FINAL
GENERAL REEVALUATION REPORT (GRR)
AND
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT (SEIS)
FOR
POPLAR ISLAND ENVIRONMENTAL RESTORATION PROJECT
CHESAPEAKE BAY, TALBOT COUNTY MARYLAND

September 2005

Volume 1 of 3
(Text)

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GENERAL REEVALUATION REPORT (GRR)

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SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT (SEIS)

FOR

POPLAR ISLAND ENVIRONMENTAL RESTORATION PROJECT (PIERP)

Chesapeake Bay, Talbot County, Maryland

Volume 1 of 3
(Report Text)

Prepared for

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COVER SHEET

LEAD AGENCY

U.S Department of Defense

TITLE **Final General Reevaluation Report (GRR) and Supplemental Environmental Impact Statement (SEIS) for Poplar Island Environmental Restoration Project, Chesapeake Bay, Talbot County, Maryland**

CONTACT

Additional copies or information concerning this document can be obtained from Mr. Mark Mendelsohn, U.S. Army Corps of Engineers, Planning Division, P.O. Box 1715, Baltimore, MD 21203. Telephone: (410) 962-9499 or 1-800-295-1610. Email: mark.mendelsohn@usace.army.mil You may view the Final GRR/SEIS and related information on the USACE web page at http://www.nab.usace.army.mil/projects/Maryland/PoplarIsland/expansion.html. The USACE has distributed copies of the Final GRR/SEIS to appropriate members of Congress, State, and local government officials, Federal agencies, and other interested parties.

ABSTRACT

In accordance with the requirements of the National Environmental Policy Act (NEPA), the U.S. Army Corps of Engineers (USACE), Baltimore District has prepared a Final General Reevaluation Report (GRR) and Supplemental Environmental Impact Statement (SEIS) for Poplar Island Environmental Restoration Project (PIERP) to evaluate the vertical and/or lateral expansion of the PIERP, design modifications to the existing project, the addition of recreational/educational opportunities to the existing project, and the potential to accept dredged material from additional channels not specified for the existing project. The expansion of Poplar Island was one of three actions specifically recommended by the USACE-Baltimore District's, *Final Dredged Material Management Plan (DMMP) and Tiered Environmental Impact Statement* (February 2005). USACE is making the Final GRR/SEIS available to the public for review and comment through a Notice of Availability published in the Federal Register. The recommendations of the Final GRR/SEIS are:

- Construction of a northern lateral expansion of approximately 575 acres of remote island habitat that incorporates an open-water embayment and includes approximately 29 percent wetland, 47 percent upland, and 24 percent open-water (embayment) habitat;

- Construction of a 5-ft vertical raising of the existing upland cells (Cells 2 and 6) on the western side of the PIERP;

- Amending the existing project authorization and Project Cooperation Agreement (PCA) to include the placement of dredged material from the southern approach channels to the Chesapeake and Delaware (C&D) Canal and other Federal navigation projects;

- Incorporation of design modifications required for the completion of the existing project, and

- Development of recreational and educational enhancements for the PIERP.

AVAILABILITY

Copies are available for public review at the following public reading rooms:

(1) Talbot County Public Library, Easton Branch, 100 West Dover Street, Easton, MD 21601

(2) Queen Anne's County Public Library, Stevensville Branch, 200 Library Circle, Stevensville, MD 21666

(3) Anne Arundel County Public Library, 1410 West Street, Annapolis, MD 21401.

(4) Talbot County Public Library, Tilghman Island Elementary School Branch, 21374 Foster Avenue Tilghman, MD 21671

(5) Enoch Pratt Free Library, 400 Cathedral St., Baltimore, MD 21201-4484

PUBLIC COMMENTS

The Department of the Army has encouraged public participation as part of the National Environmental Policy act (NEPA) process. A Notice of Intent (NOI) to prepare a General Reevaluation Report and Supplemental Environmental Impact Statement was published in the Federal Register in June 2003, and scoping meetings were held in January 2004. A public update meeting was held in October 2004. A Notice of Availability (NOA) to advertise the Draft GRR/SEIS was published in the Federal Register in June 2005 and two additional public meetings were held in July 2005 for the Poplar Island Draft GRR/SEIS Document. At all public meetings, attendees were invited to provide oral comments at the meetings and to submit additional comments to the Baltimore District. In addition, comments were solicited throughout the NEPA process as written, oral, or electronic comments. The public comment period ended on August 8, 2005. Comments that were received for the Poplar Island Draft GRR/SEIS Document were addressed as appropriate and included as an appendix of the Final GRR/SEIS.

EXECUTIVE SUMMARY

The Poplar Island Environmental Restoration Project (PIERP) is located in the Chesapeake Bay; approximately 39 miles south-southeast of the Port of Baltimore, and two miles northwest of Tilghman Island in Talbot County, Maryland (Figure ES-1). Dredged material from the Upper Chesapeake Bay Approach Channels to the Port of Baltimore is being beneficially used to restore 1,140 acres of remote island habitat (approximately 570 acres of wetland habitat and 570 acres of upland habitat), and it is estimated that the existing PIERP will provide up to 40 million cubic yards (mcy) of dredged material placement capacity by 2014. To date, approximately 12 mcy of dredged material have been placed at the site. Construction and site operation of the PIERP are a collaborative effort that is cost shared between the Federal government, the U.S. Army Corps of Engineers – Baltimore District (USACE-Baltimore) and the non-Federal sponsor, the Maryland Port Administration (MPA).

Engineering Regulation (ER) 1105-2-100 requires dredged material management planning for Federal navigation projects to ensure that sufficient dredged material placement capacity is available during the life of a navigation project. The *Baltimore Harbor and Channels Dredged Material Management Plan, Preliminary Assessment* (USACE, 2001a) identified insufficient dredged material capacity to meet Federal and State of Maryland needs in the next twenty years, insufficient time to create new placement sites to meet the near-term capacity short-fall, and the potential for inefficiencies (such as overloading of placement sites and subsequent loss of capacity) at existing placement sites if new sites are not constructed. USACE guidance (Policy Guidance Letter No. 40) specifies that the expansion of existing sites should be considered to increase placement capacity before new placement sites are proposed.

To address the predicted dredged material placement capacity shortfall, USACE-Baltimore and MPA initiated the Poplar Island Expansion Study under the existing PIERP Congressional Authorization, Section 537 of the Water Resources Development Act (WRDA) of 1996. Authorization for ecosystem restoration projects using dredged material is included in Section 204 of the WRDA of 1992, as amended by Section 207 of the WRDA of 1996. A Notice of Intent (NOI) to initiate the Integrated General Reevaluation Report (GRR)/Supplemental Environmental Impact Statement (SEIS) was published in the Federal Register in June 2003. The USACE – Baltimore District, and MPA, under the auspices of the Maryland Department of Transportation (MDOT), are the sponsors for the PIERP GRR/SEIS.

This Integrated GRR/SEIS documents the National Environmental Policy Act (NEPA) of 1969 compliance for the expansion of the PIERP, provides information specific to the actions of the GRR, and supplements the *Poplar Island Restoration Study, Maryland: Integrated Feasibility Report and Environmental Impact Statement* (ERP No. D-COE-D350557-MD) (USACE/MPA, 1996).

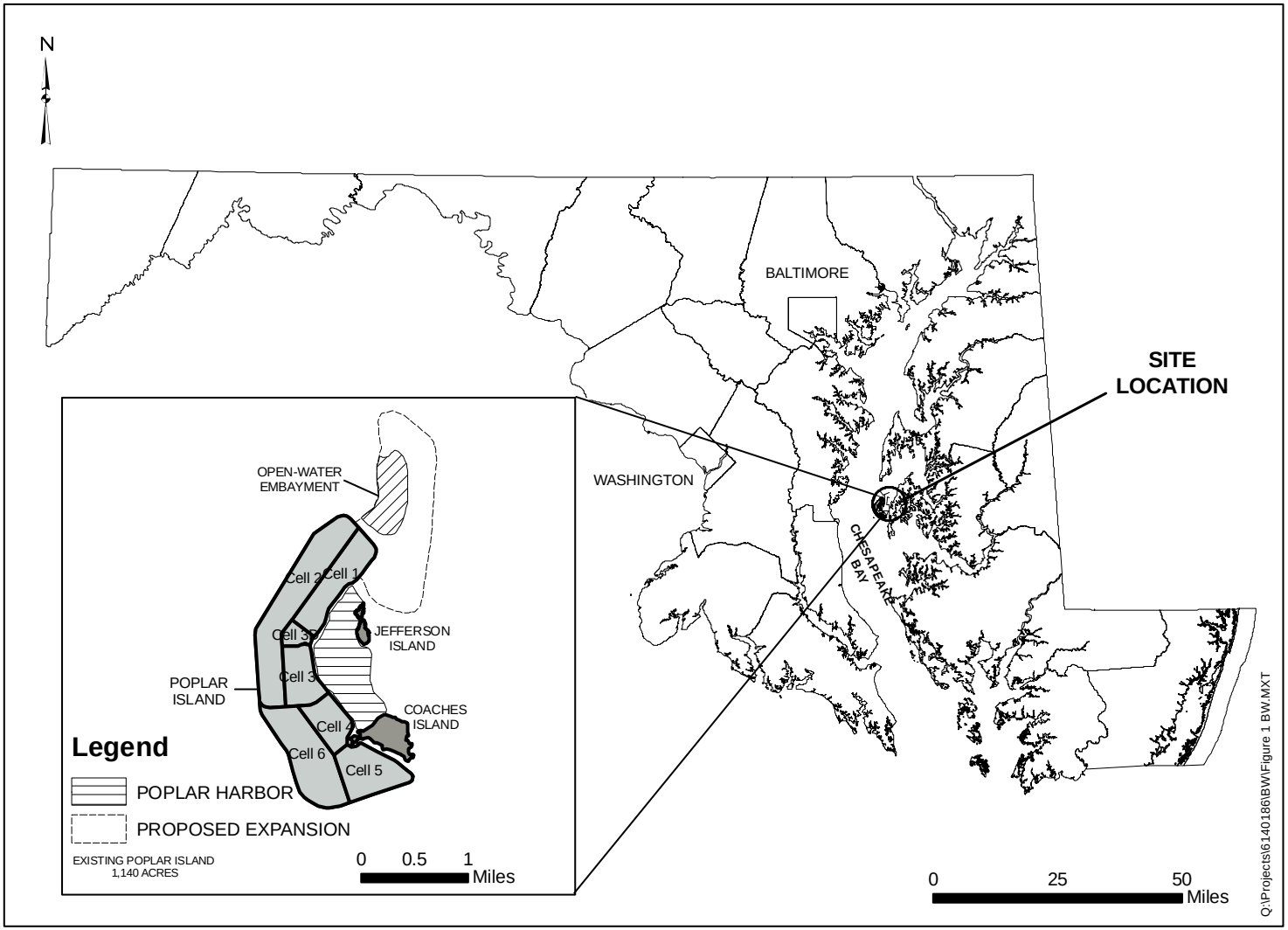

Figure ES-1. Poplar Island Site Location Map

The recommendations of the GRR/SEIS are:

- Construction of a northern lateral expansion of approximately 575 acres of remote island habitat that incorporates an open-water embayment and includes approximately 29 percent wetland, 47 percent upland, and 24 percent open-water (embayment) habitat;

- Construction of a 5-ft vertical raising of the existing upland cells (Cells 2 and 6) on the western side of the PIERP;

- Amending the existing project authorization and Project Cooperation Agreement (PCA) to include the placement of dredged material from the southern approach channels to the Chesapeake and Delaware (C&D) Canal and other Federal navigation projects;

- Incorporation of design modifications required for the completion of the existing project; and

- Development of recreational and educational enhancements for the PIERP.

The recommendations above would provide approximately 28 mcy of additional placement capacity for dredged material, and would extend the life of the PIERP by approximately seven years.

ES.1 STUDY NEED

The USACE-Baltimore District, USACE-Philadelphia District, and MPA coordinate maintenance of the Port of Baltimore's channel system, and continually assess dredging needs and placement capacity. Channel maintenance and improvement projects require 4-5 mcy of sediment be dredged from the Federal and State channels each year. The scheduled closure of the Pooles Island open water placement areas in 2010, the scheduled closure of the Hart-Miller Island Containment Facility in 2009, and the unavailability of open water placement options in Maryland waters have reduced the ability of USACE-Baltimore and Philadelphia Districts and MPA to meet dredged material placement capacity needs. Dredged material placement capacity remaining after 2009 will be insufficient to meet the annual need for maintenance dredging activity unless new placement options are developed. To plan for the dredged material placement capacity shortfall, USACE-Baltimore District and MPA initiated studies to evaluate long-term (minimum 20 years) placement options; to address the dredging needs of Federal, State, and local projects; and to maximize the use of dredged material as a beneficial resource.

