BOSTON HARBOR
MASSACHUSETTS

FEDERAL DEEP DRAFT
NAVIGATION IMPROVEMENT PROJECT

FINAL SUPPLEMENTAL
ENVIRONMENTAL IMPACT STATEMENT

AND

MASSACHUSETTS FINAL
ENVIRONMENTAL IMPACT REPORT
(EOEA #12958)

APRIL 2013

FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT
AND
FINAL ENVIRONMENTAL IMPACT REPORT (EOEA# 12958)
FOR THE
FEDERAL DEEP DRAFT NAVIGATION IMPROVEMENT PROJECT
BOSTON HARBOR, MASSACHUSETTS

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This joint Federal and State document builds on lessons learned from the Boston Harbor, Massachusetts Navigation Improvement Project (BHNIP), which was the subject of a Final Environmental Impact Report/Statement (EIR/S) prepared in 1995 (EOEA #8695). That combined maintenance and improvement project was constructed from 1998 to 2002. Additional major maintenance dredging of the harbor's deep draft channels was undertaken in 2005 to 2006 (outer harbor), 2007 to 2008 (inner harbor), 2012 (channel widening in Chelsea River at the Chelsea Street Bridge), and 2012 (inner harbor rock removal). These maintenance projects were discussed in separate NEPA documents. The currently proposed Boston Harbor Federal Deep Draft Navigation Improvement Project consists of a base plan to allow larger containerships to access the Massachusetts Port Authority's (Massport) Conley Terminal in South Boston, and three smaller improvements to other harbor channels. The base plan would deepen the harbor's main navigation channels from their existing -40-foot depth at mean lower low water (MLLW) to a depth of -47 MLLW. The entrance channel would be deepened by an additional four feet to -51 feet MLLW.

The base plan would improve access to Conley Terminal by:

- Deepening and widening the -40-foot deep lane of the lower Main Ship Channel from President Roads to the Reserved Channel to a depth of -47 feet MLLW, for the full 1200-foot width through the Roads, then with the deep lane widened to 900 feet between President Roads and Castle Island, and to 800 feet between Castle Island and the Reserved Channel, with further widening to 1,050 feet in the two bends below Castle Island;
- Deepening the President Roads Anchorage to -47 feet MLLW;

- Deepening the -40-foot lane of the Broad Sound North Entrance Channel to -51 feet MLLW to account for greater seas in the bay, with widening of the channel in the bend opposite Finns Ledge;
- Deepen the lower -40-foot portion of the Reserved Channel at the Conley Terminal to -47 feet MLLW;
- Deepening and widening the existing -400 foot by 1,200 foot Reserved Channel Turning Area to -47 feet MLLW deep with a minimum turning radius of 1,600 feet, and with limits eased to transition to the Reserved Channel along its northern side.

The other three separate navigation channel improvements include:

- Deepening the existing -40-foot MLLW Main Ship Channel from the reach above the Reserved Channel to just below the Third Harbor Tunnel to -45 feet MLLW to improve access to Massport's Marine Terminal in South Boston;
- Deepening a portion of the existing 35-foot channel of the lower Mystic River Channel to -40 feet MLLW to improve access to Massport's Medford Street Terminal.
- Deepening the -38-foot MLLW Chelsea River Channel to -40 feet MLLW, with the channel widened up to 50 feet along the East Boston shore immediately above the McArdle Bridge, and at the bend between the two bridges; primarily to improve access to the petroleum terminals along the river.

About 150,000 cy of material would be removed to deepen terminal berths at Massport facilities located on the Reserved Channel, and the Main Ship Channel, as well as private berths on the Chelsea River. In addition, about 500,000 cy of maintenance material would be removed from the proposed improved navigation channels where needed, and from other Federal navigation entrance channels and the barge anchorage to provide additional access and traffic management to the port's facilities during construction. Approximately one million cy of maintenance material remaining from the Inner Harbor Maintenance Dredging Project above Massport's Marine Terminal could be also be removed concurrent with this proposed project, as well as appromimately 370,000 cy from the Charles River portion of the Main Ship Channel.

These improvements would require the disposal of between 10 to 11 million cubic yards of parent material at the Massachusetts Bay Disposal Site (MBDS) located approximately 20 miles east from Boston Harbor. Rock removed from the project area would total up to one million cubic yards, some of which may require blasting. The base plan for disposal of the rock is also the MBDS. However, a proposal to use the rock for habitat enhancement to create a rock reef in Broad Sound and/or Massachusetts Bay or other beneficial use alternatives such as shoreline restoration or for use in shore protection projects are being considered and are discussed in this document. In addition, the use of the parent material as cover at the Industrial Waste Site is also considered.

The Federal Register will announce the availability of the Final SEIS/EIR for public review. The Massachusetts Environmental Policy Act process provides a public comment period on the FEIR. Commens on the FEIR can be sent to the Massachusetts Executive Office of Energy and Environmental Affairs, MEPA Office, 100 Cambridge Street, Boston, MA 02111 by the dates indicated in the Massachusetts Environmental Monitor. Additional information can be obtained from Mr. Mark Habel, study manager, at (978) 318-8871, Mr. Mike Keegan, project manager, at (978) 318-8087 or Ms. Catherine Rogers, ecologist, (978) 318-8231 at the U.S. Army Corps of Engineers, or Mr. Stewart Dalzell, Deputy Director, Massachusetts Port Authority, at (617) 568-3524.

FEDERAL DEEP DRAFT NAVIGATION IMPROVEMENT PROJECT
BOSTON HARBOR, MASSACHUSETTS

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AND
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BOSTON HARBOR, MASSACHUSETTS

FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT AND FINAL ENVIRONMENTAL IMPACT REPORT

EXECUTIVE SUMMARY

Introduction

The Port of Boston, Massachusetts is located on the western shore of Massachusetts Bay, an arm of the Gulf of Maine, about 50 nautical miles northwesterly of the northern tip of Cape Cod. The harbor includes all the tidal waters bound by a line drawn roughly from Point Allerton in Hull northward to Point Shirley in Winthrop. The main deep water harbor is comprised of the waterways of the Main Ship Channel, Reserved Channel, Mystic River, and Chelsea River. These channels provide access at a depth of 40 feet below mean lower low water (MLLW; all depths are referenced to below MLLW) to the Port's principal terminals, except for the Chelsea River which has an authorized depth of 38 feet, and portions of the Mystic River which provide a depth of 35 feet. Deep water access to the harbor is provided by three entrance channels improved and maintained by the U.S. Army Corps of Engineers (USACE). The three entrance channels are: 1) the Broad Sound North Channel with two shipping lanes at 35 and 40 feet deep, 2) the Broad Sound South Channel at 30 feet deep, and 3) the Narrows Channel at 27 feet deep.

Response to Draft Feasibility and Draft Supplemental Environmental Impact Statement/Environmental Impact Report Public Review Comments

The Draft Feasibility and Draft Supplemental Environmental Impact Statement/Environmental Impact Report (DSEIS/EIR) was published in the Federal Register on 18 April 2008. The public comment period for both the Federal and State review processes closed on 2 June 2008. After presentation of the project to the Civil Works Review Board in August 2008, additional economic analyses were requested, which were completed in May 2012. Resolution of the recommended project depth was made in August 2012. Additional coordination letters were then sent to Federal and State agencies on October 11, 2012 before proceeding with issuing the Final Feasibility Report and Final SEIS/EIR. These letters were sent to confirm that previous determinations provided by the agencies to the USACE and Massport on the Draft SEIS/EIR were still valid. The Massachusetts Environmetal Policy Act (MEPA) Office was also asked to formally review their 2008 Scope Certificate for consistency with the current project. No significant changes to previous comments or the Secretary's Certificate were received. A number of commenting parties had common concerns with certain aspects of the proposed project. Many of these comments requested additional investigations, which can not be performed until the Planning, Engineering, and Design phase (Design Phase) of the project (which is after public release of the Final SEIS/EIR), due to Federal time and funding constraints. The findings from these investigations may result in the need for additional planning, resource coordination and consultation, and additional NEPA and MEPA documents to comply with specific areas and topics. Any additional NEPA and MEPA documents generated would be available for public review.

Additional investigations and plans to be developed during the Design Phase include:

- Development of a Blasting Mitigation Plan once the extent of rock that may require blasting is identified during final design;
- Investigations of potential rock reef sites for beneficial use of rock;
- Investigation of other beneficial uses for rock removed from the project;
- Development of an overall Construction Sequencing Plan;
- Benthic resource definition and recolonization studies for dredged area; and
- Air quality compliance methodology and alternatives.

Details on the above investigations are available in Appendix A – Pertinent Correspondence. Other general topics discussed in this appendix include a description of the USACE Civil Works Process and the Continuation of the Interagency Technical Working Group (TWG) during the Design Phase of the project.

Purpose and Need for the Project

The purpose of this Boston Harbor Federal Deep Draft Navigation Improvement Study (Deep Draft Project) is to evaluate the feasibility of providing navigation channel deepening and related improvements at the Port of Boston, consistent with the goals of the study sponsor, the Massachusetts Port Authority (Massport), and in response to direction from Congress in the authorizing resolution and appropriations acts. Massport's goal is to provide deeper access to their Conley Container Terminal on the Reserved Channel in South Boston for the future needs of vessels calling at the Conley Terminal. Additional minor port improvements in the Mystic and Chelsea Rivers and in the Main Ship Channel above the Reserved Channel are also under consideration.

Various preliminary alternatives were formulated and screened. Alternatives were selected for detailed study on the basis of the estimated costs and benefits of the proposed channel and anchorage modifications. Project costs include the costs of channel deepening and widening through dredging and rock ledge removal, costs for disposal of dredged material, and costs for environmental mitigation.

Without channel deepening, the containerships and bulk carriers currently using Boston Harbor will continue to experience tidal delays and many vessels will continue to be light loaded or depart Conley Terminal without loading/unloading all of their cargo to ensure that they do not miss the tidal window. In some cases, vessels that would experience a tidal delay in Boston, would bypass Boston all together so as not to jeopardize their arrival schedule in other ports. As carriers add larger vessels to the services that currently include Boston, they may be forced to eliminate Boston from their rotation. Because of tidal delays and the increase in vessel size servicing the U.S. East Coast, a large part of New England cargo will continue to be shipped in or out of the Port of New York/New Jersey (PONYNJ), increasing total transportation costs to shippers. Large carriers that would use the expanded Panama Canal would not call on Boston if it meant they needed to light-load. Substantial quantities of import and export cargo have shifted from the PONYNJ to Boston Harbor in recent years because of the lower landside transportation costs for cargo shipped directly into Boston Harbor. However, the shift in cargo from the PONYNJ to the Port of Boston Harbor will reverse itself once the carrying capacity and draft of the ships calling along the U.S. East Coast increases, and the tidal restrictions caused by the current 40-foot deep maintenance dredging become unsustainable from an economic and scheduling standpoint.

Project Description, Alternatives, and Beneficial Use

This Final Supplemental Environmental Impact Statement/Environmental Impact Report builds on the lessons learned from the Boston Harbor Navigation Improvement Project (BHNIP) located in Massachusetts, which was the subject of a Final Environmental Impact Report/Statement prepared in 1995 (USACE and Massport, 1995). The currently proposed Boston Harbor Deep Draft Project (Deep Draft Project) would remove between 10 to 11 million cubic yards (cy) of dredged material from Federal navigation channels in Boston Harbor. The dredged material is composed of Boston blue clay and glacial till matter. In addition, up to about one million cy of rock will need to be removed.

The following currently authorized 40-foot depth navigation features would be deepened to between 47 to 51-feet, and widened where necessary:

- Broad Sound North Entrance Channel (deepened an additional four feet over inner harbor depths);
- President Roads Anchorage;
- Main Ship Channel from President Roads to the Reserved Channel (also widened to 800 feet, 900 feet in the bends);
- The lower 4,000-foot portion of the Reserved Channel; and
- The Reserved Channel Turning Area (also widened to a 1,600-foot minimum radius).

Other incremental improvements include:

- Deepening the Main Ship Channel to 45-feet in the reach above the Reserved Channel to just below the Third Harbor Tunnel for Massport's Marine Terminal;
- Deepen to 40-feet the 35-foot deep area of the Mystic River Channel off of Massport's Medford Street Terminal; and
- Deepen the Chelsea River an additional two feet to 40-feet.

In conjunction with these improvements, the berths at the Conley Container Terminal would be deepened to at least 50 feet (three feet deeper than the recommended channel depth of 47 feet) and the berth at the Massport Marine Terminal would be deepened to at least 45 feet MLLW. Private berths on the Chelsea River could also be deepened commensurate with the deepening of the Federal channels.

Under all options, the Broad Sound North Entrance Channel would be deepened an additional four feet over the projected Main Ship Channel depth to account for higher sea states. In areas where ledge is encountered, an additional two feet of required rock removal will be performed for vessel safety. In all areas an overdepth dredging allowance of two feet would be specified.

Maintenance dredging of the existing Federal navigation features in Boston Harbor would be carried out concurrent with the Deep Draft Project in two ways. First, while major maintenance dredging of the outer and inner harbor areas was accomplished in the 1998-2000, 2004-2005 and 2007-2008 year timeframes, respectively, and additional ledge pinnacles removed from the lower Main Ship Channel in 2012, minor amounts of maintenance material may remain at the time of the improvement dredging due to the low shoaling rates in Boston Harbor and the recent dredging operations. Second, channel and anchorage areas not maintained in the past three dredge operations may be maintained at the time of the improvement dredging. Areas under consideration include the 30-foot Broad Sound South Entrance Channel, the 35-foot northern lane of the Broad Sound North Entrance Channel, the 15-foot Nubble Channel, and the 35-foot West Anchorage at President Roads (the barge anchorage) for a total of approximately 500,000 cy of dredged material. This would minimize navigation traffic disruptions of the drilling, blasting, and dredging operations for the Deep Draft Project by providing alternative routes for shallow-draft traffic not needing the 40-foot channels that would be deepened.

Maintenance materials from these project areas would need to be tested during the design phase of the improvement project, and suitability determinations made for their disposal. At this time, given the suitable determinations issued for maintenance of adjacent areas, and the location of these project features in the Outer Harbor, it is assumed that the anchorage area and entrance channel materials would be found suitable for ocean disposal and would be disposed at the Massachusetts Bay Disposal Site. Unsuitable material would be disposed into a previously approved Confined Aquatic Disposal (CAD) cell.

The U.S. Environmental Protection Agency (EPA) has determined that the parent material is suitable for unconfined ocean water disposal. In developing the Federal National Economic Development (NED) plan for dredge material placement/disposal the USACE must select the least cost, environmentally acceptable placement plan. The Federal NED Plan identified for this project would involve the placement of all of the dredged material and rock at the Massachusetts Bay Disposal Site (MBDS). However, it is the policy of the U.S. Army Corps of Engineers to use dredged material, where practicable, for beneficial use. Beneficial use opportunities have been identified and will be examined further in the detailed design phase of the project, if the State and the U.S.EPA express an interest in pursuing those options.

A beneficial use option was identified for the rock that will be removed from the navigation channels. Five sites were evaluated for placement of rock, two of which were selected for further analysis. The two beneficial use sites selected for further study in the design phase of the project are located in Broad Sound and Massachusetts Bay. The rock reef would increase biological diversity in an area with limited hard bottom material. The reef would provide habitat for lobsters, reef finfish, and encrusting organisms. Other potential beneficial uses for the rock will also be explored with State and local agencies, including shoreline restoration/protection projects, and upland construction projects.

The Boston blue clay, sand and less consolidated glacial till material could be used to cap debris previously dumped at the Industrial Waste Site (IWS). The IWS was used historically as an industrial waste site in the 1930's through early 1970's. Chemical waste and low level radioactive material and debris were dumped at the IWS which overlaps the EPA designated MBDS.

A requirement of the BHNIP Water Quality Certification (WQC) dated January 16, 1998 was to monitor the CAD cells one year and five years after they were capped to assess the effectiveness of isolating the unsuitable material within the CAD cells with sand. A survey was performed in 2001 and in 2004 and included bathymetry, side scan sonar, video sled and sediment-profile imaging. The results of the survey confirmed that the sediment layers of the cells remained physically stable, with additional natural deposition occurring over the tops of the cells which remained depressed below the surrounding harbor bottom. Towed video footage revealed numerous small fish and crustaceans at the bottom over the CAD cells, and sediment profile imaging revealed a stressed biological community similar to ther surrounding harbor as expected for the urban harbor setting. A follow up survey was performed in 2009 including bathymetry, sub-bottom profiling, and collection of short cores. This survey confirmed the continued stability of the cells and their contents, with ongoing natural deposition further sequestering the material contained within the CAD cells.

No new CAD cell construction is currently anticipated for this Deep Draft Project for disposal of any accumulated silty maintenance material unsuitable for ocean water disposal. However, maintenance dredging of the Main Ship Channel above Massport's Marine Terminal to the Inner Confluence (both the -35' and -40' deep navigation channels), which was not accomplished during maintenance dredging of the IHMDP in 2008, would need to be dredged to realize the economic benefits of a deeper Chelsea River and Mystic River. This unsuitable material would be disposed at a CAD cell located in the Inner Confluence and proposed in the 2006 IHMDP SEIS. Additional areas of the Federal navigation channels in the upper inner harbor, and not included in the 2006 SEIS, include the Charles River branch of the 35-foot Main Ship Channel may also be maintained at this time.

Public Involvement

Public involvement in the development of a joint National Environmental Policy Act (NEPA) Supplemental Environmental Impact Statement (SEIS) and Massachusetts Environmental Policy Act (MEPA) Environmental Impact Report (EIR) document is critical to the success of the project. Several mechanisms have been employed to inform the pubic of the proposed project and to provide the opportunity for public input into the process. This Deep Draft Project builds on the public process established during the original BHNIP. A technical working group (TWG) was established during development of the BHNIP EIR/EIS to provide input and guidance on sampling plans, modeling and alternatives development. This group continued to provide input during construction of the BHNIP. Member contributions were valuable in addressing concerns raised during dredging, disposal, and CAD cell development. Below are brief summaries of the past and proposed activities used to solicit public and agency input into the development of the current proposed project.

- Federal Register Notice of Intent

A Notice of Intent (NOI) to prepare a SEIS was published in the Federal Register on August 23, 2002. The NOI notifies the public that a SEIS will be prepared and allows the public to submit comments or ask questions about the proposed action. Interested individuals can also request to be placed on mailing lists for potential meetings and future publications of the SEIS.

- Scoping Meeting

- Scoping Meeting

A scoping meeting is not required for preparation of a supplemental EIS. However, the public was invited to a public information session hosted by Massport on September 5, 2002 at the Black Falcon Cruise Ship Terminal in South Boston, MA. The purpose of the meeting, undertaken during the MEPA public comment period, was to provide an opportunity for the public to identify issues pertinent to the proposed project. Topics raised during the meeting included the location of disposal of dredged material for the navigation improvement project, the potential effect on lobsters, improvements in shore side infrastructure related to the project, the timeline for channel deepening, and cumulative impacts. A public scoping meeting for the EIR was held on February 23, 2003. Copies of written comments are provided in Appendix P of the projct Feasibility Report and SEIS/EIR.

- Cooperating Agencies

Federal agencies that have jurisdiction by law or special expertise were invited to be a cooperating agency on the development of the SEIS/EIR and include the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, NOAA-Fisheries, and the U.S. Coast Guard. The Massachusetts Executive Office of Energy and Environmental Affairs (EEA) and the Wampanoag Tribe of Gay Head (Aquinnah) also have jurisdiction by law or special expertise that is relevant to the proposed project. A letter requesting cooperating agency participation was sent by the USACE to the four Federal agencies, the lead State environmental agency, and Indian tribe on April 11 and 18, 2003.

All four Federal agencies agreed to participate as cooperating agencies on this SEIS/EIR. The Massachusetts Office of Coastal Management agreed to represent the State environmental agencies in the development of the SEIS/EIR. No response was received from the Wampanoag Tribe of Gay Head (Aquinnah).

- Technical Working Group (TWG)

As with the Boston Harbor Navigation Improvement Project, a Technical Working Group (TWG) was established to assist in the planning and review of the SEIS/EIR for this Deep Draft Navigation Improvement Dredging Project, the SEIS/Notice of Project Change for the Boston Harbor Inner Harbor Maintenance Dredging Project (IHMDP), and the recently-completed Outer Harbor Maintenance Dredging Project (OHMDP). Ten TWG meetings were held during the preparation of this Final SEIS/EIR. The first meeting was held June 10, 2003 and the last meeting on December 18, 2007. An additional meeting was held May 19, 2008 during the Draft SEIS/EIR comment period and another on December 3, 2012 to update the agencies on the status of Boston Harbor navigation projects prior to the release of the Final SEIS/EIR. The initial focus of the TWG was on the Deep Draft Project. However, since maintenance dredging projects discussed above were planned and constructed prior to the Deep Draft Project, some of the TWG meetings also included information related to issues associated with these maintenance projects. Many of those issues were also relevant to the Deep Draft Project. It is anticipated that the TWG will be an integral part of the project strategy through the design and construction phases of the proposed Deep Draft Project.

- Specific Topic Meetings

When warranted, a separate meeting was held to address a specific topic with pertinent representatives. A meeting was held August 3, 2004 between the USACE, Massport, and the Boston Harbor and Massachusetts lobstermen, and Massachusetts Division of Marine Fisheries. The purpose of the meeting was to obtain input on areas that may be appropriate for habitat enhancement sites using rock. A subgroup of the TWG was formed and will be continued in the Design Phase of the Deep Draft Project to provide input and guidance in the development of a blast mitigation plan for the proposed project.

- Massachusetts State Dredging Team and New England Regional Dredging Team (NERDT)

The Massachusetts Coastal Zone Management Office hosts recurring meetings on dredging projects within the State including relevant issues and topics for discussion. Local, State, and Federal agencies as well as public interest groups attend these meetings. The status of the recent Boston Harbor dredging projects, including this proposed project, is provided to the group for information and comment.

In addition, the status and relevant topics of the Deep Draft Project are presented to the regional subteam of the National Dredging Team. This regional subteam meets to discuss relevant dredging issues faced by the Federal and State agencies of the coastal New England States.

- Draft and Final SEIS/EIR Public Review Process

The Draft and Final SEIS and EIRs are published jointly to provide an opportunity for combined public review and comment. This format complies with the regulations of the NEPA to the fullest extent possible by reducing duplication between NEPA and comparable State requirements, such as joint environmental impact statements, and complies with the MEPA, whose governing regulations also encourage coordinated reviews under NEPA and MEPA where possible. A minimum 45-day public comment is provided once a Notice of Availability of the Draft SEIS/EIR is published in the Federal Register and Environmental Monitor. A Final SEIS/EIR is prepared once comments have been received on the Draft SEIS/EIR. The USACE will prepare a Record of Decision for publication in the Federal Register not sooner than 30 days after the public release of the FSEIS/EIR. A Final Section 61 Findings under MEPA cannot be finalized until further details become available in the Design Phase of the project. As required by the Secretary's Certificate on the Draft EIR, a Draft Section 61 Findings is included in this Final EIR that reflects the current project mitigation elements to the extent possible in this Final SEIS/EIR.

Lessons Learned from the BHNIP and Mitigation

Experience gained from the BHNIP has guided development of the dredging and disposal plans for this Deep Draft Project. Environmental monitoring required as part of the BHNIP WQC included:

- Silt plume tracking during dredging of and after disposal into CAD cells;
- Water quality testing after disposal into the CAD cells;
- Biological testing for toxicity and contaminant uptake;

- Dissolved oxygen (DO) monitoring within and outside the CAD cells; and
- Fisheries monitoring during blasting operations.

The lessons learned as a result of the extensive environmental monitoring conducted during construction of Phase 1 and Phase 2 of the BHNIP performed from 1997-2000 allowed determinion of what methodologies worked best to minimize environmental impacts. These methodologies will be implemented, where applicable, to reduce and minimize potential Deep Draft Project impacts during the course of construction. Monitoring programs may be proposed to confirm that the dredging and disposal methodologies have minimal environmental impact.

Additional investigations, outside the scope of the WQC, were performed during BHNIP construction to address concerns raised by the Technical Advisory Committee or to address potential impacts from changes in operations suggested by the dredging contractor. These additional investigations included:

- Water quality monitoring during disposal at low tide;
- Monitoring turbidity during use of a closed environmental bucket for silt removal;
- Monitoring turbidity during vessel passage over an uncapped and capped CAD cell;
- Bathymetric measurements; and
- Lobster monitoring.

Results of the monitoring showed no water quality violations or significant environmental impacts from construction of the project

Four fish kills were experienced and recorded during 14 underwater blasting events in Boston Harbor during the ledge pinnacle removal project in the late fall of 2007. These fish kills occurred despite following procedures that have been successfully employed during prior underwater blasting events in Boston Harbor and other locations. Methods employed to reduce the probability of fish kills involved the use of side scan sonar to detect and avoid blasting during times when passing schools of fish were present in the immediate projecr area, a fish startle system to deter fish of the Clupeid family (i.e. blueback herring and alewife) from entering the blast area, and a fish observer to oversee and determine the appropriate blasting times. In addition, blast delays and stemming (filling the borehole with rock) are both methods that were employed to reduce the shock waves.

Following the firstfish kill event, the USACE immediately met with the blast contractor and designated fish observer to determine the likely causes of the event and to identify corrective measures for future blasting activities. Resource agencies were also notified of the event and briefed on initial corrective actions before blasting was resumed. Despite these initial corrective measures, subsequent fish kills occurred. In response to these unexpected events, the USACE prepared an “After Action Report” to provide information on all of the blasting events and convened an interagency underwater blasting subgroup of the technical working group with Federal and State resources agencies. The goal of the “After Action Report” and the working group was to determine what lessons could be learned from the 2007 fish kill events, and apply that knowledge and any other identified corrective practicable measures to minimize potential fish impacts during blasting activities for future projects as well as for the Deep Draft Project. Lessons learned were applied to the Boston Harbor Rock Removal Project in 2012 which resulted in no fish kills during the course of the project. The “After Action Report” can be found in Appendix Y of this Final SEIS/EIR.

The blasting mitigation working group of the TWG will focus on ways to minimize impacts during construction of the proposed Deep Draft Project. These measures may include construction sequencing for several areas of the harbor time of year restrictions, operational changes and equipment changes. Some of these decisions must wait until additional rock probes and borings have been completed in the forthcoming Design Phase of the project which will identify the location and quantity of rock in the harbor. The goal of the working group discussions will be to identify practicable and implementable measures to be enacted during project operations to minimize the potential for impact.

FEDERAL DEEP DRAFT NAVIGATION IMPROVEMENT PROJECT BOSTON HARBOR, MASSACHUSETTS

FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT/ENVIRONMENTAL IMPACT REPORT

1. INTRODUCTION

Boston, Massachusetts is the hub of the nation's tenth largest metropolitan area, with a population of nearly 4.6 million as of 2010. The Port of Boston, which is located within the city of Boston and the adjacent cities of Everett, Chelsea, Hull, and Revere, and the town of Winthrop, is the largest port in New England. The Port handles about 20 million tons of cargo, worth about $9 billion annually to the regional economy. It serves a regional population of 14.3 million residents in the six New England states.

The Port of Boston, Massachusetts, as shown in Figure 1-1, is located on the western shore of Massachusetts Bay, an arm of the Gulf of Maine, about 50 nautical miles northwesterly of the northern tip of Cape Cod. The harbor includes all the tidal waters bound by a line drawn roughly from Point Allerton in Hull northward to Point Shirley in Winthrop. The harbor comprises a water area of about 47 square miles.

The main deep water harbor is comprised of the waterways of the Main Ship Channel, Reserved Channel, Mystic River, and Chelsea River. These channels provide access at a depth of 40 feet below mean lower low water (MLLW; all subsequent depths are referenced to below MLLW) to the Port's principal terminals, except for the Chelsea River which has an authorized depth of 38 feet, and portions of the Mystic River that remain at 35 feet deep. Deep water access to the harbor is provided by three entrance channels improved and maintained by the U.S. Army Corps of Engineers (USACE); the Broad Sound North Channel in two shipping lanes at 35 and 40 feet deep, the Broad Sound South Channel at 30 feet, and the Narrows Channel at 27 feet.

Terminals located in the harbor complex shipped and received about 19.1 million tons of liquid and dry bulk, containerized, and general cargo in 2010. Bulk products, principally petroleum fuels, natural gas, cement, scrap metal, gypsum, and salt, are processed through more than twenty public and private terminals. The majority of the cargo through the port by volume is petroleum (about 16.5 million tons annually between 2001 and 2010). Autos are landed at the Massachusetts Port Authority's (Massport) Boston Autoport which is located on the Mystic River. Cruise ships call on Massport's Black Falcon Terminal located on the Reserved Channel in South Boston. Containerized cargo is handled at the Massport's Conley Terminal, which is also located on the Reserved Channel in South Boston, which makes up about seven percent of the 22 million tons of cargo. In 2007 this containerized cargo had a value of more than $5 billion, more than 60 percent of the value of all cargo shipped through the port.

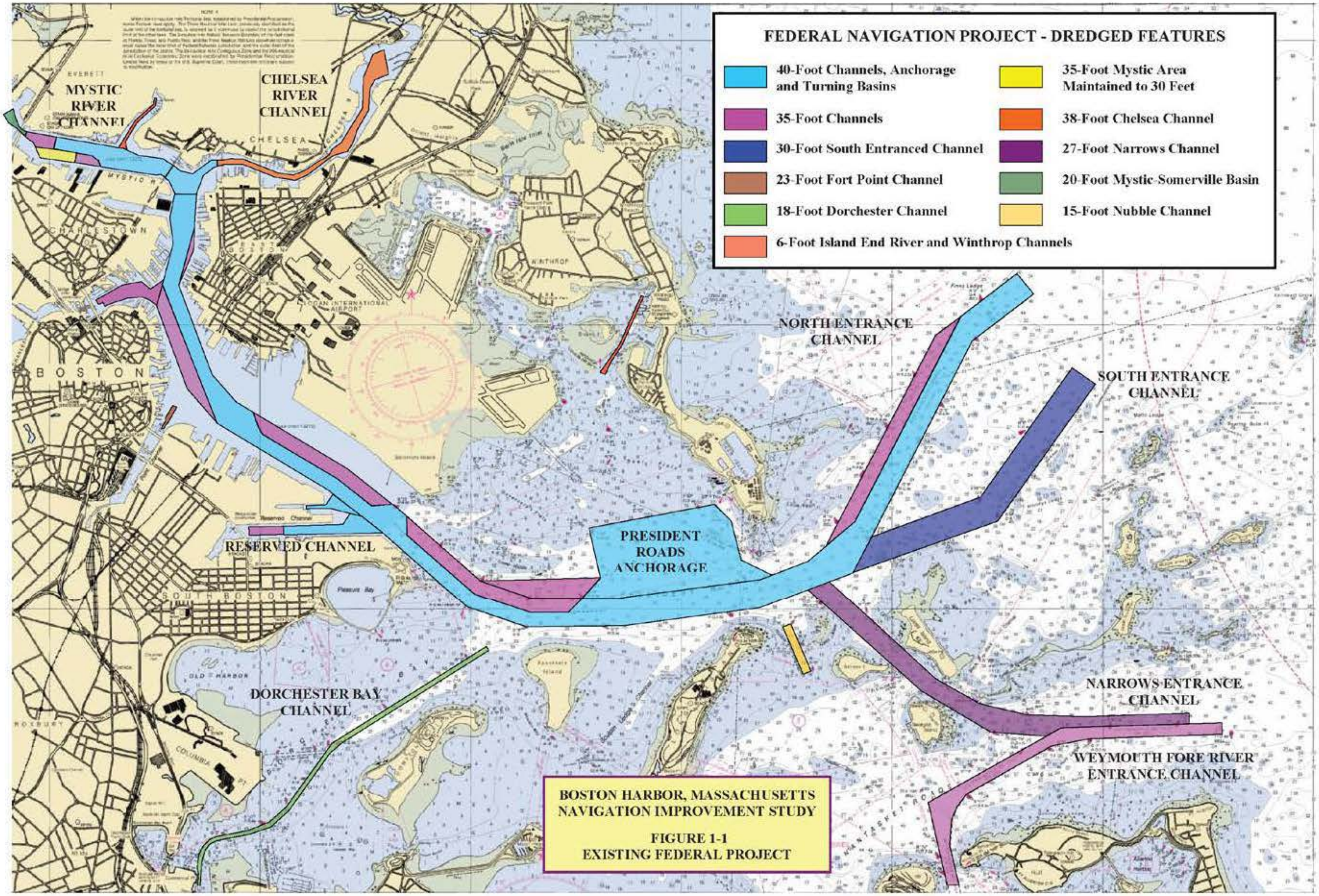


Figure 1-1. Currently Authorized Federal Navigation Project

1.1 Response to Draft Feasibility and Draft Supplemental Environmental Impact Statement/Report Comments

Notice of the availability for public review of the Draft Feasibility and joint Federal and State Draft Supplemental Environmental Impact Statement/Environmental Impact Report (DSEIS/EIR) prepared for this proposed navigation improvement project was published in the Federal Register on 18 April 2008. The public comment period for both the Federal and State review processes closed on 2 June 2008. After presentation of the project to the Civil Works Review Board in August 2008, additional economic analyses were requested, which were completed in May 2012. Resolution of the recommended project depth was made in August 2012. Additional coordination letters were sent to Federal and State agencies on October 11, 2012 to request confirmation that previous determinations provided by the agencies on the Draft SEIS/EIR remain valid before proceeding with issuing the Final Feasibility Report and Final SEIS/EIR. The Massachusetts Environmental Policy Act (MEPA) Office was also asked to formally review their 2008 Scope Certificate for consistency with the current project. No significant changes to previous comments or the Secretary's certificate were received. A number of commenting parties had common concerns with certain aspects of the proposed project. Many of these comments requested additional investigations, which can not be performed until the Planning, Engineering, and Design phase (Design Phase) of the project (which is after public release of the Final SEIS/EIR) due to Federal time and funding constraints. These investigations may result in the need for additional planning, resource agency coordination and consultation, and additional NEPA and MEPA documents to comply with specific areas and topics. Any additional NEPA and MEPA documents generated would be available for public review.

Additional investigations and plans to be developed during the Design Phase include:

- Development of a Blasting Mitigation Plan once the extent of rock thay may require blasting is identified during final design;
- Investigations of potential rock reef sites for beneficial use of rock;
- Investigation of other beneficial uses for rock removed from the project;
- Development of an overall Construction Sequencing Plan;
- Benthic resource definition and recolonization studies for dredged area; and
- Air quality compliance methodology and alternatives.

Details on the above investigations are available in Appendix A – Pertinent Correspondence. Other general topics discussed in this appendix include a description of the USACE Civil Works Process and the continuation of the interagency Technical Working Group (TWG) during the forthcoming Design Phase of the project.

1.2 Project Purpose and Need

1.2.1 Purpose of the Action

The purpose of this Boston Harbor Deep Draft Navigation Improvement Study (Deep Draft Project) is to identify, formulate, screen, and evaluate the feasibility of alternatives for channel deepening and related improvements in the Port of Boston, consistent with the goals of the study sponsor, Massport, and in response to direction from Congress in the authorizing resolution and appropriations acts. Massport's goal is to provide deeper access to their Conley Container Terminal located on the Reserved Channel in South Boston at a depth at least equal to the 45 feet depth now available at that facility's berths. Additional minor port improvements in the Mystic and Chelsea Rivers and in the Main Ship Channel above the Reserved Channel are also being investigated.

Various preliminary alternatives were formulated and screened. Alternatives were selected for detailed study on the basis of estimated costs and benefits of the proposed channel and anchorage modifications. Project costs include the costs of channel deepening and widening through dredging and rock ledge removal, costs of disposal of dredged material, and costs for environmental mitigation. Project costs also include the associated berthing improvements needed to accommodate the deepened channels.

1.2.2 Need for Improvement Dredging

Without channel deepening, the containerships and bulk carriers currently using Boston Harbor will continue to experience tidal delays. In some cases, vessels that would experience a tidal delay in Boston Harbor, would bypass Boston all together so as not to jeopardize their arrival schedule in other ports. As other ports proceed with channel deepening projects in response to the expansion of the Panama Canal carriers will add larger vessels to the services that currently include Boston Harbor. These carriers may be forced to eliminate Boston from their rotation, as the tidal restraints caused by the 40-foot deep channel make a stop in Boston Harbor more costly. Because of these factors, a large part of New England cargo will continue to be shipped in or out of the Port of New York/New Jersey (PONYNJ), increasing total transportation costs. Substantial quantities of import and export cargo have shifted from the PONYNJ to Boston Harbor because of the lower landside transportation costs for cargo shipped directly into of from Boston Harbor. However, the shift in cargo from the PONYNJ to the Port of Boston Harbor will reverse itself once the carrying capacity and draft of the ships calling along the U.S. East Coast increases, and the tidal restrictions caused by the 40-foot deep Boston Harbor navigation channel depth becomes unsustainable from an economic and scheduling standpoint.

1.2.3 Congressional Authorization

Boston Harbor and its navigable tributaries have been extensively improved and developed by the USACE, State, and local interests. The first Federal Boston Harbor navigation project was authorized in 1822. The most recent improvements and modifications were authorized by the Water Resources Development Act of 1990, for which the Boston Harbor Navigation Improvement and Berth Dredging Project (BHNIP) Environmental Impact Report/Statement (EIR/S) (USACE and Massport, 1994, 1995), which this document supplements, was prepared. These modifications consisted of deepening portions of the Mystic River, Inner Confluence, and lower Reserved Channel from -35 feet MLLW to -40 feet MLLW. In addition, a small section of the 35-foot deep Main Ship Channel across from the Reserved Channel was deepened to –40 feet MLLW to aid in turning of vessels into the Reserved Channel. The Chelsea River channel, which serves the majority of the petroleum needs of the region and supplies fuel to Boston’s Logan International Airport, was deepened from -35 feet MLLW to -38 MLLW. In addition, non-structural improvements to realign the main entrance and approach channels by designating Federal channel limits and repositioning navigation buoys were also authorized. These modifications, known as the Boston Harbor Navigation Improvement Project, were completed in 2002. See Figure 1-1. Additional work to widen the Chelsea River channel through the new Chelsea Street Bridge opening was completed in 2012.

The New England District, U.S. Army Corps of Engineers has been authorized to conduct the current Feasibility Study to evaluate whether or not Federal participation in additional navigation improvements at Boston Harbor is warranted. The Feasibility Study was authorized by a Senate Subcommittee on Public Works Resolution dated September 11, 1969. The language of the resolution is provided below:

> “Resolved by the Committee on Public Works of the United States Senate, (September 11, 1969), that the Board of Engineers for Rivers and Harbors, created under Section 3 of the River and Harbor Act of June 13, 1902, be, and is hereby requested to review the report of the Chief of Engineers on Boston Harbor, Massachusetts, published as House Document Numbered 733, Seventy-ninth Congress, and other pertinent reports, with a view to determining whether any modifications of the recommendations contained therein are advisable at this time, with particular reference to modifying the project dimensions of the

Main Ship Channel from deep water in Broad Sound to the upstream limit of the Federal project in the Mystic River."

An expedited reconnaissance investigation was initiated at the request of Massport, the study sponsor, in December 1999 using funds provided in the Fiscal Year 2000 Energy and Water Development Appropriations Act. This Act directed a study to provide a channel depth of at least 45 feet to the Conley Terminal. The 905(b) Reconnaissance Report was approved by U.S. Army Corps of Engineers North Atlantic Division and Headquarters in August 2000.

The USACE and Massport executed the Feasibility Cost-Sharing Agreement (FCSA) for this project on June 27, 2002 and the study was initiated in July 2002. A Notice of Intent to prepare a Supplemental Environmental Impact Statement for the project was published in the Federal Register on August 23, 2002, and the first public involvement meeting on the proposed project was held on September 5, 2002. An Environmental Notification Form was submitted on January 31, 2003 by Massport to the Massachusetts Environmental Policy Act (MEPA) Office and published in the Environmental Monitor on February 8, 2003 by Massport to initiate the MEPA process. The Secretary of Environmental Affairs determined on March 10, 2003 that an EIR would be required for the project. As before, to avoid duplication, a joint Federal and State environmental document was prepared (SEIS/EIR).

The preferred alternative will be selected based on the USACE economic guidance related to project net benefits as well as input from the study sponsor, while minimizing environmental impacts.

1.2.4 Laws and Regulations Governing Dredged Material Disposal

The primary authorities that apply to the disposal of dredged material in United States waters are the Marine Protection, Research, and Sanctuaries Act (MPRSA) of 1972 and the Clean Water Act (CWA) of 1972. Which requirements apply depend on whether disposal activities occur landward of the territorial sea baseline, seaward of the three-mile limit, or in the overlap area between the two lines. The jurisdiction of MPRSA and CWA overlaps within the territorial sea, which is defined as the open water between the baseline and the States' three-mile territorial limit. Where jurisdiction overlaps, CWA takes precedence where dredged material is used as fill, such as beach nourishment, while MPRSA takes precedence for transit of dredged material for disposal purposes other than fill. MPRSA does not apply to disposal actions inside the baseline, and the CWA does not apply outside the three-mile limit. The Massachusetts Bay Disposal Site (MBDS) lies seaward of the three mile limit and is therefore subject only to MPRSA. Disposal of rock from the project for beneficial use within Broad Sound or Massachusetts Bay to create habitat enhancement sites would be subject to the CWA and not MPRSA as these sites lie landward of the baseline.

Congress enacted the MPRSA of 1972 to address and control the disposal of dredged materials in ocean waters. Regulations implementing MPRSA were promulgated by U.S. EPA and are codified at 40 CFR Parts 220-228. Title 1 of the MPRSA authorized the EPA and the USACE to regulate disposal in U.S. ocean waters. EPA and the USACE share responsibility for managing dredged material. The MPRSA prohibits the disposal of dredged materials into water under its jurisdiction unless conducted in compliance with a permit issued by the USACE under Section 103 of the MPRSA or authorization under the USACE Civil Works Program (33 U.S.C. Section 1411(a) and Section 1413(a)). USACE dredged material disposal permits and authorizations are issued under MPRSA Section 103 and may include conditions deemed necessary by the USACE related to the type of material to be disposed of, time of disposal, and other matters (33 U.S.C. Section 1413 and Section 1414(a)). The dredged material disposal permitting process requires consideration of a range of disposal alternatives, including beneficial reuse and upland treatment and disposal.

The USACE approves a dredging project under its Civil Works Authority only if it has determined that dredged material disposal "will not unreasonably degrade or endanger human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities" (33 U.S.C. Section 1413(a)). The USACE makes MPRSA Section 103 determinations by the standards set forth in EPA regulations (33 U.S.C. Section 1413(b)). EPA has promulgated its ocean disposal regulations pursuant to MPRSA Section 102(a) (33 U.S.C. Section 1412(a), at 40 CFR Parts 220 to 229). The Section 404 permit program is implemented by the USACE and covers the discharge or placement of dredged and fill material into inland waters of the United States. As in MPRSA above, the USACE does not issue itself a CWA permit for projects under the USACE Civil Works Authority but does apply the 404 (b)(1) guidelines and other substantive requirements of the CWA and other environmental laws (33 CFR Part 335).

For most dredged material disposal projects, the USACE solicits comments from the NOAA – Fisheries, U.S. Fish and Wildlife Service (FWS), EPA, and State regulatory agencies to ensure that the project conforms to applicable State water quality standards (if within the State's territorial waters) and is consistent with the State Coastal Zone Management Act program. USACE permit determinations and civil works approvals are also subject to any applicable requirements of other laws (e.g. the Endangered Species Act, the Fish and Wildlife Coordination Act, etc.). See the Environmental Compliance Section below for applicable laws.

1.3 Summary of Major Changes and Lessons Learned from the 1995 Final Environmental Impact Report/Statement and Subsequent Maintenance Dredging Projects

This Final Supplemental Environmental Impact Statement/Environmental Impact Report builds on the lessons learned from the Boston Harbor Navigation Improvement Project (BHNIP) located in Massachusetts, which was the subject of a Final Environmental Impact Report/Statement prepared in 1995 (USACE and Massport, 1995) and on lessons learned from the Outer and Inner Harbor Maintenance Dredging Projects and 2012 Boston Harbor Rock Removal Project. Since the mid-1990's, the BHNIP has been constructed (see Figure 1-2 for location) and additional maintenance dredging of the navigation channels in Boston Harbor has been completed. The Boston Harbor Outer Harbor Maintenance Dredging Project (OHMDP) restored the navigation channels to their authorized depths in 2004 and 2005 in the 40-foot channel reach approximately halfway between Castle and Spectacle Island seaward to deep water in Broad Sound North Channel, as well as the President Roads Anchorage. See Figure 1-3.

In 2007 and 2008, the Boston Harbor Inner Harbor Maintenance Dredging Project (IHMDP) removed rock outcrops and dredged shoals from the 35-foot and 40-foot deep Main Ship Channel to its authorized depth from the point where the previous maintenance dredging project left off (from approximately halfway between Castle and Spectacle Islands) to a point upstream of the North Jetty (located just below the Third Harbor Tunnel), the upper Reserved Channel, and the approach channel to the Navy Dry Dock. In addition, approximately 3,600 cubic yards (cy) of material was dredged from Boston Redevelopment Authority berth #4 to a depth of -30-feet, and the abandoned Keyspan gas siphon was also removed from the channel in the vicinity of the Chelsea Street Bridge to allow for the deepening of the Chelsea River navigation channel to its authorized depth.

Two Confined Aquatic Disposal (CAD) cells were constructed in association with these efforts. One larger CAD cell was constructed in the Mystic River located near the Inner Confluence, and another smaller CAD cell constructed in the Main Ship Channel just south of the Inner Confluence. Approximately one million cy of dredged material was placed at the MBDS from construction of the CAD cells (720,000 cy) and maintenance dredging (310,000 cy). Another 380,000 cy was placed into the two CAD cells for a total of 1.4 million cy of dredged material. About 2,000 cy of rock was also removed from the project. Construction of the IHMDP began in mid-May of 2008 and was completed in mid-December 2008. The capping of the cells began on January 5, 2010 and was completed on

February 2, 2010. The CAD cells were capped with sand dredged from the Cape Cod Canal. See Figure 1-4 for project location of the IHMDP.

In 2012 the Chelsea River navigation channel was widened at the location of the Chelsea Street Bridge when MA Department of Transportation (MADOT) replaced the existing bridge with a new vertical lift bridge. The original opening for ship traffic through the Chelsea Street Bridge was only 96-feet wide. The bridge replacement included the removal of the existing fender system which would have created a navigation hazard if the channel was not widened. The navigation channel was widened to a minimum of 175 feet. In addition, the remainder of the Keyspan gas siphon (that was located under the fender system) was removed as well as a railroad bridge counterweight that was located out of the existing channel but within the widened channel area. Both the pipeline and counterweight were disposed of upland. Dredging was initiated on March 24, 2012 and completed on April 19, 2012. A total of about 33,000 cy of dredged material was removed and disposed at the MBDS. See Figure 1-5 for project location of the Chelsea River/Bridge widening.

Rock was removed from seven areas near Castle Island that were above the authorized depth in the 40-foot deep lane of the Main Ship Channel. Holes were drilled in the rock beginning on August 18, 2012 and completed on August 31, 2012. Blasting began on September 6, 2012 and was completed on September 21, 2012. The blasted rock was removed with a mechanical dredge between September 23 and October 1, 2012. All material was placed at the MBDS. See Figure 1-6 for project location of the rock removed for the Boston Harbor Rock Removal Project (BH Rock Removal).

Table 1-1 lists the construction dates for the various Boston Harbor Federal navigation maintenance and improvement projects and their acronyms.

Table 1-1. Recent and Proposed Boston Harbor Federal Navigation Projects (and Acronyms)

Project Name	Dates Constructed
Boston Harbor Navigation Improvement and Berth Dredging Project (BHNIP)	1998 to 2000 (additional minor work in 2001 and 2002)
Boston Harbor Outer Harbor Maintenance Dredging Project (OHMDP)	2004 to 2005
Boston Harbor Inner Harbor Maintenance Dredging Project (IHMDP)	2007 to 2008 (CAD cell capping in early 2010)
Chelsea River Navigation Widening (Chelsea River Widening)	2012
Boston Harbor Rock Removal Project (BH Rock Removal)	2012
Boston Harbor Deep Draft Navigation Improvement Project (Deep Draft Project)	Anticipated 2015 to 2017+

Experience gained from these projects have been used to guide development of the dredging and disposal plans for this Deep Draft Project. The lessons learned as a result of the extensive environmental monitoring conducted during construction of Phase 1 and Phase 2 of the BHNIP allowed us to identify and implement measures and techniques to reduce potential Deep Draft Project impacts. Additional plume monitoring performed during the IHMDP generally confirmed the monitoring results of the BHNIP monitoring; that except for the area below Castle Island where several bodies of water meet, all the dredged and disposal plumes stayed confined to the navigation channel. This monitoring has been used to assess potential impacts for the Deep Draft Project.

Environmental monitoring conducted as part of the BHNIP WQC included:

- Silt plume tracking during different periods if dredging of and after disposal into CAD cells;

- Water quality testing after disposal into the CAD cells;
- Biological testing for contaminants;
- Dissolved oxygen (DO) monitoring within and outside the CAD cells; and
- Fisheries monitoring during blasting operations (including a fish observer, startle system, etc.).

Additional investigations were also performed during BHNIP construction from 1997 to 2000 to address concerns raised by the Technical Advisory Committee or to address potential impacts from changes in operations requested by the dredging contractor. These additional investigations included:

- Turbidity monitoring during disposal at low tide;
- Monitoring turbidity during use of the closed environmental bucket for silt removal;
- Monitoring turbidity during vessel passage over an uncapped and capped CAD cell;
- Bathymetric measurements; and
- Lobster monitoring.

Lessons learned from Phase I (deepening berths 11 and 12 at Conley Terminal) and Phase II (the remaining project) during construction and monitoring are described below and show that with proper operational controls, physical and biological water quality impacts from dredging and disposal activities in the harbor is localized and temporary. Environmental monitoring showed that dredging silt material with a closed bucket did not result in any water quality violations either from turbidity or resuspended contaminants, according to the standards set in the WQC (USACE/Normandeau Associates 1998a-f, 1999a-k, 2000a). Turbidity values returned to normal within 600 to 1,000 feet downstream of dredging. Additionally, no water quality violations were observed during removal of parent material.

Turbidity interfered with the electronic depth sensors on the closed bucket during Phase I which resulted in under and overdredging. Other problems arose with the electronic sensors on the closed bucket when the electric wires on the closed bucket used to determine bucket closure were severed in the first few hours. A decision was made to return to traditional methods for determining the closed bucket depth, which were successful.

Monitoring of silt disposal into CAD cells was reduced from a 12 hour period after disposal in Phase I to between four and six hours in Phase II because a discernable plume could not generally be found six hours after disposal. In addition, no difference was noted in the intensity or areal expansion of the disposal plume when silt was disposed during high or low slack tides. Also, data revealed that there was no substantial difference in plume development when disposal operations occurred when the CAD cell was more than 50% full. The results of the monitoring indicate that the disposal plume did not violate any water quality standards at any time nor did the plume leave the navigation channel. Results from a vessel passage study indicated that more material was resuspended in the navigation channel by a transiting vessel heading toward sea than resuspended by the vessel passing over the uncapped the CAD cells. Biological tests (bioaccumulation, sea urchin fertilization, and bioassays) also did not reveal any significant impacts from dredging and disposal into the CAD cells in the harbor. Data referenced in USACE/Normandeau Associates Water Quality Monitoring Reports (1998a-f, 1999a-k, 2000a-b)

Lobstermen expressed concern that dredging the navigation channels when lobsters were present in greater numbers during the warm months could impact overall catch and affect their livelihood. The scows were checked in the summer when they were located in the Reserved Channel (where there is traditionally a higher concentration of lobsters) to see if lobsters were removed along with the dredged material by the dredge bucket. The results of these scow inspections indicated that lobsters were not impinged during dredging operations, which served to alleviate or eliminated the lobstermen's concerns. It is believed that the lobsters either avoid or left the areas that were being disturbed by dredging actions.

Fisheries protection measures (i.e. time restrictions on blasting and/or a fisheries observer, sonar system and fish startle system) implemented during the course of the BHNIP dredging operations appeared to be effective during blasting and CAD cell disposal activities as no fish kills were observed. Dredging operations and protective measures appeared to deter fish from the project area. However, four fish mortality events were observed and recorded during 14 underwater blasting events in Boston Harbor during the ledge pinnacle removal project as part of the IHMDP in the late fall of 2007. These fish kills occurred despite following procedures that have been successfully employed for underwater blasting for prior projects in Boston Harbor at and other locations. Methods employed during these prior projects to reduce the potential for fish kills involved the use of a side scan sonar to detect and avoid passing schools of fish, a fish startle system to deter fish of the Clupeid family (i.e. blueback herring and alewife) from entering the blast area, and a fish observer to oversee and determine the appropriate blast time. Blast delays and stemming (filling the borehole with rock) are both methods to reduce the shock wave from blasting and were employed during blasting of the ledge.

Following the first fish kill event, the USACE immediately met with the blast contractor and designated fish observer to determine the likely causes of the event and to identify corrective measures for future blasting activities. Resource agencies were notified of the event and briefed on initial corrective actions before blasting was resumed. Despite these initial corrective measures, subsequent fish kills occurred. One of these fish kills was caused by a safety/regulatory requirement that charges in the water must be fired and the area cleared prior to dusk. Detonation has been delayed by several hours waiting for the fish to clear the area, but due to human safety concerns, detonation occurred.

In response to these unexpected events, the USACE prepared an “After Action Report” to provide information on all of the blasting events and convened an interagency underwater blasting subgroup of the technical working group with Federal and State resources agencies. The goal of the “After Action Report” and the working group was to determine what lessons sould be learned from the 2007 fish kill events, and apply that knowledge and any other identified corrective practicable measures to minimize potential fish impacts during blasting activities for future projects as well as for the Deep Draft Project. Lessons learned were applied to the Boston Harbor Rock Removal Project in 2012 which resulted in no fish kills during the course of the project. The “After Action Report” can be found in Appendix Y of this Final SEIS/EIR. The blasting working group will focus on ways to minimize impacts during construction of the proposed Deep Draft Project. These measures may include construction sequencing for several areas of the harbor, time of year restrictions, potential operational changes, and equipment changes. The goals of the working group discussions will be to identify practicable and implementable measures to be enacted during project operations to minimize the portential for impact.

A hydrophone was placed in the water during three blast events for the Boston Harbor Rock Removal Project constructed in 2012. The purpose of the hydrophone was to collect sound pressure (waves) from actual blasting events. The data was used in calculations to determine protective zones for protected species such as whales, sea turtles and the Atlantic sturgeon that could be impacted from the proposed project. More detail on this data and the calculations can be found in Section 4.2.5.

From an operational perspective, one of the primary “lessons learned” from the Phase I and II dredging/disposal activities was the method to effectively cap the silt material in the CAD cells with sand and assess rates of silt consolidation. Initially, regulators were concerned that the silty dredged material deposited in the CAD cell could become resuspended by passing vessel traffic. For this reason, they required that the CAD cell be capped as soon as possible after the last placement of dredged mataerial into the cell. The initial sand caps were not successful because the silty dredged material had not consolidated sufficiently to support a sand cap. Silt consolidation increased from two weeks in Phase 1 to 60 days prior to cap placement in the Water Quality Certification for Phase II. During Phase II, the time allowed for silt consolidation was increased again from two months to more than seven months to try and create a model cap, that is, a distinct cap separating the silt from the rest of the harbor bottom. A simple “plop test” was used to determine when the silt material exhibited enough solidification to hold a sand cap. The “plop test” consisted of piece of wood with concentric circles. The silt was placed in the center of the wood. The distance the silt moved and the amount of time was measured. When the material showed minimal movement, it was determined to be of sufficient strength to support a cap. It was also determined that cap placement was far more effective when performed from a moving rather than a stationary platform. Other measures such as not anchoring (spudding) or mechanically disturbing the cap material also served to minimize overall disturbance to cell structure. In subsequent projects with CAD cell placement, the CAD cell would be surveyed at different intervals. As the material consolidates, it settles. When the settlement rate slows, the material has consolidated enough to support a cap.

Minimal or no silty maintenance material, unsuitable for ocean disposal, is expected to be removed during the Deep Draft Project, unless deferred maintenance of the upper Main Ship Channel (above the Massport Marine Terminal) is pursued. Therefore the construction of new CAD cells to hold the silty shoal material from the Deep Draft Project is unlikely, but would be needed to hold the remaining maintenance material not dug during the IHMDP.

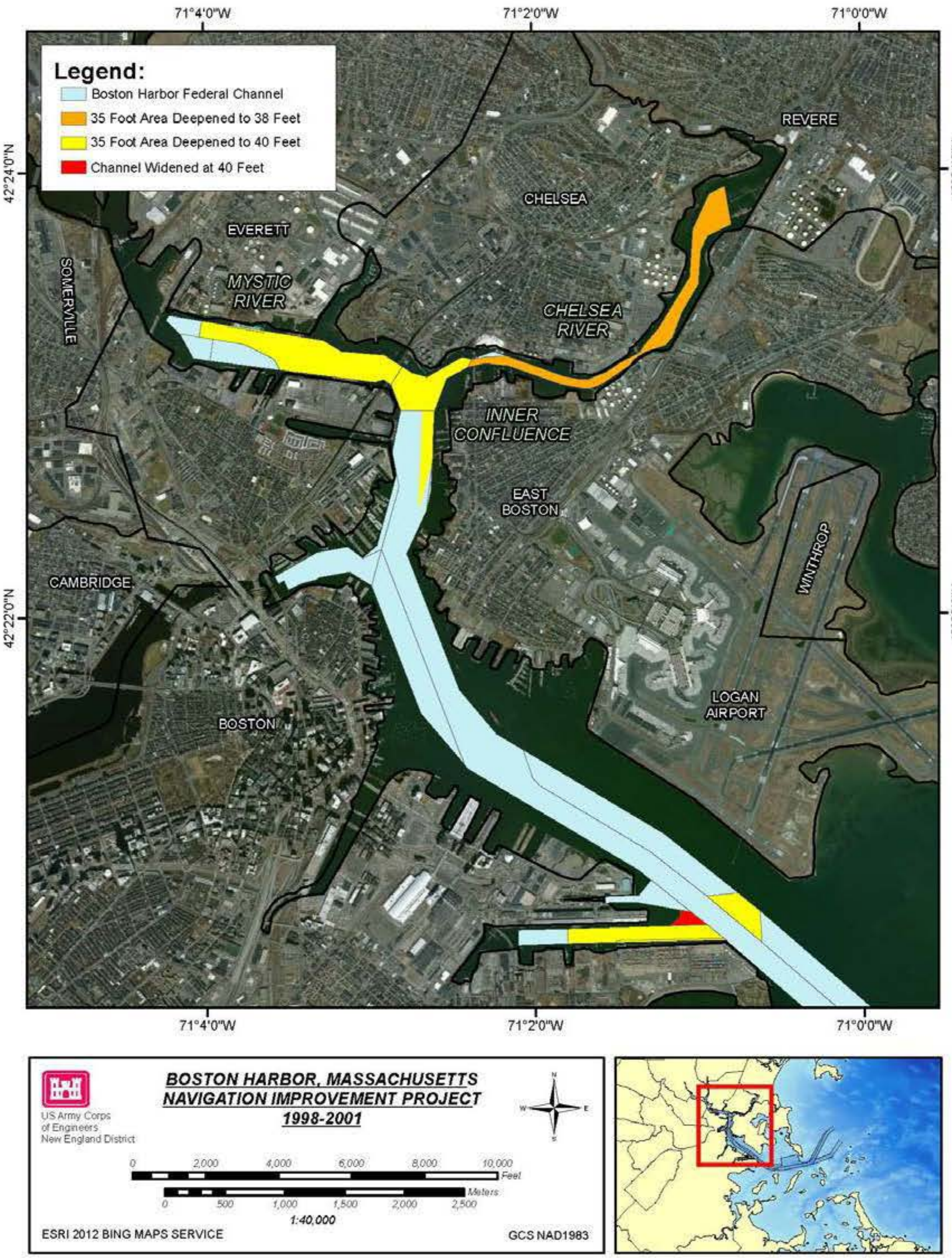


Figure 1-2. Boston Harbor Navigation Improvement Project (BHNIP)

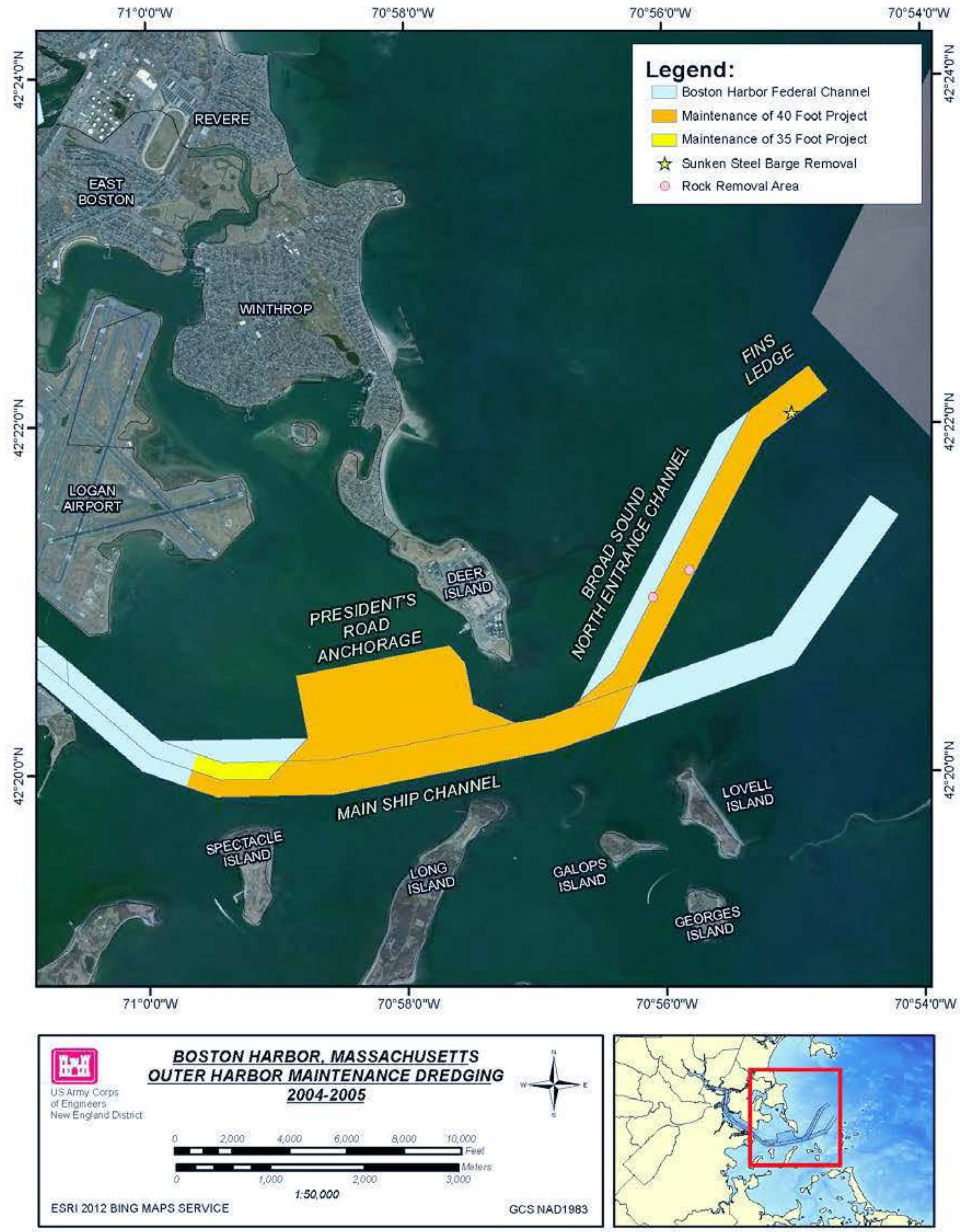


Figure 1-3. Outer Harbor Maintenance Dredging (OHMDP)

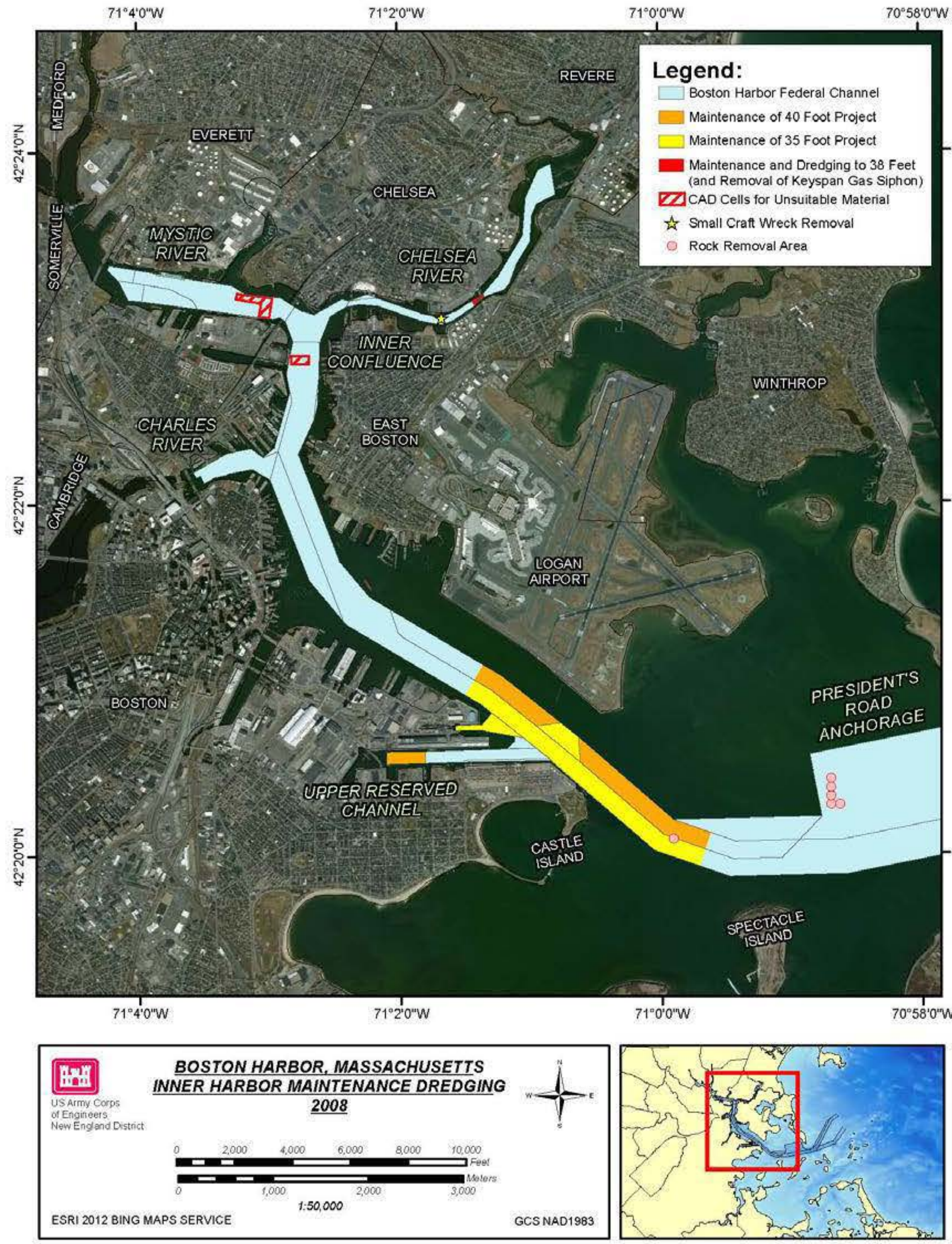


Figure 1-4. Inner Harbor Maintenance Dredging Project (IHMDP)

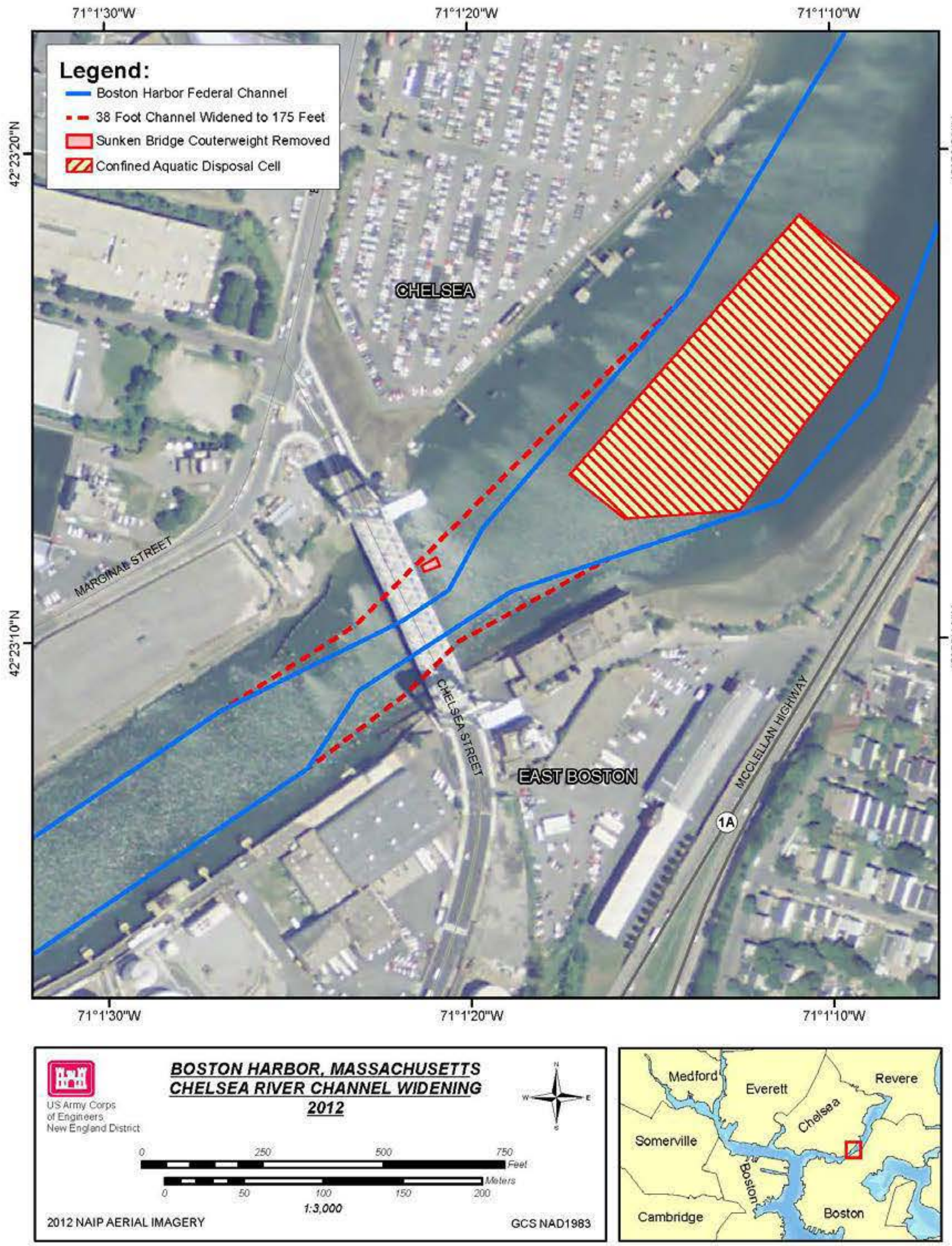


Figure 1-5. Chelsea River Navigation Widening (Chelsea River Widening)

Figure 1-6. Inner Harbor Rock Removal (BH Rock Removal)

2. ALTERNATIVES

The objective of the Boston Harbor Deep Draft Navigation Improvement Study is to develop an optimal plan for effectively and efficiently accommodating existing and likely future deep-draft vessel traffic in the Port of Boston. The optimal plan for Federal participation must be consistent with the USACE National Economic Development (NED) perspective as set forth in the USACE Principles and Guidelines and must also account for the Regional Economic Development (RED) perspective. Plans must also account for Other Social Effects (OSE), be acceptable from the perspective of Environmental Quality (EQ), and be in concert with the USACE of Engineers Chief of Engineers' Environmental Operating Principles. Plans developed for analysis must be formulated to be complete, effective, efficient and acceptable, and to reasonably maximize net benefits.

Planning objectives are statements that describe the desired results of the planning process by solving the problems and taking advantage of the opportunities identified[1]. Alternative plans were evaluated based on the extent to which they meet one or more of the following planning objectives:

- Contribute to National Economic Development by minimizing the cost of transporting cargo to and from New England in an environmentally acceptable and sustainable manner;
- Reduce current and expected future tidal delays at Boston Harbor;
- Reduced current and expected future light loading requirements for vessels calling at Boston Harbor;
- Reduce current lightering requirements and potential future increases in lightering for petroleum tank ships calling at Boston Harbor;
- Reduce current and expected future turning and maneuvering access problems in Boston Harbor;
- Maximize the beneficial use of dredged material for habitat creation and other purposes; and
- Consider all the previously identified opportunities in the formulation and evaluation of alternative plans, while achieving the above-listed objectives.

The National Environmental Policy Act (NEPA) and Massachusetts Environmental Policy Act (MEPA) scope also require a discussion of project alternatives, including the "No Action Alternative." The following sections provide a detailed overview of alternatives to the proposed project including non-structural alternatives, alternative structural/navigation channel depth alternatives, and dredging methods. Since this is a Supplemental EIS/EIR, the preferred design is evaluated in the context of disposal alternatives addressed in the BHNIP EIR/S. Options for beneficial use of dredged materials are also considered.

2.1 No Action Alternative

Under the No Action Alternative, the proposed project would not be constructed and the benefits and impacts associated with the proposed project would not occur. The No Action Alternative would become the recommended plan if no proposed alternative meets the Federal criteria of having a benefit-cost ratio (BCR) greater than or equal to 1.0 (i.e., positive net benefits) or is deemed environmentally unaccepable. Future conditions under the No Action Alternative are detailed below.

Alternative means of cargo transport consist mainly of trucking the cargo landed at more distant ports into the region. Under the existing and No Action Alternative, large volumes of New England destined cargo are landed at the Port of New York and New Jersey (PONYNJ). This cargo is then trucked into the region or loaded onto railcars for transport to Boston or to Worcester in the case of

[1] Planning Guidance Notebook, Paragraph 2-3.a(4)

rail. Barge and other feeder services linking Boston to the PONYNJ, Halifax, Portland, ME, and Portsmouth, NH have been tried in recent years, but all have failed and ceased sercie due to a lack of cargo. The practice of trucking the majority of New England's container cargo from PONYNJ is expected to continue under the No Action Alternative, with some diversion of New York landed cargo destined for eastern New England landing at the Port of Boston. As this practice is already captured in the cargo routing and volume analysis for the improvement alternatives at Boston, it is not carried as a separate alternative.

The changes in world container fleet characteristics must also be considered in determining the future No Action Alternative, as well as in analyzing channel improvements. New containerships under construction are increasing the overall average size of vessels in the world fleet substantially. There are new vessels under construction in the 7,000 to 13,000 TEU range. While the largest of the these ships will likely only serve on the Pacific trade routes, several steamship lines already engaged in North American east coast service have stated their intent to shortly begin operating vessels of 8,000 TEUs. As the average size of vessels in service continues to increase, ports that don't making corresponding improvements in channel depth could see themselves dropped from the lines' port rotation. That would leave these ports and their market regions more heavily reliant on rail, barge feeder service, and overland transportation of cargos. Increased truck, rail or barge transportation of containers destined for or originating in eastern New England is a likely result of failure to make channel depth improvements in the Port of Boston.

Containerships currently using Boston Harbor will continue to experience tidal delays to make the tidal window for arrival or departure. A large part of New England cargo will continue to be shipped in or out of the Port of New York/New Jersey (PONYNJ), increasing total transportation costs and air pollution. Recent trends show some cargo being shifted from the PONYNJ to Boston Harbor. This is due to the lower landside transportation costs when cargo is shipped directly to Boston Harbor. This trend will continue in the near term only to the extent that the ships can utilize the current 40-foot deep maintained navigation channel.

Under the No Action Alternative, the relatively shallow controlling depth in Boston Harbor would make it unlikely that any cargo liner services calling at Boston Harbor could upgrade their existing fleet with larger vessels beyond the fleet adjustments that will be made in response to the upcoming maintenance dredging. Any line that decides to increase their vessel size would likely need to drop Boston Harbor from their port call rotation for that liner service. In addition, it is unlikely that any new services with larger vessels would call at Boston Harbor. Growth of container shipping through Boston Harbor, measured in twenty-foot equivalent unit (TEU) volumes, for the two Mediterranean Shipping Company (MSC) liner services would be limited to the additional sailing draft for some of the MSC vessels afforded by the current channel depths. TEU volume growth for the China Overseas Shipping Company (COSCO) liner service is expected to continue as cargo is shifted from the PONYNJ. Boston Harbor TEU growth on the COSCO service will end when the vessels achieve their maximum sailing drafts given the existing channel depth. However it is important to note that COSCO would likely add larger vessels to this service (which runs through the Panama Canal) once the Panama Canal is deepened and widened, which is expected to be completed by late 2014 to 2015. At this point, COSCO may need to drop Boston from their rotation due to inadequate depth.

Currently, the PONYNJ handles about 62 percent of the delivered New England containerized cargo, while the Port of Boston only handles 38 percent of New England TEUs. A small volume of New England containerized cargo is handled at Los Angeles/Long Beach and is trans-shipped to New England by rail, or is landed at other ports. Since 2003, cargo volumes at Boston have increased by 22%. New vessel services have been added, and existing services have regularly increased the size of their vessels. Most of the containerships calling the port now are generally loaded to capacity given the channel depth and operating constraints of each line. As liner services have become available at Boston over the past few years, New England importers and exporters have been shifting from the PONYNJ to Boston Harbor to take advantage of lower total transportation costs via Boston Harbor.

Based on an analysis of current trucking costs and port fees at Boston versus PONYNJ, it is estimated that the average cost savings for New England cargo using Boston Harbor versus PONYNJ is $464/TEU imports and $500/TEU exports, including port fees. The trucking cost savings are based on a weighted average of actual cargo origins and destinations in New England. Some locations in southern New England, particularly much of Connecticut, are located closer to PONYNJ.

Besides container ships, tank ships and other bulk carriers also transit Boston Harbor to import and export cargo. Ship and terminal operations for barge traffic and auto carriers are not discussed as these vessels are not currently depth-constrained and their fleet mix is not expected to change significantly with or without channel improvements.

Over the period of 2001 to 2005, the Port of Boston handled an average of about 22,000,000 tons of cargo annually, of which about 17,000,000 tons were petroleum products. The Distrigas (LNG) and Exxon-Mobil terminals are located on the Mystic River's 40-foot deep navigation channel. Sunoco Logistics Petroleum, Gulf Oil, Irving Oil, and Global Petroleum are located on the Chelsea River 38-foot deep channel. Seventy percent (70%) of the harbor's fuel shipments, including all aviation fuel for Logan International Airport, comes through the Chelsea River.

Due to tidal conditions and draft restrictions, tank vessels often wait on the tide in the President Roads Anchorage where they occasionally lighter onto smaller ships or barges before completing transit to the berth, particularly Chelsea River bound vessels. Chelsea River bound vessels were, in the past, restricted in size by the old Chelsea Street Bridge and its 96-foot horizontal clearance between the fenders and air draft restrictions due to the leaf span. Transiting the Chelsea River Channel through the bridge was also restricted to daylight hours due to safety concerns. However, a new and wider bridge replaced the old Chelsea Street Bridge in the summer of 2012. The current 38-foot deep Federal channel was the maximum that could be justified without bridge replacement, removal of the Keyspan gas siphon, and other improvements to ease turns and bridge approaches in what has been a narrow channel. The channel has now been widened to 175 feet, and deepening the channel to 40 feet is being examined in this study.

Non-tank bulk carriers currently import cement, salt, frozen seafood, some manufactured goods, and other products, and export scrap metal and scrap newspaper, among other goods. All of these operations are currently afforded at least a 40-foot depth by the existing project. Exceptions are Eastern Minerals on the Chelsea River which has 38-foot access and the proposed bulk operation at the Massport Medford Street Terminal on the Mystic River, an area under consideration in this study for deepening to 40 feet.

Massport's planned use of the Massport Marine Terminal in South Boston involves shippers using larger craft than could transit further up-harbor above the tunnels. The Massport Marine Terminal currently has 40 foot deep channel access and berthing, having been deepened by Massport during the last improvement project. This terminal is now being examined in this study for deepening to 45 feet (Main Ship Channel deepening extension above the Reserved Turning Area).

In addition to the Massport Marine Terminal in South Boston, Massport also plans on deepening the two deepest Conley Terminal Berths (#11 and #12) to at least three feet deeper than any recommended channel improvement. The additional berth depth would allow vessels to take advantage of Boston's tides and the short six-mile transit distance between the Bay and Conley Terminal, as many presently do with the berths already deeper than the 40-foot channels. Massport has and will continue to invest in new post-panamax cranes, new terminal layouts, and other infrastructure to achieve greater terminal capacity and efficiency to accommodate the increase in cargo expected from larger vessels.

Impacts avoided with the No Action Alternative include the effect from construction such as a temporary decrease in water quality from turbidity, potential impacts to biological resources from dredging and blasting, and temporary water quality, and biological impacts from the disposal of dredged material. The environmental benefits that would not be realized from the No Action Alternative are: a reduction in regional air pollution from a decline in truck traffic, the loss of potential to use the rock to create a rock reef or other beneficial use,, and the potential to use the parent material as cover for barrel fields at the Industrial Waste Site. See Beneficial Use Alternatives Section 2.7 below.

2.2. Non-Structural Alternatives

Non-structural alternatives for achieving the planning objectives for this project, in whole or in part were examined. These alternatives do not involve improving the Port's existing General Navigation Feature's (GNF) and fall into three broad categories:

- Measures that allow for greater unit-loading of vessels without deepening;
- Alternative sites for cargo transfer (other terminals or ports); and
- Alternative means of cargo transport.

Carriers already use several measures that allow for increased vessel loading and shipping economy at Boston. These include transit using tidal advantage, light-loading and lightering of (bulk cargo vessels). Each of these methods is generally practiced in concert with routing of ships between multiple ports. Shippers must balance the economies of each of these methods, measured together with the importance of scheduling, alliances, land-side factors and other competitive arrangements in determining what practices to employ and what ports to use.

At Boston, the largest carriers for all cargo categories already have maximum navigation drafts in excess of the channel depths and use the tide to time their transits through the harbor to and from the terminals. Continued port operations using these loading and routing measures will only continue the problems encountered under the without-project condition, as cargo volumes increase. The sizes of vessels commonly employed in trans-Atlantic and Asian trade continue to increase, and all of the lines calling on Boston have plans to increase vessels sizes on these services, to the point that some or all of the deep draft container liner services may need to drop Boston from their rotations in the near future.

The use of alternative sites for cargo transfer of Boston-bound cargo has severe limitations. As stated above, container operations at Boston are segregated in a single terminal (Conley), the terminal located closest to the sea. In the heavily developed metropolitan area of eastern Massachusetts, no other sites exist at which a new terminal could be constructed. In any event, the cost of developing a new container terminal (several billion dollars) would far exceed the cost of improving the channel depths to the existing site.

Several years ago the State of Rhode Island had proposed to develop a new regional deep-draft container port at Quonset-Davisville, a former U.S. Navy facility. However, the proposal became a major issue in the 2004 Rhode Island gubernatorial campaign, and the new governor terminated planning efforts for development of this container port. The proposal is not expected to be resurrected in the foreseeable future. No other New England ports have the facilities and depths sufficient to provide a viable alternative to the Port of Boston for containerized cargo.

No practicable non-structural alternatives are apparent for meeting New England's need for container cargo shipping beyond continuation of the existing condition or improvement to shipping access to the Port of Boston.

2.3 Alternative Structural/Navigation Channel Depths

2.3.1. Entrance and Main Ship Channel Deepening

Containerships are currently the deepest draft vessels calling on the Port of Boston, and will remain so under the No Action and with-project Alternatives. Two classes of containership were modeled in a ship simulation study; a large 4,700-5,100 TEU Panamax ship, and a larger 5,600 TEU Post-Panamax containership. Over the project's economic life, still larger vessels may be used in the harbor if sufficient depth is available and current industry trends toward the use of larger vessels continue. These large containerships generally require an underkeel clearance of ten percent of their operating draft (about four feet in the inner harbor), depending on their sailing draft. The Boston Harbor Pilots require 10 percent of sailing draft as underkeel clearance. The anticipated transit drafts for these vessels at Boston are provided in the economic analysis conducted for containership benefits. With underkeel clearance, the Panamax vessels would require a 45-foot channel depth in the harbor and a 49-foot depth in the entrance channel due to the increased sea state. The 5,600 TEU vessel class would require a maximum of a 47-foot depth in the inner harbor and a 51-foot depth in the entrance channel to operate most tidal conditions. Larger 6,700 to 8,500 TEU ships would require 50 foot depths (54 feet in the entrance channel) to operate with most tidal conditions or 47 feet (51 in the entrance) with tidal assistance. A two-foot overdepth allowance would be added to these elevations, with an additional two feet of required over depth in areas of ledge or other hard bottom material.

Channel widths would also need to be adjusted for these ships. Additional width would be required in the channel bends, Main Ship Channel, and turning area to compensate for vessel motion relative to maneuvering lane requirements, passing vessel clearances, bank clearances, turning radius and use of tugs. Channel design calculations concluded, that in general, the 4,700 to 8,500 TEU classes of container ships will require a channel design width of: 1) at least 800 feet in the Main Ship Channel (widened to up to 900 feet through the bends at Spectacle and Castle Islands), 2) retaining the present width of 900 feet in the entrance channel, (with 1,100 feet in the transition seaward of Finn's Ledge bend, widened further in that bend itself), and 3) retaining the present width of 1,200 feet in the President Roads channel reach where the channel abuts the anchorage.

2.3.2. Reserved Channel and Turning Area

The Reserved Channel provides access between the Main Ship Channel and several terminals on the Reserved Channel, including the Conley Container Terminal. Massport has already deepened its berths at the Conley Terminal to -45 feet MLLW, to enable ships with a draft of up to 43 feet to reach the berths using the nine-foot average tide. The design vessels described under the economic scenarios above would require channel depths of -45 foot MLLW to -50 feet MLLW. The economic analysis examined all channel depths from -42 to -50 feet MLLW in one-foot increments. A two-foot payable overdepth allowance would be added to these depths, with an additional two feet of required over depth in areas of ledge or other hard bottom material.

Except for the smaller cruise ships calling on the Black Falcon Terminal, all ships enter and depart the Reserved Channel with tug assist. One-way traffic is required because of the channel's narrow 400-foot width. A portion of the Federal channel limits in the lower Reserved Channel were deauthorized in 1996 to allow for wider berths under the BHNIP. No further adjustments in channel width are included in the project design for the containership base plan. The upper reach of the Reserved Channel lying beyond the Conley Terminal would remain at its authorized depth of -35 feet MLLW for access to the upper berths at the Black Falcon Terminal.

The Reserved Channel Turning Area located at the confluence of that channel and the Main Ship Channel is currently configured with a radius of 1,200 feet spanning the two lanes of the Main Ship Channel at a depth of 40 feet with some widening of the confluence along the north side of the Reserved Channel. The new design container vessels would require a slightly larger turning radius of 1,500 feet. The Boston Harbor Pilots were consulted in the design of the expanded turning area. The two considerations in their view with the turning area are the action of easterly winds in conjunction with the large shallow (27-foot) ledge area off the Army Base pier (north side of the Reserved Channel), and tidal currents that force a turning vessel either towards that ledge (flood) or towards the outer berth at the Conley Terminal (ebb). The pilots requested that: 1) any turning basin radius be enlarged slightly westward to take these forces and hazards into consideration, and 2) that any expansion of the basin be in the Main Ship Channel and upstream of the Reserved Channel to avoid the ledge and berths. The redesigned turning basin with a radius of 1,600 feet, widened to the west towards the former Army Base pier and to the northeast outside the existing channel limit makes these adjustments.

2.3.3. President Roads Anchorage Deepening Plans

The 40 foot deep President Roads Anchorage was initially constructed in 1933-35 and enlarged by dredging in 1960. The harbor pilots, U.S. Coast Guard, Massport and others believe that deepening of the entrance and Main Ship Channels must be accompanied by a commensurate deepening of the President Roads Anchorage. Pilots point to the growing use of the anchorage for lightering of petroleum tank ships, vessels waiting for favorable tide conditions, berth access, or for inspections. Although the proposed project would deepen the anchorage, it would not eliminate the need for all lightering in the anchorage because of the larger ships that would use Boston Harbor. The anchorage lies in relatively sheltered waters inside Deer Island and Long Island and will not require any additional project design depth for the increased sea states found in the outer harbor or bay.

USACE policy on incorporation of port security features into harbor design may be found in the policy letter titled: National Security Considerations in the Planning, Design, Construction, and Operation and Maintenance of Harbor and Inland Harbor Projects. This policy letter states “the planning, formulation, engineering, design, funding and construction of security features and facilities for new and modified navigation projects will be accomplished as an integral part of the navigation project development process. Navigation projects and project modifications formulated in feasibility studies and recommended in feasibility reports will include appropriate cost effective security features and facilities.” That guidance states “features and facilities for security will be shared as General Navigation Features (GNF) under Section 101 of the Water Resources Development Act (WRDA) 86, as amended. The operation and maintenance costs of security features and facilities will be shared as GNF operation and maintenance costs.” The guidance also states, “While benefits will be identified and quantified to the extent possible, security will be considered an absolute criterion and its appropriate cost effective measures will be included in navigation projects without regard to any incremental economic justification.” Accordingly, deepening of the President Roads Anchorage to a depth equal to the design depth for the Main Ship Channel, either 45, 47, or 50 feet (plus a two-foot overdepth allowance and plus an additional two feet in ledge or hard bottom areas) will be included in the project plan to accommodate safety and security requirements.

2.3.4. Massport Marine Terminal (MMT) - Main Ship Channel Deepening Extension above the Reserved Channel

An incremental extension of the deepened Main Ship Channel upstream of the Reserved Channel Turning Area was considered to access the Massport Marine Terminal (MMT) in South Boston, the last terminal located seaward of the Ted Williams tunnels to and from the airport. Berths for this terminal front the Main Ship Channel and are currently at a depth of 40 feet. Massport plans call for the redevelopment of this terminal for bulk cargo shipping. Improvements to the existing bulkhead will be required to support bulk terminal operations at this location, and the berth may need to be deepened whether or not any channel improvements take place. Bulk operations at a new terminal at the Massport Marine Terminal are anticipated to require channel and berth depths of -45 feet. The assumed design vessel for this use is the dry bulk carrier described above. Massport or their tenant would need to deepen the berths at this terminal to a depth commensurate with that of any improved Federal channel. Extension of the Main Ship Channel deepening above this area is restricted by the clearances for the Ted Williams Tunnel and the MBTA Blue Line tunnel, which limits the upper harbor navigation channel areas to no deeper than 40 feet. Depths of 42 to 45 feet have been analyzed for this channel deepening extension to the Massport Marine Terminal. A two-foot overdepth allowance would be added to these elevations, with an additional two feet required over depth in areas of ledge or other hard bottom material.

Two-way traffic is a factor in this area of the Main Ship channel. Nearly all of the inner harbor's small craft traffic, commuter ferries, US Naval and USCG vessels, and the tanker and bulk carrier traffic to and from the Mystic and Chelsea Rivers pass this terminal. Smaller vessels will travel in the -35 foot northern channel lane when larger ships are in the 40-foot lane, but two-way traffic with larger bulk and tank vessels does occur frequently. A typical dry bulk vessel that would require a -45-foot channel would have a 105-foot beam. Two-way traffic in the -40-foot channel between such a ship and a Chelsea max tank vessel, the most likely passing situation, would require a 600-foot channel width.

2.3.5. Mystic River Channel Modification

The only modification under consideration for the Mystic River Channel is an extension of the 40-foot channel cut along the northern Charlestown shoreline, upstream above Massport's Boston Autoport (former Moran Terminal) to the Medford Street Terminal, which Massport has planned for bulk cargo operations. This area of the Federal project is authorized and maintained to a depth of -35 feet. Massport has already deepened the berth at the Medford Street Terminal to -40 feet during the recent improvement dredging of the Mystic River Channel. As the Ted Williams and MBTA Blue Line Tunnels clearance limits access to the upper harbor areas to -40 feet MLLW, deepening this additional portion of the Mystic River Channel is only considered to this depth.

Subsurface investigations revealed no ledge or other hard material present in the proposed dredging footprint for this area of the Mystic River. Accordingly, only a two-foot allowable overdepth increment for soft bottom materials need be added to the feature design and quantity estimates. Improvement dredging carried out for the 40-foot deepening project from 1998-2002 penetrated into glacial epoch blue clays and till. Dredging required for the deepening of the Medford Street channel area to -40 feet will very likely be limited to this type of material.

2.3.6. Chelsea River Channel Deepening

Deepening the Chelsea River beyond the current -38 foot project depth is possible now that the Chelsea Street Bridge has been replaced by others and the Keyspan gas siphon was removed in 2012. Ship simulation studies prepared in 1992 for the last improvement project, and design studies prepared in 1996 concluded that the maximum channel depth needed by vessels capable of passing through the existing bridge was 38 feet, and that vessels needing any greater depth would require removal and replacement of the bridge. As the Ted Williams and MBTA Tunnels clearance limits access to the upper harbor areas to -40 feet MLLW, deepening the Chelsea River Channel to 40 feet is the only increment considered. The design vessel for a 40-foot MLLW Chelsea channel is an 80,000 (DWT) tanker, loaded to a draft of 37 feet.

Subsurface investigations revealed no ledge or other hard material present in the majority of the proposed dredging limits and depth template for the Chelsea River. The exceptions are an area of ledge near the confluence of the channel and the turning basin at the head of navigation along the East Boston shore, and an area of hard material in the vicinity of the Chelsea Street Bridge, also along the East Boston Shore. In these areas an additional two feet required over depth will be incorporated into the dredging design and quantity estimates. Improvement dredging carried out for the -38-foot deepening project from 1998-2002 penetrated into glacial epoch blue clays, till and rock. Dredging required for the deepening the majority of the Chelsea River of to -40 feet MLLW will likely be limited to this type of parent material.

2.3.7. Project Dredge Feature Alternative Summary

Containership Improvement Alternatives for Conley Terminal Access

Plan ABC – The plans for Main Ship Channel improvements were developed for the primary benefit of containership traffic to Conley Terminal. These plans consist of dredging and rock removal, as needed, to deepen the Broad Sound North Entrance Channel, the President Roads Anchorage, the Main Ship Channel between the anchorage and the Reserved Channel, the Reserved Channel Turning Area/Basin and the lower reach of the Reserved Channel, for the benefit of the larger Panamax and Post-Panamax containerships that would call on the Conley Terminal. In all alternative plans, the Broad Sound North Entrance Channel would be deepened an additional four feet to compensate for increased sea states in the bay and outer harbor. Other vessels and cargos may also benefit from these improvements, particularly the entrance channel and anchorage deepening, but those benefits were not quantified.

The Main Ship Channel plans differ only with respect to depth optimization which evaluated a range of channel depths from -42 to -50 feet in one-foot increments. These plans are referred to collectively as Plan ABC. Plan ABC includes expansion of the Reserved Channel Turning Area to a 1,600-foot diameter, widened at its junctions with the Main Ship and Reserved Channels widened to the northeast as recommended by the ship simulation study. These plans also include widening the channels at three critical bends at Finns Ledge, Spectacle Island and the Lower Middle Shoal below Castle Island.

Bulk Cargo Terminals Access Plans

Plan D – Main Ship Channel Deepening Extension: Plan D consists of extending the deepened Main Ship Channel up-harbor along the Massport Marine Terminal above the Reserved Channel in South Boston to a depth of –45 feet MLLW. This plan's costs would be incremental to the main channels plans, and would be for the benefit of Massport's redevelopment of the MMT as a bulk cargo facility with -45-foot access.

Plan E – Mystic River Channel Deepening: Plan E consists of deepening a small area of the Mystic River Channel from -35 to -40 feet to access Massport's Medford Street Terminal in Charlestown. This area was not deepened as part of the 1990 authorized improvement as the benefits of improving access to an undefined planned bulk cargo facility were not yet developed. Massport has now redeveloped this terminal and deepened its berth to -40 feet to accommodate smaller bulk cargo operations for which space is not available at the Marine Terminal in South Boston.

Petroleum Terminal Access Plan

Plan F – Chelsea River Channel Deepening: Plan F consists of deepening the entire Chelsea River Channel, including its upstream turning basin from its current depth of -38 feet to -40 feet. This plan is now possible with the replacement of the Chelsea Street Bridge and the widened navigation channel. The deepening will occur within the exising channel limits with the exception of widening at two bends. This improvement would benefit the four active petroleum terminals along this waterway.

2.3.8. Quantity Estimates

Quantity estimates for the various channel features were developed using a 1:3 side slope in ordinary material and 1:1 side slopes in rock. As stated above, allowable overdepth was two feet, with an additional two feet of required overdepth in ledge and other hard-bottom areas. Quantities for both ordinary material and ledge were calculated at one-foot increments beginning at the overdepth elevation for the existing project depth. Table 2-1 shows the dredging quantities for each alternative.

Quantity calculations are presented in Appendix D, Engineering Design and Cost Estimates. Quantities for the various project features were combined to form preliminary plans of improvement for the two design container vessels and for the other additional improvements under consideration. All channel segments are maintained at their authorized depths and most have been either dredged within the past five years. Maintenance material quantities that will likely remain after these operations are complete are assumed to be negligible for this analysis in this very slow-shoaling harbor. Project features at Boston typically require maintenance on a 16 to 41 year frequency, depending on the channel. The frequency of dredging would not change with the proposed improvements.

2.4. Alternative Dredging Methods

Several types of dredges can be used to remove material from deep draft navigation channels, including hydraulic pipeline dredges, hopper dredges, and various types of mechanical bucket dredges. For the improvement dredging of the rock, hard tills, stiff clays and other glacial deposits at Boston, hydraulic and hopper dredges would be incapable of doing the work. Only large capacity bucket dredges and excavators would be capable of performing the work. Dredging to depths of -55 feet (the overdepth limit on rock excavation for a 47-foot design depth, with four feet additional in the entrance, two feet additional required removal in hard material and a two-foot allowable overdepth), plus a spring tidal range of 12 feet, allowance for the height of the dredge barge deck, and allowances for seas on the dredging platform (barge) will require equipment with a very long reach of at least 80 feet.

Mechanical dredging involves the use of a barge-mounted crane with a clamshell bucket, or a backhoe arm to dig the material from the harbor bottom. Typical dredging buckets come in various sizes from five cubic yards to thirty or more cubic yards. The material is placed in a scow for transport to the disposal site by tug. For open-water or ocean disposal, a split-hull scow is generally used for ease of disposal and to minimize the discharge plume. Although some overflow of water from the scow is typical to maintain efficiency during dredging, it is minimal in comparison to hopper dredge activities. The nature of the material being dredged under the improvement project; rock, till, other hard materials, and consolidated clay, makes the impact of dredging overflow on adjacent waters minimal. If substantial amounts of silt are encountered during project construction, then a closed environmental clamshell bucket will be used. An environmental bucket typically contains flaps on top of the bucket to contain spillage of the less consolidated dredged material.

Material at the disposal site is typically discharged at a dump buoy, or by using preset coordinates monitored by the tug. This point dumping is intended to form a discrete mound of dredged material at the disposal site to minimize possible off-site migration and assist in monitoring the disposal operation and post-disposal activities at the site such as benthic recolonization. If the proposed beneficial use involving burial of sites within the IWS, then a series of smaller overlapping mounds would be created.

A mechanical clamshell dredge is proposed and recommended for this project due to the nature of the parent material for the deepening activities.

