Final Environmental Impact Report (EOEA File Number 8695)
and
Final Environmental Impact Statement
Volume 1 of 3

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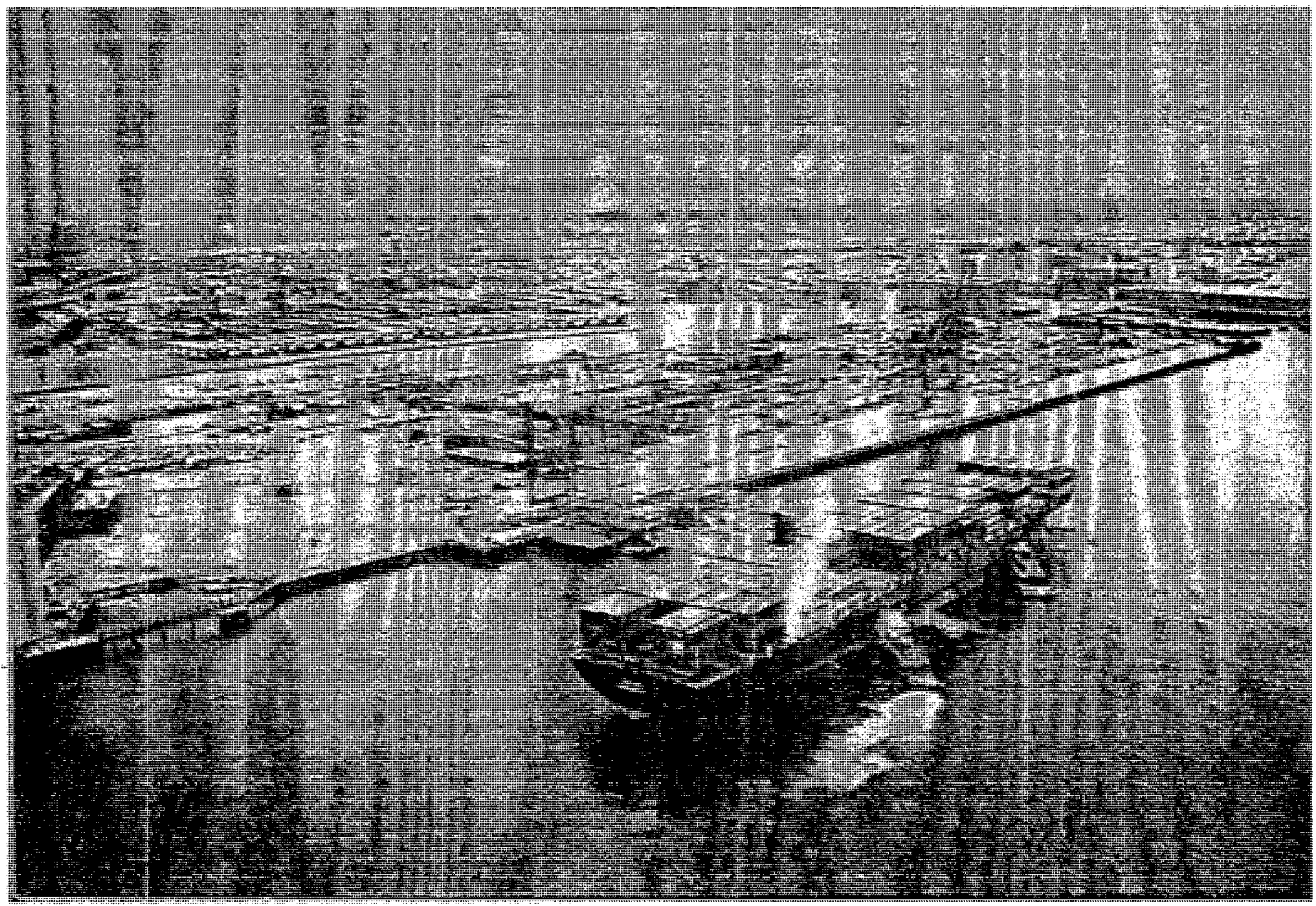
Boston Harbor, Massachusetts

Navigation Improvement Project and Berth Dredging Project



June 1995

US Army Corps
of Engineers
New England Division

massport
Massachusetts
Port Authority
Maritime Department

FINAL
ENVIRONMENTAL IMPACT REPORT/ENVIRONMENTAL IMPACT STATEMENT
(FEIR/S)
Volume 1 of 3

BOSTON HARBOR NAVIGATION IMPROVEMENT DREDGING AND BERTH DREDGING PROJECT

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This joint Federal and State document addresses the impacts associated with the Congressionally authorized navigation improvement dredging and disposal of material from the Federal navigation channel and associated berthing areas in Boston Harbor, Massachusetts. The Reserved Channel and Mystic River would be deepened from 35 feet mean low water (MLW) to 40 feet MLW. The Chelsea Creek would be deepened from 35 feet MLW to 38 feet MLW. Disposal of the underlying parent material is proposed at the Massachusetts Bay Disposal Site. Disposal alternatives for the silt material (maintenance material) overtopping the parent material are assessed and the preferred alternative selected in this FEIR/S.

Comments should be sent to Colonel Richardson at the U.S Army Corps of Engineers and Ms. Trudy Coxe, Secretary, Executive Office of Environmental Affairs, Commonwealth of Massachusetts by the date indicated in the transmittal letter. If you would like further information on this document, Mr. Peter Jackson of the U.S. Army Corps of Engineers can be reached at (617) 647-8861 or contact Ms. Janeen Hansen, Massport, at (617) 973-5355.

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BOSTON HARBOR NAVIGATION IMPROVEMENT PROJECT

FINAL ENVIRONMENTAL IMPACT REPORT/STATEMENT

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BOSTON HARBOR NAVIGATION IMPROVEMENT PROJECT FINAL ENVIRONMENTAL IMPACT REPORT/STATEMENT

EXECUTIVE SUMMARY

Project Description

The Boston Harbor Navigation Improvement and Berth Dredging Projects (BHNIP) encompass the deepening of three tributary channels (Reserved Channel, Mystic River Channel and Chelsea Creek Channel) and two areas in the Main Ship Channel (Inner Confluence and the mouth of Reserved Channel) to provide sufficient ship maneuvering areas for the deepened channels; six berth areas that would benefit directly from the channel deepening (Conley 11-13, Prolerized, Distrigas, Moran, Eastern Minerals and Gulf Oil); and six berth areas and one intake structure that would not benefit directly from (i.e., be connected to) the channel deepening (Boston Army, Boston Edison Intake, Boston Edison Barge, Conley 14-15, Revere Sugar, Mystic Piers 1, 2, 49 and 50). The President Roads Anchorage Area and adjacent channels would be re-marked to enlarge the deep water anchorage without additional dredging. Deepening of the channels to -40 ft MLW (except Chelsea Channel to -38 ft MLW) would allow greater use of the hitherto underutilized -40 ft MLW Entrance Channel and Main Ship Channel (see Figure ES-1).

The improvements to the three Federal channels were proposed as a result of a Feasibility Study completed by the Corps of Engineers in 1988.. The three-channel project was selected as the economically and environmentally preferred project alternative. It was authorized by Congress in the Water Resources Development Act of 1990 (P.L. 101-640). The authorized project would allow the Port of Boston to maintain its competitiveness in the highly competitive national and international marine trade business by reducing the cost of transporting goods and thus improving efficiency.

Massachusetts Port Authority (Massport), as local sponsor of the project, submitted an Environmental Notification Form (ENF) to Massachusetts Executive Office of Environmental Affairs in April 1991. The Secretary's Certificate on the ENF required the preparation of an Environmental Impact Report (EIR) with three major areas of focus:

- sediment characterization,
- evaluation of disposal alternatives and
- a dredging management plan.

The Corps of Engineers, New England Division, committed to preparing an EIS in 1992 due to the cumulative impacts of Federal actions (maintenance dredging, navigation improvement dredging, and permitting of the associated berthing areas) and the significant public concern over disposal of dredged material. Because the channel improvement and berth dredging projects are intricately linked and

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interdependent and would be reviewed by the same regulatory audience, it was determined that preparation of a joint Environmental Impact Report/Statement (EIR/S) would be most efficient.

A Draft EIR/S was published in April 1994. This FEIR/S is designed to respond to comments received on the Draft including the Secretary's certificate dated June 30, 1994 and to comply with the requirements for an FEIR as described in 301 CMR 11.07 (10). This document also serves to meet the requirements for an FEIS as specified in 40 CFR Part 1503. This document identifies a preferred dredging and dredged material disposal option, assesses the anticipated environmental impacts associated with each, identifies potential long-term disposal options that may be appropriate for maintenance dredging of the completed project, and responds to all comments received on the Draft.

Purpose and Need of the Project

Both the MEPA and NEPA regulations require a purpose and need statement that briefly specifies the underlying objectives and anticipated benefits of the project. The purpose of the BHNIP is to increase the navigational efficiency and safety of Boston Harbor for present types of deep draft vessels. This purpose was the basis for the 1988 Feasibility Report prepared by the Corps to conclude that the project was justified economically. There are also direct economic benefits that accrue to the Port from the BHNIP. These include: 1) increased navigational efficiency and safety by reducing the need to wait out tides or to decrease loads prior to entering the Harbor; 2) the ability to ship more tons of containerized cargo with fewer ships; 3) the ability to attract new shipping lines; and 4) ability to maintain vital refined oil products facilities and allow for double-hulled tankers.

Public Participation

Massport, the project's local sponsor, and the Corps of Engineers recognized the need to involve key agencies and groups in the planning process through consultation, information exchange and presentation of diverse viewpoints. In March 1992, Massport formally invited thirty-five federal, state and local agencies and public and private interest groups to participate in a project Advisory Committee. The Committee's function was to advise Massport and the Corps of Engineers in the overall design and planning of environmental studies which would form the basis of the environmental review. The Committee met seven times over the course of the studies leading to the preparation of this EIR/S.

Early in the public participation process two specific technical issues were identified as those which would benefit from a more focused analysis and review than that which could be provided by the Advisory Committee. As a result, two Working Groups were formed as subsets of the Advisory Committee to provide guidance and expertise in : 1) sediment characterization; and 2) disposal site identification and screening. Through the course of the project these Working Groups, and the larger Advisory Committee, provided valuable commentary on sampling and testing protocols and information on identifying and characterizing disposal sites. The Working Group process contributed in creating a dynamic and responsive work product by increasing the scope of the sediment sampling and testing and expanding the types of disposal options and specific disposal sites to be screened for the project.

The Advisory Committee convened twice during the preparation of the FEIR/S, in September 1994 and March 1995. The Advisory Committee was instrumental in assisting the project team in identifying major areas of concern regarding the DEIR/S that required additional data collection or analysis in the FEIR/S. These consisted of a working group meeting in November 1994, focusing on developing a comprehensive data base of dredged material treatment and disposal technologies. A second working group convened in December 1994, focusing dredging performance standards and monitoring concerns that would be developed into a comprehensive Dredge Management Plan.

Public participation was also extended to public meetings, meetings with concerned interest groups, and the receipt of sixty-one comment letters from federal, state, and local agencies, commercial interests, private interest groups and private citizens. Public meetings were held in Boston, Hyannis and Nahant.

In addition to the public participation process, the project team also engaged in several meetings with the combined EOEA agencies. Meetings were also held between the Federal cooperating agencies and the Corps to address Federal issues concerning comments on the Draft EIR/S.

Sediment Characterization

The BHNIP will result in removal of approximately 1.1 million cubic yards (cy) of silt (as measured in-place). The total quantity of silt requiring disposal is slightly higher, 1.4 million cy, which accounts for 0.5 feet of over-dredging into the underlying parent material and a 20% expansion factor due to dredging. An extensive sediment sampling and testing program, developed interactively with the Sediment Characterization Working Group, was undertaken to characterize the dredged material. The surficial silt layer (or "maintenance" material) was found to contain varying concentrations of metals, polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and other organics. The sediment bulk chemistry data, in combination with test organism toxicity and bioaccumulation testing, indicated that the silt was generally unsuitable for unconfined open water disposal. It was further determined that the underlying sediment (parent material) was composed of clay and sand/gravel and has low levels of metals and organics. The Corps initially determined that approximately 360,000 cy of silt was suitable for ocean disposal. Using the same data, however, the EPA determined that none of the silt was suitable for unconfined ocean disposal. In response, the Corps adopted the more conservative position and assumed that all silt from the project is considered unsuitable for unconfined ocean disposal.

The underlying parent material, composed primarily of Boston Blue Clay with gravel pockets, has been shown on this and other projects to be uncontaminated and suitable for unconfined open water disposal. The total volume of approximately 2 million cy of parent material (including the expansion factor) can be disposed at an unconfined open water site if no beneficial uses (e.g., landfill and/or capping) are identified. The final component of the dredged material is rock that would be removed from Mystic River Channel and two areas of the Main Ship Channel. Beneficial uses considered for the 132,000 cy (post-dredging volume) of rock included habitat enhancement or armoring disposal sites that are subject to high-energy hydrodynamics.

In addition to addressing the dredged material disposal needs for the BHNIP itself, disposition of the future maintenance of the deepened channels over the 50 year project life was addressed. The estimated 4.4 million cy of future maintenance material would be composed primarily of silt. For the purpose of the disposal alternatives analysis, it has been assumed that this material could contain elevated levels of contaminants. Under this assumption (which may or may not be the case), the material would have to be deposited in a confined disposal site.

Disposal Alternatives Analysis

A Disposal Options Working Group was convened to develop criteria for evaluation of the universe of potential disposal sites and beneficial uses of parent material, rock, silt and future maintenance dredging material. The group participated in the disposal site selection process at regular intervals, reviewing arguments for retaining or eliminating specific sites. The short list of potential disposal alternatives included sites in two major categories, land-based and aquatic sites, and eight subcategories: landfills, land-based inland, land-based coastal, aquatic shoreline, aquatic subaqueous, aquatic borrow pit, existing aquatic disposal sites, in-channel disposal and treatment technologies.

The disposal alternatives analysis screening process was comprised of four phases. In the first phase, comparisons were made using evaluation criteria among sites within each alternative category (i.e., landfills were evaluated together but not compared to aquatic shoreline sites). A subsequent evaluation focused on regulatory and other limiting criteria to select the sites which provided the least environmental impact with the greatest project benefit. Sites were then screened for practicability issues of cost, logistics and technology in relation to project needs and goals.

In response to comments on the DEIR/S, the site screening process was re-visited. Additional data collection activities, performed after publication of the DEIR/S, were used to upgrade the data base upon which the sites would be evaluated. A confirmatory aquatic sampling program was undertaken in October 1994 to assess fin fish, 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 on the land-based sites. This fourth-phase screening process narrowed the list of practicable alternatives from an initial list of 376 sites and eight treatment technologies to 24 sites.

The development of disposal options next focused on combining sites to meet the capacity requirements of the project. This evaluation emphasized the fact that few sites are large enough to accommodate the disposal needs of the BHNIP by themselves. Finally, an environmental and practicability evaluation of options led to the identification of the in-channel disposal option. This option disposes of silt within the dredging footprint of the Mystic and Chelsea Rivers and the Inner Confluence in cells constructed in the parent material that are

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capped with sand after filling. The in-channel option resolves concerns expressed on the DEIR against a "monofill" site by combining three sites (the Mystic and Chelsea Rivers and the Inner Confluence Area), confines impacts to the dredging footprint, and is rated the least environmentally damaging practicable alternative (LEDPA).

In response to agency comments on the DEIR/S, the project team has been asked to identify a secondary preferred alternative site for excess silt capacity should the preferred alternative fail to provide sufficient capacity after the project is underway. Based on the environmental and practicability screening process mentioned above, the Little Mystic Channel has been identified as a secondary contingency site. This site would be filled to mean low water, changing approximately 15 acres from a subtidal, but degraded condition, to intertidal habitat with clean substrate. This option provides approximately 373,000 cy of contingency capacity. If this site is required for secondary capacity, mitigation for change in substrate will be discussed with the appropriate resource agencies.

Parent material, not expended through a beneficial use, would be disposed at the MBDS. Rock will be available to cap the in-channel locations that may be subject to impacts from propeller wash, or it will be made available for another beneficial use. The remaining rock will be disposed of at the MBDS.

The FEIR/S also provides a disposal site selection process for maintenance dredging over the 50-year life of the project, or the maintenance material dredged even if the proposed navigation improvement project is delayed or not implemented. Maintenance dredging of accumulated silt material will be needed to allow ships to transit the harbor safely. Unlike the navigation improvement project, maintenance dredging would not produce clean parent material which could be used for capping. Therefore, disposal options which provide cap material, such as the Meisburger sites and Spectacle Island CAD, are preferable. Disposal could occur at other sites if suitable cap material can be found from other projects. The use of an aquatic site for maintenance dredged material would be subject to a lengthy site designation process. The Corps may be performing a demonstration of capping when suitable material becomes available so that the Massachusetts Bay Disposal Site can be used for maintenance material.

Effects of the Project

Certain short-term adverse effects of the project would be unavoidable. Some benthic organisms and demersal fish would be killed during dredging and blasting. Substrate in the areas dredged would be temporarily devoid of benthic organisms but would be recolonized in approximately one year, reforming habitat with prey suitable for fin fish. Turbidity would increase temporarily in the area of the dredge. Use of an environmental (closed) bucket will help minimize contaminant release. Other turbidity controls, such as silt curtains, will be assessed in terms of suitability depending on the location of the dredging operation. Close monitoring of the dredging operations, to identify problems and quickly seek corrective measures, will be undertaken.

The anticipated dredging rate would generate approximately two to four barges per day, depending on whether one or two dredges were operating and the size of the barges. Thus barge traffic should not

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noticeably impede normal ship traffic; interference with navigation would be minimized by coordination with the Coast Guard.

Impacts due to disposal of dredged materials are temporary since they do not permanently alter the substrate of the in-channel areas. Also, in-channel disposal impacts remain within the footprint of the dredging so that resource areas outside the navigation channels are not impacted except for temporary turbidity impacts.

During the 1½ to 2 year dredging process non-motile benthic organisms utilizing the disposal areas would be buried. Recolonization should occur within one year after disposal operations are completed based on the existing benthic population of early successional stage organisms. Fin fish would tend to avoid the area during disposal due to noise and turbidity disturbances. The benthos and fish would eventually recolonize the dredge site and will benefit from the removal of contaminated silts. Important anadromous fish populations would be protected by suspending dredging and disposal in the Mystic River during the migration season.

The water column in the vicinity of the disposal site would experience increased turbidity following each disposal event. Approximately three to five percent of the silt/clay fraction would be lost to the environment during the disposal descent phase. Disposal simulation model evaluations indicated that disposal will not cause adverse exposure (i.e., exceedances of water quality criteria). The contaminant mixing zone, based on Total Suspended Solids (TSS) and PCB loads, has been calculated based on fate and transport modeling and will not interfere with fish passage and migration. Use of mitigation measures, such as silt curtains, to contain suspended solids and associated chemicals, are proposed as additional safeguards to minimize water quality impacts in the Harbor.

Secondary impacts of the project, consisting of land-side infrastructure impacts, Harbor traffic, and other socioeconomic interests, are minimal. The BHNIP will not significantly increase vessel traffic in the Harbor but will enhance navigational safety and maintain the competitiveness of the existing Port. Vessel traffic will continue to include a mix of large container ships, barges and tankers. The Seaport Access system, which is part of the Central Artery/Tunnel project, will result in more direct and convenient connections for trucks between port terminals and the regional highway network, thereby reducing traffic impacts on local neighborhoods. This roadway system is independent of the dredging project.

Dredge Management Plan

The FEIR/S has addressed the requirement for a Dredge Management Plan (DMP), as requested in the MEPA Scope. The DMP provides an overview of the dredging operations proposed for the project The key elements of the Plan include:

- a description of alternative dredging equipment and specific recommendations for this project;
- a description of dredged material disposal operations;
- a discussion of the sequencing of the dredging and disposal operations;
- an overview of potential

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environmental impacts caused by these activities;

- proposed techniques for mitigating operational impacts;
- establishment of dredging performance standards;
- a description of recommended monitoring plans during dredging and for long term post-construction monitoring;
- and a discussion of potential operational contingency plans that would be implemented to assure the safe and successful completion of the project.

Cumulative Impacts

Cumulative impacts include all long-term maintenance requirements of the BHNIP in association with reasonably foreseeable long-ranged material disposal issues. These impacts also consider other actions in the Boston Harbor area that may have an impact on, or be impacted by, the project.

Selection of disposal sites for future maintenance dredging will be based on the environmental and practicability assessments provided in the MEPA/NEPA documentation. Factors affecting maintenance dredging sites include sediment characteristics and volume of material to be dredged. Sites that require site designation status, because of their capacity for numerous projects, would require lengthy permitting and detailed environmental assessment. Fast-track projects would have to look elsewhere for disposal. The disposal site for future maintenance of the BHNIP, and other Massachusetts projects, will be determined based on the appropriate environmental regulations and technical evaluations at that time. The New England Division Corps recommends, and will participate with the Commonwealth, in conducting an overall regional dredge material management plan for future maintenance of all of the Massachusetts Bay's harbors.

Two other large projects are currently under construction in Boston - the Deer Island wastewater treatment facilities upgrade and the Central Artery/ Third Harbor Tunnel (CA/T). The level of ship traffic generated by the BHNIP, its location relative to the Deer Island and CA/T projects, and the anticipated schedules for the three projects should result in minimal conflicts among the projects. The Massachusetts Highway Department expects that the placement of Third Harbor Tunnel excavate at Spectacle Island will be complete in 1995. As with other harbor infrastructure, coordination with the construction of the Third Harbor Tunnel would have to be carefully orchestrated. The BHNIP is expected to commence in 1997 and be completed in 1998. Coordination of ship traffic from each project with the U.S. Coast Guard will provide further safeguards. The Massachusetts Water Resources Authority (MWRA) anticipates substantial completion of the Deer Island plant upgrades by late 1995.

Water quality (and ultimately sediment quality) would continue to improve with the operation of MWRA's secondary treatment and offshore disposal facilities. The BHNIP and future maintenance dredging would continue to reduce the mass of contaminants in Boston Harbor even further.

Summary of Major Changes from the DEIR/S

Several issues were raised during the comment period that resulted in substantive changes from the proposed list of disposal alternatives presented in the DEIR/S. These issues were resolved as follows:

- Based on applicable environmental screening criteria, all silts generated by the project are considered unsuitable for unconfined ocean disposal.
- The MBDS, Subaqueous B and E, Meisburger 2 and 7, Boston Light Ship, and Spectacle Island CAD, have been eliminated from further consideration as practicable disposal sites for the BHNIP silt. These sites are still being considered as potential disposal locations for future maintenance dredging. Use of these sites for future disposal may require additional studies, demonstration projects, site designation, or the application of appropriate technologies.
- All parent material, consisting of sand/gravel, clay and rock, generated by the project is considered suitable for disposal at MBDS or for beneficial re-use, including use as a potential source of capping material for unlined municipal landfills.
- Technologies will continue to be assessed by the Corps for their potential applicability to future maintenance dredged material.

Cost considerations and capacity are no longer considered to be fatal flaws in disposal site screening. Cost is factored in only to assess the relative cost-effectiveness of disposal scenarios determined to be environmentally suitable and to determine practicability. Capacity is only one factor considered in site screening and combinations of sites of limited capacity may constitute acceptable disposal scenarios.

Federal and State Review

This FEIR/S will be reviewed by regulatory and resource agencies on the federal, state and local levels, as well as other interested parties for adherence to MEPA and NEPA guidelines and for addressing the issues raised in comment letters, at public hearings, and in the Secretary's certificate on the DEIR/S. Comments on this FEIR/S will be accepted by either the MEPA Unit at the Executive Office of Environmental Affairs or by the U.S. Army Corps of Engineers, New England Division. It is anticipated that the public comment period will be open until July 31,1995. Commentors are advised to contact these agencies directly to determine the actual date for the close of the comment period.

Federal and state permits and consistency reviews ultimately required for the project potentially include:

- U.S. Army Corps of Engineers
  - Section 10 of the Rivers and Harbors Act
  - Section 404 of the Clean Water Act
- National Marine Fisheries Service, U.S. Fish and Wildlife Service
  - Endangered Species Act/ Section 7 consultation

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- U.S. Environmental Protection Agency
  - Section 404 and Endangered Species Act consultation

- Massachusetts Department of Environmental Protection
  - Water Quality Certification
  - Division of Wetlands and Waterways review of local Order of Conditions

- Massachusetts Office of Coastal Zone Management
  - Coastal Zone Consistency Review

- local Conservation Commission(s)
  - Order of Conditions

Format of the FEIR/S

This FEIR/S is comprised of three volumes. The first volume contains the main text and consists of:

- The procedural history, and purpose and need, of the project (Chapter One);

- A detailed project description and comparison of design alternatives (Chapter Two);

- A summary of the detailed process for screening sites for material disposal (Chapter Three);

- The environmental and practicability screening of a short-list of alternatives to determine the Least Environmentally Damaging Practicable Alternative (LEDPA) (Chapter Four);

- A detailed dredged management plan to describe the dredging and disposal operations and appropriate mitigation and contingency measures (Chapter Five);

- Mitigation concepts and proposals summary and opportunities for resource enhancement (Chapter Six);

- An assessment of the permitting and regulatory requirements the project must meet (Chapter Seven);

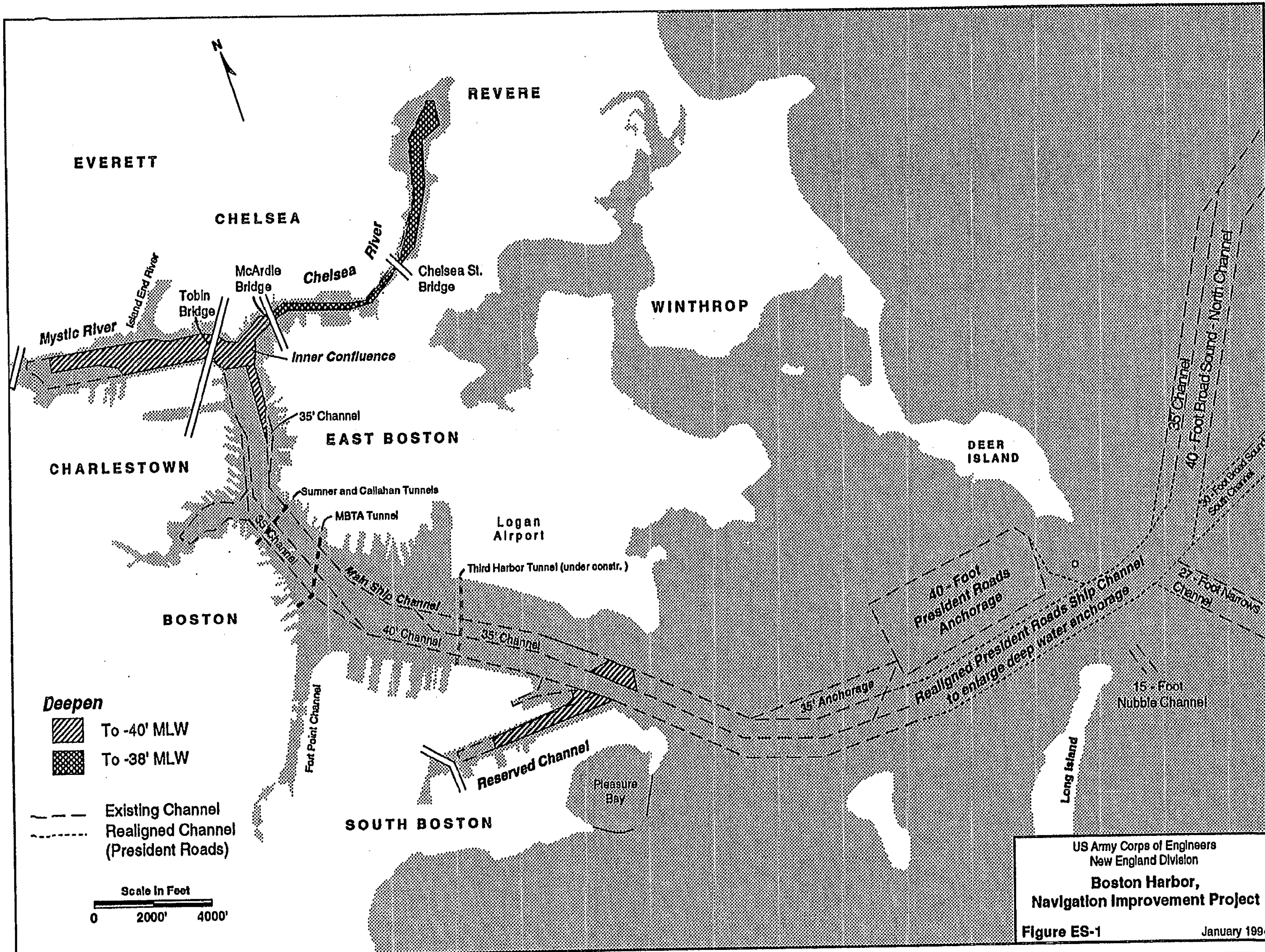
- A draft Section 61 finding to meet Massport obligations under 301 CMR 11.00 (Chapter Eight).

- A list of technical literature cited in this FEIR/S and a bibliography of references on Corps capping experience (Chapter Nine).

- A glossary of technical terms (Chapter Ten).

Attachment 1 to this volume contains detailed descriptions of the affected environment and project related impacts at the short-listed alternative sites.

Volume Two of the FEIR/S provides a copy of all comment letters received on the DEIR/S followed by a detailed response to each. Volume Three consists of appendices referenced throughout this FEIR/S.



REVERE
EVERETT
CHELSEA
Chelsea River
Island End River
McArdle Bridge
Chelsea St. Bridge
Tobin Bridge
Mystic River
Inner Confluence
WINTHROP
35' Channel
EAST BOSTON
CHARLESTOWN
DEER ISLAND
35' Channel
40 - Foot Broad Sound - North Channel
30 - Foot Broad Sound South Channel
Sumner and Callahan Tunnels
MBTA Tunnel
Logan Airport
35' Channel
Main Ship Channel
Third Harbor Tunnel (under constr.)
40 - Foot President Roads Anchorage
Realigned President Roads Ship Channel to enlarge deep water anchorage
27 - Foot Narrows Channel
BOSTON
40' Channel
35' Channel
35' Anchorage
15 - Foot Nubble Channel
Deepen
To -40' MLW
To -38' MLW
Fort Point Channel
Reserved Channel
Pleasure Bay
Long Island
Existing Channel
Realigned Channel (President Roads)
SOUTH BOSTON
Scale in Feet
0 2000' 4000'
US Army Corps of Engineers
New England Division
Boston Harbor, Navigation Improvement Project
Figure ES-1
January 1994

Chapter One: Introduction

This document constitutes a joint Commonwealth of Massachusetts Final Environmental Impact Report and Final Environmental Impact Statement (FEIR/S) prepared by the Massachusetts Port Authority (Massport) and the U.S. Army Corps of Engineers (Corps). As a joint document, this FEIR/S meets the requirements of both the Massachusetts Environmental Policy Act regulations (301 CMR 11.00 *et. seq.*) implemented by the MEPA Unit of the Executive Office of Environmental Affairs, and the National Environmental Policy Act regulations (40 CFR Parts 1500 - 1508) also known as NEPA.

This document pertains in part to the Corps' Navigation Improvement and Berth Dredging Projects. These Projects were authorized by Congress in the Water Resources Development Act of 1990 (P.L. 101-640). This document also pertains to Massport in its role as local sponsor of the Federal project and for its planned berth dredging activities.

The MEPA regulations establish environmental review thresholds, a procedure, and a timetable for a two-level review process. The process generally begins when the project proponent, in this case Massport, files an Environmental Notification Form (ENF) with the Secretary of the Executive Office of Environmental Affairs (EOEA). Upon review of the ENF, the Secretary determines whether an Environmental Impact Report (EIR) is required for the project. The Secretary determined that the Massport project required an EIR in a certificate issued on June 7, 1991. An EIR is an informational planning document which serves to inform public decision makers, and the general public, of the environmental effects of the proposed project. As a planning tool, an EIR enables both the project proponent and agency decision makers to weigh environmental impacts and benefits prior to making decisions on permits, approvals or funding. The EIR is reviewed and commented on, at both draft and final stages, by agencies, the public, the MEPA Unit, and the Secretary. The Draft EIR was published in April 1994. This FEIR/S is designed to respond to comments received on the Draft including the Secretary's certificate dated June 30, 1994 (see Appendix A), and complies with the requirements for a Final EIR as described in 301 CMR 11.07 (10).

The final component for MEPA compliance is the required review and evaluation of projects to determine whether all feasible means and measures will be used to avoid or minimize damage to the environment. This last step is a process generally referred to as a "Section 61 finding" and is required by M.G.L. c.30, § 61. No agency may act on a permit or commence a project until this finding is complete. The Draft and Final EIRs serve as the substantive bases for the Section 61 finding, and as such, the FEIR may contain a proposed finding (301 CMR 11.07(10)). This FEIR therefore, contains Massport's Draft Section 61 finding. The Department of Environmental Protection (DEP) is also required to submit its own finding prior to issuing permits and approvals for the project.

Similarly, the Federal NEPA process is designed to insure that environmental information is available to public officials and citizens before decisions and actions are taken by Federal agencies. A federal agency's decision to prepare an Environmental Impact Statements (EIS) under NEPA based on the magnitude of the project, the similarity of the project to others which normally require an EIS, or if the nature of the project is one without precedent (40 CFR §1501.4). For this project, the U.S. Army Corps of Engineers, New England Division (Corps) is the lead federal agency for the EIS. Scoping of the EIS is based on the participation of affected federal, state and local agencies and interested persons in public scoping sessions. Scoping sessions were held in June 1992 for the Boston Harbor project.

Draft EISs are prepared in accordance with the scope derived from the scoping meetings and must meet the format requirements of 40 CFR Part 1502.10. Final EISs must also respond to comments received on the Draft. Following the review of all comments received on the Draft EIS, and the review of comments received on the Final EIS, the lead federal agency must review all relevant information and must consider all alternatives described in the EIS in order to render a decision on the proposed action. At the time of its decision, the lead agency must prepare a concise "record of decision" or ROD, identifying all alternatives considered by the agency in reaching its decision and specifying the alternative considered to be environmentally preferred. The ROD must also state whether all practicable means to avoid or minimize environmental harm have been adopted, and if not, why they were not.

This document serves to meet the requirements for a Final EIR/S as specified in 301 CMR 11.07(10) and 40 CFR Part 1503. This document identifies a preferred dredging and dredged material disposal option, assesses the anticipated environmental impacts associated with each, identifies potential long-term disposal options that may be appropriate for maintenance dredging of the completed project and responds to all comments received on the Draft.

The MEPA and NEPA processes, while different, require substantially similar environmental analysis and documentation of proposed actions. Because of this similarity in substantive material, and because regulatory agencies and the public would be simultaneously reviewing both the EIR and EIS produced for the project, Massport and the Corps elected to file a joint EIR/EIS. The combination of the two documents is specifically provided for in 40 CFR 1506.2 (c). As stated earlier, the Draft EIR/S was published in April 1994.

There are further opportunities for public review and comment on the proposed action. Under MEPA, a notice of availability of the FEIR is published in the *Environmental Monitor*. This notice is followed by a thirty day comment period, after which the Secretary of the EOEA issues a statement indicating whether or not the FEIR adequately and properly complies with the provisions of the MEPA regulations. Public comments on the FEIS may also be received and reviewed by the

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Corps under NEPA and are considered in the preparation of the ROD. Readers who wish to offer comment on this document are advised to contact Ms. Nancy Baker at the MEPA office (617-727-5830) or Mr. Larry Rosenberg at the U.S. Army Corps of Engineers (617-647-8657) for the dates that the respective public comment periods close. It is anticipated that public comments will be accepted through July 31, 1995. However, individual MEPA or NEPA procedural requirements may affect this closing date.

Lastly, the proposed project will require federal, state and local permits and approvals. The MEPA and NEPA documentation will provide a substantial basis for the permit applications. The administrative procedures for acquiring the various permits and approvals also provided opportunities for agency and public comment. Permits from Massachusetts agencies cannot be issued until the MEPA process is closed by the Secretary's certificate and the preparation of a Section 61 finding by the issuing agency. Federal agencies are also barred from issuing federal permits until the NEPA process is complete and a ROD has been issued for the project. Chapter 7 of this FEIR/S describes the permits that will be required to undertake the proposed action.

Both the MEPA (301 CMR 11.07(3)) and NEPA (40 CFR § 1502.13) regulations require a purpose and need statement that briefly specifies the underlying objectives and anticipated benefits of the project. The next section provides the underlying purpose and need for the BHNIP and the economic benefits expected to accrue from its completion.

1.1 PROJECT PURPOSE AND NEED

The purpose of the Boston Harbor Navigation Improvement Project (BHNIP) is, as stated in the DEIR/S, "to increase the navigational efficiency and safety of Boston Harbor for present types of deep drafted vessel traffic..." The BHNIP will thereby enable the Port of Boston to remain competitive with other ports in the national and international marine trade business.

The existing Federal navigation project was originally constructed to serve the port's commercial terminals located along the main ship channel waterfront. Changing waterfront land use patterns have resulted in most of the port's active terminal facilities shifting from the Main Channel to the -35 foot MLW tributary channels. The BHNIP will provide for improvement dredging in the tributary channels to accommodate the current vessel fleet to a depth of -40 feet MLW.

The BHNIP as proposed is comprised of three dredging components:

1. Deepening the Mystic River and Reserved Channel areas to -40 feet MLW and deepening the Chelsea River to -38 feet MLW.

2. Deepening portions of the Inner Confluence area, as well as the Main Ship Channel at the mouth of the Reserved Channel, to provide for increased areas for navigational maneuvering.

3. Dredging associated beneficiary and related berths.

The various elements of the proposed action are described in detail in Chapter Two. The economic analysis compiled by the Corps, and contained in the 1988 Feasibility Report, concluded that the project is justified economically by increasing navigational efficiency. The BHNIP will address the Port's need to allow passage of more efficient, larger vessels which will transit the Harbor during a wider range of tidal stages. The BHNIP will enable the Port of Boston to accommodate the current fleet of container ships, with drafts up to -40 feet MLW, cruise ships, such as the QEII with a draft of -37 feet MLW, and the Chelsea-class tankers, which draw 36 feet.

Improving the tributary channel and berth depths in Boston Harbor will be the port's first major dredging project since 1982/83 when 867,000 cy of dredged material was removed from the Mystic River, Chelsea Creek and President Roads. The only additional dredging projects completed since that time have been small volume projects for maintenance of individual berths.[1]

1.1.1 Historical Importance of the Port of Boston

Boston has a long and colorful maritime history. The Port has provided jobs and economic opportunity for residents for over three hundred years. It has created fortunes in foreign trade and commerce for residents of the region. Because of a renewed interest in Boston Harbor with its commercial, recreational, scenic and commuter transportation offerings, more people are spending time there.

Today, the Port looks different from the images taken from earlier years when commercial traffic in the Harbor was heavy and terminal berths, which lined the waterfront, were always occupied by commercial vessels. Table 1.1 lists the terminals and docking facilities operating in Boston Harbor today which have been expanded to serve commercial, recreational, tourist and commuter traffic that now occupies the Harbor. Figure 1.1 depicts these docking facilities that have industrial port terminals alongside cruise ship terminals, and commuter and excursion boat docks. Boston Harbor hosts sailboat races alongside the huge container ships transiting the Harbor to reach marine terminals.

The importance of the Port to the Greater Boston metropolitan area and to the region remains vital. Over the years, it has consistently allowed the region to capitalize on its location, one day closer to Europe than other major U.S. ports.. This has been advantageous for three centuries when the bulk of trade was with North Atlantic countries. The Port now has the potential to be a U.S. gateway for trade with the rapidly growing countries in Southeast Asia, but only if its 40-foot depths are maintained.

[1] Some examples of recent dredging projects include the Mobil Oil Corp. terminal berth in the Chelsea Creek (approximately 1,500 cy) in 1991; Coastal Oil Corp. terminal berths in the Chelsea Creek and Reserved Channel (approximately 3,000 cy in 1992); and Moran Terminal in the Mystic River (approximately 10,000 cy in 1993)

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1.1.2 Economic Benefits of Project

The economic benefits of the BHNIP project can be summarized as follows:

1. Increased navigational efficiency by reducing the need to wait out tides or to decrease loads prior to entering the Harbor;

2. Ability to ship more tons of containerized cargo with fewer ships;

3. Ability to attract new shipping lines;

4. Maintain navigational safety of vital refined oil products facilities.

Each of these benefits are described inthefollowing paragraphs:.

1.1.2.1 Navigational Efficiency

Changes in the world wide shipping fleet have occurred in response to the need to minimize vessel operating costs and as a result of governmental regulations. While larger vessels are more costly to operate, they can move much more cargo on a given trip thereby lowering the cost per unit of cargo. In the highly competitive maritime industry, ports without ample depth cannot attract the new fleet of vessels. The cost to operate today's ocean-going vessels is too high to support unproductive time waiting for tide changes or traveling at less than full loads. As an example, Massport notes that it can cost $35,000 per day to operate a container ship. The 40-foot depth of Boston's main navigation channels and the proposed depth of -40 feet MLW in two of its tributaries, and -38 feet in Chelsea Creek will enable these large ships to move through the Harbor.

Alternately, if there is no dredging project and shipping lines still must wait for the high tide, the Port is likely to see a reduction in direct calls. This could discourage shippers who object to the added cost and extra time required for lightering to barges or overland movements. These shippers will seek out more direct shipping opportunities. Equally important is that without improvement dredging, there could be a reduction in cargo volume moving through the Port which translates into economic loss to the region.

1.1.2.2 Containerized Cargo Volumes

The number of deep-drafted vessels calling in the Port of Boston may have diminished over the years, as shown on Table 1.2, but larger vessels can now carry a greater volume of cargo. In 1975, for example, 272 fully containerized vessels called with some 400,000 tons of cargo. In 1994, 198 vessels called with over 1,313,000 tons of cargo (see Table 1-3 which identifies deep draft vessels by type of vessel, and Figure 1-2, which shows the volume of containerized cargo coming through the Port).

The magnitude of potential gains and losses depending on a decision about dredging is shown on Table 1-4. The table assumes that the dredging project is completed in 1998 and that cargo tonnage increases at the rate of 3% for a total of 1,514,200 tons in that year. That tonnage yields about $1.73 billion in value including 13,000 total jobs in the region.[2]

Using what Massport considers to be a conservative growth rate, 3% annually, for the volume of cargo coming through the Port, the table shows that the total new cargo volume will be over 241,000 tons at the end of five years.[3] The economic benefit of the additional tonnage will be over $277 million (not discounted to 1995 dollars). This represents almost 1,900 new jobs. The BHNIP enables this growth to occur by ensuring that vessels can transit the Harbor with a minimum of delay.

1.1.2.3 Ability to Attract New Shipping Lines.

On the other hand, news of a No-Action decision on dredging Boston Harbor will affect the decisions of shipping lines and shippers, since navigational delays and restrictions will continue, and will likely decrease the volume of cargo coming through the port. Once the decline in tonnage begins, it will be difficult to turn around. The fixed costs to operate the port for diminishing cargo volumes could eventually prove too high to operate cost-effectively.

Without dredging, the Port of Boston potentially loses the direct calls, with the accompanying loss of tonnage moved through the port. Table 1-4 shows that with annual declines of 1%, 3%, or 5% in cargo tonnage, losses in benefits to the region over a five year period, range from $85 million to $392 million. Job losses in the port community could be anywhere from about 580 to 2,700 during that time. This is for containerized cargo, alone. Cruise ships, currently drawing 25-37 feet, also need convenient access to berths to sustain this industry which has brought additional tourism to the region.[4]

1.1.2.4 Maintain Refined Oil Product Capacity

The BHNIP is especially important to the region because it keeps the Port of Boston open to supply the region's growing energy needs. Without refineries of its own, New England's refined oil products must be brought in from the Mid-Atlantic states or the Southwest, or imported from abroad. Most of the product arrives through ports, and the Port of Boston is a dominant player in this arena.[5] Vessels carrying petroleum products are also getting larger to minimize operating costs per gallon. The size of vessels also is increasing in response to the mandate for double-hulled tankers pursuant to the Oil Pollution Act of 1990. New tankers may have the same carrying capacity as the old ones, but will draw more because of the double-hull and will be wider.

