the Annotated Code of the Public General Laws of Maryland, Environmental Article, § 16-202 (e)(1)(ii).

Costs: [Still working on costs]

Total Unit Costs Per Cubic Yard: [Need]

Development & Implementation Costs: [Not sure what this is]

COMMENTS:

This is a very viable option save for the institutional constraint.

DRAFT DRAFT DRAFT DRAFT

TITLE: Hart-Miller Island: South Cell Dike Raising

PROJECT TYPE: Dredged Material Containment Facility

Existing Conditions	**Presence***	**Potential***	**Unknown***	**N/A***
Physical and Chemical Characteristics				
Substrate	X			
High Relief Area				X
Suspended Particulates, Turbidity				X
Water Quality				X
Hydrodynamics				X
Tidal Fluctuations				X
Salinity Gradients				X
Sediment Quality	X			
HTRS				X
Biological Characteristics				
RTE-Bald Eagle	X			
Aquatic Organisms				
Benthic Communities				X
Fisheries				X
Designated Spawning Area				X
Larval Habitat Area				X
Crabs				X
Mollusks				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife				X
Avian Wildlife				
Waterfowl concentration area	X			
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges		X		
SAV				X
Wetlands				
Tidal Wetlands	X			
Non-tidal Wetlands				X
Human Use Characteristics				
Groundwater				X
Water Related Recreation				X
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Crabs				X
Recreationally important fisheries				X
Commercially important fisheries				X
Aesthetics				
Air Quality			X	
Noise		X		
Critical Areas			X	
Forested Areas				X
Cultural Resources				X
Archaeological Resources				X
Potential for Benefit	X			
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A** (Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

3.3.5 Use of Existing North Cell Capacity.

CENAB examined the north cell of the Hart-Miller Island DMCF to determine if it could serve as an alternative to open-water placement.

Box XX-13
Screening of Use of Hart-Miller Island North Cell

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX..

3.3.5a Location.

3.3.5b Type of Placement Option.

3.3.5c Potential Placement Capacity.

The approximately 800-acre north cell was increased in elevation to 14.6 meters (+44 ft) MLW by the MPA in 1997. With optimal crust management and consolidation, an estimated 24 mcy of capacity will remain following inflow operations during the 1998-1999 dredging cycle. Eventually, the entire site will be converted to habitat and passive recreation in compliance with State law after dredged material placement ceases in the year 2009. The 21 mcy of capacity that is still available in the north cell has been programmed to receive various maintenance and new work dredging projects over the remaining service life of the project. The potential capacity will be decreased during placement of up to 3.2 mcy during the October 1999-March 2000 dredging cycle. The potential remaining capacity following crust management during Summer 2000 would be approximately 19.5 mcy, depending upon environmental conditions.

The north cell can only receive an annual maximum of 2.5 mcy without overburdening. The available capacity is being programmed for Harbor sediments that are unsuitable for open-water placement, insofar as practicable, consistent with other placement needs which have been programmed to HMI to correspond with dredging needs . CENAB's analysis of dredging needs indicates that there is no excess capacity available in the north cell. Diversion of material planned for open-water placement would not only be substituted for other existing needs, but would also result in a reduction in the north cell's ability to receive dredged material, as described below.

Operational records for the HMI facility document the ability to dewater and consolidate sediments in order to reduce sediment volume and regain a portion of used placement capacity. The operating history indicates that placement of quantities in excess 2.5 mcy would result in water being trapped between the crust prior to placement and the crust that forms following placement. This would have the effect of reducing the facility's overall capacity, because the state law that mandates a closure date does not allow time for a hiatus in placement operations to enable extended crust management operations to offset any overburdening. The prospective potential outcomes of overburdening the site would therefore be a shortened service life because the site would be filled more quickly, inadequate time available between placements for optimal dewatering and consolidation, and a reduction in the north cell's overall capacity. The resulting reduction in the north cell's optimal capacity would exacerbate the placement deficit that the proposed action under investigation by the DEIS is intended to relieve.

3.3.5d Bathymetry/Topography.

The Hart-Miller Island DMCF has a maximum permitted dike elevation of +44 feet MLLW. The crust within the cell has a very gradual downward slope with highest elevations at the cross dike and lowest elevations at the southern end of the facility.

3.3.5e Environmental Characteristics.

Living Resources. The north cell provides valuable "interim" habitat for migratory waterfowl during the winter flyway period when recently placement dredged material provides a food source for foraging. The Cell is also used to a lesser extent during the spring and summer while a pond is still present.

Water Quality. [XXXX]

Hydrodynamics. Not applicable.

Rare, Threatened or Endangered (RTE) Species. None.

Fishing Activity. None.

Recreational Activity. None at the facility. Utilization of the adjoining State Park would not be affected.

Historical/Archeological. No effect.

Groundwater: No significant effect.

View Shed. No significant effect.

3.3.5f Implementation Factors.

Construction Considerations. [XXXX]

Implementation Time Frame. [XXXX]

3.3.5g Institutional Constraints.

The north cell dike system was reconstructed and increased in elevation to +44 feet MLLW. State law prohibits the dike from being increased above +44 feet in elevation. Although there is a limited potential to further increase the north cell dike elevation, this is not a viable option under existing state law. The Maryland General Assembly, having only recently established this law, is unlikely to reverse itself. In this regard, recent legislative sessions have seen continuing efforts to continue to impose additional constraints on placement options.

3.3.5h Estimated Costs. [XXXX]

3.3.5i Other Factors. [XXXX]

3.3.5j Option Summary.

The diversion of additional sediments to HMI would therefore result in one or a combination of (1) substituting sediments dredged from one location for another without resolving the underlying placement need, (2) an increase rather than reduce the deficit in placement capacity through overburdening, and (3) deferral of planned dredging due to lack of capacity. In view of the preceding analysis, use of the existing capacity of the north cell is not viable as an alternative to open-water placement.

3.3.5k Option Data Sheet. **[ADD DATA SHEET]**

3.3.6 Masonville

Box XX-14
Screening of Masonville

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX..

3.3.6a Location.

3.3.6b Type of Placement Option.

3.3.6c Potential Placement Capacity.

3.3.6d Bathymetry/Topography.

3.3.6e Environmental Characteristics

3.3.6e Environmental Characteristics.

Living Resources.

Water Quality.

Hydrodynamics. Not applicable.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.3.6f Implementation Factors.

Construction Considerations.

Implementation Time Frame.

3.3.6g Institutional Constraints.

3.3.6h Estimated Costs.

3.3.6i Other Factors.

3.3.6j Option Summary.

3.3.6k Option Data Sheet. [ADD DATA SHEET]

Masonville

The Masonville site, which is operated by MPA, is located along the southern shore of the Middle Branch of the Patapsco River off the Ferry Bar Channel. The site consists of approximately 152 acres of fast land and 175 acres of submerged land. A detailed development plan and environmental impact analysis were prepared by the MPA in 1982. The site was an important part of the harbor ~~maintenance dredging~~maintenance-dredging program for the placement of dredged material from small private jobs. Currently there are five containment cells, which are essentially full and could not provide placement capacity for future dredging needs without construction of a dike [TO BE CONFIRMED BY MPA]. Dike construction in this area would be restricted due to the statute that restricts dike construction within a ~~5 mile~~5-mile radius of Hart-Miller Island. In order to raise dikes in this area, supportive public opinion would need to force a change in the current state law.

P:\Federal\DOD\ARMY\projects\6095793\NewDraft\Revised DEIS\Chapter_02\Masonville.doc

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title:
Masonville

Type:
Fastland Creation

Location: Middle Branch of Patapsco River, Baltimore Harbor

Size: approximately 175 acres of submerged lasnd and 152 acres of fastland.

Potential Capacity: None remaining; site closed

Availability: State owned

Nutrients: NA

Infrastructure Required to Implement:

Site no longer under consideration because it is filled to capacity.

Institutional Issues:

Site no longer under consideration because it is filled to capacity.
Only potential for placement would be to raise dikes above water. This would be constained by law prohibiting another diked facility within a 5-mile radius of HMI.

Costs: NA

COMMENTS:
Resource information not updated because site is no longer available for placement.

DRAFT DRAFT DRAFT DRAFT

TITLE: Masonville **PROJECT TYPE**: Fastland Creation

Existing Conditions	Presence*	Potential*	Unknown*	N/A*
Physical and Chemical Characteristics				
Substrate-very soft soils	X			
High Relief Area				X
Suspended Particulates, Turbidity		X		
Water Quality		X		
Hydrodynamics			X	
Tidal Fluctuations		X		
Salinity Gradients			X	
Sediment Quality		X		
HTRS			X	
Biological Characteristics				
RTE-			X	
Aquatic Organisms				
Benthic Communities				
Fisheries		X		
Designated Spawning Area-anadromous				X
Larval Habitat Area-anadromous		X		
Crabs				X
Mollusks				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife				X
Avian Wildlife				
Waterfowl concentration area			X	
Land and/or Waterbirds			X	
Special Aquatic Sites				
Sanctuaries and Refuges				X
SAV				X
Wetlands				
Tidal Wetlands	X			
Non-tidal Wetlands				X
Human Use Characteristics				
Groundwater				X
Water Related Recreation				X
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Crabs				X
Recreationally important fisheries			X	
Commercially important fisheries				X
Aesthetics				
Air Quality			X	
Noise			X	
Critical Areas	X			
Forested Areas				X
Cultural Resources				X
Archaeological Resources				X
Potential for Benefit				X
Potential to Minimize Adverse Effects				X

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A** (Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Maryland Port Administration. 1990. Port of Baltimore: Dredged Material Management Master Plan. Report prepared for MPA by Gahagan and Bryant Associates and EA Engineering, Science and Technology, Inc. Unpublished.

US Fish and Wildlife Service. 1979. National Wetland Inventory Maps. Non-Tidal Wetlands Maps. Prepared by Office of Biological Services. Based on USGS 7.5 minute topographic quadrangle map series.

Maryland Tax Records.

1409 3.4 New Containment Facilities

3.4.1 Bay Bridge Airport

Box XX-15
Screening of Bay Bridge Airport

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX..

3.4.1a Location.

3.4.1b Type of Placement Option.

3.4.1c Potential Placement Capacity.

3.4.1d Bathymetry/Topography.

3.4.1e Environmental Characteristics

3.4.1e Environmental Characteristics.

Living Resources.

Water Quality.

Hydrodynamics.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.4.1f Implementation Factors.

Construction Considerations.

Implementation Time Frame.

3.4.1g Institutional Constraints.

3.4.1h Estimated Costs.

3.4.1i Other Factors.

3.4.1j Option Summary.

3.4.1k Option Data Sheet. [ADD DATA SHEET]

3.4.2 Hart-Miller Island New Cell

Box XX-16
Screening of Hart-Miller Island New Containment Cell

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX..

3.4.2a Location.

3.4.2b Type of Placement Option.

3.4.2c Potential Placement Capacity.

3.4.2d Bathymetry/Topography.

3.4.2e Environmental Characteristics

3.4.2e Environmental Characteristics.

Living Resources.

Water Quality.

Hydrodynamics.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.4.2f Implementation Factors.

Construction Considerations.

Implementation Time Frame.

3.4.2g Institutional Constraints.

3.4.2h Estimated Costs.

3.4.2i Other Factors.

3.4.2j Option Summary.

3.4.2k Option Data Sheet. [ADD DATA SHEET]

3.4.3 Thoms Cove

Box XX-17
Screening of Thoms Cove Containment Cell

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX..

3.4.3a Location.

3.4.3b Type of Placement Option.

3.4.3c Potential Placement Capacity.

3.4.3d Bathymetry/Topography.

3.4.3e Environmental Characteristics.

Living Resources.

Water Quality.

Hydrodynamics.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.4.3f Implementation Factors.

Construction Considerations.

Implementation Time Frame.

3.4.3g Institutional Constraints.

3.4.3h Estimated Costs.

3.4.3i Other Factors.

3.4.3j Option Summary.

3.4.3k Option Data Sheet. [ADD DATA SHEET]

3.5 BENEFICIAL USE PLACEMENT OPTIONS

A concept that has gained considerable popularity is the use of suitable dredged sediment as a natural and economic resource rather than as a byproduct of dredging that has traditionally been treated as a waste stream, although most dredged material does not classify as contaminated sediments (NRC, 1989, 1994, 1997). Expanding from small-scale demonstration projects to large-scale application was proposed as a way to resolve the Port of Baltimore's placement needs in a manner that would contribute to Chesapeake Bay restoration efforts (MDOT, 1991).

The concept of using dredged material as a resource has continued to be of interest to the USACE, MPA, natural resource agencies, and the public, and has been the subject of intensive efforts over the past decade to implement the concept. Moving the beneficial use concept into practical application for the navigation infrastructure serving the Port of Baltimore has proven very difficult, including the implementation of the Poplar Island restoration project. Over the past decade, over 35 beneficial use projects have been proposed for locations in the upper Bay that would use dredged material as a natural resource. With the exception of Poplar Island, none of these options has been capable of implementation. A variety of factors have inhibited the application of the beneficial use concept. Hamons and Young (1999) documented the results of the continuing efforts to find beneficial use projects capable of obtaining the support necessary for implementation and identified reasons why more beneficial use projects have not been implemented.

A number of beneficial use options are screened in this annex. Most were found to be not suitable as either standalone alternatives or as a component of a combined options alternative. Some beneficial use options screened successfully as possible components of a multi-option alternative to the proposed action, as discussed in later paragraphs.

Beneficial use projects are, in general, not only more expensive per cubic yard utilized than more traditional placement options, but have usually been substantially more expensive. The cost factor makes large-scale beneficial use projects extremely difficult to implement, because the federal beneficial use authority provided by Section 204 of the **XXXXX** is directed to small-scale projects. The beneficial use options that were screened as possible alternatives ranged in cost from tens of millions to hundreds of millions of dollars more than the proposed action, as discussed in Appendix XX. Although the beneficial use concept continues to enjoy popular and institutional conceptual support, each beneficial use option was considered on its own merits as to whether or not it could serve as a practical alternative to the proposed action or as a component of a multi-option alternative.

3.5.1 Aberdeen Proving Ground Beneficial Use Options

Aberdeen Proving Ground (APG), a major U.S. military installation with multiple national defense missions, controls a large amount of shoreline, shorelands and water areas along the western side of the upper Bay. CENAB, CENAP and the MPA have maintained a continuing interest in finding opportunities for the placement of dredged material. The possibility of using APG-controlled areas for placement has also received considerable attention from the public. Accordingly, the APG-controlled area was examined for general suitability. Certain specific sites were screened as possible alternatives to the proposed action. The possibility of island placement site construction within the APG boundary was examined separately later in this annex.

Box XX-18
Screening of Aberdeen Proving Ground (General Application)

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Varies from small to large scale depending upon location. Most potential sites would have small to modest capacity.
2. Availability: APG has declined to make sites available.
3. Environmental Suitability: Site specific.
4. Infrastructure Readiness: Sites could not be ready for use when needed.
5. Institutional Feasibility: Constrained because of unresolved national-level issues with respect to remediation standards for unexploded ordnance (UXO) and associated liability for remediation.
6. Prospective Affordability: Site specific.
7. Potential for Environmental Improvements: There is potential to encapsulate UXO if aquatic and/or terrestrial encapsulation becomes an accepted long-term remediation technique.

Results of Screening: Use of APG-controlled areas is not suitable for consideration as an alternative or as a component of a multi-option alternative because of military missions, UXO liability, and, depending upon site-specific conditions, the potential for significant environmental impacts. Although there is some potential for possible future placement options within the APG-controlled area, these options cannot be effectively considered until such time that UXO remediation standards are promulgated and UXO liability is resolved.

3.5.1a Location.

The APG-controlled area totals approximately 72,000 acres located on the northern Chesapeake Bay shoreline in Harford and Baltimore Counties. Approximately 40,000 acres consists of Bay waters and tributaries. Of the remaining 32,000 acres, a significant percentage is either in use for military missions or is wetlands or forested areas CENAB, CENAP and the MPA have been involved in continuing efforts to establish placement sites within the APG area, as discussed in the following paragraphs. However, the interest in APG for dredged material management must be considered in the context of an active military installation with important national security missions that are the primary considerations for use of land and water areas controlled by the U.S. Army.

3.5.1b Types of Placement Options.

A variety of placement types have been considered since the mid-1980s for APG-controlled areas. CENAB commissioned a major study of the potential for use of APG upland areas for the disposal of dredged material. The study began in 1984 and was completed in 1987 (Century Engineering, 1987). Three technically feasible sites that would have the least environmental impacts were identified after detailed investigation of areas not affected by operating areas or critical military missions, areas with endangered species or historical attributes, water and land access, and areas with tidal wetlands. Detailed investigation was carried out for the most promising upland site which was located at the end of Abbey Point. The site had a potential capacity of 2.8 mcy. Deposition of dredged material would cover unexploded ordnance (UXO) to a depth of some 5 to 7 feet. It was subsequently determined that this use of the site for disposal would severely restrict range and recovery operations. The engineering consultant ultimately concluded that "... there is no significant acceptable dredged material disposal area at Aberdeen Proving Ground" (Century Engineering, 1987).

The MPA Master Plan initiative from 1986 to 1990 considered a number of potential placement sites in the APG-controlled water area. Potential sites were identified in the vicinity of Pooles Island, Cherry Tree Point, and Shad Battery Shoal. The Master Plan recommended use of the then existing open-water sites until their capacity was exhausted, with all dredged sediments designated for open-water disposal thereafter being placed in the Deep Trough (MPA, 1990). In lieu of implementing the Master Plan recommendations, the Maryland Governor established a task force to develop another approach to dredged material management, as previously discussed.

The DNPOP program has, since its inception, continued the active pursuit of placement options within the boundaries of APG. Alternatives that have been identified and evaluated have the potential to provide material for beneficial use projects at APG such as shoreline stabilization, habitat restoration, and encapsulation of hazardous materials and unexploded ordnance (UXO). APG representatives are participating in the DNPOP, and continue to discuss the development of alternative placement options for APG.

The Maryland Environmental Service, at the request of the MPA, prepared a multi-objective screening of the potential of four beneficial use sites for dredged material placement in support of the C&D Deepening Study that was being performed by CENAP. Three of the sites – Weir Point, Spry Island Shoal, and Pooles Island were largely within the APG controlled area. The screening addressed endangered species, waterfowl, fisheries, benthos, wetlands, shallow water habitat, colonial waterbirds, submerged aquatic vegetation, ownership and jurisdiction, and institutional constraints (MES, 1994). The report served as a technical resource for subsequent efforts to find suitable placement options at APG and identified various environmental factors and institutional constraints that would require further investigation. The possibility of encountering munitions was identified, but was not a factor that was specifically addressed during the environmental screening. The presence of UXO as a fatal flaw for projects at APG became apparent as the results of subsequent efforts to find placement sites at APG, as discussed in the following paragraphs.

A DNPOP working group identified 5 areas (Carroll Island, Spry Island Shoal, Graces Quarters, Gunpowder Neck and Pooles Island) with 16 individual concepts for creating or restoring intertidal marshes. Most of these sites are within the perimeter of APG. Many areas of APG are in Harford County but within the five mile radius of Hart-Miller Island. Use of the sites may require a modification of the State law that prohibits establishment of a containment facility within 5 miles of the Hart-Miller-Pleasure Island Chain in Baltimore County. APG, Federal and state natural resource agencies, and commercial fisherman expressed concerns regarding the environmental and economic issues related to each of the sites. Rare, threatened or endangered species (RTE) habitat, estuarine and palustrine wetlands, finfish nursery and spawning grounds, and CERCLA and UXO liability issues have all been part of the aquatic and terrestrial resources and environmental impacts discussed regarding use of APG sites for dredged material placement.

3.5.1c Potential Placement Capacity.

3.5.1d Bathymetry/Topography.

3.5.1e Environmental Characteristics

3.5.1e Environmental Characteristics.

Living Resources.

Water Quality.

Hydrodynamics.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.5.1f Implementation Factors.

Construction Considerations.

Implementation Time Frame.

3.5.1g Institutional Constraints.

3.5.1h Estimated Costs.

3.5.1i Other Factors.

The most significant concerns voiced related to the safety, liability, and cleanup cost for use of a site that contains so much UXO and is currently on the National Priority List (NPL) of hazardous waste sites. EPA Region III advised the DNPOP program participants who were considering a demonstration project a J-Field on Gunpowder Neck that there is no national standard for remediation of UXO. EPA and that there are no laws or regulations specifically addressing the liability of UXO. In the absence of definitive legal requirements, EPA Region III advised that DNPOP planning should use the CERCLA legal requirements and precedents as planning factors, including removal of UXO as the worse case remediation requirement Thus, any dredged material placement project might have to be removed in order to remediate UXO. Furthermore, any party which constructed a project that later required UXO remediation could be considered a Potentially Responsible Party by the EPA and, if so designated, would become liable for the cost of removing UXO. Neither the Army Corps of Engineers nor the Maryland Port Administration can accept the associated risk and liability. Active investigation of all potential sites and configurations within the APG boundary has been suspended from further evaluation (DNPOP, 1995b.

3.5.1j Option Summary.

Placement options with the APG area are not suitable as alternatives to the proposed open-water placement of dredged material.

3.5.1k Option Data Sheet. [ADD DATA SHEET]

~~2.2.3.a.5~~ Aberdeen Proving Ground Beneficial Use Options

The DNPOP program has, since its inception, actively pursued identification and evaluation of upland placement sites within the boundaries of the U.S. Army, Aberdeen Proving Grounds (APG). The APG-controlled area totals approximately 79~~2,000~~,-000 acres located on the northern upper Chesapeake Bay shoreline in Harford and Baltimore Counties. Approximately 40,000 acres consist~~s~~ of Bay waters and tributaries. Of the remaining 32,000 acres, a significant percentage is either in use for military missions or is wetlands or forested areas. Alternatives being evaluated have the potential to provide material for beneficial use projects at APG such as shoreline stabilization, habitat restoration, and encapsulation of hazardous materials and unexploded ordnance (UXO). APG representatives are participating in the DNPOP, and continue to discuss the development of alternative placement options for APG.

A DNPOP working group identified 5 areas (Carroll Island, Spry Island Shoal, Graces Quarters, Gunpowder Neck, and Pooles Island) with 16 individual concepts for creating or restoring intertidal marshes. [Wayne, please check. Meeting notes I have are a little different]. Most of these sites are within the perimeter of APG. APG, Federal and state resource agencies, and commercial fisherman expressed concerns regarding the environmental and economic issues related to each of the sites. The most significant concerns voiced related to the liability and cost for use of a site that contains so much UXO and is currently on the National Prioritiес~~y~~ List (NPL) of hazardous waste sites. Due to these concerns, active investigation of all potential sites and configurations has been suspended from further evaluation, although the concepts will be reconsidered should conditions change.

Given the large amount of shoreline controlled by APG on the western side of the upper Bay, the DNPOP program has maintained a continuing interest in finding opportunities for the placement of dredged material. Many areas of APG are within the ~~five~~ 5-mile radius of Hart-~~m~~Miller Island and are, therefore, unavailable for containment site development under current Maryland law. However, other smaller-scale concepts such as shoreline stabilization/beneficial use have been explored. Placement options involving APG have resulted in the inclusion of two APG-related alternatives to Site 104; Encapsulation of UXO using dredged material at two APG sites (J-Field [on Gunpowder Neck] and Graces Quarters) was actively pursued during 1994 and 1995 (Figure 2-7). One is a small-scale demonstration project combining waste encapsulation and shoreline stabilization, known as the J-Field project. This project concept is described below. The second is the expansion of Pooles Island in conjunction with development of a new island containment facility with an estimated capacity of 80 ~~million cubic yards (~~mcy~~)~~. Rare, threatened, or endangered species (RTE) habitat, estuarine and palustrine wetlands, finfish nursery and spawning grounds, and CERCLA and UXO liability issues have all been part of the aquatic and terrestrial resources and environmental impacts discussed regarding use of APG sites for dredged material placement. The Pooles Island dredged material island concepts are described and ~~evaluated in~~evaluated in Section 2.2.3.b.2.

Due to the miles of contiguous natural shoreline and relative isolation, there are significant natural resources associated with APG. The Busch and lower Gunpowder Rivers provide significant recreational fishing opportunities. Target species include white perch, striped bass,

~~and~~ croaker, channel catfish, and yellow perch. Various parts of the base provide bird nesting and foraging habitat, particularly for eagles, shorebirds, wading birds, and songbirds. Both rivers support recreational crabbing in the warmer months. Due to the shallow depths, significant submerged aquatic vegetation (SAV) beds are present along some areas of the site. The shallow depths along most of the shorelines also limit dredged material placement concepts due to access issues.

J-Field Site

A small-scale demonstration project combining encapsulation and beneficial use was considered for J-Field, which is an APG Superfund site (Figure 2-7). The site also has a unique "floating marsh" that is in danger of being lost through shoreline erosion. In 1995, APG determined that incorporating the project into the facility's installation restoration program (IRP) was potentially feasible. The demonstration project would have had about 1.5 mcy capacity, and would have only provided a partial short-term solution for the C&D Canal southern approach channels. During the course of investigating the concept, it was learned that the shoreline and water reaches within the restricted area controlled by APG are contaminated by the presence of between 3 and 30 million rounds of UXO, creating significant concerns for safety. There is also substantial uncertainty about the degree to which the placement of dredged material would create exposure to future responsibility or costs if the encapsulated ordnance would need to be excavated or removed. There is also a technical limitation in locating UXO once buried in sediments. As a result, the proposed J-Field project to encapsulate UXO and to protect an eroding shoreline with a protective marsh has been indefinitely delayed and is not likely to be available to accommodate any of the near-term placement needs for the C&D Canal northern or southern approach channels.

Graces Quarters

Two beneficial use concepts were investigated for Graces Quarters, which is an APG Superfund site (Figure 2-7): (1) A 36-acre wetland creation and shore stabilization project with an approximate capacity of 400,000 cy, and (2) a 36-acre encapsulation for shore protection with an approximate capacity of 400,000 to 824,000 cy, depending on fill elevation. Consideration of both concepts was discontinued due to: (1) the low capacity of the site, particularly if it had to be diked; (2) poor boat/scow access (very shallow water and poor truck access to most of the site; (3) difficulties in getting the materials to the identified areas even with a hydraulic dredge; (4) the need for dewatered, consolidated materials to make the concept work; and (5) existence of prime tiger beetle (endangered species) habitat. The potential presence of UXO at this site (see above) would also indefinitely delay its use for accommodating any of the near-term placement needs for the C&D Canal northern or southern approach channels.

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title:
Aberdeen Proving Ground

Type:
Beneficial Use

Location: APG is located on the western shore of the Chesapeake Bay in Harford County between the Busch and Gunpowder Rivers. Five areas were considered initially (Carroll Island, Spry Island Shoal, Graces Quarters, Gunpowder Neck and Pooles Island). Two options were advanced for further consideration (J-field, Grace's Quarters).

Size: J-Field—????
Grace's Quarters: (1) 36 acres wetland creation
(2) 36 acre shoreline encapsuation

Potential Capacity: J-Field— 1.5 mcy
Grace's Quarters: (1) 36 acres wetland creation
(2) 36 acre shoreline encapsuation

Availability: **Federallyowned**

Nutrients: [Need info]

Infrastructure Required to Implement:

Access channel, unloading facilities, de-watering facilities, and containment structures.

Institutional Issues:

Permitting required for construction in shallow water habitat.
Permitting required for critical area development
Permitting required for wetland disturbance.
APG is an NPL (hazardous waste) site
Significant amounts of UXO known to exist in all water accessible areas of APG

Costs: **[NEED]**

Total Unit Costs Per Cubic Yard: **[NEED!]**

Development & Implementation Costs: **[NEED!]**

COMMENTS:
Colonial waterbirds and Eagles occur at APG
Located in a spawning area for anadromous fish such as herring, white perch and yellow perch.
Wetlands and Critical Areas
Some SAV presence
Poor accessibility for placement.
UXO and HTRW pose significant risks/liabilities

DRAFT DRAFT DRAFT DRAFT

TITLE: APG Beneficial Use **PROJECT TYPE:** Beneficial Use

Existing Conditions	**Presence***	**Potential***	**Unknown***	**N/A***
Physical and Chemical Characteristics				
Substrate-very soft soils	X			
High Relief Area			X	
Suspended Particulates, Turbidity		X		
Water Quality		X		
Hydrodynamics			X	
Tidal Fluctuations			X	
Salinity Gradients			X	
Sediment Quality		X		
HTRS	X			
Biological Characteristics				
RTE-	X			
Aquatic Organisms				
Benthic Communities	X			
Fisheries	X			
Designated Spawning Area-anadromous	X			
Larval Habitat Area-anadromous	X			
Crabs	X			
Mollusks				
Soft shell clams			X	
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife	X			
Avian Wildlife				
Waterfowl concentration area	X			
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges		X		
SAV	X			
Wetlands				
Tidal Wetlands	X			
Non-tidal Wetlands		X		
Human Use Characteristics				
Groundwater			X	
Water Related Recreation		X		
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Crabs	X			
Recreationally important fisheries	X			
Commercially important fisheries	X			
Aesthetics				
Air Quality			X	
Noise			X	
Critical Areas	X			
Forested Areas	X			
Cultural Resources		X		
Archaeological Resources			X	
Potential for Benefit	X			
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A** (Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Chesapeake Bay Program. 1996. High Value Living Resource Map of the Upper Bay. In a memo prepared for the Bay Enhancement Phase II Working Group.

Funderburk, S.L., S.J. Jordan, J.A. Mihursky and D. Riley. 1991. Habitat Requirements for Chesapeake Bay Living Resources. Second Edition. Chesapeake Bay Program

Maryland Department of Natural Resources. 1989. Natural Oyster Bar Maps. Prepared by Coast and Geodetic Survey for the Maryland Department of Natural Resources.

Maryland Environmental Service. 1995. Sparrows Point Shoreline Reclamation Project: Assessment of Biological Productivity. August 1995. Prepared for The Maryland Port Administration.

Maryland Geological Survey. 1971. Maryland Tidal Wetlands and Critical Area Inventory Maps. Based on County maps 1:2,400 scale organized by.

US Fish and Wildlife Service. 1979. National Wetland Inventory Maps. Non-Tidal Wetlands Maps. Prepared by Office of Biological Services. Based on USGS 7.5 minute topographic quadrangle map series.

APG - Graces Quarters

Box XX-19
Screening of APG – Graces Quarters

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX..

3.5.2a Location.

3.5.2b Type of Placement Option.

3.5.2c Potential Placement Capacity.

3.5.2d Bathymetry/Topography.

3.5.2e Environmental Characteristics

3.5.2e Environmental Characteristics.

Living Resources.

Water Quality.

Hydrodynamics.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.5.2f Implementation Factors.

Construction Considerations.

Implementation Time Frame.

3.5.2g Institutional Constraints.

3.5.2h Estimated Costs.

3.5.2i Other Factors.

3.5.2j Option Summary.

3.5.2k Option Data Sheet. [ADD DATA SHEET]

3.5.2 APG - J-Field

Box XX-20
Screening of APG – J-Field

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX..

3.5.3a Location.

3.5.3b Type of Placement Option.

3.5.3c Potential Placement Capacity.

3.5.3d Bathymetry/Topography.

3.5.3e Environmental Characteristics

3.5.3e Environmental Characteristics.

Living Resources.

Water Quality.

Hydrodynamics.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.5.3f Implementation Factors.

Construction Considerations.

Implementation Time Frame.

3.5.3g Institutional Constraints.

3.5.3h Estimated Costs.

3.5.3i Other Factors.

3.5.3j Option Summary.

3.5.3k Option Data Sheet. [ADD DATA SHEET]

3.5.4 Artificial Reefs (small to medium scale)

Box XX-21
Screening of Artificial Reefs (Small to Medium)

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX..

3.5.4a Location.

3.5.4b Type of Placement Option.

3.5.4c Potential Placement Capacity.

3.5.4d Bathymetry/Topography.

3.5.4e Environmental Characteristics.

Living Resources.

Water Quality.

Hydrodynamics.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.5.4f Implementatioo Factors.

Construction Considerations.

Implementation Time Frame.

3.5.4g Institutional Constraints.

3.5.4h Estimated Costs.

3.5.4i Other Factors.

3.5.4j Option Summary.

3.5.4k Option Data Sheet. [ADD DATA SHEET]

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title:
Artificial Reefs-Thomas Point Strawman Design

Type:
Beneficial Use

Location:
Thomas Point design is located in the Chesapeake Bay in Anne Arundel County east of the Thomas Point lighthouse. Multiple concepts have been proposed for reef construction in bottom areas below the Chesapeake Bay Bridge in waters 30-50 feet deep in Anne Arundel County and Calvert County westerly and outside of navigation channels and the Deep Trough. Each area would be subject to site specific impacts. This site evaluation is for an area located immediately east of Thomas Point Lighthouse in 30 to 50 feet of water.

Size: Thomas Point is 5500 yards long [need acreage].
Overall potential concept area for reef construction is 1mile wide by 10 to 15 miles long.

Potential Capacity: Approximately 5 mcy for the Strawman design

Availability: State Owned

Nutrients: [Need info]

Infrastructure Required to Implement:
Each site could require a diked area to contain the fine grained material. The location of the berms would depend on results of a hydrodynamic study. Additional time and costs may be needed for material other than dredged material depending on the design of berm. Placement mounds may also need sand or hard substrate capping after dredged material placement.

Institutional Issues:
Potential impact to navigation due to an undesignated, yet long standing, area for anchoring ships.
State agency required that a hydrodynamic model study be performed to evaluate the ability of a berm to provide hydrodynamics conducive to fish habitat before moving this option forward.
Consensus needed from commercial and recreational fishermen for site selection and enhancement.

Costs:

Total Unit Costs Per Cubic Yard: **[NEED!]**

Development & Implementation Costs: **[NEED!]**

COMMENTS:
Hydrodynamic concerns
Potential impact to salt water wedge
Navigational issues associated with area due to long standing area for anchorage of ships
Commercial and recreational fisheries impacts
Potential impact to thermal refuge habitat for fisheries
Potential impact to Oyster bars NOB 8-6, 8-9, 10-1 and 10-2.

DRAFT DRAFT DRAFT DRAFT

TITLE: Artificial Reefs **PROJECT TYPE:** Beneficial Use

Existing Conditions	Presence*	Potential*	Unknown*	N/A*
Physical and Chemical Characteristics				
Substrate	X			
High Relief Area	X			
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics	X			
Tidal Fluctuations	X			
Salinity Gradients	X			
Sediment Quality			X	
HTRS			X	
Biological Characteristics				
RTE			X	
Aquatic Organisms				
Benthic Communities	X			
Fisheries	X			
Designated Spawning Area				X
Larval Habitat Area				X
Crabs	X			
Mollusks				
Soft shell clams	X			
Hard shell clams				X
Oyster bars	X			
Terrestrial Wildlife				X
Avian Wildlife				
Waterfowl concentration area			X	
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges			X	
SAV				X
Wetlands				
Tidal Wetlands				X
Non-tidal Wetlands				X
Human Use Characteristics				
Groundwater				X
Water Related Recreation	X			
Recreational and Commercial Fisheries				
Soft shell clams	X			
Hard shell clams				X
Oyster bars-NOB 8-6,-9, 10-1,- 2	X			
Crabs	X			
Recreationally important fisheries		X		
Commercially important fisheries		X		
Aesthetics				
Air Quality				X
Noise				X
Critical Areas				X
Forested Areas				X
Cultural Resources				X
Archaeological Resources			X	
Potential for Benefit	X			
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A** (Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Chesapeake Bay Program. 1996. High Value Living Resource Map of the Upper Bay. In a memo prepared for the Bay Enhancement Phase II Working Group.

Funderburk, S.L., S.J. Jordan, J.A. Mihursky and D. Riley. 1991. Habitat Requirements for Chesapeake Bay Living Resources. Second Edition. Chesapeake Bay Program

Maryland Department of Natural Resources. 1989. Natural Oyster Bar Maps. Prepared by Coast and Geodetic Survey for the Maryland Department of Natural Resources.

Maryland Geological Survey. 1971. Maryland Tidal Wetlands and Critical Area Inventory Maps. Based on County maps 1:2,400 scale organized by.

US Fish and Wildlife Service. 1979. National Wetland Inventory Maps. Non-Tidal Wetlands Maps. Prepared by Office of Biological Services. Based on USGS 7.5 minute topographic quadrangle map series.

3.5.5 Barren Island Restoration

Box XX-22
Screening of Barren Island Restoration

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX..

3.5.5a Location.

3.5.5b Type of Placement Option.

3.5.5c Potential Placement Capacity.

3.5.5d Bathymetry/Topography.

3.5.5e Environmental Characteristics.

Living Resources.

Water Quality.

Hydrodynamics.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.5.5f Implementation Factors.

Construction Considerations.

Implementation Time Frame.

3.5.5g Institutional Constraints.

3.5.5h Estimated Costs.

3.5.5i Other Factors.

3.5.5j Option Summary.

3.5.5k Option Data Sheet. **[ADD DATA SHEET]**

Barren Island

Barren Island is a satellite refuge of the Blackwater National Wildlife Refuge. It is an important nesting, nursery, or wintering area for colonial waterbirds, wading birds, Federally and state-listed endangered species, and waterfowl. Barren Island supports an active bald eagle nest, several rookeries, and provides erosion protection to large widgeongrass beds occurring in the lee of the island.

The protected shallow waters to the south, east, and northeast of Barren Island exhibit a sand/silt/clay bottom type, which support expansive widgeon grass beds. The SAV beds and protected shallow waters are prime nursery habitat for blue crabs, and support a fishery for watermen from nearby Hoopers Island. Minor amounts of shell and oyster spat have also been found in near-shore waters.

The middle portion of Barren Island is configured like an isthmus, comprised of salt marsh, which connects upland portions of the island to the north and south. This comparatively narrow wetland is typified by smooth cordgrass, saltmeadow hay, and marsh elder. A comparison of recent aerial photography shows the width of the wetland to be narrowing. If the wetland is bisected through erosion, SAV beds will be exposed to erosion wave climates.

Since 1848, an estimated 78% of the historical Barren Island acreage has been lost to erosion. Unless protected, the remaining 175 acres will be lost at an estimated average rate of 16 feet per year along the western shoreline. The Corps of Engineers has performed some modest-scale marsh restorations at the site. The DNPOP included wetland and island restoration of Barren Island as a placement option. A preliminary estimate of potential dredged material capacity for wetland restoration at the Barren Island site is up to a maximum of 500,000 cubic yards with some containment supplied by geotextile tubes, as the Corps has done in the past. This option would provide for about 50 acres of wetlands restoration. Placement costs are expected to be about $3.5 million, including transportation of the dredged material a distance of about 50 miles from the channels that are being dredged. Unit cost for this option is about $7.00 per cubic yard, making it a suitable project to be used in combination with other small projects in addressing placement capacity shortfall. However, the Corps has experienced mixed success with the implementation of geotextile tube structures, and given the potential severe wave climate at Barren Island and the degree of silts that will be placed there, an armored solution is probably more appropriate. Replacing the geotextile containment with a low stone sill would likely raise the cost of the restoration an additional $5 million, thereby increasing the unit cost to $17 per cubic yard.

The shallow waters proposed for the placement site exhibit a hard clay substrate that is devoid of submerged aquatic vegetation or commercially important shellfish. The substrate is comparable to the clays comprising the adjacent eroding bank (southern half of the island), and is probably island parent material. This proposal would involve a resource trade-off, primarily conversion of shallow water to estuarine emergent wetland. The great blue heron rookery located on the eastern side and lower portion of the Island is visually buffered and about ¼ mile away from the proposed placement site. Disturbance is not expected. Likewise, the bald eagle nest is about a ¼ mile away from the placement site, on the south facing shoreline and disturbance is not expected.

An island restoration project for Barren Island would face similar challenges as the smaller wetland restoration project. Replicating the 1847 shoreline west of the Island (about 1300 acres), this project could be constructed in wetland and upland cells, as is Poplar Island to the north. Discounting the size of the existing islands, the resultant wetland and upland cells would be 550 acres each, just as with Poplar Island. The expected capacity for the project is about 40 mcy. Construction costs are expected to be similar to Poplar Island, but the additional 30 miles in transportation adds another $120 million to the project cost, bringing its total to about $578.4 million. The unit cost for this option would be about $15 per cubic yard.

3.5.6 Bodkin Island Restoration

Box XX-23
Screening of Bodkin Island Restoration

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX..

3.5.6a Location.

3.5.6b Type of Placement Option.

3.5.6c Potential Placement Capacity.

3.5.6d Bathymetry/Topography.

3.5.6e Environmental Characteristics.

Living Resources.

Water Quality.

Hydrodynamics.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.5.6f Implementation Factors.

Construction Considerations.

Implementation Time Frame.

3.5.6g Institutional Constraints.

3.5.6h Estimated Costs.

3.5.6i Other Factors.

3.5.6j Option Summary.

3.5.6k Option Data Sheet. [ADD DATA SHEET]

Bodkin Island

Bodkin Island is a small island, just under one-acre in size, in Eastern Bay near the mouth of Crab Alley Bay. Wooden bulkheads and riprap revetments surround the island. Historically, it was the site of the highest black duck nesting density known in North America. Loss of quality brood rearing areas on and near the island as a result of erosion-related loses and increased development has adversely impacted populations on the island.

Wind wave- and storm surge-induced erosion separated Bodkin Island from the mainland in the late 18^{th} and early 19^{th} centuries. Bodkin Island has declined in size from approximately 50 acres in 1847, to two islands totaling 4.5 acres in 1953, and finally, to a single island less than an acre in 1999. A wooden bulkhead was constructed in 1984 around the perimeter of the island to prevent further loss due to erosion. More recently, riprap has been placed adjacent to the failing bulkhead on one side of the island to provide additional protection. The decline in the size of Bodkin Island has resulted in a corresponding loss of prime black duck habitat.

Between 1990 and 1994, the U.S. Army Corps of Engineers and the Maryland Department of Natural Resources, with assistance from the U.S. Fish and Wildlife Service, investigated the restoration of Bodkin Island as a beneficial use of sediment dredged from the Federal navigation project for the Chester River. The project would include a combination of upland nesting habitat, high marsh zones, low marsh zones, and tidal pools.

The location of the restored island was selected to minimize impacts to local razor clam populations, natural oyster bars, and to take advantage of the shallowest depths in the area. The restored island would be shaped like a horseshoe, with the opening oriented north. The rounded shape that was proposed would eliminate sharp corners and minimizes the amount of stone that would be needed for protection. The northward orientation of the opening shelters the tidal area of the island from the most severe directions of wave attack. The island would have outer slopes of 1 vertical on 3 horizontal (1V: 3H) and 1V: 6H interior slopes from the upland crest to the tidal pools. The gentler interior slopes were designed to be suitable for hens and hatchlings to transverse to reach the water. The island would be planted in lieu of colonization to insure rapid vegetation cover, to lessen potential impacts to nesting areas, to hasten the development of brood habitat, to deter the growth of undesirable plant species, and to further stabilize the placed material. The original cost of the 6.3-acre restoration project was estimated at $2.03 million, not including the cost of dredging and transporting the sediment. It was expected that the site would accommodate about 54,000 cubic yards of dredged material. The cost per cubic yard of dredged material is about $39. This unit cost is comparatively high due to the high proportion of marsh and tidal pools to upland habitat. At its present capacity and unit cost, this option represents a very limited solution as a placement site for dredged material.

It is conceptually possible to enlarge the footprint for the proposed restoration to that of the 1847 footprint (50 acres). This enlarged option would include 8 acres of upland habitat at +10 MLW, 9.8 acres of crest and upper slope, 2.8 acres of high marsh, 16 acres of low marsh and tidal pools, and 13.4 acres of inter-tidal waterways. It is likely that neighboring oyster beds and razor clam beds will be impacted by this alternative. Capacity for this option would be 568,900 cubic yards. Construction costs are expected to be about $16.7 million, or $39/cyd. Transportation costs to the project, based on $0.10/cubic yard/mile, would be about $1.5 million based on a 30-mile trip from the channels. While unit cost for this enlarged option is still comparatively high, the increased capacity may make it a suitable project to be used in combination with other small projects in addressing placement capacity shortfall.

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title:
Bodkin Island

Type:
Beneficial Use, Shoreline Stabilization

Location:

Located in Eastern Bay in Talbot County, below the southern approaches to the Kent Island Narrows.

Size: 6.3-50 acres, north of island

Potential Capacity: Approximately 54,000 to 568,900 cy, depending on concept.

Availability:
Bodkin Island is owned by the State of Maryland.

Nutrients: [Need info]

Infrastructure Required to Implement:
Access channel, unloading facility, containment needed for fine grained material and de-watering equipment.

Institutional Issues:
NEPA document from proposed Corps project will have to be updated for smaller project.
Larger projects will require:

- Permitting for construction in shallow water habitat.
- Permitting for critical area development
- Permitting for wetland disturbance.
- Avoidance of impacts to the natural resources in the area.

Costs: $2.1 million (6.3-acre project) - $16.7 million (50-acre project)

Total Unit Costs Per Cubic Yard: $39 (Poplar Island's ratio of upland to wetland is 1:1. Bodkin Island's is 1:2).

Development & Implementation Costs: [not sure what goes here]

COMMENTS:

The majority of the island is grassy upland.
Wetlands present are classified as estuarine intertidal unconsolidated shore (cobble-gravel, sand, mud, or organic) wetlands that are irregularly flooded [E2USP].
Water adjacent to the island is mesohaline and ranges in depth from two to five feet.
The bottom is mainly firm laminar mud clay with some mixture of sand on three sides, and mostly sand to the northeast.
Oyster beds around the site. NOB 7-5 mapped on the southeast side of the island. NOB 7-7 (2846 acres) and NOB 7-6 (2006 acres) are within 500 yards. NOB 7-9 (67 acres) is also in the area.
An aquatic species currently found around the island is razor clams.

Avian wildlife includes green herons, fish crows, ospreys, mallards, and black ducks and songbirds such as cardinals and mourning doves.

The original Corps plan for Bodkin Island was for a horse-shoe shaped island, 6.3 acres in size, which would be armored in stone to protect it from wave action. Subsequent plans called for a replacement of the stone with geotextile tubes to reduce the cost of the project. Due to the unreliability of the geotextile structures, the original plan with stone armor was reconsidered. The enlarged (50-acre) project is based on the historic shoreline in about 3 feet of water. The resulting project would consist of 8 acres of upland habitat, 9.8 acres of crest and upper slope, 2.8 acres of high marsh, 16 acres of low marsh and tidal pools, and 13.4 acres of intertidal waterways.

DRAFT DRAFT DRAFT DRAFT

TITLE: Bodkin Island **PROJECT TYPE:** Beneficial-Use, shoreline stabilization

Existing Conditions	**Presence***	**Potential***	**Unknown***	**N/A***
Physical and Chemical Characteristics				
Substrate	X			
High Relief Area				X
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics	X			
Tidal Fluctuations	X			
Salinity Gradients			X	
Sediment Quality	X			
HTRS			X	
Biological Characteristics				
RTE-osprey	X			
Aquatic Organisms				
Benthic Communities	X			
Fisheries	X			
Designated Spawning Area				X
Larval Habitat Area		X		
Crabs	X			
Mollusks				
Soft shell clams	X			
Hard shell clams				X
Oyster bars NOB 7-5, -6, -7, -8	X			
Terrestrial Wildlife			X	
Avian Wildlife				
Waterfowl concentration area		X		
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges		X		
SAV				X
Wetlands				
Tidal Wetlands	X			
Non-tidal Wetlands	X			
Human Use Characteristics				
Groundwater				X
Water Related Recreation	X			
Recreational and Commercial Fisheries				
Soft shell clams	X			
Hard shell clams				X
Oyster bars-NOB 7-6, -7, -8	X			
Crabs	X			
Recreationally important fisheries	X			
Commercially important fisheries			X	
Aesthetics				
Air Quality			X	
Noise		X		
Critical Areas	X			
Forested Areas			X	
Cultural Resources			X	
Archaeological Resources			X	
Potential for Benefit	X			
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A** (Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title:
Bodkin Island

Type:
Beneficial Use, Shoreline Stabilization

Location:
Located in Eastern Bay in Queen Annes County, to the southeast of Turkey Point. Immediately south of Crab Alley Bay.

Size: 0.94 acres

Potential Capacity:
Island to be restored to approximately 6 acres, could potentially create up to 10 acres
Approximately 0.04 to 0.06 mcy

Availability: State Owned

Nutrients: [Need info]

Infrastructure Required to Implement:
Access channel, unloading facility, containment needed for fine grained material and de-watering equipment.

Institutional Issues:
Permitting required for construction in shallow water habitat.
Permitting required for critical area development
Permitting required for wetland disturbance.
Permitting issues related to impacts associated with the natural resources and local ordinances in the area.

Costs:

Total Unit Costs Per Cubic Yard: **[NEED!]**

Development & Implementation Costs:

COMMENTS:
Wetlands present are classified as estuarine intertidal unconsolidated shore (cobble-gravel, sand, mud, or organic) wetlands that are irregularly flooded [E2USP].
Oyster bars in the area include NOB 7-5 (5269 acres), NOB 7-6 (2006 acres), NOB 7-7 (2846 acres), and NOB 7-9 (67 acres)
Avian wildlife includes black duck and green-backed heron, songbirds such as cardinals and mourning doves, and osprey.
An aquatic species currently found around the island is razor clams.

DRAFT DRAFT DRAFT DRAFT

TITLE: Bodkin Island **PROJECT TYPE:** Benny-Use, shoreline stabilization

Existing Conditions	Presence*	Potential*	Unknown*	N/A*
Physical and Chemical Characteristics				
Substrate	X			
High Relief Area				X
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics	X			
Tidal Fluctuations	X			
Salinity Gradients			X	
Sediment Quality	X			
HTRS			X	
Biological Characteristics				
RTE-osprey	X			
Aquatic Organisms				
Benthic Communities	X			
Fisheries	X			
Designated Spawning Area				X
Larval Habitat Area		X		
Crabs	X			
Mollusks				
Soft shell clams	X			
Hard shell clams				X
Oyster bars NOB 7-5, -6, -7, -8	X			
Terrestrial Wildlife			X	
Avian Wildlife				
Waterfowl concentration area		X		
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges		X		
SAV				X
Wetlands				
Tidal Wetlands	X			
Non-tidal Wetlands	X			
Human Use Characteristics				
Groundwater				X
Water Related Recreation	X			
Recreational and Commercial Fisheries				
Soft shell clams	X			
Hard shell clams				X
Oyster bars-NOB 7-6, -7, -8	X			
Crabs	X			
Recreationally important fisheries	X			
Commercially important fisheries			X	
Aesthetics				
Air Quality			X	
Noise		X		
Critical Areas	X			
Forested Areas			X	
Cultural Resources			X	
Archaeological Resources			X	
Potential for Benefit	X			
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A** (Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Chesapeake Bay Program. 1996. High Value Living Resource Map of the Upper Bay. In a memo prepared for the Bay Enhancement Phase II Working Group.

Funderburk, S.L., S.J. Jordan, J.A. Mihursky and D. Riley. 1991. Habitat Requirements for Chesapeake Bay Living Resources. Second Edition. Chesapeake Bay Program

Landin, Mary C. 1991. Restoration of Black Duck Habitat at Bodkin Island. World Dredging Mining and Construction. August 1991.

Maryland Department of Natural Resources. 1989. Natural Oyster Bar Maps. Prepared by Coast and Geodetic Survey for the Maryland Department of Natural Resources.

Maryland Geological Survey. 1971. Maryland Tidal Wetlands and Critical Area Inventory Maps. Based on County maps 1:2,400 scale organized by.

Maynord, S. T., et al. 1992. Design of Habitat Restoration Using Dredged Material at Bodkin Island, Chesapeake Bay, Maryland, Final Report. Wetlands Research Program Technical Report WRP-RE-3. Prepared for US Army Corps of Engineers, Waterways Experiment Station. June 1992.

USACE, Baltimore District. 1994. Chester River Bodkin Island, MD. Section 204 Detailed Project Report and Environmental Assessment. December 1994.

US Fish and Wildlife Service. 1979. National Wetland Inventory Maps. Non-Tidal Wetlands Maps. Prepared by Office of Biological Services. Based on USGS 7.5 minute topographic quadrangle map series.

3.5.7 Bodkin Point

Box XX-24
Screening of Bodkin Point

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX..

3.5.7a Location.

3.5.7b Type of Placement Option.

3.5.7c Potential Placement Capacity.

3.5.7d Bathymetry/Topography.

3.5.7e Environmental Characteristics.

Living Resources.

Water Quality.

Hydrodynamics.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.5.7f Construction Factors.

3.5.7g Institutional Constraints.

3.5.7h Estimated Costs.

3.5.7i Other Factors.

3.5.7j Option Summary.

3.5.7k Option Data Sheet. [ADD DATA SHEET]

3.5.8 Eastern Neck Island National Wildlife Refuge

Use of Eastern Neck for beneficial use applications in lieu of the proposed open-water placement has been advocated by a various public officials and private citizens. The potential of Eastern Neck Island for additional beneficial use applications was screened to determine whether it could serve as an alternative to the proposed open-water placement or as a component of a multi-option alternative.

Box XX-25
Screening of Eastern Neck National Wildlife Refuge

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide between 50,000 and 200,000 cubic yards, depending upon configuration and type of project.
2. Availability. The USFWS would only consider placement of sandy sediments. This would preclude use of the site because the material that would be dredged consists mostly of fine-grained silts and clays and an best, a small sand fraction that could not be practically separated.
3. Environmental Suitability: The west side of Eastern Neck Island is potentially suitable location for a small-scale beneficial use project for shoreline stabilization purposes.
4. Infrastructure Readiness: Sites could be ready for use when needed.
5. Institutional Feasibility: See Screening Criteria #2 above.
6. Prospective Affordability: The estimated unit cost ($20 to $85), for practical purposes, exceeds the upper cost threshold. The small scale of a potential beneficial use project relative to construction requirements and a limited placement capacity result in a very high unit cost.
7. Potential for Environmental Improvements: Considerable potential to preserve existing wetland and upland habitat.

Results of Screening: Use of the shoreline and shallow water areas along the west side of Eastern Neck Island is not suitable for consideration as an alternative due to insufficient capacity. The site is not suitable as a component of a multi-option alternative because the USFWS is only willing to accept sandy material.

3.5.8a Location.

Eastern Neck Island National Wildlife Refuge is located on Maryland's Eastern Shore at the mouth of the Chester River. It encompasses all of Eastern Neck Island.

3.5.8b Type of Placement Option.

The refuge is the responsibility of the U.S. Fish and Wildlife Service (USFWS). The refuge was previously the location of a beneficial use project. The possibility of undertaking further beneficial use options at the refuge are listed as an option in the MPA's DNPOP Program.

The earlier beneficial use application was an outgrowth of shore erosion and control measures for a portion of the island's western shoreline. The project was necessitated because the island was experiencing a significant loss of acreage due to shore erosion. Five stone segmented breakwaters were installed in 1992. The USFWS installed several sand-filled geotubes immediately southeast of the stone breakwaters, configuring them to extend the segmented breakwater system. After the geotubes were installed, CENAB deposited approximately 34,380 cubic yards of fine-grained sand between the tubes and the shoreline. About 77,000 wetlands plants were planted along the shoreline. The habitat value of the shallow water area between the breakwater system and the shoreline has subsequently improved significantly (Gill, et. al., 1995; Hurt, 1995).

The BEP II working group considered the potential of Eastern Neck Island in 1995. The working group believed that although there was some potential for a small-scale beneficial use project at the refuge, large-scale placement options were needed to meet near-term needs. Eastern Neck Island was not considered a realistic option for meeting that need due to the limited potential for placement capacity. However, supplemental information was subsequently assembled for use in DNPOP planning and was available for this DEIS.

The success of the breakwater system and fill with fine-grained sand suggests that a similar result could be obtained from a similar project to the south. A segmented breakwater could be designed and installed, subject to suitable foundation conditions. Such a project would preserve the general character of the area.

3.5.8c Potential Placement Capacity.

An estimated 50,000 cy of dredged sediments could be potentially be placed. Greater placement potential on the order of 100,000 to 200,000 cy would necessitate creating a closed dike system and constructing marshes or upland, thereby substantially changing the character of the shoreline.

3.5.8d Bathymetry/Topography.

3.5.8e Environmental Characteristics.

Living Resources.

The refuge provides habitat for nesting bald eagles, delmarva fox squirrels (endangered species), and migratory birds. There are also tidal wetlands, high value upland forest areas, diverse forage for fish, and agricultural fields. Cultural resources are believed to exist within the refuge boundaries. The southern portion of the western shoreline of the island is relatively low and dominated by fringe marsh. This portion of the shoreline is somewhat exposed, and minimal submerged vegetation (SAV) has been reported. Bottom conditions along the southern portion and immediately offshore of the western shoreline appear to be similar to conditions that exist in the vicinity of the segmented breakwaters. The shallow water areas along the eastern side of the island have historically supported the growth of considerable SAV and has considerable tidal marshes (Orth, et. al., 1997; 1998).

Water Quality. [XXXX]

Hydrodynamics. [XXXX]

Rare, Threatened or Endangered (RTE) Species. [XXXX]

Fishing Activity. [XXXX]

Recreational Activity. [XXXX]

Historical/Archeological. [XXXX]

Groundwater. [XXXX]

View Shed. [XXXX]

3.5.8f Implementation Factors.