The *Baltimore Harbor and Channels Dredged Material Management Plan and Tiered Environmental Impact Statement* (USACE, 2005) identified a combination of seven alternatives, including the expansion of the PIERP, to meet the 20-year dredged material capacity needs of the Port of Baltimore (USACE, 2005). The expansion of PIERP was also

identified as a high priority based on preliminary dredging needs studies for the Upper Chesapeake Bay Channels that were conducted as part of the State of Maryland's Dredged Material Management Program (DMMP) [*Interim Report to the Maryland General Assembly Concerning Implementation of the Dredged Material Management Act of 2001*, (DMMP, 2001)].

The purposes of the GRR/SEIS were: (1) to investigate the environmental effects of a lateral and/or vertical expansion to the existing PIERP to increase habitat restoration and provide additional dredged material capacity; (2) to evaluate other project enhancements at both the PIERP and within Poplar Harbor; (3) to evaluate the placement of dredged material at the PIERP from Federal navigation channels not authorized in the 1996 Poplar Island EIS (USACE/MPA, 1996); and (4) to assess additional actions for the completion of the existing project.

ES.2 PLAN FORMULATION

The plan formulation process for the expansion study included analysis of numerous lateral alignments, wetland/upland proportions, and combinations of lateral expansion and vertical dike raising scenarios to meet the project goals of restoring remote island habitat and providing additional placement capacity. Three initial options for expansion were considered: 1) vertical expansion only, 2) lateral expansion only, and 3) lateral expansion plus vertical expansion.

Analysis of the vertical dike raising option indicated that vertical raising of the existing uplands alone would not provide substantial additional environmental benefits to the existing project, and would not achieve the optimum capacity of the upland cells because the upland cells alone could not efficiently accommodate the projected annual dredged material quantities. In addition, the public voiced strong concerns regarding negative viewshed (aesthetic) impacts associated with dike raising to the maximum height necessary to accommodate the dredged material capacity need. Therefore, vertical expansion alone was not considered a viable option. Vertical expansion was, however, considered in combination with a lateral expansion to provide sufficient dredged material placement quantity to support proper wetland cell development and efficient placement operations.

For the lateral expansion, six alignments were initially developed and studied as part of a reconnaissance-level assessment (GBA, 2003), and a seventh alignment was added during the early stages of the USACE-Baltimore's plan formulation process. An initial screening process that considered cost, site capacity and life, engineering suitability, environmental resources, and agency and public concerns, indicated that a northern lateral alignment provided the optimal geographical location. A second screening process determined that the size of the wetland areas was constrained by the minimum acreage necessary to achieve environmental goals (50 percent wetlands) and the maximum acreage that would allow for efficient dredged material placement at the site (approximately 60 percent wetlands).

A conceptual northern alignment consisting of approximately 575 acres was evaluated within a 1,080-acre Study Area located to the north of the existing PIERP (Figure ES-2). It was

anticipated that the footprint of the northern conceptual alignment would be adjusted, in the future as necessary, within the Study Area to avoid constructing dikes over unsuitable foundation material or other unforeseen site conditions (Figure ES-2). Based on the experience at the existing project, wetland cells within the northern lateral alignment will not be constructed on top of the sand borrow area located within the footprint of the expansion. It is difficult to achieve the necessary final design elevations for functional wetland cells if they are constructed on top of the deep holes created by sand borrow. Therefore, the wetland cells within the northern lateral expansion were located in the northern and western portions of the lateral expansion, and the upland cells were located on top of the sand borrow area on the eastern side of the expansion, closest to the Eastern Shore mainland. The southwestern borrow area (Figure ES-2) would be required, in addition to borrow from within the alignment footprint, to attain sufficient sand for the expansion construction.

A total of six combinations of vertical and/or lateral expansion for the 575-acre northern lateral alignment were evaluated using a dredged material placement analysis, an environmental benefits determination, and a cost effectiveness/incremental cost analysis (CE/ICA). The six combinations were:

- 50 percent wetland habitat, 50 percent upland habitat
- 55 percent wetland habitat, 45 percent upland habitat
- 60 percent wetland habitat, 40 percent upland habitat
- 50 percent wetland habitat, 50 percent upland habitat with 5-ft raising of existing upland cells
- 55 percent wetland habitat, 45 percent upland habitat with 5-ft raising of existing upland cells
- 60 percent wetland habitat, 40 percent upland habitat with 5-ft raising of existing upland cells

Following the completion of the formal plan formulation process, a proposal from National Marine Fisheries Service (NMFS) and subsequent discussions with the U.S. Environmental Protection Agency (USEPA) - Region III, U.S. Fish and Wildlife Service (USFWS), Maryland Department of Natural Resources (MDNR), and Maryland Department of the Environment (MDE), led to the development and evaluation of an open-water embayment that could be incorporated into a northern lateral alignment. The inclusion of an open-water embayment within the footprint of the lateral expansion would provide semi-protected fisheries habitat adjacent to wetland and upland cells, and would increase the trophic exchanges and interaction between the wetland cells and the open-water embayment within the lateral expansion. In addition, the construction of small rock reefs within the open-water embayment would provide in-water refugia and physical cover to enhance fish habitat. Overall, there was general agreement that diversity of habitat types could be more beneficial than creating more of the same type of habitat currently under construction at the PIERP. However, components of the open-water embayment design, including the size of the embayment; location within the expansion (eastern vs. western portion); stability and function of the embayment; protection of wildlife; access for the public, commercial watermen, and recreational fishermen; and long-term maintenance would still need to be optimized.

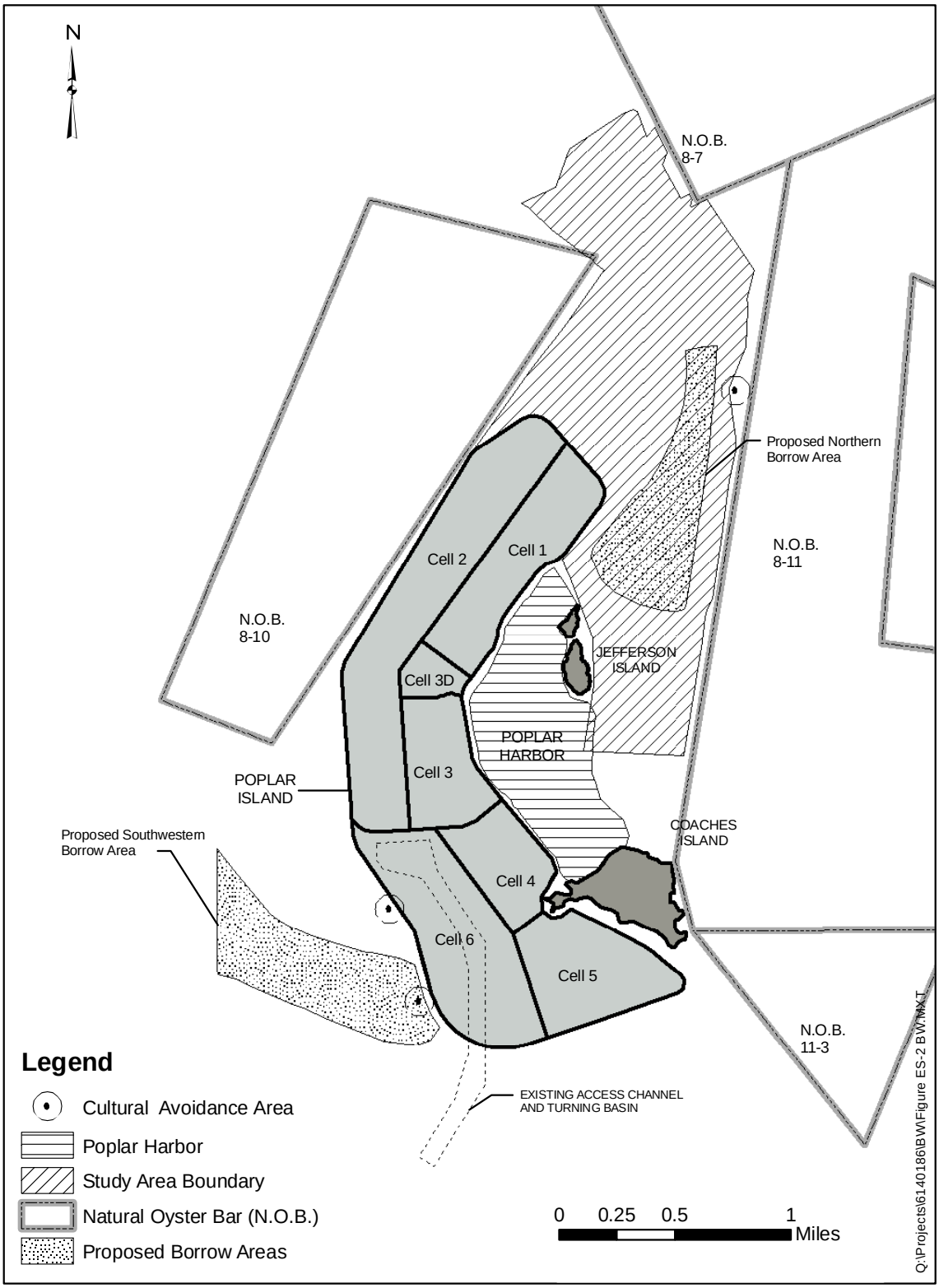

Figure ES-2. Poplar Island Expansion Study Area and Sand Borrow Areas

Based on consultation to-date with resource agencies, the open-water embayment could potentially range between 80 to 140 acres in size. Specifically, USFWS has proposed that the open-water embayment be between 80 and 90 acres, as compared to the NMFS recommendation of approximately 130 acres. With an open-water embayment of 130 acres, the lateral expansion would have a habitat proportion of 29 percent wetland habitat (165 acres), 47 percent upland habitat (270 acres), and 24 percent open water habitat (130 acres of open-water embayment habitat plus 10 acres of tidal gut habitat). Reducing the size of the open-water embayment to 80-acres, as recommended by USFWS, would result in a habitat proportion of 39 percent wetland (225 acres), 47 percent upland (270 acres), and 14 percent open-water (80 acres) within the lateral expansion. MDNR has requested further evaluation of the location and size of the open-water embayment (as it relates to long-term maintenance and stability), and MDE has raised concerns about sediment transport and water quality issues that could potentially arise from the location of the open-water embayment on the western side of the lateral expansion. The final size and location of the open-water embayment will be discussed and evaluated further in the next design phase of the project based on additional consultation with the resource agencies and MPA (the non-Federal sponsor); results of additional hydrodynamic modeling studies; and other design considerations. Analysis and design of the breakwater structures and the rock reefs included as part of the open-water embayment will also be completed during the next design phase of the project. The breakwaters and rock reefs will be designed to ensure stability under storm conditions, proper functioning within the open-water embayment (sufficient dampening of wave energy), and sufficient water exchange. For the purposes of the analyses and description of the recommended plan in this document, the size of the open-water embayment within the northern lateral expansion is estimated at approximately 130 acres in size.

Based on the results of the plan formulation process, three alternatives that are a combination of lateral and vertical expansion, in addition to the no-action alternative were carried forward in the impacts analysis:

1. **Alternative 1: (60 percent wetland / 40 percent upland and 5 ft upland raising)**: A 575-acre lateral expansion with 60 percent wetland habitat and 40 percent upland habitat, plus 5-ft vertical expansion of the existing upland cells. Sand borrow excavation from the southwestern borrow area would disturb approximately 91 acres of the borrow area. Approximately 315 acres of additional wetland habitat would be constructed, and Alternative 1 would provide approximately 29 mcy of dredged material placement capacity, and extend the life of the PIERP by approximately seven years.

2. **Alternative 2: (50 percent wetland / 50 percent upland and 5 ft upland raising)**: A 575-acre lateral expansion with 50 percent wetland habitat and 50 percent upland habitat, plus 5-ft vertical expansion of the existing upland cells. Sand borrow excavation from the southwestern borrow area would disturb approximately 49 acres of the borrow area. Approximately 275 acres of additional wetland habitat would be constructed, and Alternative 2 would provide approximately 30 mcy of dredged material placement capacity, and extend the life of the PIERP by approximately seven years.