[2] Massport calculates economic impact to the region of each ton of cargo is $1,120.

[3] Massport internal memorandum, "*Marketing Projections of Container Volumes and Vessel Calls*, January 13, 1995.

[4] Massport data indicates that 23 cruise ships called in 1993, 49 called in 1994.

[5] Massachusetts Division of Energy Resources Report, March 1992.

When the "Chelsea-class" vessels, which currently operate in the port and draw 36 feet, retire, the new vessels coming on line to replace them will be larger and will require more depth since Chelsea-class vessels are no longer financially viable to operate. The newer vessels will be restricted by two factors:

1. Tides - Insufficient depth at mean low water requires vessels to partially unload or "lighter" the vessels prior to entering the Harbor. The lightering process entails pumping product from the vessel to a barge. It is inefficient because it requires the double-handling of product.

2. Day light hours - The wait for high tide can be especially costly for vessels bound for Chelsea Creek since the Coast Guard prohibits vessels measuring more than 630.5' in length and 85.5' in beam from transiting the "marine safety zone" in Chelsea Creek between sunset and sunrise. Maintaining a schedule for accessing berths in Chelsea Creek can be difficult, especially in winter, given the need to have both high tide and daylight, and given the few hours of daylight in winter.

Each fuel company has its own method for calculating the cost to "lighter". While the transfer of product may cost 0.5 cents per gallon, that figure does not include the cost of delay to a vessel during the lightering operation. The cost of the delay depends on the amount of product requiring transfer. While there is no definitive figure for the cost of lightering in the Port of Boston, recent analyses have suggested 4-4.5 cents per gallon as a cost attributable to lightering in the Ports of Providence and New Haven. This cost is generally passed on to the customer. Given the inconvenience currently posed by lightering and delays for high tide, the BHNIP will in general, facilitate movement of cargoes through the Port, minimizing the frequency of those procedures and increase the margin of safety for those vessels currently operating in the Port.

1.2 PROCEDURAL HISTORY

The publication of this FEIR/S is the culmination of many years of analysis and review. Since the publication of the Draft EIR/S in April 1994, the project proponent and the Corps have had close coordination with state and federal agencies on all aspects of the Project. The following pages outline the procedural history and development of this document and the coordination efforts of the project partners.

1.2.1 Congressional Authorization

The genesis of the Boston Harbor dredging project can be traced back to 1968 when Congressional and local interests expressed the need for modifications to Boston Harbor channels because of the increased traffic in bulk commodities flowing through the port, and the delays being experienced by larger vessels requiring a high tide to negotiate the existing restricted ship channels into areas of the port. Local navigation interests, via two Congressional Resolutions (March 1, 1968 and September 11, 1969), requested the Corps review the present and projected navigation needs in

Boston Harbor. The Corps maintains the authority to conduct General Investigations into improving the navigability of waters of the United States under the River and Harbors Act of 1899.

A Feasibility Report and Environmental Assessment was completed in 1988 by the U.S. Army Corps of Engineers for the navigation improvement project, identifying the economically and environmentally favored alternative. Congressional authority for the project was included in the Water Resources Development Act of 1990 (P.L. 101-640). The favored alternative consisted of deepening the Mystic River and Reserved Channel from -35 feet to -40 feet MLW, and the Chelsea Creek from -35 feet to -38 feet MLW. The 1988 favored alternative also included dredged material disposal at the MBDS, with capping of unsuitable material. In addition to the proposed deepening, the favored alternative called for modifications in the Mystic River, the Inner Confluence and at the entrance to Reserved Channel to provide safe maneuvering areas. Finally, in the President Roads area, channels are to be remarked and designated along the southern reach of the roads connecting the outer confluence of the three entrance channels with the inner harbor Main Ship Channel. This will enlarge the anchorage area from about 375 acres to about 420 acres. This portion of the Congressionally authorized proposed action is termed the "improvement" project.

Six berth areas adjacent to these channels (Conley 11-13, Prolerized, Distrigas, Moran, Eastern Minerals and Gulf Oil), deepened to at least the same depth as the channel, would realize the greatest economic benefits from the "improvement" project. Deepening these berths is termed the "berth dredging" project and these selected berths are collectively termed "beneficiary" berths. The 1988 Corps feasibility study assessed the economic feasibility of the proposed "improvement" and "berth dredging" projects and found that the regional benefits of the project exceeded project costs.

In addition to the beneficiary berths, other berths within Boston Harbor, but not adjacent to the Federal project channels being improved (Boston Army, Boston Edison Intake, Boston Edison Barge, Conley 14-15, Revere Sugar, Mystic Piers 1,2, 49 and 50), would also be deepened at the same time as part of Massport's Berth Dredging Project. Both the Corps improvement and berth dredging projects, and Massport's berth dredging projects, are collectively termed the Boston Harbor Navigation Improvement Project (BHNIP). There are two main differences between the Congressionally authorized proposal and the BHNIP. First, under the BHNIP dredged silts will not be disposed of at the MBDS, unlike the 1988 proposal. It is now proposed that silts be disposed within the dredging footprint of the authorized channels in trenches excavated for that purpose. Although this will entail digging portions of these channels deeper than authorized for the navigation project, this is permissible because the extra depth is for disposal, not navigation.

Second, the non-beneficiary berths (those not adjacent to the federal improved channels) were not included in the 1988 proposal but are considered part of the BHNIP. The term BHNIP will be applied to all aspects of the Corps and Massport projects and will be treated as one throughout this document except where otherwise noted. The locations of

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proposed dredging activities are shown on Figures 1-3 through 1-9.

1.2.2 Public and Agency Review

As stated earlier, the BHNIP is subject to review under the Massachusetts Environmental Policy Act (MEPA) (M.G.L. c. 30 § 62A-H and regulations promulgated thereunder at 301 CMR 11.00). The Secretary of Environmental Affairs determined on June 7, 1991, that an Environmental Impact Report (EIR) is required since the Massport berth dredging project involves the dredging and alteration of ten or more acres of resource area protected by the wetlands regulations (310 CMR 10.00). In June 1992, the U.S. Army Corps of Engineers determined that an EIS is required for the federal project under the National Environmental Policy Act (NEPA) (42 USC 4321 *et. seq.*) due to the cumulative impacts of the Federal actions (maintenance dredging, navigation improvement dredging, and permitting of the associated berthing areas) and the significant public concern over disposal of the dredged material. The content of the EIR/S was prescribed in the June 1991 MEPA certificate and June 1992 NEPA scoping documentation which appear in Appendix A of the Draft EIR/S published in April 1994.

After publication of the Draft EIR/S in April 1994, the public review process of the DEIR/S included several public meetings, meetings with concerned interest groups, and the receipt of the sixty-one comment letters from federal, state, and local agencies, commercial interests, private interest groups and private citizens. Public meetings were held in Boston and Hyannis on May 17 and 19, 1994 respectively. These meetings were planned under the direction and guidance of the New England Division (NED) Corps and consisted of a variety of techniques tailored to the individual project including a public partnership between the NED-Corps, Massport and public advocacy groups such as the Conservation Law Foundation and Save the Harbor/Save the Bay.

The meetings were designed to offer multiple opportunities for public input in identifying issues early in the process so they could be fully addressed through additional data collection and analysis and publication in the FEIR/S. Afternoon and evening sessions were held at both locations to allow for maximum opportunity for interested public comment. The Boston sessions resulted in formal comments from sixteen individuals and public interest groups. The Hyannis meetings generated formal comments from seven individuals and groups. Transcripts of both meetings are provided in Appendix B. On July 28, 1994, a special meeting was held in Nahant in response to a request from the Board of Selectmen. Thirty one speakers offered comments for the record. A copy of the transcript from this meeting is also included in Appendix B.

At the request of specific individuals and groups, presentations were made at various locations with stakeholders and groups, and one-on-one presentations and interviews.

These meetings were in addition to the public participation process described in Section 1.4 of the DEIR/S.

1.2.3 Public Participation Process

The Corps and Massport recognize that large projects which may impact the public cannot be accomplished unilaterally. Rather, the success of the project depends on involving key groups effectively. This general principle had a number of important implications. Key parties needed to be identified which either had a stake in the outcome (regulatory agencies, environmental groups, and harbor users), or could provide useful information to the Corps, Massport, and its consultants. Effective involvement of these parties required that they be consulted early, that they be provided timely information on the progress of the project, and they have the opportunity to present diverse points of view. To that end, the Corps, Massport and its consultant developed a public participation process which consisted of a broad-based Advisory Committee supplemented by targeted, focused working groups to assist project planners in particular technical areas such as sediment characterization and disposal alternatives. A list of Advisory Committee and Working Group members is provided in Appendix C.

The Advisory Committee convened twice during the preparation of the FEIR/S, in September 1994 and March 1995. The Advisory Committee was instrumental in assisting the project team in identifying major areas of concern regarding the DEIR/S that required additional data collection or analysis in the FEIR/S. The meetings also identified the need for two supplemental working groups. These consisted of a working group meeting in November 1994 focusing on developing a comprehensive data base of dredged material treatment and disposal technologies. The results of the technology screening process are described in Chapter 3.0 of this FEIR/S. A second working group convened in December 1994, focusing on mitigation and monitoring concerns that would be developed into a comprehensive Dredge Management Plan, as required by the Secretary's MEPA certificate (see Appendix A).

1.2.4 Inter-Agency Coordination

In addition to the public participation process, the project team also engaged in several meetings with combined EOEA agencies since the late summer of 1994. These meetings assisted the project team in clarifying technical comments the agencies provided in letters responding to the DEIR/S; assisting the project team in designing data collection studies; coordinating EOEA agency responsibilities; and focusing on related pre-permitting activities. These meetings have been invaluable to the development of this FEIR/S.

Meetings were also held between the Federal cooperating agencies and the NED-Corps to address Federal issues concerning comments on the Draft EIR/S and the permitting process under the Clean Water Act and the Marine Protection, Research, and Sanctuaries Act. Formal meetings were held with the Federal agencies in November 1994 and March 1995, as well as informal meetings, to narrow the list of practicable disposal sites based on functions and values, under a process known as the Federal Highway Methodology, as well as cost and engineering feasibility.

The extensive comment and input process described above has assisted the project

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team in identifying and assessing project alternatives and their impacts. Volume 2 of this FEIR/S contains detailed comment responses for each letter received or comment made at the public meetings. The next section highlights the most significant changes made to the project in response to the public and agency review process. Each of these issues, and many others, are fully developed in the later pages of this document.

1.3 SUMMARY OF MAJOR CHANGES FROM THE DEIR/S

This section highlights significant findings and issues that were raised as concerns during the DEIR/S review process and how they have been resolved in the FEIR/S.

1.3.1 Use of Massachusetts Bay Disposal Site (MBDS)

A great deal of public comment on the DEIR/S centered on the use of the MBDS as a potential disposal site for contaminated sediments. The comments can be grouped into three major areas as follows:

- The expressed concern that the site is not suitable for the disposal of contaminated materials until capping is proven effective in eliminating transfer or bioaccumulation of contaminants into the environment in a demonstration project as required by 40 CFR 228.12, as amended.

- A perception that the Corps has not demonstrated that they can successfully cap at MBDS depths, based on the current body of engineering studies available from the Corps.

- The expressed concern that contaminated material loss during the drop of dredged silts into deep water may be more significant than that projected in the DEIR/S, with resulting potential deleterious effects on aquatic life near the site and at Stellwagen Bank.

In response to these concerns, the project proponent and the Corps have eliminated the MBDS as a viable disposal option for contaminated silt for the BHNIP project. The MBDS will be used for disposal of uncontaminated parent material and is being considered for disposal of future maintenance dredging material provided the Corps or other agencies effectively complete demonstration projects for capping or other technology as described in Section 2.4 of this document.

1.3.2 Use of Cost as a Ranking Factor in Evaluating Disposal Alternatives

In screening and ranking the desirability of various disposal options, the DEIR/S used disposal of contaminated silts at MBDS as a baseline cost against which other disposal options were measured. Since MBDS is not a viable option for the disposal of contaminated silts, for this phase of the project, this cost baseline no longer holds for disposal of that material. While costs are still used as a ranking factor in this FEIR/S it is no longer the primary consideration, nor are options rejected solely on this basis. **We have eliminated (in response to comments) any across-the-board cost cap in screening sites and**

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disposal options. This has been substituted with a two-step approach that: 1) evaluates sites and options in terms of environmental acceptability; and 2) ranks the most environmentally acceptable alternatives based on cost-effectiveness. Under this approach, no environmentally acceptable option is discarded without receiving a review on its merits.

1.3.3 Emphasis on Using Previously Impacted Areas

Many comments from the public made clear that they preferred confining the impacts of dredged silt disposal to already-impacted areas in the Inner Harbor, rather than realizing impacts in the relatively pristine Outer Harbor or Massachusetts Bay. The concerns centered on the following issues:

- Fisheries habitat disruption, especially prime valuable lobster habitat at the Meisburger sites.
- Overlap of the MWRA outfall impacts with use of Meisburger 2 could make tracing contamination sources difficult.
- Boston Harbor sediments should not be "exported" to Massachusetts Bay, but kept confined on land or in the Inner Harbor.
- The increasing pressure on the fishing industry as a result of dwindling stocks will be exacerbated by the use of the open water aquatic sites.

To address these concerns, the project proponent and the Corps undertook a detailed fish, lobster and benthic survey of all potential aquatic sites to evaluate and compare their relative resource value. The sampling program and results are fully described in Chapter Four. Based on this analysis, and in part on public concerns, **the project proponent and the Corps have eliminated the use of sites in the Outer Harbor and Massachusetts Bay from further consideration for the disposal of the BHNIP silt.** Future studies, including capping and geotextile technology review, will be undertaken to evaluate the potential use of these sites for future maintenance material.

1.3.4 Sediment Characterization

The DEIR/S indicated that the Corps determined that approximately 360,000 cubic yards (cy) of silt was suitable for ocean disposal based on bulk chemistry, bioassay and bioaccumulation data required by ocean dumping regulations in 40 CFR Chapter 1, Subpart B. However, using the same data, the U.S. Environmental Protection Agency (EPA) determined that none of the silt was suitable for unconfined ocean disposal. In response to these comments, the Corps adopted the more conservative position and assumed that **all silt from the Corps improvement and beneficiary dredging, and the Massport berth dredging, is considered unsuitable for unconfined ocean disposal.** Therefore, disposal options were developed for the entire in-situ silt volume of 1.1 million cy. Parent material, consisting of uncontaminated clay and sand, from the deepening and improvement of the Federal channels, was determined to be suitable for disposal at the MBDS. Potential options for the beneficial re-use of the clay material are discussed in Chapter 3. Rock to be removed from the channels will be used to armor disposal sites from ship and storm-generated waves

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or other beneficial uses. Rock remaining after these applications will be disposed at the MBDS.

1.3.5 Treatment Technologies

The public review process generated great interest in identifying and considering new technologies for handling and treating contaminated marine silts. A number of commentors suggested that the project proponent and the Corps look more carefully at these technologies. The technology that generated the most interest was the potential use of geotextile containers. As described in Section 2.4, the Corps is monitoring on-going projects in other Corps districts around the country, and at the Corps' Waterway Experiment Station (experimenting with geotextile containers). This technology is a containment technology rather than a chemical or biological treatment of sediments per se. The project proponent and the Corps also polled thirty-seven technology providers using a detailed questionnaire developed with the assistance of the Disposal Options Working Group.

The technologies screened through the questionnaire process are considered not currently practicable due to a lack of demonstrable success, logistics of deployment, "permittability" questions, cost, management of by-products, and the ability of the technologies to handle the volumes and types of contaminated silts generated by the Project. The technology survey is more fully described in succeeding sections of this FEIR/S. The survey form and results are presented in Appendix D. The Corps will continue to work with other Corps districts to monitor the development of treatment and containment technologies, especially geotextile containers, as they may become available and suitable for future maintenance dredging purposes.

1.3.6 Site Screening and Development of Disposal Options

As described in the DEIR/S, the site screening process was developed in coordination with the Advisory Group and a specific Disposal Options Working Group. Several commentors raised concerns as to how the screening criteria were applied, especially concerning minimum site capacity requirements and the use of a baseline cost comparison. As stated in Section 1.3.3, cost information continues to be one factor in the practicability determination, but will no longer be used as the primary screening criterion. In addition, limited site capacity is not viewed as a fatal flaw in site selection, but is considered with other factors such as environmental impacts associated with a site, developability of the site, constructability and access concerns, permittability, neighborhood impacts, and costs of development for unit of storage. **Individual sites were not screened out based solely on their limited capacity or higher total cost if, in combination with other sites, they might comprise least environmentally damaging practicable alternatives (LEDPA).** Cost, capacity and other practicability considerations were applied only after the environmental analyses were completed.

1.3.7 Detailed Dredge Management Plan

Several commentors requested more specific information on dredging and disposal performance standards to ensure compliance with permit conditions and compliance with permit conditions and general environmental quality standards. As an example, the project team has responded to these concerns by specifying the use of an environmental bucket to minimize release of contaminated sediment during dredging and outfitting the bucket with a sensor to detect whether it is in a closed condition or if closing is impeded by debris.

The Dredge Management Plan (DMP) also contains:

- specific recommendations for dredging equipment;
- detailed descriptions of the dredging and material disposal operations;
- the scheduling and timing of dredging and disposal operations;
- an overview of potential environmental impacts caused by dredging and disposal and proposed techniques for mitigating these impacts;
- environmentally-based dredging performance standards;
- a description of recommended monitoring plans during dredging and for long-term, post-construction monitoring;
- a discussion of operational contingency plans that would be implemented to assure the safe and successful completion of the project.

1.3.8 Summary of Changes

The issues addressed in the preceding paragraphs have resulted in the following project changes:

- Based on applicable environmental screening criteria, all silts generated by the project are considered unsuitable for unconfined ocean disposal.
- The MBDS, Subaqueous B and E, Meisburger 2 and 7, Boston Light Ship, and Spectacle Island CAD have been eliminated from further consideration as practicable disposal sites for BHNIP silt. These sites are still being considered as potential disposal locations for future maintenance dredging. Use of these disposal sites for future maintenance dredging may require additional studies, demonstration projects, or the application of appropriate technologies that may render these sites practicable in the future.
- All parent material, consisting of sand and clay, generated by the project is considered suitable for disposal at MBDS or for beneficial re-use, including as a potential source of capping material for unlined municipal landfills.
- Technologies will continue to be assessed by the Corps for their potential applicability to future maintenance dredged material.
- Cost considerations and capacity are no longer considered to be fatal flaws in disposal site screening. Cost is factored in only to assess

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the relative cost-effectiveness of disposal scenarios determined to be environmentally suitable and to determine practicability. Capacity is only one factor considered in site screening and combinations of sites of limited capacity may constitute acceptable disposal scenarios.

1.4 FORMAT OF THE FEIR/S

The foregoing sections highlight significant issues arising from the careful consideration this project has received by Federal, state and local agencies; commercial interests; public interest groups; and private citizens. The project proponent and the Corps are grateful for the time and effort expended by so many in assisting in the development of an environmentally acceptable and fiscally responsible project. A list of preparers is provided in Table 1-5. The remainder of this section describes the format of this document to assist the reader in locating critical text.

Due to the complexity of the project, and the extent of the public review process, this FEIR/S is designed to serve, as much as possible, as a stand-alone document. This FEIR/S incorporates by reference in its entirety the Draft EIR/S and all referenced technical reports and studies. Specific references will be made to portions of the DEIR/S as appropriate to avoid duplication of massive technical appendices. Critical issues developed in the DEIR/S will be extracted and distilled in the FEIR/S so that the general reader will understand the issues presented.

As a result of our effort to make this FEIR/S readable, and as a result of numerous comment letters, this FEIR/S consists of three volumes. Volume 1 contains the main text material; Volume 2 consists of a photocopy of comment letters received since the publication of the DEIR/S and an individual response to each letter. Volume 3 contains all referenced appendices.

A summary of the contents of Volume 1 are as follows:

- Chapter Two (Project Description) presents the dredging project, its limits and components, and the alternatives considered in designing the channel and berth dredging. This section provides the final calculations of parent material to be dredged for the maintenance and improvement projects as well as material excavated for the preferred disposal options. It also describes future maintenance dredging requirements after project completion over the 50-year design life of the project.

- Chapter Three (Material Disposal Site Selection Process) presents the dredged material disposal option selection process. Of special note is the discussion of additional data collection efforts conducted in response to comments received during the public review process. These efforts included a fishery, benthic and lobster study and short and long-term modeling to determine water quality impacts.

- Chapter Four (Selection of Preferred Disposal Option) is the heart of the environmental analysis portion of this FEIR/S. It presents a detailed explanation of the environmental benefits and detriments of a number of disposal scenarios. The discussion is developed against the framework of Massachusetts Wetlands Protection Act and water quality standards, federal functions and values assessments under the Clean Water Act, and a comparison of all least environmentally damaging alternatives. Finally, practicability concerns are layered onto the evaluation to consider cost, availability, and logistics to eventually arrive at a single preferred disposal scenario. Chapter Four culminates with a detailed description and evaluation of the preferred disposal option. The preferred option consists of in-channel disposal, with capping.

- Chapter Five (Dredge Management Plan) is the technical core of this document. It presents the detailed Dredge Management Plan (DMP) that was prepared in outline form in the DEIR/S. The DMP provides a detailed sequence of construction for both the dredging and disposal operations. The plan also addresses concerns raised in the comment letters regarding construction and post-construction monitoring and contingency planning for reasonable and foreseeable environmental or operational occurrences.

- Mitigation concepts, both resource and operationally-oriented, are described in Chapter Six (Mitigation Planning and Proposals). Mitigation concepts are presented in sufficient detail to enable the reader to understand the range of mitigation considered by the project proponent and the Corps as well as the issues which are likely to be addressed during the permitting process.

- The permitting and regulatory requirements which the project must meet are defined and described in Chapter Seven (Regulatory Compliance).

- Chapter Eight (Section 61 Finding) provides a draft Section 61 finding to meet Massport and EOEA agency obligations under 301 CMR 11.00.

- Chapter Nine (Literature Cited) provides detailed references for the technical reports cited in the text.

- Chapter Ten (Glossary of Terms) provides definitions for the technical terms used in this report.

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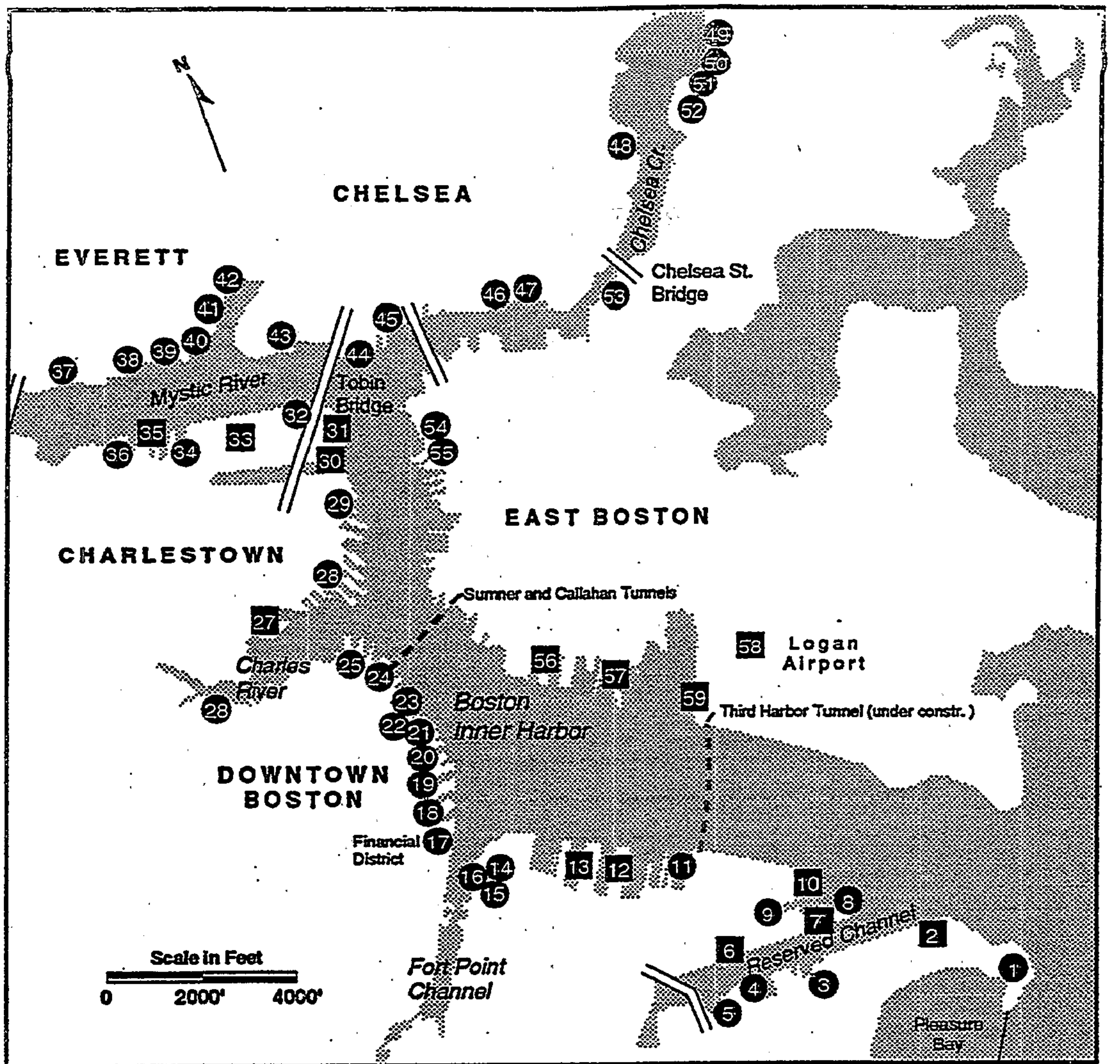


■ Massport Properties ● Non-Massport Properties

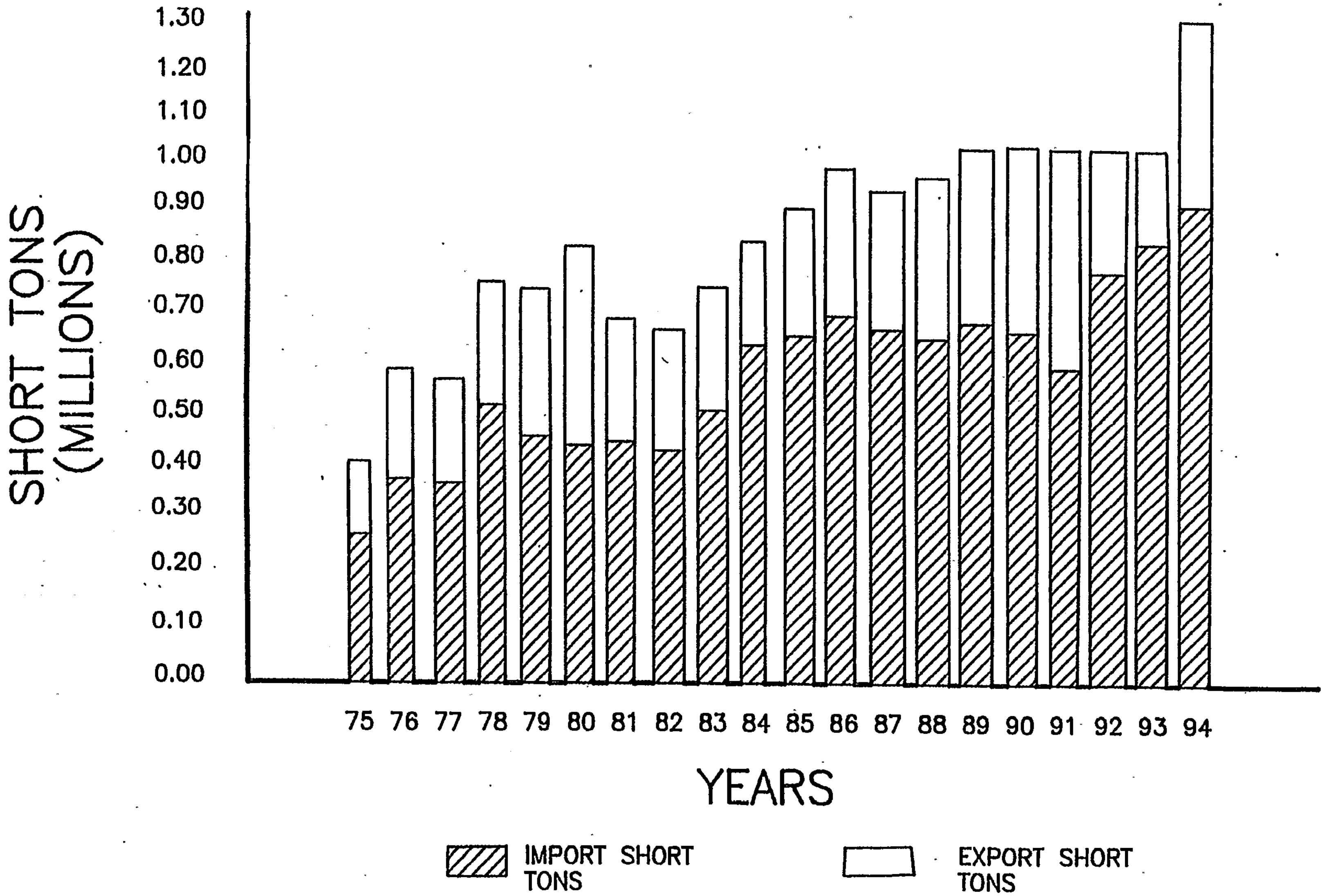
1. Fort Independence
2. Conley Terminal
3. Coastal Oil South Boston
4. MBTA Power Plant
5. Boston Edison Power Plant
6. The Black Falcon Cruise Terminal
7. The Harbor Gateway
8. Coastal Cement Term.
9. Boston Marine Industrial Park, South Jetty, Drydock 3
10. Massport Marine Terminal, North Jetty
11. General Ship Corp.
12. Boston Fish Pier
13. World Trade Center
14. Federal Courthouse site
15. Museum Wharf
16. Boston Tea Party Ship Museum
17. Rowes Wharf/Boston Harbor Hotel
18. India Wharf
19. Central Wharf
20. Long Wharf/Marriott
21. Commercial Wharf
22. Lewis Wharf
23. Lincoln Wharf
24. Battery (Constitution) Wharf
25. US Coast Guard Support Center
26. Paul Revere Park
27. Constitution Plaza and Constitution Marina
28. USS Constitution and National Park
29. Charlestown Navy Yard
30. Mystic Pier #1
31. Mystic Pier 48 Salt Terminal
32. US Gypsum
33. Moran Container Term.
34. Blue Circle Atlantic
35. Medford Street Term.
36. Charlestown Marine Park
37. Boston Edison
38. Prolerized Scrap Terminal
39. Distrigas Liquified Natural Gas Terminal
40. Exxon Oil Term.
41. Independent Cement Corporation
42. Coldwater Seafood Terminal
43. Admiral's Hill Condominium/Marina
44. Atlantic Fuel Terminal
45. Eastern Minerals Salt Terminal
46. Coastal Oil New England, Inc.
47. Walton Pier
48. Gulf Oil Terminal
49. Coastal Oil Terminal
50. Northeast Petroleum Terminal
51. BP Oil Term.
52. Global Petroleum Terminal
53. Mobil Oil Terminal
54. Boston Towing & Transportation Company, Inc./North Terminal
55. General Ship and Engine Works
56. East Boston Piers
57. Boston Marine Works
58. Logan International Airport
59. Logan Office Center

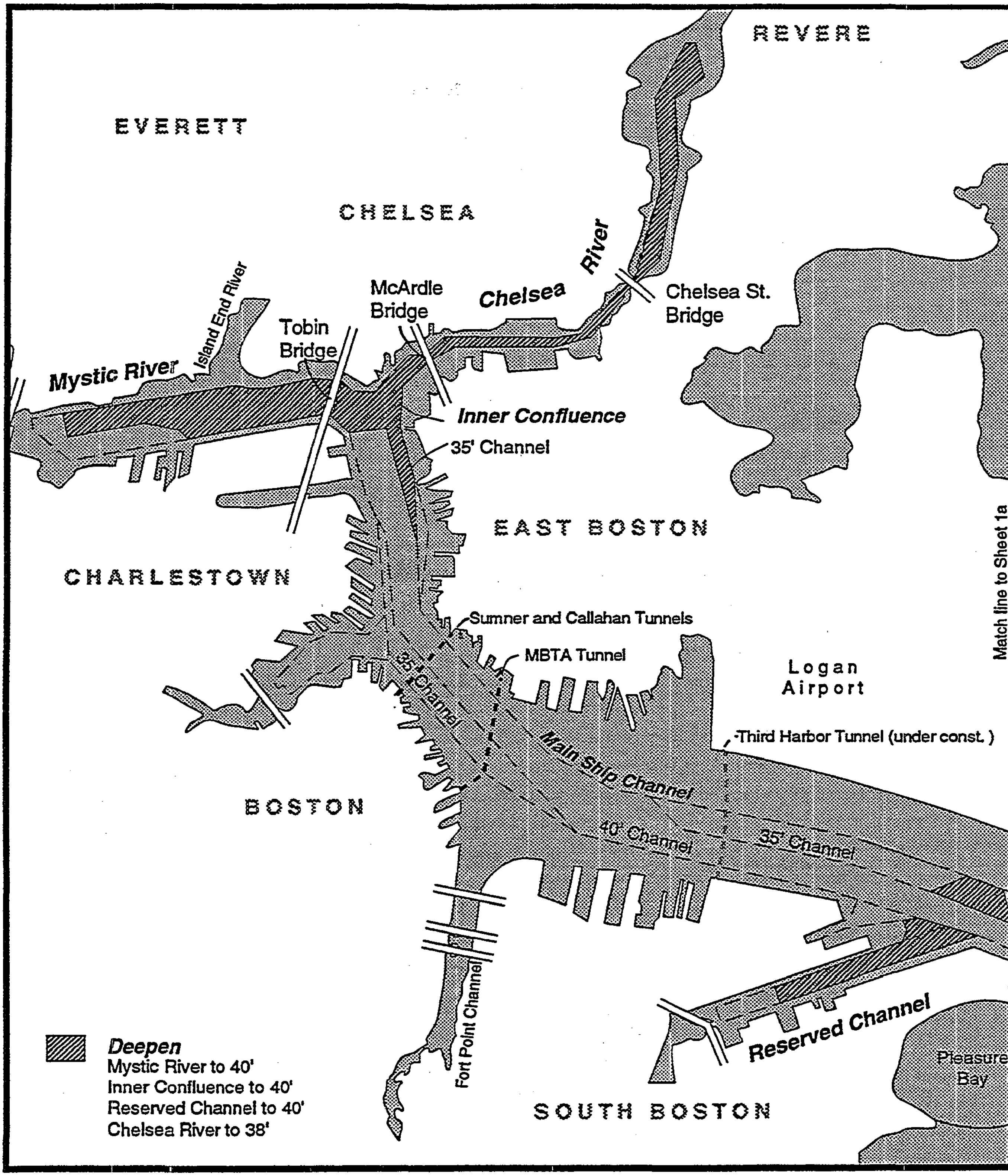
Figure 1-1

PORT OF BOSTON CONTAINER ACTIVITY

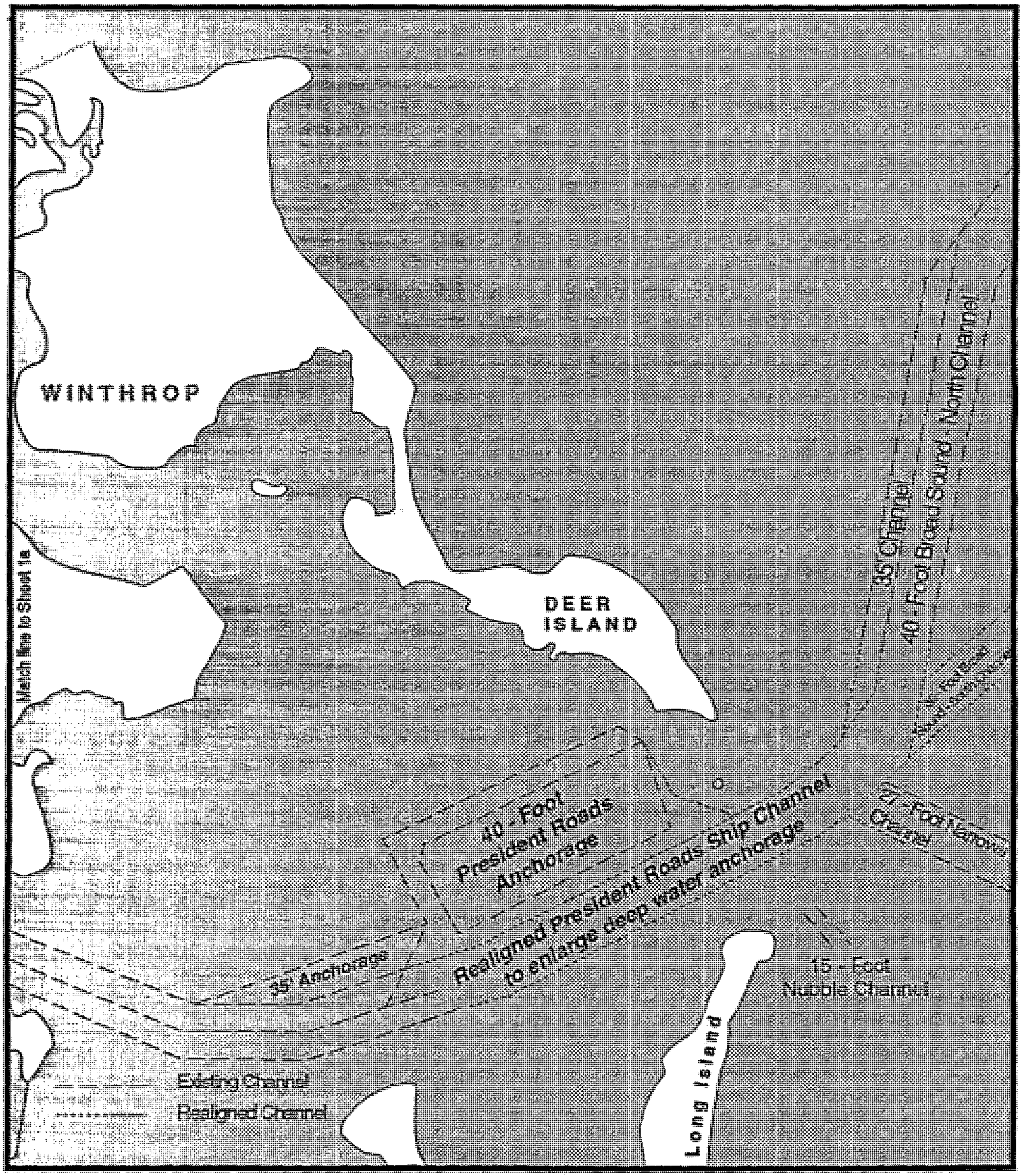
CALENDER YEARS 1975 THROUGH 1994

FIGURE 1-2





Boston Harbor Dredging Project EIR/S	Figure 1-3 Boston Harbor Navigation Improvement Project General Plan
N — Scale: 0 2000' 4000' Scale in Feet	Source: New England Division, Corps of Engineers



Boston Harbor Dredging Project EIR/S	Figure 1-4 Boston Harbor Navigation Improvement Project General Plan
N — *Scale:* 0 2000' 4000' Scale in Feet	*Source:* New England Division, Corps of Engineers

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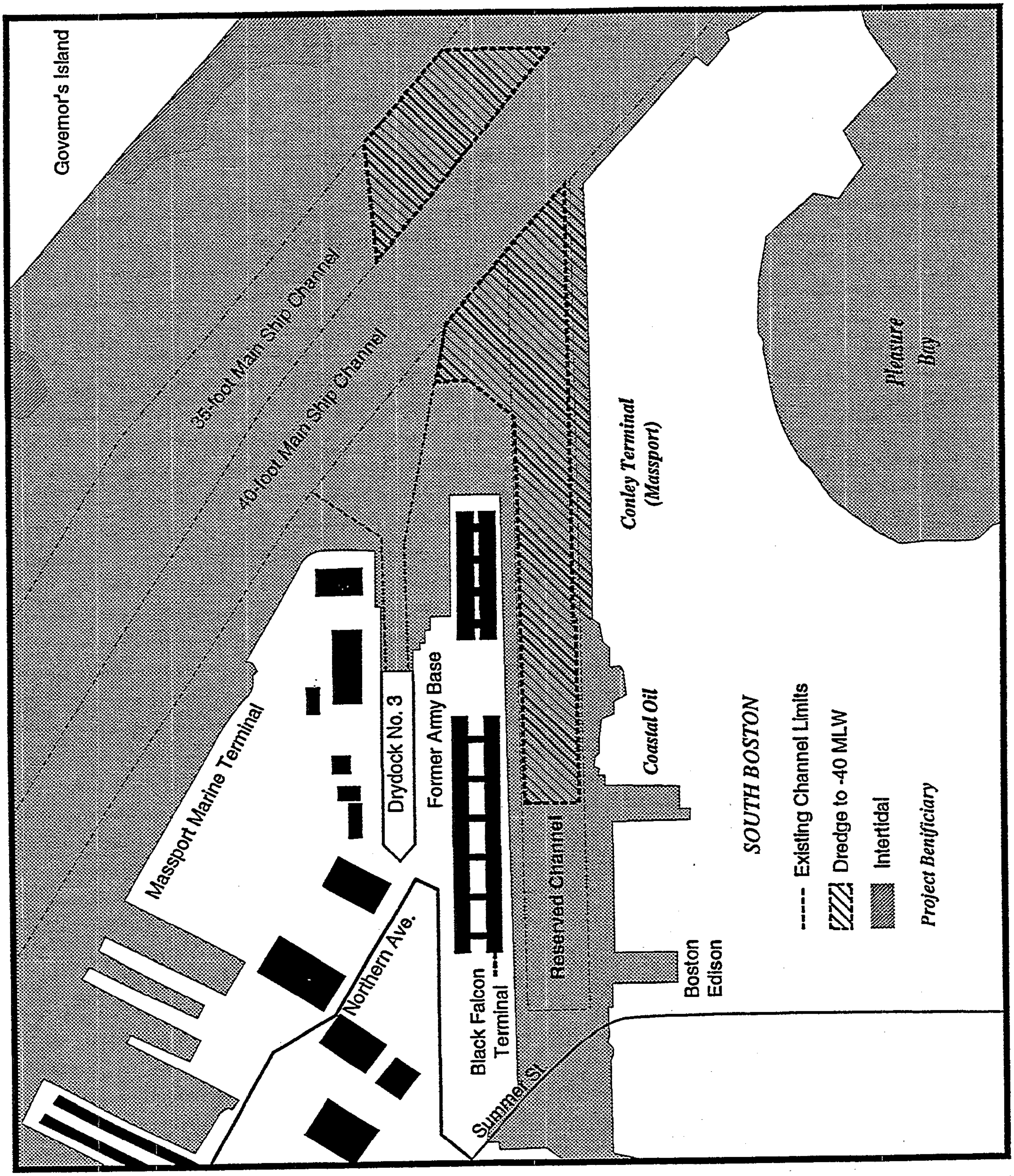

Boston Harbor Dredging Project EIS/R	Figure 1-5 Navigation Improvement Project **Reserved Channel**
N — Scale: 0 100 200 Scale in Yards	Source: Boston Inner Harbor Navigation Chart