Site Availability. Informal coordination resulted in a finding that the USFWS is only willing to accept material that is mostly sand for a beneficial use project that would maintain the character of the area. Therefore, only the smaller-scale sand option would be considered by the agency.

Construction Considerations. [XXXX]

Implementation Time Frame. [XXXX]

3.5.8g Institutional Constraints.

3.5.8h Estimated Costs.

The southwestern shore of Eastern Neck Island is 11 miles northeast of Site 104 by water. It is approximately 4 miles greater in distance from the CENAB channels that would be dredged than is Site 104. The increased transportation cost which would be borne by the State would be approximately $0.40 per cubic yard. There would be additional costs for environmental documentation, engineering design, site preparation/construction, mobilization and demobilization of equipment to Eastern Neck Island, and vegetation following completion of placement. The total cost of a beneficial use project to continue the extend the existing beneficial use project is estimated between $20 to $85 per cubic yard depending upon design, construction materials, foundation conditions, and other factors. Total costs could be on the order to $3 to $10 million. These costs are within the funding limits of Section 204, although funds from this source are competed for nationally.

3.5.8i Other Factors. [XXXX]

3.5.8j Option Summary.

Eastern Neck Island is not suitable as an alternative to open-water placement because the USFWS will only accept sandy material, and the sediment from the channels to be dredged consists primarily fine silts and clays. There is no practical way to separate out a minor amount of sand that may be dredged. It is unlikely that the estimated 50,000 cubic yard capacity could be used effectively, although this capacity would likely be available within the planned placement window.

3.5.8k Option Data Sheet. [ADD DATA SHEET]

3.5.9 Davis Tract

Box XX-26
Screening of the Davis Tract

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX..

3.5.9a Location.

3.5.9b Type of Placement Option.

3.5.9c Potential Placement Capacity.

3.5.9d Bathymetry/Topography.

3.5.9e Environmental Characteristics

Living Resources.

Water Quality.

Hydrodynamics.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater.

View Shed.

3.5.9f Implementation Factors.

Construction Considerations.

Implementation Time Frame.

3.5.9g Institutional Constraints.

3.5.9h Estimated Costs.

3.5.9i Other Factors.

3.5.9j Option Summary.

3.5.9k Option Data Sheet. [ADD DATA SHEET]

3.5.10 Grove Neck

Box XX-27
Screening of Grove Neck Upland Containment Facility

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX..

3.5.10a Location.

3.5.10b Type of Placement Option.

3.5.10c Potential Placement Capacity.

3.5.10d Bathymetry/Topography.

3.5.10e Environmental Characteristics.

Living Resources.

Water Quality.

Hydrodynamics.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.5.10f Implementation Factors.

Construction Considerations.

Implementation Time Frame.

3.5.11g Institutional Constraints.

3.5.11h Estimated Costs.

3.5.11 Other Factors.

3.5.11j Option Summary.

3.5.11k Option Data Sheet. [ADD DATA SHEET]

3.5.12 Hawkins Point

Box XX-28
Screening of Hawkins Point

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX..

3.5.12a Location.

3.5.12b Type of Placement Option.

3.5.12c Potential Placement Capacity.

3.5.12d Bathymetry/Topography.

3.5.12e Environmental Characteristics.

Living Resources.

Water Quality.

Hydrodynamics.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.5.12f Implementation Factors.

Construction Considerations.

Implementation Time Frame.

3.5.12g Institutional Constraints.

3.5.12h Estimated Costs.

3.5.12i Other Factors.

3.5.12j Option Summary.

3.5.12k Option Data Sheet. [ADD DATA SHEET]

3.5.13 Holland Island (small-scale)

Box XX-29
Screening of Holland Island (small-scale)

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX..

3.5.13a Location.

3.5.13b Type of Placement Option.

3.5.13c Potential Placement Capacity.

3.5.13d Bathymetry/Topography.

3.5.13e Environmental Characteristics.

Living Resources.

Water Quality.

Hydrodynamics.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.5.13f Implementation Factors.

Construction Considerations.

Implementation Time Frame.

3.5.13g Institutional Constraints.

3.5.13h Estimated Costs.

3.5.13i Other Factors.

3.5.13j Option Summary.

3.5.13k Option Data Sheet. [ADD DATA SHEET]

3.5.14 Holland Island (large-scale)

Box XX-30
Screening of Holland Island (Large Scale)

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX..

3.5.14a Location.

3.5.14b Type of Placement Option.

3.5.14c Potential Placement Capacity.

3.5.14d Bathymetry/Topography.

3.5.14e Environmental Characteristics

Living Resources.

Water Quality.

Hydrodynamics.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.5.14f Implementation Factors.

Construction Considerations.

Implementation Time Frame.

3.5.14g Institutional Constraints.

3.5.14h Estimated Costs.

3.5.14i Other Factors.

3.5.14j Option Summary.

3.5.14k Option Data Sheet. [ADD DATA SHEET]

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title:
Holland Island

Type:
Beneficial Use, Shoreline Stabilization.

Location:
Mid-Bay in Southern Dorchester County on the eastern shore of the Bay, approximately 55 miles south of the Bay Bridge.
The island is approximately 16 miles northeast of the mouth of the Potomac River.

Size:
Less than 80 acres.

Potential Capacity:
Approximately 0.5 to 2 mcy., depending on elevation of concept.

Availability:
The majority of the island is privately owned. Real estate transactions would have to occur to enable State and Federal involvement.
Small portion owned by DNR.

Nutrients: **[Need info]**

Infrastructure Required to Implement:
Access channel, unloading facility and de-watering equipment, design of containment for fine-grained material.

Institutional Issues:
Permitting required for construction in shallow water habitat.
Permitting required for critical area development
Permitting required for wetland disturbance.
Permitting issues related to impacts associated with the natural resources and local ordinances in the area.

Costs:

Total Unit Costs Per Cubic Yard: [Transportation costs estimated at $5.60/cy.]

Development & Implementation Costs:

COMMENTS:
Oyster bars in area (NOB 32-2, 3115 acres)
High density area for soft shell clam
High density blue crab
Avian wildlife includes blue heron, bald eagle, egrets, ducks, geese, swan, gulls, and terns,
Terrestrial wildlife includes fox, white-tail deer, and terrapins.

DRAFT DRAFT DRAFT DRAFT

TITLE: Parsons Island **PROJECT TYPE:** Benny-Use, shoreline stabilization

Existing Conditions	Presence*	Potential*	Unknown*	N/A*
Physical and Chemical Characteristics				
Substrate	X			
High Relief Area		X		
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics	X			
Tidal Fluctuations	X			
Salinity Gradients	X			
Sediment Quality	X			
HTRS			X	
Biological Characteristics				
RTE-Bald Eagle, Osprey, Terrapin	X			
Aquatic Organisms				
Benthic Communities	X			
Fisheries	X			
Designated Spawning Area				X
Larval Habitat Area		X		
Crabs	X			
Mollusks				
Soft shell clams-High Density	X			
Hard shell clams		X		
Oyster bars	X			
Terrestrial Wildlife	X			
Avian Wildlife				
Waterfowl concentration area	X			
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges		X		
SAV				X
Wetlands				
Tidal Wetlands	X			
Non-tidal Wetlands	X			
Human Use Characteristics				
Groundwater			X	
Water Related Recreation	X			
Recreational and Commercial Fisheries				
Soft shell clams	X			
Hard shell clams		X		
Oyster bars-NOB 32-2	X			
Crabs	X			
Recreationally important fisheries	X			
Commercially important fisheries	X			
Aesthetics				
Air Quality			X	
Noise			X	
Critical Areas	X			
Forested Areas	X			
Cultural Resources	X			
Archaeological Resources	X			
Potential for Benefit	X			
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A** (Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Chesapeake Bay Program. 1996. High Value Living Resource Map of the Upper Bay. In a memo prepared for the Bay Enhancement Phase II Working Group.

Funderburk, S.L., S.J. Jordan, J.A. Mihursky and D. Riley. 1991. Habitat Requirements for Chesapeake Bay Living Resources. Second Edition. Chesapeake Bay Program

Maryland Department of Natural Resources. 1989. Natural Oyster Bar Maps. Prepared by Coast and Geodetic Survey for the Maryland Department of Natural Resources.

Maryland Geological Survey. 1971. Maryland Tidal Wetlands and Critical Area Inventory Maps. Based on County maps 1:2,400 scale organized by.

US Fish and Wildlife Service. 1979. National Wetland Inventory Maps. Non-Tidal Wetlands Maps. Prepared by Office of Biological Services. Based on USGS 7.5 minute topographic quadrangle map series.

3.5.15 Holly Neck Farm

Box XX-31
Screening of Holly Neck Farm

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX..

3.5.15a Location.

3.5.15b Type of Placement Option.

3.5.15c Potential Placement Capacity.

3.5.15d Bathymetry/Topography.

3.5.15e Environmental Characteristics

Living Resources.

Water Quality.

Hydrodynamics.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

<u>View Shed</u>.

3.5.15f Construction Factors.

3.5.15g Institutional Constraints.

3.5.15h Estimated Costs.

3.5.15i Other Factors.

3.5.15j Option Summary.

3.5.15k Option Data Sheet. [ADD DATA SHEET]

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title
Holly Neck Farm

Type:
Beneficial Use, Shoreline Stabilization

Location:

Located in Anne Arundle County, south of the Chesapeake Bay Bridge. Worton Point

Size: [Need to quantify]

Potential Capacity: Approximately 0.25 mcy

Availability:

Privately owned farm, owner expressed interest in making shoreline available to the State of Maryland for beneficial use project.

Nutrients: [Need info]

Infrastructure Required to Implement:

Access channels, unloading facilities, substrate suitability for stabilization

Institutional Issues:

Permitting required for construction in shallow water habitat.
Permitting required for critical area development
Permitting required for wetland disturbance.
Permitting issues related to impacts associated with the natural resources and local ordinances in the area.

Costs:

Total Unit Costs Per Cubic Yard: **[NEED!]**

Development & Implementation Costs: **[NEED!]**

COMMENTS:

Negative impacts to wetlands, shallow-water habitats, SAV, and cultural resources (historic house).
Large natural oyster bar immediately adjacent to site.
Site extensively used by waterfowl, Some active Bald Eagle nest and herons exist on site.
High density area for soft shell clam.
Adjacent to high density summer habitat for male blue crab.
Adjacent to low density summer habitat for female blue crab.
One or more probable wood duck nest in 1982-1989.
One or more probable American Black Duck nest in 1982-1989.
Area of Great Blue Heron colony of 16-70 in 1988.
One or more confirmed Green-Backed Heron nests in 1982-1989.
Oyster bars= NOB-4-7 (144 acres), NOB 6-4 (1900 acres).

DRAFT DRAFT DRAFT DRAFT

TITLE: Holly Neck Farm **PROJECT TYPE:** Benny-Use

Existing Conditions	**Presence***	**Potential***	**Unknown***	**N/A***
Physical and Chemical Characteristics				
Substrate		X		
High Relief Area				X
Suspended Particulates, Turbidity		X		
Water Quality		X		
Hydrodynamics		X		
Tidal Fluctuations				X
Salinity Gradients	X			
Sediment Quality		X		
HTRS		X		
Biological Characteristics				
RTE-Bald Eagle	X			
Aquatic Organisms				
Benthic Communities	X			
Fisheries		X		
Designated Spawning Area				X
Larval Habitat Area		X		
Crabs	X			
Mollusks				
Soft shell clams	X			
Hard shell clams				X
Oyster bars	X			
Terrestrial Wildlife	X			
Avian Wildlife				
Waterfowl concentration area	X			
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges			X	
SAV		X		
Wetlands				
Tidal Wetlands	X			
Non-tidal Wetlands	X			
Human Use Characteristics				
Groundwater			X	
Water Related Recreation		X		
Recreational and Commercial Fisheries				
Soft shell clams	X			
Hard shell clams				X
Oyster bars-NAB1-1	X			
Crabs		X		
Recreationally important fisheries	X			
Commercially important fisheries	X			
Aesthetics				
Air Quality			X	
Noise		X		
Critical Areas	X			
Forested Areas	X			
Cultural Resources	X			
Archaeological Resources		X		
Potential for Benefit	X			
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A** (Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Living Resources Maps
MDNR Historic Oyster Bar Maps
MGS Tidal Wetland Maps
MGS Non-Tidal Wetland Maps
Lee Crockett Living Resource Map of the Upper Bay

3.5.16 James Island

Although the Poplar Island restoration project is not yet constructed nor filled and vegetated, the prospect that the project will ultimately be successful has stimulated interest in the possibility of other large-scale island restoration projects. The potential for an island restoration project at James Island at the mouth of the Little Choptank River has been informally suggested to the MPA for possible inclusion as an option in the DNPOP program, and information is being assembled to provide a resource for consideration of the island's restoration potential and restoration options by the BEP II Working Group. During the course of the NEPA process for the proposed open-water placement action, the possibility of restoring James Island was suggested as a possible alternative. The preliminary DNPOP information was made available to CENAB. Additional information was developed by CENAB to aid in determining whether or not restoration of James Island might effectively serve as an alternate.

Box XX-32
Screening of James Island

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide 35 to 50 mcy, depending upon site configuration.
2. Availability: The bottom is owned by the State and is considered to be available. The islands are privately held. Inasmuch as the islands have experienced considerable erosion, it is assumed that the owner's would be interested in a restoration project. For initial planning purposes, it is assumed that suitable real estate arrangements could be made.
3. Environmental Suitability: The are is used for fishing activity. There would be a permanent conversion of bottom habitat. The environmental tradeoffs are estimated to be similar to those at Poplar Island. For planning purposes, the site is considered potentially environmentally acceptable.
4. Infrastructure Readiness: It would take on the order of 10 to 14 years to implement the restoration project. Therefore, placement capacity at James Island could not be ready for use when needed.
5. Institutional Feasibility: No institutional constraints specific to James Island were identified.
6. Prospective Affordability: The estimated unit cost ($20) is approaches the upper screening threshold for cost. This estimate includes contingencies for unforseen conditions.
7. Potential for Environmental Improvements: Substantial potential for environmental improvements through restoration of habitat that is decreasing in the Bay area and through physical protection for shorelands to the east and southeast.

Results of Screening: Use of James Island for placement is not suitable for consideration as an alternative because the site cannot be implemented when needed. However, the option has considerable future potential for consideration on its own merits.

3.5.16a Location.

The existing James Island Archipelago was formed as a result of natural processes of shoreline change that affect the Chesapeake Bay region. James Island is portrayed on 18th century maps as being connected to the mainland of Taylors Island by a marsh. By 1847, survey data indicated that connection was nearly breached. At that time, James Island consisted of about 1253 acres of upland and fringe marshes. By 1942, the two remnant island were still connected but the connection to Taylors Island had been breached and consisted of open-water. By 1994, the remaining island was breached into two principal remnants consisting of a total of 106 acres. The islands today are estimate to be less than 100 acres. The southernmost island is separated from Taylors Island by about a mile of shallow open-water (Stevenson and Kearney, 1996). The remaining remnants are privately held by different parties.

3.5.16b Type of Placement Option.

Conceptually, James Island could potentially be restored either as an island or as a peninsula reconnected to Taylors Island. In order to be consistent with the historic footprint, the restoration would need to be on the west side of the Archipelago. Inasmuch as an upland island existed at this location, it is assumed that an upland island could be constructed to similar elevations planned for Poplar Island.

3.5.16c Potential Placement Capacity.

Potentially, the area could be restored in similar manner to Poplar Island with overall size of perhaps 1,000 to 1,200 acres and capacity also similar to that of the full Poplar Island restoration project (say, 35 to 50 mcy), depending upon the project configuration.

3.5.16d Bathymetry/Topography.

[XXXX]

3.5.16e Environmental Characteristics

Living Resources.

The shallow waters west and north of the existing remnants provide shallow water habitat for foraging. The area is exposed and does not currently support the growth of SAV (Orth et. al, 1997, 1998). The bathymetric break between the more shallow waters and the deeper waters that form the ancient bed of the Susquehanna River provide an edge that is exploited to some extent by sportsfishermen. There is a designated small natural oyster bar (14-6) of 16 acres size immediately southeast of the southernmost island remnant.

Water Quality. [XXXX]

Restoring the island with a reconnection to Taylors Island could potentially reduce physical energy affecting the east side of the James Island Archipelago and Oyster Cove, thereby improving conditions potentially favorable to colonization and growth of SAV.

Hydrodynamics. [XXXX]

The progressive erosion of James Island is believed to have contributed to increased erosion of Dorchester County shorelines that were once in the shadow of the island complex. Oyster Cove, located at the northwest tip of Taylors Island, was once enclosed on the west by the peninsula that preceded the current James Island Archipelago. This area is one of the Dorchester County shorelines that has experienced increased erosion that appears to be associated with the progressive loss of the protection that had been provided by James Island.

Rare, Threatened or Endangered (RTE) Species. [XXXX]

Fishing Activity. [XXXX]

Recreational Activity. [XXXX]

Historical/Archeological. [XXXX]

Groundwater. [XXXX]

View Shed. [XXXX]

3.5.16f Implementation Factors.

Construction Considerations.

A small-scale restoration would be problematic on the west side of the Archipelago because the location is very exposed. A substantial armored dike system similar to the western dike of the Poplar Island project would be needed for either a large-scale or small-scale restoration.

Implementation Time Frame.

The full developmental time frame for such a project would be at least as long as the Poplar Island restoration project which was fast-tracked, on the order of 10 to 14 years (the actual time frame will vary according to various factors including legislative schedules for consideration of funding authorizations). Based on the experience in building a consensus regarding the appropriateness of a large scale restoration project for Poplar Island, especially the environmental tradeoffs that were involved, it would take approximately 2 to 3 years to establish whether or to what extent a large-scale beneficial use project would be practicable at James Island. Although restoration of James Island is already under consideration as part of long term dredged material management planning, the ability to implement a project at this location is far from certain and would need to be developed on its own merits. The time frame for such development extends beyond the placement need addressed in this annex.

3.5.16g Institutional Constraints.

No institutional constraints specific to the restoration of James Island were identified.

3.5.16h Estimated Costs.

Assuming that sufficient sand is available in deposits on site for dike construction, and that there would be no mitigation requirements, a planning estimate of the cost (with a standard contingency for unanticipated conditions) for a large-scale restoration is $20 per cubic yard. This planning estimate would increase if there were a need to import dike construction materials and if mitigation were required for the conversion of shallow water habitat (mitigation was not required for Poplar Island because the environmental benefits were assessed as greater than the environmental impacts resulting from construction)

Whether or not a large-scale project can achieve the broad-based support necessary for implementation including special funding by the U.S. Congress and funding by the Maryland General Assembly of the local sponsor cost share is speculative in view of the legislative history of the Poplar Island restoration project. A small-scale restoration project on the order of 0.5 to 2.0 mcy within the Section 204 discretionary authority could cost on the order of $50 to $100 per cubic yard, depending upon site configuration, habitat types, and construction requirements.

3.5.16i Other Factors.

3.5.16j Option Summary.

Restoration of James Island to accommodate the placement deficit used for screening is not practical as an alternative to the proposed action because the time frame for implementation and first availability extends beyond the placement need period for the deficit. Obtaining funding for another large scale restoration project is assessed as problematic, particularly since the restoration of Poplar Island is many years from completion. Restoration of James Island may prove to be suitable and acceptable as a beneficial use project at a future date.

3.5.16k Option Data Sheet. [ADD DATA SHEET]

3.5.17 Parsons Island

Box XX-33
Screening of Parsons Island

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX.

3.5.17a Location.

3.5.17b Type of Placement Option.

3.5.17c Potential Placement Capacity.

3.5.17d Bathymetry/Topography.

3.5.17e Environmental Characteristics

Living Resources.

Water Quality.

Hydrodynamics.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.5.17f Implementation Factors.

Construction Considerations.

Implementation Time Frame.

3.5.17g Institutional Constraints.

3.5.17h Estimated Costs.

3.5.17i Other Factors.

3.5.17j Option Summary.

3.5.17k Option Data Sheet. [ADD DATA SHEET]

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title:
Parsons Island

Type:
Beneficial Use, Shoreline Stabilization

Location:

Located in Eastern Bay in Talbot County, below the southern approaches to the Kent Island Narrows.

Size: 85-300 acres, around southern two-thirds of Island

Potential Capacity: Approximately 1 –3.5 mcy, depending on concept.

Availability:
Privately owned land, owner expressed interest in making shoreline available to the State of Maryland in 1995 for island restoration project. Owners are not interested in selling property.

Nutrients: [Need info]

Infrastructure Required to Implement:
Access channel, unloading facility, containment needed for fine grained material and de-watering equipment.

Institutional Issues:
Permitting required for construction in shallow water habitat.
Permitting required for critical area development
Permitting required for wetland disturbance.
Permitting issues related to impacts associated with the natural resources and local ordinances in the area.

Costs: [Total cost estimated to exceed $1 million dollars]

Total Unit Costs Per Cubic Yard: **[NEED!]**

Development & Implementation Costs: [Increase transportation costs by $2.00/cy.]

COMMENTS:
Large SAV beds in and around island in footprint of proposed construction.
Oyster beds around the site (NOB7-7, 2846 acres, NOB 7-6, 2006 acres, NOB 7-8, 1926 acres).
Estuarine and Palustrine wetlands (approximately 30 and 25 acres respectively).
Forested acreage includes 30 acres.
Terrestrial wildlife includes raccoon, possum, bird, deer, black ducks (waterfowl).
High density soft shell clam area.
Blue Crab habitat
Avian wildlife include Geese, American Black Duck, Green-Backed Heron, Bald Eagle.
The owners manage the property and farming operation so as to enhance the sites habitat value for migratory waterfowl.

DRAFT DRAFT DRAFT DRAFT

TITLE: Parsons Island **PROJECT TYPE**: Benny-Use, shoreline stabilization

Existing Conditions	Presence*	Potential*	Unknown*	N/A*
Physical and Chemical Characteristics				
Substrate	X			
High Relief Area				X
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics	X			
Tidal Fluctuations	X			
Salinity Gradients			X	
Sediment Quality	X			
HTRS			X	
Biological Characteristics				
RTE-Bald Eagle	X			
Aquatic Organisms				
Benthic Communities	X			
Fisheries	X			
Designated Spawning Area				X
Larval Habitat Area		X		
Crabs	X			
Mollusks				
Soft shell clams	X			
Hard shell clams				X
Oyster bars	X			
Terrestrial Wildlife	X			
Avian Wildlife				
Waterfowl concentration area	X			
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges		X		
SAV	X			
Wetlands				
Tidal Wetlands	X			
Non-tidal Wetlands	X			
Human Use Characteristics				
Groundwater			X	
Water Related Recreation	X			
Recreational and Commercial Fisheries				
Soft shell clams	X			
Hard shell clams				X
Oyster bars-NOB 7-6, -7, -8	X			
Crabs	X			
Recreationally important fisheries	X			
Commercially important fisheries	X			
Aesthetics				
Air Quality			X	
Noise		X		
Critical Areas	X			
Forested Areas	X			
Cultural Resources	X			
Archaeological Resources				X
Potential for Benefit	X			
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A** (Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Chesapeake Bay Program. 1996. High Value Living Resource Map of the Upper Bay. In a memo prepared for the Bay Enhancement Phase II Working Group.

Funderburk, S.L., S.J. Jordan, J.A. Mihursky and D. Riley. 1991. Habitat Requirements for Chesapeake Bay Living Resources. Second Edition. Chesapeake Bay Program

Maryland Department of Natural Resources. 1989. Natural Oyster Bar Maps. Prepared by Coast and Geodetic Survey for the Maryland Department of Natural Resources.

Maryland Geological Survey. 1971. Maryland Tidal Wetlands and Critical Area Inventory Maps. Based on County maps 1:2,400 scale organized by.

US Fish and Wildlife Service. 1979. National Wetland Inventory Maps. Non-Tidal Wetlands Maps. Prepared by Office of Biological Services. Based on USGS 7.5 minute topographic quadrangle map series.

3.5.18 Poplar Island Restoration Project

Island restoration sites using dredged material are placement areas created by constructing a physical structure to enclose an estuarine or marine area on the site of existing or previously existing islands. Poplar Island, like many islands in the Chesapeake Bay, has been severely eroded. It was determined that island restoration/creation could be an ideal solution to the dredged material management problem facing the Port of Baltimore. The group of islets known as Poplar Island are located in the upper middle Chesapeake Bay, approximately 34 nautical miles southeast of the Port of Baltimore and 2 miles northwest of Tilghman Island, Talbot County, Maryland (Figure 2-7).

Through the cooperative efforts of many state and Federal agencies, as well as private organizations, a project has been developed to reconstruct Poplar Island to its approximate size in 1847. This will be accomplished using suitable dredged material from the approach channels that are part of the Baltimore Harbor and Channels Federal navigation project. Although Poplar Island is farther from some of the areas needing maintenance, the additional costs were offset by the significant beneficial use outputs of the project. The accepted restoration plan, when fully implemented, would create a 1,100-acre dredged material placement area within a 35,000-foot perimeter dike. The area would then be filled with suitable dredged material obtained from periodic maintenance dredging of Federal navigation approach channels that serve the Port of Baltimore. The site can then be developed into low and high marsh wetlands and uplands. The planned placement capacity of this island restoration is 38 mcy.

During the public comment period on the first DEIS for the proposed open-water placement, considerable attention was given in the comments to using the planned capacity of Poplar Island in lieu of the proposed action. In response to these comments, using the planned capacity of Phases I and II are screened as options as are expanding the acreage of the planned restoration, increasing the dike height to increase capacity, and converting one or more wetland cells to upland.

3.5.19 Poplar Island - Phase I

Box XX-34
Screening of Poplar Island Phase I

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX..

3.5.19a Location.

3.5.19b Type of Placement Option.

3.5.19c Potential Placement Capacity.

Construction of the Phase I Poplar Island project (670 acres, 19 mcy) began in mid-1998 and the dike system will be ready for inflow operations in 2000. The current placement capacity for the site has already been designated for uses other than those proposed for Site 104. Annual capacity at Poplar Island is limited because of it's environmental restoration, construction, and operation schedule. It is currently planned to accept 3 million cubic yards in the Year 2000 and 2 million cubic yards in Years 2001 and 2002. After that, it will be limited to 1.5 mcy annually. Because Poplar Island has an annual maximum designed placement capacity limit of 2 mcy (beyond which the site may not meet its environmental restoration specifications), additional materials cannot be placed in this site without adversely affect restoration objectives or reducing the potential capacity of the upland component of the project due to trapping of water in successive sediment layers. Consequently, Poplar Island can not provide the capacity for the near-term shortfall that necessitates considering the Proposed Action.

3.5.19d Bathymetry/Topography.

3.5.19e Environmental Characteristics

Living Resources.

Water Quality.

Hydrodynamics.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.5.19f Construction Factors.

3.5.19g Institutional Constraints.

3.5.19h Estimated Costs.

3.5.19i Other Factors.

CENAB is considering the application of an innovative technique to prepare the restoration project to receive dredged material. The concept being considered is enhanced dewatering of the placement cells and drying and consolidation from the existing mud line up. This will involve continual pumping of the cell to keep it dry once initially dewatered. In theory, this approach could result in a reduction of pore water in the bottom sediments. The associated consolidation might nominally lower the bottom elevation, thereby increasing cell volume to a limited extent. Any increase in foundation strength that might result could potentially allow an increase in dike height. The principal reason for advance dewatering is to allow installation of underdrains in the cells to aid in the dewatering of the first several placements of dredged material. The underdrain system is anticipated to decrease markedly in capability following the first two placement cycles as the fine grained material clogs, and in effect, seals the underdrains. The additional capacity that might be gained cannot be effectively predicted. As the cell elevation is below the surrounding water level, the ability to keep it dewatered will depend upon environmental conditions encountered. Extremely wet conditions would reduce the potential effectiveness of this approach. Additionally, there have been additional requests for use of Poplar Island for the placement of suitable dredged material, including material from the proposed Wilson Bridge reconstruction project. Decisions on these requests are pending. Therefore, it is not clear whether any of the additional capacity that might be gained from the innovative approach discussed above would actually be available for sediments from the approach channels to the Port of Baltimore. For these reasons, the potential for increased capacity through enhanced dewatering techniques is not included in capacity estimates for either of Poplar Island Phases I and II.

3.5.19j Option Summary.

3.5.19k Option Data Sheet. [ADD DATA SHEET]

3.5.20 Poplar Island - Phase II

Box XX-35
Screening of Poplar Island Phase II

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX..

3.5.20a Location.

3.5.20b Type of Placement Option.

3.5.20c Potential Placement Capacity.

Construction of Phase II of the Poplar Island restoration project (450 acres, 19 mcy) is projected to begin in 19**XX**. Two additional wetland cells are projected to be ready for inflow operations in 19**XX**. It is anticipated that the Phase II wetland cells would be filled within three year of initial availability. The exterior dike for this cell is planned to remain open to the Bay for approximately **XX** years so as to serve as a sheltered harbor and staging area for filling of the Phase I and II wetland cells and the Phase I upland cell. The Phase II upland cell would not be available for use until the exterior dike is closed in approximately 19**XX**.

The Phase II upland cell capacity is estimated to be **XX** mcy. The actual capacity may vary from this estimate depending upon how much sand is excavated for dike construction. It is anticipated that there would be a more limited opportunity to increase capacity of the Phase II upland cell through enhanced dewatering because the depth and configuration of the excavated borrow area will likely inhibit the installation of an underdrain system throughout the cell. Once the upland cell is available, it would be capable or receiving an average annual inflow into it will be approximately **X.X** mcy. Higher inflow rates are anticipated during the first **X** to **Y** years of cell filling may be possible because the available volume of the borrow area provides substantially more capacity than had the cell not served as a borrow area. Once the sediment placed into the upland cell rises above the ambient Bay water level, the annual optimum placement potential will be reduced to a maximum of **X.X** mcy.

3.5.20d Bathymetry/Topography.

3.5.20e Environmental Characteristics

Living Resources.

Water Quality.

Hydrodynamics.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.5.20f Implementation Factors.

Construction Considerations.

Implementation Time Frame.

3.5.20g Institutional Constraints.

3.5.20h Estimated Costs.

3.5.20i Other Factors.

3.5.20j Option Summary.

3.5.20k Option Data Sheet. **[ADD DATA SHEET]**

3.5.21 Poplar Island Expanded Footprint

3.5.21a Location.

3.5.21b Type of Placement Option.

3.5.21c Potential Placement Capacity.

3.5.21d Bathymetry/Topography.

3.5.21e Environmental Characteristics

Living Resources.

Water Quality.

Hydrodynamics.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.5.21f Implementation Factors.

Construction Considerations.

Implementation Time Frame.

3.5.21g Institutional Constraints.

3.5.21h Estimated Costs.

3.5.21i Other Factors.

3.5.21j Option Summary.

3.5.21k Option Data Sheet. [ADD DATA SHEET]

3.5.22 Poplar Island Increase in Elevation

Box XX-36
Screening of Poplar Island Increase in Elevation

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX..

3.5.22a Location.

3.5.22b Type of Placement Option.

3.5.22c Potential Placement Capacity.

3.5.22d Bathymetry/Topography.

3.5.22e Environmental Characteristics

Living Resources.

Water Quality.

Hydrodynamics.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.5.22f Implementation Factors.

Construction Considerations.

Implementation Time Frame.

3.5.22g Institutional Constraints.

3.5.22h Estimated Costs.

3.5.22i Other Factors.

3.5.22j Option Summary.

3.5.22k Option Data Sheet. [ADD DATA SHEET]

3.5.23 Poplar Island Wetland Cell Conversion to Upland

Box XX-37
Screening of Poplar Island Wetland Cell Conversion to Upland

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX..

3.5.23a Location.

3.5.23b Type of Placement Option.

3.5.23c Potential Placement Capacity.

3.5.23d Bathymetry/Topography.

3.5.23e Environmental Characteristics.

Living Resources.

Water Quality.

Construction Considerations.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.5.23f Implementation Factors.

Construction Considerations.

Implementation Time Frame.

3.5.23g Institutional Constraints.

3.5.23h Estimated Costs.

3.5.23i Other Factors.

3.5.23j Option Summary.

3.5.23k Option Data Sheet. [ADD DATA SHEET]

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title:
Poplar Island – Lateral Expansion

Type:
Beneficial Use, Shoreline Stabilization

Location:

Chesapeake Bay in Talbot County, west of Tilghman Island.

Size: Current restoration project is 1100 acres. Proposed modification would laterally expand the project by 230 acres.

Potential Capacity: Approximately 12.7 mcy.

Availability:

Currently owned by the State of Maryland.

Nutrients: [Need info]

Infrastructure Required to Implement:
Infrastructure will be on site for the existing project.

Institutional Issues:
None.

Costs: [still working on this]

Total Unit Costs Per Cubic Yard: [Need]

Development & Implementation Costs:

COMMENTS:

Due to the poor foundation condition to the north, a lateral expansion to the south is necessary. This proposal modifies the current plan for Poplar Island, to footprint previously investigated as part of the feasibility study (alternative 2). However, unlike Alternative 2 from the feasibility study, it is assumed that the additional 230 acres will be entirely upland habitat. This alternative basically follows the 8-foot contour to the south of the project.

DRAFT DRAFT DRAFT DRAFT

TITLE: Poplar Island – Lateral Expansion

PROJECT TYPE: Beneficial-Use, shoreline stabilization

Existing Conditions	Presence*	Potential*	Unknown*	N/A*
Physical and Chemical Characteristics				
Substrate	X			
High Relief Area				X
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics	X			
Tidal Fluctuations				X
Salinity Gradients				X
Sediment Quality	X			
HTRS				X
Biological Characteristics				
RTE-Bald Eagle	X			
Aquatic Organisms				
Benthic Communities	X			
Fisheries				
Designated Spawning Area				X
Larval Habitat Area				X
Crabs		X		
Mollusks				
Soft shell clams	X			
Hard shell clams	X			
Oyster bars	X			
Terrestrial Wildlife	X			
Avian Wildlife				
Waterfowl concentration area	X			
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges		X		
SAV				X
Wetlands				
Tidal Wetlands	X			
Non-tidal Wetlands				X
Human Use Characteristics				
Groundwater				X
Water Related Recreation				X
Recreational and Commercial Fisheries				
Soft shell clams	X			
Hard shell clams	X			
Oyster bars	X			
Crabs		X		
Recreationally important fisheries		X		
Commercially important fisheries		X		
Aesthetics				
Air Quality			X	
Noise		X		
Critical Areas			X	
Forested Areas				X
Cultural Resources				X
Archaeological Resources				X
Potential for Benefit	X			
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for

impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A** (Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title:
Poplar Island – Upland Expansion

Type:
Beneficial Use, Shoreline Stabilization

Location:

Chesapeake Bay in Talbot County, west of Tilghman Island.

Size: Current restoration project is 1100 acres, 550 acres of which are upland. Each foot of increase in the elevation of the upland cells adds about 1.2 mcy of additional capacity. As an alternative to Site 104 (18 mcy), raising the dikes on the upland cells from +20 MLLW to +35 MLLW would be necessary.

Potential Capacity: Up to 18 mcy.

Availability:
Currently owned by the State of Maryland.

Nutrients: [Need info]

Infrastructure Required to Implement:
Infrastructure will be on site for the existing project.

Institutional Issues:
None.

Costs: [still working on this]

Total Unit Costs Per Cubic Yard: [Need]

Development & Implementation Costs:

COMMENTS:

Adding additional capacity by raising the dikes will extend the life of the project. However, since the surface area of the placement site is not increased for that time period, the annual placement would still need to be equal to or less than _._ mcy.

DRAFT DRAFT DRAFT DRAFT

TITLE: Poplar Island – Upland Expansion

PROJECT TYPE: Benifical-Use, shoreline stabilization

Existing Conditions	Presence*	Potential*	Unknown*	N/A*
Physical and Chemical Characteristics				
Substrate	X			
High Relief Area				X
Suspended Particulates, Turbidity				X
Water Quality				X
Hydrodynamics				X
Tidal Fluctuations				X
Salinity Gradients				X
Sediment Quality	X			
HTRS				X
Biological Characteristics				
RTE-Bald Eagle	X			
Aquatic Organisms				
Benthic Communities				X
Fisheries				X
Designated Spawning Area				X
Larval Habitat Area				X
Crabs				X
Mollusks				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife				X
Avian Wildlife				
Waterfowl concentration area	X			
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges		X		
SAV				X
Wetlands				
Tidal Wetlands	X			
Non-tidal Wetlands				X
Human Use Characteristics				
Groundwater				X
Water Related Recreation				X
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Crabs				X
Recreationally important fisheries				X
Commercially important fisheries				X
Aesthetics				
Air Quality			X	
Noise		X		
Critical Areas			X	
Forested Areas				X
Cultural Resources				X
Archaeological Resources				X
Potential for Benefit	X			
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for

impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A** (Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title:
Poplar Island – Wetland Modification

Type:
Beneficial Use, Shoreline Stabilization

Location:

Chesapeake Bay in Talbot County, west of Tiilghman Island.

Size: Current restoration project is 1100 acres. Proposed modification would convert one or more of the current wetland cells (550 acres total) to upland cells.

Potential Capacity: Approximately 3.4 – 21.4 mcy, depending on concept.

Availability:

Currently owned by the State of Maryland.

Nutrients: [Need info]

Infrastructure Required to Implement:
None.

Institutional Issues:
None.

Costs: [still working on this]

Total Unit Costs Per Cubic Yard: [Need]

Development & Implementation Costs:

COMMENTS:

Raising the dikes along the wetlands cells will allow an increase in both the annual and total capacity because the surface area of the placement site in the out years increases.
To be a stand alone alternative for the placement of 18 mcy, at least three of the four wetland cells would have to be converted to upland cells. Because such a move would affect the project's environmental restoration value, such a drastic plan is unlikely. However, converting one or two of the wetlands cells may be a viable alternative when combined with other placement sites.

DRAFT DRAFT DRAFT DRAFT

TITLE: Poplar Island – Wetlands Modification

PROJECT TYPE: Benificial-Use, shoreline stabilization

Existing Conditions	**Presence***	**Potential***	**Unknown***	**N/A***
Physical and Chemical Characteristics				
Substrate	X			
High Relief Area				X
Suspended Particulates, Turbidity				X
Water Quality				X
Hydrodynamics				X
Tidal Fluctuations				X
Salinity Gradients				X
Sediment Quality	X			
HTRS				X
Biological Characteristics				
RTE-Bald Eagle	X			
Aquatic Organisms				
Benthic Communities				X
Fisheries				X
Designated Spawning Area				X
Larval Habitat Area				X
Crabs				X
Mollusks				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife				X
Avian Wildlife				
Waterfowl concentration area	X			
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges		X		
SAV				X
Wetlands				
Tidal Wetlands	X			
Non-tidal Wetlands				X
Human Use Characteristics				
Groundwater				X
Water Related Recreation				X
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Crabs				X
Recreationally important fisheries				X
Commercially important fisheries				X
Aesthetics				
Air Quality			X	
Noise		X		
Critical Areas			X	
Forested Areas				X
Cultural Resources				X
Archaeological Resources				X
Potential for Benefit	X			
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for

impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A** (Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

3.5.24 Queenstown

Box XX-38
Screening of Queenstown

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX..

3.5.24a Location.

3.5.24b Type of Placement Option.

3.5.24c Potential Placement Capacity.

3.5.24d Bathymetry/Topography.

3.5.24e Environmental Characteristics

Living Resources.

Water Quality.

Hydrodynamics.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.5.24f Implementation Factors.

Construction Considerations.

Implementation Time Frame.

3.5.24g Institutional Constraints.

3.5.24h Estimated Costs.

3.5.24i Other Factors.

3.5.24j Option Summary.

3.5.24k Option Data Sheet. [ADD DATA SHEET]

Queenstown (Upland Placement, Fastland Creation)

This site was proposed during the MDOT Master Plan process. The proposed site was 520 acres along the south shore of the Chester River, Queenstown , Queen Anne's County (Figure 2-4). Estimated capacity is 9 mcy. During the initial site identification process, the site was found to contain ~~There are~~ tidal and non-tidal wetlands ~~near and on the project, as well as forested~~and forested areas. Initial estimates of wetlands and forested areas are ~~The exact amount of acreage of wetlands is approximately~~ 9 acres ad 500 acres, respectively. ~~As a worst-case assessment, therefore, approximately 500 acres of forested area would be impacted. The site is adjacent to SAV beds.~~ The site was initially chosen due to the ~~There is~~ access from deep water and ~~there are~~ no known archeological or historical sites on or near the property. ~~The site is far from both CENAB and CENAP channels which would add as much as $1.70 per cubic yard to the cost of placement (relative to Site 104) (Section 7). For these reasons the site is impracticable at the current time.~~ Since the initial identification of this site, the property has been developed as a golf~~d~~ course and would no longer be available for dredged material placement.

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title:
Queenstown

Type:
Upland Placement; Fastland Creation

Location: Southern Shore of Chester River in Queen Anne's County

Size: approximately 520 acres

Potential Capacity: approximately 9 mcy

Availability: Privately Owned; Developed into a golf course since 1990.

Nutrients: NA

Infrastructure Required to Implement:

Site no longer under consideration due to the current land use.

Institutional Issues:

Site no longer under consideration due to the current land use.

Costs: NA

COMMENTS:
Resource information not updated because site is no longer available for placement.

DRAFT DRAFT DRAFT DRAFT

TITLE: Queenstown **PROJECT TYPE**: Upland; Fastland Creation

Existing Conditions	Presence*	Potential*	Unknown*	N/A*
Physical and Chemical Characteristics				
Substrate-very soft soils			X	
High Relief Area				X
Suspended Particulates, Turbidity				X
Water Quality				X
Hydrodynamics				X
Tidal Fluctuations				X
Salinity Gradients				X
Sediment Quality			X	
HTRS			X	
Biological Characteristics				
RTE-			X	
Aquatic Organisms				
Benthic Communities				X
Fisheries				X
Designated Spawning Area-anadromous				X
Larval Habitat Area-anadromous				X
Crabs				X
Mollusks				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife			X	
Avian Wildlife				
Waterfowl concentration area				X
Land and/or Waterbirds				X
Special Aquatic Sites				
Sanctuaries and Refuges				X
SAV				X
Wetlands				
Tidal Wetlands	X			
Non-tidal Wetlands				X
Human Use Characteristics				
Groundwater			X	
Water Related Recreation				X
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Crabs				X
Recreationally important fisheries				X
Commercially important fisheries				X
Aesthetics				
Air Quality			X	
Noise			X	
Critical Areas	X			
Forested Areas				X
Cultural Resources			X	
Archaeological Resources			X	
Potential for Benefit				X
Potential to Minimize Adverse Effects				X

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A** (Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Maryland Port Administration. 1990. Port of Baltimore: Dredged Material Management Master Plan. Report prepared for MPA by Gahagan and Bryant Associates and EA Engineering, Science and Technology, Inc. Unpublished.

US Fish and Wildlife Service. 1979. National Wetland Inventory Maps. Non-Tidal Wetlands Maps. Prepared by Office of Biological Services. Based on USGS 7.5 minute topographic quadrangle map series.

Maryland Tax Records.

3.5.25 Rocky Point

Box XX-39
Screening of Rocky Point Upland Containment Cell

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX..

3.5.25a Location.

3.5.25b Type of Placement Option.

3.5.25c Potential Placement Capacity.

3.5.25d Bathymetry/Topography.

3.5.25e Environmental Characteristics

Living Resources.

Water Quality.

Hydrodynamics.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.5.25f Implementation Factors.

Construction Considerations.

Implementation Time Frame.

3.5.25g Institutional Constraints.

3.5.25h Estimated Costs.

3.5.25i Other Factors.

3.5.25j Option Summary.

3.5.25k Option Data Sheet. [ADD DATA SHEET]

Rocky Point (Upland Placement)

Rocky Point is an upland site on the Eastern shore of the Upper Bay north of Worton Point (Figure 2-3). This site was evaluated during the MPA Master Plan process (MDOT 1991). Tidal and non-tidal wetlands and forested areas occur in and near the proposed site. ~~The ability to obtain riparian access for pumping dredged material into the site is unknown.~~ This site has an approximate size of 360 acres and an estimated placement capacity of 6 mcy. A conservative estimate would be that 360 acres of wetlands and forest would be lost to placement site development. The site is closer to CENAP channels than to CENAB channels. The predominant current use of the site and area surrounding the site is agricultural. The current landowner has no interest in allowing placement to occur on the property so the option is not viable presently.

P:\Federal\DOD\ARMY\projects\6095793\NewDraft\Revised DEIS\Chapter_02\Rocky Point (Upland Placement).doc

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title:
Rocky Point

Type:
Upland Placement

Location: Eastern Side of Rocky Point, Kent County.

Size: approximately 360 acres

Potential Capacity: approximately 6 mcy

Availability: Privately Owned; Landowner not interested in accepting dredged material

Nutrients: NA

Infrastructure Required to Implement:

Site no longer under consideration due to the current land use/availability

Institutional Issues:

Site no longer under consideration due to the current land use/availability.

Costs: NA

COMMENTS:
Resource information not updated because site is not considered available for placement. Currently in private agriculture.

DRAFT DRAFT DRAFT DRAFT

TITLE: Rocky Point **PROJECT TYPE**: Upland

Existing Conditions	**Presence***	**Potential***	**Unknown***	**N/A***
Physical and Chemical Characteristics				
Substrate-very soft soils				X
High Relief Area				X
Suspended Particulates, Turbidity				X
Water Quality				X
Hydrodynamics				X
Tidal Fluctuations				X
Salinity Gradients				X
Sediment Quality				X
HTRS				X
Biological Characteristics				
RTE-		X		
Aquatic Organisms				
Benthic Communities				X
Fisheries				X
Designated Spawning Area-anadromous				X
Larval Habitat Area-anadromous				X
Crabs				X
Mollusks				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife		X		
Avian Wildlife				
Waterfowl concentration area				X
Land and/or Waterbirds		X		
Special Aquatic Sites				
Sanctuaries and Refuges				X
SAV				X
Wetlands				
Tidal Wetlands				X
Non-tidal Wetlands				X
Human Use Characteristics				
Groundwater			X	
Water Related Recreation				X
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Crabs				X
Recreationally important fisheries				X
Commercially important fisheries				X
Aesthetics				
Air Quality			X	
Noise			X	
Critical Areas			X	
Forested Areas		X		
Cultural Resources			X	
Archaeological Resources			X	
Potential for Benefit				X
Potential to Minimize Adverse Effects				X

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A** (Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Maryland Port Administration. 1990. Port of Baltimore: Dredged Material Management Master Plan. Report prepared for MPA by Gahagan and Bryant Associates and EA Engineering, Science and Technology, Inc. Unpublished.

Maryland Tax Records.

3.5.26 Sollers Point

Box XX-40
Screening of Sollers Point Beneficial Use

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX..

3.5.26a Location.

3.5.26b Type of Placement Option.

3.5.26c Potential Placement Capacity.

3.5.26d Bathymetry/Topography.

3.5.26e Environmental Characteristics

Living Resources.

Water Quality.

Hydrodynamics.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.5.26f Implementation Factors.

Construction Considerations.

Implementation Time Frame.

3.5.26g Institutional Constraints.

3.5.26h Estimated Costs.

3.5.26i Other Factors.

3.5.26j Option Summary.

3.5.26k Option Data Sheet. [ADD DATA SHEET]

~~2.2.3.a.17~~ Sollers Point

~~This proposed site is 90 acres in the Harbor, is located near the Francis Scott Key Bridge, and has a relatively small capacity (4 mcy). The original concept included land creation for industrial use. The area is considered environmentally degraded. Disadvantages of using the site include the need to move large quantities of sediment and debris, loss of wetlands, and bottom material unfavorable for construction of containment dikes. Dike construction in this area would be restricted due to the statute that restricts dike construction within a 5 mile radius of Hart-Miller Island. In order to raise dikes in this area, supportive public opinion would need to force a change in the current state law.~~

This proposed site is 90 acres in the Baltimore Harbor, at latitude 39° 14, longitude 76° 31.2`, located just southeast of the Francis Scott Key Bridge. It has a relatively small capacity volume of 4 mcy. The original concept included land creation for industrial use. The area is considered environmentally degraded.

Disadvantages of using the site include the need to move large quantities of sediment and debris, loss of wetlands, and bottom material unfavorable for construction of containment dikes. Dike construction in this area would be restricted due to the statute that restricts dike construction within a 5 mile radius of Hart-Miller Island. In order to raise dikes in this area, supportive public opinion would need to force a change in the current State law.

Maryland's Chesapeake Bay Water Quality Monitoring Program has monitored water quality throughout the Bay since 1984. One Chesapeake Bay Program Water Quality Station in the Inner Harbor is located in the vicinity of the proposed project site. This data set provides the best representative water quality data for the proposed site. Salinity can be classified as high mesohaline (10-18 ppt) in the summer and fall and a low mesohaline (5-10 ppt) primarily occurring in late winter and spring. Surface DO concentrations range from 4.5-12.0 mg/L with bottom concentration ranges at 1-10 mg/L. Sollers Point is a shallow area and would be expected to have sufficient DO to sustain aquatic life. Turbidity in the region, measured as total suspended solids (TSS) is consistent throughout the season ranging from 10 to 30 mg/L. Chlorophyll-a concentrations are generally low and variable by season. Particulate phosphorous is generally steady throughout the year with low concentrations at the surface (mean 0.04 mg/L) when compared with a mean concentration of 0.40 mg/L in deeper regions.

There is no record of submerged aquatic vegetation (SAV) for the proposed site. SAV provides excellent habitat for organisms but due to depth and turbidity does not occur. Benthic communities provide a major trophic link in the Chesapeake Bay food chain. A biological study of Baltimore Harbor represents the best data for the proposed site. A total of 27 species were found in the harbor, which is low in comparison with other areas of the Chesapeake Bay. Most species were attributed to 3 major phyla, the mollusks (clams and snails), the arthropods (crustaceans), and the annelids (worms). The bottom sediments of Baltimore Harbor are mostly soft silts and clays, which generally favor burrowing invertebrates such as worms (Cronin 1971).

Finfish and shellfish in the Chesapeake Bay are valuable commercial and recreational fisheries resources. Finfish concentrations are lower within the proposed site compared to other regions of the Chesapeake Bay. White perch were the most abundant fish species in terms of numbers caught. No striped bass eggs or early larvae were found due to the lack of water velocities in freshwater areas normally associated with successful striped bass spawning. The harbor has lower salinities constituting greater numbers of freshwater species when compared with other proposed sites. A combination of uninhabitable bottom sediments and low oxygen levels (especially summer months) combine to exclude many species of bottom fish throughout deeper areas of the harbor. The proposed area is shallower and fish exclusion does not occur as readily. Oysters are predominantly harvested in lower reaches of the upper Bay (Chris Judy, MDNR, August 1997). Eastern oyster habitat distribution is excluded from the proposed area. There is a low density of female and male blue crabs. The only rare, threatened, or endangered species (RTE) within the area is the bald eagle. Due to the urbanization of the area, bald eagles are of no concern for the proposed site.

P:\Federal\DOD\ARMY\projects\6095793\NewDraft\Revised DEIS\Chapter_02\Sollers Point.doc

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title:
Sollers Point

Type:
Fast Land Creation

Location: The site is located in the Patapsco River, within Baltimore Harbor, immediately adjacemt to the Francis Scott Key Bridge.

Size: approximately 90 acres

Potential Capacity: approximately 4 mcy

Availability: State Owned

Nutrients: [Need info]

Infrastructure Required to Implement:

Access channel, unloading facilities, de-watering facilities, and containment structures.

Institutional Issues:
Concept could violate State law of no containment facility within 5 miles of HMI pleasure Island chain.
Permitting required for construction in shallow water habitat.
Permitting required for critical area development
Permitting required for wetland disturbance.

Costs: []

Total Unit Costs Per Cubic Yard: [NEED!]

Development & Implementation Costs: [NEED!]

COMMENTS:
Area considered degraded.
Benthic diversity poor.
Wetlands, shallow water habitat, and Chesapeake Bay Critical Area would be involved in concept.

DRAFT DRAFT DRAFT DRAFT

TITLE: Sparrows Point **PROJECT TYPE:** Habitat Development

Existing Conditions	Presence*	Potential*	Unknown*	N/A*
Physical and Chemical Characteristics				
Substrate-very soft soils	X			
High Relief Area				X
Suspended Particulates, Turbidity	X			
Water Quality		X		
Hydrodynamics			X	
Tidal Fluctuations			X	
Salinity Gradients			X	
Sediment Quality		X		
HTRS			X	
Biological Characteristics				
RTE-			X	
Aquatic Organisms				
Benthic Communities	X			
Fisheries		X		
Designated Spawning Area-anadromous				X
Larval Habitat Area-anadromous				X
Crabs		X		
Mollusks				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife			X	
Avian Wildlife				
Waterfowl concentration area			X	
Land and/or Waterbirds		X		
Special Aquatic Sites				
Sanctuaries and Refuges			X	
SAV				X
Wetlands				
Tidal Wetlands	X			
Non-tidal Wetlands				X
Human Use Characteristics				
Groundwater			X	
Water Related Recreation		X		
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Crabs		X		
Recreationally important fisheries		X		
Commercially important fisheries		X		
Aesthetics				
Air Quality			X	
Noise			X	
Critical Areas	X			
Forested Areas			X	
Cultural Resources		X		
Archaeological Resources			X	
Potential for Benefit	X			
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A** (Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Chesapeake Bay Program. 1996. High Value Living Resource Map of the Upper Bay. In a memo prepared for the Bay Enhancement Phase II Working Group.

Funderburk, S.L., S.J. Jordan, J.A. Mihursky and D. Riley. 1991. Habitat Requirements for Chesapeake Bay Living Resources. Second Edition. Chesapeake Bay Program

Maryland Department of Natural Resources. 1989. Natural Oyster Bar Maps. Prepared by Coast and Geodetic Survey for the Maryland Department of Natural Resources.

Maryland Geological Survey. 1971. Maryland Tidal Wetlands and Critical Area Inventory Maps. Based on County maps 1:2,400 scale organized by.

US Fish and Wildlife Service. 1979. National Wetland Inventory Maps. Non-Tidal Wetlands Maps. Prepared by Office of Biological Services. Based on USGS 7.5 minute topographic quadrangle map series.

Harbor Fisheries Report (need References).

3.5.27 Sparrows Point Habitat Development

The MPA proposed to develop a 300 to 400 acre site into intertidal wetlands and upland habitat. The wetlands would provide improved habitat along the shoreline whereas the upland habitat would act as a buffer between the Bethlehem Steel facility and the project and would also serve as a visual buffer to the industrialized area when viewed from the east (MES and MPA, 1983). This proposal was opposed by local citizens whose support was needed to

Box XX-41
Screening of Sparrows Point Beneficial Use

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide 10.3 mcy, or approximately 60% of the need. Site specific conditions would limit annual inflow to 800,000 cy, once the site were fully available.
2. Availability: The shoreline is owned by Bethlehem Steel. For planning purposes, it is assumed that suitable arrangements could be made for use of the shoreline. The bottom is owned by the State and is considered to be available.
3. Environmental Suitability: Bottom habitat would be permanent converted to wetlands and upland habitat. It appears that the overall environmental value of the site would be improved. Although the loss of bottom habitat is a locally important issue, it is not sufficient to singularly screen out this option.
4. Infrastructure Readiness: Based on existing circumstances, the project would not be ready for use when needed.
5. Institutional Feasibility: Use of the site is considered constrained by State law. The institutional constraint could be clarified, removed or waived at the discretion of the Legislature of the State of Maryland.
6. Prospective Affordability: The estimated unit cost ($11-$15) is below the screening threshold.
7. Potential for Environmental Improvements: Replacement of marginally productive bottom habitat with higher value wetlands buffered by upland habitat.

Results of Screening: The Sparrows Point beneficial use project is not suitable as either a standalone alternative or as a component of a multi-option alternative because capacity would not be available when needed.

3.5.27a Location.

A 300 to 400 acre habitat development project was proposed for the southern end of Sparrows Point in Baltimore County (Figure 2-7).

3.5.27b Type of Placement Option.

The project was planned to establish a habitat enhancement project contiguous to industrial shoreline by converting relatively poor bottom to aquatic and intertidal wetlands, high marsh, and upland nesting areas in order to benefit living resources. The habitat that would have been created was also envisioned as providing aesthetic relief for the entrance to the harbor. A beneficial use project in the form of habitat improvements to an industrial shoreline was proposed.

3.5.27c Potential Placement Capacity.

The Sparrows Point beneficial use project could potentially provide approximately 10.3 mcy of placement capacity (MES and MPA, 1993). However, site-specific conditions would necessitate a modest annual inflow rate of approximately 800,000 cy, with lower rates during the first and last years of placement. The projected filling cycle was 16 years from the time of initial availability for placement.

3.5.27d Bathymetry/Topography. Relatively shallow open-water area immediately south of and contiguous to the Sparrows Point shoreline.

3.5.27e Environmental Characteristics

Living Resources. An environmental study determined that the area's biological productivity was similar to that of other areas inside the harbor, but less productive than the Bay (MES, 1995a).