3. **<u>Alternative 3:</u> (wetlands, uplands, open-water embayment, and 5 ft upland raising):** A 575-acre lateral expansion with 29 percent wetland habitat, 47 percent upland habitat, and 24 percent open-water embayment; plus 5-ft vertical expansion of the existing upland cells. Alternative 3 would incorporate an approximately 130-acre open-water embayment into the lateral expansion. Sand borrow excavation from the southwestern borrow area would disturb approximately 19 acres of bottom habitat. Alternative 3 would provide approximately 28 mcy of dredged material placement capacity, and extend the life of the PIERP by approximately seven years.

4. **<u>The No-Action Alternative</u>**: The existing built-out PIERP at its 1996 authorized configuration of 1,140 acres in size with 570 acres of upland habitat and 570 acres of wetland habitat. This alternative would not provide any additional dredged material placement capacity, and placement at the PIERP would continue until approximately 2015.

Alternative 3 is the environmentally preferred alternative because it increases the complexity and diversity of habitat types within the lateral expansion, providing a connection between deep and shallow subtidal zones, an open water pelagic zone, mudflat habitat, tidal guts throughout the wetland cells, submerged reef habitat, and rock reef habitat. The open-water embayment would provide forage access and refugia in the small tributaries and tidal guts in the wetland cells for juvenile fish species, juvenile blue crabs, and diamondback terrapins**.** The alignment with the open-water embayment would impact the least amount of borrow area outside the footprint of the lateral expansion (19 acres, as opposed to 91 and 49 acres), and results of the Island Community Units (ICU) analysis indicated that the alignment with the open-water embayment will produce the greatest number of environmental benefits 9,768 ICU.

ES.3 RECOMMENDED PLAN

Based on the results of the engineering screening, the environmental benefits determination, the Cost Effectiveness/Incremental Cost Analysis (CE/ICA), and the impacts assessment, the recommended plan of the Integrated GRR/SEIS includes implementation of the following: 1) Alternative 3 - a northern lateral expansion of the existing PIERP with inclusion of an open-water embayment and 5 ft raising of existing upland Cells 2 and 6; 2) actions to complete the existing project; 3) the development of recreational and educational components at the PIERP; and 4) acceptance of dredged material from the southern approach channels to the C&D Canal and other Federal navigation projects. The recommended plan is in full compliance with the NEPA of 1969, the Clean Water Act of 1972 (as amended), the Endangered Species Act of 1973, the Fish and Wildlife Coordination Act of 1958 (as amended), the Clean Air Act of 1972 (as amended), and Section 106 of the National Historic Preservation Act of 1966. A Clean Water Action Section 404(b)(1) evaluation was completed to assess discharge into a Water of the United States (Appendix K). The lateral and vertical expansion will be constructed under a water quality certification that will be obtained from MDE prior to the start of construction, as required by section 401(c) of the Clean Water Act. Once the construction for the lateral and expansion is completed, the water quality

certification for the existing project will be amended, and the entire project (existing plus the expansion) will operate under one comprehensive water quality certification.. Specific details of the adverse and beneficial impacts of the recommended plan are summarized in Section ES.4.

Lateral and Vertical Expansion

The recommended plan (Alternative 3) consists of the expansion of the existing PIERP to the north and northeast, with a 575-acre lateral expansion component consisting nominally of 29 percent wetland habitat, 47 percent upland habitat, and 24 percent open water and a vertical expansion component consisting of a 5-ft raising of the upland cells (Cells 2 and 6) of the existing project (Figure ES-3). The wetland habitat will include high marsh, low marsh, mudflat/intertidal areas, channels, and bird islands. The recommended lateral and vertical expansion would require dredging approximately 19 acres of sand from a 215-acre sand borrow area located to the southwest of the existing project. The recommended plan would provide an additional 28 mcy of placement capacity and would extend the project life by approximately seven years.

Actions to Complete Existing PIERP

Based on the reevaluation of the existing project, the following actions necessary to complete the existing project are also included in the recommended plan:

- raising the temporary height of the existing upland dikes from +23 ft mean lower low water (MLLW) to +25 ft MLLW;
- restoration of internal borrow sites within wetland Cell 4 and construction of temporary cross dikes within wetland Cell 5;
- closing Cell 6 and relocating the southern access channel and turning basin; and
- constructing new discharge, pier, and bulkhead structures to accommodate ongoing operations after the closure of Cell 6.

Approximately 2.5 mcy of sand borrow would be required to complete the existing project. It is anticipated that between 1.0-1.5 mcy of this sand would be dredged from the southwestern borrow area, disturbing approximately 119 acres of Bay bottom. In addition, the actions required to complete the existing project would require sand borrow from previously disturbed areas in Borrow Area F (approximately 60 acres) and Borrow Area G (approximately 35 acres), and dredging to relocate the southern access channel and basin, which would disturb approximately 28 acres. This is in addition to the 19 acres of sand borrow outside the footprint of the lateral expansion required for construction of the recommended plan, and the 30 acres that would be disturbed to dredge the northern access channel and turning basin for the lateral expansion. Therefore, a total of approximately 519 acres [470 (alignment footprint) + 19 + 30 acres] of bottom habitat would potentially be disturbed by the lateral and vertical expansion, and approximately 242 acres (119 + 60 + 35 + 28 acres) of bottom habitat would potentially be disturbed by actions required to complete the existing PIERP.

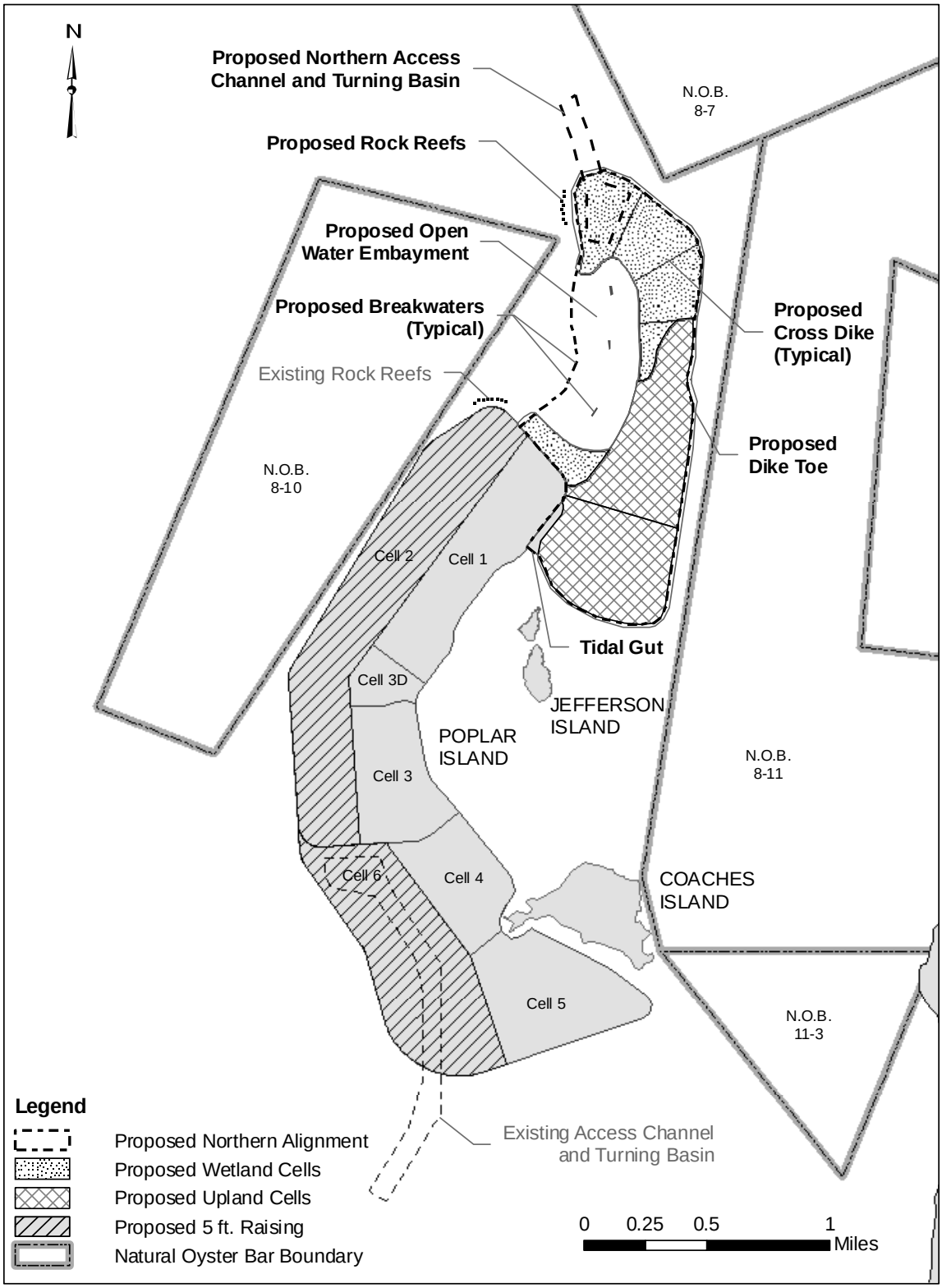

Figure ES-3. Recommended Plan (29% Wetland, 47% Upland Habitat, and 24% Open-Water Embayment Habitat, plus a 5 ft. Raising of PIERP Upland Cells 2 and 6)

Recreational / Educational Opportunities and Features

The recommended plan includes suggested recreational and educational components for the PIERP that are compatible with the project's ecosystem restoration purpose and objectives, and are intended to enhance the public's experience by taking advantage of natural values (ER 1105-2-100). Implementation of recreational/educational opportunities will be coordinated with interested parties and local jurisdictions. Recreational and educational opportunities and features would be limited to areas of the PIERP with controlled public access. Only passive recreation components were considered feasible for implementation at the PIERP because of the need to protect the project's habitat restoration goals. Components included for further consideration utilize a combination of passive recreation, education, and habitat-based improvements. The following recreational/educational opportunities may be considered for the PIERP:

- Public Tours of the Island
- Self-Guided/Interpretive Nature Trails and Boardwalks
- Kiosks with Informative Signage
- Research Opportunities for Educational Institutions
- Docking Area for Authorized Visiting Boats
- Demonstration Garden
- Avian Observation Areas
- Resting/Viewing Areas
- Volunteer Opportunities
- Picnic Areas
- Stone Sculpture/Monument/Memorial Area

Accepting Dredged Material from Additional Navigation Channels

The potential for the PIERP to accept dredged material from additional Federal navigation channels, as well as other navigation projects (including Federal, State, county and local channels) not specified in the original EIS (USACE/MPA, 1996) and PCA (April 1997) was investigated in this Integrated GRR/SEIS. Specifically, dredged material from the southern approach channels to the C&D Canal (south of the Sassafras River) and dredged material from other Federal, State, county, and local dredging projects was considered for placement at the PIERP. Dredged material from Federal navigation channels within Baltimore Harbor/Patapsco River (west of the North Point-Rock Point line) was not considered for placement at PIERP. Under the existing PIERP authorization, dredged material approved for placement at PIERP is limited to the following Baltimore Harbor and Channels project upper Chesapeake Bay Federal navigation channels: Craighill Entrance Channel, Craighill Channel, Craighill Angle, Craighill Upper Range, Cutoff Angle, Brewerton Channel Eastern Extension, Tolchester Channel, and Swan Point Channel.

The recommended plan includes amending the project authorization and PCA to include the placement of dredged material from the southern approach channels to the C&D Canal and placement of dredged material from other Federal navigation channels at the PIERP. Formal discussions with Federal and State regulatory and resource agencies indicated that the agencies supported the recommendation for future placement of the material from the southern approach channels to the C&D Canal at the PIERP following the mandatory closure of the Pooles Island open water site in 2010. Placement of material from the southern approaches to the C&D Canal will increase the annual placement volume at the PIERP from

approximately 2 mcy to 3.2 mcy per year, and the lateral and vertical expansion components of the recommended plan were designed to accommodate this additional annual placement need. Although USACE Policy Guidance Letter No. 47 states that the USACE may allow non-Federal entities to utilize Federal placement facilities, acceptance of material from other non-Federal dredging projects at the PIERP is not part of the recommended plan because of concerns expressed by Federal and State regulatory and resource agencies.

ES.4 IMPACTS ANALYSIS

The potential impacts of each of the three alternatives and the no-action alternative to environmental and cultural resources and quality of human environment were evaluated. The primary differences between the three alternatives are a difference in the amount of open-water embayment habitat and Bay bottom that will be disturbed by constructing the footprint of the northern lateral alignment (approximately 600 acres for Alternatives 1 and 2; approximately 470 acres for Alternative 3), and a difference in the extent of Bay bottom in the southwestern sand borrow area that will be disturbed during hydraulic dredging (approximately 91 acres for Alternative 1; approximately 49 acres for Alternative 2; and approximately 19 acres for Alternative 3).