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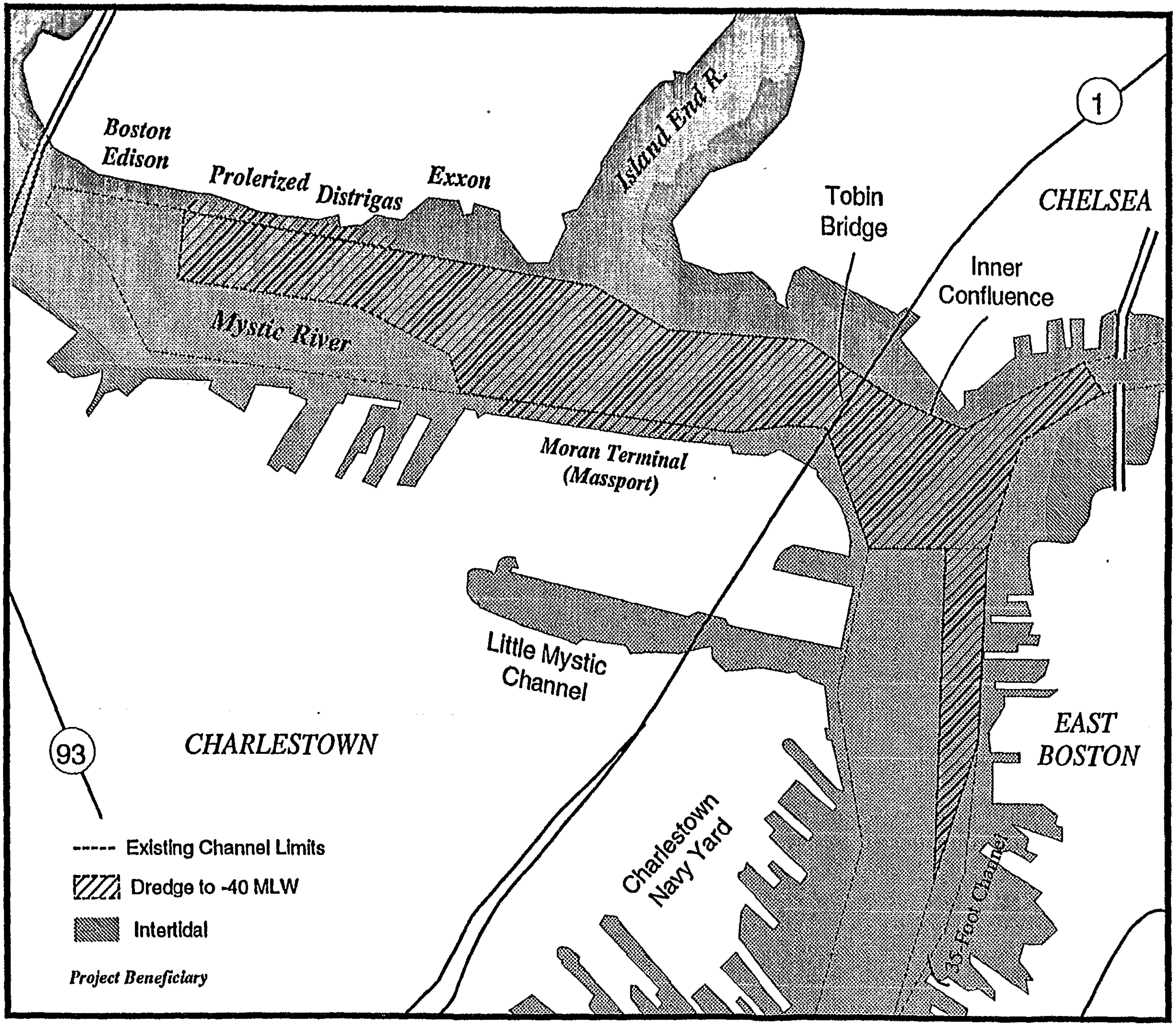

Boston Harbor Dredging Project EIR/S

Figure 1-6
Navigation Improvement Project
Mystic River

N

Scale: 0 400 800
Scale in Yards

Source: Boston Inner Harbor Navigation Chart

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Boston Harbor Dredging Project EIR/S

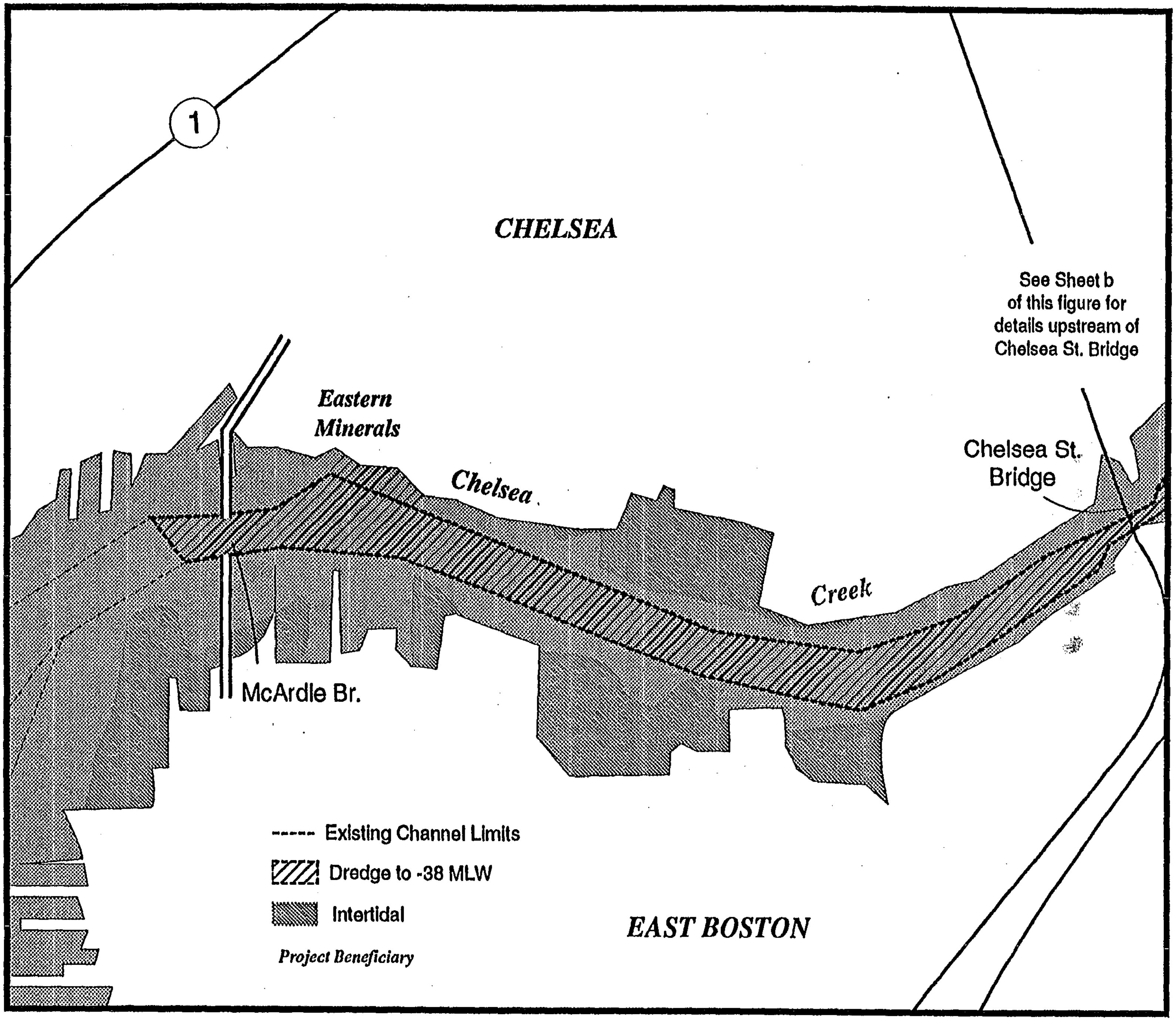
Figure 1-7

Navigation Improvement Project
Chelsea Creek
Downstream of Chelsea St. Bridge

Scale: 0 400 800
Scale in Yards

Source: Boston Inner Harbor Navigation Chart

N



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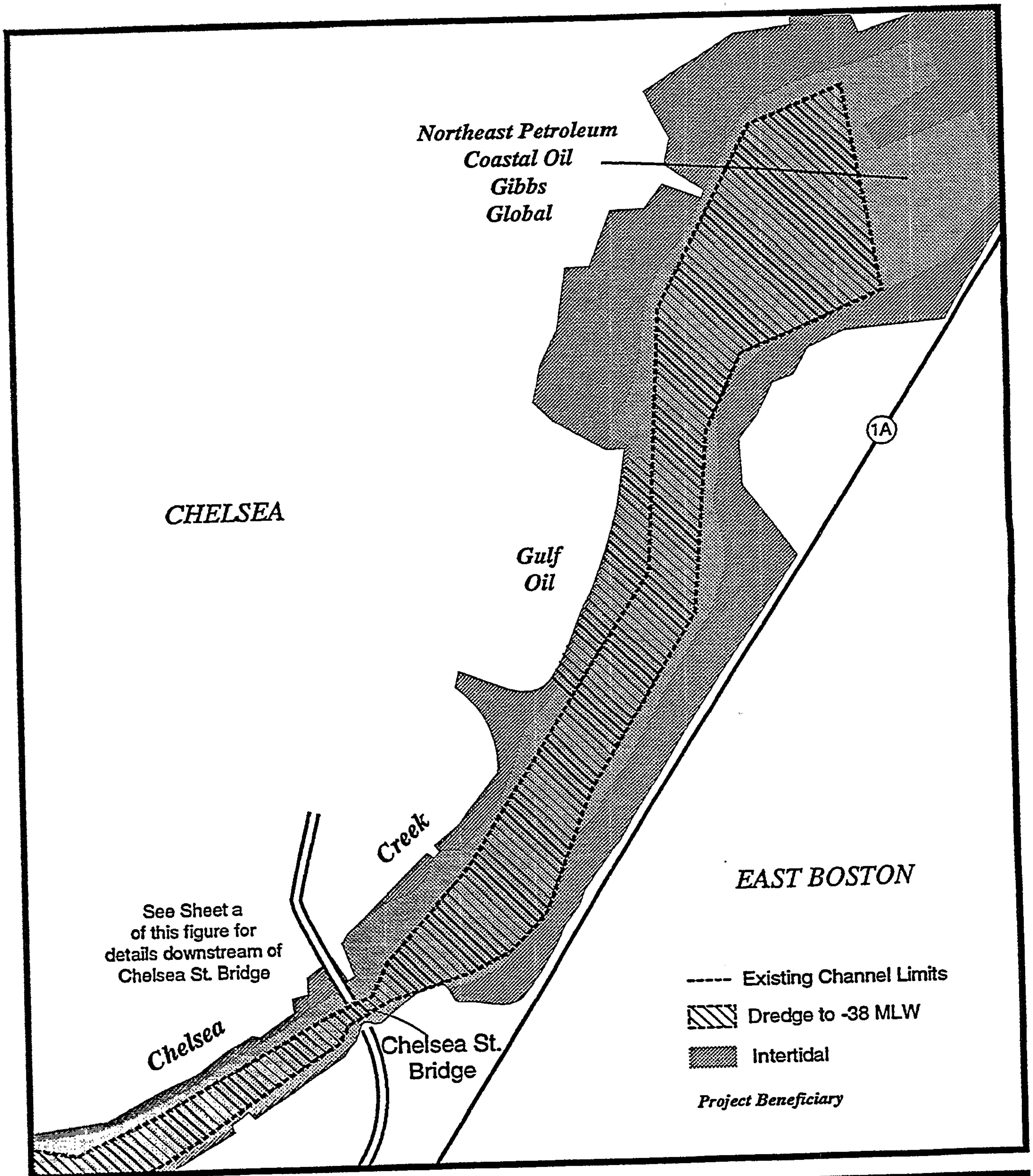

Boston Harbor Dredging Project EIR/S		Figure 1 - 8	Navigation Improvement Project Chelsea Creek Upstream of Chelsea St. Bridge
N	*Scale:* *Scale in Yards*	*Source:* *Boston Inner Harbor Navigation Chart*	

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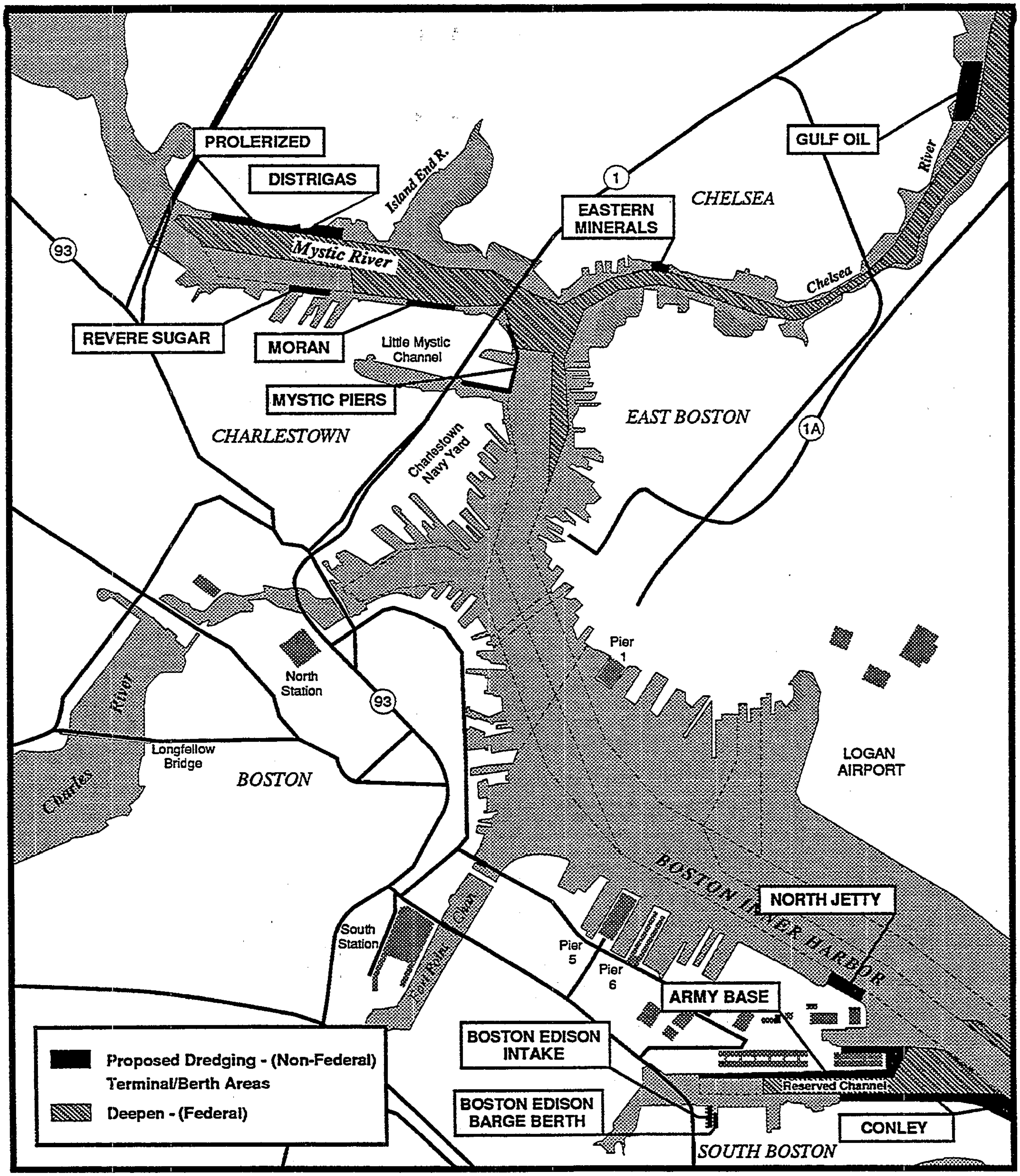

Boston Harbor Dredging Project EIR/S	**Figure 1-9** Location of Federal Channel and berth area dredging
Scale: 0 400 800 Scale in Yards	*Source:* Boston Inner Harbor Navigation Chart

1-25

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TABLE 1-1.

TERMINALS AND DOCKING FACILITIES

Conley Terminal	Distrigas LNG Terminal*
Coastal Oil*	Exxon Oil Terminal*
Black Falcon Cruise Terminal	Independent Cement Corp.
South Boston Army Base	Coldwater Seafood Terminal
Coastal Cement	Atlantic Fuel Terminal
Boston Marine Industrial Park	Eastern Minerals Salt Terminal*
Massport Marine Terminal	Coastal Oil New England, Inc.*
General Ship	Walton Pier
Boston Fish Pier	Gulf Oil*
World Trade Center	Coastal Oil Revere*
McKie Lighter	Northeast Petroleum Terminal*
Rowes Wharf	BP Oil Terminal
Central Wharf	Global Petroleum
Long Wharf	Mobil Oil Terminal
U.S. Coast Guard Support Center	Boston Towing and Transportation Co., Inc.
Charlestown Navy Yard	General Ship and Engine Works
Mystic Pier 1	East Boston Piers
Mystic Pier 48	Boston Marine Works
U.S. Gypsum	Logan Airport Water Shuttle
Moran Container Terminal	Deer Island-MWRA
Blue Circle Atlantic Cement, Inc.	Lewis Street-East Boston
Massport-Medford Street Terminal	Prolerized Scrap Metal*
Boston Edison*	

* Berths receiving direct economic benefits from BHNIP

TABLE 1-2.

VESSEL ACTIVITY IN THE PORT OF BOSTON: ARRIVALS WITH DRAFTS GREATER THAN 18 FEET*

Year	Dry Bulk Carriers	General Cargo	Fully Containerized General Cargo	Passenger	Tankers/ LNG	TOTAL
1972	225	480	163	36	635	1539
1973	235	401	244	53	665	1598
1974	132	196	276	24	633	1261
1975	129	140	272	19	571	1139
1976	120	160	279	9	583	1151
1977	126	137	262	8	628	1161
1978	134	141	265	8	542	1140
1979	118	117	284	14	548	1081
1980	118	134	289	25	440	1006
1981	106	119	291	28	427	971
1982	92	107	277	21	337	834
1985	77	91	200	14	323	705
1986	82	85	215	19	374	775
1987	81	89	248	23	315	756
1988	89	81	237	18	308	733
1989	72	74	202	13	300	661
1990	59	89	210	15	318	691
1991	39	75	168	39	296	617
1992	41	88	154	33	294	610
1993	39	78	173	20	280	590
1994	52	77	198	48	308	683

* As handled by Boston Pilots.

Source: Massport and Boston Shipping Association

TABLE 1-3.

TRIPS AND DRAFTS OF VESSELS USING BOSTON HARBOR 1960-1993

		Number of Trips				
Year	Draft 41-45 ft.	Draft 36-40 ft.	Draft 31-35 ft.	Draft 25-30 ft.	Draft 20-25 ft.	Total Trips for Year
1960	—	24	438	669	2,135	3,266
1965	3	53	440	500	2,074	3,067
1970	1	214	477	483	1,622	2,799
1975	3	195	368	598	1,051	2,213
1976	—	218	396	649	1,028	2,294
1977	—	226	427	667	826	2,146
1978	—	206	371	590	704	1,871
1979	—	219	370	675	743	2,007
1980	—	127	311	638	667	1,743
1981	—	122	314	705	669	1,810
1982	—	76	292	677	711	1,756
1983	—	77	264	539	710	1,590
1984	—	131	210	455	852	1,648
1985	—	113	209	453	848	1,623
1986	—	133	170	123	398	824
1987	—	122	199	285	351	957
1988	—	154	156	308	270	988
1990	1	174	291	387	689	1,542
1991	1	133	304	371	566	1,375
1992	1	131	326	352	576	1,386
1993	1	144	405	295	627	1,472

This tables was initially prepared as part of the Boston Harbor Marine Traffic Report by the Maguire Group, April 1988, for the Massachusetts Water Resources Authority and included data for 1960-1985. The 1986-1988 information was obtained from the U.S. Army Corps of Engineers.

Source of 1960-1988 numbers: Waterborne Commerce Statistics, U.S. Army Corps of Engineers

Source of 1990-1993 numbers: Impact Analysis Division, U.S. Army Corps of Engineers

TABLE 1-4.

CARGO VOLUME AND IMPACT ON ECONOMIC BENEFIT TO THE PORT OF BOSTON

Economic Benefit to the Port of Conservative 3% Annual Rate of Growth

Year	1998	1999	2000	2001	2002	2003	Total
Cargo tons	1,514,200	1,559,626	1,606,415	1,654,607	1,704,245	1,766,373	9,905,466
Net Change in Tons	0	45,426	46,789	48,192	49,638	51,127	241,172
Economic Benefit ($1,000's)[1]	0	52,014	53,674	56,181	55,637	58,642	$277,348

Economic Impact Assuming Annual Decline in Cargo Volume[2]

Percent Decline in $1,000 Benefit

Year	1998	1999	2000	2001	2002	2003	Total
1%	0	17,338	17,164	16,993	16,823	16,655	84,773
3%	0	52,014	50,453	48,940	47,471	46,047	244,925
5%	0	86,689	82,355	78,237	74,325	70,609	$392,215

1 Each cargo ton adds over $1,100 in value

2 To determine number of jobs/ton of cargo multiply tonnage x .0078. Therefore, the loss of 74,211 tons of cargo, representing an annual 1% loss over five years, results in the loss of 579 jobs. The loss of 642,541 tons of cargo, representing an annual 5% reduction, represents 2,672 jobs.

TABLE 1-5. LIST OF PREPARERS

PERSONNEL	TITLE	QUALIFICATIONS
MASSPORT		
Ms. Janeen Hansen	Director and Project Manager	M.A. in City and Regional Planning from Harvard University. Fourteen years experience in transportation analysis and policy planning.
Dr. Norm Faramelli	Director, Transportation & Enironmental Planning	B.S. in Chemical Engineering from Bucknell University and Ph.D. from Temple University. 10 years consulting experience and 16 years at Massport in transportation and environmental planning.
U.S. ARMY CORPS OF ENGINEERS		
Mr. Peter Jackson	Project Manager	M.S. in Civil Engineering from Stanford University. 25 years experience with the Corps of Engineers in San Francisco District and New England Division in engineering and managing water resources projects.
Ms. Catherine Demos	Marine Ecologist	M.S. in Coastal Zone Management/Biology from University of West Florida. Seven years experience with the Corps. Has written several environmental assessments and EIS's for coastal and marine projects.
Mr. Robert Meader	Engineering Manager	B.S.C.E. from Worcester Polytechnic Institute, M.C.R.P. from Rutgers. Over 18 years experience with the Corps of Engineers in the study and management of inland and coastal navigation projects.

TABLE 1-5 (CONTINUED). LIST OF PREPARERS

Dr. Thomas Fredette	Marine Scientist	Ph.D. in Marine Science from the Virginia Institute of Marine Science at The College of William and Mary. 10 years of experience in the area of environmental impact research, assessment,and monitoring. Program Manager of New England Division's Disposal Area Monitoring System (DAMOS).
NORMANDEAU ASSOCIATES		
Ms. Virginia Treworgy	Managing Corporate Officer and Principal Author	M.A. in Government and Public Policy from Harvard University and is an attorney admitted to practice in Massachusetts. 17 years experience in environmental impact assessment, permitting, and management of Remedial Investigation and Feasibility Studies at state and federal hazardous waste sites.
Ms. Ann Pembroke	Marine Ecologist	M.S. in Marine Biology from University of Delaware. 13 years experience with the firm. Project manager and senior report author for numerous assessment projects dealing with marine issues.
Ms. Sarah Allen	Wetland & Wildlife Ecologist	M.S. in Wetland Ecology from University of Rhode Island. Over 11 years in natural resource research and consulting. Specializes in wetland delineation and jurisdictional assessments, and botanical and wildlife surveys.
Ms. Mary Small	Wildlife Biologist	M.S. in Wildlife Management from University of Maine with emphasis in bird and small mammal ecology. 9 years experience life sciences.
Mr. James Bajek	Dredged Material Specialist	B.A. in Biology from University of North Florida. 17 years experience in the planning, material evaluation, and permitting of dredging projects.

TABLE 1-5 (CONTINUED). LIST OF PREPARERS

Mr. Paul Geoghegan	Fisheries Biologist	M.S. in Wildlife and Fisheries Sciences from Texas A&M University. American Fisheries Society certified fisheries scientist experienced in environmental assessment and population dynamics of fish communities.
OCEAN & COASTAL CONSULTING (OCC)	Marine Engineering, dredging specialists	Provided specialized services in dredge management planning and interpreting ship simulation data for disposal cell design.
APPLIED SCIENCE ASSOCIATES (ASA)	Fate and Transport Modeling	Provided specialized services in fate and transport water quality modeling for aquatic disposal facilities.
BOELTER & ASSOCIATES		
Ms. Alice Boelter	Principal Port Planner	Master in Public Policy studies from the University of Michigan. Over 20 years experience in urban planning and project permitting.
WADE RESEARCH, INC.		
Dr. Michael J. Wade	Principal Scientist, Marine Organic Geo-chemist	Ph.D. in Marine Geochemistry from University of Rhode Island. Dr. Wade provides chemical oceanographic consulting services to government and industrial clients. He is an organic geochemist with over 20 years technical and management experience in a variety of research programs, with special emphasis on pollutant fluxes in the environment.
DIAMOND ENVIRONMENTAL ASSOCIATES		
Ms. Harriet Diamond	Regulatory Specialist	Masters in Biological Oceanography from the University of Rhode Island. 15 years experience in environmental consulting, permitting and planning.

TABLE 1-5 (CONTINUED). LIST OF PREPARERS

WARNER & STACKPOLE		
Mr. Michael Leon	Legal Counsel	Masters in City and Regional Planning. Partner with the law firm Warner & Stackpole and head of the firm's Environmental Law Group. Admitted to practice in Massachusetts.
LINOWES & BLOCHER		
Mr. Kenneth Kamlet	Legal Counsel	Masters in Biochemical Sciences. Environmental counsel in securing necessary wetlands and other environmental regulatory approvals.

Chapter Two: Project Description

This chapter describes the elements of the final preferred option for the design of the BHNIP. This chapter also considers issues in response to comments received on the DEIR/S regarding project design alternatives that minimize or eliminate the need for the project. This Chapter begins with a description and comparison of the various alternative dredging plans that were considered in the Corps' economic impact analysis which formed the basis for Congressional approval of the project. This chapter concludes with the maintenance dredging plans for the 50-year life of the project and a description of potential future demonstration projects to be undertaken prior to maintenance dredging of the completed BHNIP.

2.1 PROJECT DESIGN ALTERNATIVES

The project design alternatives evaluated for the BHNIP include:

- no action,
- maintenance dredging only without improvements,
- full project to the proposed depths,
- expanded project,
- reduced project, and
- delayed project.

Both the MEPA certificate and NEPA guidance require that the FEIR/S provide a discussion of the consequences of not carrying out the project, often referred to as the "No Action" alternative. The BHNIP has been evaluated in terms of two scenarios under the "No Action" alternative. The first considers no improvement and no maintenance dredging. The second considers no improvement dredging, but with maintenance dredging to maintain currently established channel dimensions.

2.1.1 No Action, No Maintenance Dredging

This alternative assumes that no dredging activity, including maintenance dredging, would take place. Silty material is continually deposited in the navigation channels and berthing areas by rivers and tidal action. Organic material is deposited from combined sewer outfalls (CSO's) and the outfall pipe at Deer Island. Sediment deposited in the channels and berthing areas, since they were last dredged, will be referred to as "silt" in this report, to differentiate it from underlying ("parent") material (blue clay, gravel, etc.) and rock proposed to be dredged in the BHNIP.

The authorized channel depths in Boston Harbor were last maintained in 1983 when dredged material was disposed at the Massachusetts Bay Disposal Site. On average, the Reserved Channel and turning areas, Mystic River and the Inner Confluence, and Chelsea Creek have a siltation rate of less than 0.2 inches, 0.2 inches and 0.8 inches per year, respectively. This average rate, however, does not account for specific areas that shoal much faster and which require dredging more frequently. Areas within

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the tributaries that tend to shoal at substantially higher rates than the averages cited eventually control navigation through the tributaries. Not maintaining the channels to the currently authorized depths is increasingly making the port unable to accommodate the present shipping fleet of deep draft container ships and petroleum tankers. Currently these vessels draw at least 36 feet to 37 feet if loaded for a minimally economical operation. Some transits, particularly in the Chelsea Creek, must be made in daylight hours. There are limited opportunities for such transits at high tide, especially during the winter months. Limited tidal operations are not consistent with efficient shipping, cargo handling or scheduling. Ultimately, more material would have to be shipped into Boston via barges, necessitating more trips, higher transportation costs, and greater exposure to risks of accidental spills (see Section 1.1).

Leaving the top layer of silt material in place continues to expose marine organisms, that live in or use the area, to contaminants. This material is also subject to continual resuspension in the water column during vessel transits in shallower areas. Removing and confining the material reduces this risk of exposure. The environmental or economic benefits accrued by leaving the material in place are few. MWRA (1993) has reported that with the reduction of toxics and solids in their discharge, cleaner sediments will settle over the older, more contaminated sediment. Non-point source pollution, such as urban runoff, also contributes to the contaminant load. However, several years would be needed to cover the existing sediments with the cleaner material. Therefore benefits are provided by dredging the silt before new deposition occurs.

The no action/no maintenance dredging alternative also considered relocating appropriate port facilities to the -40 foot Main Ship Channel waterfront. This would eliminate the need to deepen the tributary channels. The 1988 Boston Harbor Navigation Improvement Project Feasibility Report prepared by the Corps of Engineers investigated the construction of pipelines and Inner Harbor offloading facilities. This alternative was found not to be feasible for several reasons. These included the minimal amount of available areas for offloading facilities, cost, and the lack of interest from terminal owners to move their facilities. Relocation of active port terminals to these sites is not readily achievable because of land assembly issues, and because of the rigorous regulatory process that such relocation would trigger. The acquisition costs notwithstanding, the roadway connections, rezoning, potential litigation, and the infrastructure required to establish the port terminals closer to the main ship channel would entail years of effort. The Port of Boston cannot wait for this to happen. The BHNIP needs to occur now.

Although the Main Ship Channel would not need to be deepened, navigational access from the Main Ship Channel to the terminals would likely be required. The terminals would be re-located along the west side in Boston along Northern Avenue and the east side of the Harbor in East Boston adjacent to the -40 foot Main Ship Channel. Much of this area is currently occupied with businesses. Additional dredging would be required from the Main Ship Channel to make these berth areas accessible.

In summary, the relocation of the infrastructure of a major port such as Boston Harbor would require an enormous

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amount of funding, relocation of terminals, availability of real estate and construction of fuel pipelines without eliminating dredging. Costs for this type of non-structural alternative would not be shared by the Federal government. Infrastructure rebuilding would be the responsibility of the individual terminal owners and appropriate State and local governments.

2.1.2 No Action, with Maintenance Dredging

The no action, with maintenance dredging (to -35 feet MLW) alternative, would allow the Boston Harbor Federal Channels and the project berths to remain in their existing configurations. Table 2-1 lists dates of the last dredging in each tributary (not including berths) as well as projections of annual and project life (50 yrs.) accumulation. The no action, with maintenance dredging alternative would be analogous to maintaining the currently authorized depths. This consists of three main entrance channels, -27, -30 and -35/40 feet MLW converging at the Outer Confluence in President Roads. A -40 foot MLW anchorage is located adjacent to the channel at President Roads. From President Roads to East Boston the Main Ship Channel has two 600 foot lanes. The inbound lane is -35 feet MLW and the outbound lane is -40 feet MLW. The 40 foot depth continues upstream at an average width of 700 feet to the -35 feet MLW Inner Confluence Area at the mouths of the Mystic River and Chelsea Creek. Three active deep draft tributary channels, the Reserved Channel, Mystic River and Chelsea Creek are provided with 35 foot depths.

This alternative however, precludes the regional economic benefits of the authorized improvement project described in Section 1.1. Environmental impacts associated with the maintenance alternative include temporary disturbance from dredging and disposal activities, which is comparable to the improvement project. Maintenance dredging would remove primarily silty materials that have been transported into the channels since they were last dredged (Table 2-1). Dredging impacts include temporary and localized water quality degradation from turbidity and release of contaminants into the water column.

Disposal impacts would be dependent on the site selected. Water-based sites would have a temporary increase in turbidity and release of contaminants. Alternative disposal sites evaluated in this report for the BHNIP are also suitable for maintenance projects if the improvement project does not proceed. There are differences between the project and no project options that must be considered in evaluating sites for disposal of maintenance material: volume differences and availability of clean parent material.

Maintenance projects typically remove material from shoal areas to keep the channels open. Therefore maintenance dredging most likely will take place over a longer period of time through smaller projects than that required for the BHNIP. Smaller capacity sites such as the shoreline sites or lined landfills, that may be inefficient for the higher full project volumes, may be more suitable for use in normal maintenance projects.

Because maintenance dredging does not involve removal of parent or clean material, those disposal alternatives that depend on containment in parent material,

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such as in-channel disposal, or borrow pits or confined aqautic disposal, are less feasible.

2.1.3 Full Project - Three Channels, All Berths

Over the past decade various dredging alternatives, which fulfill the project purpose and need, have been investigated to identify their economic and environmental implications. The results of these investigations are contained in the 1988 Feasibility Report. The recommended plan, authorized in 1990, includes the following features: deepen Reserved Channel and Mystic River from -35 feet to -40 feet MLW and Chelsea Creek from -35 feet to -38 feet MLW. Also included are non-structural boundary modifications in the Presidents Roads area. Project berths located in these three tributaries would also deepen their areas to the same depths as the adjacent channel to accommodate deeper draft ships (see Figure 1-3 through 1-7).

Deepening Boston Harbor will involve the removal of approximately 2.8 million cubic yards of silt, clay, and rock (Table 2-2). An additional 1.8 million cubic yards of clean parent material would be removed to provide for in-channel disposal. Short-term impacts from dredging will include localized turbidity, and when silty material is dredged, a temporary release of contaminants to the water column. Rock blasting will also have an impact on the biota in the area immediately surrounding the blast site. The long-term benefit from the project is the removal and sequester of silty material from biological resources. As the water in Boston Harbor becomes cleaner from additional sewage treatment, the isolation of contaminated sediment will also enhance the biological health of this Harbor.

Engineering design of the project must consider safety factors. For this reason a ship handling simulation study was conducted and evaluated to determine the impact of channel improvements on the docking masters' perception of safety. The summary report was included in Appendix D of the Draft EIR/S published in April 1994. The objectives of the simulation were to provide an "as-near-to-reality-as-possible" real-time simulation of the proposed changes and to record the actions and opinions of docking masters currently working in the Harbor. Existing channel conditions and vessel operations were tested and compared with the project channels and vessel operations of the same vessels loaded to greater drafts. Environmental and physical conditions were held constant except for forces acting on the more heavily laden ships. The results of the ship simulation study ensured the safety of the improved Harbor and minimized the area to be dredged.

Based on the ship simulation study and the economic analyses, the preferred navigation improvement project, as authorized, consists of the following components:

2.1.3.1 Reserved Channel

The existing 430-foot wide, 4,500-foot long, Reserved Channel will be deepened to -40 feet MLW from its existing -35 foot MLW with the exception of its upper 1,340 feet which will remain at -35 feet MLW. The width of the project channel will vary. The northern limit will be relocated inward by 15 feet for the entire length of the deepened channel, the southern channel limit will be relocated inward by 32 feet from the confluence with the main ship

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channel, along the Conley Terminal (Berths 11, 12 and 13) to the upstream limit of Conley Berth 11 resulting in a width of 383 feet for a distance of approximately 2,950 feet. Upstream from Berth 11 the existing southern channel line will be relocated 15 feet inward to the upstream limit of the deepened channel resulting in a width of 400 feet. The 32-foot wide reduction in the width of the existing channel along the Conley Terminal Berths 11, 12 and 13 will be deauthorized and become berth area. The channel will be widened to provide maneuvering area at the confluence of the Reserved Channel, Main Ship Channel and Drydock Channel, and deepened to -40 feet MLW, relocating the established harbor lines accordingly. A trapezoidal area of the -35 foot main ship channel, opposite the Reserved Channel, will be deepened to -40 feet to provide required maneuvering area.

Approximately 159,700 cubic yards (cy) of silty (maintenance) material and 438,800 cy of parent (new) material will be removed from the channel. Approximately 34,100 cy of rock will be blasted and removed in the maneuvering areas at the mouth of the Main Ship Channel. The Conley Terminal berths 11-13 and the Coastal Oil berth are direct project beneficiaries required for the improvement project. Approximately 45,900 cy of material will be removed from the Conley Terminal berthing area 11-13 to deepen it to -40 feet MLW. The Coastal Oil berth has been deepened recently and does not require dredging. The following berths do not receive direct benefit from the BHNIP: Boston Edison Intake and Barge Berth, Conley (Berths 14-15), and Boston Army. These berths will remove about 152,800 cy of total material. Dredging of the North Jetty berth on the Main Ship Channel will generate about 16,200 cy of material. The total amount of dredged material to be removed from Reserved Channel and associated work in the Main Ship Channel, including rock, is about 847,500 cy. The volumes are detailed in Table 2-2.

2.1.3.2 Mystic River Channel

About 5,670 feet of the existing 6,570-foot long -35 foot MLW Mystic River Channel would be deepened to -40 feet MLW. The Mystic River Channel is 580 feet wide through the Tobin Bridge, 740 to 700 feet wide from the bridge upstream to the Island End River, widening to 930 feet at the Island End River, widening further to 960 feet at the Exxon Terminal then narrowing to 440 feet at the Distrigas pier continuing upstream to the Prolerized Wharf to a depth of -40 feet MLW. Areas of the channel not requiring deepening would remain at their authorized depth of -35 feet MLW.

Also included with the Mystic River channel design is the Inner Confluence area. The existing 35-foot deep Inner Confluence Area would be deepened to -40 feet MLW as well as about 2,500 feet of the -35 foot Main Ship channel downstream of the Inner Confluence. This will improve the maneuverability of larger vessels as part of the modification to improve the approach to the Mystic River Channel.

In the Inner Confluence and Mystic River approximately 471,900 cy of silt, 791,800 cy of parent material and 54,000 cy of rock will be removed from the Channel. This includes deepening a part of the -35 foot MLW Main Ship Channel just south of the Inner Confluence.

Three of the berth areas that are direct project beneficiaries will be deepened to -40 feet MLW, with the following approximate amounts of material removed: Distrigas, 13,800 cy; Prolerized, 7,600 cy; and Moran Terminal, 6,600 cy. Boston Edison who uses the Exxon berth, are direct project beneficiaries. Exxon is currently at the -40 feet depth and does not need to be dredged. A berth that is not a project beneficiary will also be dredged. Revere Sugar, to be deepened to -40 feet, will be removing 12,800 cy.

2.1.3.3 Chelsea Creek Channel

The existing -35 foot MLW Chelsea Creek Channel will be deepened to -38 feet MLW, and widened to the fenders at the bridge openings. Chelsea Creek was investigated for deepening to -40 feet MLW, but this depth was found to be economically unjustified. The incremental cost of deepening the channel from -38 feet to -40 feet was not offset by the additional benefit a deeper channel would provide. The significant cost was the relocation or protection of the subsurface utility crossings, primarily the Boston Gas siphon. Utilities in the Chelsea Creek Channel will be modified to accommodate the deepened channel. These include: Boston Edison Cables (moved), MWRA Water Tunnels (removed and moved), MBTA Cables (moved), and the Boston Gas Siphon (protected).

Approximately 230,000 cy of silt and 320,100 cy of parent material will be removed from the Channel. The following berths are direct project beneficiaries. The Gulf Oil berthing area will be deepened to -38 feet MLW resulting in the removal of 12,300 cy of material. Eastern Minerals plans to deepen their berthing area to -38 feet MLW and remove approximately 39,900 cy of material. Northeast and Coastal are also beneficiaries. They have, however, already deepened their berths and do not need to be dredged.

2.1.3.4 Main Ship Channel

In addition to the project tributaries, three berthing areas along the main ship channel will also maintenance dredge their berths. These berths do not receive direct benefit from the BHNIP: Boston Army Base (1-3) which will remove about 40,000 cy of dredged material (of the 128,500 total for Boston Army 1-9), about 16,200 cy of dredged material will be removed from North Jetty, and 17,600 cy of dredged material will be removed from Mystic Piers 1, 2, 49, 50.

2.1.3.5 Non-Structural Improvements At Presidents Roads

Specific Federal channel limits will be designated through President Roads to connect the Entrance Channels at the Outer Confluence with the Main Ship Channel limits. This will increase the size of the President Roads Anchorage from 350 to 420 acres. The area will require a hydrographic sweep survey and relocation of several navigation buoys to ensure a safe navigation channel. No dredging is required.

2.1.3.6 Summary

All told, the full project (including channels, beneficiary berths, other berths, and related areas) will remove about 1,100,000 cy of silt, 1,680,000 cy of parent material, and 88,000 cy of rock, all measured in place. Because of expansion during removal and handling, the

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corresponding volumes required for disposal are approximately 1,360,000 cy of silt, 2,020,000 cy of parent material, and 132,000 cy of rock.

In additional 1.8 million cy of parent material will be dredged to provide in-channel silt disposal for 1.3 million cy of silt, allowing for 3-feet of headspace for capping. The total parent material to be dredged from the Federal channel is therefore, 3.3 million cubic yards as follows:

Mystic/Inner Confluence:
792,000 cy (for authorized depth)
1,333,000 cy (extra for in-channel)

Chelsea:
320,000 cy (for authorized depth)
447,000 cy (extra for in-channel)

Reserved/Main Ship:
439,000 cy (for authorized depth)
0 (extra for in-channel)

TOTAL:
1,551,000 cy (for authorized depth)
1,780,000 cy (extra for in-channel)

Future maintenance dredging of the tributaries in the Full Project is anticipated to yield 95,000 cy for the Reserved Channel, 1,300,000 cy for the Mystic River, and 365,000 cy for the Chelsea Creek over a 50-year economic project life. Approximately 1,760,000 cy of silty material from the tributaries will require removal and disposal at various times over the next 50 years.
In addition to the tributary channels, maintenance of the Main Ship Channel and the anchorages is required to maximize the benefits of all the interdependent projects that support the Port of Boston. This maintenance would require removal of about 4,365,000 cy of material over the 50-year design life.

2.1.4 Expanded Project

Deepening the tributary channels below the currently authorized -40 feet MLW and -38 feet MLW can only be accomplished downstream of the numerous Boston Harbor Tunnel crossings, leaving the Reserved Channel as the only tributary capable of being dredged to greater depth. In order to deepen the Reserved Channel, two major steps are required. First, a non-Federal cost sharing sponsor must request the project to the Corps to initiate an economic feasibility study. The Corps then determines the economic feasibility (benefit to cost ratio) by comparing the improvements in navigation efficiency by providing additional depth to the cost of implementation and maintenance. Second, if the project qualifies for Federal participation, Congressional authorization and appropriations are required to complete design and construction.

The benefits of deepening must outweigh the cost of design and construction and future maintenance of the increased depth increment. The cost must include the deepening of not only the Reserved Channel but also the Main Ship channel, President Roads, and the Broad Sound North Channel including Finn's Ledge. In addition to the navigation channels, the benefiting berths must be deepened as well as a portion of the President Roads anchorage. This feasibility process would evaluate incremental depths, including 45 feet, to optimize the efficiency of the project. The 1988 Feasibility Report included an evaluation of incremental depths for the tributaries, beyond 40 feet, of 43, 45, 47 and 50 feet. It was concluded at that time that these depths were not necessary to satisfy the needs of existing or projected vessel traffic based on benefits and costs then calculated. If operations at the Reserved Channel based terminals are expanded or changed, further analysis in the future may be warranted. However, at the present time, no steps have been taken to evaluate deepening the Reserved Channel or its approaches.

The current project was authorized in the Water Resources Development Act of 1990 (WRDA 90). Minor changes to a project are allowed within the discretion of the Chief of Engineers, however an increase in depth would be considered a change requiring further congressional authorization.

2.1.5 Reduced Project

The Navigation Improvement Project is made up of improvements to three tributary channels. The economic feasibility analysis prepared for the feasibility report and subsequently updated, viewed each tributary channel and its berth areas as individually justified. Each tributary channel can therefore be treated as a separate project or in any combination with other project tributaries.