Table 2-1. Boston Harbor Deep Draft Improvement Project - Dredging Quantities (Cubic Yards)

	Ordinary Material			Rock Removal			Total Quantity - All Material		
Detailed Plans	**Cut to Design Depth**	**2-Foot Overdepth**	**Total Ordinary Material**	**Cut to Design Depth**	**2-Foot Additional Required Plus 2-Ft Overdepth**	**Total All Rock Removal**	**Cut to Design Depth**	**All Overdepth**	**Total All Material**
CONTAINERSHIP DEEPENING PLANS Broad Sound North Entrance Channel, President Roads Channel & Anchorage, Lower Main Ship Channel, Reserved Channel & Turning Area									
Plan A: 45-Foot Containership Improvement	3,538,500	2,855,000	6,393,500	84,400	363,300	446,700	3,780,500	3,059,700	6,840,200
Plan B: 47-Foot Containership Improvement	7,093,800	3,127,100	10,220,900	409,300	583,600	992,900	7,774,700	3,439,100	11,213,900
Plan C: 50-Foot Containership Improvement	11,096,200	3,330,000	14,426,200	627,900	753,000	1,380,900	12,078,000	3,729,100	15,807,100
OTHER DEEPENING PLANS									
Plan D: 45-Foot Marine Terminal Improvement for MSC Extension	151,800	94,500	246,300	12,600	65,800	78,400	193,900	130,800	324,700
Plan E: Mystic River Channel at Medford Street Terminal to –40 Feet	38,500	28,600	67,100	0	0	0	38,500	28,600	67,100
Plan F: Chelsea River Channel to –40 Feet	80,200	262,400	342,600	0	540	540	80,200	262,900	343,100

MSC = Main Ship Channel

2.5 Disposal Alternatives-Site Selection Process

During preparation of the BHNIP EIS, over three hundred and seventy (370) disposal sites were identified and evaluated. A Disposal Options Working Group was convened to develop criteria for use in the evaluation and screening of a universe of potential disposal sites. A short-list of preferable disposal and beneficial use options for parent material (Boston blue clay), rock, and silt was developed as well as disposal alternatives for future maintenance dredged material. Because of the large quantity of parent material, mostly Boston blue clay, to be dredged during the BHNIP, and the limited alternatives available for disposal, it was determined that the most practicable and environmentally acceptable alternative was to dispose of the material at the Massachusetts Bay Disposal Site (MBDS). Therefore, the screening process in the BHNIP focused primarily on developing disposal alternatives for the 1.3 million cubic yards of silty maintenance material, which was unsuitable for unconfined open water disposal.

The amount of parent material proposed to be dredged from the current Deep Draft Project is approximately three to six times greater than amount of parent material disposed from the BHNIP, depending on the selected depth alternative. As with the BHNIP, it was also determined that due to the large volume of parent material to be disposed, that the most practicable and environmentally acceptable alternative is to dispose of the material at the Massachusetts Bay Disposal Site. However, potential opportunities for beneficial use of the parent material were identified and are discussed below along with the site screening methodology.

Although a minimal amount, if any, of silty maintenance dredged material is expected to be dredged for this Deep Draft Project, a brief summary of the site screening process used in the BHNIP for the disposal of the silty maintenance material follows in case a need arises for disposal of this material during construction. A more detailed description of the site screening process can be found in the 1995 Final Environmental Impact Report/Environmental Impact Statement (EIR/S) for the Boston Harbor Navigation Improvement Project. Any changes regarding the acceptability of any of the alternatives from the short list of potential dredged material disposal sites for this improvement dredging project is described in the following section.

The BHNIP disposal site evaluation process used a Tiered approach and consisted of four phases. Phase 1 of the screening process was limited to identifying "fatal flaws" for sites that precluded further evaluation. Fatal flaws included characteristics such as the nearby location of existing water supply wells, the presence of threatened, endangered, or rare species and/or their critical habitat, sites in or abutting State, local or Federal parks, sites containing a 21E hazardous waste property, and upland sites with less than 15 acres of developable land.

Phase II screening consisted of evaluating potentially acceptable disposal sites against objective criteria relevant to the environment and physiography of the site. Criteria were used that reflected regulatory guidelines and requirements (e.g. Clean Water Act, Coastal Zone Management Act, Massachusetts Wetlands Protection Act, Site Suitability Criteria for Solid Waste Site Assignments, etc.). Phase II criteria were applied to all sites identified as potentially feasible after Phase I screening. Quantitative evaluation of sites was performed for each disposal site category by assigning a numerical score to identify and allow comparison among sites within an individual category to focus attention on the most practicable sites. If a disposal site did not satisfy a particular criterion, a further review was conducted to determine if those concerns could be avoided or reduced through site planning and management or readily mitigated. Data for all sites were examined both quantitatively and qualitatively before determining whether a site should be short-listed.

Phase III screening involved the development of additional site-specific information for short-listed sites from Phase II screening through site visits, aerial photographs, and discussions with appropriate resources agencies. The short-listed sites were re-evaluated against Phase II criteria in light of the additional information resulting in a revised short-list.

In response to comments received during the BHNIP Draft EIR/S public comment period, the site screening process was revisited. Additional data collection activities, performed after publication of the DEIR/S, were used to upgrade the data base/criteria upon which the sites would be evaluated. A confirmatory aquatic sampling program was undertaken in October 1994 to assess finfish, benthic and lobster resources at the aquatic disposal sites. Fate and transport modeling to determine sediment load and contaminant transport was performed for all aquatic disposal options. In addition, agency files and resources were used to update and upgrade the information for the land-based sites. This fourth-phase screening process narrowed the list of least environmentally damaging alternatives (LEDA) from 376 sites (and eight treatment technologies) to 23 sites. See Figure 2-1. These 23 sites were then reviewed in terms of cost and capacity as a first step in assessing their practicability. Table 2-2 lists the LEDA sites and their capacity and costs from the Final BHNIP EIR/S.

A review of these sites in the FEIR/S concluded that most of the LEDA sites were less desirable for the BHNIP because of either the high cost or low capacity. The remaining sites were Squantum Point, Little Mystic Channel (partial fill), Mystic River (in-channel CAD cell), Chelsea River (in-channel CAD cell), and Inner Confluence (in-channel CAD cell). Further examination of the environmental impacts and practicability issues for these sites was undertaken to further distinguish among the remaining alternatives.

Squantum Point was eliminated at this stage because of intertidal dredging and wildlife habitat impacts (Table 4-2 in the BHNIP FEIR/S) and its low practicability for availability, permitting, ease of engineering and logistics (Table 4-7 in the BHNIP FEIR/S). Of the remaining four sites, use of the Little Mystic Channel would result in filling outside the footprint of the dredging project and a permanent alteration in depth from subtidal to intertidal, both of which were viewed, and would still be viewed currently, as more substantial impacts. In addition, Little Mystic Channel was lower in practicability for most issues (availability, permitability, ease of engineering, and logistics; see Table 4-7 in the BHNIP FEIR/S), than the in-channel sites.

The BHNIP FEIR/S assumed the CAD cells would be developed to a depth of approximately 20 feet below the bottom surface. During the BHNIP additional borings indicated that the CAD cells could be dug to deeper depths increasing the capacity for the in-channel CAD cells. The construction of the BHNIP has reduced the remaining CAD cell capacity for the in-channel sites. Also, the results of additional probes and borings indicate that the remaining CAD cell capacity in the Mystic River and Inner Confluence is limited. Therefore, investigations into other in-channel CAD cell sites, within the dredging footprint, were conducted and are discussed further in Section 2.8 Disposal Sites Evaluated below.

Table 2-2. List of Least Environmental Damaging Alternatives (LEDA) from the BHNIP FEIR/EIS

ALTERNATIVE	CAPACITY (CY)	COST*
UPLAND SITES		
Lined Landfill		
East Bridgewater	200,000	$62
Plainville	200,000	$94
Fitchburg/Westminster	200,000	$108
Coastal Sites		
Squantum Point	210,000	$51
Everett	37,000	$76
Inland Sites		
Woburn	159,000	$69
Wrentham	450,000	$62
AQUATIC SITES		
Shoreline-Partial Fill		
Amstar	128,000	$62
Cabot Paint	18,000	$362
Little Mystic Channel	373,000	$47
Mystic Piers	98,000	$47
Reserved Channel	86,000	$45
Revere Sugar	186,000	$93
Subaqueous Depressions		
Subaqueous B	562,000	$20
Subaqueous E	591,000	$19
Borrow Pits		
Meisburger 2	1,300,000+	$31
Meisburger 7	1,300,000+	$33
Spectacle Island CAD	1,300,000+	$21
Historic Disposal Site		
Boston Lightship	1,300,000+	$16
Existing Disposal Site		
MBDS	1,300,000+	$16
In-Channel CAD Cell		
Mystic River	742,000	$30
Chelsea River	332,000	$30
Inner Confluence	246,000	$30

*1995 Dollars

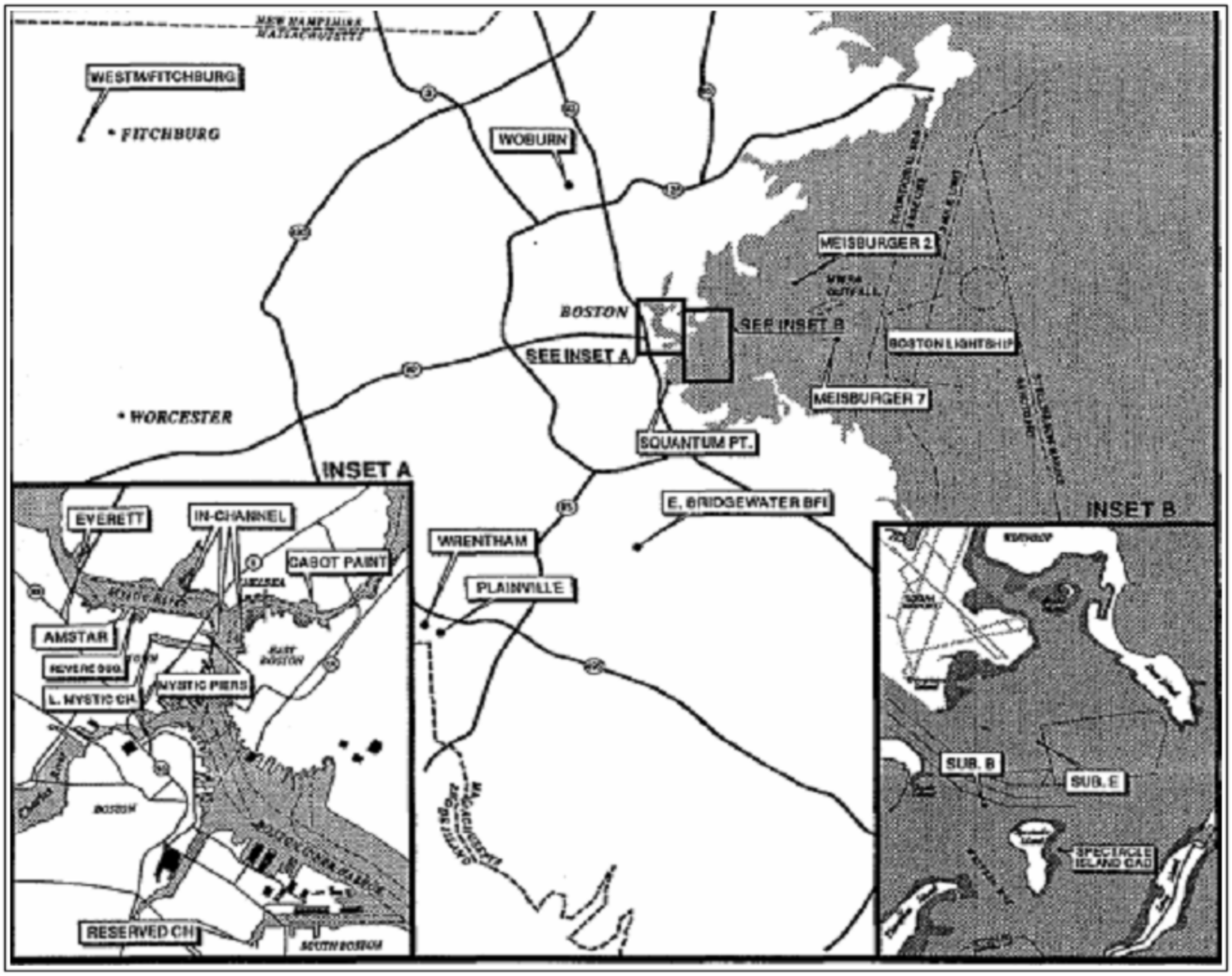


Figure 2-1. Boston Harbor Navigation Improvement Project Short-List of Disposal Sites

2.6 Disposal Alternatives Identified in the BHNIP FEIR/S for Future Maintenance Dredging

The BHNIP FEIR/S identified seven sites as potential disposal sites for future maintenance dredged material. These sites could also be used to screen for the disposal of parent material from this project. The seven sites include: the Massachusetts Bay Disposal Site (MBDS), Subaqueous B and E, Meisburger 2 and 7, Boston Lightship, and Spectacle Island CAD. The MBDS is an EPA-designated ocean disposal site that is currently open for disposal of material that after a testing protocol has been determined to be suitable for ocean disposal. The Boston Lightship site is a former disposal site, no longer open for placement of material. Both sites are located outside State waters and are subject to MPRSA. Dredged material that does not meet the ocean disposal criteria would not be allowed at the MBDS.

Subaqueous sites B or E, located in the outer harbor outside the navigation channels, would provide 562,000 cy and 591,000 cy of capacity respectively. The Meisburger sites and the Spectacle CAD sites would most likely require that a subaqueous cell be dug prior to disposal of the parent material and possibly capped with suitable material such as sand. The Spectacle Island CAD cell site is located east of Spectacle Island in the shallow subtidal (-10 feet MLW) area and is totally disassociated with the island itself. However, it is located near the Boston Harbor Island National Park, which may detract from its suitability as a disposal site. The offshore borrow pit sites, Meisburger 2 and 7, support high benthic productivity and fisheries resources that are relatively abundant. The Subaqueous B and E sites, the Meisburger sites and the Spectacle CAD sites are all located in previously undisturbed areas. None of the sites, except the MBDS, were determined to be suitable for disposal of the parent material from the Deep Draft Project for the following reasons. Disposal would occur at sites not previously disturbed, the site is recovering from past disposal activities, or the capacity of the site to hold the dredged material is too limited. Therefore these sites are not as desirable as disposal sites that have been previously impacted and have the capacity to hold the parent material.

2.7 Beneficial Use Alternatives

The materials that would be removed to deepen the navigation channels for the Deep Draft Project are composed of glacial parent material and rock ledge. The glacial materials are composed mainly of Boston blue clay and mixed tills with compacted sands, gravel and cobble. Suggested beneficial uses for the parent material include cap material for confined aquatic dredged material disposal sites or contaminated aquatic sites, creation of subtidal or intertidal habitat, construction uses, or for use in a landfill as a liner or as daily or final cap for landfill closures.

2.7.1 Parent Material

Parent material is defined as the material below the authorized/maintained depth in the navigation channel that has not been impacted by anthropogenic activities. It is generally composed of glacial till material in the outer harbor and Boston blue clay in the inner harbor. The use of the parent material to establish shallow subtidal or intertidal habitat was evaluated for the Reserved Channel and the Little Mystic River Channel in the BHNIP EIR/S. However, since this alternative would impact a previously undisturbed area, it was dropped from further consideration. No additional opportunities for creation of subtidal or intertidal habitat were identified in that document and none have been identified during Technical Working Group meetings for other previous and current Boston Harbor projects.

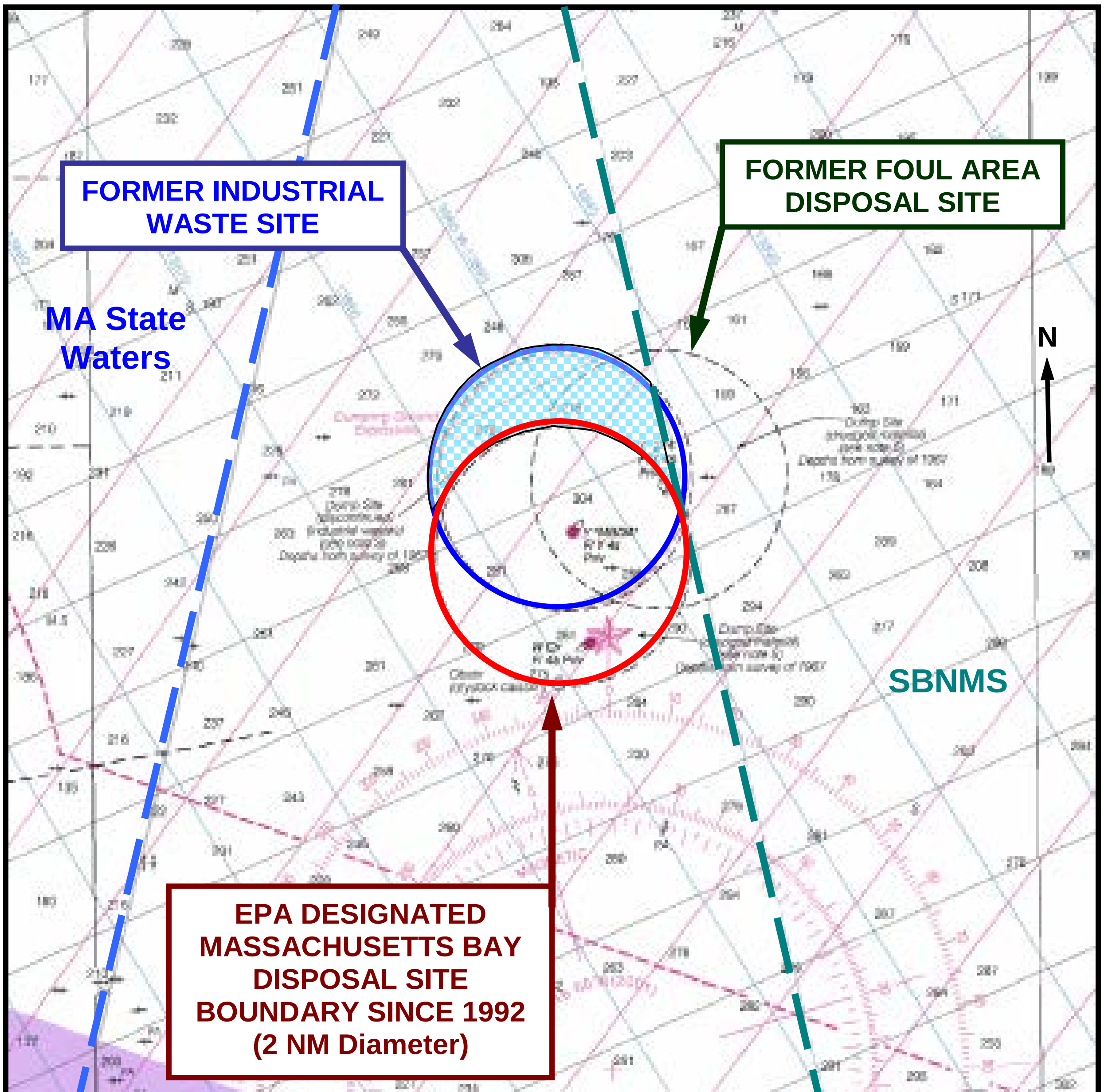
The parent material may also be useful for lining landfills or other upland sites that may require liner material. Some of the parent material is primarily clay, which is highly impermeable and could be suitable for this purpose. This material could also be useful for daily capping or final closure material at landfills. Before the material could be used at a landfill, a site suitable for dewatering the material in Boston Harbor would need to be identified. Massport owns several lots along the Boston waterfront that are currently vacant (D. Hadden, pers. com.). They are the Medford Street terminal, Mystic Piers 48-49-50, and the Massport Marine Terminal. However, Massport is actively seeking partners to redevelop the terminals in support of Boston Harbor port activities. Restricting land use at the terminals for several years would not be the best use for the port. In addition, the cost to double handle the material for dewatering makes this alternative less attractive.

The use of parent material to cap debris at the Industrial Waste Site (IWS) located in Massachusetts Bay is another potential beneficial use option for this material. This concept was initiated by the USACE and the U.S. EPA. The IWS site in Massachusetts Bay was the repository of chemical, industrial, and low level radioactive wastes, construction debris, and dredged material at various periods from the 1940's until 1976, with dredged material disposal continuing into the 1990's. Industrial waste containers include thousands of 55-gallon metal drums (barrels), concrete encased drums, and coffin shaped concrete barrels. The IWS is located in an area 20 miles east of Boston in water up to 300 feet deep, also known as the "Foul Area." This site overlaps the northern portion of the MBDS and an area known as the Interim Massachusetts Bay Disposal Site. It is located just west of the Stellwagen Bank National Marine Sanctuary. Investigations have determined that the majority of barrels are located to the north, and outside the boundary of the MBDS (Wiley, et al. 1992; NOAA 1996; Capone, 2007). See Figure 2-2.

In surveys at the IWS, most of the visually observed barrels or drums were corroded, and it is assumed that much of the contents have dispersed over time. Direct radiation measurements from the barrels, or from sediment near the barrels, were found to be at background levels and has been determined to pose no risks to human health. Based on the survey conducted in 1992 at the IWS (NOAA, 1996), the contributing agencies concluded that the low level radioactive waste or hazardous substances investigated did not pose an imminent and widespread human health or ecological threat. "However the documented presence and large concentration of waste containers along with known ordnance disposal in some areas of the IWS, pose potentially significant occupational risks to users of bottom-tending mobile gear…. The existing fish advisory and the closure for surf clam and ocean quahog harvesting should continue. Further documentation of the location of likely waste container fields within and contiguous to the IWS should be undertaken. Positions of concentrations of likely waste containers should be noted on nautical chart" (NOAA, 1996). The benefit to covering the site with parent material would be to isolate the barrels from potential occupational risk of fish trawls contact with the barrels. A cap demonstration project at the adjoining MBDS was performed in 2008 using material from the IHMDP to assess the feasibility of using material from the deepening of Boston Harbor to cap the area of the IWS that was identified as having a high density of barrels on the seafloor. The cap demonstration project revealed that material could be precisely placed in water depths comparable to the IWS using standard split-hulled scows. The project also identified a procedure for placement of material that would reduce impact to the ambient seafloor, thus limiting the potential disturbance and release of material on the seafloor (USACE, in preparation – expected early 2013).

2.7.2 Rock

Depending on the final optimized main channel depth selected, up to one million cy of rock will need to be removed. It is possible that the rock and cobble from the project could be used to enhance fish habitat diversity by providing structure and depth to areas that currently have little bottom relief in Massachusetts Bay. The rocks will vary in size from fairly large stones and small cobble to boulders. The rocks can provide interstitial space and hard substrate used for both cover and habitat for fisheries and other benthic resources that could increase the diversity and productivity of the existing habitat (niches). Five sites were identified as potential hard bottom enhancement sites based on a meeting with representatives from the Massachusetts Lobstermen Association, the Boston Harbor Lobstermen Association, and the Massachusetts Division of Marine Fisheries. Most of the five sites are in water depths of 30 feet or greater, are not readily used by lobstermen or other fishermen (according to the lobstermen). The five sites are located in Nantasket Roads, Massachusetts Bay, Broad Sound, Nahant Bay, and Magnolia (see Figure 2-3).



3-Mile Limit

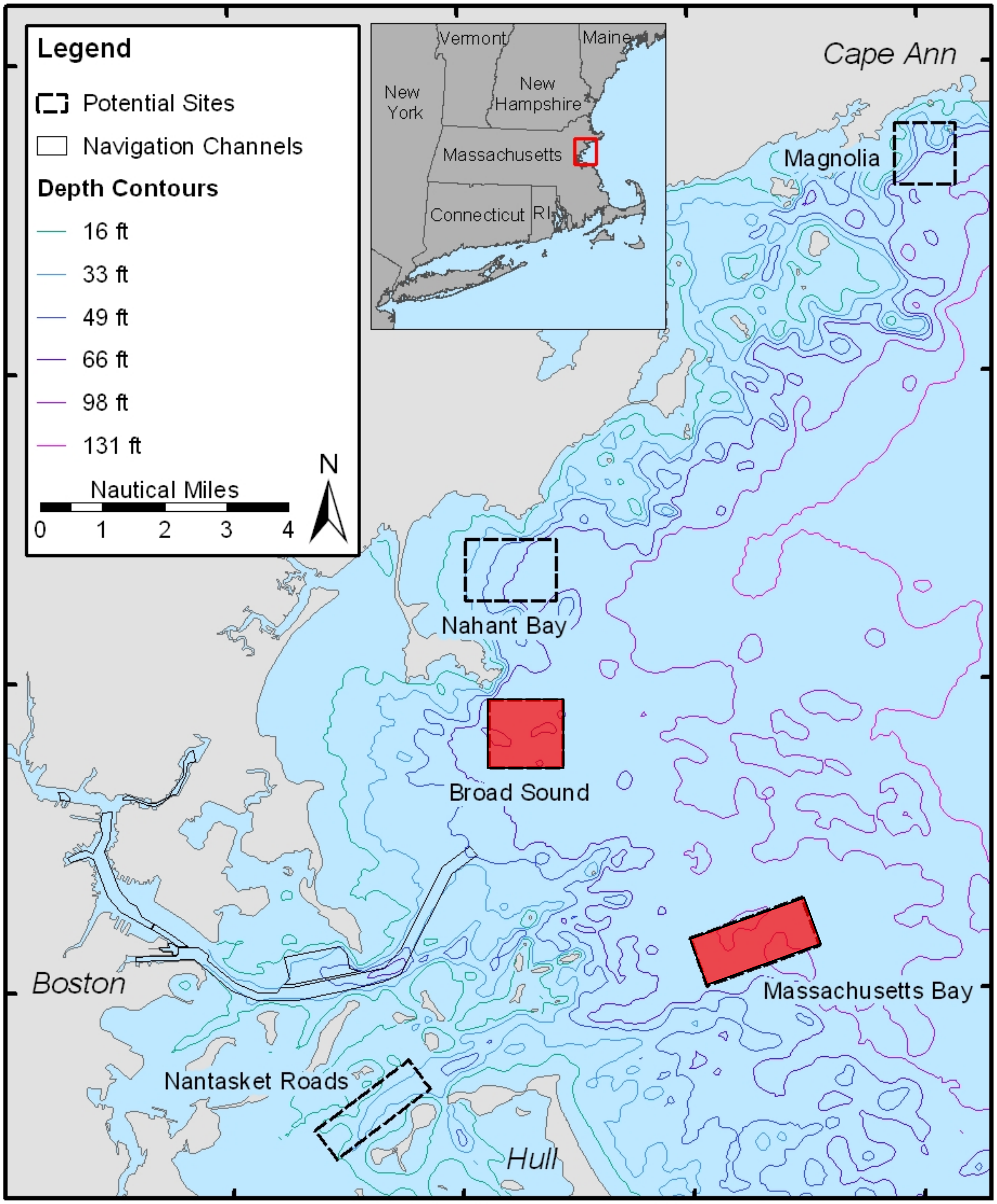
Stellwagen Bank NMS Boundary

Area of IWS that May be Added to MBDS Designation

Un-Scaled

BOSTON HARBOR, MASSACHUSETTS
NAVIGATION IMPROVEMENT FEASIBILITY STUDY

FIGURE 2-2
LOCATION OF MASS BAY DISPOSAL SITE, INDUSTRIAL WASTE SITE AND FOUL AREA



Most Suitable Sites for Creating Hard Bottom Habitat

From January 2006 Battelle Final Report as Modified by Corps

BOSTON HARBOR, MASSACHUSETTS NAVIGATION IMPROVEMENT FEASIBILITY STUDY

FIGURE 2-3
ROCK REEF HABITAT CREATION SITES INVESTIGATED

A set of five criteria (USACE, 2006) was used to perform an initial ranking and prioritization of the five potential habitat enhancement sites. These five criteria included: the biological productivity of the area, bottom type, and capacity to accept the material, other existing uses, and navigable distance to the sites from the project area. Sites with lower biological productivity, sufficient capacities and water depths were given a higher priority for habitat enhancement than those with existing abundant rock bottom habitat. The fourth criterion was the potential for the disposed material to interfere with other uses such as navigation or fishing. The last criterion was proximity to the navigation channel (project area). If no significant difference was found between the sites, based on the four criteria, then the sites closest to the navigation channel were given higher priority. Additional information on the habitat enhancement sites can be found in the appropriate sections in Chapter 3, Affected Environment.

Table 2-3, gives the final site ranking by criteria for each site. Based on the initial site ranking, the list of potential enhancement sites in the order of most suitable to least suitable is: Broad Sound, followed by Magnolia, Nahant Bay, Massachusetts Bay, and Nantasket Roads (USACE, 2006). Due to depth constraints and location, it was determined that Broad Sound and Massachusetts Bay were the most suitable sites for creating hard bottom habitat.

Other potential beneficial uses for the rock, as identified by the Massachusetts State Dredging Team in a letter from Massachusetts Coastal Zone Management (CZM), include using the material for medium to large scale shore protection efforts in the Boston Harbor region. These projects are still in the planning stage and it is unknown at this time if the rock would be suitable and available for these proposed shore protection projects. In addition, required permitting would need to be obtained in advance by the responsible respective State agency landowner.

Also, the potential exists for all or a portion of the rock to be used beneficially for construction purposes. Logistical issues regarding this alternative include the legal and policy issues of a private contractor accepting rock from a Federal project, shoreside handling facilities, and permit issues.

The feasibility of the last two options will be explored during the Design Phase of the project. All necessary permits and additional funding by others (if required) would need to be in place prior to construction for these beneficial use options to be feasible and implementable.

2.7.3 Silt

No known beneficial use options for the silt material have been identified at this time

2.8 Disposal Site Alternatives Evaluated in this SEIS/EIR

2.8.1 Confined Aquatic Disposal (CAD) Cells

At this time there is no expected need for creation of additional confined aquatic disposal (CAD) cells in Boston Harbor for this improvement dredging project. However, by the time the project is finally authorized by Congress and approved and funded for construction, some minor maintenance dredging of adjacent channel areas not maintained in the operations conducted between 1998 and 2012 may be found necessary. If so, construction of one or more smaller CAD cells from the population of previously approved but unconstructed sites may be required to properly dispose of that material or disposal in the uncapped Chelsea River CAD cell. That will be an action separate and distinct from the Deep Draft Project covered by this SEIS/EIR. Although previously permitted, maintenance material not removed near the Ted Williams Tunnel and above to the Inner Confluence during Phase 1 of the IHMDP in 2008 would need to be removed if economic benefits assessed for this proposed project are to be realized in the Mystic River and Chelsea River.

Table 2-3. Final Habitat Enhancement Site Ranking by Criteria

RANK	RANKING CLASS	BENTHIC HABITAT QUALITY	FISH	SHELLFISH	LOBSTER	BOTTOM TYPE QUALITY	CAPACITY OF SOFT BOTTOM	OTHER HUMAN USES	NAVIGABLE DISTANCE
Most suitable	1	MA, NB	NR, BS, NB	MB	NR	MB, NB, MA	NB	BS, NB, MA	NR
	2	BS	MA	BS	MA, NB, BS	BS	MB, BS, MA	MB, NR	BS
	3	NR	MB	NR, MA, NB	MB	NR	NR		NB, MB
Least suitable	4	MB							MA

BS - Broad Sound; MA - Magnolia; MB - Massachusetts Bay; NB - Nahant Bay; NR - Nantasket Roads

2.8.2 Massachusetts Bay Disposal Site

All materials proposed for dredging associated with the improvement project are parent glacial materials and rock that have been determined to be suitable for unconfined ocean disposal at the Massachusetts Bay Disposal Site. The parent material from the previous BHNIP was disposed at the EPA-designated MBDS. Regular monitoring is performed at the MBDS as part of the USACE's Dispoal Area Monitoring System Program. This monitoring has not indicated any significant impacts from previous disposal operations associated with the other Boston Harbor projects. During the Outer Harbor Maintenance Dredging Project in 2004-2005, approximately 1.1 million cy of material was placed at the MBDS. Approximately 1.5 million cy of parent material was dredged during construction of the IHMDP CAD cells. In addition to the parent material removed for construction of the IHMDP CAD cells, approximately 400,000 cy of shoal material suitable for ocean disposal was also be removed from the inner harbor sections of the Main Ship Channel during the IHMDP and disposed at the MBDS.

As with the previous Boston Harbor dredging projects, the base plan for disposal of the parent material from this Deep Draft Project is at the MBDS. This material has been determined by the EPA to be suitable for ocean disposal.

2.8.3 Industrial Waste Site

If found to be practicable, all or a portion of the parent material could potentially be used as cover to cap and isolate the barrel field identified by the EPA just north of the MBDS from biological resources and human interaction. The use of this site for disposal will be dependent on a number of factors and ultimately on the approval of the EPA to allow material placement in an area outside of the current designated MBDS (i.e. EPA will need to temporarily or permantely expand the boundary of the MBDS to include the IWS). EPA supports investigations to use project generated material to cap the IWS.

2.8.4 Habitat Enhancement Site

During the proposed improvement dredging, rock ledge will be removed from the channels. This material may be used to enhance bottom habitat in the nearshore area of Massachusetts Bay. As stated above, the two potential habitat enhancement sites selected for further evaluation based on depth, biological indices, and distance are Broad Sound and Massachusetts Bay. Future efforts may include additional field work to determine the suitability of the site for rock reef species recruitment. During the design phase, this proposal will be further examined in cooperation with the Commonwealth and the NMFS to further evaluate the two candidate sites identified by the USACE screening process, and develop a plan for placing the materials on the ocean floor. Monitoring of these habitat creation sites for several years after disposal may be necessary subject to cost-sharing by others to determine rates of colonization important for future consideration of this beneficial use option for other projects.

2.9 Preferred Design and Disposal Alternatives

2.9.1 Federal Project

Table 2-4 below provides a qualitative description of the potential benefits and impacts from a select range of proposed channel depth alternatives, including the preferred alternative, and disposal alternatives carried forward in this SEIS/EIR. The identified channel improvements are the only features that could meet the planning objectives in a reasonable cost and timeframe. Channel deepening would provide improved access to the Port's various container, liquid and dry bulk terminals and allow for the passage of fully loaded or near fully loaded deep draft vessels. Channel deepening would also permit shippers to retain or include Boston in their liner services as they upgrade to larger capacity (deeper draft) vessels on their service routes or add new services. Widening and realignment of channel segments and expansion of the turning area would improve the flow of large vessel traffic and reduce the potential for maritime accidents. Project depths would be selected to maximize net benefits from the project.

Criteria for evaluating the navigation alternatives is based on engineering feasibility, economic viability and justification, social and environmental impact considerations, and environmental enhancement opportunities. Selection of a final recommended dredging plan will depend on economic optimization of channel depth based on the number of shippers that would take advantage of deeper channel depths by modifying their shipping practices for U.S. east coast services. This will be dependent on:

- Projected growth in cargo volumes arriving at and being exported from the east coast;
- Changes in navigable depth at the various ports called at by carriers with services to Boston, including the expanded Panama Canal;
- How shippers allocate space on their vessels to cargo destined for particular ports;
- How shippers add or drop ports of call from their vessel rotation;
- How shippers manage rotation (order of calls/routing) among the ports they do use; and
- How the changes in fleet mix (range of vessel sizes and numbers of each class in service for each shipper) force adjustments to changes in navigable depth at the various ports to how the shipper manages rotation discussed above.

Boston has a roughly nine-foot mean tide range and the transit from the Bay into the terminal covers about six miles. This enables ships to use tidal advantage to some extent without compromising underkeel clearance requirements, which are generally ten percent of vessel operation draft or about four feet depending on the requirements of the different shippers, the cargo, the USCG and the pilots.

The recommended Federally preferred navigation improvement alternative includes:

- Deepening and widening the 40-foot lane of the Broad Sound North Entrance Channel to – 51 feet MLLW;
- Deepening and widening the 40-foot deep lane of the Main Ship Channel, the 40-foot deep President Roads Anchorage, the lower portion of the Reserved Channel, and the Reserved Channel Turning Basin to -47 feet MLLW to provide access to Conley Terminal in South Boston;
- Deepen the 40-foot lane of the Main Ship Channel above the Reserved Channel and below the Ted Williams Tunnel (aka Third Harbor Tunnel) to -45 feet MLLW to improve access to Massport's Marine Terminal in South Boston;
- Deepen a portion of the existing 35-foot lane of the lower Mystic River Channel to -40 feet MLLW to improve access to Massport's Medford Street Terminal; and
- Deepen the existing 38-foot deep channel in the Chelsea River to -40 feet MLLW to improve access to its petroleum terminals with widening of the channel in the two bends on the East Boston side of the river between the two bridges.

Table 2-4. Comparison of a Selected Range of Channel Depth Alternatives, Including the Preferred Alternative

Resource	45'/47' Deep MSC/BSNC (includes all plans)	47'/51' Deep MSC/BSNC (includes all plans)	50'/52' Deep MSC/BSNC (includes all plans)	MBDS	IWS	Habitat Enhancement Sites
Period of Construction (includes additional months to reduce air quality impacts)	3 years	3 years	5 years	3-5 years dependent on channel depth selected	Same as MBDS	3-5 years
Subbottom (acres, unless otherwise noted)	1,079[1] (includes 18.2 acres outside existing project limits)	1,164[1] (includes 18.2 acres outside existing project limits)	1,224[1] (includes 18.2 acres outside existing project limits)	0.75 to 2 square miles	Up to 3 square miles.	186, 365, or 518 dependent on channel depth selected.
Water Quality	Temporary turbidity impacts during construction.	Slightly longer period of temporary turbidity impact.	Longest period of temporary turbidity impact.	Temporary turbidity impact during disposal of dredged material.	Same as MBDS.	Minimal turbidity from rock impact on floor bottom and possible washing of rock.
Benthos	Temporary disruption	Slightly longer period of temporary disruption	Longest period of temporary disruption	Temporary disruption dependent on channel depth selected	Same as MBDS	Permanent conversion from soft bottom to mix of soft and hard bottom. Habitat for reef species
Fisheries	No significant impact expected to movement, or spawning habitat. Potential fish kills from blasting.	No significant impact expected to movement, or spawning habitat. Potential fish kills from blasting.	No significant impact expected to movement, or spawning habitat. Potential fish kills from blasting.	Possible entrainment from disposal. Temporary disruption to benthos.	Possible entrain-ment from disposal. Temporary disruption to benthos. Permanent displacement of some reef species.	Permanent enhanced habitat for reef species
Lobsters	Temporary disruption of habitat.	26% longer period of disruption than the 45' deep.	90% longer period of disruption than the 45'deep.	Possible burial and temporary disruption to habitat.	Same as MBDS. Permanent loss of cover.	Permanent enhanced habitat/cover.

Table 2.4 (cont.). Comparison of Alternatives

Resource	45'/47' Deep MSC/BSNC (includes all plans)	47'/51' Deep MSC/BSNC (includes all plans)	50'/52' Deep MSC/BSNC (includes all plans)	MBDS	IWS	Habitat Enhancement Sites
T &E Species	Rare occurrence of species.	Same.	Same.	Small potential for whale strikes.	Same as MBDS.	Minor chance for whale strike.
Geology	No significant change expected.	Same.	Same.	Dredged material is similar to MBDS. Mound created.	Same as MBDS. Slight decrease in bottom depth.	Permanent change from soft bottom to mixed hard bottom.
Cultural	No impact expected, some investigations required.	No impact expected, some investigations required.	No impact expected, some investigations required.	No impact expected. This is a designated disposal site.	Some investi-gation may be needed, if wrecks seen.	No impact expected, some investigations required.
Socioeconomic	Some temporary displacement of lobstermen fishing illegally in the channels.	Same.	Same.	No significant impact.	Positive reduction in fishermen snagging debris.	Not significant fishing areas, but expected to increase permanent abundance of reef species.
Air Quality	Slight temporary increase from construction equipment. Permanent reduction in regional air emissions after construction.	Slight temporary increase from construction equipment. Permanent reduction in regional air emissions after construction.	Slight temporary increase from construction equipment. Permanent reduction in regional air emissions after construction.	Slight temporary increase from construction equipment	Slight temporary increase from construction equipment.	Slight temporary increase from construction equipment.

[1] 18.2 acres does not include the additional side slope area outside the channel from deepening the channel, but is the new sections of the channel to be expanded. The new side slope areas are included in the total acres.

Construction is expected to take about three years. Rock removal is anticipated to require 26 months to complete with the required times approximately broken down as follows: 16 months in the Broad Sound North Entrance Channel; two months in the President Roads Anchorage; two months in the lower Main Ship Channel; three months in the Main Ship Channel extension above the Reserved Channel, five months in the Reserved Channel and its Turning Basin; and one month in the upper Chelsea River. Blasting if found to be required in certain areas may be accomplished by using two blast plants working in the harbor, with each plant detonating no more than one blast per day for a maximum of two blasts per day. No blasting will occur at night. The rock areas and construction times will be further refined in the Planning, Engineering, and Design Phase of the project after subsurface explorations are completed. Additional time may be needed to meet air quality standards (see the Air Quality Section). See Section 2.3 above for additional dredge plan details.

The preferred dredged material disposal alternative for the parent material and rock is the Massachusetts Bay Disposal Site, regardless of the dredged alternative selected. This material has been determined to be suitable for ocean disposal. No other environmentally acceptable alternative is currently known that can and will accept the large quantity of potential parent material to be removed from the project area. This material may be used beneficially if EPA approves the use of this material as cover at the IWS. Other beneficial uses for the rock will be explored with the Technical Working Group during the Design Phase.

The next two sections describe the berth deepening and maintenance dredging associated with the Deep Draft Project.

2.9.2 Associated Berth Deepening

Conley Terminal: Massport has already deepened its two principal berths 11 and 12 at the Conley Terminal to 45 feet. Massport completed an improvement project in 2010 to increase the efficiency of the existing terminal. Furthermore, Massport currently has underway a project to design and permit the integration of the 30-acre former Coastal Oil property into the Conley Terminal footprint to provide additional capacity, efficiency, and access improvements. The existing terminal lands (lay-down area and access), crane capacity, terminal configuration, and security features are sufficient to handle the increases in container volume projected in each of the alternative economic scenarios of container cargo benefit. All other benefits from this plan are incidental tidal delay savings for other vessels and non-containerized cargos that would have increased transit windows due to the deeper channels and greater use of the anchorage under this plan. These other benefits are minor and were not quantified for the main channels containership plans.

For main channel improvement depths of 43 feet and beyond, including the recommended 47-foot deepening project, deepening of the Conley berths would be required to continue the tidal navigation practices of shippers. Massport intends to deepen its two 45 foot- deep berths (Conley berths 11 and 12) to a depth of at least three feet greater than any improved channel depth to enable current tidal navigation practices of the shippers to continue. All other facility improvements noted will be implemented by Massport in the near term and are not dependent on the Federal deepening project. Quantity estimates for non-Federal berth deepening are provided in Table 2-5.

Massport Marine Terminal (MMT): For the 45-foot-deep Main Ship Channel extension to the Massport Marine Terminal above the Reserved Channel, bulkhead replacement and berth deepening would be required. As the berth was deepened to 40 feet during the last improvement project in 1998, it is assumed that the material would be the same parent marine clay and other glacial deposits found along the south side of the adjacent channel, and would be suitable for ocean disposal. Further improvements such as paving, bollards, and other terminal facilities to support dry bulk operations would also be required. However, Massport and its partners are likely to construct these facilities, regardless of whether or not the Main Ship Channel is deepened to 45 feet up to this facility.

Mystic River – Medford Street Terminal: For the 40-foot-deep deepening of the portion of the Mystic River Channel adjacent to Massport's Medford Street Terminal, no non-Federal facility costs would be necessary. Similar to the situation at the MMT, the Medford Street Terminal will be developed regardless of whether the adjacent channel area is deepened in the approach to the berth. The berth at Medford Street was already deepened by Massport to 40 feet during the 40-foot channel improvement dredging completed in 2000. Only a small area of the Federal Channel left at 35 feet needs to be crossed to reach the berth. Vessels use tidal assist for transit of this area and would continue to do so if the channel were not deepened. Therefore, no dredging will be needed at this terminal.

Table 2-5. Non-Federal Berth Deepening Quantities

	Berth Design Depth	Quantity (cy) (including 2-foot overdepth)
CONLEY TERMINAL BERTHS #11 & #12 QUANTITIES		
42-Foot Channel	45 Feet	0
43-Foot Channel	46 Feet	6,200
44-Foot Channel	47 Feet	12,400
45-Foot Channel	48 Feet	18,700
46-Foot Channel	49 Feet	24,900
47-Foot Channel	50 Feet	31,100
48-Foot Channel	51 Feet	37,300
49-Foot Channel	52 Feet	43,600
50-Foot Channel	53 Feet	49,800
MASSPORT MARINE TERMINAL BERTH QUANTITY		
42-Foot Channel	42 Feet	29,400
43-Foot Channel	43 Feet	44,100
44-Foot Channel	44 Feet	58,800
45-Foot Channel	45 Feet	73,500
CHELSEA RIVER CHANNEL – FOUR TERMINALS QUANTITY		
39-Foot Channel	39 Feet	16,400
40-Foot Channel	40 Feet	32,800

Chelsea River – Petroleum Terminals: For the Chelsea River Channel, the main petroleum terminals would need to deepen their berths to -40 feet MLLW to generate project benefits from a 40-foot Federal channel deepening. The four largest petroleum terminals on the Chelsea River are Sunoco Logistics, Gulf Oil, Irving Oil and Global Petroleum. Sunoco Logistics is located immediately downstream of the Chelsea Street Bridge, while the other three are located around the turning basin at the head of navigation. Vessels offloading at Sunoco Logistics pass through the bridge twice in order to turn in the basin before transiting outbound. Therefore, all four beneficiary terminals require deepening of the entire channel. These four terminals are all potential beneficiaries and would need to deepen their berths to generate sufficient benefits to justify Federal channel deepening.

Utilities: Boston Harbor has several utility crossings. Only the MWRA/NSTAR power cable in the Reserved Channel would be affected by the deepening of the proposed project. The USACE has referred the matter to U.S. Attorney's office as an enforcement action. The U.S. Attorney's office is currently in negotiations with MWRA and NSTAR to ensure that the cable will not impact the deepening project.

2.9.3 Associated Maintenance Dredging

Maintenance dredging of existing Federal navigation features could be carried out concurrent with the Deep Draft Project in four different ways. First, while major maintenance dredging in association with the BHNIP and of the outer and inner harbor areas was accomplished in the 1998-2000, 2004-2005 and 2008 timeframes respectively, minor amounts of maintenance material may have accumulated since that time and before improvement dredging of the Deep Draft Project or was not removed entirely from the previous maintenance dredging projects. In particular, the Chelsea River will need to have some additional maintenance dredging for material not dug to project overdepth.

Second, maintenance dredging to project depth will be needed to assist in harbor traffic management during the construction of the Deep Draft Project. Areas recommended for maintenance for this purpose include the 30-foot deep Broad Sound South Entrance Channel, the 35-foot deep northern lane of the Broad Sound North Entrance Channel, the 15-foot deep Nubble Channel, and the 35-foot deep West Anchorage at President Roads (the barge anchorage). Minimizing navigation traffic disruptions of the drilling, blasting, and dredging operations for the Deep Draft Project can be accomplished by providing alternative routes for shallow-draft traffic not needing the 40-foot deep channels that would be deepened. Routing of shallower-draft vessels, consistent with tidal navigation, through the South Entrance Channel with its 30-foot deep authorized depth, and later also through the 35-foot deep north lane of the North Entrance Channel, would allow deepening of the deep lane of the North Entrance Channel to progress with minimal shut-downs for large vessel passage, thereby shortening the construction duration for deepening that project feature. Similarly, encouraging a greater volume of smaller ferry and small craft traffic to use the Nubble Channel rather than transiting the Outer Confluence would aid in deepening that area of the project with minimal navigation disruption. Maintenance of the 35-foot deep anchorage would enable more barge and smaller cargo vessels to use that area instead of the 40-foot deep President Roads Anchorage while the latter area is being deepened.

Third, maintenance material located between the Massport Marine Terminal and the Inner Confluence that was not removed during Phase 1 of the IHMDP. Maintenance dredging of the Main Ship Channel above the Massport Marine Terminal would realize the economic benefits of deepening the Chelsea River and the Mystic River. Maintenance dredging of the IHMDP was covered under previous 2006 NEPA and MEPA documents

Fourth, maintenance material that has accumulated in the 35-foot Charles River segment of the Main Ship Channel that provides access to the U.S Coast Guard Station, and has not been analyzed in a previous NEPA document, may also be removed.

Table 2-6 below provides quantities of associated maintenance dredged material.

Table 2-6. Associated Maintenance Dredging of the Deep Draft Project

Existing Project Feature	Dredging Volume (cy)	2-Foot Overdepth (cy)	Total Quantity (cy)	Dredging Footprint (Acres)
Maintenance of Project Features for Navigation Traffic Management During Construction Plus Chelsea River Navigation Channel (All Material Suitable for Placement at MBDS)				
Chelsea River – Remaining Overdepth O&M Volume	101,000	82,000	183,000	Included in Improve-ment
Broad Sound North Entrance Channel – 35-Foot Lane	53,000	86,000	139,000	8.2
Broad Sound South Entrance Channel – 30 Feet	33,000	23,000	56,000	70.2
Nubble Channel - 15-Foot	200	1,300	1,500	2.3
Barge Anchorage - 35-Foot	2,000	65,000	67,000	60.1
Maintenance of Project Features Remaining after Phase I IHMDP Construction Plus Charles River Navigation Channel (All Material for MSC CAD Cell Placement)				
Main Ship Channel from Massport Marine Terminal to Inner Confluence – 35-Foot & 40-Foot Lanes	569,000	384,000	953,000	467.6
Mystic River – 35-Foot Lane	10,000	31,000	41,000	Included in Improve-ment
Charles River – 35-Foot	255,000	137,000	372,000	39.1
TOTAL FOR ALL DREDGED CHANNEL MATERIAL	**1,023,200**	**809,300**	**1,812,500**	**647.5**
Excavation of Main Ship Channel CAD Cell for Unsuitable Material Remaining after Phase I IHMDP				
Main Ship Channel CAD Cell Excavated Material to MBDS – Cell For Remaining Unsuitable Phase I IHMDP Material	1,624,00	NA	1,624,000	Included in Mainten-ance
Volume Required to Cap MSC CAD Cell	102,000	NA	102,000	NA
TOTAL REMAINING AND ASSOCIATED MAINTENANCE VOLUMES				
Suitable Channel Materials to MBDS - **TOTAL**	190,000	256,000	446,000	
Suitable CAD Cell Excavated Material to MBDS - **TOTAL**	1,624,000	NA	1,624,000	
Unsuitable Channel Materials to MSC CAD Cell - **TOTAL**	814,000	552,000	1,366,000	

Volumes include side slopes

Removal of any remaining maintenance material from the project areas being deepened under the Deep Draft Project would be accomplished concurrent with removal of the improvement materials. Given the recent two major maintenance operations and the low shoaling rate in Boston Harbor these amounts are expected to be minimal.

In project areas where the maintenance material was tested and determined suitable for ocean disposal under the 2004 and 2008 projects, any remaining maintenance materials would be removed, transported, and disposed along with the improvement materials, in accordance with existing suitability determinations, at the Massachusetts Bay Disposal Site. These areas include the Broad Sound North Entrance Channel (deep lane), the Barge Anchorage, the lower Reserved Channel and its Turning Area, and the Main Ship Channel from President Roads to Spectacle Island, and from Castle Island to the Massport Marine Terminal.

Therefore, the following maintenance areas are initially determined to be suitable for ocean water disposal (MBDS):

- Chelsea River (overdepth in parent material not removed during the BHNIP);
- Broad Sound North Entrance – 35-foot lane;
- Broad Sound South Entrance – 30-foot lane;
- Nubble Channel – 15-foot lane; and
- Barge Anchorage – 35-foot depth.

In channel areas where the maintenance material was determined unsuitable for ocean disposal, the USACE will place that material into the Main Ship Channel CAD cell previously identified for the IHMDP. Approximately 1,176,000 cy of material would need to be removed to create the Main Ship Channel CAD cell. The USACE may re-test those materials and dispose of them in accordance with any revised suitability determination. Any re-testing and any new suitability determinations will be fully coordinated with Federal, State and local agencies. These areas include the:

- Main Ship Channel above the Massport Marine Terminal to the Inner Confluence, including both the 35-foot and 40-foot lanes;
- Mystic River 35-foot section near the Medford Street Terminal; and
- Charles River – 35-foot MSC.

See Table 2-7 for volumes of disposal material and their estimated suitability for ocean water disposal and CAD cell excavation. See Figure 2-4 for the previously constructed and currently proposed Main Ship CAD cell for disposal of unsuitable maintenance dredged material.

Table 2-7. Volume of Material to be Excavated for CAD Cell and Disposal

Project Feature	Dredging Volume (cy)	2-Foot Overdepth (cy)	Total Quantity (cy)
Main Ship Channel CAD Cell Excavation	1,624,000	NA	1,624,000
Cap Material for the MSC CAD Cell	102,000	NA	102,000
Total Suitable Channel Material to MBDS	190,000	256,000	446,000
Total Unsuitable Channel Material to MSC CAD Cell	814,000	552,000	1,366,000

2.9.4 Summary

Based on costs, benefits and environmental screening conducted to date, a plan that provides harbor deepening improvements to the Port of Boston consisting of a -47-foot MLLW depth in the lower Main Ship Channel, the Reserved Channel and its Turning Basin, and the President Roads Channel Reach and Anchorage, deepened further to -51-feet MLLW in the harbor's North Entrance Channel from Broad Sound is the NED Plan (See Figure 2-5). This plan meets the NED criteria and the intent of the Environmental Operating Principals in that it meets USACE benefit policy for the recommended plans and does not result in insurmountable environmental impacts.

During design, the incorporation of environmental benefits through the potential for beneficial use of dredged material will be investigated further with the State, Sponsor, and U.S. EPA. The use of rock and other hard material for creation of lobster habitat in the nearby waters of Broad Sound and Massachusetts Bay, for for shoreline protections, or other beneficial uses will be further considered and evaluated should a sponsor be identified and an acceptable plan developed. The use of unconsolidated materials to cap the former Industrial Waste Site in Massachusetts Bay will be considered further in consultation with EPA and others if issues of sponsorship, monitoring, placement impact, and liability are worked-out.

Analysis of the proposed improvements to extend the deepening of the Main Ship Channel above the Reserved Channel Turning Area to 45-feet MLLW to access the redeveloped Massport Marine Terminal in South Boston indicates that improvement is also economically justified, environmentally acceptable and otherwise in the Federal interest.

The deepening of the small section of the Mystic River to 40-feet MLLW for access the Medford Street Terminal is also economically justified, environmentally acceptable and otherwise in the Federal interest.

The deepening of the Chelsea River Channel to 40-feet MLLW is also economically justified, environmentally acceptable, and otherwise in the Federal interest, and is included in the recommendation.

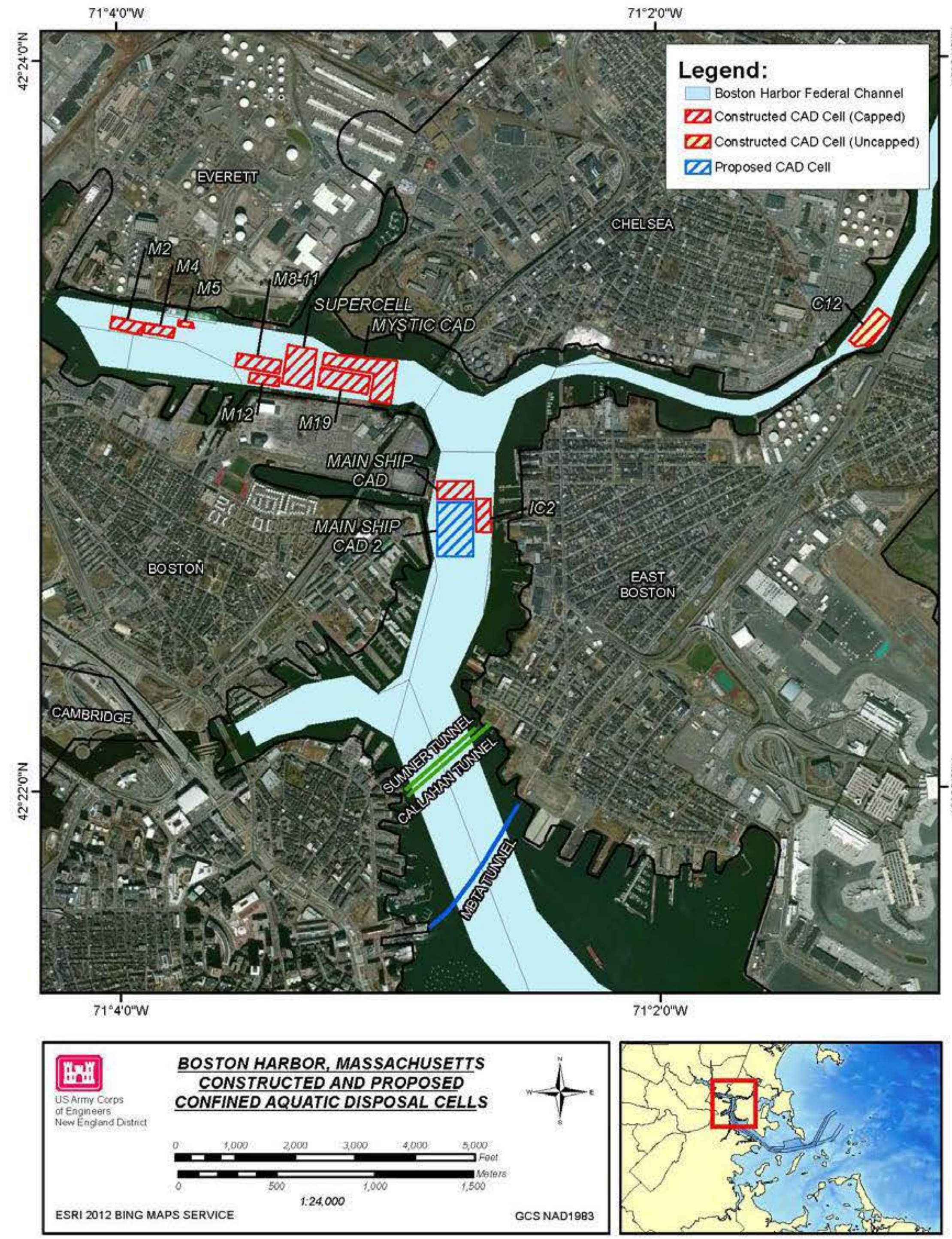
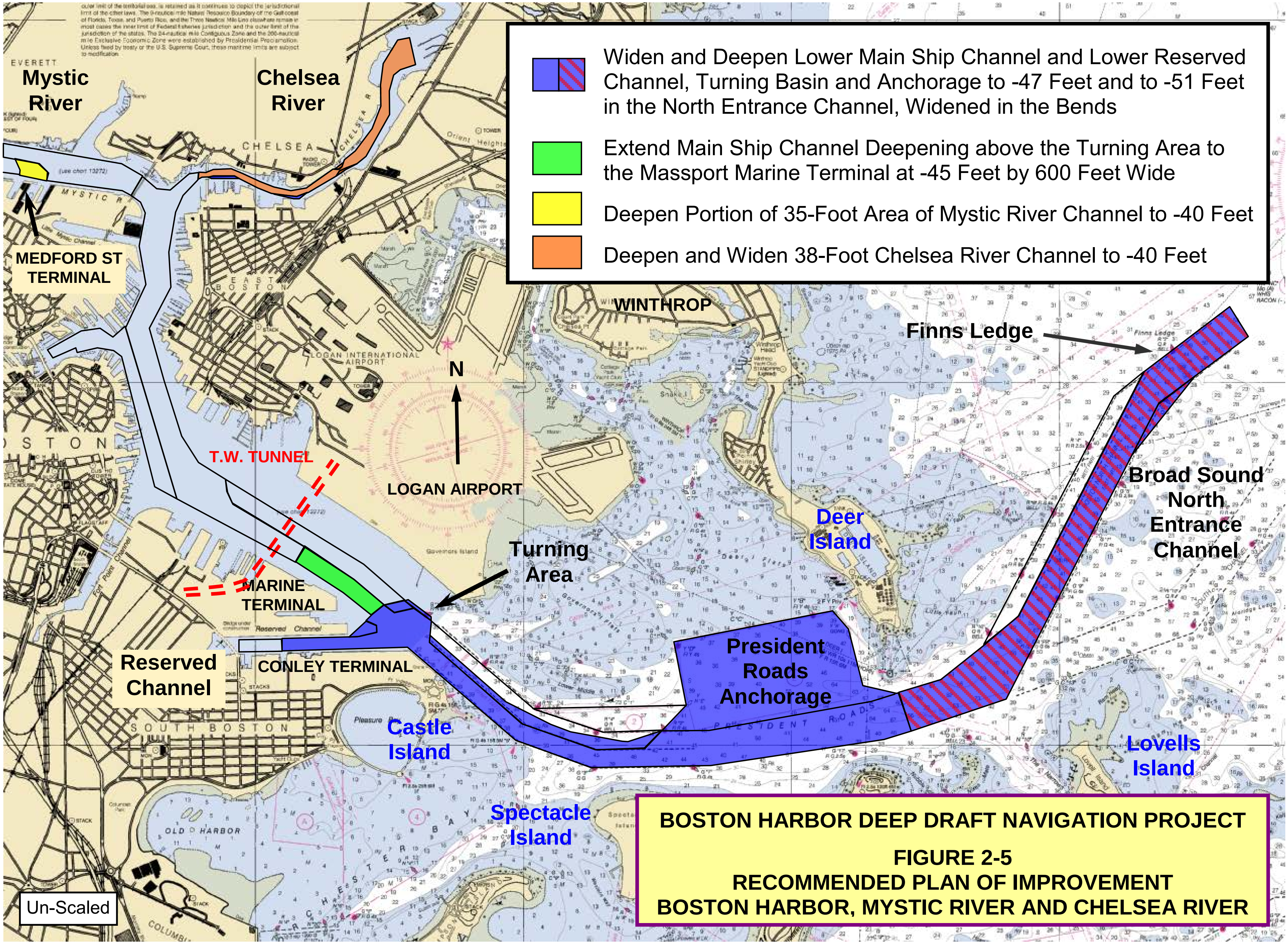


Figure 2-4. Previously Constructed and Proposed Confined Aquatic Disposal Cells



BOSTON HARBOR DEEP DRAFT NAVIGATION PROJECT

FIGURE 2-5
RECOMMENDED PLAN OF IMPROVEMENT
BOSTON HARBOR, MYSTIC RIVER AND CHELSEA RIVER

3. AFFECTED ENVIRONMENT

3.1 Historical Environment

3.1.1 Boston Harbor

Boston Harbor was historically one of the most contaminated estuaries in the United States. The shallow depths, and flow of pollutants and excessive nutrients from streams and rivers in eastern Massachusetts, contributed to the poor condition of the estuary. In addition, decades of urban runoff and an antiquated sewage treatment plant resulted in significant water quality and human health concerns (Battelle, 2000).

The environmental conditions in Boston Harbor began to change when a Federal court order was issued in 1985 to the Massachusetts Water Resources Authority (MWRA). The court order instructed the MWRA to construct a new sewage treatment plant and related facilities to address the water quality and human health concerns. These improvements occurred gradually from 1988 to 2000 (MWRA, 2004). In 1988, sewage scum was no longer discharged into the harbor but placed into a landfill instead. Sludge discharges into the harbor from the old Deer Island Treatment Plant (DITP) and the Nut Island Treatment Plant (NITP) ended in December of 1991. The beginning of secondary treatment in 1997 marked a dramatic decrease in biological oxygen demand (BOD) and continuing declines of bacteria, solids, nitrogen, and phosphorus. The new ocean outfall diffuser came on line in September 2000, beginning the discharge of treated effluent through a 9.5 mile outfall in Massachusetts Bay.

In addition to these major construction projects, MWRA continues to address the problem of combined sewer overflows (CSOs). CSOs discharge a mixture of stormwater runoff and sewage directly into the harbor during heavy rainstorms.

Since effluent discharges to the harbor have decreased, water quality has improved and the water quality classification in the Inner Harbor and President Roads area of Boston Harbor has improved from SC to SB. Class SB waters are defined as designated habitat for fish, other aquatic life and wildlife, including their reproduction, migration, growth and other critical functions, and for primary and secondary contact recreation. Where designated, these waters shall be suitable for shellfish harvesting with depuration (Restricted and Conditionally Restricted Shellfish Areas) and shall have consistently good aesthetic value. Dissolved oxygen levels shall not be less than 5.0 mg/l unless background conditions are lower. Class SC waters are similar to SB waters except they are designated for secondary contact recreation only, suitable for certain industrial cooling and process uses. Dissolved oxygen levels shall not be less than 5.0 mg/l at least 16 hours out of any 24 hour period and not less than 4.0 mg/l at any time.

The improvements to water quality within Boston Harbor should create more favorable conditions for the return of flora and fauna more typical of a healthy estuary.

Boston Harbor includes the lower portions of the Mystic River and the Chelsea River (Creek), the Inner Confluence where the two rivers meet, and the Inner Harbor, Lower Harbor and Outer Harbor portion of the Main Ship Channel area. Some of the Affected Environment sections below describe conditions in Boston Harbor as a whole or as subsection (i.e. by the rivers, Inner Harbor, Lower Harbor, and Outer Harbor).

3.1.2 Habitat Enhancement Sites

As mentioned in the Alternatives Section above, Broad Sound and Massachusetts Bay were identified as potential habitat enhancement sites for the placement of rock removed from the project. All the sites are located in Massachusetts Bay. See Figure 2-3.

Model and field results confirm that the new effluent plume from the MWRA outfall is generally confined to within 12 miles of the Massachusetts Bay outfall (Libby, et. al, 2006). With the relocation of the outfall to Massachusetts Bay, it is possible that all the sites could be minimally influenced by the diluted effluent.

Water quality at the Broad Sound and Massachusetts Bay enhancement sites are classified as SA waters. SA waters are defined as excellent habitat for fish, other aquatic life and wildlife, including for their reproduction, migration, growth and other critical functions, and for primary and secondary contact recreation. Where designated, these waters are suitable for shellfish harvesting without depuration, and have excellent aesthetic value. Dissolved oxygen levels are not to be less than 6.0 mg/l unless background conditions are lower.

3.1.3 Massachusetts Bay Disposal Site

The Massachusetts Bay Disposal Site (MBDS) is located in Massachusetts Bay in some of the deepest waters in Stellwagen Basin. The general vicinity of the MBDS received a wide range of disposed materials dating back at least to the 1940's. Intentionally sunken derelict vessels, organic and inorganic compounds, and construction debris are some of the waste disposed in the vicinity (Hubbard, et. al., 1988).

The water quality above MBDS would not have differed from the remaining portion of Massachusetts Bay prior to the relocation of the sewage outfall and has not been affected by the relocation of the effluent discharge from Boston Harbor to Massachusetts Bay. This conclusion is based on three-dimensional circulation models for Massachusetts Bay and the outfall and far field water quality monitoring. This data has also not shown any adverse impacts to areas in Massachusetts Bay where the MBDS is located (USGS, 2005).

The MBDS is located outside State waters and therefore does not have a water quality classification. However, if there was a designation, the waters of the MBDS would be expected to have a Class SA designation. The water above the MBDS is not significantly influenced by anthropogenic sources and the dredged material disposed at the site has met the suitability testing requirements. Class SA is the same classification as Massachusetts Bay waters located within the State boundaries.

3.1.4 Industrial Waste Site

The Industrial Waste Site (IWS) overlaps much of the MBDS and extends further north in Stellwagen Basin. The IWS received a wide range of wastes beginning in the 1940's until it was closed in 1977, including industrial and chemical wastes, munitions, construction debris, and derelict vessels. Disposal of low-level radioactive wastes took place at the IWS between 1946 and 1959. The area identified with a high density of waste on the seafloor (termed the barrel field) is located outside and to the north of the MBDS and has a similar environment to the MBDS. Refer to Section 2.7 for additional information.

3.2 Physical Environment

3.2.1 Physical Oceanography

3.2.1.1 Boston Harbor

Boston Harbor is relatively shallow with an average depth of about 15 feet, and is well flushed by strong tides. The water within Boston Harbor is replaced by Massachusetts Bay and river waters within five to seven days (MWRA, 2004). USGS (2005) computer modeling shows the deep channels at the mouth of the harbor to be more rapidly flushed than the Inner Harbor and shorelines of Boston Harbor.

The dominant currents in the harbor are tidal in origin, although wind driven currents occur during storms. Freshwater flow discharges from the Mystic, Charles, and Chelsea Rivers generally overlie the more dense seawater flows from the tides. Freshwater flows average 350 to 500 cubic feet per second (cfs) in the summer. Tidal inputs are orders of magnitude greater with flows averaging 320,000 cfs for a six hour period and volumes ranging from 10.6 billion gallons at low tide to 179.9 billion gallons at high tide (Metcalf and Eddy, 1976; and MDWPC, 1986). At the mouth of the Inner Harbor near Castle Island, the recorded mean tide range is 9.4 feet and the spring tide range is 10.9 feet (NOAA, 1999). The mean tide level is 5.0 feet. The fastest tidal currents in Boston Outer Harbor occur in the deep ship channels (up to 1.4 knots) during spring tides in the southern lane of the Main Ship Channel (USACE/Massport, 1994).

3.2.1.2 Habitat Enhancement Sites

Broad Sound – The Broad Sound site is located in waters southeast from the coast of Nahant in open water. The proposed site is square, measuring approximately 1.4 miles by 1.3 miles, enclosing an area of 1.73 square miles. This site has intermediate depth, with depths ranging from approximately 45 to 90 feet. This site would be expected to be influenced by local tidal conditions as well as the physical conditions described below for Massachusetts Bay.

Massachusetts Bay – The Massachusetts Bay site is located approximately three miles east of Hull in open water. The proposed site is rectangular, measuring approximately 2.2 miles by 1 mile enclosing an area of 2.12 square miles. This site is the deepest of the survey areas, with depths ranging from approximately 75 to 110 feet. This site would be expected to have physical characteristics most similar to the characteristics described below for Massachusetts Bay.

3.2.1.3 Massachusetts Bay Disposal Site

The Massachusetts Bay Disposal Site is located in the depressed Stellwagen Basin on the western edge of the Stellwagen Bank National Marine Sanctuary in Massachusetts Bay. Massachusetts Bay is a semi-enclosed embayment surrounded by the Boston metropolitan region in the north and west and by Cape Cod to the south. The bay is open to the Gulf of Maine in the east. It is about 60 miles long and 30 miles wide, and has average depth of 115 feet. Stellwagen Basin is the only deep basin in Massachusetts Bay with a depth up to 300 feet. It is bounded in the east by Stellwagen Bank with the shallowest depth of about 65 feet, and is connected to the Gulf of Maine through the North Passage off Cape Ann and the South Passage off Race Point (Jiang and Zhou, 2004a).

Previous studies have indicated that the circulation in Massachusetts Bay/Cape Cod Bay varies in response to short and long-term local and remote forcing (Geyer *et al*., 1992; Signell, *et al*., 1996 in Jiang and Zhou, 2004a). The local and remote forces include: 1) wind stresses and heat fluxes at the sea surface, 2) tides and mean surface slopes at the open boundary, and 3) freshwater runoff including outfall effluents. A counterclockwise circulation characterizes the yearly-mean current in Massachusetts Bay/Cape Cod Bay. Tides are semi-diurnal. Tidal currents vary from two knots in Stellwagen Basin, to 9.7 knots off the tip of Cape Cod. In most of Massachusetts Bay, the flow-through flushing for the surface waters ranges from 20 to 45 days (USGS, 1998).

A modeling study conducted for the MWRA indicates pronounced seasonal variation in the circulation pattern (Jiang and Zhou, 2004b). In western Massachusetts Bay, the currents are strongly driven by surface winds. In winter and spring seasons, northerly winds drive a southward coastal current thus creating a counterclockwise circulation that is consistent with the annual mean pattern (Geyer et al., 1992 in Jiang and Zhou, 2004a). In summer and early fall, predominant southwest winds produce offshore Ekman transport and coastal upwelling, which induce an overall northward coastal current along the upwelling front near the western coast, thereby reversing the counterclockwise circulation. This is confirmed by the moored Acoustic Doppler Current Profiler (ADCP) current measurements at the U.S. Geological Survey buoys (Butman *et al*., 2002) and the MWRA modeling study (Jiang and

Zhou, 2004b). The coastal upwelling and downwelling have also been discussed in previous studies (e.g., Geyer, *et al*., 1992; HydroQual and Signell, 2001 *in* Jiang and Zhou, 2004a).

3.2.1.4 Industrial Waste Site

As the IWS overlaps much of the MBDS and its extension to the north still lies within Stellwagen Basin, it has similar physical characteristics as described above for the MBDS. The IWS is located in water depths of 240 to 300 feet. The only significant topographic features include rises in the north and northeast quadrant where the bottom shoals toward Stellwagen Bank. A circular mound rises in its north-central section, and a small depression is near its center (NOAA, 1996).

3.2.2 Water Temperature and Salinity

3.2.2.1 Boston Harbor

Water temperature and salinity were measured for seven years (from 1993 to 1999) in Boston Harbor to characterize the baseline conditions prior to the discharge of wastewater from the new outfall (Taylor, 2001). Sampling stations were located in the North Harbor (north of Long Island and in the project area) and in the South Harbor region (south of Long Island and outside the project area). The average water temperature was 9.6 ^{o}C (Taylor, 2002a). Highest water temperature in the summer averaged approximately 20^{o}C and showed very little variation over the years. The minimum temperature did, however, show a slight increase from the winter 1993/1994 to the winter of 1998/1999. In general the water temperature for the two regions in Boston Harbor, the North Harbor and the South Harbor, were similar (Taylor, 2001).

Variations for salinity within a year were considerable for the harbor (Taylor, 2001). Salinity ranged from about 26 parts per thousand (ppt) to 33 ppt. Average annual salinity levels in the North Harbor, where the project area is located, were consistently lower than the average annual salinity levels in the South Harbor (Taylor, 2001). Average salinity did increase very slightly after the interisland transfer of wastewater from NITP to DITP from 29.8 to 29.9 ppt in the North Harbor and 30.8 to 30.9 in the South Harbor (Taylor, 2002a). It might be expected that salinity levels would decrease in the Inner Harbor as one moves closer to the mouth of the three rivers (Charles River, Mystic River and Chelsea River) discharging into Boston Harbor. As no significant trends in water temperature or salinity were observed in the harbor as a whole or in either the two regions (North Harbor where the project is located or South Harbor), this suggests the trends were not the result of long-term trends in freshwater flows or water temperature (Taylor, 2001).

3.2.2.2 Habitat Enhancement Sites

No site specific water temperature or salinity data are available for the Broad Sound or Massachusetts Bay enhancement sites. Although these sites are closer to the coast, they would still be considered open water sites, subject to many similar conditions described below for Massachusetts Bay with coastal influences.

River discharges influence the salinity, the stratification, and the strength of the coastal circulation, where the habitat enhancement sites are located. The Charles River mainly influences surface conditions at the outfall site, whereas the Merrimack River has more influence on bottom salinity (Libby, *et al.*, 2006). Air temperature has a substantial effect on water properties during the winter, when it sets the minimum water temperature.

3.2.2.3 Massachusetts Bay Disposal Site

Although Massachusetts Bay generally follows an annual cycle typical for temperate coastal waters, the timing of the events over the cycle is strongly influenced by regional meteorological and oceanographic conditions (Libby, *et al.*, 2006). In winter, the water column in Massachusetts Bay is well-mixed and nutrient levels are high. Stratification occurs later in the spring due to the increased spring freshets that decrease the surface salinity. This increase in stratification separates the bottom and top layers of the water column, effectively reducing the availability of nutrients to the surface from the bottom and oxygen to the bottom layer (Libby, *et al*., 2004). The summer is generally a period of strong stratification, and depleted surface water nutrients. In the fall, strong winds and cooling temperatures promote mixing of the water column (Libby, *et al*., 2004). By early winter, the water column is well-mixed and reset to winter conditions. The MBDS would be expected to follow this same annual cycle. Salinity minima occur in late spring as a result of increased spring runoff, but vary only a few parts per thousand. Most values range from 31 ppt to 33 ppt (Hubbard, *et al*., 1988).

3.2.2.4 Industrial Waste Site

The description described above for the MBDS is relevant to the IWS.

3.2.3 Water Column Turbidity

3.2.3.1 Boston Harbor

Turbidity refers to the clarity or clearness of the water. The greater the amount of total suspended solids (TSS) in the water, the murkier it appears and the higher the measured turbidity. Although turbidity is not an inherent property of water such as temperature or pH (Davies-Colley and Smith, 2001, *in* Wilde, F.D., 2005), it is an indicator of water body health. Turbidity is caused by suspended and dissolved matter; such as clay, silt, finely divided organic matter, plankton and other microscopic organisms, organic acids, and dyes (ASTM International, 2003, *in* Wilde, F.D., 2005). Natural causes of turbidity include runoff, phytoplankton and zooplankton, minute fragments of dead plants, and storm events. Anthropogenic sources of turbidity include runoff from agricultural fields, stormwater runoff from construction sites and urban areas, shoreline erosion from heavy boat traffic, bottom sediment resuspension from vessel traffic, dissolved nutrients released in treated wastewater, and organics released by sewage treatment plants.

High levels of turbidity, outside the normal range of turbidity levels, over sustained periods of time can be a concern for the health and productivity of the estuarine ecosystem for several reasons. Turbid waters can decrease light penetration into the water, thereby lowering photosynthetic activity and reducing the area available for submerged aquatic plants to grow. Algae can greatly limit light penetration and can limit primary production to the uppermost layers of water. This can cause invertebrate population decline (caused by fewer photosynthetic organisms available for food). This in turn can result in fish population decline (caused by fewer invertebrates available for food). Suspended material in large quantities for sustained periods can foul the filter-feeding systems of certain estuarine animals. Particles may accumulate on the gills of fish and inhibit breathing. High levels of turbidity can hinder aquatic predators from spotting and tracking down prey. Dissolved oxygen can be depleted if turbidity is largely due to organic particles.

Water clarity has improved in Boston Harbor since 1993 (MWRA, 2004). The water clarity gradient shows an increase from west to east. Water is more turbid toward the river and shallow margins of the harbor and clearer toward the mouth of the harbor and bay. Secchi disk measurements (a white disk lowered into the water column until it disappears) showed that up until July 1998 Secchi disk depths were generally greater than 6.6 feet over most of the harbor, but were noticeably shallower around the Nut Island outfalls and in Dorchester Bay. After closing the NITP in July 1998, Secchi disk depths increased by more than three feet near the old NITP outfalls. In other parts of the harbor, the water clarity only increased eight inches to two feet or near the DITP, not at all.

3.2.3.2 Habitat Enhancement Sites

The Broad Sound and Massachusetts Bay habitat enhancement sites are located in open water areas where conditions would be similar to Massachusetts Bay.

3.2.3.3 Massachusetts Bay Disposal Site

No apparent changes to the water clarity have been noted near the outfall (Libby *et al.,* 2006). As the MBDS is located several miles further east of the outfall, no changes to water clarity is expected. Water quality at the Massachusetts Bay Disposal Site (MBDS) has not been affected by the relocation of effluent discharge from Boston Harbor to Massachusetts Bay. Three dimensional circulation models and water quality monitoring have not shown any adverse impacts to the MBDS (USGS, 2005).

3.2.3.4 Industrial Waste Site

The description above for the MBDS is relevant for the IWS.

3.2.4 Dissolved Oxygen

3.2.4.1 Boston Harbor

Dissolved oxygen (DO) in marine waters is essential for most healthy aquatic life. If levels are too low it can be a sign of human induced impacts such as excessive runoff or nutrients or natural causes such as seasonal variations. Healthy conditions for aquatic life exist when dissolved oxygen are above 5.0 mg/L. Concentrations between 5.0 mg/L and 3.5 mg/L are generally healthy, except for the most sensitive species. When concentrations fall below 3.5 mg/L, conditions become unhealthy. The most severe effects occur if concentration levels fall below 2.0 mg/L, even for short periods of time (EPA, 1997). EPA's new recommended marine dissolved oxygen standard is an average of 4.8 mg/l with a minimum of 2.3 mg/l, currently applicable from Cape Cod south to Cape Hatteras (MWRA website).

Monitoring of DO levels in Boston Harbor show that, even before the MWRA improvements were implemented, DO levels were high enough to support healthy marine life (MWRA, 2004). With the completion of MWRA improvements, DO levels have remained relatively unchanged. This is due to the tidal flushing of the harbor that results in a well-mixed water column. Monitoring has shown that even at the end of summer, when DO levels are typically at their lowest, concentrations are still within what is considered a healthy range (Libby *et al*., 2011). DO levels increase with distance from the shoreline and are lowest in the Inner Harbor and the mouths of rivers. DO levels in the harbor range from 4.9 mg/L in the Mystic River/Inner Harbor, to 8.1 mg/L in the area south of Long Island (MWRA, 2004).

3.2.4.2 Habitat Enhancement Sites

In Massachusetts Bay, DO concentrations show a consistent trend since 1992 of maximum water bottom DO levels in the winter, a decrease over the course of the summer during seasonal stratification, and then reaching annual minimum levels just prior to stratification breaking down in the fall – usually October (Libby *et al.,* 2006). Since the outfall came on line there as has been little change in the DO cycle (Libby *et al.,* 2006). The MWRA monitoring stations closest to the outfall, and most representative of the Massachusetts Bay habitat enhancement site, show mean bottom water DO levels ranging from a low of about 7.5 mg/l to a high of 11 mg/l. The Broad Sound and Massachusetts Bay habitat enhancement sites are located in open water areas which would be similar to conditions observed in Massachusetts Bay.

3.2.4.3 Massachusetts Bay Disposal Site

MWRA monitoring stations most representative of the MBDS by water depth show healthy mean bottom water DO concentrations ranging from a low of 7.5 mg/l to a high of 10.5 mg/l (Libby *et al.,* 2006). These DO bottom water concentrations have changed little with the outfall coming on line.

3.2.4.4 Industrial Waste Site

The IWS would be expected to have similar DO levels as the MBDS due to the close proximity and similar conditions as the MBDS.

3.2.5 Nutrients

3.2.5.1 Boston Harbor

Nutrients such as nitrogen and phosphorus are necessary in a productive marine ecosystem. However, too much nitrogen, especially in the form of ammonia, can fuel and stimulate the excessive overgrowth of algae and seaweed. The dense algae blooms cloud the water and shade the bottom. When the algae die and settle to the bottom, they are decayed by bacteria that can use up oxygen. Oxygen is necessary for aquatic organisms to feed, grow, and live. In extreme conditions, some organisms may suffocate and die, while others flee the hypoxic (low dissolved oxygen level in the water) zones. Dense algae blooms can prevent enough light from reaching shallow water bottoms to support the growth of submerged aquatic vegetation, an important habitat for shellfish and juvenile fish (EPA, 1997).

Nutrient load has improved significantly in Boston Harbor since the discharges from the NITP ended and discharges from the DITP were moved in September 2000 to the diffuser offshore in Massachusetts Bay. There has been a statistically significant decrease in ammonia (NH_4), nitrate (NO_3), and phosphorus (PO_4) in Boston Harbor (Libby, *et al.*, 2006, 2011). Significant decreases in ammonia levels at the NITP outfall site were noted after discharges from NITP ended. In addition, the average concentrations of dissolved inorganic nitrogen (5.5 *u*mole 1^{-1}) and dissolved inorganic phosphorus (0.73 *u*mole 1^{-1}) decreased 55% and 31% respectively after the diffuser came on-line (Taylor, 2002b). Now ammonia in Boston Harbor shows a typical, low seasonal cycle seen in healthy estuaries (MWRA, 2004; Libby *et al*., 2011).

3.2.5.2 Habitat Enhancement Sites

Seasonal trends in nutrient concentrations are closely linked with both physical and biological factors in Massachusetts Bay (Libby, *et al.*, 2006). Physical mixing or stratification combined with biological utilization and remineralization act to increase or decrease the concentrations of nutrients over the course of the year. Nutrient concentrations are high in the winter when consumption is low and mixing is thorough; concentrations decrease in the surface waters during the winter/spring bloom due to consumption by phytoplankton, while the onset of stratification cuts off the supply of nutrients from deeper waters. As stratification strengthens, nutrients are generally depleted in surface waters and increase at depth in the summer; nutrients then return to elevated levels in the surface waters following the fall bloom and mixing of the water column (Libby, *et al.*, 2006).

Since the outfall came on line, dissolved inorganic nutrients (except SiO_4) have exhibited increases through Massachusetts (Libby, *et al.*, 2006). Statistically significant increases of ammonia were noted during each season in the area near the outfall (most representative of the Massachusetts Bay habitat enhancement site), and Broad Sound. Significant increases in NO_3, and PO_4 concentrations were also noted near the outfall and Broad Sound monitoring stations during the summer and fall. These increases are due to both the direct input of nutrients to the area near the outfall and by an apparent regional increase in ambient concentrations as evidenced by significant increase in NO_3 at the northern boundary of Massachusetts Bay (Libby, *et al.*, 2006).

3.2.5.3 Massachusetts Bay Disposal Site

The effluent plume, as measured during dye studies and characterized by NH_4 distribution during each MWRA survey, appears to be confined to within about 12 miles of the outfall(Libby, *et al.*, 2006).

Since the MBDS is located near the outside edge of this range, changes due to the effluent plume should not effect the MBDS.

3.2.5.4 Industrial Waste Site

The effluent plume from the MWRA outfall pipe should have no significant influence on the IWS due to its distance from the pipe.

3.2.6 Sediment Characteristics

> ***Sidescan Sonar*** is a technique using ultrasonic sound to visualize the structure of the seafloor using backscatter images. Bright areas on the backscatter images represent hard objects like rock which reflect sound readily (*i.e.,* strong backscatter) while dark areas showing weaker reflectance represent soft objects

3.2.6.1 Boston Harbor

Sedimentary environments in the affected environment, including Boston Harbor and Massachusetts Bay, have been mapped and interpreted from an extensive collection of sidescan sonar records and supplemental marine geologic data gathered by Knebel and Circe (1995). While this area represents a relatively complex sedimentary environment, Knebel (1993, 1995) identified three primary sedimentary environments that show direct correlation with processes of erosion, deposition, and sediment reworking. Figure 3-1, adapted from work presented by Knebel (USGS, 1999a) and available on the United States Geological Survey (USGS) web site (http://pubs.usgs.gov/of/of99-439), provides an overview of the sedimentary environments recognized in the area.

Erosional marine environments consist of subtidal, exposed bedrock, glacial drift, and coastal-plain rocks. Non-depositional areas consist of coarse-grained lag deposits. On the sidescan sonar records, these areas are recognized by patterns with isolated reflections or by patterns of strong backscatter. These areas contain bottom types ranging from boulder fields to gravelly sands and occur in areas of high energy. Inside the harbor, erosional areas were found near mainland and insular shorelines, harbor approaches, and over scattered knolls and ridges. Subbottom profile data acquired in these areas show bedrock and/or glacial till outcropping on the seafloor. As depicted on Figure 3-1, erosional/non-depositional environments are isolated to the southern shoreline regions of the Inner Harbor, but are predominant across the Outer Harbor.

Depositional environments are areas blanketed by muddy sands and/or muds that have accumulated under predominantly weak bottom current conditions. The sediments in depositional areas are fine-grained and contain relatively high concentrations of organic matter. Depositional environments are characterized on the side scan sonar records as uniform patterns of weak backscatter. They occupy a large portion of Boston Inner and Lower Harbor.

Sediment reworking environments are areas where bottom currents fluctuate considerably in strength causing sediments in the areas to be intermittently eroded and deposited. Reworked areas are characterized by sandy-gravels to mud. Environments interpreted as sediment reworking are less common in the harbor than the preceding two types of environments mentioned.

Additional sidescan and sub-bottom profile analyses were performed within the Boston Harbor Navigation channel in 2002 (USACE, 2003a). Based on these data, a similar analysis of sedimentary environment was conducted (Figure 3-2). The navigation channel passes through a number of sedimentary environments. The Lower Harbor portion of the channel appears to change from an area characterized as sediment reworking (consisting of mud and sand) in the eastern portion, to erosional in the western portion (characterized by sand and gravel). The Outer Harbor portion of the navigation channel is an erosional area characterized by poorly sorted coarse to fine grained sand, consistent with the sediment reworking classification of Knebel (USGS, 1999b), with isolated areas of gravel, rock and ledge.

Limited sidescan data in the Inner Harbor and Mystic and Chelsea Rivers (Figure 3-1), in conjunction with the grain-size data shown on Figure 3-2, appear to indicate that the sedimentary environments in these areas consist predominantly of silt, clay, and mud, which is characteristic of a depositional area. This estuarine environment, because of its protected nature, low wave climate, and large supply of sediments, is an effective trap for fine-grained material. Isolated areas of gravel were noted near the mouth of both the Mystic and Chelsea Rivers (Figure 3-1).

Physical samples were collected in August 2002 to determine grain size of the material to be dredged (see Figure 3-3). This material is located beneath the silty maintenance material which has been or will be removed during maintenance dredging. The results of the test show that the improvement material corresponds to the sidescan and sub-bottom profile data, i.e. coarser grained sediment in the lower portion of the harbor and finer grained sediment in the upper portion of the harbor and rivers. A summary of the grain size results can be found in Table 3-1.

3.2.6.2 Habitat Enhancement Sites

Broad Sound – The dominant substrate texture classes were (in decreasing order of dominance): muddy sand and a gravel/cobble mix. The coarser gravel/cobble mix roughly bisected the site along an east/west orientation. Soft bottom covered 0.99 square mile, or 57% of the site. Sediment Profile Imaging (SPI) stations at the Broad Sound site indicated that the substrate was both sandy and silty. The northern sampling stations were separated from southern stations by a broad swath of hard bottom, including coarse gravel and small cobbles. The three infaunal stations within the Broad Sound site (BR1,

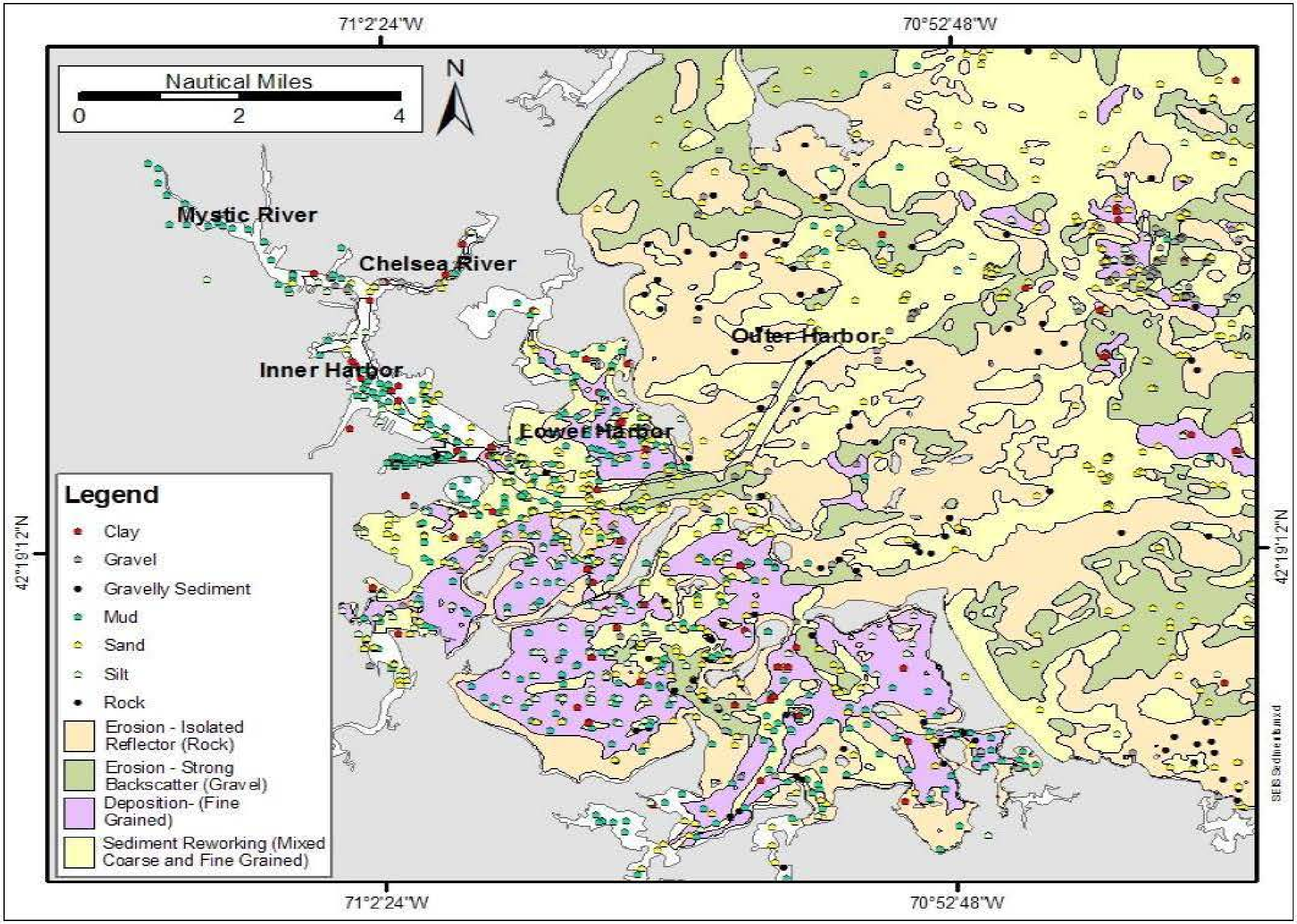
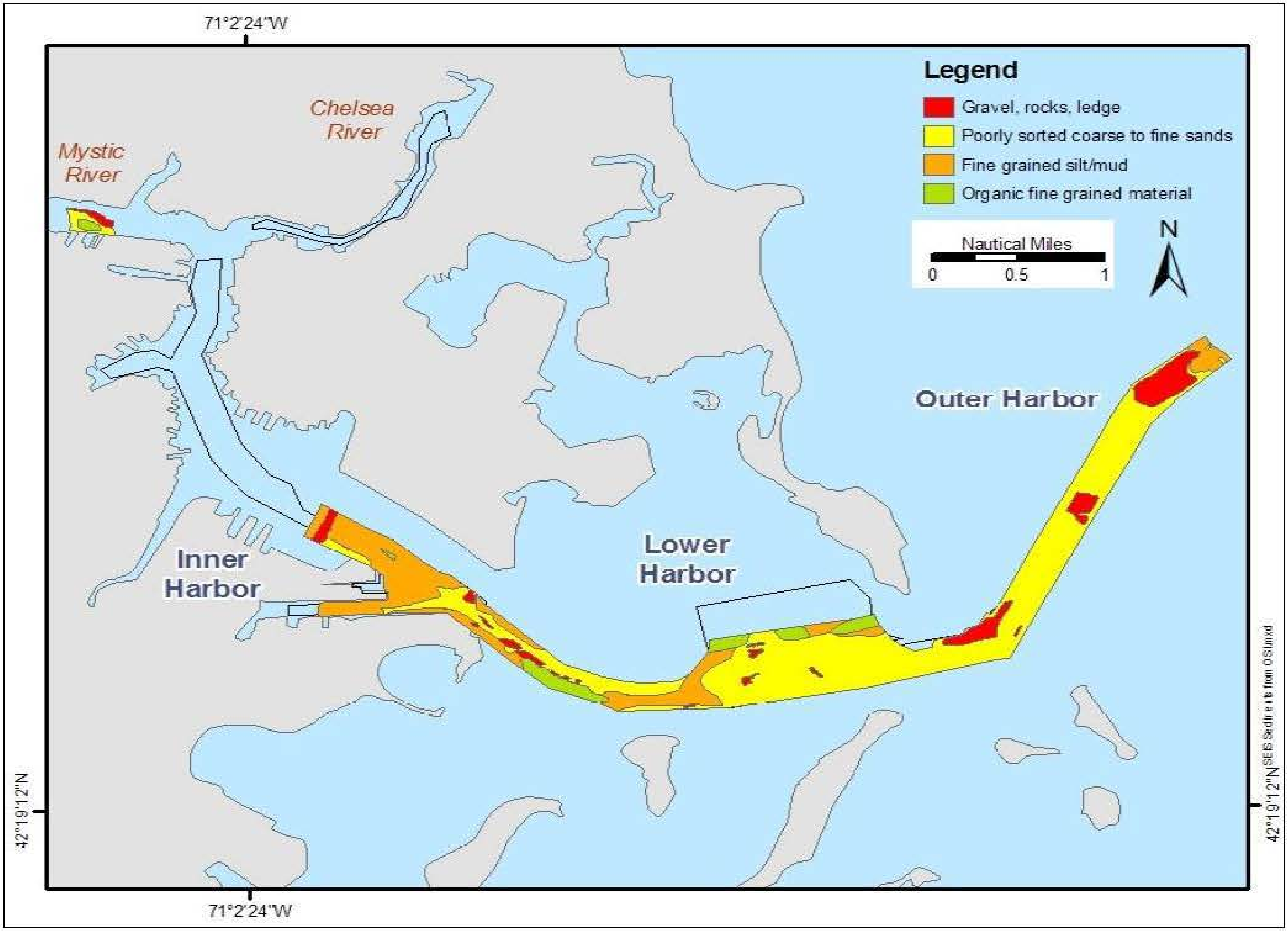


Figure 3-1. Sedimentary Environments and Sediment Botttom Types in Boston Harbor and Massachusetts Bay

Source: USGS, 1999

Note: Bottom type locations are approximate.