Water Quality. [XXXX]

Hydrodynamics. [XXXX]

Rare, Threatened or Endangered (RTE) Species. [XXXX]

Fishing Activity. No commercial fishing is authorized in the area.

Recreational Activity. Recreational boating and fishing is reported to occur in the area. The loss of recreational water area due to past filling of Bay bottom by Bethlehem Steel was cited by many citizens as reason for there opposition to the conversion of bottom habitat that would result from the proposed beneficial use project (Hamons and Young, 1999).

Historical/Archeological. [XXXX]

Groundwater: [XXXX]

View Shed. The existing view shed is of an industrialized shoreline. The view shed would be modified through the addition of wetlands and uplands.

3.5.27f Implementation Factors.

Construction Considerations. The MPA investigated use of this site, with preliminary conceptual designs and pre-feasibility environmental studies. Preliminary engineering determined that a project at the site was feasible. However, poor foundation conditions would necessitate highly specialized construction techniques in order to "float" a structure to enclose the site (GBA et al., 1992; Hamons and Young, 1999; MES and MPA, 1993).

Implementation Time Frame. In the absence of support for removal of the institutional constraint associated with this project, habitat development has been maintained as a DNPOP option but efforts to implement the project have been suspended indefinitely. Based on the accelerated time frame for the Poplar Island restoration project, it is estimated that it would take 9 or more years to implement the project of this scale from a cold start.

3.5.27g Institutional Constraints.

Institutional difficulties exist from the prohibition in current state law for construction of a containment facility within a 5 mile radius of the Hart-Miller-Pleasure Island chain. Although the proposed project was intended to improve habitat, it nevertheless would have required the water area to be fully enclosed because of site-specific conditions. Attempts on behalf of the MPA to secure citizen support for the beneficial use project and for a revision to the law were not successful (Hamons and Young, 1999).

3.5.27h Estimated Costs.

Estimated costs to construct the facility were on the order of $23 to $29.5 million, depending upon dike construction materials. The estimated unit cost in 1992 dollars was approximately $10.40 (DNPOP, 1992; GBA et al., 1992). It is estimated that if constructed today, unit costs could be in the $11 to $15 range per cubic yard, depending upon construction techniques and materials.

3.5.27i Other Factors.

Federal funding for a beneficial use project at Sparrows Points is uncertain. Potentially, a project could be undertaken using Section 204 standing authority. However, the estimated construction cost is approximately double the annual cap on Section 204 funds that are competed for nationally. In view of the cost, a special Congressional funding appropriation may be required to undertake construction as a Section 204 project.

3.5.27j Option Summary.

The existing institutional constraint would need to be removed for the Sparrows Point beneficial use project to become practicable as an alternative to the proposed action. However, the time frame for implementing a beneficial use project precludes its selection as an alternative.

3.25.27k Option Data Sheet. [ADD DATA SHEET]

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title:
Sparrows Point

Type:
Beneficial Use, Habitat Creation

Location: The site is located on the Sparrows Point Plant of the Bethlehem Steel Corporation along the Patapsco River in Baltimore County

Size: approximately 300 acres

Potential Capacity: approximately 10 mcy

Availability: Privately Owned

Nutrients: [Need info]

Infrastructure Required to Implement:

Access channel, unloading facilities, de-watering facilities, and containment structures.

Institutional Issues:

Concept violates State law of no containment facility within 5 miles of HMI pleasure Island chain.
Permitting required for construction in shallow water habitat.
Permitting required for critical area development
Permitting required for wetland disturbance.
Permitting required for potential disturbance of anadromous fish spawning

Costs: **[total costs 25 million, GBA 1992]**

Total Unit Costs Per Cubic Yard: **[NEED!]**

Development & Implementation Costs: **[NEED!]**

COMMENTS:
Black crowned night heron colony size in 1988 greater than 70.
Located in a spawning area for anadromous fish such as herring, white perch and yellow perch.
Mesozooplankton and Microzooplankton abundances found in MES (1995) study to be typical for that area of the Chesapeake Bay. Bear Creek station was rated poor in terms of speculation and abundance of fish and crabs. Bay anchovy, spot and white perch comprised over 90% of trawl catch.
MES 1995 study found that Sparrows Point does not support a biological community unique to other sites sampled in the Baltimore Harbor area. Site met the Restoration Goals index of 3 for benthos.

DRAFT DRAFT DRAFT DRAFT

TITLE: Sparrows Point **PROJECT TYPE:** Habitat Development

Existing Conditions	Presence*	Potential*	Unknown*	N/A*
Physical and Chemical Characteristics				
Substrate-very soft soils	X			
High Relief Area				X
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics	X			
Tidal Fluctuations	X			
Salinity Gradients			X	
Sediment Quality	X			
HTRS		X		
Biological Characteristics				
RTE-			X	
Aquatic Organisms				
Benthic Communities	X			
Fisheries	X			
Designated Spawning Area-anadromous	X			
Larval Habitat Area-anadromous	X			
Crabs	X			
Mollusks				
Soft shell clams	X			
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife			X	
Avian Wildlife				
Waterfowl concentration area	X			
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges		X		
SAV				X
Wetlands				
Tidal Wetlands	X			
Non-tidal Wetlands	X			
Human Use Characteristics				
Groundwater			X	
Water Related Recreation		X		
Recreational and Commercial Fisheries				
Soft shell clams	X			
Hard shell clams				X
Oyster bars				X
Crabs	X			
Recreationally important fisheries	X			
Commercially important fisheries	X			
Aesthetics				
Air Quality			X	
Noise			X	
Critical Areas	X			
Forested Areas	X			
Cultural Resources		X		
Archaeological Resources			X	
Potential for Benefit	X			
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A** (Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Chesapeake Bay Program. 1996. High Value Living Resource Map of the Upper Bay. In a memo prepared for the Bay Enhancement Phase II Working Group.

Gahagan & Bryant Associates. 1992. Feasability Evaluation of Bethlehem Steel Shoreline Enhancement Project. November 1992. Prepared for Maryland Port Administration

Funderburk, S.L., S.J. Jordan, J.A. Mihursky and D. Riley. 1991. Habitat Requirements for Chesapeake Bay Living Resources. Second Edition. Chesapeake Bay Program

Maryland Department of Natural Resources. 1989. Natural Oyster Bar Maps. Prepared by Coast and Geodetic Survey for the Maryland Department of Natural Resources.

Maryland Environmental Service and Maryland Port Administration. 1993. Sparrows Point Shoreline Reclamation Briefing. Spring of 1993.

Maryland Environmental Service. 1995. Sparrows Point Shoreline Reclamation Project: Assessment of Biological Productivity. August 1995. Prepared for The Maryland Port Administration.

Maryland Geological Survey. 1971. Maryland Tidal Wetlands and Critical Area Inventory Maps. Based on County maps 1:2,400 scale organized by.

US Fish and Wildlife Service. 1979. National Wetland Inventory Maps. Non-Tidal Wetlands Maps. Prepared by Office of Biological Services. Based on USGS 7.5 minute topographic quadrangle map series.

3.5.28 Swan Point Peninsula

Box XX-42
Screening of Swan Point Peninsula

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX..

3.5.28a Location.

3.5.28b Type of Placement Option.

3.5.28c Potential Placement Capacity.

3.5.28d Bathymetry/Topography.

3.5.28e Environmental Characteristics.

Living Resources.

Water Quality.

Hydrodynamics.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.5.28f Implementation Factors.

Construction Considerations.

Implementation Time Frame.

3.5.28g Institutional Constraints.

3.5.28h Estimated Costs.

3.5.28i Other Factors.

3.5.28j Option Summary.

3.5.28k Option Data Sheet. [ADD DATA SHEET]

~~2.2.3.a.3~~ Swan Point Peninsula Restoration (Beneficial Use, Upland Placement, Fastland Creation)

Swan Point in Kent County has been severely eroded. Projects proposed as DNPOP placement options on Swan Point have included a beneficial use project or a containment project for clean dredged material. It is estimated that a beneficial use project would result in approximately 2 to 5 mcy of capacity. It is estimated that a dike system connected to Swan Point for containment could result in approximately 10 mcy of capacity. This area is known to provide fish nursery habitat, is a waterfowl use area, and has viable oyster and clam bars in the immediate vicinity. Eagles, a recently proposed delisted endangered species, had been ~~and listed Rare, Threatened or Endangered species (eagles) have been~~ preliminarily identified by resource agencies as present near or in the project area. –Swan Point, like the majority of the Chesapeake Bay shoreline, is potential habitat for the bald eagle. [ADDITIONAL INFORMATION ON WATERFOWL AND FISH SPECIES FOR THE SWAN POINT PENINSULA MAY BE PROVIDED BY NICK CARTER OF MDNR]

Water quality characteristics for the area adjacent to Swan Point are expected to be similar to those reported for station MCB3.2 of the Chesapeake Bay Water Quality Program. Surface salinities have historically fallen within the oligohaline to mesohaline range (0 ~~ppt~~ to 14 ppt) (1992–1996 data). Bottom salinities fall in the upper mesohaline (10–18 ppt) range throughout most of the year, with the exception of years with above normal precipitation. Because MCB3.2 lies in the deeper, central area of the Bay, the water column exhibits vertical salinity stratification, with a distinct upper fresher layer and lower saltier layer. Bottom waters in these areas typically exhibit low DO during the summer and early fall (<1 mg/L), and surface waters average approximately 6 mg/L during mid-summer (CBP 1999). Historical Secchi data indicate that water clarity in the region is typically reduced during the spring, and is greatest in the late summer and early fall. Bottom total suspended solids (TSS) concentrations at MCB3.2 have historically ranged from 3 ~~mg/L~~ to 271 mg/L throughout the year, with a mean of 27 mg/L (1984–1997 data). Particulate phosphorus levels in the bottom waters during the 1984 through 1997 sampling period ranged from a high of 0.086 to 0.004 mg/L (CBP 1999). Particulate phosphorus in the surface waters of the area during the same sampling period ranged from 0.14 to 0.015 mg/L. Levels of nitrogen as nitrite + nitrate ranged from 0.99 to approximately 0.0 in the bottom waters while the level of nitrogen ranged from 1.75 to approximately 0.0 in the surface waters of the region (CBP 1999). Typically, concentrations of ammonia are elevated in anoxic bottom waters in the deep central regions of the Bay and peak during the summer (CBPWQM 1997).

A 1998 survey of submerged aquatic vegetation (SAV) in the region detected beds of SAV along the shoreline of Tavern and Swan creeks (VIMS 1999). No SAV was observed along the Swan Point shoreline of the Chesapeake Bay although the shallow depths adjacent to the shoreline would not preclude the potential for the existence of SAV near the Swan Point site. The shallow depths west and south of Swan Point may also provide shallow water habitat for various species.

A large portion of Swan Point is within the State of Maryland's Chesapeake Bay Critical Area and may contain both palustrine and estuarine wetland areas (MES GIS 1995). The presence of archeological resources may also be likely over the entire Swan Point area (MES GIS 1995).

The area immediately west of Swan Point provides summer habitat for a high density of male blue crabs, but little to no habitat value during the winter months for both male and female blue crabs. This same area includes a low density of softshell clams. Eastern oyster habitat is present within the region but does not extend to the shoreline of Swan Point (Funderburk et al. 1991).

Although time of year restrictions on placement may be sufficient to protect fisheries resources, the other natural resources at the site would still be vulnerable. The extent of wetland and forest acreage in the area has not yet been determined by studies performed to date. A conservative estimate would be that 18 acres of wetlands and forest would be lost to placement site development. ~~Due to these constraints, the alternative was dropped from further consideration.~~

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title:
Swan Point Peninsula

Type:
Beneficial Use; Fastland Creation; Upland Placement

Location:
Swan Point Peninsula is in Queen Anne's County immediately east of the mouth of the Patapsco River (Baltimore Harbor). The area considered is near the tip of the peninsula which has been severely eroded.

Size: Swan Point is approximately _____ yards long.

Potential Capacity: Beneficial use options would be provide approximately 2 to 5 mcy of placement. A dike system constructed adjacent to the site could provide as much as 10 mcy of capacity.

Availability: State Owned

Nutrients: [Need info]

Infrastructure Required to Implement:
Some diking or a berm would be required to contain the fine grained material.

Institutional Issues:
Much of the site would lie within the Chesapeake Bay Critical Area.

Costs:

Total Unit Costs Per Cubic Yard: [NEED!]

Development & Implementation Costs: [NEED!]

COMMENTS:
Commercial and recreational fisheries impacts
Waterfowl Use Area
Presence of SAV and Shallow Water Habitat
Swan Point Oyster Bar in vicinity
Within Chesapeake Bay Critical Area

DRAFT DRAFT DRAFT DRAFT

TITLE: Swan Point Peninsula **PROJECT TYPE:** BU; FC; UP

Existing Conditions	Presence*	Potential*	Unknown*	N/A*
Physical and Chemical Characteristics				
Substrate			X	
High Relief Area			X	
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics			X	
Tidal Fluctuations	X			
Salinity Gradients	X			
Sediment Quality			X	
HTRS			X	
Biological Characteristics				
RTE	X			
Aquatic Organisms				
Benthic Communities	X			
Fisheries	X			
Designated Spawning Area		X		
Larval Habitat Area	X			
Crabs	X			
Mollusks				
Soft shell clams	X			
Hard shell clams				X
Oyster bars	X			
Terrestrial Wildlife		X		
Avian Wildlife				
Waterfowl concentration area	X			
Land and/or Waterbirds		X		
Special Aquatic Sites				
Sanctuaries and Refuges			X	
SAV	X			
Wetlands				
Tidal Wetlands	X			
Non-tidal Wetlands				X
Human Use Characteristics				
Groundwater			X	
Water Related Recreation		X		
Recreational and Commercial Fisheries				
Soft shell clams	X			
Hard shell clams				X
Oyster bars	X			
Crabs	X			
Recreationally important fisheries	X			
Commercially important fisheries	X			
Aesthetics				
Air Quality				X
Noise				X
Critical Areas	X			
Forested Areas		X		
Cultural Resources				X
Archaeological Resources			X	
Potential for Benefit	X			
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A** (Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Chesapeake Bay Program. 1996. High Value Living Resource Map of the Upper Bay. In a memo prepared for the Bay Enhancement Phase II Working Group.

Funderburk, S.L., S.J. Jordan, J.A. Mihursky and D. Riley. 1991. Habitat Requirements for Chesapeake Bay Living Resources. Second Edition. Chesapeake Bay Program

Maryland Department of Natural Resources. 1989. Natural Oyster Bar Maps. Prepared by Coast and Geodetic Survey for the Maryland Department of Natural Resources.

Maryland Geological Survey. 1971. Maryland Tidal Wetlands and Critical Area Inventory Maps. Based on County maps 1:2,400 scale organized by.

US Fish and Wildlife Service. 1979. National Wetland Inventory Maps. Non-Tidal Wetlands Maps. Prepared by Office of Biological Services. Based on USGS 7.5 minute topographic quadrangle map series.

3.5.29 Worton Point Beneficial Use

Box XX-43
Screening of Worton Point Beneficial Use

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX..

3.5.29a Location.

3.5.29b Type of Placement Option.

3.5.29c Potential Placement Capacity.

3.5.29d Bathymetry/Topography.

3.5.29e Environmental Characteristics

Living Resources.

Water Quality.

Hydrodynamics.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.5.29f Implementation Factors.

Construction Considerations.

Implementation Time Frame.

3.5.29g Institutional Constraints.

3.5.29h Estimated Costs.

3.5.29i Other Factors.

3.5.29j Option Summary.

3.5.29k Option Data Sheet. [ADD DATA SHEET]

3.5.30 Innovative Use of Dredged Material

The concept of using dredged material as a non-traditional or economic resource (e.g., turning it back into soil products), a form of "beneficial use," has been widely discussed as a constructive approach to managing dredged material. For the purpose of this annex, the concept of using dredged sediments as an economic or non-traditional resource for the production of products or for non-traditional end uses is referred to as "innovative use" to distinguish it from more traditional habitat enhancement and restoration applications.

Box XX-44
Screening of Innovative Use of Dredged Material

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Up to100,000 cy if successful at production scale. Increase in throughput potential in excess of 100,000 cy would need to be progressively established. All production scale throughput is unproven for the Port of Baltimore.
2. Availability: Indefinite.
3. Environmental Suitability: Site, process, product, and end use dependent.
4. Infrastructure Readiness: Indefinite. Depends upon the results of research and development and market availability.
5. Institutional Feasibility: Site, process, product and end use dependent.
6. Prospective Affordability: The estimated unit cost for products and end uses ($25 to $100+ cy) exceeds the upper cost screening threshold. Costs for farm applications are anticipated to approximate the costs of upland containment facilities, on the order to $10-$15 per cy. Such costs would be below the upper screening threshold but have yet to be demonstrated in practical application for the Port of Baltimore. The majority of costs would likely have to be borne by the local sponsor.
7. Potential for Environmental Improvements: No direct improvement. Potential for indirect improvement through innovative uses of products and for certain end uses such as those which are associated with site remediation.

Results of Screening: Innovative use is not suitable for consideration as an alternative or as a component of a multi-option alternative because the approach has not yet been proven capable of providing a continuing capability for utilizing dredged sediments, there is limited potential for annual throughput on the scale needed, and exceptionally high costs for most applications. The potential of innovative use to make a meaningful contribution to dredged material management for the Port of Baltimore cannot be determined at this time.

The innovative use of dredged sediments is not a new issue for the Port of Baltimore nor are the many suggestions that dredged material be recycled for the reclamation of mines and sand and gravel pits. The innovative use of dredged material for the production of various products including natural and synthetic aggregates, shells, bricks, mineral wools and other materials was previously studied for the Port of Baltimore. The manufacture of lightweight synthetic aggregates was assessed as feasible, but the potential market was not available. All other products were found to be unfeasible for a various technical and economic reasons (Weston, 1974). A study was undertaken for the U.S. Department of Transportation and Baltimore City between 1984 and 1986 to examine the treatment of contaminated dredged materials (Kidde Consultants, 1984, 1986). The facility now referred to as the Cox Creek DMCF was identified as the prospective location for a recycling facility. Conceptual designs, an economic analysis, and cost estimates were developed. However, the approach was not practical for implementation. Neither the containment cells nor a market were available.

Innovative use has more recently been addressed by the Maryland Port Administration in the form of conceptual options suggested through the DNPOP Program for which the MPA has sponsored research and has announced intentions to request proposals for innovative uses. Considering these developments, the use of dredged sediments was screened to determine whether or not a specific application or applications of the innovative use concept could serve as a practicable alternative for managing up to 18 mcy of dredged sediments for the Port of Baltimore.

3.5.30a Location.

Site dependent.

3.5.30b Type of Placement Option.

Varies by process, product and end uses.

3.5.30c Potential Throughput Quantities.

The throughput potential for innovative use is undetermined inasmuch as the concept is still in the developmental stage nationwide. Initial throughput capacities planned for production scale are about 100,000 cubic yards, depending upon the technology applied and products produced or end uses. Present stated long-term objectives are on the order of 500,000 cy annually. However, the ability to reach this potential has not been proven. A 100,000 cy annual throughput would be less than 5% of the placement deficit addressed in this annex. If a 500,000 cy annual throughput could be achieved, this quantity would be less than 25% of the placement deficit. At 500,000 cy per year, it would take about 36 years to accommodate 18 mcy of sediments. The current development status with respect to capacity is described in the following paragraphs.

The majority of testing has been performed at bench, pilot and demonstration test scales (Amiran, et al., 1999; CTI, 1998; EPA, 1994; Jones, et al., 1999; McLaughlin, et al., 1999; Rehmat, et al., 1999). Certain specific innovative use applications involving the products have been demonstrated to be capable of pilot scale application on the order of 100 to 500 cubic yards. Some processes have been demonstrated to be capable of demonstration or modest scale production on the order of 30,000 to 40,000 cubic yards and others are anticipated to go to this scale in the next year. For example, about 19,000 cy of contaminated sediments from Perth Amboy, New Jersey, were converted to a cementious product and successfully placed at Bark Camp Mine in Pennsylvania as a strip mine remediation demonstration project at a cost of approximately $85 per cubic yard (CTI, 1998). The research program sponsored by the State of New Jersey is planning to advance selected processes from pilot scale (up to 30,000 cy) to full-scale commercial production of 100,000 cubic yards per year for the management of contaminated marine sediments. The goal is to develop a suite of marketable products and end uses that in combination would result in the annual conversion of up to 500,000 cy of contaminated sediments into marketable products or end uses. Implementation of the concept to date indicates that sufficient markets exist or could be developed in the New York and northern New Jersey metropolitan area (Amiran et al., 1999; McDonough et al., 1999; McLaughlin et al., 1999). However, market conditions, particular for soil products, is significantly different in Maryland where soil and fill material is readily available to meet existing demand. For this reason, the market for innovative products and end uses will need to be expanded or created in order for a technology.

Preliminary unpublished results suggest that up to 500,000 cy per year could be placed in an environmentally acceptable manner on farmland. Sediments could be placed in thin layers, naturally dried, and amended, with the farm returned to active agricultural production thereafter. Although this approach has been successfully accomplished in Maryland on a very small scale (Corletta and Duff, 1997), the large-scale approach is still experimental. Whether or not sufficient farmland would become available to enable annual placements is highly uncertain.

The MPA has publicly stated that the agency's goal is to progressively develop a capability for innovative use dredged sediments at a meaningful scale. The MPA has set a conceptual goal of 500,000 cy annual throughput, to the extent that this proves feasible, practicable and cost effective. If the concept proves successful, the MPA would like to expand its application significantly over the next decade, insofar as practicable and cost-competitive as a component of the overall dredged material management program (Hamons and Young, 1999). Assuming that a 500,000 cy annual throughput potential were realized, it would take 36 years to accommodate 18 mcy of dredged sediments.

3.5.30d Bathymetry/Topography. Site dependent.

3.5.30e Environmental Characteristics

Environmental characteristics will depend upon the processing site as well as receiving site (if an end use rather than a product is developed). With respect to site-specific conditions, the MPA has expressed interest in using the Cox Creek upland property as a processing site for innovative use of dredged material. See paragraph XXXX of this annex for details about Cox Creek.

Living Resources. Site dependent.

Water Quality. Site and process dependent.

Hydrodynamics. Not applicable.

Rare, Threatened or Endangered (RTE) Species. Site dependent.

Fishing Activity. Not applicable.

Recreational Activity. Site dependent.

Historical/Archeological. Site dependent.

Groundwater: Site dependent.

View Shed. Site and process dependent.

3.5.30f Implementation Factors.

Capability for Utilization of Products or End Uses

Assuming that a technology or technique is viable, a fundamental determinant of success is the ability to establish adequate markets and end uses in order to complete the transition from dredged sediment to viable innovative products or end uses. A successful technology or technique would not become a successful application unless products produced from dredged material can be effectively utilized (including the development of markets for these products) or suitable end uses can be found on a scale that would make a meaningful contribution to dredged material management. High-technology applications generally result in specialty products that have small markets. Low-technology applications generally combine lesser production costs (relative to high-technology approaches) and flexibility for small through large-scale applications such as reclamation of sand and gravel pits and strip mines (use of deep mines has not been attempted), provided that suitable properties become available. In general, end uses rather than products appear to provide the potential for larger scale applications. Uses that require deposition at a specific site, such as a gravel pit, would require a site-specific environmental evaluation to determine the site's suitability to receive the material, and environmental documentation as appropriate. Engineering design would also be required. Pertinent regulatory requirements would also have to be met. An economic analysis would also have to be performed to determine economic feasibility. Implementation may require the installation of offloading facilities. Use of specific sites typically would involve contractual negotiations and proprietary information. There are a considerable number of additional implementation issues that would also need to be addressed (EPA, 1994). Even if a specific site is offered for use and appears to merit consideration, contractual rules and regulations impose requirements on procurements that may preclude consideration of such a site in environmental documentation as a possible alternative to a proposed action.

As part of long-term planning for the management of dredged material, MPA has sponsored research of potential farm applications and has announced that the agency plans to issue a request for proposals for an innovative use system with initial focus on the management of harbor sediments. The objective of the MPA's agricultural applications research is to identify which soil amendments might be needed and to determine crop suitability. Bench scale testing is currently in progress to collect and assess leachate and soil quality changes over time from both untreated and amended sediments from approach channels outside of the harbor. The germination and production of various crops are also being studied. The results of the bench testing will be applied to assess geophysical conditions that would be suitable for the placement of sediments on agricultural lands. The results of the bench tests will also be used to guide the planting, monitoring and analysis of field test plots. Bench-scale testing is also being performed for industrial and agricultural residuals which could potentially be combined with dredged sediments to produce value-added agricultural products. If the results of these experiments is favorable, a field demonstration project would be undertaken, provided that a suitable location can be identified, is made available, and is capable of being permitted under applicable rules and regulations. A site-specific evaluation would be required, as would compliance with applicable rules and regulations. Whether or not a suitable test location can be found is assessed as problematic. (A private venture to apply dredged material to two farms in Kent County encountered substantial public opposition. The proposal was withdrawn (Hamons and Young, 1999)).

In addition to the MPA's farm applications research, the MPA has indicated that the agency plans to issue a solicitation that would be intended to progressively develop a capability for the innovative use of dredged sediments. The upland property adjoining the Cox Creek Dredged Material Containment Facility has been identified as potentially suitable for the siting of an innovative use system. The MPA is hopeful that "perpetual" capacity might be achieved for the Cox Creek containment cell prior to it being filled to capacity. The Cox Creek site is also envisioned as a potential staging area for both contaminated and clean dredged sediments as resources for the innovative use system (Hamons and Young, 1999). State procurement rules and regulations preclude the MPA from discussing the specific content of its solicitation prior to its public release.

<u>Construction Considerations</u>. Site and process dependent.

<u>Implementation Time Frame</u>.

With reference to innovative use initiatives for the Great Lakes (EPA, 1994) and for the New York Harbor area, it can be anticipated that it would take several years for initial testing and evaluation to determine whether or not, or to what extent, innovative uses might become practicable for managing sediment from the Baltimore Harbor and its approach channels. If the approach were to be found suitable at pilot and demonstration scale, it would remain necessary to ascertain the feasibility of production-scale utilization and the upper limits of throughput potential for suitable processes, products and end uses. It is probable that a market would have to be expanded or developed inasmuch as the soils market in Maryland is already highly competitive.

3.5.30g Institutional Constraints.

The issue of institutional constraints would need to be assessed for specific processes, products and end uses.

3.5.30h Estimated Costs/Economic Viaiblity.

The costs of treatment for remediation technologies for contaminated sediments range from about $45 per ton to over $500 per ton (EPA, 1994, 1998; McLaughlin, et al., 1999). Although this DEIS addresses suitable sediments, that is, those that can be characterized as clean, the technology for contaminated sediments can be applied to uncontaminated sediments as well. The high cost of remediation technologies detracts from their economic viability for innovative applications on a large scale, even for contaminated sediments. For example, the State of New Jersey's program to develop innovative use as an integral part of dredged material management has established a maximum of $35 per cubic yard as the amount the State is willing to pay for each cubic yard that is processed and removed from the dredged material management stream. Venders will be responsible for covering any costs in excess of this amount (State of New Jersey, 1998). Research to date has resulted in prospective State costs of from $28 to $35 dollars. Gross costs (including the State's costs) are estimated to be in the $45 to $120 dollar range, exclusive of dredging costs and the cost of delivery of material to innovative use venders (Jones, et al., 1999; McLaughlin, et al. 1999; O'Donnell and Henningson, 1999; Rehmat, et al., 1999). The prospective high costs, however, have prompted efforts to find lower cost approaches for application to suitable sediments, such as the applied research efforts of the USACE and the MPA regarding soil products and farm applications.

3.5.30i Other Factors.

[MES EXPAND THE DISCUSSION OF INNOVATIVE USE TECHNOLOGY]

Most research and development into the innovative use of dredged material has been directly related to initiatives intended to find solutions for the remediation of contaminated sediments. Development of pretreatment and treatment technologies have involved both low through high-technology solutions. Inasmuch as the national focus has been predominantly on contaminated sediments, the applications that have been tested have tended towards higher technologies. These have included thermal destruction technologies (incineration, pyrolysis, high-pressure oxidation, and vitrification), thermal desorption technologies (high-termperature thermal processor, low-temperature thermal treatment system, proprietary thermal desorption systems, desorption and vaporization extraction systems, low-temperature thermal aeration systems, and anaerobic thermal processor systems), immobilization technolgies, extraction technologies (including soil washing), chemical treatment technologies (chelation processes, dechlorination processes, chemical dehalogenation treatment, base-catalyzed dechlorination, ultrasonically assisted detoxification, oxidation processes, and chemical and biological treatment), and bioremediation technologies (bioslurry processes, contained land treatment systems, composting, and contained treatment facilities). In general, research and testing have found that pyrolysis, oxidation, and bioslurry processes have performed within acceptable limits for both silts and clays, and soil washing, solvent extraction, composting, and contained treatment facility processes have performed within acceptable limits for silts (EPA, 1994).

Technologically, there have been significant advances in the technological capability to produce products and innovative end uses from dredged marine and estuarine sediments. Technologies and techniques that are under development include the manufacturing and blending to create soil products (Amiran, et al., 1999; Graalum and Randall, 1997; Palazzo, et al., 1997; Sturgis, et al., 1997a,b), soil washing (Amiran, et al., 1999; Olin and Bowman, 1997); conversion into lightweight construction aggregates (Weston, 1974), use in landfill construction (MES, 1995b), production of construction grade cements (Rehmat, et al., 1999), forming cementious products for mine reclamation (CTI, 1998; McDonough. et al., 1999; O'Donnel and Hennington, 1999), manufacture of bricks (Cousins, et al., 1997), production of commercial tiles (McLaughlin, et al., 1999), and manufactured material using waste products such as automobile shredder byproduct and dredged sediments to produce structural and non-structural fill (McDonough, et al., 1999; Willix and Graalum, 1999). Most of these applications have been targeted towards contaminated sediments, primarily because these are the more difficult of dredged sediments for which to secure final deposition. Other applications, such as farm applications, are intended to use suitable, uncontaminated dredged material (Corletta and Duff, 1997; Dalyrmple, 1997; Landin, 1997; Price, et al., 1997). Transforming these approaches into practicable applications requires that the technology be capable of adaptation to local sediment conditions, a particular need for contaminated sediments.

For example, innovative uses would include the concept of applying dredged sediments to farmlands, with or without the subsequent addition of amendments (Dalrymple, 1997; Landin, 1997; PIANC, 1992; Price. et. al., 1997). Indeed, this concept has been used in small-scale farm applications in Maryland and elsewhere. Although reported to be successful, there currently is limited data to support general application in agriculture (Duff and Corletta, 1997). Both the USACE and MPA are conducting applied research into potential soil applications. Applied research and development into the innovative use of dredged sediments is also being pursued elsewhere, including applications for New Jersey waters in the New York Harbor area. This latter research involves federal funding through the Water Resources Development Acts of 1990, 1992 and 1996 as well, over $100 million in funding from the State of New Jersey in an effort to advance from concept to practical application (Jones, et al, 1999; McDonough, et al., 1999; Stern et al., 1997, 1998a,b).

3.5.30j Option Summary.

Inasmuch as innovative use for the port is at the initial concept stage and in consideration of the uncertainty of the marketability for products or end uses, an estimate of the potential for innovative use as a viable component of dredged material management would be speculative. Innovative use systems would therefore not constitute an alternative to the proposed open water placement. Should a significant annual capability be developed at some future date, the capability could be considered on its merits at that time relative to the dredging program.

Although there appears to be significant potential for farm applications, there is also significant potential that institutional issues may inhibit the availability of sufficient farmland. Therefore, farm application is not a practicable alternative to the proposed open-water placement as either a standalone option or a component of a multi-option alternative at this time. Should the farm application concept become viable at some future date, it could be reconsidered on its merits at the appropriate time.

3.5.30k Option Data Sheet. [ADD DATA SHEET]

3.6 Proposed Upper Bay Island Long-Term Placement Site

The following placement options were screened as possible alternatives:

- Pooles Island upper Bay island placement sites (3 configurations)
- Tolchester West (Gales Lumps)
- Site 168 (2 configurations)
- Site 170A
- Site 171

3.6.1 Pooles Island Upper Bay Island Placement Sites

Box XX-45
Screening of Pooles Island Upper Bay Island Placement Sites

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX..

3.6.1a Location.

3.6.1b Type of Placement Option.

3.6.1c Potential Placement Capacity.

3.6.1d Bathymetry/Topography.

3.6.1e Environmental Characteristics

Living Resources.

Water Quality.

Hydrodynamics.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.6.1f Implementation Factors.

Construction Considerations.

Implementation Time Frame.

3.6.1g Institutional Constraints.

3.6.1h Estimated Costs.

3.6.1i Other Factors.

3.6.1j Option Summary.

3.6.1k Option Data Sheet. [ADD DATA SHEET]

3.6.2 Tolchester West/Gales Lumps

Box XX-46
Screening of Tolchester West Upper Bay Island Placement Site

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/is not suitable for consideration as an alternative due to XXXX.

3.6.2a Location.

3.6.2b Type of Placement Option.

3.6.2c Potential Placement Capacity.

3.6.2d Bathymetry/Topography.

3.6.2e Environmental Characteristics

Living Resources.

Water Quality.

Hydrodynamics.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.6.2f Implenentation Factors.

Construction Considerations.

Implementation Time Frame.

3.6.2g Institutional Constraints.

3.6.2h Estimated Costs.

3.6.2i Other Factors.

3.6.2j Option Summary.

3.6.2k Option Data Sheet. [ADD DATA SHEET]

3.6.3 Site 168

Box XX-47
Screening of Site 168 Upper Bay Island Placement Sites

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX..

3.6.3a Location.

3.6.3b Type of Placement Option.

3.6.3c Potential Placement Capacity.

3.6.3d Bathymetry/Topography.

3.6.3e Environmental Characteristics

Living Resources.

Water Quality.

Hydrodynamics.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.6.3f Implementation Factors.

Construction Considerations.

Implementation Time Frame.

3.6.3g Institutional Constraints.

3.6.3h Estimated Costs.

3.6.3i Other Factors.

3.6.3j Option Summary.

3.6.3k Option Data Sheet. [ADD DATA SHEET]

3.6.4 Site 170A

Site 170, previously described in Section XXXX of this annex, was suggested by the Maryland Department of Natural Resources as suitable for a constructed island because of historically marginal bottom conditions for living resources. The site was considered as a possible location for a containment island under the DNPOP program (Figure 2-3). Although Site 170 was not carried forward into the prefeasibility study for the Upper Bay Island Placement Site for the aforementioned reasons, the site was screened as a possible alternative to the proposed open-water placement action.

Box XX-48
Screening of Site 170A

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide between about 35 to 75 mcy of placement capacity.
2. Availability: The bottom is State-owned and could be made available.
3. Environmental Suitability: The exchange of water between the Patapsco River and the Bay would be adversely affected. There would be a permanent conversion of marginally productive open-water bottom habitat to an upland island. There would be a permanent change to the view shed.
4. Infrastructure Readiness: The environmental, institutional and construction issues associated with this site indicated that implementation of a facility at Site 170 would be protracted and that a facility most likely could not be ready for use when needed.
5. Institutional Feasibility: A portion of the site would be within 5 miles of the Hart-Miller-Pleasure Island Chain. A waiver or relief from the State law that prohibits construction of a containment facility within 5 miles of the Chain would be needed or the facility would have to been configured irregularly to avoid the prohibited area with a reduction in placement potential.
6. Prospective Affordability: The estimated unit cost ($__) is below the upper screening threshold for cost.
7. Potential for Environmental Improvements: There would be a permanent conversion from Bay bottom to upland with possibly a beneficial use component. For the purpose of applying Criteria #7, no potential for environmental improvements is assumed.

Results of Screening: Use of the Site 170A for construction of an island placement site is not suitable for consideration as an alternative to the proposed action due to a combination of (1) significant environmental effects particularly with respect to water quality at the mouth of the Patapsco River, institutional and construction issues, and prospective implementation time frame.

3.6.4a Location/Background.

Site 170A is located at the mouth of the Patapsco River. Please refer to section XXXX of this annex for a more complete description.

The DNPOP Program's Bay Enhancement Phase II Working Group considered Site 170 as a possible location for the proposed Upper Bay Island Placement Site component of the State of Maryland's Dredged Material Management Plan. The site was configured to result in an approximate capacity of 80 mcy for consistency with dredged material placement needs for the large-scale placement island component of the State's Dredged Material Management Plan.

The Bay II working group did not develop a consensus regarding suitability of Site 170. The majority view was that a large-scale island at the mouth of the harbor would reduce the cross-sectional area and would likely inhibit circulation patterns to the detriment of water quality in the harbor and nearby tributaries. The site was suspended from further consideration as a suitable location for a containment island due to a combination of hydrodynamic concerns and potential affects on navigation near the harbor entrance. Although the majority of Working Group participants did not consider Site 170 a practical alternative for construction of a containment island, there was strong sentiment among some participants that Site 170 should be considered further. DNPOP participants recommended a hydrodynamics screening study. This was referred to the MPA for consideration. A preliminary site configuration was developed (GBA, 1999) and a preliminary hydrodynamics screening was performed (CITATION), as discussed later in this annex.

3.6.4b Type of Placement Option. Containment facility with a beneficial use component.

3.6.4c Potential Placement Capacity.

In developing Site 170 as a possible alternative, the effects of scale were considered with respect to capacity and hydrodynamic affects. Both a large-scale island of approximately 80 mcy total capacity and a smaller-scale island of 40 mcy were considered. An average depth of 16 feet was assumed across the site. An elevation of approximately 15 feet above MLLW was used to provide a dike height sufficient to withstand storm conditions (GBA, 1999). Planning assumed that sediments would be placed hydraulically and that there would be a crust management program similar to the program utilized at Hart-Miller Island to create upland conditions (Wikar and Moore, 1999).

An island of approximately 820 acres in size (over 1-1/4 square miles) and about 15 feet in elevation would be needed to accommodate approximately 40 mcy of dredged material. A 40 mcy facility would be approximately 5,100 feet wide (approximately 1 mile) and about 9,000 feet long (about 1-3/4miles). The perimeter would be on the order of 22,000 feet. An island of nearly 2½ square miles in size (1,600 acres) and about 15 foot elevation would need to be constructed in order to obtain large-scale capacity of approximately 80 mcy. A 80 mcy would be about 6,500 feet wide (about 1-1/4 miles) and about 13,400 feet long (about 2½ miles). The perimeter would be on the order of 31,600 feet in length. The larger capacity facility is consistent with the dredged need identified in the State of Maryland's Strategy for Dredged Material Management. To achieve this capacity, the northern side of the constructed island would need to be placed near the shipping channels. The southern side would be within about ½ mile of the northeastern Anne Arundel County shoreline. Using the aforementioned configurations, an approximate doubling of the perimeter results in approximately 4 times greater capacity. The relationship between perimeter length and capacity significantly affects construction costs.

3.6.4d Bathymetry/Topography. Site 170 is relative flat as the result of prior placement of dredged material throughout much of the site. Average depths are on the order of –16 feet MLLW. There are several submerged obstructions recorded in the area on nautical charts.

3.6.4e Environmental Characteristics.

A constructed island of the type described above would be considered a major federal action for the purposes of NEPA compliance. Principal environmental characteristics and potential effects are discussed below.

<u>Living Resources.</u>

Biological Productivity. Use of Site 170 for a placement island was advocated by MDNR through the DNPOP program primarily because MDNR considered the area less biologically productive than other areas that were being considered as possible sites for a constructed placement island. [ADD HERE ANY INFORMATION FROM DNR ON THE AREAS PRODUCTIVITY][ADD HERE WHY COMMERCIAL FISHING WAS CLOSED IN THE AREA]

[Biological productivity studies were conducted for the Sparrows Point area about 2 miles northwest of the centroid of Site 170 found the former area to be generally productive to marginally productive when the Chesapeake Bay Restoration Goals Index and standard fish productivity measures were applied to the data. None of the studies that were performed found a unique biological community at the location of the proposed Sparrows Point habitat enhancement project (MES, 1995). Site 170, being located in the same general area, Site 170 would be expected to exhibit biological productivity equivalent or greater to that of the harbor.]

Shallow Water Habitat. Construction of a containment island at Site 170 would permanent convert between about 820 to 1600 acres of bottom habitat, depending upon the size of the island that were constructed (GBA, 1999). The depths of water in the area range from about -9 to about -19 feet, MLLW.

<u>Sediment Quality</u>. An issue is whether or not the sediments at Site 170 are degraded as a result of contamination from the harbor. Channel sediments for the Brewerton Channel east of the Rock Point - North Point line, Brewerton Extension, Brewerton Angle, and the Craighill Channels have been determined to be suitable for general placement inasmuch as their chemical properties are below thresholds for contaminated sediments (CITATION). The material that was placed the area during open-water placement was dredged from channels east of the line. These sediments would, in general, be as clean or cleaner than the sediments that were placed there naturally. The sediments that were placed were soft and fine grained. To the extent that the bottom at Site 170 may be less productive today than the areas in the main stem of the Bay, such a condition could be associated to some degree with the physical character of the sediments (in terms of grain size and nature of material) and generally poor circulation at the mouth of the Patapsco River rather than chemical

<u>Water Quality</u>. The evolving regulatory climate with respect to the Clean Water Act holds potential to significantly effect the operation of containment facilities in the Patapsco River. The Patapasco River has been designated as an impaired water body by the Environmental Protection

Agency and is subject to the development of Total Maximum Daily Loads (TMDL). Whether or not or to what extent the TMDL requirement might apply to operation of a containment facility at Site 170 is an unresolved issue. Given the location of Site 170 in vicinity of the mouth of the Patapsco River, any containment facility constructed there might potentially be subject to more stringent regulation of effluent discharge than might be appropriate for containment facilities elsewhere in the Bay region.

Hydrodynamics. The hydrodynamics of the Patapsco River estuary are important to water quality and associated water quality management decisions. A principal concern about the suitability of Site 170 as a possible location for a large-scale constructed island is the potential effect on circulation patterns and water quality in the Patapsco River estuary. Another concern is the potential changes to hydrodynamic as well as wind conditions relative to ship maneuverability that might result from construction of an island in proximity to the shipping channels. The following discussion characterizes the current situation with respect to the understanding of harbor hydrodynamics and the potential for impacts that would be associated with construction of a containment island at the harbor mouth.

A 1982 hydrodynamic study of the estuary identified a complex circulation system. The existence of a three-layer, density driven circulation was confirmed through direct current measurements within the harbor. The study also found that wind-driven circulation often dominates other circulation components over the short term (up to 10 days). In particular, the wind-driven component is especially prominent near the mouth of the head of the harbor (Middle Branch) and the three principle tributaries (Bear Creek, Curtis Creek, and Northwest Branch). The study also found that during Patapsco River freshets, conditions can occasionally be produced in which the three-layer circulation is over-ridden by two-layered estuarine circulation. Residence times vary across these conditions from about 3 days during the strongest wind events to as much as 20 days when density and wind forcings are weak. Although the three-layer circulation pattern is the most stable feature, the strongest exchanges of water between the Patapsco River and the main stem of the Chesapeake Bay occur during the wind-driven events. The effects of wind-driven forcings vary significantly with respect to salinity depending on whether the winds are blowing upchannel or downchannel. The wind-driven events also have the more pronounced effects on reduction of stratification at the harbor head than do the effects of the more typical three-layered circulation pattern (Boicourt and Olson, 1982; Olson, et. al., 1982.)

The location of Site 170 is at the mouth of the river where the greatest exchange of water takes place between the Bay and the estuary. A constructed island at this location could significantly reduce the cross sectional area of the harbor mouth, depending upon the facility's scale, location and configuration. Such a containment could also reduce the fetch for both downchannel and upchannel wind forcings. Of concern is the potential for a constructed island to reduce fetch, reduce cross sectional area, accentuate or dissipate physical energy under various conditions, of or a combination of these factors to change the effects of wind driven forcings on hydrodynamics to the detriment of circulation patterns and water quality in the estuary. For example, if the island were to constrict the mouth of the harbor, downchannel forcings could potentially result in an increase in current velocity in the shipping channels with associated effects on harbor salinity. An island could also result in considerable dissipation of the effects of upchannel wind forcings by reducing the fetch and dissipating physical energy along the perimeter exposed to these conditions. A change in current velocity would also effect shiphandling. Placement of a constructed island close to the shipping channel could also affect maneuvering characteristics (IAPH-PIANC, 1997; NRC, 1992, 1994).

With respect to the earlier discussion of scale, the width of the facility would have significance with respect to cross sectional area and potential effects on harbor hydrodynamics. Although the smaller site has less of a potential cross sectional area, the smaller site could still result in a significant reduction in cross sectional area at the harbor's mouth. The position of a smaller scale facility could potentially be adjusted to some extent to reduce hydrodynamic effects whereas the larger facility would necessarily have to be placed close to the mouth of the harbor. In either case, there is potential for a significant reduction in cross sectional area and for potential adverse effects on hydrodynamics, with the effects of wind forcings appear to be the most vulnerable to changed conditions.

The Chesapeake Bay three-dimensional hydrodynamic model (Curvilinear Hydrodynamic Three Dimensional Modle – CH3D) was developed by the U.S. Army Engineer Waterways Experiment Station (WES) subsequent to the 1982 hydrodynamics study discussed above. Although it remains a work in progress, the CH3D model represents a substantial increase in the capability to assess hydrodynamic effects of proposed placement options in the Chesapeake Bay and its tributaries within the limitations of the model. The MPA, in response to DNPOP proceedings, sponsored use of the CH3D model to specifically perform a preliminary assessment of the effects of a large containment facility at Site 170. Preliminary results of the modeling, which is being performed by WES), indicate that XXXXXXX (CITATION).

<u>Rare, Threatened or Endangered (RTE) Species</u>. [XXXX]

<u>Fishing Activity</u>. [XXXX]

<u>Recreational Activity</u>. Site 170 is located immediately offshore between the mouths of Rock Creek and Bodkin Creek. Both Creeks and Stony Creek immediately west of Rock Creek all support recreational boating activities. Fort Smallwood Park is located immediately southwest of the site. The water area comprising Site 170 is used for recreational boating and sportsfishing activities. There is a measured mile immediately offshore of Hog Neck. Small boats, depending upon their routes, could be forced into or in proximity to the shipping channel as a result of construction of a placement island at Site 170.

<u>Historical/Archeological</u>. [XXXX]

<u>Groundwater</u>: [XXXX]

<u>View Shed</u>. The construction of a placement island at Site 170 would present a significant change to the view shed from the northeastern Anne Arundel County shoreline from Riviera Beach to Bodkin Point and from the Sparrows Point, Old Road Bay and North Point State Park areas in Baltimore County. The change would be significant because an island did not exist at this location previously and because the prospective elevation, closeness to the shoreline and the vertical viewing angle would make the island appear relatively more pronounced than if the island were located further offshore. The most pronounced effects would be on the view shed as seen from the shoreline along Hog Neck which could be within ½ mile of the site and from the Rock Point area in Baltimore County which could be slightly over 1 mile from the site.

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title: Site 170a **Type:** Island Creation

Location: Concept located in Anne Arundel County at the mouth of Patapsco River in 12-17 feet of water. Near the intersection of Brewerton Eastern Extension, Brewerton and Cuttoff Angle Channels.

Size: a 818 to 1,600 acre concept

Potential Capacity: 40-80 mcy depending on concept

Availability: State Owned

Nutrients: [Need info]

Infrastructure Required to Implement:
Access issues related to navigation channels.
Dike containment construction required.

Institutional Issues:

Concept violates the State law of no containment site within five miles of the HMI Pleasure Island chain, requiring a change in existing law.

Costs:

Total Unit Costs Per Cubic Yard: [$10-$15 per cubic yard]

Development & Implementation Costs:

COMMENTS:
Hydrodynamic concerns are an issue for creating an island. One concern is that placement of an island would exacerbate already poor circulation characteristics within this area of the estuary.
Man-made island might hinder flushing and heighten pollution concentration in Harbor, position at intersection of channels could also increase shear stress and create navigation hazards.

DRAFT DRAFT DRAFT DRAFT

TITLE: Site 170a **PROJECT TYPE**: Island Creation

Existing Conditions	Presence*	Potential*	Unknown*	N/A*
Physical and Chemical Characteristics				
Substrate	X			
High Relief Area		X		
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics	X			
Tidal Fluctuations		X		
Salinity Gradients			X	
Sediment Quality		X		
HTRS		X		
Biological Characteristics				
RTE-			X	
Aquatic Organisms				
Benthic Communities	X			
Fisheries	X			
Designated Spawning Area				X
Larval Habitat Area				X
Crabs	X			
Mollusks				
Soft shell clams	X			
Hard shell clams				X
Oyster bars-NOB 2-6, 2-8	X			
Terrestrial Wildlife				X
Avian Wildlife				
Waterfowl concentration area		X		
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges				X
SAV				X
Wetlands				
Tidal Wetlands				X
Non-tidal Wetlands				X
Human Use Characteristics				
Groundwater				X
Water Related Recreation	X			
Recreational and Commercial Fisheries				
Soft shell clams	X			
Hard shell clams				X
Oyster bars-NOB 2-6, 2- 8	X			
Crabs	X			
Recreationally important fisheries	X			
Commercially important fisheries		X		
Aesthetics				
Air Quality			X	
Noise			X	
Critical Areas				X
Forested Areas				X
Cultural Resources				X
Archaeological Resources			X	
Potential for Benefit	X			
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A** (Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Chesapeake Bay Program. 1996. High Value Living Resource Map of the Upper Bay. In a memo prepared for the Bay Enhancement Phase II Working Group.

Gahagan & Bryant Associates, Inc. 1999. Conceptual dredged and site analysis for Site 170. Prepared for MES. September 21, 1999.

Funderburk, S.L., S.J. Jordan, J.A. Mihursky and D. Riley. 1991. Habitat Requirements for Chesapeake Bay Living Resources. Second Edition. Chesapeake Bay Program

Maryland Department of Natural Resources. 1989. Natural Oyster Bar Maps. Prepared by Coast and Geodetic Survey for the Maryland Department of Natural Resources.

Maryland Geological Survey. 1971. Maryland Tidal Wetlands and Critical Area Inventory Maps. Based on County maps 1:2,400 scale organized by.

US Fish and Wildlife Service. 1979. National Wetland Inventory Maps. Non-Tidal Wetlands Maps. Prepared by Office of Biological Services. Based on USGS 7.5 minute topographic quadrangle map series.

3.6.4f Implementation Factors.

Construction Considerations.

Foundation conditions that exist at Site 170 are marginal for construction of an island placement site. A considerable amount of soft dredged material was placed throughout the area. Geotechnical boring data exist for one station inside of the Site 170 footprint. These data, although dated, are nevertheless considered to be representative of existing foundation conditions inasmuch as only the surface data would potentially have changed. The available data disclose that there is on the order of XX feet of muck from the earlier placement of dredged material (Green and Trident, 1970). Considerable undercutting of material estimated to be on the order of some 3 and 6 mcy would be necessary if the site were developed as a containment facility. This quantity would vary to some extent based on ability of the underlying material to support a constructed enclosure and the size of the facility if the site were to be developed as a placement island. Undercut material would most likely be placed within the enclosure, thereby reducing the potential capacity by an equivalent amount.

Implementation Time Frame. The time frame for constructing such a placement island is at least seven to ten years and perhaps up to 14 years or longer, regardless of scale. A more precise time frame cannot be predicted because of construction of such a facility would depend upon legislative authorizations and appropriations. It cannot be predicted whether or not the Congress would authorize such a facility as a federal project. If not, then the State would be responsible for funding construction. Whether or not the Legislature of the State of Maryland would authorize and fund such a facility cannot also not be predicted. Considering the nature of such a project, the legislative process could be protracted. For this reason, even if Site 170 were ultimately found to be suitable for a constructed island containment facility, it would not be available within the time frame needed to respond effectively to the placement deficit addressed in this annex.

3.6.4g Institutional Constraints.

The location of a major portion of the site within 5 miles of the Hart-Miller-Pleasure Island chain and potential aesthetic effects on the view shed were also identified as issues. The COMAR (CITATION) prohibits construction of a containment facility within 5 miles of the Hart-Miller-Pleasure Island chain in Baltimore County. Whether or not this institutional constraint would apply to a facility in Anne Arundel County is uncertain.

3.6.4h Estimated Costs. [XXXX]

3.6.4i Other Factors. [XXXX]

3.6.4j Option Summary.

3.6.4k Option Data Sheet. [ADD DATA SHEET]

3.6.5 Site 171

Box XX-49
Screening of Site 171 Upper Bay Island Placment Site

Screening Summary: The screening criteria were applied with the following results:

1. Placement Potential: Site could potentially provide **XX** mcy, or over XX percent of the target placement need.
2. Availability: XXXX.
3. Environmental Suitability: XXXX
4. Infrastructure Readiness: Sites could/could not be ready for use when needed.
5. Institutional Feasibility: XXXX
6. Prospective Affordability: The estimated unit cost ($__) XXXX
7. Potential for Environmental Improvements: XXXX

Results of Screening: Use of the XXXX for XXXXX placement is/isnot suitable for consideration as an alternative due to XXXX..

3.6.5a Location.

3.6.5b Type of Placement Option.

3.6.5c Potential Placement Capacity.

3.6.5d Bathymetry/Topography.

3.6.5e Environmental Characteristics

Living Resources.

Water Quality.

Hydrodynamics.

Rare, Threatened or Endangered (RTE) Species.

Fishing Activity.

Recreational Activity.

Historical/Archeological.

Groundwater:

View Shed.

3.6.5f Implementation Factors.

Construction Considerations.

Implementation Time Frame.

3.6.5g Institutional Constraints.

3.6.5h Estimated Costs.

3.6.5i Other Factors.

3.6.5j Option Summary.

3.6.5k Option Data Sheet. [ADD DATA SHEET]

~~2.2.4.i~~ Man-O~~of~~-War Shoals

The area known as Man-O-War Shoals was included as a DNPOP placement option and was considered as a possible open-water placement site (Figure 2-2). This site is located just north of the Brewerton Eastern Extension Channel, was previously used from the 1900's to 1950's as an open-water placement area, and has current depths of approximately 22 ~~feet~~. This area is estimated to have a potential placement capacity of 24.6 mcy and encompasses an estimated 1000 acres. During Bay Enhancement Phase II screening for upper Bay Island placement sites, this site was not included for consideration due to the proximity to a productive natural oyster bed (N.O.B. 2-6). An adjacent area (Site 168) was considered for island creation (Section 2.2.3.b.2. Investigations found -weak foundation soils and a soft to very soft substrate at Site 168, particularly where dredged material had been placed previously. Because Man-O-War Shoals was previously used for placement, similar substrate conditions probably exist on the site. The existing benthic community at Site 168 is stressed due to periodic summer anoxia and poor substrate. Because the depths~~,~~ and salinity regime of Sites 168 and Man-O-War are expected to be the same, the existing benthic condition of Man-O-War is probably poor. Some parts of Site 168 provide significant commercial fishing opportunities in winter, although hypoxia makes it unsuitable fish/crab habitat during most summers. Man-O-War Shoals is probably also used for some commercial harvesting. The other major potential concerns are: (1) that additional materials placed adjacent to the channel could change hydrodynamics relative to the channels and potentially affect ship maneuverability and thus ship handling, and (2) that the material could shoal in the Brewerton Channel Eastern Extension and Tolchester Channel due to the close proximity of the site to the channels and the tidal currents. Preliminary evaluations of hydrodynamics of Site 168 and Site 171 (for island creation) indicated significant localized increases in current velocities and turbulence associated with island configurations. Although the effects would be less significant for a configuration that does not -emerge from the water surface, some localized effects are expected for Site 171 as a submerged island option. Similar effects would be expected at Man-O-War Shoals. [Hydrodynamic modeling of the island options is ongoing and is expected to provide some information that can be use to help assess the significance of potential turbulence increases as a result of continued use of Man-O-War Shoals. The concern is that increases in turbulence could cause p~~P~~otential adverse effects on maneuverability and could necessitate modifications to operating procedures such as reduced speeds, thereby increasing transit times and operating costs. Extreme effects on maneuverability could increase the risk to marine safety (e.g., groundings), concurrently increasing the potential of environmental consequences such as pollution from spills.

Smith Island

Smith Island is a low-lying complex of islands with an area of almost 8,000 acres. It is part of a string of marshy islands that separate Tangier Sound from the Chesapeake Bay. The average elevation of the island is 2 feet above mean sea level (MSL) and the maximum elevation is about 5 feet above mean sea level. Smith Island has few upland areas. The communities of Ewell, Tylerton, and Rhodes Point, as well as several isolated hammocks, dunes and former dredged material disposal areas provide the only high ground. The range of tide is about 1.6 feet. The northern half of the island is owned by the U.S. Fish and Wildlife Service (USFWS) and managed as the Martin Wildlife Refuge. Big Thorofare Channel separates the refuge from the settled areas of Smith Island and is the most important water access to Ewell. Each of the three communities has a work boat basin, dredged or constructed by the Corps of Engineers, and each harbor is fringed by rows of wooden work buildings or "crab shanties."