A reduced project could result from economic justification failing for one or more of the tributaries as a result of increased cost or reduced benefits to the project. Economic justification is reviewed periodically up to the time of construction. Corps project evaluation procedures require that a project have benefits at least as great as project costs, or expressed differently, have a ratio of benefits-to-cost that is greater than or equal to one.

Another reduction in the project, a temporary reduction, could occur if there is a delay in one or two of the tributaries due to changes in the project area that might require reformulation of the authorized plan. An example would be the replacement of the Chelsea Street Bridge by the City of Boston. There is interest in reviewing the navigation channel to consider its widening and deepening to accommodate larger vessels. Changes of this magnitude would require reformulation of a plan because the benefits would change and may require authorization by Congress to implement. Such a delay in the Chelsea Creek portion of the project would not impact the Mystic and Reserved portions of the project which could move ahead independently. Such a delay in dredging the Chelsea Creek could complicate the in-channel disposal option since a portion of dredged material from Reserved Channel will be disposed in Chelsea Creek. The lost capacity may be made up with additional cells in the Inner Confluence Area. Once reformulated, the Chelsea Creek improvement could proceed. Minor changes to channel lines and berths would not delay the project.

A reduced project may also result from reductions in the dimensions of the project such as minor realignment of channel lines, berth areas, etc. Unless these changes have substantial impact on the economic justification of the project, or require reformulation and reauthorization, they should not delay or reduce the project to any great degree. It is anticipated that a number of these minor reductions and possible enlargements to the project will occur as the design is finalized.

2.1.6 Delayed Action

The present timetable is for the Boston Harbor Dredging Project to begin early in 1997. Any delays (>4 years) in this schedule could noticeably increase the impacts to shipping interests already experienced in the Port of Boston. Continued siltation will steadily reduce the useable channel and ship berth depths and could eventually create unusable and, in some instances hazardous, conditions for the larger vessels. Maintenance dredging of shoaled areas would be required to maintain navigational safety even in the absence of the improvement project. Reductions in the useable draft for the project channels and berths could limit usage by more vessels to high tide and increase the need for lightering. Also, this may result in a reduction in the size of vessels transiting Boston Harbor, increasing the overall number of vessels needed for handling the same quantity of goods. Vessel maneuverability could also be impaired for larger vessels such as the LNG (Liquified Natural Gas) tankers that turn in the inner confluence. Constraints on the size of vessels that could utilize the harbor may reduce cargo volumes and overall port employment (see Section 1.1). A reduction in flexibility of ship schedules could ultimately result in the diversion of cargo to other ports. This loss in the cargo market would have a negative impact on the Port of Boston and the New England economy.

The authorized depths in the port of Boston are difficult to maintain since it is the upper "maintenance" silty material that contains the higher contaminant concentrations. This makes finding a suitable disposal site difficult. The Harbor was last dredged in 1983 and maintenance dredging of this and other channels is now already overdue. Delaying the project another 5-10 years could have substantial impacts, by increasing the quantity of material that will eventually require dredging, and increasing the cost. A greater quantity of material coupled with inflation will increase the cost of dredging without a corresponding increase in benefits. The increased quantity will also lengthen the duration of dredging once it finally begins and could affect the project schedule further if the increase in time conflicts with environmental dredging windows.

2.2 COMPARISON OF PROJECT DESIGN ALTERNATIVES

Three major factors differentiate the project alternatives: quantities to be dredged, areas to be maintained or improved, and the timing. The quantities of sediment to be dredged affects:

- duration of dredging
- duration of turbidity plume
- amount of habitat affected
- duration of interference with navigation.

The No Action without Maintenance alternative would, of course, result in no dredging and therefore would have none of these effects. However, without maintenance the siltation will interfere with navigation and may cause hazardous conditions. In turn, the alternative would have other environmental and economic impacts. The No Action with Maintenance alternative would remove only unconsolidated silt and leave the cohesive parent material in place, resulting in virtually the same turbidity, plume and footprint, but reduced duration of dredging compared to the Full Project or the Delayed Project. Because the Delayed Project would encompass dredging a larger component of silt, dredging would take longer and result in a prolonged period of

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increased turbidity compared to the Full Project.

The physical limits (both horizontal and vertical) of the dredging alternatives affect:

- socioeconomic benefits
- navigation safety
- potential improvements to bottom sediment quality
- extent of turbidity plume
- area of habitat affected

The changing world fleet requires deeper ports to minimize double-handling of cargoes. The two No Action alternatives would allow shipping to continue in Boston Harbor but would eventually lead to greater and greater reliance on partially loaded vessels, lightering or feeder barges. The No Action with Maintenance dredging alternative has all the potential impacts of the Full Project (because of the silt removed) but without the economic benefits of the full project. Deepening of any of the channels would improve this outlook for specific components of the Port's activities. Petroleum shipping would be aided by dredging in Chelsea Creek, Mystic River and Reserved Channel. LNG shipment would be aided by activities in the Mystic River. Container shipping would be aided by deepening the Mystic River and Reserved Channel. Thus, the Full Project has the greatest potential to benefit shipping in Boston Harbor. These benefits would be reduced for the Delayed Project. Delaying the project could reduce the economic benefits if port costs or navigation conditions cause current port users to use other ports.

The Full Project is the preferred, and congressionally-authorized, alternative for the dredging project. In addition to the removal of all unconsolidated silts required for maintenance, parent material would be dredged to project depths. The purpose and need for the Full Project has been documented (ACOE 1988; and Section 1.1). It offers the greatest benefits to the port of Boston; the impacts associated with the dredging are, as with the other alternatives, temporary. The preferred project alternative can reduce the cost of products shipped through Boston, reduce associated shipping costs, maintain safety, and maintain a workforce engaged in maritime support services.

2.3 FUTURE MAINTENANCE DREDGING

One of the primary benefits of the BHNIP is that the navigational efficiency and safety of Boston Harbor will be increased and future growth of Boston, as a major international trading port, will be supported. This benefit cannot be fully sustained, however, unless future maintenance dredging within the Harbor is performed consistently and the desired channel and berth depths accomplished by the BHNIP are maintained. Future maintenance dredging of Boston Harbor will involve the removal of the upper layer of accumulated silt material from within the channels and associated berths, without the need to remove any of the underlying parent material. The issues associated with maintenance dredging are similar to those associated with the maintenance material component of the improvement project: quantity and quality of the dredged material; disposal site options; potential environmental impacts associated with the dredging operation and with the disposal of the material; and the related costs.
The following sections discuss future maintenance dredging for the BHNIP.

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Section 2.3.1 discusses the estimated quantity and quality of the material which will be removed during future maintenance dredging. The anticipated dredging cycle, is discussed in Section 2.3.2. Section 2.3.3 describes demonstration projects that are being considered to assess the effectiveness of potential disposal options for future maintenance material. Section 2.4.4 provides a summary of disposal options for future maintenance dredged material.

2.3.1 Quantity and Quality of Dredged Material

The quantity and quality of the material dredged during future maintenance cycles will directly influence both the future dredging cycles and the selection of disposal options for the material. The estimates for the quantity(s) and quality of the dredged material, are that based on information provided in the DEIR/S, provide a worst case representation of future conditions.

2.3.1.1 Quantity of Material

Estimates of the quantity of material dredged from future maintenance activities are based on the estimated rates of sediment accumulation within each of the areas to be dredged. Estimated rates are generally determined from average accumulation rates obtained from scientific studies and/or observations made over periods between dredging cycles.

Sediment accumulation rates within a specific area are dependent upon conditions such as sediment load to the harbor system, tidal flow currents, flood and ebb velocities, circulation patterns, wind and wave action, and the physical stability of the sediments. These conditions, in turn, result in variable accumulation of sediments.

The Reserved Channel and Turning Area have an average siltation rate of less than 0.2 inches per year. The Mystic River and the Inner Confluence have an average siltation rate of 0.2 inches per year. Chelsea Creek has the highest average siltation rate of 0.8 inches per year. The average rates, however, do not account for the variability in shoaling rates which would require that certain areas within those channels/tributaries be dredged frequently enough to produce adequate controlling depths. The average siltation rates within the Main Ship Channel and Anchorages are, on average, lower than those within the Tributaries. The siltation rates vary from 0.03, 0.07 and 0.08 inches per year in the 35-foot, 40-foot Main Ship Channel, and President Roads Anchorage area per year, respectively. Shoaling rates within these areas are also variable. Using these sedimentation rates, the estimated the annual rate of sediment accumulation in cubic yards (cy) over a one year period for the Tributaries, the Main Ship Channel and the Anchorages, over the 50 year project life, are estimated as follows:

SEDIMENT ACCUMULATION OVER 50-YEAR DESIGN LIFE OF PROJECT BY LOCATION
TRIBUTARIES:

Reserved Channel:
95,000 cy
Mystic River:
1,300,000 cy
Chelsea Creek:
365,000 cy

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Berth Maintenance:
1,000,000 cy
Total 2,760,000 cy

MAIN CHANNEL:
40-Foot Main Ship Channel:
2,195,000 cy
35-Foot Main Ship Channel:
717,000 cy
President Roads Anchorage:
1,455,000 cy
Total 4,365,000 cy

The 50-year project life starts at the completion of the BHNIP. Future maintenance dredging will continue for the life of Boston Harbor and its use as a commercial port. Funding for future dredging of berths, in order to fully realize project benefits, will be provided by individual berth owners.

2.3.1.2 *Quality of Material*

The Massachusetts Water Resource Authority's (MWRA) stricter controls on sludge and combined sewer outfall (CSO) discharges into the Harbor, is expected to reduce the amount of contaminants entering the Harbor and, ultimately, improve the quality of the water and sediments. Boston Harbor, however, is an urbanized working port, supporting shipping, commercial and industrial activities. Historically, urbanization results in measurable degradation of the water quality and sediments. The beneficial impacts from the BHNIP and MWRA controls will not be fully realized until some time in the future. Benefits to water quality from stricter water quality controls and the cessation of the discharge of sewage sludge are, however, already becoming apparent in the Outer Harbor at areas around Spectacle Island and Sculpin Ledge Channel in studies performed for the Central Artery/Tunnel Project (NAI 1994). A sampling and testing program of the BHNIP silt and sediment was conducted and the results reported in the DEIR/S. The program used a three tier analytical approach for marine sediment characterization. The three tier approach combines a literature and existing data review, bulk chemistry analysis of the material, and biological testing; all of which are used to determine if the material is suitable for unconfined ocean disposal (see Section 2.2.1 of the DEIR/S).

Based upon the results of the sampling and testing program, the EPA determined that the silt material was unsuitable for unconfined ocean disposal. As water and sediment quality are expected to improve over time, some silt, especially from the Main Ship Channel, may be suitable. However, as a worst case scenario for calculating future maintenance dredging quantities, it is assumed the dredged material will not be suitable for unconfined ocean disposal and that alternative disposalmethods will be required.

2.3.2 Future Maintenance Dredging Cycle

Maintenance dredging can occur as frequently as once every year to once every 20 to 30 years or more. The maintenance cycle is generally established based on a number of factors such as sediment accumulation and conditions within the area to be dredged; navigational status and priority of the dredged area; depths and widths required to produce the benefits that the project was designed to achieve; potential disruptive impacts (i.e biological, socioeconomic, transportation) from the dredging operation; availability of disposal options for the dredged material; and funding for the work.

The Corps anticipates that an approximate 10 to 20 year dredging cycle, commencing from the completion of the BHNIP, is appropriate for planning future maintenance dredging of Boston Harbor. Based on the annual rates of sediment accumulation estimated for the tributaries, Main Ship Channel and the Anchorages, each ten year dredging cycle would result in the removal of about 1.3 million cy of material, including material from required berths. As time progresses and technologies advance, additional disposal options for the dredged material may emerge for disposal of the maintenance material. For example, technologies may render the material clean or reduce the amount of material considered unsuitable for unconfined ocean disposal. These disposal options and technologies may become commercialized which may reduce the costs of options found to be impractical at this time. Maintenance dredging of Boston Harbor is one of many future dredging projects that can be expected in the Commonwealth over the next fifty years. Dredged channel access to communities with commercial fishing or recreational use harbors will also need to be maintained. As mentioned in the introduction, disposal sites for maintenance material must be provided by non-Federal interests. The Massachusetts Executive Office of Environmental Affairs (EOEA) recognizes the need for a long-term, statewide, dredging management plan and has asked the BHNIP sponsors to develop information in the MEPA and NEPA documentation that could help advance the development of such a plan.

The Corps will be completing a Massachusetts Navigation and Dredging Management Study in July 1995 to provide information on the current and projected future dredging and disposal needs of the State. The Commonwealth and the Corps will continue to work together to identify ways in which to maintain access to local harbors, including Boston, in an efficient and environmentally-sound manner.

2.3.3 Demonstration Projects

Two options presently being considered for the disposal of future maintenance dredged material are capping at open water sites and use of geotextile containers. Both options appear to be viable methods for containment of the silt material; however, unanswered questions as to their efficiency have raised questions about their viability. The use of demonstration projects is a common method by which to test and determine the effectiveness of a product or technology. Demonstration projects are designed to simulate field conditions or utilize actual field sites over a period of time and provide a realistic test of the process or product's efficacy.

Given a project source of suitable material within a reasonable accessible distance of MBDS, the Corps is interested in demonstrating the feasibility of capping. Such a project would not be experimental in that an actual dredging project, with suitable material, would be used. The demonstration phase would be monitored which may require both Federal and non-Federal participation. The timing of such an operation depends on the availability of suitable project material and funding of the monitoring phase. The Corps does not currently plan to demonstrate use of geotextile bags in New England, but will continue to evaluate other projects and demonstrations throughout the country for potential implementation.

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2.3.4 Disposal Options for Future Maintenance Dredged Material

Non-Federal interests are responsible for providing the necessary disposal sites for future maintenance material including the lands, easements, rights-of-way, dikes, other containment facilities and the necessary approvals.

Disposal sites considered in Section 4.0 of the EIR/S for the silts from the current project are also primary candidates for disposal of future maintenance material. These include MBDS with capping or other management technology, Subaqueous sites B and E, Spectacle Island CAD and Meisburger sites 2 and 7. Some of these sites may require further evaluation and design before they are used. Capping at the open water sites will require a demonstration of the process.

In the next few years, as the need for dredging of major harbors and/or ports increases, there will be increased pressure to find disposal options for the dredged material. In some instances the dredged material will be cleaner and will require no special method for its disposal. In other instances, like that of the BHNIP, the maintenance dredged material will not be suitable for unconfined open water disposal making the process more complex.
As time progresses and technologies advance, the number of disposal options for future maintenance dredged material from Boston Harbor may increase. New technologies and discovery of new containment materials subsequently increase the number of sites available for disposal of the material. The following section briefly discusses a number of potential options which may be available for disposal of future maintenance dredged material that at this time are not proven or are too costly.

2.3.4.1 Capping

Numerous commentors on the DEIR/S expressed the need for a demonstration project to prove the feasibility of capping as a future option for ocean disposal of the contaminated silt (confined ocean disposal). Since capping has not been demonstrated at MBDS depths, commentors on the DEIR/S felt there was a need to demonstrate its efficacy. If capping proves to be an option for ocean disposal, then the Massachusetts Bay Disposal Site (MBDS) and other open water sites may become viable disposal options for contaminated sediments.
A demonstration project for capping may be conducted at the MBDS using a clean silt material. The demonstration project would include point-depositing clean material by precise positioning of the barge. Once disposal is complete, clean material will be deposited over the contaminated material to form a final cap of approximately 3 feet in thickness. Monitoring of the demonstration site will be conducted over an undetermined period of time. This would likely involve monitoring for a period ranging from one to three years so that the cap can be observed over different weather and oceanic conditions (i.e. intense storms, seasonal variations, variable wave action, tidal flows).

The demonstration project will follow the guidelines under the Marine, Protection, Researach, and Sanctuary Act, the Clean Water Act, and will require consistency with the policies of the Massachusetts Coastal Zone Management Agency (CZM) under 301 CMR 20.00.

If the demonstration project determines that capping is an effective method for the long term containment of silty material at open water aquatic sites, sites where unconfined disposal was previously a concern may become preferred alternatives for future maintenance dredged material. The ocean disposal sites, including MBDS and other open water sites, may become acceptable disposal sites with capping. The short-term impacts associated with the capping process (i.e. temporary disturbance of habitat, short-term turbidity, temporary disruption of traffic) may continue to be a concern at these sites, however, the long term impacts, such as migration of sediments/contaminants and localized water quality impacts, will be addressed with the use of a cap.

The capping and disposal of dredged material at landfills will become less of an option as time goes on. Throughout the Commonwealth, landfill space is fast approaching capacity and space is limited to other, higher priority forms of solid waste. Further, state regulations requiring the closure of many of the landfills will also limit the amount of landfill space available for dredged material. Only the more expensive option of out-of-state lined landfills may be available.

2.3.4.2 Geotextile Containers

A new technology which is being considered as a disposal option for future maintenance dredged material is geotextile containers. The containers, which are generally composed of a pervious sheet of woven plastic (synthetic), monofilament or multi-filament yarn, can be filled with the dredged material and disposed in open water sites. These containers, which come in the form of either geotextile bags or "geocontainers", can range in volume up to 6,000 cy and possibly larger depending upon their application in a project. Geotextile containers have been used in deepwater aquatic environments in the United States (U.S.), Japan and Holland as underwater dikes, breakwaters and similar submerged structures for approximately five years.

Many of the commentors on the DEIR/S expressed interest in the use of geotextile containers as a disposal option for the BHNIP silts. There is limited information regarding the effectiveness of the containers, particularly when used to contain silty material. The consensus of the commentors was that the containers are a feasible disposal option; however, more information is needed to demonstrate their suitability for future disposal of the BHNIP maintenance material.

The Army Corps of Engineers has used geotextile containers at two sites in the U.S.: Red Eye Crossing on the Mississippi River in Louisiana and Marina Del Rey in Venice, California. At Red Eye Crossing, the containers were filled with dredge material and used to construct underwater structures. The containers at Marina Del Rey were placed in a shallow water habitat confined aquatic disposal site. At Red Eye Crossing, the sandy, uncontaminated dredged material was placed in both geobags and geocontainers. In Marina Del Rey, the material was a silty sand contaminated with hydrocarbons and heavy metals. In both instances, the placement of the containers was accomplished easily and accurately with minimal release of materials during placement. The only incident of leakage occurred at Marina Del Ray when the initial container was torn open to insert high pressure piping to liquify the contents to aid release from the barge. The two projects were implemented in 1994, so no long term monitoring information exists to date.

Other tests on the efficiency of geotextile containers were performed by the U.S. Army Waterways Experiment Station in Vicksburg, Mississippi. One set of samples placed in geobags were shown to release a small amount of fine-grained material after being dropped. Other tests to determine the effectiveness of the geotextile fabric to contain heavy metal contaminated materials were conducted; however, results were inconclusive, due to the lack of long-term studies. In April 1995 a single geotextile container was dropped in the New York Harbor area. Test data is still being analyzed.

A major constraint on the use of geotextile containers is the time consuming and labor intensive process required for their use. The containers must be assembled, placed onto the barge, unfolded, secured and, after being filled, must be sewn together properly and then placed at the disposal site. The entire process can require up to eight people and can take one to two hours per container, substantially increasing the dredge time and cost of the project.

The Corps is not planning a demonstration project in Boston Harbor using geotextile containers at this time. Such a demonstration would require obtaining large amounts of suitable test material approved by regulatory agencies. The geotextile project also requires additional preparation time for the containers and scheduling of the contractor(s). A demonstration project would need testing and monitoring prior to construction of the BHNIP; this would pose a serious time constrain on the project. The capping project is preferred for demonstration and the Corps will likely continue with plans for such a project. The Corps will continue to evaluate other projects that use geotextile containers and their applicability to future maintenance of the BHNIP and other dredging projects.

If geotextile containers prove to be an effective and cost-efficient method for containment of silty/contaminated material, those sites which were considered inappropriate for unconfined disposal (MBDS, BLS) may become viable options with the use of geotextile containers. Similar to the capping process, the containers would seal the material, preventing its migration from the target area. The geotextile containers may also be capped; a method which would further isolate contaminants from the environment.

2.3.4.3 Treatment Technologies

An alternative for disposing of contaminated dredged material would be treatment. As technologies advance in the next ten years, and the need for treatment of contaminated materials is realized, the number of treatment options for future dredged material may increase. As the number of technologies increase so will the options for disposal of the material.

A technology that renders the silt material clean and suitable for unconfined open water disposal would address the issues regarding disposal because MBDS is available for the disposal of clean material. Disposal options such as land disposal or reuse of the silty material would also be reasonable alternatives if the material were clean. Other technologies that could reduce the amount of material would increase future disposal options in that capacity of the disposal sites would be less

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of an issue. Technologies that render the material clean and reduce both the volume would reduce disposal concerns and regulatory constraints.

Currently there are commercial technologies available that have been used successfully on materials similar to the BHNIP silt (see Section 3.5). The largest constraint on the use of these technologies for the BHNIP silt is their implementation, cost, limited capacity to process large volumes at a substantial flow rate, and the by-product that still needs confined disposal. The time frame required to design, permit and construct a treatment facility in Boston Harbor is approximately 2 to 4 years; a time frame beyond that for use of the BHNIP material.

Treatment of future maintenance dredged material from Boston Harbor, however, may be a practicable disposal alternative. With a commitment of funding and staff time from resource agencies there may be time prior to the first maintenace dredging (ten years) for designing, permitting and constructing a treatment facility and for carrying out a demonstration project. Within the ten year period, other dredging projects in the state will increase the need for treatment thereby increasing the pressure to construct such a facility. The increase in the number of technologies which may be available in ten years may further result in decreased cost, which may make treatment a practicable disposal alternative for future maintenance dredged material.

TABLE 2-1.

MAINTENANCE DREDGING PROJECTIONS FOR THE TRIBUTARY CHANNELS AND THE MAIN SHIP CHANNEL

CHANNEL	DATE LAST MAINTAINED	ESTIMATED ANNUAL RATE OF ACCUMULATION (cy/year)	ESTIMATED 50 YEAR[1]
TRIBUTARIES			
Reserved Channel	None since deepened in 1966	1,900	95,000
Mystic River	1983	26,000	1,300,000
Chelsea Creek	1983	7,300	365,000
TOTAL for Tributaries			**1,760,000**
MAIN SHIP CHANNEL			
40-foot Main Ship Channel	1974	43,900	2,195,000
35-foot Main Ship Channel	1968	14,300	815,000
President Roads Anchorage	1983	29,100	1,455,000
TOTAL for Main Ship Channel			**4,365,000**

1 A fify (50) year project life is used for economic evaluation and starts at the timing of completion of the project. This table does not include future maintenance requirements of the berths.

TABLE 2-2.

VOLUME OF MATERIAL PROPOSED FOR DREDGING FROM CHANNELS AND ASSOCIATE PROJECT BERTHS FOR THE BOSTON HARBOR NAVIGATIONAL IMPROVEMENT PROJECT PROJECTED THROUGH 1997 (DREDGE VOLUMES IN CUBIC YARDS[a])

CHANNEL	AREA	TOTAL	ROCK	PARENT	SILT[b]
Reserved Channel/ Main Ship Channel	Federal Channel	632,600	34,000	438,800	161,600
	Conley 11-13	45,900	0	18,000	27,900
	North Jetty	16,200	0	7,800	8,400
	Boston Army 1-9	128,500	0	0	128,500
	Boston Edison Intake	1,100	0	0	1,100
	Boston Barge Berth	16,100	0	10,800	5,300
	Conley 14-15	7,100	0	2,800	4,300
Mystic River/ Inner Confluence	Federal Channel	1,317,700	54,000	791,800	497,900
	Prolerized	7,600	0	5,500	2,000
	Distrigas	13,800	0	10,000	3,800
	Moran	6,600	0	0	16,600[c]
	Revere Sugar	12,800	0	3,100	9,700
	Mystic Piers 2, 49 & 50	45,200	0	28,700	16,500
	Mystic Pier 1	17,600	0	8,400	9,200
Chelsea River	Federal Channel	550,100	0	320,100	237,300
	Eastern Minerals	39,900	0	32,700	7,200
	Gulf Oil	12,300	0	5,400	6,900
Subtotal	Federal	2,500,400	88,100	1,550,700	896,800
	Berths	370,700	0	133,200	237,500
TOTAL	In-situ	2,871,000	88,100	1,684,000	1,134,000
	After removal[d]	3,471,000	132,000	2,021,000[e]	1,361,000

[a] Rounded to nearest 1,000 cy

[b] Silt volumes assume 0.5 feet of overdredge into parent material to ensure all silt is removed.

[c] Includes 10,000 cubic yards already removed in 1993 under a reduced project design at Moran.

[d] Expansion factor (20% for silts and parent material, 50% for blasted rock) added for use in computing disposal site requirements for aquatic disposal sites. Material would be dewatered to in-situ volume for disposal in upland sites.

[e] This table does not include extra parent material to be removed for in-channel disposal.

Chapter Three: Disposal Site Alternatives

This chapter of the FEIR/S summarizes the screening process used to develop a short-list of preferred disposal alternatives for the BHNIP generated silt and parent material. MEPA required the overall process used to develop a short-list of potential disposal sites, that were identified in the DEIR/S is described in the next section. As stated in Chapter One, the site screening criteria were modified based on DEIR/S comments in two key areas. The first is the elimination of cost as a fatal flaw screening criterion. Cost is factored into the analysis only to assess the relative cost effectiveness of disposal scenarios determined to be environmentally suitable. Stated differently, cost is part of the practicability screening of environmentally suitable alternatives.

The second change in site screening was eliminating 200,000 cy as a minimum capacity criterion. Capacity is now viewed as only one factor in site screening and is related to the cost of developing a site for a given volume of disposal capacity.

The original MEPA scope required that the BHNIP evaluate disposal alternatives suitable for the current project needs and those alternatives that could provide a solution for future projects. In addition, both MEPA and NEPA require that the EIR/S consider the cumulative impacts of future maintenance dredging for fifty years after construction of the channel improvements that are contemplated.

The remainder of this chapter responds to the requirements for identifying a preferred disposal alternative for the BHNIP as well as for its maintenance dredging and other future dredging projects. This chapter culminates in a short-list of preferred disposal alternatives. Each of these alternatives is assessed against environmental and practicability concerns in Chapter Four to determine a final preferred disposal alternative.

Section 3.5 provides new material not previously available in the DEIR/S. It contains a description, and the results, of a technology survey of potential treatment and handling technologies for contaminated marine silts. Section 3.6 provides new information, since the publication of the DEIR/S, regarding the possible beneficial re-use of parent material at unlined municipal landfills in the Commonwealth. The chapter concludes with the screening of disposal options and the development of a short-list of potential specific disposal sites. It provides a description of each site in terms of existing environmental conditions and describes how the sites could be used for disposal of contaminated marine silts. This section culminates in a short-list of potential sites that are subjected to a detailed environmental analysis and practicability screening in Chapter Four.

3.1 THE EVALUATION PROCESS

The process for identifying disposal sites and alternatives involves a complex mixture of data collection, analysis, synthesis and judgment. The Disposal Options Working Group (DOWG) identified in Chapter One, assisted and reviewed the methodology and findings of every stage of the site selection process.

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The DOWG identified several key interests to be served by the site selection process:

1. Recognizing the need for responsible expenditure of public funds as reflected in the number of sites assessed, the level of detail required in data collection to assess the sites, and the development of disposal options which maintain a benefit-to-cost ratio greater than or equal to one for parent material and the least costly, environmentally acceptable, practicable alternative for silt.

2. Meeting federal, state, regional and local environmental laws and regulations.

3. Meeting the objectives set forth in the Massachusetts Environmental Policy Act (MEPA) and National Environmental Policy Act (NEPA) scoping guidance.

4. Providing disposal alternatives flexible enough to allow for changes in the project stemming from public comments, differences in dredging quantities, alterations in project limits, considerations regarding project requirements for phasing of dredging, and the length of time for handling the marine sediments.

5. Satisfying project requirements in terms of site availability, volume (for BHNIP) and duration.

6. Attempting to contribute benefits to long-term regional dredged material disposal needs. The Commonwealth of Massachusetts and various federal and state entities have established a goal of developing a long-term dredged materials management plan to simplify the process for disposing of sediments that are not suitable for unconfined ocean disposal. This plan is in the developmental stages, however, and will not be implementable for the Boston Harbor dredging project. The BHNIP can support the overall goals of the long-range plan by providing a screening process for site selection, by providing baseline information on sites potentially suitable for marine sediment disposal, and by providing excess capacity for future projects such as future maintenance dredging in Boston Harbor.

7. Demonstrating a wise use of over 2 million yards of clean marine sediments by identifying benefits for both the short-term needs of Boston Harbor clean-up and long-term dredged material management disposal needs.

The Boston Harbor Navigation Improvement Project (BHNIP) will generate up to 3.5 million cy of marine sediment and rock (as measured after removal) under the preferred development option. The materials assessment and characterization provided in the DEIR/S indicated that the parent material and rock are suitable for unconfined ocean disposal while the silt may require other options. As stated in Chapter One, the Corps has, in response to EPA comments, adopted the most conservative approach and has assumed that <u>all</u> silt would be unsuitable for unconfined ocean disposal.

Because of the large quantity of material to be dredged, it is assumed that parent material not earmarked for beneficial uses would be disposed at the MBDS. The disposal options evaluation focussed primarily on the silty maintenance and berth sediments. The remainder of this section describes the process for identifying alternative disposal sites and disposal options for the approximate 1.3 million cubic yards of this silt material, which is not suitable for unconfined open water disposal.

3.1.1 Identification of Disposal Concepts

The objectives of the disposal alternative analysis and screening process were to:

- identify potential disposal sites
- analyze and combine sites with other sites/technologies into disposal options on the basis of environmental considerations
- develop disposal options which meet the interests identified for the project.

The screening procedure consisted of an iterative process involving the development and application of evaluation criteria to a broad list of sites to eliminate infeasible disposal sites and to choose those that would result in the least environmentally damaging alternative. The ultimate aim of the disposal alternatives analysis was to identify a range of practicable alternatives which could be used for the BHNIP dredged material.

The disposal alternatives analysis process began by identifying generic types of sites. Identifying generic types ensured that no disposal opportunity would be left uninvestigated in meeting the MEPA requirement for consideration of upland, nearshore and open water alternatives. NEPA requires the consideration and evaluation of all reasonable alternatives. In general, two broad classes of sites were developed by the project team, Land-based Sites and Aquatic Sites. A general description of each category follows.

3.1.1.1 Land-Based Alternatives

Land-based disposal alternatives generally include landfilling or landfill capping, and confined disposal which may incorporate habitat creation, and commercial reuse. Use of land-based sites must comply with a variety of federal, state, and local laws and regulations. In addition, availability of landfill space and capacity, the logistics of dewatering, and the difficulties and costs associated with transporting the dredged material from the dredging site to the disposal area are important considerations in the feasibility analysis of land-based options. Disposal options which fit into the general land-based class are described in the following paragraphs.

A. Landfilling

Landfilling involves the disposal of d redged material in existing, permitted, lined landfills or for use as daily cover. In order to use dredged material as daily cover for sanitary landfills sufficient land surface area must be available to dewater the dredged materials to a suitable solids/water ratio. Daily cover of sanitary landfills has several benefits including the prevention of landfill pathogens from being carried offsite by animals, use in odor control, and as a fire retardant. For this category, Project team personnel, and the DOWG, developed a list of licensed, lined landfills for further evaluation.

Once a sanitary or hazardous landfill has met capacity and is ready to be closed, dredged material with appropriate physical and chemical characteristics can be used as a final cover or cap. In addition to the criteria for using dredged material as a daily cover, a final cover must meet minimum permeability standards, be designed to support vegetation to improve the site's aesthetics, and reduce the potential for erosion. Application of Boston Harbor dredged materials as landfill cover would be a beneficial use. If suitable, it could also result in habitat creation. For this category the Project team, and the DOWG, developed a list of former or closing landfills for evaluation.

B. Inland and Coastal Confined Disposal Facilities

Confined Disposal Facilities (CDFs) are engineered structures that are generally lined and diked, and are designed to retain dredged material solids while allowing water to be released from the containment area. A variety of site design features are required for CDFs including a perimeter retaining dike, a weir structure for release of excess water, and the development of an access road. Effects on surface water, groundwater, air quality, and plants or animals depend on the nature and characteristics of the dredged material, management and operation of the disposal site during and after dredging, and the proximity of the disposal facility to potential receptors of contaminants. Possible beneficial aspects of the development of CDFs include the potential for upland habitat creation/mitigation or filling quarries or mines into developable land.

CDFs are designed and constructed to be used over a span of many years, storing materials dredged periodically over the design life. Therefore, long-term storage capacity of a CDF is a major factor in design and management. The Project team and the DOWG identified land-based sites which could be suitable for the development of a CDF for further evaluation. These sites were categorized as inland if the immediate receiving waters are freshwater, and coastal if the immediate receiving waters are estuarine.

3.1.1.2 Aquatic Alternatives

Aquatic disposal is generally accepted for marine dredged material if environmental data indicate that water column and benthic effects are acceptable. If the water column or benthic effects are unacceptable under an open-water, un-capped scenario, aquatic disposal with restrictions may be considered. These restrictions involve disposal techniques such as capping and confined aquatic disposal that will reduce water column and benthic effects.

A. Shoreline Facilities

Nearshore aquatic habitats could be created as a result of shoreline containment area construction. Typically, this would involve direct placement of dredged material into existing shallow or intertidal sites to create new habitats. The types of beneficial habitats which can be created are intertidal wetlands (restoration and creation); migratory and nesting areas for

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waterfowl and shorebirds; and various underwater habitats such as reefs, shellfish beds, and seagrass meadows. In Boston Harbor, the use of abandoned piers as containment areas may also provide the benefit of capping potentially contaminated materials in place. Bulkheads or other containment structures may be necessary at many shoreline facilities to confine the dredged material on-site.

The nature of the dredged material, the benefits gained from the new habitat versus the lost benefits associated with the old habitat, and the stability of the site are issues that need to be considered for these shoreline facilities. If the material is of unacceptable quality or the site of the dredging is a great distance from the site of beneficial use, reuse of the dredged material may not be practical. The Project team and the DOWG identified several shoreline sites in Boston Harbor which may be created or enhanced by the placement of some portion of the BHNIP dredged material.

B. Subaqueous Depressions and Borrow Pits

Existing subaqueous depressions (e.g., historic sand and gravel mined coastal areas) or created borrow pits can be used for disposal where the walls of the depression or pit provide lateral containment of the dredged material. These sites can range in size from a few feet to tens of feet deep and from a few acres to many hundreds of acres in size. Dredged material could be disposed of in depressions or borrow pits as long as the location is suitable for capping. The cap would be designed to prevent potential contaminants from entering the water column or the food chain. The selection of sites on which to locate borrow pits needs to be based on an evaluation of potential environmental, hydrodynamic, economic, social, and cultural/historic impacts on the Boston Harbor and Massachusetts Bay region. The use of depressions and pits would reduce the lateral extent of a disposal operation, thereby reducing both physical benthic effects and the potential for release of contaminants.

The project team and the DOWG identified several subaqueous depressions and potential borrow pit sites in Boston Outer Harbor for inclusion in the list of sites for screening.

C. In-Channel Disposal

In-channel disposal consists of excavating a trench within the navigation channel limits into the parent material, filling the trench with contaminated silts, and using granular materials as capping material. The configuration of the trench would be designed so, that upon completion of filling and capping, final contours would match the previous or improved harbor bottom contours. This alternative has the advantage of being located in an already impacted area (i.e., the navigation channels) although water quality and biological impacts as a result of the double handling of dredged materials would need to be carefully evaluated. The project team and the DOWG identified several sections of the Boston Inner Harbor navigation channels where In-Channel disposal may be feasible.

D. Existing Ocean Disposal Sites

Shallow ocean disposal sites are generally designated sites on the continental shelf. This practice consists of placing silty material in the disposal area and then rendering the material immobile by capping it with "clean" dredged material. The placement of clean material over material considered potentially harmful is subject to careful monitoring during placement and after closure. The cap is intended to isolate contaminated sediments from the water column. The cap would prevent or reduce the accumulation of potentially harmful constituents in the water and biota of the disposal areas, and avoid the potential for long-term (chronic) impacts that might occur if the dredged material were left exposed to the natural environment. The resulting disposal site would be a mound of dredged material above the ambient ocean floor. This alternative may be feasible at previously used dredged material disposal sites, such as the Boston Lightship Disposal Area.

The Massachusetts Bay Disposal Site (MBDS), located approximately 20 miles off the Massachusetts coast, has been used for unregulated ocean disposal activities prior to the 1970s. The MBDS has recently received site designation status as an EPA approved national disposal site. The continued use of the disposal site would center potential impacts on existing disturbed habitats, protect the existing biological conditions in other undisturbed areas in the Massachusetts Bay, and lessen potential conflicts between interested parties.

The MBDS would receive the parent material and rock remaining after beneficial uses have been completed. The sediment characterization performed for the Project indicates that this material is suitable for unconfined, ocean disposal. The silt material from the project has been determined as unsuitable for unconfined MBDS disposal, either capped or unconfined and therefore, this site is dropped from further consideration for this project. It's use for the disposal of future maintenance material will require additional studies, demonstration projects or both.

3.1.2 Identification of Potential Disposal Sites

As a starting point for identifying disposal alternatives, a wide range of sites were developed from a number of sources to create a "universe" of sites from which potential disposal areas could be extracted. The sources for the universe of sites included potential disposal sites from the Central Artery/Tunnel Project, the MWRA Residuals Management Facilities Plan (Black and Veatch 1987), Massachusetts Bay Disposal Site Designation, an EPA study on nearshore disposal facilities (Metcalf and Eddy 1992), and conversations with local, state and federal agencies. The process through which these conceptual disposal alternatives were evaluated, and by which specific sites were identified, and evaluated, is detailed in Appendix E of the DEIR/S. A summary of the process is provided herein.

3.1.2.1 Phase 1 Site Screening

The BHNIP disposal site evaluation process consisted of three phases. The Phase I screening process was limited to identifying fatal environmental impact

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flaws of particular sites. These fatal flaws included:

- water supply wells located on a site
- sites within a sole source aquifer
- sites within the estimated habitat of rare and endangered species
- sites in or abutting state parks
- sites within Areas of Critical Environmental Concern (ACECs)
- sites containing a 21E hazardous waste property
- upland sites with less than 15 acres of developable land

Landfills were first screened against requirements for accepting dredged material and for being permitted for use until at least 1996. Disposal and stockpiling capacity and distance from the dredging locations were also used as screening criteria on those landfills that met the first two criteria.

Sites were categorized into land-based and aquatic sites. Land-based sites included inland and coastal sites and landfills. Aquatic sites included shoreline facilities, subaqueous depressions, borrow pits, in-channel trenches and existing open water disposal sites. The universe of sites in all categories that made up the first phase screening process consisted of the following:

- 312 land-based inland and coastal sites;
- 21 landfills; and
- 21 aquatic sites

An additional 22 sites within the various categories were identified in consultation with the DOWG and agency personnel. This consultation also resulted in limiting disposal site selection to sites within the Commonwealth. As stated earlier, the MEPA scope indicated an interest in using the information gained in this project to help resolve regional long-term dredging disposal needs in the Commonwealth.

The Phase 1 screening resulted in the following number of sites remaining as potentially suitable for disposal purposes:

- Land-based inland - 14
- Land-based coastal - 12
- Landfills - 4
- Aquatic shoreline - 10
- Subaqueous depressions - 6
- Borrow pits - 4
- In-channel trenches - Not identified or screened in Phase 1
- Existing open water sites - 2

The list of sites remaining after the first phase site screening (Table 3-1) were presented at a meeting of the DOWG on January 25, 1993.

3.1.2.2 Phase II Site Screening

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 (e.g., 404 (b)(1) dredge and fill guidelines; Clean Water Act, Massachusetts Coastal Zone Management regulations) and requirements, (especially Massachusetts's Wetlands Protection Act

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and Site Suitability Criteria for Solid Waste Site Assignments). Criteria recommended by DOWG participants or identified in other dredged material disposal site screening documents (e.g., Metcalf and Eddy 1992) were also included.

While each criterion is important, certain criteria stand out from the list as potential deciding factors in the site screening process. To aid in discriminating between the most important and less important criteria; each criterion was assigned a "P" (priority) or an "S" (standard) classification. "Priority" criteria are those that require compliance with a specific regulatory criterion. Inability to meet priority criteria could become a fatal flaw. "Standard" criteria are important to the overall evaluation of a site's suitability but do not rise to the level of the most stringent standard or, represent a potentially fatal flaw. Categorizing the criteria into P and S groupings enabled a semi-quantitative screening in addition to the standard qualitative analysis.

Phase II criteria were applied to all sites identified as potentially feasible after Phase I, as well as several additional sites identified with the assistance of the DOWG (see Table 3-1). A semi-quantitative evaluation of sites was performed for each disposal site category. Within each disposal site category, site "scores" were compared to focus attention on the most promising sites. Criteria that were not met were examined carefully to evaluate whether the concern 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.

The results of the Phase II screening were presented to the DOWG on April 15, 1993. Discussion at this meeting and subsequent investigations revealed additional information and issues regarding many sites that resulted in further modification of the short-list (Table 3-1).

In particular, the elimination of Rowes Quarry (MAL-01) at the end of the Phase II screening raised considerable comment in Working Group meetings because this site had been short-listed by MWRA for landfilling sludge from the Deer Island wastewater treatment facility.[1]

Several agencies commented that Rowes Quarry had been dropped from the list of potential disposal sites in the DEIR/S without adequate explanation. The project team revisited the site, reviewed the existing information on the site, and has identified several technical, environmental, social, and permitting issues that detract from the suitability of Rowes Quarry for silt disposal. These issues are discussed below.

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USEPA. 1990. Public record of decision on the "Final Supplemental Environmental Impact Statement, Long Term Residuals Management for Metropolitan Boston". U.S. Environmental Protection Agency. Boston, MA.

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A. Technical

According to a technical report[2] rebutting MWRA's selection of Rowes Quarry as a potential residuals landfill site, the quarry is characterized by exposed fractured bedrock, with groundwater within 1 to 3 feet of the ground surface. Groundwater was also observed discharging from the exposed northeast quarry wall about 30 to 40 feet above the floor, and standing water is present in portions of the quarry, due in part from groundwater. MWRA had determined that the quarry site is hydrologically linked via surface water drainage, and possibly groundwater through the bedrock fractures, with the adjacent Rumney Marsh. This 1,070-acre salt marsh is located at the confluence of the Pines and Saugus Rivers, and is considered an extremely valuable regional resource, as indicated by its 1988 designation as an Area of Critical Environmental Concern.

Converting Rowes Quarry to a lined landfill for BHNIP silts would require compliance with Massachusetts Department of Environmental Protection (DEP) regulations for siting and constructing a solid waste landfill (310 CMR 19.000). Several unconventional engineering techniques would be necessary to overcome the construction constraints imposed by the bedrock fractures, exposed bedrock, high groundwater, and vertical quarry walls. NEI (1989) calculated that 356,000 cubic yards of fill would be required to prepare the quarry prior to liner installation. Because no soils exist on the site, the entire fill quantity would need to be transported to the quarry in an estimated 17,800 truckloads. Assuming the constructed landfill would be 30 acres in size on the 43-acre site, the silt capacity is estimated to be 484,000 cubic yards (or 24,200 truckloads). Therefore, constructing the site would require importing three-quarters the amount of material the landfill would eventually accommodate.

A portion of the estimated 356,000 cubic yards of fill required to prepare the quarry floor for a landfill could potentially be obtained from the BHNIP parent material. Some mixing with clean material will be required to reduce the chloride concentrations in the BHNIP material to acceptable levels for terrestrial use. Chloride concentrations in the berth parent material averages 1.8% (BHNIP DEIR/S, Volume 2, Appendix C-3), which converts to approximately 8,000 - 18,000 μmhos/cm conductivity. The Bureau of Waste Prevention Policy 94-037 currently sets a maximum allowable conductivity of 4,000 μmhos/cm. A dredge material disposal policy currently under development is likely to set an even stricter threshold (Joel Hartman, MA Division of Solid Waste, personal communication). The amount of mixing, and thus the quantity of BHNIP material that can be beneficially used as part of the fill material will need to be more fully addressed should this site ever be used for marine material disposal.