Source: USACE, 2003

Figure 3-2. Navigation Channel Sedimentary Environments (Existing Bottom Surface)

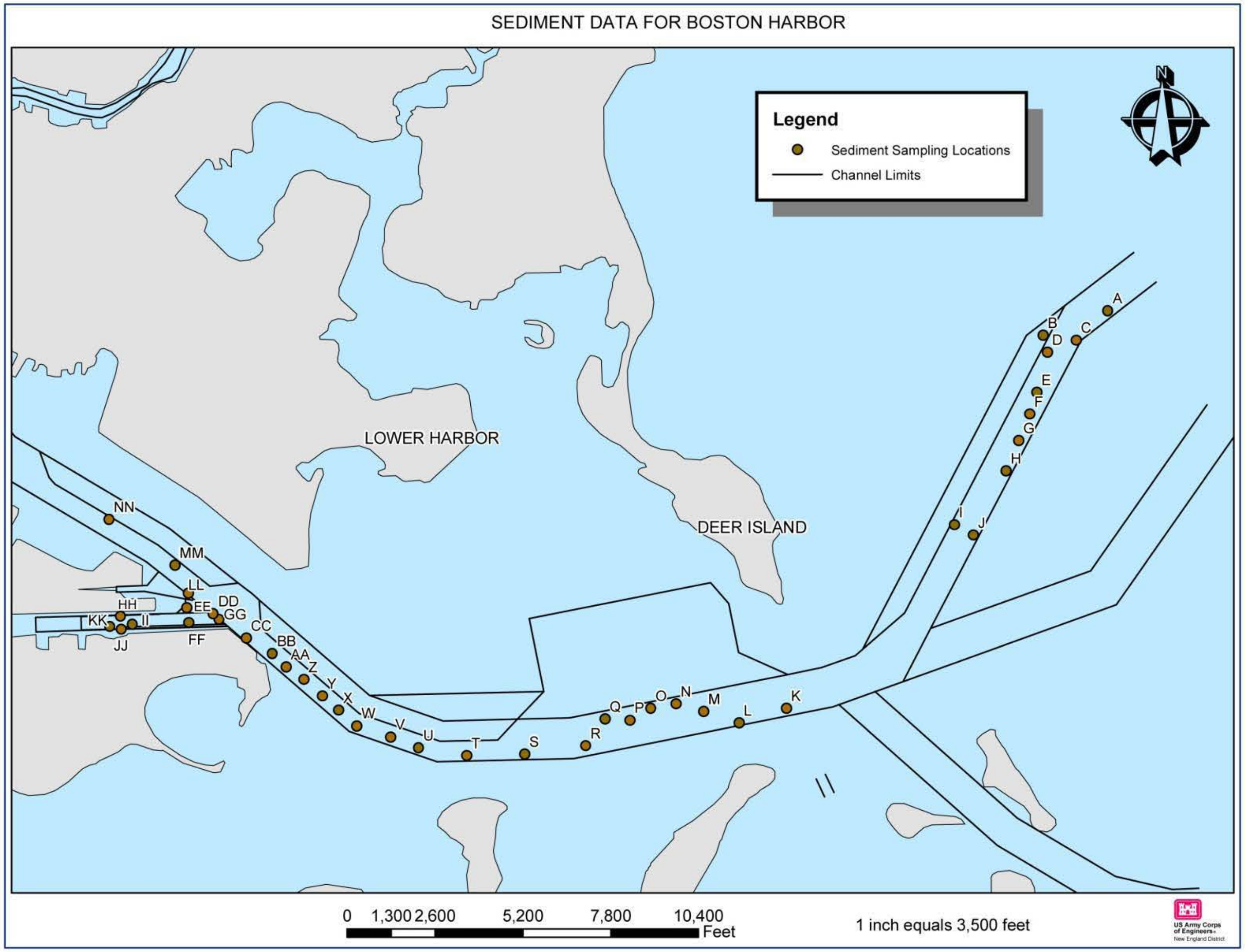


Figure 3-3a. Sediment Sample Locations

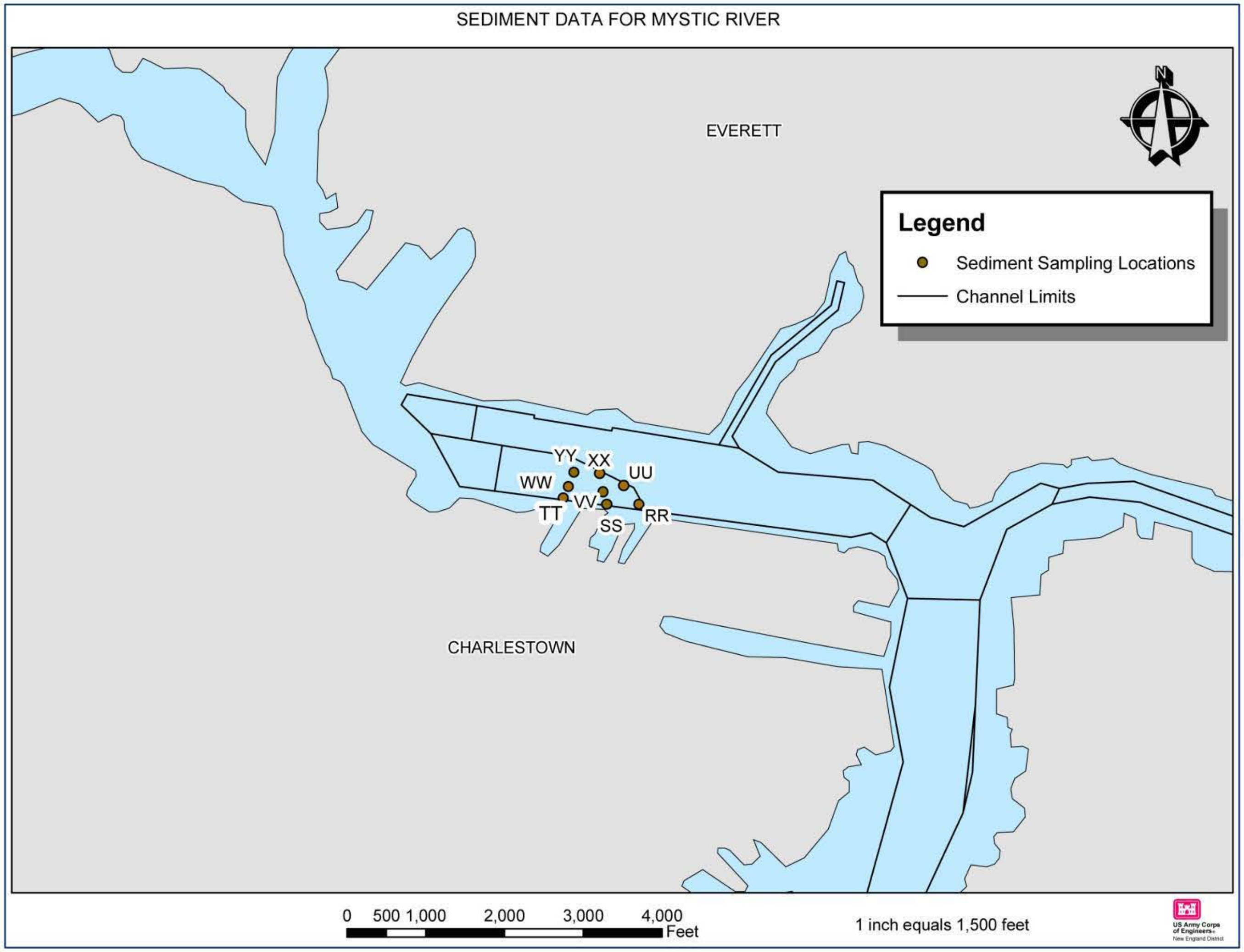


Figure 3-3b. Sediment Sample Locations

Table 3-1. Grain Analysis of Boston Harbor Samples

SAMPLE	GRAVEL %	SAND %	SILT/CLAY %
Broad Sound North Channel			
A	68.29	23.46	8.25
B	90.11	9.17	0.72
C	only cobble	0.00	0.00
D	64.82	31.00	4.18
E	26.40	69.50	4.10
F	67.88	29.96	2.16
G	91.47	7.94	0.59
H	53.19	42.09	4.72
I	81.94	15.53	2.53
J	19.78	61.44	18.78
Main Ship Channel			
K	84.36	11.28	4.36
L	42.28	32.16	25.56
M	82.87	15.06	2.07
N	10.23	63.72	26.05
O	8.60	68.92	22.48
P	61.81	25.98	12.21
Q	0.86	47.93	51.21
R	0.17	17.72	82.11
S	0.12	33.75	66.13
T	0.92	7.29	91.79
U	0.30	58.34	41.36
V	9.78	54.99	35.23
W	0.00	7.00	93.00
X	0.00	14.67	85.33
Y	0.00	94.20	5.80
Z	1.87	7.25	90.88
Reserved Channel and Adjacent Main Ship Channel			
AA	0.41	8.82	90.77
BB	0.56	3.13	96.31
CC	0.00	14.94	85.06
DD	16.25	55.27	28.48
EE	0.08	20.15	79.77
FF	0.00	12.00	88.00
GG	0.10	4.77	95.13
HH	14.41	32.95	52.64
II	31.01	44.02	24.97
JJ	23.63	65.15	11.22
KK	17.45	14.91	67.64
LL	0.07	7.92	92.01
MM	0.00	8.98	91.02
NN	0.62	4.05	95.33
Mystic River			
RR	0.00	10.54	89.46
SS	0.00	4.86	95.14
TT	0.00	7.55	92.45
UU	0.00	6.22	93.78
VV	0.00	10.63	89.37
WW	0.00	10.09	89.91
XX	0.00	5.71	94.29
YY	3.01	32.36	64.63

BR3, and BR6) were located in two large areas of sand or muddy sand. Sediments were moderately coarse at station BR1 (61% sand and gravel) and fine at stations BR3 and BR6 (66% and 78% silt and clay). Total organic carbon (TOC) content was very low at station BR1 (0.5%) and low at stations BR3 and BR6 (1.3-1.9%).

Massachusetts Bay – The dominant substrate texture classes were (in decreasing order of dominance): sand, coarse sand and gravel, mud, and cobble. A wide area of mud was located in the center of the site, surrounded by extensive areas of hard bottom to the east and southwest. Soft bottom covered 1.06 square miles or 50% of the site. Anthropogenic debris and fixed fishing gear (e.g., lobster traps) were widespread at this survey area. Sidescan sonar imagery identified many ring-shaped features, interpreted to be small mounds of disposed coarse material (e.g., construction debris). Sand waves of varying size were also widespread at the Massachusetts Bay site. SPI stations at the Massachusetts Bay site were sandy or silty. The three infaunal stations within the Massachusetts Bay site (MB1, MB4, and MB7) were located within a broad area of fine to medium sand or very fine sandy mud surrounded by extensive areas of hard bottom. Sediments generally were evenly mixed coarse and fine textures at stations MB1 and MB4, but were predominantly fine at station MB7. TOC content was low at stations MB1 and MB4, just less than 1%, and moderate at station MB7, about 3%.

3.2.6.3 Massachusetts Bay Disposal Site

The bottom in the deeper portions of the MBDS is a broad depression with natural sediments composed of fine grained material. Shoal areas to the north and northeast are covered by coarser deposits (Hubbard, *et al*., 1988). Dredged material has been disposed at the MBDS from harbors located on the east coast of Massachusetts north of Cape Cod. The dredged material disposed at the site is composed predominantly of fine silts and clays. Dredged material disposed at the site has covered a large area, but periodic monitoring at the site by the USACE has not identied disturbance or redistribution of material once placed. A section of the previously defined disposal site was set aside as an area for rock disposal (north of the existing MBDS) to enhance the biological diversity at the site, and a similar site will be considered for the existing MBDS.

3.2.6.4 Industrial Waste Site

Most of the seafloor surveyed was characterized as soft sediment with a uniform horizon typical of a depositional basin (NOAA, 1996). Within the uniform flat mud basin, topographic rises, approximately 60 feet shallower than the surrounding bottom, were observed. These glacial knolls are composed of coarser sand and cobble substrate in patches with occasional 1 ½ to three-foot diameter exposed bounders (NOAA, 1996).

3.3 Biological Environment

3.3.1 Submerged Aquatic Vegetation

3.3.1.1 Boston Harbor

Dense meadows of seagrass are characteristic of pristine, shallow depositional environments in New England (MWRA, 2004). A century ago, seagrass meadows covered hundreds of acres of subtidal flats of Boston Harbor. Eelgrass can successfully dominate areas that have sediments ranging from soft mud to coarse sand with average salinities of 10 to 30 ppt (Thayer *et al*., 1984). Light availability is a primary factor limiting both depth and upstream estuary penetration of eelgrass within its temperature and salinity ranges (Thayer *et al*., 1984).

The eelgrass meadows in Boston Harbor had all but vanished by the late 1980's, due to turbid water, viral diseases, and excessive nutrients that promote the growth of algae on seagrass leaves (MWRA, 2004). Boston Harbor now supports only small areas of seagrasses in Hull and Hingham Bay and the northwest shoreline of Long Island as part of MA DMF eelgrass restoration project (MA DMF eelgrass website). The only area to show a significant increase in eelgrass acreage is near Logan Airport. From 1995 to 2001 this patch of eelgrass increased from 20.6 acres to 27.7 acres (MA DEP eelgrass website). Video mapping by Massport in 2007 through 2011 indicates that this eelgrass bed covers nearly 50 acres. Until recently, nutrient concentrations in the harbor have been very high, and the water in most areas has not been clear enough to support seagrasses. With the reduction in nutrients in the water and the increases in clarity, an effort to restore seagrasses in Boston Harbor was started by the MA Division of Marine Fisheries in the spring of 2004 through fall 2007. The MA DMF study resulted in two hectares of restored eelgrass adjacent to Long Island and Peddocks Island within Boston Harbor (Lescher *et al*., 2010). The successful restoration occurred in well flushed areas with sediments that contained less than 35% silt/clay (Lescher *et al*., 2010). These eelgrass restoration sites are located outside the influence of any Federal navigation dredging activity and related impacts.

3.3.1.2 Habitat Enhancement Sites

None of the habitat enhancement sites are known to contain submerged aquatic vegetation based on site information prepared for this SEIS/EIR, coordination with State agencies, and the physical characteristics of some of the sites.

3.3.1.3 Massachusetts Bay Disposal Site and Industrial Waste Site

The water depths at the MBDS and the IWS are too deep to support submerged aquatic vegetation. Eelgrass needs sufficient light for growth, generally not found in waters any deeper than 12 meters MLW in clear offshore waters (Buzzards Bay National Estuary Program website). Water depths at the MBDS are 82 meters and deeper.

3.3.2 Benthic Invertebrates

3.3.2.1 Boston Harbor

The continuing studies of the benthos in Boston Harbor that are being conducted by the MWRA provide a considerable data source for a description of the changes that have occurred within the harbor since discharge modifications began over 20 years ago. As summarized by Maciolek *et al*. (2005, 2008), the major changes in discharge regimes that have occurred since the 1995 EIR/S was prepared were the stoppage of effluent discharge from Nut Island, the complete conversion to secondary treatment in 1998, and the diversion of all treatment discharges from the harbor to the new outfall in September 2000. Maciolek *et al*. (2008) compiled a concise summary of conditions in the Harbor since the mid-1970s. Maciolek *et al*. (2008, 2011) also documented the changes that have occurred in the harbor since the cessation of sludge discharge in 1991. The primary changes have involved stations in the northern part of the harbor (comprising the Inner and Lower Harbor regions considered in this SEIS/EIR, see Figure 3-4 for benthic sample locations), which were once considered to be heavily polluted. Changes in the northern harbor have been dramatic; fluctuations in infaunal abundance and an increase in species numbers and diversity have been observed through 2003. Stations in the southern part of the harbor, which were less influenced by the former treatment discharges, have not shown changes in the benthos similar to those experienced at the northern stations. Since 1992 the improvements in benthic habitat quality led to increases in deeper, bioturbating species, which likely increased trophic complexity (Maciolek *et al*., 2011). The amphipod *Ampelisca* populations had a major peak in 2003 and were virtually eliminated from the harbor in 2005, probably as a consequence of several severe storms that affected benthic habitats (Maciolek *et al*., 2008).

Infaunal communities within the project study area of Boston Harbor are clearly separable into two geographic regions. The first extends from the innermost region, the Mystic and Chelsea Rivers, to the vicinity of the Reserved Channel. Within this region, infaunal abundances (Appendix U) are very low (<1,000/m^2) to low (1,000–5,000/m^2) and species numbers (Appendix U) are also very small (<5/sample) or small (5–15/sample). Polychaete, such as *Nephtys incisa*, *Polydora cornuta*, and *Scoletoma fragilis*, predominate among the few infaunal species present. MWRA sampling at the entrance to Fort Point channel, north of the Reserved Channel, (not included on Figure 3-4) has recorded new taxa from this area since 2004. However, the fauna has been dominated by the polychaete *Nephtys cornuta* (Maciolek *et al*., 2011). The second region extends from east of Reserved Channel to the mouth of the harbor and includes the Lower Harbor, Main Ship Channel, and

Presidents Roads Anchorage area. Infaunal abundances here (based on USACE 2003 and Massport 2003 data only; Appendix U) range from medium (5,000–25,000/m^2) to large (25,000–80,000/m^2) and species numbers (Appendix U) range from medium (15–25/sample) to large (25–40/sample). Predominant taxa in this region often include several polychaete species, such as *Aricidea catherinae*, *Prionospio steenstrupi*, *Scoletoma fragilis*, and *Tharyx acutus*. The tube-dwelling amphipod, *Ampelisca abdita*, is numerically important in the region and other amphipods, such as *Orchomenella pinguis* and *Leptocheirus pinguis*, are also relatively common. As stated above, the *Ampelisca* tube mat densities had a major peak in 2003 and were virtually eliminated from the harbor in 2005, probably as a consequence of several severe storms that affected benthic habitats (Maciolek *et al.*, 2008). Between 1993 through 2003 amphipod tube mats occurred in all regions of Boston Harbor, declined to zero in 2004 to 2005 and been on the rebound since, with most increases occurring from the Lower Harbor out to the Presidents Roads Anchorage area (Maciolek *et al*., 2011).

Infaunal abundances in the Outer Harbor, generally 5,000 to 25,000/m^2, are somewhat lower than those in the Lower Harbor, Main Ship Channel, and Presidents Roads Anchorage (Appendix U). Species numbers, generally 15 to 25 species per sample, in the Outer Harbor region, which is actually part of Massachusetts Bay, are similar to those in the Lower Harbor, Main Ship Channel, and Presidents Roads Anchorage region. Predominant taxa in this region include several polychaete species, such as *Aricidea catherinae*, *Prionospio steenstrupi*, *Scoletoma fragilis*, and *Tharyx acutus*. The small bivalve, *Hiatella arctica*, was very abundant at one Outer Harbor station.

Additional benthic information can be found in Appendix U.

3.3.2.2 Habitat Enhancement Sites

In September 2004 a series of surveys (sidescan, SPI, and benthic) were conducted to collect information to describe the benthic community at the five potential habitat enhancement sites. Sidescan sonar data were collected within each site and a towed underwater video sled was deployed at five locations within each site to ground-truth the sonar data and to provide more detailed descriptions of the benthic substrates and visible biota. Based on interpretation of the sidescan mosaics and video observations, suitable locations for the SPI survey were selected and mapped. SPI locations were chosen based on identification of soft bottom areas representing the range of soft bottom habitat types with a given site.

Sediment grab samples were also collected in September 2004 at three stations within each of the five potential hard bottom enhancement sites. Station coordinates were determined based on the sidescan and SPI data collected during the earlier surveys and were chosen to represent the range of soft bottom sediments within each area. At each of the benthic infaunal stations, sediment was collected for infaunal, grain-size distribution, and total organic carbon analyses. From this information, a description of the benthic habitat for each habitat enhancement site is provided.

Rhoads and Germano (1986) established the index for estuaries and coastal waters, Organism Sediment Index (OSI) values >6 indicate good habitat conditions and are generally associated with bottoms that are not heavily influenced by stress. The OSI level that defines this breakpoint for dynamic offshore bottom, such as Massachusetts Bay, Broad Sound, and Nahant Bay, has not been determined and could be higher or lower than 6. For this document, the OSI is used as a relative indicator of habitat conditions with higher OSI values associated with higher benthic habitat quality.

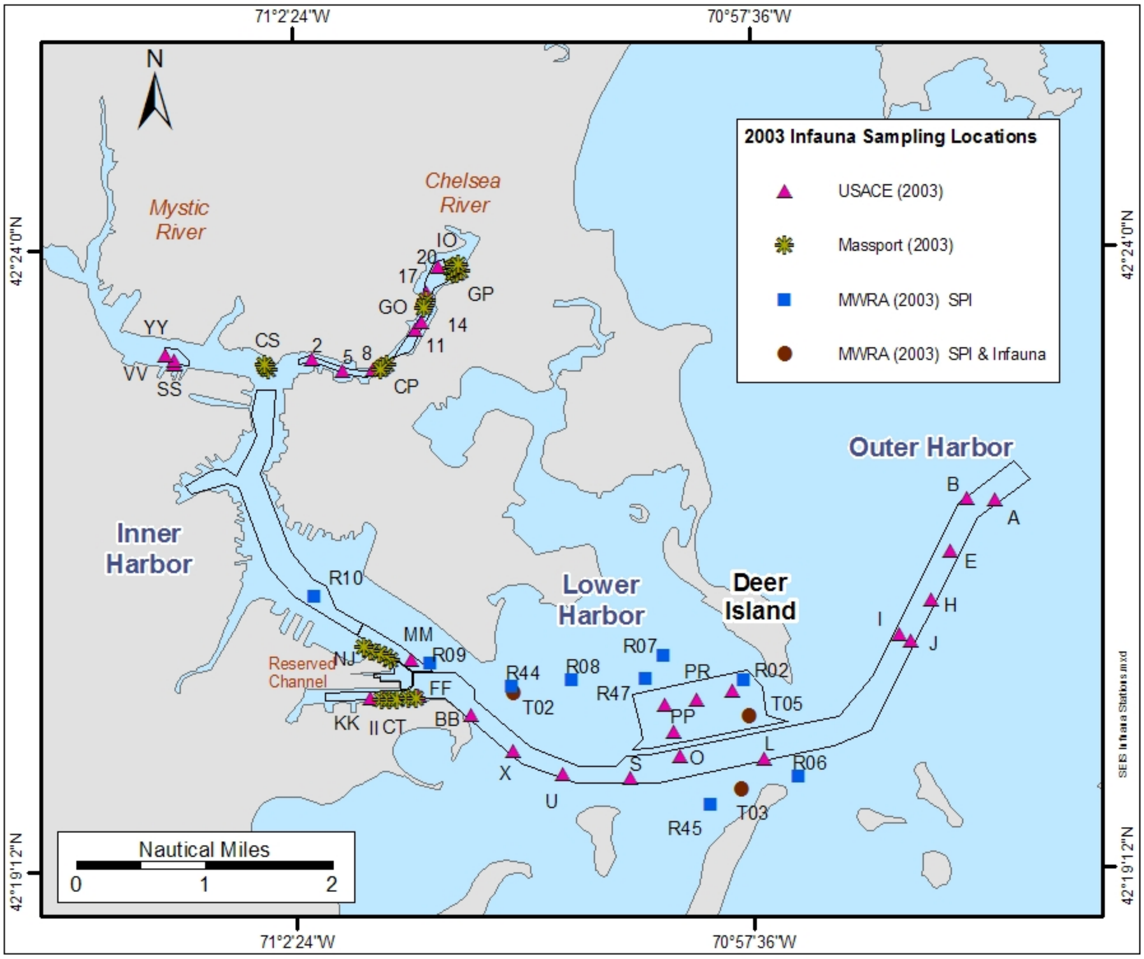


Figure 3-4. Infauna Sampling Stations

Several ecological metrics were calculated for each infaunal sample within a geographic subset: total abundance, total species, Shannon-Weiner Diversity (H'), Evenness (J'), the ten most abundant species, and log-series *alpha* diversity. Log-series *alpha* is a diversity measure used to characterize infaunal communities. Several diversity estimators increase markedly with increasing sample size. Log-series *alpha* is recommended for use because it does not exhibit much sample size bias (Rosenzweig, 1995) and is used here as an unbiased estimator of species richness.

Broad Sound – The OSI at the Broad Sound SPI stations ranged from 4.0 to 7.5. Infaunal abundance varied less than two-fold across the three Broad Sound stations, ranging from 1,367 to 2,429 individuals per sample, or about 34,000 to 61,000/m^2. Variability was low to high among the samples collected at Broad Sound. The number of species occurring at each station was relatively consistent, ranging from 28 to 35 species per sample. Variability in species numbers within each station was moderately low (13 to 23%). Species diversity among the Broad Sound stations was moderately low and consistent among all three stations with log-series alpha ranging from 4.5 to 6.7 and Shannon's *H'* ranging from 2.9 to 3.9. Variability in species diversity within each station was low to moderate, with coefficient of variation (CV) for log-series alpha ranging from 12 to 33%.

The species composition of the samples from the three Broad Sound stations was also typical for Massachusetts Bay sediments. Polychaete worms accounted for the largest proportion of the species-level infaunal abundance. *Prionospio steenstrupi*, *Tharyx acutus*, *Mediomastus californiensis*, *Levinsenia gracilis*, and *Spio limicola* characterized the samples from two of the stations. Despite the numerical importance of *Prionospio steenstrupi* and *Mediomastus californiensis* at the third station, the fauna at that station differed from the other two in that the polychaete *Owenia fusiformis* accounted for 22% of the species-level infaunal abundance there. Additionally, the isopod crustacean *Edotia montosa*, was among the ten most abundant taxa at one station, but was uncommon or not found at the other two stations. The small bivalve mollusk *Nucula delphinodonta* was the third or fourth most abundant species among the Broad Sound stations.

Northern starfish were also observed in the video transects from within this site.

Massachusetts Bay – OSI at the Massachusetts Bay SPI stations ranged from 6.0 to 9.0. Infaunal abundance varied slightly more than two-fold across the three Massachusetts Bay stations, ranging from 438 to 1,067 individuals per sample, or approximately 11,000 to 27,000 m^2. Variability was moderate to high among the samples collected at each of the three Massachusetts Bay stations. The number of species occurring at each station also varied moderately, ranging from 21 to 31 species per sample. Variability in species numbers within each station was moderately low (19 to 26%). Species diversity among the Massachusetts Bay stations was moderately low and consistent among all three stations with log series alpha ranging from 5.5 to 6.7 and Shannon's *H'* ranging from 3.3 to 3.5. Variability in species diversity within each station was moderately low (15 to 26%).

Most of the numerically dominant taxa at the three Massachusetts Bay stations were polychaete worms. All of these worms, especially *Prionospio steenstrupi*, *Tharyx acutus*, *Mediomastus californiensis*, *Levinsenia gracilis*, and *Spio limicola*, are typically among the predominant species in Massachusetts Bay. The small deposit feeding clam, *Nucula delphinodonta*, also was relatively abundant and is a common taxon among Massachusetts Bay samples.

3.3.2.3 Massachusetts Bay Disposal Site

As would be expected, benthic recolonization and community type on the disposal mounds at the MBDS would be dependent on the type of material disposed at the site and the age of the mounds. Older mounds have a more stable, later successional Stage II and Stage III (burrowing and deposit feeding populations), while the newly deposited mounds would be dominated by Stage I pioneering benthic organisms. Boston blue clay disposed at the MBDS tends to be more cohesive and less conducive to burrowing Stage III organisms. More mixed materials would have a diversity of organism types. See Section 4.4.3 for a more extensive discussion regarding benthic community structure at the MBDS.

3.3.2.4 Industrial Waste Site

The soft bottom sediments at the IWS are marked with features of biogenic origin characterized by small-scale bioturbation associated with polychaete worms and amphipods (NOAA, 1996). At the transition depths, about 280 feet, high densities of anemone *(Cerianthus* spp.) forests were found (NOAA, 1996). The attached hard-rock faunal assemblage (*Telia* anemones, tunicates, brachiopods, hydroids, bryozoans, and sponges) increased dramatically on the glacial knolls. Water turbidity was less at these slightly shallower depths, presumably due to a lesser effect of flocculent settlement characteristic of the deeper nepheloid layer found at the deeper 280 to 300-foot depths (NOAA, 1996).

3.3.3 Shellfish

3.3.3.1 Boston Harbor

Several commercially and recreationally important species of shellfish, such as softshell clam (*Mya arenaria*), blue mussels (*Mytilus edulis*), razor clams (*Ensis directus*), rock crabs (*Cancer irroratus*), and Jonah crabs (*C. borealis*) occur within the affected environment and are discussed in this section.

Lobsters are discussed in Section 3.3.4. Infaunal invertebrates that occur in the project area are discussed in Section 3.3.2. Shellfish that are designated as having Essential Fish Habitat (EFH) within the project area (Atlantic sea scallop [*Placopecten magellanicus*], Atlantic surf clam [*Spisula solidissima*], and ocean quahog [*Arctica islandica*]) are discussed in more detail in the Essential Fisheries Habitat (EFH) Evaluation (Appendix T).

Recent data (*i.e.*, since 1995) describing the distribution of shellfish in Boston Harbor are very limited. The National Marine Fisheries Service (NMFS) identified softshell clam, blue mussels, and Atlantic surf clams (in nearby Broad Sound) as shellfish resources of concern within or near the project area (NMFS, 2005).

The Massachusetts Department of Marine Fisheries (MA DMF), in collaboration with the Massachusetts Office of Coastal Zone Management (CZM) and the NOAA Coastal Services Center (CSC), developed a map of shellfish suitability areas that shows the approximate location of potential habitats suitable for ten species of shellfish along the coast of Massachusetts (Figure 3-5). These areas were determined to be suitable for shellfish based on the expertise of the MA DMF, the opinion of local Massachusetts Shellfish Constables, and information contained in maps and studies of shellfish in Massachusetts. These areas include sites where shellfish have historically been sighted but may not currently support any shellfish.

Site-specific shellfish studies were not conducted for this project. Recent samplings conducted within the harbor (Pellegrino, 2003; Massport, 2003) (Figure 3-4 in the Benthic Infaunal section) in September 2003 were designed to collect benthic infaunal community data, although some data regarding the presence of shellfish were generated. Absence of a species from samples collected does not necessarily mean that the species does not occur in the project area.

Mystic River - Habitat for softshell clams has been identified by MA DMF along the northern bank of the Mystic River (Figure 3-5). The bottom type within these areas is mostly mud (Figure 3-1), which is consistent with the preferred substrate of softshell clams (fine sediments). Grab samples collected within the deepening area did not contain harvestable shellfish species (Pellegrino, 2003).

Chelsea River - The bottom type within the Chelsea River is a heterogeneous mix of gravel and sand, with areas of finer sediments (silt, mud, clay) (Figure 3-1). Softshell clam habitat is present along the banks of the Chelsea River (Figure 3-5), with smaller areas of razor clam and blue mussel habitat in the upper reaches of the river. The presence of softshell clam was confirmed by one grab sample collected in the general area of this identified habitat (Massport, 2003).

Inner Harbor - Mud and clay is the predominant sediment type within the Inner Harbor (Figure 3-1). No suitable shellfish habitat is identified by MA DMF within the Inner Harbor (Figure 3-5) project areas. Blue mussel and Jonah crab were present in grab samples collected at North Jetty, just to the north of the Reserved Channel, in an area of mud and sand (Massport, 2003). Blue mussels were also present in samples from Conley Terminal within the Reserved Channel. EPA staff have noted European oysters (*Ostrea edulis)* along the East Boston shoreline (letter dated May 23, 2008).

Lower Harbor - Suitable habitat for several shellfish species is present along the coastline of the Lower Harbor, although none is located within the Presidents Roads Ship Channel or Anchorage to be dredged (Figure 3-5). Softshell clam habitat exists along almost the entire coastline of the harbor north of the channel and along the coastline and shores of the islands (*i.e.*, Long Island, Spectacle Island, Thompson Island) to the south of the channel. This habitat is interspersed with large areas of blue mussel habitat and smaller, localized razor clam habitat. Blue mussel habitat is also located just outside the Presidents Roads Anchorage and Channel at the tip of Deer Island. These habitats coincide with areas of mixed coarse and fine-grained sediment or rock (Figure 3-1). Rock crabs were present in the grab samples collected within the Presidents Roads Anchorage and Main Ship Channel

(Pellegrino, 2003). EPA staff have noted European oysters along the Winthrop shoreline (letter dated May 23, 2008).

Outer Harbor - The bottom type of the Outer Harbor is much more erosional and rockier than other portions of the harbor. In general, sediments consist mostly of sand, gravel, and rock, with isolated areas of finer sediments (silt, mud, and clay) (Figure 3-1). The closest shellfish habitat to the channel in the Outer Harbor is along the coast of Long Island (softshell clam, blue mussel, razor clam), and an area of scallop habitat between Long Island and Gallops Island (Figure 3-5). Areas of softshell clam, blue mussel, razor clam, and Atlantic surf clam habitat are present in nearby areas of Broad Sound to the north. Habitat for these species, as well as European oyster, also exists in Quincy Bay to the south of the channel, though little evidence of live oysters has been found in this area or elsewhere in Boston Harbor (MA DMF, 1996).

In nearby areas, HubLine surveys conducted in 2002 and 2004 identified various types of shellfish habitat off the mouth of Boston Harbor, approximately 1.5 nautical miles (nmi) east of the project area (TRC Environmental and Normandeau Associates, 2003; Normandeau Associates, 2005). Scallop survey results showed that the bottom type near the mouth of Boston Harbor generally consisted of medium- to coarse-grained sediments, with areas of coarse glacial till and fine grained sediment (mud, clay) (Figure 3-6) (TRC Environmental and Normandeau Associates, 2003; Normandeau Associates, 2005). The highest scallop densities in 2002 and 2004 off the mouth of Boston Harbor were found on medium- to coarse-grained substrate, with the majority of scallops observed being greater than 4 inches in shell height, exceeding the minimum harvest size of 3.5 inches. Glacial till sampling in 2004 at the mouth of Boston Harbor determined that small mussels, including blue mussels, were very abundant at the two sampling station near the mouth of Boston Harbor (Figure 3-6) (TRC Environmental and Battelle, 2005). Decapod crustaceans, such as juvenile rock crabs, and softshell clams were also present in areas of sand, fine gravel, cobble, and some boulder. The hard bottom study conducted in October and November 2004 characterized the bottom type at those stations to the east of the project area (Figure 3-6) as an exposed bedrock ledge surrounded by cobbles, mussel shells, and sand, with some boulders (TRC Environmental *et al.*, 2005). Commonly observed fauna included mussels, *Cancer* sp. crabs, and a few scallops. These data illustrate the variability of habitat type in the Outer Harbor in areas surrounding the project area.

Life history information, landing data and shellfish designation areas for species with habitat within the project area are presented in Appendix V and summarized in Table V3-2.

Recent data describing the distribution of shellfish in Boston Harbor are very limited. Potential habitat for several commercially and recreationally important species of shellfish (softshell clam, blue mussels, razor clams, and sea scallops) occurs along the banks of the Chelsea and Mystic Rivers and along the coastlines of the Lower and Outer Harbors. The presence of softshell clam, blue mussel, rock crab, and Jonah crab was confirmed by grab samples collected within the project area (Pellegrino, 2003; Massport, 2003). Of these species, softshell clam is the most common commercially harvested shellfish within Massachusetts and Boston Harbor

Most of the productive softshell clam beds within the project area are closed to harvesting, except for conditionally restricted areas near Logan Airport in North Boston Harbor and areas near the Neponset River and Dorchester Bay.

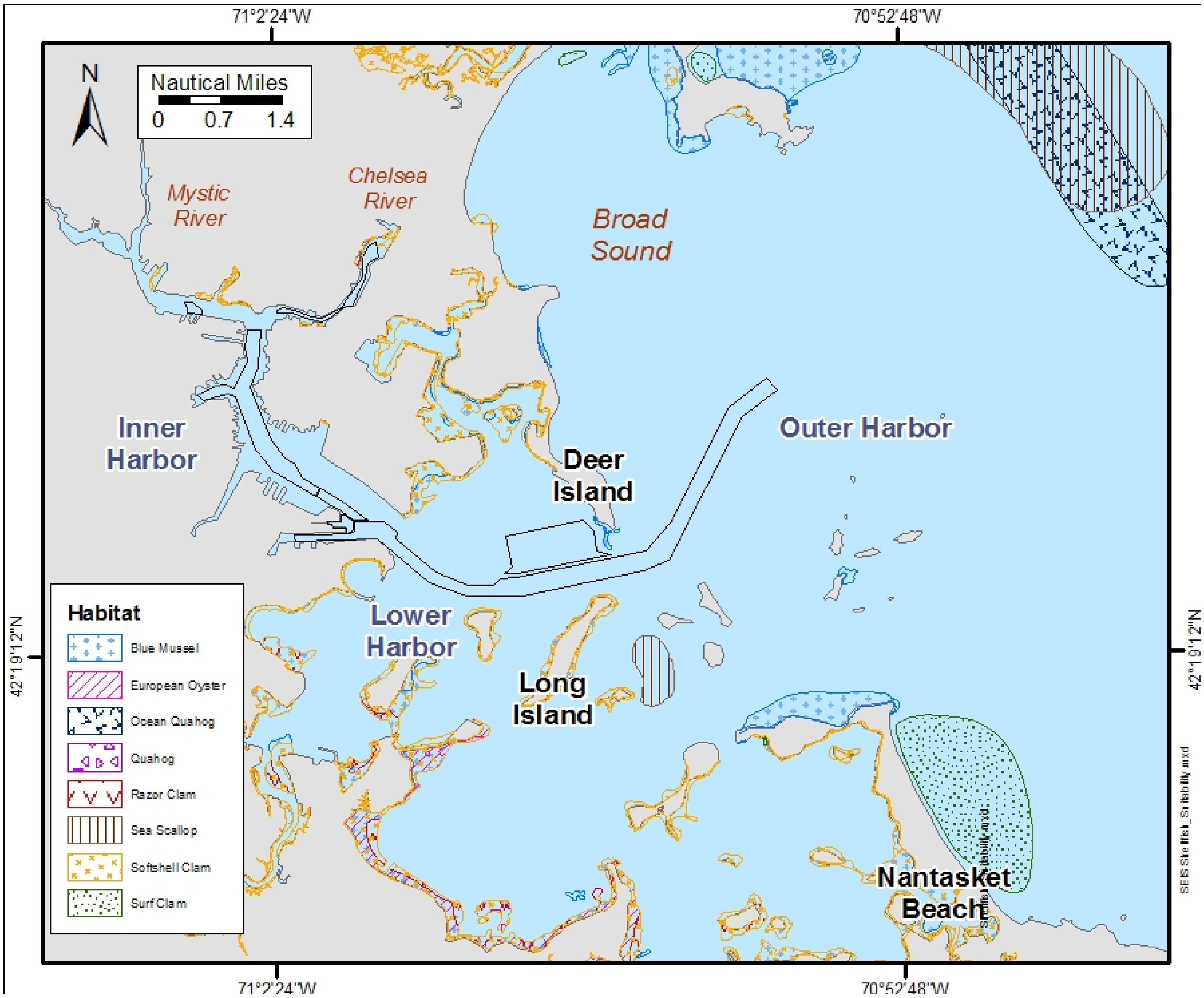


Figure 3-5. Shellfish Suitability Areas (MA DMF, 2004)

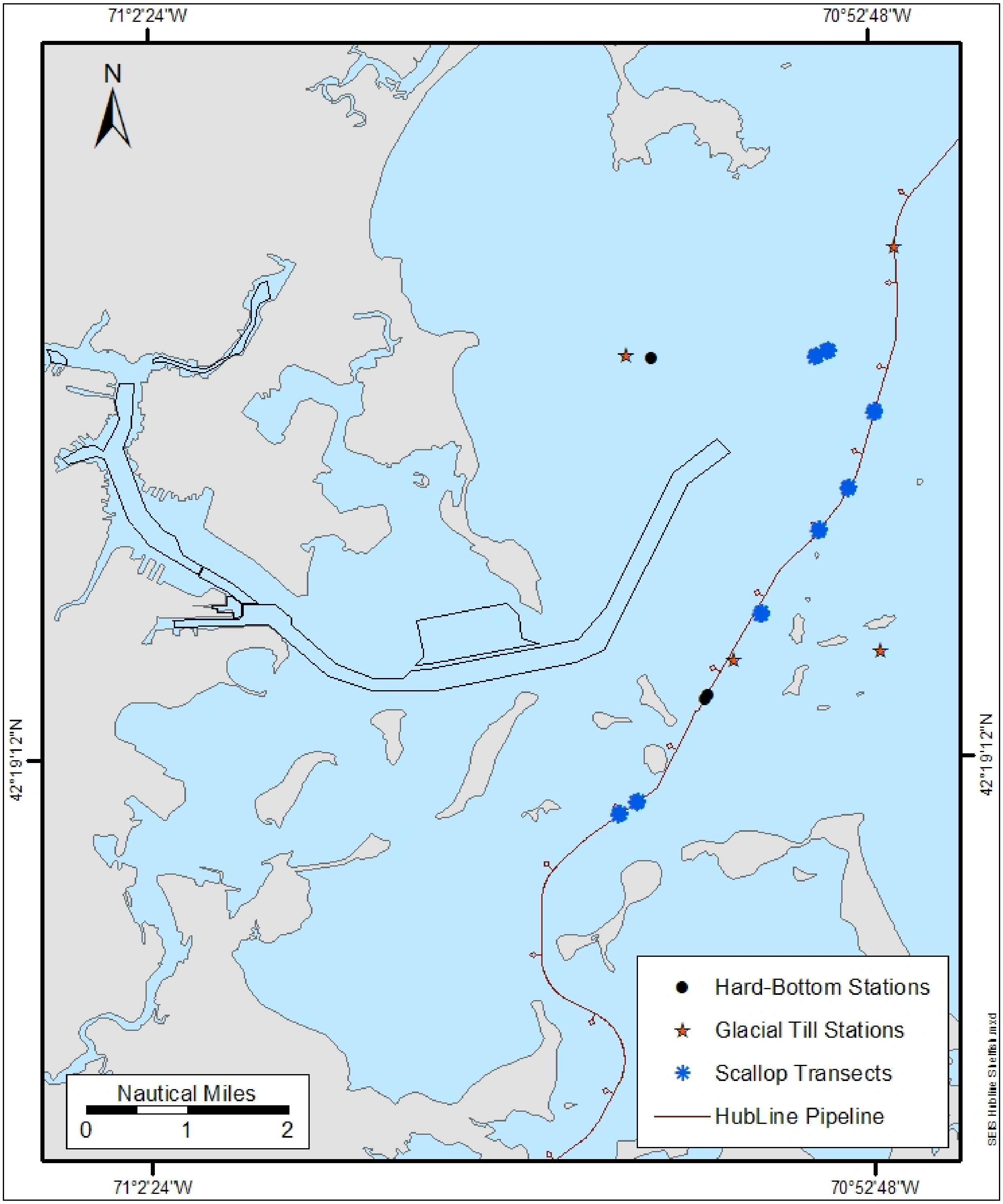


Figure 3-6. Hubline Pipeline Sampling Stations in the Outer Harbor

3.3.3.2 Habitat Enhancement Sites

The potential for shellfish habitat to exist in the two habitat enhancement sites is illustrated by Essential Fish Habitat (EFH) descriptions for the area, a MA DMF map of shellfish suitability areas, and by video drift footage of the sites. The two potential habitat enhancement sites are covered by two 10 x 10 minute EFH squares. Sea scallops (all life stages), and surf clams (juvenile and adults only) are EFH designated within all sites.

Broad Sound – None of the potential shellfish habitats identified by MA DMF occur within the Broad Sound site. Rock crabs were predominant in the mud/sand bottom drift video footage within this site.

Massachusetts Bay – None of the potential shellfish habitats identified by MA DMF occur within the Massachusetts Bay site. Rock crabs were predominant in the mud/sand bottom drift video footage within this site.

3.3.3.3 Massachusetts Bay Disposal Site and Industrial Waste Site

No commercial shellfish species are known to occur at the MBDS based on benthic data collected for the USACE's Disposal Area Monitoring System (DAMOS) Program. Given its overap with the MBDS, similar conditions are expected at the IWS.

3.3.4 Lobster

With the decline of cod and other groundfish fisheries, the American lobster (*Homarus americanus*) has emerged as the most economically important fishery in Massachusetts State waters (Estrella and Glenn, 2001; Dean, *et al.*, 2005; Dean, 2010), where it has been found to occur from the intertidal zone offshore to water depths of 2,360 feet (ft) (MacKenzie and Moring, 1985). This section describes the habitat requirements, and fishery data for lobster within the affected environment. The life history of lobsters can be found in Appendix N.

3.3.4.1 Boston Harbor and Surrounding Project Area

Published scientific literature and results from larger scale lobster studies conducted by the Massachusetts Division of Marine Fisheries (MA DMF) may be used to predict the distribution of lobster and their various life stages within the project area based on the substrate present. In general, lobster habitats are highly variable (Cooper and Uzmann, 1980). Inshore habitats used by populations of early benthic phase (EBP), juveniles, adolescents, and adults include mud, cobble, bedrock, peat reefs, eelgrass beds, sand, and for smaller individuals, the intertidal zone (Thomas, 1968; Cooper, 1970; Cobb, 1971; Cooper *et al.*, 1975; Hudon, 1987; Able *et al.*, 1988; Heck *et al.*, 1989; Wahle and Steneck, 1991; Lawton and Robichaud, 1992; Cowan *et al.*, 2002). Young-of-the-year (YOY) (EBPs, <15 mm CL) are typically restricted to shelter-providing habitats that protect them from predators (Lavalli and Barshaw, 1986; Hudon, 1987; Johns and Mann, 1987; Barshaw and Lavalli, 1988; Able *et al.*, 1988; Wahle and Steneck, 1991; Wahle and Steneck, 1992). Larger juveniles may be less susceptible to inshore predators and, thus, are able to exploit a wider range of habitats, including those less likely to provide ready-made shelter, and habitat that allows them to build shelters (e.g., mud) (Cobb, 1971; Berrill and Stewart, 1973; and Botero and Atema, 1982). Adolescents (sub-legal lobsters) and adults (mostly legal-sized lobsters), particularly those that remain in shallow coastal waters, have fewer predators and are found in featureless substrates, such as sand and fine-grained mud (Cooper and Uzmann, 1980). While shelters are necessary for the purposes of molting and mating (Tremblay and Smith, 2001; Karnofsky, *et al.*, 1989), these larger lobsters show little shelter fidelity within a home range over a period of several days, except during over-wintering months (Watson, 2005). Thus, there is a trend of increased ability to exploit all available habitats, both featureless and shelter providing, as the size of a lobster increases.

In 1995, MA DMF began a suction-sampling program to monitor densities of newly settled postlarvae and subsequent YOY. The goals of this program were to document important nursery habitat and develop a lobster settlement index to better understand environmental factors influencing population trends. Currently 18 sites are sampled in Massachusetts, including seven within the Boston Harbor/Massachusetts Bay area, spanning from the Inner Harbor to the Outer Harbor and southwards towards Cohasset (Figure 3-7). It should be noted that not all sites are sampled every year. As a result, there is no long-term time series of abundance of EBP lobster within Boston Harbor. This severely limits the ability to correlate changes in EBP density with any natural or anthropogenic events in this region. Nevertheless, interannual variability in EBP density and settlement appears to be synchronous over a broad regional area, from New Brunswick, Canada to Cape Cod (and including Boston Harbor), suggesting that factors such as annual egg production, larval survival, or oceanographic transport patterns may play important roles (Wahle *et al*., 2004). Table 3-2 lists the EBP lobster sampling sites within Boston Harbor and the substrate and water depth at each sampling location.

While there is great interannual variability in densities of YOY (up to 12 mm CL) among the sites within Boston Harbor, most sites in the Outer Harbor near the navigation channel (Brewster Island, Long Island and Sculpin Ledge) have a greater density than the other sites in Boston Harbor (Figure 3-8). The density of early benthic phase lobsters from 0 to 40 mm CL appears to follow the same location trend, but at higher densities than the YOY (Figure 3-9). The same trends continue through 2011 although the data is not included in Figures 3-8 and 3-9. After a recent drop in the young-of-the-year lobster (5-12 mm) index, the Boston Harbor sites in the 2011 Early Benthic Phase Juvenile Lobster Suction Survey increased to 0.17/m^2, approximating the time-series (1997-2011) mean of 0.18/m^2. There was an average density of 0.42 early benthic phase lobsters (5-40 mm) per square meter in 2011 (MA DMF, unpublished data). This was below the time-series mean of 0.80/m^2.

Table 3-2. EBP Lobster Sampling Site Characteristics

Location	Sampling Site	Substrate	Water Depth
Inner Harbor	Castle Island (located 164 ft south of green can 5A, at a distance of 656 to 984 ft from the shore)	cobble interspersed with kelp holdfasts	10–20 ft
	Long Island (located 246 ft from shore off the southeast corner of the island)	cobble bottom with moderate kelp cover that changes to mud/gravel toward shore	12-20 ft
	Sculpin Ledge Reef (located ¼ mile south of the Sculpin Ledge Channel)	"man-made" rip-rap rock approximately 2 to 6 inches in diameter, stacked 3 to 4 layers deep	NA
	Bumpkin Island	cobble mixed with loose shell rubble and sparse macroalgae	10-15 ft
	Grape Island (located 246 ft from shore off the northwest corner of the island),	gravel/mussel shell rubble with small patches of cobble	10-15 ft
Outer Harbor	Greater Brewster Island (located 328 ft from shore off the southeast portion of the island)	cobble interspersed with boulders and moderate macroalgae cover	15-20 ft
	Point Allerton (located 492 ft from shore off the eastern-most portion of the point)	large boulder/sand substrates with moderate patches of cobble and heavy to moderate macroalgae cover	15-20 ft

NA = not available
Source: Robert Glenn, Coastal Lobster Investigations Project, MA DMF, Pocasset, MA.

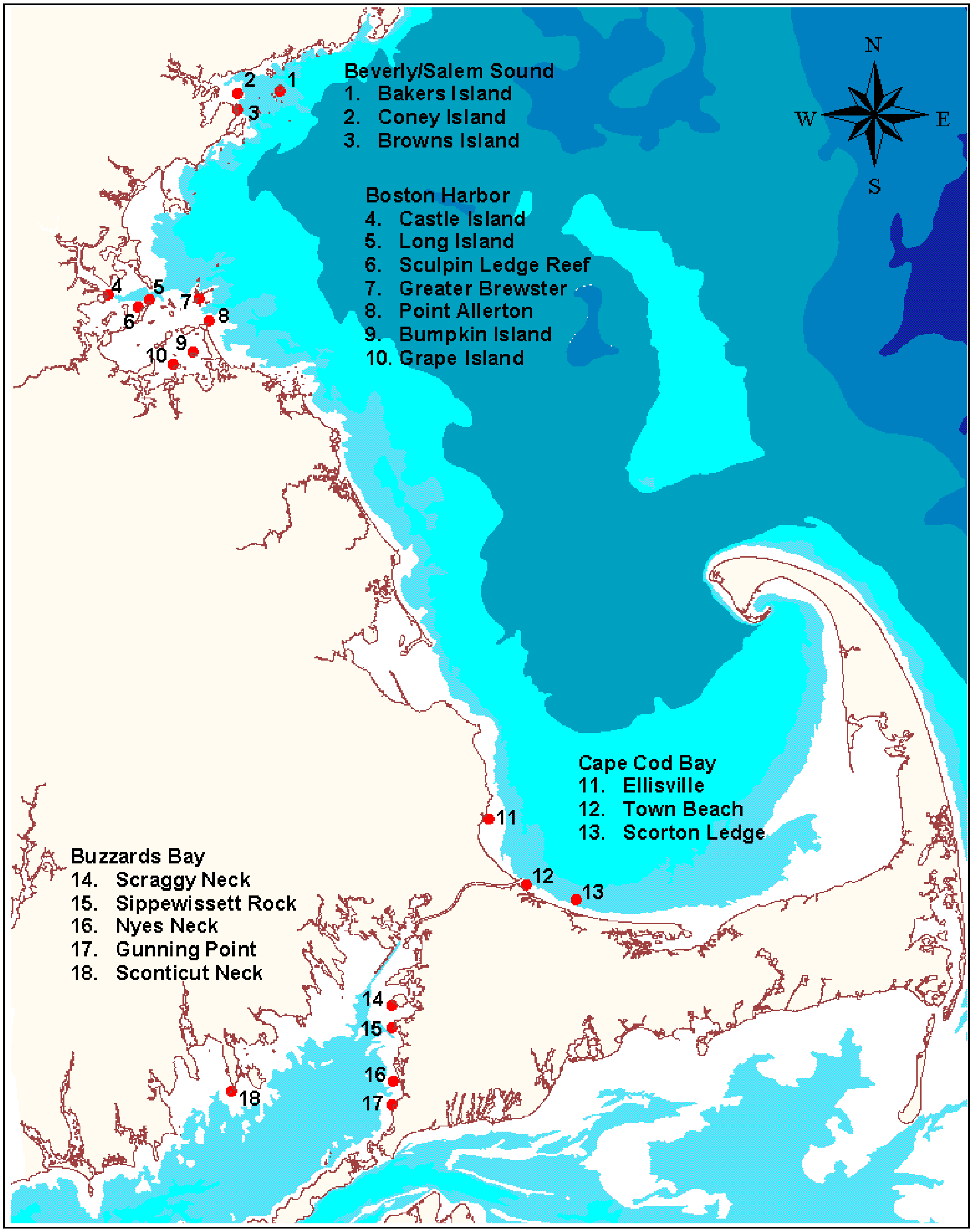
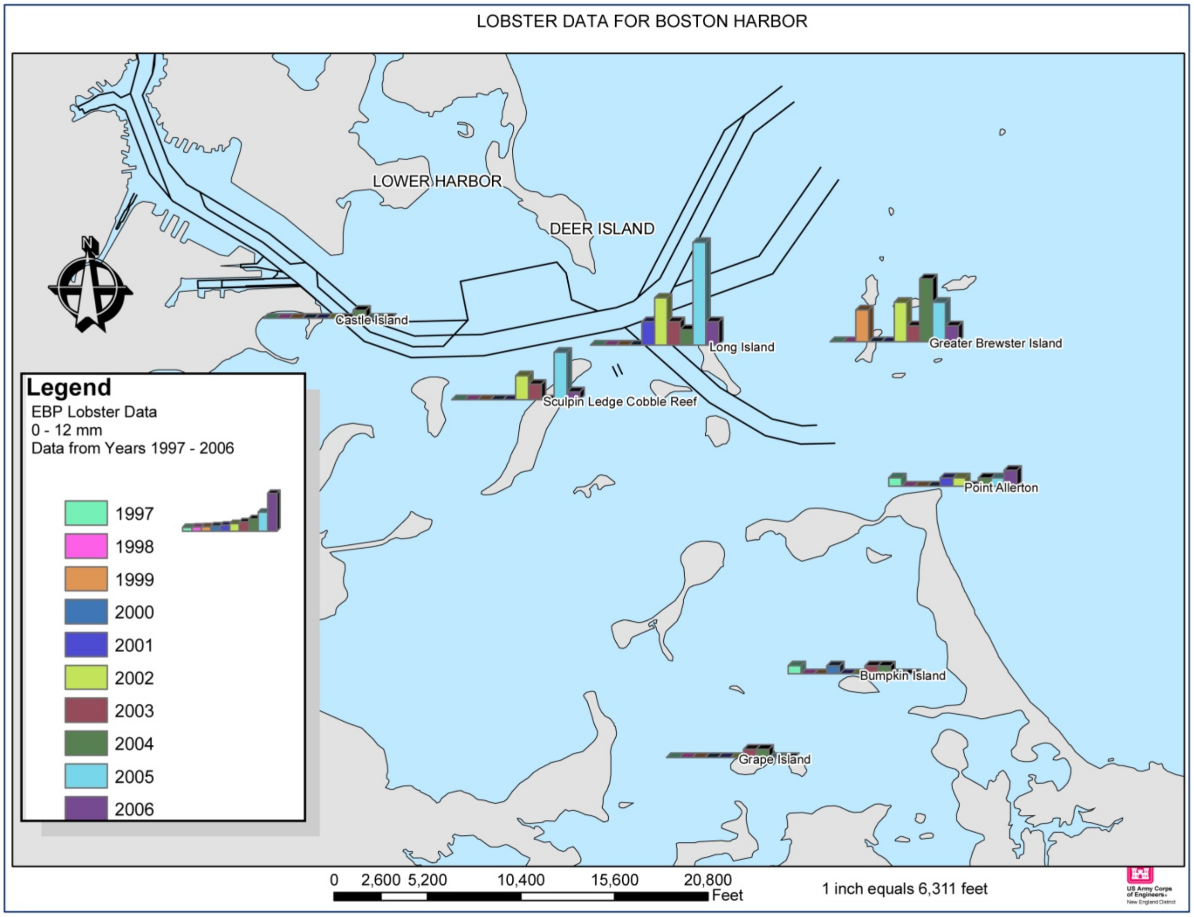


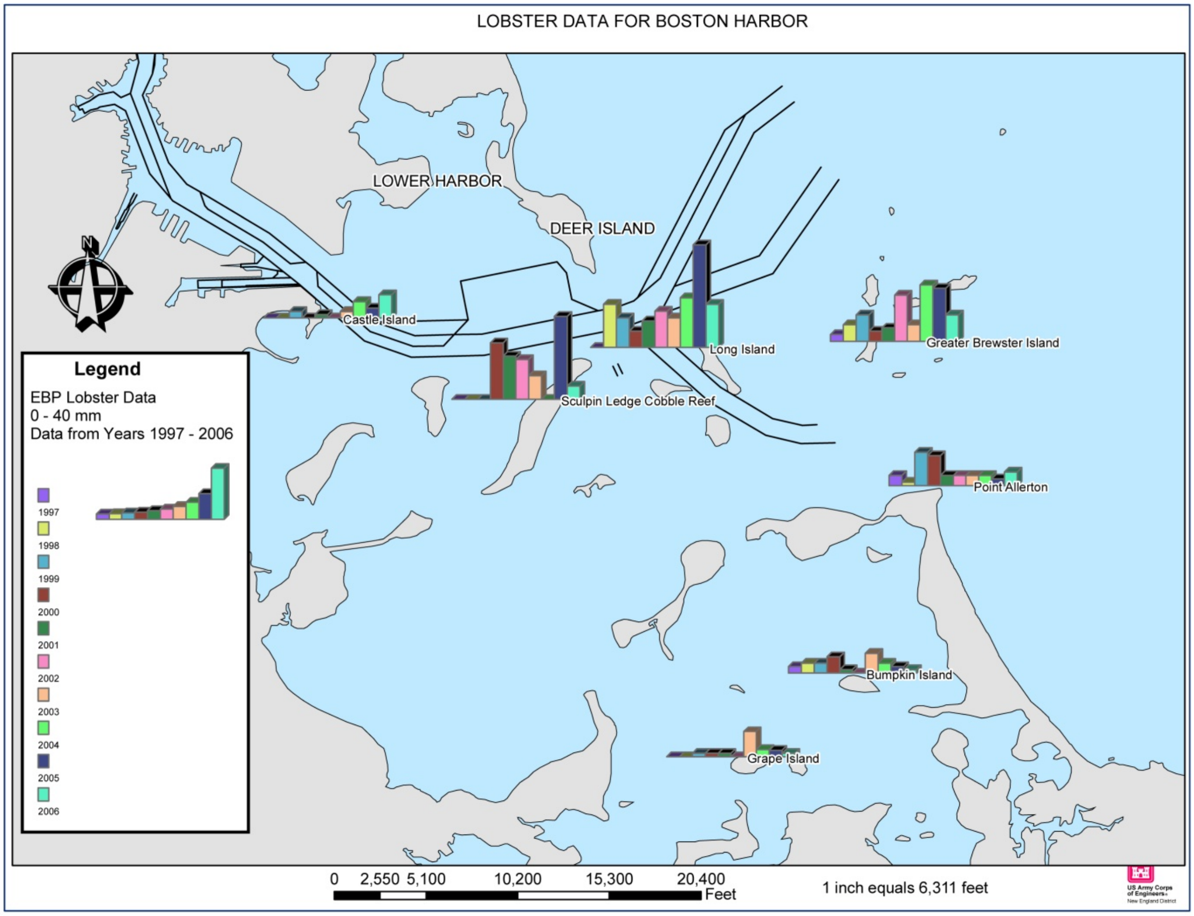
Figure 3-7. EBP Sampling Sites with Massachusetts State Waters

Source: Robert Glenn, Coastal Lobster Investigations Project, MA DMF, Pocasset, MA.



Note: Bars show relative densities.
Note: Sculpin Ledge was not sampled until 2000, and it was not sampled in 2004 due to inclement weather. Castle and Grape Islands were not sampled until 1999.

Figure 3-8. Average Annual Densities (# per m2) of Early Benthic Phase Lobsters (0-12 mm CL) for Sampling Sites within Boston Harbor, 1997-2006



Source: Robert Glenn, Coastal Lobster Investigations Project, MA DMF, Pocasset, MA.
Note: Bars show relative densities.
Note: Sculpin Ledge was not sampled until 2000, and it was not sampled in 2004 due to inclement weather. Castle and Grape Islands were not sampled until 1999.

Figure 3-9. Average Annual Densities (# per m2) of Early Benthic Phase Lobsters (0-40 mm CL) for Sampling Sites within Boston Harbor, 1997-2006

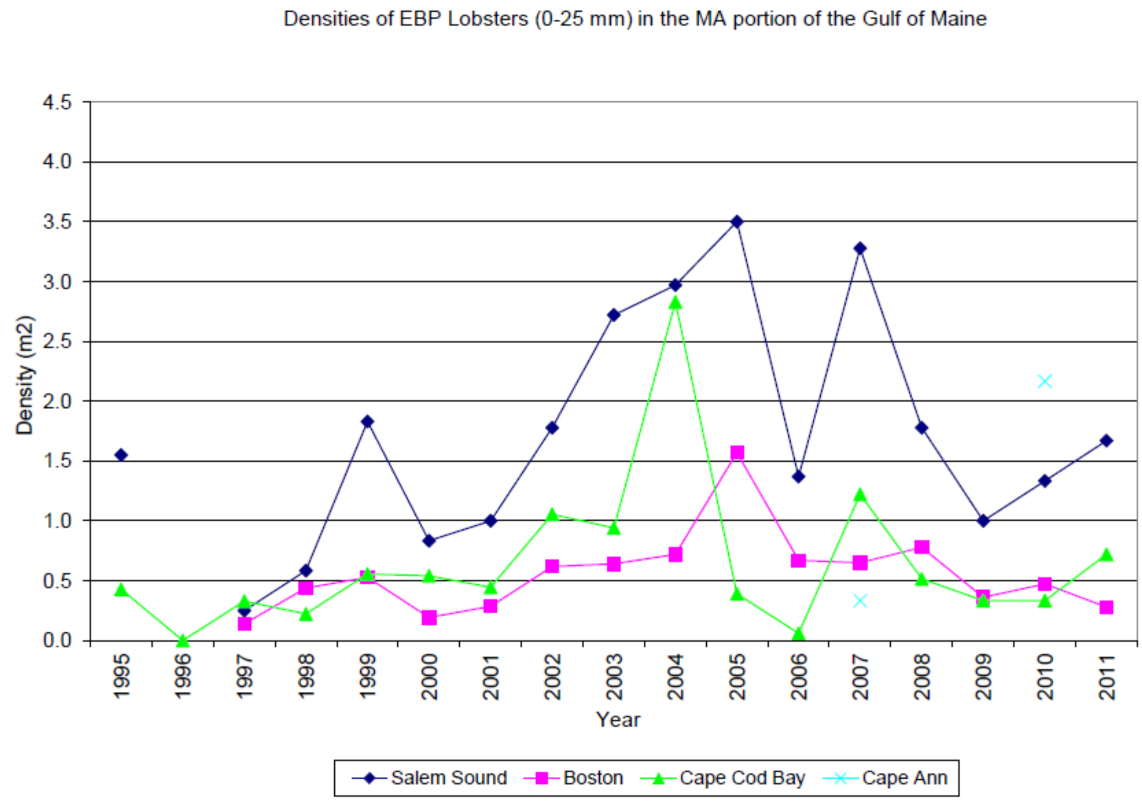
The density differences among sites adjacent to the navigation channel, and those south of the channel, appear to be the result of habitat type at these locations, but also may be reflective of post-larval supply to these sites, as well as preferred habitat selection of post-larvae during settlement. At the sites closer to the channels, the bottom type is predominately cobble where the southern sites are gravel, sand, or larger boulder. As the EBP lobster appears to be dependent on the sediment type, this may explain the difference in densities.

The small increases in the larger juveniles (12-40 mm CL) in Boston Harbor between 1997 and 2005could have been due to "walk-ins[2]" from other settlement sites, as well as from growth of settlers in the previous year. Although there are some increases in average densities of EBPs within the harbor, the rate of increase is significantly lower than the multi-fold increase in Salem Sound and Cape Cod Bay during the same period (Figure 3-10). It should be noted that the fluctuations in these areas are generally synchronous, such that low densities EBP (2000, 2006) are seen at all sites, while increases in densities occur in the same years (2001-2006), although the Boston Harbor populations stopped following the trend from 2007 through the 2011 sampling (Figure 3-10). Harbor densities are likely dependent on surface currents during the months when larvae and postlarvae are present in the water column, and/or to the numbers of resident, ovigerous (i.e., egg-bearing) females within the harbor (which have also been slowly increasing during this same time period). Such surface currents may affect the Boston Harbor region differently from Salem Sound and Cape Cod Bay and, thus, may impact EBP densities.

Since 2005 MA DMF has been conducting a multi-year ventless trap survey in an effort to characterize the importance of substrate type and depth to lobster abundance and size distribution (Glenn *et al.*, 2005; Glenn *et al*., 2007). The sampling involves 80 randomly selected, but fixed, stations in Massachusetts Bay (including several in Boston Harbor; Figure 3-11) with each stratum (depth and substrate) represented by at least seven stations. Sampling occurs twice monthly from May through November aboard commercial vessels using a six-trap haul at each station, in which vented and ventless traps are alternately strung on the trawl line. The samples are combined to reflect spring (May and June), summer (July, August, and September), and fall (October and November) months. No sampling is done directly in the Boston Harbor navigation channel because the traps can only be recovered by grappling without buoys present to mark their location, and thus there is great potential for loss of these trawl lines and data. In addition, lobstering is not allowed within the Federal channels because it is a hazard to navigation. Instead, several stations that are in close proximity to the channel are sampled.

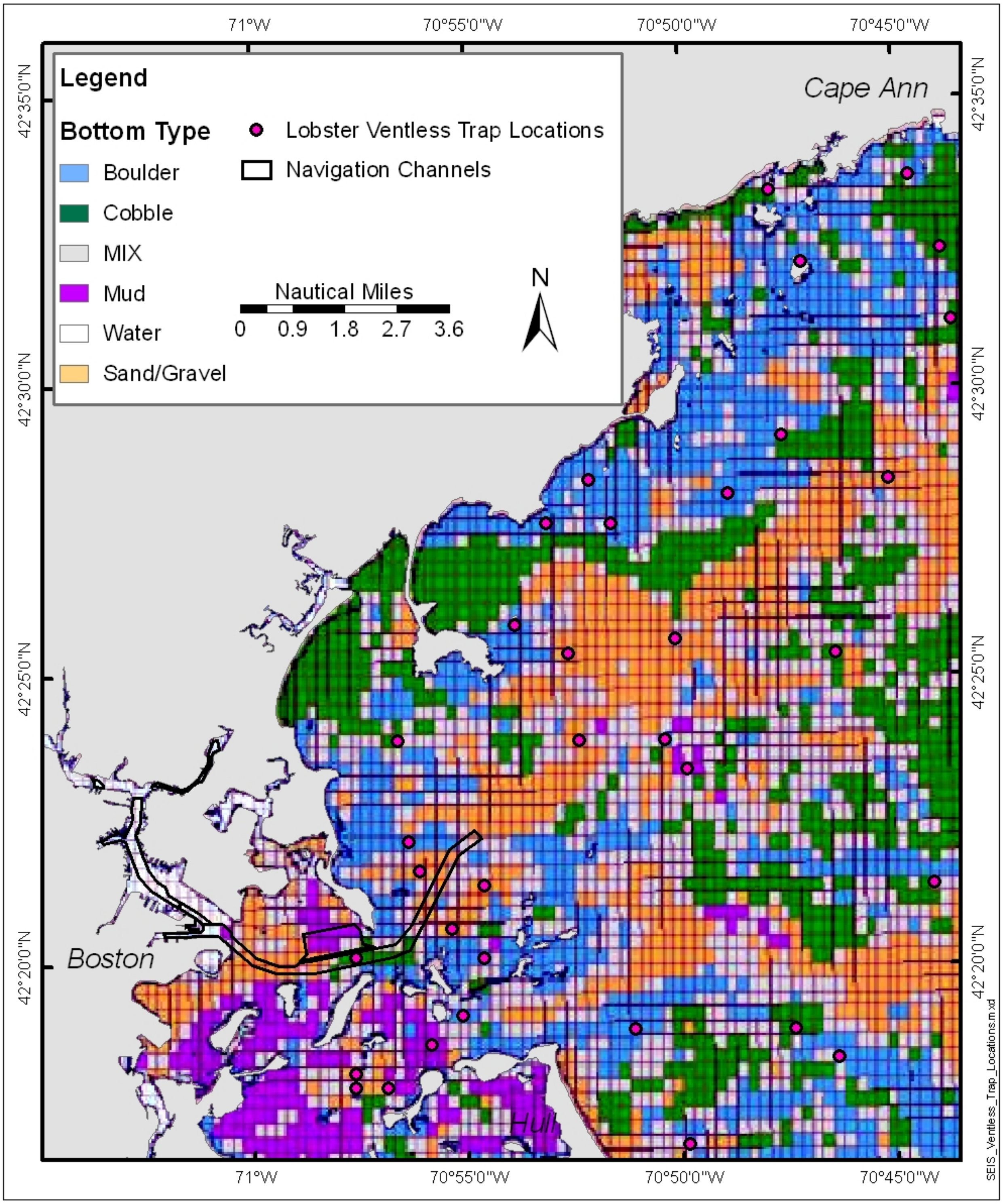
Data from the 2005 ventless trap survey provide initial information on the size distribution of lobsters in various types of bottom habitats in the Massachusetts Bay/Boston Harbor area. As expected from previous studies, juvenile (41-58 mm CL) and adolescent (59-70 mm CL) lobsters were more common in the shelter-providing habitats of boulder and cobble than in sand/gravel or mud (Figure 3-12), and were more common in shallow waters (0-15 m depth) (Figure 3-13). Again, these data reflect the needs of smaller juveniles for shelter-providing habitats that offer protection against predators. The data for sub-legal sized adult lobsters (71-82 mm CL) also show a preference for boulder and cobble habitat over mud and sand/gravel habitat, and of sand/gravel habitat over mud (Figure 3-12). This size of lobster is also more abundant than legal-sized adult lobsters (> 83 mm CL), indicative of the highly exploited nature of this resource (Glenn *et al.*, 2005; and see Appendix N demonstrating the decline in lobsters after attaining legal size). Both of these larger size classes of lobsters have fewer inshore predators than do the smaller class size lobsters and, thus, fewer restrictions in habitat usage, as is noted by their high numbers in shallow, mid, and deep waters (see Figure 3-13).

[2] The term "walk-in" refers to juvenile lobsters that are greater than 12-15 mm CL and somewhat more mobile; they tend to be more vagile in their movements and can move from site to site over short distances. Thus, if a particular settlement site becomes saturated, the larger juveniles can fan out from that site, immigrating to non-saturated sites. This movement pattern will result in different densities for YOY (0-12 mm CL) versus larger EBPs (12-40 mm CL), as is seen in the Boston Harbor sampling program.



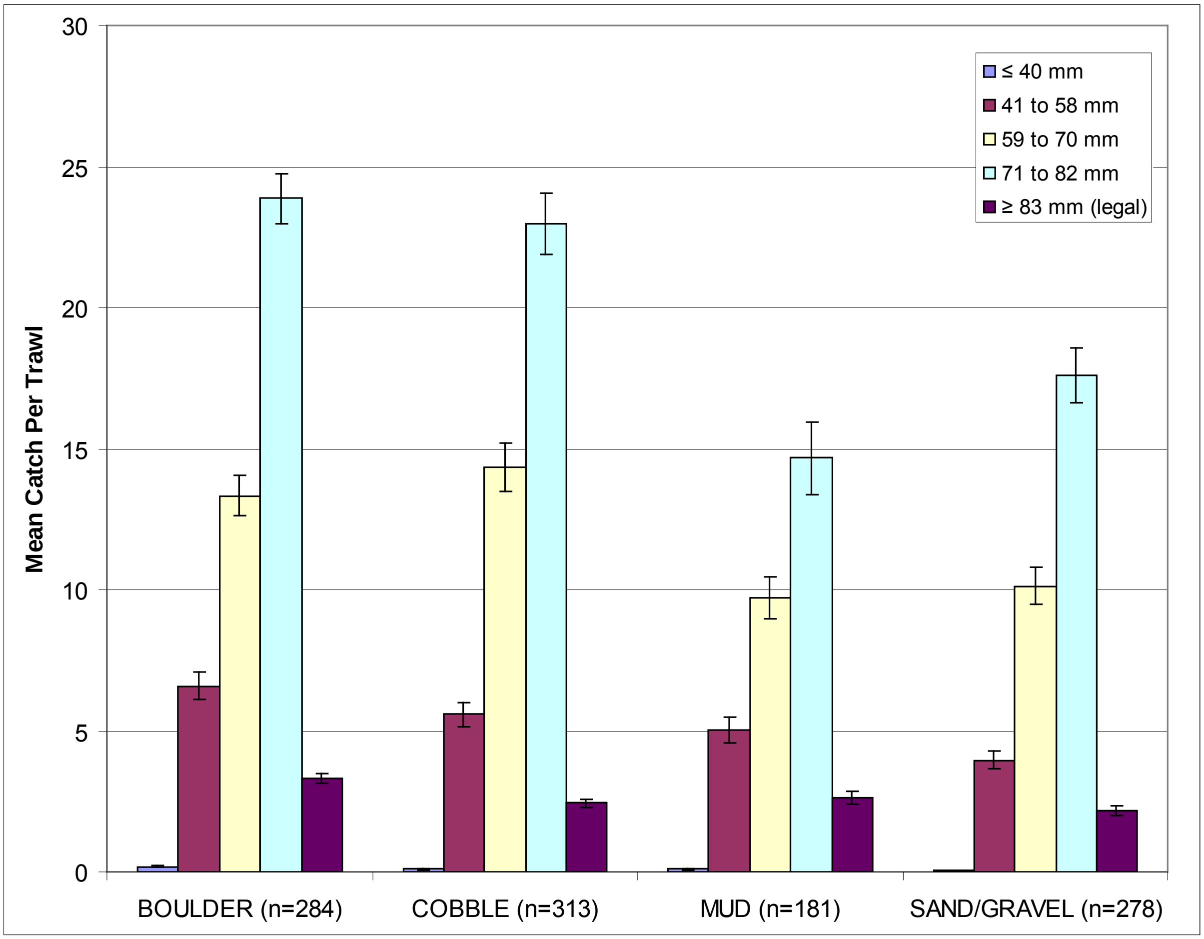
Source: Robert Glenn and Derek Perry, Coastal Lobster Investigations Project, MA DMF, Pocasset, MA.

Figure 3-10. Densities of EBP Lobsters (0-25 mm CL) in the Massachusetts Portion of the Gulf of Maine



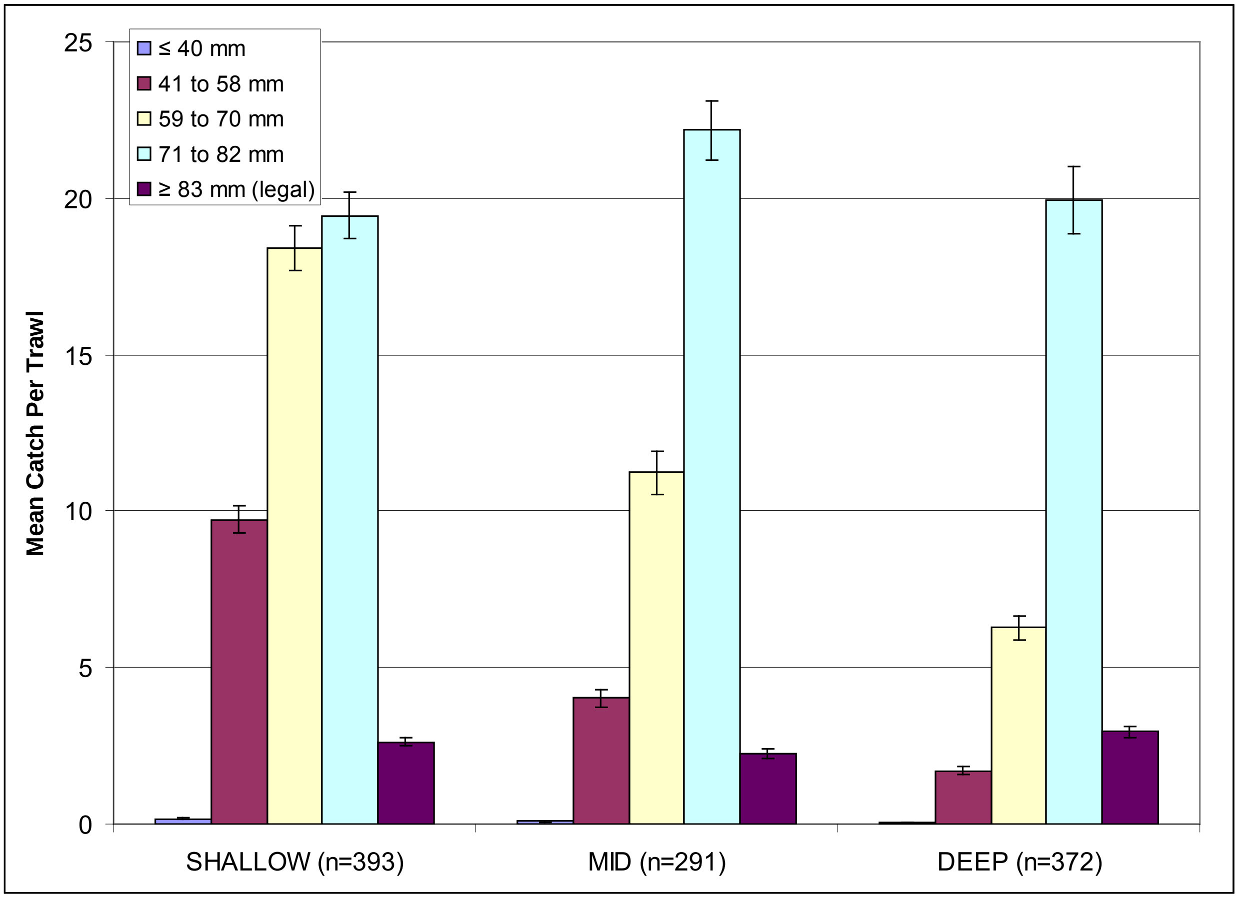
Source: Glenn *et al*., 2005.
Note: One location appears to be within the navigation channel; however, sampling at this station occurred just outside the channel

Figure 3-11. MA DMF Massachusetts Bay Ventless Trap Study Area Showing the 2005 Sample Locations and Strata



Source: Robert Glenn, MA DMF.
Note: Bars represent ± one standard error. “n” represents sample size.

Figure 3-12. Catch-per-Trawl During the Ventless Trap Study of Four Size Classes of Lobster by Sediment Type: Juveniles (30-58 mm CL), Adolescents (59-70 mm CL), Sub-Legal (71-82 mm CL), and Legal (> 83 mm CL)



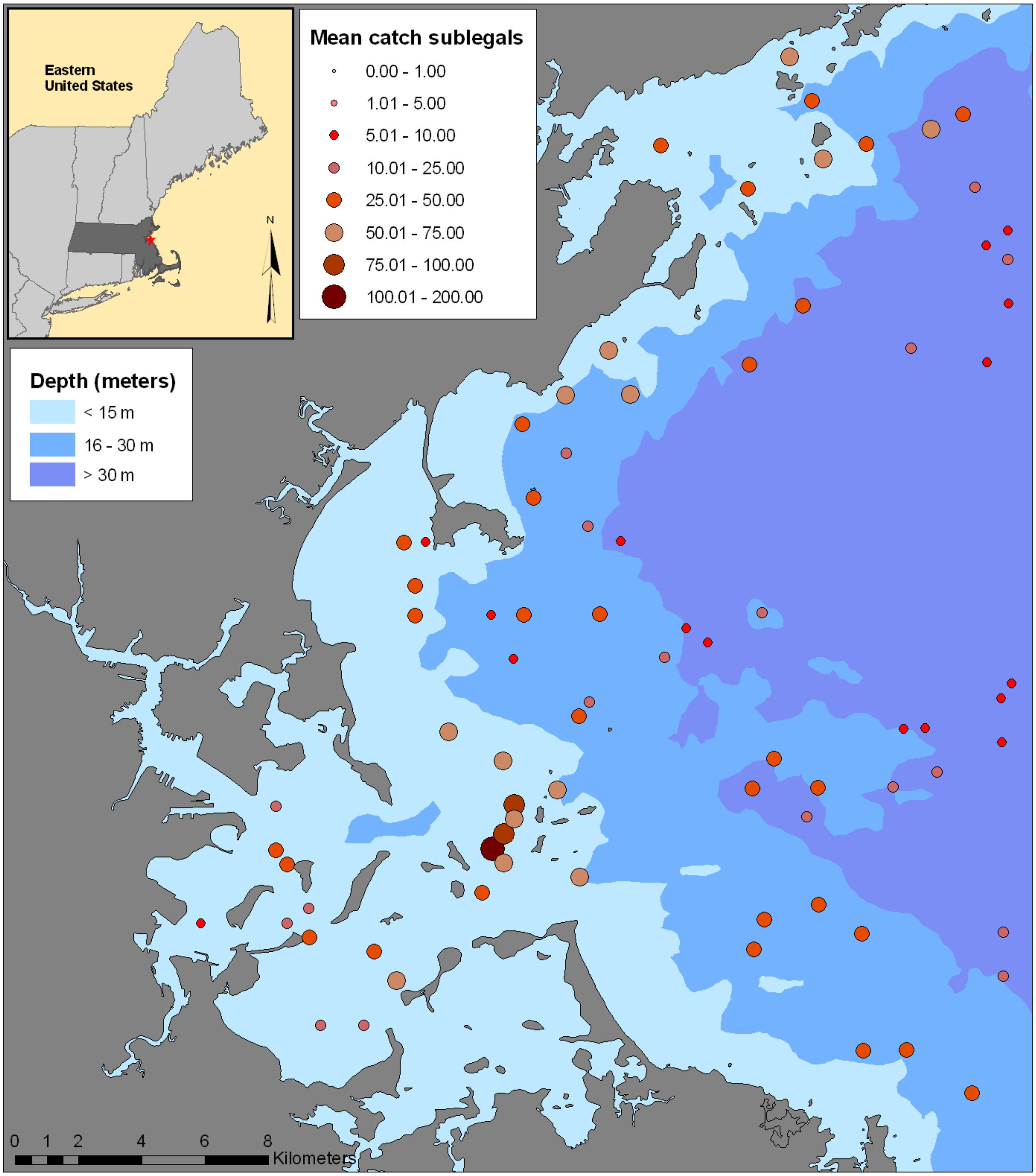
Source: Robert Glenn, MA DMF.
Note: Bars represent ± one standard error. "n" represents sample size.

Figure 3-13. Catch-per-Trawl During the Ventless Trap Study of Four Size Classes of Lobster by Depth: Juveniles (30-58 mm CL), Adolescents (59-70 mm CL), Sub-Legals (71-82 mm CL), and Legal (> 83 mm CL); Shallow, 0-15 m; Mid, 16-30 m; Deep, > 30 m

Populations of EBP lobsters less than 12 mm CL are known to exist in high densities just outside the navigation channel and along island coastlines. Here, they utilize cracks within the bedrock, boulders/cobble, and rocks within glacial drift for their shelter-providing habitat. The depth and bottom substrate of the navigation channel may restrict habitat exploitation by EBPs, which prefer shallower, non-depositional habitats outside of the footprint of the channel (see Table 3-2). EBPs lobsters are found in very high densities in the intertidal zone, where salinity varies widely (Cowan *et al*., 2001). The presence of these high densities would indicate that there are no recruitment impacts from salinity gradients within the Inner Harbor.

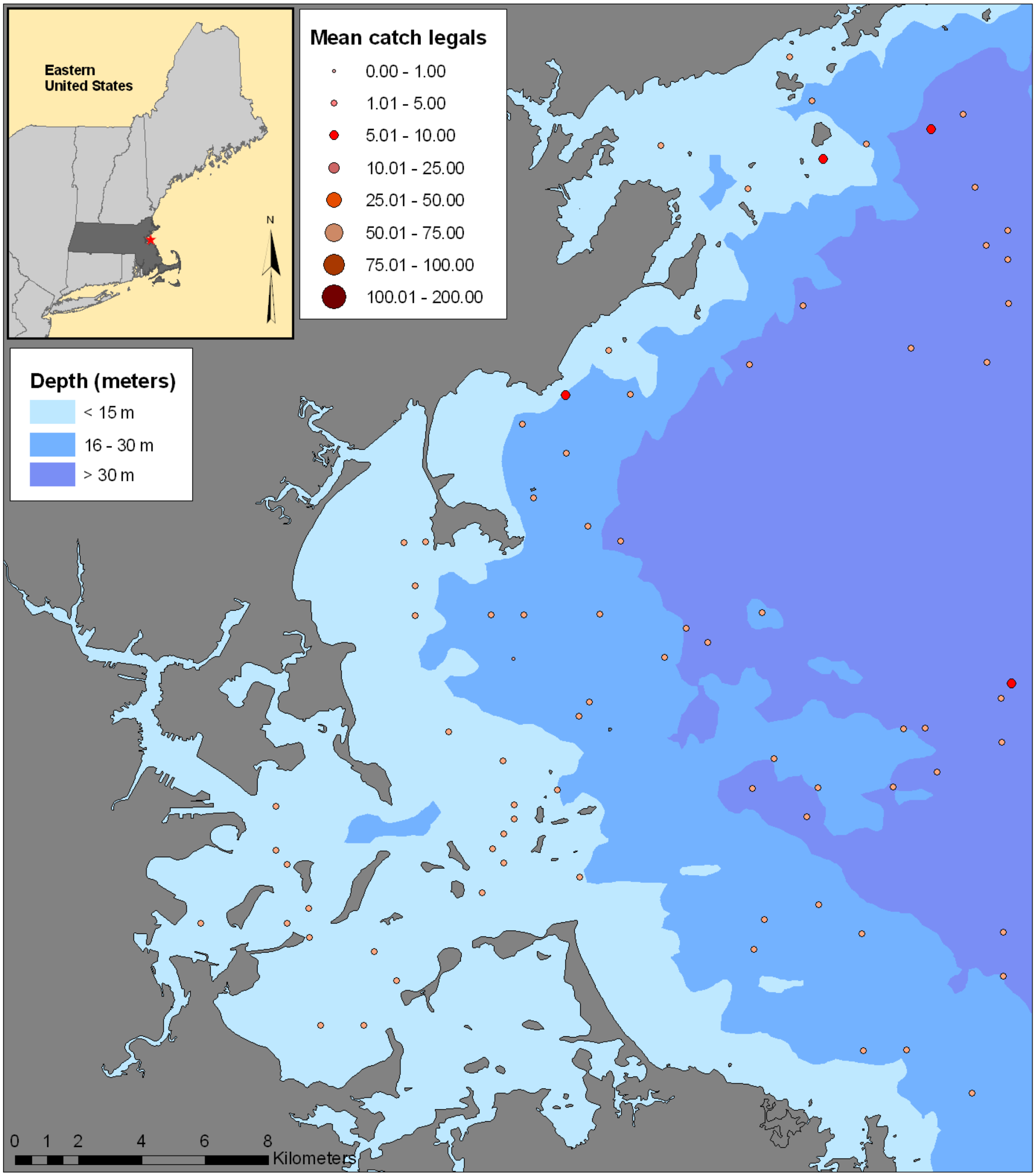
The other size classes of lobsters (i.e., larger juveniles [> 40 mm CL], sub-legal sized lobsters [> 59 mm CL], and adults) are capable of utilizing all of the described habitats in the navigation channel (see Figure 3-1), as shown in the ventless trap study by MA DMF, and are found in all of these environments in Boston Harbor (Figures 3-14 and Figure 3-15). Within the planned dredge footprint for the navigation channel, both non-depositional and depositional environments exist; therefore, lobsters of these larger class sizes are likely to exploit the habitats in the same manner as they are exploiting the habitats outside of the planned dredge footprint.

Summary - Lobsters captured from Massachusetts State waters have been increasing, with 6.9 million pounds and 7.4 million pounds landed in 2010 and 2011, respectively. Despite these years being the highest annual landings values since 2002, both years are still below the time-series mean of 7.5 million pounds. Likewise, Greater Boston Harbor (Massachusetts Stat. Area 4) lobster landings have been increasing with 1.7 million pounds landed in both 2010 and 2011, which were the highest landings since 2000. Despite the increase, both 2010 and 2011 are below the time-series mean of 2.2 million pounds. Greater Boston Harbor accounted for 24% of Gulf of Maine commercial lobster landings in Massachusetts state waters in 2011, which is consistent with recent years. Lobsters continue to be an important fishery in the State, and as such, are being carefully studied and managed. Recent studies have focused on lobster larval development and movement within Massachusetts Bay. Populations of EBP lobsters less than 12 mm CL are known to exist in high densities outside of the navigation channel and along island coastlines. Here, they utilize cracks within the bedrock, boulders/cobble, and rocks within glacial drift for their shelter-providing habitat. The depth of the navigation channel and the substrate in the Inner Harbor and Mystic and Chelsea Rivers likely restrict habitat exploitation by EBPs, which prefer shallower, non-depositional habitats outside of the footprint. Other size classes of lobsters, such as larger juveniles (> 40 mm CL and <59 mm CL), sub-legal sized lobsters (≥ 59 mm CL and < 83 mm CL), and adults/legal-sized lobsters (≥ 83 mm CL) capable of utilizing all of the described habitats in the navigation channel (see Figure 3-2), as shown in the ventless trap study by MA DMF, are found in all of these environments in Boston Harbor. Within the planned dredge footprint for the navigation channel, both non-depositional and depositional environments exist; therefore, lobsters of these larger class sizes are likely to exploit the habitats in the same manner as they are exploiting the habitats outside of the planned dredge footprint.



Source: Robert Glenn, Coastal Lobster Investigations Project, MA DMF, Pocasset, MA, 2005.

Figure 3-14. Mean Catch per Trawl Haul of Sub-legal Lobsters (<83 mm CL) at each Ventless Trap Survey Sampling Station for the 2005 Season



Source: Robert Glenn, Coastal Lobster Investigations Project, MA DMF, Pocasset, MA, 2005.

Figure 3-15. Mean Catch per Trawl Haul of Legal Lobsters (≥ 83 mm CL) at each Ventless Trap Survey Sampling Station for the 2005 Season

3.3.4.2 Habitat Enhancement Sites

Data from the October through November 2004 ventless trap pilot study (16 sampling trips, 40 stations, three depth strata, four substrate strata for 936 trap hauls) provided initial information on the size distribution of lobsters in various types of bottom habitats in the Massachusetts Bay/Boston Harbor area. As expected from previous studies, juvenile (30-58 mm CL) and adolescent (59-70 mm CL) lobsters were more common in the shelter providing habitats of boulder and cobble than in sand/gravel or mud, and were more common in shallow waters (0-15 m depth). Again, these data reflect the needs of smaller juveniles for shelter providing habitats that offer protection against predators. In contrast, sublegal sized adult lobsters (71-82 mm CL) were nearly equally distributed in all habitats at all depths, sampled, and were more abundant than legal-sized adult lobsters (> 83 mm CL), indicative of the highly exploited nature of this resource (Glenn *et al.*, 2005). Both of these larger size classes of lobsters have fewer inshore predators than do the smaller size class lobsters and, thus, fewer restrictions in habitat usage.

The results of the ventless trap program can be used to generally describe the expected distribution of lobster within the two potential enhancement sites based on the substrate present and depth of these sites. Based on the substrate classifications identified by the ventless trap study, juvenile, and adolescent lobsters are expected to be more abundant at the Broad Sound sites, which are characterized as containing predominantly boulder, cobble, and sand/gravel substrate (see Section 3.2.2). Conversely, the Massachusetts Bay enhancement site, which contains mostly sand/gravel and mud, would be expected to contain less juvenile and adolescent lobsters relative to the Broad Sound site. The Massachusetts Bay enhancement site, which falls into the “deep” category, is expected to have fewer juvenile and adolescent lobsters and more sublegal-sized adults.

3.3.4.3 Massachusetts Bay Disposal Site

Although there are no direct reports of lobster activity at the disposal site, lobster activity has been noted at the nearby reference site FG-23 where some benthic disturbance due to lobster fishing activity was noted (USACE, 2002). It is probable that the disposal site and disposal mounds may provide forage and habitat for some larger sized adults.

3.3.4.4 Industrial Waste Site

Lobster resource data within the IWS is limited. However, investigations of the IWS have shown disruptions of the mud surface from burrowing activities from lobsters as well as beneath boulders and 55-gallon drums (NOAA, 1996).

3.3.5 Fish

The coastal waters of Massachusetts have extensive finfish resources including numerous demersal, pelagic, migratory, and anadromous species, as well as smaller ecologically important forage species. These waters support substantial commercial and recreational fisheries. Many of the species found in these waters are managed at the Federal level by NOAA Fisheries (*i.e*., National Marine Fisheries Service or NMFS) through the Magnuson-Stevens Fishery Conservation and Management Act or through the Federal Endangered Species Act. The Massachusetts Division of Marine Fisheries (MA DMF) also regulates several key fisheries in the nearshore coastal waters. The sections below discuss the finfish species that may occur in the project area. Because no long-term finfish monitoring occurs in the project area, limited site-specific finfish data in terms of catch-per-unit- effort (CPUE) are available for review. MA DMF does conduct long-term bi-annual bottom trawl surveys that are designed to describe the groundfish resources over a particular area (*i.e*., coastal MA) but these are conducted outside the project area (see Figure 3-16). A list of species from this sampling effort is included as some of these species may be present in the project area (see Table 3-3).

Therefore, the discussion below will focus on the life-history characteristics of the managed species and several forage/inshore species of ecological importance that may occur in the project area based on geographic locale and bottom type. A short summary of which species are likely to occur in the specific locations within Boston Harbor (Mystic and Chelsea Rivers, Inner, Lower and Outer Harbor) and the habitat enhancement sites based on species life history characteristics as well as the bottom type in that area is also presented.

Federally Managed Species Including Essential Fish Habitat - The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act strengthened the ability of NMFS and the Fishery Management Councils to "protect and conserve the habitat of marine, estuarine, and anadromous finfish, mollusks, and crustaceans." This habitat, referred to as essential fish habitat (EFH), is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The Magnuson-Stevens Act requires the Fishery Management Councils to describe and identify EFH for managed species and to draft Management Plans for these species that describe ways to minimize, to the extent practicable, adverse effects on EFH from fishing practices and to identify other actions to encourage the conservation and enhancement of EFH.

The Magnuson-Stevens Act, the Fish and Wildlife Coordination Act, and the Federal Endangered Species Act requires that Federal agencies proposing or undertaking activities that may impact fish populations or their habitat consult with NMFS and Fish and Wildlife Service before permits for the proposed activities may be issued. An EFH consultation has been conducted for this SEIS/EIR and is included as Appendix T. The consultation includes a detailed description of the fish species and their life-history stages that may be impacted from the proposed action. The consultation also includes a description of how these species may be affected and measures that would be considered to mitigate these impacts. The NMFS 10 x 10 minute squares of latitude/longitude that encompass the project area were queried to determine which of the Federally managed species and their respective life-history stages have EFH designated within the project area. The 10 x 10 minute squares included in the project area are presented in Figure 3-17.

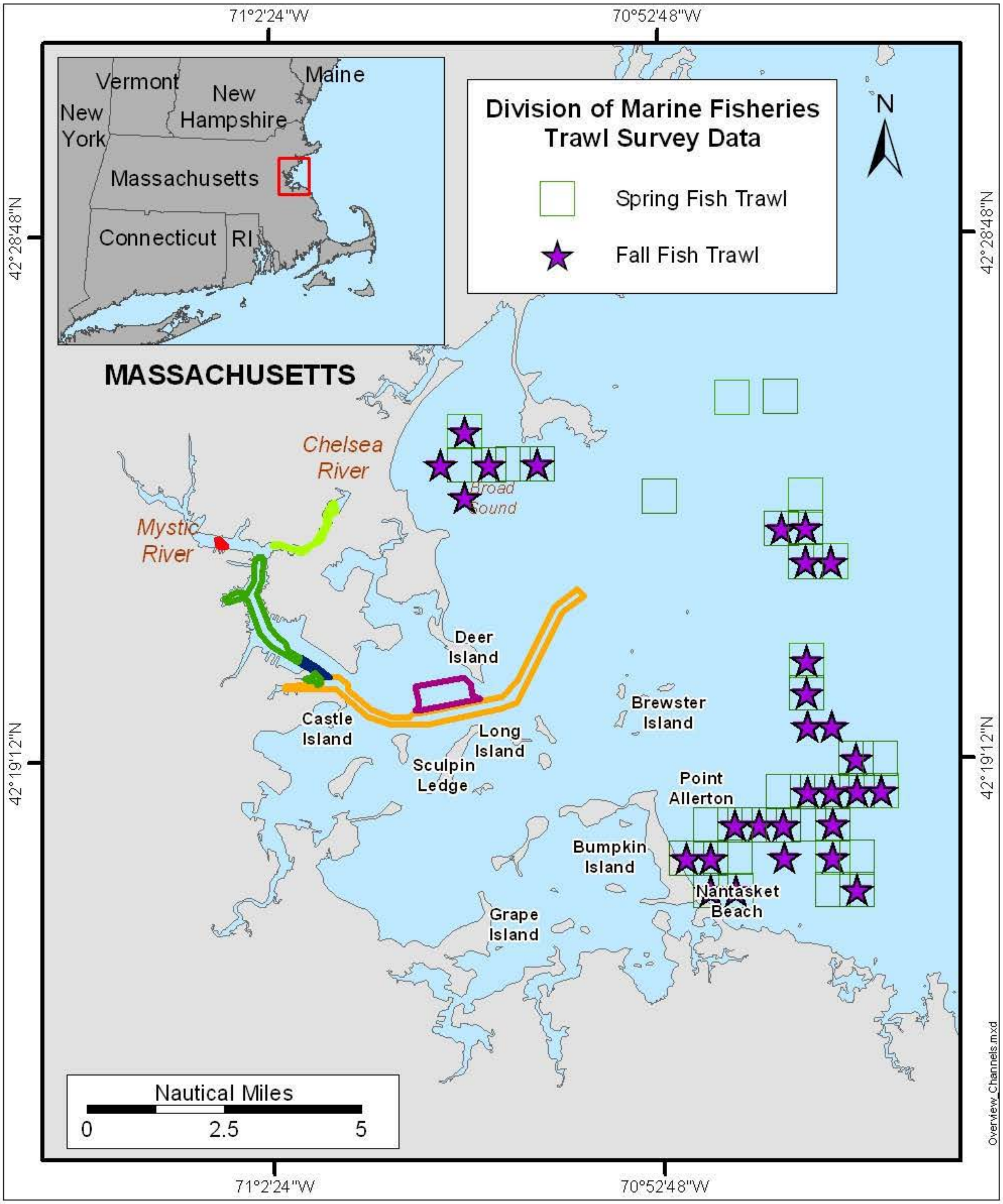


Figure 3-16. MA Division of Marine Fisheries Spring and Fall Trawl Locations

Table 3-3. Spring and Fall Survey Trawls 1978-2005

Spring Survey Trawls 1978 - 2005		
Common Name	Scientific Name	Total Number (1978-2005)
Spiny dogfish	*Squalus acanthias*	1
Winter skate	*Leucoraja ocellata*	144
Clearnose skate	*Raja eglanteria*	3
Little skate	*Leucoraja erinacea*	1145
Thorny skate	*Amblyraja radiata*	41
Atlantic herring	*Clupea harengus*	274
Alewife	*Alosa psuedoharengus*	256
Blueback herring	*Alosa aestivalis*	248
American Shad	*Alosa sapidissima*	49
Rainbow smelt	*Osmerus mordax*	1807
Silver hake	*Merluccius bilinearis*	173
Atlantic cod	*Gadus morhua*	5308
Haddock	*Melanogrammus aeglefinus*	2
Pollock	*Pollachius virens*	377
White hake	*Urophycis tenuis*	60
Red hake	*Urophycis chuss*	207
American plaice	*Hippoglossoides platessoides*	263
Summer flounder	*Paralichthys dentatus*	2
Fourspot flounder	*Paralichthys oblongus*	36
Yellowtail flounder	*Limanda ferruginea*	2502
Winter flounder	*Pseudopleuronectes americanus*	10510
Witch flounder	*Glyptocephalus cynoglossus*	20
Windowpane	*Scophthalmus aquosus*	1199
Atlantic silverside	*Menidia menidia*	2
Threespine stickleback	*Gasterosteus aculeatus*	20
Northern pipefish	*Syngnathus fuscus*	1
Atlantic mackerel	*Scomber scombrus*	6
Butterfish	*Peprilus triacanthus*	1
Striped bass	*Morone saxatilis*	5
Black sea bass	*Centropristis striata*	3
Scup	*Stenotomus chrysops*	1
Longhorn sculpin	*Myoxocephalus octodecemspinosus*	2878
Sea raven	*Hemitripterus americanus*	66
Lumpfish	*Cyclopterus lumpus*	2
Northern searobin	*Prionotus carolinus*	2
Cunner	*Tautogolabrus adspersus*	44
Rock gunnel	*Pholis gunnellus*	1
Snakeblenny	*Lumpenus lumpretaeformis*	2
Daubed shanny	*Lumpenus maculatus*	1
Atlantic wolfish	*Anarhichas lupus*	1
Ocean pout	*Macrozoarces americanus*	2766
Goosefish	*Lophilus americanus*	1
American lobster	*Homarus americanus*	4833
Jonah crab	*Cancer borealis*	170
Atlantic rock crab	*Cancer irroratus*	1890
Spider crab-unclassified	*Majidae*	2
Horseshoe crab	*Limulus polyphemus*	2
Moon snail, Shark eye, and baby	*Naticidae*	265
Blue mussel	*Mytilus edulis*	93
Northern moonsnail	*Euspira heros*	3
Sea scallop	*Placopecten magellanicus*	11
Ocean quahog	*Arctica islandica*	6
Razor and Jackknife clams	*Solenidae*	1
Longfin squid	*Loligo Pealeii*	4

Fall Survey Trawls 1978 – 2005		
Common Name	Scientific Name	Total Number (1978-2005)
Spiny dogfish	*Squalus acanthias*	511
Winter skate	*Leucoraja ocellata*	132
Little skate	*Leucoraja erinacea*	1621
Atlantic herring	*Clupea harengus*	204
Alewife	*Alosa psuedoharengus*	12
Blueback herring	*Alosa aestivalis*	96
American Shad	*Alosa sapidissima*	2
Rainbow smelt	*Osmerus mordax*	12864
Silver hake	*Merluccius bilinearis*	577
Atlantic cod	*Gadus morhua*	5043
Haddock	*Melanogrammus aeglefinus*	19
Pollock	*Pollachius virens*	75
White hake	*Urophycis tenuis*	635
Red hake	*Urophycis chuss*	259
Spotted hake	*Urophycis regia*	1
American plaice	*Hippoglossoides platessoides*	120
Summer flounder	*Paralichthys dentatus*	2
Fourspot flounder	*Paralichthys oblongus*	48
Yellowtail flounder	*Limanda ferruginea*	807
Winter flounder	*Pseudopleuronectes americanus*	6475
Windowpane	*Scophthalmus aquosus*	548
Atlantic silverside	*Menidia menidia*	378
Northern pipefish	*Syngnathus fuscus*	2
Atlantic mackerel	*Scomber scombrus*	11
Butterfish	*Peprilus triacanthus*	19720
Atlantic moonfish	*Selene setapinnis*	31
Scup	*Stenotomus chrysops*	103
Longhorn sculpin	*Myoxocephalus octodecemspinosus*	361
Sea raven	*Hemitripterus americanus*	17
Lumpfish	*Cyclopterus lumpus*	17
Atlantic seasnail	*Liparis atlanticus*	4
Cunner	*Tautogolabrus adspersus*	129
Rock gunnel	*Pholis gunnellus*	16
Ocean pout	*Macrozoarces americanus*	170
Goosefish	*Lophilus americanus*	2
Atlantic saury	*Scomberesox saurus*	1
Mackerel scad	*Decapterus macarellus*	984
Bigeye scad	*Selar crumenophthalmus*	3
Rough scad	*Trachurus lathami*	21
American lobster	*Homarus americanus*	18322
Jonah crab	*Cancer borealis*	511
Atlantic rock crab	*Cancer irroratus*	3729
Spider crab-unclassified	*Majidae*	1
Lady crab	*Ovalipes ocellatus*	88
Moon snail, Shark eye, and baby	*Naticidae*	226
northern horsemussel	*Modiolus modiolus*	1
Blue mussel	*Mytilus edulis*	18
Sea scallop	*Placopecten magellanicus*	25
Atlantic surfclam	*Spisula solidissima*	1
Ocean quahog	*Arctica islandica*	14
Northern shortfin squid	*Illex illecebrosus*	4
Longfin squid	*Loligo pealeii*	33152
Longfin squid egg mops	*Loligo pealeii egg mops*	

The latitude/longitude coordinates for these squares are:

Table 3-4. Coordinates for Essential Fish Habitat Squares in the Project Area

	North	East	South	West
Square 1	42° 30.0' N	71° 00.0' W	42° 20.0' N	71° 10.0' W
Square 2	42° 20.0' N	71° 00.0' W	42° 10.0' N	71° 10.0' W
Square 3	42° 30.0' N	70° 50.0' W	42° 20.0' N	71° 00.0' W
Square 4	42° 20.0' N	70° 50.0' W	42° 10.0' N	71° 00.0' W

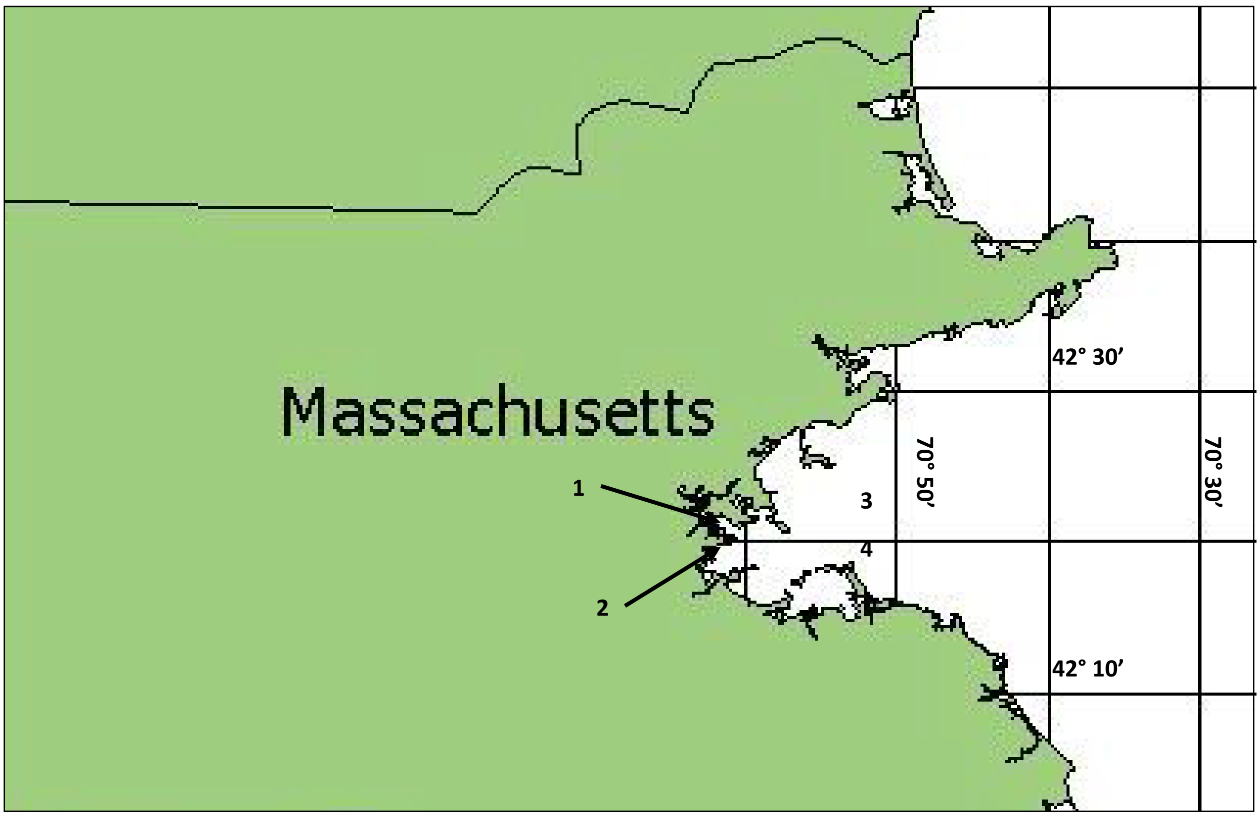


Figure 3-17. Essential Fish Habitat 10 x 10 Minute Squares Encompassing the Project Area

The species that may be present in the project area based on the bottom habitat present are listed below in Table 3-5. Fourteen of these species are managed by the New England Fishery Management Council. Nine are managed by the Mid-Atlantic Fishery Management Council, and one, the bluefin tuna, is managed as a highly migratory species. Two shellfish species (Atlantic sea scallop [*Placopecten magellanicus*] and surf clam [*Spisula solidissima*] [see Section 3.3.3 for discussion of shellfish resources]), two invertebrates (long-finned squid [*Loligo pealei*] and short-finned squid [*Illex illecebrosus*]), and 20 finfish species have EFH designated within the project area. Finfish species include demersal and pelagic species, several of which are migratory to the northeast region and within the project area. In addition to the EFH species mentioned above, on February 6, 2012, five distinct population segments (DPS) of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) that inhabit the waters of the northeast and the southeast were listed under the Endangered Species Act. This species will be discussed further in the Endangered and Threatened Species Section of this report.