It is important to note that each of the three alternatives considered, as well as the no-action alternative, also include impacts related to the actions required to complete the existing PIERP and impacts to additional borrow areas (both are discussed in more detail in Section ES.4.3).

The existing project was constructed and dredged material was placed in compliance with a Water Quality Certification from the State of Maryland. The existing project also maintains an extensive monitoring and adaptive management plan, and the lateral and vertical expansion would be incorporated into both plans.

ES.4.1 Long-Term Impacts of the Lateral and Vertical Expansion

The primary long-term, significant adverse impact of the lateral expansion will be the loss of approximately 470 acres of open water and bottom habitat within the footprint of the northern lateral alignment. The loss of open water habitat would have a direct impact on finfish species, the blue crab fishery, and indirect impacts to the avian community. Each of these groups will be displaced, but most species will utilize the surrounding area after the construction is complete. The loss of bottom habitat would have a direct impact on the benthic community, clams, and blue crabs, and an indirect impact on the potential for submerged aquatic vegetation (SAV) recovery within the alignment. Specifically, the loss of approximately 100 acres of shallow-water habitat within the alignment may directly affect utilization by fish species for which the area serves as Essential Fish Habitat (EFH), recreational fisheries and blue crabs, and will directly affect the potential for SAV and clams to repopulate this area. An additional long-term adverse impact of the lateral expansion is that the expansion alignment would occupy a larger portion of the view of the Bay from Coaches and Jefferson Islands. The lateral expansion would displace commercial and recreational fishing and crabbing activities and require both commercial watermen and recreational boaters to motor further north to avoid the northern tip of the expansion.

With the inclusion of the open-water embayment, the interaction between the wetland and open-water embayment habitats would be expected to increase the overall productivity of the habitats created within the northern lateral alignment, resulting in a beneficial impact to avian, fish, and wildlife species, particularly when the vegetation within each cell matures. The trophic exchange and interaction between wetland cells and open water could particularly benefit EFH species such as summer flounder, and would support juvenile blue crabs, and a diversity of juvenile fish species, including Atlantic silverside. The open-water embayment would provide forage access and refugia in the small tributaries and tidal guts in the wetland cells for juvenile fish species, juvenile blue crabs, and diamondback terrapins. No dredged material would be placed in the open-water embayment, thus conserving the existing substrate, benthic community, and natural bathymetry. The conservation of the bottom habitat within the open-water embayment will have a beneficial impact on the benthic community, clams, and blue crabs. The anticipated enhancement of the existing benthic community within the open-water embayment will provide more forage opportunities for EFH species and other finfish. In addition, the 130-acre open-water embayment should create quiescent conditions that could potentially support additional SAV beds along the shorelines and habitat of particular concern (HAPC) preferred by EFH species, other finfish species, and waterfowl.

A long-term beneficial impact of the lateral expansion would be an increase in dredged material placement capacity and an increase in remote island habitat by approximately 470 acres, and the creation of 130 acres of sheltered open-water embayment habitat. The combination of a lateral and vertical (5-ft raising of existing upland dikes) expansion in the recommended plan is expected to provide approximately 28 mcy of additional dredged material capacity. The success of the existing PIERP is an indication that a multitude of terrestrial and aquatic species will utilize the wetland and upland habitat created through the beneficial use of dredged material, even prior to the completion of cell development. The creation of additional wetland habitat would both provide nursery area for juvenile finfish and shellfish species and be utilized by the avian community and other wildlife. Long-term beneficial impacts of the lateral expansion also include the protection of Jefferson Island. This protection will decrease water column turbidity, thereby improving water clarity in Poplar Harbor. Increased water clarity and enhanced protection of Poplar Harbor would provide additional quiescent areas in Poplar Harbor for blue crabs, clam species, finfish species, and EFH. Protected areas in Poplar Harbor could support the reestablishment of SAV and provide cover for finfish.

The lateral expansion will create approximately 470 acres of additional remote island habitat at the PIERP. This habitat will have a beneficial impact to numerous avian and wildlife species, in particular when the vegetation and habitat within the cells matures. The development of island habitat specifically for targeted avian species provides a significant long-term positive impact as a result of the lateral expansion. Offshore remote islands are a unique ecosystem component in the Chesapeake Bay watershed. Many migratory birds and water birds preferentially select these islands as resting and nesting locations. Although similar vegetative communities may occur on the mainland, the isolation, relative lack of human disturbance, and reduced number of predators make islands more desirable as nesting sites for colonial water birds and other avian species, including the Federally-listed Bald Eagle (*Haliaeetus leucocephalus*).

ES.4.2 Short-Term Impacts of the Lateral and Vertical Expansion

Short-term, adverse impacts of the lateral expansion include an increase in water column turbidity and sedimentation in the construction and dredging areas. These short-term impacts would directly affect the water quality in the project area, and may indirectly affect the phytoplankton and zooplankton communities, the adjacent natural oyster bars (NOBs), clams, blue crabs, finfish species, and SAV species in Poplar Harbor. These impacts are not considered significant because of their short duration and localized effects. Time of year (TOY) restrictions will be in place to protect resources and minimize adverse impacts during dredging and construction activities. Another short-term impact of the lateral expansion is an increase in the duration of project-related noise and night-time lighting during perimeter dike construction, additional dredged material inflow operations, and general island cell development. Specifically, the residents and wildlife of Jefferson Island would experience increased noise levels during the construction phases of the project. These noise-related impacts will be most prevalent during the exterior dike construction and dike raising phases of the expansion, which are expected to occur concurrently over approximately two years.

Additional short-term beneficial impacts associated with the lateral expansion include additional interim benefits related to the additional acreages of wetland and upland habitat, and the increased spending that will create jobs both locally and at the state level. The jobs created as part of the expansion will temporarily increase employment rates, income, and revenues.

ES.4.3 Impacts Common to All Alternatives

Several additional project actions are required to complete the existing project. These actions include: (1) raising the existing upland cells from +23 ft MLLW to +25 ft MLLW; (2) closing Cell 6; (3) constructing new discharge, pier and bulkhead structures; (4) relocating the southern access channel and turning basin; (5) restoration/development of existing cells; and (6) implementing recreational/educational components. Because these activities are needed regardless of which alternative is ultimately selected, they were evaluated separately. Impacts associated with these activities are common to each of the alternatives considered for the lateral and vertical expansion.

Short-term, minor impacts to air quality and noise quality may occur from raising the existing upland cells from a temporary dike height of +23 ft MLLW to a temporary dike height of +25 ft MLLW; closing Cell 6; and constructing the new discharge, pier, and bulkhead structures, but effects are expected to be similar to those noted during current site operations at the PIERP. Aesthetic impacts associated with increasing the height of the temporary dike raising for Cells 2 and 6 by two feet to +25 ft MLLW; closing Cell 6; and constructing the new discharge, pier and bulkhead structures would be negligible and short-term.

The educational and passive recreational components that were considered as part of this project would not interfere with the original project goal of remote island habitat and would be constructed to avoid or minimize impacts to the created habitats and the wildlife species

currently using the interim habitats available at the PIERP. Additional beneficial impacts to wildlife would result from the construction of nesting platforms.

Impacts Associated with Borrow Area and Access Channel Dredging

Each of the three alternatives considered also include impacts related to the actions to complete the existing PIERP, which include Bay bottom disturbance of additional borrow areas. To support the construction of the lateral and vertical expansion, hydraulic dredging will disturb approximately 19 acres of the southwestern borrow area for Alternative 3 (recommended plan) (Figure ES-4). In addition, approximately 30 acres will be dredged in the northern portion of the expansion for the northern access channel and turning basin (Figure ES-3). Therefore, in addition to the 470 acres impacted by the footprint of the northern lateral expansion, a total of approximately 49 (19 + 30) acres of bottom habitat will be disturbed by the lateral and vertical expansion.

In addition to the sand borrow required for the lateral and vertical expansion, sand borrow will also be required to support activities required to complete the existing project, which will require dredging approximately 119 acres in the southwestern borrow area, 60 acres in Borrow Area F, and 35 acres in Borrow Area G. Also, approximately 28 acres of dredging would be necessary to relocate the southern access channel and basin (Figure ES-4). A total of approximately 242 acres (119 + 60 + 35 + 28 acres) of Bay bottom outside the footprint of the lateral expansion would be disturbed by actions required to complete the existing PIERP. Therefore, a total of approximately 291 acres (49 + 242 acres) outside the footprint of the lateral expansion would be disturbed as a result of the sand borrow required to construct the recommended plan.

Short-term water quality impacts associated with increased turbidity during dredging will affect the water quality in the project area and may indirectly affect the phytoplankton and zooplankton communities, clams, oysters, blue crabs, finfish species, and potentially the EFH species summer flounder. Dredging in the sand borrow areas may temporarily impact clam species, blue crabs, benthic species, and finfish species expected to utilize this area following sand borrow activities. Dredging the southwestern borrow area could also have potential short-term impacts on noise quality, light, economic impacts to aquatic resources (specifically, clams, blue crabs, and finfish species), and commercial and recreational fishing. The temporary use of the southwestern borrow area may also conflict with pound net and gill net fisheries if nets cannot be shifted to equally productive sites. Additionally, the excavation of the southwestern borrow area will increase the water depths to a maximum depth of -25 ft MLLW, which may have a long-term impact on blue crab and finfish utilization of this area following excavation activities, particularly in warmer months when deeper areas of the Chesapeake Bay are prone to seasonal reduction in oxygen. The USACE will work with regulatory agencies to develop a plan for the sand borrow that will minimize impacts associated with sand borrow dredging.

ES.4.4 Impacts from the No-Action Alternative

The primary benefit of the no-action alternative would be no loss of open water habitat, Bay bottom habitat, and shallow water habitat within the footprint of the expansion alignment. In addition, no areas currently utilized for commercial crabbing would be lost.

The no-action alternative has several adverse impacts. Without construction of a PIERP expansion, the capacity goals of the Federal Dredged Material Management Plan (DMMP) (USACE, 2005) will not be met, resulting in the inability to maintain the navigation channels to authorized depths and higher than expected quantities of dredged material placement in the existing PIERP. Increasing the dredged material placement quantity at the existing PIERP would shorten the overall life of the site, decrease placement efficiency, overload the cells, and reduce the ability to maintain proper habitat development. Another adverse impact of the no-action alternative will be that additional valuable remote island wetland and upland would not be created and available to avian species, diamondback terrapins, and other wildlife. The third adverse impact of the no-action alternative is that no additional protection of Poplar Harbor, Jefferson Island, Coaches Island, and the Eastern Shore mainland would be provided. Without the additional protection from wave action provided by the lateral expansion, erosion of habitats located on Jefferson and Coaches Island would continue at current rates.

ES.5 CUMULATIVE IMPACTS

Cumulative impacts are those combined effects on the quality of the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Recent and reasonably foreseeable human actions that have converted or would convert open water habitat to island upland and tidal wetland habitat include the existing PIERP, the lateral expansion of the PIERP, the proposed island restoration project at James Island in the Mid-Bay region, the proposed restoration of Barren Island, the proposed SAV and wetlands protection and restoration measures at Smith and Tangier Islands, and the proposed wetland restoration project in Dorchester County (USACE, 2005). The cumulative impact of these USACE projects would total approximately 3,803 acres of open water habitat lost and approximately 4,168 acres of bottom habitat lost or disturbed. However, these same projects would also create/restore approximately 3,571 acres of wetland habitat and approximately 1,770 acres of upland habitat, and would minimize future loss of existing island habitat. Approximately 10,000 acres of remote island habitat has been lost to erosion throughout the Chesapeake Bay in the last 150 years.

The loss of Chesapeake Bay bottom is not expected to have major cumulative impacts on fisheries of the region. It is expected that fish and fishermen will be able to shift to new regions outside the footprints of the island restoration projects. The lateral expansion of the PIERP and the proposed James Island restoration project will have a beneficial impact by creating additional remote island habitat in the Chesapeake Bay. The additional wetland habitat will provide important nursery habitat, and both projects, along with Barren Island, are being designed to protect Tier I SAV habitat. Recovery of SAV adjacent to the PIERP, Barren Island, and James Island would be a significant positive cumulative effect on HAPC in this reach of the Chesapeake Bay.