B. Environmental

Rowes Quarry's proximity to the Rumney Marshes ACEC will probably require

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2 NEI. 1989. An independent assessment of the selection process for MWRA residuals landfill in the greater Boston area. Normandeau Engineers, Inc., Concord, NH. Prepared for the City of Revere, MA 24 pp + App.

extensive studies of the marsh and estuary in order to determine the risk to the ACEC from the landfill should the liner or leachate collection system fail. These studies are likely to include calculations of the probability and frequency of several design failure scenarios, estimates of both acute and chronic levels of contamination, and the probable fate of contaminants in the ACEC, as well as hydrologic testing and modeling to understand the ground and surface water connections between the site and the ACEC. The time and costs required to complete these studies and the difficulty of designing, building, and permitting a secured disposal facility makes the option prohibitive.

C. Social/Economic

The high densities of residences and sensitive receptors (including several schools and a nursing home) in the immediate vicinity of Rowes Quarry are also a strong deterrent against the use of this site. NEI (1989) reported over 12,000 residences within 1 mile and 2,500 within one-half mile. In the 7 years since the report, the population numbers have likely increased due to the high development pressures in the surrounding communities of Malden and Revere.

The quarry owner has consistently rejected any discussion of selling Rowes Quarry, which would require BHNIP to take this site by eminent domain. This approach is objectionable to the Project team because of both the loss of a thriving business and the associated jobs, and the length, and expense of the eminent domain process. The cost to buy the property is estimated to be 5 to 14 times higher than the other possible sites.

D. Permitting

The permitting process for Rowes Quarry will likely be disproportionally long and complex compared to most other sites on the current disposal options list. This is due primarily to: 1) its proximity to Rumney Marshes ACEC; 2) its location straddling the Malden/Revere corporate boundary, which would necessitate permitting in both towns, and; 3) the surrounding high-density residential population which voiced opposition to the use of the quarry by MWRA because of nuisance issues and the likelihood of a decline in property values. Additionally, as described above, obtaining the property by eminent domain could result in lengthy court proceedings. Some or all of these permitting obstacles would result in delaying the BHNIP well into the future.

E. Future Maintenance

In light of Rowes Quarry's current siting limitations, this site may be a more reasonable disposal option for future maintenance dredging material because several major obstacles may be eliminated or reduced in magnitude over time. The owner of the quarry stated in 1989 that the quarry resources will be exhausted within the next several decades (NEI 1989). At that point, the quarry operation will cease and the owner may be more amenable to selling, which would eliminate two BHNIP concerns of interrupting an active business and taking the property by eminent domain. Also, technological advances may improve the dewatering techniques currently available, which will make all land-based disposal options more available in terms of both environmental impacts and costs. In such a case, Rowes Quarry

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may be an advantageous disposal site because of the quarry's proximity to Boston Harbor. Finally, designation of the site for future maintenance disposal would allow sufficient time to complete the anticipated lengthy permitting process well in advance of the need for the site.

3.1.2.3 Phase III Site Screening

Phase III involved the development of additional site-specific information for the short-listed sites through site visits, aerial photographs, and discussion with appropriate resource agencies. The short-listed sites were re-evaluated against the Phase II criteria in light of the additional information resulting in a revised short-list (see Table 3-1).

3.1.2.4 Phase IV Site Screening

In response to comments received during the DEIR/S public comment period, two areas of additional information were identified that would benefit the site selection process. These included: 1) water resources at the land-based inland sites; and 2) biological conditions at the aquatic sites, excluding MBDS. The following sections discuss the additional data acquisition efforts undertaken by the project partners to further screen the short-listed sites remaining after the Phase III screening.

A. Review of Phase II Evaluative Criteria for Land-based Inland Sites

Additional information was collected to review selected Phase II Evaluative Criteria for Land-based Inland Sites. Information was obtained from Massachusetts DEP representatives regarding public water supplies. A Normandeau representative also visited the DEP Northeast regional office to review the DEP Water Supply Protection Atlas and the Bureau of Waste Site Cleanup (BWSC) Resource Maps. Individual BWSC Resource Maps were obtained for all fourteen Land-based Inland Sites.

Normandeau obtained information on public water supplies from the DEP regional offices. Mr. J. Otavio Paula-Santos of the DEP, Division of Water Supply in Boston provided Normandeau with the "List of Public Water Supplies and Their Sources" for DEP Northeast Region. Mr. Larry Dane (DEP Southeast Regional Office in Lakeville, MA) provided a listing of towns in the DEP southeast region which have surface water supplies and their surface water sources. Mr. Dave Erickson (DEP Northeast Regional office in Woburn, MA) informed Normandeau that the Massachusetts Water Resource Authority (MWRA) supplies water to most of the Boston Metropolitan area. The second largest water supply source is the Merrimac River upstream of the Lawrence Dam. Additional surface water supplies include the Hobbs Brook/Stony Brook Reservoirs along Route 128 and also the Concord River.

A Normandeau representative visited the DEP Northeast Regional office in Woburn, MA on December 9, 1994. The purpose of this visit was to review the DEP Water Supply Protection Atlas and the DEP, BWSC Resource Maps relative to the Phase II Evaluative Criteria concerning surface water and groundwater resources. Information that was collected from the regional offices was used to re-evaluate

certain screening criteria and to evaluate those criteria which were previously listed as "undetermined" (see Appendix E, DEIR/S), meaning that information for a particular site was not available.
The re-evaluating confirmed the screening of the 14 inland sites. The only change occurred at the Wrentham site (W-495). The DEP, BWSC Resource Maps show that the W-495 is located within a DEP Zone II Wellhead Protection Area.

B. Additional Sampling in Marine/Coastal Habitats Since Draft EIR/S

Additional sampling at nearshore aquatic and marine sites was conducted in October 1994 (see Appendix E). The sampling plan was reviewed by Federal and State resource agencies and modified in response to agency comments. The purpose of the sampling was to add an additional data point to the body of information already existing and used in the DEIR/S and to confirm or refute the earlier findings. Nineteen locations in Boston Harbor and three locations on Massachusetts Bay were surveyed using a sediment profile imaging (SPI) camera. Samples were collected for benthic infauna at each location using a 0.04 m^2 Van Veen grab. The dredging and disposal sites surveyed in this study are shown in Table 3-2.

A finfish resource evaluation was conducted in October and November 1994 (see Appendix E). Demersal fishes were collected using a nine-foot otter trawl with a 0.64 cm cod end mesh at the six stations shown in Table 3-2. Three trawls, lasting either 5 or 20 minutes (depending on conditions) were made at each location. Gill nets were utilized to collect demersal fish at eight stations, including the four dredge or disposal sites listed in Table 3-2. Scientific gill nets measuring 30.3 m x 3.03 m with varying mesh sizes were set a surface and bottom depths for a total of 72 hours, and were fished at a 24 and 48 hour interval.

Lobster resources were assessed through a trapping program (see Appendix E). Modified lobster traps (escape vent closed) were set at three offshore, one outer harbor, and nine inner harbor locations. These included the dredge and disposal sites listed on Table 3-2. Traps were harvested every twenty-four hours for a three-day period in October 1994. Lobsters were measured, sexed, and enumerated.

The results of these sampling events are fully discussed in Chapter Four of the FEIR/S and were factored into the environmental assessment of each potential aquatic disposal site. The sampling reports fish, benthic, and lobster resources are included as Appendix E (see Volume 3). The findings of the October 1994 sampling confirm the earlier data gathered in sampling programs conducted in July and November 1986 and April 1993, as summarized in the DEIR/S.

3.2 SEDIMENT/SITE MATCHING

As stated in the original MEPA scope and the 1988 Feasibility Report, ocean disposal (Massachusetts Bay Disposal Site) is the preferred disposal option for uncontaminated marine sediments of acceptable quality and is the option against which other alternatives were originally evaluated. However, a substantial component of this project has focussed on the issue of quantifying the levels of metals and organics in project sediments. Review

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of these results has indicated a wide range of chemical concentrations in sediments throughout the project area (Section 2.2 and Appendix C of the DEIR/S). Characterization of sediments for disposal options relies on interpretation of the results of bioassessment in terms of ecological significance, and is, therefore, not a clearcut decision. The Corps has joint responsibility for making this determination. The EPA has veto authorization The silt from the Reserved Channel area was the only material for which a consistent opinion was not reached. However, based on public and agency comments on the DEIR/S, and to ensure that the disposal option alternatives analysis would identify sufficient space, it has been concluded that alternatives to unconfined ocean disposal would have to be sought for <u>all</u> silt materials from the project.

Potential impacts arising from disposal of the silt vary among the generic alternatives. These differences are reflected in testing requirements and required control measures (Table 3-3). All disposal types evaluated require bulk chemical analysis of most parameters identified in the "Green Book" (EPA/ACOE, 1991). Unconfined open water disposal and lined and unlined landfills, each have identified thresholds for a suite of parameters that must be met for disposal to be permitted (Table 3-4). Thresholds for non-landfill upland disposal are not currently established; however, site suitability was evaluated assuming that such a facility would be lined and that the Category A (lined) landfill criteria would be appropriate.

Similarly, regulatory thresholds for in-harbor or coastal containment have not been defined. Both alternatives would provide isolation of the disposed material from the surrounding environment once disposal is complete. The in-harbor containment alternative provides the opportunity for isolation during disposal. It was assumed that there were no sediment quality thresholds necessary for in-harbor containment or open-water containment, but that either alternative would be dependent on achieving acceptable water quality conditions as demonstrated by acceptable water quality modeling results or monitoring. Stability of the disposed material after emplacement on the bottom would also have to be addressed.

In response to agency and public comments received on the DEIR/S, and to address these latter issues of water quality impacts and sediment stability, the project team performed extensive studies in preparation of this FEIR/S. The first was a series of models to determine the transport and fate of silt disposal at the aquatic short-listed sites. The results of these models are used in Chapter 4 in evaluating impacts among the short-listed sites. The complete water quality modeling report appears as Appendix F in Volume 3 of the FEIR/S.

The second series of studies included a characterization of near bottom water velocities generated by typical vessel operations in the improved Boston Harbor. This study, and other studies on sediment stability, are included in Appendix G in Volume 3 of the FEIR/S. This information is used in evaluating the need for armoring and stabilizing sediments disposed under aquatic conditions in the Inner and Outer Harbor.

In sum, site-specific sediment data were compared to thresholds for each disposal alternative (Table 3-5). Clay and rock from all dredging areas were acceptable for any type of disposal, provided capacity was available. The following section discusses how silt material could be managed for each of the generic disposal options, including special handling or design features required for disposal, with the least environmental impact.

3.3 SUITABILITY OF GENERIC TYPES OF DISPOSAL ALTERNATIVES FOR DREDGED SILT

The types of impacts associated with disposal of dredged materials can be categorized generally as habitat loss or alteration, water quality degradation, emigration (physically or biologically) of contaminants from the disposal site, and socioeconomic concerns (primarily fishing, land use and traffic) and are related to site preparation and management activities. The following paragraphs summarize the site preparation and management requirements needed for each generic disposal alternative to minimize these impacts. The findings are summarized on Table 3-6.

3.3.1 Land-Based Alternatives

A. Inland and Coastal Sites

In general, upland sites would have to be cleared and graded before construction of a silt containment facility. The containment facility would include a liner, diked disposal cells constructed in sequence, runoff and leachate controls, and access roads (Table 3-6). Closure of the site would include capping and landscaping. Configuration of the containment facility would be designed to minimize impacts to critical environmental features.

Locations of upland sites are shown in Figure 3-1. Access to inland sites is restricted to truck or rail transportation. Coastal sites could be accessible by barge, although this could require dredging of access channels.

Potential impacts associated with developing an upland (either inland or coastal) disposal facility are, in contrast to landfills, relatively severe (Table 3-7). While it would be desirable to focus on previously degraded sites, areas that have received other waste materials are not always suitable for disposal facility development without remediation first. While chemically-degraded sites may be suitable for a long-term future regional facility after remediation, sites that have experienced habitat alteration (clearing, excavation and mining) are the most likely candidates available for the BHNIP. Development of a disposal facility on such a site could result in loss and/or alteration of terrestrial habitat (particularly Wrentham (W-495) and Woburn (WOB-11)), possibly including wetlands. Loss of vegetated wetland habitat (Table 3-8) would occur with development of the Wrentham (9 acres), Woburn (1 acre) and Squantum Point (QUI-03) (0.3 acres) sites. Everett (EVR-04), Squantum Point and Wrentham all provide habitat for state-listed species of special concern (Table 3-8).

Development of the coastal sites (Everett and Squantum Point) would affect marine resources due to dredging. Prevention of

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water quality impacts would depend on site design features including design criteria to minimize the risk of exposure of freshwater resources to elevated chloride levels (inland sites only) or contaminants. Marine waters could experience locally-elevated turbidity and contaminant concentrations at the dewatering site (Mystic Pier or North Jetty) for inland sites, but this would be limited by proper design and monitoring. Depending on site access, use of coastal sites could affect marine water quality during site preparation (dredging for barge access) or dewatering (for truck transportation). Both inland and coastal sites offer some risk of contaminant emigration due to the prolonged period required for drying the sediments before capping. Although the disposed materials would remain azoic, the containment area would appear pondlike and may be attractive to birds.

Both types of sites could have socio-economic impacts - displacement or alteration of land use and high truck traffic volumes. None of the short-listed sites are currently in use except Woburn which has a closed, but uncontained, municipal landfill onsite. Due to its large capacity, Wrentham would experience the highest truck volume but its proximity to major highways would minimize the neighborhood effects of this traffic. Rail access could become available for Woburn. Barge transport would be likely for Everett and Squantum Point.

Disposal of silty sediments from Boston Harbor in an upland area would remove this associated chemical load from the harbor environment (Table 3-9). A regional facility might be able to use a chemically-degraded area, but the remedial actions necessary to develop such a site would be greater than a single project (even a large one) could bear. Thus, such sites were not short-listed although any upland site that demonstrated merit for potential development would require a preliminary assessment, as a minimum, for hazardous materials. Parent material (clay) could be used in construction of the site, although the silt would then have to be stockpiled during construction. There would be potential for enhancement of terrestrial habitats once the facility was closed. Any landscaping would have to preserve the integrity of the cap, probably eliminating the planting of trees.

B. Landfills

Existing landfills can provide disposal space for marine dredged materials under two scenarios - use for daily cover or burial. In the case of the BHNIP, the surficial silts would have to be mixed with clean materials to meet the regulatory thresholds for daily cover.

No special site modifications would be required for landfills, although all the short-listed landfills have odor limitations. Three existing landfills (Figure 3-1), Plainville/Laidlaw, East Bridgewater and Fitchburg/Westminister, were identified as having the ability to accept marine sediments in the approximate time frame for the BHNIP.

From a qualitative perspective, use of lined landfills for disposal of dredged materials provides the least environmentally damaging alternative (Table 3-8) because the natural environment has already been disturbed to develop the landfill. However, competition for space at landfills is a key issue. Landfill space is fast approaching capacity, and while various landfills are capable of handling marine sediments, this type of use could displace other, higher-priority uses. Of the 122 landfills currently permitted to accept municipal solid waste in Massachusetts, 114 are scheduled for closure by 1996 (DEP, January 1993 active MSW landfill list). The three sites short-listed have limited capacity for burial of dredged material (Table 3-8). The exception is that there continues to be a need for daily cover and final closure material. Dredged material can be suitable for these purposes under some circumstances. To be used for daily cover, sediment must have contaminant levels within a range that, after mixing with a "reasonable" amount of clean material, would meet TCLP regulatory levels (Table 3-4). Maximum need for daily cover that could be provided by BHNIP dredged materials ranges from 50 cy/day (Plainville/ Laidlaw) to 250 cy/day (Fitchburg/Westminister) (Table 3-8). Only clean material that would contribute to construction of an impermeable layer could be used for a cap. Marine clay can be suitable for this purpose (S. Lipman, MADEP, 1993, pers. comm.). The limited available capacity for dredged materials at these landfills would minimize the traffic burden associated with the BHNIP.

The benefits (Table 3-9) of using landfills for disposal of marine sediments are relatively high, primarily because this alternative utilizes existing facilities. Again, however, this apparent benefit must be weighed against the constraint of competing uses for a limited resource.

3.3.2 Aquatic Alternatives

A. Shoreline Facilities

There are two fill alternatives proposed for the Mystic Pier sites, Revere Sugar, Amstar and Cabot Paint (see site locations Figure 3-1). The first alternative is for partial fill which would result in a final elevation (including cap) of mean low water. The total fill alternative elevation would be mean high water (or higher where adjacent land elevations would allow it). For both alternatives, a bulkhead would be constructed to isolate the site from the harbor during disposal. The bulkhead would remain in place after disposal in the total fill alternative but be cut off at MLW after the cap was secured for the partial fill alternative.

Two fill alternatives were considered for these sites since the cost of disposal site development can only be offset by maximizing the disposal site capacity. However, the total fill option creates an irretrievable loss of subtidal habitat by replacing it with fast land. The partial fill option is designed to allow for the establishment of intertidal habitat.

Little Mystic Channel and Reserved Channel (Figure 3-1) would require maintenance of aquatic habitat. Little Mystic Channel would be filled to a final elevation (including cap) of -6 to -3 ft MLW. Fill in the Reserved Channel would encompass either the entire area west of Summer Street or only the western end of that area. The western end would, in either case, be filled to a final grade (including cap) of +9 ft MLW, a suitable elevation for establishing salt marsh vegetation. The eastern portion would be filled to a final elevation of -6 ft MLW.

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Both sites would be bulkheaded during disposal.

Both shoreline fill scenarios would result in loss of marine habitat, although in the partial fill scenario loss would be temporary (Table 3-7). Permanent habitat losses would be highest at Cabot Paint (total fill). Temporary habitat losses would be highest at Reserved Channel (if entire area used) or Little Mystic Channel (Table 3-10). There were no marked differences in benthic infauna among the six potential disposal sites, but the pier areas (Amstar, Cabot Paint, Mystic Piers and Revere Sugar) may provide slightly better finfish refuge potential than the channels (Little Mystic, Reserved) because of the pilings. Ultimately, in the partial fill alternative, marine habitat could be altered from fine-grained substrate to vegetated or rocky substrate of potentially higher productivity (Reserved Channel, Little Mystic Channel).

Temporary localized water quality impacts could be minimized by appropriate site management (e g., dredging and disposal methodology, disposal behind bulkheads, use of silt curtains, disposal timing) for both total and partial fill alternatives. In both scenarios, the disposal site would be essentially isolated from the rest of the harbor. The partial fill scenario could pose a slightly higher risk of emigration of silty sediments in the long term than the total fill. Since the short-listed shoreline sites are in relatively quiescent parts of the harbor, and thus relatively safe from erosional currents, other forces (e.g.; boats, biological activity) are unlikely to disrupt the cap of the partial fill.

Land use impacts would be site dependent. Any fastlands created would have to be used for a water-dependent activity. Alterations in current use would be greatest at Amstar because of MWRA's newly constructed floating dock (for transport of Deer Island workers). Other pier areas are not presently in use. Filling in the eastern portion of Reserved Channel could interfere with the existing marina operations. Traffic impacts would be minimal at pier sites since sediments would be transported by barge. It could be necessary to use a barge and truck combination for Little Mystic Channel and Reserved Channel because of low clearance bridges across the entrance of each site.

Each of these fill alternatives could result in environmental or socioeconomic benefits (Table 3-9). All of the shoreline sites are likely to have or have been demonstrated currently to contain, contaminated sediments with elevated chemical constituents. Either the total or partial fill alternative would isolate these contaminants from the Boston Harbor environment. The partial fill scenario has the potential to enhance the environmental quality of the site by providing clean substrate for benthic organisms (all sites), or plantings to increase primary productivity (especially Reserved Channel and Little Mystic Channel). Totally filled sites could be developed for port-related activities. Clay from the improvement dredging could be used in capping these sites, reducing the need to transport material to MBDS.

C. Subaqueous Depressions

Use of the outer harbor subaqueous sites B and E (Figure 3-1) would rely on existing bathymetric conditions to keep disposed

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sediments in place. Sediments would be transported by bottom-dumping scow. After disposal of silt is complete, the area would be capped by depositing granular material over the sediments.

Use of the subaqueous depressions would result in temporary habitat losses until capping was complete (Table 3-7). The disposal site footprint would be smallest at the Winthrop Harbor site (8 acres). Subtidal habitat would be altered by changes in substrate texture and depth. Some fine-grained sediments and associated contaminants would remain in suspension and be transported away from the disposal site. ADDAM'S model results indicate that the plume could extend a distance of approximately 4,500 ft from the disposal site and on a flood tide potentially carry contaminants (which may exceed water quality criteria by 2x) outside the disposal site.

Commercially harvested clam beds on the Snake Island flats and the Basin could be sensitive to sediments with elevated contaminants dispersed from a Winthrop Harbor disposal site. Disposed sediments would be exposed to currents for the duration of disposal activities, presenting a risk for further emigration and bioaccumulation.

The model results imply that water quality exceedences should not extend up-channel beyond Chelsea Point in Winthrop, so the Belle Isle Main ACEC should not be at risk (Table 3-11). Subaqueous B and E are exposed to higher current velocities than Winthrop Harbor but water modeling showed no impacts to areas of potential exposure including the Governor's Island flats and Deer Island flats. There would be no land-based traffic impacts to any of these sites, although some impacts to navigation would occur. Restrictions would be temporary in Winthrop Harbor and Subaqueous B. Seasonal recreational boating could restrict disposal operations in Winthrop Harbor. Small boat use of the channel passing across Subaqueous E could also cause seasonal restrictions on use of the site.

Using subaqueous depressions for material disposal would isolate dredged contaminants from the harbor ecosystem. Another benefit associated with the subaqueous disposal alternatives is the ability to use project parent material for the cap (Table 3-9).

D. In-Channels and Borrow Pits

Both In-Channel and Borrow Pit alternatives would require additional dredging of *in-situ* parent material. Sufficient surficial material dredged from the borrow pit areas would be stockpiled to use as final capping material to restore the site to pre-existing substrate conditions. Native clay from channel deepening could be used for the initial cap at borrow pits. Sand, from either the parent material or bought, would be used to cap the in-channel areas due to the tolerances that have to be achieved in the final bathymetry in the navigation channels.

In-Channel alternatives would include Chelsea Creek, Inner Confluence and Mystic River navigational channels. Borrow pit alternatives include Meisburger 2 and 7, and Spectacle Island CAD (see Figure 3-1). This latter site is located in the shallow (-10' MLW) subtidal area east of the Island and is totally disassociated

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from the Island itself and the CA/T project work in progress.

Both the In-Channel and the borrow pit alternatives would temporarily remove marine subtidal habitat from production. There would be a greater impact at the previously undisturbed Meisburger sites than the In-Channel alternatives. Surface substrates at borrow pit sites could be altered somewhat but substrate in the In-Channel sites would not be noticeably different from the planned post-dredging conditions.

Containment of sediments during disposal for inshore alternatives is an issue requiring mitigation to lessen the resulting turbidity plume. ADDAM'S model results indicate that water quality criteria exceedences would not occur at the offshore (Meisburger) or Spectacle Island CAD site. Sediments would be exposed for the duration of the disposal operation, resulting in some potential for emigration through current transport or biological activity. The smaller capacities of the In-Channel alternatives would result in shorter periods of exposure than the borrow pits. However, ADDAM's model results, for the Subaqueous E site, indicate that there could be water quality criteria exceedences during flood tide after four hours; and silt/clay plumes were predicted to extend as much as 4,500 ft upstream of this in-harbor disposal site. Because of shallower water near the Spectacle Island CAD site, dilution to below water quality criteria was predicted at greater distances, but reached that distribution level in less than four hours.

Biological impacts could vary among the In-Channel alternatives primarily because of the Mystic River's value to anadromous fish although seasonal restrictions on disposal in the Mystic River Channel could avoid these impacts. The offshore borrow pit sites, Meisburger 2 and 7, support high benthic productivity and fisheries resources are relatively abundant. The outer harbor Spectacle Island CAD appears to support substantially lower benthic production. Its location in the general vicinity of the proposed Central Artery/Tunnel fish reef mitigation and beach project, however, would mean that disposal methods and/or mitigation efforts would need to account for the protection to this resource if it is in place by the time the Harbor is dredged. Additionally, special plans to avoid or mitigate for fishing gear losses (lobster, pots, etc.) from barge traffic or construction activities may be necessary at the Meisburger and Spectacle Island sites.

The In-Channel alternative would use suitable granular material (sand and gravel) as a capping material due to the tight tolerances needed in the in-channel option and the ability to reduce voids in the cap by using sand rather than cohesive clay. Clay could be incorporated into the borrow pit cap. Sediments (sand and gravel) dredged from the borrow pit sites during site preparation could be used for beach nourishment or construction, if the need exists. Otherwise, this sediment would have to be disposed at MBDS. The In-Channel alternative has the advantage of being located in an already impacted area (i.e., the navigational channels).

E. Existing Disposal Sites

Previously-used dredged material disposal sites, MBDS and Boston Lightship (Figure 3-1), could be utilized for the project for silt disposal, with capping. At MBDS

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disposal of contaminated material with capping is prohibited unless a successful demonstration is made; with respect to the BLDS, the Corps has successfully demonstrated effective capping at sites with similar depths elsewhere in New England. A containment area would be prepared by configuring parent material in a specific area. Silt would be point-deposited by accurate positioning of the barge. Once disposal was complete, additional granular material would be deposited over the silt to form the final cap.

Disposal of silty dredged materials at a previously-used disposal site would have impacts generally similar to use of a borrow pit (Table 3-7). Since disposal of the silty sediments at the Massachusetts Bay Disposal Site is currently prohibited by EPA without further testing, a field program to demonstrate the effectiveness of capping moves this site out of a reasonable time frame for use on the current project. Agency concerns associated with capped disposal at MBDS have largely focussed on emigration of contaminants/sediments during disposal and long-term integrity of the cap. In a recent study by EPA (1993) ADDAM'S models were run for the MBDS using this project's data and no water quality exceedences were predicted outside the site during the disposal phase (Table 3-12). These results were used to conclude that disposal activities from this project (BHNIP) would not add to impacts from the MWRA ocean outfall at a level to cause a risk to threatened and endangered species in the area. ADDAM'S model results for the Boston Lightship also indicate that water quality criteria would not be exceeded outside that disposal site which is half as deep and twice as close to Boston as MBDS. In the foreseeable future BHNIP is the only project that could provide its own capping material, perhaps representing the only opportunity to cap silty sediments of this volume and provide a demonstration of this option's effectiveness. This scenario would provide beneficial use of all parent material dredged from the project. Capping at the MBDS may represent a practicable alternative for the future maintenance material as it is not considered implementable at this time due to the EPA and CZM requirement for a demonstration of its efficacy. The ability of the Corps to perform a capping demonstration would hinge, in part, on the availability of suitable material.

3.4 DEVELOPMENT OF DISPOSAL OPTIONS

As discussed previously, there are few alternative disposal sites that have the capacity to handle all the dredged material, parent, silt and rock, for this project. In addition, disposal considerations must include the requirement of future disposal of maintenance (silt) material. In order to address both the present and future capacity needs individual disposal sites have been combined into disposal options which attempt to balance environmental consequences with practicability concerns.

The volume of material requiring disposal from the proposed BHNIP was conservatively estimated to ensure sufficient capacity will be provided at disposal options. Table 2-1 presented the estimated volumes of rock, parent and silt material requiring disposal. The volumes shown assume up to a 0.5 foot of parent material is also dredged to ensure all silt

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material is removed. The volumes also factor in a 20% expansion of silt and parent material over in-situ volumes to account for the water entrained in the dredging process. Rock was assumed to expand by 50% over in-situ conditions due to the blasting fractures. Based on the measured in-situ volumes and expansion factors the BHNIP will generate approximately 132,000 cy of rock, 2 million cy of parent material and 1.3 million cy of silt. These quantities represent one consideration used in developing potential disposal options. As discussed in Section 3.2 and summarized on Table 3-5, sediment quality must also be taken into account in considering disposal sites. Environmental impacts of using undeveloped sites for disposal, presented in Section 3.3, are also a factor in developing disposal options, particularly related to contaminated dredged material. Finally, practicability considerations of costs, technology and logistics which are reasonably related to project needs must be factored into the development of disposal options.

These four factors: sediment quality, environmental impact, volume and practicability, were used to formulate several disposal options by combining land-based and aquatic sites. The following sections describe options in four categories developed through the process defined above. Each option assumes that dredged parent material and rock will be used for beneficial uses to the maximum extent possible and that these uses will be identified and expanded throughout the EIR/S process. The remaining quantity of this material after beneficial uses are accomplished will be disposed at the MBDS.

Options for disposal of silt material considered potentially unsuitable for unconfined ocean disposal (Table 3-13) are the primary focus of the next section. Options defined as group "A" include combining land-based sites for silt disposal. The "B" group options focus on combining aquatic sites while "C" group options include combinations of land-based sites and aquatic options. The "D" group options consider aquatic sites previously used for offshore disposal and which have the capacity to receive all the project material.

Tables 3-14 through 3-19 and 3-21 provide the costs of alternative disposal options described in the following paragraphs. The objective of preparing these tables was to determine relative unit costs by estimating the total cost to dredge the silts, process the dredged material, transport the material to the disposal site, construct any required features at the disposal site and any other costs associated with the dredging and disposal of silts. The costs are based on April 1995 price levels.

The unit costs should not be used to estimate a project cost. Project costs, once a disposal site is selected, will be computed based on optimal use of equipment, distribution of silts to other disposal sites if applicable, and other factors that can not be estimated until a final disposal plan is selected and the cost of disposal of the parent material is determined. Also cost for mobilization would have to be added as well as associated design and construction management costs required for the selected plan.

Assumptions used are listed on each table. Existing information was used when available. Experience from other projects was used when specific site data was unavailable. These assumptions should be carefully reviewed since, in some cases, significant cost items are not included (i.e., real estate acquisition costs for upland and shoreline sites).

3.4.1 Land-Based Options (A)

Use of any of the upland sites for silt disposal would require that the material be dewatered prior to disposal. Dewatering would occur at Boston Harbor shoreline sites to facilitate trucking efficiency and minimize potential chloride impacts to freshwater systems. For calculations of disposal needs it was assumed that dewatering and compaction would reduce the silt volume nearly to its in-situ estimate of approximately 1.1 million cy.

Option A1. Option A1 would involve disposal of all silt at landfills. The three landfills which survived the screening process (see Table 3-1) are expected to have a combined maximum need of 1,000 cy/day of cover material. TCLP results indicated that most of the harbor silts would have to be mixed with equal quantities of clean materials to be suitable for daily cover, reducing the total potential daily use of project material to 500 cy/day, or 7-13% of the anticipated dredging rate. Over the anticipated 100 days of silt dredging (assuming two dredges, yielding 8,000 cy/day each), the total daily cover needs at the landfills of 50,000 cy would fall far short of project disposal needs. In order for landfills to provide the necessary capacity, project sediments would have to be buried, not simply used as daily cover. Using all three landfills, a total of 525 cy/day of silt material, or 52,500 cy over the 100 day dredging period could be buried. The maximum disposal capacity for project silts combining daily cover and burial is, therefore, 102,500 cy.

As pointed out in preceding sections, there are definite environmental advantages to using landfills since they are engineered and permitted designated disposal areas. The major drawbacks to using landfills are daily limitations on quantities that the landfills can handle and competing public uses for landfill capacity. It would take more than 4 years to accommodate the 1.1 million cy generated by the BHNIP using Option A1. Costs would range from $62 - $108/cy to dispose of material at the landfills not including the cost of land needed to stockpile silt for four years (see Table 3-14).

Option A2. Option A2 would involve a combination of one or more landfills and one or more inland sites. Meeting the capacity requirements of the BHNIP would, at a minimum, involve using Wrentham (W-495), Squantum Point (QUI-03), and all three landfills. To reduce the volume of dredged materials to be buried at the landfills (52,500 cy), a third upland site, Everett (EVR-04), would have to be included. Any other combination of inland and landfill sites would fail to provide adequate capacity. Distribution of dredged material to four or five different locations would be difficult logistically and each town would feel the maximum potential effects of disposal. In addition, all dredged material would have to be dewatered. Once dewatering started, dredged materials would have to be removed at the rate of 4,000-8,000 cy/day (200-400 truckloads) while silt was being dredged.

This option also assumes that a lined disposal facility would need to be designed and constructed at two or more inland or coastal sites and that silt overburden in excess of landfill capacity would have to be stored until access to sufficient quantities of clay become available for the facility's liner. Costs for Option A2 would be approximately $63/cy (see Table 3-15).

Option A3. Option A3 would rely entirely on developing land-based disposal sites for the silty material. Individually none of the four upland sites could provide the total capacity needed for the BHNIP, but the combination of the Wrentham (W-495), Woburn (WOB-11) and Squantum Point (QUI-03) sites meet the capacity needs. This option also provides some excess capacity beyond the current project needs. The benefits of Option A3 include reserving landfills for other public uses, minimizing the area and time needed for stockpiling and minimizing impact to the marine environment. Significant drawbacks include long-term management of three sites along with attendant costs, the minor capacity available for future dredging projects and on-site and neighborhood impacts from constructing the facilities and transporting up to 55,000 truckloads of silt to the sites. Costs for implementation of the above scenario of the Wrentham, Woburn and Squantum sites would be $60/cy (see Table 3-15).

3.4.2 Aquatic Options (B)

Aquatic options must be able to accommodate an estimated 1.3 million cy silt material which includes the 20% expansion factor over in-situ volumes.

Option B1. Option B1 relies on placing all the silt material in shoreline containment areas. Use of all the sites short-listed could not provide all the disposal capacity needed for the BHNIP, but use of some or all of the sites could provide a variety of disposal configurations in combination with other types of sites. Filling these sites (Amstar, Cabot Paint, Mystic Piers, Revere Sugar to fastland; Little Mystic Channel to -3 ft MLW; and Reserved Channel to MHW in its western end and -6 ft MLW near the Summer St. bridge) would result in a temporary or permanent loss of marine habitat. However, this option would benefit the Boston Harbor aquatic environment by covering the silty sediments that presently exist at these sites, would enhance sediment quality for benthic organisms and could enhance primary productivity by creation of low salt marsh in Reserved Channel or subtidal productivity in parts of the Little Mystic Channel. Impacts to harbor traffic are also minimized by providing disposal within the vicinity of the proposed dredging. This option would not have capacity remaining for future use unless an additional site were included in the development plans.

Costs for maximum capacity at all six sites range from $7 - $362 cy depending upon the amount of engineering and site preparation required (Table 3-16). Costs include construction of a bulkhead across the face of each site and transfer of sediments from barge to truck by crane.

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Option B2. Option B2 involves filling existing outer harbor subaqueous sites. No site by itself would provide the capacity necessary for the BHNIP. Combination of the maximum fill scenarios at Subaqueous B and Subaqueous E and Winthrop Harbor would provide sufficient project capacity. Because development of the subaqueous sites would not include construction of a physical containment structure, future use (if any capacity remained) would be dependent on having sufficient capping material. This option would result in temporary water quality impacts, and loss of marine subtidal habitat during the disposal and capping process. The habitat would be altered in depth, microtopography, and potentially, sediment grain size characteristics. The logistical benefits to this option are substantial as it would mean disposal sites would be near the dredge sites, minimizing conflicts with ship traffic and greatly reducing transportation costs and impacts.

Costs for this option would be approximately $20 per cubic yard (see Table 3-17). No site preparation costs would be incurred.

Option B3. Option B3 would require overdredging in at least three navigational channel areas, creating cells beneath the authorized channel, filling the dredged cells with silt and capping it with sand. Because this scenario would be confined to the footprint of the federal portion of the BHNIP, no additional habitat would be impacted. This option would prolong the dredging process by 3-6 months and require temporary barge storage of dredged silt until the initial cell was dredged. The three channel areas where it would be feasible to overdredge, Mystic, Chelsea and Inner Confluence, would be able to provide the capacity needed for BHNIP. Parent material would have to be disposed elsewhere (probably MBDS) or put to some beneficial use. Overdredging would be impractical in the Reserved Channel because it is the only tributary of Boston Harbor that has no physical restrictions to future deepening. The ability to localize any impacts makes this an attractive option for the BHNIP, it would also offer a potential solution to hold aside capacity for future maintenance dredging. Again, transportation disturbances and costs would be minimized by this option.

This option would cost approximately $30 per cy (see Table 3-18).

Option B4. Option B4 would require dredging and capping a borrow pit for containment of BHNIP silts. A beneficial use would be sought for the material dredged from the pit. Meisburger 7 could provide capacity for all the silt dredged during the BHNIP. Meisburger 2 also has the capacity if the sand and gravel deposits are proved to average more than 10 feet thick. The Spectacle Island CAD with a 45-acre footprint could also provide the necessary capacity. Each of these sites could be constructed to provide capacity for other projects if they occur during the time frame of the BHNIP. The Meisburger sites could provide sufficient additional capacity for future maintenance dredging of Boston Harbor, assuming disposal was confined to discrete cells.

Impacts associated with this option would be temporary but would include disturbance to areas utilized by commercial fish and fishing activities. In-harbor sites

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may experience some water quality exceedences while the offshore sites would not. Costs would range between $21 and $33 per cy, depending on the site selected (see Table 3-19). Reuse of sediment dredged at the disposal site could reduce the costs.

Option B5. Option B5 assumes a combination of aquatic shoreline sites and any of the other aquatic sites. This option would require use of at least two sites - an aquatic shoreline site and a subaqueous, in-channel or borrow pit site. An advantage over Option B1 would be the avoidance or minimization of permanent habitat loss, depending on the aquatic shoreline site selected. For example, this option could provide the capacity needed for the BHNIP by filling Revere Sugar to fastland and constructing an intermediate footprint at the Spectacle Island CAD. Any aquatic shoreline site could similarly be combined with the Spectacle Island CAD or with reduced disposal scenarios at the Meisburger sites to meet project capacity needs. Other possible combinations within this option would require the use of four or more sites (e.g. Little Mystic Channel, Subaqueous E, Inner Confluence In-Channel and Mystic River In-channel). Any sites not used could potentially be available for future disposal of Boston Harbor dredged materials.

3.4.3 Land-Based Aquatic Combinations (C)

Option C1. Option C1 would utilize a combination of landfills and aquatic shoreline sites. The combination of all six shoreline sites (to full capacity) and three landfills (50,000 cy of daily cover plus burial of 52,500 cy) would provide disposal capacity for a total of 1.18 million cubic yards. This option does not provide any future maintenance disposal and is logistically quite complex in terms of requiring dewatering locations, barge and truck loading at various sites around the dredging location and increased truck traffic in shoreline and landfill communities. In addition the option removes landfill capacity from other public users. The costs for this option range from $37 to $362/cy depending upon the site.

Option C2. Option C2 would combine non-landfill upland and aquatic shoreline sites. It could be implemented by using as few as three sites; a combination of Wrentham (W-495) and Everett (EVR-04) with Reserved Channel or Little Mystic Channel (to -6 ft MLW). That option would yield excess capacity. Alternatively, Squantum Point (QUI-03), Wrentham, and Mystic Piers (at maximum capacities) would meet needs but provide very little excess capacity. The costs for these scenarios would range between $30 and $76/cy depending on the site selected.

Not using Wrentham would require a minimum of eight sites: Squantum Point, Everett and the six aquatic shoreline sites except Little Mystic Channel, to their maximum capacities. Truck traffic impacts would be reduced in this scenario but construction of shoreline facilities would keep the cost range high, between $37 and $362 depending on the site.

Option C3. Option C3 would utilize a combination of landfills and aquatic disposal sites. Use of any of the borrow pits to full capacity would make landfill disposal essentially superfluous; however, landfills could be used in part if there were strong public pressure for landfill use. Without the landfills, this option becomes similar to Options B4 or B5, discussed earlier. The Spectacle Island CAD, Meisburger 2 or Meisburger 7 (borrow pits) could provide the 1.3 million cy capacity and would be the simplest way to minimize use of landfill space and completely confine the dredged materials. No habitat would be permanently lost although capping the aquatic site would likely result in some alteration of substrate character. Spectacle Island CAD is located in shallow enough water to enable use of control structures to isolate the site during disposal. At other sites, because no physical structure other than lateral constraints provided by bathymetric conditions (existing or created) would be in place during disposal, some emigration of sediments and contaminants might occur from the aquatic disposal site during placement, potentially affecting nearby fisheries and other aquatic resources. If borrow pits were not used for this option, a minimum of two subaqueous depressions would be required.

Since no structures would be needed, costs for disposal under Option C3 would be less than C1 or C2. Assuming use of Spectacle Island CAD and East Bridgewater landfill, Option C3 costs range from $21 to $62/cy.

Option C4. Option C4 would combine development of a new land-based disposal facility with a non-shoreline aquatic site. Many possible combinations of two or three sites could meet current needs and potentially provide excess capacity for future dredging. Most efficient implementation of this option would likely focus on aquatic disposal first; development of the upland facility would start when clay dredged from the improvement portion of the BHNIP could be provided for the liner of the upland facility. The selection of both the upland and aquatic sites would determine whether excess capacity would remain for future dredged material disposal. Presumably, any excess capacity would be provided at the upland site, provoking the question of costs and responsibility for long-term management of the facility. Possible combinations of sites include Wrentham (W-495) and Subaqueous E; Wrentham, Everett (EVR-04), and Mystic River; and Squantum Point (QUI-03), Woburn (WOB-11), Subaqueous E, Mystic River and Inner Confluence.

Providing a constructed facility with substantial excess capacity would drive the costs of the BHNIP up substantially and would render this option impracticable. A regional use facility could be constructed and maintained by a separate authority. Costs for the suggested combinations of sites would range from $19 to $76 per cy, assuming that upland site preparation costs would be offset by future users of the excess capacity provided.

3.4.4 Previously Used Aquatic Disposal Sites

Option D1. Option D1 would rely on solidification of silty sediments prior to disposal at either MBDS or Boston Lightship. Solidification processes have been demonstrated to stabilize metals, PAHs and PCBs (Breslin, et al. 1988; IWT Co. 1993, pers. comm.) and have been considered to provide permanent removal of these contaminants from the ecosystem when applied in the terrestrial environment (see Section 3.5 and Table 3-20). There would be no short-term water

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quality impacts associated with offshore options, as demonstrated by the ADDAM'S model results. This option would also address concerns about resuspension and/or transport of silt sediments offsite, as well as further reducing on-site risks. However, this option would require special handling of the dredged material, and this, along with the cost of the treatment material, would make this option more costly. Disposal of solidified material at an offshore site could increase habitat complexity or make habitat reestablishment more difficult.

Costs for solidification with offshore disposal would be approximately $90 per cy (see Table 3-20).

Option D2. Option D2 would rely on disposal of the silty sediments at either MBDS or Boston Lightship and subsequent capping with parent material (primarily clay) from the channel deepening. As discussed in prior sections, resuspension of contaminants during disposal and from the boundaries of the designated disposal site has been the major concern associated with the capping option. However, modeling done in this study and by the EPA indicates that short-term water quality criteria exceedences should not be a problem with these sites. This project overcomes a major stumbling block faced in the past by proposals for capping at MBDS: availability (or lack thereof) of suitable capping material. The BHNIP will produce over 2 million cy of parent material, 1.5 times the quantity of silt to be dredged. Further, due to the physical constraints created by the transportation tunnels under the Main Ship Channel, it is likely that the Inner Confluence, Mystic Channel and Chelsea Channel will never be deepened below the authorized 40 feet. Thus, the supply of potential capping material is unlikely to be available for this purpose again without relying on an outside source. However, in its final site designation, EPA has found that disposal-and-capping (of unsuitable material) is prohibited at MBDS until its efficacy can be effectively demonstrated (40 CFR 228.12 as amended).

Cost for this option would be approximately $13 to $27 per cy for disposal of project silt (see Table 3-21).