Smith Island is exposed to a long open-water fetch from the west, southwest, and northwest. The western shore of the island is 30 miles from the Virginia shoreline. Because of its exposed position, the entire island is subject to erosion and flooding. Although it once supported wooded areas, agricultural fields, and pastures, the island is currently a complex of salt marsh islands separated primarily by narrow tidal creeks and shallow water areas. Vulnerability to the effects of erosion, flooding, and storms constitute an obvious problem for the three towns on the island, however, important natural resources are also threatened.

Rhodes Point is the most vulnerable to impending damage from wave energy and erosion. The location of the island's only boat repair facility, at the southern end of Marsh Road, bears the original name of the community: Rogue's Point. The community has a Methodist Church, post office, and a Community Building that houses the Senior Citizens Center.

Since 1849, there has been a significant amount of perimeter erosion along the western shore and from the northeast corner of the island, reflecting exposure to the maximum fetch. The continual loss of land on Smith Island is attributable to current, near-term and eventual damage scenarios on Smith Island. The towns of Rhodes Point and Tylerton are currently suffering the economic cost of continual erosion. These islanders face shoaling delays weekly, damages to their boats sporadically, and increased road, sewer, dock, ramp, and bulkhead maintenance costs annually. If current conditions persist without any relief, there is an imminent danger that the continual shoreline erosion on portions of Rhodes Point and Tylerton will result in major infrastructure damages to the roads, sewer pipes, water pipes, docks, ramps, houses, and marinas in these two towns. It is estimated that these major infrastructure costs could be incurred by year five in the current analysis. It is also possible that these major infrastructure damages are imminent, given the particular vulnerability to storm damage that the continual erosion has created. Whenever these major infrastructure damages do occur, many of the 288 structures on the island, the sewer pump station, and roads and utilities would be in immediate danger of tidal or storm flooding.

A June 1981 report by the Corps of Engineers stated that by the year 2000, the erosion along Hog Neck would lead to a situation which would "allow waves to pass over or through the barrier islands more frequently." The report also said that some sort of protection would be provided to Hog Neck and the shoreline of Rhodes Point. Some protection has indeed been constructed along Hog Neck by the Corps in the form of geotextile tube placement and backfill. The shoreline of Rhodes Point itself has not yet been protected with new bulkheading or similar construction.

A preliminary estimate of potential dredged material capacity for wetland restoration at the Barren Island site is up to a maximum of 300,000 cubic yards with some containment supplied by geotextile tubes, as the Corps has done in the past. This option would provide for about 30 acres of wetlands restoration. Placement costs are expected to be about $3.5 million, including transportation of the dredged material a distance of about 80 miles from the channels that are being dredged. Unit cost for this option is about $12.00 per cubic yard. However, the Corps has experienced mixed success with the implementation of geotextile tube structures particularly in their implementation at Smith Island. Given the potential severe wave climate at Smith Island and the degree of silts that will be placed there, an armored solution is more appropriate. Replacing the geotextile containment with a low stone sill would likely raise the cost of the restoration an additional $3 million, thereby increasing the unit cost to $22 per cubic yard.

Conceptually, a larger-scale project could be developed that would replicate the 1849 shoreline along the Hog Neck peninsula (about 300 acres). Such a project would likely be constructed entirely at an upland elevation (+10 ft MLLW) to protect Rhodes Point and the island's wetlands. Such a project would likely hold in excess of 8 million cubic yards of dredged material. Expected cost would be about $100 million, or roughly $13 per cubic yard.

P:\Federal\DOD\ARMY\projects\6095793\NewDraft\Revised DEIS\Chapter_02\Smith Island.doc

Chesapeake & Delaware Canal Upland Placement Areas

Approximately 8,853 acres adjacent to the Chesapeake and Delaware Canal are Federally owned. Approximately 6,551 acres have been used for dredged material placement, of which 1,125 acres have been filled and 5,426 are still active. There are nineteen upland placement sites that have been actively used by Philadelphia District in the last 28 years for maintenance dredging of the Chesapeake and Delaware Canal and Northern Approach channels between Station 0+000 at the Delaware River and Station 160+000 located at the Sassafras River. As of December 1994 these sites had an existing diked capacity of approximately 28 million cubic yards. It was also estimated that with dike raisings to a height of 50 feet, these sites have a maximum design capacity of approximately 104 million cubic yards. Maximum design capacity is the remaining (dry) capacity (excluding the volume placed before November 1994) up to an ultimate fill elevation of 50 feet. Maximum design capacities are estimated values based on repeated dike raisings; the actual values may be more or less depending on field conditions. Of the nineteen currently utilized upland placement sites, all but Pearce Creek have perimeter dikes that are sparsely to densely vegetated and several areas have prolific vegetation. Areas no longer used for placement purposes are leased to the states of Maryland and Delaware and managed as wildlife refuges, recreational hunting grounds, and baseball fields. Through the use of digested sewage sludge, abandoned and barren placement areas have been revegetated with a dense cover of perennial grasses such as red fescue and Kentucky blue grass. Eventual plant succession and the establishment of shrubs and trees such as white pine, dogwood, and Norway spruce has increased the habitat diversity of these areas and provide cover and food for wildlife. A ten-year monitoring program commenced in 1987 to evaluate the environmental impacts of the planting. Some diked placement areas contain wetlands that are vegetated primarily with pondweed, cattail, Phragmites, and duckweed.

Although these upland sites are reserved by the Federal government for placement, all of the capacity at each site may not be available for use in the future. Constraints exist at some of the sites that would preclude use of all of the maximum design capacity such as construction limitations, environmental conditions, or existing and currently proposed recreational use, and/or impacts from other projects. The real estate instruments as described in the 1974 Master Plan for such use reserve the rights of the Corps to terminate the recreational use if the sites are needed for project purposes. Five million five hundred and sixty thousand cubic yards of capacity at the Reedy Point North and South placement areas have been identified for placement of dredged material from the Delaware River from year 1997 to the year 2005. In addition, approximately 1 million cubic yards of capacity at Reedy Point South was used for placement of dredged material from the Salem River in 1995. All or parts of six placement areas (Penn Central west, Summit East, Upper Summit, Lower Summit, Bethel, Goose Point) were amended with sewage sludge and lime during a study conducted with the States of Maryland and Delaware to produce more vegetation and reduce erosion on these sites.

Once barren landscape was transformed into meadows with a dense cover of grasses such as red fescue, tall fescue, Kentucky blue, and weeping love. A ten-year monitoring program was commenced in 1987 to monitor heavy metal concentrations in the vegetation, surface water, and the groundwater. Soil sampling, groundwater monitoring, and surface water sampling are conducted on a regular basis by the Maryland Department of Natural Resources and the

Delaware Department of Natural Resources and Environmental Control. Monitoring, thus far, has indicated no problems concerning ground water contamination, pH levels, and surface water contamination. If in the future the full capacity of these sites were to be used, the sludge must be scraped off and disposed of or sold as fertilizer.

The Upper Summit and Penn Central West placement areas are currently used or are proposed for use as recreation areas (Dog Pond in Upper Summit and proposed baseball field in Penn Central West). The Long Creek site is heavily forested and is used as wildlife conservation and hunting areas through lease easements with the State of Maryland. This site would be difficult to use unless costly construction preparation measures were taken (heavy grubbing, sluice repairs, recreation relocation or protection, etc.). Because of this "restricted capacity", the total ultimate usable capacity at a 50-foot dike height for the remaining sites is approximately 109 million cubic yards (Table 18).

Based upon the average annual maintenance quantities, there will be adequate capacity at these placement sites along the Chesapeake and Delaware Canal land-cut for maintenance dredging needs for the next 50 years. The Courthouse Point and Pearce Creek placement sites, located along the Northern Approach Channel, will not have adequate capacity to meet maintenance dredging placement needs from that channel for the 50-year period.

Material dredged during maintenance operations in the C&D Canal is placed in existing Federal upland sites along the Canal. Capacity of these sites is adequate and the Federal government anticipates continued use of these sites. However, in recent years there have been some problems obtaining water quality certificates for the Courthouse Point and Pearce Creek placement areas near the Elk River due to groundwater issues. Approval has been granted to continue using Courthouse Point, but the Corps will not be given a water quality certificate for Pearce Creek until the issue is resolved.

Biddles Point. Biddles Point is located in Delaware in along the C&D Canal. This upland site is approximately 273 acres in size and used periodically for the placement of maintenance dredged material from Reach 1. Some dike construction and earthwork would be required before this site is ready to receive material. New dike slopes would be approximately 10 feet high with a 10-foot wide crest and 3 horizontal to 1 vertical side slopes. Baffle dikes would be constructed as necessary to ensure proper slurry residence time in order for the dredged material to settle out of suspension adequately before discharge out of a regulated sluice. The most abundant cover type is phragmites, covering both upland and wetland portions (about 42% of the site). Phragmites, although a native species, is generally considered a pest species due to its invasive growth habit and low wildlife value as food.

Woody vegetation is the second most common cover type (20%) comprised mostly of sapling trees (i.e. box elder, mulberry, red maple, sycamore, and silver maple) and a dense shrub layer (i.e. multiflora rose, Russian olive, tartarian honeysuckle, and blackberry). About 10% of the site is meadow. There are no species of concern reported for this site by the Delaware Natural Heritage Inventory. However, many gray birch saplings were found in the sapling/shrub cover type (21%) and future placement operations should be designed to avoid this area. The remaining cover types (7%) include groundcover species and bare soil. Wildlife observed on the site were typical of early successional shrubland and pioneer woodland. Wildlife value is considered low for this site.

St. Georges. St. Georges is located in Delaware along the C&D Canal. This upland site is approximately 134 acres in size and is used periodically for the placement of maintenance dredged material from the C&D Canal. Some dike construction and earthwork would be needed to prepare the site to receive material. In addition to perimeter dikes, it would be necessary to construct dikes to separate the dredged slurry from the bridge abutments for the new St. Georges high level bridge, which now crosses the existing placement area. New dikes would be approximately 10 feet high with a 10-foot wide crest and 3 to 1 side slopes. Baffle dikes would be constructed, as necessary, to ensure proper slurry residence time in order for the dredged material to settle out of suspension adequately before discharge out of a regulated sluice.

Although 134 acres are diked, the total possible area is an irregularly shaped 200 acres site with several low-lying woodlands in drainage swales north of the dike. The only wetland areas are found outside the diked area to the north and east. Jewelweed, a smartweed, phragmites, and various grasses and sedges dominate vegetation. The largest single cover type within the dike is cultivated field (mowed grass), about 34% of the site. The most abundant natural cover is pole-sized pioneer woodland dominated by black locust and staghorn sumac (35%). A dense shrub layer of multiflora rose, tartarian honeysuckle, arrowwood, and blackberry provides 80-100% cover. The Delaware Natural Heritage Inventory has not yet evaluated this site and therefore, did not report any species of concern. This site is largely field and early successional forest of low structural complexity. The habitat supports a low diversity of wildlife species and wildlife value of the site is considered low.

Goose Point. Most of the Goose Point site is located in Delaware with about 500 feet of the western end situated across the Maryland border. This diked upland area is approximately 92 acres in size but actually measures 169 acres based on aerial photography. It is used periodically for the placement of maintenance dredged material from the C&D Canal. Some dike construction and earthwork would be necessary in order to prepare the site to receive dredged material. New dikes would be approximately 10 feet high with a 10-foot wide crest and 3 to 1 side slopes. Baffle dikes would be constructed, as necessary, to ensure proper slurry residence time in order for the dredged material to settle out of suspension adequately before discharge out of a regulated sluice.

The site slopes sharply down to the north, east, and west. The lowest portions of the site have standing water. A low berm runs longitudinally through much of the center of the site separating most of the uplands from the wetlands and ponds. Wetlands make up 33% of the site with 3 separate ponds (6% of the site). Mallards, green heron, muskrat, and frogs were observed using the westernmost pond. The pond is surrounded by several acres of marsh containing woolgrass and beggar-ticks, broad-leaved cattail, and common three-square. Shallow (1-3 inches) water areas within the marsh contain square-stem spikerush and small spikerush with soft-stem bulrush and fall panic grass. The vegetation around the eastern pond is more of a wet meadow with a mixture of small stands of phragmites and woolgrass, with tick-seed sunflower, purple loosestrife, smartweeds, and soft rush.

The most extensive wetland cover type is phragmites (13% of the site). The largest stands of this plant occur in the north and western half of the site. Uplands on the site are dominated by grassland (41% of the site). The dominant species are tall fescue and nodding foxtail grass with common ragweed, lespedeza, broomsedge, weeping love grass, small white aster, goosefoot, horseweed, wild lettuce, barnyard grass, smartweed, and pokeweed. The second most abundant upland type is bare ground (14% of the site). There are three large areas of bare ground, plus some small isolated spots. These areas are devoid of vegetation except for an occasional clump of grass. The Delaware Natural Heritage Inventory lists two species of concern for this site: gray birch was reported for the southwestern portion but was not found in any of the site. The other species is weakstalk bulrush, which was reported and located in the wetlands on the eastern side of the site. Increasing the height of the low longitudinal berm and avoiding any impact to hydrological sources should protect the existing wetlands. The large area of freshwater marsh surrounding scattered ponds forms a good interspersion of cover types, plus the extensive area of grassland and meadow give this area a moderate to high potential for wildlife use.

Summit East. Summit East is located in Delaware along the C&D Canal. This upland site is approximately 110 acres in size with approximately 88 acres of mature woodland. Like the previously mentioned sites, dike construction and earthwork would be necessary to prepare this site for dredged material. Dike design would be similar to that described for the previous 3 sites. As this site has not been used for placement for some time, it would be necessary to clear and grub some trees and stumps that exist within the diked area.

There are no wetlands or open water areas on the site. The majority of the site (56%) is woodland dominated by loblolly pine. Other occasional overstory species include red maple, black locust, black cherry, pin oak, Virginia pine, willow oak, and black oak. Meadow, covering 9% of the site, exists as several small, loosely connected stands along the southern edge of the placement area, and opens into a larger stand in the southwest corner. Bare ground covers approximately 1% of the site and occurs primarily in the southern and western edges where vehicle traffic and dumping have kept the area open.

The site is comprised mostly of mature forest. The forest structure forms a 2 to 3 layer habitat which can support a greater diversity of species than the less complex structure of the habitats previously described. The overall potential wildlife use is therefore fairly high. Future use of this site for dredged material placement should minimize the impact to as much of the forest cover as possible.

Bethel. Bethel is approximately 350 acres in size, located in Maryland just east of Chesapeake City. Wetlands occur on 35% of the site and exist as a large block in the south central portion of the site and as a smaller area in the western end. The largest wetland cover and largest cover type on the entire site is a 65 acre stand of phragmites. A large area of permanent water exists in this area but only 3% of the site remains as standing water during the growing season with 32 acres of American lotus (9% of the site). The eastern end of the pond is consecutive narrow stands of floating seedbox, then common three-square, and then phragmites. The south pond edge is vegetated with duck potato, swamp rosemallow, and phragmites. The shallow water of the pond contains Eurasian watermilfoil.

The majority of uplands on the site fall into one of two types: maple-gum-hickory forest (75 acres) and bare ground-lespedeza (65 acres). The maple-gum-hickory forest occurs mostly as one large stand in the southeast corner of the placement area. Smaller stands occur along the northeast fringe of the site where the stand is actually part of a larger adjacent stand of woods, and as a small stand in the center of the site. The western end of the woodland is not as mature and dominated by tulip poplar. This portion showed evidence of past disturbance from off-road motorcycles.

Grassland types totaling 53 acres comprise most of the remaining uplands. Except for one large planted stand dominated almost entirely by tall fescue, switchgrass is the dominant grass species. The fescue stand along the north edge of the site covers approximately 8% of the site. There are no species of concern reported for this site by the Maryland Natural Heritage Program since they have not done any survey work on the area. However, American lotus (*Nelumbo lutea*) is currently listed as a rare and vulnerable species in Maryland. Large blocks of low value habitat such as phragmites and bare ground dominate the area. While habitat interspersion is fairly good with scattered stands of forest cover among the various bare ground/grass types, the overall habitat structure is poor. The large area of permanent water, however, somewhat increases the overall habitat value of the site. The overall wildlife value of the site is considered low.

<u>Pearce Creek</u>. Pearce Creek is located in Maryland along the northern approach channel to the C&D Canal. This upland area is approximately 240 acres in size and is used periodically for the placement of maintenance dredged material from the northern approach channel to the C&D Canal and occasional for material form the southern approach channel to the C&D Canal. Dike construction and earth work required would be similar to that described in the previous sites. The dominant plant species at this site is phragmites, covering nearly 80% of the site with scrub/shrub growth on the slopes of the dike. Some standing water was observed in the center of the site but is most likely seasonal. Pearce Creek has been used for dredged material placement in the recent past and thus, its vegetation is representative of a disturbed habitat with very low value and wildlife usage.

<u>Courthouse Point</u>. Courthouse Point is located in Maryland along the northern approach channels to the C&D Canal. This upland area is 170 acres in size and has been used recently for placement of maintenance dredged material from the northern approach channel to the C&D Canal. Dike construction and earth work would also be required for this site in a manner similar to that described above. The most extensive cover type is monotypic phragmites, covering most of the diked placement area with shrub/sapling growth along the fringes. Like Pearce Creek, habitat value and wildlife usage is low.

The following paragraphs provide discussions of both general and specific potential impacts associated with use of the existing Federal upland sites.

<u>Groundwater</u>. Impacts to groundwater quality can result from the placement of dredged material in confined upland areas if contaminated leachate reaches an underlying aquifer. This is generally more of a concern for new placement sites as the placement of fine-grained material acts as a groundwater protection blanket, effectively sealing the site as it consolidates. As successive lifts of material are placed into a site and dewatered, the ability of water to percolate

through the material and into the underlying aquifer is reduced. All sites being considered have been used in the past.

Surface Water Quality. Surface water quality impacts associated with the use of selected dredged material placement sites are limited to the discharge of effluent during a placement operation. A hydraulic dredge, hydraulic rehandler, or hopper dredging operation pumps a significant amount of water along with dredged material into a confined placement site. This water must be drained from the site so that the dredged material settles and consolidates. An efficiently drained placement site maximizes capacity and insures site stability at higher elevations.

Excess water drained from the selected sites will be released back into the C&D Canal or approach channels. This water typically contains suspended sediments, and has the potential to contain dissolved inorganic and organic constituents previously associated with the dredged sediments. Depending on the nature of this effluent, water quality in the vicinity of the placement site can temporarily be degraded during a placement operation. Potential impacts include elevated levels of turbidity, decreased dissolved oxygen concentrations, and increased concentrations of nutrients and other chemical constituents. These impacts would be similar to those discussed in relation to the water quality impacts from open water placement. The effluent discharged from a containment site is expected to have a much lower impact on water quality than the open water discharge of dredged material since the majority of suspended solids and chemical constituents would be retained in the containment site.

The concentration of suspended sediment in the effluent discharged from a placement site can be controlled through proper operation of the weir structure. The elevation of the weir can be raised to increase the time water remains in the site before being discharged. The water should remain within the placement site a sufficient amount of time to allow suspended sediments to settle out of the water column. Through monitoring of the effluent leaving the site, the weir can be appropriately adjusted to achieve the desired degree of settling. The effluent discharge from existing dredged material placement sites during placement operations is currently monitored and controlled to insure that it contains no more than the allowable suspended sediment limits.

With regard to potential impacts related to the chemical nature of the effluent discharged from placement sites, chemical testing is employed to identify problems prior to their occurrence. The standard elutriate test was developed by the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency to monitor the soluble release of contaminants into the water column during placement operations. This test provides a suitable analysis of contaminants that would be released into the water column during a dredging operation, and back into the water through discharge of effluent at the placement site.

Habitat. Environmental Resources, Inc. (1994) conducted an on-site assessment of habitat value of 13 existing or previously used upland placement areas. These include: Reedy Point North, Reedy Point South, Biddle's Point, St. Georges, Schoolhouse Road, Summit East, Goose Point, Bethel, Chesapeake City, and Emily Point. A combination of aerial photography and walk-overs were used to determine the types and percent cover of vegetation present, the presence or absence of standing water, the presence and extent of jurisdictional wetlands, general topography, surface soil type, and wildlife use of the sites. This study was to assess the habitat complexity, determine acreage of cover types and to identify species that may be disturbed by changes likely to occur from placement operations.

The most common cover types were Phragmites (Phragmites australis) and a pioneer scrub tree community dominated by black locust (Robinia pseudoacacia). Phragmites is considered a pest species of low wildlife value and black locust is a short-lived, pioneer tree species of disturbed and low fertility sites. Reedy Point North and Reedy Point South were colonized mostly by Phragmites. Few of the sites contained any mature forest. Summit East and Emily Point were the only sites containing large areas of mature forest. Emily Point's forested area encompasses more than 100 acres in size and is of importance to declining populations of forest interior dwelling birds.

The majority of the wetland acreage was vegetated with dense stands of Phragmites. More than half the sites had permanent standing water. Most of the sites had low juxtaposition of cover types, with many of these cover types in large blocks. The Delaware City site contains large areas of both open water and Phragmites. The long irregular boundary between these two areas with much of the Phragmites ponded year-round and the dense stands of submerged aquatic vegetation (SAV) in the open water make this area of particular value to migratory waterfowl. The Delaware Division of Fish & Wildlife considers this area of highest wildlife value. The Upper and Lower Summit sites were also listed by the Division as areas of special concern due to their dog-training and dog-trial areas.

Wildlife. Common species of wildlife observed at nearly all the sites included white-tail deer (Odocileus virginianus), Eastern cottontail (Sylvilagus floridanus), gray fox, (Urocyon cinereoargentcus), and raccoon (Procyon lotor). A variety of song bird species were also recorded, although the time of year of the study field work was not optimum for evaluating breeding bird use. Wild turkey (Meleagris gallopavo), a species reintroduced to Delaware and currently expanding its range, was observed at the Summit East and School House Road sites. Pheasant tracks (Pipilo erythrophthalmus) were observed at Reedy Point South. No animal species are listed as threatened or endangered.

Most of the wildlife recorded would, at least temporarily, be displaced from areas redeveloped for placement of dredged material. The adjacent cover types to the sites are either additional placement areas, woodland, or farm fields. Therefore, most of the wildlife would be able to move into adjacent areas as disturbance exceeded their threshold tolerance. Some, however, like the forest interior dwelling birds, would be permanently displaced, as their habitat would take 50-70 years to begin to recover. Also, any break in the contiguous forest would cause additional habitat to be negatively impacted outside the placement area boundaries. Reconfiguring the dike alignments to avoid wetlands, open water, and forests can reduce impacts to wildlife.

Ten of the sites had 1 or more state-listed species present. Some of these species had not been previously recorded for these locations. Grey birch (Betula chinensis), for example, was only listed by Delaware for the Goose Point site. While it was not observed at Goose Point during this study, it was found at 4 other sites: Summit East, School Road, Delaware City, and Biddles Point. Most of the species of concern were localized on a site or were otherwise within an area that could easily be avoided in dike realignment. These include Diffuse rush (Juncus diffusissimus) at Goose Point. The weak stem bulrush (Scirpus validus) listed for Goose Point but observed at Chesapeake City and Lower Summit only. Curtis' threeon (Aristida dichotoma var. Curtissii) at Chesapeake City and Reedy Point South.

The 13 sites studied were ranked as to their habitat value, potential to minimize impacts, and opportunities for recovery in the following descending order:

Emily Point
Summit East
Delaware City
Upper Summit
Goose Point
School House Road
Biddles Point
St. Georges
Lower Summit
Bethel
Chesapeake City
Reedy Point South
Reedy Point North

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title: Bethel Dredged Material Containment Facility

Type: Upland Placement.

Location: Cecil County, Maryland
The site is located on the south bank of the C&D Canal, just east of Chesapeake City.

Size: 370 Acres diked.

Existing Capacity: Approximately 1 mcy.

Potential Capacity: Approximately 9.62 mcy.

Availability: Owned by U.S. Government

Nutrients: [Need info]

Infrastructure Required to Implement: Last used in 19__. The site receives dredged material from dredging of the C&D Canal.

Institutional Issues:

Costs:

Total Unit Costs Per Cubic Yard: $

Development & Implementation Costs:

COMMENTS:

DRAFT DRAFT DRAFT DRAFT

TITLE: Bethel DMCF **PROJECT TYPE:** Upland Containment Facility

Existing Conditions	Presence	Potential	Unknown	N/A*
Physical and Chemical Characteristics				
Substrate				X
High Relief Area				X
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics				X
Tidal Fluctuations				X
Salinity Gradients				X
Sediment Quality				X
HTRS			X	
Biological Characteristics				
RTE-				X
Aquatic Organisms				
Benthic Communities				X
Fisheries				X
Designated Spawning Area-anadromous		X		
Larval Habitat Area-anadromous fish		X		
Crabs		X		
Mollusks				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife	X			
Avian Wildlife				
Waterfowl concentration area			X	
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges				X
SAV				X
Wetlands				
Tidal Wetlands				X
Non-tidal Wetlands			X	
Human Use Characteristics				
Groundwater			X	
Water Related Recreation				X
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Crabs		X		
Recreationally important fisheries		X		
Commercially important fisheries				X
Aesthetics				
Air Quality		X		
Noise		X		
Critical Areas	X			
Forested Areas		X		
Cultural Resources		X		
Archaeological Resources		X		
Potential for Benefit			X	
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A**

(Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Brown, Christopher J. 1998. C&D Canal Disposal Area Inspection Report for FY 1998.

Environmental Resources, Inc. 1994. December 1994.

USACE, Philadelphia District. 1996. Chesapeake and Delaware (C&D) Canal – Baltimore Harbor Connecting Channels (Deepening), Delaware and Maryland Final Feasibility Report and Environmental Impact Statement. August 1996.

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title: Biddles Point Dredged Material Containment Facility

Type: Upland Placement.

Location: New Castle County, Delaware
The site is located on the north bank of the C&D Canal, just east of the St. Georges Bridge.

Size: 300 Acres. 273 Acres diked.

Existing Capacity: Approximately 1.4 mcy.

Potential Capacity: Approximately 12.24 mcy.

Availability: Owned by U.S. Government

Nutrients: [Need info]

Infrastructure Required to Implement: Last used in 19__. The site received dredged material from dredging of the C&D Canal. Site requires repairs to western containment dikes to achieve existing capacity.

Institutional Issues: The State of Delaware has requested that only dredged material from the State of Delaware be placed in the site.

Costs:

Total Unit Costs Per Cubic Yard: $/cy

Development & Implementation Costs:

COMMENTS:

DRAFT DRAFT DRAFT DRAFT

TITLE: Biddles Point DMCF **PROJECT TYPE:** Upland Containment Facility

Existing Conditions	Presence	Potential	Unknown	N/A*
Physical and Chemical Characteristics				
Substrate				X
High Relief Area				X
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics				X
Tidal Fluctuations				X
Salinity Gradients				X
Sediment Quality				X
HTRS			X	
Biological Characteristics				
RTE-				X
Aquatic Organisms				
Benthic Communities				X
Fisheries				X
Designated Spawning Area-anadromous		X		
Larval Habitat Area-anadromous fish		X		
Crabs		X		
Mollusks				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife	X			
Avian Wildlife				
Waterfowl concentration area			X	
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges				X
SAV				X
Wetlands				
Tidal Wetlands				X
Non-tidal Wetlands			X	
Human Use Characteristics				
Groundwater			X	
Water Related Recreation				X
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Crabs		X		
Recreationally important fisheries		X		
Commercially important fisheries		X		
Aesthetics				
Air Quality		X		
Noise		X		
Critical Areas	X			
Forested Areas		X		
Cultural Resources		X		
Archaeological Resources		X		
Potential for Benefit			X	
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A**

DRAFT DRAFT DRAFT DRAFT

(Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Brown, Christopher J. 1998. C&D Canal Disposal Area Inspection Report for FY 1998.

Environmental Resources, Inc. 1994. December 1994.

USACE, Philadelphia District. 1996. Chesapeake and Delaware (C&D) Canal – Baltimore Harbor Connecting Channels (Deepening), Delaware and Maryland Final Feasibility Report and Environmental Impact Statement. August 1996.

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title: Chesapeake City Dredged Material Containment Facility

Type: Upland Placement.

Location: Cecil County, Maryland
The site is located on the south bank of the C&D Canal, just west of Chesapeake City.

Size: 230 acres. 196 Acres diked.

Existing Capacity: Approximately 3.3 mcy.

Potential Capacity: Approximately 9.16 mcy.

Availability: Owned by U.S. Government

Nutrients: [Need info]

Infrastructure Required to Implement:

Institutional Issues:

Costs:

Total Unit Costs Per Cubic Yard: $

Development & Implementation Costs:

COMMENTS:

DRAFT DRAFT DRAFT DRAFT

TITLE: Chesapeake City DMCF **PROJECT TYPE**: Upland Containment Facility

Existing Conditions	Presence	Potential	Unknown	N/A*
Physical and Chemical Characteristics				
Substrate				X
High Relief Area				X
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics				X
Tidal Fluctuations				X
Salinity Gradients				X
Sediment Quality				X
HTRS			X	
Biological Characteristics				
RTE-				X
Aquatic Organisms				
Benthic Communities				X
Fisheries				X
Designated Spawning Area-anadromous		X		
Larval Habitat Area-anadromous fish		X		
Crabs		X		
Mollusks				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife	X			
Avian Wildlife				
Waterfowl concentration area			X	
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges				X
SAV				X
Wetlands				
Tidal Wetlands				X
Non-tidal Wetlands			X	
Human Use Characteristics				
Groundwater			X	
Water Related Recreation				X
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Crabs		X		
Recreationally important fisheries		X		
Commercially important fisheries		X		
Aesthetics				
Air Quality		X		
Noise		X		
Critical Areas	X			
Forested Areas		X		
Cultural Resources		X		
Archaeological Resources		X		
Potential for Benefit			X	
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A**

DRAFT DRAFT DRAFT DRAFT

(Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Brown, Christopher J. 1998. C&D Canal Disposal Area Inspection Report for FY 1998.

Environmental Resources, Inc. 1994. December 1994.

USACE, Philadelphia District. 1996. Chesapeake and Delaware (C&D) Canal – Baltimore Harbor Connecting Channels (Deepening), Delaware and Maryland Final Feasibility Report and Environmental Impact Statement. August 1996.

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title: Courthouse Point Dredged Material Containment Facility

Type: Upland Placement.

Location: Cecil County, Maryland
The site is located on the east side of the northern approach channel to the C&D Canal, in the vicinity of Courthouse Point.

Size: 170 Acres

Existing Capacity: Approximately 3.8 mcy.

Potential Capacity: Approximately 10.9 mcy.

Availability: Owned by U.S. Government

Nutrients: [Need info]

Infrastructure Required to Implement: Last used in 1998. The site is used every year to every other year for maintenance dredging of the northern approach channels to the C&D Canal. The site has recently received dredged material from maintenance dredging of the southern approach channels to the C&D Canal in lieu of the Pearce Creek placement area.

Institutional Issues:

Costs:

Total Unit Costs Per Cubic Yard: $

Development & Implementation Costs:

COMMENTS:

DRAFT DRAFT DRAFT DRAFT

TITLE: Courthouse Point DMCF **PROJECT TYPE**: Upland Containment Facility

Existing Conditions	Presence	Potential	Unknown	N/A*
Physical and Chemical Characteristics				
Substrate				X
High Relief Area				X
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics				X
Tidal Fluctuations				X
Salinity Gradients				X
Sediment Quality				X
HTRS			X	
Biological Characteristics				
RTE-				X
Aquatic Organisms				
Benthic Communities				X
Fisheries				X
Designated Spawning Area-anadromous		X		
Larval Habitat Area-anadromous fish		X		
Crabs		X		
Mollusks				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife	X			
Avian Wildlife				
Waterfowl concentration area			X	
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges				X
SAV				X
Wetlands				
Tidal Wetlands				X
Non-tidal Wetlands			X	
Human Use Characteristics				
Groundwater	X			
Water Related Recreation				X
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Crabs		X		
Recreationally important fisheries		X		
Commercially important fisheries		X		
Aesthetics				
Air Quality		X		
Noise		X		
Critical Areas	X			
Forested Areas		X		
Cultural Resources		X		
Archaeological Resources		X		
Potential for Benefit			X	
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A**

DRAFT DRAFT DRAFT DRAFT

(Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Brown, Christopher J. 1998. C&D Canal Disposal Area Inspection Report for FY 1998.

Environmental Resources, Inc. 1994. December 1994.

USACE, Philadelphia District. 1996. Chesapeake and Delaware (C&D) Canal – Baltimore Harbor Connecting Channels (Deepening), Delaware and Maryland Final Feasibility Report and Environmental Impact Statement. August 1996.

Option Data Sheet

Title: Delaware City Dredged Material Containment Facility

Type: Upland Placement.

Location: New Castle County, Delaware
The site is located on the north bank of the C&D Canal, southwest of Delaware City.

Size: 300 Acres. 364 Acres diked.

Existing Capacity: Approximately 4.0 mcy.

Potential Capacity: Approximately 21.65 mcy.

Availability: Owned by U.S. Government

Nutrients: [Need info]

Infrastructure Required to Implement: Last used in 19__. The site received dredged material from dredging of the C&D Canal.

Institutional Issues: The State of Delaware has requested that only dredged material from the State of Delaware be placed in the site.

Costs:

Total Unit Costs Per Cubic Yard: $

Development & Implementation Costs:

COMMENTS:

DRAFT DRAFT DRAFT DRAFT

TITLE: Delaware City DMCF **PROJECT TYPE:** Upland Containment Facility

Existing Conditions	Presence	Potential	Unknown	N/A*
Physical and Chemical Characteristics				
Substrate				X
High Relief Area				X
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics				X
Tidal Fluctuations				X
Salinity Gradients				X
Sediment Quality				X
HTRS			X	
Biological Characteristics				
RTE-				X
Aquatic Organisms				
Benthic Communities				X
Fisheries				X
Designated Spawning Area-anadromous		X		
Larval Habitat Area-anadromous fish		X		
Crabs		X		
Mollusks				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife	X			
Avian Wildlife				
Waterfowl concentration area			X	
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges				X
SAV				X
Wetlands				
Tidal Wetlands				X
Non-tidal Wetlands			X	
Human Use Characteristics				
Groundwater			X	
Water Related Recreation				X
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Crabs		X		
Recreationally important fisheries		X		
Commercially important fisheries		X		
Aesthetics				
Air Quality		X		
Noise		X		
Critical Areas	X			
Forested Areas		X		
Cultural Resources		X		
Archaeological Resources		X		
Potential for Benefit			X	
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A**

DRAFT DRAFT DRAFT DRAFT

(Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Brown, Christopher J. 1998. C&D Canal Disposal Area Inspection Report for FY 1998.

Environmental Resources, Inc. 1994. December 1994.

USACE, Philadelphia District. 1996. Chesapeake and Delaware (C&D) Canal – Baltimore Harbor Connecting Channels (Deepening), Delaware and Maryland Final Feasibility Report and Environmental Impact Statement. August 1996.

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title: Emily Point Dredged Material Containment Facility

Type: Upland Placement.

Location: Cecil County, Maryland
The site is located on the north bank of the C&D Canal, just west of Chesapeake City.

Size: 180 Acres. 60 Acres diked.

Existing Capacity: Approximately 0.33 mcy.

Potential Capacity: Approximately 2.22 mcy.

Availability: Owned by U.S. Government

Nutrients: [Need info]

Infrastructure Required to Implement: Last used in 1998. The site has been used to receive dredged material from dredging of the C&D Canal. Repairs necessary to the deteriorated spillways.

Institutional Issues:

Costs:

Total Unit Costs Per Cubic Yard: $

Development & Implementation Costs:

COMMENTS:

DRAFT DRAFT DRAFT DRAFT

TITLE: Emily Point DMCF **PROJECT TYPE**: Upland Containment Facility

Existing Conditions	Presence	Potential	Unknown	N/A*
Physical and Chemical Characteristics				
Substrate				X
High Relief Area				X
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics				X
Tidal Fluctuations				X
Salinity Gradients				X
Sediment Quality				X
HTRS			X	
Biological Characteristics				
RTE-				X
Aquatic Organisms				
Benthic Communities				X
Fisheries				X
Designated Spawning Area-anadromous		X		
Larval Habitat Area-anadromous fish		X		
Crabs		X		
Mollusks				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife	X			
Avian Wildlife				
Waterfowl concentration area			X	
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges				X
SAV				X
Wetlands				
Tidal Wetlands				X
Non-tidal Wetlands			X	
Human Use Characteristics				
Groundwater			X	
Water Related Recreation				X
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Crabs		X		
Recreationally important fisheries		X		
Commercially important fisheries		X		
Aesthetics				
Air Quality		X		
Noise		X		
Critical Areas	X			
Forested Areas		X		
Cultural Resources		X		
Archaeological Resources		X		
Potential for Benefit			X	
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A**

DRAFT DRAFT DRAFT DRAFT

(Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Brown, Christopher J. 1998. C&D Canal Disposal Area Inspection Report for FY 1998.

Environmental Resources, Inc. 1994. December 1994.

USACE, Philadelphia District. 1996. Chesapeake and Delaware (C&D) Canal – Baltimore Harbor Connecting Channels (Deepening), Delaware and Maryland Final Feasibility Report and Environmental Impact Statement. August 1996.

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title: Goose Point Dredged Material Containment Facility

Type: Upland Placement.

Location: New Castle County, Delaware
The site is located on the north bank of the C&D Canal, east of Chesapeake City.

Size: 190 Acres. 161 Acres diked.

Existing Capacity: Approximately 4.5 mcy.

Potential Capacity: Approximately 4.5 mcy.

Availability: Owned by U.S. Government

Nutrients: [Need info]

Infrastructure Required to Implement: Last used in 19__. The site receives dredged material from dredging of the C&D Canal. Sewage sludge was applied to the site to encourage vegetative growth.

Institutional Issues: The State of Delaware has requested that only dredged material from the State of Delaware be placed in the site.

Costs:

Total Unit Costs Per Cubic Yard: $

Development & Implementation Costs:

COMMENTS:

DRAFT DRAFT DRAFT DRAFT

TITLE: Goose Point DMCF **PROJECT TYPE**: Upland Containment Facility

Existing Conditions	Presence	Potential	Unknown	N/A*
Physical and Chemical Characteristics				
Substrate				X
High Relief Area				X
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics				X
Tidal Fluctuations				X
Salinity Gradients				X
Sediment Quality				X
HTRS			X	
Biological Characteristics				
RTE-				X
Aquatic Organisms				
Benthic Communities				X
Fisheries				X
Designated Spawning Area-anadromous		X		
Larval Habitat Area-anadromous fish		X		
Crabs		X		
Mollusks				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife	X			
Avian Wildlife				
Waterfowl concentration area			X	
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges				X
SAV				X
Wetlands				
Tidal Wetlands				X
Non-tidal Wetlands			X	
Human Use Characteristics				
Groundwater			X	
Water Related Recreation				X
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Crabs		X		
Recreationally important fisheries		X		
Commercially important fisheries		X		
Aesthetics				
Air Quality		X		
Noise		X		
Critical Areas	X			
Forested Areas		X		
Cultural Resources		X		
Archaeological Resources		X		
Potential for Benefit			X	
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A**

DRAFT DRAFT DRAFT DRAFT

(Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Brown, Christopher J. 1998. C&D Canal Disposal Area Inspection Report for FY 1998.

Environmental Resources, Inc. 1994. December 1994.

USACE, Philadelphia District. 1996. Chesapeake and Delaware (C&D) Canal – Baltimore Harbor Connecting Channels (Deepening), Delaware and Maryland Final Feasibility Report and Environmental Impact Statement. August 1996.

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title: Lower Summit Dredged Material Containment Facility

Type: Upland Placement.

Location: New Castle County, Delaware
The site is located on the north bank of the C&D Canal, just west of the Summit Bridge.

Size: 72 Acres diked.

Existing Capacity: Approximately 0 mcy.

Potential Capacity: Approximately 1.33 mcy.

Availability: Owned by U.S. Government

Nutrients: [Need info]

Infrastructure Required to Implement: Last used in 19__. The site was closed in 19__. The site received dredged material from dredging of the C&D Canal. Sewage sludge was applied to the site to encourage vegetative growth.

Institutional Issues: The State of Delaware has requested that only dredged material from the State of Delaware be placed in the site.

Costs:

Total Unit Costs Per Cubic Yard: $

Development & Implementation Costs:

COMMENTS:

DRAFT DRAFT DRAFT DRAFT

TITLE: Lower Summit DMCF **PROJECT TYPE:** Upland Containment Facility

Existing Conditions	Presence	Potential	Unknown	N/A*
Physical and Chemical Characteristics				
Substrate				X
High Relief Area				X
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics				X
Tidal Fluctuations				X
Salinity Gradients				X
Sediment Quality				X
HTRS			X	
Biological Characteristics				
RTE-				X
Aquatic Organisms				
Benthic Communities				X
Fisheries				X
Designated Spawning Area-anadromous		X		
Larval Habitat Area-anadromous fish		X		
Crabs		X		
Mollusks				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife	X			
Avian Wildlife				
Waterfowl concentration area			X	
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges				X
SAV				X
Wetlands				
Tidal Wetlands			X	
Non-tidal Wetlands	X			
Human Use Characteristics				
Groundwater			X	
Water Related Recreation				X
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Crabs		X		
Recreationally important fisheries		X		
Commercially important fisheries		X		
Aesthetics				
Air Quality		X		
Noise		X		
Critical Areas	X			
Forested Areas		X		
Cultural Resources		X		
Archaeological Resources		X		
Potential for Benefit			X	
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A**

(Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Brown, Christopher J. 1998. C&D Canal Disposal Area Inspection Report for FY 1998.

Environmental Resources, Inc. 1994. December 1994.

USACE, Philadelphia District. 1996. Chesapeake and Delaware (C&D) Canal – Baltimore Harbor Connecting Channels (Deepening), Delaware and Maryland Final Feasibility Report and Environmental Impact Statement. August 1996.

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title: Pearce Creek Dredged Material Containment Facility

Type: Upland Placement.

Location: Cecil County, Maryland
The site is located on the east bank of the northern approach channel to the C&D Canal, between Arnold and Worton Points.

Size: 260 Acres

Existing Capacity: Approximately 4.7 mcy.

Potential Capacity: Approximately 15.25 mcy.

Availability: Owned by U.S. Government

Nutrients: [Need info]

Infrastructure Required to Implement: Last used in 1991. Local West View Shores community has complained about well water contamination.

Institutional Issues:

Costs:

Total Unit Costs Per Cubic Yard: $

Development & Implementation Costs:

COMMENTS:

DRAFT DRAFT DRAFT DRAFT

TITLE: Pearce Creek DMCF **PROJECT TYPE**: Upland Containment Facility

Existing Conditions	**Presence**	**Potential**	**Unknown**	**N/A***
Physical and Chemical Characteristics				
Substrate				X
High Relief Area				X
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics				X
Tidal Fluctuations				X
Salinity Gradients				X
Sediment Quality				X
HTRS			X	
Biological Characteristics				
RTE-				X
Aquatic Organisms				
Benthic Communities				X
Fisheries				X
Designated Spawning Area-anadromous		X		
Larval Habitat Area-anadromous fish		X		
Crabs		X		
Mollusks				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife	X			
Avian Wildlife				
Waterfowl concentration area			X	
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges				X
SAV				X
Wetlands				
Tidal Wetlands			X	
Non-tidal Wetlands			X	
Human Use Characteristics				
Groundwater	X			
Water Related Recreation				X
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars				
Crabs		X		
Recreationally important fisheries		X		
Commercially important fisheries		X		
Aesthetics				
Air Quality		X		
Noise		X		
Critical Areas	X			
Forested Areas		X		
Cultural Resources		X		
Archaeological Resources		X		
Potential for Benefit			X	
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A**

(Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Brown, Christopher J. 1998. C&D Canal Disposal Area Inspection Report for FY 1998.

Environmental Resources, Inc. 1994. December 1994.

USACE, Philadelphia District. 1996. Chesapeake and Delaware (C&D) Canal – Baltimore Harbor Connecting Channels (Deepening), Delaware and Maryland Final Feasibility Report and Environmental Impact Statement. August 1996.

USACE, Philadelphia District. 1998. Information Paper – Pearce Creek Disposal Area. November 24, 1998.

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title: Penn Central Cutoff Dredged Material Containment Facility

Type: Upland Placement.

Location: New Castle County, Delaware
The site is located on the north bank of the C&D Canal, east of the Conrail Railroad Bridge.

Size: 197 Acres diked.

Existing Capacity: Approximately 1.5 mcy.

Potential Capacity: Approximately 5.92 mcy.

Availability: Owned by U.S. Government

Nutrients: [Need info]

Infrastructure Required to Implement: Last used in 19__. The site received dredged material from dredging of the C&D Canal.

Institutional Issues: The State of Delaware has requested that only dredged material from the State of Delaware be placed in the site.

Costs:

Total Unit Costs Per Cubic Yard: $

Development & Implementation Costs:

COMMENTS:

DRAFT DRAFT DRAFT DRAFT

TITLE: Penn Central Cutoff DMCF **PROJECT TYPE**: Upland Containment Facility

Existing Conditions	**Presence**	**Potential**	**Unknown**	**N/A***
Physical and Chemical Characteristics				
Substrate				X
High Relief Area				X
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics				X
Tidal Fluctuations				X
Salinity Gradients				X
Sediment Quality				X
HTRS			X	
Biological Characteristics				
RTE-				X
Aquatic Organisms				
Benthic Communities				X
Fisheries				X
Designated Spawning Area-anadromous		X		
Larval Habitat Area-anadromous fish		X		
Crabs		X		
Mollusks				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife	X			
Avian Wildlife				
Waterfowl concentration area			X	
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges				X
SAV				X
Wetlands				
Tidal Wetlands			X	
Non-tidal Wetlands		X		
Human Use Characteristics				
Groundwater			X	
Water Related Recreation				X
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Crabs		X		
Recreationally important fisheries		X		
Commercially important fisheries		X		
Aesthetics				
Air Quality		X		
Noise		X		
Critical Areas	X			
Forested Areas		X		
Cultural Resources		X		
Archaeological Resources		X		
Potential for Benefit			X	
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A**

DRAFT DRAFT DRAFT DRAFT

(Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Brown, Christopher J. 1998. C&D Canal Disposal Area Inspection Report for FY 1998.

Environmental Resources, Inc. 1994. December 1994.

USACE, Philadelphia District. 1996. Chesapeake and Delaware (C&D) Canal – Baltimore Harbor Connecting Channels (Deepening), Delaware and Maryland Final Feasibility Report and Environmental Impact Statement. August 1996.

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title: Penn Central East Dredged Material Containment Facility

Type: Upland Placement.

Location: New Castle County, Delaware
The site is located on the north bank of the C&D Canal, east of the Conrail Railroad Bridge.

Size: 215 acres. 136 Acres diked.

Existing Capacity: Approximately 1.4 mcy.

Potential Capacity: Approximately 6.4 mcy.

Availability: Owned by U.S. Government

Nutrients: [Need info]

Infrastructure Required to Implement: Last used in 19__. The site received dredged material from dredging of the C&D Canal.

Institutional Issues: The State of Delaware has requested that only dredged material from the State of Delaware be placed in the site.

Costs:

Total Unit Costs Per Cubic Yard: $

Development & Implementation Costs:

COMMENTS:

TITLE: Penn Central East DMCF **PROJECT TYPE:** Upland Containment Facility

Existing Conditions	Presence	Potential	Unknown	N/A*
Physical and Chemical Characteristics				
Substrate				X
High Relief Area				X
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics				X
Tidal Fluctuations				X
Salinity Gradients				X
Sediment Quality				X
HTRS			X	
Biological Characteristics				
RTE-				X
Aquatic Organisms				
Benthic Communities				X
Fisheries				X
Designated Spawning Area-anadromous		X		
Larval Habitat Area-anadromous fish		X		
Crabs		X		
Mollusks				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife	X			
Avian Wildlife				
Waterfowl concentration area			X	
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges				X
SAV				X
Wetlands				
Tidal Wetlands			X	
Non-tidal Wetlands		X		
Human Use Characteristics				
Groundwater			X	
Water Related Recreation				X
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Crabs		X		
Recreationally important fisheries		X		
Commercially important fisheries		X		
Aesthetics				
Air Quality		X		
Noise		X		
Critical Areas	X			
Forested Areas		X		
Cultural Resources		X		
Archaeological Resources		X		
Potential for Benefit			X	
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A**

DRAFT DRAFT DRAFT DRAFT

(Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Brown, Christopher J. 1998. C&D Canal Disposal Area Inspection Report for FY 1998.

Environmental Resources, Inc. 1994. December 1994.

USACE, Philadelphia District. 1996. Chesapeake and Delaware (C&D) Canal – Baltimore Harbor Connecting Channels (Deepening), Delaware and Maryland Final Feasibility Report and Environmental Impact Statement. August 1996.

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title: Penn Central West Dredged Material Containment Facility

Type: Upland Placement.

Location: New Castle County, Delaware
The site is located on the north bank of the C&D Canal, east of the Summit Bridge and west of the Conrail Railroad Bridge.

Size: 103 acres. 89 Acres diked.

Existing Capacity: Approximately 0.8 mcy.

Potential Capacity: Approximately 2.8 mcy.

Availability: Owned by U.S. Government

Nutrients: [Need info]

Infrastructure Required to Implement: Last used in 19__. The site received dredged material from dredging of the C&D Canal. Sewage sludge was applied to the site to encourage vegetative growth.

Institutional Issues: The State of Delaware has requested that only dredged material from the State of Delaware be placed in the site. The site is currently used as a baseball recreational area.

Costs:

Total Unit Costs Per Cubic Yard: $

Development & Implementation Costs:

COMMENTS:

DRAFT DRAFT DRAFT DRAFT

TITLE: Penn Central West DMCF **PROJECT TYPE:** Upland Containment Facility

Existing Conditions	Presence	Potential	Unknown	N/A*
Physical and Chemical Characteristics				
Substrate				X
High Relief Area				X
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics				X
Tidal Fluctuations				X
Salinity Gradients				X
Sediment Quality				X
HTRS			X	
Biological Characteristics				
RTE-				X
Aquatic Organisms				
Benthic Communities				X
Fisheries				X
Designated Spawning Area-anadromous		X		
Larval Habitat Area-anadromous fish		X		
Crabs		X		
Mollusks				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife	X			
Avian Wildlife				
Waterfowl concentration area			X	
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges				X
SAV				X
Wetlands				
Tidal Wetlands			X	
Non-tidal Wetlands			X	
Human Use Characteristics				
Groundwater			X	
Water Related Recreation				X
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Crabs		X		
Recreationally important fisheries		X		
Commercially important fisheries		X		
Aesthetics				
Air Quality		X		
Noise		X		
Critical Areas	X			
Forested Areas		X		
Cultural Resources		X		
Archaeological Resources		X		
Potential for Benefit			X	
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A**

DRAFT DRAFT DRAFT DRAFT

(Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Brown, Christopher J. 1998. C&D Canal Disposal Area Inspection Report for FY 1998.

Environmental Resources, Inc. 1994. December 1994.

USACE, Philadelphia District. 1996. Chesapeake and Delaware (C&D) Canal – Baltimore Harbor Connecting Channels (Deepening), Delaware and Maryland Final Feasibility Report and Environmental Impact Statement. August 1996.

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title: Reedy Point North Dredged Material Containment Facility

Type: Upland Placement.

Location: New Castle County, Delaware
The site is located on the north bank of the C&D Canal, at the eastern end of the C&D Canal.

Size: 122 Acres diked.

Existing Capacity: Approximately 0.98 mcy.

Potential Capacity: Approximately 2.82 mcy.

Availability: Owned by U.S. Government

Nutrients: [Need info]

Infrastructure Required to Implement: Last used in 19__. The site received dredged material from dredging of the C&D Canal.

Institutional Issues: The State of Delaware has requested that only dredged material from the State of Delaware be placed in the site. The site is committed to taking material from the Delaware River deepening project.

Costs:

Total Unit Costs Per Cubic Yard: $

Development & Implementation Costs:

COMMENTS:

DRAFT DRAFT DRAFT DRAFT

TITLE: Reedy Point North DMCF Facility **PROJECT TYPE:** Upland Containment

Existing Conditions	Presence	Potential	Unknown	N/A*
Physical and Chemical Characteristics				
Substrate				X
High Relief Area				X
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics				X
Tidal Fluctuations				X
Salinity Gradients				X
Sediment Quality				X
HTRS			X	
Biological Characteristics				
RTE-				X
Aquatic Organisms				
Benthic Communities				X
Fisheries				X
Designated Spawning Area-anadromous		X		
Larval Habitat Area-anadromous fish		X		
Crabs		X		
Mollusks				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife	X			
Avian Wildlife				
Waterfowl concentration area			X	
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges				X
SAV				X
Wetlands				
Tidal Wetlands			X	
Non-tidal Wetlands			X	
Human Use Characteristics				
Groundwater			X	
Water Related Recreation				X
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Crabs		X		
Recreationally important fisheries		X		
Commercially important fisheries		X		
Aesthetics				
Air Quality		X		
Noise		X		
Critical Areas	X			
Forested Areas		X		
Cultural Resources		X		
Archaeological Resources		X		
Potential for Benefit			X	
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A** (Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Brown, Christopher J. 1998. C&D Canal Disposal Area Inspection Report for FY 1998.

Environmental Resources, Inc. 1994. December 1994.

USACE, Philadelphia District. 1996. Chesapeake and Delaware (C&D) Canal – Baltimore Harbor Connecting Channels (Deepening), Delaware and Maryland Final Feasibility Report and Environmental Impact Statement. August 1996.

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title: Reedy Point South Dredged Material Containment Facility

Type: Upland Placement.

Location: New Castle County, Delaware
The site is located on the south bank of the C&D Canal, at the eastern end of the C&D Canal.

Size: 133 Acres diked.

Existing Capacity: Approximately 0.64 mcy.

Potential Capacity: Approximately 3.32 mcy.

Availability: Owned by U.S. Government

Nutrients: [Need info]

Infrastructure Required to Implement: Last used in 19__. The site received dredged material from dredging of the C&D Canal.

Institutional Issues: The State of Delaware has requested that only dredged material from the State of Delaware be placed in the site. The site is committed to taking material from the Delaware River deepening project.

Costs:

Total Unit Costs Per Cubic Yard: $

Development & Implementation Costs:

COMMENTS:

DRAFT DRAFT DRAFT DRAFT

TITLE: Reedy Point South DMCF Facility **PROJECT TYPE**: Upland Containment

Existing Conditions	**Presence**	**Potential**	**Unknown**	**N/A***
Physical and Chemical Characteristics				
Substrate				X
High Relief Area				X
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics				X
Tidal Fluctuations				X
Salinity Gradients				X
Sediment Quality				X
HTRS			X	
Biological Characteristics				
RTE-				X
Aquatic Organisms				
Benthic Communities				X
Fisheries				X
Designated Spawning Area-anadromous		X		
Larval Habitat Area-anadromous fish		X		
Crabs		X		
Mollusks				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife	X			
Avian Wildlife				
Waterfowl concentration area			X	
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges				X
SAV				X
Wetlands				
Tidal Wetlands			X	
Non-tidal Wetlands			X	
Human Use Characteristics				
Groundwater			X	
Water Related Recreation				X
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Crabs		X		
Recreationally important fisheries		X		
Commercially important fisheries		X		
Aesthetics				
Air Quality		X		
Noise		X		
Critical Areas	X			
Forested Areas		X		
Cultural Resources		X		
Archaeological Resources		X		
Potential for Benefit			X	
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A** (Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Brown, Christopher J. 1998. C&D Canal Disposal Area Inspection Report for FY 1998.

Environmental Resources, Inc. 1994. December 1994.

USACE, Philadelphia District. 1996. Chesapeake and Delaware (C&D) Canal – Baltimore Harbor Connecting Channels (Deepening), Delaware and Maryland Final Feasibility Report and Environmental Impact Statement. August 1996.

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title: Schoolhouse Road Dredged Material Containment Facility

Type: Upland Placement.

Location: New Castle County, Delaware
The site is located on the north bank of the C&D Canal, east of the Conrail Railroad Bridge and east of the St. Georges Bridge.

Size: 160 Acres. 132 Acres diked.

Existing Capacity: Approximately 0.8 mcy.

Potential Capacity: Approximately 3.6 mcy.

Availability: Owned by U.S. Government

Nutrients: [Need info]

Infrastructure Required to Implement: Last used in 19__. The site received dredged material from dredging of the C&D Canal.

Institutional Issues: The State of Delaware has requested that only dredged material from the State of Delaware be placed in the site.