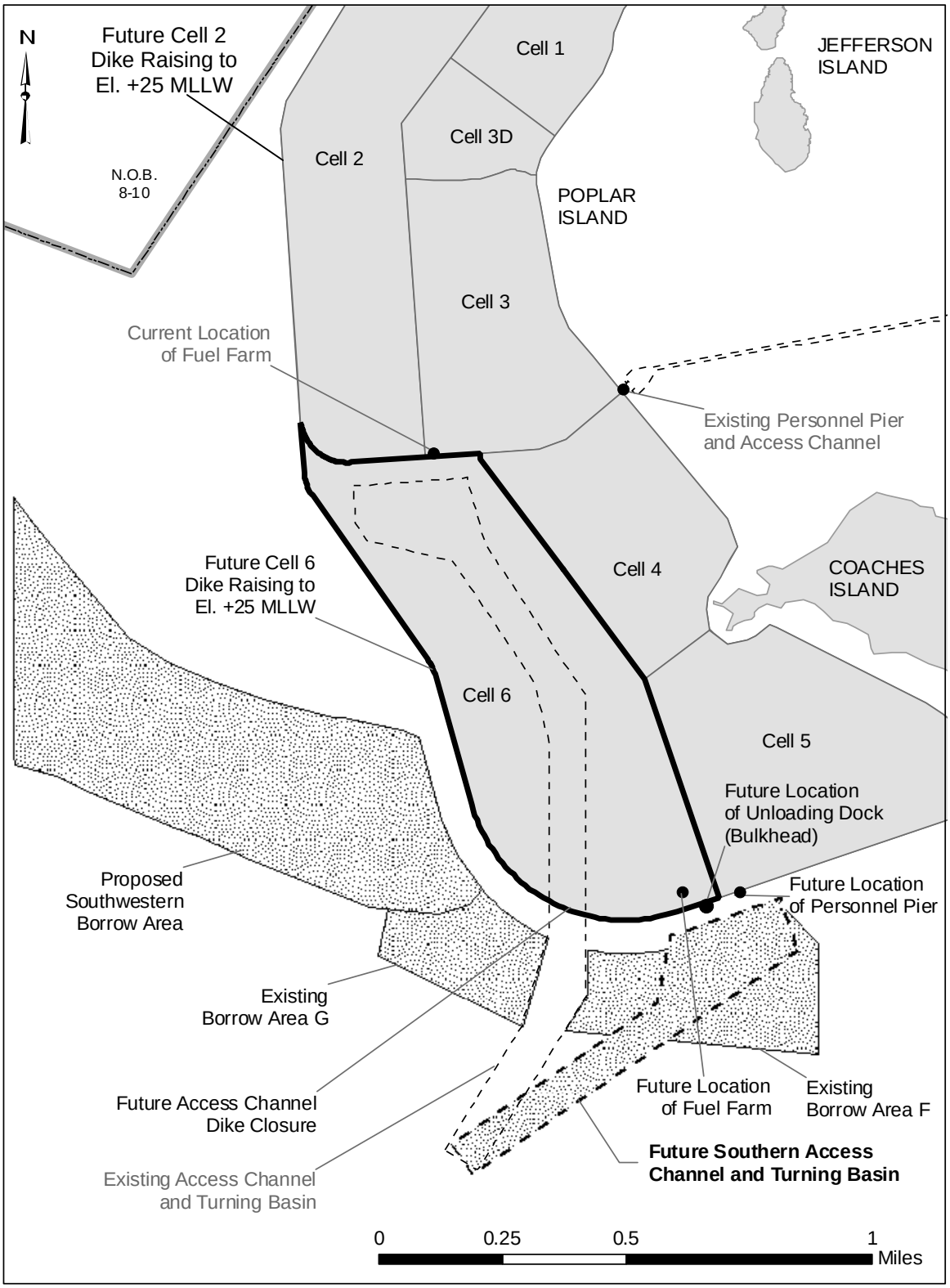

Figure ES-4. Activities Required for the Completion of the Existing Project ***(also includes cell restoration and development in Cells 4 and 5)***

ES.6 FUTURE EXPANSION AT PIERP AND OTHER FUTURE PROJECTS

In the future, if or when the USACE is in need of placement capacity, USACE policy will require an assessment of expansion and maximization of existing sites first. Based upon the results of the engineering analyses (including engineering suitability and placement analyses), agency concerns and public comments, environmental benefits analyses [including the ICU analysis to quantify the environmental benefits of the project], and the incremental cost analysis conducted as part of this study, it does not appear that further vertical expansion (additional raising of the upland dikes) would result in additional substantive environmental benefits to the PIERP. In addition, lateral expansion in the future would be geographically unlikely based on the existing environmental and engineering constraints at the site (i.e., locations of NOBs, other environmental resources, water depths, and availability of sand borrow materials). The current recommended plan was designed to maximize the benefits of a one-time lateral expansion. Further study of additional environmental restoration in this geographic area (vicinity of the PIERP) would not, as currently assessed, lead to recommended future expansion scenarios at the PIERP.

It is important to note that USFWS and NMFS have indicated that the inclusion of an open-water embayment in lieu of wetland habitat within the northern lateral expansion is an environmentally preferred option based on site-specific conditions. Both agencies have indicated that the open-water embayment design would be applicable only to the lateral expansion of Poplar Island. The general agency agreement of constructing 50 percent (minimum) vegetated wetland habitat would continue to be applicable for future island ecosystem restoration projects.

ES.7 PROJECT SUMMARY

The total, fully-funded project cost for the PIERP is an estimated $715.7 million. The fully funded cost for the PIERP, as currently authorized, is $401.5 million; and the estimated fully funded cost for the recommended plan for the lateral and vertical expansion of the PIERP is $314.2 million. The recommended plan for the lateral and vertical expansion of the PIERP is to be cost-shared $235.7 million for the Federal government (75 percent) and $78.5 million for the non-Federal sponsors (25 percent). The total, fully-funded project cost does not include approximately $6.4 million in costs for project betterments, which were paid for 100 percent by MPA, the non-Federal sponsor. Under an existing PCA, MPA has contributed approximately $59.3 million in cash and in-kind services to support the project, to date. It is anticipated that the existing PCA would be amended to include the expansion of the PIERP.

In summary, the results of the Integrated GRR/SEIS support Federal involvement in placing dredged material from the Upper Chesapeake Bay Approach Channels to the Port of Baltimore (not including the Baltimore Harbor channels in the Patapsco River) to beneficially restore remote island habitat, including wetlands and uplands, at Poplar Island, Maryland. The non-Federal sponsor, MPA, agrees with the findings in this GRR/SEIS. In view of this expression of non-Federal support, the District Engineer recommends that the Integrated GRR/SEIS be approved and that the improvements associated with the recommended plan be authorized for construction.

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LIST OF ABBREVIATIONS, ACRONYMS, and UNITS

AACC	Anne Arundel Community College
Ac	Acre
ACES	Automated Coastal Engineering System
AD	Anno Domini
ADCIRC	ADvanced CIRCulation model
AES	Atmospheric Environmental Service of Canada
AFB	Alternative Formulation Briefing
ANSI	American National Standards Institute
APHIS	Animal and Plant Health Inspection Service
ASACW	Assistant Secretary of the Army Civil Works
AVS	Acid Volatile Sulfides
BA	Biological Assessment
BC	Before Christ
B-IBI	Benthic Index of Biotic Integrity
BOD	Biochemical Oxygen Demand
bu/hr	Bushels Per Hour
BEWG	Bay Enhancement Working Group
BFE	Base Flood Elevation
BWI	Baltimore-Washington International Airport
C&D	Chesapeake and Delaware
CAC	Citizens' Advisory Committee
CBL	Chesapeake Biological Laboratory
CBP	Chesapeake Bay Program
CBIA	Coastal Barriers Improvement Act
CBRA	Coastal Barriers Resource Act
CBRS	Coastal Barriers Resource System
CCA	Coastal Conservation Association
CEQ	Council of Environmental Quality
CE	Cost Effectiveness
CEM	Coastal Engineering Manual
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHESFIMS	Chesapeake Bay Fishery-Independent Multispecies Survey
CIRP	Coastal Inlets Research Program
cm/s	Centimeter(s) Per Second
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
COMAR	Code of Maryland Regulations
CPUE	Catch Per Unit Effort
cy	Cubic Yard
CZCD	Coastal Zone Consistency Determination
CZMA	Coastal Zone Management Act

CZMP	Coastal Zone Management Program
dBA	A-Weighted Decibel
DE	Delaware
DEIS	Draft Environmental Impact Statement
DEM	Digital Elevation Model
DEPRM	Department of Environmental Protection and Resource Management (Baltimore County)
DO	Dissolved Oxygen
DMMP	Dredged Material Management Plan
DPR	Detailed Project Report
DPW	Department of Public Works
E	East
EA	EA Engineering, Science, and Technology
ECI	Environmental Concern, Inc.
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
ENE	East Northeast
EO	Executive Order
ER	Engineering Regulation
ERC	Environmental Regulations Consultant, Inc.
ERDC	Engineer Research and Development Center
ERPCT	Ecosystem Restoration Project Coordination Team
ESA	Endangered Species Act
ESE	East Southeast
EST	Empirical Simulation Technique
^{o}F	Degrees Fahrenheit
FEMA	Federal Emergency Management Agency
FHA	Federal Highway Administration
FIRM	Floodplain Insurance Rate Map
FPPA	Farmland Protection Policy Act
ft	Foot/Feet
ft/sec	Feet per Second
ft/yr	Feet per Year
FTE	Full Time Equivalent
FY	Fiscal Year
GBA	Gahagan and Bryant Associates, Inc
GIS	Geographic Information System
GPS	Global Positioning System
GRR	General Reevaluation Report
H&H	Hydrologic and Hydrodynamic

H:V	Horizontal-to-Vertical Ratio
HAPC	Habitat of Particular Concern
HDPE	High Density Polyethylene
HPEL	University of Maryland Center for Environmental Studies – Horn Point Environmental Laboratory
hrs/yr	Hours per Year
HT	Harbor Team
HTRW	Hazardous, Toxic, and Radioactive Waste
ICA	Incremental Analysis
ICI	Island Community Index
ICU	Island Community Unit
IMPLAN	Impact Planning (regional economic modeling system)
in	Inches
ITM	Inland Testing Manual
ITR	Independent Technical Review
lbs	Pounds
LEED	Leadership for Energy and Environmental Design
LHH	League for Hard of Hearing
m	Meter(s)
mcy	Million Cubic Yard(s)
mcy/yr	Million Cubic Yards per Year
MAFMC	Mid-Atlantic Fisheries Management Council
MCACES	Micro-Computer Aided Cost Engineering System
MD	Maryland
MDE	Maryland Department of the Environment
MDOT	Maryland Department of Transportation
MDNR	Maryland Department of Natural Resources
MES	Maryland Environmental Service
mg/L	milligrams per liter
MGS	Maryland Geological Survey
MHT	Maryland Historic Trust
mi	Mile
MLLW	Mean Lower Low Water
M&N	Moffatt and Nichol Engineers
MPA	Maryland Port Administration
mph	Miles per Hour
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
MSHW	Mean Spring High Water
MSL	Mean Sea Level
MSSA	Maryland Saltwater Sportfisherman's Association
MTL	Mean Tide Level
MWA	Maryland Waterman's Association

N	North
NAAQS	National Ambient Air Quality Standards
NAD	North American Datum
NCAR	National Centers for Atmospheric Research
NCEP	National Centers for Environmental Protection
NEPA	National Environmental Policy Act
NER	National Ecosystem Restoration
NHPA	National Historic Preservation Act
NM	Nautical Mile
NMFS	National Marine Fisheries Service
NE	Northeast
NNE	North-Northeast
NNW	North-Northwest
NO_x	Nitrogen Oxides
NOAA	National Oceanic and Atmospheric Administration
NOB	Natural Oyster Bar
NOI	Notice of Intent
NOS	National Ocean Service
NPS	National Parks Service
NTU	Nephelometric Turbidity Unit
NW	Northwest
NWF	National Wildlife Refuge
O_3	Ozone
OCTI	Offshore and Coastal Technologies, Inc.
OMB	Office of Management and Budget
OTC	Ozone Transport Commission
OTR	Ozone Transport Region
PAH	Polynuclear Aromatic Hydrocarbon
Pb	Lead
PCA	Project Cooperation Agreement
PCB	Polychlorinated Biphenyl
PDT	Project Delivery Team
PED	Preconstruction, Engineering, and Design
PGL	Policy Guidance Letter
PH	Poplar Harbor
PI	Poplar Island
PIERP	Poplar Island Environmental Restoration Project
PIES	Poplar Island Expansion Study
PIT	Passive Integrated Transponder
PL	Public Law
PM	Particulate Matter