3.5 ALTERNATIVE TECHNOLOGY ASSESSMENT

The silt portion of material to be dredged from Boston Harbor could undergo certain treatment processes that may either immobilize or reduce chemical concentrations to a level that may be acceptable for open water or other disposal options. Various commercial treatment processes exist that have been successfully utilized elsewhere in the country on sediment and on other material that may be applicable to dredged material. In response to interest generated by the DEIR/S in potential treatment technologies, the project team developed a questionnaire survey of technology providers. Section 3.5.1 details the development and results of this survey.

3.5.1 Treatment Technologies

To gather information on technologies available for the treatment of the contaminated dredged materials, the DOWG developed a survey questionnaire. The survey questionnaire was sent to 38 providers of treatment/disposal services. The format of the survey was based upon a rating system developed by the USEPA for screening treatment options for Superfund sites. This rating method was also used by the Corps and the EPA in the evaluation of treatment and disposal options for the remediation of contaminated sediment in the Great Lakes (Averett et al. 1990.). To evaluate the different treatment technologies, information on the effectiveness, implementability and cost was requested. In addition, the respondent was requested to rank ten factors, from 1 to 10, which affected the estimated cost. A letter was also sent with the survey form to provide background information on the proposed project and to provide a summary of laboratory results on the physical and chemical characteristics of the dredged materials. A copy of the survey questionnaire is included as Appendix D in Volume 3 of the FEIR/S.

Of the 38 survey questionnaires sent, 14 were completed and returned (37 percent response rate). The companies contacted are listed in Table 3-22. The technologies represented by the responding firms included: thermal treatment (7), solvent extraction (2), soil washing (1), biotreatment (1), solidification/stabilization (2), and landfill (1). The questionnaire responses were summarized and are presented in Table 3-23. Of the 14 responses, 13 were further evaluated. The response from Soil Technology was not considered for additional evaluation due to limited development of the technology (laboratory scale).

The following paragraphs summarize each technology category its potential applicability to the BHNIP.

1. Thermal. This category includes incineration processes, pyrolytic processes, vitrification processes, wet air oxidation, and other processes that involve heating the sediment hundreds or thousands of degrees above the ambient temperature. A number of these processes have been widely demonstrated, and are considered effective for destroying organic contaminants. However, they are often more expensive than other options. For example, the low fuel value and high water content of sediments results in high additional energy input requirements during incineration. In addition, volatilized metals and other incineration by-products must be removed from flue gases, ash or other residues for treatment and disposal. Incineration processes may also be difficult to implement because of siting problems related to complex permitting requirements and generally poor community acceptance. On the other hand, few of the non-incineration thermal processes have been demonstrated on other than a bench-scale or pilot basis.

2. Solvent Extraction, Soil Washing and Other Chemical Treatments. These technologies use chemical agents and processes to destroy, modify, remove (extract) or chemically immobilize toxic materials, or to alter them in a way that affects their solubility, stability, separability and other properties affecting handling and disposal. Averett et al. (1990) identifies available chemical treatment processes, including chelation and nucleophilic substitution (dechlorination), as well as 22 extraction technologies, most of which can be viewed as essentially chemical in nature. Variations of these technologies are potentially effective in treating PCBs, non-halogenated semi-volatiles such as PAHs, and metals. However, according to the literature, many chemical processes may be difficult to

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implement because of materials handling and process control requirements that have not been fully demonstrated for application to dredged material. Heterogeneity of grain size and density can limit the effectiveness of the extraction processes. For those processes, there may also be problems associated with recovery and disposal of the extraction solvents.

3. Biotreatment. These technologies, which include such processes as aerobic and anaerobic bioreclamation and digestion, treat contaminated sediment through the biodegrading action of microorganisms or enzymes produced by microbes. However, biodegradation is effective only to materials high in organic content, and is generally ineffective for treatment of heavy metals. In addition, biodegradation generally works best under operating conditions which permit a high degree of control of critical process parameters such as temperature, moisture, and nutrient content. These conditions may not be readily achievable for a large volume of material where climatic conditions vary widely or in instances when the treated materials are highly heterogeneous. Furthermore, biodegradation processes are complicated by the possible toxic effects of one contaminant in the treated matrix on the microorganisms used to treat another contaminant.

4. Solidification/Stabilization. These technologies typically isolate and limit mobility of contaminants through solidification and/or stabilization (S/S), and are usually applied to sediments that are ultimately placed in a confined site or disposal area. Averett et al. (1990) cite 12 such processes, including lime-based and Portland cement-based solidification processes, as well as encapsulation. S/S facilitates materials handling, decreases the surface area of the sediment mass across which contaminant loss or transfer can occur, and can limit contaminant solubility through Ph adjustment or sorption phenomena. According to the literature, S/S processes can be effective for both organics and metals. The most common of these technologies have been demonstrated on a pilot or full-scale basis for treatment of soils and solid residues from other treatment processes. In addition, the immobilization processes are generally not as sensitive to process control conditions as the biological and chemical-extractive processes. However, the effectiveness of cement-based solidification processes may be impeded by organics in the treated materials which reduce the binding capacity of the fixative, resulting in premature structural degradation. Another limiting factor in the use of immobilization technologies is the availability of a suitable confined disposal area or beneficial use for the solidified material. Marine applications may be available, however. Artificial reefs constructed of stabilized incinerator residues have been placed in Long Island Sound. Studies on mobility from these reefs of dioxins and furans (Wente and Roethal 1993) and various metals (Breshlin, et al. 1988) have indicated that these constituents have neither leached nor been accumulated by organisms attached to the reef. Other proprietary stabilizing agents have been demonstrated to immobilize PCBs and PAHs (IWT 1993, pers. comm.). Blocks constructed of solidified dredged material may also be useful for shoreline protection and reinforcement.

5. Physical, Mechanical and Landfill Disposal. These are largely dewatering and separation technologies often used to prepare materials for additional treatment or landfill disposal. Dewatering processes include passive settling and drainage systems, as well as active mechanical systems such as belt filter presses and centrifugation. Mechanical separation and particle classification processes employ equipment such as grizzlies, hydroclones, and hydraulic classifiers to separate fine-grained clays and organic matter from coarser dredged material. This process may be desirable for the Boston Harbor material not only to facilitate handling, but because contaminants tend to sorb primarily onto the finer-grained material, thereby reducing the volume of material which would require treatment. These mechanical technologies are generally widely available, and many have been fully demonstrated in the treatment of sludges as well as in mining and other materials-handling industries. Factors limiting the effectiveness of these technologies can include the moisture content, flow rates, particle size distribution of the subject materials, and practicability of handling the large volumes and high daily production (dredging) rates. In addition, debris typically found in the harbor would have to be carefully removed prior to processing.

Many of the specific processes which fall within each of the technology categories identified above have been reviewed in published literature, either generically or in connection with specific dredging or sediment remediation projects. From this review it was apparent that different investigators have used varying approaches to process nomenclature and categorization of specific processes (e.g., some reviewers classify chelation as a chemical process, others as a physical process; some place extraction within the chemical treatment category, others regard extractive processes as a treatment category by itself.) Averett et. al. (1990) have organized over 70 treatment process options within six technology categories. It is important to note that while many of these technologies have been widely demonstrated in non-marine applications, only a few have been used for bench scale and pilot scale tests on marine dredged materials, and few are considered commercially demonstrated and available for this purpose. The total volume of material being handled on this project and its rate of production are also serious impediments to the use of these technologies.

3.5.2 Technology Screening Criteria

A wide range of treatment technologies from the above described processes have been assessed with respect to effectiveness in treating the specific parameters of interest in the BHNIP (PCBs, PAHs, metals) as well as the implementability of each process considering the volume and through-put expected from the project.

The critical characteristics of the Boston Harbor Dredging Project that impact the selection of the alternative technologies include the following:

- The types of contaminants that are of concern, based upon contaminant concentrations found during the sampling and testing program, are polychlorinated biphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs), petroleum hydrocarbons and trace metals. The ability of each technology to treat these contaminants in the medium of dredged material is an important qualifier on effectiveness.

- Approximately 1.3 million cubic yards of dredged material may be unsuitable for unconfined ocean disposal and therefore could require treatment. Depending on the disposal option selected, production rates could range from 4,000 to 9,000 cy per day. This quantity and rate of dredged material would require a large scale facility for any of the applicable treatment technologies to be used. It is therefore, important to select demonstrated technologies that have operated on similar types of dredged materials at the scale required by the project schedule. This imposes a substantial constraint because there is very limited experience with operating treatment technologies at the scale of the proposed project for marine dredged materials.

- Implementation of any alternative treatment technology will result in residue streams to the environment. The ability of each technology to control these residue streams, and thus to mitigate environmental impacts, is another important consideration for effectiveness.

Appendix D in Volume 3 contains a copy of the technology questionnaire that was sent to the selected treatment providers. This questionnaire was reviewed and commented on by the DOWG and contains the technology screening criteria deemed important by the group. The results of the questionnaire are described in the next section.

3.5.3 Treatment Technology Rating

The treatment technology and disposal options were rated based upon their stated effectiveness, implementability and estimated cost (Table 3-24). For this study, effectiveness is defined as the ability of a process to meet the desired remediation goals while minimizing impacts to human health and the environment during the construction and implementation of the process and the overall reliability of the process. The relative rating criteria used a numerical scale of 1 to 4 with the following effectiveness ratings (Averett et al. 1990):

> Rating = 4. Process option can achieve the performance objective with greater than 99 percent efficiency. The process is highly reliable.
>
> Rating = 3. Process option can achieve the performance objective with 70 to 99 percent efficiency. This process is moderately reliable.
>
> Rating = 2. Process option can achieve the performance objective within 40 to 70 percent efficiency. This process is minimally reliable.
>
> Rating = 1. Process option is less than 40 percent efficient in achieving performance objectives. The process is not reliable.

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Since both inorganic and organic contaminants have been detected in harbor sediments, the effectiveness of the process was rated for each contaminant group, for a maximum combined rating of eight.

The second factor evaluated was implementability, which is defined as the technical and administrative feasibility of using a treatment or disposal technology option. The implementability ratings are defined as follows (Averett et al 1990):

> Rating = 4. The process option is commercially available, has proven applicability to the contaminated sediments and has been field demonstrated at process rates similar to those proposed.
>
> Rating = 3. The process option is commercially available, has proven applicability to contaminated sediments and has been demonstrated on a pilot scale for sediments.
>
> Rating = 2. The process option has been demonstrated on a bench scale to be applicable to contaminated sediment and adequate information is available to proceed to a pilot-scale demonstration. Innovative technologies developed in laboratory studies may be assigned this rating.
>
> Rating = 1. The process option is conceptual or emerging and requires additional developmental work for application to contaminated sediment.

The last factor to be evaluated and rated was estimated cost. The ratings for estimated costs are as follows (Averett et al 1990):

> Rating = 4. Unit cost for the process option is less than \$20 per cubic yard.
>
> Rating = 3. Unit cost for the process option is in the range of \$20 to \$100 per cubic yard.
>
> Rating = 2. Unit cost for the process is between \$100 and \$200 per cubic yard.
>
> Rating = 1. Unit cost for the process option is greater than \$200 per cubic yard.

The individual rating scores for effectiveness, implementability and costs were added together to determine the composite score. Since the effectiveness of the processes on both inorganic and organic contaminants were rated separately, the maximum score for effectiveness is 8 and the maximum total score achievable is 16.

The composite scores ranged from 7 to 13 (Table 3-24). The lowest composite score was for the LADS System process. The LADS System combined thermal solidification/stabilization process had a low composite score because it is an emerging technology, has a high estimated unit cost (>\$100/cy) and because no information was provided on this method's effectiveness on organic contaminants.

Commercial Recycling and Laidlaw Waste Systems received the highest ratings of the group. The Commercial Recycling solidification/stabilization process provides high effectiveness in treating both organic

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and inorganic contaminants, relative ease of implementation and relatively low cost ($55 to $95/ton). Disposal of the dredged material in the Laidlaw landfill also received a high rating because of its effectiveness, relative ease of implementation and low cost ($50 to $65/ton). Although this option is highly rated, its implementation may be compromised by the volume of material that can be disposed of on a daily basis at the landfill, and the concentration at which some of the contaminants in the dredged sediments have been detected. The landfill would be able to accept up to 2,500 tons of material per day. The material would be accepted as long as the concentration of regulated contaminants (particularly PCBs and lead) did not exceed state standards.

These ratings of the different treatment and disposal options is based solely upon the information provided by the companies which completed and returned their survey questionnaires. Based on these responses, none of the technologies demonstrated experience in treating marine dredged sediments or any data which seems translatable to the BHNIP. If treatment of dredged materials is required as part of any future maintenance dredging, the development of a pilot test program for the highest rated technologies should be considered to collect additional information on the effectiveness, implementability and cost of using technology.

3.6 BENEFICIAL USES

There is a strong potential for a portion of the Boston Harbor dredged material to be used for one or more beneficial uses. The types and volumes of parent material may never be available again from Boston Harbor and therefore provide some unique mitigation

opportunities for dealing with the silt. The parent material, specifically the rock and Boston Blue Clay could have a variety of beneficial uses.

It is also possible that the silt portion of the dredged material containing elevated levels of organics (PCBs, PAHs and petroleum hydrocarbons) and heavy metals could be utilized for daily cover at Massachusetts Category A lined landfills. However, the concentration of certain contaminants in the material must meet the DEP criteria for this type of use. One drawback to utilization of the dredged material for landfill cover is that each landfill is limited to receiving small quantities (50-250 cubic yards at the short-listed sites) of material for daily cover use. Stockpiling at landfills is limited due to the confined space available. Consequently, only a small portion of the Full Project quantity of dredged silt material (approximately 1.1 million cubic yards total) could be used in this manner.

Beneficial uses for rock and parent material are broader in scope and could include the uses described in the following paragraphs.

3.6.1 Use of Rock Material

A limiting factor to the beneficial use of any of the rock material is that some or all of the rock may be used to armor the in-channel disposal sites to prevent prop wash of deep draft vessels from affecting cap stability. The following are potential uses of rock remaining from the project after construction and project uses.

A. Fish Habitat Enhancement

There will be a large quantity (< 132,000 cubic yards) of rock removed from this project which could be utilized for constructing or improving a fishery habitat. For a perspective on the overall volume of material available, a containment structure with an approximate height of 15 feet and encompassing an area of over 5 acres could be constructed. A structure of this magnitude could be located in an in-harbor or offshore area considered to be in need of hard-substrate to enhance fisheries habitat but away from heavily utilized locations and high energy areas. A drawback to the rock to be removed for the BHNIP is that it will be mostly small in size (< 10") and mixed with some clay which would not provide large interstitial space for fisheries habitat. It would however, provide hard substrate for benthic organisms and some interstitial space which could increase the diversity and productivity of habitat niches.

B. Shoreline Protection

Some of the rock material could be utilized for shoreline protection along certain areas in and around Boston Harbor. Specifically, there are waterfront areas in Chelsea and Mystic Rivers and along the Main Ship Channel that may be structurally unstable due to erosion from inadequate protection. As an example, an area that may benefit from increased shoreline protection is a city property located along the south shore of the Chelsea Creek near Condor Street. Additionally, there may be shoreline areas outside of Boston Harbor proper that could benefit from increased protection. Massport does not have any waterfront areas that could readily use the rock material for protection. However, due to the size of the rock material after blasting (10" diameter) its use as shoreline protection will be limited.

C. Containment Site Development/Armoring

The rock removed from dredging could be useful for developing a containment site for the unconsolidated (silty) dredged material. One such use could be for the construction of subaqueous berms that could assist in retaining the finer material during disposal operations at some types of sites. Likely sites for this use would include the subaqueous sites in the outer harbor and Spectacle Island CAD. The rock could particularly be useful in providing armor aggregate for a portion of the containment berms. However, it is expected that a substantial quantity of other larger size rock may be needed to completely protect the exposed faces of the containment berms.

As stated earlier, some quantity of the rock may be used to armor the in-channel disposal areas in the areas that may subject to the highest prop wash effects (Inner Confluence). The final quantity expected to be used for armoring will be determined during the final design of this disposal option.

D. Upland Fill/Commercial Reuse

The dredged rock mixed with clay could be useful for various upland filling applications where clean fill is needed (highway construction, etc.). It would be relatively easy to handle and transport, and could provide a suitable foundation for certain light commercial or industrial uses. Additionally, the rock could have some commercial reuse potential as construction aggregate. Its clay content may decrease its utility.

3.6.2 Use of Parent Material

A. Open Water Disposal Cap

There will be approximately 2 million cubic yards of parent material (primarily clay and sand/gravel) available from the Boston Harbor Dredging Project. The clay fraction is highly cohesive and could be useful as capping material at an open water disposal site. Capping would be initiated soon after the disposal of silt material was completed. The operation would be conducted using traditional barge scows with bottom operating doors. The material would be point dumped within specific radii from the center of the silt material to form a continuous mound deposit of approximately 1 meter thick on top of the silt. This would effectively provide a clay cap which would seal off the silt from the environment.

However, since the open water options have been dropped from further consideration as disposal sites for this phase of the project, based on DEIR/S comments, there will be no opportunity to demonstrate capping with the parent material.

B. Nearshore Containment Cap

The parent material could also be used in a similar fashion for capping any of the nearshore containment. However, because of limited barge access to some of these sites, it may be necessary to utilize land-based equipment or a barge mounted crane for offloading the sediments from barges for cap placement.

C. Subtidal/Intertidal Habitat Creation

The Reserved Channel and Little Mystic Channel containment options will require surface material that would be suitable for establishment of subtidal and intertidal habitat. The parent material to be dredged would be suitable as base material that could be placed directly onto the silty dredged material in the containment site. A surface layer of clean sand/silt mixture placed over the clay would provide substrate favorable for benthic recruitment and establishment of vegetation.

D. Landfill Liner/Cap/Closure Material

The parent material could also be useful for lining landfills or other upland sites that may require liner material. Since the parent material is primarily clay, it is highly impermeable and could be suitable for this purpose. This material could also be useful for capping or covering some of the silt to be dredged from this project that may require burial. The predominately clay parent material may also be useful as final closure material at certain landfills. Massachusetts DEP, Division of Solid Waste Management has identified a state-wide need of 7 million cubic yards of clay for municipal landfill capping and a need for at least an equal amount of fill for landfill grading prior to capping.

The Central Artery/ Third Harbor Tunnel project has been working with the DEP in developing a clay distribution program to meet part of this need. The CA/T has identified some 82 communities in Massachusetts that could use a portion of the clay coming from the CA/T project. Appendix H in Volume 3 of this FEIR/S contains the application form and requirements for communities to receive clay from the CA/T project.

The Corps is willing to investigate ways of working with the DEP to further this program. However, a limiting factor on the Corps is that the project's parent material is considered improvement material and therefore, its dredging and disposal must consider the least costly option to meet the 1988 Feasibility Study cost-effectiveness evaluation. The parent material is suitable for unconfined ocean disposal at the MBDS, which is also the least costly option. Beneficial use of the parent material cannot increase the cost of its disposal above that of using the MBDS. However, to advance the interests of the DEP, the project team evaluated means of making the parent material available for use at municipal landfills if there is still a need and interest after CA/T project benefits are realized.

Trucking and transporting project clay would be cost prohibitive. However, the project team investigated barge access facilities within the Commonwealth that could serve as distribution points for project parent material. Assuming that a 15-foot minimum depth would be required for a barge, the project team identified several ports and the unlined municipal landfills that could be served from them (see Table 3-25). Should these communities express an interest in receiving project clay, individual arrangements may be made with the Corps to barge a specific quantity of clay to a designated site for off-loading, handling, transporting and stockpiling at the municipalities expense.

Based on the contaminant profile and physical characteristics of the parent material, the material would be suitable for liner material, intermediate cover, a subgrade layer, or a final cap. Should a municipality demonstrate an interest in this material, further testing will be required to ascertain the suitability of the material under DEP Policy #BWP-94-037 and Solid Waste Management regulations. The project team will continue to coordinate interests in the beneficial re-use of the clay with the DEP.

3.6.3 Summary of Beneficial Uses

In summary, beneficial uses of rock and parent material may include a variety of enhancement and containment purposes as follows:

ROCK (Amount available: approximately 132,000 cubic yards)

- Fish habitat enhancement
- Shoreline protection
- Containment site development/armoring
- Upland fill
- Commercial reuse (construction aggregate)

PARENT MATERIAL (Amount available: approximately 3.3 million cubic yards)

- Open water disposal cap
- Nearshore containment site cap
- Landfill liner/cap
- Landfill final closure material
- Other upland site liner/cap

3.7 PREFERRED DISPOSAL OPTION

The preceding discussions have demonstrated the complexity of identifying and combining sites to form disposal options. This section will assess the issues involved in critically evaluating the merits of the disposal options to select the preferred option.

Selection of the Preferred Disposal Alternative will be based on screening the options through a series of key criteria which include:

- ability of disposal sites/methods to meet regulatory criteria for receiving material
- minimization of negative environmental impacts
- maximization of environmental benefits
- reasonable capacity for this project
- reasonable in light of logistics, technology and cost.

Environmental impact is the most important criterion. Land-based (landfill and development of new inland or coastal sites) and aquatic (nearshore and various open water alternatives) disposal sites would inherently involve different types of impacts (Table 3-7) since different resource types would be involved in each case. Thus, while comparisons among land-based alternatives and among aquatic alternatives are fairly straight forward, comparisons between upland and aquatic alternatives are more complex. The types of environmental impacts that would weigh most heavily against a site being included in the preferred alternative (based on sensitive resources identified in this study) would include unmitigatable risks to:

- marine and/or upland habitat
- wetlands
- anadromous fish passage
- important resident fish and shellfish
- water quality
- threatened and endangered species
- traffic (marine and/or roadway)
- neighborhood impacts

Distinctions can be made among disposal alternatives based on their ability to provide environmental benefits (Table 3-9), although, again, it is difficult to weigh benefits against each other, particularly on the generic level. However, benefits that would weigh most heavily toward including a particular alternative would include:

- maximizing use of parent material
- use of any available sand or gravel
- providing capacity for future dredging needs
- providing clean bottom habitat within Boston Harbor
- providing alternatives which are practicable and achievable

Identifiable future disposal estimates (i.e., 50-year maintenance for Boston Harbor) point out the necessity to evaluate disposal options on both the generic and specific levels. As indicated in Section 3.4, identifying capacity for the BHNIP is the first challenge. Adding future dredging projections to the equation makes the evaluation more complex but is critical to the process and was identified as such in the MEPA scope. The preferred disposal option should include a site or sites and methods to accommodate future dredging as well as the current need.

Cost, in addition to logistics and technology, is a factor in determining practicability of the disposal options. Final cost comparisons among disposal options cannot be made without considering specific sites. An acceptable benefit/cost ratio must be reached in order to qualify for Federal participation in a navigation improvement project. The three major costs used to compute the benefit/cost ratio include: design, dredging and disposal costs incurred to deepen the Federal Channels (parent material); design, dredging and disposal costs incurred to deepen those berths that receive direct project benefits (silt and parent material); and costs associated with maintenance of the improvement project for its economic life (50 years). Costs to dredge and dispose of silt (maintenance material) from the Federal channel during initial construction of the improvement project is not included as part of the improvement project cost as this is considered maintenance of the existing channels. The total improvement cost must be compared to the benefits that the deeper project will provide. Therefore, the benefit-to-cost ratio for the project or each separable increment of the project must be at least 1:1 for the project to qualify for Federal funding.

While a particular disposal option may pass the Federal participation criteria, the sponsor may find its cost contribution unacceptably high. There is no cost criterion that applies to the project related berths, however, affordability relative to the perceived benefits in site management would likely be used by individual owners in their decision to participate.

Identification of suitable disposal options for BHNIP has been an open process involving valuable collaboration with the project's working groups. The DEIR/S was another step in that process.

Table 3-26 provides a summary of the principal impacts associated with the twenty-four disposal sites and one treatment technology that remained potentially suitable for BHNIP material disposal after site screening. The existing conditions at each site and principal environmental impacts associated with its use are provided in Attachment 1 in Volume 1 of this FEIR/S.

The next chapter provides a detailed environmental analysis of the sites described in Attachment 1 and listed on Table 3-1 as having survived the site screening process. The Chapter also includes a practicability screening applying cost, technology and logistics, culminating in a selection and description of the preferred alternative. That alternative is in-channel disposal with sand capping.

The In-Channel disposal scenario assumes that the silt material will be dredged from each channel and placed on a barge, while deeper cells will then be dug in the Mystic River, Chelsea Creek and Inner Confluence channels (parent material); the silt would then be placed within the cells and capped with sand. Parent material removed from the trench would be disposed at MBDS. Each channel/tributary would then contain its own capped silt material. The environmental resources impacted for this disposal alternative are the same as for the dredging site.

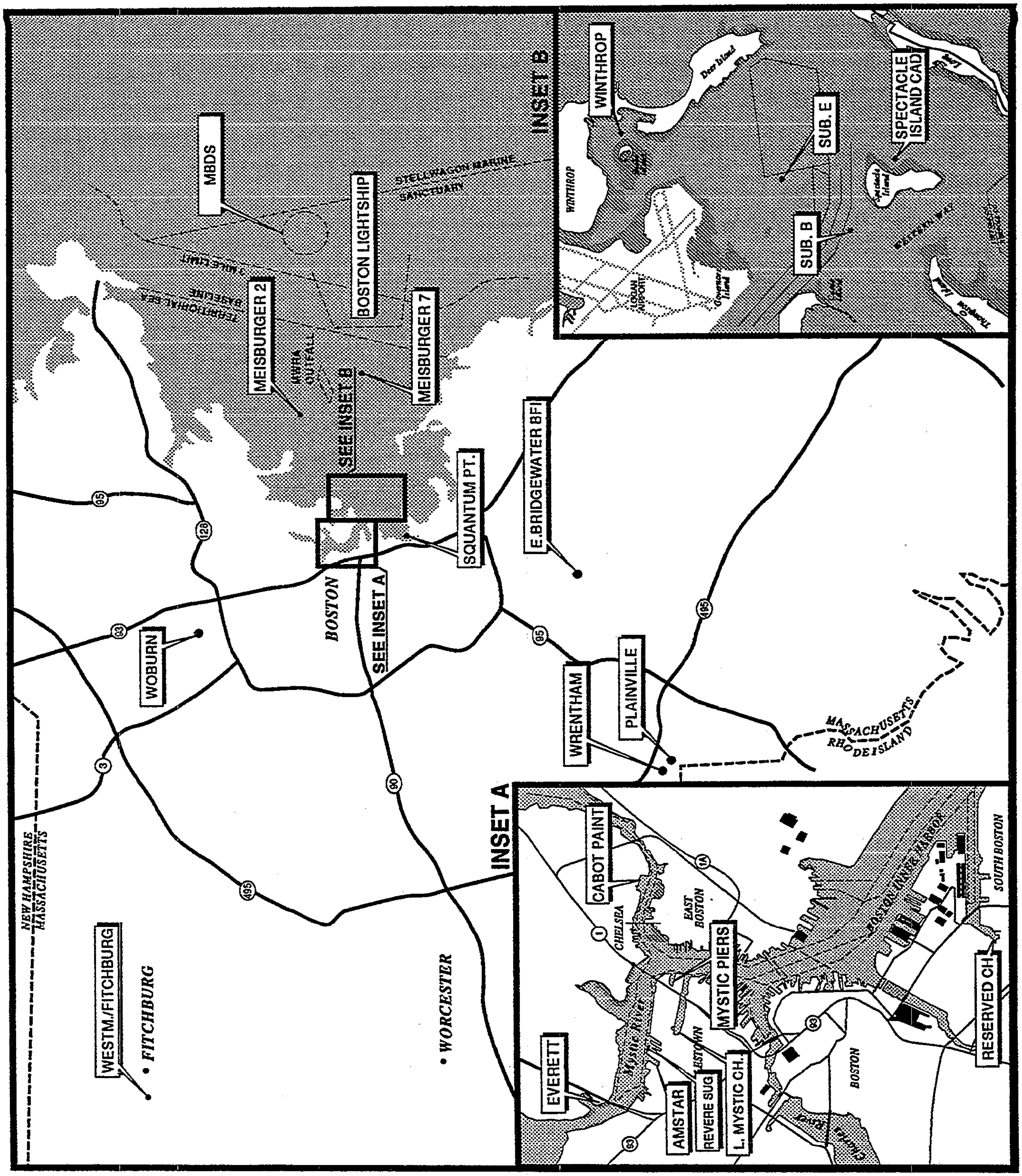
Benefits from this alternative include keeping the silt material within the channel to be dredged, thus reducing the amount of silt exposed to biological resources elsewhere and keeping transportation costs, vessel traffic disturbances and socio-economic impact to a minimum.

The proposed disposal sites occur in tributaries currently used by ship traffic. The U.S. Coast Guard would need to coordinate between ships needing to use the tributary and disposal activities. However, since material would essentially be disposed at or near the same place it is dredged, only barges for temporary storage and those required to dispose of excess parent material would have to be dealt with; major barge movement within the Harbor should not be necessary.

The characteristics of the underlying sediments in the channels have been described in Section 2.2 of the DEIR/S as clean parent material. Bulk sediment analysis indicated that no parameter exceeded Category I limits. The channel would be filled with silt and capped with sand. The remaining parent material would be disposed at the MBDS or other suitable site. Since the channels are currently covered with silt material, returning the silt to its place of origin and capping it with sand would provide an environmental benefit.

The disposal site would end up, as proposed, 3.0 to 5.0 feet deeper than the channel's current authorized depth. The area would of course remain subtidal; the substrate would change from a silt material to sand with gravel or rock armoring in areas affected by prop wash. The benthic community may change as a result of this sediment change but should be "healthier" because the availability of contaminants for bioaccumulation will be reduced, at least until future siltation occurs. No federally or state-listed threatened or endangered species are expected to be at risk from this activity in the channel and tributaries.

Each of the channels falls within the Designated Port Areas of Boston Harbor (e.g., Mystic River, Chelsea Creek, East Boston and South Boston designations) under State jurisdiction (310 CMR 10.00) and within Tidal Water jurisdiction under Section 404 of the Federal Clean Water Act. Since these proposed disposal sites are part of the overall maintenance dredging operation, their construction will not impact these regulated resources beyond the impacts of the dredging itself, other than from increased silt plumes during disposal. ADDAM's model results indicate that these plumes should not directly impact economically important fish and shellfish resources. Any impacts would be temporary and, upon capping and project completion, the resources should restore themselves to natural conditions. Newly-exposed substrate and clean capping materials will provide better substrate conditions for benthic community development in the near-term.



Boston Harbor Dredging Project EIR/S	*Figure 3-1* Locations of potential disposal sites extensively evaluated.
N *Scale:* 0 — 10 *Approx. Scale in Miles*	*Source:* USGS Quadrangles Revised by NAI to reflect pertinent site conditions.

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TABLE 3-1. POTENTIAL DISPOSAL SITE LISTS BY CATEGORY PRODUCED AT THE END OF EACH SCREENING PHASE.

PHASE 1	PHASE 2	PHASE 3 (DEIR/S)
LAND-BASED OPTIONS: Land-based Inland		
BRN-06	BRN-06	
CAN-17		
EBROOK		
HLB-13	HLB-13	
NAT-02	NAT-02	
NOR-02	NOR-02	
RAYNHAM		
RED-03	RED-03	
SAG-02	SAG-02	
W-495		W-495
WEY-13		
WIL-06		
WIL-07		
WOB-11		WOB-11
Land-based Coastal		
BOS-13	BOS-13	
BOS-23	BOS-23	
BOS-25		
BOS-31	BOS-31	
EVR-04		EVR-04
LOGAN		
LYN-02	LYN-02	
MAL-01		
CHAR-01	CHAR-01	
PROV		
QUI-03		QUI-03
QUI-09	QUI-09	

(Continued)

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TABLE 3-1. (CONTINUED)

PHASE 1	PHASE 2	PHASE 3 (DEIR/S)
Landfills		
Agawam		
E. Bridgewater	E. Bridgewater	E. Bridgewater
Fall River	Fall River	
Plainville	Plainville	Plainville
Fitchburg/Westminister	Fitchburg/-Westminister	Fitchburg/-Westminister
	GCR Peabody*	
AQUATIC OPTIONS: Aquatic Shoreline Sites		
Amstar	Amstar	Amstar
Cabot Paint	Cabot Paint	Cabot Paint
CHEL-01	CHEL-01	
FPC	FPC	
LMC	LMC	LMC
Mystic Piers	Mystic Piers	Mystic Piers
Northend Park	Northend Park	
ResChn	ResChn	ResChn
Revere Sugar	Revere Sugar	Revere Sugar
Spec CDF	Spec CDF	
	Hangman's Island*	
	Island End River*	
Subaqueous Depressions		
Subaq B	Subaq B	Sub B
Subaq D		
Subaq E	Subaq E	Subaq E
Subaq F		
CHEL-02	CHEL-02	
Winthrop		Winthrop

(Continued)

TABLE 3-1. (CONTINUED)

PHASE 1	PHASE 2	PHASE 3 (DEIR/S)
<u>Borrow Pits</u>		
Willet I	Willet I	
Willet III	Willet III	
Meis 2		Meis 2
Meis 7		Meis 7
	Spec Is CAD	Spec Is CAD
<u>In-Channel Sites</u>		
		Chelsea Creek**
		Mystic River**
		Inner Confluence**
<u>Existing Disposal Sites</u>		
MBDS	MBDS	MBDS
Boston Lightship	Boston Lightship	Boston Lightship

*Added after DOWG meeting, 1/25/93
**Added after DOWG meeting, 4/15/93

TABLE 3-2. ADDITIONAL INFORMATION COLLECTED FOR NEARSHORE AQUATIC, IN-CHANNEL, BORROW PITS, SUBAQUEOUS AREAS AND EXISTING DISPOSAL SITES (OCTOBER 1994)

SITE	BENTHOS SPI[1]	BENTHOS	FISHERIES: PELAGIC[2]	FISHERIES: DEMERSAL[3]	LOBSTER TRAPS
Nearshore Aquatic					
Mystic Piers	X	X			
Revere Sugar	X	X	X		X
Amstar	X	X			
Cabot Paint	X	X			
Little Mystic Channel	X	X	X		X
Reserved Channel		X	X		X
In-Channel/Borrow Pits					
In-Channel Mystic River	X	X		X	X
In-Channel Chelsea Creek	X	X		X	X
In-Channel Inner Confluence	X	X		X	X
Spectacle Island	X	X	X		X
Meisburger 2 & 7	X	X	X		X
Subaqueous					
Subaqueous B	X	X			
Subaqueous E	X	X		X	X
Winthrop Harbor					
Disposal Sites					
Boston Light Ship	X	X		X	X

[1] Sediment Profile Camera

[2] Gillnets

[3] Otter Trawl

TABLE 3-3. CHARACTERISTICS OF GENERIC DISPOSAL ALTERNATIVES.

CHARACTERISTIC	LINED LANDFILL (CATEGORY A)	UNLINED LANDFILL (CATEGORY B)	LAND-BASED (NON-LANDFILL)	AQUATIC SHORELINE CONTAINMENT	OPEN WATER	OPEN-WATER WITH CONTAINMENT
Potential Environmental Problems	• Leachate impacts • (Minimal since lined)	• Leachate impacts	• Groundwater contamination • Wetland impacts	• Contaminant migration • Burial impacts	• Water column impacts • Benthic impacts • Bioaccumulation	• Contaminant migration • Burial impacts
Major Testing Requirements	• Bulk analysis • TCLP[a] • Elutriate	• Bulk analysis • TCLP • Elutriate	• Bulk analysis • TCLP • Elutriate	• Bulk analysis • TCLP • Elutriate	• Bulk analysis • Benthic toxicity • Bioaccumulation	• Bulk analysis • Elutriate or water quality modelling • Benthic impacts • Bioaccumulation
Available Options	• Daily cover • Disposal with burial	• Unconfined disposal • Contouring/grading material • Daily cover	• Unconfined disposal • Confined disposal • Reuse	• Habitat creation • Upland use	• Unconfined disposal • Capping	• Habitat enhancement • Burial
Design Considerations	• Existing site design • Transportation	• Existing site design • Transportation	• Capacity • Containment • Monitoring • Transportation	• Capacity • Containment • Monitoring • Transportation	• Capacity • Containment • Monitoring • Transportation	• Capacity • Containment • Monitoring • Transportation
Available Control Measures	• Mix with cleaner materials • Dewatering	• Diking • Runoff control • Dewatering	• Diking • Runoff control • Leachate control • Dewatering	• Bulkheading • Diking • Subaqueous berm • Capping	• Point dumping • Capping	• Subaqueous berm • Borrow pit • Capping • Point dumping

[a] TCLP = toxic concentrations leaching potential

TABLE 3-4. MASSACHUSETTS REGULATORY GUIDELINE LEVELS OF DREDGED MATERIALS FOR VARIOUS DISPOSAL ALTERNATIVES.

		OPEN WATER DISPOSAL						UPLAND DISPOSAL			
		MASSACHUSETTS SEDIMENT CLASSIFICATION						LANDFILL CATEGORY			
		I[a]	II[b]	III[c]	A	B	C	(LINED) A[d]	(UNLINED) B	MIN. BULK SOIL CONC.[e] FOR TCLP ANALYSIS (ppm)	TCLP REGULATORY LEVELS[f] (mg/l)
BULK ANALYSIS	(ppm)										
Mercury		<0.5	0.5-1.5	>1.5				10	2		
Lead		<100	100-200	>200				500	500		
Zinc		<200	200-400	>400							
Arsenic		<10	10-20	>20				40	40		
Cadmium		<5	5-10	>10				25	14		
Chromium		<100	100-300	>300				500	100		
Copper		<200	200-400	>400							
Nickel		<50	50-100	>100							
Total PCBs		<0.5	0.5-1.0	>1.0				2	2		
Total PAHs								100	100		
Total VOCs								10	4		
Total PHC								1000	500		
Volatile Solids	(%)				<5	5-10	>10				
Water Content	(%)				<40	40-60	>60				
Silt/Clay	(%)				<60	60-90	>90				
Oil & Grease	(%)				<0.5	0.5-1.0	>1.0				
TCLP											
Arsenic										100	5
Cadmium										20	1
Chromium										100	5
Lead										100	5
Mercury										4	0.2
Selenium										20	1
Silver										100	5

[a]= normally approved for unconfined open water disposal
[b]= the presence of several parameters in this category may require bioassay and bioaccumulation testing for evaluating open water disposal
[c]= the presence of one or more parameters in this category will most likely require bioassay and bioaccumulation testing for evaluating open water disposal
[d]= dredged material which exceeds any of the limits may be mixed with cleaner material to bring the material into compliance with this classification
[e]= TCLP analysis would be needed for those parameters that exceed any listed threshold
[f]= material has non-hazardous characteristics if listed regulatory levels are not exceeded using the TCLP test methods

TABLE 3-5. EVALUATION OF SUITABILITY OF BOSTON HARBOR NAVIGATION IMPROVEMENT PROJECT SEDIMENTS FOR VARIOUS DISPOSAL ALTERNATIVES.

		MASS BAY DISPOSAL SITE (UNCONFINED)			OPEN WATER AQUATIC UNRESTRICTED			OPEN WATER AQUATIC (CAPPING)			NEARSHORE AQUATIC W/ CONTAINMENT			UPLAND COASTAL			UPLAND INLAND			LINED LANDFILL		
DREDGE SITE		SILT	PARENT	ROCK	SILT	PARENT	ROCK	SILT	PARENT	ROCK	SILT	PARENT	ROCK	SILT	PARENT	ROCK	SILT	PARENT	ROCK	SILT	PARENT	ROCK
Reserved Channel	FP	U	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S	A,S	S	U	A,B,C,S	S
Conloy	P	U	S	NA	U	S	NA	S	S	NA	S	S	NA	S	S	NA	S	A,S	NA	D,E	A,B,C,S	NA
Army Base	P	U	S	NA	U	S	NA	S	S	NA	S	S	NA	S	S	NA	S	A,S	NA	D,E	A,B,C,S	NA
Boston Edison (Barge Berth)	P	U	S	NA	U	S	NA	S	S	NA	S	S	NA	S	S	NA	S	A,S	NA	D,E	A,B,C,S	NA
Boston Edison (Intake)	P	N	NA	NA	N	NA	NA	S	NA	NA	S	NA	NA	S	NA	NA	S	NA	NA	D,E	NA	NA
Main Ship Channel	FP	N	S	S	N	S	S	S	S	S	S	S	S	S	S	S	S	S	S	D,E	A,B,C,S	S
North Jetty	P	N	S	NA	N	S	NA	S	S	NA	S	S	NA	S	S	NA	S	A,S	NA	D,E	A,B,C,S	NA
Mystic Piers	P	N	S	NA	N	S	NA	S	S	NA	S	S	NA	S	S	NA	S	A,S	NA	D,E	A,B,C,S	NA
Chelsea River	FP	N	S	NA	N	S	NA	S	S	NA	S	S	NA	S	S	NA	S	A,S	NA	U	A,B,C,S	NA
Eastern Minerals	P	N	S	NA	N	S	NA	S	S	NA	S	S	NA	S	S	NA	S	A,S	NA	D,E	A,B,C,S	NA
Gulf Oil	P	U	S	NA	U	S	NA	S	S	NA	S	S	NA	S	S	NA	S	A,S	NA	D,E	A,B,C,S	NA
Mystic River	FP	N	S	S	N	S	S	S	S	S	S	S	S	S	S	S	S	A,S	S	U	A,B,C,S	S
Moran	P	N	NA	NA	N	NA	NA	S	NA	NA	S	NA	NA	S	NA	NA	S	NA	NA	D,E	NA	NA
Revere Sugar	P	N	S	NA	N	S	NA	S	S	NA	S	S	NA	S	S	NA	S	A,S	NA	D,E	A,B,C,S	NA
Distrigas	P	N	S	NA	N	S	NA	S	S	NA	S	S	NA	S	S	NA	S	A,S	NA	D,E	A,B,C,S	NA
Prolerized	P	N	S	NA	N	S	NA	S	S	NA	S	S	NA	S	S	NA	S	A,S	NA	D,E	A,B,C,S	NA

Keys: FP = Federal project; P = Non-Federal project

A = suitable as liner
B = suitable as closure material
C = suitable as daily cover without mixing
D = suitable as solid waste for disposal in a lined landfill
E = suitable as daily cover with mixing
N = unsuitable
NA = not applicable
S = suitable
U = unresolved; treated as unsuitable for disposal option alternatives analysis

TABLE 3-6. SUMMARY OF POTENTIAL SITE PREPARATION, MANAGEMENT REQUIREMENTS FOR USE OF GENERIC DISPOSAL ALTERNATIVES.

	UPLAND			AQUATIC			
	LANDFILL	UPLAND INLAND	UPLAND COASTAL	NEARSHORE	BORROW PITS	OPEN WATER	EXISTING DISPOSAL SITES
SITE PREPARATION							
•Baseline investigations		x	x	x	x	x	
•Permitting	x	x	x	x	x	x	x
•Acquisition		x	x	x			
•Dredging			x		x		
•Containment structure-dike		x	x			x	
-berm				x			
-bulkhead				x			
•Access road/rail		x					
•Alteration of navigational channel						x	
•Liner		x	x				
MATERIAL PREPARATION							
•Dewatering	x	x	x				
•Mixing	x						
TRANSPORTATION							
•Barge	x	x	x	x	x	x	x
•Truck	x	x	x	x			
•Rail	x	x					
SITE MANAGEMENT							
•Runoff control	x	x	x				
•Closure							
-landscaping		x	x				
-dredged clay	x	x	x	x		x	x
-soil		x	x				
-structure				x			
-marine organic				x			
-marine mineral					x		
-prior demonstration of success							x
-marine habitat				x	x		
•Burial		x	x		x	x	x
•Daily Cover	x	x	x				

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TABLE 3-7. POTENTIAL IMPACTS FROM SILT DISPOSAL AT GENERIC ALTERNATIVE DISPOSAL SITES.