Costs:

Total Unit Costs Per Cubic Yard: $

Development & Implementation Costs:

COMMENTS:

DRAFT DRAFT DRAFT DRAFT

TITLE: Schoolhouse Road DMCF **PROJECT TYPE**: Upland Containment Facility

Existing Conditions	Presence	Potential	Unknown	N/A*
Physical and Chemical Characteristics				
Substrate				X
High Relief Area				X
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics				X
Tidal Fluctuations				X
Salinity Gradients				X
Sediment Quality				X
HTRS			X	
Biological Characteristics				
RTE-				X
Aquatic Organisms				
Benthic Communities				X
Fisheries				X
Designated Spawning Area-anadromous		X		
Larval Habitat Area-anadromous fish		X		
Crabs		X		
Mollusks				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife	X			
Avian Wildlife				
Waterfowl concentration area			X	
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges				X
SAV				X
Wetlands				
Tidal Wetlands			X	
Non-tidal Wetlands			X	
Human Use Characteristics				
Groundwater			X	
Water Related Recreation				X
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Crabs		X		
Recreationally important fisheries		X		
Commercially important fisheries				X
Aesthetics				
Air Quality		X		
Noise		X		
Critical Areas	X			
Forested Areas		X		
Cultural Resources		X		
Archaeological Resources		X		
Potential for Benefit			X	
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A**

(Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Brown, Christopher J. 1998. C&D Canal Disposal Area Inspection Report for FY 1998.

Environmental Resources, Inc. 1994. December 1994.

USACE, Philadelphia District. 1996. Chesapeake and Delaware (C&D) Canal – Baltimore Harbor Connecting Channels (Deepening), Delaware and Maryland Final Feasibility Report and Environmental Impact Statement. August 1996.

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title: St. Georges Dredged Material Containment Facility

Type: Upland Placement.

Location: New Castle County, Delaware
The site is located on the north bank of the C&D Canal, just west of the St. Georges Bridge.

Size: 155 Acres. 134 Acres diked.

Existing Capacity: Approximately 1.0 mcy.

Potential Capacity: Approximately 2.82 mcy.

Availability: Owned by U.S. Government

Nutrients: [Need info]

Infrastructure Required to Implement: Last used in 19__. The site received dredged material from dredging of the C&D Canal. Site requires repairs to containment dikes to achieve existing capacity.

Institutional Issues: The State of Delaware has requested that only dredged material from the State of Delaware be placed in the site.

Costs:

Total Unit Costs Per Cubic Yard: $

Development & Implementation Costs:

COMMENTS:

DRAFT DRAFT DRAFT DRAFT

TITLE: St. Georges DMCF **PROJECT TYPE:** Upland Containment Facility

Existing Conditions	Presence	Potential	Unknown	N/A*
Physical and Chemical Characteristics				
Substrate				X
High Relief Area				X
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics				X
Tidal Fluctuations				X
Salinity Gradients				X
Sediment Quality				X
HTRS			X	
Biological Characteristics				
RTE-				X
Aquatic Organisms				
Benthic Communities				X
Fisheries				X
Designated Spawning Area-anadromous		X		
Larval Habitat Area-anadromous fish		X		
Crabs		X		
Mollusks				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife	X			
Avian Wildlife				
Waterfowl concentration area			X	
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges				X
SAV				X
Wetlands				
Tidal Wetlands			X	
Non-tidal Wetlands			X	
Human Use Characteristics				
Groundwater			X	
Water Related Recreation				X
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Crabs		X		
Recreationally important fisheries		X		
Commercially important fisheries		X		
Aesthetics				
Air Quality		X		
Noise		X		
Critical Areas	X			
Forested Areas		X		
Cultural Resources		X		
Archaeological Resources		X		
Potential for Benefit			X	
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A**

DRAFT DRAFT DRAFT DRAFT

(Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Brown, Christopher J. 1998. C&D Canal Disposal Area Inspection Report for FY 1998.

Environmental Resources, Inc. 1994. December 1994.

USACE, Philadelphia District. 1996. Chesapeake and Delaware (C&D) Canal – Baltimore Harbor Connecting Channels (Deepening), Delaware and Maryland Final Feasibility Report and Environmental Impact Statement. August 1996.

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title: Summit East Dredged Material Containment Facility

Type: Upland Placement.

Location: New Castle County, Delaware
The site is located on the north bank of the C&D Canal, just east of the Summit Bridge.

Size: 195 Acres diked.

Existing Capacity: Approximately 0 mcy.

Potential Capacity: Approximately 3.31 mcy.

Availability: Owned by U.S. Government

Nutrients: [Need info]

Infrastructure Required to Implement: Last used in 19__. The site was closed in 19__. The site received dredged material from dredging of the C&D Canal. Sewage sludge was applied to the site to encourage vegetative growth.

Institutional Issues: The State of Delaware has requested that only dredged material from the State of Delaware be placed in the site.

Costs:

Total Unit Costs Per Cubic Yard: $

Development & Implementation Costs:

COMMENTS:

DRAFT DRAFT DRAFT DRAFT

TITLE: Summit East DMCF **PROJECT TYPE**: Upland Containment Facility

Existing Conditions	Presence	Potential	Unknown	N/A*
Physical and Chemical Characteristics				
Substrate				X
High Relief Area				X
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics				X
Tidal Fluctuations				X
Salinity Gradients				X
Sediment Quality				X
HTRS			X	
Biological Characteristics				
RTE-				X
Aquatic Organisms				
Benthic Communities				X
Fisheries				X
Designated Spawning Area-anadromous		X		
Larval Habitat Area-anadromous fish		X		
Crabs		X		
Mollusks				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife	X			
Avian Wildlife				
Waterfowl concentration area			X	
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges				X
SAV				X
Wetlands				
Tidal Wetlands			X	
Non-tidal Wetlands			X	
Human Use Characteristics				
Groundwater			X	
Water Related Recreation				X
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Crabs		X		
Recreationally important fisheries		X		
Commercially important fisheries		X		
Aesthetics				
Air Quality		X		
Noise		X		
Critical Areas	X			
Forested Areas		X		
Cultural Resources		X		
Archaeological Resources		X		
Potential for Benefit			X	
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A**

DRAFT DRAFT DRAFT DRAFT

(Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Brown, Christopher J. 1998. C&D Canal Disposal Area Inspection Report for FY 1998.

Environmental Resources, Inc. 1994. December 1994.

USACE, Philadelphia District. 1996. Chesapeake and Delaware (C&D) Canal – Baltimore Harbor Connecting Channels (Deepening), Delaware and Maryland Final Feasibility Report and Environmental Impact Statement. August 1996.

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title: Upper Summit Dredged Material Containment Facility

Type: Upland Placement.

Location: New Castle County, Delaware
The site is located on the north bank of the C&D Canal, just west of the Summit Bridge.

Size: 62 Acres diked.

Existing Capacity: Approximately 0.7 mcy.

Potential Capacity: Approximately 3.7 mcy.

Availability: Owned by U.S. Government

Nutrients: [Need info]

Infrastructure Required to Implement: Last used in 19__. The site was closed in 19__. The site received dredged material from dredging of the C&D Canal. Sewage sludge was applied to the site to encourage vegetative growth.

Institutional Issues: The State of Delaware has requested that only dredged material from the State of Delaware be placed in the site.

Costs:

Total Unit Costs Per Cubic Yard: $

Development & Implementation Costs:

COMMENTS:

DRAFT DRAFT DRAFT DRAFT

TITLE: Upper Summit DMCF **PROJECT TYPE**: Upland Containment Facility

Existing Conditions	Presence	Potential	Unknown	N/A*
Physical and Chemical Characteristics				
Substrate				X
High Relief Area				X
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics				X
Tidal Fluctuations				X
Salinity Gradients				X
Sediment Quality				X
HTRS			X	
Biological Characteristics				
RTE-				X
Aquatic Organisms				
Benthic Communities				X
Fisheries				X
Designated Spawning Area-anadromous		X		
Larval Habitat Area-anadromous fish		X		
Crabs		X		
Mollusks				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife	X			
Avian Wildlife				
Waterfowl concentration area			X	
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges				X
SAV				X
Wetlands				
Tidal Wetlands			X	
Non-tidal Wetlands		X		
Human Use Characteristics				
Groundwater			X	
Water Related Recreation				X
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Crabs		X		
Recreationally important fisheries		X		
Commercially important fisheries		X		
Aesthetics				
Air Quality		X		
Noise		X		
Critical Areas	X			
Forested Areas		X		
Cultural Resources		X		
Archaeological Resources		X		
Potential for Benefit			X	
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A**

DRAFT DRAFT DRAFT DRAFT

(Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Brown, Christopher J. 1998. C&D Canal Disposal Area Inspection Report for FY 1998.

Environmental Resources, Inc. 1994. December 1994.

USACE, Philadelphia District. 1996. Chesapeake and Delaware (C&D) Canal – Baltimore Harbor Connecting Channels (Deepening), Delaware and Maryland Final Feasibility Report and Environmental Impact Statement. August 1996.

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title: Welch Point Dredged Material Containment Facility

Type: Upland Placement.

Location: Cecil County, Maryland
The site is located on the north bank of the C&D Canal, at the western end of the C&D Canal, at Welsh Point, between the C&D Canal and Elk River.

Size: 50 Acres

Existing Capacity: N/A.

Potential Capacity: N/A.

Availability: Owned by U.S. Government

Nutrients: [Need info]

Infrastructure Required to Implement: Last used in 1960s. The site previously received dredged material from new work dredging of the northern approach channels to the C&D Canal. The site was closed in 19__ and is no longer receiving dredged material.

Institutional Issues:

Costs:

Total Unit Costs Per Cubic Yard: $

Development & Implementation Costs:

COMMENTS:

DRAFT DRAFT DRAFT DRAFT

TITLE: Welch Point DMCF **PROJECT TYPE**: Upland Containment Facility

Existing Conditions	Presence	Potential	Unknown	N/A*
Physical and Chemical Characteristics				
Substrate				X
High Relief Area				X
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics				X
Tidal Fluctuations				X
Salinity Gradients				X
Sediment Quality				X
HTRS			X	
Biological Characteristics				
RTE-				X
Aquatic Organisms				
Benthic Communities				X
Fisheries				X
Designated Spawning Area-anadromous		X		
Larval Habitat Area-anadromous fish		X		
Crabs		X		
Mollusks				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife	X			
Avian Wildlife				
Waterfowl concentration area			X	
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges				X
SAV				X
Wetlands				
Tidal Wetlands			X	
Non-tidal Wetlands			X	
Human Use Characteristics				
Groundwater			X	
Water Related Recreation				X
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Crabs		X		
Recreationally important fisheries		X		
Commercially important fisheries		X		
Aesthetics				
Air Quality		X		
Noise		X		
Critical Areas	X			
Forested Areas		X		
Cultural Resources		X		
Archaeological Resources		X		
Potential for Benefit			X	
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A**

(Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Brown, Christopher J. 1998. C&D Canal Disposal Area Inspection Report for FY 1998.

Environmental Resources, Inc. 1994. December 1994.

USACE, Philadelphia District. 1996. Chesapeake and Delaware (C&D) Canal – Baltimore Harbor Connecting Channels (Deepening), Delaware and Maryland Final Feasibility Report and Environmental Impact Statement. August 1996.

REFERENCES

Amiran, M. C., C. L. Wilde, R. L. Haltmeier, J. D. Pauling, and J. G. Sontag, Jr. 1999. Advanced Sediment Washing for Decontamination of New York/New Jersey Harbor Dredged Materials. Pp. 567-574 in R. E. Randall, ed., Proceedings of the Western Dredging Association Nineteenth Technical Conference and Thirty-first Texas A&M Dredging Seminar, May 15-18, 1999, Louisville, Kentucky. CDS Report No. 371. College Station, Texas: Center for Dredging Studies, Texas A&M University.

Century Engineering. 1987. Report on Dredged Material Disposal Site Selection Study at Aberdeen Proving Ground Maryland. Contract report prepared for Baltimore District, U.S. Army Corps of Engineers. Towson, Maryland: Century Engineering, Inc.

Corletta, R. and J. L. S. Duff. 1997. Beneficial Uses of Dredged Material: Agricultural Use. Pp. 100-101 in M. C. Landin, ed., Proceedings: International Workshop on Dredged Material Beneficial Uses, Baltimore, Maryland, July 28 – August 1, 1997. Baltimore, Maryland and Washington, D.C.: Baltimore District, U. S. Army Corps of Engineers and U. S. Environmental Protection Agency.

Cousins, L., F. Beason, and J. Shuman. 1997. Brick Manufactiure from Dredged Material, A Reality? P. 141 in M. C. Landin, ed., Proceedings: International Workshop on Dredged Material Beneficial Uses, Baltimore, Maryland, July 28 – August 1, 1997. Baltimore, Maryland and Washington, D.C.: Baltimore District, U. S. Army Corps of Engineers and U. S. Environmental Protection Agency.

CTI. 1998. Summary Report: Pilot Project for Dredging City of Perth Amboy Municipal Marina, City of Perth Amboy, Middlesex County, NJ, and Beneficial Use of Dredged Sediment for Mine Reclamation at Bark Camp Mine Facility, Huston Township, Clearfield County, PA. Report prepared for Pennsylvania Department of Environmental Protection, New Jersey Department of Commerce and Economic Development, City of Perth Amboy, and New York/New Jersey Clean Ocean and Shore Trust. Blue Hill, Pensylvania: Consolidated Technologies, Inc (CTI).

Dalyrmple, K. 1997. Use of Dredged Material as a Soil Amendment. P. 99 in M. C. Landin, ed., Proceedings: International Workshop on Dredged Material Beneficial Uses, Baltimore, Maryland, July 28 – August 1, 1997. Baltimore, Maryland and Washington, D.C.: Baltimore District, U. S. Army Corps of Engineers and U. S. Environmental Protection Agency.

DNPOP. 1995a. Composite Summary Results of Interagency Discussions About Deep Trough Placement Options Issues. Report prepared by W. Young for the Management Committee, Dredging Needs and Placement Options Program, November 1995. Annapolis, Maryland: Maryland Environmental Service.

DNPOP. 1995b. Report to the Management Committee, Dredging Needs and Placement Options Program (DNPOP), Aberdeen Proving Grounds Placement Options prepared by W. Young and G. Savage, August, 1995. Annapolis, Maryland: Maryland Environmental Service.

DNPOP. 1995c. Special Report to the Executive Committee, December 20, 1995. Report prepared by W. Young for Bay Enhancement Phase II Working Group, Dredging Needs and Placement Options Program (DNPOP). Annapolis, Maryland: Maryland Environmental Service.

EPA. 1994. Assessment and Remediation of Cantaminated Sediments (ARS) Program: Remediation Guidance Document. EPA 905-B94-003. Chicago, Illinois: Environmental Protection Agency (EPA) Great Lakes National Program Office.

EPA. 1998. Costs of Remediation at Mine Sites. Washington, D.C.: U.S. Environmental Protection Service (EPA), Office of Solid Waste.

Garbarino, S. D., R. Blama, M. C. Landin, T. R. Patin, and S. R. Maynord. 1994. Envirnmental Restoration and Enhancement Using Dredged Material in Chesapeake Bay, Maryland. Pp. 384-393 in Dredging 94: Proceedings of the Second International Conference on Dredging and Dredged Material Placement. New York, New York: American Society of Civil Engineers.

GBA. 1999. Conceptual Dredging and Site Analysis for Site 170. Contract report prepared for the Maryland Environmental Service in response to a request from the Maryland Port Administration. Baltimore, Maryland: Gahagan & Bryant Associates (GBA).

GBA, E2SI and ECI. 1992. Feasibility Evaluation of Bethlehem Steel Shoreline Enhancement Project. Contract report prepared for Maryland Port Administation, November, 1992. Baltimore, Maryland: Gahagan & Bryant Associates (GBA), Earth Engineering and Sciences, Inc.(E2SI), and Environmental Concern, Inc. (ECI).

Gill, J. W., Pl McGowan, and L. E. Gerlich. 1995. Monitoring Study, Eastern Neck Island National Wildlife Refuge. Technical Report WRP-RE-12. Vicksburg, Mississippi: U.S. Army Engineer Waters Experiment Station.

Graalum, S. J. and R. E. Randall. 1997. Feasibility of Manufacturing Soil from Texas Gulf Intracoastal Waterway Dredged Material. Pp. 46-47 in M. C. Landin, ed., Proceedings: International Workshop on Dredged Material Beneficial Uses, Baltimore, Maryland, July 28 – August 1, 1997. Baltimore, Maryland and Washington, D.C.: Baltimore District, U. S. Army Corps of Engineers and U. S. Environmental Protection Agency.

Green and Trident. 1970. Selection and Preliminary Design of Dike Disposal Areas for Dredged Spoil from Baltimore Harbor. Contract report prepared for the Maryland Department of General Services. Three volumes. Baltimore and Annapolis Maryland: Green Associates and Trident Engineering Associates.

Gucinski, H., and Ecological Analysts. 1984. Deep Trough Study of the Chesapeake Bay. Contract report number TWA-CRD 1-84 prepared for Coastal Resources Division, Tidewater Administration, Maryland Department of Natural Resources. Arnold, Maryland and Sparks, Maryland: Anne Arundel Community College and Ecological Analysts, Inc.

Hamons, F. L. 1988. Port of Baltimore: Dredged Material Management Master Plan. Pp. 112-118 in Proceedings of the International Seminar on Environmental Impact Assessment of Port Development. London, England: International Maritime Organization.

Hamons, F. L., and W. Young. 1999. Beneficial Use of Dredged Material: Upper Chesapeake Bay Case Study. Pp. 405-427 in R. E. Randall, ed., Proceedings of the Western Dredging Association Nineteenth Technical Conference and Thirty-first Texas A&M Dredging Seminar, May 15-18, 1999, Louisville, Kentucky. CDS Report No. 371. College Station, Texas: Center for Dredging Studies, Texas A&M University.

Hurt, S. 1995. Shore Stabilization: Shoreline Enhancement at Eastern Neck. Land and Water: May/June 1995.

Jones, K.W., A. J. Guadagni, E. A. Stern, K. R. Donato, and N. L. Clesceri. 1998. Commercialization of Dredged-Material Decontamination Technologies. Pp. 43-54 in Remediation/Srping 1998. New York, New York: John Wiley and Sons.

Kidde Consultants. 1984. Feasibility Study Phase I: Recycling, Reusing and/or Rehandling Dredged Materials. Contract report prepared for U.S. Department of Transportation, Federal Highway Administration and Interstate Division of Baltimore City.

Kidde Consultants. 1986. Feasibility Study Phase III: Recycling, Reusing and/or Rehandling Dredged Materials. Contract report prepared for U.S. Department of Transportation, Federal Highway Administration and Interstate Division of Baltimore City.

Landin, M. C. 1997. Current Agricultural Applications of Dredged Material in Washington, New Jersey, South Carolina, and Mississippi. P. 101-102 in M. C. Landin, ed., Proceedings: International Workshop on Dredged Material Beneficial Uses, Baltimore, Maryland, July 28 – August 1, 1997. Baltimore, Maryland and Washington, D.C.: Baltimore District, U. S. Army Corps of Engineers and U. S. Environmental Protection Agency.

Leatherman, S. P., R. Chalfont, E. C. Pendleton, T. L. McCandless, and S. Funderburk. 1995. Vanishing Lands: Sea Level, Society and Chesapeake Bay. College Park Maryland: Stephen Leatherman.

McDonough, F. M., G. A. Boehm, and W. S. Douglas. 1999. Dredged Material Management in New Jersey: A Multifaceted Approach for Meeting Statewide Dredging Needs in the 21st Century. Pp. 349-368 in R. E. Randall, ed., Proceedings of the Western Dredging Association Nineteenth Technical Conference and Thirty-first Texas A&M Dredging Seminar, May 15-18, 1999, Louisville, Kentucky. CDS Report No. 371. College Station, Texas: Center for Dredging Studies, Texas A&M University.

McLaughlin, D. F., S. V. Dighe, D. L. Keairns, and N. H. Ulerich. 1999. Decontamination and Beneficial Use of Dredged Estuarine Sediment: The Westinghouse Plasma Vitrification Process. Pp.533-554 in in R. E. Randall, ed., Proceedings of the Western Dredging Association Nineteenth Technical Conference and Thirty-first Texas A&M Dredging Seminar, May 15-18, 1999, Louisville, Kentucky. CDS Report No. 371. College Station, Texas: Center for Dredging Studies, Texas A&M University.

MDOT. 1996. State of Maryland's Strategic Plan for Dredged Material Management. September 5, 1996. Baltimore-Washington International Airport, Maryland: Maryland

Department of Transportation.

MES. 1994a. Initial and Multi-Objective Screening of Four Proposed Dredged Material Placement Sites in the Upper Chesapeake Bay. Contract report prepared for the Maryland Port Administration. Annapolis, Maryland: Maryland Environmental Service (MES).

MES. 1994b. Prefeasibility Report for the Poplar Island Restoration Project. Contract Report prepared for the Maryland Port Administration. Annapolis, Maryland: Maryland Environmental Service (MES).

MES. 1995a. Sparrows Point Shoreline Reclamation Project: Assessment of Biological Productivity. Contract report prepared for the Maryland Port Administration. Annapolis, Maryland: Maryland Environmental Service (MES).

MES. 1995b. Use of Dredge Material as a Drainage Layer at Midshore Regional Solid Waste Facility. Contract report prepared for the Maryland Port Administration. Annapolis, Maryland: Maryland Environmental Service (MES).

MES. 1996. Finfish Data Compilation for Six Selected Sites in the Upper Chesapeake Bay. Contract report prepared for the Philadelphia District, U.S. Army Corps of Engineers. Annapolis, Maryland: Maryland Environmental Service (MES).

MES. 1997. Final Environmental Assessment: Designation of Aquatic Dredged Material Placement Areas G-East and Site 92 for Maintenance Dredging, Inland Waterway Delaware River to Chesapeake Bay, Delaware and Maryland Northern Approach Channel. Contract Report prepared for the Philadelphia District, U.S. Army Corps of Engineers and the Maryland Port Administration, August, 1997, by the Maryland Environmental Service (MES). Philadelphia, Pennsylvania: Philadelphia District, U.S. Army Corps of Engineers.

MES and MPA. 1993. Sparrows Point Shoreline Reclamation: Briefing, Spring 1993. Annapolis and Baltimore, Maryland: Maryland Environmental Service (MES) and Maryland Port Administration (MPA).

MPA. 1989. Master Plan (draft). Draft technical report. Baltimore, Maryland: Maryland Port Administration (MPA).

MPA. 1990. Port of Baltimore Dredged Material Management: Master Plan. Baltimore, Maryland: Maryland Port Administration (MPA).

NRC. 1989. Contaminated Marine Sediments: Assessment and Remediation. Marine Board, National Research Council (NRC). Washington, D.C.: National Academy Press.

NRC. 1994. Restoring and Protecting Marine Habitat: The Role of Engineering and Technology. Marine Board, National Research Council (NRC). Washington, D.C.: National Academy Press.

NRC. 1997. Contaminated Sediments in Ports and Waterways: Cleanup Strategies and Technologies. Marine Board, National Research Council (NRC). Washington, D.C.: National

Academy Press.

O'Donnel, S., and J. Henningson. 1999. The Beneficial Use of Dredged Material to Mitigate Acid Mine Drainage. Pp. 499-512 in R. E. Randall, ed., Proceedings of the Western Dredging Association Nineteenth Technical Conference and Thirty-first Texas A&M Dredging Seminar, May 15-18, 1999, Louisville, Kentucky. CDS Report No. 371. College Station, Texas: Center for Dredging Studies, Texas A&M University.

Olin, T. J., and D. W. Bowman. 1997. Soil Washing Potential at Confined Disposal Facilities. P. 139 in M. C. Landin, ed., Proceedings: International Workshop on Dredged Material Beneficial Uses, Baltimore, Maryland, July 28 – August 1, 1997. Baltimore, Maryland and Washington, D.C.: Baltimore District, U. S. Army Corps of Engineers and U. S. Environmental Protection Agency.

Orth, R. J., J. F. Nowak, D. J. Wilcox, J. R. Whiting, and L. S. Nagey. 1997. Distribution of Submerged Aquatic Vegetation in the Chesapeake Bay and Tributaries and the Coastal Bays – 1996. Report prepared for the U.S. Environmental Protection Agency, Chesapeake Bay Program Office (EPA-CBPO). Annapolis, Maryland: (EPA-CBPO).

Orth, R. J., J. F. Nowak, D. J. Wilcox, J. R. Whiting, and L. S. Nagey. 1998. Distribution of Submerged Aquatic Vegetation in the Chesapeake Bay and Tributaries and the Coastal Bays – 1997. Report prepared for the U.S. Environmental Protection Agency, Chesapeake Bay Program Office (EPA-CBPO). Annapolis, Maryland: (EPA-CBPO).

Palazzo, A. J., C. R. Lee, T. C. Sturgis, and P. Zang. 1997. Manufactured Soil Concept in the Rehabilitation of Housing Demolition Soil and Military Training Land. Pp. 48-49 in M. C. Landin, ed., Proceedings: International Workshop on Dredged Material Beneficial Uses, Baltimore, Maryland, July 28 – August 1, 1997. Baltimore, Maryland and Washington, D.C.: Baltimore District, U. S. Army Corps of Engineers and U. S. Environmental Protection Agency.

PIANC. 1992. Beneficial Uses of Dredged Material: A Practical Guide. Report of PIANCE Working Group 19. Brussels, Belgium: Permanent International Association of Navigation Congresses (PIANC).

Price, R. A., P. R. Schroeder, L. E. Banks, J. G. Sanders, and D. R. Johnson. 197. Agricultural Use of Yazoo River Dredged Material. P. 100 in M. C. Landin, ed., Proceedings: International Workshop on Dredged Material Beneficial Uses, Baltimore, Maryland, July 28 – August 1, 1997. Baltimore, Maryland and Washington, D.C.: Baltimore District, U. S. Army Corps of Engineers and U. S. Environmental Protection Agency.

Pushkar, D. J. 1975. Baltimore Harbor: An Assessment of the Capacity of Discontinued Spoil Disposal Areas. Report prepared by the Water Quality Services Division, Water Resources Administration. Annapolis, Maryland: Maryland Department of Natural Resources.

Rehmat, A., A. lee, A. Goyal, and M. C. Messinger. 1999. Construction-Grade Cement Production from Contaminated Sediments Using CEMENT-LOCK™ Technology. Pp. 555-566 in R. E. Randall, ed., Proceedings of the Western Dredging Association Nineteenth Technical Conference and Thirty-first Texas A&M Dredging Seminar, May 15-18, 1999, Louisville, Kentucky. CDS Report No. 371. College Station, Texas: Center for Dredging Studies, Texas A&M University.

Seay, E. E. 1995. Managing Sediments and Nutrients in the Susquehana River Basin: Final Report. Report prepared for Susquehana River Basin Commission, Publication Number 164. Harrisburg, Pennsylvania: Susquehanna River Basin Commission.

State of New Jersey. 1998. Bid Documents: Sediment Decontamination Demonstration Project. Bid Number 98-X-99999. Two volumes. Issued by the State Department of the Treasury, Department of Commerce and Economic Development, and the Office of New Jersey Maritime Resources. March 4.

Stern, E. A., K. R. Donato, N. L. Clesceri, and K. W. Jones. 1997. Integrated Sediment Decontamination for the New York-New Jersey Harbor. Pp. 71-81 in Proceedings of the National Conference on Management and Treatment of Contaminated Sediments, Cincinnati, Ohio, May 13-14, 1997. Report Number EPA/625/R-98/001. Washington, D.C.: Environmental Protection Agency.

Stern, E. A., K. W. Jones, K. Donato, and N. L. Clesceri. 1998a. Processing Contaminated Dredged Material from the Port of New York-New Jersey. Estuaries 21(4A):646-651.

Stern, E. A., K. Jones, K. Donato, J. D. Pauling, N. L. Clesceri, M. C. Mensinger, and C. L. Wilde. 1998b. Maintaining Access to America's Intermodal Ports/Technologies for Decontamination of Dredged Sediment: New York/New Jersey Harbor. Technical Paper Number 8007 presented at 1998 S.A.M.E. National Conference, New York City, New York. West Chester, Pennsylvania: Roy F. Weston, Inc.

Stevenson, J. C., and M. S. Kearney. 1996. Shoreline dynamics on the windward and leeward shores of a large temperate estuary. Pp. 233-259 in K. F. Nordstrom and C. T. Roman, eds., Estuarine Shores: Evolution, Environments and Human Alternations. New York, New York: John Wiley and Sons, Ltd.

Sturgis, T. C., C. R. Lee, and P. Langan. 1997a. Manufactured Soil from Mobile Harbor Dredged Material. P. 46 in M. C. Landin, ed., Proceedings: International Workshop on Dredged Material Beneficial Uses, Baltimore, Maryland, July 28 – August 1, 1997. Baltimore, Maryland and Washington, D.C.: Baltimore District, U. S. Army Corps of Engineers and U. S. Environmental Protection Agency.

Sturgis, T. C., C. R. Lee, and K. A. Taplin. 1997b. Manufactured Soil from St. Lucie Muck. P. 48 in M. C. Landin, ed., Proceedings: International Workshop on Dredged Material Beneficial Uses, Baltimore, Maryland, July 28 – August 1, 1997. Baltimore, Maryland and Washington, D.C.: Baltimore District, U. S. Army Corps of Engineers and U. S. Environmental Protection Agency.

Versar. 1990a. Assessment of the Feasibility of Utilizing the Deep Trough as a Dredge Disposal Site. Contract report prepared for the Power Plant and Environmental Review Division, Maryland Department of Natural Resources in response to a request from the Maryland Port Administration. Columbia, Maryland. Versar.

Versar. 1990b. Impact Assessment of Craighill Channel Dredged Material Placement in the Deep Trough. Contract report prepared for the Power Plant and Environmental Review Division, Maryland Department of Natural Resources in response to a request from the Maryland Port Administration. Columbia, Maryland: Versar.

Weston. 1974. The Technical and Economic Feasibility of Producing Beneficial Products from Baltimore Harbor Dredged Spoil. Contract report prepared number W.O. 1086-1 for the Maryland Environmental Service. West Chester, Pennsylvania: Roy F. Weston, Inc.

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title:
Tolchester West

Type:
Island Creation

Location:
Upper Bay in the vicinity of Gales Lumps. West of the northern part of theTolchester Channel, in 10-16 feet of water.

Size:
790-1060 acres

Potential Capacity:
80 mcy

Availability:
State owned

Nutrients: Minimum loadings:
N- 3.6 lbs
P- 0.08 lbs

Infrastructure Required to Implement:
Dikes and receiving areas would have to be constructed. Some access channel construction may be necessary, depending on final configuration.

Institutional Issues:
Permitting required for construction in open water.
Permitting issues related to impacts associated with the natural resources and local ordinances in the area.
Site lies within the 5-mile radius of HMI

Costs:

Total Unit Costs Per Cubic Yard: $6.91 to 7.05

Development & Implementation Costs:
Construction: $62-70 million
Dredging and Transport: $464 million

COMMENTS:
Moderate depth; good aquatic resource habitat
Oyster bars in area but not within site
Low density area for soft shell clam
High density are for Blue crab in some seasons
Good benthic diversity; area not considered stressed
Important finfish harvest and recreational area

DRAFT DRAFT DRAFT DRAFT

TITLE: Tolchester West **PROJECT TYPE:** Island Creation

Existing Conditions	Presence*	Potential*	Unknown*	N/A*
Physical and Chemical Characteristics				
Substrate	X			
High Relief Area		X		
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics	X			
Tidal Fluctuations	X			
Salinity Gradients	X			
Sediment Quality	X			
HTRS			X	
Biological Characteristics				
RTE			X	
Aquatic Organisms				
Benthic Communities	X			
Fisheries	X			
Designated Spawning Area				X
Larval Habitat Area	X			
Crabs	X			
Mollusks				
Soft shell clams-Low Density		X		
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife				X
Avian Wildlife				
Waterfowl concentration area				X
Land and/or Waterbirds				X
Special Aquatic Sites				
Sanctuaries and Refuges	X			
SAV				X
Wetlands				
Tidal Wetlands				X
Non-tidal Wetlands				X
Human Use Characteristics				
Groundwater				X
Water Related Recreation	X			
Recreational and Commercial Fisheries				
Soft shell clams		X		
Hard shell clams				X
Oyster bars				X
Crabs	X			
Recreationally important fisheries	X			
Commercially important fisheries	X			
Aesthetics				
Air Quality		X		
Noise		X		
Critical Areas				X
Forested Areas				X
Cultural Resources				X
Archaeological Resources				X
Potential for Benefit		X		
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A** (Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Chesapeake Bay Program. 1996. High Value Living Resource Map of the Upper Bay. In a memo prepared for the Bay Enhancement Phase II Working Group.

Funderburk, S.L., S.J. Jordan, J.A. Mihursky and D. Riley. 1991. Habitat Requirements for Chesapeake Bay Living Resources. Second Edition. Chesapeake Bay Program

Maryland Department of Natural Resources. 1989. Natural Oyster Bar Maps. Prepared by Coast and Geodetic Survey for the Maryland Department of Natural Resources.

Maryland Geological Survey. 1971. Maryland Tidal Wetlands and Critical Area Inventory Maps. Based on County maps 1:2,400 scale organized by.

US Fish and Wildlife Service. 1979. National Wetland Inventory Maps. Non-Tidal Wetlands Maps. Prepared by Office of Biological Services. Based on USGS 7.5 minute topographic quadrangle map series.

MPA. 1997. Prefeasibility Study for Upper Bay Island Placement Sites—Draft Consolidated Report. December.

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title:
Site 168

Type:
Island Creation

Location:
Upper Bay, north of the intersection of Brewerton Chanel and Tolchester Channel.
Depths range from 16- 28 feet

Size:
1075-1195 acres

Potential Capacity:
80 mcy

Availability:
State owned

Nutrients: Minimum loadings:
N- 3.6 lbs
P- 0.08 lbs

Infrastructure Required to Implement:
Dikes and receiving areas would have to be constructed.

Institutional Issues:
Permitting required for construction in open water.
Permitting issues related to impacts associated with the natural resources and local ordinances in the area.
Site lies withi the 5-mile radius of HMI.

Costs:

Total Unit Costs Per Cubic Yard: $8.37 to 8.54

Development & Implementation Costs:
Construction: $184-199 million
Dredging and Transport: $459 million

COMMENTS:
Moderate to deep water; experiences summer anoxia
Oyster bars in area but not within site; N.O.B. 2-9 fairly close.
High density are for Blue crab in some seasons
Poor benthic community; considered stressed
Important finfish harvest area in winter

DRAFT DRAFT DRAFT DRAFT

TITLE: Site 168 **PROJECT TYPE:** Island Creation

Existing Conditions	**Presence***	**Potential***	**Unknown***	**N/A***
Physical and Chemical Characteristics				
Substrate	X			
High Relief Area		X		
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics	X			
Tidal Fluctuations	X			
Salinity Gradients	X			
Sediment Quality	X			
HTRS			X	
Biological Characteristics				
RTE			X	
Aquatic Organisms				
Benthic Communities		X		
Fisheries	X			
Designated Spawning Area				X
Larval Habitat Area		X		
Crabs	X			
Mollusks				
Soft shell clams-Low Density				X
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife				X
Avian Wildlife				
Waterfowl concentration area				X
Land and/or Waterbirds				X
Special Aquatic Sites				
Sanctuaries and Refuges				X
SAV				X
Wetlands				
Tidal Wetlands				X
Non-tidal Wetlands				X
Human Use Characteristics				
Groundwater				X
Water Related Recreation		X		
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars		X		
Crabs	X			
Recreationally important fisheries	X			
Commercially important fisheries	X			
Aesthetics				
Air Quality		X		
Noise		X		
Critical Areas				X
Forested Areas				X
Cultural Resources				X
Archaeological Resources				X
Potential for Benefit		X		
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A** (Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Chesapeake Bay Program. 1996. High Value Living Resource Map of the Upper Bay. In a memo prepared for the Bay Enhancement Phase II Working Group.

Funderburk, S.L., S.J. Jordan, J.A. Mihursky and D. Riley. 1991. Habitat Requirements for Chesapeake Bay Living Resources. Second Edition. Chesapeake Bay Program

Maryland Department of Natural Resources. 1989. Natural Oyster Bar Maps. Prepared by Coast and Geodetic Survey for the Maryland Department of Natural Resources.

Maryland Geological Survey. 1971. Maryland Tidal Wetlands and Critical Area Inventory Maps. Based on County maps 1:2,400 scale organized by.

US Fish and Wildlife Service. 1979. National Wetland Inventory Maps. Non-Tidal Wetlands Maps. Prepared by Office of Biological Services. Based on USGS 7.5 minute topographic quadrangle map series.

MPA. 1997. Prefeasibility Study for Upper Bay Island Placement Sites—Draft Consolidated Report. December.

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title:
Site 171 (Swan Point West)

Type:
Island Creation

Location:
Upper Bay, northwest of Swan Point Channel. Depths range from 24-32 feet

Size:
975-1065 acres; island option
3000 acres as a submerged option

Potential Capacity:
80 mcy

Availability:
State owned

Nutrients: Minimum loadings:
Island: N- 3.6 lbs; P- 0.08 lbs
Submerged: N-10.08; no P

Infrastructure Required to Implement:
Dikes would have to be constructed for either option. Receiving areas would be required for emergent island.

Institutional Issues:
Permitting required for construction in open water.
Permitting issues related to impacts associated with the natural resources and local ordinances in the area.
Site lies within the 5 mile radius of HMI (not pertinent for submerged option).

Costs:

Total Unit Costs Per Cubic Yard: $10.05 to 10.26 (emergent); $7.17 submerged

Development & Implementation Costs:
Emergent: Construction: $307-320 million; Dredging and Transport: $474 million
Submerged: Construction: $89 million; Dredging and Transport: $272 million

COMMENTS:
Deep water; experiences summer anoxia
Significant Oyster bars in area; NOB 4-2 and NOB 5-1
Poor Blue crab habitat
Poor benthic community; considered stressed
Important finfish harvest area in winter
Submerged option has potential for significant beneficial use

DRAFT DRAFT DRAFT DRAFT

TITLE: Site 171 **PROJECT TYPE:** Island Creation

Existing Conditions	**Presence***	**Potential***	**Unknown***	**N/A***
Physical and Chemical Characteristics				
Substrate	X			
High Relief Area		X		
Suspended Particulates, Turbidity	X			
Water Quality		X		
Hydrodynamics	X			
Tidal Fluctuations	X			
Salinity Gradients	X			
Sediment Quality	X			
HTRS			X	
Biological Characteristics				
RTE			X	
Aquatic Organisms				
Benthic Communities				X
Fisheries	X			
Designated Spawning Area				X
Larval Habitat Area			X	
Crabs				X
Mollusks				
Soft shell clams-Low Density				X
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife				X
Avian Wildlife				
Waterfowl concentration area				X
Land and/or Waterbirds				X
Special Aquatic Sites				
Sanctuaries and Refuges				X
SAV				X
Wetlands				
Tidal Wetlands				X
Non-tidal Wetlands				X
Human Use Characteristics				
Groundwater				X
Water Related Recreation		X		
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars	X			
Crabs				X
Recreationally important fisheries	X			
Commercially important fisheries		X		
Aesthetics				
Air Quality		X		
Noise		X		
Critical Areas				X
Forested Areas				X
Cultural Resources				X
Archaeological Resources				X
Potential for Benefit	X			
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A** (Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Chesapeake Bay Program. 1996. High Value Living Resource Map of the Upper Bay. In a memo prepared for the Bay Enhancement Phase II Working Group.

Funderburk, S.L., S.J. Jordan, J.A. Mihursky and D. Riley. 1991. Habitat Requirements for Chesapeake Bay Living Resources. Second Edition. Chesapeake Bay Program

Maryland Department of Natural Resources. 1989. Natural Oyster Bar Maps. Prepared by Coast and Geodetic Survey for the Maryland Department of Natural Resources.

Maryland Geological Survey. 1971. Maryland Tidal Wetlands and Critical Area Inventory Maps. Based on County maps 1:2,400 scale organized by.

US Fish and Wildlife Service. 1979. National Wetland Inventory Maps. Non-Tidal Wetlands Maps. Prepared by Office of Biological Services. Based on USGS 7.5 minute topographic quadrangle map series.

MPA. 1997. Prefeasibility Study for Upper Bay Island Placement Sites—Draft Consolidated Report. December.

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title:
Site 171 (Swan Point West)

Type:
Open Water

Location:
Upper Bay, northwest of Swan Point Channel. Depths range from 24-32 feet

Size:
3000 acres

Potential Capacity:
80

Availability:
State owned

Nutrients: Minimum loadings:
N-10.08; no P

Infrastructure Required to Implement:
None

Institutional Issues:
Permitting required for placement in open water.
Permitting issues related to impacts associated with the natural resources and local ordinances in the area.

Costs:

Total Unit Costs Per Cubic Yard: $3.41

Development & Implementation Costs:
Dredging and Transport: $272 million

COMMENTS:
Deep water; experiences summer anoxia
Significant Oyster bars in area; NOB 4-2 and NOB 5-1
Poor Blue crab habitat
Poor benthic community; considered stressed
Important finfish harvest area in winter

DRAFT DRAFT DRAFT DRAFT

TITLE: Site 171 **PROJECT TYPE:** Open Water

Existing Conditions	**Presence***	**Potential***	**Unknown***	**N/A***
Physical and Chemical Characteristics				
Substrate	X			
High Relief Area		X		
Suspended Particulates, Turbidity	X			
Water Quality		X		
Hydrodynamics	X			
Tidal Fluctuations	X			
Salinity Gradients	X			
Sediment Quality	X			
HTRS			X	
Biological Characteristics				
RTE			X	
Aquatic Organisms				
Benthic Communities				X
Fisheries	X			
Designated Spawning Area				X
Larval Habitat Area			X	
Crabs				X
Mollusks				
Soft shell clams-Low Density				X
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife				X
Avian Wildlife				
Waterfowl concentration area				X
Land and/or Waterbirds				X
Special Aquatic Sites				
Sanctuaries and Refuges				X
SAV				X
Wetlands				
Tidal Wetlands				X
Non-tidal Wetlands				X
Human Use Characteristics				
Groundwater				X
Water Related Recreation		X		
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars	X			
Crabs				X
Recreationally important fisheries	X			
Commercially important fisheries		X		
Aesthetics				
Air Quality		X		
Noise		X		
Critical Areas				X
Forested Areas				X
Cultural Resources				X
Archaeological Resources				X
Potential for Benefit		X		
Potential to Minimize Adverse Effects		X		

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A** (Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Chesapeake Bay Program. 1996. High Value Living Resource Map of the Upper Bay. In a memo prepared for the Bay Enhancement Phase II Working Group.

Funderburk, S.L., S.J. Jordan, J.A. Mihursky and D. Riley. 1991. Habitat Requirements for Chesapeake Bay Living Resources. Second Edition. Chesapeake Bay Program

Maryland Department of Natural Resources. 1989. Natural Oyster Bar Maps. Prepared by Coast and Geodetic Survey for the Maryland Department of Natural Resources.

Maryland Geological Survey. 1971. Maryland Tidal Wetlands and Critical Area Inventory Maps. Based on County maps 1:2,400 scale organized by.

US Fish and Wildlife Service. 1979. National Wetland Inventory Maps. Non-Tidal Wetlands Maps. Prepared by Office of Biological Services. Based on USGS 7.5 minute topographic quadrangle map series.

MPA. 1997. Prefeasibility Study for Upper Bay Island Placement Sites—Draft Consolidated Report. December.

DRAFT DRAFT DRAFT DRAFT

Option Data Sheet

Title:
Pooles Island Area

Type:
Island Creation

Location:
Upper Bay adjacent or attached to Pooles Island.\

Size:
4A- 1300-1475 acres
4B- 825-1125 acres
4B-R- 680-780 acres

Potential Capacity:
4A, 4B-80 mcy
4B-R- 40 mcy

Availability:
Held by US Army; Aberdeen Proving Grounds

Nutrients:	Minimum loadings:
4A, 4B:	N- 3.6 lbs
	P- 0.08 lbs
4B-R:	N- 1.8 lbs
	P- 0.04 lbs

Infrastructure Required to Implement:
Dikes and receiving areas would have to be constructed. Some access channel construction may be necessary, depending on final configuration.

Institutional Issues:
Permitting required for construction in open water.
Permitting issues related to impacts associated with the natural resources and local ordinances in the area.
Site lies within the 5-mile radius of HMI;
One configuration lies within APG restricted area;
UXO potential: NPL Site

Costs:

Total Unit Costs Per Cubic Yard:
4A: $9.52 to 9.97
4B: $8.28 to 8.93
4B-R: $10.56-10.82

Development & Implementation Costs:
4A: Construction: $283-316 million; Dredging and Transport: $455 million
4B: Construction: $165-213 million; Dredging and Transport: $471 million
4B-R: Construction: $173-186 million; Dredging and Transport: $235 million

COMMENTS:

Shallow water; good aquatic resource habitat
Low potential for soft shell clams; no oyster bars in area
Good benthic diversity; area not considered stressed
Important finfish harvest and recreational area
Important Finfish spawning and rearing area
Cultural and Historical Resource Issues for some configurations
RTE and Terrestrial resource issues for some configurations
Significant Henronry and other avian resources on Island
Waterfowl use area

DRAFT DRAFT DRAFT DRAFT

TITLE: Pooles Island **PROJECT TYPE:** Island Creation

Existing Conditions	Presence*	Potential*	Unknown*	N/A*
Physical and Chemical Characteristics				
Substrate		X		
High Relief Area	X			
Suspended Particulates, Turbidity	X			
Water Quality	X			
Hydrodynamics	X			
Tidal Fluctuations	X			
Salinity Gradients	X			
Sediment Quality	X			
HTRS	X			
Biological Characteristics				
RTE	X			
Aquatic Organisms				
Benthic Communities	X			
Fisheries	X			
Designated Spawning Area		X		
Larval Habitat Area	X			
Crabs	X			
Mollusks				
Soft shell clams-Low Density				X
Hard shell clams				X
Oyster bars				X
Terrestrial Wildlife	X			
Avian Wildlife				
Waterfowl concentration area	X			
Land and/or Waterbirds	X			
Special Aquatic Sites				
Sanctuaries and Refuges		X		
SAV		X		
Wetlands				
Tidal Wetlands	X			
Non-tidal Wetlands	X			
Human Use Characteristics				
Groundwater				X
Water Related Recreation	X			
Recreational and Commercial Fisheries				
Soft shell clams				X
Hard shell clams				X
Oyster bars				X
Crabs	X			
Recreationally important fisheries	X			
Commercially important fisheries	X			
Aesthetics				
Air Quality		X		
Noise		X		
Critical Areas	X			
Forested Areas	X			
Cultural Resources	X			
Archaeological Resources	X			
Potential for Benefit		X		
Potential to Minimize Adverse Effects	X			

(*) **Presence** (Feature present in or adjacent to site; therefore resource could be impacted), **Potential** (Feature potentially present; complete documentation not available to verify presence therefore, there exists a potential for impacts), **Unknown** (No data available to predict presence or absence of feature and therefore potential impacts are unknown), **N/A** (Feature does not exist in or adjacent to the site or the feature is not applicable to site; In either case, no impacts are projected).

Resources Used

Chesapeake Bay Program. 1996. High Value Living Resource Map of the Upper Bay. In a memo prepared for the Bay Enhancement Phase II Working Group.

Funderburk, S.L., S.J. Jordan, J.A. Mihursky and D. Riley. 1991. Habitat Requirements for Chesapeake Bay Living Resources. Second Edition. Chesapeake Bay Program

Maryland Department of Natural Resources. 1989. Natural Oyster Bar Maps. Prepared by Coast and Geodetic Survey for the Maryland Department of Natural Resources.

Maryland Geological Survey. 1971. Maryland Tidal Wetlands and Critical Area Inventory Maps. Based on County maps 1:2,400 scale organized by.

US Fish and Wildlife Service. 1979. National Wetland Inventory Maps. Non-Tidal Wetlands Maps. Prepared by Office of Biological Services. Based on USGS 7.5 minute topographic quadrangle map series.

MPA. 1997. Prefeasibility Study for Upper Bay Island Placement Sites—Draft Consolidated Report. December.

ANNEX F

HYDRODYNAMICS

~~5.1.3 Hydrodynamics~~

F.1 EXISTING CONDITIONS

Hydrodynamics is a term used to describe the study of fluid motion and fluid interactions with boundaries. At Site 104, this includes ~~Site conditions germane to the hydrology/hydrodynamics of Site 104 include~~ average water depths, water levels, astronomical tides, storm surge, wind conditions, tidal currents, sedimentation, and wave conditions for the part of the Chesapeake Bay near Site 104. Each of these topics is discussed in the following sections.

F.1.1 Average Depths

~~5.1.3.a Average Depths.~~ Hydrographic data are those data that relate to the physical features of an area of water. ~~i~~In the vicinity of Site 104, hydrographic data were obtained from National Oceanic and Atmospheric Administration (NOAA) charts 12263, 12273, and 12278. Hydrographic data within Site 104 were obtained from the U.S. Army Corps of Engineers, Baltimore District (CENAB) survey data collected in September 1997. Vertical data are referenced to mean lower low water (MLLW) based upon the 1960 to 1978 tidal epoch. Tides occur semi-diurnally in the Chesapeake Bay, which means that there are two high tides (or high waters) and two low tides (or low waters) each day. MLLW is the average height of the lower of the two low tides.~~, and h~~ Horizontal data are referenced to the Maryland State Plane, North American Datum (NAD) 1983.

~~The bathymetry of the site is presented in Figure 2-1.~~ Water depths at Site 104 range from -12.8 m (-42.0 ft) MLLW to -23.8 m (-78.0 ft) MLLW. ~~As stated in Section 5.1.2.a, t~~The slopes are very flat, with a range of 100:1 to flat. The typical slope where placement would occur in the site is about 100:1 to 400:1, in areas within Site 104 that are below -13.7 m (-45.0 ft) MLLW.

Over the northern portion of Site 104, the bottom depths range from -12.8 m (-42.0 ft) to -14.0 m (-46.0 ft) MLLW. From the northern end of the site, the bottom gently slopes downward towards the south. About halfway through the site, the downward slope increases, reaching a maximum depth of -23.8 m (-78.0 ft) MLLW at the southern boundary of the site.

The site slopes are steeper along the eastern edge, extending upward from -14.0 m (-46.0 ft) MLLW in the northern end and -23.8 m (–78.0 ft) MLLW in the southern end, to approximately -11.0 m (-36.0 ft) MLLW just east of the site. The bottom then continues to slope upwards towards the western shoreline of Kent Island.

F.1.2 Water Levels

~~5.1.3.b Water Levels.~~ Normal water level variations in the upper Bay are generally dominated by astronomical tides, although wind effects and freshwater discharge can be important influences. Depending on direction and duration, wind can force water into or out of rivers and embayments, ~~subsequently~~ thereby causing a localized increase or decrease, respectively, of water level within the affected body of water. Relatively high occurrences of freshwater discharges from a river or stream can also locally raise water levels where it flows into the Bay. Extremely high water levels, on the other hand, are dictated by storm tides. A storm tide is a temporary rise in water level generated either by large-scale extra-tropical storms (nor'easters) or by hurricanes. The rise in water level results from wind action, the low pressure of the storm disturbance, and the Coriolis effect.

Long-term rise in sea level began about 18,000 years ago to create the Chesapeake Bay. In 1984, the U.S. Army Corps of Engineers (USACE) reported that the rise in sea level was continuing at an average rate of about 0.001 to 0.002 m/yr (0.003 to 0.007 ft/yr) (USACE 1984). In 1987, the National Research Council (NRC) reported that sea level rise resulting from melting of the polar ice caps for the past century has been about 0.12 m (0.4 ft), resulting in a rise of approximately 0.0012 m/yr (0.004 ft/yr) (NRC 1987).

A recent hydrodynamics modeling study performed by Waterways Experiment Station (WES), for the proposed Delaware Bay deepening work, showed that an assumed sea level rise of 0.305 m (1.0 ft) at the mouth of the Chesapeake Bay would result in an increase in water depth of about 0.274 m (0.9 ft) at the Chesapeake Bay Bridge. Therefore, a rate of sea level rise in the oceans of 0.0012 m/yr (0.004 ft/yr) would equate to a potential water level rise at Site 104 of approximately 0.0011 m/yr (0.0036 ft/yr). At the time the model was run for the Delaware Bay deepening work, it had not yet been developed to include the Chesapeake and Delaware (C&D) Canal and therefore may not adequately represent a predicted change in sea level rise in the area of Site 104. A model of both the Chesapeake Bay and Delaware Bay that includes the C&D Canal and extends out onto the Atlantic continental shelf would have to be developed to adequately address sea level rise in these areas (WES 1998).

F.1.3 Astronomical Tides

~~5.1.3.c Astronomical Tides.~~ As stated before, ~~A~~astronomical tides (i.e., tides caused by the attractive forces of the sun and moon) in the Chesapeake Bay are semi-diurnal. For Site 104, the mean tide level is between 0.22 and 0.26 m (0.73 and 0.84 ft) above MLLW; the mean tidal range is between 0.30 and 0.37 m (0.99 and 1.16 ft); and the spring tidal range is between 0.45 and 0.52 m (1.49 and 1.72 ft) (NOS 1996). Tidal datum characteristics for two locations in the upper Bay near Site 104 reported from the National Ocean Service (NOS) are presented in Table ~~5~~F-1. Matapeake is located on the western shore of Kent Island at latitude 38° 57.4' N and longitude 76° 21.3' W, approximately 3 km (2 miles) south of the site. Love Point is located on the northeastern shore of Kent Island at latitude 39° 1.9' N and longitude 76° 18.1' W, approximately 3 km (2 miles) east of the site. The difference in elevation between MLLW and the national geodetic vertical datum (NGVD) is approximately 0.35 ft. MLLW will serve as the datum for this project since it is the standard datum for nautical charts.

Tide and current data were also obtained from an extensive survey conducted by the NOS in the 1970s and 1980s (NOS 1988). The 1970s data were collected in a cooperative effort with USACE for use in the design of the physical model of the Bay. Two survey locations were in the

Table 5F-1

Astronomical Tidal Datum Characteristics for Selected Chesapeake Bay Locations

Tidal Datum	Matapeake [ms (ft)]	Love Point [ms (ft)]
Mean Higher High Water (MHHW)	0.45 (1.49)	0.52 (1.72)
Mean High Water (MHW)	0.37 (1.22)	0.43 (1.42)
Mean Tide Level (MTL)	0.22 (0.73)	0.26 (0.84)
National Geodetic Vertical Datum (NGVD)	0.11 (0.35)	0.11 (0.35)
Mean Low Water (MLW)	0.07 (0.23)	0.08 (0.26)
Mean Lower Low Water (MLLW)	0.00 (0.00)	0.00 (0.00)

vicinity of Site 104. The first was at Matapeake; tidal harmonic constants for tidal amplitude and phase were developed for this location. The second location was within the boundaries of Site 104 (Station No. 175 in the survey at latitude 39° 0.2' N and longitude 76° 20.9' W); tidal harmonic constants for tidal currents (speed, direction, and phase) were developed for this station. Table ~~5~~F-2 presents the tidal harmonic constants from these two locations. ~~This~~ These data ~~was~~ were used to generate tidal current velocity characteristics for modeling of the fate and transport of placed dredged material ~~(Section 6.1.3)~~. Figures ~~5~~F-1 and ~~5~~F-2 present the predicted tidal heights for 1 year and for 30 days, respectively, based upon the harmonic constants shown in Table ~~5~~F-2. These figures show that maximum amplitude above and below mean tide level is almost 0.3 m (1.0 ft), compared to the spring tidal range of about 0.5 m (1.6 ft).

F.1.4 Storm Surge

~~5.1.3.d Storm Surge.~~ Extreme water levels are dominated by storm effects (i.e., storm surge and wave setup) in combination with astronomical tide. Wave setup describes the rise in water level due to wave breaking. Specifically, it refers to change in momentum that attends the breaking of waves propagating towards shore result~~s~~ing in a surf zone force, which raises water levels at the shoreline.

A comprehensive evaluation of storm-induced water levels for several Chesapeake Bay locations has been conducted by the Virginia Institute of Marine Science (1978) as part of the Federal Flood Insurance Program. Results of this study are summarized in Table ~~5~~F-3 and shown as water-level versus frequency curves ~~presented~~ in Figure ~~5~~F-3. The table provides water levels in meters above MLLW (NGVD) for various return periods. A return period is a statistical probability of occurrence for a given event (e.g., a 5-year return period has a 20 percent chance of occurring, a 50-year return period has a 2 percent chance of occurring, and a 100-year return period has a 1 percent chance of occurring at any given time). Data in Table ~~5~~F-3 and Figure ~~5~~F-3, for stations closest to Site 104, indicate that the storm tide elevation for a 10-year return period is 1.2 m (4.1 ft) MLLW and the 100-year water level for the project area is 2.3 m (7.7 ft) MLLW.

F.1.5 Wind Conditions

~~5.1.3.e Wind Conditions.~~ Wind data from the NOAA, National Climatic Data Center (NOS 1982) for Baltimore-Washington International (BWI) Airport~~,~~ were used to estimate wind conditions at the project site (Table ~~5~~F-4). Data are presented as fastest mile winds, ~~that~~which are defined as the highest recorded wind speeds that last long enough to travel 1 mile, during a 24 hour recording period (NOS 1982). These winds were used to develop wind speed–return period relationships based upon a Type I (Gumbel) statistical distribution. The specific return periods examined were 5, 10, 15, 20, 25, 30, 35, 40, 50, and 100 years.