Table 3-5. Essential Fish Habitat Species within the Project Area

Species	Eggs	Larvae	Juveniles	Adults	Spawning Adults
Atlantic cod* *Gadus morhua*	S	S	S	M,S	M,S
Haddock* *Melanogrammus aeglefinus*	S	S			
Pollock* *Pollachius virens*	S	S	S	S	S
Whiting (silver hake)* *Merluccius bilinearis*	S	S	M,S	X	
Red hake* *Urophycis chuss*	X	S	S	S	
White hake* *Urophycis tenuis*	S	S	S	S	
Winter flounder* *Pseudopleuronectes americanus*	M,S	M,S	M,S	M,S	M,S
Yellowtail flounder* *Pleuronectes ferruginea*	S	S	S	S	S
Windowpane flounder* *Scophthalmus aquosus*	M,S	M,S	M,S	M,S	M,S
American plaice* *Hippoglossoides platessoides*	S	S	S	S	S
Ocean pout* *Macrozoacres americanus*	X	X	S	S	
Atlantic halibut* *Hippoglossus hippoglossus*	S	S	S	S	S
Atlantic sea scallop* *Placopecten magellanicus*	S	S	S	S	S
Atlantic sea herring* *Clupea harengus*		S	M,S	M,S	
Bluefish** *Pomatomus saltatrix*			M,S	M,S	
Long-finned squid** *Loligo pealei*	n/a	n/a	X	X	X
Short-finned squid** *Illex illecebrosus*	n/a	n/a	X	X	X
Atlantic butterfish** *Peprilus triacanthus*	S	S	X	X	
Atlantic mackerel** *Scomber scombrus*	M,S	M,S	M,S	M,S	
Summer flounder** *Paralichthys dentatus*				X	
Scup** *Stenotomus chrysops*			X	X	
Black sea bass** *Centropristus striata*			X	X	
Surf clam** *Spisula solidissima*	n/a	n/a	X	X	
Bluefin tuna *Thunnus thynnus*			X	X	
M = Mixing Seawater/Brackish Salinity Zone; S – Seawater (Salinity >25 ppt; X = EFH designated for given species and lifestage.					

Source: NOAA Fisheries Service, Habitat Conservation Division, http://www.nero.noaa.gov/hcd/ma1.html
*Managed species by the New England Fishery Management Council
**Managed species by the Mid-Atlantic Fishery Management Council

Demersal species are those that live on or near the bottom and feed on benthic organisms or other bottom dwelling fish. Flat-bodied groundfish species such as winter flounder, summer flounder, yellowtail flounder, windowpane flounder, and the American plaice, as well as the more full-bodied species such cod, haddock, halibut, pollock, hakes, ocean pout, sea bass, and scup are considered demersal. Pelagic species are those that occupy open waters between the coast and edge of the continental shelf, often in depths of 66 to 1,312 ft. Pelagic species tend to be more mobile than demersal species, and many are highly migratory. Some species also form large schools. Examples of pelagic species include herrings, butterfish, squid, mackerels, and bluefish. Species such as the Atlantic mackerel, bluefin tuna, and bluefish are also highly migratory. More detailed information pertaining to the life-history characteristics, such as geographic distribution, bottom type preferences, migrations, spawning and food preferences are described in Table 3-6 for these Federally managed species.

The Estuarine Living Marine Resource Database (ERLM; Jury *et al*., 1994) categorizes the species present in Boston Harbor in terms of highly abundant, abundant, common, or rare. Highly abundant species are numerically dominant relative to other species with similar life modes; abundant species are those that are often encountered in substantial numbers relative to other species with similar life modes; common species are defined as those that are frequently encountered, but not in large numbers; and rare species are those that are definitely present but not frequently encountered.

In the project area, Jury *et al*. (1994) suggest that highly abundant Federally managed species include winter flounder. Abundant species include Atlantic herring, American plaice, and yellowtail flounder. Common species include Atlantic cod, whiting (silver hake), pollock, red hake, white hake, bluefish, ocean pout, Atlantic mackerel, and windowpane flounder. Rare species include spiny dogfish, haddock, scup, butterfish, and smooth flounder.

In a July 21, 2005 letter from the U.S. Department of Commerce, NOAA Fisheries, Northeast Region to Mr. Michael Keegan at the U.S. Army Corps of Engineers, NOAA Fisheries suggested that among the species listed with EFH in the project area, particular attention should be focused on the winter flounder (*Pseudopleuronectes americanus*). Winter flounder is one of the most common commercially exploited species found in Massachusetts Bay. North of Cape Cod, this species spawns in estuaries or nearshore areas from February through May (Klein-MacPhee, 1978), generally over sandy bottoms in water from 6 to 20 ft in depth (Bigelow and Schroeder, 2002). Winter flounder eggs are demersal and adhesive (Pearcy, 1962) and may be found on tidally submerged gravel bars and attached to fronds of macroalgae (Crawford and Carey, 1985). In Boston Harbor, eggs are abundant between February and May (Jury *et al*., 1994). Winter flounder larvae stay near the bottom (Pearcy, 1962) and are highly abundant in Boston Harbor in March through May (Jury *et al*., 1994), including the tributaries. The presence of larvae, young-of-year, juveniles, and winter flounder adults in the Mystic River indicate that eggs are also likely in the Mystic River, even though they were not collected during biomonitoring of the Mystic Station. The demersal and adhesive nature of winter flounder eggs may have accounted for their absence in the entrainment samples (Boston Generating, 2006). However, winter flounder larvae densities were low (0.7 to 4.0 fish per 100 m^3) in the Mystic River, even during their spawning season (March through June) (Boston Generating, 2006).

Table 3-6. Life History Information of Managed Species and Non-managed Species Likely to be Found in the Project Area

Species	Distribution	General Habitat	Bottom Type	Migrations	Spawning	Eggs and Larvae	Food
Federally Managed Species							
Demersal Species							
American plaice (*Hippoglossoides platessoides)*	Labrador and to Montauk Point New York	Bays and continental shelf waters from 148 to 574 ft in depth	Bottom habitats with fine-grained sediments or sand and gravel	Move inshore in spring for spawning	March through mid June	Pelagic eggs and larvae	Small crustaceans, polychaetes, sand dollars sea urchins and primarily brittle stars
Atlantic cod (Gadus morhua)	Greenland to North Carolina	Continental shelf waters from 33 to 492 ft in depth	Rocky slopes or ledges, rock, gravel, mud, sand, clay	Extensive migrations with seasons, and in response to food	November through May	Pelagic eggs and larvae	Extensive diet but mainly mollusks, crabs, lobsters, shrimp, brittle stars
Atlantic halibut (Hippoglossus hippoglossus)	Greenland and Labrador to Virginia	Bays and continental shelf waters from 328 to 2297 ft in depth	Bottom habitats with a substrate of soft mud, sand, gravel or clay; rough or rocky bottoms along slopes of outer banks	Juveniles have extensive migrations	Late fall through early spring peaking in Nov. – Dec.	Bathypelagic eggs (170-656 ft) and pelagic larvae	Changes with increasing size including a variety of crustaceans, mollusks and fish
Black sea bass (Centropristis striata)	Maine to Florida	Estuaries, Bays and continental shelf waters from 66 to 164 ft in depth	Structured hard bottom (shellfish beds, pilings, wrecks, offshore ledges, reefs)	Move inshore during spring and summer	May through July	Pelagic eggs and larvae	Crabs, lobsters, shrimp, mollusks
Haddock (Melanogrammus aeglefinus)	Greenland to North Carolina	Continental shelf waters from 40 to 492 ft in depth	Sand, rock, pebbles, broken shell	May move in response to food	January through June	Pelagic eggs and larvae	Extensive diet of crustaceans, mollusks, worms, shrimp
Ocean pout (Macrozoarces americanus)	Labrador to Delaware	Continental shelf waters 105 to 112 ft in depth	Sand-mud, sticky sand, gravel, rocks	Changes habitats when seasons change: winter-spring in sand-gravel areas; summer-fall in rocky area	September and October	Demersal eggs and larvae	Shelled mollusks, crustaceans, echinoderms
Pollock (Pollachius virens)	Scotian Shelf, Georges Bank, Great South Channel and Gulf of Maine	Continental shelf waters from 49 to 1198 ft in depth	Hard, stony or rocky bottoms, including artificial reefs	As juveniles, inshore-offshore movements linked to temperatures eventually staying offshore as adults	September through April peaking in Dec – Feb.	Pelagic eggs and larvae	Euphausiid crustaceans, fish and mollusks
Red hake (Urophycis chuss)	Gulf of St. Lawrence to Virginia	Continental shelf waters from 33 to 427 ft in depth	Soft mud and silt (juveniles near shellfish beds)	Extensive seasonal migrations – inshore in spring and summer and offshore in winter	May through November	Pelagic eggs and larvae	Shrimp, crustaceans, squid, small fish
Scup (Stenotomus chrysops)	Massachusetts to North Carolina	Continental shelf waters from shoal areas (7 ft) to deeper waters (607 ft)	Rocky bottoms	Move inshore in spring-summer and offshore in winter	Summer	Pelagic eggs and larvae	Crustaceans, worms, hydroids, sand dollars, young squid
Summer flounder (Paralichthys dentatus)	Gulf of Maine to South Carolina	Estuaries, Bays and continental shelf waters to 82 ft in depth	Mud or sand	Move offshore in fall	Fall and early winter	Pelagic eggs and larvae	Small fish, shrimp, crustaceans squid, mollusks, worms, sand dollars
Whiting (Merluccius bilinearis)	Newfoundland to South Carolina	Continental shelf waters from 98 to 1066 ft in depth	All substrate types	Move inshore in spring and offshore in fall – vertical migrations in response to prey	Late spring and early summer	Pelagic eggs and larvae	Herring, other small schooling fish
White hake Urophycis tenuis	Gulf of St. Lawrence to Mid-Atlantic Bight	Estuaries, Bays and continental shelf and slope waters from 16 to 1066 ft in depth	All substrate types	May retreat to the deeper waters during winter	Early spring off Southern Georges Bank	Pelagic eggs and larvae	Polychaetes, shrimps, crustaceans and fish
Windowpane flounder (Scophthalmus aquosus)	Gulf of St. Lawrence to Florida	Large estuaries in waters up to 246 ft in depth	Sand, mixtures of sandy silt or mud	Not likely to undergo inshore – offshore migrations	Late spring and summer	Pelagic eggs and larvae	Squid, crabs, small mollusks, worms
Winter flounder (Pseudopleuronectes americanus)	Labrador to Georgia	Estuaries, Bays and continental shelf waters from tide mark to 328 ft in depth	Muddy sand with patches of eelgrass, sand, clay, gravel or cobble	Generally localized small scale migrations inshore in winter	February – June	Demersal eggs, pelagic larvae	Mollusks, crustaceans, worms, sea cucumbers
Yellowtail flounder (Pleuronectes ferruginea)	Labrador to Chesapeake Bay	Continental shelf waters from 66 to 164 ft in depth	Sand or sand and mud mixtures	Not likely to undergo inshore – offshore migrations	Spring and summer – may spawn at depths up to 410 feet	Pelagic eggs and larvae	Small bivalves, crustaceans, shrimp, worms

Table 3-6 (continued). Life History Information of Managed Species and Non-managed Species Likely to be Found in the Project Area							
Species	**Distribution**	**General Habitat**	**Bottom Type**	**Migrations**	**Spawning**	**Eggs and Larvae**	**Food**
Pelagic Species							
Atlantic butterfish (*Peprilus triacanthus*)	Newfoundland to Florida	Estuaries and Bays to continental shelf waters generally less than 394 ft in depth	Surface waters over sand bottoms	Move offshore and south during winter	June through August	Pelagic eggs and larvae	Small fish, squid, amphipods, shrimp
Atlantic mackerel (*Scomber scombrus*)	Gulf of St. Lawrence to North Carolina	Continental shelf waters from surface to 1247 ft in depth	Not dependent on coastline or bottom	Highly migratory – appear near coast in spring – disappear in fall	Spring and early summer	Pelagic eggs and larvae	Copepods, pelagic crustaceans, small fish
Atlantic sea herring(*Clupea harengus*)	Labrador to North Carolina	Continental shelf waters from 66 to 427 ft in depth; in large schools	Only during spawning – in gravel, cobble, sand substrates	May migrate to inshore areas during spawning	July through November	Demersal eggs, demersal, then pelagic larvae	Plankton (larval snails, diatoms, crustaceans)
Bluefish (*Pomatomus saltatrix*)	Highly migratory: Maine to Florida	Continental waters (~80 nautical miles (nmi) offshore) in schools	Juveniles may occur along beaches, estuaries, tidal creeks over sand and gravel	Migrate north in spring and south in fall	June through October	Pelagic eggs and larvae	Fish, crustaceans
Bluefin tuna(*Thunnus thynnus*	Highly migratory, worldwide in temperate and tropical waters	Continental shelf and slope waters	All substrate types	Known to migrate across the Atlantic	Appear in New England waters in June, unknown when spawning occurs	Pelagic eggs and larvae	Fish
Long-finned squid (*Loligo pealei*)	Gulf of Maine through Cape Hatteras, NC	Continental shelf waters to 1000 ft	All substrate types; eggs found in sandy-mud bottoms; attached to rocks, pilings or algae	Move inshore during spring and summer and offshore in mid-late fall and winter	Spawn in May, hatch in July	Eggs are demersal and enclosed in gelatinous capsules of up to 200 eggs	Small planktonic prey, crustaceans, small fish
Short-finned squid*Illex illecebrosus*	Gulf of Main through Cape Hatteras, NC	Continental shelf waters to 597 ft	All substrate types	Move offshore in late fall	Spawn December through March	Gelatinous egg balloons containing 10,000 – 100,000 eggs	Small planktonic prey, crustaceans, small fish
Non-Federally Managed Species							
Anadromous Species							
Alewife (*Alosa seudoharengus*)	Newfoundland and Gulf of St. Lawrence to SC	Streams, Rivers, Estuaries and Bays and out to 60 nmi offshore	Spends most of life at sea as a pelagic schooling species; will run up rivers/streams to spawn in still water	Run up rivers in May through June to spawn and may be seen moving out of rivers after spawning as late as August	May through August	Eggs and larvae develop in freshwater where spawning occurred, after a month, begin movement downstream. Eggs stick to brush or stones	Generally a Plankton feeder: copepods, amphipods, shrimps, appendicularians
American shad (*Alosa sapidissima*)	Newfoundland and Gulf of St. Lawrence to FL	Streams, Rivers, Estuaries and Bays and offshore to depth of 156 to 408 ft	Spends most of life at sea as a pelagic schooling species; will run up rivers/streams to spawn in areas with sandy or pebbly shallows	Enter rivers in spring and early summer to spawn and may be seen moving out of rivers as late as August	May through August	Eggs and larvae develop in freshwater where spawning occurred, after a month, begin movement downstream. Eggs are semi buoyant	Generally a Plankton feeder: copepods, euphausiid shrimps, fish eggs and occasionally bottom dwelling amphipods
Blueback herring (*Alosa aestivalis*)	Southern New England to Northern FL	Streams, Rivers, Estuaries and Bays and near bottom in shelf waters	Spends most of life at sea as a pelagic schooling species; will run up rivers/streams to spawn in still water	Similar to the alewife, runs up rivers to spawn, only runs later in the season that the alewife (when water temps are warmer)	May through August	Eggs and larvae develop in freshwater where spawning occurred, after a month, begin movement downstream. Eggs stick to brush or stones	Generally a Plankton feeder: copepods, pelagic shrimps, launce and small fish fry
Rainbow smelt (*Osmerus mordax*)	Labrador to northern NJ, Alaska and Arctic Canada	Harbors, Estuaries, Bays, River mouths and Inshore areas not more than 0.9 nmi out	Spends most of life in harbors or brackish estuaries as a pelagic schooling species; will run upriver to spawn; generally not as far upstream as others	Runs up rivers to spawn, may also move slightly offshore from the Bays and Harbors if water gets too warm during summer months	March through May	Eggs and larvae develop in freshwater where eggs stick to rocks, brush *etc*. larvae begin moving into more saline waters at about 1¼ inch.	Small crustaceans, sea worms, small fish

Table 3-6 (continued). Life History Information of Managed Species and Non-managed Species Likely to be Found in the Project Area

Species	Distribution	General Habitat	Bottom Type	Migrations	Spawning	Eggs and Larvae	Food
American eel (*Anguilla rostrata*) Catadromous species	Eastern North America to northern South America including the Bahamas	Streams. Rivers, Estuaries and Bays and coastal waters	Muddy bottom and still water	Reside in freshwater regions and migrate to sea water during winter and early spring to spawn	Spawns midwinter far out at sea	Thought to have pelagic eggs; have pelagic leptocephalus larvae	Scavengers; will eat anything living or dead including a variety of small fish and crustaceans
Forage/Shore Species							
Atlantic menhaden (*Brevoortia tyrannus*)	Nova Scotia to Florida; Gulf of Mexico, and South to Argentina	Bays, estuaries and continental shelf waters	Pelagic schooling species, all substrate types	Migrate north in spring and south in fall	Spawns June through August	Pelagic eggs and larvae	Microscopic plants and small crustaceans
Atlantic tomcod (*Microgadus tomcod*)	Gulf of St. Lawrence to Virginia	Estuaries, Bays, Harbors, mouths of rivers	Strictly an inshore fish, demersal, muddy bottoms, salt marshes	Do not carry out inshore-offshore migrations regularly, but some more south populations may move into deeper (cooler) waters during summer	Spawn November through February in estuaries and moths of streams/rivers	Demersal eggs masses which stick to seaweeds or stones; unknown larval stages	Small crustaceans, worms, small mollusks, squid, fish fry
Cunner (*Tautogolabrus adspersus*)	Newfoundland and the Gulf of St. Lawrence to Chesapeake Bay	Coastal waters just below the tidemark; generally in waters 15 – 20 ft deep. Will run into deep salt creeks	Demersal species on bottom substrates of eelgrass, pilings of wharves, under floats in harbors, rock pools	Are year-round residents but may move into slightly deeper water during winter or to escape really high temperatures during summer	Spawn late spring through early summer	Pelagic eggs and larvae	Omnivorous and will feed on eelgrass, amphipods, shrimp, lobsters, crabs, bivalves, mollusks, worms, sea urchins and fish such as silversides, sticklebacks, pipefish, mummichogs and fish fry
Tautog (*Tautoga onitis*)	Nova Scotia to SC	Coastal waters not more than 3 nmi from land or 30 to 60 ft in depth	Demersal species around steep rocky shores, breakwaters, ledges, wrecks, piers and cocks and rock piles/boulders and mussel beds	No apparent migrations with seasons. Like cunner, may move into slightly deeper water during extreme cold or warm periods	Spawn primarily in June	Pelagic eggs and larvae	Primarily bivalve and univalve mollusks, crabs, hermit crabs, sand dollars, shrimps, lobsters
Striped bass (*Morone saxatilis*)	Gulf of St. Lawrence to north FL, northern Gulf of Mexico, pacific coast	Inshore coastal waters, seldom more than a few nautical miles from shore; may move into estuaries, river mouths and rivers	Powerful swimmers, often swim at surface, congregate in small groups, may sink to the bottom during the daylight ; sandy, rocky substrates	Move north in the spring and south in the fall. May run into estuaries or freshwater rivers to spawn	Spawn primarily in June	Eggs are semi-buoyant and are spawned in turbulent waters to prevent eggs from settling; pelagic larvae	Other fish and a wide variety of invertebrates (lobsters, crabs, shrimps, squid, mussels)
White perch (*Morone americana*)	Gulf of St. Lawrence and Nova Scotia to SC	Estuaries, Bays, River mouths, land-locked freshwater ponds. Generally shallow water	Not a bottom fish (except in winter), are a schooling species	May run up into freshwater or brackish water for spawning. Tend to be year-long residents but will move to deeper locations in Bays/creeks during winter	Spawn April through June	Eggs will stick together in masses and sink or stick to objects they encounter. Larvae are pelagic	Small fish fry, spawn of other fish, young squid, shrimps, crabs.
Mummichog (*Fundulus heteroclitus*)	Gulf of St. Lawrence to Texas	Salt marshes, tidal creeks, shores of harbors, moths of streams and estuaries	Sheltered shores where tide flows over eelgrass or *Spartina* , will bury in mud	No migration, a stationary fish – will overwinter in mud	Spawn June through early August in a few inches of water	Eggs are sticky and will mass in clumps and stick to sand grains, or other objects	Omnivorous – plant and animal (diatoms, eelgrass, shrimps, small crustaceans), dead or alive
Silversides (*Menidia spp*)	Southern Gulf of St. Lawrence to Chesapeake Bay	Confined to coastline in inner bays, brackish water and mouths of rivers	Sandy shores, gravelly shores, among the *Spartina* in salt marshes	Resident throughout the year but may sink deeper in winter	May through early July on sandy bottom or among Spartina	Eggs sink and stick in ropy clusters or sheets	Omnivorous – algae, diatoms, copepods, mysids, shrimps, small decapods, fish eggs, young squid, annelid worms and mollusk larvae
Northern searobin (*Prionotus carolinus*)	Bay of Fundy to SC	Coastal waters from the tide line to depths of 30 to 180 ft	Around rocks, smooth hard grounds, less often on mud	Seasonal inshore – offshore migrations (appear inshore in may-June and move to deeper waters of the shelf in October	June through September with peaks in July and August	Pelagic eggs and larvae	Shrimps, crabs, amphipods, crustaceans, squid, bivalve mollusks and small fish
Longhorn sculpin (*Myoxocephalus ctodecemspinosus*)	Newfoundland and Gulf of St. Lawrence to VA	Estuaries, Bays, Harbors and coastal waters where it may come to flats at high tides and to depths of 300 ft	Demersal on shoals and flats, wharves	No seasonal migrations but will stay in the deeper channels in coldest part of winter and during heat of summer	Spawning November through January	Eggs sink and stick together in clumps and will adhere to anything (empty clamshells, finger sponges *etc.*); planktonic larvae	Shrimps, crabs, amphipods, hydroids, worms, mussels, other mollusks and fish fry; are scavengers

Table 3-6 (continued). Life History Information of Managed Species and Non-managed Species Likely to be Found in the Project Area							
Species	**Distribution**	**General Habitat**	**Bottom Type**	**Migrations**	**Spawning**	**Eggs and Larvae**	**Food**
Shorthorn sculpin (*Myoxocephalus scorpius*)	Northern Labrador to Southern New England	Bays and ledges rising from smooth bottom in shoal waters	Demersal fish on substrates of mud, sand, pebbles, bare bottom or among weeds, wharves,	No seasonal migrations but will stay in the deeper channels in coldest part of winter and during heat of summer	Spawning November through February	Eggs sink and stick together in spongy masses on sandy bottoms, pools in rocks, seaweeds, or any crevice or hollow; planktonic larvae	Crabs, shrimps, sea urchins, worms, fish fry; are scavengers and will eat debris
Grubby (*Myoxocephalus aenaeus*)	Gulf of St. Lawrence and Nova Scotia to NJ	Estuaries, Bays, and coastal waters from tide mark to 90 ft in depth	Demersal on many substrates including eelgrass	Local resident, no apparent migrations	Spawning continues throughout the winter	Eggs sink and adhere to any object it encounters; planktonic larvae	Annelid worms, shrimps, crabs, copepods, snails, nudibranch mollusks, ascidians and small fish
Threespine stickleback (*Gasterosteus aculeatus*)	Labrador and Newfoundland to Chesapeake Bay	Strictly a shore fish; freshwater and saltwater; may drift out to sea	A small fish (< 4 inches); ditches and creeks of tidal marshes; brackish ponds and lagoons; weedy shores in shallow water; hiding under clumps of floating eelgrass and rockweed if away from shore	No apparent migrations	Spawning in estuaries; likely to be May and June	Male builds nest of grass/weeds and eggs stick to nest; male guards eggs and young fry until fry drift away.	Small invertebrates, small fish fry and fish eggs
Fourspine stickleback (*Apeltes quadracus*)	Gulf of St. Lawrence and Nova Scotia to Virginia	Strictly a shore fish; freshwater and saltwater	A small fish (< 2 ½ inches); ditches and creeks of tidal marshes, brackish ponds/lagoons, weedy shores in shallow water	No apparent migrations	Spawning in May through July	Male builds a nest and places eggs in the nest and guards	Assumed to be similar to the diet of the Threespine stickleback
Ninespine stickleback (*Pungitius pungitius*)	Arctic seas south to New York	Strictly a shore fish; freshwater and saltwater	A small fish (< 3 inches); Creeks in tidal marshes; shore lines in harbors	No apparent migrations	Likely during summer months	Male may build a nest in grass or weeds. May be similar to the Threespine stickleback	Spawn and young of other fish
Northern pipefish *Syngnathus fuscus*)	Southern Gulf of St. Lawrence to SC	Salt marshes, harbors and river mouths; may drift out to sea	A small fish (4-8 inches); found among eelgrass or seaweeds; hiding under clumps of rockweed if found at sea	No apparent migrations	March to August	Males nurse eggs in a brood pouch; males maintain young in brood pouch until 8-9 mm	Minute crustacean, fish eggs and small fry
Rock gunnel (*Pholis gunnellus*)	Hudson Strait to Delaware Bay; numerous north of Cape Cod	Shoal waters; along low tide mark; also on offshore banks to depths of 240 ft	Under stones, among seaweed, prefers, pebbly, gravelly, stony ground or shell beds	No apparent migrations	Assumed to be November through February or March	Eggs are laid in holes or crannies, adhesive eggs,; planktonic larvae	Assumed to be carnivorous – small mollusks and crustaceans
American sand lance (*Ammodytes americanus*)	Labrador, Newfoundland and Gulf of St. Lawrence to Cape Hatteras, NC	Sandy foreshores; shoaled parts of offshore banks, congregate in dense schools	Sandy substrates where they burrow in the sand	Moves offshore into deeper water during the winter	Unknown, but egg production appears to be in late fall/early winter	Eggs appear to be deposited on sandy bottoms where they stick to sand grains; pelagic larvae	Small crustaceans and fish fry
Skates (*Raja spp*)	Eastern coast of the US spp vary, but may extend from Nova Scotia south to FL	Bottom dwelling in Bays, estuaries and continental shelf waters at various depths	Smooth, rocky, soft bottoms or sand and gravel	Variable, some species may move inshore and offshore seasonally	Variable, eggs may be laid during winter months and hatch in spring, laid in the summer and into autumn	Lay large eggs which become fastened to seaweeds or other objects	Omnivorous, shrimps, crabs, lobsters, mollusks worms and fish
Spiny dogfish (*Squalus acanthias*)	Labrador to Florida	Coastal waters and shelf edge waters	All substrate types	Seasonal migrations moving north in spring and summer and south in fall and winter. Also make inshore-offshore migrations in response to temperature	Female dogfish bear young live (1-15 pups). This occurs offshore in winter	Fertilization in internal, embryonic development is internal and young are born live	Fish, crustaceans
Source: Bigelow and Schroeder, 2002; Cross et al., 1999; U.S. Fish and Wildlife, EFH source documents: http://www.nefsc.noaa.gov/nefsc/habitat/efh/							

As winter flounder larvae mature and metamorphose into juveniles, they move to the lower portions of the estuary. Winter flounder larvae are negatively buoyant and appear to maintain their positions in estuaries by rising and sinking in the water column to take advantage of incoming and outgoing tides (Crawford and Carey, 1985; Pearcy, 1962). In the fall, young-of-the-year (YOY) winter flounder will move out of estuaries and shallow-water areas to deeper water. Juvenile winter flounder less than four years of age are common in shallow waters during the summer along the New England coast.

Juvenile and adult winter flounder are highly abundant in Boston Harbor year-round (Jury *et al*., 1994). During summer months when temperatures are high, juveniles and adults move to deeper channels and areas where water temperatures are cooler (McCracken, 1963; Howe and Coates, 1975). In late fall and winter, when temperatures drop, juveniles and adults move into deeper waters or move out of the estuary (Pearcy, 1962). In the spring, winter flounder return to their natal estuary to spawn (Saila, 1961; Howe and Coates, 1975).

In support of long-term monitoring for the Massachusetts Water Resource Association (MWRA) outfall, winter flounder are collected annually from 1991 to the present to obtain tissue for chemical analysis. The specific objective of this sampling program is not to address winter flounder abundance and distribution, but to obtain sufficient numbers of specimens for contaminant analysis of tissues. To collect sufficient numbers of fish for tissue samples, otter trawls are conducted during the late spring of each year and the numbers of fish collected during each trawl are counted and standardized to the length of time of the tow to calculate a catch of winter flounder per unit effort (CPUE). Although these data cannot be used to quantitatively describe winter flounder abundance in the study area, the methods and sampling timeframe have been consistent over the 21 year period and some general observations can be made by comparing the numbers of fish observed at four locations within the study area. These locations include Deer Island, Nantasket Beach, the Outfall location, and East Cape Cod Bay.

Figure 3-18 presents the results of 21 years of winter flounder catch data in support of the MWRA program (Moore *et al*., 2011). Winter flounder catches appeared to fluctuate at several of the locations. Deer Island also shows some of the largest variations in catch. Peaks in the catch are seen in 2002 at three of the four locations including Deer Island Flats, Nantasket Beach, Outfall Site, and East Cape Cod Bay. At the outfall location CPUE fluctuated consistently until 1999. A large increase in catch was observed in 2000, and catch appeared to be increasing through the 2004 sampling period with 2005 CPUE falling back to pre-outfall startup levels, except for Deer Island which did not reach its highest peak until 2010. The presence of winter flounder at all sites suggests that adequate habitat may exist at these locations to support winter flounder. The differences observed may be due to fish moving to different locations throughout the harbor and surrounding areas to feed or escape temperature extremes.

State-Regulated Species - In addition to the Federally managed species, MA DMF regulates various finfish species that are restricted by quotas. MA DMF also regulates fisheries by gear types other than hook and line. MA DMF compiles data by gear type for sea bass, conch, and scup from fish pots, and for a variety of finfish collected by fish weirs and gill nets. Quotas on landings are set as a means of conserving various species and may be adjusted for any given year based on projected landings. Quota-managed species for 2012 include black sea bass, bluefish, dogfish, summer flounder, scup, tautog, and striped bass.

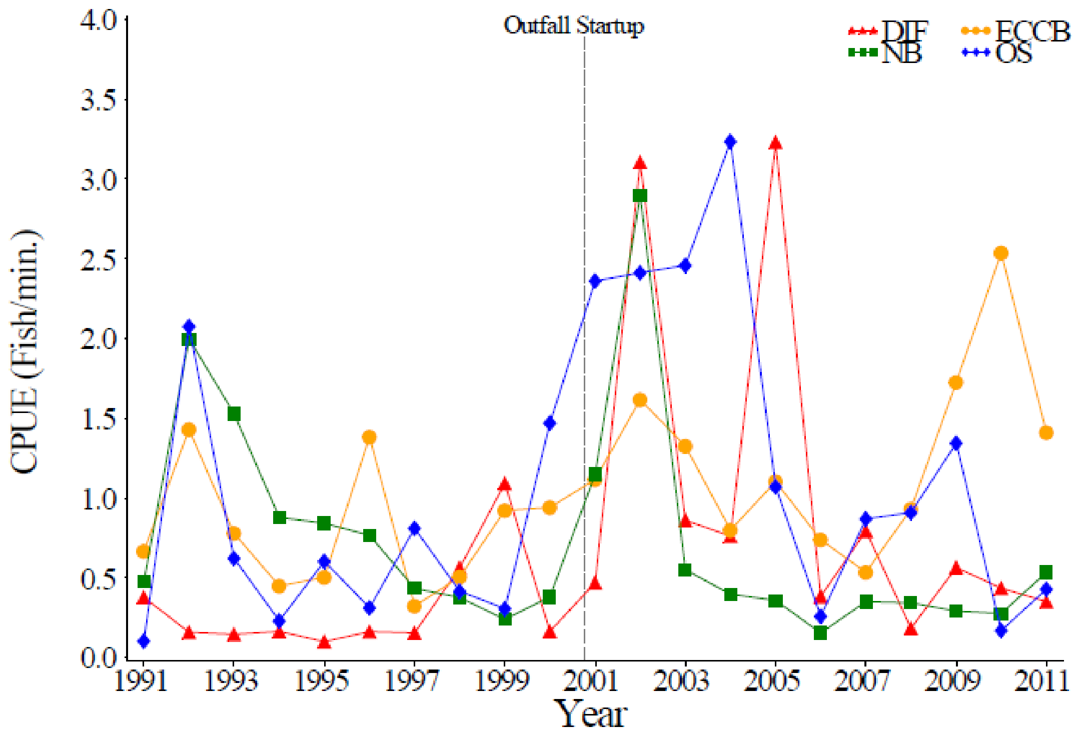


Figure 3-18. Winter Flounder CPUE Data from Locations within Boston Harbor

Of the fish managed by MA DMF, one of the most heavily fished species in and around the project area is the striped bass (Vin Malkoski, personal communication, Aug. 2005). The striped bass, or "striper," is one of the most avidly pursued of all U.S coastal sport fish. It is native to most of the eastern Atlantic coast, ranging from the lower St. Lawrence River in Canada to Northern Florida, and along portions of the Gulf of Mexico. Striped bass have been introduced into the west coast and, because of its adaptability to freshwater, its range has expanded to include inland areas as well. Striped bass are stocked into lakes and reservoirs in at least 31 states.

Striped bass can live up to 40 years and reach weights greater than 100 pounds, although individuals larger than 50 pounds in Massachusetts state waters are rare (MA DMF, 2005b). Sexual maturity is attained at two or three years of age for males and after age four for females. The size of females at sexual maturity has been used as a criterion for establishing minimum legal size limit regulations.

In general, the striped bass is a migratory species and is seen in Massachusetts's waters from the spring through autumn. Although juveniles less than two years of age do not appear to migrate, adults will move north to the New England coastal areas during the spring and return to more southern locales in the autumn. Striped bass are most abundant in the New England states following years when reproduction in the Chesapeake Bay has been particularly successful. While in Massachusetts's coastal waters, striped bass are rarely found more than several nautical miles from the shoreline. These fish are generally located in river mouths, in small, shallow bays and estuaries, and along rocky shorelines and sandy beaches. They are particularly active within tidal and current flows and in the wash of breaking waves. Most feeding occurs from dusk to dawn. Their diet is extensive and includes alewives, flounder, sea herring, menhaden, mummichogs, sand lance, silver hake, tomcod, smelt, silversides, and eels, as well as lobsters, crabs, soft clams, small mussels, annelids (sea worms), and squid.

Other Regulated and Non-Regulated Species - In addition to the Federally managed species and State-regulated species, the Estuarine Living Marine Resource Database (ERLM; Jury *et al*., 1994) identifies additional Atlantic States Marine Fisheries Commission (ASMFC) regulated species and non-regulated species present in the project area and categorizes them in terms of highly abundant, abundant, common or rare. Highly abundant species include mummichog and silversides. Abundant species include skates, American eel, alewife, rainbow smelt, Atlantic tomcod, and cunner. Common species include blueback herring, Atlantic menhaden, fourspine stickleback, threespine stickleback, ninespine stickleback, northern pipefish, grubby, longhorn sculpin, striped bass, tautog, rock gunnel, and American sand lance. Rare species include American shad, northern searobin, shortfin sculpin and white perch. Alewives, blueback herring, American eel, striped bass, and tautog are regulated by the ASMFC. Life history characteristics of these species, including general distribution, habitat and food preferences, as well as spawning and migratory information, are presented in Table 3-6.

In a July 21, 2005 letter from the U.S. Department of Commerce, NOAA Fisheries Northeast Region to Mr. Michael Keegan at the USACE, three anadromous species included in the ELMR database (Jury *et al*., 1994) have been identified through the Fish and Wildlife Coordination Act as species requiring particular attention. Although not regulated by Federal or State agencies, the coastal waters, bays, and estuaries off Massachusetts also support a variety of anadromous fish species. Anadromous species are those that spend most of their juvenile and adult lives in coastal or estuarine regions, but will migrate into freshwater rivers to spawn. The rainbow smelt (*Osmerus mordax*), alewife (*Alosa pseudoharengus*), and blueback herring (*Alosa aestivalis*) use Boston Harbor, the Mystic River, and Chelsea River for passage to upstream spawning locations. Due to the low populations of alewife and blueback herring (collectively known as river herring) throughout the Commonwealth of Massachusetts, the MA DMF has extended into perpetuity the moratorium on the harvest, possession, and sale of river herring in Massachusetts; the moratorium has been in effect since 2006. In addition, the alewife, blueback herring, and rainbow smelt have been identified as a “species of concern” by NMFS, who is assessing whether the species warrants listing under the Endangered Species Act. Alewife and blueback herring are also “candidate species”, which are species that are undergoing a status review which has been announced in a *Federal Register* notice by NMFS.

The rainbow smelt is an inshore species that spends most of the year in harbors and estuaries (Bigelow and Schroeder, 2002). The smelt is not a large fish, generally not exceeding 13-14 inches in length, and is very slender, weighing from one to six ounces. Adults are common in Boston Harbor except during the summer months (Jury *et al*., 1994). During the warmest periods of the summer, smelt leave the harbor to find slightly cooler water (Collette and Klein-MacPhee, 2002). Spawning occurs in freshwater in early spring. Rainbow smelt migrate into the Mystic and Chelsea Rivers; however this species generally does not move too far upstream and may only venture a few hundred yards above the tidewater (Bigelow and Schroeder, 2002). There is a dam on the Mystic River and currently, the fish do not move above this dam; however, there are plans to have a fish passage constructed for this area. Adult smelts return to the harbors and estuaries immediately after spawning. Eggs remain in freshwater areas adhering in clumps to pebbles, sticks, grass, or weeds; hatching occurs in about 13 days (Bigelow and Schroeder, 2002). Young fry appear to move out of the river spawning areas in early summer. Juveniles are abundant or common in Boston Harbor year-round (Jury *et al*., 1994).

The alewife is common in Boston Harbor from April through October, with adults becoming abundant during May and June (Jury *et al*., 1994). The alewife is not a particularly large fish, never attaining lengths much more than 15 inches and weights of 8 – 9 ounces (Bigelow and Schroeder, 2002). The alewife spends most of its life in large schools in coastal waters. Spawning occurs in the spring when adults move up into freshwater rivers where they were hatched, such as the Chelsea and Mystic Rivers, to spawn (Bigelow and Schroeder, 2002). Spawning takes place in sluggish waters, with females depositing from 60,000 to 100,000 eggs, dependant on body size. Following spawning, the alewife immediately returns from freshwater to the coastal areas. Eggs remain in fresh water attached to brush, stones, or anything they settle upon, and hatch in approximately six days. When fry are about one month old, they begin making their way downstream to more saline environments (Bigelow and Schroeder, 2002).

The blueback herring is closely related to the alewife and is very similar in size and habitats. It is a schooling species that spends most of its life in seawater, but swims into freshwater regions to spawn. Together with the alewife, these two species comprise the commercially important river herring fishery in the Gulf of Maine. The blueback herring is common in Boston Harbor from May through October (Jury *et al*., 1994). Blueback herring migrate into the freshwater Mystic and Chelsea rivers to spawn; however, unlike the alewife, the blueback migrate into these rivers a little later in the season and does not go as far upstream as the alewife (Bigelow and Schroeder, 2002). Eggs sink and will stick to anything they encounter. Hatching occurs in approximately 50 hours. Within one month, young show characteristics of the adult and begin moving downstream into saltwater regions (Bigelow and Schroeder, 2002).

In addition to the anadromous species listed above, and the Federally-managed and State-regulated species that support many fisheries, the project area is home to many species of small, local fish populations such as mummichog, silverside, various species of stickleback, sculpin, grubby, gunnel, and the sand lance. Although these fish serve no commercial or recreational fishery, they are ecologically important. Many are small and confined to inshore areas only. They can be found in saltwater canals and creeks, particularly in marsh areas bordering harbors and estuaries. Many of these species serve as food sources for coastal and shore birds, foraging mammals, and the commercial and recreationally important fish species. More detailed life history information for these species is presented in Table 3-6.

3.3.5.1 Boston Harbor

Mystic River - The bottom type within the Mystic River is predominately fine sediments (mud, silt and clay) (Figure 3-1). All of the anadromous species listed in Table 3-6 (alewife, American shad, blueback herring, and the rainbow smelt) may be found moving into the Mystic to spawn during the spring and early summer months. The Atlantic tomcod, a demersal inshore species, may also be present around the mouth of the river feeding and spawning (fall and early winter). White perch are generally a schooling species that is often found in the mouths of rivers along the Massachusetts coastline. This species may also run up into more freshwater portions of the river during spring for spawning. Striped bass may also be found in the mouths of rivers, particularly in areas where there is tidal and current flow. Several small forage species including mummichogs, silversides, sticklebacks and pipefish are also year-round residents in inshore areas both in freshwater and saltwater. These species are often found along weedy shorelines or hiding under clumps of floating eelgrass or rockweed if away from the immediate shoreline.

Chelsea River - The bottom type within the Chelsea River is a heterogeneous mix of gravel and sand, with areas of finer sediments (silt, mud, clay) (Figure 3-1). The same fish species that are likely to be present in the Mystic River are also likely to use various regions of the Chelsea River for feeding and/or spawning.

Inner Harbor - Mud and clay are the predominant sediment types within the Inner Harbor (Figure of 3-1) and any number of the fish species presented in Table 3-6 above may be present in the harbor at various times or may be permanent residents. Many of the anadromous species that move into the Mystic and Chelsea Rivers will migrate through the Inner Harbor en route to spawning locations in the rivers. Some species like the rainbow smelt may spend most of its life in the harbor area. Striped bass may also be found moving through the Inner Harbor to locations near the mouths of the Mystic and Chelsea Rivers. Local, inshore species present in the Inner Harbor may include Atlantic tomcod, cunner, tautog, white perch, mummichogs, silversides, northern pipefish, longhorn and shorthorn sculpins, and threespine, fourspine and ninespine sticklebacks. Several Federally managed demersal species may also be found in the Inner Harbor based on their preference for muddy bottom types and life history characteristics. These include: black sea bass, summer flounder, winter flounder, windowpane flounder, and white hake. These species will move to inshore locations during spring and summer, but if temperatures get too warm may stay in the deeper channels in those inshore areas.

Lower Harbor - The Lower Harbor consists primarily of muddy and sandy substrate. This type of bottom habitat (Figure 3-1) is suitable to a number of the fish species presented in Table 3-6. Similar to the Inner Harbor, many of the anadromous species migrate through the lower portions of the harbor en route to spawning locations in the Mystic and Chelsea Rivers. Rainbow smelt are likely to be found in pelagic schools for a large portion of their life in the Lower Harbor region migrating to the river regions to spawn. Striped bass may also migrate through the area to reach more rocky shorelines or sandy areas of the small islands located in the lower harbor region. Several of the small inshore forage fish species including mummichogs, silversides, sculpins, grubby, shorthorn and longhorn sculpin, and ninespine stickleback may be present along the shorelines of many of the small islands in the Lower Harbor region. Various species of skates as well as spiny dogfish are also likely to be present, moving between more inshore and offshore locations depending on water temperature.

Of the managed species, many demersal fish preferring either muddy and more fine grained substrates or sandy substrates will be found foraging in the Lower Harbor and may make seasonal migrations between the Lower and Inner and/or the Lower and Outer Harbor in response to water temperatures. The demersal species likely to be present include American plaice, Atlantic halibut, summer flounder, winter flounder, windowpane flounder, red and white hake, and yellowtail flounder. Scup and black sea bass may also be present in the Lower Harbor around any rocky outcroppings or structured hard bottom such as shellfish beds pilings, or ledges. Pelagic species such as Atlantic butterfish and Atlantic mackerel may make seasonal migrations to the Lower Harbor areas for spawning and foraging.

Outer Harbor - The bottom type of the Outer Harbor is much more erosional and rockier than other portions of the harbor. In general, sediments consist mostly of sand, gravel, and rock, with isolated areas of finer sediments (silt, mud, and clay) (Figure 3-1). In the areas of finer sediment, many of the demersal species observed in the Lower Harbor may also be present in the Outer Harbor, including the American plaice, Atlantic halibut, summer flounder, winter flounder, windowpane flounder, red and white hake, and yellowtail flounder. Other demersal species such as black sea bass, cod, haddock, ocean pout, and pollock prefer more structured hard bottom areas with rocky or gravel bottoms and will likely be found in these regions within the Outer Harbor. Pelagic species such as Atlantic butterfish, Atlantic sea herring, and Atlantic mackerel, as well as long-finned and short-finned squid are also likely to be present in the Outer Harbor. These pelagic species are often seasonal in the waters of Boston harbor and may move between the Lower harbor and further offshore depending on water temperatures. Highly migratory species such as bluefish and bluefin tuna may appear in Outer Harbor waters when in pursuit of prey.

3.3.5.2 Habitat Enhancement Sites

The two habitat enhancement sites are located outside Boston Harbor and within Massachusetts Bay. Massachusetts Bay is located between Cape Ann and Cape Cod, in the southwest corner of the Gulf of Maine. Cape Cod is generally considered the biogeographic boundary between the Virginian province to the south and the Scotian province to the north. However, this boundary is not considered absolute but as a selective filter (Gosner, 1978) because many of the cold-temperate, boreal fauna that dominate the North Atlantic have ranges extending south of the of the Cape and several eurythermal migrants from the south enter the Gulf of Maine seasonally (Jury, *et. al*, 1994). The bay's most prominent submarine feature, Stellwagen Bank, is located at the bay's eastern edge. Stellwagen Bank is a shallow (average water depth of 100 to 120 feet), glacially deposited, primarily sandy feature with high biological productivity that provides habitat for a number of fish species.

The following finfish species and their abundance in Massachusetts Bay were identified by Jury, et al. (1994). Species that are highly abundant in Massachusetts Bay during at least one lifestage and during at least one month of the year include: silversides, cunner, American plaice, and winter flounder. Species with at least one lifestage classified as abundant in Massachusetts Bay include spiny dogfish, skates, American eel, alewife, Atlantic menhaden, Atlantic herring, rainbow smelt, pollock, red hake, mummichog, silversides, longhorn sculpin, cunner, American sand lance, Atlantic mackerel, American plaice, winter flounder, and yellowtail flounder. See Table 3-7 for fish species present at various times of the year in Massachusetts Bay, as reported by Jury *et al*. (1994).

Species having EFH designated in the two 10 x 10 minute squares that encompass the two potential enhancement sites include two shellfish species, two squid species, and 24 finfish species. Skates, such as little skate (juvenile and adult), thorny skate (juvenile), and winter skate (juvenile) also have EFH in coastal Massachusetts waters which include all five of the potential sites. See Table 3-8 for the list of EFH species. In addition, several species of finfish were observed in the video-drift footage collected within the two potential sites. These species included flounders, red hake, sculpin, cunner, and ocean pout.

In general, sediments within the potential enhancement sites consisted mostly of sand, coarse sand and gravel, cobble, and rock, with isolated areas of fine sediment (i.e., mud). In the areas of finer sediment, demersal species including the American plaice, Atlantic halibut, summer flounder, winter flounder, windowpane flounder, witch flounder, red and white hake, and yellowtail flounder may be present. Other demersal species (black sea bass, cod, haddock, ocean pout, pollock, redfish, and scup) prefer more structured hard bottom areas and may be present in areas with rocky or gravelly bottom. Pelagic species, such as Atlantic butterfish, Atlantic sea herring, juvenile bluefish, and monkfish, are likely to be present in areas with sand and/or gravel bottom. Atlantic mackerel, bluefin tuna, and long- and short-finned squid are pelagic species that are associated with all substrate types. Forage and shore species, such as cunner, sculpin, skates, and spiny dogfish, may also be present within the potential enhancement sites. Little skate and juvenile thorny and winter skate prefer sandy, gravelly, or muddy substrates.

Broad Sound – EFH for 20 finfish species is designated within square 30, which encompasses the Broad Sound site. See Table 3-8. Flounder, red hake, and sculpin were observed in the video transects from within this site.

Massachusetts Bay – EFH for 22 finfish species is designated within square 31, which encompasses the Massachusetts Bay site. See Table 3-8. Of the four squares, square 6 is the only one that contains EFH for witch flounder, monkfish, and spiny dogfish. Several red hake were observed at the soft bottom video transects within this site. In the gravel and cobble bottom and in areas of sand waves, cunner, flounder, sculpin, and ocean pout were observed.

Table 3-7. Relative Abundance, Temporal Distribution, and Habitat Prefernces of Fishes by Lifestage in Massachusetts Bay

SPECIES	TYPE[1]	LIFE STAGE	RELATIVE ABUNDANCE BY MONTH[2] J	F	M	A	M	J	J	A	S	O	N	D
Spiny dogfish	D	Adults						C	A	A	A	C		
	D	Juvenile						C	A	A	A	C		
		Eggs	C	C	C	C	C	C	C	C	C	C	C	C
Skates	D	Adults	C	C	C	A	A	A	A	A	A	C	C	C
		Spawning	C	C	C	C	C	C	C	C	C	C	C	C
American eel	D	Adults									C	C		
	D	Juvenile				C	A	A	C					
		Larvae				C	C	C						
Blueback herring	P	Adults					C	C	C	C	C	C		
	P	Juvenile					C	C	C	C	C	C	C	
Alewife	P	Adults				C	A	A	C	C	C	C		
	P	Juvenile				C	C	A	A	A	A	C	C	
Atlantic menhaden	P	Adults					C	C	A	A	A	C	C	
		Spawning					C	C	C	C				
	P	Juvenile					C	C	C	C	C	C	C	
	P	Larvae						C	C	C	C			
	P	Eggs					C	C	C	C	C			
Atlantic herring	P	Adults	A	A	A	A	C				C	C	A	A
	P	Juvenile	A	A	A	A	A	C	C	C	A	A	A	A
	P	Larvae	A	C	C	C	C					A	A	A
Rainbow smelt	P	Adults	C	C	C	C	C	C				C	C	C
	P	Juvenile	A	A	A	A	A	A	A	A	A	A	A	A
Atlantic cod	D	Adults			C	C	C	C				C	C	C
		Spawning	C	C	C	C	C							C
	D	Juvenile	C	C	C	C	C	C	C	C	C	C	C	C
	P	Larvae	C	C	C	C	C	C	C					C
	P	Eggs	C	C	C	C	C	C						C
Silver hake	D	Adults				C	C	C	C			C	C	
		Spawning					C	C	C	C	C			
	D	Juvenile				C	C	C	C	C	C	C	C	
	P	Larvae					C	C	C	C	C	C		
	P	Eggs					C	C	C	C	C	C		
Atlantic tomcod	D	Adults			C	C	C	C	C	C	C	C	C	
	D	Juvenile	C	C	C	C	C	C	C	C	C	C	C	
Pollock	P/D	Adults	C	C	C	C	C	C			C	C	C	C
		Spawning	C	C										
	P/D	Juvenile	C	C	C	A	A	A	C	C	A	A	C	C
		Larvae	C	C	C									C
		Eggs	C	C	C									C
Red hake	D	Adults	C	C	C	C	C	C	C	C	C	C	C	C
		Spawning						C	C	C	C	C		
	D	Juvenile	C	C	C	C	C	C	C	C	C	C	C	C
	P	Larvae						A	A	A	A	C	C	
	P	Eggs						A	A	A	A	A		
White hake	D	Adults			C	C	C	C	C	C	C			
	D	Juvenile			C	C	C	C	C	C	C	C	C	
	P	Larvae					C	C	C	C	C	C	C	
	P	Eggs					C	C	C	C	C	C		
Mummichog	D	Adults	C	C	C	A	A	A	A	A	A	A	A	C
		Spawning					C	C	C	C				
	D	Juvenile	C	C	C	A	A	A	A	A	A	A	A	C
		Larvae					C	C	C	C				
	D	Eggs					C	C	C	C				
Silversides	P/D	Adults	C	C	A	A	H	H	H	H	H	H	A	C
		Spawning				C	H	H	A					
	P/D	Juvenile				A	H	H	H	H	H	H	H	C
	P	Larvae				C	H	H	A	C				
	D	Eggs				A	H	H	A					
Fourspine stickleback	D	Adults	C	C	C	C	C	C	C	C	C	C	C	C
	D	Juveniles	C	C	C	C	C	C	C	C	C	C	C	C
Threespine stickleback	P/D	Adults	C	C	C	C				C	C	C	C	C
	D/P	Juvenile	C	C	C	C	C	C	C	C	C	C	C	C

SPECIES	TYPE[1]	LIFE STAGE	RELATIVE ABUNDANCE BY MONTH[2]											
			J	F	M	A	M	J	J	A	S	O	N	D
Northern pipefish	D	Adults			C	C	C	C	C	C	C	C	C	
		Spawning				C	C	C	C	C				
		Juvenile				C	C	C	C	C	C	C	C	
		Larvae				C	C	C	C	C	C			
Northern searobin	D	Adults					C	C	C	C				
	D	Juvenile					C	C	C	C				
Grubby	D	Adults	C	C	C	C	C	C	C	C	C	C	C	C
		Spawning	C	C	C	C								C
	D	Juvenile	C	C	C	C	C	C	C	C	C	C	C	C
		Larvae	C	C	C	C	C							
		Eggs	C	C	C	C								C
Longhorn sculpin	D	Adults	A	A	A	A	A	A	A	A	A	A	A	A
		Spawning	A	A	C	C								C
	D	Juvenile	A	A	A	A	A	A	A	A	A	A	A	A
		Larvae	A	A	A	C	C	C						
		Eggs	A	A	C	C								C
Shorthorn sculpin	D	Adults	C	C	C	C	C	C	C	C	C	C	C	C
		Spawning	C	C	C									C
	D	Juvenile	C	C	C	C	C	C	C	C	C	C	C	C
		Larvae		C	C	C								
		Eggs	C	C	C									C
Striped bass	P	Adults				C	C	C	C	C	C	C		
	P	Juvenile				C	C	C	C	C	C	C		
Bluefish	P	Adults						C	C	C	C	C		
	P	Juvenile						C	C	C	C	C		
Scup	D	Juvenile							C	C	C			
Tautog	D	Adults	C	C	C	C	C	C	C	C	C	C	C	C
		Spawning					C	C	C	C				
	D	Juvenile	C	C	C	C	C	C	C	C	C	C	C	C
	P	Larvae						C	C	C	C			
	P	Eggs					C	C	C	C				
Cunner	D	Adults	A	A	A	A	A	A	A	A	A	A	A	A
		Spawning						A	A	A	A			
		Juvenile	A	A	A	A	A	A	A	A	A	A	A	A
	P	Larvae						H	H	H	A	C		
	P	Eggs						H	H	H	A			
Ocean pout	D	Adults	C	C	C	C	C	C	C	C	C	C	C	C
		Spawning								C	C	C		
	D	Juvenile	C	C	C	C	C	C	C	C	C	C	C	C
	D	Larvae	C									C	C	C
	D	Eggs								C	C	C	C	
Rock gunnel	D	Adults	C	C	C	C	C	C	C	C	C	C	C	C
		Spawning	C	C	C									C
	D	Juvenile	C	C	C	C	C	C	C	C	C	C	C	C
		Larvae	C	C	C	C	C	C						
		Eggs	C	C	C	C								C
American sand lance	D/P	Adults	C	C	C	A	A	A	A	A	A	A	C	C
		Spawning	C	C	C								C	C
	D/P	Juvenile	C	C	C	A	A	A	A	A	A	A	C	C
		Larvae	A	A	A	A	A	A	C					C
	D	Eggs	A	A	A	A	A	C					A	A
Atlantic mackerel	P	Adults					C	C	C	C	C	C		
		Spawning					C	C	C	C				
	P	Juvenile					C	C	C	C	C	C		
	P	Larvae					C	A	A	A				
	P	Eggs					C	A	A	A				
Butterfish	P	Adults							C	C	C			
	P	Juveniles							C	C	C			
	P	Eggs						C	C	C	C			
Windopane	D	Adults			C	C	C	C	C	C	C	C	C	
		Spawning					C	C	C	C	C			
	D	Juvenile	C	C	C	C	C	C	C	C	C	C	C	C
		Larvae					C	C	C	C	C	C		
		Eggs					C	C	C	C	C			
American plaice	D	Adults	H	H	H	H	H	H	H	H	H	H	H	H
		Spawning			H	H	H	H						
	D	Juvenile	H	H	H	H	H	H	H	H	H	H	H	H

SPECIES	TYPE[1]	LIFE STAGE	RELATIVE ABUNDANCE BY MONTH[2]											
			J	F	M	A	M	J	J	A	S	O	N	D
		Larvae			C	A	A	A	A					
		Eggs			A	A	A	A						
Winter flounder	D	Adults	H	H	H	H	H	H	H	H	H	H	H	H
		Spawning	C	A	A	A	C	C						
	D	Juvenile	H	H	H	H	H	H	H	H	H	H	H	H
	D/P	Larvae		A	H	H	H	A	C	C				
	D	Eggs	C	A	A	A	A	A	C					
Yellowtail flounder	D	Adults	A	A	A	A	A	A	A	A	A	A	A	A
		Spawning				A	A	A	A	A				
	D	Juvenile	A	A	A	A	A	A	A	A	A	A	A	A

[1]D=Demersal, P=Pelagic
[2]H=Highly Abundant, A= Abundant, C=Common, Blank=Not Present Or Rare

3.3.5.3 Massachusetts Bay Disposal Site

As stated above, many of the species described for the habitat enhancement sites would be expected to also inhabit the MBDS as part of the Gulf of Maine/Massachusetts Bay ecosystem. Although the majority of species likely to be present in the vicinity of the MBDS are year-round residents in Massachusetts Bay, 12 species are seasonal (mostly summer) migrants. Approximately 80% of the species likely to occur near the MBDS are demersal, semi-demersal, or semi-pelagic. Twenty-three species, including 10 seasonal migrants, are of importance to commercial and/or sport fisheries (Hubbard, *et al*., 1988).

The MBDS is located within a depression with deposits of dredged material and areas dominated by fine grained sediment (i.e., mud). Hard sand is located in the northeast portion of the MBDS (EPA, 1989). In the areas of finer sediment, demersal species including the American plaice, Atlantic halibut, summer flounder, winter flounder, windowpane flounder, witch flounder, red and white hake, and yellowtail flounder may be present. Other demersal species (cod, haddock, ocean pout, pollock, and redfish) prefer more structured hard bottom areas and are not likely to be present in large numbers at the disposal site. Pelagic species, such as Atlantic butterfish, Atlantic sea herring, and monkfish, prefer areas with sand and/or gravel bottom, which is not common at the MBDS. Atlantic mackerel, bluefin tuna, and long- and short-finned squid are pelagic species that are associated with all substrate types.

Site specific finfish information was collected in 1985 and 1986 for the Massachusetts Bay Disposal Site Designation study (Hubbard, *et al.*, 1988) using gill nets, trammel nets, bottom trawls, submersible video observations, and interviews with local fishermen. A total of 32 species were documented at the MBDS. See Table 3-9 for a list of species caught at MBDS and nearby reference location. American plaice, witch flounder, and redfish were the predominant non-migratory, demersal species at MBDS (Hubbard, *et al*., 1988). Principal seasonal migrants are silver hake, red hake, and spiny dogfish (Hubbard, *et al*., 1988). Species reported from MBDS by fishermen, but not otherwise noted in the USACE studies, were bluefish and bluefin tuna (Hubbard, *et al*., 1988). Both are pelagic, summer migrants to the Gulf of Maine.

The resident finfish community on the muddy bottom of the MBDS is dominated by American plaice and witch flounder (Hubbard, *et. al.*, 1988). Hard bottom communities at MBDS (approximately 25 percent of the total area) are likely dominated by redfish, ocean pout, sculpins, and Atlantic wolffish. Although stock assessments have shown changes over the past twenty years, the species described above are likely the same now as described in 1985 and 1986 at the MBDS (Hubbard, *et. al.*, 1988).

EFH designated species in the 10 x 10 minute squares that encompass Massachusetts Bay Disposal Site include one shellfish species, two squid species, and 18 finfish species. See Table 3-10 for the list of EFH species.

3.3.5.4 Industrial Waste Site

Finfish species collected from the IWS for chemical analysis included American plaice, winter flounder, yellowtail flounder, witch flounder, silver hake, blueback herring, Atlantic herring, goosefish, longhorn sculpin, sea raven, spiny dogfish, skate, redfish, wrymouth, ocean pout, and cod. Other species captured included whelk, sea scallop, squid, spider crab, rock crab, Pandalid shrimp, and lobster (NOAA, 1996). Higher concentrations of fish were noted on the glacial knolls or rises, such as cod, redfish, American plaice, witch flounder, and ocean pout (NOAA, 1996). Redfish were frequently found near barrels resting on the flat surfaces, demonstrating a strong attraction to the relief and refuge offered by these waste containers (NOAA, 1996).

Table 3-8. Essential Fish Habitat Species within the Two Potential Habitat Enhancement Sites

SPECIES	MASSACHUSETTS BAY	BROAD SOUND
Atlantic cod	E, L, J, A	E, L, J, A
Haddock	E, L, J	E, L
Pollock	E, L, J, A	E, L, J, A
Whiting	E, L, J, A	E, L, J, A
Red hake	E, L, J, A	E, L, J, A
White hake	E, L, J, A	E, L, J, A
Redfish	L, J, A	
Witch flounder	E, L, A	
Winter flounder	E, L, J, A	E, L, J, A
Yellowtail flounder	E, L, J, A	E, L, J, A
Windowpane flounder	E, L, J, A	E, L, J, A
American plaice	E, L, J, A	E, L, J, A
Ocean pout	E, L, J, A	E, L, J, A
Atlantic halibut	E, L, J, A	E, L, J, A
Atlantic sea herring	L, J, A	L, J, A
Monkfish	E, L	
Bluefish	J, A	J, A
Atlantic butterfish	E, L, J, A	E, L, J, A
Atlantic mackerel	E, L, J, A	E, L, J, A
Summer flounder		A
Scup	J, A	J, A
Spiny dogfish	J, A	
Bluefin tuna	J, A	J, A
Black sea bass		A
Long-finned squid	J, A	J, A
Short-finned squid	J, A	J, A
E=eggs; L=larvae; J=juvenile; A=adult		

Table 3-9. List of Finfish Species Noted at or Near the Massachusetts Bay Disposal Site

Species	Method[1]	Species	Method[1]
Demersal		***Pelagic***	
American plaice	G, I, T	Atlantic herring	G
Thorny skate	G, N, T	Alewife	G
Red hake	G, T	Atlantic mackerel	G, I
Fourbeard rockling	G, T	Bluefish	I
Longhorn sculpin	G, T	Bluefin tuna	I
Atlantic wolfish	I, T[2]	Blueback herring	
Cusk	I, T	American shad	
Yellowtail flounder	I, T		
Witch flounder	I, T	***Semi-Demersal or Semi-Pelagic***	
Winter flounder	I, N, T	Silver hake	G, I, N, T
Ocean pout	S, T	Atlantic cod	G, I, T
Snakebleny	S	Redfish	G, I, T
Sandlance	S	Spiny dogfish	G, S, T
White hake	T	Haddock	I
Windowpane	T	Pollock	I
Alligatorfish	T	Butterfish	
Wrymouth	T		
Goosefish	T		
Clearnose skate	T		
Pipefish	T		
Northern searobin	T		
Unidentified Skate	S		
Unidentified Flounder	S		
Unidentified Sculpin	S		

[1] G=gill net; I=interview with commercial or sport fishermen; N=tramel net; S=submersible observations; T=bottom trawl

Table 3-10. Essential Fish Habitat Species within the Massachusetts Bay Disposal Site Square

Species	Eggs	Larvae	Juveniles	Adults	Spawning Adults
Atlantic cod* *Gadus morhua*	X	X	X	X	X
Haddock* *Melanogrammus aeglefinus*	X		X		
Whiting (silver hake)* *Merluccius bilinearis*	X	X	X	X	X
Red hake* *Urophycis chuss*	X	X	X	X	X
White hake* *Urophycis tenuis*	X	X	X	X	X
Redfish* *Sebastes fasciatus*	n/a	X	X	X	X
Witch flounder* *Glyptocephalus cynoglossus*	X	X	X	X	X
Winter flounder* *Pseudopleuronectes americanus*	X	X	X	X	
Yellowtail flounder* *Pleuronectes ferruginea*	X	X	X	X	X
Windowpane flounder* *Scophthalmus aquosus*	X	X			
American plaice* *Hippoglossoides platessoides*	X	X	X	X	X
Ocean pout* *Macrozoacres americanus*	X	X	X	X	
Atlantic halibut* *Hippoglossus hippoglossus*	X	X	X	X	X
Atlantic sea scallop* *Placopecten magellanicus*	X	X	X	X	X
Atlantic sea herring* *Clupea harengus*		X	X	X	
Monkfish* *Lophius americanus*	X	X	X	X	X
Long-finned squid** *Loligo pealei*	n/a	n/a	X	X	X
Short-finned squid** *Illex illecebrosus*	n/a	n/a	X	X	X
Atlantic butterfish** *Peprilus triacanthus*	X	X	X	X	X
Atlantic mackerel** *Scomber scombrus*	X	X	X	X	
Bluefin tuna *Thunnus thynnus*			X	X	

Source: NOAA Fisheries Service, Habitat Conservation Division, http://www.nero.noaa.gov/hcd/ma1.html
M = Mixing water/brackish salinity zone (0.5 ppt < salinity < 25 ppt); S = Seawater salinity zone (salinity $\geq$ 25 ppt)
n/a = species does not have this lifestage in its life history
X = EFH has been designated within a 10 x 10 minute square for the species and lifestage; however, no additional information as to salinity zone is reported
*Managed species by the New England Fishery Management Council
**Managed species by the Mid-Atlantic Fishery Management Council

3.3.6 Marine and Coastal Birds

Many different types of resident, migratory, and coastal birds may potentially use the areas of Boston Harbor and Massachusetts Bay as feeding, nesting or resting areas. The diversity of birds nesting in Boston Harbor is high (Paton *et al*., 2005). Besides the many species that nest on islands throughout the Harbor, broad arrays of migrants use the area during spring and fall migration. In general, shallow open water areas may provide feeding habitat for many wading birds. Deeper open water areas may provide feeding habitat for several species of waterfowl and waterbirds such as cormorants, grebes, and loons.

For over 100 years, the Audubon Society Christmas Bird Counts (National Audubon Society, 2005) have identified and recorded many species along the Massachusetts coastline and Stellwagen Bank. Appendix W lists the coastal and marine birds that have been recorded in the Boston Harbor and Massachusetts Bay areas from these surveys as well as other local surveys. These birds are classified by their marine habitat as pelagic, shorebirds, waterfowl, colonial water birds, raptors, and marsh birds.

3.3.7 Marine Mammals and Reptiles

All marine mammals in U.S. waters are protected under the Marine Mammal Protection Act of 1972 (MMPA), reauthorized most recently in 1994. The MMPA established a moratorium, with certain exceptions, on the taking of marine mammals in U.S. waters and on the taking of marine animals by U.S. citizens on the high seas. The term “take” is statutorily defined to mean “to harass, hunt, capture, or kill, or attempt to harass, hunt, capture or kill any marine mammal.” The moratorium also prohibits the importation of marine mammals and marine mammal products into the United States. NOAA Fisheries (NMFS) has responsibilities under MMPA that include monitoring populations of marine mammals to ensure that they stay at optimum levels. If a population falls below its optimum level, it can be designated as “depleted,” and a conservation plan is developed to guide research and management actions to restore the population to healthy levels.

In general, only transient marine mammals and reptiles (sea turtles) are found in the Boston Harbor area. However it is noted that harbor seals and harbor porpoises are regular seasonal visitors to the harbor (EPA letter dated May 23, 2008). Harbor porpoise are routinely observed near the Charles River dam in the spring during the inward migration of anadromous fish. They have also been observed in Chelsea Creek. Harbor seals have been observed year round throughout the harbor. The likelihood of finding marine mammals and sea turtles increases in Massachusetts Bay. Most marine mammals and reptiles that may be possible visitors to Boston Harbor and Massachusetts Bay areas are listed as Federally threatened or endangered and are discussed in the section below. Marine mammal species that may travel within the project areas and are not discussed in another section include the harbor seal, white-sided dolphin, harbor porpoise, gray seal, and minke whale. Their life history can be found in Appendix X.

Information on other marine mammals and sea turtles that are listed on the Federal threatened and endangered species list and that may be possible visitors to Boston Harbor and/or Massachusetts Bay areas can be found in the following section.

3.4 Threatened and Endangered Species and Species of Special Concern

The Federal Endangered Species Act (ESA) provides for the conservation of species that are endangered or threatened with extinction throughout all or a significant portion of their range, and the conservation of the ecosystems on which they depend. Endangered species are species that are in danger of extinction throughout all or part of their range, or that are in danger of extirpation. Threatened species are native species that are likely to become endangered in the foreseeable future, or that are declining or rare (NOAA Fisheries, n.d.). State governments are also concerned with species of special concern, which are native species that have experienced a decline which, if continued unchecked, could threaten the species, or that are so restricted in abundance, distribution, or specialized habitat requirements that they could easily become threatened. Any native species listed as endangered or threatened by the U.S. Fish and Wildlife Service is also included on the Massachusetts

State list as threatened or endangered (MA NHESP, 2004). However, no State-protected rare species have been identified in the project area (letter dated May 31, 2005).

Section 7 of the Endangered Species Act of 1973 (ESA, P.L. 93-205) requires that all Federal agencies ensure that any action they authorize, fund, or carry out will not jeopardize the continued existence of any Federally endangered or threatened species or result in the destruction or adverse modification of any critical habitat of such species. The USACE is mandated by Section 7 of the ESA to consult with the Department of Commerce (NOAA Fisheries) and the Secretary of Interior (U.S. Fish and Wildlife Service [USFWS]) to determine if any Federally protected species may be affected by a project. This consultation may include preparation of a Biological Assessment to determine if the proposed action is likely to result in adverse effects to threatened or endangered species. The USACE initiated consultations with NOAA Fisheries and USFWS to determine the presence of any Federally Protected species that may coincide with the proposed project.

In response to the consultations with NMFS, the USACE was notified of the following ten Federally endangered or threatened marine mammals, reptiles and fish. All ten species are also considered to be endangered or threatened by the Commonwealth of Massachusetts. While it is possible that any of these species may be found in the project area, it is an unlikely event, especially within the dredge site or during certain seasons.

The Federally endangered North Atlantic right whales *Eubalaena glacialis*, humpback whales *Megaptera novaeangliae*, fin whales *Balaenoptera physalus*, sei whales *Balaenoptera borealis*, and sperm whales *Physter macrocephalus* may all be found seasonally in Massachusetts' waters. North Atlantic right whales have been documented in the nearshore waters of this region including Massachusetts Bay from January through September. Humpback whales feed during the spring, summer, and fall over a range that encompasses the eastern coast of the United States. Fin, sei and sperm whales are common in deeper offshore waters. While these whale species are not considered residents of Boston Harbor or Massachusetts Bay, it is possible that transients may enter the area during seasonal migrations.

The sea turtles in northeastern nearshore waters are typically small juveniles with the most abundant being the Federally threatened loggerhead *Caretta caretta* followed by the Federally endangered Kemp's ridley *Lepidochelys kempi*. Federally endangered leatherback sea turtles *Dermochelys coriacea* are located in New England waters during the warmer months as well. While leatherbacks are predominantly pelagic, they may occur close to shore, especially when pursuing their preferred jellyfish prey. The Federally threatened green sea turtles *Chelonia mydas* may also occur sporadically in Massachusetts' waters, but those instances would be rare.

Humpback Whale (*Megaptera novaeangliae*) – Humpback whales occur in all oceans of the world, except possibly the Arctic (NMFS, 1991). Until the early 20th century, humpback whales were an important commercial species throughout most of their range, including New England waters (Allen, 1916), and some taking of the species occurred in northwest Atlantic waters until the mid-1950's. The International Convention for the Regulation of Whaling (adopted in 1946) afforded the North Atlantic population of humpback whales full protection in 1955 (Best, 1993). Humpback whales were afforded endangered species status in the United States in 1970 (USFWS, 1986). The best abundance estimate currently available for humpbacks in the Gulf of Maine is 902 whales, with a minimum population estimate of 647 individuals (Waring *et al*., 2004).

The humpback whale is a migratory species that spends the summer in highly productive northern latitude feeding grounds (40° to 75° N latitude) (NMFS, 1991). Humpback whales regularly visit the waters of southern New England, including the deeper, continental shelf areas of Massachusetts, where they are present in greatest abundance between June and September. All age classes, including mother/calf pairs, are present during the summer. Humpback whales spend most of their time in New

England waters concentrated in areas where their preferred foods are most abundant. One of the primary feeding grounds is Stellwagen Bank, located off the coast of Massachusetts at the mouth of Massachusetts Bay. Humpback whales are the top carnivores in a relatively simple food chain consisting of phytoplankton, zooplankton, small forage fish (sand lance), and crustaceans. During their seasonal northern residency in the area, they may also feed on several commercially important fish and invertebrates, such as herring (*Clupea harengus*), mackerel (*Scomber scombrus*), menhaden (*Brevoortia tyrannus),* pollock (*Pollachius virens*), small haddock (*Melanogrannus aeglfinus*), and squid (*Illex ilecebrosus*) (Overholtz and Nicolas 1979; Whitehead and Class 1985; Whitehead 1987; Piatt *et al*. 1989; NMFS 1991).

There may be seasonal movement (May to October) of humpback whales in the vicinity of MBDS.

Fin Whale (*Balaenoptera physalus*) - Fin whales are present in all major oceans of the world, from the Arctic to the tropics, with greatest numbers in temperate and boreal latitudes (Evans, 1987). Fin whales were identified as endangered throughout their range in 1970 by the Federal government. Because of their high cruising speed, fin whales were not harvested commercially in large numbers until other species, such as slow-moving right whales, were depleted and whalers developed high speed boats (Leatherwood *et al*., 1976). A fishery for this species existed in Nova Scotia from 1964 to 1972 (Mitchell, 1974), and commercial harvesting of fin whales elsewhere in the world continued at least into the early 1990s. For the western North Atlantic fin whale population, the best estimate of abundance is 2,814, with a minimum population estimate of 2,362 (Waring *et al*., 2004). Due to the fin whale's extended distribution and poorly understood population structure, this is considered to be an extremely conservative estimate.

Fin whales are commonly seen on the continental shelf in waters less than 328 feet deep. New England waters are important summer feeding grounds for fin whales, and the species is most abundant off of the Massachusetts coast along the 130 to 165-foot depth contour, particularly in the Great South Channel east of Cape Cod, across Stellwagen Bank, and northeastward to Jeffrey’s Ledge (north of Cape Ann, Massachusetts) (Hain *et al*., 1992). During the fall and winter, the majority of these whales migrate south to wintering grounds offshore of the Delmarva Peninsula and the Outer Banks of North Carolina (Winn, 1982). Others concentrate at the mid-shelf region east of New Jersey as well as areas on Stellwagen Bank and Georges Bank. Year after year, juveniles will return to the same feeding areas they first visited with their mothers (Seipt *et al*., 1990; Clapham and Seipt, 1991). The fin whales’ preferred feeding grounds in the coastal areas (130 to 165-foot depth contour) indicate that these whales may be found in the area of the MBDS.

Northern Right Whale (*Eubalaena glacialis*) - The northern right whale (also known as the North Atlantic Right Whale) was a prime target of early whale fisheries along the coast of the eastern United States from the 1600s through the early 1900s, due to its coastal distribution, slow swimming speed, high oil yield, and characteristic of floating when dead (Brown, 1986; Aguilar, 1987). Due to intense exploitation, it is now the rarest of the large whales and is in danger of extinction. The northern right whale was classified as endangered in 1970 (35 FR 8495) by the Federal government. Three areas have been designated as critical habitat for the northern right whale: the Great South Channel, Cape Cod Bay, and southeastern U.S. waters 13 nmi offshore from the Alameda River, Georgia to Sebastian Inlet, Florida. The western North Atlantic population will be considered “recovered” when it reaches 60 to 80 percent of its pre-exploitation number (NMFS, 1991), or about 7,000 animals. The 1998 population estimate was 291 individuals (Kraus *et al*., 2001). Despite the cessation of whaling and the implementation of the MMPA (1972) and the ESA (1973), it is unclear if the population of northern right whales is static, growing at a very slow rate, or declining as recent modeling exercises suggest (NOAA, 2006).

Generally, right whales are found along the east coast of North America (Winn, 1982). Some female right whales have been observed to migrate more than 1,500 nmi from their northern feeding grounds to the southern calving/wintering grounds (Knowlton *et al*., 1992). Right whales can be expected to visit Massachusetts Bay and Cape Cod Bay throughout the year (Brown *et al*., 2002), but Cape Cod Bay is a primary feeding ground and nursery used from late winter until early spring. Most whales are found in areas where their primary food sources, including copepods and juvenile euphasiids, can be easily located.

The most significant human impacts to right whales are collisions with vessels and entanglement in fishing gear. Habitat change is believed to be another cause of decline in right whale populations. Anthropogenic sources of change include pollution, oil and gas exploration, seabed mining, wastewater discharges, dredged material disposal, and a general increase in coastal activities due to an increase in human population along the U.S. east coast (NMFS, 1991; Steinback *et al*., 1999).

Sei Whale (*Balaenoptera borealis*) - The sei whale breeds and feeds in open oceans and is generally restricted to more temperate waters, although it can be found in the North Atlantic Ocean from Iceland south to Venezuela. These whales are generally found in deeper waters characteristic of the continental shelf edge region (Hain *et al*., 1985). During feeding season, the sei whale population is generally centered in northerly waters with occasional trips into more shallow and inshore waters. The sei whale, like the right whale, is largely planktivorous, feeding primarily on euphausiids and copepods. It feeds mostly by filtering plankton while swimming (skim feeding) but is also known to gulp-feed on krill, shrimp, and small fish (New York State Department of Environmental Conservation [NYSDEC], 2005). Reduced predation on copepods by other predators, and thus greater abundance of this food source, has increased the reports of sei whales in more inshore locations such as Stellwagen Bank (Waring *et al*., 2004). Mitchell (1975) described two "runs" of sei whales, in June-July and in September-October. The sei whale population migrates from south of Cape Cod and along the coast of eastern Canada in June and July, and returns on a southward migration again in September and October; however, such a migration remains unverified. Sei whales are typically found in deeper offshore waters so they are unlikely to be found in Boston Harbor.

The total number of sei whales in the U.S. Atlantic is unknown. Two estimates by two different methods have estimated the western North Atlantic stock to range from 253 individuals (Cetacean and Turtle Assessment Program [CETAP], 1982) to between 1,393 and 2,248 individuals (Mitchell and Chapman, 1977). Sei whales are listed as endangered by both the Federal government and the State of Massachusetts. There are no reports of fishery-related mortality or serious injury to sei whales in fisheries observed by NMFS during 1991-1997. There are also no reports of mortality, entanglement, or injury in Northeast Fisheries Science Center (NEFSC) databases with the exception of one reported ship strike.

Sperm Whale (*Physeter macrocephalus*) - Sperm whales are generally found on the continental shelf edge, over the continental slope, and into mid-ocean regions and are listed as endangered under the ESA. This offshore distribution is more commonly associated with the Gulf Stream edge and other features as suggested by Waring *et al*. (1993). The best available abundance estimate for sperm whales is from two studies that encompass the area from the Gulf of St. Lawrence to Florida, which estimate the population to be approximately 4,702 individuals. The sperm whale is the deepest diver of the great whales; it can descend to depths of over 3,300 feet and stay submerged for over an hour. Average dives are 20 to 50 minutes long to depths of 980 to 1,970 feet (American Cetacean Society [ACS], 2004). In winter, sperm whales are concentrated east and northeast of Cape Hatteras. In spring, the distribution shifts northward to east of Delaware and Virginia and is widespread throughout the central portion of the mid-Atlantic bight and the southern portion of Georges Bank. In summer, the distribution is similar to the spring but also includes areas east and north of Georges Bank and the continental shelf of New England. In the fall, sperm whales tend to migrate south of New England on the continental shelf. The main food source of the sperm whale is medium sized deep-water squid, but it also feeds on species of fish, skate, octopus, and smaller squid.

There is documentation of sperm whales being entangled in fishing gear. The estimated number of hauls of sperm whales in the pelagic drift net fishery increased from 714 individuals in 1989 to 1,144 in 1990 (Waring *et al*., 2004). In 1999, NMFS issued a Final Rule prohibiting the use of driftnets in the North Atlantic swordfish fishery. Fishing-related mortality or serious injury to the sperm whale decreased to zero from 1991 to 1998. Eighteen sperm whale strandings were documented along the Atlantic coast between Maine and Florida during 1994-2000 (NMFS, unpublished data). The potential for accumulation of stable pollutants such as PCBs, pesticides, PAHs, and heavy metals in long-lived high trophic-level animals is possible, but there is no definitive evidence at this time.

Loggerhead Turtle (*Caretta caretta*) - The loggerhead sea turtle is listed as threatened under the ESA. It is the most common and seasonally abundant turtle in inshore coastal waters of the western North Atlantic. The Turtle Expert Working Group (TEWG) (2000) reports that the South Florida subpopulation appears to be increasing and that no trends are apparent in the northern subpopulation.

Loggerhead turtles are abundant during spring and summer months in coastal waters off New York and the mid-Atlantic States; small numbers of individuals may reach as far north as New England. In New England coastal waters, loggerheads feed primarily on small benthic crabs such as spider crabs, rock crabs, and green crabs, typically in water depths less than 20 m (Burke *et al*., 1990; Morreale and Standora, 1992, 1993). In the fall, loggerheads migrate south to coastal waters off the south Atlantic states, particularly Florida, and to the Gulf of Mexico. During the winter, the turtles tend to aggregate in warmer waters along the western boundary of the Gulf Stream off the Florida coast (Thompson, 1988). In the spring, they congregate off southern Florida before migrating north to their summer feeding ranges (Winn, 1982).

For loggerheads that have not migrated south as water temperatures cool, strandings due to cold stunning may occur, particularly between November and January in Long Island, Rhode Island, and Massachusetts waters. Strandings due to the cold may occur when the water temperature drops below 12 ºC. The metabolic rate of these cold-blooded reptiles decreases to the point where they are unable to swim and digest food; they become comatose and may die if not warmed quickly. Information from strandings, entanglements, mariner reports, and the U.S. Coast Guard suggest that loggerheads can be expected to occur in the project area in the summer and fall months, but most of the strandings are recorded from Cape Cod beaches. The major sources of mortality of loggerheads caused by human activities include incidental take in bottom trawls, particularly shrimp trawls (Henwood and Stuntz, 1987; Thompson, 1988), coastal gill net fisheries, ingestion or entanglement of marine debris, and channel dredging (hopper dredges) (Thompson, 1988; NMFS, 1992). Collisions with vessels and entrainment in electric power plant cooling water may also cause loggerhead mortality.

Kemp's Ridley Turtle (*Lepidochelys kempii*) - The Kemp's ridley sea turtle is the most endangered sea turtle in the world. It is distributed throughout coastal areas of the Gulf of Mexico and the northwestern Atlantic Ocean and is assumed to constitute a single stock (TEWG, 1998). Juveniles dominate the Atlantic population. Recovery efforts are increasing the population from the low of 500 individuals reported by Carr and Mortimer in 1980. Kemp’s ridley population has declined since 1947 when an estimated 42,000 females nested in one day, to a nesting population of approximately 1000 in the mid-1980’s (NMFS, n.d.).

Although the Kemp's ridley sea turtle is found primarily in the Gulf of Mexico, juveniles do occur during the summer along the Atlantic seaboard from Florida to Long Island Sound, Martha’s Vineyard, and occasionally north of Cape Cod, in Cape Cod Bay, Massachusetts Bay, the Gulf of Maine, and as far north as the Canadian Maritime Provinces (Lazell, 1980). Prey species include various crabs and other crustaceans. Although rare, ridleys may visit project areas in Massachusetts Bay and Boston Harbor. Ridleys begin leaving northern waters in mid-September and most are gone by early November. Some may hibernate in nearshore sediments during the winter (Carminati *et al.*, 1994). However, most observed in northern waters after the beginning of November are cold-stunned.

Leatherback Turtle (*Dermochelys coriacea*) - The Federally endangered leatherback turtle is the second most common sea turtle along the eastern seaboard of the United States and is the most common sea turtle north of the 42ºN latitude. Leatherbacks forage in temperate and subpolar waters and nest on tropical beaches. They have a layer of subcutaneous fat and circulatory adaptations to reduce the rate of heat loss through their flippers (Greer *et al*., 1973), thus allowing them to survive and feed in colder temperate waters than other sea turtles.

Because leatherback turtles are a largely pelagic, open ocean species, estimates of their population status and trends have been difficult to obtain. In addition, only a small fraction of the North Atlantic population nests on beaches of the continental United States, mostly in Florida (Meylan *et al*., 1994) and the U.S. Virgin Islands (Boulon *et al*., 1994); others nest on islands in the Caribbean.

Adult leatherback turtles are common during the summer months in North Atlantic waters from Florida to Massachusetts (Goff and Lien, 1988). New England and Long Island Sound waters support the largest populations on the Atlantic coast during the summer and early fall (Lazell, 1980; Prescott, 1988; Shoop and Kenney, 1992). During the summer, leatherbacks move into fairly shallow coastal waters (but rarely into bays), apparently following their preferred jellyfish prey. In the fall, they move offshore and begin their migration south to the winter breeding grounds in the Caribbean (Payne *et al*., 1984).

Being a temperate water species, leatherbacks do not seem to be sensitive to cold temperatures, and strandings cannot be attributed to cold stunning. Leatherbacks are very susceptible to entanglement in shrimp nets and other fishing gear and plastic debris (Mager, 1985; Witzell and Teas, 1994). On their way south in August and September, they often stop in Cape Cod Bay where they occasionally get entangled in lobster pot lines (Mass Audubon, 2003).

Green Turtle (*Chelonia mydas*) - The green turtle is the largest of the hard-shelled sea turtles. The species is distributed throughout the Caribbean Sea, the Gulf of Mexico, and in the western North Atlantic from Florida to Massachusetts. Primary nesting sites are on the east coast of Florida. Current population trends are unavailable. However, since 1980, the number of green turtles nesting each year and the total population of green turtles in Florida waters appear to have increased gradually (Thompson, 1988; Steinback *et al*., 1999).

During the summer, small numbers of green turtles venture as far north as New England. Green turtles are herbivorous as adults and feed in shallow coastal waters on sea grasses and marine algae. Some green turtles become cold-stunned each year by falling water temperatures in the fall and winter, especially in northern waters (Morreale *et al*., 1992). Green turtles occasionally strand on Cape Cod beaches (4 stranding in 2003 (Mass Audubon, 2003)). Natural and anthropogenic disturbances affect green turtles at their nesting locations and in offshore waters. Nesting habitat is lost to erosion, shoreline fortification, and beach renourishment.

Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) - On February 6, 2012, five distinct population segments (DPS) of the Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) that inhabit the waters of the northeast and the southeast United States were listed under the endangered species act. These include in the northeast, the Gulf of Maine (GOM) DPS, listed as threatened, the New York Bight (NYB) DPS, listed as endangered, and the Chesapeake Bay (CB) DPS listed as endangered; and in the Southeast, the Carolina DPS listed as endangered, and the South Atlantic, listed as threatened. Atlantic sturgeon belonging to each of the five DPSs occur in marine and estuarine habitat, including freshwater reaches of large rivers with access to the sea, ranging from Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida, in the U.S. The ranges of all five DPSs overlap (http://www.nero.noaa.gov/prot_res/esp/ListE&Tspec.pdf). Despite extensive mixing in coastal waters, Atlantic sturgeons return to their natal river to spawn (ASSRT, 2007). Therefore, although individual sturgeon from each of the distinct population segments would generally be expected to be found within the designated areas for their populations, because their ranges overlap it is possible that fish from a given DPS may be found throughout the entire geographic range of the species.

The Federally threatened GOM DPS of Atlantic sturgeon includes all Atlantic sturgeon whose range occurs in watersheds from the Maine/Canadian border and extending southward; to include all associated watersheds draining into the Gulf of Maine as far south as Chatham, MA. It also includes wherever these fish occur in coastal bays, estuaries, and the marine environment from the Bay of Fundy, Canada, to the Saint Johns River Florida (FR, 2010). Only one river located in Massachusetts, the Merrimack, is known to support Atlantic sturgeon. Boston Harbor is not known to have been used historically by Atlantic sturgeon (NMFS, 1998; Julie Crocker, NMFS, Personal Communication, October 17, 2012).

Generally, the life history pattern of Atlantic sturgeon is that of a long lived, (approximately 60 years; Mangin, 1964; Stevenson and Secor, 1999), late maturing, estuarine dependent, anadromous species (in ASSRT, 2007). It can reach lengths of up to 14 feet (4.26 m) and weigh over 800 pounds (364 kg) (FR, October 6, 2010 [2010]). They generally grow faster and mature earlier in the southern populations. For example, Atlantic sturgeons mature in South Carolina rivers at 5 to 19 years of age, in the Hudson River at 11 to 21 years, and in the Saint Lawrence River at 22 to 34 years (www.nmfs.noaa.gov/pr/species/fish/atlanticsturgeon). They are bluish-black or olive brown (on their back) with paler sides and a white belly. They have five major rows of dermal “scutes”. Atlantic sturgeons are omnivorous benthic feeders and filter quantities of mud along with their food. The diets of adult sturgeon include mollusks, gastropods, amphipods, isopods and fish. Juvenile sturgeon feed on aquatic insects and other invertebrates (ASSRT, 2007).

Atlantic sturgeon spawn in freshwater, but spend most of their adult life in the marine environment. Generally, spawning adults migrate upriver in the spring/early summer; February-March in southern systems, April-May in mid-Atlantic systems, and May-July in Canadian systems (Murawski and Pacheco, 1977; Smith, 1985; Bain, 1997; Smith and Clugston, 1997; and Caron *et al.,* 2002; *in* ASSRT, 2007). In addition, a fall spawning migration may occur in some southern rivers (Rogers and Weber, 1995; Weber and Jennings, 1996; Moser *et al.*, 1998). Atlantic sturgeons likely do not spawn every year, and multiple studies have indicated spawning intervals ranging from 1-5 years for males (Smith, 1985; Collins, *et al*., 2000; Caron *et al*., 2002) and 2-5 years for females (Vladykov and Greeley, 1963; Van Eenennaam *et al*., 1996; and Stevenson and Secor, 1999; *in* FR, 2010). Fecundity of female Atlantic sturgeons is correlated with age and body size and ranges from 400,000 to 8 million eggs.

Spawning is believed to occur between the salt front of estuaries and the fall line of large rivers in flowing waters with optimal flows ranging from 46-76 cm/s and depths from 11-27 meters (Borodin, 1925; Leland, 1968; Scott and Crossman, 1973; Crance, 1987; and Bain *et al*., 2000; *in* FR, 2010). Their highly adhesive eggs are deposited on the bottom substrate usually on hard surfaces such as cobble (Gilbert, 1989 and Smith and Clugston, 1997, *in* FR, 2010). It is likely that cold, clean water is important for proper larval development. Following spawning, males may remain in the river or lower estuary until the fall; females typically exit the rivers within four to six weeks (www.nmfs.noaa.gov/pr/species/fish/atlanticsturgeon).

Eggs hatch in approximately 94 and 104 hours after deposition at temperatures of $20^{o} – 18^{o}$ C respectively; the larvae are demersal after hatching (Smith *et al*., 1980; *in* FR 2010).

The yolk sac larval stage is completed in about 8-12 days, during which time the larvae move downstream to rearing grounds over a 6-12 day period (Kynard and Horgan, 2002; *in* ASSRT, 2007). Downstream movement occurs only during the night in the first half of their migration (Kynard and Horgan, 2002), and in the latter half of their migration during both day and night. During the first half of their downstream migration, the larvae use benthic structure such as gravel matrix for refuge during the day. The larvae continue downstream movement toward the estuary, transitioning to juveniles in the process and developing a tolerance for increased salinity.

Juveniles (subadults)[3] move downstream and inhabit brackish waters for a few months. When they reach a size of about 30 to 36 inches (76-92 cm) they move into nearshore coastal waters. Tagging data indicate that these immature Atlantic sturgeons travel widely once they emigrate from their natal (birth) rivers. Subadults and adults live in coastal waters and estuaries when not spawning, generally in shallow (10-50 meter depth) nearshore areas dominated by gravel and sand substrates (www.nmfs.noaa.gov/pr/species/fish/atlanticsturgeon). When at sea, the adults mix with populations from other rivers, but return to their natal rivers to spawn as indicated from tagging records (Collins *et al*., 2000a, K. Hattala, NYSDEC, Pers. Comm. 1998; *in* ASSRT, 2007) and from population genetic studies showing relatively low rates of gene flow (King *et al*., 2001 and Waldman *et al*. 2002; *in* ASSRT, 2007).

Atlantic Sturgeon in Boston Harbor

Based on the above life history description (i.e. subadult and adult Atlantic sturgeon live in shallow coastal waters 10-50 meter deep), Atlantic sturgeon would not be expected to occur at the Massachusetts Bay Disposal Site (which is about 90 meters deep). Therefore, this description will only evaluate the portion of Boston Harbor that has the potential to be affected by the proposed blasting and dredging.

Within the U.S. Gulf of Maine, Atlantic sturgeon have been documented from the following rivers: Penobscot, Kennebec, Androscoggin, Sheepscot, Saco, Piscataqua, Presumpscott, and Merrimack. Table 3-11 below provides a list of the historic and current spawning rivers in the Gulf of Maine as well as their current use by Atlantic sturgeon.

Table 3-11. Historic and Current Spawning Status of Atlantic Sturgeon in the U.S. Gulf of Maine and its Current Uses in the Riverine Habitat (ASSRT, 2007 and FR 2012)

Canadian Prov/State	River	Historical Spawning Status	Current Spawning Status	Use of River by Atlantic Sturgeon
NB/ME	Saint Croix	Yes	Possibly	Nursery
ME	Penobscot	Yes	Possibly	Nursery
ME	Kennebec	Yes	Yes	Spawning, Nursery
ME	Androscoggin	Yes	Possibly	Nursery
ME	Sheepscot	Yes	Possibly	Nursery
ME	Saco[4]	Unknown	Unknown	Unknown
ME/NH	Piscataqua	Unknown	No	Unknown
NH/MA	Merrimack River	Yes	No	Nursery

The first consideration in evaluating the effect of the proposed project is whether or not the species may be in the project area, or at a minimum, during the time of construction, and which life stages may potentially be affected by either direct or indirect impacts. As noted above in Table 3-11, neither

[3] Juveniles and subadults are used interchangeably in the ASSRT, 2007 report (and therefore in this Biological Assessment), and are defined as any sturgeon that is not considered a young-of-year (Age 0) or mature adult.