PMP	Project Management Plan
PPMD	Program and Project Management Division
ppt	Parts per thousand
PSDDF	Primary Consolidation Secondary Compression and Dessication of Dredged Fill
PWC	Personal Watercraft
QA	Quality Assurance
QC	Quality Control
RAS	Resource Assessment Service
RGI	Restoration Goal Index
ROD	Record of Decision
RRT	Relative Retention Time
RS	Raw Score
RTE	Rare, Threatened, or Endangered
S	South
SAV	Submerged Aquatic Vegetation
SDD	Sustainable Design and Development
SE	Southeast
SEIS	Supplemental Environmental Impact Statement
SEM	Simultaneously Extracted Metals
SHPO	State Historic Preservation Office
SMS	Surface Wave Modeling System
SNS	Shortnosed Sturgeon
SO_2	Sulfur Dioxide
SPCC	Spill Prevention Control and Countermeasure
SPiRiT	Sustainable Project Rating Tool
SQ	Sediment Quality
SQG	Sediment Quality Guidelines
SSE	South-Southeast
SSI	Supplemental Security Income
SSW	South-Southwest
STWAVE	Spectral Wave Transformation Model
SVOC	Semivolatile Organic Compound
SW	Southwest
SWH	Shallow Water Habitat
TDN	Total Dissolved nitrogen
TDP	Total Dissolved phosphorus
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TOC	Total Organic Carbon
TOY	Time of Year

TSS	Total Suspended Solids
UCB-FEM	Upper Chesapeake Bay Finite Element Model
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UMCES	University of Maryland Center for Environmental Studies
UXO	Unexploded Ordinance
VA	Virginia
VIMS	Virginia Institute of Marine Science
VOC	Volatile Organic Compound
VRAP	Visual Resources Assessment Procedure
W	Watt
WES	Waterways Experiment Station
WF	Weighting Factor
WNW	West-Northwest
WQ	Water Quality
WQC	Water Quality Certification
WRDA	Water Resources Development Act
WS	Weighted Score
WSW	West-Southwest
yr	Year

GLOSSARY OF TECHNICAL TERMS

(***** denotes definitions which are quoted verbatim from guidelines, such as definitions at 40 CFR 230.3 and/or other parts)

A-Weighted Decibel (dBA): An overall frequency-weighted sound level in decibels which approximates the frequency response of the human ear.

Abundance: Mean number of individual organisms.

Accretion: The natural or artificial buildup of land by deposition of waterborne or airborne material or by an act of man, such as the construction of a groin or breakwater.

Acid volatile sulfide (AVS): The sulfides removed from sediment by cold acid extraction, consisting mainly of H_2S and FeS. AVS is a predictive tool for divalent metal sediment toxicity.

Acute: An effect having a sudden onset, lasting a short time.

Acute water quality criteria: A water quality criteria recommendation for the highest in-water concentration of a chemical or effluent to which organisms can be exposed for a brief period of time without causing an acute effect.

A.D.: An abbreviation used with a date, indicating how many years have passed since the birth of Jesus. It stands for *anno Domini*, a Latin phrase meaning "in the year of our Lord".

Algae: Simple rootless plants that grow in bodies of water (e.g. estuaries) at rates in relative proportion to the amounts of nutrients (e.g. nitrogen and phosphorus) available in water.

Ammonium: (NH4+) chemical compound that is a source of nitrogen for plants and microorganisms.

Amphipod: Small crustacean belonging to phylum Arthropoda.

Anadromous: Fish that spend most of their life in salt water but migrate into freshwater tributaries to spawn (i.e. shad, sturgeon).

Analyte: A single chemical constituent.

Analytical fraction: A group of chemical constituents that is measured using a single analytical method or instrument.

Anoxia/Anoxic: Without dissolved oxygen or in oxygen deficit. Dissolved oxygen concentrations of 0 mg/l (MDE 1994).

Anthropogenic: Influenced by the activities of humans.

Archipelago: Group or string of islands.

Assemblage: A group of populations of similar organisms that co-occur and interact.

Astronomical tide: The tidal levels and character which result from gravitational effects from the Earth, Sun, and Moon, without atmospheric influences.

Bathymetry: The physical characteristics, including depth, contour, and shape of the bottom of a body of water, such as oceans, seas, bays and lakes.

Bay Bridge: WM Preston Lane Jr. Memorial Bridge. Located between Kent Island and Cape St. Clair, Maryland.

B.C.: An abbreviation used with dates of events that took place before the birth of Jesus. B.C. stands for *before Christ*.

Benthic: Living in, on, or in close association with the bottom of a body of water.

Benthic Index of Biotic Integrity: Evaluates the ecological condition of a sample by comparing values of key benthic community attributes to reference values expected under non-degraded conditions in similar habitat types.

Benthic macroinvertebrates: Macroinvertebrates are large, generally soft-bodied organisms that lack backbones. Benthic macroinvertebrates live in or on the bottom sediment in aquatic environments.

Benthos: A group of organisms, most often invertebrates, that live in or on the bottom in aquatic habitats (such as clams that live in the sediments) which are typically immotile or of limited motility or range.

Bioaccumulation: The accumulation of chemical constituents in the tissue of organisms through any route, including respiration, ingestion, or direct contact with chemical constituents in water, sediment, pore water, or dredged material.

Bioavailable: In a form that is readily consumed or assimilated by organisms. Some metals and chemical constituents bind to particulates and are not available for uptake by organisms.

Biochemical oxygen demand (BOD): A measure of the quantity of oxygen used by microorganisms in the oxidation of organic matter.

Biodiversity: The assemblage of different species found in any ecosystem.

Biological Diversity: The variety of life in all its forms, levels and combinations including ecosystem diversity, species diversity and genetic diversity.

Biotic: Life and living organisms.

Bivalve: An organism that has a two-part shell (e.g., clams, mussels, oysters).

Bloom: A large population increase of phytoplankton that remains within a defined part of the water column.

Body burden: The concentration of a chemical constituent that accumulates in the tissue of an organism.

Borrow area: Area from which material (e.g., sand, soil, etc.) is taken for use in another location.

Brackish: Somewhat salty water, as in an estuary.

Breakwater: A structure protecting a shore area, harbor, anchorage, or basin from waves.

Bulk sediment chemistry: Results of chemical analyses of whole sediments (in terms of wet or dry weight), without normalization (e.g., to organic carbon, grain-size, acid volatile sulfide).

Catadromous: Fish that live in freshwater and migrate to saltwater to spawn (i.e. American eel).

Chain of custody: Documentation that describes the date and time of collection for each environmental sample (sediment, water, or tissue), and the date and time of transfer of each environmental sample to the analytical or ecotoxicological laboratory.

Chemical constituents: Chemical substances associated with or contained in or on dredged material.

Chemical oxygen demand (COD): A measure of the oxygen required to oxidize all compounds in water, both organic and inorganic.

Chlorophyll *a*: A photosynthetic pigment found in plants, including phytoplankton. Frequently utilized as an estimate of plant or phytoplankton standing crop.

Chronic: An effect involving a stimulus that is lingering or which continues for a long time.

Chronic water quality criteria: A water quality criteria recommendation for the highest in-water concentration of a chemical or effluent to which organisms can be exposed indefinitely without causing unacceptable effects.

Clay: A fine grained, plastic, sediment with a typical grain size less than 0.004 mm. Possesses electromagnetic properties which bind the grains together to give a bulk strength or cohesion.

Coast: A strip of land of indefinite width that extends from the shoreline inland to the first major change in terrain features.

Coastal plain: The level land with generally finer and fertile soils downstream of the piedmont and fall line, where tidal influence is felt in the rivers.

Coastline: Line separating the coast and the shore, or, more commonly, the boundary between land and water.

Cohesive sediment: Fine-grained sediment containing a significant proportion of clays, the electromagnetic properties of which cause the sediment to bind together. Cohesive sediments tend to have high shear strengths.

Community: An ecological unit consisting of the micro-organisms, animals, and plants that inhibit a particular area.

Compaction: A decrease in the volume or thickness of a sediment or soil under load through the closer packing of constituent particles; accompanied by a decrease in porosity and an increase in density.

Comparability: The confidence with which one data set can be compared to others and the expression of results consistent with other organizations reporting similar data. Comparability of procedures also implies using methodologies that produce results comparable in terms of precision and bias.

Compatibility: The degree to which landscape elements and characteristics are still unified within their setting.

Congener: A member of a family of chemical compounds sharing similar structure and characteristics.

***Contaminant:** A chemical or biological substance in a form that can be incorporated into, onto, or be ingested by and that harms aquatic organisms, consumers of aquatic organisms, or users of the aquatic environment.

Copepod: Minute aquatic crustaceans having elongated bodies and forked tails belonging to the subclass Copepoda.

Core sample: Rock, sediment, or soil that is extracted by drilling and used for analysis.

Coterminous: Having a boundary in common; contiguous

County subdivision: The primary legal or statistical division of a county or statistically equivalent entity, as defined by the United States Census Bureau.

Crab pot: An approximately one cubic yard cage used commercially and recreationally to trap blue crabs.

Crustaceans: The class of aquatic Arthropods including copepods, isopods, amphipods, barnacles, shrimp, and crabs which are characterized by having jointed appendage and gills.

Current: A flow of water, typically generated by wave action, tidal fluctuations, or winds.

Current rose: Graphic representation of currents, utilizing arrows to the direction toward which the prevailing current flows and a percentage to show the frequency of any given flow

Decapod: Crustacean such as crab, lobster, or shrimp of order Decapoda.

Decibel: A unitless measure of sound on a logarithmic scale, which indicates the squared ratio of sound pressure amplitude to a reference sound pressure amplitude. The reference pressure is 20 micro-pascals.

Deep water: Water deep enough that the Bay bottom does not affect waves (greater than –12 ft MLLW).

Demersal: Fish that live on or near the ocean bottom. They are often called benthic fish, groundfish, or bottom fish

Depth: The vertical distance from a specified tidal datum to the sea floor.

Designated use: An element of a water quality standard, expressed as a narrative statement, describing an appropriate intended human and/or aquatic life objective for a water body. Designated uses for a water body may include: recreation, shellfishing, water supply and/or aquatic life habitat.

Diatoms: Microscopic algae with plate like structures composed of silica. Diatoms are considered a good food source for zooplankton.

Dike: An embankment constructed (typically using soil and rock) to contain dredged material or to serve as a protective barrier.

Dioxin: A family of carcinogenic hydrocarbons.

Direct economic impact: Amount of direct economic activity and change in local business activity occurring as a direct consequence of the project.

Dissolved organic carbon (DOC): The fraction of carbon bound in organic compounds in water that is made up of particles smaller than 0.45mm, which is separated out from total organic carbon by filtration.

Dissolved oxygen: Microscopic bubbles of oxygen that are mixed in the water and occur between water molecules. Dissolved oxygen is necessary for healthy lakes, rivers, and estuaries. Most aquatic plants and animals need oxygen to survive. Fish will drown in water when the

dissolved oxygen levels get too low. The absence of dissolved oxygen in water is a sign of possible pollution.

District: A U.S. Army Corps of Engineers administrative area.

Diversity: A measure of the number of species coexisting in a community.

***Dredged material:** Material that is excavated or dredged from waters of the United States.

Dredging: Excavation or displacement of the bottom or shoreline of a water body with mechanical or hydraulic machines. Done to maintain channel depths or berths for navigational purposes, for shellfish harvesting, for cleanup of polluted sediments, and as a source for placement of sand on beaches

Ebb current: The movement of a tidal current away from shore or down a tidal stream. The terms of maximum ebb and minimum ebb are applied to the maximum and minimum velocities of a continuously running ebb current, the velocity alternately increasing and decreasing without coming to a slack or reversing. The expression maximum ebb is also applicable to any ebb current at the time of greatest velocity

Ebb tide: The period of tide between high water and the succeeding low water; a falling tide.

Effluent: The discharge to a body of water from a defined source, generally consisting of a mixture of waste and water from industrial or municipal facilities.

Environmental Impact Statement (EIS): Required by NEPA for actions that could result in significant environmental impacts or for projects that are not eligible for an Environmental Assessment (EA) and Finding of No Significant Impact (FONSI). Results in a Record of Decision from the District Commander, Army Corps of Engineers (ACOE).

Emergent: Plants whose roots are in shallow water but whose stems and leaves rise above the surface of the water.

Emissions: Refers to pollution being released or discharged into the air from natural or man-made sources. Pollutants may be released directly into the air from a structural device (i.e., smokestack, chimney, exhaust pipe) or indirectly via volatilization or dispersal (i.e., aerosol spraying).

Endemic species - A species that is restricted in its distribution to a particular locality or region.

Environmental Assessment (EA): A document required by NEPA, which provides sufficient information to the District Commander, ACOE on potential environmental effects of the proposed action and its alternatives to determine if an EIS or FONSI is required.