Table ~~5~~F-5 shows that the wind speeds for a 5-year return period storm range from 14 m/s (32 mph) for winds from the east direction to 24 m/s (54 mph) for winds from the northwest direction. The wind speeds for a 100-year return period storm range from 29 m/s (65 mph) for winds from the east direction to 43 m/s (97 mph) for winds from the southwest direction. These wind speeds were used to estimate storm wave conditions for Site 104 (Section ~~5.1.3.h~~F.8).

Table 5F-2
Astronomical Tidal Harmonic Constants

Constituent	Speed (degrees/hr)	Amplitude (m)	Epoch (degrees)	Major Direction Speed (cm/s)	Epoch (degrees)	Minor Direction Speed (cm/s)	Epoch (degrees)
M2	28.9841	0.14	146.8	36.8	154	0.7	154
S2	30	0.02	169.1	4.2	184	0.4	184
N2	28.43973	0.03	126.4	5.8	126	1.7	126
K1	15.04107	0.06	276.2	15.9	216	0.3	216
O1	13.94304	0.05	288.8	7.2	230	0.2	230

Where: M2 = principal lunar, S2 = principal solar, N2 = larger lunar elliptic, K1 = luni-solar diurnal, and O1 = principal lunar diurnal.

Table 5F-3
Water Level Elevation per Return Period

Return Period (years)	Water Level [m (ft) MLLW]
5	1.2 (4.0)
10	1.2 (4.1)
15	1.3 (4.2)
20	1.4 (4.5)
25	1.5 (5.0)
30	1.6 (5.3)
35	1.7 (5.6)
40	1.9 (6.1)
50	2.0 (6.7)
100	2.3 (7.7)

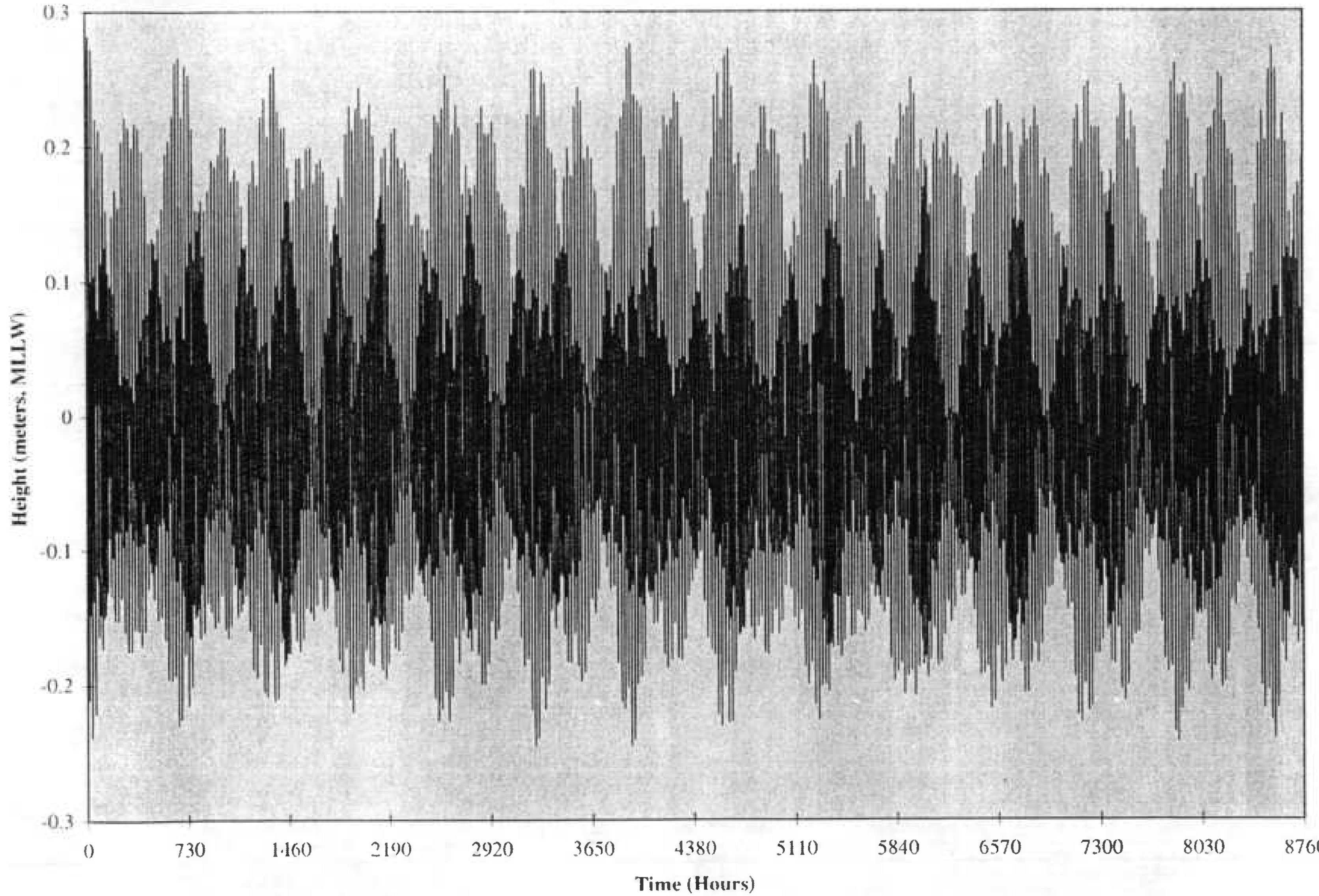


Figure 5F-1. Predicted Astronomical Tidal Amplitude for One Year.

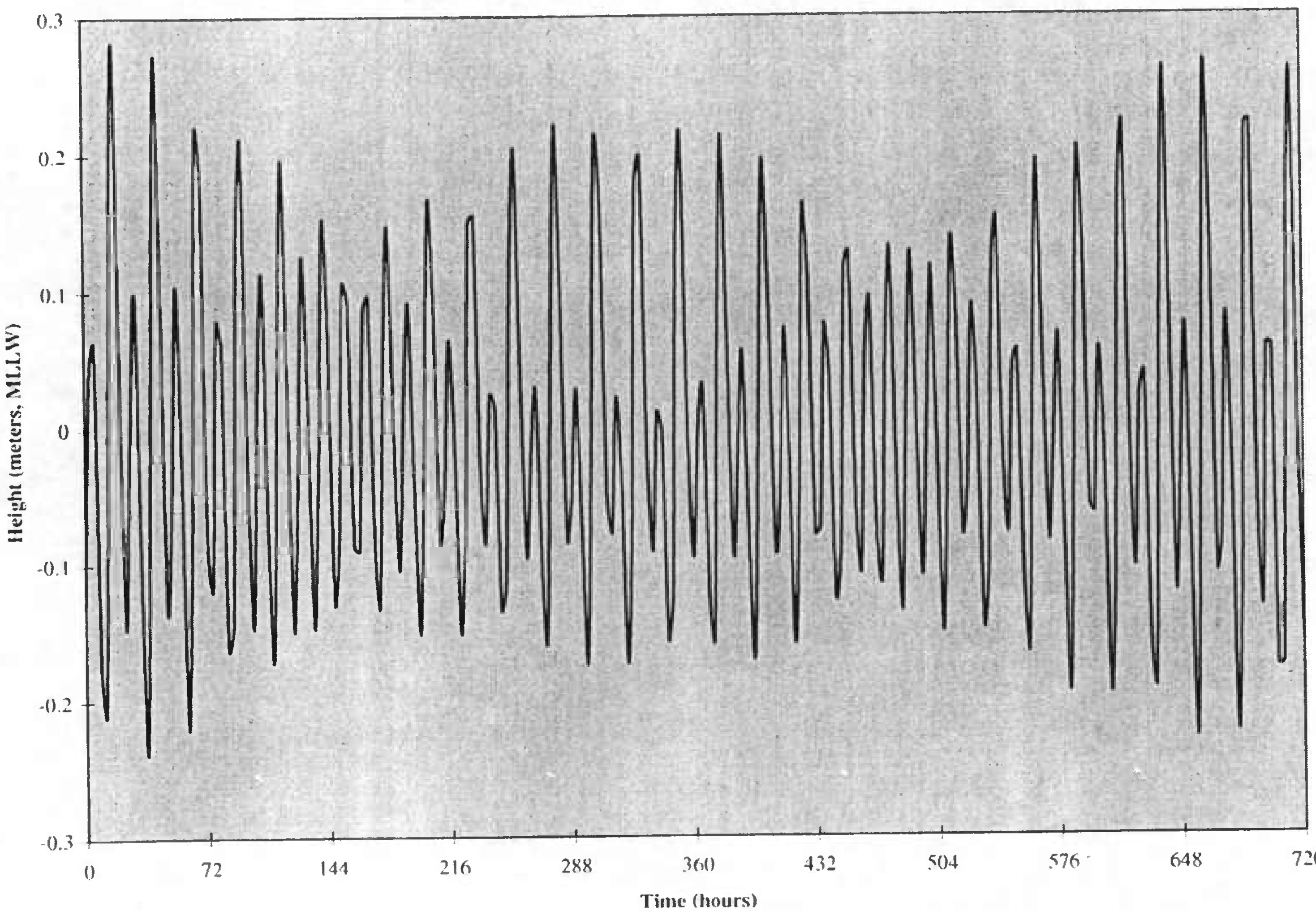


Figure 5F-2. Predicted Astronomical Tidal Amplitude for 30 Days.

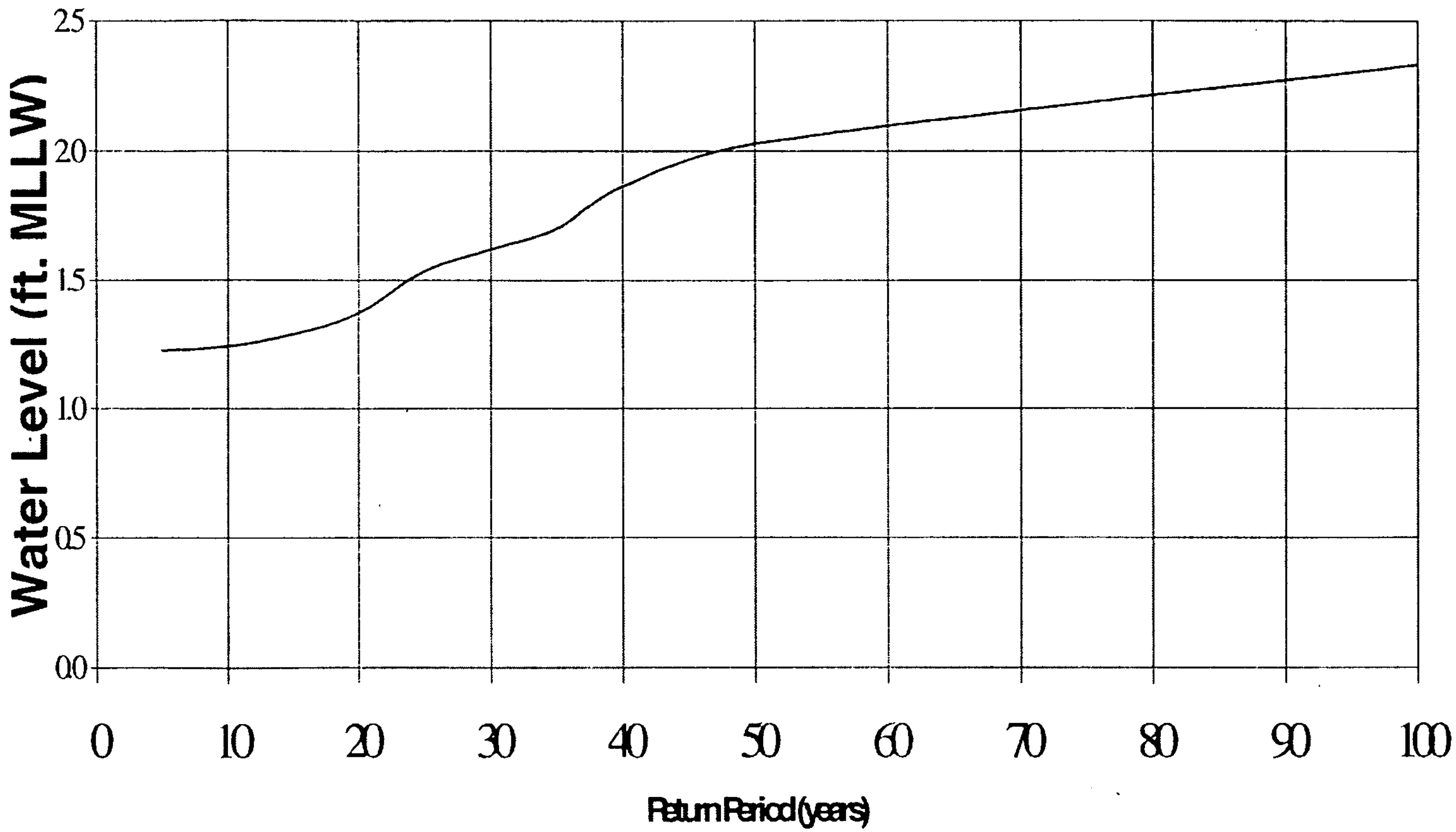


Figure 5F-3. Storm Water Levels (ft, MLLW) for the Site 104 Study Area.

Table 5F-4

Annual Extreme Wind Speed Per Direction forBaltimore-Washington International (BWI) Airport, 1951-1982 Fastest Mile Wind Speed

Year Year	N North		NE		E Northeast		SE		S East		SW		W Southeast		NW	
	m/s	mph	m/s	mph	m/s	mph	m/s	mph	m/s	mph	m/s	mph	m/s	mph	m/s	mph
1951	11	24	18	41	12	27	15	34	17	39	13	29	19	42	21	46
1952	30	66	11	25	21	47	30	66	18	41	30	66	21	46	19	43
1953	9	20	13	28	10	22	12	27	15	34	17	39	21	47	19	43
1954	14	31	12	27	10	22	27	60	13	28	17	39	25	57	20	44
1955	9	21	19	43	13	29	13	28	19	43	24	53	18	40	19	43
1956	13	29	15	34	11	25	11	24	13	28	15	34	25	56	18	40
1957	13	29	24	53	16	35	15	33	15	33	13	30	21	46	21	46
1958	13	30	23	52	11	25	15	33	17	37	19	43	18	40	19	43
1959	13	28	12	26	9	20	12	27	10	23	17	38	21	46	19	43
1960	12	26	17	38	13	28	12	27	11	25	16	35	18	40	24	53
1961	20	45	13	28	13	28	13	29	11	24	31	70	18	41	24	54
1962	25	56	18	41	13	28	8	17	11	25	16	36	19	42	27	61
1963	17	38	14	32	8	18	15	34	11	25	13	28	20	44	27	60
1964	15	34	14	31	10	23	11	24	21	47	10	23	21	48	27	61
1965	16	36	12	26	13	28	15	34	16	36	24	54	20	44	20	44
1966	14	32	11	25	13	29	11	24	21	47	19	43	22	50	21	48
1967	13	30	13	29	11	25	17	39	12	27	21	46	24	53	19	43
1968	20	45	13	30	16	36	12	26	8	19	20	45	21	48	22	50
1969	13	28	9	21	9	20	15	34	12	26	20	45	20	45	24	53
1970	13	28	13	28	8	18	9	21	17	39	15	34	21	48	27	60
1971	14	31	20	45	12	26	8	18	9	21	18	41	17	39	26	58
1972	13	28	11	25	16	35	12	26	9	20	18	41	18	41	18	41
1973	18	40	12	26	12	26	17	38	12	26	16	35	22	49	15	33
1974	14	32	10	23	21	46	13	29	15	33	15	33	20	45	18	41
1975	18	40	12	26	9	21	11	24	11	25	17	38	24	54	20	45
1976	14	31	8	18	9	20	13	28	14	32	13	28	20	45	24	54
1977	14	32	14	31	8	19	13	28	12	26	11	25	22	49	21	48
1978	17	39	13	28	16	36	13	28	8	19	23	52	15	33	20	45
1979	14	32	11	25	12	27	16	36	14	32	14	32	20	45	21	47
1980	15	33	12	27	8	18	14	32	9	20	14	32	20	45	22	50
1981	11	24	11	24	8	19	12	26	10	23	13	28	18	41	19	42
1982	14	31	9	20	10	23	10	23	13	29	15	34	18	40	21	48

Note: Data adjusted to 10 m height as per the methodology in the USACE Shore Protection Manual, 1984.

F.1.6 Tidal Currents

5.1.3.f Tidal Currents. Vertical water movement associated with the rise and fall of the tide creates horizontal water movement called tidal currents. Tidal currents in the upper Chesapeake Bay are moderate to weak with an average maximum velocity of about 0.6 meters (m/s) per second (m/s) ([2 ft per second (ft/s)], NOS 1996). The Horn Point Environmental Laboratory (HPEL) of the University of Maryland, Center for Environmental Sciences (UMCES) conducted current velocity measurements for Site 104 using an Acoustic Doppler Current Profiler (ADCP), which was surveyed for one complete tidal cycle (about 13 hours) on 28 July 28, 1997 [UMCES 1997 (see Appendix F)]. Maximum ebb velocities were measured on the order of 0.45 to 0.6 m/s (1.5 to 2 ft/s), while maximum flood velocities were measured to be on the order of 0.3 to 0.45 m/s (1 to 1.5 ft/s). Velocity vector plots for peak ebb and peak flood are shown in Figures 5F-4 and 5F-5, respectively (Moffatt and Nichol Engineers [M&N], 1998). These velocity measurements are similar to those reported in NOS (1996) for historic average conditions.

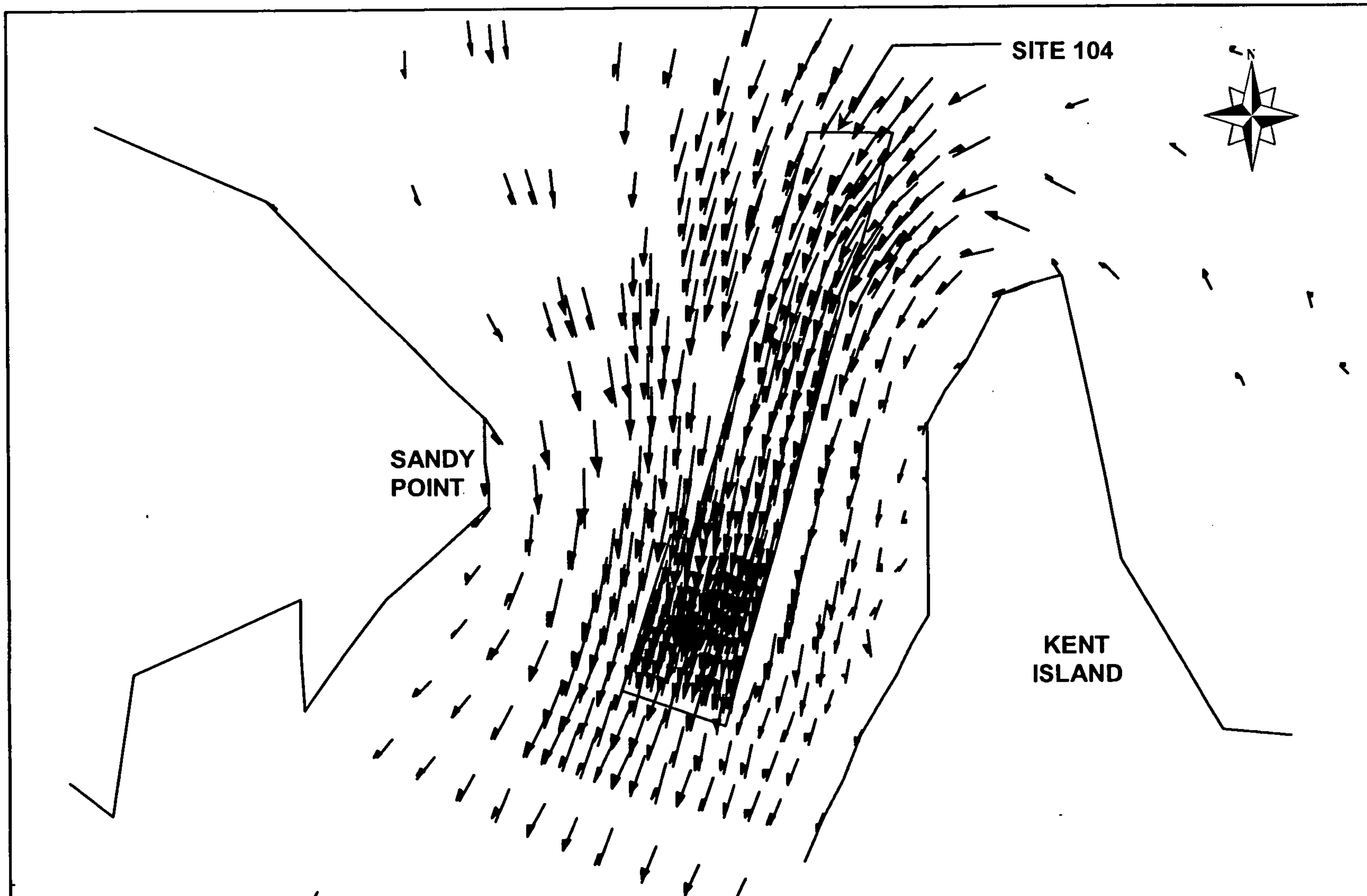
The tidal harmonic constants shown in Table 5F-2 were used to generate predicted tidal current velocities for Site 104. Figures 5F-6 and 5F-7 present tidal current velocities over time for 1 year and for 30 days, respectively. Maximum velocities are about 0.6 m/s (2 ft/s).

F.1.7 Sedimentation

5.1.3.g Sedimentation. The upper Chesapeake Bay is a region where a relatively large quantity of fine-grained sediment is deposited (Maryland Environmental Service [MES] 1995). The two primary sources of these fine-grained sediments are discharge from the Susquehanna River and adjacent shoreline erosion from within the upper Bay.

The primary input of suspended sediment into the upper Chesapeake Bay is due to discharge from the Susquehanna River. The Susquehanna River supplies more than 50 percent of the fresh water to the Bay and more than 90 percent of the fresh water to the upper Bay north of Baltimore (Magnien *et al.* 1993—"a" or "b"?). According to Biggs (1970), the Susquehanna River accounts for 96 percent of the total fresh-water discharge to "Station VI," which is located at the northern limit of Site 104. Mean annual average discharge from the Susquehanna River (measured at the Conowingo Dam) between 1928 and 1975 was about 1,000 m^3/sec (36,000 ft^3/sec). The long- term mean discharge is approximately 1,099 m^3/sec (38,800 ft^3/sec); however, freshwater inflow to the upper Bay varies daily, weekly, monthly, and yearly, with relatively high discharge in the spring and low to moderate discharge in the summer and fall (Schubel and Pritchard 1987). Average flows in March and April exceeded 2,200 m^3/sec (78,000 ft^3/sec) between 1929 and 1984 (Schubel and Pritchard 1987); flows from 1984 through 1991 for February through April ranged from 1,100 to 2,100 m^3/sec [40,000 to 75,000 ft^3/sec (MES 1997—"a," "b," or "c"?)].

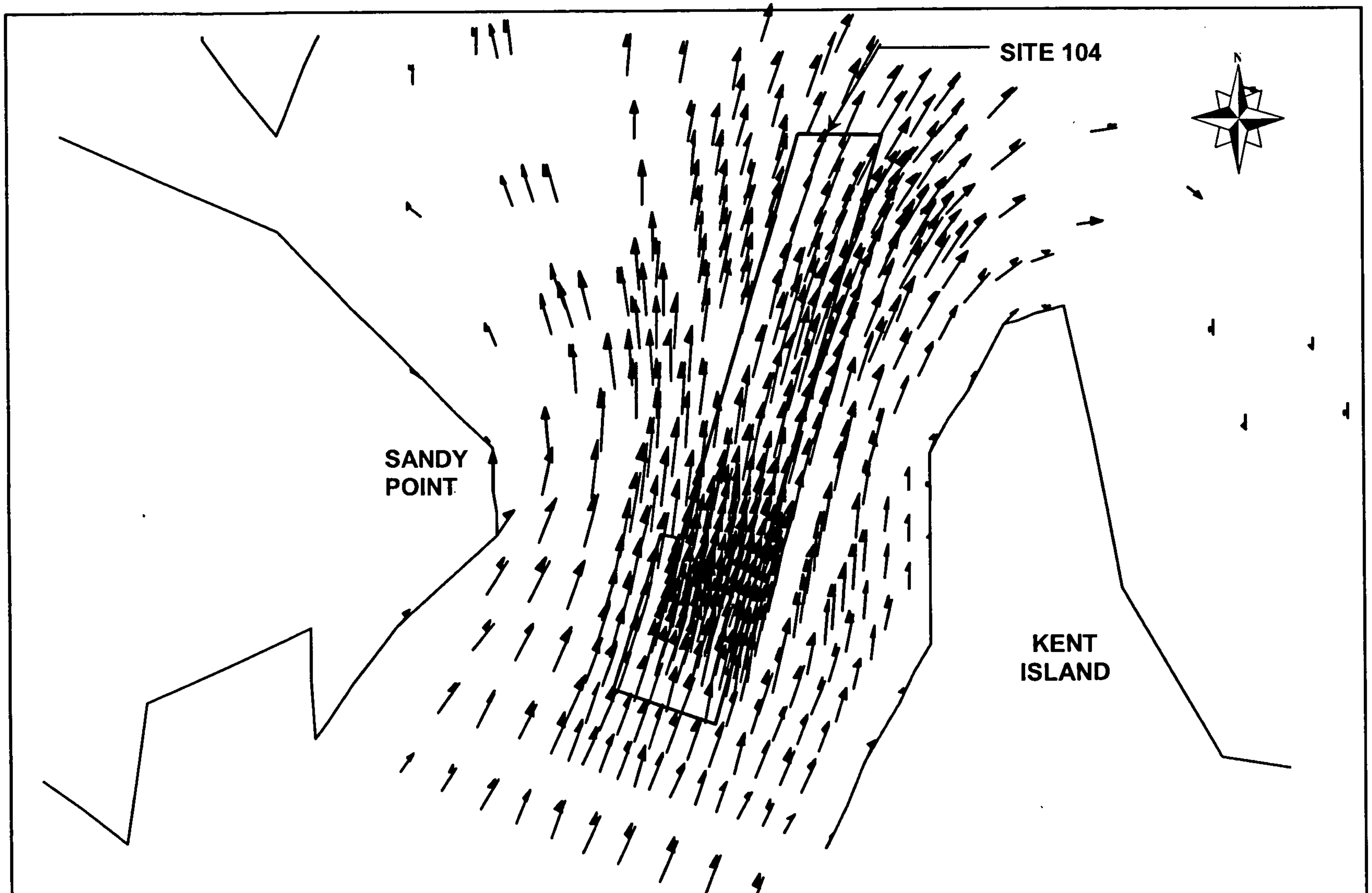
Previously, the Maryland Department of Natural Resources (MDNR) estimated that from 1928 through 1975, the discharge from the Susquehanna River provided an average of about 540,000 metric tons (600,000 tons) of sediment each year to the Bay (MDNR 1976). This estimate was based upon suspended sediment concentrations measured from the discharge of water through



NOTE: VECTORS INDICATE VELOCITY, MAGNITUDE & DIRECTION; SPACING BETWEEN VECTORS IS BASED ON CREATED GRIDS WITHIN THE MODEL.

SITE 104 OPEN WATER PLACEMENT AREA EIS REPORT

FIGURE 5F-4
PEAK EBB VELOCITY VECTORS IN VICINITY OF SITE 104



NOTE: VECTORS INDICATE VELOCITY, MAGNITUDE & DIRECTION; SPACING BETWEEN VECTORS IS BASED ON CREATED GRIDS WITHIN THE MODEL.

SITE 104 OPEN WATER PLACEMENT AREA EIS REPORT

FIGURE 5F-5
PEAK FLOOD VELOCITY VECTORS IN VICINITY OF SITE 104

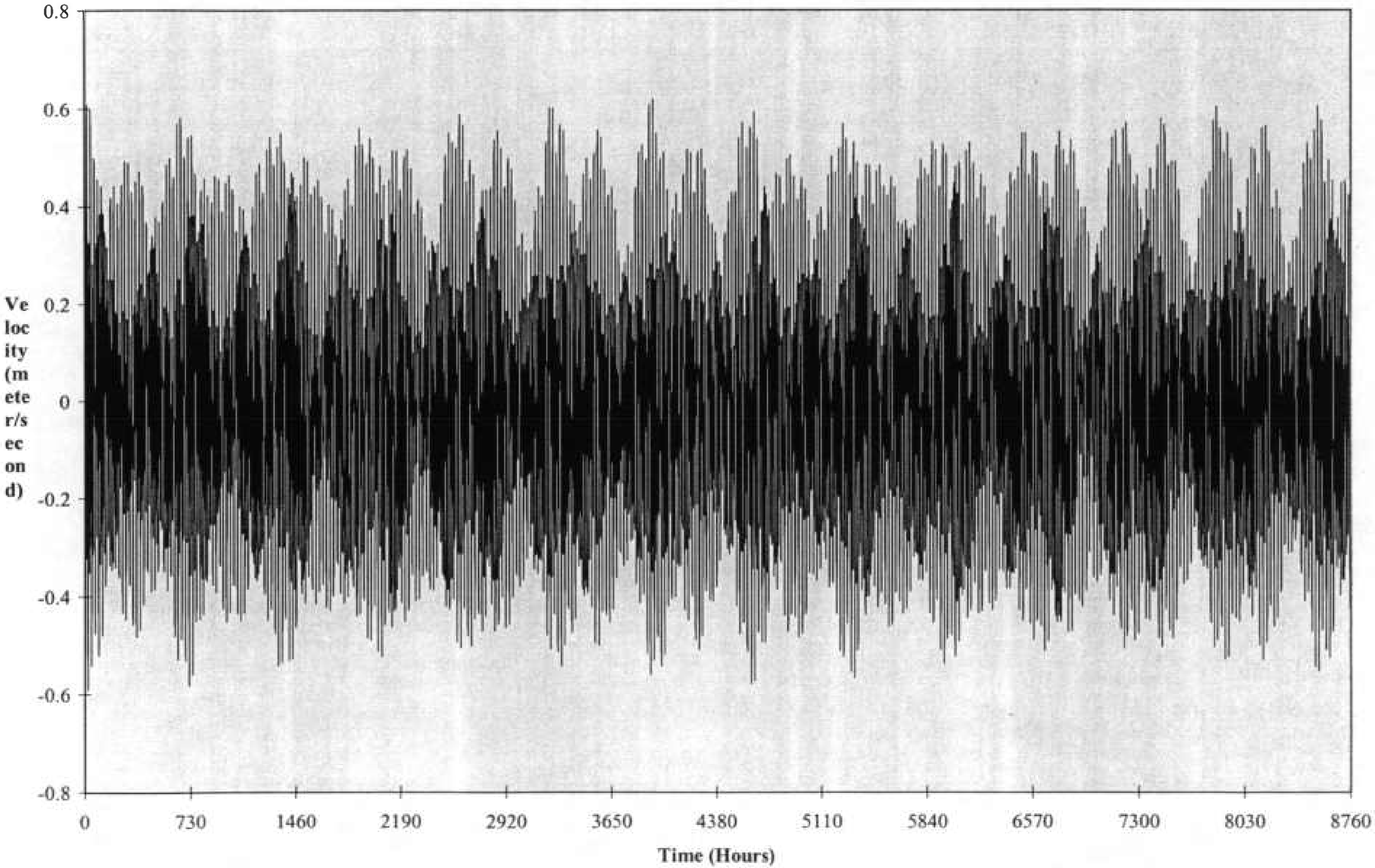


Figure F-6. Predicted Astronomical Tidal Current Velocity for One Year.

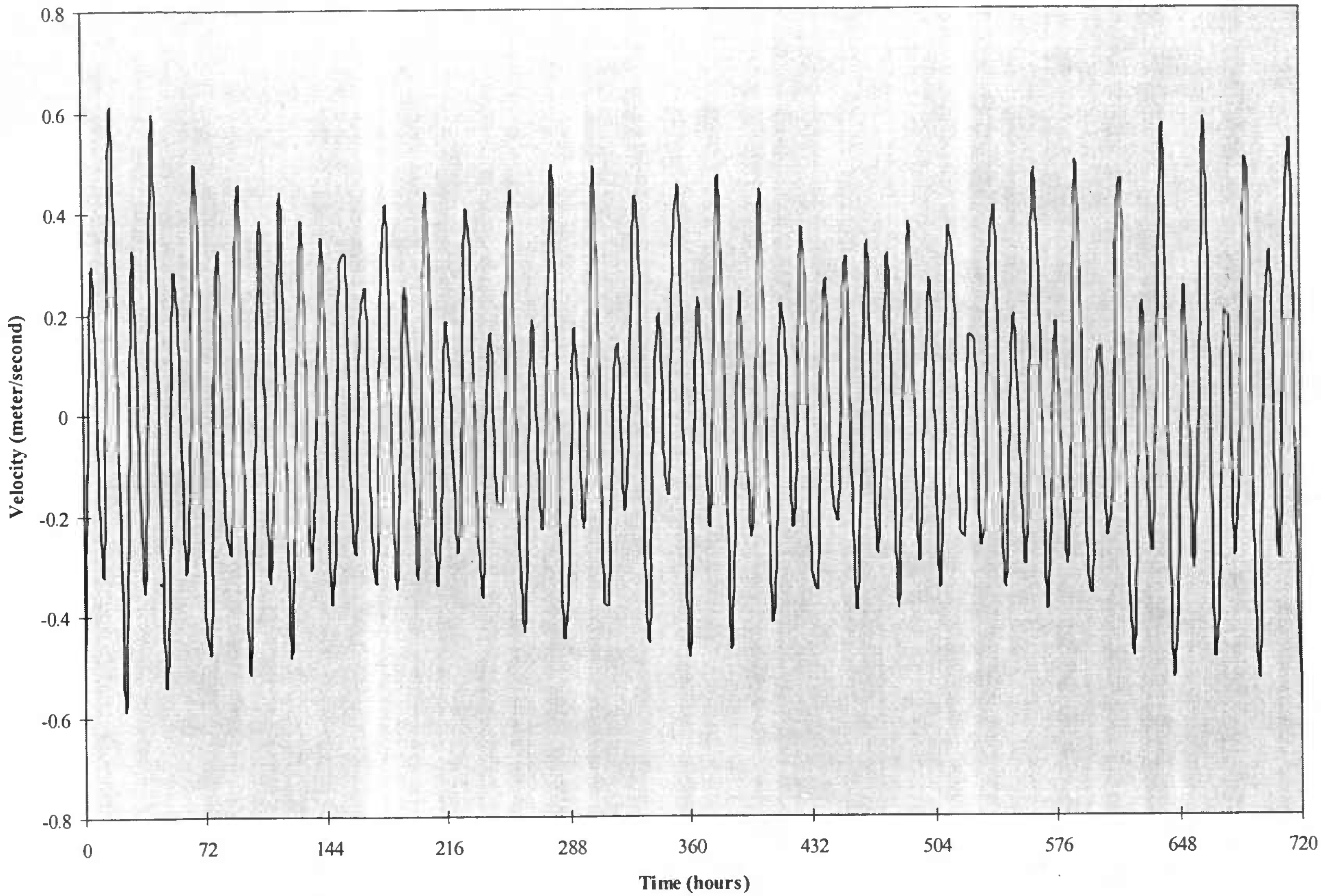


Figure 5F-7. Predicted Astronomical Tidal Current Velocity for 30 Days.

the Conowingo Dam. More recent data (1978–1993) indicate that the sediment load from the Susquehanna River (measured at Conowingo Dam) is approximately 1.3 million metric tons per year [1.4 million tons (MES 1995~~)~~; ~~and~~ Panageotou *et al.* 1996)]. During 1978–1993, the estimated annual total suspended load from the Susquehanna River varied from about 400,000 metric tons (440,000 tons) to 2.7 million metric tons (3 million tons). It is believed that a relatively small fraction of this sediment load actually reached the Site 104 area (Halka, personal communication), although occurrences of high-suspended sediment caused increased turbidity in the area (MDNR 1976). Biggs (1969) stated that more than 90 percent of the suspended sediment contributed by the Susquehanna River was deposited north of Station VI (north of Site 104).

Sediment input to the Bay due to extreme weather events can be significant. In January 1996, record snowfall followed by a heavy rainfall and warm temperatures caused major flooding in the Chesapeake Bay watershed. During the January 1996 flood, the Susquehanna River discharged a total of about 9 billion m^3 (320 billion ft^3) of sediments at an average of 3,400 m^3/sec (120,000 ft^3/sec). This equates to approximately 1.8 million metric tons (2 million tons) of sediment carried into the Bay by the Susquehanna River during this single event, more than the average yearly input between the years 1978 and 1993 (U.S. Geological Survey [USGS] 1996—Add to ref. list).

Suspended sediment resulting from erosion of the shoreline from within the upper Bay is an additional significant source of material. Estimates of the quantity of material due to shoreline erosion in the upper Bay range from 300,000 metric tons (330,000 tons) (Biggs 1970) to 390,000 metric tons (430,000 tons [Kerhin *et al.* 1988]). The fine-grained fraction of this material is estimated to range from 110,000 metric tons (120,000 tons [Biggs 1970]) to 180,000 metric tons (200,000 tons [Kerhin *et al.* 1988]).

Based upon a review of the data presented above, the total quantity of sediment supplied to the upper Bay averages ~~from~~ approximately 1.6 to 1.7 million metric tons (1.8 to 1.9 million tons)~~.~~

per year. In addition, according to suspended sediments concentration data collected at various locations throughout the upper Bay, Biggs (1969) estimated that about 4 percent of the annual supply of material to the upper Bay is transported south of Station VI (the northern limit of Site 104). Based upon this estimate, a mean of approximately 60,000 to 70,000 metric tons (66,000 to 77,000 tons) is supplied annually to the Site 104 area and south. This sediment is deposited over a large area of the Bay, including an estimated small percentage at Site 104. Most of this remaining material is deposited north of the mouth of the Potomac River (Officer *et al.* 1984; Donoghue 1990; Colman *et al.* 1992; Hobbs *et al.* 1992).

Sedimentation at Site 104 corresponds primarily to sediment particle size and classification and is influenced by particle settling velocity, density throughout the water column, and current velocity. Typical fine-grained, naturally-occurring sediments suspended in the waters of the upper Bay are approximately 0.010 to 0.015 mm (0.0004 to 0.0006 in.) in diameter, with settling (falling) velocities in the range of 0.004 cm/sec (1.5×10^{-4} ft/sec, MDNR 1976). Samples collected by Earth Engineering Sciences Inc. (E2Si) (1997) and the Maryland Geological Survey (MGS) (1997)—Add MGS 1997 to ref. list in Site 104 contained material with particle sizes ranging from 0.005 to 0.1 mm (0.0002 to 0.004 in.), with a mean of 0.02 mm (0.0008 in.). Settling velocity for a 0.02 mm (0.0008 in.) particle is approximately 0.06 cm/sec (0.002 ft/sec). Due to these relatively slow-settling velocities, this suspended material can be transported over large distances by tidal currents, and some material may never settle to the bottom. In addition, wave-forced resuspension of deposited material is an important factor influencing the transport of material (Sanford 1994).

Biggs (1970) estimated that sedimentation in the area around Site 104 is approximately 1.1 mm/yr (0.04 in./yr). This estimate assumes a uniform distribution of 303,000 metric tons (334,016 U.S. tons) of particulate matter spread evenly over the bottom of this region. The amount of material being deposited is based upon the difference in suspended matter measured at the designated upstream and downstream stations from 1 February 1996 through 31 January 1997. Eskin *et al.* (1996) estimates that the sedimentation rate in the area is about 1.2 to 10 mm/yr (0.05 to 0.4 in./yr) as a result of lead-210 analyses of core samples collected at stations in and around Site 104.

Sedimentation rates in the deeper portions of the Chesapeake Bay are generally higher than in the surrounding shallower waters, due in part to lower current velocities and lessened effects from wave action. The deeper channels are relict features incised during times of lower sea level by the Susquehanna River and its tributaries, and are now filling relatively rapidly with sediments (Colman *et al.* 1992). It is estimated that over more than a 10,000-year period, the long-term average rate of sediment accumulation in the vicinity of Site 104 has been approximately 0.003 m/yr (0.12 in./yr) (Colman and Halka 1990). Pollen-dating techniques applied to three recent sediment cores collected in the vicinity of Site 104 indicate that a rate of sediment accumulation since the time of European occupation has averaged approximately 0.004 m/yr (0.156 in./yr Brush 1990; Brush *et al.* 1997). Although these cores were not located within the Site 104 boundaries, and extrapolation of sedimentation rates from specific core locations is questionable, the results corroborate the long-term average (Halka 1998). Higher sedimentation rates [0.01 to 0.03 m/yr (0.396 to 1.176 in./yr)] have been calculated from radionuclide dating of two cores collected from the deep-water areas to the south of Kent Island (Goldberg *et al.* 1978). Assuming a surface sediment bulk density of 1.25 grams per cubic centimeter (g/cc) in Site 104, Halka (1998) calculated the sedimentation rate of 0.004 m/yr (0.156 in./yr), which would result in a sediment mass accumulation rate of 1,600 g/m^2/yr.

F.1.8 Wave Conditions

~~5.1.3.h Wave Conditions.~~

~~**Average Wave Conditions**~~

F.1.8.a Average Wave Conditions. One year of hourly-averaged wind speed and directional data were obtained from the NOS for C-MAN station TPLM2, located at latitude 38° 58.5' N and longitude 76° 24' W, less than 1 mile southwest of Site 104. These data were used to generate an average wave height and period for the year using methods presented in the Shore Protection Manual (USACE 1984). Figures F-8 and F-9 present the hourly-averaged wave heights and periods for 1 year, respectively, using the TPLM2 data. The figures show the variability of the

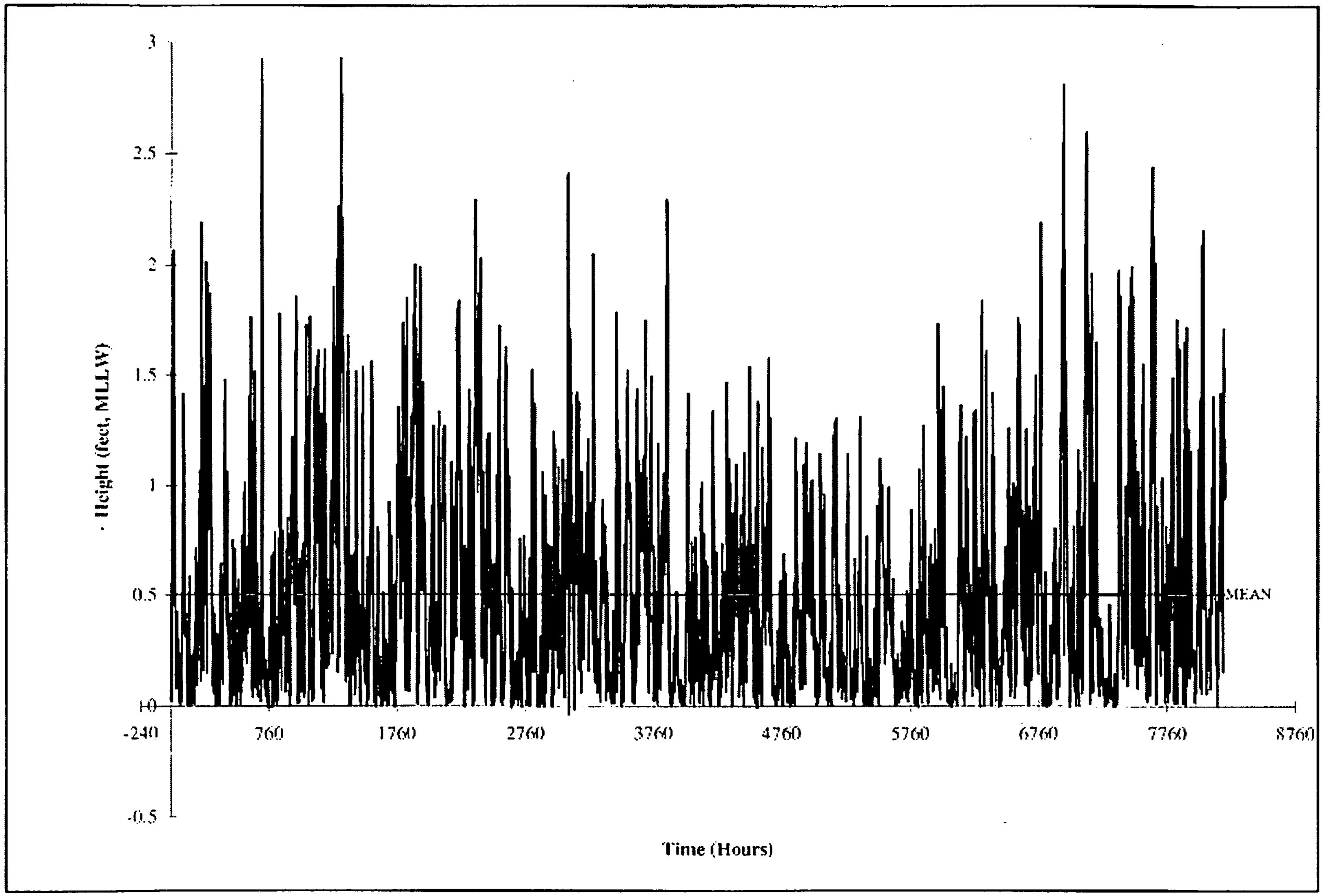


Figure 5F-8. Hourly-averaged Wave Heights for One Year (based on NOS C-MAN data, 1990).

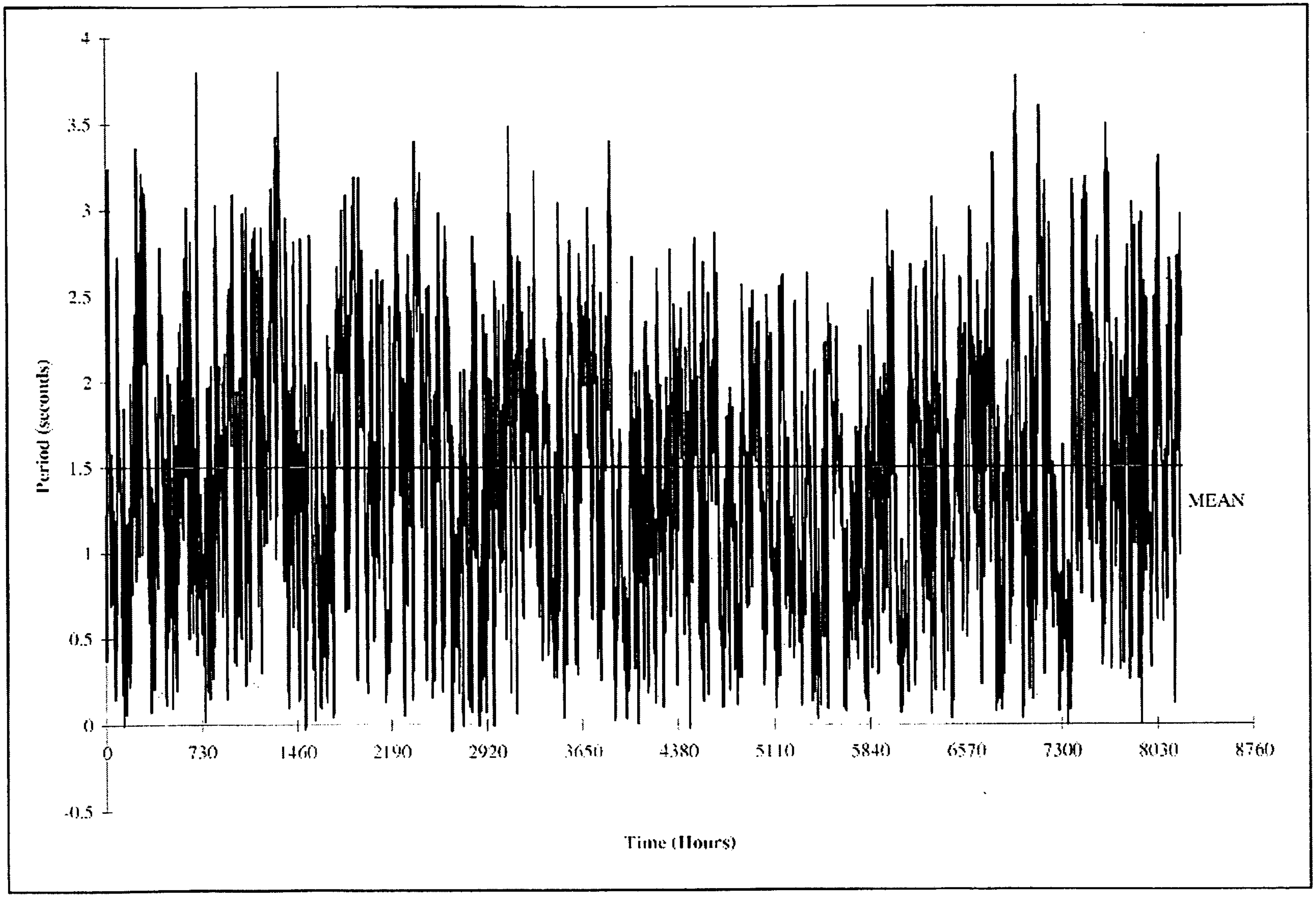


Figure 5F-9. Hourly-averaged Wave Periods for One Year (based on NOS C-MAN data, 1990).

wave heights and periods for the year. The mean wave height and period for the year were computed from the above analysis output. The mean wave height was computed to be about 0.15 m (0.5 ft) and the mean wave period was computed to be about 1.5 seconds.

~~**Extreme Wave Conditions**~~

F.1.8.b Extreme Wave Conditions. Site 104 is exposed to wind-generated waves approaching primarily from the north and south directions. The longest fetch distances (i.e., the area of the water over which a wind of constant direction and speed blows to generate waves) to which the site is exposed correspond to these two directions. In accordance with procedures recommended by the U.S. Army Shore Protection Manual (USACE 1984), a radially averaged fetch distance was computed for the two directions. The radially averaged fetch distances for the north and south directions are shown in Figures ~~5~~F-10 and ~~5~~F-11, respectively. Wave conditions were hindcast for each fetch direction for the winds (Table ~~5~~F-5) adjusted appropriately for duration, water levels (Table ~~5~~F-3), and mean water depths along the fetch directions (Figure ~~5~~F-3). The results are shown in Tables ~~5~~F-6 and ~~5~~F-7.

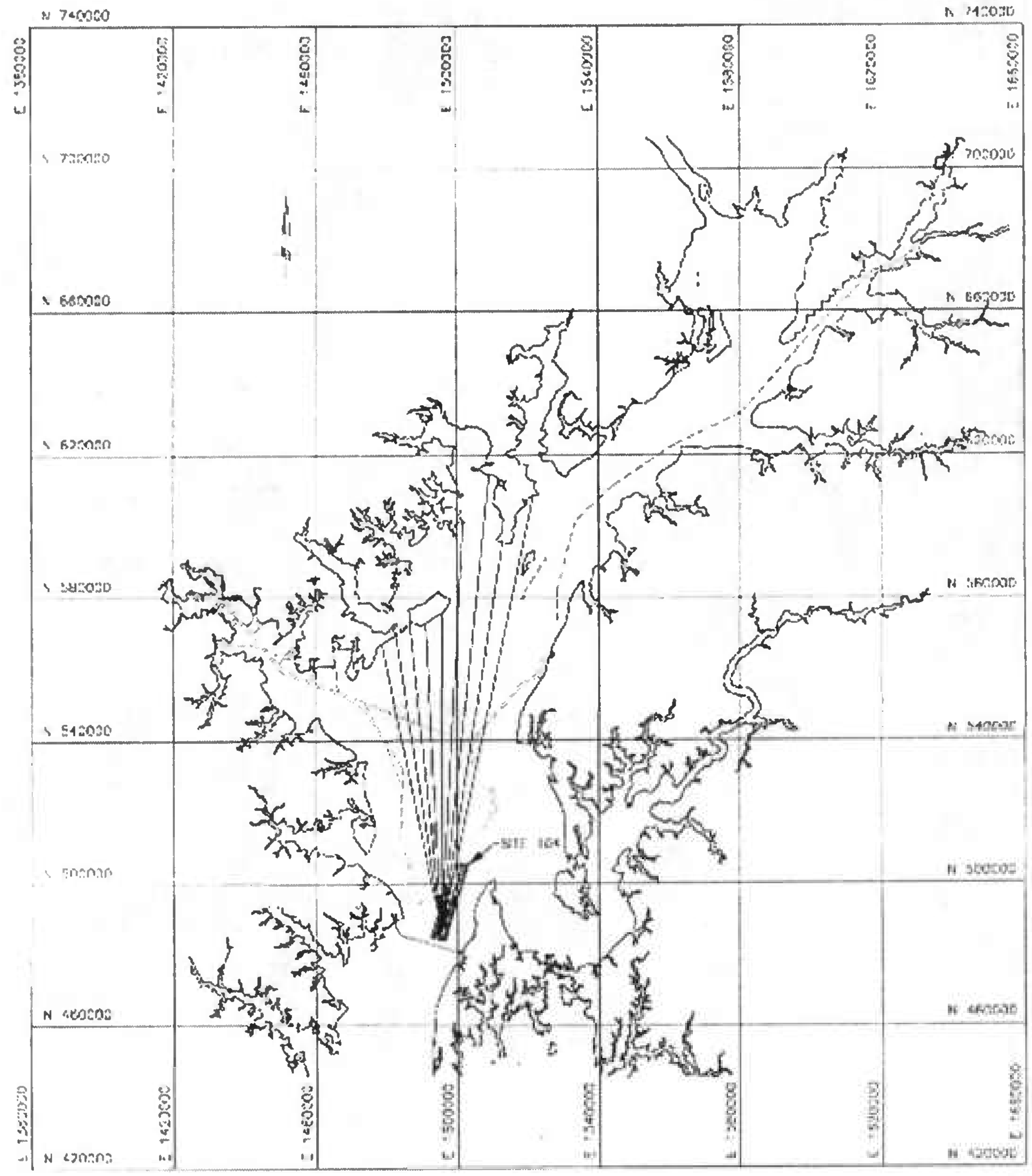
A sea state is normally composed of a spectrum of waves with varying heights and periods that may range from relatively long waves to short ripples. In order to summarize the spectral characteristics of a sea state, it is customary to represent that wave spectrum in terms of a distribution of wave energy over a range of wave periods. Having made this distribution, known as a wave spectrum, it is convenient to represent the wave spectrum for Site 104 by a single representative wave height and period. The wave conditions reported in Tables ~~5~~F-6 and ~~5~~F-7 are the significant wave height, H_s, and the peak spectral wave period, T_p. The significant wave height, H_s, is defined as the average of the highest one-third of the waves in the spectrum. Depending on the duration of the storm condition represented by the wave spectrum, maximum wave heights may be as high as 1.8 to 2 times the significant wave height computed above. The peak spectral period, T_p, is the wave period that corresponds to the maximum wave energy level in the wave spectrum. Higher return periods for both wave height and periods lead to a greater potential for storm-induced resuspension of sediments from the bottom.