[4] Atlantic sturgeons are using the Saco River for significant portions of the year. Studies are underway to determine how the fish are using the river (e.g., just a foraging area or attempting to reestablish a spawning population). Email from NMFS dated May 1, 2012.

Boston Harbor nor its tributaries are known spawning or nursery habitat; therefore, no spawning Atlantic sturgeon adults, eggs or larval life stages would be expected in the project area. Life stages that may appear in Boston Harbor are juveniles and adults. This was confirmed recently when a three foot long juvenile Atlantic sturgeon was observed this past February in the Charles River, a tributary to Boston Harbor (Boston Globe, February 20, 2012). Boston Harbor is not known as a concentration area for Atlantic sturgeon based on the FR 2010. However, the sighting of a juvenile in the Charles River would not be inconsistent with the life-history description above that immature Atlantic sturgeon travel widely once they leave their natal rivers. Age-1 and age-2 juveniles (called early juveniles) occur in the uppermost part of the estuaries, while older juveniles and subadults have a wider distribution, extending into more saline waters (Munro *et al*., 2007).

Dunton *et al.* (2010) discusses the results from five fish surveys of captured juvenile Atlantic sturgeon from Maine to North Carolina. Essential habitat for juvenile marine migrant Atlantic sturgeon can be broadly defined as coastal waters <20 meters in depth, and concentrated in areas adjacent to estuaries such as the Hudson River-NY Bight, Delaware Bay, Chesapeake Bay, Cape Hatteras, and the Kennebec River, Maine. This narrow band of shallow water appears to represent an important habitat corridor and potential migration path. Other authors reported by Dunton *et al.* (2010) have reported concentrations of Atlantic sturgeon in Long Island Sound, North Carolina, and bycatch data indicated concentrations in Massachusetts Bay, Rhode Island, New Jersey, and Delaware. None of this data indicates Boston Harbor as a concentration area for juveniles.

In addition, catches reported by Dunton *et al.* (2010) were greatest during the fall and spring months. Winter appears to be the next highest season of captured juvenile Atlantic sturgeon, with the summer months showing very low capture rates. However, the bycatch mortality estimates by Stein *et al.* (2004) and ASMFC (2007b) do not include the bycatch that occurs in estuaries and rivers, which are not covered by the observer programs. Many juveniles and adults stay in marine foraging areas from fall through spring and then migrate into the estuaries and rivers in the summer seeking thermal refuges (Stein *et al.*, 2004). While bycatch decreases in the ocean during the summer relative to fall through spring due to the migration to estuaries and rivers, bycatch likely increases in estuaries and rivers during that time.

Tagging studies of adult Atlantic sturgeon from the Hudson River (Erikson *et al.*, 2011) indicate that 13 of the 15 tagged fish that left the Hudson River remained within the mid-Atlantic Bight. Of the two fish that traveled outside the mid-Atlantic Bight, one traveled north to the terminal end of the Bay of Fundy, Nova Scotia and the other fish traveled south to the coast of Georgia. This would indicate that, in general, fish from the mid-Atlantic Bight do not travel to the Gulf of Maine and that most areas of concentration are located south of Cape Cod.

For the Gulf of Maine DPS of Atlantic sturgeon, FR 2012 lists the rivers of known habitat use by Atlantic sturgeon. Only one river located in Massachusetts, the Merrimack, is known to support Atlantic sturgeon. Boston Harbor is not known to have been used historically by Atlantic sturgeon (NMFS, 1998). Although the presence of foraging juvenile or adult Atlantic sturgeon in Boston Harbor during the summer months could occur, it is expected to be low based on the lack of sightings of Atlantic sturgeon in the summer, or in Boston Harbor in general, and that the only recent sighting of an Atlantic sturgeon was in the winter (February). It should be noted however, that due to the overlapping of the ranges of the five DPSs, any Atlantic sturgeon found in Boston Harbor could have originated from any of the five DPSs.

Therefore, although this species is not believed to forage or spawn in Boston Harbor or its tributaries, transient individuals may occasionally be found in these areas (as noted a juvenile was observed in the Charles River in February of 2012). However, there have been only anecdotal reports of Atlantic sturgeon being in the area, and no other confirmed reports other than the single fish observed in the Charles River in February, 2012 (Julie Crocker, NMFS, Personal Communication, October 17, 2012).

Any single sturgeon that may be found in Boston Harbor could have originated from any of the five DPSs due to the overlapping of the species range. However, due to the fact that the Gulf of Maine includes Boston Harbor, it is more likely that any sturgeon found in Boston Harbor would be from the GOM DPS, which is listed as threatened.

3.5 Historical and Archaeological Resources

3.5.1 Boston Harbor

The following narrative is culled from several investigations conducted on behalf of the USACE during planning for the Deep Draft Project Supplemental EIS/EIR. The subject studies include the following: *Remote Sensing Archaeological Survey and Geologic Interpretation, Boston Harbor Navigation Improvement Study, Boston Harbor, Boston, Massachusetts* prepared by the University of Massachusetts Archaeological Services (UMAS) (Mulholland *et al*., 2003); *Inspection of Magnetic Anomalies, Remote Sensing Archaeological Survey, Boston Harbor Deep Draft Navigation Improvement Study* prepared by the Public Archaeology Laboratory Inc. (PAL) (Robinson and Ford, 2003); and *Archaeological Subsurface Testing for the Boston Harbor Navigation Improvement Study, Boston Harbor, Boston, Massachusetts* prepared by UMAS (Lynch *et al*., 2004). More detailed information is available in these references. For purposes of this SEIS/EIR, a brief summation of the pre-Contact context and Historic Period Shipwreck background for the project area is included.

Pre-Contact Context - The Mystic, Neponset, and Charles Rivers of southeastern Massachusetts, which feed into the Massachusetts Bay Basin, were focal points for Native American occupation for more than 9,000 years. Dena Dincauze's survey of the archaeological resources in the greater Boston area, conducted in 1967-8, included the Boston Harbor islands and revealed the potential for significant archaeological data from sites within the harbor district. A later investigation of the 12 Harbor Islands by Luedtke resulted in the Boston Harbor Islands being nominated as a National Register Historic District. Luedtke's studies confirmed that the harbor islands contained the best-preserved concentration of Native American archaeological sites in the metropolitan Boston area. Currently, 60 documented sites spanning the Early Archaic to the Late Woodland Periods are distributed among 21 islands within the district (Robinson and Ford, 2003).

The Boston Basin area included two core areas of Native American settlement during the Contact Period: the Neponset core situated in the southern part of Massachusetts Bay and the Mystic core situated in the northern portion of the Bay. The Mystic River area included several smaller adjacent coastal river drainages such as the Malden, Pines, and Saugus Rivers. Larger lakes and ponds including Fresh and Spy Pond near the estuary, and Spot Pond and Crystal Lake in the Middlesex Fells formed part of the inland section of the Mystic core area. Contact era sites in the Boston Basin include isolated burial and cemetery locations. Contact Period burials from the Mystic River area are known from West Medford, Winthrop, Revere Beach, and Nahant (Robinson and Ford, 2003).

Historic Period Shipwreck Context - Many historic period shipwreck sites are known to exist in Boston Harbor, with a large number of probable sites within the study area. State and Federal Government compilations of vessel losses date only from the late 1800s and most of these are incomplete (Mulholland *et al.*, 2003).

In addition to any recorded vessel losses, many more were likely lost in Boston Harbor and simply not recorded. Many lost vessels are simply recorded as missing at sea, whether they had just left the harbor, were returning from a long voyage, or were blown in while trying to sail past the shore. In these cases, their actual fate can only be revealed through the efforts of underwater archaeologists. Such vessels would include small and large fishing boats, coasters, transoceanic merchantmen, and warships (Mulholland *et al*., 2003).

Because little is known of the early vessels, how they were made and used, and life aboard the early merchant vessels, the remains of any historic ship or boat would be archaeologically and historically significant on a local, regional, and national level. Historic shipwreck sites in New England are sources that provide archaeologists with information about shipping, vessel construction, lifeways of mariners, and also about early terrestrial life in New England (Mulholland *et al*., 2003).

Major changes took place in shipping during the latter 19th and early 20th centuries that would affect the number and size of boats and ships lost throughout the United States and especially the Boston Harbor region. During this time, the introduction of important technical and safety innovations allowed seamen to keep their vessels afloat. Engine power, rather than sail and oar, made nearshore voyages much safer. First, tugboats, and then internal engines could move a vessel away from danger. Navigation aids along the sides of channels, buoys and beacons, on-shore ranges, and electric navigation lights all assisted small and large vessels navigate through the harbor. Wireless telegraphy and later radio communications helped crews call for assistance and communicate with other vessels. Federal agencies such as the U.S. Life Saving Service and eventually the U.S. Coast Guard were established to search for and assist vessels in distress (Mulholland *et al.*, 2003).

All of the potentially significant historic period sites that might be found in the study area are likely to be water vessels and their contents. Since Boston Harbor has attracted almost all types of ships, boats, and barges throughout the centuries, the remains of any type of vessel used in the Atlantic during the last four centuries could conceivably be found. There is no complete listing of shipwreck files for the Boston region; however, even incomplete records or compilations suggest numerous types, sizes, and cargoes lost in Boston Harbor (Mulholland *et al.*, 2003).

Most recorded shipwrecks are large, transoceanic and coastal ships because until the late 19th century researchers and the media were primarily interested in larger vessels. Therefore, the potential for other, unknown smaller vessels in a larger, urban harbor is usually high. The remains of pre-20th century small oceanic and coastal vessels would be particularly significant due to their archaeologically important cargoes and hulls. However, since these vessels typically did not carry large amounts of iron, they are more difficult to discern through only the use of a marine magnetometer. Additional remote sensing data, including side scan sonar records, would need to be utilized in conjunction with magnetic anomalies to determine the existence of cultural resources (Mulholland *et al*., 2003).

3.5.2 Habitat Enhancement Sites

Beneficial use of the dredged material at several sites for hard-bottom habitat creation has been identified offshore in Broad Sound and Massachusetts Bay. No shipwrecks were observed during physical or biological sampling of the areas. Since these areas were not included in the original navigation improvement EIR/S, it is recommended that further evaluation of any beneficial use sites, outside of the previously surveyed Federal navigation channel footprint, be conducted as part of the recommended remote sensing archaeological survey. Once selected habitat areas are identified, these locations should be subject to further study and possible survey, if required, and in coordination with the MA Board of Underwater Archaeological Resources and the MA State Historic Preservation Office.

3.5.3 Massachusetts Bay Disposal Site and Industrial Waste Site

The Massachusetts Bay Disposal Site (MBDS) is the Federal base plan for disposal of all dredged material from the deep draft navigation improvement project. The MBDS was designated by the EPA for disposal of dredged material in 1992 after preparation of an Environmental Impact Statement. The former Industrial Waste Site (IWS) is located north of and overlaps the northern portion of the MBDS. The IWS was used from the 1940s to 1970s for disposal of a wide range of hazardous wastes. The site was also used for general disposal of dredged material, construction debris and other materials before and during that time. Remains of waste barrels are located throughout the IWS and most are concentrated in several areas just north of the MBDS. The USACE and EPA are investigating the potential to use the improvement project's millions of cubic yards of unconsolidated dredged materials to form a cap over these areas with a high density of barrels exposed on the seafloor. A side scan sonar survey of the IWS and portions of the MBDS was conducted by EPA Region I in July 2006. A number of shipwrecks were identified within the IWS and the MBDS in the area where those two sites overlap. Disposal activities, including any capping of areas of the IWS would be designed to avoid shipwrecks determined to be of archeological significance.

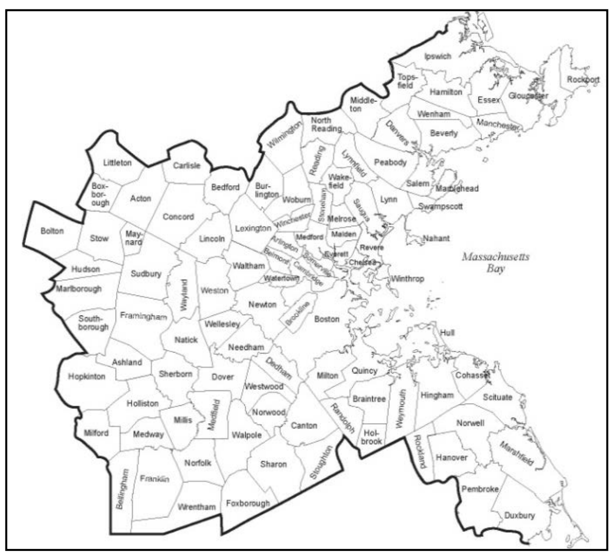
3.6 Air Quality

This section describes the air quality analysis study area, as well as the regulatory and environmental setting. The regulatory setting is described in terms of Federal and State requirements. The environmental setting is described in terms of climate and meteorological conditions, and existing ambient air concentrations.

3.6.1 Area of Analysis

The air quality impact analysis evaluates the existing conditions and impacts in and around Boston Harbor. Boston Harbor is located in the Metropolitan Boston Intrastate Air Quality Control Region (AQCR), which includes the City of Boston and its outlying suburbs.[5] It also extends to the State Territorial Seas Boundary, which is three nautical miles from the Massachusetts coastline.[6] The project area is also in an area designated as nonattainment or is subject to a maintenance plan. The relevant areas for the project are the Boston-Lawrence-Worcester (Eastern Massachusetts), MA moderate eight-hour ozone nonattainment area and the Boston area carbon monoxide attainment area with an associated maintenance plan. The Deep Draft Navigation Improvement Project (Project) dredging equipment, delivery and container trucks, and construction employee traffic would generate emissions within this air quality region. Figure 3-19 shows the air quality area of analysis.

Figure 3-19. Air Quality Area of Analysis



Source: Central Transportation Planning Staff, Boston Region Metropolitan Planning Organization Transportation Improvement Program Air Quality Conformity Determination Fiscal 2006-2010, 2006.

[5] Beverly, Brockton, Cambridge, Chelsea, Everett, Gloucester, Lynn, Malden, Marlborough, Medford, Melrose, Newton, Peabody, Quincy, Revere, Salem, Somerville, Waltham, Woburn.

[6] Marc Wallace, CDM Smith telephone conversation with Don Cooke, U.S. EPA Region 1, October 26, 2005.

3.6.2 Regulatory Setting

Ambient Air Quality Standards and Attainment Status

The Clean Air Act (Act) was passed in 1970 and was amended three times (including in 1990, 42 USC 7401 et seq.). The Act establishes the framework for modern air pollution control, and delegates primary responsibility for regulating air quality to the States, with oversight by the U.S. Environmental Protection Agency (EPA). EPA develops rules and regulations to preserve and improve air quality as minimum requirements of the Act, and delegates specific responsibilities to State and local agencies. EPA has identified seven specific pollutants (called criteria pollutants) that are of concern with respect to the health and welfare of the general public. The criteria pollutants are carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), particulate matter 10 micrometers or less in aerodynamic diameter (PM_{10}), particulate matter 2.5 micrometers or less in aerodynamic diameter ($PM_{2.5}$), and lead (Pb). Since publication of the Draft SEIS/EIR for the Project, EPA has promulgated several new National Ambient Air Quality Standards (NAAQS) for criteria pollutants, including an eight-hour average O_3 standard of 0.075 parts per million (ppm), a one-hour average NO_2 standard of 100 parts per billion (ppb), a one-hour average SO_2 standard of 75 ppb, and a rolling three-month average Pb standard of 0.15 micrograms per cubic meter ($\mu g/m^3$); EPA has also revoked the NAAQS for the PM_{10} annual averaging time as well as the NAAQS for the SO_2 annual and 24-hour averaging times. As can be noted in Table 3-11, both the 1997 eight-hour O_3 NAAQS and the 2008 eight-hour O_3 NAAQS are in existence at the time of this report. Although these changes have been approved, implementation of the new standards and monitoring of ambient conditions relative to these new standards is an ongoing process.

Similarly, the Massachusetts Department of Environmental Protection (MADEP) has established Massachusetts Ambient Air Quality Standards (MAAQS), which are equal to current or former NAAQS. Currently, Massachusetts has not adopted the 1997 or 2008 eight-hour average O_3 standards, the 24-hour and annual average $PM_{2.5}$ standards, the three-month Pb standard, the one-hour NO_2 standard, or the one-hour SO_2 standard. Table 3-12 lists the National and Massachusetts standards for criteria pollutants. The standards are divided into primary and secondary standards; the former are set to protect the public (i.e., human) health with an adequate margin of safety, and the latter to protect the public welfare (e.g., environmental quality, such as plant and animal life).

Areas that do not meet the NAAQS are called non-attainment areas. For non-attainment areas, the Act requires States to develop and adopt State Implementation Plans (SIPs). SIPs are air quality plans showing how air quality standards will be attained. SIPs, which are reviewed and approved by EPA, must demonstrate how the NAAQS will be achieved. Failing to submit a plan to EPA or secure approval from EPA could lead to denial of Federal funding (i.e., grants to States) and permits for activities such as highway construction and sewage treatment plants. In cases in which a SIP is submitted by the State but fails to demonstrate achievement of the standards, EPA is directed to prepare a Federal Implementation Plan for that area.

Table 3-12. National and Massachusetts Ambient Air Quality Standards

Pollutant	Averaging Period	NAAQS Primary	NAAQS Secondary	MAAQS	Compliance Method
Carbon monoxide	1 hour	35 ppm	NA	35 ppm	Not to be exceeded more than once/year
	8 hour	9 ppm	NA	9 ppm	Not to be exceeded more than once/year
Lead	Calendar quarter	NA	NA	1.5 µg/m^3	Not to be exceeded
	3 months	0.15 µg/m^3	0.15 µg/m^3	NA	Not to be exceeded
Nitrogen dioxide	1 hour	100 ppb	NA	NA	98th percentile averaged over 3 years
	Annual	0.053 ppm	0.053 ppm	0.05 ppm	Not to be exceeded
Ozone	1 hour	NA	NA	0.12 ppm	Expected number of days at standard of 1
	8 hour (1997)	0.080 ppm	0.08 ppm	NA	Annual average 4th highest
	8 hour (2008)	0.075 ppm	0.075 ppm	NA	Annual 4th highest over 3 years
PM_{10}	24 hour	150 µg/m^3	150 µg/m^3	150 µg/m^3	Not to be exceeded more than once/year
	Annual	NA	NA	50 µg/m^3	Not to be exceeded
$PM_{2.5}$	24 hour	35 µg/m^3	35 µg/m^3	NA	98th percentile averaged over 3 years
	Annual	15.0 µg/m^3	15.0 µg/m^3	NA	Not to be exceeded
Sulfur dioxide	1 hour	75 ppb	NA	NA	99th percentile averaged over 3 years
	3 hour	NA	0.5 ppm	0.5 ppm	Not to be exceeded more than once/year
	24 hour	NA	NA	0.14 ppm	Not to be exceeded more than once/year
	Annual	NA	NA	0.03 ppm	Not to be exceeded
Notes:					
ppb = parts per billion					
ppm = parts per million					
µg/m^3 = micrograms per cubic meter					

Sources: 310 CMR 6.00, April 2002.
40 CFR 50, July 2012.

As stated above, the Deep Draft Project is located in the Metropolitan Boston Intrastate AQCR (40 CFR 81.19). As shown in Table 3-13, the AQCR is considered to be in attainment with all NAAQS, with the exception of O_3 for which it is designated as "non-attainment" , although the area is considered "attainment/maintenance" for CO [7] (40 CFR 81.322). On December 12, 1994, the MADEP submitted a request to redesignate the Boston area CO non-attainment area to attainment for CO. As part of the redesignation request, MADEP submitted a maintenance plan, which included a base year (1993 attainment year) emission inventory for CO and a demonstration of maintenance of the CO NAAQS with projected emissions inventories to the year 2010 (U.S. EPA, *Massachusetts; Boston Harbor Area Carbon Monoxide Redesignation to Attainment*, December 2005). Maintenance plans are required to contain measures to keep newly redesignated attainment areas from backsliding into non-attainment. Therefore, stringent emission thresholds continue to apply to Federal actions in maintenance areas.

Table 3-13. Attainment/Non-Attainment Designations for Metropolitan Boston

Pollutant	Designation
Carbon Monoxide	Attainment/Maintenance
Lead	Attainment
Nitrogen Dioxide	Attainment
Ozone (1997 8-hour)	Non-attainment
Ozone (2008 8-hour)	Attainment
Particulate Matter (<10 microns)	Attainment
Particulate Matter (< 2.5 microns)	Attainment
Sulfur Dioxide	Attainment

Source: U.S. EPA, 2012.

Massachusetts was designated non-attainment for the one-hour O_3 NAAQS State-wide, with a classification of "serious." Accordingly, MADEP was required to demonstrate attainment in Eastern Massachusetts and proposed to attain the one-hour NAAQS by December 15, 2007 (MADEP, Final Eastern Massachusetts 1-Hour Ozone NAAQS Attainment Demonstration SIP, September 2002). However, EPA revoked the one-hour NAAQS on June 15, 2005. Subsequently, Eastern Massachusetts was designated non-attainment for the 1997 eight-hour O_3 NAAQS, with a classification of "moderate." On May 29, 2012, EPA issued a final rule (77 FR 31496) with an effective date of June 28, 2012, finding that Eastern Massachusetts attained the 1997 eight-hour O_3 NAAQS by the applicable attainment date of June 15, 2010. It should be noted that as part of that rule, EPA indicated its finding did not constitute a redesignation to attainment for the 1997 eight-hour O_3 NAAQS. Therefore, the area remains a moderate non-attainment area for the 1997 eight-hour O_3 NAAQS until such time as the area is redesignated to attainment for the 1997 eight-hour O_3 NAAQS or the 1997 eight-hour O_3 NAAQS is revoked. On May 21, 2012, EPA issued a final rule (77 FR 30088), with an effective date of July 20, 2012, with the area designations for the 2008 eight-hour O_3 NAAQS. With the exception of Dukes County, Eastern Massachusetts is designated as attainment for the 2008 eight-hour O_3 NAAQS. As of the time of writing this report (March 2013), the Deep Draft Project would be subject to addressing the general conformity requirements for O_3 precursors, NO_x and VOC because the area remains a non-attainment area for the 1997 eight-hour O_3 NAAQS.

[7] Attainment means there are no recorded exceedances of the NAAQS in the area; non-attainment means exceedances of the NAAQS have occurred in the area; and attainment/maintenance means the area was non-attainment but now is in attainment and is required to implement additional measures through a maintenance plan to remain in attainment.

General Conformity

Section 176 (c) of the Act requires any entity of the Federal government that engages in, supports, or in any way provides financial support for, licenses or permits, or approves any activity to demonstrate that the action conforms to the applicable SIP required under the Act. In this context, conformity means that such Federal actions must be consistent with a SIP's purpose of eliminating or reducing the severity and number of violations of NAAQS and achieving expeditious attainment of those standards. In 1993, the EPA promulgated regulations prescribing general criteria and procedures for analysis of transportation and general conformity which apply in non-attainment and maintenance areas only. Since that date, most if not all State and local air pollution control agencies have adopted conformity requirements at least as stringent as the EPA regulations.

EPA promulgated two regulations to address the conformity requirements of the Act. On November 24, 1993, EPA issued final transportation conformity regulations at 40 CFR 93 Subpart A to address Federally assisted transportation plans, programs, and projects. These regulations have been revised several times since they were first issued to clarify and simplify them. On November 30, 1993, EPA issued final general conformity regulations at 40 CFR 93 Subpart B for all Federal activities except those covered under transportation conformity. On April 5, 2010, EPA promulgated revised general conformity requirements at 40 CFR 93 Subpart B (75 FR 17254), with an effective date of July 6, 2010, to simplify and add flexibility to the requirements and reduce paperwork burdens.

The general conformity regulations apply to a Federal action (in this case, the Federal portion of the Deep Draft Project) if the total of direct and indirect (only for actions that the Federal agency has control over) emissions for a criteria pollutant from the action equals or exceeds the de minimis thresholds. By requiring an analysis of direct and indirect emissions, EPA intended the Federal agency to make sure that only those emissions that the Federal agency can practicably control, and that are subject to that agency's continuing program responsibility, will be reasonably controlled.

The 2010 revisions to the general conformity rule made several notable changes to the original rule. For example, the regional significance test was removed from the rule. EPA also added an allowance for Federal agencies to work with States in developing facility-wide emissions budgets for inclusion in the respective SIPs. Furthermore, the rule now allows for interpollutant trading of precursor emissions as offsets. While the rule generally requires that emissions offsets and mitigation occur in the calendar year when the Federal action takes place, the 2010 revision would allow alternate schedules for mitigating emission increases in future years (beyond project implementation) if there would be a long-term reduction in emissions from the Federal action. The reader is directed to the April 5, 2010, Federal Register notice for a more detailed discussion of these and other revisions to the rule.

The Deep Draft Project is subject to the general conformity rule since the U.S. Army Corps of Engineers is the lead Federal agency (i.e. Federally funded). For the Deep Draft Project, the de minimis thresholds for general conformity analysis are presented in Table 3-14.

In addition to projects where the total of direct and indirect emissions of a pollutant are projected to be less than the de minimis levels, the following types of projects are also exempt from a conformity analysis:

- Actions which carry out plans which previously have been determined to conform to the SIP;
- Special actions where conformity is not required;
- Actions where the emissions are not reasonably foreseeable; and
- Actions which are presumed to conform (e.g., maintenance dredging).

In order for a Federally-supported action to conform to the SIP, the total of direct and indirect emissions associated with the action must be in compliance or consistent with all applicable requirements in the SIP. If a general conformity determination is required for a Federal action, the action must meet certain criteria spelled out in the regulations. These include either:

- Having the emissions specifically identified and accounted for in the SIP's attainment or maintenance demonstration; or
- Fully offsetting the emissions within the non-attainment or maintenance area, or a nearby non-attainment or maintenance area that impacts the area where the project is located; or
- Including the emissions within the SIP's emissions budget; or
- Conducting dispersion modeling analyses to demonstrate that the emissions do not cause or contribute to any new violation of the NAAQS and do not increase the frequency or severity of any existing violation of the NAAQS.

Table 3-14. General Conformity De Minimis Thresholds for the Eastern MA Area

Pollutant	Federal Status	De Minimis Value (tons/yr)
Nitrogen Oxides (NO_x) (as an Ozone Precursor)	Non-attainment, moderate 8-hour Ozone	100
Carbon Monoxide (CO)	Attainment/Maintenance	100
Volatile Organic Compounds (VOCs) (as an Ozone Precursor)	Non-attainment, moderate 8-hour Ozone	50

Sources: U.S. EPA 2010, 2010

A conformity analysis must follow general procedures outlined in the regulations. For example, the Federal agency must employ the latest planning assumptions, based on projections of population, employment, travel, and congestion, approved by the local metropolitan planning organization (MPO). Also, the Federal agency must use the latest and most accurate emission estimation methods approved by EPA. Further, if the Federal agency performs any dispersion modeling, it must be consistent with EPA modeling guidance. In addition, the Federal agency must perform the analysis using the total of direct and indirect emissions from the action estimated for the mandated attainment year, the year of maximum emissions, and any year for which the SIP specifies an emissions budget. EPA's revised general conformity rule added provisions on how to address emissions occurring beyond the time period covered by the applicable SIP.

Because Eastern Massachusetts is still designated non-attainment under the 1997 eight-hour O_3 NAAQS, it would still be necessary to address general conformity for the Deep Draft Project with respect to O_3 precursor compounds (oxides of nitrogen and volatile organic compounds) absent a further change in status. However, EPA plans to promulgate a rule possibly by July 2013 to implement the 2008 eight-hour O_3 NAAQS, and it is anticipated that that rule would also revoke the 1997 eight-hour O_3 NAAQS[8]. This is a reasonable assumption because EPA has set precedent for revoking older standards when new standards are implemented. For example, EPA's rule to implement the 1997 eight-hour O_3 NAAQS revoked the one-hour O_3 NAAQS in most areas of the U.S. one year after area designations were promulgated under the 1997 eight-hour O_3 NAAQS. In addition, general conformity under the one-hour O_3 NAAQS no longer applied in former one-hour O_3 non-attainment areas one year after area designations were promulgated under the 1997 eight-hour O_3 NAAQS. Assuming EPA takes the same approach to implement the 2008 eight-hour O_3 NAAQS, then as long as the USACE does not take or start the Federal action[9] prior to revocation of the 1997 eight-hour O_3 NAAQS, it would not be necessary to address general conformity for the O_3 precursors.

[8] Letter dated November 9, 2012, from Timothy L. Timmermann, EPA/Region 1 to John R. Kennelly, USACE.
[9] According to 40 CFR 93.152, "take or state the Federal action" means the date that the Federal agency signs or approves the permit, license, grant, or contract or otherwise physically begins the Federal action that requires a conformity evaluation.

It should be noted that general conformity with respect to CO would continue to apply to the Deep Draft Project notwithstanding the method or timing of the implementation of the 2008 eight-hour O_3 NAAQS.

3.6.3 Environmental Setting

The climatic characteristics of the Boston area (42.4°N, 71.03°W) include a variety in seasonal weather throughout the year with a large range in temperatures but with an equitable distribution of precipitation. Annual average daily temperatures range from about 26°F (January) to 72°F (July) and the area receives an average of about 54.1 inches per year of precipitation in the form of rain and snow. Winds are predominantly out of the west (prevailing westerlies). However, sea breeze effects are a common diurnal occurrence near the coastline during the spring and summer months. Although infrequent, violent storms (tornadoes, tropical storms and hurricanes) are a concern during the spring, summer and fall months. Nor'easters are more frequent than the other types of violent storms and they often occur during the fall and winter months (data based on 1982 – 2011 average weather observations at Blue Hill Observatory in Milton, MA and retrieved from http://www.ncdc.noaa.gov/oa/climate/research/cag3/w7.html, accessed on November 16, 2012).

3.6.4 Existing Air Quality

The quantitative description of existing air quality conditions is based upon the EPA's AIRDATA internet-based database and supplemented with annual MADEP air quality reports. Table 3-15 shows the relevant pollutant concentration metrics as measured at the closest monitoring sites to the project area for each pollutant. Monitoring data available for the most recent three-year period (2009 - 2011) are presented. The monitoring data indicate that criteria pollutant concentrations, with the exception of the 8-hour average O_3 concentrations, meet the applicable NAAQS and MAAQS at the monitoring stations near the project area. The 2008 eight-hour O_3 NAAQS was exceeded 3, 1, and 1 days in 2009, 2010, and 2011, respectively.

Table 3-15. Background Pollutant Concentrations

Pollutant	Averaging Period	2009 (1)	2010 (2)	2011 (3)	Metric	NAAQS/ MAAQS
Carbon Monoxide	1 hour	2 ppm	3 ppm	2 ppm	2nd highest	35 ppm
	8 hour	1 ppm	2 ppm	1 ppm	2nd highest	9 ppm
Lead	Calendar quarter	0.01 μg/m³	0.03 μg/m³	0.02 μg/m³*	Highest 24-hour	1.5 μg/m³
	3 months	ND**	ND	ND	Highest rolling 3 months	0.15 μg/m³
Nitrogen dioxide	1 hour	54 ppb	52 ppb	53 ppb	98th percentile	100 ppb
	Annual	0.020 ppm	0.019 ppm	0.020 ppm	Mean	0.053 ppm
Ozone	1 hour	0.086 ppm	0.087 ppm	0.082 ppm	2nd highest	0.120 ppm
	8 hour	0.080 ppm	0.074 ppm	0.074 ppm	2nd highest	0.075 ppm
PM_{10}	24 hour	43 μg/m³	37 μg/m³	38 μg/m³	2nd highest	150 μg/m³
	Annual	21 μg/m³	16 μg/m³	17 μg/m³	Mean	50 μg/m³
$PM_{2.5}$	24 hour	24 μg/m³	24 μg/m³	24 μg/m³	98th percentile	35 μg/m³
	Annual	10.2 μg/m³	10.0 μg/m³	10.3 μg/m³	Mean	15.0 μg/m³
Sulfur dioxide	1 hour	23 ppb	21 ppb	19 ppb	99th percentile	75 ppb

	3 hour	ND	ND	ND	2nd highest	0.5 ppm
	24 hour	0.01 ppm	0.01 ppm	0.01 ppm	2nd highest	0.14 ppm
Notes:						
*Calendar quarter value not available; data point represents highest 24-hour average.						
** ND = no data calculated for this averaging period.						
ppb = parts per billion						
ppm = parts per million						
$\mu g/m^3$ = micrograms per cubic meter						

Sources: (1) Data from "Commonwealth of Massachusetts 2009 Air Quality Report", Massachusetts Department of Environmental Protection, August 2010.
(2) Data from "Commonwealth of Massachusetts 2010 Air Quality Report", Massachusetts Department of Environmental Protection, June 2011.
(3) Data from "Massachusetts 2011 Air Quality Report", Massachusetts Department of Environmental Protection, August 2012.
(4) http://www.epa.gov/airdata/, accessed November 16, 2012.

3.7 Socioeconomic Environment

Boston Harbor is an active harbor with many users. These users include recreational boaters, shipping, and fishing interests. In addition, the towns surrounding the harbor are home to a large and diverse group of people. Additional information is provided below.

3.7.1 Shipping

Improvement dredging is critical to the economic viability of the region and to ships reaching their destination in Boston safely, reliably and without significant delays. In the last few years the Port of Boston handles approximately 22 million tons of cargo-including more than one million tons of containerized cargo and 12,000 automobiles. In addition, 107 passenger ships called on the Port of Boston carrying 310,238 cruise passengers in the year 2011. In recognition of the importance of the marine industry to the State, the Commonwealth has designated certain coastal areas around the State as Designated Port Areas (DPAs). Four DPAs partially or completely fall within the boundaries of the City of Boston. They are: 1) the Chelsea Creek DPA; 2) the East Boston DPA; 3) the Mystic River DPA; and 4) the South Boston DPA. DPAs benefit the greater Boston region as well as the Commonwealth of Massachusetts in a variety of ways.

These benefits, as described by The Boston Harbor Association (2003), include:

- Provide direct economic benefits and job creation through industries including shipping, cruise activity, and fishing processing;
- Generate an indirect multiplier effect on the regional economy through increased opportunities for importing and exporting goods;
- Contain vital regional infrastructure, including key components of the region’s energy supply and preponderance of road salt;
- Protect and maintain the character of Boston’s working port, which serves as both
    - a key source of the city’s historical identity, and
    - a means to differentiate its “sense of place” amidst a landscape of increasingly homogenized American cities; and
- Allow flexibility in responding to unforeseen future marine industrial demands.

The importance of the Designated Port Areas and the attendant result is clear. Each year the working port generates \$2.4 billion in economic benefit for the region, directly or indirectly employs over 34,000 workers, provides an economic edge for countless regional businesses, furnishes critical regional infrastructure, and protects and maintains Boston’s maritime character and diverse workforce (Massport, 2005). The support of all marine businesses of all sizes – from shipping terminals to tugboats and salvage companies - is vital to the economy. DPAs provide a place of affordable rent and financial viability. Without DPAs, these maritime users could fail, threatening the foundations and vitality of the working port, as well as the regional economy that is dependent on its use (The Boston Harbor Association, 2003).

3.7.2 Commercial Fishing

Commercial finfishing does not occur within Boston Harbor due to the shipping activity and shallow depths. In contrast, lobsters are commercially fished within Boston Harbor. Although it is illegal to do so, due to potential impacts to navigation (Section 10 of the Rivers and Harbor Act of 1899), lobster fishing also occurs in the navigation channels. The amount of commercial lobster activity is dependent on the season and the movement of these animals. Questionnaires were sent to commercial lobstermen in 2005 in which they were requested to voluntarily provide information on where and when they fish in Boston Harbor. The following discussion is based on the information received from these surveys. For survey purposes, Boston Harbor was divided into seven areas; five of those areas are pertinent to this project. See Table 3-16 for area locations.

Table 3-16. Commerical Lobster Fishing Survey Locations

Area	Location
A	Mystic River
B	Chelsea River
C	Main Ship Channel – From Ted Williams Tunnel Seaward to Spectacle Island
D	Main Ship Channel – President Roads Anchorage and President Roads Ship Channel
E	Main Ship Channel – Broad Sound North Entrance Channel

No commercial lobstering, or very little, was reported in either the Mystic or Chelsea Rivers between August and the end of April. Minor lobstering activity was noted in May, June and July for these two rivers. Areas C, D, and E are fished year around, but at varying intensities. More lobstermen fish the Main Ship Channel (areas C, D, and E) from May through November with a peak in the summer months and early fall. Area D, the President Roads Anchorage and Channel, generally report the most lobstermen compared to the other two Areas C and E. Area C, below the Ted Williams Tunnel, reported more lobstermen than Area E, Broad Sound Entrance Channel, between March and August. The reverse occurred in Areas C and E during the months of September through February (i.e. more lobstermen fished Area E than Area C during these months). If the number of lobstermen fishing in an area is indicative of the lobster population, then it would appear that the lobsters tend to move out into the open water areas during the cooler months of the year.

3.7.3 Population

Boston Harbor is located in a metropolitan area bordered by the cities of Boston, Chelsea, and Revere, all located within Suffolk County. Boston is the capital of the Commonwealth of Massachusetts as well as the largest city in the State with a population of 617,594. The population of Boston makes up 86% of the total population of Suffolk County.

Suffolk County has a diverse and dense population compared to the rest of the State. According to the 2010 U.S. Census Bureau, 56 percent of the Suffolk County population is White, 22 percent African American, 20 percent Hispanic and eight (8) percent is Asian. The number of families and individuals that live below the poverty line in Suffolk County is higher than the State average; however the number of children less than 18 years of age is slightly below the State average. See Table 3-17 below for a comparison with the rest of the State.

Table 3-17. Population Data for the Commonwealth of Massachusetts and Suffolk County

Data	Massachusetts	Suffolk County
Total Population	6,547,629	722,023
White (%)	80.4	56.0
Black or African American (%)	6.6	21.6
Asian (%)	5.3	8.2
Hispanic (%)	9.6	19.9
Density/Square Mile of Land	840	12,416
Individuals below the Poverty Line (%)	10.7	20.8
Children under 18 Years of Age (%)	21.3	17.6

Source: 2010 and 2011 U.S. Census Bureau

3.8 Harbor Infrastructure

In addition to the many users of the harbor, the harbor also supports several important infrastructure components critical to the metropolitan area. A discussion of the tunnel crossings, subway crossings, and utility cable crossings in Boston Harbor is provided below.

3.8.1 Harbor Tunnel Crossings

There are four tunnels crossing beneath the Main Ship Channel; one subway tunnel and three highway tunnels. The Ted Williams Tunnel I-90 (TWT) is the most seaward crossing, although it is located upstream of the Massport Marine Terminal in South Boston. The three remaining tunnels upstream of the TWT are the Massachusetts Bay Transportation Authority's Blue Line subway tunnel, which connects downtown Boston with Logan Airport, East Boston and the City of Revere, and the paired Callahan and Sumner Tunnels connecting downtown Boston with East Boston which carries US Route 1A beneath the harbor.

3.8.2 Sewer Tunnel Crossings

The Massachusetts Water Resources Authority (MWRA) operates the metropolitan area's water and sewer facilities. The MWRA has four sewer lines that cross beneath the harbor channels. All four tunnels were bored through bedrock. A large sewer force main crosses the harbor connecting MWRA facilities on Nut Island and Deer Island. The line crosses beneath the President Roads reach of the Main Ship Channel just west of the Outer Confluence. The main outfall for MWRA's new Deer Island sewage treatment passes beneath the Broad Sound North Entrance Channel on its route seaward to the diffuser array located in about 105 feet of water about 8.8 miles east of Deer Island.

The Main Drainage Tunnel for the City of Boston, completed in 1959, is a deep bore cut in bedrock, about 300 feet below MLW, crossing from approximately beneath Fort Independence in South Boston north-northeasterly under the Main Ship Channel and north of the Anchorage to Deer Island. The Chelsea Drainage Tunnel is also a deep bore cut in bedrock, from Chelsea southeasterly beneath the Chelsea River Channel, East Boston and Logan Airport, to Deer Island.

3.8.3 Utility Crossings

There are a number of utilities crossing the harbor, particularly in the upper reaches. Utilities located beneath the Reserved Channel are of particular noteworthy importance. MWRA's main power supply line to its Deer Island Treatment Plant runs from the South Boston generating plant on the Reserved Channel, underneath the Reserved Channel and Main Ship Channel, and across the flats southeast of Logan International Airport to Deer Island. These 115KV hydraulically cooled power lines were placed in a trench dredged beneath the channels and jetted into the harbor bottom in areas outside the channels.

4. ENVIRONMENTAL CONSEQUENCES

4.1 No Action Alternative

The No Action Alternative is required to be evaluated as prescribed by NEPA and the Council on Environmental Quality (CEQ). Similarly, the MEPA regulations require projects to evaluate a No-Build Alternative. The No Action (or No-Build) Alternative serves as a baseline against which the proposed action can be evaluated. Evaluation of the No Action Alternative involves assessing the environmental effects that would result if the proposed action does not take place.

In this case, the No Action Alternative means that the Federal navigation channel in Boston Harbor would not be deepened; existing conditions would persist, and current practices (e.g., light-loading, tidal delays, etc.) would continue. If deep draft vessels cannot safely and efficiently transit the harbor to access the Port terminals, significant economic and potential environmental impacts could result. Failure to deepen the port to its optimum depth could result in some ships bypassing the port altogether. It could also increase the need for lightering as well as the likelihood of a grounding, both of which could result in adverse environmental consequences.

Without the project, more truck traffic would be required to transport goods from the Port of New York/New Jersey (PONYNJ) to New England. This would result in a continued decrease in air quality from the additional truck traffic miles to transport goods from PONYNJ. With the proposed project, there would be a slight increase in truck traffic and associated air emissions from the proposed project within the immediate Boston metropolitan area. However, the overall regional air quality in New England would improve. This is because there would be a corresponding decrease in truck traffic miles transporting goods from the Port of New York/New Jersey (PONYNJ) throughout New England (in particular northern New England).

The following potential environmental impacts could be avoided if the proposed project is not constructed: temporary turbidity impacts from deepening the channels, temporary disruption of benthic habitat and EFH in the navigation channels, as well as potential disruption of lobster habitat in the channels, and potential impacts to fish from blasting. Temporary disruption of benthic and EFH would also be avoided at the disposal site if the project does not proceed.

Potential environmental benefits that would not accrue from the proposed project include the benefit of better regional air quality gained through more efficient regional transport of waterborne commernce in and out of New England, the regulated removal of (potentially contaminated) silt removal and reduction of silt resuspension associated with vessel propwash, reduction of risks to the aquatic environment associated with container vessels lightering and/or riding the tides, and reduction of ship calls as pertains to potential marine mammal ship strikes. In addition, the potential permanent creation of hard bottom habitat for rock reef species, and the covering of submerged chemical waste, low level radioactive and debris barrels at the Industrial Waste Site (IWS), would be lost. These benefits are discussed in more detail below.

4.2 General Impacts of Dredging in Boston Harbor

The primary impacts of dredging are generally attributable to suspended plumes which result from both dredging and disposal operations. Sediments and other materials suspended in a water body are referred to as total suspended solids (TSS) and are measured in milligrams of solids per liter of water (mg/L). Turbidity, a related parameter, is an expression of the optical properties of water that cause light to be scattered and absorbed rather than transmitted in a straight line. During dredging, a plume would be created containing elevated levels of suspended sediments and associated contaminants. The three broad categories of sediment plume impacts are physical, chemical and biological. Sediments temporarily suspended during dredging and disposal can affect aesthetics, light penetration, feeding by benthic organisms and fish, and, at very high levels, can destroy or injure fish and benthic organisms.

Therefore, concentrations of TSS resulting from dredging and disposal operations, over time, can be predicted either through modeling or previous monitoring to assess potential impacts. Contaminants within the sediments to be dredged may dissolve when the dredged material is exposed to the water column that can kill or impair marine animals if they are exposed to high concentrations over a sufficiently long period of time. The following sections describe the potential impacts from dredging and disposal to the physical, chemical and biological environment, and the lessons learned from monitoring during the BHNIP.

The proposed project would dredge between approximately 10 to 11 million cy of dredged material to achieve the -47-foot Main Ship Channel and -51-foot deep Broad Sound North Channel. In addition, up to about 1,000,000 cy of rock would also be removed. Blasting impacts are described below in Section 4.2.5. The project is expected to take about three years to complete; approximately 26 months to remove rock by blasting could be needed. Additional rock boring and probes in the Design Phase will determine the amount and location of rock in Boston Harbor to be removed.

4.2.1 Physical Impacts

All types of dredge equipment create some form of sediment plume in the water column. The nature, degree, and extent of dredged material dispersion around a dredging operation are controlled by many factors (Barnard, 1978 in Herbich and Brahme, 1991). These factors include the characteristics of the dredged material such as its size distribution, solids concentration, and composition; the nature of the dredging operation such as the dredge type and size; and the characteristics of the hydrologic regime in the vicinity of the operation, including salinity and hydrodynamic forces (waves, currents, etc.). The relative importance of these factors varies from site to site. The amounts of sediments suspended during dredging are generally highest in the immediate vicinity of the dredging operations and return to background levels within a short distance of the dredging site based on monitoring results from Boston Harbor.

Bohlen *et al*. (1979), estimated that 1.5% to 3.0% of the volume of substrate (fine-grained sands and silts) contained in an open clamshell dredge bucket is introduced into the water column. However, a number of operational variables, such as bucket size and type (open or enclosed), prohibiting scow overflow, volume of sediment dredged per cycle, operator experience, hoisting speed, and hydrodynamic conditions in the dredging area can significantly affect the quantity of material suspended (LaSalle, 1988; Lunz *et al*., 1984). Sediment resuspension from clamshell dredges can be reduced by using an enclosed clamshell bucket or by slowing the raising or lowering of the bucket through the water column. The latter reduces the production rate of the dredge (Hayes, 1986), increases air emissions and prolongs the time at the dredge site. An enclosed bucket was used to dredge the silty material which was unsuitable for open water disposal during the BHNIP.

A substantial amount of information about TSS concentrations and turbidity plumes was collected during dredging and disposal of Phase 1 (Conley Terminal) and Phase 2 of the Boston Harbor Navigation Improvement Project (BHNIP), as well as the Boston Inner Harbor Maintenance Dredging Project (IHMDP). This information, in conjunction with information from the New Haven Harbor and Providence River dredging projects, was used to predict anticipated turbidity and TSS impacts to the water column in the area of the dredging operations for this Deep Draft Project (see below). As minimal, if any disposal of silty material is expected, only a brief description of potential disposal impacts based on Boston Harbor monitoring results is included below.

New Haven

Monitoring of dredge induced suspended sediment concentrations was conducted at New Haven Harbor under the Army Corps of Engineers, Disposal Area Monitoring System (DAMOS) Program to address concerns relative to winter flounder spawning grounds near the Federal channel (USACE, 1996). Dredging at New Haven Harbor was conducted with an enclosed bucket. The sediments from

New Haven Harbor are siltier than the sediments to be dredged in Boston Harbor. The parent material to be dredged in Boston Harbor is composed of either Boston blue clay or glacial till material. Both types of material are less likely to be suspended for long distances compared to silt. The two major objectives of the New Haven monitoring were to: 1) establish the background suspended solids concentration before and after dredging, and 2) document the movement of the dredge plume relative to fisheries resource areas such as winter flounder spawning grounds.

The results of the acoustic survey revealed that the dredge-induced sediment plume did protrude into the shoal areas to the east and west of the navigation channel. These excursions onto the shoals only occurred when the dredge was in the immediate vicinity. The DAISY (Disposal Area In-Situ System), which was deployed on the eastern end of the winter flounder spawning area, also showed elevated suspended materials concentrations attributable to the dredge operating in the upper reaches of the harbor. The time series of the DAISY data showed numerous aperiodic short duration spikes of 100 mg/L. The observed concentrations were an order of magnitude higher than the preceding background concentrations. However, in the last half of the deployment, while the dredge was located well south of the DAISY site, there were several long duration (1-3 days), and very high perturbations. During these events concentrations reached 700 mg/L that could not be related to the dredging operation. Evidence from the meteorological data and wastewater effluent records indicate that these events were likely the result of winds and wind-generated waves, alone or in combination with discharges from wastewater treatment plant outfalls.

Based on these findings, dredged induced sediment resuspension was found to be a minor perturbation to the much longer duration, larger amplitude events associated with wind, wind-waves, and effluent discharges from outfalls. The effects of dredge related spikes in suspended sediments on the winter flounder spawning grounds, and the regional water quality in general, appear to have been limited in duration and of relatively low amplitude (USACE, 1996).

Boston Harbor

Monitoring was conducted for dredging of the surface silty material during construction of the first confined aquatic disposal (CAD) cell for Phase 1 of the BHNIP. This monitoring included: 1) documentation of the spatial and temporal distribution of the sediment plume for the four extremes of tidal currents (high water slack, maximum ebb, low water slack, maximum flood) on two days within the first week of dredging; 2) collection of water samples from the lower half of the water column at two locations – 1,000 feet up current of the dredging and 500 feet down current from the dredging; and 3) analysis of water samples for TSS. Additional parameters (turbidity, DO, arsenic, and copper) were analyzed when dredging the parent material.

During dredging, turbidity measurements ranged from 3-5 NTU (Nephelometric Turbidity Units) at the reference station 1,000 feet up current from dredging the silty surface material using an environmental bucket. Turbidity was only slightly elevated at the station 500 feet down current of the dredging ranging from 4-11 NTU. TSS ranged from 4-5 mg/L at the reference station and from 5-9 mg/L at the down current station. No plume was visible at the surface outside the immediate area of the dredging operation, and no significant plume was detected in the water column (ENSR, 1997).

Suspended solids in the water column were visible for a greater distance when dredging the parent material, which contained comparatively higher amounts of fine clay, during CAD cell construction with an open clamshell bucket (ENSR, 1997). The parent material dredged from the CAD cell is a better indication of the material proposed to be dredged for this Deep Draft Project. Turbidity measurements ranged from 3-7 NTU at the reference station 1,000 feet up current of the dredging, while 300 feet down current of the dredging turbidity ranged from 8-56 NTU. TSS ranged from 8-60 mg/L at the reference station and from 19-48 mg/L at the down current station. All values were well below the 200 mg/L performance criteria established by the WQC for a point 500 feet down current of the dredging in the navigation channel.

Monitoring of the turbidity plume associated with dredging of silty maintenance material (using the environmental bucket) was performed on one occasion during Phase 2 of the project in September 1998 (USACE/Normandeau, 1998b). Mapping of the turbidity associated with use of the environmental bucket to dredge maintenance (silty) material in Boston Harbor was required as part of the Water Quality Certificate (WQC) for the BHNIP. Monitoring was performed during periods of high and low water slack and during maximum flood and ebb tides in the Mystic River. The mapping required generation of plan views of turbidity at mid-depth and near bottom extending from 300 feet up current to 1,000 feet down current of continuous dredging operations. Generation of a cross section of turbidity located 300 feet down current of the dredging was also required.

Near bottom turbidity values were highest for all measurements with values no higher than 100 NTU approximately 300 feet down current of the dredging operation. Mid-depth turbidity was much less, and all values returned to background levels (10-20 NTU) between 600 and 1,000 feet down current (ENSR, 2002). A separate monitoring trial was performed when the dredging contractor (Great Lakes Dredge and Dock Company [GLDD]) proposed to use their own environmental bucket (in addition to the approved Cable Arm® bucket).

The WQC for the BHNIP required the use of a closed environmental bucket for maintenance dredging. The bucket manufactured by Cable Arm® was specified as acceptable, and other closed buckets could be used if they could meet specified performance standards of suspended solids not to exceed 25 mg/L over background and turbidity not to exceed background by more than 30% at 75 feet from the dredge.

Monitoring of GLDD's closed environmental bucket was performed in September 1998 (USACE/Normandeau, 1998b). The bucket met the performance standard for total suspended solids, but not for turbidity. It was noted that the turbidity standard (not to exceed 30% above background at 75 feet) was a much more stringent standard for the conditions of this test when compared to the TSS. With a background turbidity of three NTU, the resulting performance threshold at 75 feet was only four NTU. Consequently, the MA Department of Environmental Protection (MA DEP) ultimately allowed the use of the environmental bucket based on its performance as related to suspended solids (ENSR, 2002). A more detailed bucket study performed by the USACE Engineer Research Development Center was also conducted in August 1999 during the BHNIP.

A conventional (open-faced) clamshell bucket, a Cable Arm® clamshell bucket, and an enclosed environmental clamshell bucket were evaluated relative to sediment resuspension and loading characteristics under similar operating and environmental conditions in Boston Harbor during August 1999 (Welp, *et al*., 2001). Monitoring was conducted to characterize each bucket's near and far field sediment resuspension characteristics.

Sediment resuspension data consisted of suspended solids samples and turbidity measurements collected within 26 feet (in the horizontal plane) of the bucket position (near field) and 82 to 1312 feet from the dredge (far field). Near field data included continuous turbidity measurements taken at four depths (5, 18, 26, 34.5, and 38 feet in a water depth of about 38 feet) and discrete water samples were analyzed for TSS. Far field data included indirect turbidity observations using a Broad Band Acoustic Doppler Current Profiler (BBADCP), and direct turbidity, conductivity, temperature measurements, and direct water samples for TSS analysis collected by the Battelle Ocean Survey System (BOSS). The BBADCP collected acoustic measurements of the suspended sediment plume to produce images of the relative distribution of suspended-sediment concentrations in the water column.

Near field monitoring results showed that the conventional bucket generated the highest turbidity and suspended sediment, probably because of loss of sediments from the open top. The conventional bucket distributed turbidity throughout the water column. The TSS ranged from 105 mg/L in the middle of the water column to 455 mg/L near the bottom. Average turbidity varied a bit less and ranged from 46 to 64 FTU (formazin turbidity units). Although both the Cable Arm® and the GLDD enclosed bucket leaked substantially through the seals and grated vents in the upper part of the buckets, neither resulted in as much turbidity or TSS as the conventional bucket. The depth-averaged turbidities were 57 FTU, 31 FTU and 12 FTU for the conventional bucket, Cable Arm® and GLDD enclosed buckets respectively. The depth averaged TSS values for the conventional bucket, Cable Arm® and enclosed buckets were, respectively, 210 mg/L, 31 mg/L and 50 mg/L. The most significant difference was in the middle water column where turbidity values were substantially less than at the bottom or near the surface. Turbidity for the Cable Arm® bucket ranged from 6 to 55 FTU, and TSS from 14 mg/L to 66 mg/L. The GLDD enclosed bucket resulted in turbidity from 1 to 31 FTU and TSS from 14 to 112 mg/L.

Monitoring was also completed for the Boston IHMDP during dredging, ship passage and disposal into the CAD cell from June 30, 2008 through October 28, 2008. Plume tacking included cross channel transects 300 feet up-current of the dredge and from 100 to 1500 feet down-current of the dredge. Dredge plumes were monitored during four slack tides (two high and two low), two ebb and two flood tides in each study area (near the Inner Confluence and halfway between Castle Island and Spectacle Island). Additional ADCP transects and CTD/turbidity vertical profiles were opportunistically taken in the wake of large vessels that transited the area during monitoring (USACE, 2009).

The above results show that a turbidity plume can be produced during dredging but is generally limited to the immediate vicinity of the dredge. An environmental (closed) bucket or Cable Arm bucket can reduce the amount of suspended solids in the water column during silt dredging. Due to the low turbidity associated with hard pack Boston blue clay and glacial till material that will be removed for the Deep Draft Project, a conventional, and not an environmental dredge bucket will be used to dredge the project. Also, an environmental bucket can not remove the clay and hard pan material. Dredging of the parent material (i.e. Boston blue clay) from the CAD cell in Boston Harbor did not show substantial turbidity plumes within or outside the navigation channel.

Plume tracking following disposal into a CAD cell was performed five times during Phase 2 of the BHNIP. Results of the turbidity measurements showed that elevated turbidity levels generally remained within the boundaries of the disposal cell itself, with limited down current transport. During one of the largest disposal events in Boston Harbor (7,200 cy of maintenance material in one 3-hour high tide window), elevated turbidity extended beyond the cell boundaries, but a significant plume was not identified beyond 300 feet down current of the cell. The Boston IHMDP monitoring of disposal into the Mystic River CAD cell occurred during five disposal events. The densest part of the plumes (40-50 NTU above background) were never observed beyond 500 feet from the point of release and usually well within the CAD cell or on one occasion at the CAD cell boundary. Any plume filament observed outside the CAD cell at or within 500 feet of the CAD cell boundary were at low concentrations (<20 NTU above background) (USACE, 2009).

4.2.2 Contaminant Impacts

Dissolved organic and inorganic contaminants in the environment may become adsorbed to sediment particles that can affect water quality during the dredging process. However, since the material to be dredged is far removed from anthropogenic influences, that is, the parent material which underlies material previously exposed to contaminants, (see Section 4.4.2 below) no or very minimal release of contaminants to the water column during dredging is anticipated. No significant water quality impacts from contaminants are predicted for this Deep Draft Project. No water quality violations were noted during dredging and disposal of silt material during construction of the BHNIP.

4.2.3 Dissolved Oxygen

Dissolved oxygen (DO) measurements were taken during disposal of silty surface material into the CAD cell for Phase 1 of the BHNIP at the reference point, 300 feet down current and 200 feet lateral of the cell, and 1,000 feet down current of the cell (ENSR, 1997). DO concentrations ranged from 6.4-8.2 mg/L over the five monitoring events. There was no apparent difference between reference and down current locations. Lower DO concentrations were consistently noted at all monitoring locations during the later stages of ebb tide.

For Phase 2 water quality monitoring, DO levels varied widely from 4-11 mg/L as the monitoring was performed throughout the year (ENSR, 2002). However, during any given monitoring event, background and down current concentrations were very similar.

After completion of the first round of capping, the elevations of the tops of capped cells M4, M5, and M12 ranged from 9 to 15 feet below the surrounding harbor bottom. Concern was raised that the DO levels might be further lowered due to reduced circulation over the depressed CAD cells. MADEP amended the WQC to require measurement of DO in near bottom (within three feet) waters over the three cells and in surrounding waters during the months of July-October 1999 (USACE/Normandeau, 2000b).

DO levels displayed a clear decrease as water temperatures increased in the late summer, with values dropping below the State's 5.0 mg/L standard. However, the decrease was similar to that noted in the surrounding areas beyond the boundaries of the cells (ENSR, 2002). Although the high organic content of the newly exposed dredged material in the cells was expected to cause anoxic conditions at the sediment-water interface, the depressed nature of the cells did not appear to affect dissolved oxygen content of the immediate overlying waters.

As the material to be dredged will have low organic matter and be disposed outside Boston Harbor, no impacts to DO are expected from the proposed project. The change in elevation within the navigation channel will not cause a significant difference in DO levels as this area is well flushed by the tides and currents passing in and out of Boston Harbor.

4.2.4 Biological Resource Impacts

4.2.4.1 Eelgrass

There are no eelgrass beds within the Boston Harbor Federal Navigation Project. The eelgrass bed closest to the project would be the MA DMF restored bed off of northern Long Island (Leschen *et al*., 2010) which is at least 2,000 feet south of the Federal channel. The Boston IHMDP monitoring showed that at most low concentration dredge plume filaments traveled outside the channel as far 650 feet from the edge of the channel (USACE, 2009). The northern Long Island eelgrass bed would not be expected to be impacted by any dredge plumes since the plumes typically stay within the channel, and any plume filaments that do leave the channel boundaries are not expected to travel the distance necessary to reach the eelgrass bed.

4.2.4.2 Benthic

Most shallow benthic habitats in estuarine systems are subject to deposition and resuspension events on daily or even tidal time scales (Oviatt and Nixon, 1975). Many organisms have behavioral or physiological responses to sediments that settle on or around them. Many organisms avoid the area of disturbances while others have a tolerance to attenuated light conditions or anaerobic conditions caused by partial or complete burial. Direct effects of sedimentation include smothering, toxicity (exposure to anaerobic sediment layers), reduced light intensity, and physical abrasion, where as indirect effects include changes in habitat quality (Wilber, *et al*., 2005).

Studies of burial of estuarine invertebrates found species specific responses. According to Hinchey *et al*. (in Berry, *et al*., 2003), the responses varied as a function of motility, living position and inferred physiological tolerance of anoxic conditions while buried. The deposition of dissimilar sediments has a greater impact on organisms than sedimentation of like materials (Maurer, *et al*., 1978, 1986). In the navigation channel, the benthic community already experiences and has adapted to sedimentation stress caused by resuspension of sediments due to large vessel traffic. Monitoring of previous dredging activities has shown that any sediment plumes settle out predominantly in the dredge area (see Section 4.2.1 General Impacts of Dredging in Boston Harbor) limiting the extent of additional stress to the system.

Temporary increases in turbidity can have a short-term localized effect on the benthic community and potential effect on fish. Effects associated with turbidity include reduced vision and masked odors, both of which are important to foraging organisms. Suspended silts may also clog or abrade gill structures and interfere with feeding mechanisms of filter feeders. The usually high organic content of silt/clay material would reduce ambient, dissolved oxygen concentrations. Increased turbidity would reduce light penetration lessening primary productivity, and, therefore, oxygen release from primary producers would be lessened. Finally, upon settling, the suspended sediment load could cover non-motile plants and animals.

Turbidity impacts are dependent on the concentration and the duration of the suspended sediments (Clarke and Wilber, 2000). Motile organisms can generally avoid unsuitable conditions in the field. Under most dredging scenarios, fish and other motile organisms encounter localized suspended-sediment plumes for exposure durations of minutes to hours, unless the organism is attracted to the plume and follows its location. Adult fish responses to suspended sediments for durations of less than one day at concentrations $\leq$1,500 mg/l, i.e., conditions relevant to most dredging project scenarios, have not been sufficiently studied to reach definite conclusions (Clarke and Wilber, 2000). Fish eggs and larvae are more sensitive to suspended sediment impacts than older life history stages; however, most of the available data for eggs and larvae pertain to freshwater conditions (Clarke and Wilber, 2000).

Although adult bivalve mollusks are silt-tolerant organisms (Sherk, 1972 in Clarke and Wilber, 2000), they can be affected by high suspended sediment concentrations. Hard clams (Pratt and Campbell, 1956 in Clarke and Wilber, 2000), and oysters (Kirby, 1994 in Clarke and Wilber, 2000), exposed to fine silty-clay sediments have exhibited reduced growth and survival, respectively. Suspended sediment concentrations required to elicit these responses and mortality, however, are extremely high, i.e., beyond the upper limits of concentrations reported for most estuarine systems under natural conditions, as well as typical concentrations associated with dredging operations. Sublethal effects, such as reduced pumping rates and growth, were evident for adult bivalves at concentrations that occur under natural conditions, but may be of a short-term (i.e. hours to days) duration, for example, during a storm (Schubel, 1971; Turner and Miller, 1991 in Clarke and Wilber, 2000). As with estuarine fish, the egg and larval stages of shellfish are more sensitive to suspended sediment impacts than adults. Estimates of suspended sediment impacts to these pelagic, early life history stages must consider the local hydrodynamics of the dredging site, which strongly influence the likelihood of extended exposure to suspended sediment plumes (Clarke and Wilber, 2000).

The benthic community in the navigation channel will be initially eliminated by direct removal from the dredge. Once dredging is completed, the benthic community is expected to return to pre-dredge conditions within a relatively short period of time (months in some cases), depending on the time of year of disturbance, location within the harbor and substrate. The Benthic Subsection of the Affected Environment (Section 3.3.2) presents details on benthic communities that were sampled about three years after being dredged. Monitoring of the CAD cells located in the Inner Confluence, Mystic River and Chelsea River four to seven years after they were capped with sand, showed that the benthic community in this portion of the harbor was stressed. Both the CAD cell stations and the reference stations were predominated by pioneering Stage I fauna (ENSR, 2007). However, despite the stressed nature of the benthic community in the Inner Harbor, abundant small and medium-sized fish, including juvenile flounder, and shrimp and crabs were evident in the video images. Monitoring revealed that the sand caps on top of the CAD cells are accumulating a layer of silt/clay. Areas both within and outside of the CAD cells appear to be providing comparable epibenthic habitat (ENSR, 2007). Studies by McCauley *et al*. (1977) in Oregon indicated that pre-dredging conditions in a channel could be reestablished in as little as 28 days after dredging ceases. However, complete recolonization by sedentary adult forms of many pre-dredging organisms could take up to several years.

Side scan sonar, core samples, grab samples, and subbottom profile data was collected as part of geological study for the proposed Deep Draft Project in the Main Ship Channel (Ocean Surveys, 2006, Appendix J). Ocean Surveys, Inc. correlated coring data with the remote sensing data to enhance the previously presented surface map and generate sediment type maps of the seafloor and at -47 feet MLLW and -50 feet MLLW. This information can be used to help predict what type of sediment may be exposed after dredging. Based on Ocean Surveys, Inc. data, the surficial material east of Deer Island appear to be Type 1 (predominantly coarse grained materials consisting of gravel and/or bedrock) and Type 2 (poorly sorted fine to coarse grained material, consisting of coarse to fine grained sand). West of Deer Island the material was predominantly Type 2 and further west the material became Type 3 (predominantly fine grained materials, consisting of fine sands, silt and mud. Although the data was sparser at the deeper depths, significant amounts of clay were mapped in the eastern part of the Reserved Channel, continuing southeastward in the Main Ship Channel and the President Roads area at the -47 feet MLLW depth. In other areas of the Main Ship Channel north of the Reserved Channel, it was also estimated that clay existed at the -47 feet depth, but with lower confidence. Although there was no direct evidence of clay at the -50 foot depth MLLW, areas were classified as clay to -50 feet MLLW where the subbottom record indicated a clear continuation of the acoustic properties of clay. It was also considered likely that silt may be encountered at water depths at or below -47 and -50 feet because of the silt contained at the surface of the cores.

The results of this mapping effort indicate that dredging in the Main Ship Channel, Reserved Channel and Presidents Roads may expose a finer surface than currently exists. If significant amounts of Boston blue clay are exposed, than the benthic community may be reduced in the number of species and the number of organisms. New material deposited in the new navigation channel will encourage the return of a more diverse benthic community in the future.

While the Federal navigation channels, anchorage area, and berth areas are previously disturbed sites, they still provide some habitat for estuarine organisms. However, approximately 22 acres of previously undisturbed bottom would be impacted from the Deep Draft Project. The benthic community inhabiting this undisturbed habitat would be expected to vary with the sediment type and location within the harbor. Sediment type would be expected to range from coarse grained sand and gravels to fine grained silts and mud. The exposed sediment may be similar to what is described above for the deepened navigation channels.

Most mobile organisms living on the surface would be displaced during dredging operations, but would return as benthic organisms recolonize the area and are available to serve as a food source. Some motile organisms such as crabs and lobster are not always capable of leaving their shelter due to physiological circumstances such as molting or cold temperatures in which case dredging would directly impact these individuals.

The MA Division of Marine Fisheries (DMF) has identified suitable shellfish habitat for softshell clams, blue mussels, and razor clams in the vicinity of some of the dredge areas. No significant populations of shellfish are noted in the navigation channels. However, the presence of softshell clams was confirmed by one grab sample collected in the Chelsea River outside the navigation channel. The deepening of the Chelsea River may impact some shellfish beds (see Figure 3-5). No other shellfish beds are expected to be directly impacted from the widening of the navigation channels (see Figure 3-5). If any shellfish inhabit the Federal channel areas, they will be removed and destroyed from dredging. Any shellfish inhabiting the surrounding areas are not expected to be significantly impacted by sedimentation given the nature of the turbidity plume to stay within the confines of the navigation channel and because the shellfish beds are located close to shore. Any shellfish inhabiting adjacent areas near the navigation channel, outside the direct impact of dredging, would be expected to be capable of tolerating short-term temporary increase in suspended sediments, such as experienced during ship traffic or naturally occurring storm events.

4.2.4.3 Lobsters

Lobsters are present in Boston Harbor and the larger class sizes are likely to inhabit the navigation channel in the same manner as they use the habitats outside the dredge footprint. The larger lobsters are motile and have the ability to leave any area of disturbance, except during the winter when movements are restricted due to the cold temperatures or when molting (Cobb, 1976). The early benthic phase (EBPs) and juvenile lobsters that need shelter for survival tend to inhabit the more shallow areas outside the navigation channel and along island coastlines, and not in depositional areas such as the Entrance Channel, Mystic and Chelsea River channel areas, as discussed in the Lobster subsection of the Affected Environment. All lobsters <40 mm CL are defined as early benthic phase lobsters (Wahle and Steneck, 1991), as determined by their presence in the same habitats as YOY and by their restricted mobility (Wahle and Steneck, 1991). Both YOY and second year lobsters (those between 12-40 mm CL) are found in the greatest densities in depths between 5 and 10 meters (Wilson, 1998). This is confirmed by MA DMF in their suction sampling program in Boston Harbor by contrasting the lower density of YOY (<12 mm CL; Figure 3-13) with the higher densities of larger EBPs (Figure 3-14), at the same location, and by noting that the depths at which these lobsters occur range from 12-20 ft (see Table 3-12).

As YOY lobsters will not likely settle in the deeper navigation channels, due to depth restrictions and possible presence of thermoclines, and lobsters <40 mm CL are less mobile than those >40 mm CL, then it is likely that such lobsters will remain in the same habitats as the YOY and be subject to the same perturbations as the YOY. Thus, actual dredging activities are unlikely to have an effect on such lobsters because they are unlikely to be located in the navigation channels.

The larger juveniles, and adult lobsters could be present in the areas of ledge removal. However, they are expected to have the ability to move away from project activities associated with rock removal (drilling and setting the charges) operations. Blast activities, which could spread plumes of sedimentary material and shockwaves, are expected to impact those locations near the navigation channel where YOY and EBP lobsters (<40 mm CL) are likely to be found (see Figures 3-14 for known locations). There is currently no information on effects of blast shockwaves on these life history stages, so no predictions can be made with regard to how they will be impacted by such perturbations. These sizes of lobsters are capable of sediment digging activities (Cobb, 1972) and presumably could withstand increased particulate matter in the water column, as long as it is not of such a degree as to clog their gills. Since lobsters do not have a swim bladder they should be resistant to the shockwave effects of any blasting activity (Keevin and Hampen, 1997), unless in they are in the immediate vicinity of the blast.

Lobster investigations were conducted during the BHNIP to address concerns that the fishery was being impacted by the dredging operations. In response to this concern, the MA DMF increased the number of MA DMF observers on lobster trips and additional efforts were made to assess and document catches/landings in the Reserved Channel by the Independent Observer hired by the State for the BHNIP (ENSR, 2002). Dredged material was screened in the barges for lobster and an underwater video was used to survey areas to be dredged. The results of these surveys showed juvenile lobsters in the project area, but not in large numbers. In addition, no lobsters were observed during any of the dredging oversight or on screened material (ENSR, 2002).

It is assumed that some ovigerous (egg bearing) females are likely to remain in Boston Harbor, spawning early, and brooding and hatching their eggs annually within the harbor (see Subsection 3.3.4). If the females remain resident in the area throughout the year, they are likely to remain within their shelters and move little during the winter months. As a result, any physical disruption of their habitat in winter months could directly impact these individuals and their brooding embryos due to their reduced ability to move quickly during cold temperatures. Lobsterman fish within the Boston navigation channels year round (although it is illegal to do so), indicating that at least some of the lobsters are mobile within the channel areas during the winter months. It is unknown what percentage of this mobile population are ovigerous females. Consequently, there may be some direct impact to these individuals. However, dredging operations would only impact a small area at any one time allowing the lobsters capable of moving to leave the area of disturbance. Also, the elimination of illegal lobster fishing due to the construction activities in the navigation channels could potentially offset construction impacts to lobsters as lobsters may be expected to more likely avoid a dredge bucket than a lobster pot.

Surveys submitted by the lobstermen indicate that most of the lobster fishing activity occurs below the Third Harbor Tunnel. It is assumed that this may be an indication of the relative abundance of lobster in the Boston Harbor project area. Although fishing in the navigation channel is prohibited, the lobstermen will be notified by email prior to movement of the dredge so that they may relocate their pots to not be impacted by dredging activities. A similar notification process was effectively employed for BHNIP, the OHMDP, and the IHMDP to minimize impacts to lobster gear by the dredging operation.

4.2.4.4 Fisheries

Minimal levels of sedimentation can potentially have an adverse impact on early and/or critical life stages of fish and shellfish. Sediments have the potential to bury demersal eggs, while larvae may be trapped or buried by the sediments (Wilbur and Clarke, 2001; Berry *et al*., 2003). Winter flounder is a Federally managed demersal (bottom dwelling) fish that is commercially exploited and found in the project area. Winter flounder eggs are demersal and larvae are found near the bottom in shallow areas. However, since winter flounder spawn on various substrates and in areas less than 16 feet deep, the navigation channel with it's greater depths (> 16 feet) and ship disturbance would not be considered spawning habitat for winter flounder.

Monitoring from BHNIP showed that the dredging plume was generally localized to the immediate dredge area (within 600 feet) irrespective of tide direction and stayed within the navigation channel (USACE/Normandeau, 1998c-f, 1999a,b,d-i,k-n, 2000a). Monitoring from the IHMDP also showed the dredging plumes to be of relatively low concentrations and localized to the immediate dredge area (within 500 feet for the highest turbidity readings) (USACE, 2009). Therefore, it is expected that most of the suspended sediments from this dredging operation, which are composed of glacial till or Boston blue clay, will resettle quickly in nearby areas. Consequently, any impacts associated with sediment resuspension and transport are expected to be limited to the near-field areas. Also, plume modeling of the Boston Harbor Outer Harbor Maintenance Dredging Project using the SSFATE model (USACE, 2003b) showed that the heaviest deposition of sediment would occur within the immediate vicinity of the dredge. Some deposition occurred outside the navigation channel, but the majority was contained with the channel or anchorage area. Monitoring from the IHMDP did show low concentration plume filaments (<10 NTU) on two occasions as far as 650 feet from the channel. This was only observed in the southern monitoring area (half way between Castle Island and Spectacle Island) where current flows are more complex than within the inner harbor between Castle Island and the Inner Confluence (USACE, 2009).

The sedimentation rate predicted from modeling is significantly less than the amount reported to affect winter flounder eggs, as reported in two separate experiments (one laboratory and one field). In the laboratory experiment, Berry *et al.* (2005) performed a series of three tests to better determine the effects of burial in clean sediment on the hatching success of winter flounder eggs. Recently spawned eggs (three to five days after fertilization) were exposed to clean, fine-grained sediment with burial depths from a dusting (<0.5 mm) to 9.3 mm (> 10 egg diameters), and a control (no sediment). Results showed that percent total hatch eggs buried in < 1.0 mm sediment was generally not statistically different from that of controls. Percent total hatch was highly variable in eggs buried in about 3 mm of sediment, while there was little or no hatch of eggs buried in sediment > 3 mm. The "dusting" (<0.5 mm) is five times greater than the sediment deposition the SSFATE predictive model indicated would be deposited outside the channel (0.01 to 0.1 mm). In addition, no statistical difference was noted between the control test and burial of < 1.0 mm of sediment, which is 10 times greater than the amount of deposition predicted by the SSFATE model.

In the second experiment, field tests were conducted in 2003 and 2004 with winter flounder eggs and larvae during dredging of the Providence River and Harbor Maintenance Dredging Project (Klein-MacPhee, Macy, and Berry, 2004). Newly spawned flounder eggs were placed in weighted arrays holding nine chambers with 100 winter flounder eggs per chamber. One array was placed adjacent to the dredge (test) and another outside the influence of the dredge (reference). There was a significant difference in the amount of sediment deposited within the chambers, depending on the location; 3.59 g dry weight in the test chamber vs. 0.69 g dry weight in the reference chamber. Sediment deposition in the test chamber was 8 mm thick and 4 mm thick in the reference chamber (Klein-MacPhee and Macy, 2005). However, there was no statistically significant difference in response between the reference and test chambers containing the live eggs and larvae as a result of deposition. There was, though, a slightly higher greater survival in the reference chambers of eggs and larvae when compared to the experiment (15.5% vs. 14.1%). Larvae were observed hatching and wriggling up through the sediment in both chambers.

Although the above described results of the predictive modeling did not include the Mystic River and the Chelsea River, dredge plumes tend to generally follow the same pattern of heaviest deposition within the navigation channel based on the above dredge plume monitoring results. Taken in context the predictive model results with available laboratory and field experiments, dredging is likely to have little, if any, impact on the survival of winter flounder eggs and larvae outside the navigation channels. Monitoring from the IHMDP (USACE, 2009) did address the potential for suspended sediment to be transported and deposited on potential winter flounder spawning grounds during dredging and disposal activities. At no time were any dredge plume remnants found to migrate onto sensitive resource areas. Juveniles and adults of demersal fish are motile and have the ability to swim away from any disturbances caused by dredging activities.

The SSFATE model also predicted where the turbidity plume might disperse depending on the location of the dredge. Turbidity values were predicted for the mid-depth of the water column and generally ranged from 30 to 50 mg/l. The plume and associated elevated turbidities were confined primarily to the navigation channel. This was far less than the disposal criteria as required in the WQC for the BHNIP.

The results of the SSFATE modeling as noted above generally agree with the plume monitoring conducted when dredging a CAD cell in the Mystic River during the previous BHNIP. Monitoring of the dredge plume was conducted on one occasion during the four required tidal events: slack ebb, slack flood, maximum ebb, and maximum flood. For each tidal cycle, sufficient data was collected to produce a plan view of turbidity contours, both upstream and downstream of the dredging activity, as well as a cross section 300 feet down current to reflect the full depth of the water column.

The overall results of the dredge plume monitoring show that near-bottom turbidity levels were highest for all measurements with values as high as 100 NTUs (from disturbance during spud removal) approximately 300 feet down current of the dredging operations during maximum flood tide. Mid-depth turbidity levels were much less. Turbidity levels for the near bottom and mid-depth levels were generally lower, ranging from between 25 and 60 NTUs. The plume dissipated between 600 and 1,000 feet down current where all values returned to background levels (10-20 NTUs) irrespective of the tide direction or intensity. Typically, the plume also returned to background levels within 200 feet or less laterally (or to the side) of the dredge (USACE/Normandeau, 1998).

The Boston IHMDP dredge plume monitoring (USACE, 2009) showed that in strong tidal currents the plumes were narrow and concentrated near the dredge (150-250 feet wide), up to 20 NTU above background, and usually present from surface to bottom; then they widened, dissipated and settled to the lower half to two-thirds of the waver column as they were carried down the channel by the tide. The plumes dissipated to background levels typically between 1000 and 1500 feet down-current. As the dredge plumes dissipated they tended to be found across the full width of the channel in the lowest one-third (or less) of the water column at low concentrations (<5 NTU above background) as they approached background levels. During slack tide conditions the dredge plumes pooled beneath the dredge, typically no wider than 100-150 feet wide and dissipated to background levels in as little as 500 to 1000 feet down-current of the dredge. The dredge plumes were typically confined to the channel, although low concentration plume filaments were observed on two occasions as far as 650 feet from the channel in the southern monitoring area, but did not impact any nearby sensitive resource areas.

Plume tracking during the BHNIP and IHMDP also showed limited turbidity transport during disposal into a CAD cell. Any elevations in turbidity were generally limited to the boundaries of the disposal cell, with minor down current transport. During the largest disposal event of the BHNIP (7,200 cy of dredged material disposed during high slack tide), elevated turbidity levels extended beyond the cell boundaries, but a significant plume was not identified beyond 300 feet down current of the CAD cell. Monitoring from the IHMDP showed that within 15 minutes of release all observed disposal plumes were limited to the lower two-third of the water column, where the plumes were confined to the channel. The lack of a substantial plume at the surface of the water column, to the sides of the dredge, or 600 feet downstream indicates that the plume from dredging or disposal is narrow when compared to the overall width of the harbor and should not impede the passage of any anadromous fish movements.

Turbidity was also monitored for the Providence River and Harbor Maintenance Dredging Project. The purpose of the Providence River and Harbor Maintenance Dredging Project monitoring was to ensure compliance with the State of Rhode Island Water Quality Standards. The timing and intensity of the monitoring were triggered by specific disposal events with the results compared to specific project compliance criteria along downfield transects. The results of this monitoring showed that the sediments resuspended by the CAD cell disposal events (as well as nearby dredging) generally returned to background levels within 500-800 feet of the disposal cell. No elevations were observed at the 1,800 feet down current compliance transect, even when the dredges were working adjacent to the disposal cell.

Turbidity studies conducted for the previous BHNIP, as discussed above, indicated that the turbidity only affected a small portion of the cross section of river at the time of dredging. No large schools of fish were observed in the vicinity of cell excavation or disposal. Although fish may be deterred by the construction activities, there was no evidence that construction presented an overall impediment to fish passage (ENSR, 2002) given the dredge footprint and nearfield water quality impact. Anadromous fish such as smelt, alewife, and blueback herring use Boston Harbor, the Mystic River and Chelsea River for passage to upstream spawning locations. These species spawn in freshwater located upstream of the project area. Based on the above modeling and turbidity studies; dredging is not expected to have a significant impact on anadromous fish species migrating towards their spawning areas during the course of dredging.

4.2.4.5 Marine and Coastal Birds

The effects of dredging on marine and coastal birds in the Federal channel would be minimal. Most of the species of birds identified in the Marine and Coastal Birds Section and Appendix W may be found in various areas of Boston Harbor and Massachusetts Bay, depending on the season and species-specific foraging habits. Many of these bird species have large foraging and migrating ranges; therefore, the chances of dredging having an adverse effect on a particular species' population in these areas are small. Most birds in the Boston Harbor area would use the shallow and intertidal habitats and not the channel areas where dredging operations would occur. The operation of the dredge in the channel would likely cause most birds to avoid or leave the immediate project area(s). The food value for any waterfowl, especially diving birds in the area is limited by depth. Dredging may temporarily decrease the prey availability for some species; however, impacts would be minimal given the overall project footprint relative to other potential feeding areas within the harbor.

4.2.4.6 Marine Mammals and Reptiles

The use of Boston Harbor by whales, dolphins, seals, or sea turtles is possible but not common. The potential for finding any of these species does increase at the MBDS and the areas used to travel through to get to the disposal site. All of the sea turtle and most of the whale species that have any potential of being in Boston Harbor and Massachusetts Bay are endangered species and discussed in the Threatened and Endangered Section in the Affected Environment. The harbor seal, harbor porpoise, gray seal, white-sided dolphin, and minke whale all have the potential to be present in some area of the project operations. The white-sided dolphin has the least potential to be impacted by the dredging and disposal operations since they tend to be found further out on the continental shelf. Minke whales are found in Massachusetts Bay and while none have been recorded at the MBDS they have been identified in surrounding areas (Short and Schaub, 2005). The harbor seal, harbor porpoise, and gray seal have the potential to be found at both the dredge areas and along the path to the disposal area, but if any wander into the harbor during dredging activities their mobility will allow them to avoid impact. Therefore, no significant impacts to any of these species are expected as a result of dredging or disposal activities. Potential impacts to marine mammals from rock blasting are discussed in the next section.

4.2.5 Underwater Blasting Impacts

Up to about one million cy of rock could be removed from the harbor, some of which may require blasting to deepen the navigation channels and anchorage area in Boston Harbor. Potential aquatic impacts associated with blasting include noise, thermal energy release, increased turbidity, damage to structures, and effects on aquatic life, all of which are expected to be minor and temporary in nature due to the precautions to minimize the shock wave. These impacts would be generated as a result of vibrations, explosion-induced surface water waves, or air overpressure.

Similar construction techniques used in previous Boston Harbor dredging and blasting projects did not result in any observed damage to piers, bulkheads, tunnels, or bridge foundations. Because the same techniques will be used for the Deep Draft Project, it is unlikely that permanent damage to these structures will occur.

Any impacts to aquatic populations would be localized and temporary, with the most pronounced effect on aquatic species in the immediate vicinity. Below is a discussion of potential impacts to aquatic resources by group. Additional discussions on blasting impacts to threatened and endangered species are provided in Section 4.6 below.

4.2.5.1 Invertebrates

The effect of blasting on hard-bodied invertebrates would tend to be small except in the immediate vicinity of the blast. Damage to hard-bodied invertebrates near the blast site might include cracked or broken shells and carapaces. Soft-bodied invertebrates in the immediate vicinity would be killed, while populations of those in outlying areas would sustain less damage. Long term impacts are not expected.

4.2.5.2 Sea Turtles

The sea turtles in Massachusetts nearshore waters are typically small juveniles. While no surveys for sea turtles have been conducted in Boston Harbor, National Marine Fisheries Service (NMFS) believes that suitable forage and habitat exists in this area and it is likely that sea turtles may occasionally visit Boston Harbor. Measures to protect sea turtles are described in more detail in Section 4.6 below. Due to the protective measures that will be in place and the rare presence of sea turtles in Boston Harbor, any impacts to sea turtles from blasting are not expected to be significant.

4.2.5.3 Fish

The extent of damage to fish populations depends primarily on the proximity to the blast and the presence or absence of a swim bladder. Fish with swim bladders (e.g., Atlantic herring) will be unable to adjust to the abrupt change in pressure propagated by the blast. If they are within a zone of influence, fish with swim bladders may be injured or killed. Fish without swim bladders (e.g., winter flounder) are less likely to be injured, and would likely sustain injuries only if they are in the immediate vicinity of the blast. Blasting may displace resident fishes, although this impact is expected to be only temporary. Blasting impacts will be avoided or minimized by the methods discussed in the following paragraphs.

Several precautionary measures were put in place to avoide or minimize the incidence of injury to fish and marine mammals from blasting in Boston Harbor for the BHNIP and IHMDP. Blasting mitigation measures included:

- Use of a fish detecting and startle system to avoid blasting when fish are present or transiting through the area;
- Require the use of sonar and the presence of a fisheries and marine mammal observer;
- Prohibiting blasting during the passage of schools of fish, or in the presence of marine mammals, unless human safety was a concern;
- Using inserted delays of a fraction of a second per blast drill hole, and;
- Placing material on top of the borehole (stemming) to deaden the shock wave reaching the water column.

No injuries to fish were reported during blasting for the BHNIP. However some fish kills were noted during blasting in Boston Harbor for the IHMDP.

Four fish mortality events were observed and recorded during 13 underwater blasting events in Boston Harbor during the ledge pinnacle removal project in late fall of 2007. These fish kills happened despite following procedures that had been successfully employed for underwater blasting in Boston Harbor and other locations. Methods employed to reduce or eliminate fish kills involved the use of a side scan sonar fish finder to detect and avoid passing schools of fish, a fish startle system to deter fish of the Clupeidae family (i.e. blueback herring and alewife) from entering the blast area, and a fish observer to oversee and determine the appropriate blast time.

Following the first mortality event, the USACE immediately met with the blast contractors and fish observer to determine the causes of the event and identify measures to correct the problem. Resource agencies were also notified and briefed on initial corrective actions before blasting was resumed.

Despite these measures, subsequent fish kills occurred. In response to these unexpected events, the USACE prepared an "After Action Report" to summarize information on all of the blasting events.

One of the lessons learned from the above fish kills is that the fish startle system appeared to be less effective when it was placed on the blast barge. The blast barge is stationary and moved away from the blast site just prior to the blast, thougth there is some lag time. For the Boston Harbor Rock Removal Project in 2012, the fish startle system was placed on separate boat which circled the blast area. With the fish startle turned on, fish could be seen scattering from the safety area. By having the startle system on a smaller more mobile boat, the startle system could be employed until seconds before the blast, thereby significantly reducing the time for fish to re-enter the blast area. No fish kills were reported with any of the six separate blast events in 2012.

This lesson learned will be added to the list of precautionary measures for the Deep Draft Project and conveyed to the interagency underwater blasting technical working group of Federal and State resources agencies. The goal of the working group is to determine what lessons can be learned from the 2007 fish kill events and 2012 rock removal, the knowledge and other corrective measures identified and found practicable to minimize potential fish impacts from blasting during construction of the Boston Harbor Deep Draft Project.

The above group will also focus on construction sequencing for several areas of the harbor, constraints on work during certain tidal and weather conditions, and potential air emission mitigation. The results of this research will form the basis for agency discussions on measures to be implemented for the Deep Draft Project and the development of a Dredging/Blasting Mitigation Measures Plan. See Appendix A for response to General Topic #3 for additional details.

4.2.5.4 Marine Mammals

Although marine mammals are infrequent visitors of Boston Harbor, they could be potentially be affected by blasting if they should occur too close to the blast site. If present during a detonation, individuals would likely sustain injuries as a result of pressure waves produced by the blast. To avoid this potential impact, a marine mammal observer will be present during all blasting events and will provide guidance to the contractor on when to restrict blasting if a marine mammal is within or in close proximity to the established safety zone (assuming no human safety concerns exist). Additional details on protective measures for marine mammals can be found in Section 4.6 below.

4.2.6 Confined Aquatic Disposal (CAD) Cells

The potential for use of CAD cells for the Deep Draft Project is limited. As described above in Sections 4.2.1, 4.2.2, and 4.2.4, physical, chemical, and biological impacts from constructing and disposing of dredged material are temporary and not significant, based on the monitoring results for the BHNIP.

4.3 Benefits and Impacts at the Potential Habitat Enhancement Sites

The placement of blasted rock in a shallow area with low biological productivity has the potential to provide critical reef habitat for several life stages of commercially important species such as American lobsters. This hard-bottom substrate type exhibits surficial complexity which provides the relief and interstitial spaces necessary to shelter cryptic species such as lobster and juvenile finfish (MA DMF, 2006). Numerous other species of fish and shellfish such as Atlantic herring, ocean pout, and Atlantic wolfish also find refuge in cobble/gravel habitat areas during vulnerable early life stages (MA DMF, 2006). Sessile invertebrates, important to the productivity and diversity of an area, also are dependent on complex hard bottom (MA DMF, 2006).

Rock removed from Boston Harbor will have an assortment of sizes and shapes. The pieces are expected to range from cobble to boulder size. This variation in size and shape would accommodate a variety of species and life stages. Proper placement of the reef is of critical importance.

Selection of an appropriate reef site is based on the criteria presented in Section 2.7. Other criteria are also important for successful reef placement such as the presence of hard substrate located at or near the ocean floor to prevent the reef from sinking. Natural sedimentation rates in the placement area should be low enough to prevent burial of structures over time. In high-energy coastal waters, reef structures usually require mechanical stabilization to prevent shifting or relocation by waves or storm surges. The area should exhibit good water quality. Areas with chronic low DO (hypoxia), and rapid changes in salinity, water clarity, temperature, and nutrient concentrations will negatively impact reef fish and invertebrate communities (USACE, 2003). Based on these considerations, the Broad Sound and Massachusetts Bay sites would be most compatible nearshore areas to Boston Harbor for rock placement.

Prior to selection of the final site for rock placement, the USACE expects to conduct additional studies in coordination with State and Federal resource agencies. The results of the study will help determine which of the two remaining sites is most suitable for habitat enhancement.

Depending on the design of the reef(s), the placement of between 450,000 and 1.4 million cy of rock would cover between 220 acres to 530 acres of soft bottom habitat. See Table 4-1 below. This amount of cover assumes linear rows of rock placed 100 feet apart, and five feet high. Rock placed in rows would create more edge habitat and increase circulation.

Table 4-1. Hard Bottom Habitat Creation

Navigation Channels Improvements – plus Plans D and F	45 Foot Main Channel	47 Foot Main Channel	50 Foot Main Channel
Volume of Rock Generated by the Project			
Main Channels Improvements – A-B-C	446,700	899,800	1,380,900
Main Ship Channel Extension to MMT	78,400	78,400	78,400
Chelsea River Channel (40 Feet)	500	540	500
Total Rock (Cubic Yards)	**525,600**	**978,740**	**1,459,800**
Area of Bay Bottom Needed for Habitat Creation Site			
Cross-Sectional Area (SF) of 5-Foot High Mound with 50-Foot Base and 1:3 Slopes	175	175	175
Linear Feet of Mound Formed	81,093	151,006	225,226
Square Miles Covered at 100-Ft Spacing (Approximate Acres)	0.29 (186 acres)	0.57 (365 acres)	0.81 (518 acres)

Like any water disposal option, the placement of rock for habitat enhancement could have a temporary impact on water quality. Turbidity from the placement of rock can occur during two phases. One when sediment clinging to the rocks is washed away during placement, and two, from displacement of the floor bed as the rock hits the bottom. Turbidity levels would be expected to return to background levels within a few minutes or hours after disposal.

Biological productivity and diversity may be temporarily reduced in the habitat enhancement area prior to the colonization of the rocks by encrusting organisms and larval settlement. It would be expected that mobile macroinvertebrates, fish and solitary tunicates would be able to utilize the new habitat rapidly, as well as crabs and lobsters (Barber, *et. al*., 2007).

Demersal species such as American plaice, Atlantic halibut, summer flounder, winter flounder, windowpane flounder, witch flounder, red and white hake, and yellowtail flounder may be present in the finer sediments at the proposed enhancement sites. The placement of a rock reef in the fine sediment areas of the proposed enhancement sites would displace some of these EFH listed species, but not all. Some EFH species such as juvenile and adult American plaice, juvenile Atlantic halibut, and adult winter flounder may also continue to use the rock reef as habitat.

Artificial reefs were recently created from cobble and rocks to mitigate for the loss of hard bottom habitat from construction of the HubLine (gas pipeline). Although there are similarities between the artificial reefs created for the HubLine project and natural reefs, there are also several differences. These differences may be attributed to the lack of time (about a year) for the artificial reef to develop ecologically or to real differences in structure between the artificial reef and natural reef used for comparison. The following information is based on the first year progress report prepared by the MA DMF (Barber, *et. al.*, 2007).

Diversity analysis on enumerated species indicated that there was no significant difference between the artificial reefs created for the HubLine project and the natural reef located in Massachusetts Bay for mobile macroinvertebrates, solitary tunicates, bivalves, and fish. The diversity analysis conducted on species assessed using percent cover (i.e. encrusting tunicates, sponges, barnacles, and macroalgae) revealed no differences across sites or seasons; although it is possible with a larger sample size that the variance would decrease and trends in these results would be more evident.

Some differences noted between the natural reef and artificial reef included the greater sponge diversity and abundance on the natural reef than the artificial reef. The natural reef had five species of sponges with a cover per square meter of 4% while the artificial reef only had three species of sponge cover of less than 1%. Red filamentous algae and common kelp (*Laminaria* sp.) cover was higher on the natural reef but is expected to catch up on the artificial reef.

The fish tagging study indicated that the artificial reef is likely to continue supporting relatively large cunner populations, a structure-oriented fish, as compared to the natural reef or sand areas due to the high relief and large number of variable-sized interstial spaces of the artificial reef. However the report cautioned that the large cunner population could have an influence, although unlikely, on species composition of the reef. The air-lift monitoring program is able to sample larvae, young-of-year fish and crustaceans. The results of this program showed that the larval settlement on the artificial reefs reached comparable levels to that of the nearby natural reef in a matter of months. Artificial reefs reached similar levels of species diversity relative to the natural reefs within five months of their deployment.

Although the first year progress report prepared by MA DMF (2007) cautions the use of artificial reefs as direct mitigation as was the case for the HubLine project, the proposed beneficial use of rock from this proposed project would be used for enhancement in an area with little or no hard bottom habitat, and not as mitigation. It appears from the results of the MA DMF first year progress report that an artificial reef can support a diverse and productive reef habitat in a short amount of time, especially when the reef provides various sized interstial spaces for different life stages of organisms and edge relief. The proposed Deep Draft Project would provide various size rocks created during blasting and/or dredging. MA DMF plans to continue monitoring the progress of the HubLine artificial reefs in Massachusetts Bay. The proposed rock reef design for this project can be modified if the results of the MA DMF monitoring program indicate that a particular design is more favorable for rock reef ecology than another. The artificial rock reef created by the Deep Draft Project would be monitored after construction to determine if the rock reef can provide a greater level of species diversity and abundance than the habitat it replaced.

4.4 Disposal Impacts at the Massachusetts Bay Disposal Site (MBDS)

4.4.1 Physical Impacts at the MBDS

Dredged material is released from scows operating on the surface and passes through several phases as it travels to the seafloor at the Massachusetts Bay Disposal Site. Several factors influence the behavior of the descending plume, including the properties of the sediment (e.g., silt, sand, clumps, etc.), water depth, water column stratification, and the interplay of the descending sediment with the water through which it passes. In general, the behavior of the plume can be described as occurring in three phases: convective descent, dynamic collapse, and passive diffusion. The three phases are discussed in more detail below.

- **Convective descent -**The first phase of plume following release of the dredged material from the barge into the water column is the convective descent. This phase begins with the release of the material from the transport device (disposal scow). During this phase, the material descends through the water column under the influence of gravity, generally maintaining its identity as a single mass (Brandsma and Divoky, 1976). During its descent, the area occupied by the plume expands as the local water is entrained into the descending cloud of dredged material. Kraus (1991) found that plumes resulting from the disposal of up to 5,000 cy of sediment (most scows fall in this range of size) in waters up to 65 feet deep spread 300 to 600 feet during the convective descent phase. In addition, the suspended sediment concentration was reduced by turbulence and dilution with the surrounding water mass. The duration of this phase depends on the depth of water, lasting from seconds in relatively shallow areas to minutes in waters over 984 feet. Field and laboratory studies indicate that approximately 1 to 5 percent of the sediment discharged from a barge remains in the water column following the convective descent phase (Ruggaber and Adams, 2000a; Ruggaber and Adams, 2000b; Tavolaro, 1984; USACE, 1986).
- **Dynamic Collapse –** This phase occurs when the descending plume impacts the bottom or reaches a neutrally buoyant position in the water column and diffuses horizontally under its own momentum. In areas with strong stratified water columns, particularly in water columns of several thousand feet, this process is complicated because portions of the plume may attain neutral buoyancy before hitting the seafloor. In those situations, a portion of the descending mass loses its downward momentum and comes to reside as a plume at its neutrally buoyant depth. The plume can oscillate around the depth of neutral buoyancy, creating a vertical oscillation of material. The residence of the materials within such an oscillation results in increased turbulence in the water column and increases the speed with which the plume dilutes and spreads horizontally as it comes into hydrostatic equilibrium. Studies have shown that this condition does not occur in water less than 262 feet. This is because the sediment impacts the bottom regardless of the water stratification. This is due to the fact that the initial momentum and specific gravity are too great to be overcome by plume buoyancy. Depending on water depth, dredged materials may have sufficient momentum to travel laterally for hundreds of feet upon impacting the bottom.
- **Passive diffusion -** Passive diffusion refers to the transport and dispersion of the disposed material by the ambient oceanographic conditions (currents and turbulence) rather than the hydrodynamics occurring during the descent of the plume body. This phase results in the dispersion and transport of the suspended sediments and may last for several hours. Numerous field studies have confirmed that plumes are transient features of dredged material disposal from barges (Dragos and Lewis, 1993; Dragos and Peven, 1994; SAIC, 1988).

Verification of Dredged Material Disposal Plume Dynamic – During the disposal operation, a portion of the dredged material released (generally a fraction of any fine silt and clay particles present) may remain in the water column as a turbid plume for several hours, where it will drift with the current. Dredged material plume dynamics for offshore operations have been verified at several sites in New England and in other locations in the United States. For example:500 to 5,000 cy of dredged material released in shallow depths of 50 to 66 feet in the Gulf of Mexico (Krause, 1991) had an associated plume spread (widening) of 110 to 220 yards during the convective descent phase.

Increased turbidity from the plumes in the water column has been documented for up to two hours after disposal of 4,000 to 6,000 cy of dredged material in the New York Bight (water depth approximately 92 feet) (Dragos and Lewis, 1993; Dragos and Peven, 1994). Dilution of the dredged material within 2 ½ hours of disposal had achieved ratios of 3,000:1 to 600,000:1 (based on total suspended solids (TSS) analyses of water samples). Observed plume spreading at the time was generally less than 550 yards, and local currents carried the plumes up to about 0.6 mile from the discharge point, which was consistent with the current velocities at the time of the survey. Turbidity profiles collected throughout the disposal site and surrounding areas before and after disposal events did not find elevated turbidity in the vicinity of the disposal site that could be attributed to dredged material disposal (Dragos and Lewis, 1993; Dragos and Peven, 1994).

Plume transport at the Rockland Disposal Site in Maine was limited to approximately 500 yards from the point of discharge for a 1,900 cy disposal event (SAIC, 1988). However, the plume from a larger barge volume (3,640 cy) was transported approximately 1 mile from the disposal point over a two hour period, with suspended solids concentrations decreasing by 99 percent of those initially measured (~1,500 mg/L, decreasing to 14 mg/L).