IMPACT	LAND-BASED			AQUATIC		SUBAQUEOUS		BORROW PITS	EXISTING SITES		SOLIDIFICATION
	LANDFILL	INLAND	COASTAL	TOTAL	PARTIAL	OUTER HARBOR	CHANNEL	W/ CAP	W/ CAP	W/O CAP	
Exceeds Sediment Criteria										X	
Loss of Habitat											
Terrestrial		X	X								
Wetland (F.W.)			P								
Marine subtidal				X	T	T	T	T	T	T	
Marine intertidal			T	X							
Alteration of Habitat											
Terrestrial		X	X								
Wetland (F.W.)		P	P								
Marine subtidal			T	X	X	X	X	T	T	T	T
Marine intertidal			X	X	P						
Water Quality											
Freshwater		P									
Marine			T	T	T	T	T	T	T	T	
Current Use (Displacement)	X	X	X	X	X						
Socioeconomic											
Traffic											
Truck	X	X	X								
Barge	X	X	X	X	X	X	X	P	P	P	P
Historic/ Archeological		P	P	P	P	P	P	p			
Emigration Potential for Contaminants											
During disposal						P	P	P	P	P	
Prior to containment						P	P	P	P		
Volatization		P	P								
Long-term	P	P	P		P	P	P	P	P	X	
Bioaccum. potential						T	T	T	T	X	

Key: X = Impact; P = Possible impact; T = Temporary impact.

TABLE 3-8. IMPACTS CAUSED BY USING SPECIFIC UPLAND SITES FOR BOSTON HARBOR DREDGED MATERIAL DISPOSAL.

RESOURCE	PLAINVIEW/ LAIDLAW LANDFILL	WESTMINSTER LANDFILL	EAST BRIDGEWATER LANDFILL	WRENTHAM
SITE DESIGN	•Dewatering facility at Mystic Pier or North Jetty •No special site modifications required •Available capacity: daily cover ≤ 500 cy/day •Waste ≤ 150-200 cy/day	•Dewatering facility at Mystic Pier or North Jetty •No special site modifications required •Available capacity: daily cover ≤ 250 cy/day •Waste ≤ 200 cy/day	•Dewatering facility at Mystic Pier or North Jetty •No special site modifications required •Available capacity: daily cover ≤ 400 cy/day •Waste ≤ 75 cy/day	•Dewatering facility at Mystic Pier or North Jetty •Site modification from undeveloped forest/shrub to lined landfill •Footprint approx. 60 acres •Capacity approx. 785,500 cy
WATER QUALITY	None			•No groundwater impacts •Possible temporary surface water impacts from sedimentation and contaminants
MARINE INTERTIDAL	None			
MARINE SUBTIDAL	None			
SHELLFISH	None			
FINFISH	None			
FRESHWATER AQUATIC RESOURCES	None			
WETLAND VEGETATION, WILDLIFE	None			•Permanent loss of 9 ac. wetland •Permanent loss of habitat to resident species and fragmentation of wooded land
THREATENED & ENDANGERED SPECIES	None			Possible habitat for northern hairstreak and Philadelphia panic grass
HISTORIC & ARCHEOLOGICAL	None			
SOCIOECONOMIC & LANDUSE	No change in land use, but use for dredge material disposal would preempt other uses			Possible change from undeveloped forest and shrubland to lined containment facility
TRAFFIC	Increase in truck traffic for transporting dredged material to landfill			•Increase in truck traffic during construction and dredge disposal phase •Heavy truck use already occurs from adjacent gravel operation

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TABLE 3-8(CONTINUED). IMPACTS CAUSED BY USING SPECIFIC UPLAND SITES FOR BOSTON HARBOR DREDGED MATERIAL DISPOSAL.

RESOURCE	WOBURN	EVERETT	SQUANTUM POINT
SITE DESIGN	•Dewatering facility at Mystic Pier or North Jetty •Capping closed municipal landfill with lined facility • Footprint=25 acres • Capacity=158,600 cy	•Dredge barge lane •Site modified from abandoned urban land to landfill • Footprint=6 acres • Capacity=70,000 cy	•Dredge barge lane •Construct lined containment berm and fill with dredged materials up to 10 feet deep •Dewater through detention basin, cap when dry • Footprint=18 acres • Capacity=210,000 cy
WATER QUALITY	•May improve groundwater quality by capping landfill •Possible temporary surface water impacts from sedimentation and contaminants	•Temporary local increase in suspended solids during dredging •Temporary release of contaminants during dredging	
MARINE INTERTIDAL	None	•Dredging of 2 acres of intertidal habitat •Potential siltation during dredging and barge manuevering	Permanent loss of approximately 0.3 ac. of fine-grained tidal flat and 0.03 ac. of salt marsh
MARINE SUBTIDAL	None	Dredging of approximately 0.03 ac. of fine-grained sediment and disturbance during barge manuevering will result in temporary loss of benthic production	Alteration of approximately 1.4 ac. of fine-grained habitat
SHELLFISH	None	No harvestable shellfish beds in area	Temporary impact to mussel and softshell clam habitat
FINFISH	None	Temporary disturbance to finfish habitat.	Temporary disturbance to finfish habitat.
FRESHWATER AQUATIC RESOURCES	Possible temporary impacts to tributary to Hall's Brook	None	
WETLAND VEGETATION, WILDLIFE	•Permanent loss of portion of 1 ac. wetland •Permanent loss of early successional field and wooded habitat	•No freshwater wetland impacts •Loss of open land in an urban setting	•Permanent loss of approximately 0.33 ac. of wetland •Permanent loss of shrubland bird habitat and disturbance of salt marsh tidal flat habitat
THREATENED & ENDANGERED SPECIES	None	None	Loss of short-eared owl migratory/wintering habitat
HISTORIC & ARCHEOLOGICAL	None	Jacknife drawbridge within 1000 ft of site	None
SOCIOECONOMIC & LANDUSE	Permanent capping of closed municipal landfill	Permanent change from abandoned urban land to landfill	None
TRAFFIC	•Construction traffic •Increase in truck and rail traffic due to transport of dredged material to landfill	•Construction traffic •Dredged material transported by barge	•Construction traffic •Dredged material transported by barge

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TABLE 3-9. POTENTIAL BENEFITS OF DREDGED MATERIAL DISPOSAL ALTERNATIVES.

BENEFIT	UPLAND			AQUATIC SHORELINE		SUBAQUEOUS		BORROW PITS	EXISTING DISPOSAL SITES		SOLIDIFICATION
	LANDFILL	INLAND	COASTAL	TOTAL	PARTIAL	OUTER HARBOR	CHANNEL	W/ CAP	W/ CAP	W/O CAP	
Remove/Isolate Contaminated Sediment from Environment	X	X	X	X	X	X	X	X	X		X
Cover Existing Contaminated Sediments	P			X	X				P		
Enhance Resource/Habitat		P	P		X				P		X
Economic Benefits				P				P			
Cap Existing Disposal Site	X								X	X	
Beneficial Use of Parent Material	X	X	X	X	X	X	X	X	X		
Use of Existing On-site Materials								X			
Future Use of Impacted Area	X	P	P	X	X	X			X	X	P

Key: X = Benefit; P = Possible benefit

TABLE 3-10. IMPACTS CAUSED BY USING SPECIFIC AQUATIC SHORELINE SITES FOR BOSTON HARBOR DREDGED MATERIAL DISPOSAL.

RESOURCE	MYSTIC PIERS		REVERE SUGAR		AMSTAR	
	TOTAL FILL	PARTIAL FILL	TOTAL FILL	PARTIAL FILL	TOTAL FILL	PARTIAL FILL
SITE DESIGN	Bulkhead harbor face; fill behind silt curtain/weir to MHW or higher. Dragline to position sediments. Footprint-2.7 ac.; capacity=167,000 cu. yds.	Bulkhead harbor face; fill behind silt curtain/weir to 0 ft MLW, cap with sand to MLW. Dragline to position sediments. Footprint= 2.7 ac.; capacity=98,000 cu. yds.	Bulkhead harbor face; fill behind silt curtain/weir to MHW or higher. Dragline to position sediments. Footprint-3.7 ac.; capacity=204,000 cu yds.	Bulkhead harbor face; fill behind silt curtain/weir to 0 ft MLW, cap with sand to MLW. Dragline to position sediments, Footprint= 3.7 ac.; capacity=85,000 cu yds.	Bulkhead harbor face; fill behind silt curtain/weir to MHW or higher. Dragline to position sediments. Footprint=3.5 ac.; capacity=241,000 cu yds.	Bulkhead harbor face fill behind silt curtain/weir to 0 ft MLW, cap with clay to MLW. Dragline to position sediments. Footprint= 3.5 ac.; capacity=128,000 cu.yds.
WATER QUALITY	•Permanent loss of 38 million gal. of Boston Harbor capacity, no impact on current velocity •Dewatering controls needed.	•Permanent loss of 29 million gal. of Boston Harbor capacity, no impact on current velocity •Dewatering controls needed	•Permanent loss of 21 million gal. of Boston Harbor capacity, no impact on current velocity •Dewatering controls needed.	•Permanent loss of 27 million gal. of Boston Harbor capacity, no impact on current velocity •Dewatering controls needed.	•Permanent loss of 53 million gal. of Boston Harbor capacity, no impact on current velocity •Dewatering controls needed.	•Permanent loss of 39 million gal. of Boston Harbor capacity, no impact on current velocity •Dewatering controls needed.
MARINE INTERTIDAL	Permanent loss of macroalgae, barnacle, and blue mussel production on hard substrate	No loss of hard substrate	Permanent loss of macroalgae, barnacle, and littorina snail production on hard substrate	No loss of hard substrate	•Permanent loss of barnacle, mussel and green algae production on hard substrate •Permanent loss of gravel beach	No loss of hard substrate
MARINE SUBTIDAL	Loss of 2.7 acres fine-grained soft habitat	•Alteration of 2.7 ac. fine-grained soft substrate. •Capping of existing contaminants •Loss of piling and bulkhead (hard substrate)	Loss of 3.7 acres fine-grained soft habitat	•Alteration of 3.7 ac. fine-grained soft substrate. •Capping of existing contaminants •Loss of piling and bulkhead (hard substrate)	Loss of 3.5 acres fine-grained soft habitat	•Alteration of 3.5 ac. fine-grained soft substrate. •Capping of existing contaminants •Loss of piling and bulkhead (hard substrate)
SHELLFISH	Loss of intertidal mussels on pilings		None			
FINFISH	•Mortality of demersal fish eggs; larvae and adults trapped behind bulkhead. •Permanent loss of finfish refuge and foraging habitat	•Mortality of demersaal fish eggs; larvae and adults trapped behind bulkhead. •Temporary loss of finfish refuge and foraging habitat	•Mortality of demersal fish eggs; larvae and adults trapped behind bulkhead. •Permanent loss of finfish refuge and foraging habitat	•Mortality of demersal fish eggs; larvae and adults trapped behind bulkhead. •Temporary loss of finfish refuge and foraging habitat	•Mortality of demersaal fish eggs; larvae and adults trapped behind bulkhead. •Permanent loss of finfish refuge and foraging habitat	•Mortality of demersal fish eggs; larvae and adults trapped behind bulkhead. •Temporary loss of finfish refuge and foraging habitat
FRESHWATER AQUATIC RESOURCES	None					
WETLAND VEGETATION, WILDLIFE	Permanent loss of 2.7 acres subtidal wetlands Possible bird forage habitat	Alteration of substrate of 2.7 acres subtidal wetlands. Possible bird forage habitat	Permanent loss of 3.7 acres subtidal wetlands Possible bird forage habitat	Alteration of substrate of 3.7 acres subtidal wetlands. Possible bird forage habitat	Permanent loss of 3.5 acres subtidal wetlands Possible bird forage habitat	Alteration of substrate of 3.5 acres subtidal wetlands. Possible bird forage habitat
THREATENED & ENDANGERED SPECIES	None					
HISTORIC & ARCHEOLOGICAL	None					
SOCIOECONOMIC & LANDUSE	•Conversion of aquatic habitat to fastland. •Proposed future use compatible with neighborhood.	Eliminate future potential use in commercial port activity	•Conversion of aquatic habitat to fastland. •Proposed future use compatible with neighborhood.	Eliminate future potential use in commercial port activity	•Elimination of MWRA floating dock on eastern edge of site. •Conv. of aquatic hab. to fastland •Prop. future use of compatible w/surrounding landuse	•Elimination of MWRA floating dock on eastern edge of site. •Restriction of ship to shore transfer of people and freight
TRAFFIC	•Transport sediments by barge (approx. 100 barge trips) •No truck traffic impacts	•Transport sediments by barge (approx. 70 barge trips) •No truck traffic impacts	•Transport sediments by barge (approx. 100 barge trips) •No truck traffic impacts	•Transport sediments by barge (approx. 60 barge trips) •No truck traffic impacts	•Transport sediments by barge (approx. 130 barge trips) •No truck traffic impacts	•Transport sediments by barge (approx. 90 barge trips) •No truck traffic impacts

TABLE (3-10(CONTINUED). IMPACTS CAUSED BY USING SPECIFIC AQUATIC SHORELINE SITES FOR BOSTON HARBOR DREDGED MATERIAL DISPOSAL.

RESOURCE	CABOT PAINT		LITTLE MYSTIC CHANNEL	RESERVED CHANNEL	
	TOTAL FILL	PARTIAL FILL		AREA A	AREA B (WEST END)
SITE DESIGN	Bulkhead harbor face; fill behind silt curtain/weir to MHW or higher. Footprint=5.6 ac; capacity=198,000 cu. yds.	Bulkhead harbor face; fill behind silt curtain/weir to-0 ft MLW, cap with sand to MLW. Footprint= 5.6 ac.; capacity=18,000 cu. yds.	Bulkhead river face; fill behind silt curtain/weir to -3 ft MLW, cap 3 ft thick with sand to MLW. Footprint-15 ac.; capacity-303,000 cu. yds.	Bulkhead near Summer St. Bridge, west of marina. Fill to -6 ft MLW; Cap; Cut bulkhead, Footprint=8.9 ac capacity=14,000 cy	Bulkhead westernmost end; Fill to 9.5 ft MLW, Cap to MHW; Remove bulkhead; Saltmarsh Footprint=7.7 ac Capacity=186,000
WATER QUALITY	•Permanent loss of 33 million gallons of Boston Harbor capacity •Dewatering controls needed.	•Permanent loss of 12 million gallons of Boston Harbor capacity •Dewatering controls needed.	•One CSO and six discharge pipes may need to be diverted •Siltation controls needed.	•Perm. loss of 48.5 million gallons of Boston Harbor Capacity, no impact on current velocity •Siltation controls needed.	•Perm. loss of 16 million gallons of Boston Harbor Capacity •3 CSO's would need to be relocated •Siltation controls needed.
MARINE INTERTIDAL	•Perm. loss of Fucus & barnacle production on hard substrate •Permanent loss of gravel beaches on northeast and northwest	Permanent loss of gravel beaches on northeast and northwest	•Temporary reduction in Fucus, green algae and barnacle production on hard substrate •Short-term impact on small sandy-gravel beach	Temporary reduction in Fucus, green algae and barnacle production on hard substrate	•Perm. loss of barnacle, Fucus, green algae and barnacle prod. on hard sub. •Perm. loss of small rocky beach •Increase in intertidal habitat •Increase primary prod. (saltmarsh)
MARINE SUBTIDAL	Permanent loss of 5.6 acres fine-grained soft habitat	•Alteration of 5.6 ac. of soft substrate. •Improve sediment quality	•Conversion to shallow subtidal habitat •Improve sediment quality •Temporary loss of 15.0 acres of soft substrate	•Conversion to shallow subtidal habitat •Improve sediment quality •Temporary loss of 8.9 acres of soft substrate	•Conversion to shallow subtidal habitat, then to salt marsh •Permanent loss of 7.7 ac. of soft substrate
SHELLFISH	None		Short-term impacts on mussels and metal bulkhead	None	
FINFISH	•Mortality of demersal fish eggs; larvae and adults trapped behind bulkhead. •Permanent loss of finfish refuge and foraging habitat	•Mortality of demersal fish eggs; larvae and adults trapped behind bulkhead. •Temporary loss of finfish refuge and foraging habitat	•Short-term mortality of fish eggs; larvae and adults trapped behind bulkhead. •Temporary reduction on prey available to species which feed primarily on benthic invertebrate •Temporary loss of finfish refuge and foraging habitat		•Mortality of fish eggs; larvae and adults trapped behind bulkhead. •Temporary loss of finfish refuge and foraging habitat
FRESHWATER AQUATIC RESOURCES	Not applicable				
WETLAND VEGETATION, WILDLIFE	Permanent loss of 5.6 acres of intertidal and subtidal wetlands	Alteration of 5.6 acres of intertidal and subtidal wetlands	Temporary impact of 15 ac. of subtidal wetlands	Temporary loss of 8.9 ac. of subtidal wetlands	Temporary loss of 7.7 ac. of intertidal and subtidal wetlands
THREATENED & ENDANGERED SPECIES	None				
HISTORIC & ARCHEOLOGICAL	None				
SOCIOECONOMIC & LANDUSE	•Conversion of aquatic habitat to fastland.	None	None	Possible conflict with yacht club	
TRAFFIC	•Transport sediments by barge (approx. 70 barge trips) •No truck traffic impacts	•Transport sediments by barge (approx. 15 barge trips)	•Transport sediments by barge (approx. 170-220 barge trips or 11,700 - 15,200 truck trips)	•Sediment by barges (140) and trucks (9800): minor delays to commercial/recreational boating traffic. •Some roadway traffic delays and noise impacts	

TABLE 3-11. POTENTIAL IMPACTS CAUSED BY USING SPECIFIC SUBAQUEOUS, BORROW PIT AND IN-CHANNEL SITES FOR BOSTON HARBOR DREDGED MATERIAL DISPOSAL.

RESOURCE	SUBAQUEOUS B	SUBAQUEOUS E	WINTHROP HARBOR	CHELSEA CREEK IN-CHANNEL	INNER CONFLUENCE IN-CHANNEL
SITE DESIGN	Place silt and cap with sand to final depth of -15 ft MLW. Footprint=83 ac. Capacity=up to 562,000	Place silt and cap with sand to⁰ final depth of -8 ft MLW. Footprint=79 acres Capacity=up to 591,000	Place silt and cap with sand to final depth of -12 ft MLW. Footprint=9 acres Capacity=167,000 cy	•Over dredge channel to -65 ft MLW •Fill to 42 ft MLW with contaminated sediments •Cap to -40 ft MLW with sand •Capacity=332,000cy	•Over dredge channel to -60 ft MLW •Fill to -44 ft MLW with contaminated sediments •Cap to -42 ft MLW with sand •Capacity=246,000 cy
WATER QUALITY	•Potential for water quality exceedences after 4 hrs up to 4500 ft from dump site. •Permanent loss of up to 204 million gal. of Boston Harbor water capacity	•Potential for water quality exceedences after 4 hrs up to 4500 ft from dump site. •Permanent loss of up to 201 million gal. of Boston Harbor water capacity	•Potential for water quality exceedences after 4 hrs up to 4500 ft from dump site •Permanent loss of up to 64.8 million gal. of Boston Harbor water capacity	•Potential for water quality exceedences after 4 hrs up to 4500 ft from dump site •Negligible effect on current velocity •No change in Harbor volume	•Potential for water quality exceedences after 4 hrs up to 4500 ft from dump site •Negligible effect on current velocity •No change in Harbor volume
MARINE INTERTIDAL	Not applicable				
MARINE SUBTIDAL	Temporary loss of up to 83 ac. of soft substrate	Temporary loss of up to 79 ac. of soft substrate	•Temporary loss of up to 8.14 ac. of soft substrate •Improved habitat quality for benthic fauna	No habitat loss beyond that caused by improvement dredging project.	
SHELLFISH	Short-term impact on softshell clam and lobster populations due to increased suspended sediments		Short-term impact on softshell clam population due to increased suspended sediments	Potential short-term impacts to nearby resources due to impacts to water quality, although no commercial beds nearby.	
FINFISH	• Short-term mortality of fish eggs, larvae, and adults • Temporary reduction of prey available to species which feed primarily on invertebrates • Temporary interference with commercial fishery				
FRESHWATER AQUATIC RESOURCES	Not applicable				
WETLAND VEGETATION, WILDLIFE	Temporary impact on 83 ac. of subtidal wetland	Temporary impact on 79 ac. of subtidal wetland	Temporary loss of 8.14 ac. of subtidal wetland	No impacts beyond those incurred due to dredging project	
THREATENED & ENDANGERED SPECIES	• None expected				
HISTORIC & ARCHEOLOGICAL	• None				
SOCIOECONOMIC & LANDUSE	Minor temporary impact on boat traffic	Interruption of use of small vessel navigation channel	Temporary impact on boat traffic	Prolonged dredging in navigational channel resulting in additional minor interruption of shipping traffic	
TRAFFIC	•Transportation of dredged material by barge •Approx. 450 barge trips •Temporary interruptions in Dorchester Channel	•Transportation of dredged material by barge •Approx. 450 barge trips •Relocation of small vessel channel	•Transportation of dredged material by barge •Approx. 120 barge trips •temporary interruptions in Winthrop Harbor Channel	•Addit. dredging would require 60 days •120 barge trips required to remove clay sediments	• 30 days of additional dredging • 60 barge trips to remove clay

TABLE 3-11(CONT'D). POTENTIAL IMPACTS CAUSED BY USING SPECIFIC SUBAQUEOUS, BORROW PIT AND IN-CHANNEL SITES FOR BOSTON HARBOR DREDGED MATERIAL DISPOSAL.

RESOURCE	MYSTIC RIVER IN-CHANNEL	MEISBURGER 2	MEISBURGER 7	SPECTACLE ISLAND CAD
SITE DESIGN	•Over dredge to -70 ft MLW •Fill to -44 ft MLW with silt •Cap to -42 ft MLW with sand •Capacity=742,000 cy	•Dredge pit 13 ft deep •Fill with dredged silt •Cap with clay and sand to pre-existing contours •Footprint=86 acres •Capacity=1,320,000 cy	•Dredge pit 10 ft deep •Fill with dredged silt •Cap with clay and sand to pre-existing contours •Footprint=121 acres •Capacity=1,320,000 cy	•Dredge existing sediments to -31 ft MLW •Fill with dredged silt •Cap with clay and sand to pre-existing contours •Footprint=20-50 acres •Capacity=1,320,000 cy
WATER QUALITY	•Potential for water quality exceedences after 4 hrs up to 4500 ft from dump site •No change in Harbor volumes	Water quality criteria not exceeded outside site 4 hrs after dump.	Water quality criteria not exceeded outside site 4 hrs after dump.	Potential for water quality exceedences; Construction/mitigation steps would be planned
MARINE INTERTIDAL	Not applicable			
MARINE SUBTIDAL	No habitat loss beyond that caused by improvement dredging project	•Temporary loss of 150 ac. of soft substrate •Beach improvement from excavated material	•Temporary loss of 82-403 ac. of soft substrate •Beach improvement from excavated material	Temporary loss of 20-70 ac. of soft substrate
SHELLFISH	Potential short-term impacts to nearby resources due to impacts to water quality	•Short-term impact on lobster population •Temporary interference with commercial fishery		Potential temporary siltation on nearby mussel beds
FINFISH	•short-term mortality of fish eggs, larvae and adults •Temporary reduction of prey available to species which feed primarily on invertebrates •Temporary interference with commercial fishery			
FRESHWATER AQUATIC RESOURCES	Not applicable			
WETLAND VEGETATION, WILDLIFE	No impacts beyond those incurred due to dredging project	•No state jurisdictional wetlands (>80 ft MLW) •Temporary interference with commercial fishery		Temporary loss of 22 ac. of subtidal wetlands
THREATENED & ENDANGERED SPECIES	None expected	None expected, although some species of whales and sea turtles could occur in area incidentally		Not applicable
HISTORIC & ARCHEOLOGICAL	None			
SOCIOECONOMIC & LANDUSE	Prolonged dredging in navigational channel resulting in additional minor interruption of shipping traffic	Temporary impact on fishing and recreational boating		•Temporary impact on recreational boating •Possible conflict with construction of fish reef
TRAFFIC	•90 days of additional dredging •185 barge trips to remove parent material	•Dredge will be on-site for > 1 year •660 barge trips required to remove sediments •660 barge trips required to transport harbor sediments to site	•Dredge will be on-site for > 1 year •660 barge trips required to remove sediments •660 barge trips required to transport harbor sediments to site	•Dredge will be on-site for> 3 months •660 barge trips required to remove sediments •660 barge trips required to transport harbor sediments to site

TABLE 3-12. IMPACTS CAUSED BY USING EXISTING OPEN WATER DISPOSAL SITES FOR BOSTON HARBOR DREDGED MATERIAL DISPOSAL.

RESOURCE	MASSACHUSETTS BAY DISPOSAL SITE	BOSTON LIGHTSHIP
SITE DESIGN	Continuous point disposal of silt two weeks after start of dredging; Capping with parent material.	
WATER QUALITY	No water quality criteria exceedences after four hours outside the site.	
MARINE INTERTIDAL	Not applicable	
MARINE SUBTIDAL	•Benthic resources maintained in pioneering stage due to regular disposal •No significant change from existing conditions	Possible mature benthic community now existing. Disposal would temporarily convert to a pioneering community.
SHELLFISH	Gills of any shellfish in immediate vicinity of disposal site could become clogged	
FINFISH	•Some mortality of demersel fish due to burial •Avoidance of disposal operation	
FRESHWATER AQUATIC RESOURCES	Not applicable	
WETLAND VEGETATION, WILDLIFE	Designated disposal site	Alteration of subtidal habitat conditions in Tidal Waters
THREATENED & ENDANGERED SPECIES	•Endangered whales and turtles are transients in area, and would likely avoid disposal activities	
HISTORIC & ARCHEOLOGICAL	None	Needs further review
SOCIOECONOMIC & LANDUSE	•Designated dredged material disposal site •No change in current use	Former dredged material disposal site
TRAFFIC	•Disposal of parent material and rock would require up to 500 barge trips (4000 cy capacity) •Disposal of silt would require up to 170 barge trips (4000 cy capacity) •Average of two barge trips per day	

TABLE 3-13. ALTERNATIVE DIPSOSAL OPTIONS FOR DISPOSAL OF SILT SEDIMENTS

SITE TYPE	SITE	CAPACITY (CY)	COST	DISPOSAL OPTION
UPLAND				
Landfill	E. Bridgewater	200 daily cover, 200 fill in cy/day	$62	A1, A2, C1, C3
	Plainville	50 daily cover, 250 fill in cy/day	$94	A1, A2, C1, C3
	Fitchberg/			
	Westminster	75 daily cover, 250 fill in cy/day	$108	A1, A2, C1, C3
Inland	Woburn	158,600	$69	A2, A3, C2, C4
	Wrentham	451,200	$62	A2, A3, C2, C4
Coastal	Everett	37,000	$76	A2, C2, C4
	Squantum Pt.	210,000	$44-$51	A2, A3, C2, C4
AQUATIC				
Shoreline	Amstar	128,000 MLW, 241,000 MHW	$62-$50	B1, B5, C1, C2
	Cabot Paint	18,000 MLW, 198,000 MHW	$362-$66	B1, B5, C1, C2
	Lt. Mystic			
	Channel	303,000 to -3 ft. MLW	$47	B1, B5, C1, C2
	Mystic Piers	98,000 MLW, 187,000 MHW	$47-$38	B1, B5, C1, C2
	Reserved A	14,000 MLW, 390,000 MHW	$341-$44	B1, B5, C1, C2
	Reserved B	186,000 MLW, 315,000 MHW	$45-$40	B1, B5, C1, C2
	Revere Sugar	86,000 MLW, 204,000 MHW	$93-$61	B1, B5, C1, C2
Subaqueous	Sub. B	562,000	$20	B2, B5, C3, C4
	Sub. E	591,000	$19	B2, B5, C3, C4
In-Channel	Chelsea	332,000	$30	B3, B5, C3, C4
	Mystic	742,000	$30	B3, B5, C3, C4
	Inner Confl.	246,000	$30	B3, B5, C3, C4
Borrow Pit	Meisburger 2	1,320,000	$30	B4, B5, C3, C4
	Meisburger 7	1,320,000	$33	B4, B5, C3, C4
	Spec. Isl. CAD	1,320,000	$21	B4, B5, C3, C4
Existing Sites	Boston Lt. Ship	1,320,000	$16	D1, D2
	MBDS	1,320,000	$27	D1, D2
TREATMENT	Solidification	6,000 per day	$55	D1

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TABLE 3-14. COST ESTIMATES FOR LANDFILL SITES FOR BHNIP SILT DISPOSAL

Landfills

Location	Distance (miles)	Silt Volume (CY)	Dredging Cost $8.29	Dewatering Cost $17.00	Hauling Cost/CY	Hauling Cost	Tipping Fee ($/CY)	Tipping Cost	Total Cost	Unit Cost for Silt ($/CY)
East Bridgewater	25	200,000	$1,658,000	$3,400,000	$9.20	$1,840,000	$28	$5,600,000	$12,498,000	$62.00
Plainville	35	200,000	$1,658,000	$3,400,000	$12.25	$2,450,000	$56	$11,200,000	$18,708,000	$94.00
Fitchburg/Westminster	45	200,000	$1,658,000	$3,400,000	$12.25	$2,450,000	$70	$14,000,000	$21,508,000	$108.00

ASSUMPTIONS

Silt volume includes disposal and possible contour capping.
Hauling costs assumed fleet of 20 trucks and 3 loaders working 5 days per week.
Dewatering cost based on combined use of air drying and belt filter press and includes land rental.

TABLE 3-15. COST ESTIMATES FOR LAND-BASED SITES FOR BHNIP SILT DISPOSAL

Woburn-11

Footprint (Sq Ft)	Perimeter (FT)	Dike Material (CY)	Dike Cost $15.00 /CY	Lining Cost $26.00 /SY	Road Fill $13.00 /CY	Clearing/ Drainage
617,500	3,100	63,400	$951,000	$1,783,889	$1,560,000	$59,200

Silt Volume (CY)	Dredging Cost $8.29 /CY	Hauling Cost $9.30 /CY	Cap Cost $15.00 /CY	Dewatering Cost $17.00 /CY	Treatment Cost $2.00 /CY
158,600	$1,314,794	$1,474,980	$525,000	$2,696,200	$317,200

Land Cost	Total Cost	Unit Cost for Silt
$212,638	$10,895,000	$68.69

ASSUMPTIONS

Footprint (area) planimetered from quad sheet.
Footprint selected to avoid wetlands and power lines. As a result two of three areas were not large enough to use.
Dike volume computed from dike height of 12', top width of 10' and side slopes of 1V to 3H ("CAD CELL" program).
Sediment thickness 10' with 2' cap thickness.
Liner consists of geomembrane for positive cut-off, 1' of sand and a geotextile filter.
Also included in cost of liner is a geotextile filter at the cap layer.
Sand cost $12/CY, geotextile $3/SY and geomembrane $16/SY.
Volume of road fill calculated for road within the diked area requiring 120,000 CY.
Clearing costs determined by assuming $2800/acre for 14 acres.
Drainage costs assumed to be rerouting local drainage @ $20,000.
Hauling costs assumed fleet of 30 trucks and 4 loaders working 7 days/wk for 3 months.
Cap was assumed to be trucked from Boston (Boston Blue Clay from Improvement Project).
Dewatering cost based on combined use of air drying and belt filter press and includes land rental.
Treatment of leachate from site is expected to require saline tainted water to be reansported
to a local treatment plant, construction of package treatment plant or trucking to the ocean.
Dewatering site rental calculated @ $1.57/SF.

TABLE 3-15 (CONTINUED). COST ESTIMATES FOR LAND-BASED SITES FOR DISPOSAL OF BHNIP SILTS

Wrentham-495

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Footprint (Sq Ft)	Perimeter (FT)	Dike Material (CY)	Dike Cost $11.00 /CY	Lining Cost $26.00 /SY	Road Fill $13.00 /CY	Clearing/ Drainage
1,524,600	6,185	91,200	$1,003,200	$4,404,400	$1,950,000	$188,000

Silt Volume (CY)	Dredging Cost $8.29 /CY	Hauling Cost $12.00 /CY	Cap Cost $11.00 /CY	Dewatering Cost /CY $17.00	Treatment Cost /CY $2.00
451,200	$3,740,448	$5,414,400	$1,977,800	$7,670,400	$902,400

Land Cost	Total Cost	Unit Cost for Silt
$525,000	$27,776,000	$61.56

ASSUMPTIONS

Footprint (area) planimetered from quad sheet and added for two separate diked areas.
Footprint selected to avoid wetlands, power lines and residential areas.
Dike volume computed from dike height of 12', top width of 10', side slopes of 1V to 3H ("CAD CELL" program).
Sediment thickness 10' with 2' cap thickness.
Liner consists of geomembrane for positive cut-off, 1' of sand and a geotextile filter.
Also included in cost of liner is a geotextile filter at the cap layer.
Sand cost $12/CY, geotextile $3/SY and geomembrane $16/SY.
Volume of road fill calculated for road within the diked area requiring 150,000 CY.
Clearing costs determined by assuming $2800/acre for 60 acres.
Drainage costs assumed to be rerouting local drainage @ $20,000
Hauling costs assumed fleet of 30 trucks and 4 loaders working 7 days/wk for 15 months.
Cap was assumed to be purchased locally with volume of 96,000 CY determined from "CAD CELL" program.
Dewatering cost based on combined use of air drying and belt filter press and includes land rental.
Treatment of leachate from site is expected to require saline tainted water to be transported
to a local treatment plant, construction of package treatment plant or trucking to the ocean.
Dewatering site rental calculated @ $1.57/SF.
Land cost calculated @ $15,000/Ac.

TABLE 3-15 (CONTINUED). COST ESTIMATES FOR LAND-BASED SITES FOR DISPOSAL OF BHNIP SILTS

UPLAND

Squantum - (Trucking)

Footprint (Sq Ft)	Perimeter (FT)	Dike Material (CY)	Dike Cost $15.00 /CY	Clearing/ Drainage	
782,500	4,300	87,900	$1,318,500	$45,200	
Silt Volume (CY)	**2' Cap Volume (CY)**	**Total Volume (CY)**	**Dredging Cost $8.29 /CY Silt $7.76 /CY Parent**	**Hauling Cost/CY $5.00**	
210,000	46,000	256,000	$2,097,860	$1,280,000	
Dewatering Cost $17.00 /CY	**Road Fill $13.00 /CY**		**Land Cost**	**Total Cost**	**Unit Cost for Silt**
$3,570,000	$650,000		$269,456	$9,231,000	$43.96

Squantum - (Barging)

Footprint (Sq Ft)	Perimeter (FT)	Dike Material (CY)	Dike Cost $15.00 /CY	Clearing/ Drainage
782,500	4,300	87,900	$1,318,500	$45,200
Silt Volume (CY)	**2' Cap Volume (CY)**	**Total Volume (CY)**	**Dredging Cost $8.29 /CY Silt $7.76 /CY Parent**	**Land Cost**
210,000	46,000	256,000	$2,097,860	$269,456
Dredging Access (CY)	**Dredging Access $8.50 /CY**	**Rehandling Cost $15.00**	**Total Cost**	**Unit Cost for Silt**
160,000	$1,360,000	$5,550,000	$10,641,000	$50.67

ASSUMPTIONS

Footprint (area) planimetered from quad sheet.
Footprint selected to avoid wetland.
Dike volume computed from dike height of 12', top width of 10' and side slopes of 1V to 3H time perimeter of 4300'.
Sediment thickness 10' with 2' cap thickness.
Clearing costs determined by assuming $1400/acre for 18 acres.
Drainage costs assumed to be rerouting local drainage @ $20,000.
Hauling costs assumed fleet of 10 trucks and 3 loaders working 7 days/wk for 4.5 months.
Dewatering cost based on combined use of air drying and belt filter press and includes land rental.
Volume of road fill calculated for road within the diked area requiring 50000 CY.
The 2700' x 175' access channel assumed to have existing depth of -4'MLW and require a 12' depth.
Rehandling cost is for a barge-mounted crane to unload all scows.
Dredging costs - parent = $7.76, silt = $8.29.
Dewatering site rental calculated @ $1.57/SF and land cost calculated @ $15,000/Ac.

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TABLE 3-15 (CONTINUED). COST ESTIMATES FOR LAND-BASED SITES FOR BHNIP SILT DISPOSAL

Everett-04

Silt Volume (CY)	2' Cap Volume (CY)	Total Volume (CY)	Mechanical Dredging Cost/CY	Rehandling Cost/CY	Total Dredging Cost	Bulkhead (LF)	Depth of Piles (FT)	Bulkhead Cost ($30/SF)
37,000	18,000	55,000	$8.29 Silt $7.76 Parent	$15.00	$1,271,410	400	105	$1,260,000

Dike (CY)	Dike Cost $15.00 /CY	Footprint Area (SQ FT)	Average Depth (FT)	Wier/Silt Curtain Cost	Total Cost	Unit Cost for Silt ($/CY)
17,100	$256,500	243,936	8	$36,590	$2,824,500	$76.34

ASSUMPTIONS

Footprint (area) planimetered from quad sheet.
Footprint selected to avoid crossing municipal boundary.
Dike volume computed from dike height of 8', top width of 10' and side slopes of 1V to 3H.
Dike length 1700'.
Sediment thickness varies (assumed to be 8') with cap thickness of 2'.
Volumes shown are dredged volumes (expansion of dredged material has not been applied).
Rehanding cost is for a barge-mounted crane to unload the scows.
Bulkhead costs reflect $30/SF for steel.
Bulkhead assumed to tie to fast ground and only be necessary along fronting water edge.
Wier required and is based on cost of $0.15/CY of material contained.
Dredge costs - parent = $7.76, silt = $8.29.

TABLE 3-16. COST ESTIMATES FOR AQUATIC SHORELINE OPTIONS

	Fill to level of: (MLW)	Volume: Sediment Volume (CY)	Volume: 3' Cap Volume (CY)	Volume: Total Volume (CY)	Surface Footprint (SQ FT)	Depth (FT)	Capacity/ Ft Depth (CY)	Concrete Panel Bulkhead: Bulkhead (LF)	Concrete Panel Bulkhead: Depth of Piles (FT)	Concrete Panel Bulkhead: Panel Cost ($4/SQ FT)	Concrete Panel Bulkhead: Steel H-piles ($85/LF)
Revere Sugar	20	204,000	18,000	222,000	160,000	37.5	6,000	1545	125	$339,900	$2,051,953
Amstar	20	241,000	17,000	258,000	153,000	45.5	6,000	1065	125	$234,300	$1,414,453
Mystic Piers	20	187,000	13,000	200,000	120,000	45	4,000	195	125	$42,900	$258,984
Cabot Paint	20	198,000	27,000	225,000	243,000	25	9,000	1605	125	$353,100	$2,131,641
Little Mystic Channel	20	840,000	70,000	910,000	630,000	39	23,000	360	125	$79,200	$478,125
Reserved Channel A	20	390,000	43,000	433,000	390,000	30	14,000	825	110	$181,500	$984,219
Reserved Channel B	20	315,000	38,000	353,000	334,000	28.5	12,000	225	110	$49,500	$262,969

	Dredging/Handling: Dredging Cost/CY (silt)	Dredging/Handling: Dredging Cost/CY (parent)	Dredging/Handling: Rehandling Cost/CY	Dredging/Handling: Total Dredging Cost	Tie-Backs: Three Rows Cost/row ($220/LF)	Geotextile/Drainage Quantities: Fabric (SY)	Geotextile/Drainage Quantities: Sand Filter (CY)	Geotextile/Drainage Quantities: T-drains (EA)
Revere Sugar	$8.29	$7.76	$15.00	$5,160,840	$1,019,700	24,215	11,852	77
Amstar	$8.29	$7.76	$15.00	$5,999,810	$702,900	22,384	11,333	53
Mystic Piers	$8.29	$7.76	$15.00	$4,651,110	$128,700	14,308	8,889	10
Cabot Paint	$8.29	$7.76	$15.00	$5,225,940	$1,059,300	31,458	18,000	80
Little Mystic Channel	$8.29	$7.76	$15.00	$21,156,800	$237,600	71,560	46,667	18
Reserved Channel A	$8.29	$7.76	$15.00	$10,061,780	$544,500	46,083	28,889	41
Reserved Channel B	$8.29	$7.76	$15.00	$8,201,230	$148,500	37,824	24,741	11

	Wier/Silt Curtain Cost	Design and Const. Mgt Cost	Contingency Cost (25%)	Total Cost	Unit Cost for Silt ($/CY)	Geotextile/Drainage Costs: Fabric ($7/SY)	Geotextile/Drainage Costs: Sand Filter ($13/CY)	Geotextile/Drainage Costs: T-drains ($560/EA)	Geotextile/Drainage Costs: B'head Labor ($4/SF)
Revere Sugar	$24,000	$654,000	$2,499,000	$12,496,630	$61.26	$169,507	$154,074	$43,260	$380,396
Amstar	$22,950	$628,000	$2,400,000	$11,998,470	$49.79	$156,689	$147,333	$29,820	$262,215
Mystic Piers	$18,000	$376,000	$1,436,000	$7,180,879	$38.40	$100,158	$115,556	$5,460	$48,011
Cabot Paint	$36,450	$679,000	$2,595,000	$12,974,748	$65.53	$220,208	$234,000	$44,940	$395,169
Little Mystic Channel	$94,500	$1,628,000	$6,220,000	$31,100,528	$37.02	$500,920	$606,667	$10,080	$88,636
Reserved Channel A	$58,500	$891,000	$3,406,000	$17,031,862	$43.67	$322,583	$375,556	$23,100	$203,124
Reserved Channel B	$50,100	$655,000	$2,504,000	$12,519,391	$39.74	$264,765	$321,630	$6,300	$55,397

ASSUMPTIONS

Volumes shown are dredged volumes (expansion of dredged material has not been applied).
Surface area planimetered from navigation chart vertical sides assumed.
Depth is an average as shown on navigation chart or recent survey.
Dredging cost is not dependent on distance to disposal site.
Bulkhead assumed to tie to fast ground and may be necessary along several sides.
Wier required if disposal site to create fast land (cost is $0.15 x surface area).
Rehandling includes floating crane plus repositioning of material in the site.

Bulkhead design source: J. Fowler & NY District MOTB.
T-drains thru bulkhead every 20' extend into filter.
Sand filter laid on top of fabric in 2' layer.
Fabric placed on bottom and sides.
Concrete panels fitted between H-piles @ 384 SF/day.
H-piles spaced 8' apart.
Tie-backs assumed to run length of bulkhead.
Labor costs for divers, crane and laborers @ $1720/day.