F.2 POTENTIAL ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

~~**6.1.3 Hydrodynamics**~~

F.2.1 Introduction

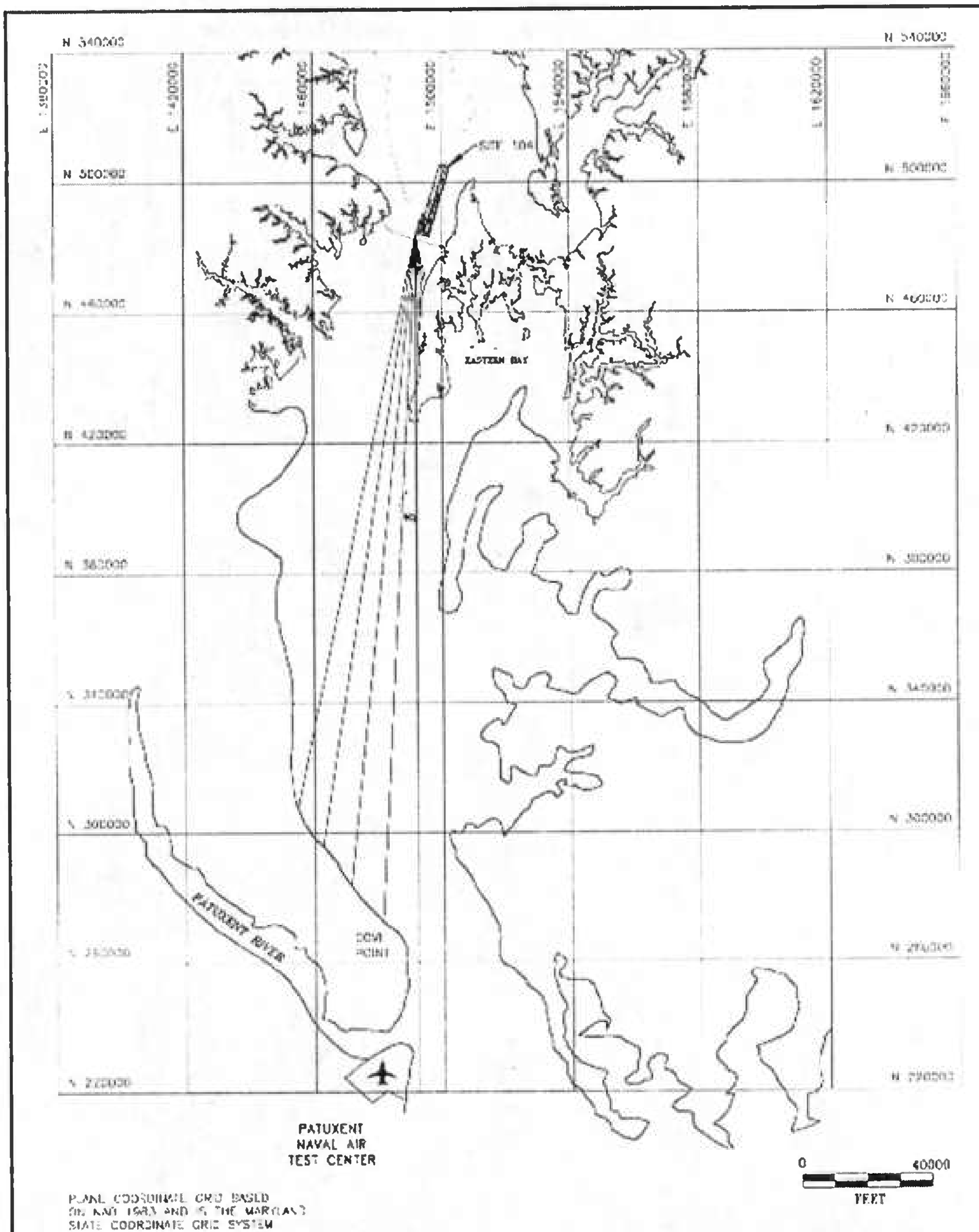
~~**6.1.3.a** Introduction.~~ Computer models were run by ~~Moffatt & Nichol Engineers (~~M&N~~)~~ and ~~the U.S. Army Corps of Engineers Waterways Experiment Station (~~WES~~)~~ to simulate potential hydrodynamic changes due to placement of dredged material at Site 104. Models simulated the motion of the water (hydrodynamics) flowing through Site 104 and the resulting potential for erosion and movement of placed dredged material using both controlled hydraulic bottom pipeline placement and bottom-release scow placement methods. The erosion models also provided information on potential annual changes in water depths.



PLANE COORDINATE GRID BASED ON NAD 1983 AND IS THE MARYLAND STATE COORDINATE GRID SYSTEM

0 40000
FEET

	SITE 104 OPEN WATER PLACEMENT AREA EIS REPORT	FIGURE F-10. NORTHERLY WAVE DIRECTION RADIALLY-AVERAGED FETCH



	SITE 104 OPEN WATER PLACEMENT AREA EIS REPORT	FIGURE F-11. SOUTHERLY WAVE DIRECTION RADIALLY-AVERAGED FETCH

Table 5F-5
Fastest Mile Wind Speeds per Direction and Return Period (RP)

RP Year Year	N North		NE		E Northeast		SE		S East		SW		W Southeast		NW	
years	m/s	mph	m/s	mph	m/s	mph	m/s	mph	m/s	mph	m/s	mph	m/s	mph	m/s	mph
5	18	40	17	37	14	32	17	37	16	36	21	47	22	50	24	54
10	21	48	20	44	17	38	20	45	19	43	25	56	24	54	26	59
15	23	52	21	48	18	41	22	50	21	47	27	61	25	56	28	62
20	25	56	23	52	20	45	25	55	23	51	30	67	26	59	29	65
25	26	59	25	55	21	47	26	58	24	54	31	70	27	60	30	67
30	28	62	25	57	22	49	27	61	25	56	33	73	27	61	30	68
35	29	64	27	60	23	51	28	63	26	58	34	76	28	62	31	70
40	30	66	28	62	24	53	29	65	27	60	35	78	28	63	32	71
50	31	69	30	66	25	55	31	69	28	63	37	82	29	64	33	73
100	36	81	34	76	29	65	37	82	33	74	43	97	31	69	36	81

Table 5F-6
Wave Height per Return Period

Fetch Direction	**Return Period (years)**									
	1 m (ft)	**2 m (ft)**	**5 m (ft)**	**10 m (ft)**	**20 m (ft)**	**25 m (ft)**	**30 m (ft)**	**40 m (ft)**	**50 m (ft)**	**100 m (ft)**
North	0.9 (3.0)	1.2 (3.9)	1.5 (4.8)	1.7 (5.7)	2.0 (6.6)	2.1 (6.9)	2.2 (7.2)	2.3 (7.7)	2.4 (8.0)	2.8 (9.3)
South	0.9 (3.0)	1.3 (4.2)	1.7 (5.5)	2.0 (6.5)	2.3 (7.7)	2.5 (8.1)	2.5 (8.3)	2.7 (8.9)	2.8 (9.3)	3.3 (10.7)

Table 5F-7
Wave Period (seconds) per Return Period

Fetch Direction	Return Period (years)									
	1	**2**	**5**	**10**	**20**	**25**	**30**	**40**	**50**	**100**
North	3.7	4.1	4.5	4.8	5.1	5.2	5.3	5.5	5.6	5.9
South	3.9	4.4	5	5.4	5.8	5.9	6	6.1	6.3	6.7

–Laboratory testing was conducted by WES to characterize the erodability of the dredged materials proposed for placement at Site 104. The information gained from the laboratory testing was ultimately used in the modeling of the potential erosion and movement of placed dredged material. The annual placement plans were developed using the MDFATE model in accordance with the following criteria: minimize loss of material during placement; minimize loss of material following placement due to erosion; minimize mounding of the material at each placement location (which subsequently serves to minimize erosion); prevent material from mounding above elevation –13.7 m~~eters~~ (-45 f~~eet~~); place material in the deeper portions of the site to achieve as uniform a depth as possible throughout the site; and maximize capacity.

–The quantities of material to be placed originated from the State of Maryland's Strategic Plan for Dredged Material Management (Table ~~6-2~~F-8). In the model, 2,755 m^3 (3,600 cy) of material (holding capacity of one barge) was placed during each placement event. The number of placement events in any one day or placement season depended upon the total amount of dredged material to be placed in that year. A placement window from 1 November into March was utilized.

F.2.2 Summary

~~6.1.3.b Summary.~~ A summary of potential impacts to hydrodynamic processes is provided in Table ~~6-3~~F-9. Water levels, astronomical tides, extreme water levels, and wind conditions will not be impacted by the proposed action. The changes in the depth-averaged currents due to a decrease in the water depths at Site 104 from dredged material placement were determined to be small (less than 2%).

-Changes in the resulting bottom forces that could move the bottom sediments varied by ±15% depending upon where and in what order material was placed. Based on the assumptions and the material placement plan used for the erosion model studies, the modeled results indicated a worst-case potential for 16.9% of the material placed by bottom-release scow to leave the site boundary and a potential for 6.2% of the material placed by controlled hydraulic pipeline bottom placement to leave the site boundary.

–Available models of the Chesapeake Bay are not able to predict sediment transport. It is, therefore, unknown exactly where material potentially leaving the site boundaries will end up, although smaller particles will tend to travel farther than larger ones. The hydraulic placement modeling simulated the hydraulic unloading of individual barges by pump-out through a pipeline and diffuser, to locations within about 2 m~~eters~~ (6.0 f~~eet~~) of the Site 104 bottom. Most of the predicted erosion is anticipated to take place during ~~the~~ placement of the material ~~placement period~~ (WES 1998). These predicted sediment losses are thought to be higher than what actually would be expected to occur, since the model does n~~'~~ot take into account any material that leaves the site and is then carried back into the site by tidal action. The losses could vary for either of the placement methodologies under actual conditions (WES 1998).

Sedimentation rates are controlled by the physical characteristics of the sediments and surrounding water and the hydrodynamics of the area. Since the hydrodynamics models revealed that the variations in tidal currents through the site area would not change significantly (WES

Table F-86-2
Five Year Placement Plan for Site 104

Year	Volume (m^3) / (cy)	Modeled Placement Days
1	1,913,265 / 2,500,000	140
2	3,443,878 / 4,500,000	140
3	2,295,918 / 3,000,000	168
4	4,591,837 / 6,000,000	168
5	1,530,612 / 2,000,000	140
Total	**13,775,510 / 18,000,000**	

Table F-96-3

Summary of impacts to hydrodynamic processes in the vicinity of Site 104

Hydrodynamics	**No Impact**	**No Significant Impact**	**Impact**
Average Depth			✔
Water Level	✔		
Astronomical Tides	✔		
Extreme Water Levels	✔		
Wind Conditions	✔		
Tidal Currents		✔	
Sedimentation Rates		✔	
Sediment Erodability			✔
Material Spreading			✔
Potential Sediment Transport			✔
Wave Conditions		✔	

1998), it is anticipated that natural sedimentation rates within Site 104 will not be significantly impacted by the proposed action. Physical analysis of sediments proposed for placement at Site 104~~,~~ indicated that the particle sizes of material to be placed at the site are similar to the sediments that currently exist at the site. The majority of sediment proposed for placement consists of silt and clay particles. Analysis of sediments from the Craighill Angle, the Cutoff Angle, the Brewerton Channel Eastern Extension, the Tolchester Channel, and the Swan Point Channel indicated that the mean sediment particle size was $10.88\text{x}10^{-6}$ m~~eters~~ ($3.57\text{x}10^{-5}$ f~~eet~~). Existing sediments in the Site 104 area consist primarily of very soft to soft gray silty clay with localized pockets of silty sand and red-brown silty clay (E2Si 1997~~,~~; MGS 1997~~,~~; EA 1998).

The water quality model developed by WES and described below was run using a tracer concentration that indicated the long-term movement of water over the Site 104 bottom to be to the north. This indicates~~, indicating~~ that sediments remaining in suspension over multiple tidal cycles would ultimately move in a northerly direction. However, it should be noted that the amount of suspended sediments that will remain in the water column over tidal cycles will be low.

This northward movement is not expected to interfere with the turbidity maximum zone in the upper Bay or with ~~planktonic~~ transport of plankton associated with the movement of the turbidity maximum zone. Impacts to recreational and commercial fishing, due to the northerly movement of the suspended sediment, will be minimal due to the time-of-year that placement will occur and the small amount that will likely be transported. In addition, northerly movement is not expected to impact clam beds adjacent to the site because the movement will be restricted to the deeper areas that are located west of the clam beds.

F.2.3 Model Descriptions

~~6.1.3.c Model Descriptions.~~ Preliminary investigations into the hydrodynamics of Site 104 and the development of dredged material placement plans to minimize the potential for erosion were performed by M&N using the following models: FASTTABS, STFATE, SURGE, MDFATE, and LTFATE. More detailed investigations of the Site 104 hydrodynamics, potential sediment erosion and transport, and placement plan development were performed by WES using the following models: CH3D-WES, STFATE, SURGE, MDFATE, LTFATE, and CEQUAL-ICM. Each of these models is state-of-the-art, is utilized both nationwide and internationally, and is the best tool available for making respective predictions for areas within the Chesapeake Bay.

–A joint effort by M&N and WES was made to compute the initial footprint (i.e., the outline and surface area) generated by hydraulically placed material based on work by Thevenot *et al.* 1992—add to ref. list. Reports on both modeling studies are located in Appendix F. Validation and calibration of the models and a discussion of the assumptions for each model are also included in these reports. Brief descriptions of each model utilized are provided in the following sections.

F.2.3.a FASTTABS. FASTTABS is the personal computer version of the main-frame based TABS-2 model (Thomas and McAnally 1985—add to ref. list) developed by ~~the~~ USACE. It was used to simulate existing depth-averaged tidal current velocities in and around Site 104. Predicted depth-averaged current velocities were used as inputs to the MD-FATE model that was used for development of a dredged material placement plan to be utilized in the WES modeling studies. The FASTTABS model encompasses an area of the Chesapeake Bay from the Susquehanna River and C&D Canal to near the southern tip of Calvert County in the south, and was refined in the area of Site 104 to provide greater detail. The model requires that the estuarial system be represented by a network of nodal points (i.e., points defined by coordinates in the horizontal plane and water depth) and elements (i.e., areas made up by connecting adjacent nodal points). The nodes were connected to form quadrilateral and triangular two-dimensional elements. The resulting nodal/element network is commonly called a finite element mesh and provides a computerized representation of the estuarial geometry and bathymetry. The site bathymetry modeled was provided by CENAB from a survey conducted in September 1997 (Appendix F.3;~~,~~ M&N 1998).

F.2.3.b CH3D-WES. The CH3D-WES (Curvilinear Hydrodynamics in Three Dimensions) model was developed jointly through funding by ~~the~~ USACE, EPA, and the State of Maryland, with oversight provided by the Chesapeake Bay Program. This model simulates the hydrodynamics, salinity, and temperature of the entire Chesapeake Bay system in three dimensions (WES 1998). The principal model extends from the mouth of the Chesapeake Bay in the south to the Susquehanna River and C&D Canal in the north. A version of this model was developed for simulations within the upper Bay to provide more detailed predictions within the upper Bay, including Site 104, with relatively short model run times. The boundary conditions of the upper Bay model were initially driven by the full-Bay model, but were then changed to utilize -data. Both models contain layers of cells that are ~~five~~ 5 ~~feet~~ thick, with the exception of the top layer, which varies with the tides.

The modeling study conducted for the proposed action used data collected during the year 1993 for specifying conditions at the model boundaries. The year 1993 was a high fresh-water flow year into the Bay, and it was deemed that modeling with these flows would provide a worst case for the project area hydrodynamics, resulting in a higher estimate of potential sediment losses, since higher flow rates generate higher forces that are able to dislodge more sediments from the estuary bottom than the forces produced by average flow conditions. During the period of time being simulated, the CH3D-WES model generated depth-averaged current velocities and bottom shear stresses. The bottom shear stresses ~~result in~~are due to forces along the bottom of the study area, resulting from the varying movement of water over the sediments, and control whether or not the sediments will move off of the bottom. These depth-averaged current velocities and the bottom shear stresses computed by CH3D-WES were applied in the MDFATE modeling. The CH3D model was rerun at the end of each simulated placement year to produce the new depth-averaged current velocities and bottom shear stresses based on the changed bathymetry produced by MDFATE from dredged material placement. Therefore, the results account for any changes in the area currents caused by decreased depths from dredged material placement in the previous model year (Appendix F.2;~~,~~ WES 1998).

F.2.3.c STFATE. The earliest version of the STFATE (Short Term FATE) model was developed by ~~the U.S. Environmental Protection Agency~~EPA (Koh and Chang~~,~~ 1973—add to ref. list) to predict the behavior of dredged material placement in open water. This model was later modified and refined by WES to predict the behavior of discrete discharges of dredged material from hoppers or barges. The model computes the fate of the placed material during its descent through the water column, its spread over the bottom, and finally the transport and diffusion of material remaining in suspension.

The STFATE model grid for Site 104 covered most of the site, with the exception of the shallow water areas to the north that are planned to receive very little dredged material. The model utilizes input data describing characteristics of the planned placement vessel (i.e., bottom-release scow or hopper dredge), dredged material being placed, and the placement site (Site 104). STFATE modeling for Site 104 computed the fate of dredged material placed with a bottom-release scow as the material falls through the water column and then impacts with the bottom. It also computed the movement of the suspended sediments stripped from the main mass during material descent until this stripped material reaches the site boundary~~;~~, and, therefore, predicting the quantity of material potentially leaving the site during this phase of placement.

The model output provided the following information: (1) the amount of placed dredged material that is stripped; (2) the potential horizontal movement of the material until it reaches the edge of the site boundary while in suspension; (3) the footprint on the Bay floor resulting from the material placed within the site; and (4) the dynamics when the material encounters the site bottom. This output was used in determining material placement set-backs (i.e., recesses) within the site boundaries in order to minimize the potential for material movement outside of the site. A limitation in the application of STFATE and in the model used to evaluate the spreading of hydraulically placed material is that both models assume that the bottom being impacted by the dredged material is essentially flat. To compensate for this limitation, the extent of material spreading on bottom slopes was evaluated using the SURGE model (Appendi~~x~~ces F.3 ~~&~~and F.2~~;~~; M&N 1998 and WES 1998).

F.2.3.d SURGE. SURGE modeling provided a basic analysis of the extent of material mass movement from the moment it impacts the site bottom until it comes to rest. The model was run for various slopes expected to be found at Site 104. SURGE uses output from the STFATE model including the velocity and diameter of the material cloud just before impact and a description of the bottom slopes expected to be encountered during placement. The energy stored (potential energy) in the falling cloud is converted to active energy (kinetic energy) by the SURGE model to establish the extent of potential material mass movement along the bottom slope (Appendi~~x~~ces F.3 ~~&~~and F.2~~;~~; M&N 1998 and WES 1998). These results can also be used for determining set-backs from the site boundaries for material placement that will minimize the amount of placed material leaving Site 104.

F.2.3.e MDFATE and LTFATE. The MDFATE (Multiple Dump FATE) and LTFATE (Long Term FATE) models were used to evaluate the extent of long-term movement of dredged material that has been placed on the bottom when subjected to the forces produced by the CH3D model described earlier. A version of STFATE is a component of MDFATE which models the descent and spreading of each placement load. The MDFATE/LTFATE evaluation considers potential erosion of material after it has settled to the bottom and remained in place for a relatively long period of time, which is specific to the simulation being performed. This period of time ~~and~~ can range from hours to years after the initial placement of material. For the Site 104 study, a period of one calendar year from 1 November to 31 October was used for each material placement year evaluated, since at the time the modeling was being performed, it was thought that the placement window would begin with 1 November. Multiple placement plans were assessed to devise an optimal placement location and timing sequence to minimize material losses during the simulated placement of dredged materials at Site 104 over a ~~five~~5-year period. This optimal placement plan was then input to the model. Physical characteristics of the dredged material proposed for placement at Site 104 were determined through laboratory analyses and were also used as input in the model. During the model runs, only the material that was being placed for the year was evaluated. Thus, the model scenario was set up so that existing sediment as well as the previous year's material could not erode, since material that remains at the site longer than one year would be minimally susceptible to erosion compared to the year being evaluated. The object of the modeling was to determine the lost quantities of the material placed during the modeled year. This was done by assessing the model output of the mass remaining on the site bottom following the model run and comparing it with the mass of dredged material placed at the beginning of that modeled year (Appendices F.4 ~~&~~and F.3~~,~~; M&N 1998 and WES 1998).

F.2.3.f CEQAL-ICM. CEQUAL-ICM (Corps of Engineers Quality—Integrated Compartment Model) is a three-dimensional model of the entire Bay developed (Cerco and Cole 1994—add to ref. list) to be used in conjunction with the CH3D-WES hydrodynamics model to evaluate water quality and compute the fate of water quality constituents. CH3D-WES provides 3-D velocities and diffusion coefficients to CEQUAL-ICM that contains a database of sediment characteristics measured throughout the Bay. Since no model has been developed to track sediment transport throughout the Chesapeake Bay, CEQUAL-ICM was used to track a tracer concentration released in the bottom model cell which covers Site 104 and to provide an indication of where in the Bay the fraction of suspended sediment leaving Site 104 that remains in the water column over multiple tide cycles may end up. It must be noted, however, that this model does not simulate the true physical behavior of sediments and cannot therefore provide information on the final destination of the sediments that might leave Site 104. These computations primarily provided insight into the effect of bottom residual currents near Site 104 (Appendix F.2~~,~~; WES 1998).

The formation of a footprint of material resulting from hydraulic placement of dredged material at Site 104 was computed based upon the USACE ~~&~~and U.S. EPA (1992) approach. For the simulations run for the Site 104 study, it was assumed that the estuary bottom was horizontal, the viscosity (or thickness of the slurried material) was constant, the overlying flow exerted negligible shear stress on the underflow, and the spreading of the placed material was radially-outward around the discharge end of the pipe. The assumptions chosen were those that fit the conditions most likely to be encountered during this type of placement at Site 104. The model assumptions simulated the hydraulic unloading of an individual barge holding 2,755 m^3 (3,600 cy) of dredged material that was pumped out through a pipeline and diffuser and placed within 2 ~~meters~~ (6.6 ~~feet~~) of the site bottom. These assumptions were used because they minimized water column losses (Appendi~~x~~ces F.3 and F.2~~,~~; M&N 1998 and WES 1998). Hydraulic placement, with the discharge pipe positioned just under the water surface, would maximize material exposure to the currents in the -14 to -24 ~~meter~~ (-45' to -78 ~~feet~~) water column, and would result in a larger bottom footprint, with more erosion than mechanical placement. The characteristics of the dredged material being placed were based on laboratory analyses of the channel sediments proposed for placement. The output of the computation is a footprint of placed material providing its predicted radius and thickness. The resulting material footprint data were input into a modified version of the MDFATE model by WES to determine the potential for erosion. The results of the models are discussed in the following ~~sub~~sections.

F.2.4 Model Results

~~6.1.3.d~~F.2.4.a Average Water Depths. Average water depths at Site 104 will be directly impacted by the proposed action since placement of dredged materials would cause the depths to become shallower. Existing water depths at Site 104 range from –12.8 to –23.8 m~~eters~~ (-42.0 to -78.0 f~~eet~~) MLLW. Proposed placement of dredged material at Site 104 would reduce the water depths from a maximum of –23.8 m~~eters~~ (-78.0 f~~eet~~) MLLW to a current design depth of –13.7 m~~eters~~ (-45.0 f~~eet~~) MLLW. Areas where water depths are currently at or shallower than –13.7 m~~eters~~ (-45.0 ft) MLLW are not targeted for material placement. A minimum depth of -12.2 m~~eters~~ (-40.0 f~~eet~~) MLLW should be maintained throughout the Site 104 area to promote navigational access to the Swan Point Channel.

The most recent bathymetric surveys performed by CENAB in 1997 indicate that the bottom depths at the proposed placement Site 104 range between -12.8 m~~eters~~ (-42 f~~eet~~) MLLW and -23.8 m~~eters~~ (-78 f~~eet~~) MLLW. Although dredged material was placed at the site for ~~over~~more than 50 years, the material was not consistently placed to a particular depth at all locations to achieve a consistent bottom contour. The proposed action would raise the deeper areas within the site to -13.7 m~~eters~~ (-45 f~~eet~~) MLLW and will not affect the areas that are shallower than -13.7 m~~eters~~
(-45 f~~eet~~) MLLW. Bathymetric studies would be required before, during, and after placement to ensure that the placement is limited to approved depths. The proposed action at Site 104 is not expected to significantly affect the surrounding bathymetry outside of the site.

The modeling of hydraulic placement (hydraulic unloading of individual barges by pump-out through a pipeline and diffuser to locations within 2 m~~eters~~ ~~(~~[6.6 f~~eet)~~] of the site bottom) of 3,600 cy of dredged material from one barge resulted in a footprint with a thickness of 7.8 cm (3.1 in.) and a radius of 129 m~~eters~~ (423 f~~eet~~). This footprint was used in the MDFATE modeling for each hydraulic placement event and resulted in changes in bathymetry similar to the stacking of disks or pancakes. Although this does not accurately represent what is expected to occur under actual conditions, it was the closest representation that could be modeled. The modeled footprint of material placed by bottom-release scow varies with each placement and depends on the depth of the water column through which the material is placed and the ambient current at the time of placement. In both placement scenarios, the cumulative height of mounded material above the surrounding bathymetry was attempted to be kept below 3.1 to 4.6 m (10 to 15 ft) and the exposed surface area of newly placed material minimized. This was done in an attempt to minimize material exposure to erosive forces and thus minimize material erosion.

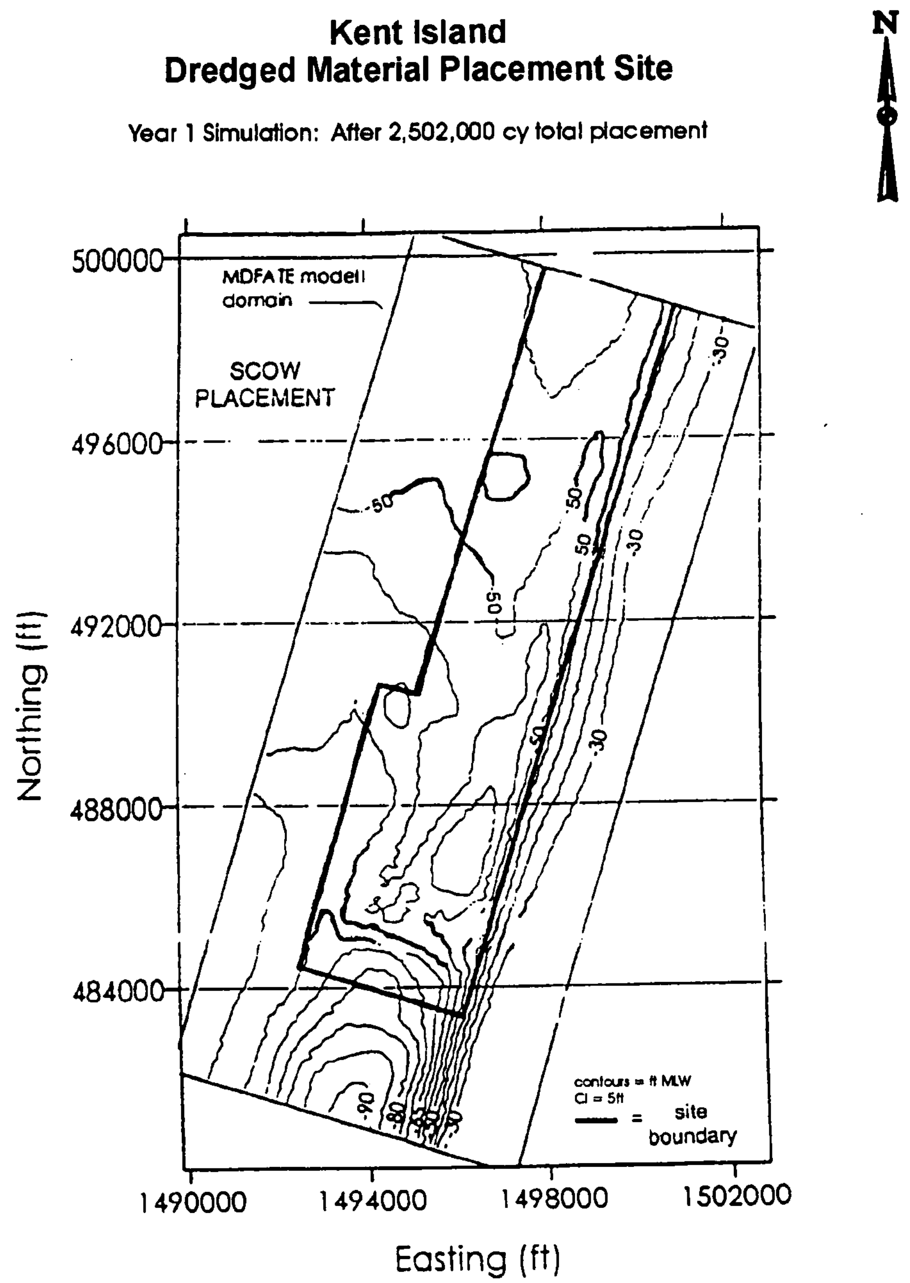
Changes to water depths within the site would vary from year to year. The water depth changes will depend upon the quantities and locations of material placed in any one year, and the equipment and methods used for placement (i.e., bottom hydraulic placement vs. bottom-release scow or hopper dredge placement). The proposed action would raise the deeper areas within the site to -13.7 m~~eters~~ (-45 f~~ee~~t) MLLW and will not affect the areas that are shallower than -13.7 m~~eters~~ (-45 f~~ee~~t) MLLW. Figures ~~6-1~~F-12 through ~~6-5~~F-16 and Figures ~~6-6~~F-17 through ~~6-10~~F-21 show predicted cumulative changes to the bathymetry following each year of placement resulting from the MDFATE modeling for both bottom-release scow and hydraulic bottom placement, respectively. At the end of the fifth year, slopes range from basically flat throughout the majority of the site with steep slopes between 20:1 and 35:1 at the southern portion of the western boundary and at the southern boundary, where material accumulation above the existing depths is greatest. The steeper slopes would be formed in an attempt to maximize the capacity of the site.

–The same placement plan was used for each of the modeled placement scenarios discussed above and allowed for a 152.4- m~~eters~~ (500- f~~ee~~t) buffer along the site perimeter. The placement plan for the modeling was developed to place an estimated 13.8 million m^3 (18 mcy) of dredged material at Site 104. The bathymetry at the end of the fifth year of placement is shown in Figures ~~6-5~~F-16 and ~~6-10~~F-21. However, these average water depths will increase over time due to consolidation of the placed material. This consolidation will occur due to the overlying weight of the newly placed dredged material. It is anticipated that areas where 9.1 m~~eters~~ (30.0 f~~ee~~t) of dredged material are placed will consolidate by up to 1.1 m~~eters~~ (3.5 f~~ee~~t). In areas with less placed material, less consolidation should be seen. Fifty percent of the consolidation has been calculated to occur within the first ~~eight~~ 8 years following placement. The remaining consolidation should occur more gradually over the next three to four decades (E2Si 1998).

~~6.1.3.e~~F.2.4.b Water Levels. Placement of dredged material at Site 104 would not affect extreme high water levels resulting from storm tides that are predominantly driven by wind forces and atmospheric pressure forces. Long-term sea level rise will cause higher average water levels. However, long-term sea level rise is a small percentage (less than ~~one percent~~1%) of the existing normal water level variations as discussed in Section ~~5.1.3.e~~F.1.3, and it is not anticipated to be affected by the proposed action.

~~6.1.3.f~~F.2.4.c Astronomical Tides. Astronomical tides in the Chesapeake Bay and the Site 104 area also would ~~also~~ not be impacted by the proposed action. Astronomical tides result from gravitational forces of the moon and the sun on the earth and from the earth's rotation, and are influenced, in part, by the three-dimensional shape of the estuary. Decreasing the water depth at Site 104 would not affect the magnitude of tidal height at Site 104.

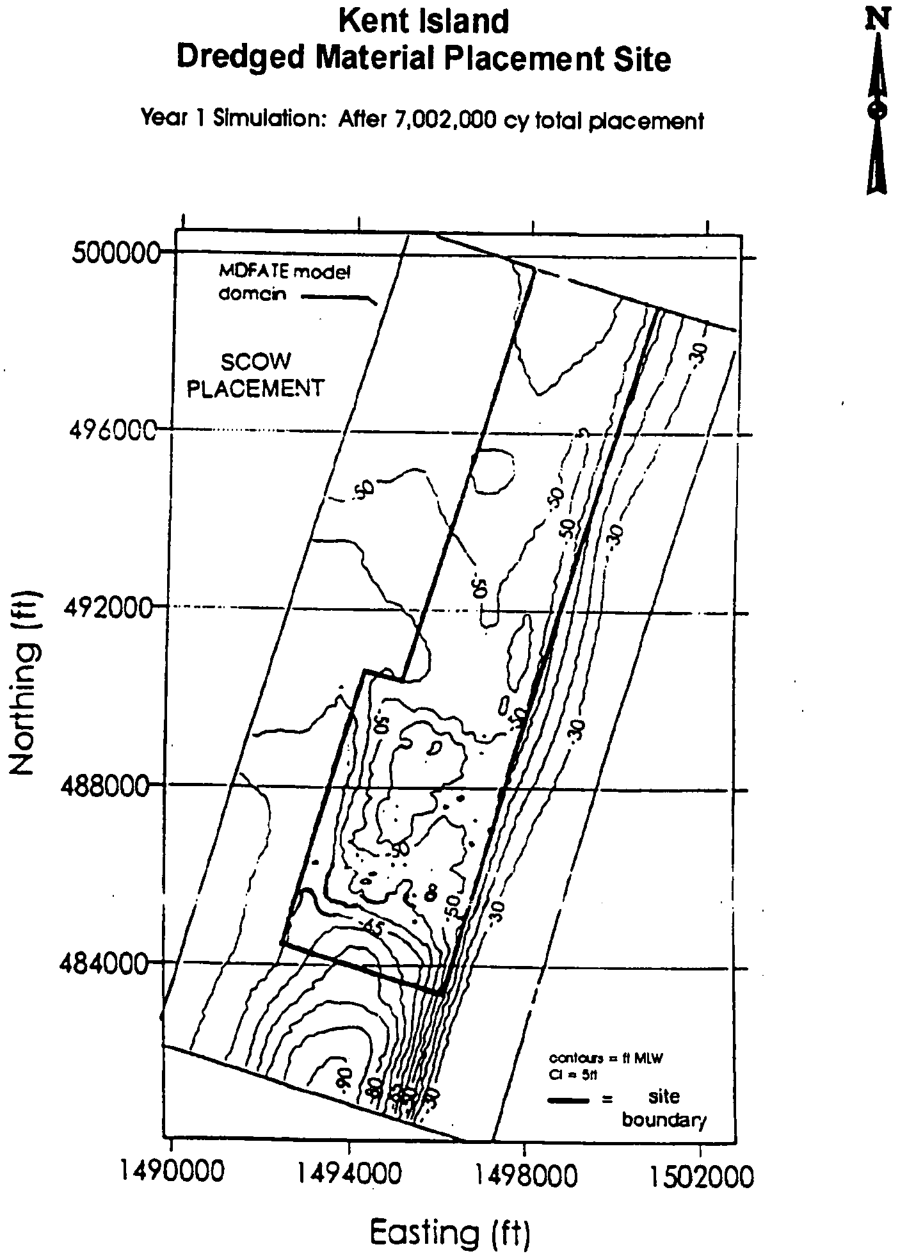
~~6.1.3.g~~F.2.4.d Extreme Water Levels (Storm Surge and Wave Setup). Extreme water levels would not be impacted by the proposed action as they are dominated by storm effects (i.e., storm surge and wave setup) in combination with astronomical tide. Storm surge is a temporary rise in water level from wind stress generated either by large-scale extra-tropical storms known as nor'~~th~~easters, or by hurricanes. The rise in water level results from wind action, the low pressure of the storm disturbance, and the Coriolis force. Wave setup is a term used to describe the rise in water level due to wave breaking. Specifically, change in momentum that attends the breaking of waves propagating toward shore results in a surf zone force that raises water levels at the shoreline. Decreasing the water depth at Site 104 has no effect on these forces, and the area of Site 104 where the estuary bottom will be raised is a small percentage of the entire upper Bay. The storm surge at the site itself will not be higher due to the decrease in water depth.



	SITE 104 OPEN WATER PLACEMENT AREA EIS REPORT	Figure F-12. Bathymetry at end of first year bottom-release scow placement

Kent Island
Dredged Material Placement Site

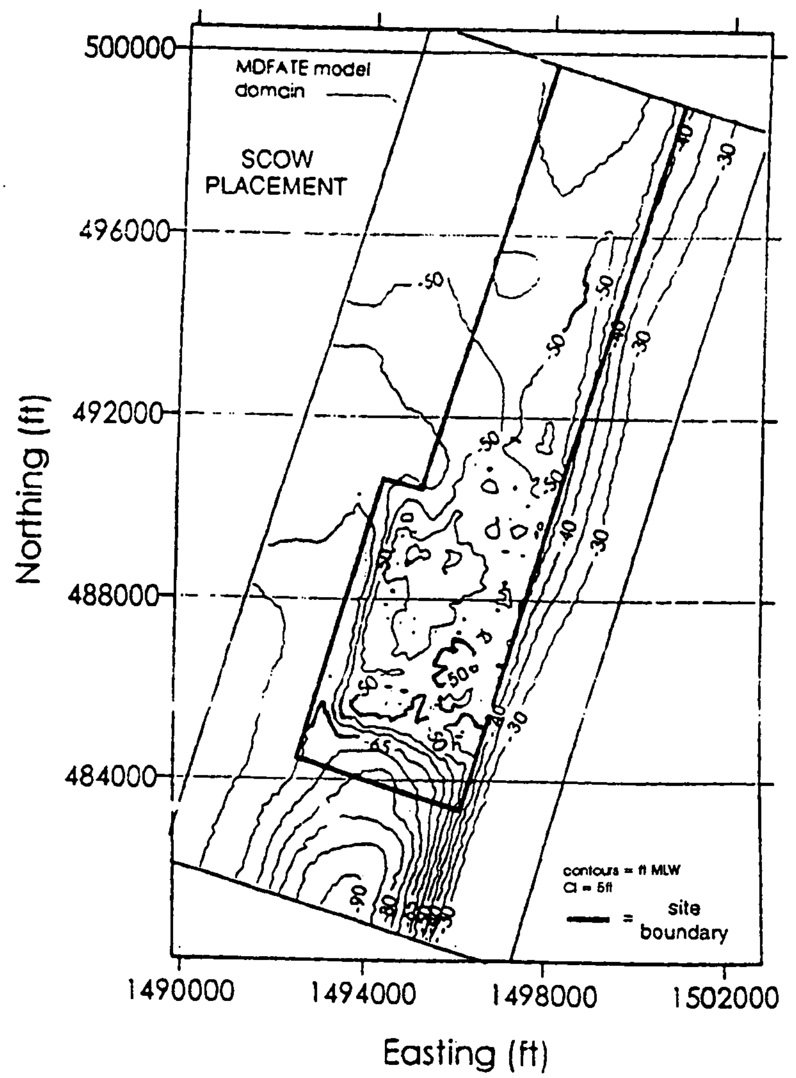
Year 1 Simulation: After 7,002,000 cy total placement



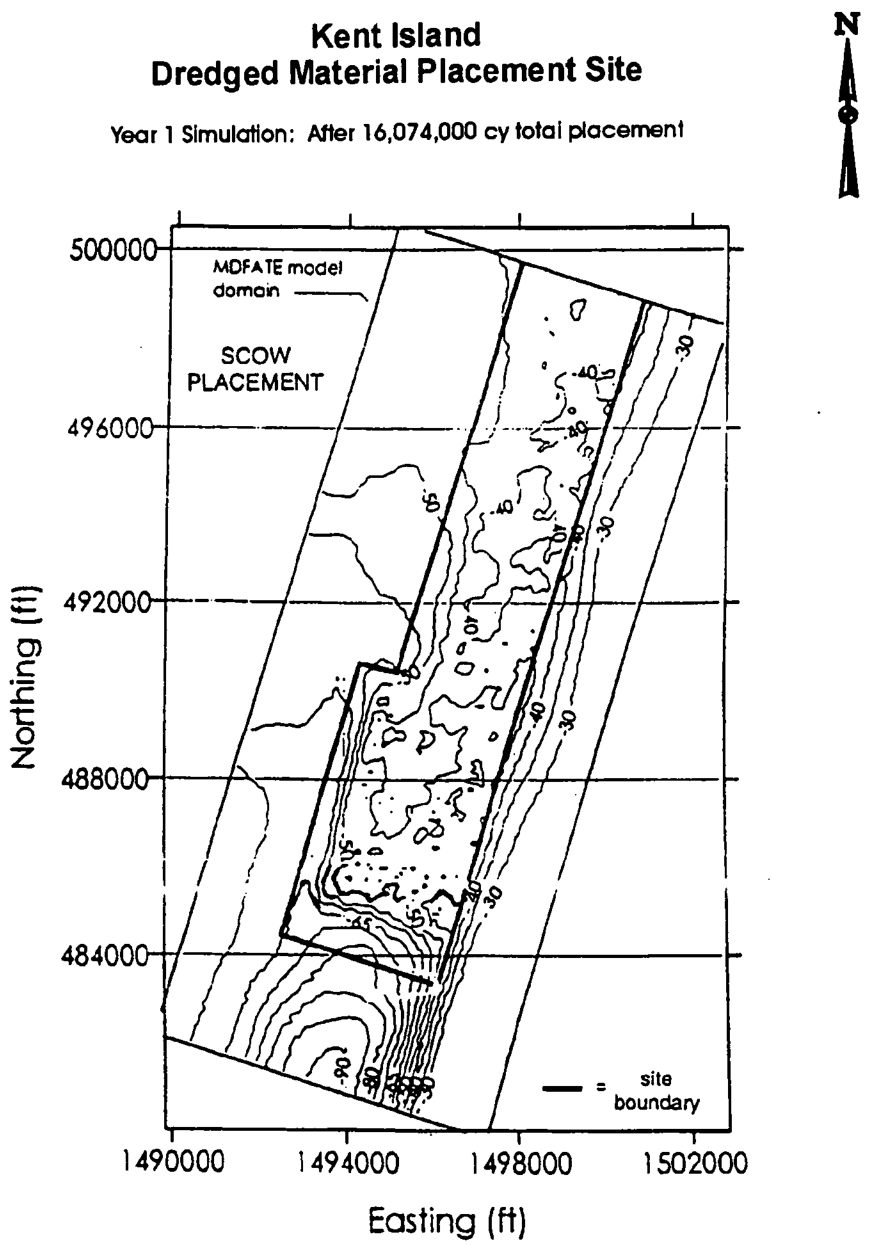
SITE 104 OPEN WATER PLACEMENT AREA EIS REPORT	Figure F-13. Bathymetry at end of second year bottom-release scow placement

Kent Island
Dredged Material Placement Site

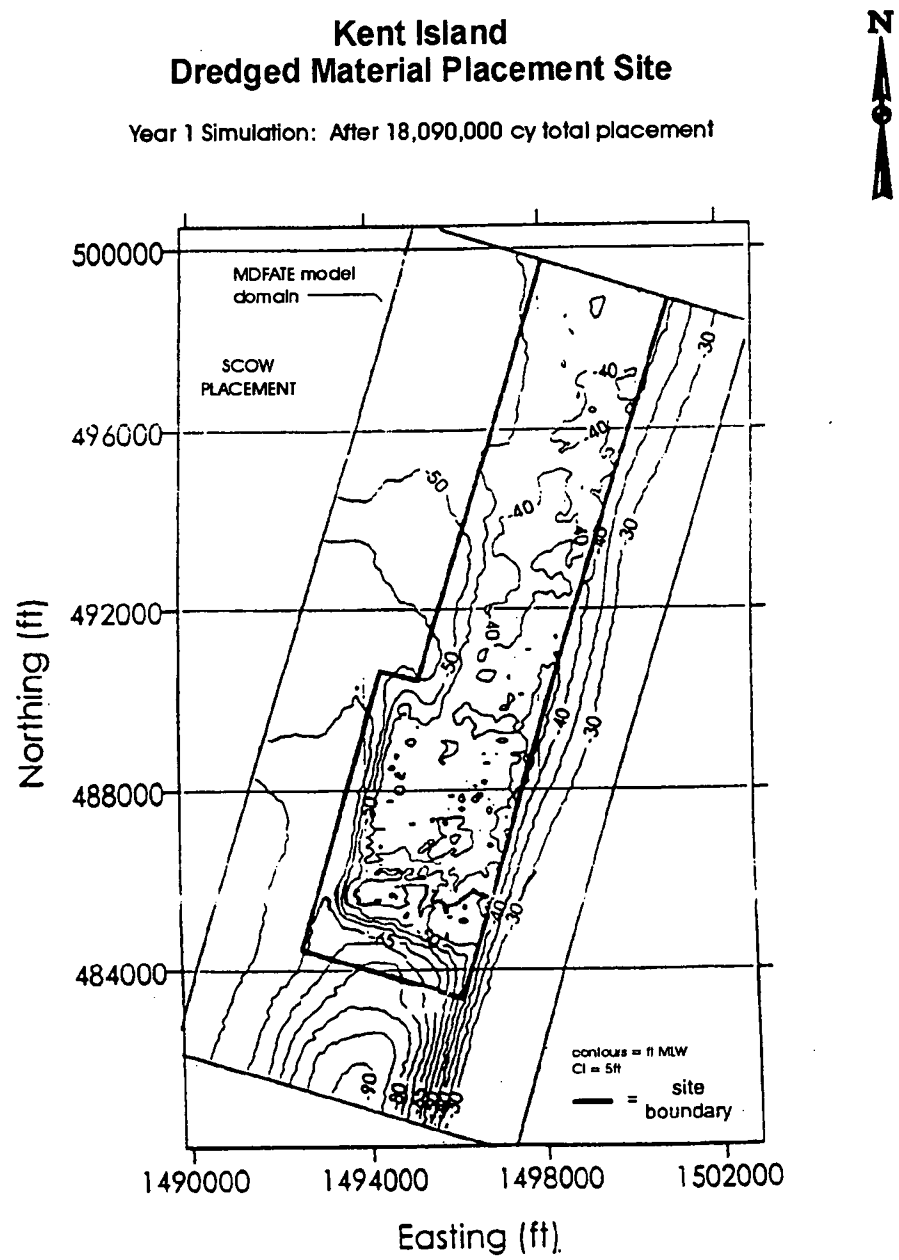
Year 1 Simulation: After 10,026,000 cy total placement



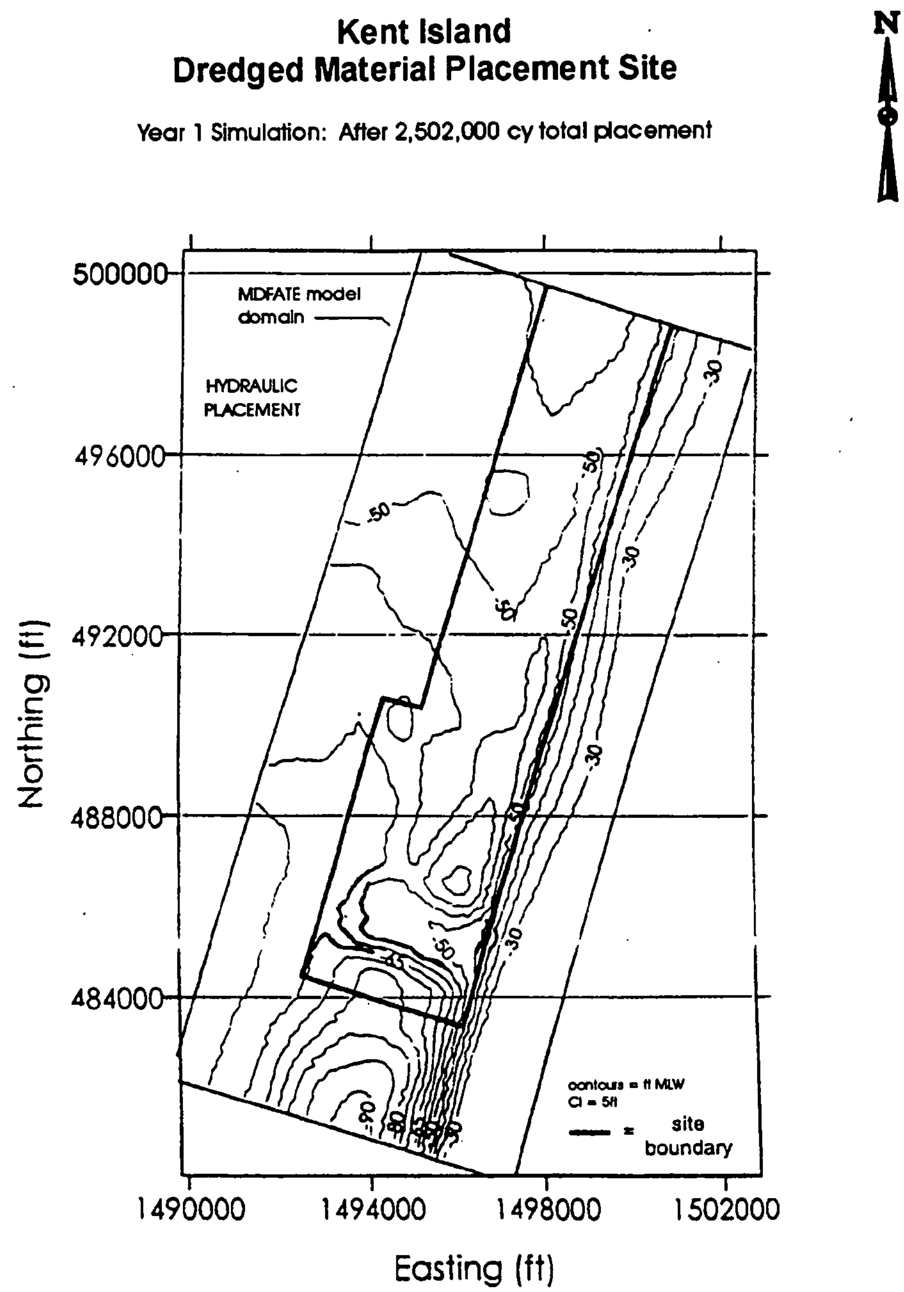
	SITE 104 OPEN WATER PLACEMENT AREA EIS REPORT	**Figure F-14. Bathymetry at end of third year bottom-release scow placement**



	SITE 104 OPEN WATER PLACEMENT AREA EIS REPORT	Figure F-15. Bathymetry at end of fourth year bottom-release scow placement



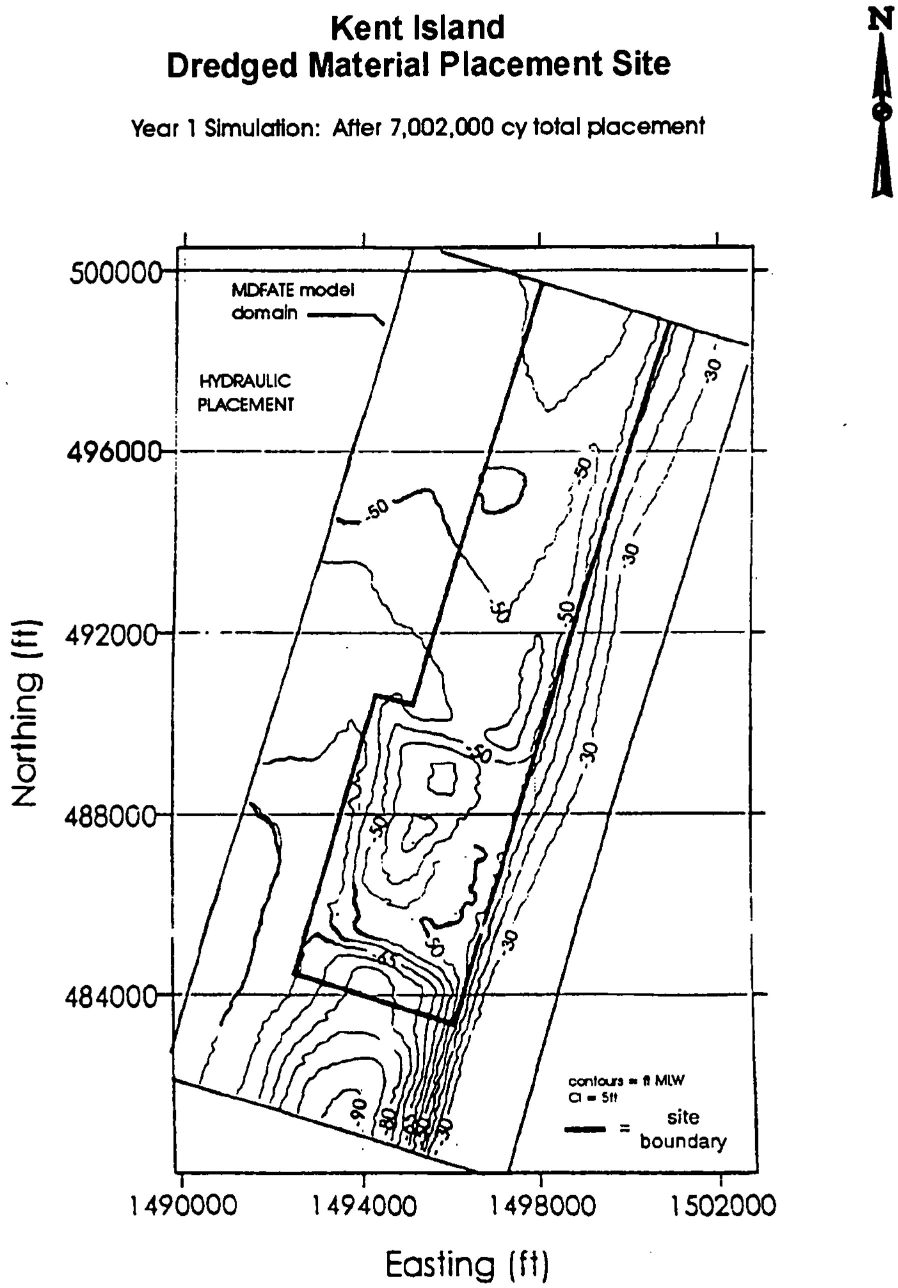
	SITE 104 OPEN WATER PLACEMENT AREA EIS REPORT	**Figure F-16. Bathymetry at end of fifth year bottom-release scow placement**



SITE 104 OPEN WATER PLACEMENT AREA EIS REPORT	Figure F-17. Bathymetry at end of first year hydraulic (controlled bottom pipeline) placement

Kent Island
Dredged Material Placement Site

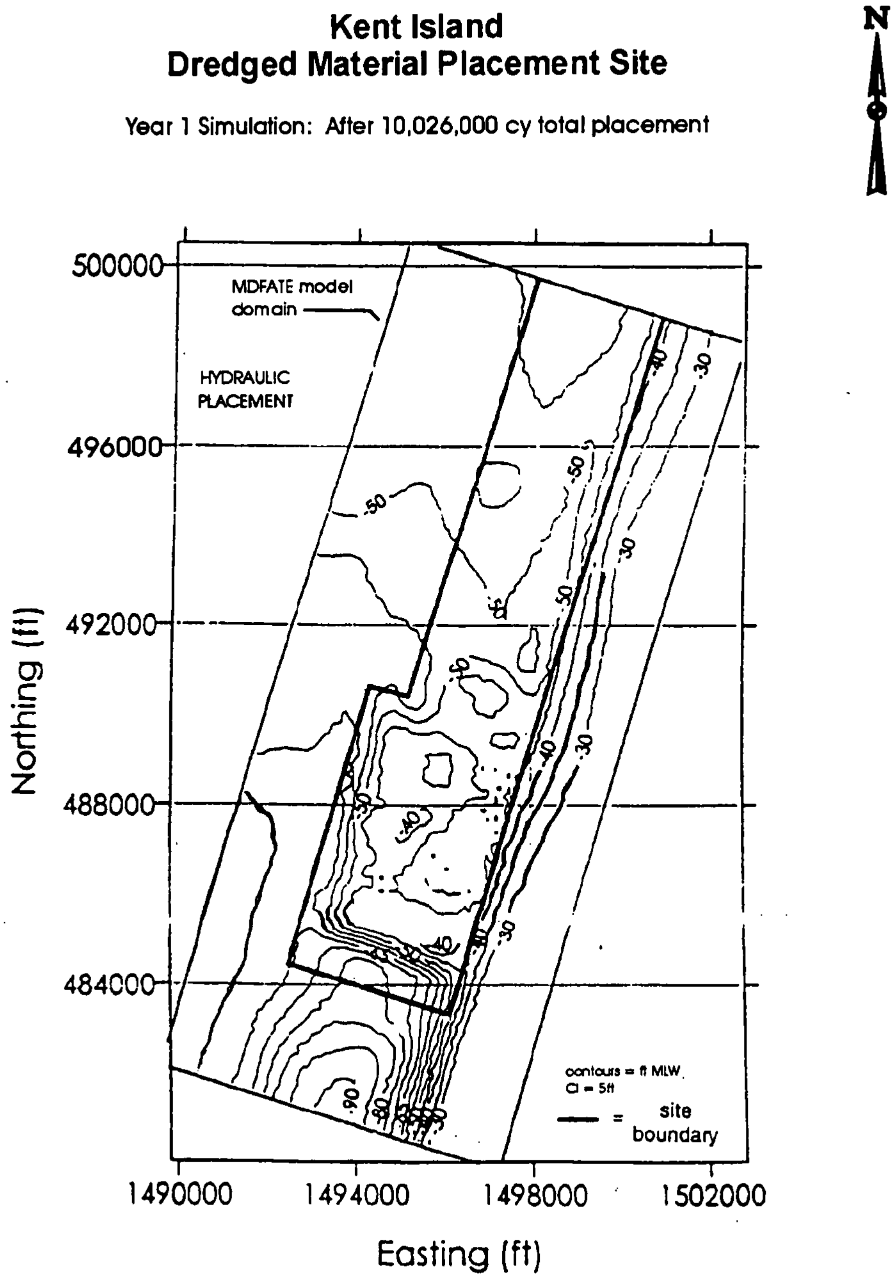
Year 1 Simulation: After 7,002,000 cy total placement



	SITE 104 OPEN WATER PLACEMENT AREA EIS REPORT	Figure F-18. Bathymetry at end of second year hydraulic (controlled bottom pipeline) placement

Kent Island
Dredged Material Placement Site

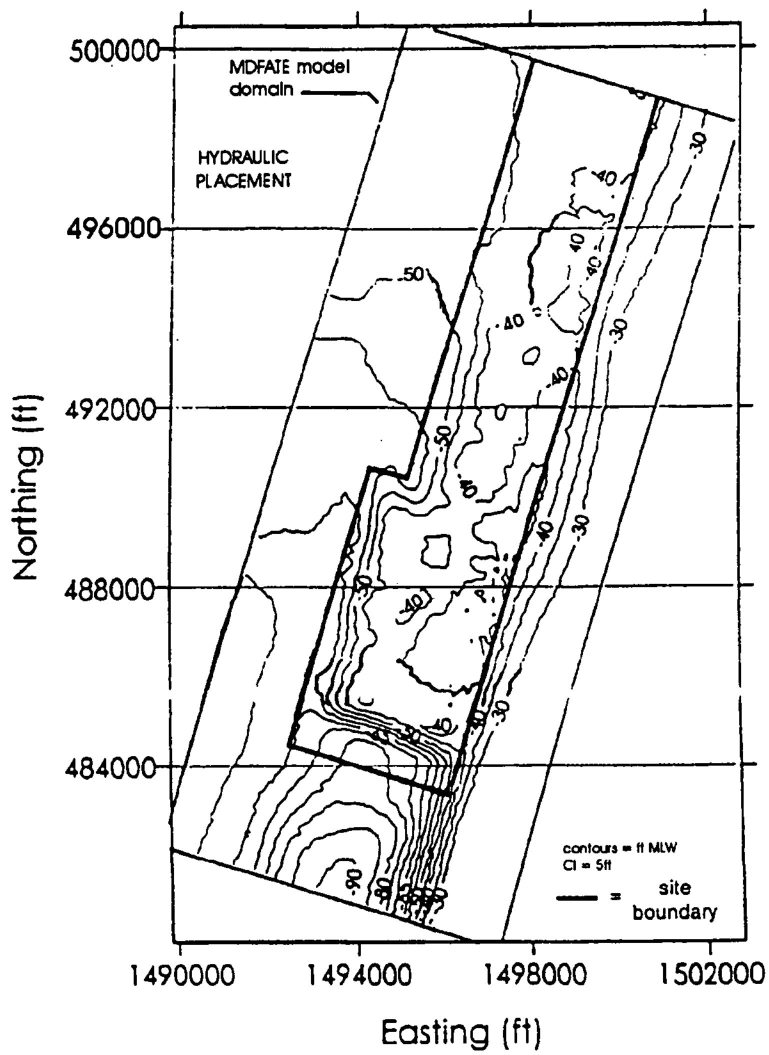
Year 1 Simulation: After 10,026,000 cy total placement



	SITE 104 OPEN WATER PLACEMENT AREA EIS REPORT	Figure F-19. Bathymetry at end of third year hydraulic (controlled bottom pipeline) placement

Kent Island
Dredged Material Placement Site

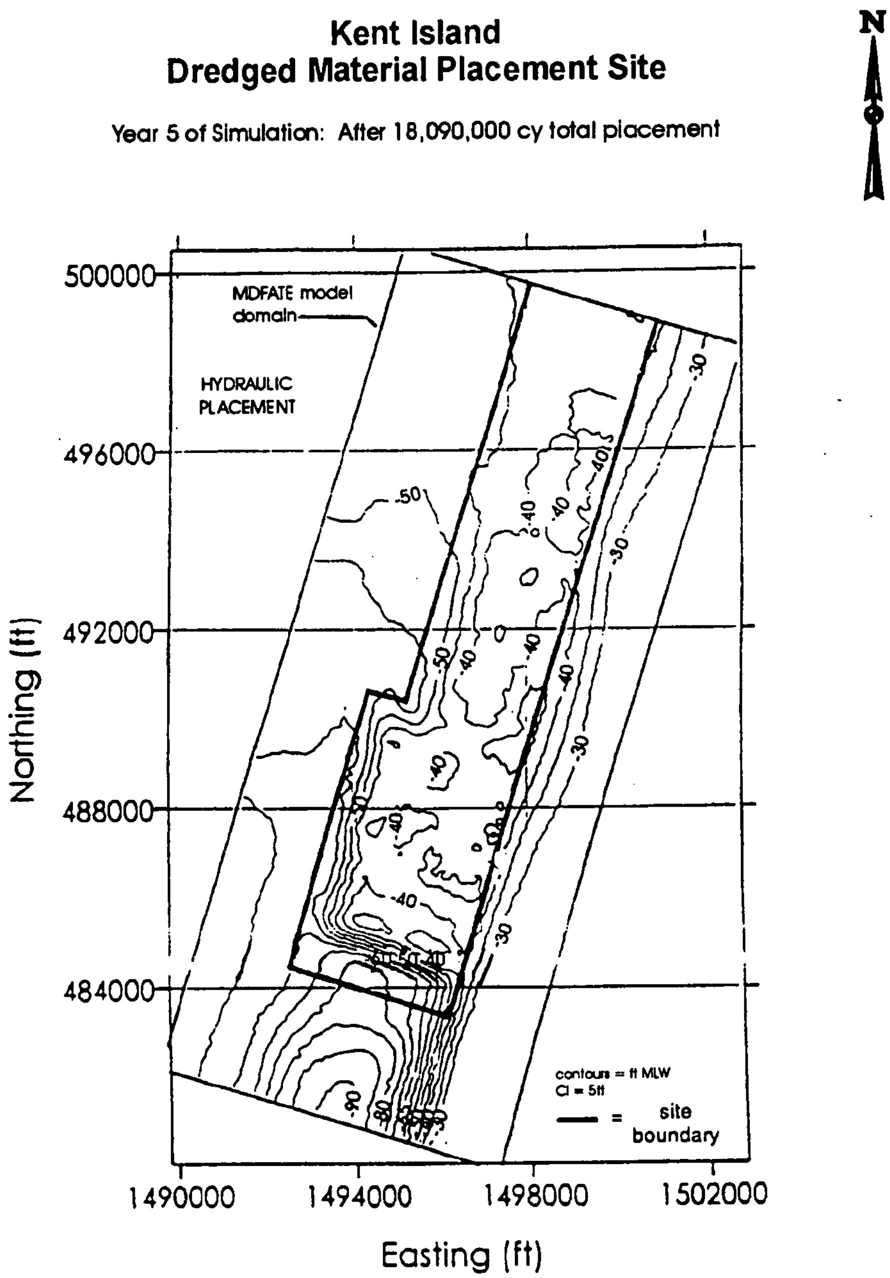
Year 4 of Simulation: After 16,074,000 cy total placement



	SITE 104 OPEN WATER PLACEMENT AREA EIS REPORT	Figure F-20. Bathymetry at end of fourth year hydraulic (controlled bottom pipeline) placement

Kent Island
Dredged Material Placement Site

Year 5 of Simulation: After 18,090,000 cy total placement



	SITE 104 OPEN WATER PLACEMENT AREA EIS REPORT	Figure F-21. Bathymetry at end of fifth year hydraulic (controlled bottom pipeline) placement

Storm surge would indirectly affect the changed conditions at Site 104 as a factor in the development of extreme wave conditions: higher storm surge would allow for higher waves, longer wave periods, and longer wavelengths. For a given water depth, the longer the wavelength, the greater the erosional effect of the wave energy on the bottom. Based on the LTFATE modeling conducted, a 25-year storm event would not effect the bottom below –13.7 m~~eters~~ (-45.0 f~~ee~~t), which is the current design elevation to which dredged material is proposed to be placed at Site 104. Storms greater than 25-year events would increasingly affect the bottom. For storms greater than a 25-year event, significant erosion and turbidity will occur in shallow waters east and north of the site, before Site 104 is affected. The 100-year storm event modeled using LTFATE predicts about 0.3 m~~eters~~ (1.0 f~~ee~~t) erosion for a bottom at elevation –13.7 m~~eters~~ (-45.0 f~~ee~~t) (M~~offatt & Nichol~~ 1998). Similar erosion rates for these storm events would be expected for the same type of sediments found at depths of -13.7 m~~eters~~ (-45.0 f~~ee~~t) in the areas of the Bay- in the vicinity of Site 104. Due to placement activities, the Site 104 area would be more susceptible to erosion from storm events occurring less frequently than the 25-year storm.