Studies at the Massachusetts Institute of Technology (MIT) (Ruggaber and Adams, 2000a; Ruggaber and Adams, 2000b) used “flow visualization” devices in a laboratory setting to confirm that a small percentage of sediment remains in the water column after a disposal event. This laboratory study evaluated how plumes form and how sediment particle characteristics affect the plume formation. The study was also designed to determine how much material is incorporated into the descending cloud and how much is lost during convective descent. The study estimated that less than one percent of the original mass exiting the barge separates from the material contained within the collapse phase during the discharge and remains in the water column. This is consistent with the lower range reported from field studies (Tavolaro, 1984; USACE, 1986).

Extensive plume monitoring was performed at the Rhode Island Disposal site following placement of large volumes of material from the Providence River and Harbor Maintenance dredging project. These surveys found rapid plume reduction related to settling of material and dispersion in the open ocean setting, with a return to background conditions within several hours of placement (SAIC 2005a, 2005b).

These studies show that only a small amount of sediment remains in the water column after a disposal event and that, in general, the material is rapidly diluted and dispersed and is not discernible after two to three hours. The concern about the small amount of material that remains in the water column pertains to potential impacts from: (1) reduced light penetration induced by the residual sediment in the water column which may reduce photosynthesis and, (2) the possible release of nutrients or contaminants from the sediments during the descent phase. Reduction in light penetration is usually short in duration (on the order of hours). Studies of the nutrient and other contaminant releases from the descending dredged materials show that the release is limited with no toxicity to sensitive marine organisms as determined through biotoxicity testing. The incremental addition of nutrients or contaminants from dredged material disposal, relative to other sources such as rivers, wastewater treatment facilities and nonpoint sources is small and inseparable from ambient conditions (USACE, 1982). The intermittent nature of the disposal operations, the short time period that material stays in the water column (usually less than two to three hours), along with rapid dilution and settling further limit any potential effects.

Topographic change occurs within an open water dredged material disposal site over the course of the site's history. Initially, the disposed material creates a mound, changing the local topography. Mound building may be intermittent or continuous, depending on dredging cycles and projects. Final site topography depends on site management practices. Several long-term processes can reduce mound height or modify the mound topography after disposal is complete. These include physical and biological processes that act to "smooth" the roughness of the mound (Rhoads, 1994). Also, newly deposited dredged material compacts under its own weight and often deforms the seafloor beneath it. Both actions reduce the mound height. Bottom currents winnow, transport, and redistribute materials from the mound surface. The amount of transport and redistribution depends on the sediment texture (grain size), sediment cohesiveness, and current strength. Biological processes such as colonization (including burrowing) and foraging by megafauna also act to smooth the mound's surface, modify its response to erosion forces, and change its topography. These physical and biological processes may also modify the nature of the surface sediments on the mound over time. Many studies have demonstrated that the upper inch or two of dredged material mounds can be winnowed of fine-grained sediments, leaving behind coarse sediments that are more resistant to erosion. Such winnowing eventually reaches an equilibrium distribution that reflects the critical erosion velocity at the site.

The location of the Massachusetts Bay Disposal Site (MBDS) in a deep water basin (almost 300 feet deep), protects the site from the effects of major storms. Studies from the Disposal Area Monitoring System (DAMOS) program have shown that the material disposed at a specified target within the MBDS forms a distinct mound. Multiple disposal mounds have been formed within the boundaries of the MBDS. MBDS had been subject to at least two major storms, Hurricane Bob in 1991 and the Halloween Storm also in 1991. Monitoring surveys were conducted at the MBDS in 1990 and 1992 (pre- and post-storm) as part of the DAMOS. Surveying and monitoring were conducted with precision bathymetry and REMOTS® sediment profile photography. Previous bathymetric/REMOTS monitoring surveys at MBDS occurred in August 1990. Since 1990, initiation of a major construction project in the Boston area, the Central Artery/Third Harbor Tunnel project, resulted in increased disposal activity at the site. One of the objectives of the 1992 DAMOS field work was to map the distribution and thickness of dredged materials that MBDS received following the 1990 survey.

It was predicted that the dredged materials disposed since 1990 would have increased the size of the mound detected by bathymetry in 1990. The precision bathymetric survey detected the maximum thickness of the disposal mound approximately 300 feet west of the target buoy, which was the location of the active disposal within the MBDS at that time. Dredged material detected by the 1992 REMOTS® survey extended up to 2,000 feet from the buoy location. The results of the survey showed there to be no substantial resuspension or transport of dredged material as a result of Hurricane Bob and the Halloween Storm. Periodic monitoring is performed at the MBDS as part of the USACE's Disposal Area Monitoring System Program, with the most recent survey in October 2012 (Battelle, in preparation, expected April 2013).

Sediments in the area of the MBDS are composed predominantly of fine-grained silts and clays. The dredged sediments are silt and clays with some sand and gravel that is considered to be suitable for unconfined open water disposal. Only material that is found suitable for ocean water disposal after testing will be disposed at the MBDS. However, DAMOS studies indicate levels of metals and organics in the dredged material within the disposal site can be above background levels, indicative of the industrial nature of the areas dredged that utilize the site. On average, approximately 300,000 cy of dredged material a year has been disposed at the MBDS from previous Boston Harbor dredging projects and other harbors in the region. As our waterways become cleaner (i.e. Boston Harbor), material disposed at the MBDS has not and is not expected to significantly change the present character of the disposal site in Massachusetts Bay.

4.4.2 Chemical Impacts at the MBDS

To determine if the dredged material is suitable for disposal below mean low water in Massachusetts Bay, it is regulated according to both Section 103 of the Marine Protection, Research, and Sanctuaries Act or Section 404 of the Clean Water Act. Dredged material which meets the criteria in one of the following three paragraphs is environmentally acceptable for ocean disposal without further testing.

a. Dredged material that is predominately sand, gravel, rock, or any other naturally occurring bottom material with particle size greater than silt and is found in areas of high current or wave energy can be disposed of in a 103 site without further testing. The material from the fourteen samples in the North Channel, Presidents Roads, and Reserved Channel Turning Basin (Samples A through M and Sample DD) had high proportions of gravel and sand. The fines in these samples ranged from 0.59% to 28.48%. The sediments from these areas meet this exclusion and are suitable for unconfined open water disposal at MBDS without further testing.
b. Dredged material that is proposed for beach nourishment and is predominantly sand, gravel or shell with grain sizes similar to the receiving beaches can be disposed of without further testing. None of the material from this project is proposed for beach disposal.
c. When the dredged material is substantially the same as that at the disposal site and the dredged material is taken from a site far removed from known sources of pollution, it can be disposed of without further testing. This project's material meets this exclusion. The sediment to be removed is parent material (mostly silts and clays) underlying the contaminated surficial material, which is being removed by the ongoing maintenance dredging. It is far removed from known sources of contamination, having been laid down by glaciers before the Industrial Revolution and insulated from industrial contaminants by soon-to-be-removed surficial material. It is the same type of material as at the disposal site, as the same glaciers laid sediments at both areas.

The regulations state that if the dredged material does not meet the criteria of paragraph b above, it must undergo further testing of the liquid, suspended particulate and solid phases before it can be considered acceptable for ocean disposal. This section does not apply to this project, as the dredge materials meet the criteria in paragraphs a or c above.

Based on the above criteria, the material to be dredged and disposed at the MBDS meets the testing exclusion criteria and is acceptable for disposal at the MBDS. Therefore no significant long-term impacts are expected. See the suitability testing memo in Appendix L for additional details.

Maintenance materials from the project areas, described in Section 2.9.3, would need to be tested during the design phase of the Deep Draft Project, and suitability determinations made for their disposal. At this time, given the suitable determinations issued for maintenance of adjacent areas, and the location of these project features in the Outer Harbor, it is assumed that the materials would be found suitable for ocean disposal and would be disposed at the Massachusetts Bay Disposal Site.

4.4.3 Biological Impacts at the MBDS

The MBDS was monitored for benthic recovery in the fall of 2000 (SAIC, 2002), after most of the Boston Harbor Navigation Improvement Project was completed. Most of the material disposed at the MBDS was Boston blue clay, similar to the material to be disposed from the Deep Draft Project. Remote Ecological Monitoring of the Seafloor (REMOTS®) surveys were employed to monitor the recolonization of the disposal mound after disposal. The fall 2000 REMOTS® sediment-profile images examined the surface sediment composition and evaluated the benthic recolonization status over each disposal mound. The images confirmed the presence of the deposited Boston blue clay. Past environmental monitoring surveys at subaqueous dredged material disposal sites have shown that sediments of a glaciomarine origin (i.e., Boston blue clay) tend to be very cohesive and devoid of organic matter. Although a firm substrate is ideal for surface dwelling, Stage I benthic infauna and epifauna, this type of material can impede the development of a stable Stage III (burrowing and deposit feeding) population. As a result, dredged material mounds showing a high percentage of glacial clay in the surficial layers often display a slower rate of benthic recolonization relative to marine sediment deposits.

As expected, the disposal mounds displayed a benthic infaunal community composed primarily of Stage I pioneering polychaetes with some occurrence of Stage III head-down deposit feeders. The older mounds exhibited a higher occurrence of Stage III activity. However, the benthic community appeared to be recovering on the newer mounds as anticipated, although at a lower community status than the surrounding reference areas. The benthic habitat conditions over the disposal mounds were expected to continue to recover over the next several years, as Stage III activity becomes more widespread and the redox potential discontinuity (RPD) depths deepen as the glacial clay is biologically reworked and additional silts are incorporated through natural deposition. Any benthic organisms inhabiting the disposal area would be buried during disposal events. However, once disposal ceases, recolonization of the mound would begin.

As predicted, the monitoring of the MBDS in September 2004 confirmed that the disposal mounds would fully recover once disposal ceased (ENSR, 2005). Six disposal mounds (MBDS-A, MBDS-B, MBDS-C, MBDS-D, MBDS-E, and MBDS-F) have been formed from dredged material. Three disposal mounds (MBDS-C, MBDS-D, and MBDS-E) were constructed over a short period of time (1998-2000), consisting primarily of Boston blue clay as part of the Boston Harbor Navigation Improvement Project, and monitored during the fall 2000 survey. The MBDS-C mound is the largest of the mounds, formed by the placement of nearly 1.4 million m^3 dredged material between November 1998 and August 1999. The MBDS-D mound is the smallest mound, formed by the disposal of approximately 386,000 m^3 of dredged material from Boston Harbor placed at the site over a 2.5-month period (August-October 1999). The last disposal site to receive a significant amount of material from Boston Harbor is MBDS-E. At this site over 750,000 m^3 of dredged material was disposed between October 1999 and June 2000.

The sixth disposal mound (MBDS-F) was initiated in September 2000, but no obvious mound had formed at the time of the fall 2000 survey (ENSR, 2005). Between the fall 2000 survey and the September 2004 survey, approximately 560,000 m^3 of dredged material has been disposed at MBDS-F, including the material from the Boston Harbor OHMDP. Dredged material from the OHMDP comprised approximately 1/5 (110,000 m^3) of the total material disposed at MBDS-F. Disposal of dredged material at MBDS-F resulted in the distinct formation of a mound, approximately 450 m in diameter and 4 m in height based on comparison of the 2000 and 2004 bathymetry. The measured mound height matched the predicted height of 4 m. Given the limitations in the bathymetric depth difference technique to resolve the outer extent of the mound apron, where dredged material thicknesses are less than 0.25 m, the measured diameter (450 m) was consistent with the predicted diameter of the full extent of the mound (800 m). The MBDS-F mound is expected to continue to increase in size as the disposal marker buoy remained at the same position during the winter of 2004-2005.

During the monitoring survey at MBDS in 2000, it was observed that benthic recolonization within MBDS has proceeded as expected, but there were notably fewer occurrences of mature, deposit-feeding communities present on the MBDS-C mound compared with the MBDS-B mound. This was attributed to the presence of consolidated Boston blue clay at the MBDS-C mound (SAIC, 2002). The closer the clay was to the sediment surface the greater the resistance of the sediment to burrowing infauna and, as a result, the shallower the RPD depths. The 2000 survey was conducted about one year after completion of disposal at MBDS-C mound, and it was anticipated that as time progressed, a more mature infaunal community would develop. Numerous studies performed within the DAMOS program in the past (Germano *et al.*, 1994) as well as at other dredged material disposal sites (e.g., Rhoads *et al.*, 1978; Rhoads and Germano, 1986; Hall, 1994; Newell *et al.*, 1998; Smith and Rule, 2001) have shown that even in dredged material deposits exceeding a meter or more, or consisting of highly cohesive, consolidated material, benthic recolonization and community succession will occur with full ecosystem recovery over time. The time for these recoveries has taken from as little as 18 months to as long as three to five years.

The latest survey conducted in September 2004 on both the MBDS-C and MBDS-D mounds showed that, in the five years since disposal activities at these two mounds had ceased, the resident benthic community had completely recovered, and both mounds exhibited benthic conditions comparable to those found on the three reference areas. Equivalence tests supported these observations, demonstrating that differences in RPD depth and organism-sediment index (OSI) values between the MBDS mounds and the reference areas were not significant.

4.4.4 Marine and Coastal Birds

Pelagic birds and waterfowl are more common in the open waters of Massachusetts Bay and would likely be the only species that could potentially be impacted by disposal activities at the MBDS. These birds spend most if not all of their time on the water or foraging in the water for fish, crustaceans, or invertebrates.

Birds in the area of a disposal site would most likely avoid the immediate vicinity during disposal operations. Birds resting on the water or foraging in the area would likely leave during disposal activities and would not be permanently impacted. Some species, such as gulls, would be attracted to disposal operations to forage but they are not expected to be negatively impacted by disposal activities.

4.5 Disposal Impacts at the Industrial Waste Site

The disposal alternative of disposing of dredged material at the IWS would involve capping areas of the site identified with high density of waste containers exposed on the seafloor. If this alternative is implemented, many of the physical, biological, and chemical impacts described above for the MBDS would be expected to occur at the IWS. According to NOAA, 1996, "No evidence was gathered that would support a conclusion that LLW (low level radioactive wastes) or the hazardous substances investigated posed an imminent and widespread human-health or ecological threat. However, the documented presence and large concentration of waste containers along with known ordnance disposal in some areas of the IWS pose potentially significant occupational risks to users of bottom-tending mobile gear. Therefore, according to the conclusion of this screening survey, wastes previously disposed of in the area should be considered only as one of several sources of contamination to Massachusetts Bay." Using the dredged material to cover the existing material at the IWS would reduce the risk to fishermen and further isolate potentially contaminated areas from the environment.

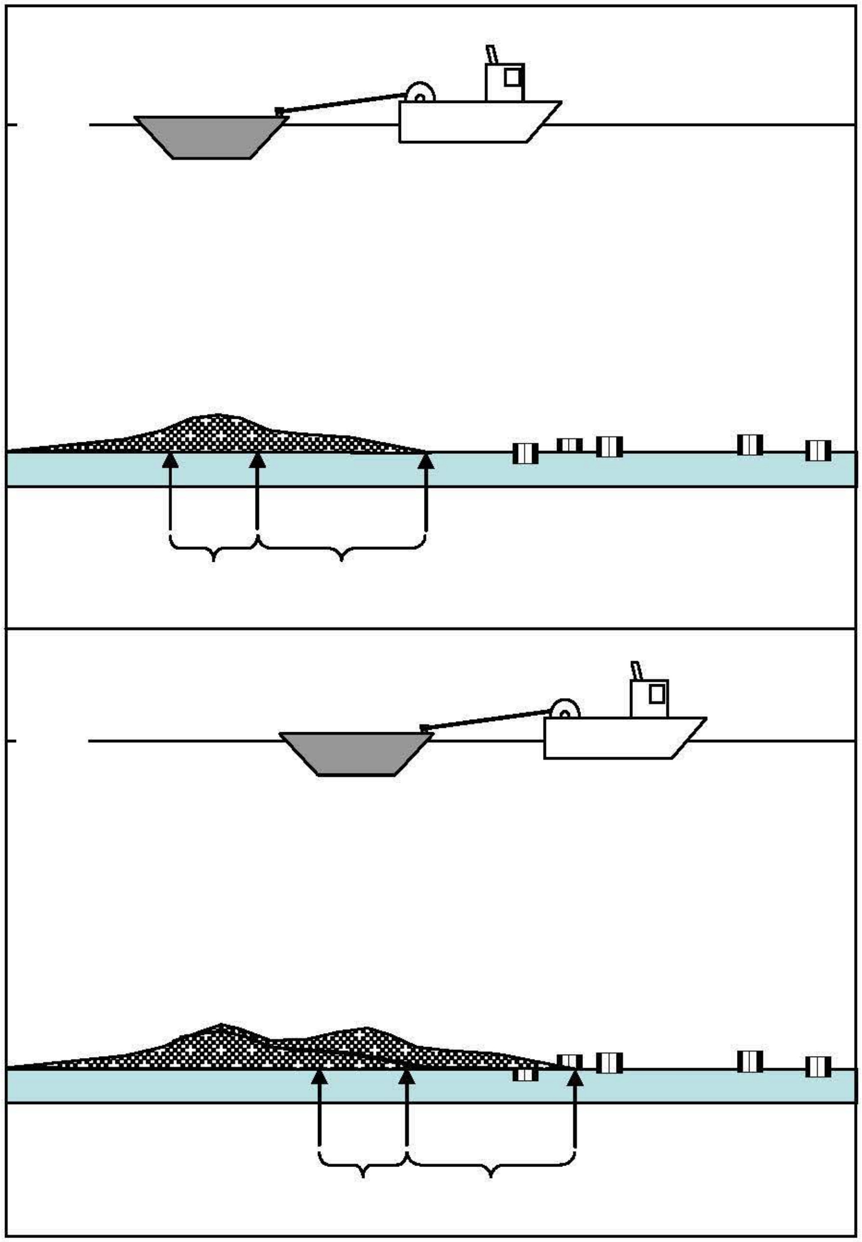
Table 4-2 gives the amount of material that would be dredged for three representative depth alternatives and the area of coverage that would be provided at incremental foot thicknesses. The area of coverage ranges from a low of 0.85 square miles with an eight-foot thick cap and 45-foot depth to 3.65 square miles with a four-foot thick cap and 50-foot depth.

Table 4-2. Industrial Waste Site Capping Areas

Main Channels Improvements – Plans A-B-C Depths	45 Foot Main Channel	47 Foot Main Channel	50 Foot Main Channel
Volume of Ordinary Material Generated by the Project			
Main Channels Improvements - A-B-C	6,393,500	10,220,900	14,754,700
Main Ship Channel Extension to MMT	246,300	246,300	246,300
Mystic River Channel (40 Feet)	67,100	67,100	67,100
Chelsea River Channel (40 Feet)	342,600	342,600	342,600
Total Ordinary Material (Cubic Yards)	**7,049,500**	**10,876,900**	**15,082,200**
Area of Industrial Waste Site Covered at Various Cap Thicknesses			
Square Miles Covered by 4-Foot Cap	1.71	2.63	3.65
With 5-Foot Cap Thickness	1.37	2.11	2.92
With 6-Foot Cap Thickness	1.14	1.76	2.43
With 7-Foot Cap Thickness	0.98	1.50	2.09
With 8-Foot Cap Thickness	0.85	1.32	1.83

Dredged material would be placed at the site in a manner that would minimize the potential for ambient sediment to become resuspended from disposal. Initial placement of dredged material would occur on the edge of the barrel field. Subsequent drops of dredged material would be placed on top of the flanks of the initial sediment mound to help absorb energy from the drop and to create an apron that would build to cover the barrel field. See Figure 4-1 for a schematic of the proposed cover. A pilot study of this cover method has been proposed and will be conducted at the MBDS by the USACE, outside the barrel field. Depending on the results of this pilot study, this method or a variation of the method will be used at the IWS.

Figure 4-1. Schematic of Remediation Capping Approach. A - Initial Cap Placement Events to Occur Outside Barrel Field Creating Zones of Direct Bottom Impact and Zones Where Sediment Spreads Laterally. B - Later Cap Placement Events to Occur over Lateral Spread Zone Which Helps Protect Original Seafloor and Minimizes Resuspension.



4.6 Threatened and Endangered Species and Species of Special Concern

As described in Section 3.4, Boston Harbor has served as habitat for a variety of Federally listed threatened and endangered species and State Species of Special Concern. The following sections first describe potential dredging impacts and then blasting impacts to these species.

4.6.1 Dredging Impacts to Sea Turtles, Atlantic Sturgeon and Whales

4.6.1.1 Sea Turtles

According to correspondence from NOAA Fisheries (July 21, 2005) there have been no surveys for sea turtles in Boston Harbor, but suitable forage and habitat exist in the area and it is likely that sea turtles occasionally are present in Boston Harbor. However, no direct impacts to sea turtles are likely from project operations given the low likelihood of their occurrence within the immediate area and because any sea turtles that may be present during dredging operations should be able to avoid the mechanical dredge. Also, sea turtles have been known to be impacted from hopper dredges only, not mechanical dredges (Dickerson, et al. 2004). Since a mechanical dredge is proposed for the project, it is unlikely that any impacts to these species would result from dredging even if they were present in the construction area. Any indirect impacts to sea turtles that may occasionally transit the area, such as impacts to forage items, are expected to be minimal since they are mobile and suitable foraging areas occur elsewhere in the vicinity of the project.

4.6.1.2 Atlantic Sturgeon

Dredging activities can pose significant impacts to aquatic ecosystems by removing, disturbing and resuspending bottom sediments. Environmental impacts of dredging include the following: direct removal/burial of organisms; turbidity/siltation effects; contaminant release and uptake; noise/disturbance; alterations to hydrodynamic regime and physical habitat and actual loss of riparian habitat (Chytalo, 1996 and Winger *et. al*, 2000; *in* ASSRT, 2007). According to Smith and Clugston (1997, *in* ASSRT, 2007), dredging and filling disturbs benthic fauna, eliminates deep holes, and alters rock substrates; all habitat features important to sturgeon.

If sturgeon are in the area, it would be expected that they would have the ability to move from the disturbance caused by the construction and dredging activities. Hatin *et al*, (*in* ASSRT, 2007) compared catch per unit effort (CPUE) before and after dredging events in 1999 and 2000. The authors documented a three to seven-fold reduction in Atlantic sturgeon presence after dredging operations began, indicating that sturgeon avoid these areas during operations.

In addition to the above potential indirect impacts, mechanical, hopper and hydraulic dredging can also have a direct impact on sturgeon. Hydraulic dredging can directly harm sturgeon by lethally sucking fish up through the dredge dragarms and impeller pumps. The number of captures of Atlantic sturgeon as reported by the U.S. Corps of Engineers for the U.S east coast from 1990 to 2005 is located in Table 4-3. It should be noted that this only reports trips when an observer was on board to document capture; the numbers do not reflect all sturgeon captures.

Table 4-3. Atlantic Sturgeon Captured by Dredge Type 1990-2005 (ASSRT, 2007)

Year	Dredge Type		
	Hopper	Clam	Pipeline
1990	1		
1991			
1992			
1993			
1994	3		
1995			
1996			
1997			
1998	2	1	1
1999			
2000	2	1	
2001		1	
2002			
2003			
2004	1		
2005	1		
Totals	**10**	**3**	**1**

None of the documented captures are associated with dredging within Boston Harbor. Also, the use of mechanical bucket (clamshell) dredge for this project would appear to have less potential impacts to Atlantic sturgeon than a hopper dredge, (as noted in the above table where only three Atlantic sturgeon were captured in a bucket dredge as compared to 10 captured in a hopper dredge). Again, the study by Hatin *et al.*, appears to indicate that Atlantic sturgeon, if present, would generally move away from the disturbance caused by the dredging activities.

Based upon the information presented, above, it is unlikely that Atlantic sturgeon juveniles and adults would be present in the Main Ship Channel (either transiting through the area, or possible use as a forage area) during the proposed rock removal within Boston Harbor. Moreover, actions will be taken to lessen the probability for negative impact to this species. These will be discussed in the next section.

Although Atlantic sturgeon are not believed to forage or spawn in Boston Harbor or its tributaries, transient individuals may occasionally be found in these areas. However, as mentioned previously, a mechanical dredge will be used for the removal of the unconsolidated materials and for removal of the rock after it has been fractured. Although sturgeon have been impacted by mechanical dredges, the majority of dredging related injuries to these species have resulted from entrainment in the dragarms of hopper dredges (ASSRT, 2007). Therefore dredging operations are not expected to adversely affect any Atlantic sturgeon (or sea turtles) that may be found in Boston Harbor due to the type of dredge employed and the unlikelihood of their being in the area.

4.6.1.3 Whales

Whales are not likely to occur in Boston Harbor; therefore, it is highly unlikely that they will be affected by the proposed dredging activities.

4.6.2 Blast Impacts on Sea Turtles, Atlantic Sturgeon and Whales

Concerns were raised during the comment period for the Draft SEIS/EIR that blasting during project construction could cause an adverse impact to threatened and endangered whales and sea turtles, as well as the buoy listening and monitoring system recently installed in the separation zone of the Boston Harbor traffic lanes. In addition Atlantic sturgeon were recently listed under the ESA and therefore blasting impacts to this species are also a concern. These concerns are addressed in the following section which discusses the potential effects of blasting with recommended safety zones to avoid potential impacts to threatened and endangered species

Anthropogenic sound waves can impact sea turtles, marine mammals and fish in several ways. Increased ambient noise over extended periods can make it difficult for animals to receive and decipher the sounds relevant to their survival. This may result in poor communication between members of the same species, reduced ability to echolocate and find food, and altered behavior with respect to migration, mating, stranding, and predators.

More intense sounds, such as those generated by underwater explosions, can cause physiological injuries based on the sudden impact of the sound wave as it hits the ears and gas-filled body organs. Impacts range from inner ear damage, tissue shearing in the lungs, intestines, and swim bladders (of fish), and even death depending upon the animal's proximity to the blast. The degree of impact experienced by fish is related to the species, size, life stage of the animal, water depth, the weight of the explosive charge, and the distance of the fish from the charge (Wright, 1982). Fish with swim bladders and smaller fish have been found to be more susceptible to damage from shock waves than non-swim bladder fish and larger sized fish (Wright, 1982; Keevin and Hempen, 1997). Fish eggs and larvae may also be damaged or killed by an explosion.

Sound waves generated by blasting are known as "transients" or short, powerful pulses of noise. Peak pressure, measured in Pascals (Pa) or pounds per square inch (psi), and impulse, measured in Pascal seconds (Pa.sec), are the units used to describe severity of blast transients. Impulse is defined as the average pressure level of the wave acting over a given time. When looking at the effects on marine mammals, sea turtles and fish, it is important to consider both the level of the noise and its duration.

The term decibel (dB) is most often used to compare the level, or intensity of a sound, but the reference medium must be stated so that the reader understands whether in-air or underwater acoustics are being used. In water, acousticians use the standard reference sound pressure of 1 micropascal, abbreviated **re 1 µPa** (the in-air reference is 20 µPa).

The Navy has done considerable research on pressure waves generated by unconfined TNT detonations. These large scale studies have been used to approximate the effects on marine mammals. Table 4-3 shows the ranges developed by the National Marine Fisheries Service (letter from NMFS Headquarters) which reflect the available data on the impact of transient pressure waves to marine mammals.

When it is necessary to use explosives to remove rock for deepening harbors and channels, several measures are put in place to significantly reduce pressure waves. Charges are not only confined in boreholes, but the boreholes are then packed, or stemmed, to further direct the force of the explosion downward into the substrate. Additionally, the charges are detonated on a timed delay so that the pressure is calculated on each individual blast event per 25 millisecond delay, instead of the cumulative weight of all boreholes detonated in the sequence. Criteria provided by NMFS for the effects of blasting on marine mammals, sea turtles and fish (sturgeon) are presented in Table 4-4 below.

Table 4-4. Effects, Criteria, and Thresholds (for Marine Mammals) for Impulsive Sounds from Underwater Detonation (provided by NMFS Headquarters)

Effect	Criteria	Metric	Threshold	Effect
Mortality	Onset of Extensive Lung Injury	Goertner modified positive impulse	indexed to 30.5 psi-msec (assumes 100 percent small animal at 26.9 lbs)	Mortality
Injurious Physiological	50% Tympanic Membrane Rupture	Energy flux density	1.17 in-lb/in^2 (about 205 dB re 1 microPa^2-sec)	Level A
Injurious Physiological	Onset Slight Lung Injury	Goertner modified positive impulse	indexed to 13 psi-msec (assumes 100 percent small animal at 26.9 lbs)	Level A
Non-injurious Physiological	TTS	Greatest energy flux density level in any 1/3-octave band (> 100 Hz for toothed whales and > 10 Hz for baleen whales) - for total energy over all exposures	182 dB re 1 microPa^2-sec	Level B
Non-injurious Physiological	TTS	Peak pressure over all exposures	23 psi	Level B
Non-injurious Behavioral	Multiple Explosions Without TTS	Greatest energy flux density level in any 1/3-octave (> 100 Hz for toothed whales and > 10 Hz for baleen whales) - for total energy over all exposures (multiple explosions only)	177 dB re 1 microPa^2-sec	Level B

Although NMFS has not yet developed acoustic criteria for blasting activities, based on studies done by Yelverton and Richmond (1981), Finneran *et al*. 2002, and Southall *et al*. 2007, they believe that blasting levels have varying impacts by size, as follows:

- ≥46 psi, 230$_{peak}$ dB re 1 μPa or 198 dB re 1 μPa^2-s (SEL) will cause injury or mortality[10];
- ≥23 psi, 224$_{peak}$ dB re 1 μPa or 183 dB μPa^2-s will cause harassment, via temporary threshold shifts (TTS)[11]; and,
- levels at or above 166 dB$_{RMS}$ re 1μPa will cause behavioral modification (Baker, 2008).[12]

[10] Sound Exposure Level (SEL) is defined as that level which, lasting for one second, has the same acoustic energy as the transient and is expressed as dB re: 1μPa^2•sec.

[11] TTS-Temporary - fully recoverable reduction in hearing sensitivity caused by exposure to sound.

[12] Root Mean Square (RMS) pressure is the square root of the time average of the squared pressure and is expressed as dB re: 1 μPa.

As the Deep Draft Project involves the removal of rock, minimal amounts of turbidity and siltation impacts from blasting and rock removal are expected. Contaminants do not generally adhere to rock, so insignificant amounts, if any, of contaminant release or uptake would occur. Rock would be removed from seven general areas within Boston Harbor including the Broad Sound North Entrance Channel; the President Roads Anchorage; the lower Main Ship Channel; the Main Ship Channel extension area below the Ted Williams Tunnel; the Reserved Channel and its Turning Area; and the upper Chelsea River. Since these areas are already in existing channels, no effects to the hydrodynamic regime within Boston Harbor or its physical habitat are expected. Although rock would be removed to authorized depth in the shipping channel, the underlying material is rock ledge. Once construction is complete, the ledge will become recolonized with benthic organisms and provide forage habitat again for estuarine animals. Sturgeon are generally associated with muddy and sandy substrates feeding on benthic organisms, but can also be associated with rock and cobble (ASMFC, 2009); therefore it is less likely that they would be using immediate project area for foraging and feeding given these substrates consist primarily of rock. Also, several research studies as well as anecdotal information received from NMFS (email dated May 11, 2012) indicate that sturgeon forage over tidal flats given the occurrence of preferred prey species in these areas. The nearest tidal flats to the project area are outside the channel near Castle Island or located more than 600 feet to the Governors Island Flats.

Based on studies by Moser (1999), peak pressure levels at, or below, 75.6 psi, and peak impulse levels at or below18.4 psi-msec, do not cause injury or mortality to species of sturgeon, including Atlantic sturgeon.

It should be noted that for both marine mammals and turtles, peak pressure levels above 23 psi result in Level B harassment (as noted in the NMFS criteria presented in the above table). Therefore, levels below 23 psi would be expected to be non-injurious to both seas turtles and marine mammals. Also peak pressures below 75.6 psi would not be expected to cause injury or mortality to sturgeon. Therefore, peak pressures below 23 psi would be expected to be protective of marine mammals, sea turtles and Atlantic sturgeon.

Due to the fact that for marine mammals, sound that would cause Level B harassment, (non-injurous behavior) is also measured by energy flux density and defined as having an energy flux density of less than177 dB re 1 μPa^2-sec, it is assumed that any sound below this level would be protective of marine mammals and therefore would have peak pressures of less than 23 psi. Also for sea turtles, criteria for Level B harassment are given as having peak pressures greater than 23 psi as well as energy flux densities equal to 183 dB μPa^2-s (which is greater than the energy flux density criterion given for marine mammals). Therefore it would be assumed that energy flux densities of less than177 dB re 1 μPa^2-sec (i.e. the criterion for marine mammals to prevent Level B harassment) would be protective of marine mammals, sea turtles and Atlantic sturgeon (i.e. it is assumed that sound energy at this level would be have peak pressures of less than 23 psi).

When the blast is detonated, shock waves are diminished as they spread outward from the blast according to the cube root of the charge weight. As the wave travels further through the water from the detonation point, it reflects repeatedly from the surface and seabed and loses energy. This reduction, referred to as "cube root scaling", was utilized by Cole (1948) in conjunction with small land animals and humans, to construct an open-water mortality radius (MR_{OW}) for single, open-water shots according to the following formula:

$$\mathbf{MR_{OW} = 260 \times W_{OW}^{1/3}}$$

Where $\mathbf{W_{OW}}$ = the maximum charge weight (in lbs.) per delay of a single, open-water blast.

Given the blast attenuation facilitated by confined borehole charges and the ability of marine animals to withstand pressure levels <u>higher</u> than land-based test subjects (small land animals and humans), Cole's equation provides a conservative calculation of safety ranges around a blasting project. This approach is further supported by Young (1991) who suggested that "cube root scaling" may be used to provide an upper limit in the absence of data for a specific effect."

Miami Harbor

Blasting was part of the Miami Harbor Channel deepening project performed by the Jacksonville District Corps of Engineers[13]. Three different safety radii around the blast zone were calculated, using Cole's equation (for unconfined open water blasting), to insure the protection of several threatened and endangered species. These zones were calculated as follows:

1) Danger Zone: The represents the inner most circle, with radius measured in feet, around the point of detonation. Any animal within this area during a blast would incur severe injury or death. The area immediately outside of this radius was determined to have no expected mortality or severe injury from any individual explosion.

Danger Zone (Feet) = 260 x $W^{1/3}$

W = charge weight in lbs per delay

2) The Safety Zone (or exclusion zone) is the second concentric circle immediately outside of the Danger Zone. Animals entering this area but not reaching the Danger Zone would potentially experience Level A harassment as defined in the Marine Mammal Protection Act.

Safety Zone (Feet) = 520 x $W^{1/3}$

W = charge weight in lbs per delay

3) The Watch Zone is three times the radius of the Danger Zone to insure animals entering or traveling close to the Safety Zone are spotted and appropriate actions can be implemented before or as they enter any impact areas (i.e., a delay in blasting activities).

Watch Zone (Feet) = 3 x Radius of Danger Zone

Based on explosive weight per delay of 119 lbs (54 kg), the Miami project calculated safety distances as follows:

Danger zone = $(260) * (119\ \text{lbs})^{.333} = 1{,}276.8$

Safety zone = $(520) * (119\ \text{lbs})^{.333} = 2{,}533$

Watch zone = 3 * 1,278 = 3,834 ft

Confined Blasting

The radii calculated above for the three zones were based on the effects of open water blasting. The Miami Harbor Channel Deepening Project noted above provided an opportunity to conduct pressure measurements during rock removal and compare those data with computed peak pressures for open water explosions. In that project, water-borne blast pressures from confined blasts were also recorded. The blasting was confined within the rock floor by stemming. Shot patterns of stemmed borings were recorded, as were two open-water shots. One hole of one shot was not confined properly, which allowed comparison of confined and a poorly confined larger charge weights per delay. The pressure

[13] For full project details pertaining to blasting, see Hempen, Keevin, Jordan. 2007. Underwater Blast Pressures from a Confined Rock Removal during the Miami Harbor Deepening Project. International Society of Explosive Engineers. Vol 1.

data were intended to gain information on typical pressure measures from the rock removal program relative to impacts on marine organisms (Hempen et al, 2007).

Results showed that the maximum pressures from the confined blasts were significantly lower than much smaller charges shot in open water. Where the mortality radius was determined to be 260 feet (using Cole's equation noted above) for a 1-lb booster that was shot in open water, it would have been only 56 feet for a 1-lb charge that was confined by stemming within the rock at Miami Harbor. The same charge may only have a mortality radius of 22 ft (6.7 m) or smaller when detonated within rock that was properly stemmed for confinement. Radiation of the wave energy into rock reduced the available energy reaching the water column. The pressures entering the water column were well below those pressures that typically propagate away from open-water (unconfined by solid media that may radiate the energy away with less harm) charges relative to charge weight per delay (Hempen et al, 2007).

Therefore, for confined rock blasting, the coefficient in Cole's equation above (that defined the mortality radius) was reduced from 260, to 56 as follows:

$$\mathbf{MR_C\ (feet) = 56w_C^{\ 1/3}}$$

where, w_C = the maximum charge weight (in pounds) per delay of a single, confined blast. (Hempen et al, 2007).

Boston Harbor

Blasting was most recently conducted in Boston Harbor in September 2012 and prior to that in 2008. Safety zones for the September, 2012 date were calculated using the equation above for confined blasting by using a maximum charge weight of 42.9 lbs per delay, which was the maximum charge weight used in the 2008 blasting. The radius of the mortality zone was calculated as follows:

$$\mathbf{MR_C\ (feet) = 56\ (42.9^{1/3}) = 196\ feet}$$

Once this maximum mortality zone radius was determined, the calculated radius to determine the potential fish injury zone was doubled. An additional 50 feet was then added to the potential fish injury zone to determine the radius of the safety observation zone for fish. The safety observation zone is the zone that will be monitored by the fish observer prior to blasting events. Therefore, for a single charge of 42.9 lbs of explosives per delay, the safety zone would be calculated as 442 feet. If more than one hole is shot per delay, then the safety zones would be greater, depending upon the total weight of explosives shot per each delay. It should be reiterated that in the formula given above, the variable "**wc**" is the weight of the charge per delay and not the total weight of the explosives shot per blast.

Boston Harbor September 2012 Blasting

Blasting was conducted in Boston Harbor for the Boston Harbor Rock Removal Project from September 6 – September 21, 2012. For the three blasts that occurred on September 6, 8 and 10, underwater sound monitoring was conducted by Tech Environmental to determine sound pressure levels at specific distances from the blast relative to protective criteria for marine mammals. Based on these data, protective zones were adjusted to ensure that they would be beyond the behavioral (Level B) threshold for marine mammals (i.e. 177 dB re 1 μPa^2-sec). The total weights of explosives per blast were 314 lbs for blast 1 (12 delays), 407 lbs for blast 2 (15 delays) and 554 lbs for blast 3 (17 delays). Calculated distances (based on the sound measurements) where sound pressure had attenuated to below Level B harassment thresholds for marine mammals were 773 feet, 783 feet, and 930 feet for the blasts 1-3 respectively. It should be noted that the protective radii from these three blasts increased with the total weight of explosives per blast.

When comparing these protective radii to those calculated using Cole's equation (noted above) for confined blasting, since the distance (using Cole's equation) is calculated only on the weight of the single charge per delay, the protective radius does not change regardless of the weight of the total charge. In addition, this radius calculated on the single delay appears to underestimate the distance necessary to reduce effects. Using the example of blast 1, the total weight of explosives was 314 lbs for 12 delays. Based on the blast reports, the maximum weight of charge per delay was 32 lbs. Therefore, using the equation above, the zone where there would be mortality would be 178 feet from the blast as noted below:

$$\mathbf{MR_C\ (feet) = 56(32)^{1/3} = 178\ feet}$$

Doubling this and adding 50 feet brings it to 406 feet which is the distance that would have been used for the Boston Rock Removal Project. However, based on the measured sound data (i.e. Tech Environmental report), the calculated distance to protect from Level B harassment was 783 feet. Similarly for blast 2, (total weight of explosives was 407 lbs) the maximum charge per delay was 33.5 lbs. The mortality zone for this single charge would be 181 feet, and doubling it and adding 50 feet would be 412 feet. However the calculated distance based on the measured sound data to protect from Level B harassment was 830 feet. Also for Blast 3, using 38.8 lbs per charge (total of 554 lbs of explosives) the protective zone based on Cole's equation is 429 feet, but the calculated zone based on the sound data was 920 feet (see Appendix Z for a copy of the Tech Environmental report). In addition, since Cole's equation is calculated on the weight of the charge per single delay and not on the total weight of explosives per blast, the exclusion zones will not change regardless of the total weight of explosives per blast event. However, the data collected from the September 2012 blasting events suggests attenuation distance does increase with an increase in the total weight of explosives per blast event. These data are summarized in Table 4-5 below.

Table 4-5. Comparison of Calculated Blast Safety Distances using Cole's Equation with those Measured from Tech Environmental for Boston Harbor Blasts 1-3, September 2012

Blast #	Number of Holes	Charge/ Hole (lbs)	Total lbs/ Blast	Calculated Mortality Zone (feet) (Coles) (D)	Safety Zone Dx 2 +50	Safety Zone (feet) (from Tech Envir. data) (ft)	Cole's Calculated on Total Wt x 2 (ft)
1	12	32	314	178	408	773	761
2	15	33.5	407	181	411	783	830
3	17	38.8	554	190	429	930	920

It should be noted that if Cole's equation is used on the total weight of explosives per blast event and then multiplied by 2, then the estimated distances to protect animals from Level B harassment approximate those calculated from the actual measured data (Table 2, last two columns). Therefore, when using Cole's equation to calculate distances to avoid Level B harassment, it may be more accurate to use the total weight of explosives used in each blast and then doubling it to calculate the safety zone.

Calculation of Boston Harbor Deep Draft Project Blasting Safety Zones

For the proposed Boston Harbor Deep Draft blasting, it is anticipated that a maximum of approximately 60 boreholes will be drilled to a maximum depth of approximately 18 feet. Based upon blasting reports from the September 2012 blasting, the pounds of explosives used per hole ranged from 5 to 44 lbs/hole, with an approximate mean weight of 28.5 lbs/hole. Using the formula noted above (Cole's equation), the safety zones are calculated on the approximate mean (28.5 lbs) and the approximate mean of the maximum amounts (40 lbs) of explosives estimated to be shot per bore hole or delay. In addition, safety zones are calculated on the mean (28.5 lbs) and maximum total amount of explosives (40 lbs) used per blast. In order to estimate the total amount of explosives per blast, the estimated maximum weight of explosives to be shot per hole of 40 lbs is used. This value is used because it slightly exceeds the mean of the maximum weights of charges per hole used in the September 2012 blasting in Boston Harbor (38.8 lbs, as noted in the blast reports).

Table 4-6 below provides the range in feet from the blast for the mortality and safety zones calculated on both the weight of charge per delay (i.e. individual borehole) and total estimated charge per blast (using 60 holes and a maximum charge of 40 lbs/hole) and multiplied by 2, in order to approximate the zones calculated by actual sound measurements (noted above). This is done for both the approximate mean weight of explosives expected to be used per charge (28.5 lbs), and the expected maximum weight of explosives to be used for charge (40 lbs). Note that a total charge weight per blast using 60 holes and 40 lbs of explosives per hole would be 2400 lbs. Based on the calculations used to protect species for the recent September 2012 Boston Harbor Rock Removal , it is presumed that the safety zone which is calculated on the single charges per delay, doubled with 50 feet added to it (column 5), would be sufficient to protect the listed species. However given the actual sound measurement from Boston Harbor blasting in September 2012, the safety zone calculated based on the total charge per blast and then doubled (last column) would be expected to be completely protective of marine mammals, sea turtles and Atlantic sturgeon; that is where no behavioral effects (Level B Harassment) would be incurred at all.

Table 4-6. Estimated Safety Zone for Blasting in Boston Harbor

Number of Holes and/or Delays	Charge per Hole/Delay (lbs)	Total Charge per Blast (lbs)	Mortality Zone Based on Charge/Delay (feet)	Safety Zone Based on Charge/Delay x 2 + 50’	Mortality Zone Based on Total Charge/Blast (feet)	Safety Zone Based on Total Charge/Blast x 2 (feet)
60	28.5	1995	171	392	705	1410
60	40	2400	192	433	750	1500

Therefore based on the above calculations it would be expected that a safety zone radius of 1500 feet (based on the estimated maximum total charge of 2400 lbs) would be completely protective of marine mammals, sea turtles and Atlantic sturgeon for the Boston Harbor blasting. This zone is shown overlain on a map in Figure 4-2 to indicate the extent of the safety zone relative to the outermost area of blasting for the project in the Broad Sound North Entrance Channel. A 50 foot observation zone would be added to observe for animals approaching the safety zone. Figure 4-3 shows the most seaward location of the blast safety zone in relation to the distribution of right whales from 2002 to 2012 in Massachusetts Bay.

Blasting Effects on Individual Species

Sea Turtles - As there have been no known sightings of sea turtles in Boston Harbor reported to the U.S. Army Corps of Engineers (USACE) by the resource agencies, it is likely that a sea turtle in the Boston Harbor navigation channels would be rare.

Atlantic Sturgeon - As noted above, the Atlantic sturgeon occurrences in Boston Harbor are also rare, particularly in those specific areas where blasting would take place in the lower harbor, harbor entrance, and upper Chelsea River. Aside from the Chelsea River turning basin, no blasting or rock removal would occur in the upper harbor (above the tunnels).

Whales - Based on the above analysis of the distance underwater blasting noise would have to travel to have an impact on whales, and the distribution of whales in Massachusetts Bay, no impacts to whales are expected. The listening buoys, located more than 10.5 miles from the entrance to Boston Harbor, would also not be expected to be impacted by blasting. Therefore there would not be any impairment to the Right Whale Listening Network resulting from blasting activities

Blasting Mitigation Measures

Therefore, based on the above calculations and analysis of effects on listed species, and the distribution and low probability of whales, sea turtles and Atlantic sturgeon occurring in the project area, it is expected that the Boston Harbor Deep Draft Project would not be likely to adversely affect listed species. To further reduce potential impacts to threatened and endangered whales, sea turtles, and Atlantic sturgeon in the project area, the following mitigation measures will be implemented:

- One or more NMFS-approved endangered species observers will be present at each blast site. The number of observers will depend on the number that is necessary to observe the entire safety zone. No blasting will occur until the safety zone is free from any observations of whales or sea turtles for 60 minutes, subject to safety considerations. These rerquirements can be added to the monitoring plan for blasting which can be submitted to NMFS for review and comment.
- The Right Whale Sightings Advisory System will be monitored as well as other communication media (i.e. NOAA weather radio, U.S. Coast Guard NAVTEX broadcasts, Notices to Mariners, and U.S. Coast Pilots) for general information regarding North Atlantic Right Whale sighting locations. In addition, the Contractor will be required to monitor the Right Whale Listening Network for information on Right Whales detected near the shipping lanes.
- No blasting will occur if Right Whales are present within the safety zone of the blast area or within a specified distance agreed to between NMFS and USACE, barring any safety concerns.
- In the unlikely event that any whales or sea turtles are observed within the safety zone during a blast event, all reasonable attempts to monitor the condition and behavior of the animal will be undertaken. These incidences will be reported immediately to NMFS to determine whether or not they would require reinitiating Section 7 Consultation. Detonation would not occur until the animal has moved from the area barring jeopardizing human safety.
- All blasting will be conducted using inserted delays of a fraction of a second per borehole as well as the use of stemming, which will be placed into the top of the borehole to deaden the shock wave reaching the water column.
- No blasting will occur when schools of fish are observed in the area (assuming that human safety is not jeopardized). A fish observer will use hydro-acoustic monitoring (i.e. side-scan sonar) prior to any blasting event to determine that schools of fish are not located within or transiting the blast zone area (including any listed Atlantic sturgeon). In addition to the sidescan sonar, a fish startle system will be employed to deter fish. Existing startle systems are most effective with species from the Clupeid family. The startle system uses high amplitude sound at specific frequencies. Lessons learned from the previous blasting in Boston Harbor will be incorporated, where appropriate, into the Contractor's blasting plan. Some of these lessons include the development of a communication plan between the fish observer and the Contractor, and the location of the fish startle system that will be deployed on an alternate vessel instead of the blast barge.
- All project vessels will comply with voluntary speed restrictions (10 knots or less) to minimize the risk of ship strikes, as implemented in Dynamic Management Areas (DMAs) that may be established by NOAA Fisheries Service. NOAA Fisheries Service will announce DMAs to mariners through its customary maritime communication.
- All previously established permit conditions for use of the MBDS, including use of lookouts for whales and sea turtles and vessel speed restrictions, will be required,including:

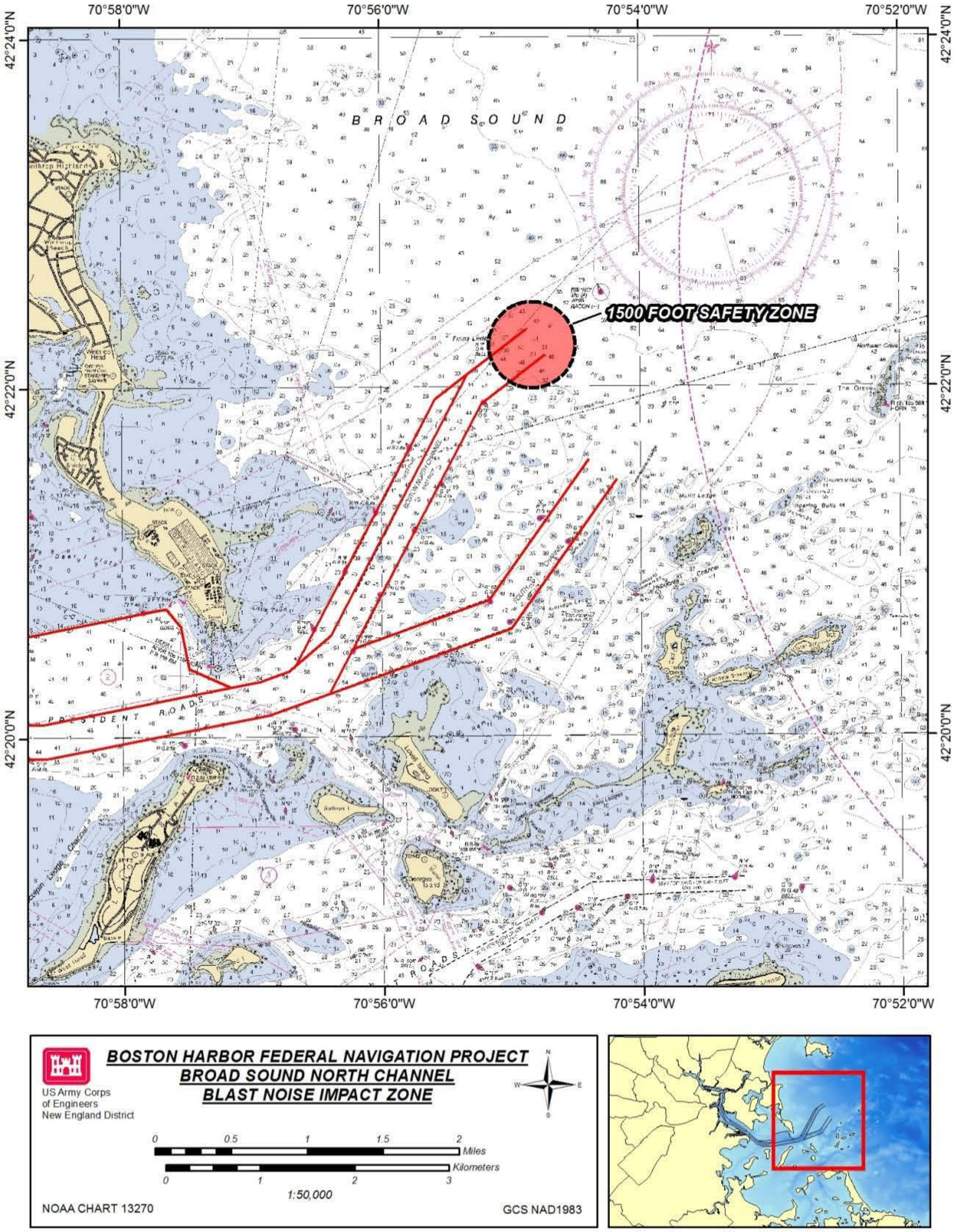


Figure 4-2. Blast Noise Impact Zone for Boston Harbor Federal Navigation Project

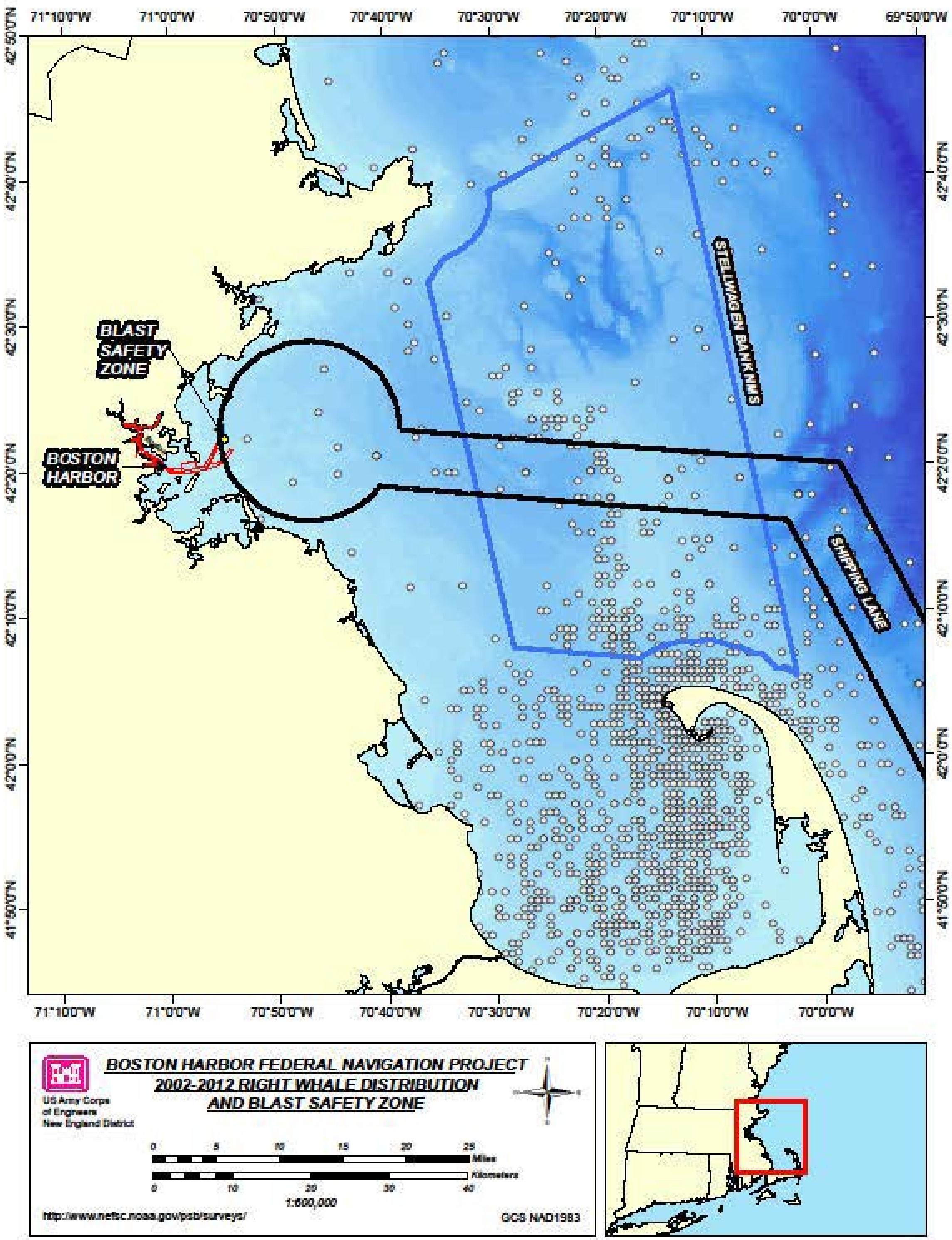


Figure 4-3. Right Whale Distribution from 2002-2012 with Shipping Lane into the Port of Boston

- Use NMFS guidelines to minimize interaction with and harassment of marine mammals during transit (i.e., tugs/scows will not approach within 100 feet of threatened or endangered species of whales (http://www.nero.noaa.qov/prot res/mmv/approach.html) or within 500 yards of a right whale 50 CFR 224.103 (c). Any vessel finding itself within the 500 yard buffer zone around a right whale must depart the area immediately at a safe, slow speed, unless one of the exceptions applies (see 50 CFR 224.103 (c));
- When sea turtles are sighted, attempt to maintain a distance of 50 yards or greater between the animal and the vessel whenever possible;
- Report all sightings of right whales to NMFS as soon as possible and, report within 24 hours any interaction with listed species to NMFS.This includes any reports of injuriesor mortalities.

The above analysis was based on an analysis that was provided to NOAA-Fisheries in response to their comments dated June 2, 2008 during the public review comment period for the Draft SEIS/EIR. Their letter indicated that Section 7 Endangered Species Act Consultation needed to be reinitiated due to potential blasting impacts and additional dredged material volumes not specified in our previous correspondence. As noted, based on our analysis above and that the additional volume of dredged material did not result in an extended period of time to construct the project, we believe that the proposed Boston Harbor Deep Draft Project would not result in a likely adverse effect on a listed species. Also, as noted previously, Section 7 consultation with NOAA Fisheries was reinitiated on November 7, 2012. They have concurred with our determination that the proposed project would not likely adversely affect any NMFS listed species (see letter dated November 27, 2012, (Appendix A)

Sea turtles and/or whales may be encountered by tugs and scows transiting to the MBDS or IWS. Consequently, NOAA Fisheries and the USACE and have agreed to conditions to reduce the potential for vessel collisions with endangered species. From February 1 through May 31 of any year, disposal vessel including tugs, barges, and scows transiting between the dredge site and the MBDS will operate at speeds not to exceed five knots between sunset and sunrise, or in daylight conditions where visibility is less than one nautical mile. From February 1 through May 31 of any year, an approved marine mammal observer will be present aboard disposal vessels transiting between the dredge site and the MBDS during daylight hours. Dredge contractors would also be required to monitor the right whale listening buoys for right whale status in the separation zone of the Boston Harbor traffic shipping lanes. To date, the marine mammal observation reports from previous disposal operations have not indicated any physical contact with whales while transiting to MBDS. The Massachusetts Water Resources Authority has conducted monitoring surveys that have included marine mammal observers as part of the Harbor and Outfall Monitoring Project since 1995. Since 1998 no endangered species have been identified in the MBDS area, but in 2004 two finback whales were identified from an area slightly south of the disposal site (Short and Schaub, 2005).

The MBDS is a EPA designated dredged material disposal site. The U.S. EPA will determine how they will comply with the Endangered Species Act if the boundary of the MBDS is expanded to include the IWS.

Correspondence dated September 16, 2005 received from the Massachusetts Natural Heritage and Endangered Species Program (NHESP) states that there are no state-listed rare animals in the immediate vicinity of the dredge site.

4.7 Historical and Archaeological Resources

4.7.1 Boston Harbor

Each of the four proposed improvement plans are discussed below, along with the investigations and coordination already undertaken, and conclusions reached about the potential for submerged cultural and archaeological resources and any additional investigations determined to be necessary.

Main Channels Improvement Plan: The main channels improvements to provide deeper-draft vessel access from Broad Sound to the Conley Terminal are being examined to provide a depth of between -45 to -50 feet at mean lower low water (MLLW), with an additional two feet in the north entrance channel under all plans. These improvements would deepen the Broad Sound North Entrance Channel, the Main Ship Channel through President Roads and up-harbor to the Reserved Channel, the President Roads Anchorage Area, the lower two-thirds of the Reserved Channel and the Reserved Channel Turning Area. All the project areas to be deepened under the main channels plan are presently part of the existing 40-foot and 35-foot deep Federal navigation project features, with the exception of small ledge areas that would be removed to widen the outer approach turn in the entrance channel opposite Finns Ledge and enlargement of the Reserved Channel Turning Area.

Earlier cultural resources studies are discussed in greater detail in the Affected Environment Section 3-5 (Historic and Archaeological Resources). Previous studies are noted with references. The 25 and 40-foot channel areas of the lower and outer harbor included in the Main Channel Improvement Plan and the Marine Terminal Extension plan were constructed between 1900 and the 1950s. All of these areas are periodically maintained by dredging.

The remote sensing survey and vibracore investigations did not cover the northern-most areas of the President Roads Anchorage, as those areas were not proposed for inclusion in the deepening project at the time of the fieldwork. Under prior improvement dredging projects from the 1940s to the present, this area had been excavated into the blue clay and bedrock. Significant cultural resources should not be present in this area due to the prior dredging. Based upon the aforementioned remote sensing survey (Mulholland et al. 2003) and follow-up inspection of magnetic anomalies (Robinson and Ford 2003), and vibracore investigation (Lynch et al. 2004), significant cultural resources should not be impacted by the proposed improvement dredging of the Federal navigation project for the main channels improvement.

Main Ship Channel Extension Plan: The Main Ship Channel deepening extension plan would deepen that channel in the reach above the Reserved Channel Turning Area and below the Ted Williams Tunnel to access the Massport Marine Terminal in South Boston. The 600-foot width of the existing 40-foot channel cut and a 50-foot width of the adjacent 35-foot channel would be deepened to a depth of -45 feet MLLW. This improvement will require ledge removal over most of its area. This area was also included in the remote sensing survey and magnetic anomaly inspection and no significant resources were encountered. Significant cultural resources should not be impacted by the proposed improvement dredging under this plan.

Mystic River Channel Deepening: This plan consists of deepening a small portion of the 35-foot area of the Mystic River Channel to -40 feet MLLW to access Massport's Medford Street Terminal. This area was also included in the remote sensing survey and no anomalies were identified. Vibracore samples were also taken from this area of the Mystic River during the study. Significant cultural resources should not be impacted by the proposed improvement dredging under this plan.

Chelsea River Channel Deepening: This plan consists of deepening the Chelsea River Channel from its currently authorized depth of -38 feet MLLW to a depth of -40 feet MLLW. The work involves dredging to deepen the existing project limits, except for two small areas along the Chelsea River Channel. The area immediately upstream of the A.P. McArdle Bridge, and the area of the bend between the bridges just downstream of the Sunoco Logistics Terminal, both along the East Boston side of the channel, would be widened by no more than 50 feet. The Chelsea Street Bridge was replaced in 2010-2011 by the City and U.S. Coast Guard, and the Federal channel widened to 175 feet in the vicinity of the new Chelsea Street Bridge in 2012.

The Chelsea River Channel was deepened from 35 feet to 38 feet in 1998-2001. Dredging for this deepening extended into the Boston blue clay, yellow till and granite ledge, all deposits that pre-date habitation of the region. The two areas where the channel will be widened in the bends between the bridges will need to be examined during the design phase of the project. A remote sensing archaeological survey of these two areas is recommended in order to identify the presence of submerged archaeological resources including shipwrecks in these areas. The original remote sensing survey of the Federal navigation channel (Mulholland et al. 2003) did not include the Chelsea River. Borings of the Chelsea Channel are also proposed for the project's design phase to confirm material types and examine the areas of channel widening for the presence of buried land surfaces and pre-Contact archaeological sites.

Any maintenance dredging of the project features discussed above is not expected to impact any historical and/or archaeological sites due to the fact that these areas have been previously disturbed.

4.7.2. Habitat Enhancement Sites

Beneficial use of the dredged material at several sites for hard-bottom habitat creation were investigated at five sites: offshore of Magnolia, in Nahant Bay, in Broad Sound south of Nahant, in Massachusetts Bay east of the Brewster Islands, and Nantasket Roads. Two of these areas (Broad Sound and Massachusetts Bay) show potential for development of new hard bottom habitat. Since these areas were not included in the remote sensing surveys conducted for the channel areas, it is recommended that such surveys be conducted if these features are included in the final project plan. This work will be planned and evaluated in coordination with the MA BUAR and the MA SHPO.

4.7.3. Massachusetts Bay Disposal Site and Industrial Waste Site

The MBDS and IWS are located seaward of the territorial sea (three-mile limit) in Federally regulated waters. These areas were previously surveyed (side scan sonar) by EPA, Region 1 and a number of shipwrecks were identified. If the IWS is ultimately recommended for capping via beneficial use of the dredged material from the improvement project, further data on the significance of the identified wrecks may be required if the capping plan were determined to have an impact on those resources. If impacts are unavoidable, a Phase II site examination level survey of the wrecks may be needed to determine the boundaries of these potentially significant resources and determine whether any are eligible for listing on the National Register of Historic Places. The scope of any studies and results would be coordinated with EPA as well as the Massachusetts Historical Commission and the Board of Underwater Archaeological Resources. However, given the large area available for disposal and capping and the fact that disposal sites can be shifted to avoid any potentially significant resources, unavoidable impacts are unlikely.

Summary of Additional Cultural Resources Investigations

In summary, the remaining cultural resource investigation work to be accomplished during the design phase of the project will consist of:

- Remote sensing surveys of the northern portion of the areas of the Chelsea River Channel proposed for widening;
- Borings for both of these areas;
- Laying-out a disposal plan at the MBDS and a capping plan for the IWS (if selected) to avoid the located shipwrecks (additional survey and Phase II site investigations may be required to determine the significance of identified shipwrecks); and
- Remote sensing surveys of any of the proposed rock reef sites included in the final plan and avoidance of any resources identified.

The preceding comments are offered in partial compliance with Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended and implementing regulations 36 CFR 800. The MA BUAR and MA SHPO have concurred with these recommendations via correspondence dated 2 June

2008 and 5 May 2008, respectively (Appendix A). The USACE will work closely with their offices as these additional studies are formulated.

As for earlier studies, the USACE will solicit comment from the MA BUAR and SHPO on the scope of these additional investigations and incorporate these comments in our implementation efforts. Field results and evaluations are provided for those agencies' review and concurrence before the USACE makes its determination on addressing any impacts. Depending upon identified historic properties and impacts to these, if any, the USACE in coordination with BUAR and SHPO will develop appropriate minimization and mitigation measures in an enforceable Agreement document if deemed appropriate.

Lastly, it should be noted that consultation with both the Mashpee and the Aquinnah Wampanoag Tribes, the two Federally recognized Indian Tribes in Massachusetts was initiated. The initial coordination letter, dated 18 April 2003, with the Wampanoag Tribe is included in the Public Involvement Appendix. Letters seeking comment on the draft Feasibility Report and SEIS/EIR were sent to the two tribes on 11 April 2008. No comments were received. However, consultation will continue with the Tribes for any remaining cultural resources studies, again in accordance with Section 106 of the NHPA and 36 CFR 800.

4.8 Air Quality

The air quality impact analysis presented in the Draft SEIS/EIR was conducted for three potential alternatives:

- No Action Alternative;
- Alternative 1 – -45-foot deep MLLW navigation channel; and
- Alternative 2 – -50-foot deep MLLW navigation channel.

After further design review and evaluation, USACE has determined that its proposed action would consist of the following modifications to the existing Federal Navigation Project for Boston Harbor and the Mystic River:

- Deepen the main channels between deep water in Massachusetts Bay and the Conley Terminal to a depth of -47 feet MLLW in the Main Ship Channel at 1200 to 800 feet wide; President Roads Anchorage, lower Reserved Channel and Turning Area, and deepen the 40-foot lane of the Broad Sound North Entrance Channel to a depth of -51 feet MLLW, all with widening of the channels in the bends;
- Deepen that reach of the Main Ship Channel above the Reserved Channel Turning Area to the Ted Williams Tunnel to -45 feet MLLW;
- Deepen the portion of the Mystic River Channel's 35-foot lane accessing the Medford Street Terminal to -40 feet MLLW;
- Deepen the 38-foot Chelsea River Channel to -40 feet MLLW with widening in two bends between the bridges.

Because the air quality impact analysis presented in the Draft SEIS/EIR provides a range of impacts surrounding the proposed action, the following discussion will utilize the data from the previous analyses to bracket the potential impacts of the proposed action and provide context for a qualitative discussion of the anticipated air quality impacts. The resulting proposed action will be for the -47-foot deep MLLW navigation channel, based on a conservative qualitative analysis of the emissions from the initially proposed Alternative 1 and Alternative 2.

Under current conditions (the No Action Alternative), larger cargo ships either delay (i.e., slow down) their arrival to ride the high tide into Boston Harbor, or wait at the berth or in the anchorage area or outside the project area for high tide. The lack of depth in the navigation channels may also cause a ship to delay departure or leave early from Boston Harbor or carry less cargo. In addition, larger cargo ships are diverted to the Port of New York/New Jersey (PONYNJ). The container boxes are then loaded on trucks at the PONYNJ for delivery to destinations in New England. The No Action Alternative would limit the number of container ships that can sail into Boston Harbor causing economic and air quality impacts. The economic and air quality benefits of the Deep Draft Project would include newer, deeper draft container ships as well as a decrease in truck miles traveled between the PONYNJ and destinations for shipping container boxes into and from New England.

The Deep Draft Project would include harbor deepening of the main ship channels and other areas seaward of the Reserved Channel for improved containership access to the Conley Terminal plus the three smaller improvements listed above. Various navigation depth increments were considered. The two build alternatives considered in the Draft SEIS/EIR cover a range of potential air quality impacts since the final depth of the Main Ship Channel is anticipated to be 47-foot MLLW, which is between (bracketed by) the 45-foot MLLW and 50-foot MLLW build alternatives previously evaluated.

Air Quality Analysis Alternative 1 (45-foot deepening) would require removal of approximately 6,394,000 cubic yards (cy) of dredged material and approximately 447,000 cy of ledge material for the main channels plan and a total of 7,050,000 cubic yards (cy) of dredged material and approximately 526,000 cy of ledge if the three minor improvements were included. This alternative would take approximately three years to complete.

Air Quality Analysis Alternative 2 (50-foot deepening) would require the removal of approximately 14,426,000 cy of dredge material and approximately 1,381,000 cy of ledge material for the main channels plan and a total of 15,082,000 cubic yards (cy) of dredged material and approximately 1,460,000 cy of ledge if the three minor improvements were included. This plan would take approximately four years to complete.

The modified recommended plan for a 47-foot project would require removal of approximately 10,221,000 cy of dredge material and approximately 900,000 cy of ledge material for the main channels plan and a total of 10,877,000 cubic yards (cy) of dredged material and approximately 979,000 cy of ledge with the three minor improvements included. This plan would take approximately three years to complete. It is anticipated that the proposed action would occur from 2014 through 2017.

4.8.1. Standards for Determining Significance

NEPA and MEPA Comparisons

There are two principal criteria for evaluating project air quality impacts:

1. Estimating the increase in air emissions levels above the No Action Alternative as a result of the Deep Draft Project, and
2. Determining compliance with relevant standards and regulations.

The National Environmental Policy Act (NEPA) criteria for determining significance are listed in 40 CFR 1508.27. NEPA requires comparing project-related air quality impacts with the No Action Alternative air quality impacts. The Massachusetts Executive Office of Energy and Environmental Affairs (EEA) is responsible for enforcing the Massachusetts Environmental Policy Act (MEPA) regulations (301 CMR 11.00). The purpose of MEPA is to provide meaningful opportunities for public and state agency review of the potential environmental impacts of projects requiring State permits or proposed by State agencies.

The MEPA regulations do not set environmental significance criteria to evaluate project-related impacts in the same manner as NEPA. They contain impact-related thresholds which presume environmental significance if exceeded, mandating that an EIR be required to examine alternatives that avoid, minimize, and/or mitigate impacts. MEPA also relies on State agencies, such as MADEP, to determine environmental significance and appropriate avoidance, minimization, and mitigation. Based on other EIR project experience, MADEP requires comparing project build air quality impacts with no-build air quality impacts similar to the NEPA requirements. In addition, MADEP requires estimating secondary air emissions. Under 310 CMR 7.00, secondary emissions are defined as those related to the construction or operation of a major stationary source/facility or major modification not directly related to the source/facility or major modification itself. Secondary emissions may include, but are not limited to: 1) emissions from motor vehicles, ships or trains going to or from the major stationary source/facility, and 2) emissions from any offsite support facility which would not otherwise be constructed, or increase its emissions as a result of the construction or operation of the major stationary source/facility or major modification. The shipping and cargo trucking emissions calculated for the indirect emissions would also represent the No Action Alternative and the Project (Post-Construction) operations. The Deep Draft Project will produce a net benefit to the environment for these secondary emissions.

A comparison of the net changes in indirect emissions for the No Action Alternative and the Deep Draft Project was conducted to compare with the NEPA and MEPA significance criteria. If the project emissions exceed the No Action Alternative emissions, then the project is considered to cause an impact requiring mitigation. For the purposes of this air quality impact analysis, it was also assumed that secondary emissions are the same as indirect emissions associated with cargo trucks and ship operations calculated for the general conformity evaluation. However, from a Clean Air Act conformity determination perspective, 40 CFR 93 Subpart B only requires the inclusion of indirect emissions where the agency has practicable control over future emissions. As the USACE has no control over ship traffic once the project is built, indirect emissions would not typically be included in a general conformity evaluation, so the evaluation of indirect emissions is primarily for compliance with NEPA and MEPA.

General Conformity Thresholds Comparison

The direct and indirect emissions were determined for each piece of equipment that would be used in the Deep Draft Project (e.g. construction equipment, trucks, ships). As noted above, direct emissions are those that occur during construction of the Project, and indirect emissions are those that occur from implementation of the Project after construction. The direct and indirect emissions were then summed on an annual basis for all equipment. The general conformity regulations require that the total of direct and indirect emissions be evaluated for:

- The year of maximum emissions;
- The mandated attainment year (for non-attainment pollutants) or the year of farthest emissions projections in the State Implementation Plan (SIP) (for maintenance pollutants); and
- Any year with an emissions budget specified in the SIP.

The annual emissions were compiled for each appropriate year for each build alternative, and each year's net emissions were then compared to the de minimis threshold values.

4.8.2. Air Emissions Estimation Methodology

Air emissions were estimated for the No Action Alternative and each year for Air Quality Analysis Alternatives 1 and 2. The total of the direct and indirect emissions (the net emissions increases) for a proposed project represent the difference between the build and the no-build scenarios. The general conformity regulations (40 CFR 93.152) define "direct emissions" as the emissions of a criteria pollutant or its precursors that are caused or initiated by the Federal action, originating in the same non-attainment or maintenance area, occurring at the same time and place as the action, and are reasonably foreseeable. Similarly, "indirect emissions" are defined as the emissions of a criteria pollutant or its precursors that are caused or initiated by the Federal action, originating in the same non-attainment or maintenance area, occurring at a different time or place as the action, are reasonably foreseeable, which the Federal agency can practicably control, and for which the Federal agency has continuing program responsibility.

For the purposes of the general conformity analysis, it was assumed that dredging and construction activities define direct emissions and the effects on cargo vessel operations including scheduling, volume of ship calls, fleet mix and associated trucking operations define indirect emissions. It is anticipated that changes in shipping operations for Alternatives 1 and 2 would occur after the dredging operations are complete. Therefore, there would be no overlapping of either Alternative 1 or 2 indirect emissions with the direct emissions from the dredging operations in any particular year.

Emissions of oxides of nitrogen (NO_x), volatile organic compounds (VOCs) and carbon monoxide (CO) were estimated for the general conformity applicability analysis and support of this SEIS/EIR. Emissions of sulfur dioxide (SO_2) and particulate matter (PM_{10} and $PM_{2.5}$) were only estimated in support of the SEIS/EIR air quality impact analysis. The emission sources for Alternatives 1 and 2 would consist of marine and land-based mobile sources that would be used during the 3 to 5 year dredging activities. The marine sources would include tugboats and barges, as well as support equipment, such as crew and drill boats, and dump scows. The land-based emissions would include both non-road and on-road equipment. The non-road equipment would consist of heavy equipment, such as clamshells, backhoe excavators, loaders, cranes, generators, pumps, etc. The on-road equipment would be made up of construction employee vehicles and any delivery trucks.

Direct Emissions

A dredging operations schedule was estimated for Air Quality Analysis Alternatives 1 and 2. The schedule included a breakout of the number of pieces of equipment, engine sizes, and power loadings for each major phase of dredging. These data were used to estimate emissions from marine vessels, nonroad (dredging) equipment and on-road vehicles. It was assumed that all equipment, except for on-road vehicles, would use diesel fuel. The on-road vehicles were assumed to be a mix of both gasoline- and diesel-fueled engines. Appendix O presents the proposed dredging operations schedule for Air Quality Analysis Alternatives 1 and 2.

Annual emissions calculated from all three types of emissions sources were summed to obtain the total direct emissions for Alternatives 1 and 2, which were compared to the general conformity de minimis thresholds. A detailed discussion of the methods used to estimate emissions from all three types of emissions sources is provided below.

Marine Vessels

Marine vessel (tugboats, survey boats and pushboats) emissions were estimated using the latest U.S. EPA technical report available at the time of the Draft SEIS/EIR for developing load factors and emissions factors for large compression-ignition marine diesel engines as prescribed in U.S. EPA, *Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data*, EPA420-R-00-002, February 2000. The technical report is a compilation of engine and fuel usage test data from various types of marine vessels including bulk carriers, container ships, dredges, tankers and tugboats. This report was used to determine the load factors and emissions factors for the various ship types that would be used during the dredging operations. The load factors for the marine vessels are based on the suggested operating mode of the vessel. These load factors are based on different operating modes (cruise, slow cruise, maneuvering and hoteling) for different types of vessels.

The report contains emissions factors based on a regression analysis of representative test data for various marine vessels. Emission factor algorithms were derived for different pollutants and also for fuel consumption, which in turn was used to determine the SO_2 emission factor. The sulfur content used to calculate the SO_2 emission factor was based on low sulfur diesel fuel (500 parts per million (ppm)), which is used by local tugboat operators and is required by EPA as part of the marine vessel emissions standards (U.S. EPA, *Clean Diesel Program for Locomotives and Marine, EPA 420-F-04-041*, May 2004). Table 5-1 of that EPA technical report presents the emission factor and fuel consumption rate algorithms, which are applicable to all engine sizes, since there is no statistically significant difference in emissions across engine sizes. All marine vessels used to support the dredging operations are accounted for in the emissions modeling.

The recommended number of tugboats and the size of the tugboat engines used for the analysis of Air Quality Analysis Alternatives 1 and 2 were used in the emissions calculations based on a conversation with a local tugboat company[14]. It was recommended that a single screw (2,150 horsepower) and a twin screw (3,000 horsepower) tugboat would be used to tow barges to and from the disposal sites for Alternative 1 and a second twin screw tugboat was added for Alternative 2 due to an increased amount of material that would be disposed.

Monthly emissions (tons/month) were calculated based on the number of tugboats, survey boats and pushboats, their rated horsepower, average power load factor, and hours of operation per day. The emissions were summed for each month to calculate the annual emissions. The annual emissions are based on a maximum of 239 days per year of dredging operations. This number of days per year takes into account downtime associated with inclement weather and maintenance of equipment.

Non-Road Equipment

The non-road equipment emissions were calculated using information from an U.S. EPA computer model NONROAD2.5. This model was developed to assist states and regulatory agencies to more accurately predict non-road emissions inventories. NONROAD2.5 calculates emissions for many nonroad equipment types by categorizing them by horsepower rating and fuel type. It estimates exhaust emissions for NO_x, SO_2, CO, PM and VOC. NONROAD2.5 contains several different sets of data files that are used to specify the options for a model run. These data files provide the necessary information to calculate and allocate the emissions estimates. The data files contain information on load factors, emission factors, equipment population, activity, average lifetime hours, growth estimates, equipment scrappage function, geographic location, and temporal allocation. The data files can be modified to reflect the project conditions relative to equipment population, annual hours of use, region of use, fuel source, equipment growth factors, and the phase-in of higher tier emission factors. NONROAD2.5 is best suited for estimating emissions for large-scale emissions inventories at the county, state or regional level. However, at the smaller project level, to modify the model to represent a smaller-scale project, the model can be cumbersome. Based on discussions with the U.S. EPA NONROAD model support specialist regarding this issue, it was recommended that for this project it may be better to estimate emissions using data provided in the U.S. EPA report, *Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling – Compression-Ignition, EPA420-P-04-009*, April 2004. Information in this document was directly incorporated into NONROAD2.5.[15]

NONROAD2.5 includes future emissions standards recently promulgated by U.S. EPA for gasoline- and diesel-fueled equipment. It also estimates the effects of deterioration in the emissions calculations as a function of age of the equipment. A range of 8 to 18 years for the age of the equipment was used for the calculations. A median age of 13 years was used to calculate the deterioration factors for each pollutant.

Since PM and SO_2 emissions are dependent on the sulfur content of the fuel, it was assumed that ultra-low sulfur diesel (ULSD) would be used in all non-road equipment, as required by U.S. EPA (40 CFR 89). A sulfur content of 15 ppm was used in calculating SO_2 and PM emissions.

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[14] Kristin Lemaster, CDM Smith telephone conversation with Dave Clarke, Boston Towing & Transportation Company, November 11, 2005.

[15] Kevin Eagar, CDM Smith telephone conversation with Craig Harvey, EPA, October 13, 2005.

Similar to the marine vessels emissions calculations, monthly emissions (tons/month) were calculated for the dredging operations based on the number of pieces of equipment, rated horsepower, average power load factor, and hours of operation per day. The emissions were summed for each month to calculate the annual emissions.

It should be noted that the current version of the NONROAD model at the time of preparation of this document, NONROAD2008a, became available from U.S. EPA in July 2009. The major differences between NONROAD 2008a and NONROAD2.5 (the model used to determine emissions for the Draft SEIS/EIR) is the accounting for diesel recreational marine standards in the locomotive/marine final rule and for small spark ignition and spark ignition recreational marine final rule. NONROAD2008a predicts substantially less VOC and CO emissions and somewhat less NOx and PM emissions for those types of engines than with NONROAD2.5 with use of comparable scenario inputs; any comparison depends on the pollutant, equipment type, year evaluated, and fuel choice. Since these changes would have little to no effect on the air quality analysis for the Deep Draft Project, no adjustments to the emissions from non-road equipment were deemed necessary.

On-Road Vehicles

The on-road vehicle emissions were calculated using the U.S. EPA model MOBILE6.2. It is an emission factor model that calculates emissions, in grams per mile, for different vehicle types under various operating conditions. Crew sizes and delivery truck sizes were estimated. An average commute of 25 miles each way at an average speed of 27.6 miles per hour was assumed for each vehicle. The number of miles per trip was then multiplied by the total number of days per year to determine the total number of miles traveled[16]. MOBILE6.2 input files representative of 2011 and beyond for eastern Massachusetts were obtained from MA DEP that would be representative of vehicles to be used on the project[17]. The results for the different emission quantities from the MOBILE6.2 model runs were multiplied by the number of vehicle miles traveled during each calendar year. The MOBILE6.2 model input and output files are available.

In March 2010 (75 FR 9411), U.S. EPA replaced MOBILE6.2 with the MOVES (MOtor Vehicle Emission Simulator) model as the primary model for calculating emissions from on-road vehicles. The latest version of MOVES at the time of preparation of this document is MOVES2010b, which was issued by U.S. EPA in April 2012. While MOVES2010b is considered to be more accurate in estimating emissions from on-road vehicles than MOBILE6.2, and may result in a reduction of the contribution of emissions from on-road vehicles for the Deep Draft Project, emissions from on-road vehicles have not been revised for this analysis. The previous analysis assumed emissions from on-road vehicles beginning in 2011, but anticipating that these emissions would not begin until 2014, emission rates would be expected to decline to match improving emission rates with newer model vehicles. So, the on-road vehicle emissions presented in this report would represent a conservative or higher than expected estimate.

Indirect Emissions

Under Air Quality Analysis Alternatives 1 and 2, the Main Ship Channel would be deepened to a depth greater than the currently authorized depth of -40 feet MLLW. Deeper channel depth would put Boston Harbor more in line with channel depths at other U.S. East Coast and foreign container ports, which are mostly 50 feet deep in the U.S. or deeper abroad. A deeper channel would allow larger vessels to access the port facilities in an economically efficient manner; thereby increasing the volume of twenty-foot equivalent units (TEU) loaded and unloaded at Boston Harbor while maintaining

[16] M. Wallace, CDM Smith, Conference Call meeting notes with the USACE on September 28, 2005.
[17] Email to Marc Wallace, CDM Smith from Craig Woleader, MADEP, December 5, 2005.

existing sailing schedules and port rotations[18]. For the purposes of evaluating the potential air quality impacts or benefits of the Project (Post-Construction) shipping and trucking operations, a -48-foot MLLW was selected. This depth was selected because it represented the median depth between the bracketing build alternative depths and has the highest net benefits. Because the channel depth used for the analysis of post-construction shipping is so close to the depth represented by the proposed action (-47-feet), no changes were made to the emissions analysis. Therefore, the indirect emissions analysis in this report would represent a conservative estimate.

The No Action Alternative and Deep Draft Project (Post-Construction) container, cargo and petroleum vessel operations including scheduling, volume of ship calls, fleet mix and associated trucking operations were obtained from the David Miller Associates report, *Boston Harbor Channel Deepening Containerized Cargo Benefits Analysis*, August 2007. (Information on the sizes and numbers of containerships expected for the Deep Draft Project (Post-Construction) from a David Miller Associates 2012 report is included in Table 4-5, but emission estimates are based on data from the 2007 report). The shipping and trucking operations data were used to estimate indirect emissions for the No Action Alternative and Deep Draft Project (Post-Construction). It was assumed that routine shipping operations would be the same under Air Quality Analysis Alternatives 1 and 2 during dredging activities.

Annual emissions (tons/year) were calculated based on changes in sizes of ships (i.e., smaller to larger vessels), changes in ship mode operations (i.e., anchoring, cruising and hoteling) and the number of ship calls per year. The net reductions in trucking emissions for the Deep Draft Project were also calculated using the MOBILE6.2 emissions model. The emissions were summed for each vessel type to calculate the annual emissions. The net change in trucking emissions was added to the total project emissions.

A similar approach was also conducted to estimate the air quality benefit for the New England region because of the reduced truck miles due to cargo trucked from Boston Harbor instead of from the PONYNJ. The results of this analysis are discussed as part of the comparison between No Action Alternative and the Deep Draft Project (Post-Construction) scenarios.

Ship Emissions

The No Action Alternative and Deep Draft Project (Post-Construction) shipping emissions were calculated based on the effects on container, cargo and petroleum vessel operations including scheduling, volume of ship calls, fleet mix and associated trucking operations. The No Action Alternative and Deep Draft Project (Post-Construction) shipping emissions were also estimated using emissions factors presented in the EPA report, *Final Regulatory Support Document: Control of Emissions from New Marine Compression-Ignition Engines at or Above 30 Liters per Cylinder, EPA420-R-03-004*, January 2003. However, for new container ships, it was assumed they would comply with the International MARPOL Annex VI NO_x emissions standards. For ships with Category 3 marine diesel engines, the MARPOL Annex VI NO_x Tier 1 standard applies to engines installed on vessels constructed beginning in 2004 but before 2011; the Tier 2 standard applies to engines installed on vessels constructed beginning in 2011 but before 2016; and the Tier 3 standard applies to engines installed on vessels constructed beginning in 2016. U.S. EPA has adopted these standards under its Tier 1, 2, and 3 standards for Category 3 marine diesel engines (engine sizes 3,000 to 100,000 horsepower). Engines meeting the Tier 1 standards have emission levels about 20 percent lower than uncontrolled levels (U.S. EPA, *Emission Standards Adopted for New Marine Diesel Engines, EPA420-F-03-001, January 2003*) while engines meeting the Tier 3 standards will have emission levels about 80 percent below uncontrolled levels. For the analysis conducted for the Draft SEIS/EIR,

[18] David Miller Associates, Draft Boston Harbor Channel Deepening Project, Containerized Cargo Economic Benefits Analysis, August, 2007.

Tier 1 emission standards were utilized. Therefore, for newer container ships a NO_x emission factor of 23.60 g/kW-hr was used to calculate the Project (Post-Construction) emissions and that analysis is considered a conservative estimate of expected emissions. It should also be noted that on March 26, 2010, the International Maritime Organization established an Emission Control Area (ECA) around the North American coastline extending outwards to 200 nautical miles. Beginning on August 1, 2012, marine vessels in the ECA must use fuel with sulfur content no greater than 1.0 percent, and starting on January 1, 2015, marine vessels in the ECA must use fuel with sulfur content no greater than 0.1 percent. This standard will significantly reduce emissions of sulfur dioxide and particulate matter from these ships in the ECA, and because emissions for these pollutants estimated for this analysis did not account for this standard, those emissions estimates will be conservative.

Under the project condition, Large Post-Panamax containership vessels (6,700 and 8,500 TEU; 48-foot maximum draft) are projected to use Boston Harbor for the Deep Draft Project (Post-Construction). The larger class ships are also expected to be newer models (2002) than the current fleets (average model year of 1994). The No Action Alternative bulk cargo shipments assume 24 bulk shipments/year on 40,000 dead weight tonnage (DWT) bulk carriers. It is estimated that the project bulk cargo shipments would decrease to 16 bulk shipments/year, but the size of the ships would increase to 60,000 DWT bulk carriers. Finally, the net change in petroleum shipments between the No Action Alternative and the Project is projected to be a decrease of 19 ship calls per year. However, the Deep Draft Project would generate a net increase of 34 ship calls/year (77 calls to 114 calls) for larger petroleum tankers 35,000 DWT or greater. Table 4-7 presents a summary of the No Action Alternative and the Deep Draft Project (Post-Construction) shipping operations.

Table 4-7. No Action and Post Construction Alternative Shipping Operations

No Action Alternative		Post Construction Alternative	
Ship Type	**No. of Calls/Year**	**Ship Type**	**No. of Calls/Year**
Containership - 4,000 TEUs (Foreign)	104	Containership - 5,100 TEUs (Foreign)	52
		Containership – 6,700 TEUs (Foreign)	52
Containership - 5,100 TEUs (Foreign)	52	Containership – 8.500 TEUs (Foreign)	52
Bulk Carrier - 40,000 DWT (Foreign)	25	Bulk Carrier - 40,000 DWT (Foreign)	7
Bulk Carrier - 25,000 DWT (Foreign)	12	Bulk Carrier - 55,000 DWT (Foreign)	18
Petroleum Ship - <20,000 DWT	356	Petroleum Ship - <20,000 DWT	337
Petroleum Ship - 20,000 DWT	0	Petroleum Ship - 20,000 DWT	0
Petroleum Ship - 25,000 DWT	6	Petroleum Ship - 25,000 DWT	0
Petroleum Ship - 35,000 DWT	81	Petroleum Ship - 35,000 DWT	38
Petroleum Ship - >35,000 DWT	77	Petroleum Ship - >35,000 DWT	114
TOTAL SHIPS	**713**	**TOTAL SHIPS**	**670**

Annual emissions were calculated based on the number of ship calls per year, engine load factors and anchoring, cruising and hoteling hours of operation per day. The shipping modes of operation (i.e., anchoring, cruising and hoteling) were based on information provided by USACE[19]. The deepening of the harbor would eliminate anchoring activities for petroleum ships and improve ship movement activities in the harbor. The power load factors were 0.1 for anchoring and hoteling modes and 0.25 for cruising mode within the reduced speed zone (RSZ) per guidance in the U.S. EPA report, *Final Regulatory Support Document: Control of Emissions from New Marine Compression-Ignition Engines at or Above 30 Liters per Cylinder, EPA420-R-03-004*.

Cargo Truck Emissions

The cargo truck emissions were calculated using the EPA model MOBILE6.2. The pollutant emission factors from the MOBILE6.2 model runs were multiplied by the number of truck miles traveled. These emission factors and input files were the same as those used to calculate the direct emissions from on-road vehicles one year after dredging is completed. The net change in projected truck emissions were added to the net change in shipping emissions between the No Action Alternative and Deep Draft Project (Post-Construction) scenarios. The MOBILE6.2 model input and output files are available.

4.8.3. Air Emissions Modeling Results

Since the project requires Federal funding and approvals, the Act's general conformity rule (40 CFR 93 Subpart B) requires that an evaluation be made on whether or not the general conformity requirements apply to the Deep Draft Project and, if so, whether the total of the direct plus indirect air emissions (only if the Federal agency has practicable control of indirect emissions) associated with the project would "conform" with the Massachusetts SIP to attain the NAAQS. The Boston area is part of a designated non-attainment area for the 1997 eight-hour O_3 NAAQS and a maintenance area for the one- and eight-hour CO NAAQS. Accordingly the general conformity applicability analysis was conducted for the pollutants that cause O_3 formation (precursor compounds VOC and NO_X) and for CO (See Section 3.6).

A formal general conformity determination is **not** required for projects that are "de minimis". De minimis project emissions are those that have net emissions increases less than the thresholds of 100 tons of NO_X/year, 50 tons of VOC/year, or 100 tons of CO/year. If, however, the maximum potential net emissions increases from the project could exceed these thresholds, then the project must demonstrate conformity with the SIP, or else the Federal approvals and funding must be denied. Making a positive finding of general conformity can be difficult, because the regulations only allow prescribed approaches:

- Showing that the proposed project and its associated net emissions increases are specifically identified in the SIP;
- Showing that the net emissions increases from the proposed project, along with all other emissions in the non-attainment or maintenance area, would not exceed the emissions budgets in the SIP;
- Showing that the net emissions increases from the proposed project are fully offset within the non-attainment or maintenance area, or another nearby non-attainment or maintenance area that impacts the subject area;
- Fully mitigating the net emissions increases from the proposed project to zero; or
- For CO, showing through either local or area wide dispersion modeling that the NAAQS are not threatened.

[19] Telephone conversation between Karen Umbrell, USACE and Marc Wallace, CDM Smith based on information provided by Boston Pilots, January 24, 2007.

A goal of the general conformity applicability analysis is to identify opportunities to modify a project to comply with the SIP. Accordingly, a component of this analysis involves evaluating opportunities to manage the project's emissions rates to be below the de minimis values. The critical pollutant for this analysis was NO_x. The uncontrolled emissions increase associated with the sum of direct and indirect emissions from the proposed Project would likely exceed the 100-ton/year de minimis threshold for NO_x.

The general conformity applicability analysis was conducted by calculating NO_x, VOC and CO emission rates for Air Quality Analysis Alternatives 1 and 2 and for changes in shipping and trucking operations after the completion of the project, based on likely equipment and operations data. If the resulting uncontrolled net emission increases exceeded any of the de minimis values, then emissions reduction measures were evaluated. These measures included modifying dredging methods, increasing the duration of dredging activities, and/or requiring the use of low-emitting equipment. Such measures would also have to be adopted as part of the project's design.

Note that, as mentioned in Section 3.6, if the Deep Draft Project commences construction after EPA revokes the 1997 eight-hour O_3 NAAQS (possibly by July 20, 2013), it is anticipated that the general conformity rule would no longer apply to the Project with respect to O_3 and its precursor compounds, NO_x and VOC. Under that scenario, the general conformity applicability analysis presented below for NO_x and VOC for the Project would be moot.

4.8.3.1 Direct Emissions

Air Quality Analysis Alternative 1

The project dredging emissions represent the estimated total direct emissions that would occur with the proposed deepening of Boston Harbor to the -45-feet MLLW depth. The emissions for the marine, non-road and on-road equipment were determined as discussed in Section 4.8.2. The calculated direct emissions were totaled on an annual basis over the three years of construction for all equipment involved for Air Quality Analysis Alternative 1. The direct emissions represent the net change in total emissions, since the indirect emissions would not occur during the three-year dredging schedule. Therefore, the total direct emissions were compared to the general conformity de minimis thresholds.

The estimated emissions for Air Quality Analysis Alternative 1 are summarized in Table 4-6. This table presents a summary of each pollutant's emissions categorized by marine vessels, nonroad equipment and on-road construction, employee, and truck deliveries emissions. The marine vessels include emissions from tugboats, survey boats, and push-boats required to assist the dredging during deepening operations. The non-road equipment would include a clamshell, backhoe excavator, drill towers, and their support equipment (i.e., generators, pumps, winches, and welders).

The first set of emissions calculations, identified as "uncontrolled" emissions, represents preliminary estimates without making adjustments to the dredging operations, schedule or equipment. Table 4-8 shows that the total emissions for the uncontrolled conditions for NO_x and CO exceed the general conformity de minimis thresholds for all three years. In addition, the total emissions for the uncontrolled conditions for VOC are less than the general conformity de minimis thresholds for all three years. Therefore, VOC emissions are exempt from further analysis under the general conformity rule.

The peak year direct emissions (Year 2) for NO_x and CO are 256 and 151 tons, respectively, which far exceed the 100 ton/year de minimis thresholds for both pollutants. The major contributors to these exceedances are the marine construction vessels and in particular the tugboat operations and the nonroad equipment, specifically the clam shell and backhoe operations. The on-road vehicle emissions are a minor contributor to the total emissions (i.e., less than five percent of the total emissions). The tugboat NO_x emissions represent 92 percent of the total marine vessel NO_x emissions and 23 percent of the total direct NO_x emissions. The clamshell and backhoe NO_x emissions represent 86 percent of the total non-road NO_x emissions and 64 percent of the total direct NO_x emissions, respectively. Similarly the tugboat CO emissions represent 95 percent of the total marine vessel CO emissions, but only represent approximately five percent of the total direct CO emissions. The clamshell and backhoe CO emissions represent 81 percent and 88 percent of the total non-road CO emissions and total direct CO emissions, respectively.

Since the uncontrolled direct emissions for NO_x and CO substantially exceeded the de minimis thresholds, two options were evaluated to reduce the net emissions increases. The first option would require replacing older, higher emitting equipment with newer and cleaner burning equipment that has been available since 2011. The second option would require using new, lower-emitting equipment and extending the proposed three-year dredging schedule. This approach would allow for spreading the peak year emissions over the entire dredging schedule. These options are presented in Table 4-8.

Emission Reduction Option 1 requires replacing all nonroad equipment with newer, lower-emitting equipment that would meet EPA Tier 3 and 4 emissions standards that are required for equipment model years 2011 and beyond. Appendix O presents a summary of the EPA Nonroad Emissions Standards. The clamshell and backhoe engines would need to meet Tier 4 emissions standards and support equipment would need to comply with Tier 3 and Tier 4 emissions standards, depending on the equipment category and engine size. In addition, the tugboats would also have to be equipped with engines that meet EPA's Tier 2 marine diesel engine emissions standards (U.S. EPA, *Overview of EPA's Emission Standards for Marine Engines, EPA420-F-04-031,* August 2004). Table 4-9 presents the Tier 2 emissions standards for Category 2 marine diesel engines.

Table 4-8 shows that the NO_x, CO, and VOC emissions for Emissions Reduction Option 1 were reduced significantly for each year. Table 4-8 shows that the replacement of older equipment with newer, lower-emitting equipment would reduce total NO_x, CO and VOC emissions by 53, 57 and 63 percent, respectively. Under this option, the marine vessel and non-road NO_x and CO emissions totals are separately below their respective 100 ton/yr thresholds in each of the three years of dredging operations. However, the peak year total emissions (Year 2) for NO_x would be 119 tons, which would still exceed the 100 ton/yr de minimis threshold. The use of new equipment would reduce peak year CO emissions below the 100 ton/year de minimis threshold, even though tugboats equipped with Tier 2 engines were projected to increase CO by 263 percent (from 8 tons to 29 tons in Year 2). This is because engine modifications to reduce NO_x emissions would cause CO emissions to increase. As noted above, uncontrolled VOC emissions are less than the de minimis thresholds and are exempt from further analysis under the general conformity rule.

Emission Reduction Option 2 would include both the replacement of older equipment with newer, lower-emitting equipment and increasing the dredging scheduling by six months (from 36 months to 42 months). The extension of the dredging schedule over four calendar years is based on nine months of operation per year. Table 4-8 shows that the peak year (Year 3) total NO_x and CO emissions for Emissions Reduction Option 2 would be reduced to 91 tons and 50 tons, respectively. As noted above, uncontrolled VOC emissions are less than the de minimis thresholds and are exempt from further analysis under the general conformity rule. Table 4-10 shows that the replacement of older equipment with newer equipment and stretching the dredging schedule to four calendar years would reduce total NO_x and CO emissions by 65 and 67 percent, respectively. Emission Reduction Option 2 demonstrates dredging operations would remain below the de minimis levels and therefore be exempt from the general conformity rule. Figures 4-4 through 4-6 present graphs for Uncontrolled Emissions, Emissions Reductions Option 1, and Emissions Reductions Option 2 respectively, for NO_x, CO and VOC emissions for Alternative 1 direct emissions.