Epibenthic: The area on top of the sea floor. Epibenthic organisms may be freely moving or sessile (permanently attached to a surface).

Epifaunal: Plants, animals and bacteria that are attached to the hard bottom or substrate (for example, to rocks or debris); are capable of movement; or that live on the sediment surface.

Epiphyte: A plant that lives on the surface of other plants but does not derive water or nourishment from them.

Equilibrium species: In estuaries, equilibrium species are the species that dominate a given habitat after pioneer colonization; in stable, unstressed areas, these organisms tend to be larger, longer-lived species; in dynamic areas they essentially the dominant pioneers.

Essential fish habitat (EFH): Those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity.

Estuary: Semi-enclosed coastal body of water which has free connection with the open sea, and which within freshwater and seawater mix.

Estuarine circulation: Characteristic circulation in an estuary; flow is seaward at the surface, landward at depth.

Eutrophic: Describes an aquatic system with high nutrient concentrations. These nutrient concentrations fuel algal growth. This algae eventually dies and decomposes, with reduces the amount of dissolved oxygen in the water.

Eutrophication: The fertilization of surface waters by nutrients that were previously scarce. Eutrophication through nutrient and sediment inflow is a natural aging process by which warm shallow lakes evolve to dry land. Human activities are greatly accelerating the process. The most visible consequence is the proliferation of algae. The increased growth of algae and aquatic weeds can degrade water quality.

Evaluation: The process of judging data in order to reach a decision.

Exposure: The period of time during which an organism is exposed to a laboratory test concentration or field condition.

Extirpated: A wildlife species that no longer survives in regions that were once part of its native range and is locally extinct, but still exists somewhere else.

Fecundity: The capacity of an individual or a species to multiply rapidly.

Federal Standard: The dredged material placement alternative(s) identified by the U.S. Army Corps of Engineers that represent the least costly, environmentally acceptable alternative(s) consistent with sound engineering practices and which meet the environmental standards established by the 404(b)(1) evaluation process. [See Engle et al. (1988) and 33 CFR 335-338]. The Federal standard was developed from a national perspective and considers, but is not bound by, State or local regulations.

Fetch: The horizontal distance (in the direction of the wind) over which a wind generates waves.

Fetch-limited: Situation in which wave energy (or wave height) is limited by the size of the wave generation area (fetch).

Flood current: The movement of a tidal current toward the shore or up a tidal stream. The terms maximum flood and minimum flood are applied to the maximum and minimum velocities of a flood current the velocity of which alternately increases and decreases without coming to slack or reversing. The expression maximum flood is also applicable to any flood current at the time of greatest velocity

Flood tide: The period of tide between low water and the succeeding high water; a rising tide.

Furan: A family of colorless, volatile organic compounds.

Generalist species: A species having a broad range of ecological niches, tolerant.

Geographic information system (GIS):

Geotextile: A permeable synthetic fabric, which may be woven or non-woven, that is used as a filter in construction projects.

Glare: Light emitted at an intensity great enough to reduce a viewer's ability to see, and in extreme cases causing momentary blindness.

Grab sampling: The collection of surficial sediments (the top 4-8 inches) using a sampling device with a jaw that grabs a bite of sediment.

Grain-size effects: Mortality or other effects in laboratory whole sediment bioassays due to sediment granulometry, not chemical toxicity. [It is clearly best to use test organisms which are not likely to react to grain-size, but if this is not reasonably possible, then testing must account for any grain-size effects.]

Guild: A group of species that exploit the same class of environmental resources in a similar way.

High tide (high water): Maximum elevation reached by each rising tide.

Higher high water: The higher of the two high waters of any tidal day.

Hindcasting, Wave: In wave prediction, the retrospective forecasting of waves using measured wind information

Hurricane: An intense tropical cyclone in which winds tend to spiral inward toward a core of low pressure. Maximum surface wind velocities equal or exceed 75 mph for several minutes or longer at some point.

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).

Impaired waters list (or impairments): Impaired waters are waters that do not meet State water quality standards. Under the Clean Water Act, section 303(d), States, territories and authorized tribes are required to develop lists of impaired waters. The law requires that these jurisdictions establish priority rankings for waters on the lists and develop TMDLs for these waters.

Indirect economic impact: The economic activity felt by businesses that supply goods and services to support the project, such as meals bought in local restaurants.

Induced economic impact: The impact generated when surrounding businesses purchase additional products and services, and hire more employees to meet the demand brought on by the direct and indirect impacts of the project.

Infauna: Aquatic organisms that live in the substrate of a body of water, especially in a soft bottom or reef.

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 , in contrast to measurements conducted in a laboratory.

Intertidal: The area of shore located between high and low tides.

Invertebrates: Animals which lack a backbone and include such as squids, octopuses, lobsters, or shrimps, crabs, shellfishes, sea urchins and starfishes.

Juvenile: Strictly speaking, a juvenile is any of a species which is not yet sexually mature. In the context of many surveys, however, it is most often used interchangeably with young-of-year (YOY).

Keystone species: A predator at the top of a food web, or discrete subweb, capable of consuming organisms of more than one trophic level beneath it.

Knot: The unit of speed used in navigation equal to 1 nautical mile (6,076.115 ft or 1,852 m) per hour.

Land use: The way land is developed and used in terms of the kinds of anthropogenic activities that occur (e.g. agriculture, residential areas, industrial areas).

Lee: the side of an island that is sheltered from the wind; the side opposite to that from which the wind blows.

Lethal: Causing death.

Lift: The layer of dredged material placed in a wetland or upland cell in each year.

Light attenuation - Absorption, scattering, or reflection of light by water, chlorophyll a, dissolved substances, or particulate matter. Light attenuation reduces the amount of light available to submerged aquatic vegetation.

Light Trespass: Light that shines beyond the boundaries of the property on which it is located and onto areas where it is unwanted or interferes with land use.

Lipids: Any of a diverse class of compounds found in all living cells, insoluble in water but soluble in organic solvents, and which include fats and oils.

Low tide: Minimum elevation reached by each falling tide.

Lower low water: The lower of the two low waters of any tidal day.

Macroinvertebrate: Organisms greater than 0.5 mm, possessing no internal skeleton.

Macroplankton: Planktonic organisms that are 200-2,000 micrometers in size.

Macrotidal: An estuary with a tidal range greater than 4 meters.

Maintenance dredging: Dredging necessary to keep the channels serving the Port at their nominal authorized depth and width.

Mean abundance: Number of organisms per square meter.

Mean sea level: The average height of the surface of the sea for all stages of the tide over a 19-year period.

Mean tidal range: Difference in height between mean high water and mean low water.

Mean (Higher High, High, Low, Lower Low) Water: Average height of the (higher high, high, low, lower low) waters over a 19-year period.

Mesohaline: Moderately brackish water with low range salinities (from 5-18 parts per thousand).

Mesotidal: An estuary with a tidal range between 2 and 4 meters.

Method detection limit (MDL): The minimum concentration of a substance which can be identified, measured, and reported with 99 percent confidence that the analyte concentration is greater than zero.

Microtidal: An estuary with a tidal range less than 2 meters. The Chesapeake Bay is a good example of a microtidal estuary.

Midden: A deposit marking a former habitation site and containing such materials as discarded artifacts, bone and shell, food refuse, charcoal, ash, rock, human remains, structural remnants, and other cultural leavings.

Migratory: Describing groups of organisms which move from one habitat to another on a regular or seasonal basis.

Mixed layer: Near-surface waters down to the pycnocline, where water show little change in temperature or salinity with depth.

Mixing factor: Amount of dilution required to achieve compliance with water quality criteria; the mixing factor is determined by dividing the criterion by the concentration detected in the full-strength sample (elutriate).

Nearshore zone: An indefinite zone extending seaward from the shoreline well beyond the breaker zone.

Nekton: Organisms with swimming abilities that permit them to move actively through the water column and to move against currents (i.e. fish, crabs).

Neotropical: referring to a region that includes southern Mexico, Central America, and most of South America; a neotropical migrant bird species nests in North America and winters south of the continental United States.

New work dredging: Dredging needed to widen and deepen channels below existing conditions.

Nitrate: Salt or ester of nitric acid (NO3-). It is an essential nutrient for phytoplankton growth, and its low surface water concentrations typically limit phytoplankton productivity.

Nitrite: Salt or ester of nitrous acid (NO2-).

Noise: Sound that is loud, unpleasant, unexpected, or otherwise undesirable.

Noise attenuation: The reduction in the strength or energy of noise with increasing distance.

Non-cohesive sediment: Sediments, such as coarse grained sediment (sand), that have low shear strenghts.

Non-detect: A chemical constituent that is not detected or measured above the method detection limit in an analytical test.

Non-point sources: A diffuse source of pollution that cannot be attributed to a clearly identifiable, specific physical location or a defined discharge channel. This includes the nutrients that runoff the ground from any land use - croplands, feedlots, lawns, parking lots, streets, forests, etc. - and enter waterways. It also includes nutrients that enter through air pollution, through the groundwater, or from septic systems.

Nutrients: Compounds of nitrogen and phosphorus dissolved in water which are essential to both plants and animals. Too much nitrogen and phosphorus act as pollutants and can lead to unwanted consequences - primarily algae blooms that cloud the water and rob it of oxygen critical to most forms of aquatic life. Sewage treatment plants, industries, vehicle exhaust, acid rain, and runoff from agricultural, residential and urban areas are sources of nutrients entering the Bay.

Open water placement: Placement of dredged material in rivers, lakes, or estuaries via pipeline or release from hopper dredges or barges.

Opportunistic species: Generally small organisms that are short-lived and reproduce rapidly. They generally dominate communities in disturbed or stressed habitats.

Organophosphorus pesticide: Similar in structure to some compounds acting as nerve gases. These were developed as more selective and less persistent alternatives to organochlorine pesticides such as DDT.

Overloading (cells): Placement of large quantities of dredged material in a cell during a given placement year and exceeding the optimal lift thickness.

Overtopping: Water carried over the top of a coastal structure because of wave run-up exceeding the crest height

Particulate matter: Matter composed of particles that are not bound together (e.g., sand or dust).

Pelagic: The open water, excluding the ocean bottom and shore.

pH: A measure of acidity or alkalinity on a scale of 0 (acidic) to 14 (basic), with 7 being neutral.

Phaeophytin: Degraded product of chlorophyll *a.* The amount of this compound in the water is an important estimate of the amount of phytoplankton in the surface water.

Phosphate: The anion (PO_4-) or a salt of phosphoric acid. Essential to the metabolism of living organisms because inorganic phosphate is required for the synthesis of ATP. Plants and microorganisms take up phosphorus mainly in the form of phosphates, and various phosphates

are used as fertilizers. Excess phosphate washed into streams and lakes contributes to eutrophication and formation of algal blooms.

Photic zone: Layer of a body of water that receives ample sunlight for photosynthesis (usually less than 100m).

Phytoplankton: Microscopic plants (primary producers) found throughout aquatic systems. Plankton are usually very small organisms that cannot move independently of water currents. Phytoplankton are any plankton that are capable of making food via photosynthesis.

Piscivorus: Animals that primarily eat fish.

Planktivorous: Animals that primarily eat plankton.

Plankton: Passively drifting or weakly swimming small or microscopic algae and organisms associated with surface water and the water column.

Plankton bloom: Unusually high concentration of plankton (usually phytoplankton) in an area, caused either by an explosive or gradual multiplication of organisms

Plume: A space containing a substance or characteristic released from a point source.
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Polynuclear aromatic hydrocarbons (PAH): A group of over 100 different chemicals that are formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat. Some PAHs are manufactured. These pure PAHs usually exist as colorless, white, or pale yellow-green solids.

Polychlorinated biphenyl (PCB): A large group of toxic synthetic lipid-soluble chlorinated hydrocarbons that are used in various industrial processes and that have become persistent environmental contaminants that can be concentrated in food chains.

Pound net: A net used for entrapping and catching fish, that is attached to stakes and has a large inclosure and narrow entrance into which fish are directed.

Primary producers: Organisms, such as algae, that convert solar energy to organic substances through the molecule, chlorophyll. Primary producers serve as a food source for higher organisms.

Primary productivity: The amount of organic matter fixed by the autotrophic organisms in an ecosystem per unit time.

Probable effect level (PEL): An estimate of the concentration of a potentially toxic substance in the sediment above which the substance is likely to cause adverse effects to aquatic organisms.

Pycnocline: The zone between waters with different densities. An example from an estuary would be a pycnocline separating deep, more saline water and shallow, more fresh water.

Quality assurance (QA): The total integrated program for assuring the reliability of data. A system for integrating the quality planning, quality control, quality assessment, and quality improvement efforts to meet user requirements and defined standards of quality with a stated level of confidence.