~~6.1.3.h~~F.2.4.e Wind Conditions. Wind conditions on the earth are ultimately caused by energy from the sun and rotation of the planet. Subsurface placement of dredged material at Site 104 would have no effect on wind conditions. Wind would have an effect only on the surface of the water where waves would be generated. Section ~~6.1.3.k~~F.2.4.h (Wave Conditions) discusses the potential impacts on wave conditions caused by wind, whereas Section ~~6.1.3.g~~F.2.4.d (Extreme Water Levels) discusse~~d~~s the effects of extreme wind/wave conditions.

~~6.1.3.i~~F.2.4.f Tidal Currents. Placement of dredged material at Site 104 and subsequent decrease in water depth would theoretically cause a slight increase in tidal current velocity directly proportional to the decrease in water depth. Hydrodynamic model results indicated a slight increase for some depth-averaged velocity points as material was placed at the site~~,~~; however, the magnitude of this change from year to year was negligible (see Figures ~~6-11~~F-22 through ~~6-15~~F-26). Changes measured in the model are practically imperceptible (from ~~zero~~ 0 to a maximum ~~of two percent~~2% increase in velocity from year to year) for the three observation points within the Site 104 project area (i.e., different elevations in the water column; one near the southern end of the site, one near the center of the site, and one further to the north of the site) (Appendix F.3).

Note that although the boundary forcings from the 1993 data remain the same for each simulated year, the CH3D-WES model was rerun after each year of proposed placement using the changed bathymetry from the previous placement year (See Figures ~~6-1~~F-12 to ~~6-10~~F-21). The reruns resulted in changes to bottom shear stresses that were input to the subsequent years of -MDFATE modeling. Therefore, any minor changes in currents that were predicted to occur due to the decreased depths associated with dredged material placement~~,~~ were taken into consideration during the erosion modeling.

Residual currents in the upper Bay would not be appreciably impacted with placement of material at the site. Existing residual current flow is toward the north. The tracer concentration studies show that the long-term movement of water over the site bottom is to the north due to

SITE 104 OPEN WATER
PLACEMENT AREA
EIS REPORT

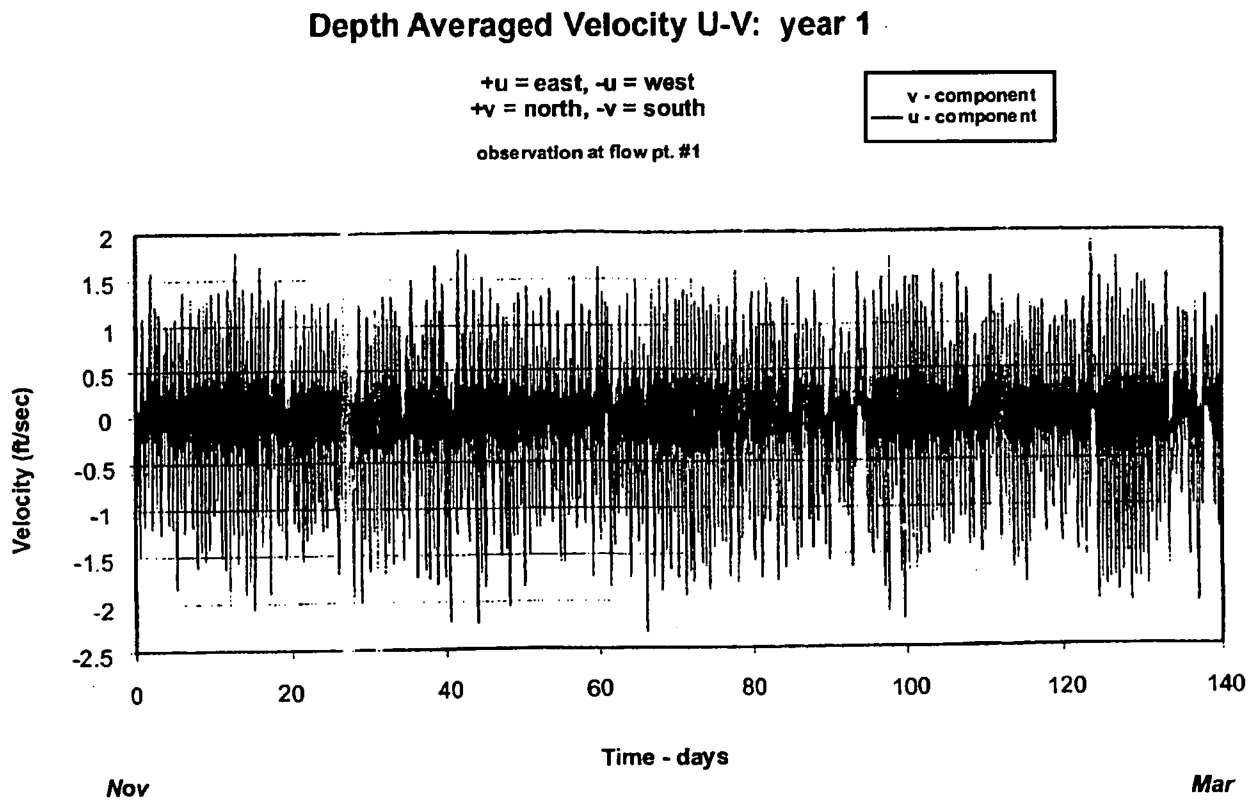
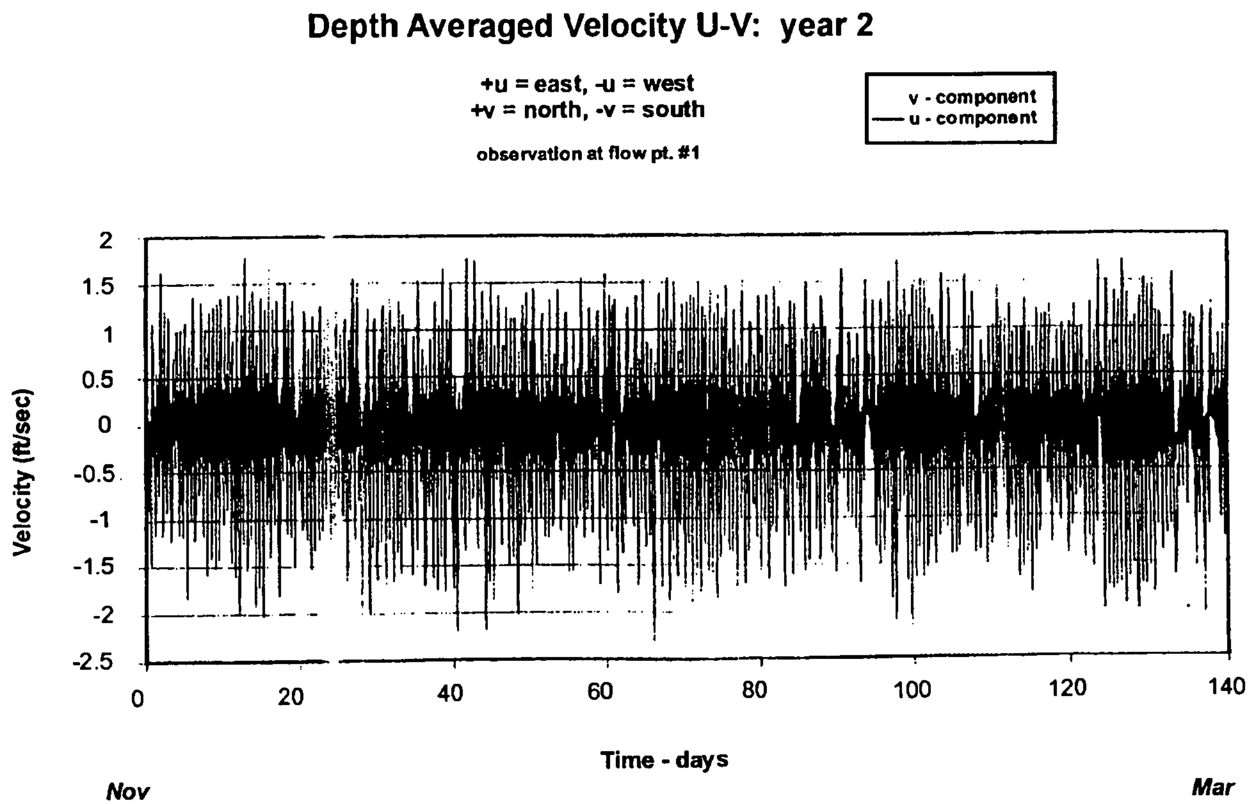


Figure F-22.
Current Velocity at End
of First Year



SITE 104 OPEN WATER PLACEMENT AREA EIS REPORT

Figure F-23. Current Velocity at End of Second Year

SITE 104 OPEN WATER PLACEMENT AREA EIS REPORT

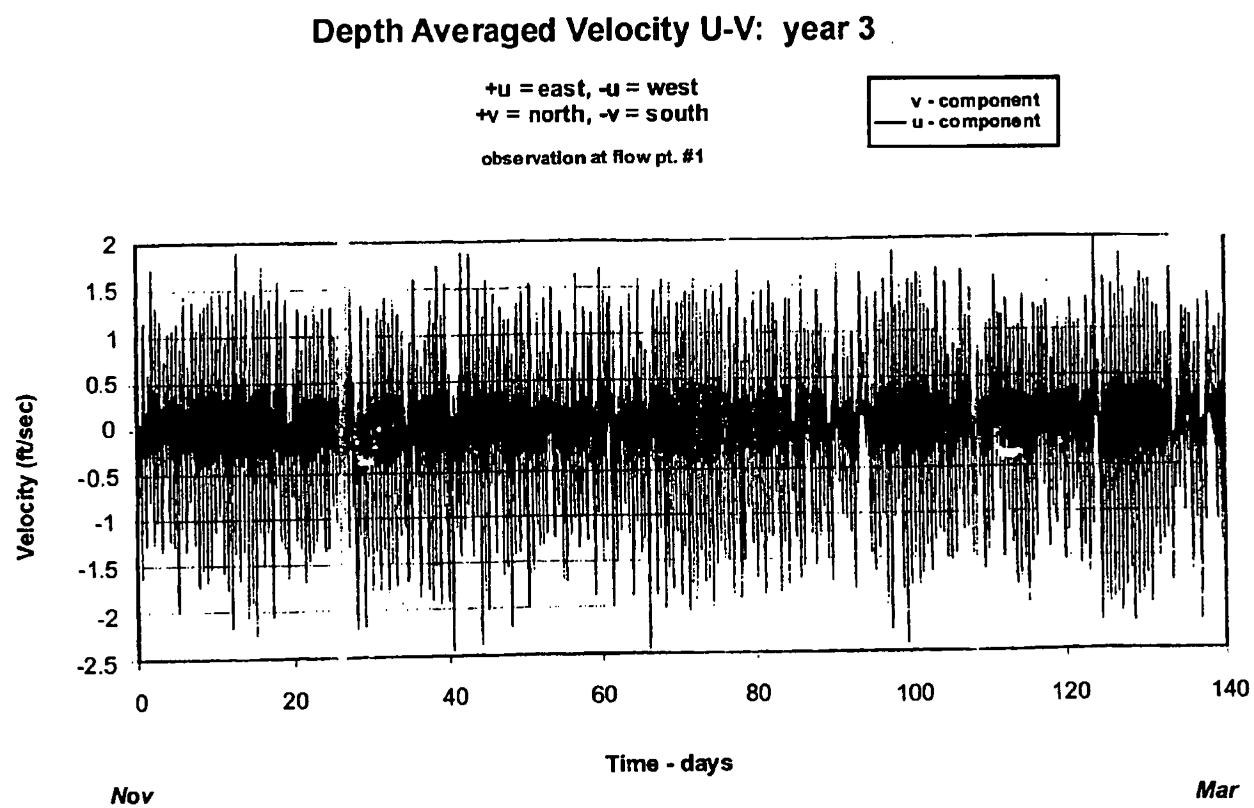


Figure F-24. Current Velocity at End of Third Year

SITE 104 OPEN WATER PLACEMENT AREA EIS REPORT

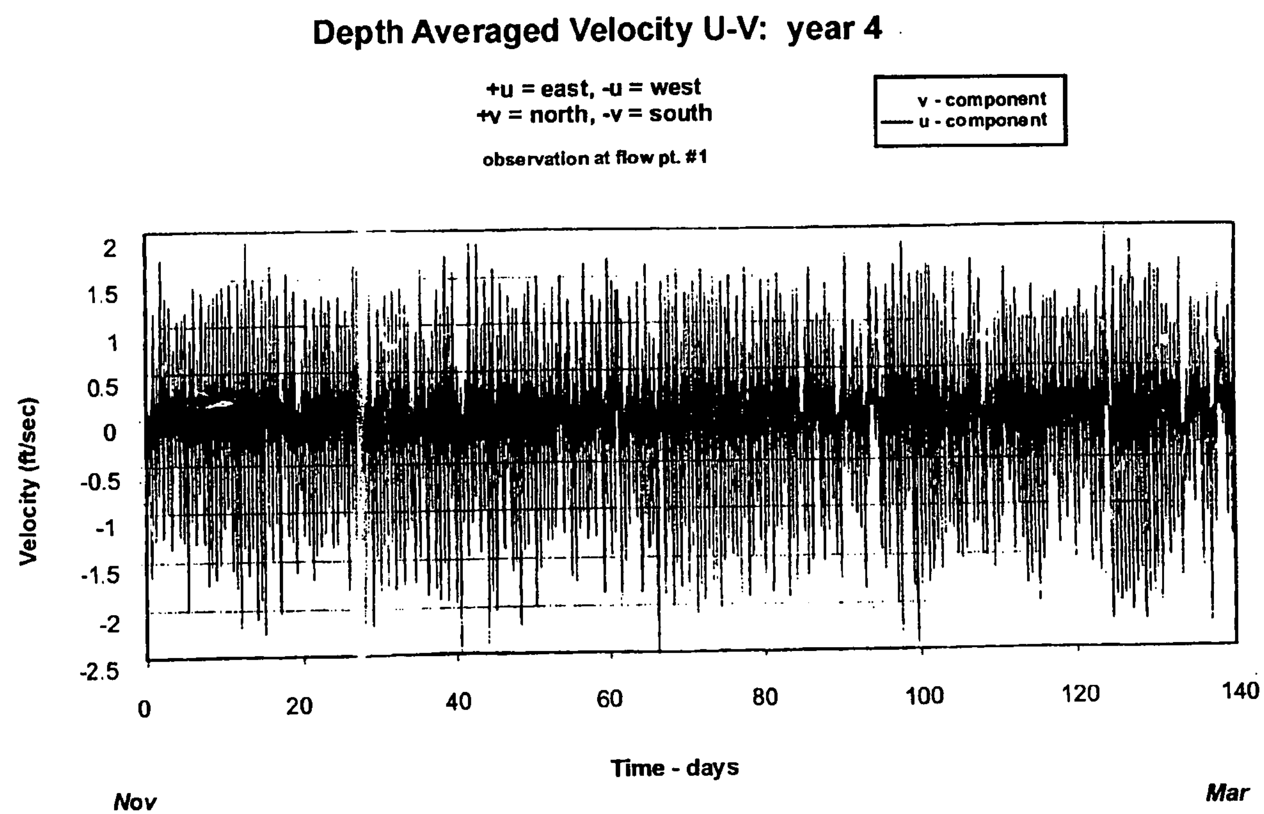
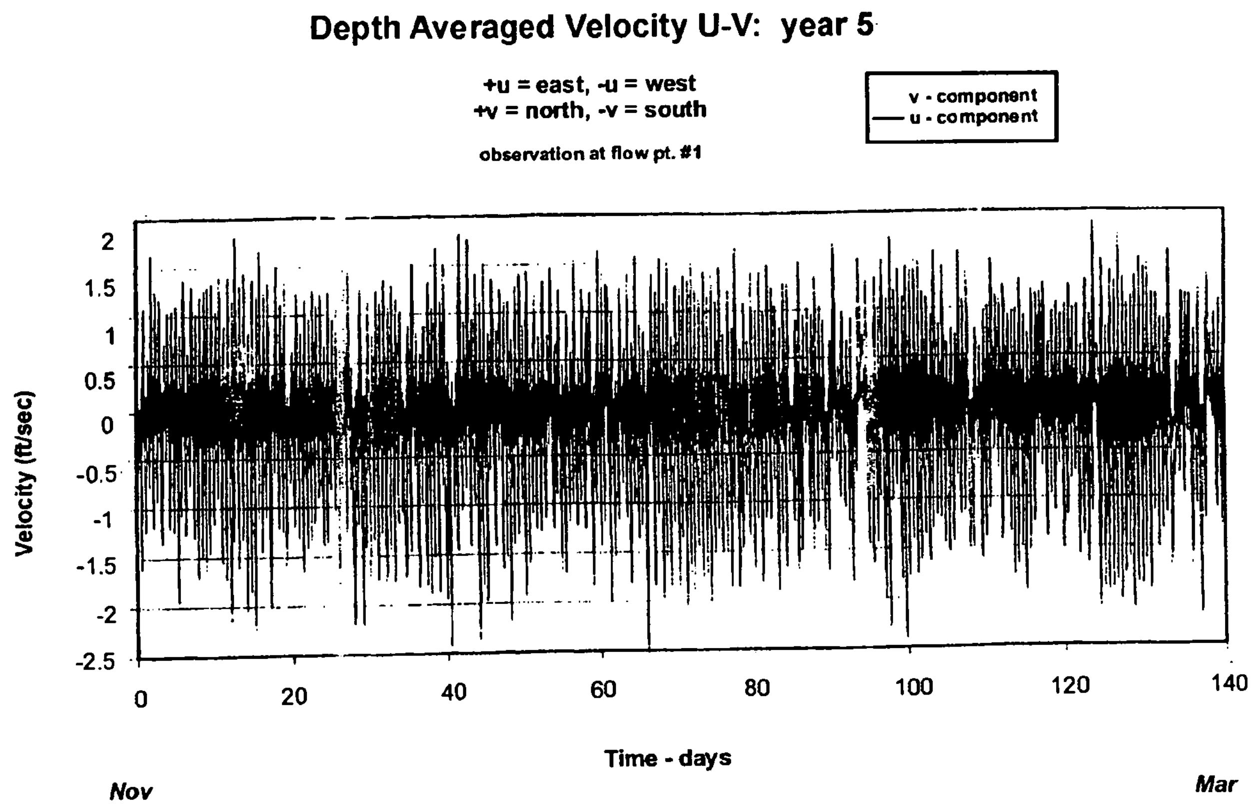


Figure F-25. Current Velocity at End of Fourth Year



SITE 104 OPEN WATER PLACEMENT AREA EIS REPORT

Figure F-26. Current Velocity at End of Fifth Year gravitational circulation (WES 1998). Therefore, if material or nutrients remain in suspension for long periods of time, it is likely that some of the material or nutrients carried through the southern boundary of the site during an ebb flow could be carried back into the site during the subsequent flood cycle, with the net drift being to the north.

~~6.1.3.j~~F.2.4.g Sedimentation. Sedimentation rates are controlled by the physical characteristics of the sediments and the hydrodynamics of the area. _The hydrodynamic modeling revealed that variations in depth-averaged current velocities through the site area would change as little as ~~zero~~ 0 to ~~two percent~~2% and would not change significantly (WES 1998). -Based on these results, it is anticipated that natural sedimentation rates within the Site 104 area will -not be significantly impacted by the proposed action.

Sedimentation and the potential for material movement at Site 104 due to placement of dredged material is dependent on: (1) the physical sediment characteristics of the placed material; (2) the physical characteristics of the water through which the material is being placed (i.e., temperature, salinity, and density, which are not anticipated to significantly change following the proposed action); (3) the created and existing bottom geometry; and (4) the hydrodynamics on the surrounding area.

–Based on grain size analyses, the majority of the dredged material proposed to be placed at Site 104 (± 95%) is made up of fine-grained silts and clays that typically would take a long period of time to settle as individual particles. Placement using bottom-release scows or hoppers causes the material to settle *en masse*, allowing it to reach the bottom faster than if individual particles were released. This is particularly true of cohesive sediments such as those proposed for placement at Site 104. A portion of the mass, however, does become removed (or stripped) from the cloud of placed material as it descends and remains in the water column.

–The duration of time that this material remains in the water column depends on factors such as grain size and surrounding hydrodynamics. The STFATE model run for Site 104 indicated that < 1% of material placed using bottom-release scows was stripped during descent and dispersed throughout the water column. This loss is not seen in bottom hydraulic placement since the material being placed is contained within the pipeline during descent and the discharge end of the pipeline is normally located within a few feet of the estuary bottom.

When a load of mechanically placed dredged material (either placed with a bottom-release scow or a hopper dredge) reaches the site bottom and collapses, a portion of the material's clay fraction remains in suspension in the water column above the bottom surface. _Modeling conducted for Site 104 using this placement technique indicated that loss of this suspended clay material would account for another 3.3% of the total of the mechanically placed material. It was assumed during the modeling that all of the hydraulically placed material settles to the bottom before erosive forces act on it.

–No portion of the hydraulically placed material will experience the collapse phase to which mechanically placed material is subjected because the material will be pumped to the bottom through a pipeline. A combination of both mechanical (bottom-release scow) and -controlled hydraulic pipeline - bottom-placement will likely be used for dredged material placement at Site 104.

~~6.1.3.j~~F.2.4.g.1 Sediment Erodability

To characterize the erodability of both in-place and dredged maintenance material currently proposed for placement at Site 104, sediment samples were obtained by ~~Maryland Geological Survey (~~MGS~~)~~ and provided to WES for laboratory erosion experiments described below. One sediment core was collected from each of the following channels with the exception of the Brewerton Channel Eastern Extension from which two samples were collected (one was collected at each end of the channel): Craighill Angle, Cutoff Angle, Tolchester, and Swan Point. The cores were collected in shoaling areas and are representative of the material proposed for placement at Site 104. Other channels proposed for maintenance dredging were not sampled because the channels had already been dredged for the season at the time of sampling. Previous sediment characterization studies in these channels (EA 1996) indicate that the physical characteristics of sediments in the non-sampled channels are similar to those of the cores collected for the erosion experiments. Generally, the sediments proposed for maintenance dredging are primarily comprised of silt/clay particles. ~~Section 6.1.5.a provides a description of the core samples' physical characteristics.~~

Results from the erosion tests were used to provide erosion parameters, such as critical shear stresses, for the modeling of material placement and potential erosion of the material placed both hydraulically and by bottom-release scow. This modeling was subsequently performed using MDFATE. The experiments tested both original channel sediments and sediments mixed with water from Site 104 (which had a constant and uniform density ~~which is~~ representative of the waters 12.0 m~~eters~~ (39.4 f~~ee~~t) below the surface, within 3.0 m~~eters~~ (9.8 f~~ee~~t) of the sediments at Site 104).

The sediment samples were placed in the 11.75-cm (4.63-in.) diameter test cylinder, covered with 12.7 cm (5.0 in.) of additional water from Site 104, and allowed to settle over specified increments of time between ~~one~~ 1 and ~~eight~~ 8 days prior to testing. The original sediments were representative of the material as it exists in the channels. The sediments mixed with water and allowed to settle were representative of material dredged and placed. A mechanical oscillating disk moved water over the surface of the sediments in the test cylinder at various rates equivalent to shear stresses of 0.1, 0.2, 0.3, 0.4, and 0.5 Pascals (allowing 30 minutes at each step) to simulate movement of water over sediments in Site 104 at various velocities.

The mass of sediments eroded from the test bed at each rate was measured to determine erosion rates and critical shear stresses to be used in the FATE modeling along with the shear stresses generated by the CH3D modeling for each year of placement. The effects of water pressure and gravitational forces were not simulated directly since these experiments simulated the impact on material erosion of a range of shear stresses acting on the bottom sediments. How those shear stresses are created in the real world is not considered by the model, (e.g., the total shear stress at Site 104 is influenced by tidal circulation). However, it is not each individual component of the shear stress that is important, but the total stress acting on the bottom which could potentially dislodge the sediments (Appendix F.2; WES 1998).

Potential Erosion of Placed Dredged Material

The MDFATE model was run, as explained in the beginning of Section 6.1.3F.2.3 under "Model Descriptions" and in the study report located in Appendix F.3, for both bottom-release scow and bottom hydraulic placement scenarios to predict the percentages of material potentially lost from the site during placement. Long-term erosion losses as a five5-year, weighted average were predicted to be 12.6% for placement with a bottom-release scow and 6.2% for hydraulic pump-out of individual barges. The weighted averages were determined by multiplying the annual predicted percent losses by the placement quantity for that year and then adding the resulting quantities and dividing them by the total quantity to be placed over the five 5-year time period.

Predicted percent losses for bottom-release scow and hydraulic pump-out of individual barges by placement year and the five5-year averages are provided below in Tables 6-4F-10 and 6-5F-11, respectively. Percentages vary from year to year based primarily on the total quantities of material placed and the placement locations. The greater the exposed surface area of new material and the closer the placement location is to the site boundaries, the more likely it is that placed material will erode and move outside of those boundaries.

As discussed earlier in Section 6.1.3.jF.2.4.g, the bottom-release scow methodology was predicted to lose an additional 4.3% into the water column between the time the material left the barge and settled on the site bottom. It was assumed that all of the hydraulically placed material settles to the bottom before erosional forces act on it, since no portion of this material experiences water column stripping or the collapse phase to which mechanically-_placed material is subjected. Therefore, the total predicted worst-case losses were 16.9% for bottom-release scow and 6.2% for hydraulic placement (Table 6-5F-11). However, these predicted losses are thought to be higher than will be experienced under actual conditions because the model could not predict the return of sediments back into the site effectively (WES 1998). As previously discussed, some sediment may leave the site during ebb tide and be transported back to the site during flood tide. The model can only predict the portion of material that has the potential to leave the site, not the portion that would be expected to return.

For each placement method scenario, a representative year-long run was made for each year of proposed placement. The major impacts on the model results are the erosion parameters discussed above, the size of the material footprint from each placement event, and the bottom shear stresses generated from the CH3D-WES model for each simulated year of placement. Since the erosion parameters and the bottom shear stresses were the same for both placement scenarios, the controlling factor for material losses due to erosion was the footprint. As discussed in Section 6.1.3.dF.2.4.a, the footprint generated from the hydraulic placement modeling was smaller than the footprints generated from the bottom-release scow modeling. Reasons why a single barge pump-out results in a smaller footprint size and less erosion than a bottom-release scow include:

- Hydraulic pump-out will result in material reaching the bottom at a higher concentration and thus with a lower total volume than a barge release.

Table F-10~~6-4~~
Dredged Material Erosion from the Bottom Surface by Placement Year

Year	Mechanical (bottom-release scow)	Hydraulic (controlled bottom pipeline placement)
1	16.0%	6.3%
2	9.5%	4.0%
3	18.9%	10.4%
4	9.5%	4.7%
5	15.6%	9.2%
Weighted 5-Year Average	12.6%	6.2%

Source: WES 1998

Table F-11~~6-5~~
Total Dredged Material Erosion as a Five Year Average

Erosion	Mechanical (bottom-release scow)	Hydraulic (controlled bottom pipeline placement)
Water Column	4.3%	0.0%
Bottom	12.6%	6.2%
Total	16.9%	6.2%

Source: WES 1998

- Hydraulic pump-out results in a spreading layer that is of more limited height, is thicker, and has a smooth flow over a short distance from the discharge point, whereas~~,~~ bottom release is turbulent and continues to pick up water as it spreads over the bottom.

- Hydraulically placed material spreads closer to the bottom surface and is, therefore, less affected by currents.

- Hydraulic pump-out will result in a spreading layer which will get denser more rapidly than a barge release and, due to the limited volume being pumped, will not spread as far from the release point as a barge release does (WES 1998).

Therefore, as shown in Table ~~6-4~~F-10, the bottom erosion for mechanical placement is predicted to be greater than hydraulic placement for each placement year. However, results would be different if hydraulic placement were conducted with a continuous flow instead of pump-out of individual barges. In this case, the hydraulic placement footprint would be larger and thus subject to greater erosion.

~~6.1.3.j~~F.2.4.g.2 Material Spreading

One aspect of dredged material placement that is not considered by STFATE, MDFATE, and hydraulic footprint modeling is the spread of material on a slope. SURGE modeling was performed to evaluate distances that placed material could travel along the bottom from the location at which the material reaches the site bottom. The modeling was performed using data from the STFATE modeling of bottom-release dredged material placement at the deepest part of the site (i.e., near the southern boundary since bottom slopes are greater there). Although not specifically modeled (since no model exists that can do so), hydraulically placed material should also be expected to spread further on slopes versus a flat bottom.

–Typical slopes anticipated to be encountered at Site 104 were between 0.0% and 1.5%. Typical slopes were measured from existing bathymetry, and modeling calculations determined the post-shearing angles that result from "slumping" of placed material, as described in the study report in Appendix F.3. Predicted dredged material spreading over the slopes ranged from approximately 220 m~~eters~~ (720 f~~ee~~t) to 920 m~~eters~~ (3,020 f~~ee~~t). The model assumes that the slopes are continuous, whereas in reality, opposing slopes could be encountered, therefore reducing the amount of material spreading.

–A SURGE model run was made on a 1.5% slope with a created 6 m~~eters~~ (20 f~~ee~~t) high opposing slope of approximately 7H:1V placed approximately 305 m~~eters~~ (1,000 f~~ee~~t) away. The results of the model run indicated that the surge produced from placement on the 1.5% slope would not have enough energy to overtop the opposing slope. The results of the SURGE model should be viewed with caution, since actual surge data for placement operations at Site 104 do not exist to verify the model. Also, some input parameters for the Site 104 modeling had to be obtained from what were thought to be similar projects for which these data were available (WES 1998).

~~6.1.3.j~~F.2.4.g.3 Potential Sediment Transport

It should be noted that a portion of the predicted losses is comprised of material that leaves the boundaries of the MDFATE model to the south during an ebb tide or to the north during a flood tide and could potentially re-enter the site boundaries during a flood tide or ebb tide, respectively. The model does not track sediments once they leave the model boundaries. The site boundaries are rectangular and were established to include the bottom two-thirds of the Site 104 project area, and extend approximately an additional 915 ~~additional meters~~ (3,000 feet) to the south and 610 meters (2,000 feet) on both the east and west sides of the southern portion of the site.

–In reality, material in suspension is influenced by the tidal cycles and, therefore, material that moves from the site due to tidal fluctuations could be brought back into the site boundaries on the next opposing tide (i.e., what leaves with the ebb tide could return with the flood tide). In addition, material that left the northern model boundary could still be in the northern third of Site 104. –These "losses,"; therefore, would not truly be lost from the site. This dynamic process will continue over a period of time. Sediment will consolidate and movement will eventually approach or equal the normal sediment redistribution patterns in the upper Bay.

The tracer studies conducted using the CEQUAL-ICM model to evaluate net long-term movement of suspended material within the Site 104 area indicated that the net residual current is directed northward. Material that remains in suspension would thus have a tendency to be transported northwards. Material placement at Site 104 is proposed for the -southern deeper portions of the site where depths are currently greater than –13.7 meters (–45 feet) MLLW. This equates to approximately the lower two-thirds of the site. Material would not be placed in the northern portion of the site in depths shallower than –13.7 meters (-45 feet) MLLW (approximately the northern one-third of the site).

–No model of the Chesapeake Bay exists that can quantifiably track potential sediment movement throughout the Bay. Therefore, the final destination of the material that was predicted to leave the site remains unknown. Based on typical settling rates, however, it is believed that any material placed at Site 104 that is suspended in the bottom currents will settle out over a short distance and, depending on the location of the -placement, will most-likely stay within the site boundaries unless further erosion takes place.

~~6.1.3.k~~F.2.4.h Wave Conditions. Average and extreme wave conditions for Site 104 are dependent on wind conditions within the Chesapeake Bay region. As stated in Section ~~6.1.3.g~~F.2.4.d above, wind conditions would not be affected by the proposed action and, subsequently, placement of dredged material at Site 104 would not affect wave conditions at the site. Average depths at the site will not change to the extent that normal wave conditions would have an effect on the increased bottom elevations. Effects from extreme wave conditions due to storms were discussed earlier in Section ~~6.1.3.e~~F.2.4.b. The proposed action is not expected to change the characteristics of surficial waves at the site. For storm events greater than or equal to a 25-year storm event, however, sub-surface waves will impact the bottom.

~~6.1.3.l~~F.2.4.i Effects of a Berm on Flow Field and Dredged Material Placement

If a berm is built at the southern boundary of Site 104, there could be two impacts relative to the proposed placement of dredged material at the site. The first impact (probably the most significant) is related to the possibility of the berm stopping bottom density surges containing suspended sediment. These surges result from the encounter of the placement material striking the bottom. The second is the impact on erosion of deposited placement material.

When the placement material descends through the water column as a cloud or jet, it entrains ambient water and grows. At the moment of bottom encounter, the jet or cloud of material possesses a certain amount of energy, which is the sum of its potential and kinetic energy. An outward flow of the suspended sediment and water mixture then occurs along the sea floor. This is referred to as the bottom surge. This outward movement of suspended sediment and water mixture continues until the energy possessed by the surge is dissipated. Dissipation of its kinetic energy occurs due to friction~~al effects~~. Potential energy is converted to kinetic energy and is also lost due to the fact that as the surge lo~~o~~ses energy and slows down, suspended material is deposited on the bottom, resulting in a decrease of the surge's density.

Whether placement occurs on a flat bottom, a down slope, or an up slope, all of the processes described above occur. However, if a down slope is encountered, the surge also gains energy due to the gravitational force accelerating the surge down the slope. Likewise, when the surge attempts to move up a slope, the kinetic energy of the surge decreases due to the resisting gravitational force.

The behavior described above has been incorporated into the model called SURGE. A simulation of the placement by bottom scow release in a water depth of 21.3 m~~eters~~ (70 ft) at Site 104 that occurs 304.8 m~~eters~~ (1,000 ft) in front of a 6.0 m~~eters~~ (20 ft) high berm with an angle of repose of 8 degrees has been made with SURGE. The model predicted that the energy of the bottom surge would be dissipated before the surge over topped the berm. Of course, these results should be viewed with caution since results are dependent on parameters such as the rate of dissipation and the rate of conversion of potential energy to kinetic energy. However, depending on the characteristics of the placement material, the placement process, and the placement bathymetry, berms can obviously be used to control the spreading of placement material contained in bottom surges.

The second impact of constructing a berm at the southern boundary of Site 104 relates to changes in erosion of deposited material that might occur due to changes in the flow field caused by the berm. These impacts will be very localized and relatively insignificant. The impact on the flow field will be determined by the magnitude of the ambient flow and the height of the berm. In any case, the impact away from the berm should not extend more than ~~2-3~~<u>two to three</u> times the height of the berm. Thus, changes in erosion rates will only be seen within perhaps 50-100 ft of the location of the berm.

~~Section 9~~ANNEX I

SITE 104 MONITORING FRAMEWORK

9I.1 PURPOSE

Monitoring for the Site 104 placement operations will be performed as part of regulatory compliance, to ensure that performance criteria are met, to confirm and to limit the predicted potential impacts, and to provide information to further assist in the management of the site. Results of the Site 104 monitoring framework can be used to verify assumptions and predictions or to provide a basis for modifying the site management process. This monitoring framework was developed with the objective of providing the information needed by regulatory and resource agencies to meet their operational requirements and data needs, and serves as a template for developing the monitoring plan. The monitoring framework will be submitted by CENAB to MDE for approval as part of the Water Quality Certification requirements for this project should a favorable Record of Decision be issued for use of Site 104 for placement of dredged material.

9I.2 INTRODUCTION

This monitoring framework, like the study process and project design, is the result of a collaborative effort. It has been developed to provide a multi-disciplinary monitoring program that meets the regulatory and resource agencies requirements for the Site 104 open--water placement project. Monitoring needs have been identified in a collaborative manner by a multi-disciplinary group of state and Federal regulatory and resource agencies for similar sites throughout the upper Bay (e.g., Hart-Miller Island, Pooles Island sites, and Poplar Island).

Agencies providing expertise and information on Region III and CBP monitoring elements will include NMFS, USFWS, MDNR, MGS, MPA, MDE, MES, EPA, USACE, UMCES HPEL, and CBL. A collaborative, multi-disciplinary team will participate in the development of the monitoring framework in order to contain costs, to ensure comprehensive monitoring, and to provide concurrent peer review of the monitoring effort.

The development of the monitoring approach is a dynamic process, and monitoring elements will evolve to fit changing conditions and findings. The specifics of each monitoring element will be controlled by the final project details. Changes will continue to be presented to the agency team for their review and comment. Monitoring is intended to be flexible in order to meet the needs of the project and the requirements of the resource and regulatory agencies over time. Each element will be evaluated at the end of each monitoring year, and the monitoring team will decide upon appropriate changes as necessary.

These monitoring needs require that data be collected before, during, and after placement at Site 104. The baseline data include information previously collected for the NEPA process to document existing conditions in or around Site 104. Data collected would be used to compare and assess future conditions both during and after placement occurs. Baseline data collection was initiated in the spring of 1996.

The use of fish (demersal and pelagic) and crustaceans such as crabs to directly monitor the impacts of the placement operations is not appropriate. They move into and out of the Site 104 area, which makes it impossible to determine how representative they would be in assessing the impacts of placement operations in Site 104. Also, the direct effects of dredged material placement in open waters on the behavior and long-term physiological response of fish and crabs is poorly understood. There are no indices or coefficients (such as toxicity tests) that allow the direct exposure effects on predators to be quantified.

Although not included in this framework, a ~~two~~ 2-year monitoring program for the shortnose and Atlantic sturgeon was developed by the NMFS, USFWS, and USACE and implemented by the USFWS and funded by CENAB and CENAP. An interim Biological Assessment (BA) is being prepared by the Baltimore District and will be provided to NMFS at the time of the public release of this draft EIS. This interim BA will include all sturgeon-related field data available at that time. In addition to the data collected during this sturgeon monitoring program, the interim BA will include data collected during the USFWS Bounty Program.

9I.3 MONITORING ELEMENTS

9I.3.1 Site Management

The objectives of this monitoring element are as follows:

1. To provide guidelines for placement of material at Site 104;

2. To specify operational criteria where controls are necessary;

3. To provide detailed plans for meeting restrictions imposed by certification; and

4. To provide monitoring of site performance.

The following methodologies will be used to achieve the above objectives:

Guidelines for material placement would be designed to minimize resuspension and dispersion of sediment, and to ensure that material is placed in accordance with pre-designated locations and depths within the placement site. Placement plans will be developed prior to each year's dredging and will be developed based on pre-placement surveys performed to verify the capacity of the Site 104 area. The specific minimum performance criteria may include, but are not necessarily limited to: (1) verification of dredging and placement depth by bathymetric surveys, (2) use of specified routes for travel between the dredging and placement sites, and (3) verification of dredging and placement locations using data from electronic navigation systems.

Implementing operational controls on the placement activities would minimize the opportunity for sediment resuspension and dispersion during the placement process while maximizing operational efficiency and safety. Control techniques may include, but are not limited to: (1) contractually requiring that the placement operations meet specific minimum environmental performance standards and environmental windows; (2) contractually requiring submittal and implementation of project_-specific plans; (3) placement of marker buoys to identify routes or -the designated material placement locations; (4) use of a Global Positioning System with onboard recording capability to identify and document the location of material placement and/or requirements for inspectors to verify placement locations; (5) requiring the dredging contractor(s) to meet specific minimum competency and experience standards; and (6) notifications to fishing and boating interests of dredge and scow movements and schedules.

CENAB will submit a finalized Site Management Plan to MDE to ensure coordination of all parties involved and will obtain approval for use of Site 104 prior to commencement of any placement activity. The Site Management Plan will include estimates of placement capacity and coordinates of the designated grid area in which all placement will occur. This will include the placement sequence of material and the designated locations and volumes. The operations plan to be used by the contractor for dredged material placement will also be appended to the Site Management Plan.

Study Endpoint:

The study endpoint of this monitoring element will be determined within a window to be defined following the last placement action. This window will be clarified based upon information collected following the completion of all placement activities.

9I.3.2 Consolidation and Erosion

The objectives of this monitoring element are as follows:

1. To determine the initial capacity of the Site 104 area before and the remaining capacity after each placement season;

2. To measure and evaluate changes in the material placed within and around the Site 104 area due to erosion and consolidation of sediments;

3. To evaluate the monitoring data and suggest modifications as necessary in the monitoring program design and in site management.

The hypothesis being evaluated is as follows:

> Dredged sediment is subject to predictable forces after placement which result in relatively standard rates of consolidation and erosion, based on the type of material, the method of placement, and the placement location. Placement of dredged material will not materially deviate from these expected conditions.

Observations of consolidation and erosion in the Site 104 area would be determined through sample collection, laboratory analysis, and data processing and synthesis. Existing sediments in the Site 104 location would be collected and analyzed before dredging and placement operations begin. Bathymetric surveys of the placement area would also be performed prior to placement to evaluate changes in capacity of the placement area over time. At the conclusion of the proposed placement activities and at the end of the monitoring period, core samples would be collected from the placement area to provide a baseline for evaluating changes in the deposited sediments over time. Selected samples would be subjected to grain size and bulk property analyses. These data would be analyzed to determine volumetric changes due to consolidation of the foundation sediments.

Study Endpoint:

Monitoring would be performed each year that placement occurs within the Site 104 area, and up to ~~one~~ 1 year after placement is completed to document consolidation and erosion.

9I.3.3 Shellfish Bed Sedimentation

The objective of this monitoring element would be to provide information on the change in sedimentation rates on nearby charted oyster bars (State of Maryland Natural Oyster Bars [N.O.B.] 6-5 and 4-8), otherwise known as Broad Creek and the Bear Creek Bar, respectively) and at adjacent reference sites.

The hypothesis being evaluated is:

There is no discernable increase in sedimentation rates on the charted oyster bars during placement when compared to sedimentation rates prior to placement activities, adjusted to reflect seasonal and annual variations in sedimentation.

To test this hypothesis, the baseline sedimentation rate within the oyster bar must first be determined and then compared to rates obtained during placement operations. This will be accomplished using bathymetric surveying combined with a side-sonar survey and acoustic bottom classification. The baseline accumulation rates will be determined by measurements made at predefined locations within the oyster bar for a specified period prior to initiation of placement operations. The rates will be adjusted to reflect seasonal and annual variations to enable an appropriate comparison. The specific approach will be developed prior to submission of the monitoring framework.

If it is determined that sedimentation within the oyster bar has increased due to placement of the dredged materials, operations will be discontinued until the placement methods can be re-evaluated and refined.

Study Endpoint:

Evaluations would continue annually to determine whether monitoring should continue.

9I.3.4 Sediment Quality Monitoring

The objectives of this monitoring element are as follows:

1. To characterize the chemical composition of the sediments in the channels to be placed at Site 104;

2. To track the quality of sediments placed at Site 104; and

3. To distinguish the anticipated improvement of the sediment quality at station KI-7 (which had the highest levels of contaminants).

The hypotheses being evaluated are as follows:

1. The priority pollutant organic compound concentrations in sediments taken from the channels and placed at Site 104 will be below detection limits or below the appropriate criteria for these constituents.

2. The metal concentrations in sediments placed at Site 104 will be below appropriate criteria for these constituents; and

3. After ~~one~~ 1 year of placement at KI-7, the concentrations of metals and organics will be below the appropriate sediment criteria for these constituents.

Sediment samples would be collected both inside and outside the boundaries of Site 104 every ~~three~~ 3 years -at the same locations as in the baseline sampling ~~(Figure 5-13)~~. Sediment samples would be analyzed for organics, inorganics, nutrients, and grain size (including the Atterberg limit tests).

Samples would be collected from the Chesapeake Bay approach channels and analyzed using field and laboratory methods as defined by the Chesapeake Bay Program to support the Inland Testing Manual guidelines (EPA and USACE~~,~~ 1998). The results of these samples are used to define the materials dredged during channel maintenance operations.

After ~~one~~ 1 year of placement, sediments at station KI-7 would be analyzed to verify equal or improved sediment quality over baseline conditions.

Study Endpoint:

The study endpoint of this monitoring element will be the final monitoring following the last proposed placement action at Site 104.

~~9~~1.3.5 Sediment Nutrient Flux

The objectives of this monitoring element are as follows:

1. To characterize nutrient loading in and around Site 104; and

2. To verify that placement at Site 104 will have no long-term impact on nutrient flux rates and, therefore, water quality (short-term impacts are expected).

The hypothesis being evaluated is as follows:

> Sediment nutrient flux rates will -remain within the expected ranges for -a similar -area that experiences summer hypoxia.

In order to evaluate this hypothesis, stations in and around Site 104 would be monitored each year during hypoxic/anoxic periods (May--September) at a time when microbial activities and potential nutrient releases are highest. Sediment carbon, oxygen, and nutrient flux sampling would take place during May, June, July, August, and September following placement each season. A total of five sets of measurements would be made at each station (vertical water column profiles of temperature, salinity and DO, water column samples, and sediment core samples). The water column samples would be analyzed for ammonium, nitrite, nitrite+nitrate, dissolved inorganic phosphorus (DIP) corrected for salinity, and silicious acid. The sediment cores would be used to measure oxidation-reduction potential (Eh) of the sediments at 1--cm intervals for the top 10 cm, particulate carbon, particulate nitrogen, particulate phosphorus, total and active chlorophyll-a, and net exchanges of carbon, oxygen, and dissolved nutrients between sediments and overlying waters.

Study Endpoint:

When sediment nutrient flux rates return to within expected ranges for the area, or are predictable in nature based upon data collected over a minimum of ~~three~~ 3 years, the study team will determine whether monitoring should continue.

91.3.6 Water Quality Monitoring

The objectives of this monitoring element are as follows:

1. To characterize water quality in and around Site 104 to evaluate whether long-term water quality changes have resulted from the proposed action (short--term water quality impacts are expected);

2. To monitor turbidity resulting from placement activities at the edge of the mixing zone; and

3. To comply with the Water Quality Certificate requirements during placement.

The hypotheses being evaluated are as follows:

1. There will be no significant long-term change in water quality conditions at Site 104 (a slight short-term change in turbidity is expected immediately after placement operations within the boundaries of Site 104); and

2. Turbidity levels outside the defined mixing zone will remain in compliance with the Water Quality Certification limitations during and after placement activities.

In order to evaluate these hypotheses, stations within and outside of Site 104, including the Chesapeake Bay Program Water Quality Monitoring (CBP) stations, would be monitored seasonally during placement. Typically three water quality samples would be taken per station (surface, mid, and bottom). The same parameters would be used for water quality testing as are evaluated in the Chesapeake Bay Program (spatial location, depth, temperature, salinity, conductivity, turbidity, total suspended solids [(TSS)], secchi depth, pH, dissolved oxygen, chlorophyll-a, and nutrients such as nitrogen, phosphorus, carbon, and silica species). The CBP approach is specific to the Bay and will function as the tool to satisfy the ITM guidelines. In addition, data from CBP stations would be evaluated for use as a historical comparison for baseline data sets.

TSS and nutrient samples would be collected upstream, in and downstream of the turbidity plume. Samples would be collected at three depths in the water column including surface, mid, and bottom layers. This would be repeated during each placement year.

Compliance turbidity monitoring is not defined as yet. It would depend upon the mixing zone, which has yet to be developed. Turbidity monitoring would be required during placement since compliance limits would be set in the Water Quality Certification issued by the Maryland Department of the Environment.

Study Endpoint:

Evaluations would be made by the monitoring team annually on whether the monitoring should be continued.

91.3.7 3-D Water Quality Modeling of Sediment Nutrient Flux Impacts on Water Quality

The objective of this monitoring element is as follows:

> To provide data to evaluate potential water quality impacts from sediment nutrient fluxes and to substantiate the model predictions under actual placement conditions at Site 104.

The hypothesis being evaluated is as follows:

1. The use of Site 104 for placement is expected to have a short-term and localized impact on water quality, primarily through increased turbidity, total suspended solids, and nutrient concentrations at the time of placement;

2. Placement of dredged material at Site 104 will provide a moderate increase in dissolved oxygen concentrations in bottom waters due to decreasing water depth;

3. Salinity concentrations in the upper Bay will not change more than 0.1 ppt; and

4. No long-term impacts to water quality are expected.

In order to evaluate these hypotheses, water quality data from Site 104 during the first, second, and third year of placement would be collected. These data would be used to re-run the water quality module of the WES CH3D Chesapeake Bay Model to assist in the verification of predicted impacts to water quality from the placement of dredged material at Site 104.

Study Endpoint:

Evaluations would continue annually by the study team to determine whether monitoring should continue.

9I.3.8 Benthics Monitoring

The objectives of this monitoring element are as follows:

> To verify re-establishment of the benthic community and to compare the results of sampling with established Chesapeake Bay benchmarks, including the B-IBI, to evaluate benthic community conditions at Site 104;

The hypotheses being evaluated are as follows:

1. The benthos at Site 104 will show no long-term loss in terms of the multi-metric Benthic Index of Biotic Integrity (B-IBI) within a specified time period after all placement has ceased; and

2. The elevation of the site depths may potentially embellish benthic colony establishment (due to reductions in low oxygen events) and may promote non-opportunistic species colonization.

In order to evaluate these hypotheses, benthic stations would be monitored once in the summer, fall, winter, and spring beginning ~~one~~ 1 year after placement of material has ceased. Three replicate samples per station would be collected. Reference stations would be established outside the area of impact for comparison purposes. The Chesapeake Bay Program's Benthic Monitoring Program and baseline data would provide useful data for comparison. The ~~Benthic Index of Biotic Integrity (~~B-IBI~~)~~ would be used to compare the benthos at the active placement site to the benthos at the reference sites. Appropriate depth stations would be compared. At least one of the reference stations would be a Chesapeake Bay Program Benthic Monitoring Program Site.

Study Endpoint:

The study endpoint of this monitoring element is ~~eighteen~~ 18 months after the last placement action at Site 104.