Table 4-8. Summary of Dredging Operation Emissions for 45-Foot MLLW Alternative

Year	Pollutant	Emissions (tons/year)												General Conformity Thresholds (tons/year)
		Uncontrolled Conditions				Emission Reduction Option 1				Emission Reduction Option 2				
		Marine	Non-Road	On-Road	Total	Marine	Non-Road	On-Road	Total	Marine	Non-Road	On-Road	Total	
1	$PM_{2.5}$	3	13	0.02	16	3	2	0.02	5	2	1.1	0.02	3	-
	PM_{10}	3	13	0.04	16	3	2	0.04	5	2	1.1	0.04	3	-
	SO_2	187	0.1	0.01	187	187	0.1	0.01	187	126	0.1	0.01	126	-
	NO_x	61	142	0.84	**203**	50	49	0.84	99	34	30	0.84	65	100
	CO	7	101	8.77	**117**	27	20	8.77	56	18	13	8.8	40	100
	VOC	1	16	0.37	17	1	5	0.37	6	0	3	0.4	4	50
2	$PM_{2.5}$	3	17	0.02	20	3	2	0.02	5	2	1.8	0.02	4	-
	PM_{10}	3	18	0.03	21	3	3	0.03	6	2	1.9	0.03	4	-
	SO_2	200	0.2	0.01	200	200	0.2	0.01	200	154	0.1	0.01	154	-
	NO_x	65	191	0.71	**256**	54	65	0.71	**119**	41	48	0.7	90	100
	CO	8	135	8.40	**151**	29	27	8.40	64	22	20	8.4	50	100
	VOC	1	21	0.34	22	1	7	0.34	8	1	5	0.3	6	50
3	$PM_{2.5}$	3	17	0.02	19	3	2	0.02	5	2	1.9	0.02	4	-
	PM_{10}	3	17	0.03	20	3	2	0.03	5	2	2.0	0.03	4	-
	SO_2	174	0.1	0.01	174	176	0.1	0.01	176	154	0.1	0.01	154	-
	NO_x	56	182	0.61	**239**	47	55	0.61	**103**	41	49	0.61	91	100
	CO	7	128	8.09	**143**	25	24	8.09	57	22	20	8.1	50	100
	VOC	1	20	0.31	21	1	6	0.31	7	1	5	0.31	6	50
4	$PM_{2.5}$	-	-	-	-	-	-	-	-	2	1.7	0.02	4	-
	PM_{10}	-	-	-	-	-	-	-	-	2	1.7	0.03	4	-
	SO_2	-	-	-	-	-	-	-	-	127	0.1	0.01	128	-
	NO_x	-	-	-	-	-	-	-	-	34	41	0.5	75	100
	CO	-	-	-	-	-	-	-	-	18	18	7.9	44	100
	VOC	-	-	-	-	-	-	-	-	0	4	0.3	5	50

Notes: 1. Values in bold print and underline represent exceedances of the general conformity de minimis thresholds

2. Emission Reduction Option 1 is based on replacing older equipment with newer ones meeting EPA emissions standards. Emission Reduction Option 2 is based on lengthening the construction schedule from 36 months to 42 months and requiring the contractor to use their new equipment meeting applicable EPA non-road emissions standards.

Table 4-9. Tier 2 Standards for Category 2 Marine Diesel Engines

Displacement (liter/cylinder)	Power (kW)	HC+ NOx (g/kW-hr)	PM (g/kW-hr)	CO (g/kW-hr)
5.0</= disp. <15	--	7.8	0.27	5.0
15</= disp. <20	<3300	8.7	0.50	5.0
15</= disp. <20	>/= 3300	9.8	0.50	5.0
20</= disp. <25	--	9.8	0.50	5.0
25</= disp. <30	--	11.0	0.50	5.0

Source: U.S. EPA, Overview of EPA's Emission Standards for Marine Engines, EPA420-F-04-031, August 2004.

Table 4-10. Summary of % Emission Reduction with Newer Equipment and More Construction Time for Alternative 1.

Pollutant	Emission Reduction Option 1			Emission Reduction Option 2		
	Marine	Non-Road	Total	Marine	Non-Road	Total
NO_x	-18%	-66%	-53%	-36%	-75%	-65%
CO	263%	-80%	-57%	175%	-85%	-67%
VOC	0%	-66%	-63%	0%	-75%	-72%

Note: CO emissions increased with tugboat operations.

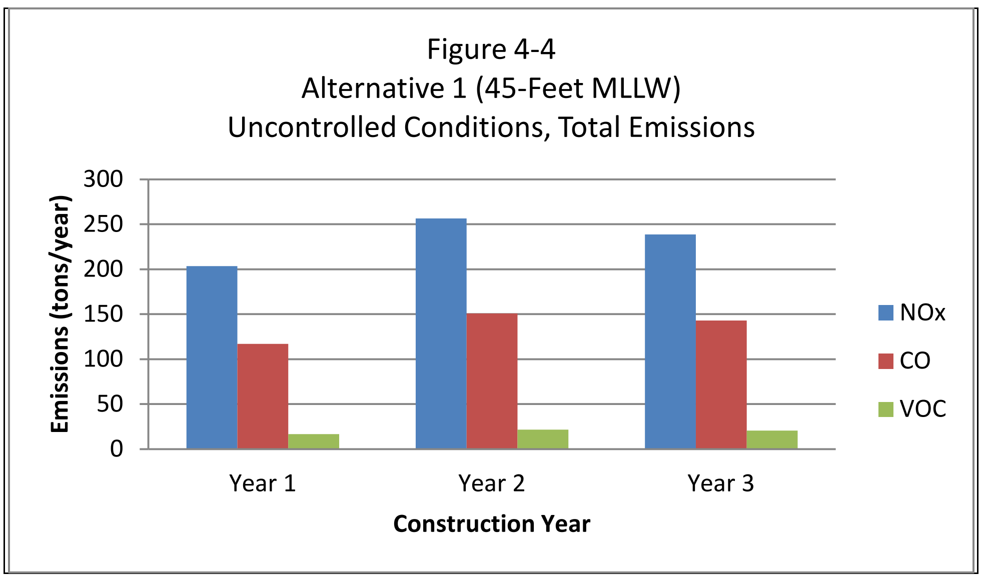


Figure 4-4
Alternative 1 (45-Feet MLLW)
Uncontrolled Conditions, Total Emissions

Figure 4-5
Alternative 1 (45-Feet MLLW)
Emissions Reduction Option #1, Total Emissions

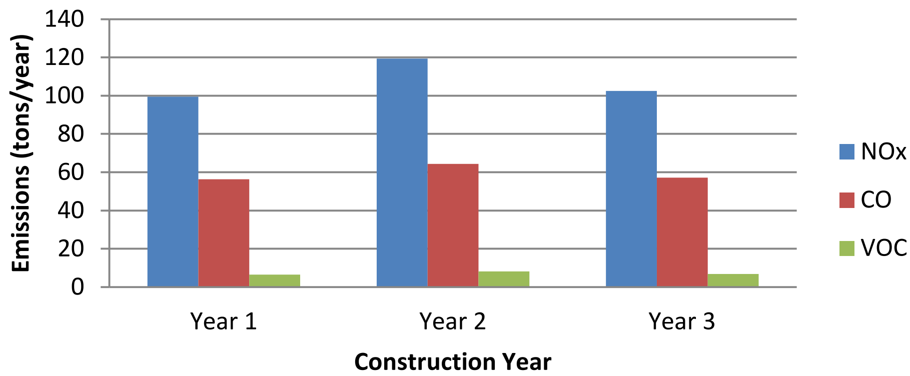


Figure 4-6
Alternative 1 (45-Feet MLLW)
Emissions Reduction Option #2, Total Emissions

Air Quality Analysis Alternative 2:

The project dredging emissions represent the estimated total direct emissions that would occur with the proposed deepening of Boston Harbor to the -50-feet MLLW depth. The estimated emissions for Air Quality Analysis Alternative 2 are summarized in Table 4-11. This table presents a summary of each pollutant's emissions categorized by marine vessels, nonroad equipment and on-road construction employee and truck deliveries emissions. The marine vessels include emissions from tugboats, survey boats, and push-boats required to assist the dredging during deepening operations. The nonroad equipment would include two clamshells, a backhoe excavator, drill towers, and their support equipment (i.e., generators, pumps, winches, and welders).

The first set of emissions calculations identified as "uncontrolled" emissions represents preliminary estimates without making adjustments to the dredging operations, schedule or equipment. Table 4-11 shows that the total emissions for the uncontrolled conditions for NO_x and CO exceed the general conformity de minimis thresholds for all four years and the uncontrolled conditions for VOC exceed the general conformity de minimis threshold in two out of four years. The peak year emissions (Year 2) for NO_x and VOCs would be 557 tons and 53 tons, respectively, which would far exceed the 100 tons/year de minimis threshold for NO_x and exceed the 50 tons/year de minimis threshold for VOCs. In addition, the peak year emissions (Year 3) for CO would be 352 tons, which also far exceeds the 100 tons/yr de minimis threshold for CO. The major contributors to these exceedances are the marine vessels and in particular the tugboat operations and the nonroad equipment, specifically the clamshells and backhoe operations. The on-road vehicle emissions are a minor contributor to the total emissions (i.e., less than five percent of the total emissions). The tugboat NO_x emissions represent 96 percent of the total marine vessel NO_x emissions and 22 percent of the total direct NO_x emissions. The clamshells and backhoe NO_x emissions represent 83 percent of the total non-road NO_x emissions and 64 percent of the total direct NO_x emissions, respectively. Similarly the tugboat CO emissions represent 96 percent of the total marine vessel CO emissions, but only represent less than five percent of the total direct CO emissions. The clamshells and backhoe CO emissions represent 76 percent and 71 percent of the total non-road CO emissions and total direct CO emissions, respectively.

Since the uncontrolled direct emissions substantially exceeded the de minimis thresholds for NO_x, CO, and VOC, the two options that were evaluated to reduce the net emissions increases under Air Quality Analysis Alternative 1 were also used to reduce net emissions increases under Air Quality Analysis Alternative 2. Emission Reduction Option 1 would require replacing all older non-road equipment with newer, lower-emitting equipment that would meet EPA Tier 2, 3 and 4 emissions standards that would be required for equipment model years 2011 and beyond. Under Emission Reduction Option 1, VOC emissions would be reduced to less than the de minimis thresholds for all four years and therefore would be exempt from further analysis under the general conformity rule.

Since the direct net emissions of NO_x would be significantly higher than the 100 ton/yr de minimis threshold, both the replacement of older equipment with newer equipment and extending the dredging schedule would not eliminate the peak year emissions exceedances. Therefore, the dredging operations were revised to be the same as Air Quality Analysis Alternative 1 and the dredging schedule extended from 48 months (four years) to 73 months over eight calendar years. The extension of the dredging schedule an additional four calendar years is based on 10 months of dredging operations in the first year and nine months of dredging operation for years two through eight. Table 4-11 shows that the peak years (Years 2 and 3) total NO_x and CO emissions for Emissions Reduction Option 2 would be reduced to 96 tons and 56 tons, respectively. Table 4-12 shows that the replacement of older equipment with newer equipment and stretching the dredging schedule over eight calendar years would reduce total NO_x and CO emissions by 83 and 84 percent, respectively. Emission Reduction Option 2 demonstrates dredging operations would remain below de minimis levels and therefore be exempt from the general conformity rule. Figures 4-7 through 4-9 present graphs, respectively, of the uncontrolled and Emissions Reductions Options 1 and 2 for the three pollutants for Air Quality Analysis Alternative 2 direct emissions.

Table 4-11. Summary of Dredging Operation Emissions for Air Quality Analysis Alternative 2

Emissions (tons/yr)														General Conformity Thresholds (tons/yr)
Year	Pollutant	Uncontrolled Conditions				Emission Reduction Option # 1				Emission Reduction Option # 2				
		Marine	Non-Road	On-Road	Total	Marine	Non-Road	On-Road	Total	Marine	Non-Road	On-Road	Total	
1	$PM_{2.5}$	5	14	0.03	20	5	2	0.03	8	2	1	0.03	3	--
	PM_{10}	5	15	0.04	20	5	3	0.04	8	2	1	0.04	4	--
	SO_2	353	0.1	0.01	353	353	0.2	0.01	353	143	0.1	0.01	143	--
	NO_x	114	141	1.0	**257**	94	68	1.0	**163**	38	38	1.0	77	100
	CO	14	108	10	**131**	52	30	10	93	20	18	10	49	100
	VOC	1	16	0.4	18	1	8	0.4	9	1	4	0.4	5	50
2	$PM_{2.5}$	6	45	0.02	51	6	5	0.02	11	2	2	0.02	4	--
	PM_{10}	6	46	0.04	52	6	5	0.04	11	2	2	0.04	4	--
	SO_2	395	0.4	0.01	396	395	0.3	0.01	396	154	0.1	0.01	154	--
	NO_x	128	428	0.8	**557**	105	123	0.8	**230**	41	53	0.8	96	100
	CO	15	325	9.8	**350**	58	49	9.8	**117**	22	24	9.8	56	100
	VOC	1	51	0.4	**53**	1	14	0.4	16	1	6	0.4	7	50
3	$PM_{2.5}$	6	46	0.02	52	6	5	0.02	11	2	2	0.02	5	--
	PM_{10}	6	47	0.04	53	6	5	0.04	11	2	2	0.04	5	--
	SO_2	395	0.3	0.01	396	395	0.3	0.01	396	154	0.1	0.01	154	--
	NO_x	128	418	0.7	**547**	105	122	0.7	**228**	41	53	0.7	96	100
	CO	15	327	9.4	**352**	58	48	9.4	**116**	22	25	9.4	56	100
	VOC	1	51	0.4	**53**	1	14	0.4	16	1	6	0.4	7	50
4	$PM_{2.5}$	5	32	0.02	38	5	5	0.02	10	2	2	0.02	5	--
	PM_{10}	5	33	0.04	39	5	5	0.04	11	2	2	0.04	4	--
	SO_2	367	0.3	0.01	367	367	0.3	0.01	367	154	0.1	0.01	154	--
	NO_x	119	342	0.6	**461**	98	108	0.6	**206**	41	53	0.6	95	100
	CO	14	246	9.2	**269**	54	41	9.2	**105**	22	24	9.2	55	100
	VOC	1	36	0.3	37	1	12	0.3	14	1	6	0.3	7	50

Notes:

1. Values in bold print and box represent exceedances of the General Conformity de minimis thresholds.

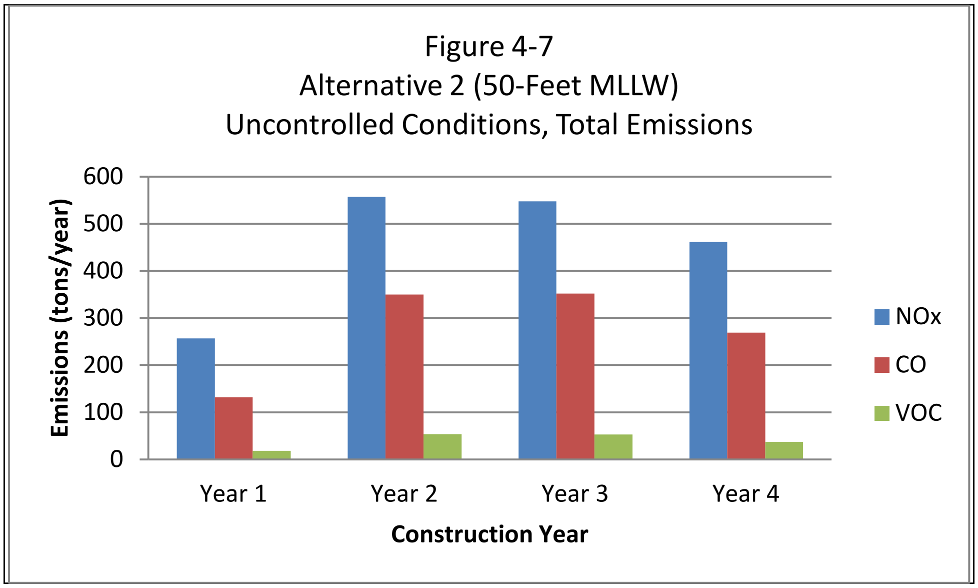
Year	Pollutant	Emissions (tons/yr)												General Conformity Thresholds (tons/yr)
		Uncontrolled Conditions				Emission Reduction Option # 1				Emission Reduction Option # 2				
		Marine	Non-Road	On-Road	Total	Marine	Non-Road	On-Road	Total	Marine	Non-Road	On-Road	Total	
5	$PM_{2.5}$	--	--	--	--	--	--	--	--	2	2	0.02	5	--
	PM_{10}	--	--	--	--	--	--	--	--	2	2	0.03	4	--
	SO_2	--	--	--	--	--	--	--	--	154	0.1	0.01	154	--
	NO_x	--	--	--	--	--	--	--	--	41	53	0.5	95	100
	CO	--	--	--	--	--	--	--	--	22	25	8.9	55	100
	VOC	--	--	--	--	--	--	--	--	1	6	0.3	7	50
6	$PM_{2.5}$	--	--	--	--	--	--	--	--	2	2	0.02	5	--
	PM_{10}	--	--	--	--	--	--	--	--	2	2	0.03	4	--
	SO_2	--	--	--	--	--	--	--	--	154	0.1	0.01	154	--
	NO_x	--	--	--	--	--	--	--	--	41	53	0.5	95	100
	CO	--	--	--	--	--	--	--	--	22	24	8.8	55	100
	VOC	--	--	--	--	--	--	--	--	1	6	0.3	7	50
7	$PM_{2.5}$	--	--	--	--	--	--	--	--	2	2	0.02	5	--
	PM_{10}	--	--	--	--	--	--	--	--	2	2	0.03	4	--
	SO_2	--	--	--	--	--	--	--	--	154	0.1	0.01	154	--
	NO_x	--	--	--	--	--	--	--	--	41	53	0.4	95	100
	CO	--	--	--	--	--	--	--	--	22	25	8.6	55	100
	VOC	--	--	--	--	--	--	--	--	1	6	0.3	7	50
8	$PM_{2.5}$	--	--	--	--	--	--	--	--	2	2	0.02	4	--
	PM_{10}	--	--	--	--	--	--	--	--	2	2	0.03	4	--
	SO_2	--	--	--	--	--	--	--	--	140	0.1	0.01	140	--
	NO_x	--	--	--	--	--	--	--	--	38	44	0.3	82	100
	CO	--	--	--	--	--	--	--	--	20	20	8.5	49	100
	VOC	--	--	--	--	--	--	--	--	0.5	5	0.3	6	50

2. Emission Reduction Option #1 is based on replacing older equipment with newer ones meeting EPA emissions standard, Emission Reduction Option #2 is based on lengthening the construction schedule from 48 months to 73 months, the same dredging equipment and operations as Alternative 1 (45-ft MLLW) and requiring the contractor to use new equipment meeting applicable EPA non-road emissions standards.

Table 4-12. Summary of Percent Emission Reductions for Air Quality Analysis Alternative 2

Pollutant	Emission Reduction Option 1			Emission Reduction Option 2		
	Marine	Non-Road	Total	Marine	Non-Road	Total
NO_x	-18%	-71%	-59%	-68%	-88%	-83%
CO	287%	-85%	-67%	47%	-93%	-84%
VOC	0%	-73%	-70%	0%	-88%	-87%

Note: CO emissions increased with tugboat operations



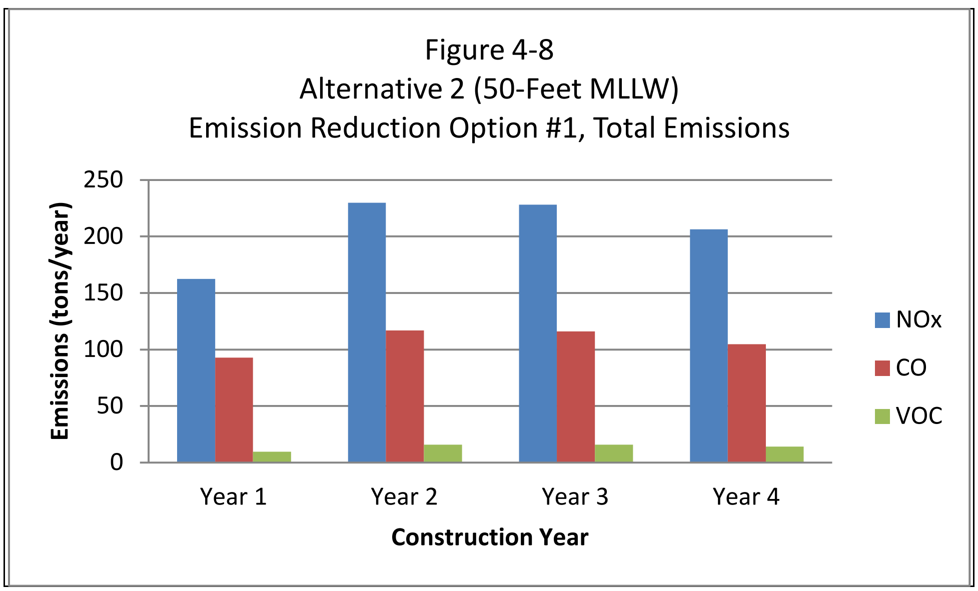
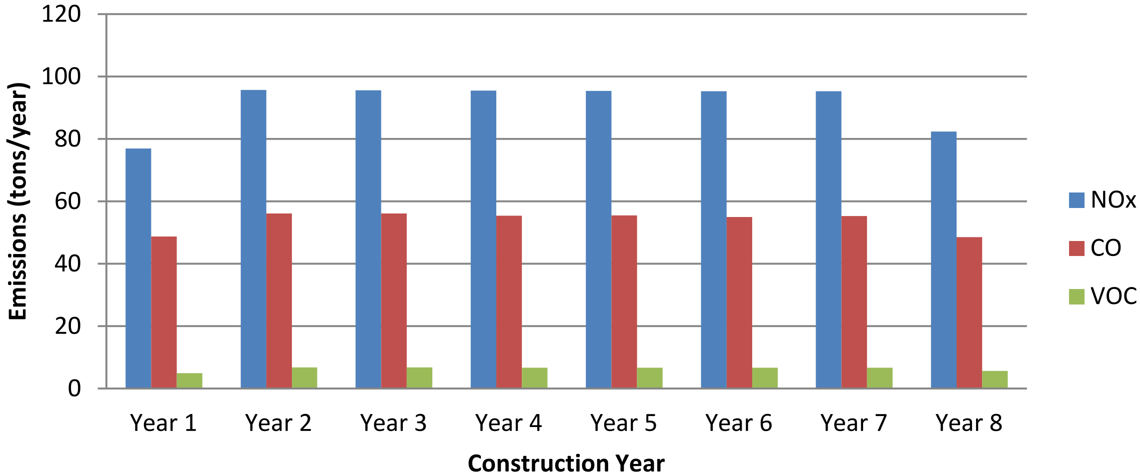


Figure 4-9
Alternative 2 (50-Feet MLLW)
Emission Reduction Option #2, Total Emissions



Proposed Action

The project dredging emissions represent the estimated total direct emissions that would occur with the proposed deepening of Boston Harbor to the -47-feet MLLW depth. Because the depth of the proposed action lies between (is bracketed by) the depths of Air Quality Analysis Alternatives 1 and 2, the associated direct emissions would be expected to lie between (be bracketed by) the emissions of Air Quality Analysis Alternatives 1 and 2. This limited evaluation of the proposed action is qualitative in nature, focuses solely on NO_x, CO and VOC, and is based on our best professional judgment given the previous quantitative analysis of Air Quality Analysis Alternatives 1 and 2.

Based on a proportional evaluation of the emissions from Air Quality Analysis Alternatives 1 and 2, and assuming a dredging schedule of either 3 or 4 years, it is estimated that the uncontrolled emissions of NO_x and CO in the peak year of dredging operations would exceed the de minimis thresholds and thus be subject to further analysis under the general conformity rule, but that uncontrolled emissions of VOC in the peak year of dredging operations would be less than the de minimis threshold and thus be exempt from further analysis under the general conformity rule. In evaluating the application of Emissions Reduction Option 1 to the proposed action, it is estimated that the controlled emissions of NO_x in the peak year of dredging operations would still exceed the de minimis threshold whether on a 3- or 4-year schedule and that controlled emissions of CO in the peak year of dredging operations would exceed the de minimis threshold on a 3-year schedule but not on a 4-year schedule. In evaluating the application of Emissions Reduction Option 2 to the proposed action, it is estimated that the controlled emissions of NO_x in the peak year of dredging operations would exceed the de minimis threshold on a 5-year schedule but not on a 6-year schedule and that controlled emissions of CO in the peak year of dredging operations would exceed the de minimis threshold on a 3-year schedule but not on a 4-year schedule. Thus, if USACE commences construction on the Project after EPA revokes the 1997 eight-hour O_3 NAAQS, and general conformity no longer applies to emissions of NO_x and VOC, the recommended action could likely be completed with the use of Emissions Reduction Option 1 on a 4-year schedule to remain below the de minimis thresholds for CO; otherwise, the proposed action would likely require use of Emissions Reduction Option 2 on a 6-year schedule to remain below the de minimis thresholds for NOx and CO.

4.8.3.2 Indirect Emissions

The project indirect emissions were calculated based on the net difference of container, cargo and petroleum vessel operations including scheduling, volume of ship calls, fleet mix and associated cargo truck operations comparing the No Action Alternative and Project (Post-Construction) scenarios.

Table 4-13 presents a summary of both the No Action Alternative and Project indirect emissions and the net change in annual emissions.

The Deep Draft Project would reduce annual NO_x, CO and VOC emissions by 71, 28 and 17 tons, respectively, i.e., there would be a net environmental benefit associated with indirect emissions by implementing the Project. The reductions in pollutant emissions are primarily due to changes in fleet mix for all shipping operations (i.e., fewer, but larger ships), no anchoring activities for petroleum ships and less time for ships to move in and out of the harbor. However, the cargo trucking miles in Massachusetts would increase by 766,276 miles under the Project (Post-Construction) shipping operations due to increased truck volumes departing from Conley Terminal[20,21]. An average travel speed of 27.6 miles per hour was assumed in the model. The estimated NO_x, CO and VOC annual emissions from cargo trucking would increase by 1.91, 0.51 and 0.24 tons, respectively in the project area. These small increases in pollutant emissions would be more than offset by the emissions reductions estimated for the changes in shipping activities associated with the Project. Therefore, the Project's indirect emissions would remain below de minimis levels and be exempt from the general conformity rule, even if USACE could be considered to have practicable control over such emissions.

Table 4-13. Shipping and Trucking Operations-Summary of Indirect Emissions

Pollutant	No Action Alternative (tons)	Project, Post-Construction (tons)	Net Change (tons)	Net Change (%)
$PM_{10}/PM_{2.5}$	96	91	-5	-5.2
SO_2	248	247	-0.6	-0.2
NO_x	634	563	-71	-11.2
CO	377	349	-28	-7.3
VOC	231	214	-17	-7.5

Notes:

1. Indirect emissions without project the No Action Alternative are associated with projected shipping operations in 2016 and beyond. It is assumed that the shipping operations would be constant during the dredging years.

2. Indirect emissions with project are associated with projected shipping operations one year after the dredging operations are completed. It is anticipated that there would be no overlap of indirect and direct emissions at the end of the project.

3. With project emissions includes emissions reductions associated with the projected reduction of truck traffic from the Port of New York/New Jersey.

Source: Dave Miller Report for the Deep Draft Navigation Improvement Project

General Conformity Applicability Results

The general conformity regulations (40 CFR 93.159(d)) require that the total of direct and indirect emissions be evaluated for: (1) the year of maximum emissions; (2) the mandated attainment year (for non-attainment pollutants); (3) the year of farthest emissions projections in the SIP (for maintenance

[20] David Miller & Associates, Inc., Technical Memorandum to Karen Umbrell, USACE, July 13, 2006.

[21] Email from Karen Umbrell, USACE, to Marc Wallace, CDM Smith, Revised Truck Miles Saved Spreadsheet, October 13, 2007.

pollutants); and (4) any year with an emissions budget specified in the SIP. The annual emissions were compiled for each appropriate year for Air Quality Analysis Alternatives 1 and 2, and each year's net emissions were then compared to the de minimis values.

The years of maximum emissions for Air Quality Analysis Alternatives 1 and 2 are presented in Tables 4-8 and 4-11, respectively. The mandated attainment year for the 1997 eight-hour O_3 NAAQS was 2010. The CO emissions inventory data for 2010 represents the year of farthest emissions projections in the SIP. Likewise, emissions budgets in the SIPs for O_3 and CO have only been projected to 2010. Annual emissions were estimated based on daily summer projections for NO_x and VOC and daily winter projections for CO. Because the Project could not occur in 2010, the only relevant criteria to examine for the general conformity evaluation are the years of maximum emissions.

In this report, it is assumed that dredging and construction activities define direct emissions. Indirect emissions are assumed to originate from the cargo vessel operations including scheduling, volume of ship calls, fleet mix and associated trucking operations. It is anticipated that changes in shipping operations for Air Quality Analysis Alternatives 1 and 2 would occur after the dredging operations are complete. Therefore, there would be no overlapping of indirect emissions with the direct emissions from the dredging operations in any particular year for Air Quality Analysis Alternatives 1 and 2. Table 4-14 presents the results of the general conformity applicability analysis. This table shows that, under Emission Reduction Option 2, the maximum emissions year for Air Quality Analysis Alternative 1 (Year 3 of dredging operations) and Air Quality Analysis Alternative 2 (Year 2 of dredging operations) would not exceed the general conformity de minimis thresholds.

By extension to the proposed action, the following results are anticipated: (1) if the Project commences construction after the 1997 eight-hour O_3 NAAQS is revoked and general conformity no longer applies to NO_x and VOC emissions, then the Project would avoid applicability of general conformity for CO under Emission Reduction Option 1 on a four-year dredging schedule; and (2) if the Project commences construction before the 1997 eight-hour O_3 NAAQS is revoked and general conformity continues to apply to NO_x and VOC emissions, then the Project would avoid applicability of general conformity for NO_x and VOC under Emission Reduction Option 2 and a six-year dredging schedule. Furthermore, the change in indirect emissions for NO_x, VOC and CO between the No Action Alternative and Air Quality Analysis Alternatives 1 and 2 would decrease. Therefore, Air Quality Analysis Alternatives 1 and 2 direct and indirect emissions, and by extension direct and indirect emissions for the proposed action, would be below the de minimis levels and general conformity would not apply to the Project.

Comparison of No Action Alternative and Project (Post-Construction) Emissions

For the purposes of satisfying the NEPA and MEPA requirements, Table 4-13 shows that the project ship and cargo truck emissions which represent project secondary (indirect) emissions would be less than those for the No Action Alternative. In addition, emissions calculations incorporate potential truck mileage savings estimated for the project in the remainder of New England. These reductions are due to cargo trucked to New England destinations from Boston Harbor instead of from the PONYNJ and total more than 7 million miles per year. Table 4-15 presents the results of the modeling analysis, which indicate that annual NO_x, CO, and VOC emissions would decrease by 18.9, 5.4 and 2.5 tons, respectively, in the remainder of New England (i.e., outside Massachusetts) after dredging operations are complete. The emissions reductions for the other pollutants would be less than one ton. The regional air quality benefits of more direct and efficient cargo transport within New England are expected to offset significantly any potential adverse project air quality impacts.

Table 4-14. Summary of General Conformity Applicability Analysis

		Alternative 1 (45-Ft MLLW)			Alternative 2 (50-Ft MLLW)		
Indirect Emissions with No Action Alternative	**Year**	**Pollutant**			**Pollutant**		
		NO_x	**CO**	**VOC**	**NO_x**	**CO**	**VOC**
	Year After Dredging Complete	634	377	231	634	377	231
Indirect Emissions with Project	**Year**	**Pollutant**			**Pollutant**		
		NO_x	**CO**	**VOC**	**NO_x**	**CO**	**VOC**
	Year After Dredging Complete	563	349	214	563	349	214
Direct Emissions	**Year**	**Pollutant**			**Pollutant**		
		NO_x	**CO**	**VOC**	**NO_x**	**CO**	**VOC**
	Year 1	65	40	4	77	49	5
	Year 2	90	50	6	**96**	**56**	**7**
	Year 3	**91**	**50**	**6**	96	56	7
	Year 4	75	44	5	95	55	7
	Years 5-7	--	--	--	95	55	7
	Year 8	--	--	--	82	49	6
Summary (tons, except where noted)		**Pollutant**			**Pollutant**		
		NO_x	**CO**	**VOC**	**NO_x**	**CO**	**VOC**
	Indirect Emissions Net Change	-71	-28	-17	-71	-28	-17
	Direct Emissions Net Change	91	50	6	96	56	7
	GC Threshold	100	100	50	100	100	50
	SIP Mandate Year	2010	2010	2010	2010	2010	2010

Notes:

1. Indirect emissions with the No-Action Alternative are associated with projected shipping operations in 2010 and beyond.
2. The net change in indirect emissions is based on comparing indirect emissions for the No-Project Alternative and Alternatives 1 and 2.
3. Indirect emissions with Project are associated with projected shipping operations one year after the dredging operations are completed. It is anticipated that there will be no overlap of indirect and direct emissions at the end of the project
4. Direct emissions are based on stretching the construction schedule and requiring new equipment meeting the newest EPA emissions standards

Sources: U.S. Army Corps of Engineers, Boston Harbor, Massachusetts Navigation Improvement Study, Alternative Formulation Briefing Technical Memorandum, July 2005.

Table 4-15. Remainder of New England Cargo Truck Emission Reductions (tons/year)

State	NO_X	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2
Rhode Island	-5.55	-1.71	-1.04	-0.30	-0.19	-0.05
Connecticut	-3.02	-0.78	-0.33	-0.11	-0.08	-0.01
New Hampshire	-5.17	-1.55	-0.70	-0.24	-0.18	-0.03
Maine	-4.26	-1.09	-0.36	-0.16	-0.12	-0.01
Vermont	-0.94	-0.25	-0.10	-0.03	-0.02	0.00
Total	**-18.9**	**-5.4**	**-2.5**	**-0.84**	**-0.60**	**-0.11**

4.8.4. Environmental Commitments

The following environmental commitment has been made regarding air quality to avoid or minimize the effects of the Deep Draft Project:

Environmental Commitment: Use of New Equipment Meeting More Stringent EPA Emissions Standards.

All construction contractors would be required, as a contractual condition; to use new equipment meeting the most stringent EPA emissions standards in effect at the commencement of construction of the Project, as well as to extend the number of years the project would be constructed as necessary to maintain peak annual emissions below the general conformity de minimis thresholds. The number of years will be dependent on the final dredge depth selected. The additional years for each depth alternative required to conform is presented in Appendix D. This environmental commitment requires replacing all non-road equipment with newer, lower-emitting equipment that would meet EPA Tier 3 and Tier 4 emissions standards that would be required for equipment model years 2014 and beyond. The clamshell and backhoe engines would need to meet Tier 4 emissions standards and support equipment would need to comply with Tier 3 and Tier 4 emissions standards, depending on the equipment category and engine size. Table 4-16 presents the Tier 3 and Tier 4 emissions limits based on engine size, in horsepower. In addition, the tugboats would also have to be equipped with engines that meet EPA's Tier 2 emission standards for Category 2 marine diesel engines presented in Table 4-9. General conformity would be satisfied (i.e., would not be applicable) by the implementation of the above actions falling below the emission thresholds (EPA letter dated May 23, 2008).

Table 4-16. Non-Road Emissions Limits

Engine Power (hp)	Tier 3 and 4 Technology Type Emission Limits * (g/hp-hr)				
	HC	CO	NO_x	PM	SO_2
0 - 11 (Tier4A)	0.55	4.11	4.3	0.28	0.006
12 - 25 (Tier 4A)	0.55	4.11	4.3	0.28	0.006
26 - 50 (Tier 4A)	0.28	1.53	4.7	0.2	0.006
51 - 75 (Tier 4A)	0.18	2.37	3.0	0.2	0.006
76 - 100 (Tier 3B)	0.18	2.37	3.0	0.3	0.006
101 - 175 (Tier 3)	0.18	0.87	2.5	0.22	0.006
176 - 300 (Tier 4 transitional)	0.13	0.075	1.39	0.009	0.006
301 - 600 (Tier 4 transitional)	0.13	0.084	1.39	0.009	0.006
601 - 750 (Tier 4 transitional)	0.13	0.13	1.39	0.009	0.006
>750 (Tier 4)	0.28	0.08	2.39	0.07	0.006

* Tier 3 and 4 emission factors are taken from Table A2 of the EPA Technical Document "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling --Compression-Ignition," 2004.

Emission Reduction Credits

Another alternative means to meet general conformity, besides those proposed to lengthen the project and use lower-emitting equipment to avoid the applicability of general conformity, would be to offset the net emissions increases from construction through the purchase of emission reduction credits (ERCs). However, alternative project measures to demonstrate general conformity cannot be finalized in the Feasibility Phase due to factors such as uncertainties in the project timeline, the availability of ERCs in the years that they would be required to offset construction- related emissions, and the potential for conformity regulatory changes to occur in the near term. The only certain means of complying with air quality requirements at the Feasibility Phase are construction period shutdowns that avoid exceeding the emissions thresholds and thus avoid triggering general conformity applicability.

Emission reduction credits in the form of discrete, or mass-based, credits would be needed for NO_x and CO and would be purchased from companies that have registered a net benefit in air emissions (reduced air pollution) with MADEP. NO_x credits are broken down into ozone season (May 1-September 30) and non –ozone season (October 1-April 30) credits depending on the time of the year, and some of each type would be required. Enough ERCs for each pollutant would be needed for the years in which each pollutant has exceeded the threshold. Credits would be needed for all Project net emissions, not just the amounts over the thresholds, but to bring the net emission level back down to zero. The Commonwealth of Massachusetts Emission Reduction Registry lists all approved ERCs. Currently (as of August 2012), the Registry lists enough ERCs for NOx to complete the proposed project mission, but not enough for CO. The general conformity rule allows a State to approve offsets of different precursors of the same criteria pollutant if such inter-precursor trades are allowed by the applicable SIP, if they are technically justified, and if there is a demonstrated environmental benefit. Thus, it would be conceivable to utilize NO_x and VOC ERCs to offset NO_x emissions, since both NO_x and VOC are precursors for O_3. At this moment in time, the cost to purchase the required ERCs would be approximately equivalent to the cost of one mobilization and demobilization of the construction equipment. However, the credit costs are based on a free market and total costs could change in the future.

The air quality analysis will be re-examined following the final Design Phase field investigations and development of a construction sequencing plan to determine if a more desirable and cost-effective means of compliance exists that would mitigate emissions rather than merely deferring them over a longer construction duration with shutdowns. USACE and Massport are committed to working with EPA, the Commonwealth of Massachusetts, and interested TWG participants with experience in air quality mitigation issues to develop an appropriate air quality compliance strategy, should one still be required. This could be accomplished through establishment of a formal TWG air quality subcommittee. Changes in Federal and State standards and implementation plans will be incorporated into the revised analysis at that time. Should any change in the method of ensuring compliance of the Deep Draft Project with air quality requirements result from this review, USACE and Massport would give notice of these changes to the public and provide an opportunity for public comment through the general conformity analysis and review process. The final determination on which mitigation method would be used to meet air quality standards will be made during the final Design Phase of the Project.

4.9 Socioeconomic Impacts

Boston Harbor is an active harbor with many users. These users include recreational, shipping, and fishing interests. Without a well maintained harbor, goods can not be shipped as efficiently and jobs associated with this industry, both directly and indirectly, are affected. Dredging and disposal would have minimal beneficial or adverse impacts on recreational boating and vessel passage because the dredge contractor must allow free navigation at all times, and because recreational boats do not need the deeper channels and have access to additional maintained entrance channels. However, a viable working harbor can benefit all marine users.

4.9.1 Commercial Lobstermen

At least 16 lobstermen fish in the project area at any one time, based on the survey information received in 2005. Most of the lobstermen fish in the area between the Ted Williams Tunnel and Spectacle Island and most of the fishing activity occurs during the summer and early fall months. Although fishing is illegal within the Federal navigation channels without a Section 10 permit, the dredge contractor will issue a public notice at the beginning of the project to notify the lobstermen of the planned dredging and rock removal efforts so that the lobstermen can remove their traps. With the exception of some disruption during the active dredging periods, no long-term adverse affects on commercial lobstering is anticipated.

4.9.2 Environmental Justice

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority and Low-Income Populations* was signed on February 11, 1994. This EO is designed to focus the attention of Federal agencies on the human health and environmental conditions in minority and low-income communities. Environmental justice analyses are performed to identify potentially disproportionately high and adverse impacts from the proposed actions in minority communities and low-income communities and to identify alternatives that might mitigate these impacts.

No significant adverse environmental impacts to minority or low income populations are anticipated as a result of this project. According to the 2010 U.S. Census Bureau, 64 percent of Suffolk County population, which includes the cities and towns surrounding Boston Harbor, is Caucasian. Twenty one percent of the individuals are below poverty limit. Although the project area has a larger percentage of minorities and low-income population compared to the rest of the Commonwealth of Massachusetts, this dredging and disposal project is not expected to have a significant human health or environmental effect on any portion of the human population. Extensive environmental monitoring for the BHNIP, which contained sediments with higher contaminant levels than this proposed project, did not reveal any water quality violations. In addition, any potential air quality impacts from construction will be mitigated to be in compliance with the State Implementation Plan.

4.9.3 Protection of Children

Executive Order 13045, *Protection of Children from Environmental Health Risks and Safety Risks* was signed on April 21, 1997. A growing body of scientific knowledge demonstrates that children may suffer disproportionately from environmental health risk and safety risks. Based on this risk, each Federal agency has been directed by this EO to identify and assess environmental health risks and safety risks that may disproportionately affect children. Each Federal agency is directed to ensure that its policies, program activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks.

The project activities are located in the waters of Boston Harbor and Massachusetts Bay, not an area that would be used disproportionately by children. The environmental impacts are generally temporary and contained within the aquatic environment. As discussed in the previous sections, any potential air quality impacts will be mitigated to conform to State and Federal emission standards during construction. Completion of the proposed project will reduce future regional air emissions and thereby slightly decreasing potential health risks from poor air quality.

4.10 Harbor Infrastructure

A discussion of the tunnel crossings, subway crossings, and numerous utility cable crossings in Boston Harbor and their potential to be damaged during project construction is provided below.

4.10.1 Harbor Tunnel Crossings

As stated above in Section 3.8, there are four tunnels crossing beneath the Main Ship Channel; one subway tunnel and three highway tunnels. The elevation of armor protection atop the Ted Williams Tunnel I-90 (TWT), which is the most seaward crossing, may permit deepening of the Main Ship Channel up to a depth of 45 feet, as stated by the former Massachusetts Turnpike Authority (MTA) in their letter of 27 February 2003. However, as the letter suggests, this assumption would need to be tested by additional analyses if deepening over the tunnel was proposed.

There are three remaining tunnels upstream of the TWT, including the Massachusetts Bay Transportation Authority's Blue Line subway tunnel. The elevation of the three upstream tunnels, particularly the Blue Line, will not permit any deepening of the Main Ship Channel beyond the 40 feet deep MLLW now provided. However, there are no marine terminal facilities located above the TWT and below the Blue Line that would benefit from any increased depth in the Main Ship Channel at this time. The 40 foot access navigation channel already provided to the shipyard, the Fish Pier, the World Trade Center and Massport's East Boston Piers is sufficient for all existing and expected future traffic to these facilities. Future deep draft port improvements at Boston, except for minor modifications limited to -40 foot MLLW, are only practicable in areas downstream of the TWT.

4.10.2 Sewer Tunnel Crossings

The four Massachusetts Water Resources Authority (MWRA) sewer lines that cross beneath the harbor channels are all bored through bedrock. A large sewer force main crosses the harbor connecting MWRA facilities on Nut Island and Deer Island. The line crosses beneath the President Roads reach of the Main Ship Channel just west of the Outer Confluence. This tunnel was bored through bedrock, and where it crosses beneath navigation channel, it does so beneath the deep depression of the outer confluence, where no dredging or rock removal would be required, even with a 52-foot entrance channel design depth.

The main outfall for MWRA's new Deer Island sewage treatment passes beneath the Broad Sound North Entrance Channel on its route seaward to the diffuser array located in about 105 feet of water about 8.8 miles east of Deer Island. This outfall tunnel was a deep bore cut through the bedrock and would not be impacted by the proposed channel deepening.

The Main Drainage Tunnel for the City of Boston, completed in 1959, is a deep bore cut in bedrock, about 300 feet below MLW, crossing from approximately beneath Fort Independence in South Boston north-northeasterly under the Main Ship Channel and north of the Anchorage to Deer Island. This tunnel would not be impacted by the proposed deepening of the Main Ship Channel.

The Chelsea Drainage Tunnel is also a deep bore cut in bedrock, from Chelsea southeasterly beneath the Chelsea River Channel, East Boston and Logan Airport, to Deer Island. This tunnel would not be impacted by the proposed deepening of the Chelsea River.

4.10.3 Utility Crossings

The only utility line located beneath the Reserved Channel is the main power supply line to MWRA's Deer Island Treatment Plant from NSTAR's South Boston generating plant. These three cables run from the power plant at the head of the Reserved Channel, underneath the Reserved Channel along its southern limit, across the Main Ship Channel, and then across the flats southeast of Logan Airport to Deer Island. These 115KV hydraulically cooled power lines were placed in a trench dredged beneath the channels and jetted into the harbor bottom in areas outside the channels. The U.S. Army Corps of Engineers issued a Section 10 permit for the cable in 1989, and the permitted depth of the line was designed to accommodate future port deepening of the Main Ship and Reserved Channels as required by Massport and the USACE. However, the cable was placed shallower than the minimum depths specified in the permits in several locations beneath the Reserved Channel. The USACE has referred the matter to U.S. Attorney's office as an enforcement action. The U.S. Attorney's office is currently in negotiations with MWRA and NSTAR to ensure that the cable will not impact the deepening project. This action is included in the without-project (no action) condition.

This document will be available for public review, for any additional review of potential project impacts on utility crossings in Boston Harbor.

4.11 Cumulative Impacts

The National Environmental Policy Act (NEPA) defines cumulative effects as: “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions” (40 CFR 1508.7).

Cumulative effects analysis is an emerging discipline, and the continuing challenge of this analysis is to focus on the important cumulative issues, recognizing that a better decision, rather than a perfect cumulative effects analysis, is the goal of NEPA. Determining the threshold beyond which cumulative effects significantly degrade a resource, ecosystem, and human community is often problematic, as no definitive thresholds for cumulative analysis exist. Ultimately, however, cumulative effects analysis under NEPA should be incorporated into the agency’s overall environmental planning and the regional planning of other Federal agencies and stakeholders (CEQ 1997). Similarly, the Massachusetts Environmental Policy Act (MEPA) regulations also require discussion of cumulative impacts of the project.

The Certificate of the Secretary of Environmental Affairs on the Environmental Notification Form (ENF) for the Deep Draft Project, dated March 10, 2003 (EOEA Number 12958) required that the following projects be included in the cumulative impacts analysis: the HubLine submarine natural gas pipeline and the Everett Extension to the HubLine; the Army Corps of Engineers Outer Harbor Maintenance Dredging Project; and the NOMES I offshore borrow site for the Winthrop Shores Reservation and Restoration project (this project was initially denied a permit by the USACE; a change in source of beach nourishment material has been proposed). In addition, an ENF comment letter submitted by the MA Department of Environmental Protection listed the following additional projects for consideration for the cumulative impact analysis: the Central Artery/Tunnel project (including opening of the park at Spectacle Island); the Massachusetts Water Resources Authority Boston Harbor Cleanup; and “numerous shore-side development projects” including Pier 4 and Fan Pier. Additional projects have been included for consideration since the submittal of the 2008 Draft SEIS/EIR, including several proposed development projects (Boston East, New Street), Conley Terminal Expansion, Logan Runway Safety Areas project, several maintenance dredging projects, and infrastructure improvement (seawall rehabilitation, pier improvement) projects.

Thus the cumulative impact analysis includes major infrastructure projects within Boston Harbor which have recently been completed, as well as projects in or adjacent to Boston Harbor planned to be undertaken within the timeframe of the Deep Draft Project. The time range of projects extends back to 1985 (MWRA Harbor Cleanup Projects) and 1995 (CA/T project), and into the future to 2019. The year 2019 was selected based on the public informational filings available in the MEPA Office during preparation of the cumulative impact analysis. However, it is important to note that the most information is available on projects recently completed and those currently within the planning (ie public information filings) or permitting phase.

Section 4.11.1 describes the Boston Harbor dredging projects, including the proposed project, to provide an overview of recent and proposed USACE and/or Massport activities. Section 4.11.2 provides information (as available) on other ongoing and planned projects within the inner and outer reaches of Boston Harbor and Massachusetts Bay. Information on the projects listed in Section 4.11.2 was collected from public informational filings with the MEPA Office.

Figure 4-11 depicts the locations of the Boston Harbor dredging projects described in Section 4.11.1 while Figure 4-12 depicts the location of the relevant projects presented in Section 4.11.2. Table 4-15, at the end of Section 4.11.2 presents the summary of cumulative impacts.

4.11.1 Boston Harbor Dredging Projects

1. Boston Harbor Navigation Improvement Project (BHNIP) (1998-2000+, Completed)

The BHNIP (EOEA No. 8695) consisted of maintenance and improvement dredging in a portion of the channels and berths within Boston's Inner Harbor. The lower Mystic River, Inner Confluence, and Reserved Channel Federal navigation channels were deepened from –35 feet MLLW to –40 feet MLLW. The Chelsea River was deepened from –35 feet MLLW to –38 feet MLLW. A number of berths were also deepened to various depths. A portion of the Chelsea River dredging in the vicinity of the Chelsea Street draw bridge was not completed due to the presence of an existing natural gas pipeline siphon. This issue was resolved and the remaining dredging in the Chelsea River was completed as part of the Inner Harbor Maintenance Dredging project, described below.

Phase 1 consisted of dredging Conley Terminal Berths 11 and 12 to –45 feet MLLW and disposing of the material into a CAD cell located in the Inner Confluence in the summer of 1997. Phase 2 included dredging the remainder of the area with disposal into eight CAD cells between August 1998 and September 2000, with some additional work completed by December 2002.

Approximately one million cy of silty maintenance material and one million cy of improvement material (also referred to as parent material) of channel and berth material, plus an additional 1.4 million cy of parent material was removed in the construction of the CAD cells, for a total of 3.4 million cy of dredged material. The maintenance material was placed into CAD cells located within the Mystic River, outside of the Main Ship Channel and in the Chelsea River. All of the CAD cells, with the exception of the Chelsea River CAD cell, were capped with three feet of sand. The Chelsea River CAD cell was not capped to allow for future maintenance material disposal. The parent material was placed at the MBDS. The area of temporary impact associated with this project is estimated to be approximately 1,200 acres.

2. Boston Harbor Outer Harbor Maintenance Dredging Project (OHMDP) (2004-2005, Completed)

Maintenance dredging of the outer harbor channels in Boston Harbor occurred from August 2004 through June 2005. No MEPA filing was required as this was exclusively a Federal project. Approximately 1.1 million cy of material from the Broad Sound North Channel, President Roads Channel and Anchorage, and portions of the Main Ship Channel approximately half way between Spectacle Island and Castle Island outbound was removed to restore this area to its authorized depths. The dredged material was placed at the MBDS. Approximately 520 acres of subtidal habitat was temporarily altered by maintenance dredging in the Outer Harbor. Rock removal from the Main Ship Channel, President Roads Anchorage and Broad Sound North Channel was begun in the fall of 2007.

3. Boston Harbor Inner Harbor Maintenance Dredging Project (IHMDP) (Initial Phase Completed in 2008, Phase 2 Planned concurrent with BHDDNIP)

The Boston Harbor Inner Harbor Maintenance Dredging Project (IHMDP) removed rock ledge and dredged shoals from the 40-foot deep Main Ship Channel to its authorized depth from the point where the previous maintenance dredging project left off (from approximately halfway between Castle and Spectacle Islands) to a point upstream of Massport's Marine Terminal (located just below the Third Harbor Tunnel), the upper Reserved Channel, and the approach channel to the Navy Dry Dock. In addition, approximately 3,600 cy of material was dredged from Boston Redevelopment Authority berth #4 to a depth of -30-feet, and the abandoned Keyspan gas siphon was also removed in the channel downstream of the Chelsea Street Bridge to allow for the deepening of the Chelsea River navigation channel to its authorized depth. Phase 2 would dredge from Massport's Marine Terminal upstream to the Inner Confluence.

Two CAD cells were constructed. One larger CAD cell was constructed in the Mystic River located near the Inner Confluence, and another smaller CAD cell constructed in the Main Ship Channel just south of the Inner Confluence. Approximately one million cy of dredged material was placed at the MBDS from construction of the CAD cells (720,000 cy) and maintenance dredging (310,000 cy). Another 380,000 cy was placed into the two CAD cells for a total of 1.4 million cy of dredged material. About 2,000 cy of rock was also removed from the project. Construction of the IHMDP began in mid-May of 2008 and was completed in mid-December 2008. The capping of the cells began in January 2010 and was completed in February 2010. The CAD cells were capped with sand dredged from the Cape Cod Canal.

This project was evaluated by MEPA as a project change to the previously discussed BHNIP (EOEA No. 8695). The original IHMDP proposed to dredge 1.7 million cy of maintenance material. The initial phase, completed in 2008, dredged 700,000 cy. Dredging of one million cy of maintenance dredged material from between Massport's Marine Terminal and the Inner Confluence is planned concurrent with Deep Draft Project. Approximately 732 acres of subtidal habitat will be temporarily impacted by the IHMDP.

4. Chelsea River Navigation Channel Widening in the Vicinity of the Chelsea Street Bridge (Chelsea River Widening) (2012)

The Chelsea River navigation channel was widened at the location of the Chelsea Street Bridge when MA Department of Transportation (MADOT) replaced the existing bridge with a new vertical lift bridge. The original opening for ship traffic through the Chelsea Street Bridge was only 95-feet wide. The bridge replacement included the removal of the existing fender system which would have created a navigation hazard if the channel was not widened. The navigation channel was widened to a minimum of 175 feet. In addition, the remainder of the Keyspan gas siphon (that was located under the fender system) was removed as well as a railroad bridge counterweight that was outside of the existing channel but would have been within the widened channel. The counterweight removal was performed by the USACE at the request of and with funding from MA DOT. Both the pipeline and counterweight were disposed of upland. Dredging was initiated in March 2012 and completed in April 2012. A total of about 33,000 cy of dredged material was removed and disposed at the MBDS.

5. Boston Harbor Inner Harbor Rock Removal (Boston Harbor Rock Removal) (2012)

Rock was removed from seven areas near Castle Island that were above the authorized depth in the 40-foot deep lane of the Main Ship Channel. Holes were drilled in the rock beginning in August 2012, followed by blasting which began in September 2012. A total of six blasts were performed. The blasted rock was removed with a mechanical dredge in September 2012. All material was placed at the MBDS.

6. Boston Harbor Deep Draft Navigation Improvement Project (Deep Draft) (2014-2017+)

The proposed Deep Draft Project, which is the subject of this SEIS/EIR, involves deepening the navigation channels in the outer harbor to between –45 feet MLLW and –50 feet MLLW (EOEA No. 12958). The areas proposed to be deepened are the Broad Sound North Channel, the President Roads Anchorage Area and portions of the Main Ship Channel, Reserved Channel, and the Mystic River, and the length of the Chelsea River.

Since the 2008 release of the Draft Feasibility Report and DSEIS/EIR, the USACE conducted additional economic studies of the proposed port improvements at the direction of USACE Headquarters. That process resulted in a slight reduction in the scope of improvements initially recommended for Boston Harbor. The change consists of a reduction in the recommended project depth in the inner harbor from the President Roads Channel and Anchorage and Main Ship Channel to Massport's Conley terminal from 48 feet to 47 feet at Mean Low Low Water (MLLW). Other project elements remain unchanged from those described in the draft EIR. Past and current improvements recommended include:

- Improving access to Conley Terminal for containerships by deepening the harbor's existing 40-foot channels, turning basin and anchorage to a depth of -47 feet MLLW (formerly -48 feet MLLW), with an additional four feet of depth in the Broad Sound North Entrance Channel (up to -51 feet MLLW).
- Deepening of the berths at the Conley Terminal by Massport to at least 50 feet
- Improving access to Massport's Marine Terminal in South Boston. The 40-foot lane of the Main Ship Channel above the Reserved Channel and below the Ted Williams Tunnel would be deepened to -45 feet MLLW
- Improving access to Massport's Medford Street Terminal on the Mystic River for lesser draft dry and break-bulk carriers. This small area of the existing 35 foot lane of the lower Mystic River Channel accessing the terminal would be deepened to -40 feet MLLW.
- Improving access to the Chelsea River primarily to its petroleum terminals by deepening the existing -38 foot channel to -40 feet MLLW.

Approximately 9.8 million cubic yards of clays, sands, and tills, all parent materials largely of glacial origin, will be dredged from the harbor bottom. In addition, up to one million cubic yards of rock would be removed from the harbor. All material has been tested and found suitable for ocean disposal at the MBDS. Rock removed from the project is proposed to be placed at the MBDS or outside Boston Harbor for habitat enhancement.

Approximately 1,164 acres of subtidal habitat would be temporarily impacted by the dredging activities for the Deep Draft Project. Up to an additional 530 acres of subtidal area could be permanently impacted by the creation of the habitat enhancement sites in one or more of the following locations: Broad Sound or Massachusetts Bay. This is considered a positive impact as the placement of rock from the dredging activities would be used to create additional habitat diversity at the selected locations.

Depending on the design of the reef(s), the placement of between 450,000 and 1.4 million cy of rock, five feet deep, would cover between 186 acres and 518 acres of soft bottom habitat. The placement of rock in rows would create more edge habitat and increase circulation.

Once the Deep Draft Project has been constructed, maintenance dredging in Boston Harbor is not expected for at least another twenty years.

4.11.2 Relationship to Other Projects

Projects were reviewed for their nature, location, and time frame of projected environmental impacts in order to determine what, if any, contributing impacts they might have to the anticipated environmental impacts of the proposed project. Figure 4-12 illustrates the project locations. Table 4-16, presented at the end of this section, presents a summary of the potential impacts to intertidal and subtidal resources in Boston Harbor from the projects described briefly below. Publicly available information sources were consulted to obtain the most up-to-date information possible; however, it is important to note that project scopes are often modified during the planning process, and this information is not always readily available.

An important component of the Deep Draft Project is the development of communication channels and coordination procedures with the agencies and organizations responsible for implementing the projects not yet underway in order to minimize the potential for conflicts and environmental damage. The

Deep Draft Project is not expected to conflict with other projects; the USACE has been, and will continue to be, in communication with other agencies if there is a potential for conflict with infrastructure or utilities. This issue is discussed further in Section 4.10.

1. Station #385 – Harbor Walk (2003-2004, Completed)

This project involved the construction of a harborwalk along Boston's Reserved Channel, and was designed to provide public access and improve passive recreational opportunities at the waterfront in compliance with City of Boston zoning requirements. According to the project's ENF, a portion of the harborwalk was proposed to be located approximately 3,000 sq ft above coastal bank, supported by piles with an actual impact of 20 sq ft. This project was implemented as a mitigation measure associated with the expansion of the outdoor electrical switching station #385 in South Boston, which was authorized under Massachusetts General Laws Chapter 91, the Public Waterfront Act. No significant short-term or long-term impacts to marine resources resulted from this project.

2. HubLine Submarine Natural Gas Pipeline (2002 -2004, Completed)

The HubLine natural gas pipeline was constructed by Algonquin Gas Transmission Company in Massachusetts Bay during 2002 and 2003. This project consisted of the construction of 29.4 miles of a 24-inch submarine high-pressure natural gas pipeline from Beverly to Weymouth. The pipeline is buried at a minimum depth of 3 feet, with several exceptions (where it was armored), and installed via a combination of horizontal directional drilling, conventional dredging, jetting, plowing, and blasting. A 5.4 mile lateral pipeline to Deer Island was also proposed as part of the project, with later plans extending the lateral to Everett, but available information indicates that the lateral extension was never constructed. As shown in Figure 4-2, the HubLine pipeline enters the harbor approximately 1.3 mile southeast of the proposed Deep Draft Project area.

Total impacts to subtidal resources resulting from the entire HubLine project (including the Deer Island lateral) were estimated at 7,800 acres in the HubLine DEIS (of this total, approximately 7,300 acres were assumed to be attributable to cable sweep from the pipeline installation activities). If an estimated area of impact associated with the uninstalled Deer Island lateral (which comprised approximately 15 percent of the total number of pipeline miles), is subtracted, then the HubLine area of temporary impacts was approximately 6,630 acres. A permanent impact to subtidal areas due to armoring of the alignment was estimated at 3.7 acres. There was also a 1.7 acre area altered to install six artificial reefs along the HubLine just southeast of Lovell Island in Boston Harbor as mitigation for hard bottom habitat loss.

In terms of the portion of the project that falls within the Boston Harbor area, it was calculated that approximately nine miles of the main HubLine fall within the general area of the Deep Draft Project. This is about 31 percent of the total length of the pipeline. Using that percentage as a multiplier, the area within the harbor experiencing temporary impacts associated with the HubLine project is approximately 2,055 acres; information on the specific location of areas with permanent impacts was not available from public documents, so all of the areas of permanent impact associated with armoring and the artificial reef are conservatively assumed to be within Boston Harbor, resulting in 5.4 acres of permanent impact to subtidal resources in the harbor.

The MA Division of Marine Fisheries (DMF) was designated as the lead agency with respect to providing effective mitigation and/or restoration of aquatic resources and habitat in response to potential HubLine construction impacts. DMF is implementing ongoing monitoring and assessment for lobster impacts, as well as mitigation programs for bottom sediment enhancement (the artificial reefs) and shellfish stock enhancement, and restoration programs for eelgrass and anadromous fish. Assessments are ongoing in terms of the long term impacts to the Boston Harbor area on this large and complex project. Reports issued in 2008 indicate that the permanently altered areas have not recovered to preexisting conditions, although there is some evidence of the reestablishment of similar function in terms of diversity and abundance of species.

3. MWRA - Boston Harbor Cleanup (1985 to 2000, Completed)

In the mid-1980's the Massachusetts Water Resource Authority (MWRA) embarked on the Boston Harbor Project, a massive clean up project which involved the eventual construction of the new sewage treatment facilities on Deer Island (DITP), the decommissioning of the Nut Island Treatment Plant (NITP), and extensive CSO control improvements.

Activities affecting the subtidal regions of the Harbor include an inter-island tunnel to transfer South System flows from the NITP to the new DITP, and installation of a deep rock tunnel for the 9.5 mile ocean outfall diffuser for discharge of treated effluent into Massachusetts Bay. These activities were completed by 2000. Since that time, significant improvements in Boston Harbor's water quality and clarity (2010 Outfall Monitoring Overview Report, MWRA Report 2011-16), as well as the bottom sediment quality, have been documented. There are no other known plans associated with the cleanup project that involve subtidal work in Boston Harbor. The MWRA's ongoing efforts to improve water quality in Boston Harbor are primarily focused on implementation of CSO and stormwater control projects, which are not expected to have significant subtidal work in the harbor.

4. Winthrop Shores Reservation Restoration Program (2012 – 2013)

The MA Department of Conservation and Recreation (DCR, formerly the MDC) planned to use an offshore borrow site (NOMES I) as a source of sand for the beach restoration efforts at Winthrop Shores Beaches. The project was denied a permit by the USACE, and subsequently two NPC's were filed to address alternate borrow sites. The project's Final EIR (2007) for this project (EEA #10133) and supplemental information from the NPC's described proposed improvements to the beaches, including the following elements that would affect marine resources:

- Removal of an estimated 520,000 cy of nourishment material from two sources (Saugus I-95 highway embankment borrow site and dredged material from the Winthrop Beach tombolo),and transport to the beach by truck;
- Placement of beach nourishment fill along 37 acres of supratidal, intertidal and subtidal areas at Winthrop Beach;
- Reconstruction of existing groins; removal of one groin and construction of a new terminal groin at Winthrop Beach; and
- Construction a new storm drainage system.

The Winthrop Shores Reservation project is currently in the permitting phase. If all necessary approvals are obtained, the project would involve 37 acres of permanent impact. The proposed project is planned for completion by late 2013.

5. Central Artery (1995 – 2003, Completed)

A number of Central Artery activities have occurred in or around Boston Harbor. One component of this large transportation project involved the creation of a new 100-acre public park on Spectacle Island in Boston Harbor. The park has docking access for public ferry and recreational boats, two public bathing beaches, picnic areas, a trail system, recreation areas, and a visitors' center. During construction of the park, a net total of 6.4 acres of intertidal and subtidal area was permanently filled in order to close the abandoned landfill that existed on the island.

Other Central Artery activities that have impacted marine resources include:

- The Ted Williams Tunnel across Boston Inner Harbor which required 3,415 square feet of fill (South Boston/BMIP);

- The I-90 immersed tube tunnel across Fort Point Channel where the top of the tunnel box protrudes above the mud line to the presence of existing MBTA Red Line tunnel. Armor rock was placed on top of the tunnel box, which involved alteration of 2.1 acres of subtidal waters; and,
- The Zakim/Bunker Hill Bridge across the Charles River and the Millers River where the bridge piers required permanent fill of 3,500 square feet in Charles River and 1,500 square feet in Millers River.

6. Portside at Pier One (Phased Construction to resume in 2012)

This project involves the redevelopment of the East Boston waterfront into residential apartments and, in the future, condominiums with supporting retail, community and office space. The renovated residential project will also include transient dockage and commuter water transportation services.

The existing marina is being upgraded, and major capital investments, boat building, and ship repair continue in the existing East Boston Shipyard.

7. Pier 4 (Originally 2003 – 2005, Estimated Completion 2017-2019)

The Pier 4 project involves redevelopment of a site located on the South Boston waterfront at the location formerly occupied by Anthony's Pier 4 Restaurant and associated parking into a multi-use area with retail, office, residential, hotel uses and public spaces. The project was originally proposed in the early 2000's, but had languished for several years. A Boston Globe article (September 26, 2007) and an editorial (Fan Pier rising, September 27, 2007) indicated that the Pier 4 project was taken over by a new developer and merged with the Fan Pier Development project (below). Both projects were initiated in 2008. Work is expected to include construction of a below-ground parking garage, access ramps, roadways, three buildings, pile-supported structures, and accessory structures associated with open space usage. There will also be dredging, seawall stabilization and repair, and minor filling of subtidal areas as well as a marina and water taxi dock. Information on the area affected is not available from existing public documents. The project received approval by the Boston Redevelopment Authority under the Boston Zoning Code.

8. Fan Pier Development (2000 – 2007, Estimated Completion 2017-2019)

This ongoing project (EEA #12083) will redevelop Fan Pier into a multi-use area with retail, office, residential, and hotel uses. The project design and composition has changed from the initial proposal, and was recently merged with the Pier 4 project (above). A new marina and water transportation terminal may be constructed as part of the project; the initial design included an estimated 9,800 cy of dredging (project information did not provide an area estimate). The project has received approval by the Boston Redevelopment Authority under the Boston Zoning Code.

9. Russia Wharf (Completed)

This project (EEA #12821) involved refurbishment of several historic buildings on Atlantic Avenue and Congress Street for mixed use as residences with retail space on the ground floor. It also included construction of a new 31-story office tower, a 500-space underground parking garage, and a waterfront plaza on Fort Point Channel that will provide dockage for transient boats. Other than pilings for the transient dock, there was no permanent impact to marine resources. It should be noted that some dredging occurred to support the proposed marina and water ferry dock; however, specific acreage or volumes are not presented in publicly available information.

10. Marina Bay Maintenance Dredging (Completed)

This maintenance dredging project involved dredging of a 107,800 square foot area (2.4 acres), representing less than seven percent of the area of the active boat basin in Marina Bay. Approvals were received for removal of approximately 9,000 cy of dredged material. No improvement dredging was conducted.

11. Clippership Wharf (In Predevelopment Phase: Estimated completion contingent upon financing)

The proposed project (EEA #12556) involves development of 400 housing units, 455 parking spaces, commercial and retail space, and associated infrastructure in five buildings on a 12.9-acre site. The development also includes plans for water transit terminals and water taxi stops; the project's planning strategy fosters development in and around a network of public transportation. Clippership Wharf will incorporate 1,715 linear feet of Harborwalk and will add 4 acres of new open space, including the following landscaped and pedestrian areas: Central Garden, Lewis Mall and Street, the Cove, the Arts Lawn, and Clippership Lane. Offstreet parking will be accommodated in an underground 670-space garage. Work in intertidal areas is likely to include removal or stabilization of old sea walls and the installation of piles to support new docking facilities. No significant impacts to subtidal marine resources are anticipated.

12. Sterling Marine Terminal (Originally 2008-2012)

The proposed project (EEA #13126), situated in East Boston along the Chelsea River, involves the reconstruction of approximately 300 linear feet of existing bulkhead, construction of a new 20-foot by 60-foot pile-supported transfer bridge, maintenance dredging of approximately 101,000 square feet (2.3 acres), and the construction of a confined aquatic disposal (CAD) cell in Boston Inner Harbor in East Boston, outside the boundaries of the Federal navigation channel. The proposed CAD cell is estimated at 3.8 acres. Approximately 155,000 cy will be dredged to create the CAD cell, and 21,000 cy of surficial sediments would be disposed at an approved upland disposal site. The CAD cell would be capped following the completion of dredged material disposal activities. The remainder of the dredged material (134,000 cy) will be disposed of at the MBDS. Based on publically available information, the project proponent is currently seeking to obtain environmental permits for the project and the project schedule is tentative. According to the MEPA Certificate on the DEIR, the results of the proponent's water quality modeling indicate that the proposed project will result in only temporary impacts to water quality and turbidity during dredging and disposal. Water quality will be monitored during this project. Review of publically available information did not yield new updates on this project.

13. Chelsea Sandcatcher Stabilization (Completed)

This project involved removal of crumbling portions of an obsolete concrete-and granite grit collection chamber extending onto the bank of the Chelsea River. The interior of the chamber was cleared of debris and filled with concrete. Steel sheeting and stone riprap were placed along the perimeter of the chamber to stabilize it and blend it into the riverbank, and the deteriorated roof of the chamber will be capped with a layer of concrete. No permanent impacts to subtidal resources resulted from the project.

14. Yard's End Research Center (Completed)

This project involved construction of two new research buildings totaling 527,000 square feet of floor space on 16th Street in the Charlestown Navy Yard. The project also created three acres of public open space along the waterfront, which will be part of the Boston Harborwalk system. The project is located entirely upland, and no permanent impacts to marine resources resulted from this project.

15. Long Island Bridge Abutment Stabilization (Completed)

This project involved the stabilization of bridge abutments on the Long Island Bridge, which links Long Island with the City of Quincy. The abutments are located on the southwest point of Long Island, known as West Head. Based on available information, minor impacts to subtidal resources resulted from abutment repair activities.

16. Shipyard Quarters Marina Extension (Completed)

This project involved expanding the existing marina at Pier 8 in the Charlestown Navy Yard. New piles were constructed to support 55 new slips, increasing the total capacity from 187 slips to 242 slips, and covering an additional 19,460 square feet of water surface.

17. Pier 5, 8th Street (Originally 2004 – 2006, Project Cancelled)

This project entailed construction of a new residential complex with 59 units totaling 170,000 square feet on Pier 5 in the Charlestown Navy Yard. The project would have added 1,400 linear feet of public space to the Boston Harborwalk system, and construct a 21-slip marina along the southern end of Pier 5. The area of impact associated with this project was not available from available information. Publically available information indicated this project was cancelled, with BRDA issuing requests for alternate development in January of 2011.

18. Global Petroleum, Chelsea River Dredging (Originally 2005, Actual Depends on Obtaining Necessary Permits)

This project (EEA #13291) proposes maintenance dredging of the existing Global Petroleum marine terminal located in the Chelsea River. Approximately 14,000 cy of marine sediment will be removed from a 2.5 acre area. Sediment is proposed to be disposed of in one of the following locations: a local landfill; a Rhode Island Dredge Disposal Facility (MBDS is not a disposal option because the material is unsuitable for unconfined ocean disposal); or a CAD cell at the Sterling Marine Terminal site.

19. Irving Oil, Chelsea River Dredging (Originally 2005, Actual Depends on Obtaining Necessary Permits)

This project (EEA #13297) involves maintenance dredging of the existing Irving Oil marine terminal located in the Chelsea River. The work will be done in coordination with the neighboring Global Petroleum dredging project. According to available documentation, approximately 13,000 cy of marine sediment will be removed. Sediment will be disposed of in one of the following: a local landfill; a Rhode Island Dredge Disposal Facility; or a CAD cell at the Sterling Marine Terminal site.

20. Spectacle Island Maintenance Dredging (Completed)

This project involved dredging 16,000 cy of sand from the marina area at Spectacle Island and using dredged materials to restore the northern half of West Beach, which was been eroded by wave action. The marina and beach were created in 1996 and 1997. Since then sand from the beach has washed into the marina area, reducing the water depth by up to 10 feet MLLW. Approximately 175,000 square feet (4 acres) of subtidal area and 215,000 square feet (4.9 acres) of intertidal area were temporarily affected. Periodic maintenance dredging is expected to be required in the future, although the frequency is not known.

21. New South Side Harborwalk (Completed)

This project created 350 linear feet of boardwalk along the south side of Commercial Wharf in Boston, supported by about 22 new timber piles. The boardwalk has a total area of approximately 2,180 square feet and will be part of the Boston Harborwalk system. Minor impacts were likely experienced from the installation of new piles. The area of impact is not specified in available information.

22. Lovejoy Wharf (Completed)

This project resulted in a mixed-use residential and retail complex adjacent to Lovejoy Wharf, which fronts the Charles River in the North End section of Boston. The project involved the renovation of one existing building at 160 North Washington Street and the demolition and replacement of a second building at 131 Beverly street to create 260 residential units and 38,000 square feet of retail space. Lovejoy Wharf will also be rehabilitated and integrated into the Boston Harborwalk system. No specific impacts to intertidal or subtidal areas are known.

23. St. Lawrence Cement/Boston Sand & Gravel, Island End River Dredging (Completed)

This project involved dredging of approximately 10,900 cy of material from an existing commercial wharf owned by Boston Sand & Gravel on the Island End River in Everett. The dredging covered an area of 81,950 square feet (1.9 acres) and increased the bottom depth from 26 feet below mean low water (MLW) to 31 feet below MLW to allow St. Lawrence Cement to dock a new deeper draft vessel at the facility. The dredged material was removed to an upland disposal site.

24. Release Abatement Measure, Island End River (In Progress)

This project (EEA #13443) involves dredging approximately 72,000 cy of contaminated sediment in the Island End River adjacent to a former coal tar processing facility. A 1.9-acre confined disposal facility (CDF) will be constructed on the riverbank to contain about 52,000 cy of the dredged material and prevent leaching of toxic organic compounds; the remainder will be removed to an off-site disposal facility. Constructing the CDF will result in permanent impacts to 1.9 acres of subtidal and a small area of tidal flat (intertidal) area, creating new upland area for marine use in a Designated Port Area. A wharf will be constructed atop the CDF.

25. Old Colony Yacht Club (Completed)

This project included maintenance dredging in the Old Colony Yacht Club Marina, which is located in Boston at the confluence of the Neponset River and Dorchester Bay. Approximately 15,000 cy of sediment was removed from an area of 80,000 square feet (1.8 acres). A portion of the sediment which was contaminated by the former operations of a manufactured gas plant was removed for treatment and upland disposal. The contaminated material was dredged to a depth of 12 feet below MLW, and the maintenance dredge material placed into this deeper channel to recreate the original bottom profile.

26. Mill Creek Center (Original Completion 2005 – 2006; Estimated Completion 2009)

This project involves construction of a 28,000 square foot mixed-use retail and office building adjacent to Mill Creek in Chelsea. A riverwalk and canoe launch dock are planned to be constructed as public open space along the riverbank. No significant permanent impact to intertidal and tidal resources is anticipated. No new information was available on this project.

27. Boston Children's Museum Expansion (Completed)

This project expanded the existing museum building with the construction of a three story, 22,300 square-foot addition adjacent to the Fort Point Channel in Boston. As part of the project, the land surface between the museum and the harborwalk along the water was filled to create a single level area. The building's addition is equipped with a green roof, and the museum also installed a new stormwater reclamation system on the entire building which will significantly reduce stormwater runoff into Fort Point Channel. The Children's museum reopened to visitors in April 2007. No fill was proposed or placed in Fort Point Channel; impacts were limited to adjacent upland areas only.

28. Weymouth Fore River Maintenance Dredging (Completed)

The project involved maintenance dredging of about 430,000 cy of primarily clay, silt and sand from the project to restore the Federal navigation channel to its authorized channel dimensions. As a result of this project, approximately four million square feet (91.8 acres) of subtidal bottom was temporarily impacted. The material was disposed MBDS.

29. Acushnet Marine (Original Completion 2006-2007; In Progress)

This marina expansion project (EEA #13744) includes the construction of an 8- by 200-foot timber pile deck and access pier supported by 30 pilings, a 4- by 45-foot gangway, and an 18- by 80- foot pile supported steel float roughly located within the footprint of a historic supply pier on Hull Bay in Hull. Approximately 3,080 square feet of subtidal area will be affected by the project.

30. Waveland Marina (2007 – 2008, Completed)

The project included the expansion of an existing marina from 65 floating slips to 150 pile-supported slips; installation of pile-supported piers with a ramp and float system for access; relation of an existing travel lift; installation of steel sheet-pile sections at the location of the abandoned and proposed lift sites, and installation 900 linear feet of pile-supported floating wave attenuators. Approximately 260 square feet of subtidal area were be affected by the project, along with approximately 850 square feet of intertidal impacts.

31. UMass/Savin Hill Cove Dredging (Original Completion 2008)

The project is comprised of improvement dredging of an existing navigation channel in Savin Hill Cove adjacent to the University of Massachusetts-Boston in Dorchester Bay. Approximately 22,000 cy of sediment would be dredged from a navigation channel extending southwesterly from the existing Fort Point Basin docking facility for a distance of approximately 1,000 feet then turning southeasterly for 1,000 feet to connect with the Dorchester Bay Channel. An estimated area of 204,824 square feet (4.7 acres) of subtidal area will be affected by the project. Based on publically available information, the project is in the permit application phase.

32. M Street Seawall Construction (Completed)

The project involved the replacement of approximately 500 linear feet of the existing M Street concrete block seawall in South Boston. Also included was the rehabilitation of the granite block bulkhead adjacent to the new seawall. No subtidal area was affected by the project; approximately three acres of intertidal area was impacted.

33. Thompson Island Salt Marsh Restoration (Completed)

The project included the restoration of a salt marsh and salt pond on the southwestern side of Thompson Island in Boston Harbor. The restoration was accomplished by removing an existing debris pile that prevented tidal flushing. By opening up the hydrologic connection to the ocean, diurnal tidal flushing will replenish the water in the salt pond twice daily during normal high tides, and expose a fringe of mud flat habitat during low tides. Tidal exchange would improve water quality in the pond, increasing dissolved oxygen levels and preventing the formation of algal mats over the pond surface during the growing season. No subtidal areas were expected to be directly affected by the project.

34. Boston Harbor Islands General Management Plan

This is an ongoing effort with multiple activities concerning the long term management of the Boston Harbor Islands park system by the National Park Service (NPS). Concepts for the management plan include; increased opportunities for visitors to discover the natural and cultural history of the islands, preservation of natural and historical resources, providing visitor programs that focus on cultural and natural history, and promoting use and stewardship of natural and historical resources.

Visitor facilities (e.g., dock and transient marina at Spectacle Island) at numerous islands within the park system are existing structures or facilities, and no additional significant construction activities affecting subtidal resources are known. The island's current capital plan contains proposals for some minor dock improvement and seawall rehabilitation projects; however no specific construction or program activities are expected to affect marine resources. This General Management Plan is listed because of the close proximity of the project area to Boston Harbor Islands.

35. Parcel E (Completed)

Parcel E is located at 242 Northern Avenue in Boston's Seaport District, and is the former location of Jimmy's Harborside Restaurant, Jimbo's Fish Shanty and Massport office space. Redevelopment of Parcel E (EEA #14124) consists of two main buildings and a small kiosk building which accommodate restaurant and office space. Project also includes a new 570-foot section of Harborwalk on the harbor side of the building connecting Northern Avenue at the Marine Industrial Park back to Northern Avenue at the Fish Pier. Other public access improvements include an expanded deck area for food service with outdoor seating and the construction of a public landing to support transient dockage, water taxis, and charter fishing vessels. No dredging was conducted for this project. The ENF was filed with MEPA in November 2007 and the Secretary's Certificate issued in December 2007. The project had limited temporary impacts associated with the removal of 450 timber piles and the installation of 160 new 16" pipe piles. The ENF notes expected impacts to Land under Ocean of 142 square feet. The new pilings support the new buildings and deck structure. The project was completed in 2011.

36. Logan Runway Safety Areas (Phase 1 completed 2012, Phase 2 by 2015)

Under this project (EEA #14442) Logan Airport Runway Safety Areas (RSAs) for Runways 33L and 22R will be modified and enhanced. At runway-end 33L a pile supported deck of approximately 300 feet wide by 500-feet long was constructed over Boston Harbor. In addition to alteration of the constructed riprap coast bank at this location, the project directly or indirectly impacted approximately 66,000 sf of eelgrass and approximately 2,000 sf of subtidal area. This worked commenced in spring 2011 and was completed in November 2012.

Proposed safety improvements at Runway-end 22R will be constructed 2014/2015 and will require alteration of approximately 35,000 ft^2 of saltmarsh, 63,545 ft^2 of shellfish beds, coastal bank, 31,200 ft of coastal beach and a small subtidal area (1800 sf).

The EA/EIR document and subsequent permits incorporated coastal impact mitigation measures including the restoration of previously filled or degraded salt marsh and restoration of eelgrass habitat. The existing storm water collection/treatment system for these RSAs is considered adequate to protect receiving water quality.

37. Cottage Park Marina Expansion and Maintenance (Completion Date 2012/post-2012)

The Cottage Park expansion and maintenance dredging project (EEA #14952) has been proposed to install 561 feet of pile supported floating dock and several finger floats to offer 27 new boat slips, enhanced public transient slips and an area for the youth sailing program. The project as proposed according to the ENF includes the dredging of 9500 cubic yards (cy) of material over an area of 4.1 acres including 2000 ft^2 of tidelands and shellfish classification area GBH5.1.

An environmental window has been established (Feb 15 to Sept 30) to protect flounder and clam spawning, larval settling and juvenile development.

38. Winthrop Ferry Dock (Completed)

The Town of Winthrop upgraded its public landing to include ferry service with the necessary ramps and safety features (EEA #12940). New pier construction affected 46 ft^2 of wetland directly. Wetland shading occurred over 5820 ft^2, although the design allows light to continue to infiltrate the area.

39. Georges Island Pier Improvement Project (Planned Completion Date Not Available)

The Massachusetts Department of Conservation and Recreation and the National Park Service have cooperated to develop/construct replacement pier and docks at Georges Island, as well as two new pile supported wave screens. The project (EEA #14824) consists of the removal/replacement of existing piles and avoids dredging. Based on publically available information, the completion date for this project is not available.

40. Shaughnessy Pier (Planned Completion 2012)

The Shaughnessy Pier project according to the ENF (EEA #14805) involves the construction of a deck, pier and floating docks at a single-family residence. The proposed structure will extend 162.5 feet into Quincy Bay with a 65 foot extension for floating docks, moorings, storage and a boat lift.

The initial plan would affect 72 feet of coastal beach, 540 ft^2 of rocky intertidal and a 2078 ft^2 of the subtidal zone. A smaller scaled pier and dock were recommended by CZM and DMF.

41. Rock Chapel Marine (Planned Completion 2012)

The Rock Chapel Marine project (EEA #14722), located in Chelsea, has been proposed to repair and/or remove old structures including oil tanks and renovate a garage for reconfiguration into an office building to support marine terminal operations. Installation of multiple truck scales are intended to reduce truck queuing and idling. The project will also create public access to the area. No impacts to wetlands, intertidal or sub tidal areas are proposed.

42. Harbor Towers Seawall Repair (Planned Completion 2011)

The Harbor Towers project (EEA #14662) is located at the Harbor Towers condominiums in Boston and includes repairs and maintenance of an existing seawall and harborwalk. According to the ENF, the project will affect 5250 ft^2 of wetlands, including 1845 ft^2 in the subtidal environment, 1525 ft^2 of the rocky intertidal, and 1880 ft^2 of land subject to coastal storm flows. Coastal bank (690 ft) will also be affected.

The area is not mapped as shellfish habitat and placement of project rip rap will include voids to allow it to function as rocky intertidal habitat. No new updates on project status were publically available.

43. Port Norfolk Yacht Club Maintenance Dredging (Planned Completion 2009)

The Port Norfolk Yacht Club, located in Dorchester, has proposed a dredging project (EEA #14336) to address shoaling areas within the marina. Under the proposed dredging plan, 15,000 cubic yards (cy) of material will be removed from the marina and according to the ENF will affect about 98,527 ft^2 of subtidal and shellfish areas. Information regarding actual completion date is not publically available.

44. Pappas Way Roadway Improvement Project (Planned Completion 2013)

This project (EEA# 14695) involves improvements to the Pappas Commerce Center as part of an overall long term rehabilitation plan from an industrial park to a mixed-use urban center. Site improvements include bulkhead repairs, roadway grading, drainage improvements, a new pedestrian pier and platform with waterfront access, wind turbine installation, and construction of a pedestrian harborwalk.

The proposed project includes revetment that affects approximately 27,500 ft^2 of flowed tidelands. Mitigation measures include enhanced bulkhead habitat, improved storm-water filtration, and habitat restoration totaling approximately 27,500 ft^2 in the Chelsea Creek intertidal zone along Condor Street in East Boston.

45. Boston National Park/Ferry (Planned Completion 2008)

The Charleston Navy Yard in Charlestown includes a ferry landing facility and the National Park Service project plan (EEA #14195) is to construct a new more secure landing that complies with accessibility standards. The pier design includes a concrete deck slab supported by steel pipe piles.

No beach or bank areas occur within the work site and there is no evidence of eelgrass during a recent bathymetry survey. The site is presumed not to contain shellfish habitat. Wetland impacts will be limited to just 18 ft^2. Information regarding an actual completion date is not publically available.

46. Boston East Development Project (Planned Completion 2011)

The Boston East site has historically been used commercial and industrial purposes, contains structures in disrepair, represents 87,118 ft^2 of historically filled wetlands, and is currently inaccessible to vehicular and pedestrian traffic. According to the PNF/ENF (EEA #14123) The project proposes to construct a residential building on the north portion of the site and a two-story marine industrial facility with travel lift and a landscape exhibit on the south side.

Finger piers will be constructed to support the marine travel lift. Coastal impacts will be limited to 100 ft^2 of subtidal area and 19,650 ft of coastal beach as well as 69,650 ft^2 of land subject to coastal storm flowage.

The project provides housing, jobs, public access and tax revenues. Information regarding actual completion date is not publically available.

47. New Street Development (Planned Completion 2010)

This is an East Boston project (EEA# 14102) located on New Street that was designed to develop/redevelop housing units and possibly a hotel facility. Several buildings will be removed from the site and parking capacity added. A small marina will be constructed and 2,300 cy of material dredged. A harbor walk will be added and landscaped.

Information regarding actual completion date is not publically available.

48. Conley Terminal Expansion Project (Beginning in 2013)

The upcoming Conley Terminal expansion project is designed to enhance ground transport to and from the terminal area, create open space buffer between existing parks and playgrounds, and increase container storage facilities at the site.

The transportation infrastructure enhancements will include several components including:

- A dedicated freight corridor to remove Conley Terminal container truck traffic from East First Street and part of Summer Street;
- A new roadway traversing the Coastal Oil Terminal property, the former MBTA/DCR property, and Exelon corporation property, and
- Construction of a bridge across the embayment on the Exelon property to join Summer Street (replacing an existing bridge).

For this project phase, in-water work will be limited to the construction of bridge abutments and pilings. The bridge abutments will replace the existing bulkheads, and will not likely require any new fill area. The new pilings are expected to impact an area of 200 ft^2 or less.

The open space buffer zone will be about 100 feet wide in most areas and will be established along the north side of East First Street extending about 2,000 feet from Farragut Road to the Exelon property. It will create new open space between Castle Island and other parks along the harbor, parks and playgrounds along East First Street and the community to the west.

Added container storage will be established with expansion onto the former Coastal Oil property and include possible reefer storage, full and empty box storage in stacks served by rubber-tire gantries, and container processing facilities. These improvements may potentially expand ground container storage from about 4,050 TEUs to 5,200 TEUs at Conley Terminal. The final security perimeter will incorporate the expanded area onto the former Coastal Oil property and a security checkpoint at the western end of the facility.

Future Conley construction phases could include waterfront improvements. With the deepening of Boston Harbors' navigation channels to -47 feet, Massport is considering deepening existing berths at Conley Terminal (#11 and #12) from -45 feet to -50 feet to maximize shipping efficiencies gained by the continued use of Boston’s tidal range.

With the Conley expansion onto adjacent Coastal Oil Terminal property, Massport is also considering the long-range potential of constructing another berth on this property. If it is assumed that the current proposed Coastal Oil berth depth is about -40 feet at present (plus OD), and the (deeper) existing Conley Terminal berth dredging would require only ½ the depth to be dredged vs. the new berth on the Coastal Oil property, then the resulting material volume would be roughly twice at the new Coastal Oil site. The resulting dredged material volume generated from the new Coastal Oil Terminal berth would then likely be on the order of 50,000 cy for placement at either the MBDS or the IWA.

4.11.3 Summary of Cumulative Impacts

The Deep Draft Project will provide deeper access channels for ships using the Port of Boston. Construction will occur in an area that is both heavily utilized by a wide range of human activities and experiencing a large number of projects with potential impacts to biological resources and water quality.

The Boston Harbor dredging projects summarized in Section 4.11 resulted in the cumulative, temporary disturbance to approximately 1,720 acres to-date of subtidal habitat within the inner and outer harbor areas for the completed projects (BHNIP and OHMDP), as well as an additional 1,886 acres of temporary disturbance associated with the recently completed IHMDP and the proposed Deep Draft Project. Thus the major Boston Harbor navigation dredging projects have (or will) temporarily impact a total of 3,600 acres. These areas of disturbance are limited to the boundaries of the existing Federal navigation channels and anchorage areas within the harbor. It is important to note that some of the areas of the dredging projects overlap, as is clearly shown in Figure 4-10. In addition the Deep Draft Project could have permanent beneficial impacts to subtidal areas of between 220 and 530 acres (depending on the selected alternative) if the habitat enhancement program is implemented.

Additionally, there is a range of smaller harbor projects that add to the overall cumulative impacts of completed or planned harbor projects and those have also been addressed. Assessing the cumulative impact associated with projects identified in Section 4.11.2 is based on available information during document development. Some of the available documentation for small projects expresses impacts in terms of cubic yards, not square footage, but most of the large projects (e.g., HubLine, Weymouth Fore River) do have square footage information available so while the totals do not include all projects, they are representative of activity in the harbor.

Roughly half of the projects presented in Section 4.11.2, are completed. These completed projects created temporary impact of about 2,170 acres (95 percent of which is the HubLine project), and permanent impact of approximately 5 acres. Of the remaining projects, about 30 acres of temporary subtidal impacts are anticipated. The total estimated intertidal area within Boston Harbor to be affected by the projects is about 50 acres, including a large fraction (37 acres) of permanent impacts associated with the Winthrop Shores Reservation. These data are comparable to findings presented in the 2008 Draft SEIS/EIR.

Evaluating all completed and anticipated harbor construction projects results in several thousand acres of subtidal impact. Given the roughly 50 square mile area of the harbor (approximately 32,000 acres), the cumulative projects impact will be less than 20 percent of the total, and the vast majority of these subtidal impacts will occur in areas that are already disturbed (i.e., maintained navigation channels). Further, the removal of sediment from these areas will affect the biologically active zone only temporarily, until sedimentation proceeds and benthic biological resources re-colonize these areas, re-work the sediments, and increase in abundance and diversity over time. The majority of the cumulative impacts are the result of the Boston Harbor dredging projects described in Section 4.11.1 and the completed HubLine natural gas pipeline described in Section 4.11.2. See Tables 4-17 and 4-18.

Based on the summary of the cumulative impact of the projects presented in Section 4.11.2 and the timing, location and magnitude of the projects analyzed, the Deep Draft Project is unlikely to result in significant cumulative impacts to water quality with respect to temperature and salinity, dissolved oxygen concentrations or nutrient concentrations. Temporary local increases in water column turbidity will result from dredging operations, and the impacts could be more pronounced if one or more of the proposed development projects are being constructed at the same time and in the vicinity of the dredging activities for the Deep Draft Project. Given that many of the projects are subject to obtaining necessary permits and approvals, it is not possible to determine whether some of these projects will occur at the same time as the Deep Draft Project. Those near the project footprint in Chelsea that could potentially have overlapping timeframes include the Sterling Marine Terminal, Irving Oil, and Global Petroleum. In the harbor, perhaps the UMASS/Savin Hill Cove Dredging and/or the Winthrop Shores Restoration projects could experience overlapping schedules. Implementation of the proposed mitigation measures for dredging and dredged material disposal activities will minimize any potential temporary turbidity impact and will be further mitigated for the development of sensitive fishery resources by observing environmental dredging windows established to protect larval and juvenile life stages.

Likewise, temporary cumulative impacts to biological resources in Boston Harbor could result if any of the adjacent development projects are being constructed at the same time as Deep Draft Project activities. These potential cumulative impacts could result from additional noise, benthic habitat disturbance, and/or permanent displacement of harbor bottom. Implementation of the proposed mitigation measures for the Deep Draft Project will minimize any potential cumulative impacts.

Geological resources in the harbor project areas are represented by subsurface rock material and Boston Blue Clay. The rock resources may be re-used to create additional rocky bottom habitat for the lobster fishery and others, and the clay resource may be used to cap the IWS area near the MBDS

4.11.4 Conclusions

Generally, most of the cumulative impact related to the range of harbor projects will occur in the subtidal areas, where benthic resources reside, but as indicated, the vast majority of these areas already exist within the existing Federal navigation channels and benthic resource impacts related to dredging activities have been documented to be temporary, with gradual re-colonization of these areas with biological resources.

A far lesser impact will occur in the intertidal zone, where roughly 50 acres are/will be affected cumulatively by the range of projects recently completed or planned. Further, the loss of some of these areas may be mitigated with the construction/reconstruction of saltmarsh locally or in the harbor region. Water quality impacts related to turbidity are also expected, but will be temporary, and mitigated by observing environmental dredging windows.

Small impacts will also occur in storm flowage areas where a few acres of expected impacts have been documented, in coastal bank areas (about one acre documented), and in Essential Fish Habitat areas (a few acres documented). Critical habitat has not been identified in any of the harbor project areas.

Overall, the cumulative impacts of the Deep Draft Project are not substantial and temporary in nature. No unique marine resources are expected to be impacted from the proposed project which will therefore not result in a cumulatively significant adverse impact to marine resources. The benthic community will be temporarily disturbed and the substrate exposed may be finer in content. However, this exposed layer will eventually be covered by silt and the benthic community could change slightly again. Less than two percent of the proposed project will impact previously undisturbed areas. The overwhelming portion of the project will deepen only previously disturbed areas in Boston Harbor. The habitat enhancement will be a positive impact, if approved. No CAD cell construction within Boston Harbor is currently expected for the Deep Draft Project. Further, many of projects recently completed or planned for construction will have a positive effect on recreation, the local economy, employment, and housing.