Quality Control (QC): The overall system of technical activities for obtaining prescribed standards of performance in the monitoring and measurement process to meet user requirements.

Quiescent: Marked by inactivity, tranquil.

Recruitment: The residue of those larvae that have: (1) dispersed; (2) settled at the adult site; (3) made some final movements toward the adult habitat; (4) metamorphosed successfully, and (5) survived to be detected by the observer.

Reference sediment: A whole sediment, collected near an area of concern, that is used as a point of comparison to assess sediment conditions exclusive of the material(s) or activities of interest. The reference sediment may be used as an indicator of localized sediment conditions exclusive of the specific pollutant of concern. Such sediment would be collected near the site of concern and would represent background concentrations.

Reference site: The location from which reference sediment is obtained.

Region: U.S. Environmental Protection Agency administrative area.

Regulations: Administrative rules published in the Code of Federal Regulations (CFR) or Code of Maryland Regulations (COMAR).

Residence time: Time required for the flow of water to replace the amount of water originally present in a given volume.

Revetment: A facing of stone, concrete, etc., built to protect erosion by wave action or currents.

Rip-rap: Loose assemblage of broken stones erected in water or on soft ground as a foundation to protect an erodible surface.

RMA-2: A depth-averaged finite element model for the simulation of velocities and water elevations for river systems, estuaries and other shallow water bodies. The model can be applied in either a one- or two-dimensional mode.

Rookery: A breeding place for colonial birds.

Rotifers: Microscopic members of the Phylum Rotifera, many of which are planktonic.

Run up: The rush of water up a structure, associated with the breaking of a wave. The amount of runup is measured according to the vertical height above still water level that the rush of water reaches.

Salinity regime: A portion of an estuary distinguished by the amount of tidal influence and salinity of the water. The major salinity regimes are, from least saline to most saline:

- **Tidal Fresh** – Describes waters with salinity between 0 and 0.5 parts per thousand (ppt). These areas are at the extreme reach of tidal influence.
- **Oligohaline** – Describes waters with salinity between 0.5 and 5 ppt. These areas are typically in the upper portion of an estuary.
- **Mesohaline** – Describes waters with salinity between 5 and 18 ppt. These areas are typically in the middle portion of an estuary.
- **Polyhaline** – Describes waters with salinity between 18 and 30 ppt. These areas are typically in the lower portion of an estuary, where the ocean and estuary meet.

Salt wedge estuary: High-flow circulation pattern with seawater intrusion along the bottom of the estuary; characterized by a pronounced increase in salinity from the surface to bottom.

Sampling reach: Refers to a channel, placement site, or reference area where samples were collected. Sediment from each channel reach was tested and evaluated separately to determine if material from a particular reach was suitable for open water or ocean placement.

Sand: Sediment particles, often largely composed of quartz, with a diameter of between 0.062 mm and 2 mm, generally classified as fine, medium, coarse or very coarse. Beach sand may sometimes be composed of organic sediments such as calcareous reef debris or shell fragments.

Scale contrast: The difference in absolute or relative scale in relation to other distance objects or areas in the landscape.

Scour: Removal of underwater material by waves and currents, especially at the base or toe of a shore structure

Secchi disk: A white and black disc used to gauge depth of light penetration in the water column.

SED-2D: A two-dimensional flow model for sediment transport related to unsteady flows. The model is based on the solution of the depth-averaged convection-diffusion equations of sediment with bed sources terms. SED-2D is capable of modeling cohesive and non-cohesive sediment transport.

Sediment: Particulate organic and inorganic matter that settles and accumulates in a loose form on the bottom of a body of water or waterway. It may be chemically precipitated from solution, secreted by organisms, or transported from land by air, ice, or water, and deposited. Inorganic

sediments on the bottom of the Bay include cobble, gravel, sand, silt, and clay. These materials are classified by grain-size.

Sediment transport: The main agencies by which sedimentary materials are moved are: gravity (gravity transport); running water (rivers and streams); ice (glaciers); wind; the sea (currents). Running water and wind are the most common transporting agents.

Sedimentation: The separation of suspended particles from water by gravity Decreased drought flow – inadequate groundwater recharge causes diminished or loss of flow in watercourses.

Sediment quality guidelines (SQG): Concentrations of chemical constituents in sediments that are used in order to differentiate sediments of little concern from those predicted to have adverse biological effects.

Semidiurnal tide: A tide with two high and two low waters in a tidal day.

Shallow water: Water of such depth that surface waves are noticeably affected by bottom topography.

Shallow water habitat (SWH): Areas generally less than six ft in depth where light penetration is sufficient to support SAV.

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'=(ni/N)log(ni/N) where ni = number of individuals of a given species and N = total number of individuals in each sample (Brower and Zar 1984).

Shoal: An area of submerged accumulation of sediments in shallow or deep water.

Shore: The narrow strip of land in immediate contact with the sea.

Shoreline: The intersection of a specified plane of water with the shore or beach (typically taken as mean high water or mean higher high water).

Silt: Sediment particles with a grain size between 0.004 mm and 0.062 mm, i.e. coarser than clay particles but finer than sand.

Soil classification: The systematic arrangement of soils into groups or categories on the basis of their characteristics.

Sound: A vibratory disturbance created by a vibrating object, which, when transmitted by longitudinal pressure waves through a medium such as air, is capable of being detected by a receiving mechanism, such as the human ear or a microphone.

Spat: Juvenile oysters that have settled by attaching to a hard substrate. The spat set is the process of settling and attachment of planktonic larvae and onset of shell growth, establishing new recruitment on a reef.

Spatial dominance: The prevalent occupation of a space in a landscape by an object(s) or landscape element.

Spring bloom: Sudden proliferation of phytoplankton that occurs when the critical depth (as determined by the penetration of sunlight) exceeds the depth of the mixed, stable surface layer (as determined by the pycnocline).

Standard operating procedure (SOP): A written document which details an operation, analysis, or action whose mechanisms are thoroughly prescribed and which is commonly accepted as the method for performing certain routine or repetitive tasks.

Stoplog: A low-head damn structure that controls the flow of water.

Storm surge: A rise above normal water level on the open coast due to the action of wind stress on the water surface or atmospheric pressure differentials associated with storm events.

Stratification: Vertical arrangement in layers, e.g. distinct temperature bands within a water body.

Supernatant: Liquid floating on the surface of sediments or precipitate.

Surf zone: The area of breaking waves.

Swell: Wind-generated waves that have traveled out of their generating area.

Submerged aquatic vegetation (SAV): Vascular plants that grow completely underwater are referred to as SAV. Light penetration, turbidity, water depth, salinity (mesohaline species require 5 to 18 ppt), and nutrient availability influence the distribution, growth and viability of SAV. SAV normally occurs in water depths to 10 feet, although SAV is more likely to be found in depths of three to five feet or less in the Bay because of increased turbidity levels (Batiuk et. al, 1992).

Substrate: Surface on which a sessile organism lives and grows. The substrate may simply provide structural support, or may provide water and nutrients. A substrate may be inorganic, such as rock or soil, or it may be organic, such as wood.

Target detection limit (TDL): A performance goal set by consensus between the lowest, technically feasible, detection limit for routine analytical methods and available regulatory criteria or guidelines for evaluating dredged material. The target detection limit is, therefore, equal to or greater than the lowest amount of a chemical that can be reliably detected based on the variability of the blank response of routine analytical methods. However, the reliability of a chemical measurement generally increases as the concentration increases. Analytical costs may

also be lower at higher detection limits. For these reasons, a target detection limit is typically set at not less than 10 times lower than available dredged material guidelines.

Tests/testing: Specific procedures which generate biological, chemical, and/or physical data to be used in evaluations. The data are usually quantitative, but may be qualitative (e.g., taste, odor, organism behavior). Testing for discharges of dredged material in waters of the United States is specified in 40 CFR 230.60 and 230.61 and is implemented through the procedures in this manual.

Thermocline: A specific depth at which there is a layer of water where the temperature changes dramatically. Warmer surface water is separated from the cooler deep water. This temperature gradient results in the formation of a density barrier.

Threshold Effects Level (TEL): Concentrations below which a contaminant will rarely induce adverse biological effects.

Tiered approach: A structured, hierarchical procedure for determining data needs relative to decision-making, which involves a series of tiers or levels of intensity of investigation. Typically, tiered testing involves a decreased uncertainty and increased available information with increasing tiers. This approach is intended to ensure the maintenance and protection of environmental quality, as well as the optimal use of resources. Specifically, least effort is required in situations where clear determination can be made of whether (or not) unacceptable adverse impacts are likely to occur based on available information. Most effort is required where clear determinations cannot be made with available information.

Tidal datum: The plane or level to which soundings, elevations, or tide heights are referred.

Tidal day: The time of the rotation of the Earth with respect to the Moon, or the interval between two successive upper transits of the Moon over the meridian of a place, approximately 24.84 solar days.

Tidal range: The difference in height between consecutive high and low (or higher high and lower low) waters.

Tide: Periodic rise and fall of the ocean and atmosphere, caused by the gravitational attraction of the moon and sun acting on the earth.

TMDLs: "Total Maximum Daily Load" or TMDL. A TMDL defines the pollutant load that a water body can assimilate without causing violations of water quality standards, and allocates the loading between contributing point sources and non-point source categories.

Toe dike: A trapezoidal rock section that extends outward from the armored dike slopes (at 3H:1V) from the Bay bottom to approximately MLLW.

Topography: The configuration of a surface, including its relief and the positions of its streams, roads, buildings, etc.

Total dissolved nitrogen (TDN): Measures both the inorganic and organic forms of the dissolved nitrogen, which includes nitrate, nitrite, and ammonia.

Total dissolved phosphate (TDP): Measures both the inorganic and organic forms of the dissolved phosphorus.

Total organic carbon (TOC): The sum of all organic carbon compounds in water.

Total suspended solids (TSS): Organic or inorganic particles that are suspended in water; includes sand, silt, and clay particles as well as biological material.

Tributyltin: Compounds that belong to a group known as the organotins. TBT's are manufactured compounds that have no counterparts in nature. They are extremely toxic over a broad spectrum

Trophic level: Layer in the food chain in where one group of organisms serves as the source of nutrition of another group of animals. Primary produces constituent the first trophic level, herbivores the second, and carnivores the third, and highest, trophic level.

Tropical storm: A tropical cyclone with maximum winds less than 75 mph.

Turbidity: Cloudiness in the water column created by suspended particles, algae, or other materials; high turbidity reduces the amount of light that penetrates into the water column and, therefore, high turbidity can be harmful to aquatic life.

Visual compatibility: The degree to which landscape elements and characteristics are still unified within their setting.

Void ratio: The ratio of the volume of voids (space) in a soil to the volume of solids.

Volatile organic compound: An organic compound that evaporates readily at atmospheric temperatures.

Water quality certification: A state certification, pursuant to Section 401 of the Clean Water Act, that the proposed discharge of dredged material will comply with the applicable provisions of Sections 301, 303, 306, and 307 of the Federal Clean Water Act and relevant State laws.

Water quality criteria: A constituent concentration or narrative statement representing a quality of water that supports a particular use. When criteria are met, water quality will generally protect the designated area. See **acute water quality criteria**, **chronic water quality criteria**.

Water quality standard: A law or regulation that consists of the beneficial designated use or uses of a water body, the numeric and narrative water quality criteria that are necessary to protect the use or uses of that particular water body, and an anti-degradation statement.

Wave climate: The combination of waves of different heights, periods, and directions.

Wave crest: The highest point on a wave.

Wave direction: The direction from which a wave approaches.

Wave height: The vertical distance between a crest and the preceding trough.

Wave length: The horizontal distance between similar points on two successive waves measured perpendicular to the wave crests.

Wave period: The time for a wave crest to traverse a distance equal to one wavelength.

Weight-of-evidence: Preponderance of data to support a hypothesis or determination.

Year class: Most fish species in temperate waters (like those found in the Chesapeake Bay and offshore Virginia) reproduce during a relatively short (one or two month) period each year. That period may be different for each species. Fisheries scientists refer to all of the fish of any species hatched during one annual spawning period as a year class. For mathematical purposes, fishery analysts often treat members of the year class as if all fish were hatched on one day.

Young-of-the-year: All of the fish of a species younger than one year of age. Usually scientists assign an arbitrary "birth date" to all fish of a species hatched over a two or three month period in one year. The fish are then assigned to Age 1 status on that birth date. By convention, this is usually January 1.

Zooplankton: A community of floating, often microscopic animals that inhabit aquatic environments. Unlike phytoplankton, zooplankton cannot produce their own food, and so are consumers.

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