Table 4-17. Subtidal and Intertidal Impacts from Boston Harbor Projects

Figure – 4-11, Key #	Project	City	Location	Subtidal Impacts	Intertidal Impacts	Timeframe	Comments
1	Station #385-Harborwalk	Boston	Boston Harbor Reserved Channel	None	~ 1,400 s.f.	Completed	
2	Hubline	Boston, Weymouth	Mass. Bay, Boston Harbor-Beverly to Weymouth	In Boston Harbor, up to 2,055 acres temporary impact; 5.4 acres permanent impact	None	Completed	These estimates reflect work in Boston Harbor only; estimated at 31 percent of the full length of the HubLine
3	MWRA Harbor Cleanup	Boston, Winthrop	Deer Island, Boston Outer Harbor	Periodic maintenance dredging at Deer Island and Nut Island roll-on/roll-off piers will be required – area to be determined	None	Completed	Maintenance Dredging ongoing. Harbor activities included construction of roll on/roll off pier at Deer Island; Deep bored outfall tunnel to Mass Bay
4	Winthrop Shores Reservation Restoration Program	Winthrop	Broad Sound	450,000 cy embankment borrow site; 91,000 – 98,000 cy from W.B. Tombolo	37 acres of supratidal, intertidal and subtidal impacts	Estimated Completion 2012-2013	Subject to funding and permitting approval.
5	Central Artery	Boston	Spectacle Island; Ted Williams Tunnel; Fort Point Channel	Spectacle Island-6.4 acres; Ted Williams Tunnel-3,415	See comments	Completed	Spectacle Island and Fort Point Channel impacts include minor amounts of Intertidal areas –

Figure – 4-11, Key #	Project	City	Location	Subtidal Impacts	Intertidal Impacts	Timeframe	Comments
				sf; Fort Point Channel-2.1 acres; Charles/Millers Rivers-5,000 sf			beach at Spectacle Island, mud flat in Fort Point Channel. Small salt marsh (supratidal) area on Spectacle Island permanently impacted
6	Portside at Pier One	East Boston	Boston Inner Harbor	None	None	In Progress. Phased Completion recommenced in 2012	
7	Pier 4	Boston	Boston Inner Harbor	Unspecified area of maintenance dredging	None	In Progress. Estimated Completion 2017-2019	Seawall stabilization
8	Fan Pier Development	Boston	Boston Inner Harbor	9,800 cy-no area specified.	None	In Progress. Estimated Completion 2017-2019	Temporary impacts to adjacent seawall
9	Russia Wharf	Boston	Fort Point Channel	Potential dredging	None	Completed	
10	Marina Bay Maintenance Dredging	Quincy	Dorchester Bay	107,800 sf (2.5 acres); 9,000 cy dredged	None	Completed	Maintenance dredging of navigation channel.
11	Clippership Wharf	East Boston	Boston Inner Harbor	201,070 sf (4.6 acres)	14,680 s.f (0.3 acres)	In Progress, Estimated Completion 2016	Marina construction
12	Sterling Marine Terminal	East Boston	Chelsea River	3.38 acres of Subtidal habitat to construct	None	Presently Seeking Permits;	Dredging of 155,000 cy to construct CAD cell; upland disposal

Figure – 4-11, Key #	Project	City	Location	Subtidal Impacts	Intertidal Impacts	Timeframe	Comments
				CAD cell		Estimated completion 2013-2017	of 21,000 cy; MBDS disposal of 134,000 cy
13	Chelsea Sandcatcher Stabilization	Chelsea	Chelsea River	None	~ 800 sf	Completed	
14	Yard's End Research Center	Charlestown	Mystic River	None	None	Completed	Assumed impacts to adjacent upland areas only
15	Long Island Bridge Abutment Stabilization	Boston	Boston Harbor	550 sf (0.01 acres)	24,000 sf temporary; 2,560 s.f. permanent	Completed	
16	Shipyard Quarters Marina Extension	Charlestown	Inner Harbor	170 sf	None	Completed	Installation of pilings
17	Pier 5, 8th Street	Charlestown	Inner Harbor	26 sf	None		Project Cancelled
18	Global Petroleum	Revere	Chelsea River	75,950 sf	None	Dependent on Obtaining Permits	Dependent on obtaining permits. Approx. 14,000 cy dredged and disposed in a landfill or CAD cell
19	Irving Oil	Revere	Chelsea River	85,706 sf	None	Dependent on Obtaining Permits	Approx. 13,000 cy dredged and disposed in a landfill or CAD cell
20	Spectacle Island Maintenance Dredging	Boston	Boston Outer Harbor	175,000 sf (4 acres)	215,000 sf (4.9 acres)	Completed	Dredging of 16,000 cy and nourishment of beach

Figure – 4-11, Key #	Project	City	Location	Subtidal Impacts	Intertidal Impacts	Timeframe	Comments
21	New South Side Harborwalk	Boston	Inner Harbor	17 sf	None	Completed	22 timber piles
22	Lovejoy Wharf	Boston	Inner Harbor	36,213 sf of wharf	None	Completed	Replacement temporary impacts from pile replacement
23	St. Lawrence Cement/Boston Sand & Gravel, Island End River Dredging	Everett	Island End River; Mystic River	81,950 sf (1.8 acres)	None	Completed	10,867 cy of dredged material
24	Release Abatement	Everett; Chelsea	Island End River; Mystic River	53,856 sf (1.2 acres)	None	In Progress	Remedial dredging of contaminated sediments
25	Old Colony Yacht Club	Boston	Neponset River; Dorchester Bay	80,000 sf (1.8 acres)	None	Completed	15,000 cy of sediment dredged
26	Mill Creek Center	Chelsea	Chelsea River; Mill Creek	None	None	In Progress Planned 2009	8,000 sf of salt marsh (supratidal)
27	Boston Children's Museum Expansion	Boston	Fort Point Channel	None	None	Completed	Impacts only to adjacent upland areas
28	Weymouth Fore River	Weymouth	Fore River	Approx. 91.8 acres (9,000,000 sf) temporary impact	None	Completed	
29	Acushnet Marine	Hull	Hull Bay	3,080 sf	None specified	In Progress	Marina expansion
30	Waveland Marina	Hull	Hull Bay	262 sf	850 sf	Completed	Marina expansion

Figure – 4-11, Key #	Project	City	Location	Subtidal Impacts	Intertidal Impacts	Timeframe	Comments
31	UMass/Savin Hill Cove Dredging	Boston	Dorchester Bay	4.7 acres (204,824 sf)	None	2008 Obtaining permits	Improvement dredging of existing navigation channel
32	M Street Seawall Reconstruction	Boston	Dorchester Bay	None	3 acres (129,200 sf)	Completed	Reconstructed in place.
33	Thompson Island Salt Marsh Restoration Project	Boston	Dorchester Bay	None	Conversion of 5,009 sf of Land Under Salt Pond to Intertidal area	Completed	Additional 395 sf of impact to Coastal Bank
34	Boston Harbor Islands General Management Plan	Boston, Hingham, Hull	Boston Harbor	None known	None known	Ongoing	No specific construction activities identified
35	Parcel E/Liberty Wharf	Boston	Boston Harbor	142 sf	None known	Completed	Remove 450 timber pilings and install 160 new 16” pipe piles to support new buildings and deck structure. No dredging.
36	Logan Runway Safety Areas	Boston	Boston Harbor	1745 SF	Saltmarsh (35,040 sf) and shellfish beds (63,545 sf)	Runway-End 33L Completed 2012, Runway-End 22R, completed by 2015	Total wetland impact 215,320 SF
37	Cottage Park Yacht Club	Winthrop	Winthrop Harbor	4.1 acres	2000 sf of flowed tidelands	Planned 2012	Shellfish classification (dredging area) GBH5.1
38	Winthrop Ferry	Winthrop		5820 sf shaded	-	Completed	EIR not required

Figure – 4-11, Key #	Project	City	Location	Subtidal Impacts	Intertidal Impacts	Timeframe	Comments
	Dock						
39	Georges Island Pier Improvement	Boston	Boston Harbor	425 sf	-	Not Available	70 sf coastal beach
40	Shaughnessy Pier	Quincy	Boston Harbor	2078 sf	540 sf	Planned 2012	1596 sf of EFH and 72 sf coastal beach affected
41	Rock Chapel Marina	Chelsea	Mystic	No Impact	No impact anticipated	Planned 2012	
42	Harbor Towers	Boston	Boston Harbor	1845 sf	1525 sf	Planned 2011	Total Wetland 5250 sf including 1880 sf subject to storm flow
43	Port Norfolk Yacht Club	Boston/Dorchester	Neponset	98,527 sf	No impact anticipated	Planned 2009	15,000 cy to be dredged; placement at MBDS
44	Pappas Way Seawall Rehab	S. Boston	Pappas Way	None expected	30190 sf	Planned 2013	Intertidal Revetment
45	Boston National Park/Ferry	Boston	Boston Harbor	18 SF (steel piles)	No impact anticipated	Planned 2008	Upgrade ABAAS compliant, smaller footprint
46	Boston East	Boston	Boston Harbor	100 SF	19670 SF	Planned 2011	Also 69,650 SF subject to coastal storm flowage
47	New Street Development	Boston	Boston Harbor	Not Available	No impact anticipated (marina at existing wharf)	Planned 2010	2,300 cy of dredged material generated
48	Conley Terminal Expansion	Boston	Boston Harbor	12 – 15 acres	No impact anticipated	Planned 2013	Potential for future dredging of 50,000 cy of new dredged material (Coastal Oil Terminal)

Figure 4-10. All Recent Federal Boston Harbor Dredge Projects Combined

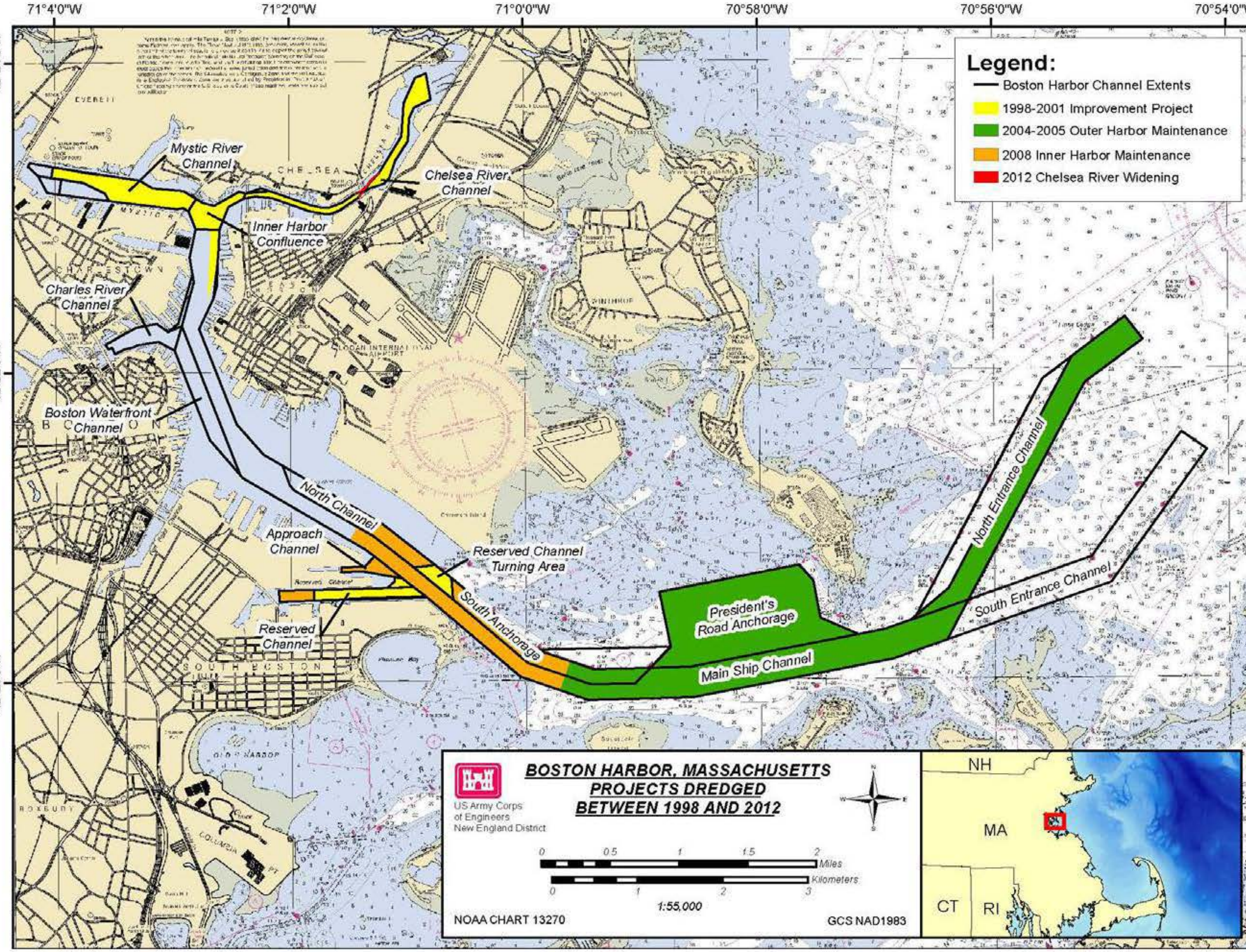
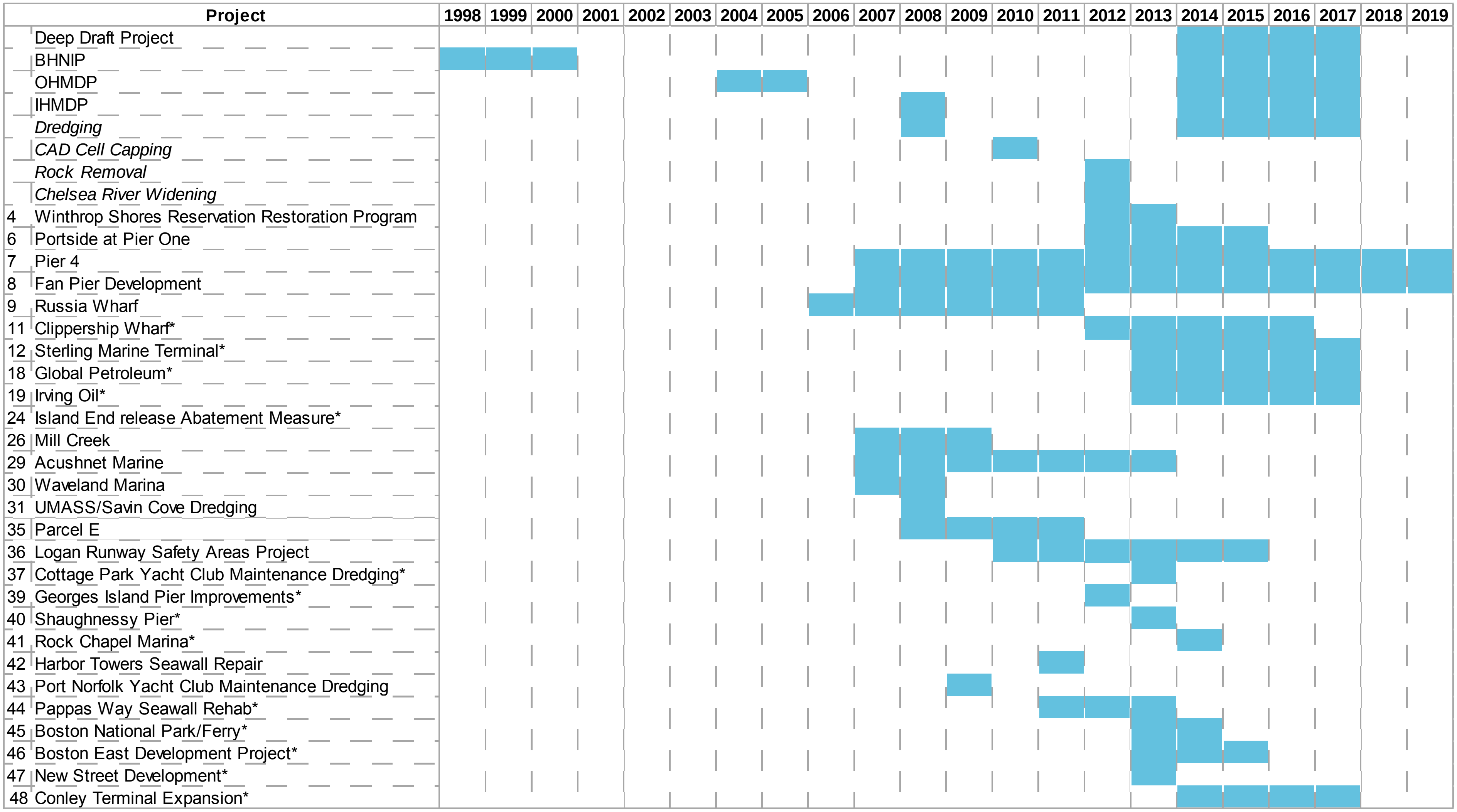


Table 4-18 Cumulative Impacts



* Estimated Schedules; actual completion dates unknown.

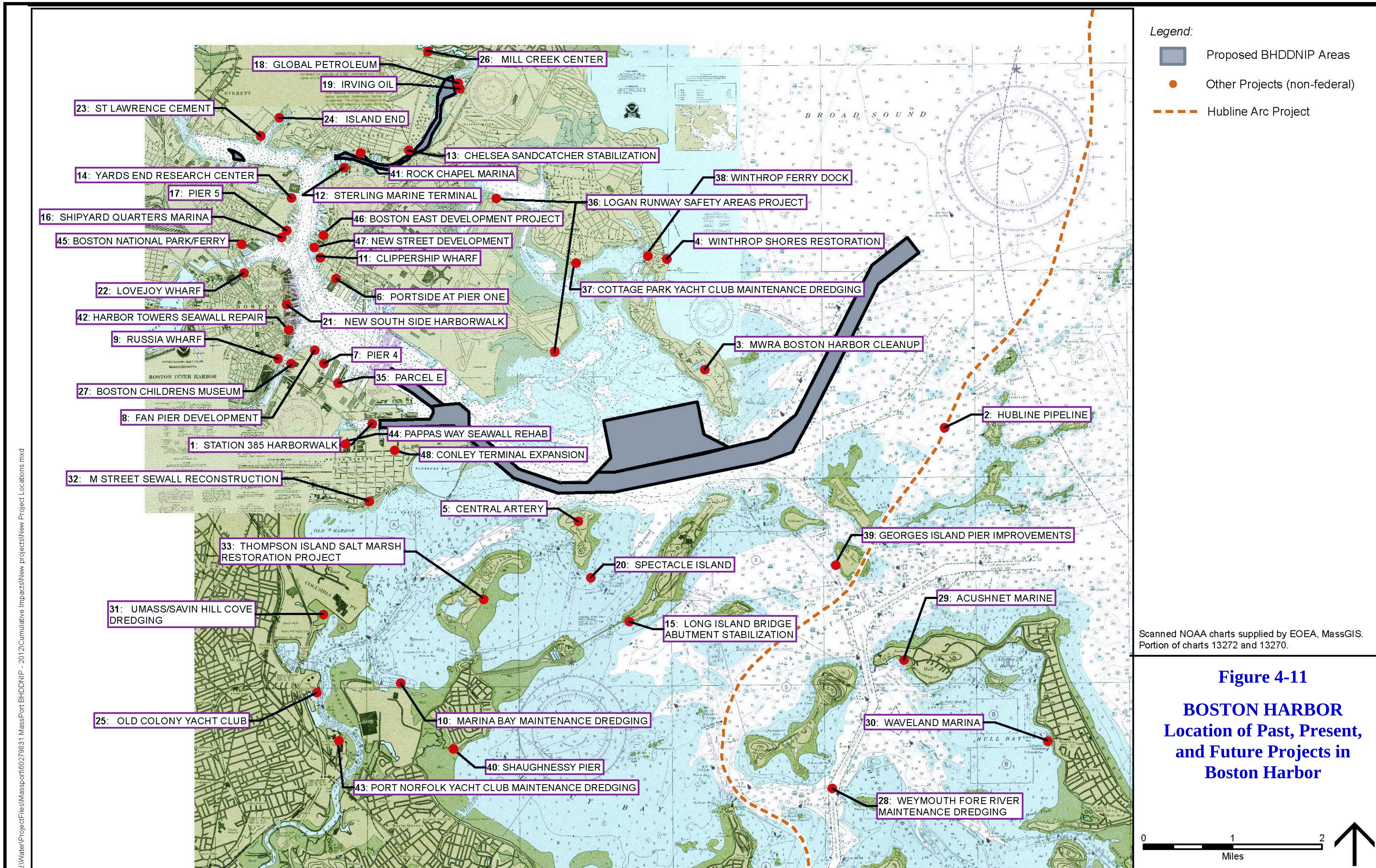


Figure 4-11

BOSTON HARBOR
Location of Past, Present, and Future Projects in Boston Harbor

4.12 Secondary Impacts

The proposed Deep Draft Project alternatives would dredge the Main Ship Channel to a depth greater than the currently authorized depth of -40 feet at mean lower low water (MLLW). This would put Boston Harbor more in line with other U.S. east coast and foreign container ports, which are mostly -48 to -50 feet deep. The Deep Draft Project would allow larger vessels to access the port facilities in an environmentally safer and economically efficient manner, thereby increasing the volume of container cargo loaded and unloaded at Boston Harbor while maintaining existing sailing schedules and port rotations[22].

This section discusses the secondary, or indirect, impacts likely associated with the Deep Draft Project and the related increases in the sizes of ships calling on the Port of Boston. Direct effects are caused by the proposed dredging and occur contemporaneously at or near the location of the action. As defined in NEPA, indirect effects:

> "are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems." (40 CFR 1508.8)

The Port of Boston is well established and has experienced a large volume of ship traffic for many years. Within this context, the Deep Draft Project represents a continuation of navigation channel alterations following numerous historical maintenance and improvement projects. Major maintenance dredging generally occurs at a frequency of 16 to 41 years depending on the harbor area.

The proposed Deep Draft Project would allow a greater percentage of New England cargo to be shipped through the Port of Boston, rather than through the Port of New York and New Jersey (PONYNJ) and moved throughout New England by truck. Shipping a greater percentage of New England cargo through the Port of Boston would reduce the overall volumes of cargo moved by truck over New England roads but would increase vehicle trips in the vicinity of the port and on some roads in the Boston area. These transportation changes would, in turn, affect regional air emissions. Therefore, this secondary impacts analysis focuses on air quality, with supporting shipping and ground transportation data to address the post-construction marine fleet mix and schedules, and new trucking patterns.

To evaluate secondary impacts, a dredging depth of -48 feet (MLLW) was selected for modeling purposes (as the approximate midpoint between the potential Project alternative endpoints of -45 and -50 feet) for comparison to the No Action Alternative. Although the final recommended construction depth is -47 feet, the modeling results are considered valid for this modest difference, particularly since vessels would continue using the tidal advantage at the Port of Boston and the fleet mix associated with a minus 47-foot channel (versus a minus 48-foot channel) would not change appreciably.

4.12.1 Shipping Patterns

The Deep Draft Project would allow larger, deeper-draft vessels to access Boston Harbor port facilities in an environmentally safer and economically-efficient manner and for those vessels to carry more cargo. Table 4-19 summarizes the shipping volumes for the No Action and Post Construction alternatives. The table illustrates the following shifts in the projected container, bulk cargo, and petroleum vessel operations in response to the proposed channel deepening:

[22] David Miller Associates, 2012, Draft Boston Harbor Channel Deepening Project, Containerized Cargo Economic Benefits Analysis.

- Loss of direct Asian container service calls to Boston from the existing condition if the harbor is not deepened.
- Resumption in Asian-Panama service and retention of the Northern Europe and Mediterannean services with deepening to at least 45 feet. No change in the number of container ship calls over existing conditions, but an increase over the No Action Alterantive with the Deep Draft Project, and all three services shift to larger container ships—resulting in a substantial increase in container cargo volume.
- A decrease in the number of bulk cargo shipments with the project, offset by a shift to larger bulk cargo ships—resulting in no substantial change in bulk cargo volume.
- A decrease in the number of petroleum ships, offset by a shift to larger petroleum ships—resulting in no substantial change in bulk cargo volume.

4.12.2 Port Throughput

By allowing larger vessels to access the port facilities in an economically-efficient and environmentally safer manner, the Deep Draft Project may not affect bulk carrier or petroleum vessel traffic, but would increase the volume of container cargo loaded and unloaded at Boston Harbor while maintaining existing sailing schedules and port rotations[23]. Table 4-20 summarizes estimates of daily container shipping volume through Boston Harbor, measured in twenty-foot equivalent units (TEUs), identified in the Containerized Cargo Economics Benefits Analysis[24] for the No Action Alternative and several of the many shipping scenarios discussed in the Economic analysis of containership cargo benefits (Appendix C-1).

Table 4-19. No Action Alternative and Post-Deepening Shipping Operations

Ship Type	Number of Calls per Year	
	No Action Alternative	**Post Construction**
Containership – 4,000 TEUs (Foreign)	52	0
Containership – 5,100 TEUs (Foreign)	52	52
Containership – 6,700 TEUs (Foreign)	0	52
Containership – 8,000 TEUs (Foreign)	0	52
Total Containerships	**104**	**156**
Bulk Carrier - 25,000 DWT (Foreign)	12	0
Bulk Carrier - 40,000 DWT (Foreign)	25	7
Bulk Carrier - 55,000 DWT (Foreign)	0	18
Total Bulk Carriers	**37**	**25**
Petroleum Ship - <20,000 DWT	356	337
Petroleum Ship - 20,000 DWT	0	0
Petroleum Ship - 25,000 DWT	6	0
Petroleum Ship - 35,000 DWT	81	38
Petroleum Ship - >35,000 DWT	77	114
Total Petroleum Ships	**520**	**489**
Total Ships	**713**	**670**

Notes: TEU indicates twenty-foot equivalent unit, a standard measure of container cargo. DWT indicates dead weight tons, a measure of vessel size by displacement.
Source: David Miller Associates, 2012, Boston Harbor Channel Deepening Project, Containerized Cargo Economic Benefits Analysis.

[23] David Miller Associates, 2012, Boston Harbor Channel Deepening Project, Containerized Cargo Economic Benefits Analysis.
[24] David Miller Associates, 2012, Boston Harbor Channel Deepening Project, Containerized Cargo Economic Benefits Analysis.

Table 4-20. Estimated Annual Container Transport Volumes at Conley Terminal under Various Shipping Scenarios

Alternatives	Daily Container Shipping Volume (TEUs)	
	Total	**Increment Over No Action**
Without Project Condition	62,598	-
Base Case	275,261	212,663
	47-foot Deep Project	**Increment Over Base Case**
Base Plus Asia-Suez Service	423,793	361,195
Med Service to 8400 TEU ship	283,048	220,450
Base Plus Second Med Service	314,149	251,551
No Post-Panamax Med Service	267,817	205,219

Source: David Miller Associates, 2012, Boston Harbor Channel Deepening Project, Containerized Cargo Economic Benefits Analysis.

There are several assumptions for each shipping scenario:

- The No Action Alternative assumes that an undeepened Boston Harbor would lose its direct Asian service call via the Panama Canal once both the Canal and the Port of New York and New Jersey have been deepened to their 55 and 50-foot design depths, respective, by 2015;
- The Base Case is the most likely future alternative. The Base Case assumes continuation of the three existing container services currently calling the Port of Boston, but assumes that those services would use larger vessels of up to 8,000 TEUs;
- The four other alternatives presented above include: the base case plus adding a second Asian service via the Suez Canal using an 8,000 TEU vessel, the Base Case plus adding a second Mediterannean service using an 8,400 TEU vessel, the plans case plus a second Medterannean service using a smaller vessel, and the Base Case plus limiting the size of Mediterannean service vessels to 5,100 TEUs (Panamax).

In the Port of Boston, all container cargo is handled at Conley Terminal. Massport has constructed or is planning a number of improvements at Conley Terminal, separate from and unrelated to the Deep Draft Project. These improvements will enhance ground transport to and from the terminal area and storage capacity.

The transportation infrastructure enhancements will include several components:

- A dedicated freight corridor to remove Conley Terminal container truck traffic from East First Street and part of Summer Street;
- A new roadway traversing the Coastal Oil Terminal property, the former Massachusetts Bay Transportation Authority/Department of Conservation and Recreation (MBTA/DCR) property, and the Exelon corporation property; and
- A bridge across the embayment on the Exelon property to join Summer Street.

Added container storage will be established with expansion onto the former Coastal Oil property and will include possible reefer storage, full and empty box storage in stacks served by rubber-tire gantries, and container processing facilities. These improvements potentially would expand ground container storage from about 3,900 TEUs to 6,500 TEUs at Conley Terminal. With these improvements, the terminal capacity will approach 550,000 TEUs annually, an amount that exceeds the total container shipping volumes associated with all project shipping scenarios. Thus, ample landside throughput capacity will exist at the Conley Terminal to process anticipated growth in container cargo volumes.

4.12.3 Ground Transportation

The growth in container volumes at Boston would, in turn, increase trucking operations in the vicinity of the port. As most New England cargo currently is landed in New Jersey and trucked through New England, bringing more cargo to Boston by water would save several million truck-miles annually over New England roads. However, as more cargo would be shipped through the Port of Boston, roads in the immediate vicinity of the Conley Terminal would see an increase in truck traffic. Table 4-21 summarizes estimates of daily truck trips that correlate with projected container shipping volume through Boston Harbor, identified in the Draft Containerized Cargo Economics Benefits Analysis[25]for several shipping scenarios.

Table 4-21. Estimated Daily Container Shipping Volume and Truck Trips for Conley Terminal

Alternatives	Container Shipping Volume (TEUs)		Estimated Truck Trips	
	Total	Increment Over Base Case	Total	Increment Over Base Case
2007 Actual Condition	220,139	-	1,024	
Without Project Condition	62,598	-	291	
Base Case	275,261	212,663	1,280	989
	47-foot Deep Project			
Base Plus Asia-Suez Service	423,793	361,195	1,971	1,680
Med Service to 8400 TEU ship	283,048	220,450	1,317	1,025
Base Plus Second Med Service	314,149	251,551	1,461	1,170
No Post-Panamax Med Service	267,817	205,219	1,246	955

Source: David Miller Associates, 2012, Boston Harbor Channel Deepening Project, Containerized Cargo Economic Benefits Analysis.

Most New England cargo landed at Conley Terminal would be trucked to the nearby Interstate 90 ramps, about one mile west of the terminal, mostly through the industrial seaport area. As indicated earlier, planned improvements at the terminal will enhance ground transport to and from the terminal area by providing a dedicated freight corridor to remove Conley Terminal container truck traffic from East First Street and Summer Street; constructing a new roadway that traverses the Coastal Oil Terminal, former MBTA/DCR, and Exelon Corporation properties; and constructing a bridge across the embayment on the Exelon property to join Summer Street.

Massport is preparing a new strategic plan for the seaport that includes forecasts for the port from 2012 to 2025. The projections will be used, among other purposes, to assess and compare several conceptual transportation scenarios (i.e., truck routes) for moving containers from Conley to the nearby haul road and/or interstate roadways. Although the strategic plan forecast methodology differs somewhat from that employed for this FSEIS/EIR, the ratio of annual TEUs to truck trips per day (i.e., 215) is transferable and has been used to calculate the number of truck trips per day for the Deep Draft Project.

As of this writing, work on the strategic plan is too preliminary to assess the level of service and impact of additional trucks from Conley terminal on intersections along the truck route scenarios. However, it is anticipated that this work will advance in time to inform final design.

[25] David Miller Associates, August 2012, Boston Harbor Channel Deepening Project, Containerized Cargo Economic Benefits Analysis.

4.12.4 Air Quality

Section 4.8 incorporates post-construction estimates of ship traffic emissions that considers the traffic volume, the type, size and age of the ships (the latter especially relevant because newer ships operate more efficiently). The results of air quality modeling presented in Section 4.8.3 indicates that the Deep Draft Project would decrease pollutant emissions in the New England region due to changes in fleet mix (i.e., fewer but larger ships), reduced anchoring activities, reduced transit time for ships moving in and out of the harbor, and reduced truck traffic transporting goods from the PONYNJ to New England. The regional decrease would be only slightly offset by a small increase in vehicle emissions from cargo trucking transporting goods from Boston Harbor.

The No Action Alternative and Deep Draft Project (Post-Construction) container, cargo and petroleum vessel scheduling, ship traffic volume, fleet mix and associated trucking operations were obtained from the Draft Containerized Cargo Economics Benefits Analysis[26]. The shipping and trucking operations data were used to estimate indirect emissions for both scenarios. It was assumed that routine shipping operations would be the same under Alternatives 1 and 2 during dredging activities.

Annual emissions (tons/year) were calculated based on changes in sizes of ships (i.e., smaller to larger vessels), changes in ship mode operations (i.e., anchoring, cruising and hoteling) and the number of ship calls per year. The net reductions in trucking emissions for the project were also calculated using MOBILE6.2 emissions model. The emissions were summed for each vessel type to calculate the annual emissions. Detailed air quality modeling information related to shipping and trucking is provided in Section 4.8.

Based on the modeling results, the Deep Draft Project would reduce annual NOx, CO, and VOC emissions by 71, 28, and 17 tons, respectively. The reductions in pollutant emissions are primarily due to changes in fleet mix for all shipping operations (i.e., fewer, but larger ships), no anchoring activities for petroleum ships, reduced time for ships to move in and out of the harbor, and reduced truck traffic transporting goods from the PONYNJ to New England. However, the cargo trucking miles in Massachusetts would increase by 766,276 miles under the project (Post-Construction) shipping operations due to increased truck volumes departing from Conley Terminal. The estimated NOx, CO, and VOC emissions from cargo trucking would increase by 1.91, 0.51, and 0.24 tons, respectively, in the project area. However, these small increases in pollutant emissions would be more than offset by the emissions reductions estimated for the changes in shipping activities associated with the project.

The net secondary emissions are presented in Table 4-22, comparing the No Action Alternative and Project scenarios. Overall, the project would provide a net benefit to long-term regional air quality, as well as significant savings in cost, time, and fuel from shipping New England cargo through Boston rather than the PONYNJ.

[26] David Miller Associates, August 2012, Boston Harbor Channel Deepening Project, Containerized Cargo Economic Benefits Analysis.

Table 4-22. Shipping and Trucking Operations - Summary of Indirect Emissions

Pollutant	No Action Alternative (tons)	Project, Post-Construction (tons)	Net Change (tons)	Net Change (%)
$PM_{10}/PM_{2.5}$	96	91	-5	-5.2
SO_2	248	247	-0.6	-0.2
NO_x	634	563	-71	-11.2
CO	377	349	-28	-7.3
VOC	231	214	-17	-7.5

Notes:
1. Indirect emissions without the project are associated with projected shipping operations in 2016 and beyond. It is assumed that the shipping operations would be constant during the dredging years.
2. Indirect emissions with the project are associated with projected shipping operations one year after the dredging operations are completed. It is anticipated that there would be no overlap of indirect and direct emissions at the end of the project.
3. With-Project emissions include emissions reductions associated with the projected reduction of truck traffic from the Port of New York/New Jersey.

Source: David Miller Associates, Draft Boston Harbor Channel Deepening Project, Containerized Cargo Economic Benefits Analysis, 2012.

4.13 Mitigation

Mitigation will be included in the design of the Deep Draft Project. Best management practices will be utilized to reduce or eliminate impacts from dredging, blasting, and disposal of dredged material on air quality, natural resources, as well as social impacts. In particular, mitigation will be provided for any exceedances of air quality thresholds, for identifiable silty shoal material, for blasting impacts, for reduction of potential barge collisions with whales (in particular right whales), and for notification to lobstermen in Boston Harbor of dredge movements. Additional details are provided in the paragraphs below. The mitigation plan does not include mitigation for temporary impacts such as the temporary loss of benthic habitat, or temporary displacement of lobsters. No impacts to vegetated wetlands or the littoral zone are expected. Additional mitigation may be required based on the results of the investigations conducted in the Design Phase of the project. Supplemental information on these investigations may be found in Section 6.4 below and in Appendix A - Response to General Topics.

It was originally anticipated that two to three large mechanical dredges (bucket or clamshell) would be employed on the job, around the clock and year-round for the period of construction. At the conclusion of the air quality analysis it was determined that use of a third dredge would increase annual emissions beyond the level that could be reasonably addressed through biannual construction shutdowns. The final plan is based on two dredges working 24/7 except during the air quality shutdown periods which will occur every other winter as described in the air quality section above. In addition the construction equipment would use the latest efficient engines to further reduce air emissions. The purchase of emission credits will also be investigated as mitigation for air impact in the event that is required. A determination will be made as to the viability of emission credits for this project during the Design Phase.

Since 2008, Boston Harbor's Federal navigation channels have completed a major maintenance cycle. The areas maintained include all the areas now under consideration in this improvement project for deepening, except for the 35-foot deep section of Mystic River navigation channel proposed to be deepened. However, some silty shoal material may remain in the maintenance horizon overlying the parent material to be removed by the improvement project. The cores taken during the subsurface characterization program during design will determine if any significant shoal material remains in the improvement areas. If areas of shoal material are identified that can be removed separately (thickness of greater than two feet) then a closed bucket will be used for the silty shoal material to reduce turbidity impacts and no scow overflow will be allowed. This will minimize potential impacts to finfish or shellfish and their habitat.

Rock removal during the 1998-2001 improvement dredging of the Reserved Channel, Turning Basin, Inner Confluence and Mystic River was accomplished by ripping the bedrock with a large toothed bucket mounted on a heavy excavator. Only the granite ledge in the upper Chelsea River required blasting for removal under that project. However, until the conclusion of the subsurface exploration program included in the design phase of this project, it cannot be determined whether the large volumes of rock required to be removed will lend itself to ripping or removal by other means such as a rock hammer. It may be that the rock cuts from the last improvement project were from zones that were more heavily weathered and fractured thus lending themselves to removal by ripping, and that the rock encountered in this improvement will be different in character. Rock cuts of more than five feet were made by ripping in most areas of the 1998-2001 work without difficulty.

No blasting will occur when schools of fish, sea turtles or mammals are observed in the vicinity of the blasting, as determined by the fisheries, sea turtle, and marine mammal observer unless required due to human safety considerations. To reduce fish mortality, all blasting will be conducted using inserted delays of a fraction of a second per hole and stemming shall be rock or similar material placed into the top of the borehole to deaden the shock wave reaching the water column. Methods employed during prior projects to reduce the potential for fish kills involved the use of a side scan sonar to detect and avoid blasting during times when passing fish were present in the immediate project area, a fish startle system to deter fish of the Clupeid family (i.e. blueback herring and alewife) from entering the blast area, and a fish observer to oversee and determine the appropriate blasting times.

Following the first event, the USACE immediately met with the blast contractors and designated fish observer to determine the likely causes of the event and to identify potential corrective measures for future blasting activities. Resource agencies were also notified of the event and briefed on initial corrective actions before blasting was resumed. Despite these measures, subsequent fish kills occurred. In response to these unexpected events, the USACE prepared an “After Action Report” (Appendix Y) to provide information on all of the blasting events and to document any lessons learned. Lessons learned from this project were applied to the Boston Harbor Rock Removal Project which resulted in no observed fish kills during the course of the project. The results from this project and the “After Action Report” will provide the basis for convening an interagency underwater blasting technical working group with Federal and State resources agencies. The goal of the working group is to determine potential mitigation measures that may be practicable to minimize potential fish impacts during blasting for the Deep Draft Project. The blasting working group will focus on practicable ways to minimize impacts during construction of the proposed Deep Draft Project. These measures may include construction sequencing for several areas of the harbor, constraints on work during certain tidal and weather conditions, and time of year restrictions if practicable. The goals of the working group discussions will be to identify practicable and implementable measures to be enacted during project operations to minimize the potential for impact.

A hydrophone was placed in the water during three blast events for the Boston Harbor Rock Removal Project constructed in 2012. The purpose of the hydrophone was to collect sound pressure (waves) from actual blasting events in order to determine a safety zone for protected species such as whales, sea turtles, and the Atlantic sturgeon. More details on this monitoring effort can be found in Section 4.2.5.

A Public Notice will be issued at the initiation of the Deep Draft Project to provide mariners and lobstermen notice of the project so that equipment may be moved out of the navigation channels being dredged. In addition the barge and scow will be required to use a short-tow line to minimize dragging which can damage lobster pots that are in the project area.

Between February 1 and May 31, whale observers will be on board scows transiting to the MBDS/IWS to avoid potential ship strikes with the endangered northern right whales, or other marine mammals and sea turtles. Dredge contractors would also be required to monitor the right whale listening buoys for right whale status in the shipping lanes.

During the forthcoming Design Phase of the project, additional investigations may be conducted based on comments received during the Draft Feasibility and Draft SEIS/EIR. See Section 6.4 below for more information on the proposed investigations. If as a result of the above investigations it is determined that additional mitigation is required beyond what has already been identified in the SEIS/EIR, then additional Federal and/or Sponsor funding would be sought to cover those costs as part of the project. It is anticipated that those issues would be addressed in additional NEPA and/or MEPA filings if needed.

5. AGENCY COORDINATION AND COMPLIANCE

5.1 Cooperating Agency Request

The National Environmental Policy Act (NEPA) and the Massachusetts Environmental Policy Act (MEPA) both encourage early agency cooperation. A Federal agency which has jurisdiction by law shall be a cooperating agency upon request of the lead agency (the USACE in this instance). In addition, any other Federal agency which has special expertise on environmental issues, which should be addressed in the SEIS/EIR, may also be a cooperating agency upon request of the lead agency. Where appropriate, the lead agency should also seek the cooperation of the State or local agencies of similar qualifications. Cooperating agencies shall participate in the NEPA process at the earliest possible time, participate in scoping meetings, help prepare information or environmental analyses which the cooperating agency has expertise, and provide staff support as requested by the lead agency (USACE) to enhance interdisciplinary capability. Cooperating Federal agencies that have jurisdiction by law or special expertise include the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, NOAA-Fisheries, and the U.S. Coast Guard. The Massachusetts Executive Office of Energy and Environmental Affairs, and the environmental agencies it oversees, and the Wampanoag Tribe of Gay Head (Aquinnah) also have jurisdiction by law or special expertise that is relevant to the proposed project. A letter requesting cooperating agency participation was sent by the USACE to the four Federal agencies, the lead State Environmental agency, and Indian tribe on April 11 and 18, 2003.

All four Federal agencies agreed to participate as cooperating agencies on this Supplemental EIS/EIR. The Massachusetts Office of Coastal Zone Management agreed to represent the State environmental agencies in the development of the SEIS/EIR. See Appendix A for a copy of the correspondence. No response was received from the Wampanoag Tribe of Gay Head (Aquinnah).

5.2 Threatened and Endangered Species Consultation

The U.S. Fish and Wildlife Service responded that no Federally-listed or proposed, threatened or endangered species or critical habitat under their jurisdiction are known to occur in the project areas(s) and no further consultation was necessary (letter dated March 2, 2005). No response was received from the U.S. Fish and Wildlife to our letter dated October 11, 2012 requesting any updates since 2008. The Massachusetts Division of Fisheries & Wildlife, Natural Heritage and Endangered Species Program (NHESP) stated that they did not have any concerns about State protected rare species in the project area (letter dated May 31, 2005). NOAA Fisheries initially determined that no further consultation pursuant to Section 7 of the Federal Endangered Species Act (ESA) was required if restrictions outlined in a letter dated August 29, 1997 under separate Section 7 consultation between the USACE and National Marine Fisheries Service (NMFS) on the use of the Massachusetts Bay Disposal Site (MBDS) was adhered to for disposal operations (letter dated September 6, 2005). However, based on an understanding that the amount of dredged material would increase and that blasting would occur during project construction, NMFS requested reinitiation of Section 7 consultation. The USACE provided a letter with analysis of the impact area from blasting and additional dredged material. The USACE concluded in a letter dated June 30, 2008 that the Boston Harbor Deep Draft Project is unlikely to adversely affect listed species. Since that time the Gulf of Maine DPS of Atlantic sturgeon (as well as four other Atlantic sturgeon DPSs) have been listed under the Federal Endangered Species Act as either threatened or endangered. Therefore consultation was reinitiated under Section 7 of the Endangered Species Act for the effects of the proposed project (specifically rock removal by blasting) on Federally listed whales, sea turtles and Atlantic sturgeon. A letter with was submitted to NMFS on November 7, 2012 that included an analysis of the effects of blasting on listed species based on updated blasting data and species information, requesting concurrence that the Boston Harbor Deep Draft Project is unlikely to adversely affect Federally listed whales, sea turtles and Atlantic sturgeon. A response was received on November 27, 2012 from

NOAA Fisheries, concurring with the USACE determination that the Boston Harbor Deep Draft Project is not likely to adversely affect listed species (See Appendix A).

5.3 Essential Fish Habitat Consultation

The 1996 amendments to the Magnuson-Stevens Fishery Conservation Management Act strengthen the ability of the National Marine Fisheries Service and the New England Fishery Management Council to protect and conserve the habitat of marine, estuarine, and anadromous finfish, mollusks, and crustaceans. This habitat is termed "essential fish habitat (EFH)" and is broadly defined to include "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Managed species listed for the 10' x 10' square of latitude and longitude for Boston Harbor are: Atlantic cod, haddock, pollock, whiting, red hake, white hake, winter flounder, yellowtail flounder, windowpane flounder, American plaice, ocean pout, Atlantic halibut, Atlantic sea scallop, Atlantic sea herring, long finned squid, short finned squid, Atlantic butterfish, Atlantic mackerel, summer flounder, scup, black sea bass, surf clam, and bluefin tuna. See Section 3.3.5. Except for redfish, monkfish, and spiny dogfish, the same species are listed for the habitat enhancement sites as the Boston Harbor species. The same species are listed for the 10' x 10' square of latitude and longitude which includes the MBDS, except for pollock, summer flounder, scup, black sea bass, and surf clam. See Section 3.3.5. Species listed in the MBDS square that are not listed for Boston Harbor include redfish, witch flounder, and monkfish.

Appendix T lists the managed species and their appropriate life stage history for the designated 10' x 10' EFH squares that include Boston Harbor, the habitat enhancement sites, and the Massachusetts Bay Disposal Site, including the Industrial Waste Site.

The only managed EFH species that may be expected to occur in the dredge area (Boston Harbor) are the: pollock (juveniles), red hake (eggs and larvae), white hake (all life stages), winter flounder (all life stages), windowpane flounder (all life stages), long finned squid (pre-recruits and recruits), short finned squid (pre-recruits and recruits) Atlantic mackerel (eggs, juveniles, and adults), summer flounder (adults), scup (juveniles and adults). The remaining species or life stages are not expected to occur in Boston Harbor due to either incorrect water depths or substrate type.

The only managed EFH species that may be expected at the MBDS, and IWS, are the: pollock (eggs and larvae), whiting (all life stages), red hake (larvae, adults, and spawning adults), white hake (all life stages), redfish (all life stages), witch flounder (all life stages), American plaice (larvae, juveniles and adults), ocean pout (adults), Atlantic halibut (eggs and spawning adults), Atlantic sea scallop (eggs), Atlantic sea herring (juveniles and adults), monkfish (eggs, larvae, juveniles, and adults), long finned squid (both life stages), short finned squid (both life stages), Atlantic mackerel (all life stages), summer flounder (adults), scup (juveniles and adults), and bluefin tuna (juveniles and subadults). The remaining species or life stages are not expected to occur at the MBDS because of improper depths or substrate type, or are not an abundant species.

Due to the various depths, substrate types and locations, managed EFH species and the various life stages may be expected to occur at the habitat enhancement sites. With the addition of rock to the potential habitat enhancement sites, it is expected that several EFH species would benefit from the cover and protection provided by the structure. Several EFH species (and their life stages) that could benefit from the addition of rock habitat, including cobble and gravel are: Atlantic cod (juveniles and adults), pollock (juveniles and adults), whiting (juveniles and adults), redfish (juveniles and adults), winter flounder (eggs and adults), ocean pout (eggs, larvae, juveniles, and adults), Atlantic halibut (juvenile), Atlantic sea herring (adults), black sea bass (juveniles and adults).

Although dredging and disposal are expected to occur intermittently for approximately three to five years due to the large amount of material to be dredged, based on lessons learned from the BHNIP and the limited areas of activity, overall impacts to EFH and associated managed species are expected to be temporary and insignificant. As mentioned above, turbidity studies conducted in Boston Harbor showed that the silt from the inner portions of Boston Harbor did not travel far from the point of dredging.

The most vulnerable life stages, such as the eggs and larvae, would be the most affected by direct and indirect dredging and disposal activities. Direct impacts include removal by dredging or burial by disposal, and indirect impacts from entrainment in the dredge and disposal plume. While some mortality of eggs and larvae may be expected, the SSFATE plume model does not show a measurable amount of deposit on potential winter flounder spawning habitat in Winthrop Harbor and Logan flats. Juveniles and adults are expected to be able to escape direct impact from dredging and disposal activities and indirect impacts such as turbidity and loss of food. Benthic animals are expected to begin recolonization the area rapidly, depending on the time of year the construction activities occur.

NMFS provided specific EFH conservation recommendations in a letter dated November 26, 2012. The USACE responded to their EFH conservation recommendations in a letter dated December 5, 2012. Some of the information requested by NMFS such as blasting mitigation measures, a sequencing plan for dredging activities, and, alternative beneficial reuse options (i.e. for the rock) will be developed in the Design Phase.

5.4 Coastal Zone Management Consistency Determination

The Coastal Zone Management (CZM) Act of 1972 established a national program to "preserve, protect, develop, and where possible, to restore or enhance, the resources of the Nation's coastal zone for this and succeeding generations" and to "encourage and assist the states to exercise effectively their responsibilities in the coastal zone through the development and implementation of management programs to achieve wise use of the land and water resources of the coastal zone..." (16 U.S.C. 1452, Sec. 303 (1) and (2)). Section 307 (c)(3)(A) of the CZMA provides that "...any applicant for a required Federal license or permit to conduct an activity, in or outside the coastal zone, affecting any land or water use or natural resource of the coastal zone of that state shall provide...a certification that the proposed activity complies with the enforceable policies of the state's approved program and that such activity will be conducted in a manner consistent with the program." Similar requirements are included for activities conducted by or funded by a Federal agency.

A Federal Consistency Determination was sent to the Massachusetts Office of Coastal Zone Management for concurrence that the proposed Deep Draft Project is consistent to the maximum extent practicable with the CZM policies of the Commonwealth of Massachusetts. CZM consistency concurrence was received from the Commonwealth of Massachusetts in a letter dated November 29, 2012. The policies that are applicable to the proposed dredging project and the project’s consistency with those policies are as follows:

Water Quality Policy #1. – Ensure that point-source discharges in or affecting the coastal zone are consistent with federally approved state effluent limitations and water quality standards. *The material proposed for dredging is parent material, not associated with contaminants. Any future associated maintenance dredging will be tested for contaminants. Also the dredged material is composed of Boston blue clay and glacial till material, not likely to produce a large sediment plume. The disposal of rock in one of the identified habitat enhancement sites would not create any water quality violations. Only minimal amounts of sediment would adhere to the rock which would be washed away as the rock falls through the water column. Any turbidity created should dissipate rapidly. The material would not be a carrier of contaminants as the rock is surrounded by material suitable for ocean disposal.*

Habitat Policy #1. **-** Protect coastal resource areas including salt marshes, shellfish beds, dunes, beaches, barrier beaches, salt ponds, eelgrass beds, and fresh water wetlands for their important role as natural habitats. *These resources are outside the zone of influence from the project or the resource* *occurs in limited amounts. Rock removed from the navigation channel is under consideration to be disposed at a beneficial use site to create hard bottom habitat.*

Coastal Hazards Policy #1. – Preserve, protect, restore and enhance the beneficial functions of storm damage prevention and flood control provided by natural coastal landforms, such as dunes, beaches, barrier beaches, coastal banks, land subject to coastal storm flowage, salt marshes and land under the ocean. *Deepening a portion of the Boston Harbor navigation channels would result in a very minor increase in land under the ocean. No significant change in the beneficial function of the land under the ocean is expected from the proposed project.*

Coastal Hazards Policy #2. **-** Ensure construction in water bodies and contiguous land areas will minimize interference with water circulation and sediment transport. *The proposed dredging activities will not interfere with water circulation in Boston Harbor. No permanent structures are proposed in the body of water. Proposed dredging may result in slight increases in water circulation.*

Coastal Hazards Policy #3. **-** Ensure that state and Federally funded public works projects proposed for location in the coastal zone will not exacerbate existing hazards or damage natural buffers or other natural resources and will not promote growth and development in hazard-prone or buffer areas. *The proposed dredging will improve navigation in Boston Harbor by deepening the navigation channels and berths to accommodate deeper draft ships expected to be added to the fleet to utilize the deeper and wider Panama Canal. The project area is in area of marine commerce and is located in or adjacent to the State's Designated Port Area. Therefore the project is consistent with the State's policy of promoting marine development in Designated Port Areas. The proposed Deep Draft Project will remove ledge that could create a navigation hazard if not removed during deepening of the navigation channels. The proposed project is not expected to have long-term significant adverse damage to natural resources or promote growth and development in hazard-prone or buffer areas.*

Ports Policy #1. **-** Ensure that dredging and disposal of dredged material minimize adverse effects on water quality, physical processes, marine productivity, and public health. *The material proposed for dredging is parent material, not associated with contaminants. Also the dredged material is composed of Boston blue clay and glacial till material, not likely to produce a large sediment plume. In addition, if feasible, rock removed during construction would be used to enhance biological productivity by increasing hard bottom habitat for marine species that favor rock habitat. Any adverse impacts will be localized and temporary. Therefore, the proposed project is not likely to have a significant long-term impact on water quality, physical processes, or public health, and could benefit marine productivity.*

Ports Policy #2. **-** Obtain the widest possible public benefit from channel dredging, ensuring that designated ports and developed harbors are given highest priority in the allocation of federal and state dredging funds. Ensure that this dredging is consistent with marine environmental policies. *The proposed improvement dredging is located in the Port of Boston, the largest port in New England. The proposed project would continue to promote commercial navigation in Boston Harbor by allowing larger ships to transit the port more efficiently to load and unload goods.*

Ports Policy #3. **-** Preserve and enhance the capacity of Designated Port Areas (DPAs) to accommodate water-dependent industrial uses, and prevent the exclusion of such uses from tidelands and any other DPA lands over which a state agency exerts control by virtue of ownership, regulatory authority, or other legal jurisdiction. *Portions of the Port of Boston are in a DPA. Deeping Boston Harbor will enhance the safety of deep draft vessels transiting to these marine terminals in the DPA. This will accommodate and further promote water-dependent industrial uses.*

5.5 Environmental Compliance

This section describes the Federal laws, regulations and programs that are relevant to the dredging and disposal of improvement material from the Boston Harbor Federal navigation channels and berth areas.

Federal Statutes

1. Preservation of Historic and Archeological Data Act of 1974, as amended, 16 U.S.C. 469 et seq.

Compliance: Not applicable; project is not expected to require mitigation of historic or archaeological resources.

2. Clean Air Act, as amended, 42 U.S.C. 7401 et seq.

Compliance: The "general conformity" requirements of Section 17(c)(1) of the Clean Air Act, 42 U.S.C. 7506(x)(1), will be adhered to by limiting construction and using "clean" equipment to avoid exceeding air quality standards or by purchasing emission credits.

3. Clean Water Act of 1977 (Federal Water Pollution Control Act Amendments of 1972) 33 U.S.C. 1251 et seq.

Compliance: Under Section 401 of the Clean Water Act, any Federal activity that will result in a discharge to waters or wetlands subject to Federal jurisdiction is required to obtain a State Water Quality Certification (WQC) to ensure compliance with State water quality standards. An application will be filed with the Commonwealth of Massachusetts for a WQC pursuant to Section 401 of the Clean Water Act for the disposal of dredged material into CAD cells within Boston Harbor and/or disposal of rock for habitat enhancement.

Section 404 of the Clean Water Act governs the disposal of fill, including dredged material into waters of the United States within the three mile territorial sea. This applies to discharges landward of the baseline of the territorial sea and in instances seaward of the baseline when the intent is to fill or nourish beaches. A draft Section 404(b)(1) Evaluation and Compliance Review has been prepared for the possible disposal of rock within potential habitat enhancement sites, and potential disposal of silty maintenance material into a CAD cell(s).

4. Coastal Zone Management Act of 1972, as amended, 16 U.S.C. 1451 et seq.

Compliance: The U.S. Army Corps of Engineers completed a Federal consistency determination pursuant to Section 307 of the Coastal Zone Management Act that determined the proposed project is consistent to the maximum extent possible with the MA Office of Coastal Zone Management program. A summary of that determination is provided in Section 5.4, above. Concurrence of the CZM consistency determination was received in a letter dated November 29, 2012.

5. Endangered Species Act of 1973, as amended, 16 U.S.C. 1531 et seq.

Compliance: Coordination with the U.S. Fish and Wildlife Service (FWS) and/or NOAA Fisheries has yielded no formal consultation requirements pursuant to Section 7 of the Endangered Species Act (see letters dated March 2, 2005 and September 6, 2005). Informal consultation under Section 7 of the Endangered Species Act for listed whales, sea turtles and Atlantic sturgeon was initiated with NOAA Fisheries on November 7, 2012. NOAA Fisheries concurred that the proposed action is not likely to adversely affect listed species (See letters dated November 7, 2012 and November 27, 2012). Section 7 consultation has been completed.

6. Estuarine Areas Act, 16 U.S.C. 1221 et seq.

Compliance: The Chief of Engineers Report will beg submitted to Congress.

7. Federal Water Project Recreation Act, as amended, 16 U.S.C. 4601-12 et seq.

Compliance: Public notice of availability of this report to the National Park Service (NPS) and Office of Statewide Planning relative to the Federal and State comprehensive outdoor recreation plans signifies compliance with this Act.

8. Fish and Wildlife Coordination Act, as amended, 16 U.S.C. 661 et seq.

Compliance: Coordination with the U.S. FWS, NOAA Fisheries, and Massachusetts Department of Marine Fisheries signifies compliance with the Fish and Wildlife Coordination Act. See Section 7.0 above and Appendix A.

9. Land and Water Conservation Fund Act of 1965, as amended, 16 U.S.C. 4601-4 et seq.

Compliance: Public notice of the availability of this report to the National Park Service (NPS) and the Office of Statewide Planning relative to the Federal and State comprehensive outdoor recreation plans signifies compliance with this Act.

10. Marine Protection, Research, and Sanctuaries Act of 1971, as amended, 33 U.S.C. 1401 et seq.

Compliance: Applicable; project involves the transportation or disposal of dredged material in ocean waters pursuant to Sections 102 and 103 of the Act, respectively. No disposal of materials at the MBDS and/or IWS will occur unless it meets the requirements of MPRSA.

11. National Historic Preservation Act of 1966, as amended, 16 U.S.C. 470 et seq.

Compliance: Coordination with the State Historic Preservation Office is ongoing.

12. National Environmental Policy Act of 1969, as amended, 42 U.S.C 4321 et seq.

Compliance: Preparation of this Supplemental Environmental Impact Statement signifies partial compliance with NEPA. Full compliance shall be noted at the time the Record of Decision is issued.

13. Rivers and Harbors Act of 1899, as amended, 33 U.S.C. 401 et seq.

Compliance: This report will be sent to Congress for approval.

14. Watershed Protection and Flood Prevention Act as amended, 16 U.S.C 1001 et seq.

Compliance: Not applicable, project area is not a watershed protection or flood prevention act area.

15. Wild and Scenic Rivers Act, as amended, 16 U.S.C 1271 et seq.

Compliance: Not applicable, project area is not a Wild or Scenic River.

16. Magnuson-Stevens Act, as amended, 16 U.S.C. 1801 et seq.

Compliance: Coordination with the NOAA Fisheries and preparation of an Essential Fish Habitat (EFH) Assessment signifies partial compliance with the EFH provisions of the Magnuson-Stevens Act. A response to EFH conservation recommendations in a letter dated December 10, 2012 completes EFH compliance. See Section 5.3 above and Appendix A.

Executive Orders

1. Executive Order 11593, Protection and Enhancement of the Cultural Environment, 13 May 1971.

Compliance: Coordination with the State Historic Preservation Officer signifies compliance.

2. Executive Order 11988, Floodplain Management, 24 May 1977 amended by Executive Order 12148, 20 July 1979.

Compliance: Not applicable; project is not located within a floodplain.

3. Executive Order 11990, Protection of Wetlands, 24 May 1977.

Compliance: Not applicable; project does not involve nor impact Federal wetlands.

4. Executive Order 12114, Environmental Effects Abroad of Major Federal Actions, 4 January 1979.

Compliance: Not applicable; project is located within the United States.

5. Executive Order 12898, Environmental Justice, 11 February 1994.

Compliance: Not applicable; project is not expected to have a significant impact on minority or low income population, or any other population in the United States.

6. Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks, 21 April 1997.

Compliance: Not applicable; the project would not create a disproportionate environmental health or safety risk for children.

7. Executive Order 13175, Consultation and Coordination with Indian Tribal Governments, 6 November 2000.

Compliance: Consultation with Indian Tribal Governments, where applicable, and consistent with executive memoranda, DoD Indian policy, and USACE Tribal Policy Principals signifies compliance.

Executive Memorandum

1. Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing NEPA, 11 August 1980.

Compliance: Not applicable; project does not involve or impact agricultural lands.

2. White House Memorandum, Government-to-Government Relations with Indian Tribes, 29 April 1994.

Compliance: Consultation with Federally Recognized Indian Tribes, where appropriate, signifies compliance.

6. PUBLIC INVOLVEMENT

6.1 Federal Register

A Notice of Intent (NOI) to prepare a Supplemental Environmental Impact Statement (SEIS) was published in the Federal Register on August 23, 2002. The NOI notifies the public that an EIS will be prepared and allows the public to ask questions about the proposed action. Interested individuals can also be placed on mailing lists for potential meetings and future publications of the SEIS/EIR.

The public was invited to a meeting hosted by Massport on September 5, 2002 at the Black Falcon Cruise Ship Terminal in South Boston, MA. The purpose of the meeting was to provide an opportunity for the public to identify issues pertinent to the proposed project. Topics raised during the meeting included the location of disposal of dredged material for the navigation improvement project, the effect on lobsters, improvements in shore side infrastructure related to the project, the timeline for channel deepening, and cumulative impacts.

Consistent with the goals of NEPA and MEPA to reduce duplication between NEPA and comparable State requirements, the Draft and Final SEIS and State Environmental Impact Reports (EIR) are prepared as a joint Federal/State document. The SEIS and EIR will share comment periods and associated public review opportunities to the maximum extent practicable. A minimum 45-day public comment is provided once a Notice of Availability of the Draft SEIS/EIR is published in the Federal Register. A public meeting was held May 20, 2008 during the public comment period for the Draft SEIS/EIR to describe the project, answer questions, and receive comments. This Final SEIS/EIR has been prepared in response to comments received on the Draft SEIS/EIR. The USACE will prepare a Record of Decision for publication in the Federal Register not sooner than 30 days after the public release of the Final SEIS/EIR.

6.2 MEPA Certificate

The Massachusetts Secretary of Environmental Affairs determined that an Environmental Impact Report (EIR) would be required for this project pursuant to the Massachusetts Environmental Policy Act (MEPA) in the Secretary's Certificate dated March 10, 2003 (EOEA number 12958). MEPA requires that State agencies (i.e., Massport, as the local sponsor) study the environmental consequences of their actions, including permitting and financial assistance. It also requires them to take all feasible measures to avoid, minimize, and mitigate damage to the environment. MEPA further requires that State agencies "use all practicable means and measures to minimize damage to the environment, " by studying alternatives to the proposed project, and developing enforceable mitigation commitments, which will be become permit conditions for the project, if and when it is permitted.

To avoid duplication with the requirement to prepare a SEIS, this document combines the requirements of NEPA and MEPA. Issues not covered by NEPA are the responsibility of the local sponsor, Massport.

The scope in the Secretary's Certificate identified the issues to be addressed in the EIR. Scope items include describing this proposed project with the previous improvement and maintenance dredging projects in Boston Harbor and the responsible parties; environmental impacts to biological, archaeological resources, threatened and endangered species, noise and odor; cumulative and secondary impacts, coordination with other harbor utility and infrastructure owners, and mitigation. These scope comments have been addressed in the appropriate sections of this SEIS/EIR. Appendix P contains a copy of the Secretary's ENF Certificate, comment letters on the ENF and a copy of the June 13, 2008 Secretary's Certificate on the Draft SEIS/EIR, and responses to all EIR comments. On December 12 2012, the Secretary of the Executive Office of Energy and Environmental Affairs confirmed that the 2008 scope for the Final EIR remained appropriate for the revised project program (see Appendix A).

6.3 Technical Working Group

As with the Boston Harbor Navigation Improvement Project (BHNIP), a Technical Working Group (TWG) was established to assist in the planning and review of the SEIS/EIR for this deep draft navigation improvement dredging project, the SEIS/NPC for the Boston Harbor Inner Harbor Maintenance Dredging Project (IHMDP), and the recently-completed Outer Harbor Maintenance Dredging Project (OHMDP). The initial focus of the TWG was on this Deep Draft Project. However, as a result of the maintenance dredging projects moving forward before this project, some of the TWG meetings were primarily focused on issues associated with the maintenance projects. Nevertheless, many of those issues were also relevant to the Deep Draft Project.

The TWG is comprised of representatives from Federal, State, and local resource agencies, environmental advocates, scientists, and Port-of-Boston stakeholders. See Table 6-1 for a list of TWG members.

Table 6-1. List of Boston Harbor Deep Draft Technical Working Group Members

Technical Working Group Members	
Federal Agencies	MEPA Office
U.S. Army Corps of Engineers	**Local Agency**
U.S. Environmental Protection Agency	Boston Envir Dept & Conservation Comm
National Marine Fisheries Service	Chelsea Conservation Commission
U.S. Fish and Wildlife Service	Revere Conservation Commission
U.S. Coast Guard	**Academia**
State Agencies	Univ. of Massachusetts - Boston
Coastal Zone Management	MIT Sea Grant Program
Department of Environmental Protection	**Environmental and Private Groups**
Division of Marine Fisheries	The Boston Harbor Association
MA Water Resources Authority	Save the Harbor/Save the Bay
Massachusetts Port Authority(Massport)	Boston Harbor Pilots Association

Ten TWG meetings were held during the preparation of the Draft SEIS/EIR. Two additional TWG meetings were held between the public release of the Draft and Final SEIS/EIR. The first meeting was held June 10, 2003 and the last meeting on December 3, 2012. The agenda items discussed at the first meeting included a description of the proposed project, lessons learned from the previous BHNIP, a review of the scope of work for biological and physical testing, and a review of the physical, chemical and biological sediment testing.

The second meeting was held on January 27, 2004. The benthic results were posted on the USACE webpage. The status of the economic study was discussed as well as the results of the historic and archaeological survey. A subsurface exploration was initiated to determine the amount of bedrock and ledge that will need to be removed based on the preferred depth alternative. Results of a literature search were presented and TWG members invited to add any other known sources of information not included in the report.

During the third TWG meeting held on June 22, 2004, TWG members were informed that maintenance material west of Castle Island in the Federal navigation channel was found to be unsuitable for ocean water disposal. Therefore, this material will not be dredged with the rest of the maintenance material in the outer harbor, but will be dredged and disposed when the IHMDP proceeds. The literature search and data gap analysis were finalized and the results posted on the USACE website. Beneficial reuse of the rock blasted from the proposed project was also discussed and agencies interested in identifying bottom areas that could benefit from creation of new hard bottom habitat were solicited.

The fourth meeting was held on January 5, 2005. The biological resource assessment strategy was developed to address the TWG's concern that the proposed biological sampling plan was too limited. To address this concern, the USACE and Massport proposed to use a conservative approach to assess impacts for biological resources, assuming the resources are there unless a physical, chemical or biological parameter would limit the occurrence of the resource.

The fifth meeting was held November 29, 2005. Concern was raised that preparing a SEIS vs. an EIS was segmenting the project. It was explained that the project area and disposal is similar to the original EIS and that the SEIS builds on the lessons learned from the original EIS. The cumulative impact section of the SEIS/EIR will also discuss all of the past, current and future Boston Harbor projects. A presentation on lessons learned from the original BHNIP was shown. The biological resource studies and the 5-year monitoring report for the CAD cells were posted on the USACE web site.

A sixth meeting was held January 23, 2006 to brief the TWG on the recently released Draft SEIS/Notice of Project Change for the Inner Harbor Maintenance Dredging Project. The seventh and eighth TWG meeting prior to the release of the Final SEIS for the Inner Harbor Maintenance Dredging Project was held on April 10, 2006. Another TWG meeting was held on July 25, 2006 to discuss comments on the Final Supplemental EIS for the Inner Harbor Maintenance Dredging Project (IHMDP) and associated permitting issues. A report on the progress of the feasibility study (deep draft project) was discussed. The USACE continued to focus on project cost reviews, economics and the air quality analysis.

The ninth was held on August 15, 2007. This meeting was held to discuss the development of the potential rock reef in the project vicinity. The tenth meeting, before the release of the Draft SEIS/EIR, was held on December 18, 2007 to discuss the SEIS/EIR recommendations, schedule for the release of the Draft SEIS/EIR and Draft Feasibility Report, and overall project schedule. It is anticipated that future TWG meetings will be held during the FSEIS/EIR, design and construction phases.

The eleventh meeting was held during the comment period for the Draft SEIS/EIR on May 19, 2008. A brief overview of the project and its importance to the Port of Boston was presented and then comments from the TWG were discussed. General comments received on the Draft SEIS/EIR were related to additional design and monitoring information, and benefits of replacing soft bottom habitat for hard bottom habitat for the proposed rock reef, additional information on the capping demonstration for the beneficial reuse of the parent material at the IWS, discussion on the fish kills from the previous fall and reducing blast impacts, discussion of impacts to marine mammals from blasting, and alternatives to meet air quality conformity.

Two meetings were held before the public release of the Final SEIS/EIR. The first meeting was held on July 21, 2008 to discuss the project status to date, our response to comments, and the project schedule. The second meeting was held on December 3, 2012 to discuss maintenance dredging in Boston Harbor and the Deep Draft Project changes since the Draft SEIS/EIR in 2008.

6.4 Design Phase Investigations

Several requests were received during the Draft SEIS/EIR comment period for an explanation of the USACE Civil Works Process and for additional investigations. Before additional investigations can begin the following process needs to occur:

- A Record of Decision (ROD) would need to be issued by the Assistant Secretary of the Army for Civil Work once the draft Chief of Engineers Report, which includes the Final Feasibility Report and Final SEIS/EIR, is reviewed at the Federal cabinet level and the public.
- The State would also need to provide a letter of support for the project before a ROD is released.

- The Chief of Engineers and Final Feasibility Reports would then be forward to Congress for approval.
- Upon submittal of the Chief of Engineers Report, the project would advance into the Design Phase (Planning, Engineering and Design, or PED).
- Construction would require authorization by Congress through a Water Resources Development Act.

The Design Phase will cover the following tasks:

- Complete any necessary field investigations to support detailed design of the project;
- Prepare and publish for public review any needed additional NEPA/MEPA documents to present Design Phase investigations and any project design changes;
- Secure any required regulatory approvals; and
- Prepare the documents necessary to solicit bids for construction of the project.

The Feasibility Report includes a list and estimate of the costs of the several tasks to be undertaken in the Design Phase. These include: subsurface investigations to define the exact nature of hard materials at depth and differentiate between rock and other materials; development of several "plans" in consultation with the Technical Working Group as detailed below (blasting mitigation measures, project sequencing plan), further investigation(s) and recommendation(s) on potential beneficial uses of rock and other dredged material, and development of monitoring plans for various aspects of the project.

The Design Phase investigations will yield additional detailed data on several technical issues and topics as listed below. At this time the following principal study areas are expected to include:

- Conduct subsurface investigations, revise dredged material quantities and prepare a blasting mitigation plan.
- Conduct resource characterization efforts and dredge area baseline monitoring to allow for impact and recovery assessment of the benthic, fisheries, and shellfish resources.
- Develop a construction sequencing plan employing the dredged materials estimates, blasting mitigation plan and the resource characterization effort.
- Conduct an air quality emissions conformity evaluation to determine if there are any cost-effective alternatives available to meet the emissions requirements other than construction period shutdowns. The availability and cost of emission credits and offset opportunities will be investigated. Adjustments to the construction sequencing plan would be made according to the selected final plan of meeting air quality requirements.
- Investigate beneficial use opportunities for rock. Once final rock quantities, types and locations are identified, the potential for beneficial use other than rock reef creation will be further investigated with the State and local communities.
- Additional opportunities for the creation of rock reef habitat will be further investigated with the NMFS, EPA, the State, and other interested TWG members. Modification to site selection locations, site investigations, reef design, placement methods, and post-construction monitoring will be developed in coordination with affected resource agencies.
- A USACE pilot project determined that dredged material from Boston Harbor could successfully be deployed to cap the former Industrial Waste Site. In the event this disposal alternative is selected, the U.S. EPA will need to prepare a NEPA document and issue an amendment or rule to permit placement of the dredged material as cap at the IWS.

The information generated by the above investigations may result in changes to the Federal project base plan, which would require preparation of one or more additional NEPA and/or MEPA documents. These document(s) would present the findings and recommended actions consistent with the investigations initiated during the Design Phase and subsequent negotiations with the Federal and

State agencies, and other TWG participants. This will allow for public review and input into the design of the project. If, as a result of the above investigations it is determined that additional mitigation is required beyond what has already been identified in the Draft and Final SEIS/EIR, then additional Federal and/or Sponsor funding would be required to cover those costs as part of the project.

7. LIST OF PREPARERS

U.S. ARMY CORPS OF ENGINEERS

Valerie Cappola: Marine Ecologist, New England District, U.S. Army Corps of Engineers
Education: Ph.D. in Marine, Estuarine and Environmental Sciences from University of Maryland, M.S. in Biology from Texas A&M University, B.S. in Biology from Eckerd College.
Experience: Dr. Cappola is a specialist in benthic marine ecology, and the systematics of crustaceans and cnidarians. After teaching at Salve Regina University in Newport, RI and Emerson College in Boston, MA, she joined the U.S. Army Corps of Engineers. She has spent over three years working on environmental assessments (EAs) for dredging projects.
Role in Preparing this SEIS/EIR: Dr. Cappola was responsible for the sections on birds, mammals, and threatened, endangered and rare species.

Mark L. Habel: Chief, Navigation Planning Section, New England District, U.S. Army Corps of Engineers
Education: B.S. Geology, Northeastern University, 1980. J.D. Suffolk University Law School, 1997.
Experience: Mr. Habel has over 33 years experience with the Corps of Engineers in marine resource studies and project management for design and construction of navigation and coastal protection projects. Mr. Habel has been the chief of the New England District's Navigation Planning Section from 1985 to 1990 and from 2001 to present. He was the study manager for the 1986-1990 Boston Harbor deepening project.
Role in Preparing this SEIS/EIR: Mr. Habel is currently the study manager for the Boston Harbor Deep Draft Improvement Project Feasibility Study, author of the Feasibility Report, and was a technical reviewer of all sections of the SEIS/EIR.

Michael F. Keegan: Project Manager, New England District, U.S. Army Corps of Engineers
Education: B.S. Civil Engineering, Lowell Technological Institute.
Experience: Mr. Keegan is a registered professional engineer and a licensed construction supervisor with over 34 years experience in project management directing the evaluation, design, and construction of civil works projects focusing on navigation, flood risk management and environmental restoration. He was the project manager for the Boston Harbor Inner and Outer Harbor Maintenance Dredging Project and the Boston Harbor Deep Draft Project.
Role in Preparing this SEIS/EIR: Mr. Keegan is currently the project manager for the Boston Harbor Deep Draft Improvement Project Feasibility Study. He is responsible for overall project management, development, and implementation of the public outreach program and was a technical reviewer of all sections of the SEIS/EIR. Mr. Keegan was also responsible for all coordination efforts with Massport.

Kenneth M. Levitt: Biologist, New England District U.S. Army Corps of Engineers
Education: B.S. with a major in Fisheries, University of Washington, 1982.
Experience: Mr. Levitt has been employed as a biologist for the U.S. Army Corps of Engineers since 1988, conducting fisheries and water quality investigations at New England lakes and rivers, as well as preparing NEPA compliance documents (environmental assessments and endangered species biological assessments) for Corps construction/navigation projects. Previous employment in the private sector involved the mass cultivation of microalgae in support of the aquaculture of various marine and freshwater organisms; conducting immunological and microbiological testing at a microbiological laboratory, as well as the ocean ranching of Pacific salmon.
Role in Preparing this SEIS/EIR: Preparation of documentation for consultation under Section 7 of the Endangered Species Act as well preparation of blasting calculations and sections of the EIS on the effects of proposed blasting on threatened and endangered species.

Robert Meader: Civil Engineer, New England District, U.S. Army Corps of Engineers
Education: M.C.R.P. Rutgers, The State University, New Brunswick, NJ; B.S. in Civil Engineering, Worcester Polytechnic Institute, Worcester, MA.
Experience: Over thirty years experience with the Corps of Engineers in planning and design of navigation projects, both shallow and deep draft. Most recently, engineering and design for improvement dredging in Boston Harbor and maintenance dredging in Providence Harbor.
Role in Preparing this SEIS/EIR: Technical oversight of project design.

Marcos A. Paiva: Archaeologist/Tribal Liaison (Regional Technical Specialist), New England District, U.S. Army Corps of Engineers
Education: Ph.D. Candidate in Anthropology at Brandeis University, Waltham, MA; M.A. in History/Historical Archaeology from the University of Massachusetts at Boston; B.A. in History (minor in Anthropology) from the University of Massachusetts at Dartmouth.
Experience: Mr. Paiva has over 24 years of experience in addressing cultural resource impact assessments and compliance as a result of Federal projects including civil works, military, Superfund, project operations and work for others. Underwater archaeology has been addressed as part of the Hyannis Harbor Navigation Improvement Project, Providence River and Harbor Maintenance Dredging Project, and the Boston Harbor Deep Draft Navigation Improvement Dredging Project. Mr. Paiva was a technical reviewer and contract manager for cultural resources for the Providence River and Harbor EIS as well as the Long Island Sound EIS.
Role in Preparing this SEIS/EIR: Mr. Paiva was responsible for the historic and archaeological sections of the SEIS/EIR.

Catherine J. Rogers: Ecologist (Regional Expert), New England District, U.S. Army Corps of Engineers
Education: M.S. in Ecological and Evolutionary Biology/Coastal Zone Study from University of West Florida; B.S. in Plant and Soil Science from University of Massachusetts, Amherst.
Experience: Ms. Rogers serves as a technical lead in the preparation of NEPA documents; Marine Protection, Research and Sanctuaries Act (MPRSA) and Clean Water Act Section 404 compliance; and other applicable environmental compliance for civil works projects. She has prepared numerous Environmental Assessments and prepared and provided technical review of Environmental Impact Statements for USACE water resources development projects including maintenance and improvement dredging projects, shoreline protection projects and environmental restoration projects for over 25 years. Major relevant projects include the Boston Harbor Navigation Improvement Project EIR/S and the Rhode Island Region Long-Term Dredged Material Disposal Site Evaluation Project EIS.
Role in Preparing this SEIS/EIR: Ms. Rogers provided the technical lead on preparation of this SEIS/EIR. She also authored subsections of the Affected Environment and Environmental Consequences Section of the SEIS/EIR, as well as other sections of the SEIS/EIR.

Steven Wolf: Disposal Area Monitoring System Program Manager, New England District, U.S. Army Corps of Engineers
Education: M.S./C.E. in Environmental Engineering from Massachusetts Institute of Technology; M.S. in Marine Science from Universtiy of South Florida; B.S. in Science Education from University of North Carolina, Chapel Hill.
Experience: Mr. Wolf serves as the manager and technical lead for the New England District's monitoring of dredging and dredged material disposal sites. Prior to joining the USACE in 2010, Mr. Wolf worked as a consultant on a wide range of environmental monitoring and assessment programs for the USACE and other agencies as well as a number of private sector clients. Relative project work includes monitoring at the majority of dredged material disposal sites in New England, serving as the lead independent observer for the Boston Harbor Navigation Improvement Project, and performing water column monitoring as part of the Massachusetts Water Resources Authority's Harbor and Outfall Monitoring Program.

Role in Preparing this SEIS/EIR: Mr. Wolf helped provided edits related to disposal site monitoring and the capping demonstration for potential placement of material at the IWS.

MASSPORT

Deborah Hadden: Acting Port Director and Deputy Port Director, Properties and Transportation, Massachusetts Port Authority
Education: M.S. in Biology from Northeastern University, B.S. in Biology from Bucknell University.
Experience: Ms. Hadden has over 26 years of environmental permitting experience including extensive experience preparing Environmental Impact Reports under the Massachusetts Environmental Policy Act and Environmental Impact Statements under the National Environmental Policy Act. For the past nine years, she has served as Massport's project manager for the Boston Harbor Navigation Improvement Project and other harbor dredging projects in coordination with the Army Corps of Engineers. For the past five years, her role at Massport has shifted to focus on maritime property development and management and port transportation and environmental issues in addition to dredging. She is also currently serving as Acting Port Director.
Role in Preparing this SEIS/EIR: Providing port and maritime industry input and overall technical review.

Stewart Dalzell: Deputy Director, Environmental Planning and Permitting, Massachusetts Port Authority
Education: B.S. Biology, Springfield College.
Experience: Mr. Dalzell has over 30 years of private and public sector experience in the preparation of Federal and State environmental permit documentation. Since 2000, he has served as Deputy Director for Massport where he oversees environmental planning and permitting and mitigation tracking for major Massport aviation, port, commercial development, and infrastructure projects. A focus of many of these projects has been coastal and waterfront issues, and mitigation planning associated with port activities and projects along Logan's extensive waterfront.
Role in Preparing this SEIS/EIR: Providing environmental management, overall technical review, managing the MEPA Final EIR preparation and coordination of the Technical Working Group.

Jacquelyn Wilkins: Senior Project Manager, Environmental Planning and Permitting, Massachusetts Port Authority
Education: Working towards an M.S. in Environmental Studies, University of Massachusetts at Lowell; A.B. Geology, Lafayette College.
Experience: Ms Wilkins has over 30 years of varied public and private sector experience in the environmental arena in Massachusetts, including five years as regulator for the Department of Environmental Protection, 11 years as an Environmental Analyst in the Massachusetts Environmental Policy Act (MEPA) Office, six years consulting on complex projects requiring various Federal, State, and local; and 10 years managing environmental planning and permitting projects for Massport.
Role in preparing this SEIS/EIR: Managing the MEPA Environmental Impact Report preparation and coordination with the Draft SEIS/EIR.

BATTELLE

Jennifer Field: Principal Research Scientist, Battelle
Education: M.S. in Biological Science from Old Dominion University; B.S. in Biological Science from Florida State University**.**
Experience: Ms. Field has more than 11 years of experience working on the biology and ecology of marine organisms, including fish, crustaceans, and marine mammals, and five years of experience working on anthropogenic impact studies in the marine environment.
Role in Preparing this SEIS/EIR: Ms. Field was the lead contributor of the fish subsection for the Affected Environment.

Roy Kropp: Senior Research Scientist, Battelle
Education: Ph.D. in Zoology from the University of Maryland; M.S. in Biology from the University of Guam; B.S. in Zoology from San Diego State University.
Experience: Dr. Kropp is a specialist in benthic marine ecology, toxicology, and the systematics of crustaceans and mollusks with 21 years of experience. He has served as the principal investigator for or participated in marine environmental surveys in the tropical and boreal Pacific, off the coast of California, in the Gulf of Mexico, along the Atlantic Coast of the United States, and in the Mediterranean. Currently, Dr. Kropp is a Senior Scientist for Benthic Biology for the Massachusetts Water Resources Authority Monitoring Program. Dr. Kropp has analyzed Rhode Island Sound infaunal data and described infaunal communities in a series of reports for the U.S. Army Corps of Engineers (USACE). Since matriculating to the Marine Sciences Laboratory from Battelle's Duxbury facility, Dr. Kropp has directed several toxicological studies involving the testing of marine and freshwater species. He was the technical project manager for the preparation of the Final EIS prepared for the Providence River dredging project by the USACE.
Role in Preparing this SEIS/EIR: Dr. Kropp contributed the benthic subsection for the Affected Environment.

Kari Lavalli: Assistant Professor of Natural Sciences, Boston University
Education: Ph.D. in Biology from Boston University's Marine Program; B.A. in Bio-Mathematics from Wells College.
Experience: Dr. Lavalli has over 15 years of research experience on the behavioral ecology and basic biology of multiple species of lobsters (clawed, spiny, and slipper) and has worked as a consultant on several projects that could have potential impact on lobsters. Her experience has included aspects of pollutant contaminant loads in lobster tissues and sewage effluent impacts on settling postlarva. She has served as an editor for a book on slipper lobster biology and fisheries, as a section editor on lobster behavioral ecology for a marine journal, and as an associate editor for the Journal of Crustacean Biology.
Role in Preparing this SEIS/EIR: Dr. Lavalli contributed to the lobster subsection of the Affected Environment.

Lisa Lefkovitz: Project/Program Manager, Battelle
Education: M.S. in Water Chemistry from the University of Wisconsin; B.S. in Chemistry from Case Western Reserve University.
Experience: Ms. Lefkovitz has over 15 years of project management and environmental science experience working with public- and private-sector clients. Her project management experience has included all aspects of dredged material management as well as a variety of multidisciplinary environmental and engineering projects.
Role in Preparing this SEIS/EIR: Ms Lefkovitz contributed the sedimentary environment subsection for the Affected Environment.

Stacy Pala: Research Scientist, Battelle
Education: B.A. in Biology, with Chemistry and Russian Minors, Wheaton College, 1994; coursework in Environmental Risk Analysis and Environmental Toxicology, University of Massachusetts, Boston.
Relevant Experience: Ms. Pala has over 11 years of experience in environmental science, including work in biological assessments (BAs) and EAs, environmental microbiology, chemical analyses, and task management.
Role in Preparing SEIS/EIR: Ms. Pala contributed to the shellfish subsection of the Affected Environment.

EARTHTECH (Now AECOM)

Mary Ellen Radovanic, AICP: Senior Environmental Planner, Earth Tech
Education: Master of Urban Affairs from Boston University, a M.B.A. from the University of Rhode Island, and a B.S. in Criminal Justice from Northeastern University.
Experience: Ms. Radovanic has over ten years of experience in the preparation of environmental impacts assessment for major public infrastructure projects.
Role in Preparing this SEIS/EIR: Ms. Radovanic authored the Draft SEIS/EIR Cumulative Impacts Section.

AECOM

Victor P. Frankenthaler: Senior Environmental Planner, AECOM
Education: M.S. in Geography from Boston University and a B.S. in Environmental Planning and Design from Rutgers University.
Experience: Mr. Frankenthaler has over 30 years of experience in the preparation of environmental impact analyses in compliance with the National Environmental Policy Act and Presidential Executive Order 12114—Environmental Effects Abroad of Major Federal Actions, and State regulations.
Role in Preparing this SEIS/EIR: Mr. Frankenthaler authored the revised Secondary Impacts Section.

Dion Lewis: Technical Specialist, AECOM
Education: M.S. in Chemical Oceanography from the University of New Hampshire; B.S. in Geology from Syracuse University.
Experience: Mr. Lewis has 28 years of experience in the planning, performance, and reporting of environmental studies supporting riverine, coastal marine and oceanographic investigations. From 2006 until 2012, Mr. Lewis served as the Sediment Characterization Resource Leader for CENAE's DAMOS program. He has authored several dredged material suitability reports to support agency decision-making under MPRSA §103, CWA §404, and supported EIS documentation for projects in EPA Regions I, II, IV, and IX.
Role in Preparing this SEIS/EIR: Mr. Lewis contributed to the revised Cumulative Impacts Section.

Maura Surprenant: Project/Program Manager, AECOM
Education: B.S. in Biology from Suffolk University.
Experience: Ms. Surprenant has 26 years of experience in the planning, implementation and reporting of environmental monitoring and sediment management programs. She has served for over ten years as project/program manager on evaluations of sediment for dredge and disposal operations for the U.S. Army Corps of Engineers (USACE), under various environmental services and DAMOS contracts. She has also served as technical lead on numerous ocean monitoring programs and sediment characterization studies for private and public sector clients.
Role in Preparing this SEIS/EIR: Ms. Surprenant contributed to the revised Cumulative Impacts Section.

DAYLOR CONSULTING GROUP

Joseph Freeman: Senior Program Director, Daylor Consulting Group
Education: M.A. in Public Policy from Tufts University; B. A. in Liberal Arts from Goddard College.
Experience: Mr. Freeman has more than 30 years experience in the preparation of environmental impact assessment and environmental permitting documentation for major public infrastructure and coastal development projects.

Role in Preparing this SEIS/EIR: Mr. Freeman was the lead contributor of the Cumulative Impacts Section in the Draft SEIS/EIR and was also the principal author of the MEPA Notice of Project Change.

Jessica Dominguez: Environmental Scientist, Daylor Consulting Group
Education: B.S. in Biology-Environmental Science from Colby College.
Experience: Ms. Dominguez has more than five years of experience working on project s involving water quality assessment, endangered species management, field identification of flora and fauna species, developmental impact assessment, wetlands monitoring, environmental permitting, and coastal resource management.
Role in Preparing this SEIS/EIR: Ms. Dominguez was a supporting author for the Draft SEIS/EIR Cumulative Impacts Section.

CDM/Smith

Marc Wallace: Senior Air Quality Scientist QEP, CDM
Education: M.S. in Environmental Studies from the University of Massachusetts at Lowell, B.S. in Meteorology, Lyndon State College, Vermont.
Experience: Mr. Wallace has over 20 years of experience specializing in all aspects of air quality management, including air permitting, control technology evaluations, dispersion modeling, and air monitoring. He has experience using U.S. EPA air quality dispersion models and is familiar with Federal and State agency air quality guidelines and regulations. His project experience includes evaluating construction and operational air quality impacts for transportation, wastewater treatment, composting and industrial facilities siting studies and permit preparations.
Role in Preparing this SEIS/EIR: Mr. Wallace provided the technical lead in the Air Quality General Conformity Applicability Analysis presented in the Draft SEIS/EIR. He also authored the Air Quality Affected Environment and Environmental Consequences Sections of the Draft SEIS/EIR.

George Siple: Associate QEP, CDM Smith
Education: M.B.A. from Duke University, M.S.P.H. in Air and Industrial Hygiene from the University of North Carolina, B.A. in Chemistry from Case Western Reserve University.
Experience: Mr. Siple is a senior environmental scientist with 38 years of experience in all aspects of air quality management, including air permitting, compliance assessments, control technology evaluations, dispersion modeling and air monitoring. His areas of expertise include facility permitting, regulatory assessments, compliance assistance, hazardous waste investigations, and health risk assessments. Mr. Siple has worked on numerous projects for industrial, municipal, and transportation facilities; state and federal environmental agencies; and electric utilities. Currently, as a member of a team conducting a wide variety of environmental projects, he provides senior technical support related to air quality management.
Role in Preparing this SEIS/EIR: Mr. Siple provided the technical lead in the Air Quality General Conformity Applicability Analysis. He also authored the Air Quality Affected Environment and Environmental Consequences Sections of the Final SEIS/EIR.

Lauren Miller: Project Manager, CDM Smith
Education: M.A. in Energy and Environmental Analysis from Boston University, B.S. in Environmental Studies from Elon University.
Experience: Ms. Miller is an environmental scientist with experience in climate change mitigation, climate change adaptation, air quality management, and regulatory compliance. Ms. Miller has worked on numerous projects for industrial and municipal facilities; state and federal environmental agencies; electric utilities facilities; and airports. As a project manager, she is responsible for project execution, budget, and quality.

Role in Preparing this SEIS/EIR: Ms. Miller served as CDM Smith's project manager, responsible for coordination with Massport. She provided support for the Air Quality Affected Environment and Environmental Consequences Sections of the Final SEIS/EIR.

Cynthia Strong Hibbard: Vice President, CDM Smith
Education: M.S. in Environmental Engineering from Harvard University, B.A. in Environmental Engineering from Harvard/Radcliffe College.
Experience: Ms. Hibbard is a Vice President and air quality and greenhouse gas expert with 31 years of experience in air quality management. This includes obtaining air permits, assisting with air regulatory compliance, and conducting emissions and dispersion modeling, control technology evaluations, air pollutant monitoring and sampling, environmental impact assessments and noise studies. She manages projects with major air quality components, provides technical oversight and expert testimony on air quality issues, and negotiates permit and consent agreement conditions on behalf of clients. Her recent experience includes greenhouse gas inventory and management strategy projects for public sector and industrial clients. Ms. Hibbard is a leading air quality expert, and represents CDM Smith at conferences, agency meetings, and with citizens groups, industry groups and professional organizations on air regulatory issues
Role in Preparing this SEIS/EIR: Ms. Hibbard provided senior technical oversight and support for the Air Quality Affected Environment and Environmental Consequences Sections of the Final SEIS/EIR.

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9.0 BOSTON HARBOR SEIS/EIR ACRONYM LIST

IHMDP	Boston Harbor Inner Harbor Maintenance Dredging Project
OHMDP	Boston Harbor Outer Harbor Maintenance Dredging Project
BHNIP	Boston Harbor Navigation Improvement Project and Berth Dredging Project
BUAR	MA Board of Underwater Archaeological Resources
CAD	Confined Aquatic Disposal
CFR	Code of Federal Regulations
COSCO	China Overseas Shipping Company
cm	Centimeter
CPUE	Catch per Unit Effort
CSO	Combined Sewer Overflow
CTD	Conductivity, Temperature, and Density
CWA	Clean Water Act
cy	Cubic Yards
CZMA	Coastal Zone Management Act
DAMOS	Disposal Area Monitoring System
DEIS	Draft Environmental Impact Statement
DITP	Deer Island Treatment Plant
DO	Dissolved Oxygen
EFH	Essential Fish Habitat
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ENSR	ENSR, International
ERDC	Engineer Research and Development Center
EO	Executive Order
EPA	U.S. Environmental Protection Agency
FEIS	Final Environmental Impact Statement
ft	foot or feet
GLDD	Great Lakes Dredge and Dock Company
LC_{50}	Lethal Concentration (concentration of a substance at which 50% of a group of experimental organisms are killed in a given time)
MA DEP	Massachusetts Department of Environmental Protection
MA DMF	Massachusetts Department of Marine Fisheries
MA DOT	Massachusetts Department of Transportation
Massport	Massachusetts Port Authority
MEPA	Massachusetts Environmental Policy Act
MHC	Massachusetts Historic Commission
MHW	Mean High Water
mi	mile(s)
MLW	Mean Low Water
MLLW	Mean Lower Low Water
mm	Millimeter
MMT	Massport Marine Terminal
MPRSA	Marine Protection Research and Sanctuaries Act
MSC	Mediterranean Shipping Company
MWRA	Massachusetts Water Resources Authority
NEPA	National Environmental Policy Act
NITP	Nut Island Treatment Plant
NMFS	National Marine Fisheries Service
Nmi	nautical mile
NOAA-Fisheries	National Oceanographic and Atmospheric Administration-Fisheries

NOI	Notice of Intent
NTU	Nephelometric Turbidity Units
OSI	Organism Sediment Index
PAH	Polynuclear Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PONYNJ	Port of New York/New Jersey
ppm	Parts per Million
REMOTS	Remote Ecological Monitoring of the Seafloor
RPD	Redox (Reduced Oxygen) Potential Discontinuity
SAIC	Science Applications International Corporation, Inc.
SHPO	State Historic Preservation Officer
SPI	Sediment Profile Imaging
STFATE	Short Term Fate Computer Model
TAC	Technical Advisory Committee
TEU	Twenty-foot Equivalent Unit
TCLP	Toxicity Characteristic Leaching Procedure
TOC	Total Organic Carbon
TSS	Total Suspended Solids
TWG	Technical Working Group
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USGS	U.S. Geological Survey
WRDA	Water Resources Development Act

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11.0 INDEX

CLEAN WATER ACT

SECTION 404(b)(1) EVALUATION

NEW ENGLAND DISTRICT, U.S. ARMY CORPS OF ENGINEERS

CLEAN WATER ACT SECTION 404(b)(1) EVALUATION

PROJECT: Boston Harbor Federal Deep Draft Navigation Improvement, Boston, Massachusetts

PROJECT DESCRIPTION:

The currently proposed Boston Harbor Deep Draft Navigation Improvement Project (Deep Draft Project) involves dredging parent material from navigation channels and related features of the Boston Harbor Federal Navigation Project. The project consists of four separate plans for channel improvements. The first involves providing deeper container vessel access from the Bay to the Conley Terminal in South Boston. This plan would deepen the Broad Sound North Entrance Channel, the President Roads Anchorage Area, the Main Ship Channel Reaches between the Outer Confluence and the Reserved Channel, the lower Reserved Channel, and the Reserved Channel Turning Basin, to a depth of 47 feet deep MLLW, with an additional four feet of depth in the entrance channel (to -51 feet MLLW), and widening of the turning basin and the channel bends. The preferred alternative also involves extending the deepened portion of the Main Ship Channel above the Reserved Channel to the Massport Marine Terminal below the Ted Williams Tunnel to depths of 45 feet, deepening a small area of the lower Mystic River Channel at Massport's Medford Street Terminal from its current 35-foot depth to 40 feet, deepening the Chelsea River Channel and its turning basin to 40 feet from its current 38-foot depth. The project would generate between 10 and 11 million cubic yards of unconsolidated parent glacial material and up to about 1 million cubic yards of rock and other hard materials. These materials would be hauled by scow to the Massachusetts Bay Disposal Site for ocean placement unless one or both of the candidate beneficial use options are ultimately approved as part of the project.

In addition, maintenance dredging of existing Federal navigation features would be carried out concurrent with the Deep Draft Project in two ways. First, maintenance dredging of the Broad Sound South Entrance Channel 30-foot lane, the 35-foot North Lane of the Broad Sound North Entrance Channel, the 15-foot Nubble Channel and the 35-foot Lower Middle Ground Barge Anchorage. These areas would be maintained to facilitate vessel movement during construction of the Deep Draft Project.

Second, remaining areas covered by the 2006 SEIS for the Inner Harbor Maintenance Dredging Project that were not dredged; that is the area between Massport's Marine Terminal and the Inner Confluence.

Third, remaining maintenance material (overdepth) in the Chelsea River, and fourth, maintenance material from the Charles River portion of the 35-foot Main Ship Channel.

Only the maintenance material from the Main Ship Channel, including the Charles River portion, is unsuitable for ocean water disposal and would be disposed into a Confined Aquatic Disposal (CAD) cell located in the Main Ship Channel.

Beneficial use of all or a portion of the unconsolidated material for placement as cap at the overlapping former Industrial Waste Site will be further examined by the USACE and U.S. EPA and other agencies during the Design Phase of the project. Both the MBDS and former IWS lie outside the Territorial Sea in waters regulated by the Federal Government under the Marine Protection Research and Sanctuaries Act, and are not covered by this Draft Clean Water Act Section 404(b)(1) Evaluation.

This Section 404 (b)(1) Evaluation only covers the potential beneficial use of rock material removed from Boston Harbor and disposed at one or both of the two candidate habitat enhancement sites in Massachusetts Bay, and the potential disposal of maintenance material discussed below into a Boston Harbor CAD cell. The two potential beneficial use sites identified to date are the Broad Sound and Massachusetts Bay enhancement sites, both located landward of the Territorial Sea boundary. Up to approximately one million cubic yards of rock could be disposed to provide beneficial hard bottom habitat for lobsters, finfish and other species. An area between 186 acres and 518 acres of subbottom Massachusetts Bay habitat would be covered with rock deposited in rows spaced to leave undisturbed soft bottom between each row to provide a more diverse habitat.

Only maintenance material from the Charles River, and any remaining maintenance material deposited since completion of the Inner Harbor Maintenance Dredging Project or other completed navigation projects are covered under this CleanWater Act analysis. Maintenance dredging that has been deferred, and that will or could be dredged in association with this Deep Draft Improvement Project, has been covered under previous Clean Water Act analyses for disposal into previously identified CAD cells within Boston Harbor. These pre-existing USACE Clean Water Act 404(b)(1) Evaluations and State Water Quality Certificates will be evaluated during the Design Phase to assure thatcompliance with the Clean Water Act continues for the deferred maintenance dredging and for any other identified dredged material determined to be unsuitable for open water disposal.

PROJECT: Boston Harbor Deep Draft Navigation Improvement Dredging Project, Boston, Massachusetts

1. Review of Compliance (Section 230.10(a)-(d)). Draft

a. The discharge represents the least environmentally damaging practicable alternative and if in a special aquatic site, the activity associated with the discharge must have direct access or proximity to, or be located in the aquatic ecosystem to fulfill its basic purpose;

X YES ___ NO

b. The activity does not appear to:
1) violate applicable state water quality standards or effluent standards prohibited under Section 307 of the CWA; 2) jeopardize the existence of Federally listed threatened and endangered species or their critical habitat; and 3) violate requirements of any Federally designated marine sanctuary;

X YES ___ NO

c. The activity will not cause or contribute to significant degradation of waters of the U.S. including adverse effects on human health, life stages of organisms dependent on the aquatic ecosystem, ecosystem diversity, productivity and stability, and recreational, aesthetic, and economic values;

X YES ___ NO

d. Appropriate and practicable steps have been taken to minimize potential adverse impacts of the discharge on the aquatic ecosystem.

X YES ___ NO

2. Technical Evaluation Factors (Subparts C-F).

	N/A	Not Significant	Significant
a. Potential Impacts on Physical and Chemical Characteristics of the Aquatic Ecosystem (Subpart C).			
1) Substrate;		X	
2) Suspended particulates/turbidity;		X	
3) Water;		X	
4) Current patterns and water circulation;		X	
5) Normal water fluctuations;	X		
6) Salinity gradients.	X		
b. Potential Impacts on Biological Characteristics of the Aquatic Ecosystem (Subpart D).			
1) Threatened and endangered species;		X	
2) Fish, crustaceans, mollusks and other aquatic organisms in the food web;		X	
3) Other wildlife.		X	
c. Potential Impacts on Special Aquatic Sites (Subpart E).			
1) Sanctuaries and refuges;	X		
2) Wetlands;	X		
3) Mud flats;	X		
4) Vegetated shallows;	X		
5) Coral reefs;	X		
6) Riffle and pool complexes.	X		
d. Potential Effects on Human Use Characteristics (Subpart F).			
1) Municipal and private water supplies;	X		
2) Recreational and commercial fisheries;		X	
3) Water related recreation;		X	
4) Aesthetics;		X	
5) Parks, national and historic monuments, national seashores, wilderness areas, research sites, and similar preserves.	X		

3. Evaluation and Testing (Subpart G).

a. The following information has been considered in evaluating the biological availability of possible contaminants in dredged or fill material. (Check only those appropriate.)

1)	Physical characteristics;	X
2)	Hydrography in relation to known or anticipated sources of contaminants;...	X
3)	Results from previous testing of the material or similar material in the vicinity of the project;……………….	
4)	Known, significant sources of persistent pesticides from land runoff or percolation;	
5)	Spill records for petroleum products or designated hazardous substances (Section 311 of CWA);	
6)	Public records of significant introduction of contaminants from industries, municipalities, or other sources;	
7)	Known existence of substantial material deposits of substances that could be released in harmful quantities to the aquatic environment by man-induced discharge activities;	
8)	Other sources (specify).	

List appropriate references: *Boston Harbor Deep Draft Navigation Improvement Dredging SEIS/EIR Affected Environment/Environmental Consequences Sections.*

b. An evaluation of the appropriate information in 3a above indicates that there is reason to believe the proposed dredge or fill material is not a carrier of contaminants, or that levels of contaminants are substantively similar at extraction and disposal sites and not likely to require constraints in handling the material. The material meets the testing exclusion criteria.

X	___
YES	**NO**

4. Disposal Site Delineation (Section 230.11(f)).

a. The following factors, as appropriate, have been considered in evaluating the disposal sites.

1) Depth of water at disposal site	X
2) Current velocity, direction, and variability at disposal site	X
3) Degree of turbulence	X
4) Water column stratification.	X
5) Discharge vessel speed and direction.	___
6) Rate of discharge	X
7) Dredged material characteristics (constituents, amount, and type of material, settling velocities)	X
8) Number of discharges per unit of time	___
9) Other factors affecting rates and patterns of mixing (specify: disposal at low and high tide)	X

List appropriate references: *Boston Harbor Deep Draft Navigation Improvement Dredging SEIS/EIR.*

b. An evaluation of the appropriate factors in 4a above indicates that the disposal site and/or size of mixing zone are acceptable.

X	___
YES	**NO**

5. Actions To Minimize Adverse Effects (Subpart H).

All appropriate and practicable steps have been taken through application of recommendation of Section 230.70 - 230.77 to ensure minimal adverse effects of the proposed discharge

X	___
YES	**NO**

List actions taken:

This proposed beneficial use of rock disposal would create permanent hard bottom habitat where little or none currently exist.

Monitoring of CAD cell disposal for previous Boston Harbor dredging projects have not revealed any significant water quality violations.

6. Factual Determination (Section 230.11).

A review of appropriate information as identified in items 2 - 5 above indicates that there is minimal potential for short or long term environmental effects of the proposed discharge as related to:

a. Physical substrate (review sections 2a, 3, 4, and 5 above).	YES X	NO___
b. Water circulation, fluctuation and salinity (review sections 2a, 3, 4, and 5).	YES X	NO___
c. Suspended particulates/turbidity (review sections 2a, 3, 4, and 5).	YES X	NO___
d. Contaminant availability (review sections 2a, 3, and 4).	YES X	NO___
e. Aquatic ecosystem structure, function and organisms(review sections 2b and c, 3, and 5)	YES X	NO___
f. Proposed disposal site (review sections 2, 4, and 5).	YES X	NO___
g. Cumulative effects on the aquatic ecosystem.	YES X	NO___
h. Secondary effects on the aquatic ecosystem.	YES X	NO___

7. Findings of Compliance or Noncompliance.

a. The proposed disposal site for discharges of dredged or fill material complies with the Section 404(b) (1) guidelines... **X**
YES

10 Apr 13
Date

Charles P. Samaris
Colonel, Corps of Engineers
District Engineer