TABLE 3-16. (CONTINUED) ESTIMATES FOR AQUATIC SHORELINE OPTIONS TO MLW

		Volume						Concrete Panel Bulkhead			
	Fill to level of: (MLW)	Sediment Volume (CY)	3' Cap Volume (CY)	Total Volume (CY)	Surface Footprint (SQ FT)	Depth (FT)	Capacity/ Ft Depth (CY)	Bulkhead (LF)	Depth of Piles (FT)	Panel Cost ($4/SQ FT)	Steel H-piles ($85/LF)
Revere Sugar	0	86,000	18,000	104,000	160,000	17.5	6,000	1545	105	$216,300	$1,723,641
Amstar	0	128,000	17,000	145,000	153,000	25.5	6,000	1065	105	$149,100	$1,188,141
Mystic Piers	0	98,000	13,000	·111,000	120,000	25	4,000	195	105	$27,300	$217,547
Cabot Paint	0	18,000	27,000	45,000	243,000	5	9,000	1605	105	$224,700	$1,790,578
Little Mystic Channel	-3	303,000	70,000	373,000	630,000	16	23,000	360	102	$46,080	$390,150
Reserved Channel A	-6	14,000	44,000	58,000	390,000	4	14,000	825	84	$95,700	$736,313
Reserved Channel B	9.5	186,000	37,000	223,000	334,000	18	12,000	225	99.5	$40,050	$237,867

	Dredging/Handling				Tie-Backs	Geotextile/Drainage Quantities			Bulkhead Cost		
	Dredging Cost/CY (silt)	Dredging Cost/CY (parent)	Rehandling Cost/CY	Total Dredging Cost	Three Rows Cost/row ($220/LF)	Fabric (SY)	Sand Filter (CY)	T-drains (EA)	Bulkhead (LF)	Depth of Piles (FT)	Bulkhead Cost ($30/SQ FT)
Revere Sugar	$6.29	$7.76	$15.00	$2,412,620	$1,019,700	20,782	11,852	77	165	105	$519,750
Amstar	$6.29	$7.76	$15.00	$3,368,040	$702,900	20,018	11,333	53	375	105	$1,181,250
Mystic Piers	$6.29	$7.76	$15.00	$2,578,300	$128,700	13,875	8,889	10	225	105	$708,750
Cabot Paint	$8.29	$7.76	$15.00	$1,033,740	$1,059,300	27,892	18,000	80	930	105	$2,929,500
Little Mystic Channel	$8.29	$7.76	$15.00	$8,650,070	$237,600	70,640	46,667	18	360	102	$1,101,600
Reserved Channel A	$8.29	$7.76	$15.00	$1,327,500	$544,500	43,700	28,889	41	585	84	$1,474,200
Reserved Channel B	$6.29	$7.78	$15.00	$5,174,060	$148,500	37,561	24,741	11	585	99.5	$1,746,225

						Geotextile/Drainage Costs			
	Wier/Silt Curtain Cost	Design and Const. Mgt Cost	Contingency Cost (25%)	Total Cost	Unit Cost for Silt ($/CY)	Fabric ($7/SY)	Sand Filter ($13/CY)	T-drains ($560/EA)	B'head Labor ($4/SF)
Revere Sugar	$24,000	$419,000	$1,600,000	$8,000,138	$93.02	$145,474	$154,074	$43,260	$242,070
Amstar	$22,950	$414,000	$1,582,000	$7,911,270	$61.81	$140,123	$147,333	$29,820	$166,864
Mystic Piers	$18,000	$225,000	$861,000	$4,304,540	$43.92	$97,125	$115,556	$5,460	$30,553
Cabot Paint	$36,450	$341,000	$1,303,000	$6,514,421	$361.91	$195,242	$234,000	$44,940	$251,471
Little Mystic Channel	$94,500	$741,000	$2,831,000	$14,153,197	$46.71	$494,480	$606,667	$10,080	$51,570
Reserved Channel A	$58,500	$250,000	$956,000	$4,780,170	$341.44	$305,900	$375,556	$23,100	$107,102
Reserved Channel B	$50,100	$440,000	$1,682,000	$8,408,256	$45.21	$262,928	$321,630	$6,300	$44,622

ASSUMPTIONS

Volumes shown are dredged volumes (expansion of dredged material has not been applied).
Surface area planimetered from navigation chart vertical sides assumed.
Depth is an average as shown on navigation chart or recent survey.
Dredging cost is not dependent on distance to disposal site.
Bulkhead assumed to tie to fast ground and may be necessary along several sides.
Wier required if disposal site to create fast land (cost is $0.15 x surface area).
Rehandling includes floating crane plus repositioning of material in the site.

Bulkhead design source: J. Fowler & NY District MOTB.
T-drains thru bulkhead every 20' extend into filter.
Sand filter laid on top of fabric in 2' layer.
Fabric placed on bottom and sides.
Concrete panels fitted between H-piles @ 384 SF/day.
H-piles spaced 8' apart.
Tie-backs assumed to run length of bulkhead.
Labor costs for divers, crane and laborers @ $1720/day.

TABLE 3-17. COST ESTIMATE FOR SUBAQUEOUS DEPRESSION OPTION FOR BHNIP SILT DISPOSAL

Subaqueous B

	Footprint (Sq Ft)	Perimeter (FT)	Fill to Depth Below MLW (FT)	Existing to Depth Below MLW (FT)	Volume: Silt Volume (CY)	3' Cap Volume (CY)	Total Silt/Cap (CY)	Closure Dike (CY)
	Length=>	1250						
	Width=>	2000						
(North)	2,500,000	6,500	15	21	268,109	274,539	542,649	130,000
	Length=>	800						
	Width=>	1200						
(South)	1,080,000	4,200	15	26	294,440	117,912	412,352	255,600

Costs

	Parent Material (CY)	Dredging Cost	Design and Constr. Mgt Cost (7%)	Contingency Cost (25%)	Total Cost Silt	Unit Cost for Silt ($/CY)
(North)		$1,867,829	$161,000	$507,000	$2,535,829	$11.35
						($11.34) w/no cap
(South)		$2,051,264	$174,000	$556,000	$2,781,264	$11.34
Parent for Dike =	385,600	$2,394,576	$168,000	$641,000	$3,203,576	
						$19.71 w/sand cap
Parent for Cap but to MBDS =	392,451	$3,045,422	$213,000	$815,000	$4,073,422	
Sand for Cap =		$3,924,513	$275,000	$1,050,000	$5,249,513	
Parent to MBDS =	(60,000)	($465,600)	($33,000)	($125,000)	($623,600)	<= See note 1
				(Portion)	$3,019,264	Rock
					$14,989,754	
					$20,239,267	w/sand cap

Note 1: There is a shortfall of parent material if this site used alone.
The negative cost when combined with Sub-E cancels a portion of the 250,000 cy parent material shown being sent to MBDS.

ASSUMPTIONS

Footprint (area) planimetered from navigation chart.
Existing depth calculated from navigation chart soundings within area.
Fill depth is finished depth including a 3 foot cap.
Design effort involves minimal site hydrographic survey ($20,000) and benthic and fish studies ($10,000).
Dredging costs - silt = $8.36, parent = $7.76, cap = $6.21, dike = $6.21.
Cap and dike both consist of parent material.
Parent material to MBDS is ratio of silt/(total silt) x total parent.

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TABLE 3-17 (CONTINUED). COST ESTIMATE FOR SUBAQUEOUS DPRESSION OPTION FOR BHNIP SILT DISPOSAL

Subaqueous E

Footprint (Sq Ft)	Perimeter (FT)	Fill Depth Below MLW (FT)	Existing to Depth Below MLW (FT)	Volume: Silt Volume (CY)	3' Cap Volume (CY)	Total Silt/Cap (CY)	Closure Dike (CY)
Length=>	850						
Width=>	4100						
3,485,000	9,900	8	15.8	591,164	382,280	973,444	62,200

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	Costs: Parent Material (CY)	Dredging Cost	Design and Constr. Mgt Cost (7%)	Contingency Cost (25%)	Total Cost Silt	Unit Cost for Silt ($/CY)
		$4,128,298	$319,000	$1,112,000	$5,559,298	$19.34 w/sand cap
Parent for Dike =	62,200	$387,506	$27,000	$104,000	$518,506	
Parent for Cap but to MBDS =	382,280	$2,966,490	$208,000	$794,000	$3,968,490	$11.28 w/no cap
Sand for Cap =		$3,822,796	$268,000	$1,023,000	$5,113,796	
Parent to MBDS =	310,000	$2,405,600	$168,000	$643,000	$3,216,600	
				(Portion)	$3,172,845	Rock
					$16,435,739	
					$21,549,535	w/sand cap

ASSUMPTIONS

Footprint (area) planimetered from navigation chart.
Existing depth calculated from navigation chart soundings within area.
Fill depth is finished depth including a 3 foot cap.
Design effort involves minimal site hydrographic survey ($20,000) and benthic and fish studies ($10,000).
Dredging costs - silt = $8.38, parent = $7.76, cap = $6.23, dike = $6.23.
Cap and dike both consist of parent material.
Parent material to MBDS is ratio of silt/(total silt) x total parent.

TABLE 3-18. COST ESTIMATE FOR IN-CHANNEL DISPOSAL OPTIONS FOR BHNIP SILT

IN-CHANNEL

									Volume					Costs			
	Cell size	Cell Depth	Number of Cells	Silt Removed per cell	Parent Removed per cell	Extra Parent Removed per cell	3' Cap Required per cell	Silt Capacity per cell	Total Silt Removed	Total Parent Removed	Total Extra Parent Removed	Total Silt Capacity	Cap Volume (CY)	Dredging Cost	Design and Const. Mgt Cost (7%)	Contingency Cost (25%)	Total Cost
Mystic River																	
	200x500	48	2	9,300	16,100	19,600	10,400	9,100	18,600	32,200	39,000	18,200	20,800	$857,000	$60,000	$229,000	$1,148,000
		50	1	9,300	16,000	24,900	10,400	14,600	9,300	16,000	24,900	14,500	10,400	$462,000	$32,000	$124,000	$618,000
		55	6	9,300	16,000	36,000	10,400	25,600	55,800	96,000	216,000	153,600	62,400	$3,190,000	$223,000	$853,000	$4,266,000
		56	1	9,300	16,100	37,800	10,400	27,400	9,300	16,100	37,800	27,400	10,400	$544,000	$38,000	$146,000	$728,000
		60	2	9,300	16,100	44,000	10,400	33,600	18,600	32,200	88,000	67,200	20,800	$1,166,000	$82,000	$312,000	$1,560,000
		65	7	9,300	16,100	49,400	10,400	39,000	65,100	112,700	345,800	273,000	72,800	$4,317,000	$302,000	$1,155,000	$5,774,000
		70	3	9,300	16,000	52,600	10,400	42,100	27,900	48,000	157,600	126,300	31,200	$1,906,000	$133,000	$510,000	$2,649,000
	150x500	55	1	7,300	12,300	24,900	7,700	17,200	7,300	12,300	24,900	17,200	7,700	$390,000	$27,000	$104,000	$521,000
		60	1	7,300	12,300	29,200	7,700	21,500	7,300	12,300	29,200	21,500	7,700	$417,000	$29,000	$112,000	$558,000
		70	1	7,300	12,300	30,900	7,700	23,200	7,300	12,300	30,900	23,200	7,700	$427,000	$30,000	$114,000	$571,000
Inner Confluence																	
	200x500	48	1	9,300	16,100	19,600	10,400	9,100	9,300	16,100	19,600	9,100	10,400	$429,000	$30,000	$115,000	$574,000
		55	4	9,300	16,000	36,000	10,400	25,600	37,200	64,000	144,000	102,400	41,600	$2,127,000	$149,000	$569,000	$2,845,000
		60	4	9,300	16,100	44,000	10,400	33,600	37,200	64,400	176,000	134,400	41,600	$2,331,000	$163,000	$624,000	$3,118,000
Chelsea																	
	200x500	55	3	9,300	16,000	36,000	10,400	25,600	27,900	48,000	108,000	76,800	31,200	$1,595,000	$112,000	$427,000	$2,134,000
		56	2	9,300	16,100	37,800	10,400	27,400	18,600	32,200	75,600	54,800	20,800	$1,088,000	$76,000	$291,000	$1,455,000
		58	4	9,300	16,100	41,100	10,400	30,700	37,200	64,400	164,400	122,800	41,600	$2,258,000	$158,000	$604,000	$3,020,000
		60	1	9,300	16,100	44,000	10,400	33,600	0	0	0	0	0	$0	$0	$0	$0
		65	2	9,300	16,100	49,400	10,400	39,000	18,600	32,200	98,800	78,000	20,800	$1,234,000	$86,000	$330,000	$1,650,000
	150x500	49	7	7,300	12,200	16,100	7,700	8,400	0	0	0	0	0	$0	$0	$0	$0
									412,500	711,400	1,780,300	1,320,400	459,900	$24,736,000	$1,730,000	$6,619,000	$33,087,000

Remaining In Channel Capacity =	1 x 33600 + 7 x 8400 =	92,400				
Remaining Silt to In Channel =	1099100 - 412500 =	686,600	$5,692,000	$398,000	$1,523,000	$7,613,000
Remaining Parent to MBDS =	1684000 - 711400 =	972,600	$7,547,000	$528,000	$2,019,000	$10,094,000

Unit Cost for Silt
$30.31 w/o parent
$37.03

Rock	$7,081,500
Grand Total	$57,875,500

ASSUMPTIONS

$8.29 = Unit Cost of Silt

$7.76 = Unit cost of Parent (even if used as cap)
$6.29 = Unit cost of Extra Parent
$10.00 = Unit Cost of Cap

1,684,000 = Total Parent

1,099,100 = Total Silt

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TABLE 3-19. COST ESTIMATES FOR AQUATIC BORROW PIT OPTION FOR BHNIP SILT DISPOSAL

Meisburger 2

Footprint (Sq Ft)	Perimeter (FT)	Existing Depth Below MLW (FT)	Excavate to Depth Below MLW (FT)	Volume: Silt Volume (CY)*	Volume: 3' Cap Volume (CY)*	Volume: Total Volume (CY)	Dredging Cost	Costs: Design and Constr. Mgt Cost (7%)	Costs: Contingency Cost (25%)	Costs: Total Cost Silt	Costs: Unit Cost for Silt ($/CY)
Length=>	2000										
Width=>	1873										
3,746,000	7,746	80	93	1,319,518	412,361	1,731,879	$24,926,242	$1,775,000	$6,675,000	$33,376,242	$30.37
							Dredging Cost	Design and Constr. Mgt Cost (1%)	Contingency Cost (25%)	Total Cost Parent	
Parent to MBDS =					1,684,000		$13,067,840	$131,000	$3,300,000	$16,498,840	
										$49,875,082	
										$7,081,500	Rock
										$56,956,582	

* Total volume of sediments and cap exceed estimated yield of sand/gravel
(it is possible that yield did not account for lenses of silt)

Meisburger 7

Footprint (Sq Ft)	Perimeter (FT)	Existing Depth Below MLW (FT)	Excavate to Depth Below MLW (FT)	Volume: Silt Volume (CY)	Volume: 3' Cap Volume (CY)	Volume: Total Volume (CY)	Costs: Dredging Cost	Costs: Design and Constr. Mgt Cost (7%)	Costs: Contingency Cost (25%)	Costs: Total Cost	Costs: Unit Cost for Silt ($/CY)
Length=>	2500										
Width=>	2107										
5,267,500	9,214	80	90	1,319,497	580,683	1,900,180	$27,400,430	$1,948,000	$7,337,000	$36,685,430	$33.38
							Dredging Cost	Design and Constr. Mgt Cost (1%)	Contingency Cost (25%)	Total Cost Parent	
Parent to MBDS =					1,684,000		$13,067,840	$131,000	$3,300,000	$16,498,840	
										$53,184,270	
										$7,081,500	Rock
										$60,265,770	

ASSUMPTIONS

Footprint (area) provided by Normandeau (possibly from Meisburger report).
Existing depth obtained from navigation chart soundings.
Proposed sediment thickness is the difference between existing and excavated depths minus the 3 foot cap.
Side slopes of 1 vertical to 3 horizontal were assumed.
Volumes shown are dredged volumes (expansion of dredged material has not been applied).
Dredging costs account for dredging CAD and Boston Harbor sediments. (Meisburg mat. = $6.65, parent = $7.76, silt = $9.18).
No value was assigned to material excavated from disposal sites.
Design effort invloves minimal site hydrographic surveys ($20,000)and benthic and fish studies ($10,000).
Contingency is 25%.

TABLE 3-19 (CONTINUED). COST ESTIMATES FOR AQUATIC BORROW PIT OPTION FOR BHNIP SILT DISPOSAL

CAD (Spectacle)

	Footprint (Sq Ft)	Perimeter (FT)	Existing Depth Below MLW (FT)	Excavate to Depth Below MLW (FT)	Volume			Costs					
					Silt Volume (CY)	3' Cap Volume (CY)	Total Volume (CY)	Dredging Cost	Silt Curtain Cost ($30/SY)	Design and Const. Mgt Cost (7%)	Contingency Cost (25%)	Total Cost	Unit Cost for Silt ($/CY)
	1,974,554	4,980	8.3	31.3	1,318,766	216,905	1,535,671	$17,244,430	$96,000	$1,237,000	$4,644,000	$23,221,430	$21.13
								Dredging Cost		Design and Const. Mgt Cost (1%)	Contingency Cost (25%)	Total Cost	
ASSUMPTIONS			Parent to MBDS =			1,684,000		$13,067,840		$131,000	$3,267,000	$16,465,840	
												$39,687,270	
												$7,081,500	Rock
												$46,768,770	

The CAD is to be located further offshore than CA/T plan to avoid unsuitable material.
Footprint (area) planimetered from navigation chart for two different sized areas.
Existing depth calculated from navigation chart soundings within area.
Proposed sediment thickness is the difference between existing and excavated depths minus the 3 foot cap.
Side slopes of 1 vertical to 3 horizontal were assumed.
Volume shown are dredged volumes (expansion of dredged material has not been applied).
Dredging costs account for dredging CAD and Boston Harbor sediments. (CAD mat. = $4.71, silt = $8.42, parent = $7.76)
Design effort involves minimal site hydrographic surveys ($20,000) and benthic and fish studies ($10,000).
Contingency is 25%.
Silt curtain was assumed to consist of two square enclosures 200' on a side and 18' deep.
No cost was assumed for deployment of silt curtain.

TABLE 3-20. COSTS FOR ALTERNATIVE TREATMENT TECHNOLOGIES FOR BHNIP DREDGED MATERIAL

TECHNOLOGY TYPE	COST PER TON	COST PER CUBIC YD
Thermal	\$75 to \$120	\$113 to \$180
Solvent Extraction, Soil Washing and Other Chemical Treatments	\$80	\$120
Biotreatment	\$135	\$200
Solidification/Stabilization	\$90	\$135
Physical, Mechanical & Landfill Disposal	\$55	\$80

TABLE 3-21. COST ESTIMATES FOR USING EXISTING AQUATIC DISPOSAL SITES FOR BHNIP SILT DISPOSAL

Boston Lightship

	Footprint (SF)	Silt Volume (CY)	3' Cap Volume (CY)	Remaining Parent Volume (CY)	Dredging Cost	Design and Constr. Mgt Cost (7%)	Contingency Cost (25%)	Total Cost	Unit Cost for Silt ($/CY)
Note 1 =>	8,454,800	1,107,500	1,055,500	628,100	$23,352,370	$1,655,000	$5,838,000	$30,845,000	$15.87

MBDS

	Footprint (SF)	Silt Volume (CY)	3' Cap Volume (CY)	Remaining Parent Volume (CY)	Dredging Cost (per CY)	Design and Constr. Mgt Cost (1%)	Contingency Cost (25%)	Total Cost	Unit Cost for Silt ($/CY)
Note 1 =>	8,454,800	1,107,500	1,055,500	628,100	$23,774,261	$258,000	$6,008,000	$30,040,000	$13.05
Note 2 =>	8,454,800	1,099,100	1,055,500	628,100	$23,693,033	$257,000	$5,988,000	$29,938,000	$27.24
Note 3 =>	8,454,800	1,099,100	1,055,500	628,100	$18,818,977	$208,000	$4,757,000	$23,784,000	$21.64
Note 4 =>	8,454,800	1,099,100	1,055,500	628,100	$10,628,297	$126,000	$2,689,000	$13,443,000	$12.23
								$7,081,500 Rock	
								$37,019,500	

ASSUMPTIONS

Dredge costs - silt = $9.67,parent and cap = $7.76.
Unit cost for silt disposal = (dredge cost for silt + dredge cost for cap) divided by silt volume
Cap volume calculated for 3' cap over footprint of 9,500,000 SF.
Volumes shown are dredged volumes (expansion of dredged material has not been applied).
Design effort involves minimal site hydregraphic surveys ($20,000).

Note: 1) Unit cost doesn't consider remaining parent material or design/contingencies costs.
2) Unit costs include all parent material, design and contingencies costs. (expanded vol)
3) Unit cost doesn't consider remaining parent material but does consider design/contingencies costs. (expanded vol)
4) Unit cost includes only silt, design and contingencies it does not include cap.

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TABLE 3-22.

COMPANIES SENT QUESTIONNAIRES FOR INFORMATION TREATMENT TECHNOLOGY FOR THE BOSTON HARBOR NAVIGATION IMPROVEMENT PROJECT

COMPANY	RESPONSE
Retech, Inc., Ukiah, CA	None
IT Corporation, Knoxville, TN	None
ConTeck Environmental Services	Yes
Canonie Environmental Services Corp. (SoilRech ATP Systems, Inc.)	Yes
ECOVA Corporation	None
Carlo Environmental Technologies, Inc.	Yes
Separation and Recovery Systems, Inc.	Yes
Maxymillian Technologies (formerly Clean Berkshires, Inc.)	Yes
Hrubetz Environmental Services, Inc.	Yes
Seaview Thermal Systems	None
Remediation Technologies, Inc.	None
SRE, Inc.	None
ART International, Inc.	Yes
CF Systems Corp.	None
Dehydro-Tech Corp.	Yes
Bergmann USA	None
Cleantech of Arkansas, Inc.	None

TABLE 3-22 (CONTINUED)

COMPANIES SENT QUESTIONNAIRES FOR INFORMATION TREATMENT TECHNOLOGY FOR THE BOSTON HARBOR NAVIGATION IMPROVEMENT PROJECT

COMPANY	RESPONSE
OHM Corporation	Yes
Grace Dearborn, Inc.	None
MEET	None
Marine Remediation Systems, Inc.	None
Concurrent Technologies Corp.	None
LADS Systems, Inc.	Yes
Applied Environmental Recycling Systems	None
ReSHAPE Corporation	None
Laidlaw Waste Systems, Inc.	Yes
Bardon Trimount Inc.	None
WEB Engineering Associates, Inc.	None
IWT Corporation	None
GeoCon	None
Modell Environmental Corporation	None
Commercial Paving Co., Inc. (Commercial Recycling Systems)	Yes
Charles Group Inc.	None
Waterways Experiment Station	None

TABLE 3-22 (CONTINUED)

COMPANIES SENT QUESTIONNAIRES FOR INFORMATION TREATMENT TECHNOLOGY FOR THE BOSTON HARBOR NAVIGATION IMPROVEMENT PROJECT

COMPANY	RESPONSE
Zenon Environmental Inc.	None
BioSafe, Inc.	Yes
Soil Technology	Yes
Resources Conservation Company	None

TABLE 3-23. TECHNOLOGY SURVEY QUESTIONNAIRE RESPONSES

The following abbreviations and notations apply to the following Table 3-23.

b	bench scale
c	commercial scale
d	day
D	demonstration
Dm	demobilization
dw	dewatering
el	electricity
hrs	hours
l	laboratory scale
M	mobilization
m	month
min	minutes
Ms	moisture
mt	metals
N	No
NA	not available/applicable
ng	natural gas
o	organics
pp	proprietary
pt	pilot scale
sc	screen
sft	square feet
t	theoretical
Y	Yes

TABLE 3-23. TECHNOLOGY SURVEY QUESTIONNAIRE RESPONSES

COMPANY	ART International	BioSafe	Carlo Environmental Technology	Commercial Recycling Systems
TECHNOLOGY TYPE	Solvent Extraction	Thermal Destruction	Thermal Desorption	Solidification Stabilization
EFFECTIVENESS				
Demonstrated Through-Put cy/d	2	1000	525	1000
Maximum Through-Put cy/d	3	8000	600	NA
Meet Target Levels	O-Y M-N	O-Y M-Y	O-Y M-N	O-Y M-Y
Waste By-Products	Yes	Yes	No	No
Applicable to Dredged Material	Yes-b&pt	Yes-b&pt	Yes	Yes-c
Efficiencies in Scale	NA	Yes	Yes	Yes
Minimum Contaminant Concentr	None	NA	None	None
Processing Time	None	NA	600 cy/d	Varies
IMPLEMENTABILITY				
Pre-Treatment Requirements	Yes-sc&dw	Yes-sc&dw	Yes-sc&dw	Yes-dw
Mob-Demob Requirements	M-2m,Dm-1m	M-2m,Dm-2m	M-2wk,Dm-NA	M-2d,Dm-NA
Space Requirements	15,000 sft	NA	70,000 sft	10,000 sft
Traffic Impacts	Truck	None	None	Truck
Logistics	15,000 sft	NA	Land	Land
Special Fabrication	None	None	None	None
Building Requirements	Yes	Yes	Yes	Yes
Availability of Technology	Pp,l,pt	C	C	Pp,l,c
Number of Handling Events	Two	Varies	Three	Seven
Environmental Impacts	Air	None	Air	Water
Permittability	Air, Water	Water	Air	Air, Water
Site Safety	Yes	No	No	No
Environmental Constraints	None	None	Tm, Ms	Tm
Marketability of Residuals	Yes	Yes	Yes	Yes
COST DATA				
Estimated Price Range	$55-$65/ton	$122/ton	$28-$40/ton	$55-$95/ton
Factors Affecting Price:				
Initial Contaminant Concentrati	2	1	8	8
Target Contaminant Concentra	1	9	5	9
Quantity of Waste	4	2	6	2
Characteristics of Residuals	5	4	10	10
Labor Rates	4	10	7	6
Moisture Content	2	6	4	1
Facility Preparation	3	7	9	5
Waste Handling	3	3	3	4
Characteristics of Material	4	5	2	3
Utility/Fuel Rates	5	8	1	7

TABLE 3-23 (Continued) TECHNOLOGY SURVEY QUESTIONNAIRE RESPONSES

COMPANY	ConTeck Environmental Services	Dehydro-Tech Corporation	Hrubetz Environmental Services, Inc.	LADS System, Inc
TECHNOLOGY TYPE	Thermal Desorption	Solvent Extraction	Thermal Desorption	Thermal Solid/ Stabilization
EFFECTIVENESS				
Demonstrated Through-Put cy/d	750	50 t/d	10	None
Maximum Through-Put cy/d	360 t/d	NA	NA	1000
Meet Target Levels	O-Y M-N	O-Y M-N	O-S M-N	O-NA, M-Y
Waste By-Products	No	Yes	Yes	Yes
Applicable to Dredged Material	Yes	Yes-t	Yes-t	Yes-l
Efficiencies in Scale	Yes	Yes	NA	Yes
Minimum Contaminant Concentr	None	None	NA	None
Processing Time	20 min	1-2 hrs	Varies	hrs
IMPLEMENTABILITY				
Pre-Treatment Requirements	Yes-sc&dw	Yes-sc	Yes-sc&dw	Yes-sc&dw
Mob-Demob Requirements	M-2wk,Dm-NA	M-2yr,Dm-NA	M-1wk,D-1wk	M-1-2yr,D-1wk
Space Requirements	39000 sft	NA	6,700 sft	NA
Traffic Impacts	Truck	Varies	Unknown	Truck
Logistics	w, ng, el	NA	Land	Barge
Special Fabrication	Yes	None	Yes	None
Building Requirements	Yes	Yes	None	None
Availability of Technology	C	Pp,l,pt,c	C	Pp,pt
Number of Handling Events	Five	NA	Varies	Six
Environmental Impacts	Air, sec	None	Air	Air, Water
Permittability	Air, Water	Air, Water	NA	Air, Water
Site Safety	Yes	No	Air, Noise	Noise, Odors
Environmental Constraints	Tm, Ms	None	Ms	
Marketability of Residuals	Yes	No	No	No
COST DATA				
Estimated Price Range	$26-$65/ton	$50-$150/ton	$40-$100/ton	$90-$130/ton
Factors Affecting Price:				
Initial Contaminant Concentrati	6		9	
Target Contaminant Concentra	2		5	
Quantity of Waste	3	1	6	1
Characteristics of Residuals	8		10	
Labor Rates	6	3	7	
Moisture Content	1		1	
Facility Preparation	7	1	8	
Waste Handling	5	2	3	
Characteristics of Material	4	2	2	3
Utility/Fuel Rates	5	3	4	2

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TABLE 3-23 (Continued) TECHNOLOGY SURVEY QUESTIONNAIRE RESPONSES

COMPANY	Laidlaw Waste Systems	Maxymillian Technologies	OHM Remediation Services Corporation	Separation and Recovery Systems	SoilTech ATP Systems, Inc.
TECHNOLOGY TYPE	Lined Landfill	Thermal Dest/ Incineration	Slurry-Phase Bio-Treatment	Thermal Desorption	Thermal Desorption
EFFECTIVENESS					
Demonstrated Through-Put cy/d	2500	200-1400	135	100	200
Maximum Through-Put cy/d	2500	200-1400	275	300	700
Meet Target Levels	NA	O-Y M-N	O-Y M-N	O-Y M-N	O-Y M-N
Waste By-Products	NA	Yes	Yes	Yes	No
Applicable to Dredged Material	Yes	Yes-d	Yes-b	Yes-t	Yes-c
Efficiencies in Scale	NA	Yes	Yes	Yes	No
Minimum Contaminant Concentr	NA	None	Yes	None	None
Processing Time	NA	10-30 min	5-15 day	NA	40 min
IMPLEMENTABILITY					
Pre-Treatment Requirements	None	Yes-sc&dw	Yes-sc&sw	Yes-sc&dw	Yes-sc&dw
Mob-Demob Requirements	None	M-1-2m,D-1m	NA	M-3m,D-1m	M-2m,D-2m
Space Requirements	NA	32,500 sft	NA	17,000 sft	62,500 sft
Traffic Impacts	NA	None	None	None	None
Logistics	NA	Land	None	10,000 sft	Storage
Special Fabrication	NA	None	None	None	Yes
Building Requirements	NA	Yes	Yes	Yes	Yes
Availability of Technology	C	C	C	C	C
Number of Handling Events	Once	Six	Four	Two	Four
Environmental Impacts	NA	Air, Water	None	None	None
Permittability	NA	Air, Water	Water	Air, Water	Air
Site Safety	No	No	No	No	Air, Odor
Environmental Constraints	NA	None	Tm	Tm, Ms	None
Marketability of Residuals	NA	NA	Yes	Yes	Yes
COST DATA					
Estimated Price Range	$50-$65/ton	$40-$200/ton	$130-$140/ton	$80-$225/ton	$50-$100/ton
Factors Affecting Price:					
Initial Contaminant Concentrati	2	8	1	6	6
Target Contaminant Concentra	2	9	1	5	10
Quantity of Waste		1	1	2	2
Characteristics of Residuals		10	2	9	7
Labor Rates		6	2	10	4
Moisture Content		4	2	1	1
Facility Preparation		5	2	7	8
Waste Handling		2	1	8	5
Characteristics of Material	1	3		4	3
Utility/Fuel Rates		7		11	9

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TABLE 3-24. TECHNOLOGY RATING SUMMARY

COMPANY NAME	TREATMENT TECHNOLOGY	STATE OF DEVELOPMENT	APPLIED TO DREDGED MATERIAL	AVAILABILITY	RATING			COMPOSITE SCORE
					EFFECTIVENESS	IMPLEMENTABILITY	COSTS	
ART International, Inc.	Solvent Extraction	Pilot	No	Proprietary	M=0, O=4	2	3	9
Biosafe	Thermal Destruction	Demonstrated	No	Commercial	M=0, O=4	3	2	9
Carlo Environmental	Thermal Desorption	Demonstrated	Yes	Commercial	M=0, O=4	3	3	10
Commercial Recycling	S/S	Demonstrated	Yes	Commercial	M=3, O=3	4	3	13
ConTeck Environmental	Thermal Desorption	Demonstrated	No	Commercial	M=0, O=4	3	3	10
Dehydro-Tech Corp.	Solvent Extraction	Demonstrated	No	Proprietary	M=0, O=4	3	3	10
Hrubetz Environmental	Thermal Desorption	Demonstrated	No	Commercial	M=0, O=3	3	3	9
LADS System, Inc.	Thermal S/S	Pilot	Yes	Emerging	M=3, O=NA	2	2	7
Laidlaw Waste Systems	Lined Landfill	Demonstrated	Yes	Commercial	M=3, O=3	4	3	13
Maxymillian Technologies	Thermal Destruction	Demonstrated	Yes	Commercial	M=0, O=3	4	2	9
OHM Remediation Services	Bio-treatment	Demonstrated	No	Commercial	M=0, O=3	3	3	9
Separation and Recovery	Thermal Desorption	Demonstrated	No	Commercial	M=0, O=3	3	2	8
SoilTech ATP Systems	Thermal Desorption	Demonstrated	Yes	Commercial	M=0, O=4	4	3	11

TABLE 3-25. PORTS MEETING MINIMUM DEPTH REQUIREMENTS FOR TRANSFER OF BHNIP MATERIAL TO UNLINED MUNICIPAL LANDFILLS

PORT[1]	DEPTH RELATIVE TO MLW	PROXIMAL UNLINED MUNICIPAL LANDFILLS[2]
Gloucester Inner Harbor	varies, > 15± ft.	Gloucester, Rockport, Rowley, Topsfield, Haverhill
Salem Harbor	30± ft.	Topsfield, Middleton, Lowell, Reading, Woburn, Andover
Beverly Harbor	varies, > 19± ft.	Topsfield, Middleton, Lowell, Reading, Woburn, Andover
Lynn Harbor	13 ft. in 1970 from Feb. '78 NOAA chart, No. 13275	Newton, Reading, Lowell, Reading

PORT	DEPTH RELATIVE TO MLW	MUNICIPALITIES
Chelsea Creek	varies, but sufficient	Natick, Needham, Newton, Milton, Millis
East Boston	varies, but sufficient	Natick, Needham, Newton, Milton, Millis
South Boston	varies, but sufficient	Natick, Needham, Newton, Milton, Millis
Weymouth, Fore River	varies, > 22 ft.	Milton, Needham, Cohasset, Newton, Norwood, Sharon, Holbrook, Rockland, Weymouth, Scituate
Plymouth Cordage	11 ft. (1977) at MLW	Middleboro, Duxbury, Marshfield, Bourne, Lakeville, Plymouth, Kingston, Rockland, Scituate
New Bedford/Fairhaven	varies, > 15 ft.	New Bedford, Fairhaven, Dartmouth, Westport, Freetown, Mattapoisett, Lakeville, Middleboro, Raynham, Taunton
Mount Hope Bay	varies, > 15 ft.	Freetown, Lakeville, Attleboro, Taunton, Raynham, New Bedford, Fairhaven, Middleboro

[1] From: Designated Port Areas as defined in the Wetlands Protection Act Regulations (310 CMR 10.26).

[2] From: Central Artery/Third Harbor Tunnel Clay Distribution List, July 5, 1994.

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TABLE 3-26. SCREENING MATRIX FOR DETERMINING THE LEAST ENVIRONMENTALLY DAMAGING PRACTICABLE ALTERNATIVE FOR DISPOSAL OF SILT FROM THE BHNIP.

TYPE	SITE	PERMANENT HABITAT LOSS OR ALTERATION	WATER QUALITY EXCEEDENCES BEYOND DISPOSAL SITE	SOCIOECONOMIC EFFECTS	REASONABLE CAPACITY	BENEFICIAL USE[b]	COST ($/cy)	LEAST ENVIRONMENTALLY DAMAGING ALTERNATIVES
LANDFILL	E. Bridgewater	no	no	displacement of other users	no	minor	$62	*
	Fitchburg/ Westminster	no	no	displacement of other users	no	minor	$108	*
	Plainville/ Laidlaw	no	no	displacement of other users	no	minor	$94	*
LAND-BASED-Inland	Woburn	no	no	traffic	no	cap landfill	$69	
	Wrentham	yes	no	traffic	yes	no	$62	
Coastal	Everett	yes	no	minor	no	no	$76	
	Squantum Point	yes	no	neigborhood, traffic	yes	no	$45-$50	
AQUATIC Shoreline (Partial Fill)	Amstar	altered	mitigated	displacement of MWRA pier	no	contain contaminants	$37	*
	Cabot Paint	altered	mitigated	minor	no	contain contaminants	$278	*
	Little Mystic Channel	altered	mitigated	neighborhood	yes	contain contaminants	$30	*

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TYPE	SITE	PERMANENT HABITAT LOSS OR ALTERATION	WATER QUALITY EXCEEDENCES BEYOND DISPOSAL SITE	SOCIOECONOMIC EFFECTS	REASONABLE CAPACITY	BENEFICIAL USE[b]	COST ($/cy)	LEAST ENVIRONMENTALLY DAMAGING ALTERNATIVES
	Mystic Piers	altered	mitigated	minor	no	contain contaminants	$35	*
	Reserved Channel	altered	mitigated	neighborhood, traffic	yes	resource enhancement; contain contaminants	$85	*
	Revere Sugar	altered	mitigated	minor	no	contain contaminants	$35	*
Subaqueous	Subaqueous B	altered	yes	minor	yes	no	$20	
	Subaqueous E	altered	yes	minor	yes	no	$19	
In-Channel	Chelsea Creek	no	mitigated	minor	yes	no	$37	*
	Inner Confluence	no	mitigated	minor	no	no	$37	*
	Mystic River	no	mitigated	minor	yes	no	$37	*
Borrow pit	Meisburger 2	no	no	displacement of fisheries	yes	minable resource	$31	
	Meisburger 7	no	no	displacement of fisheries	yes	minable resource	$33	
	Spectacle Island CAD	no	mitigated	minor	yes	minor	$21	*
Existing	MBDS	no	no	minor	yes	no	$16	*

TYPE	SITE	PERMANENT HABITAT LOSS OR ALTERATION	WATER QUALITY EXCEEDENCES BEYOND DISPOSAL SITE	SOCIOECONOMIC EFFECTS	REASONABLE CAPACITY	BENEFICIAL USE[b]	COST ($/cy)	LEAST ENVIRONMENTALLY DAMAGING ALTERNATIVES
Disposal Site								
	Boston Light Ship	no	no	displacement of fisheries	yes	no	$27	*
TREATMENT	Various	no	no	minor	yes	potentially	$55-$200	

≥200,000 cy
through site preparation or use of silt, parent material not included since it has universal benefit
cost could be reduced by beneficial use of mined sediments

Chapter Four: Selection Of Preferred Disposal Location

This Chapter provides a detailed environmental analysis of potential disposal sites to determine the least environmentally damaging and practicable alternative for the disposal of silt from the BHNIP.

Under NEPA (40 CFR 1505.2) and MEPA (MGL c.30, s.61-62h and 301 CMR 11.00), the BHNIP must demonstrate that the proposed project avoids or minimizes any adverse impacts to environmental quality. This analysis must consider all applicable local, State and Federal regulations, including Section 404 of the Clean Water Act and the 404(b)(1) Guidelines (40 CFR 230.20-.54), the Massachusetts Wetlands Protection Act (MGL c.131, s.40) and its implementing regulations (310 CMR 10.00), the Massachusetts Waterways Act and its implementing regulations (310 CMR 9.00), and consistency with the Massachusetts Coastal Zone Management Program regulatory and non-regulatory policies, and federal consistency (MGL c.6A, s.2-7; c.21a; c.706; and c.1230) and their implementing regulations (301 CMR 20.00 and 21.00).

The selection process involves comparison of the long-term and short-term impacts that would arise through implementation of each alternative. The "short-list" of land-based and aquatic-based sites, selected as a result of the site screening process described in Chapter 3 (see Table 3-1), is evaluated based on direct and indirect impacts within each alternative. The evaluation of environmental impacts at potential disposal sites includes information developed as a result of comments on the DEIR/S. The information collected since the DEIR/S caused us to reduce the available footprint of the Wrentham site. For example, to avoid impacts to Zone II aquifer protection area. Investigation at the aquatic disposal sites in the fall of 1994 confirmed our understanding of the biological conditions at the aquatic sites as evaluated in the DEIR/S.

In performing the LEDPA, identification of the least environmentally damaging alternative(s) is performed separately from the practicability analysis. These two issues have been separated in response to several comments received during review of the DEIR/S. Environmental impacts now receive more emphasis than practicability, and thus is more in keeping with the intent of the above-stated regulations. Separating the analyses also permits identification of sites that may be more suitable for other disposal projects or for disposal of future maintenance material from the BHNIP.

For example, while a number of the sites discussed in this section would have insufficient capacity to be used as the sole repository of the silt from the BHNIP, they could be of interest for a combination of alternatives, if practicable, or a smaller project in the future. This assessment of environmental effects addresses these sites from the dual perspectives of suitability for the BHNIP and for future maintenance or an unidentified future project. Site capacity is relevant in comparing environmental impacts because the use of several sites requires construction disturbances at each and therefore, have greater cumulative environmental impacts.

The parallel process for identifying the most practicable alternative(s) is based on an assessment of technical requirements and constraints, and a comparison of cost estimates for each site. Selection of the LEDPA results from the weighting of the least environmentally damaging alternatives with the practicability analysis results.

The following section identifies the least environmentally damaging alternative among the short-listed, land-based sites.

4.1 LAND-BASED SITES

Land-based sites are being considered in the context of providing an alternative for placement of approximately 200,000 cy, in the event that there are volume, suitability, permitting or practicability constraints from other alternatives that cannot be resolved. Potential land-based sites include the short-list of coastal sites and inland sites identified on Table 3-1. Consideration of the land-based sites involves two aspects: generic issues which are applicable to all land-based sites; and site-specific issues which are unique to individual sites. The following land-based sites are considered in this discussion:

Lined Landfills

- BFI-East Bridgewater Landfill
- Plainville Sanitary Landfill
- Fitchburg-Westminster Sanitary Landfill

Coastal Sites

- Squantum Point
- Everett

Inland Sites

- Woburn
- Wrentham

Full descriptions of each site are provided in Attachment 1 to this Volume.

4.1.1 Generic Issues

Use of any of the land-based sites for silt disposal will require that the silt be transported by barge to a waterfront dewatering facility, off-loaded onto the facility, dewatered, and loaded onto trucks, rail cars, or barges for transportation to the land-based disposal site for final disposal. With each additional handling and transportation step, the potential for environmental impacts increases. This section will address several of the major issues unique to land-based disposal, specifically dewatering and hauling. Additionally, proposed use of any inland site as a disposal facility (monofill) would trigger a rigorous

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environmental site review under the Massachusetts DEP Solid Waste Siting Suitability regulations.

4.1.1.1 Dewatering

Land-based transport and handling logistics require that the silt material be dewatered prior to hauling to a land-based disposal area. The present water content of the in-situ silts ranges from 33%-74%, with an average water content of 51%. For economical and safe handling, transportation, and disposal, the water content will need to be reduced so that no free water is available.

Several dewatering options are available for dredged materials. These include air drying, mechanical drying, chemical stabilization and mixing with dry material. However, the sheer volume of silt material to be dredged in the BHNIP eliminates most options as environmentally risky, too costly or slow (see Appendix I for a description and assessment of dewatering technologies). Of the available options, the least problematic and most economical methods are mechanical dewatering with belt presses, and air drying. A combination of the two methods may be most feasible.

Belt filter presses have been effectively used on numerous projects of similar magnitude, including dewatering of municipal sludges, industrial processing sludges and harbor silts. Belt filter presses have the distinct advantages of being mobile, requiring relatively little space, being unaffected by precipitation and temperature, and generating few odor problems. A potential limitation to belt filter presses on the BHNIP project is that the silt has a high clay content that may be difficult and slow to process with this method.

A single 2-meter wide belt filter press is truck-mounted and can process approximately 350 cy of silt per day, assuming a 24-hour operation. Six presses would be required to process the silt from a 2,000 cy scow. At this daily rate, dewatering 200,000 cy would be accomplished in approximately 4 months. The silt might need to be mixed with water and a polymer to achieve the desired consistency for spreading on the presses. The leachate from the presses could potentially be recycled into the mixing tank for future processing, thereby reducing the need for water treatment. The recycled leachate would be treated on-site using portable flow-through filters to remove particulates and contaminants prior to discharge into the Harbor, in order to meet water quality criteria.

To air dry the silts, a series of diked and sealed asphalt containment cells would need to be constructed at one or several sites. Air drying estimates indicate that approximately 5 acres are required to handle 15,000 cy of silt, assuming a maximum depth of 2 feet (see Appendix I). An average of 14 days is anticipated, with daily working of the silts, to reduce the water content so that no free water remains. Because this method relies on suitable weather, its use would be limited to the standard construction season (April-November), and would not be efficient during rainy or high humidity periods.

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Most of the water would be removed by evaporation, although some discharge would occur to remove surface water picked up during the dredging process and precipitation from storm events.
Assuming that a maximum of 56,000 cy of silt can be dredged per week, approximately 20 acres would be necessary to air dry one week's worth of silt.
Ideally, four 20-acre sites consisting of four 5-acre cells each, for a total of 80 acres would be needed. This arrangement would provide sufficient space to allow for one site for off-loading silts, a second site in which silts are drying, a third site for removing the dried silt, and a fourth site for emergency storage during wet weather or unexpected delays in transporting off-site. A settling basin would be needed for every 10 acres of cells to collect and treat excess water prior to discharge back into the Harbor. This dewatering arrangement would be necessary to keep pace with dredging and allow 200,000 cy of silt to be dredged, dewatered and hauled to an upland site in 6 to 8 weeks.

Sufficiently large areas of open space on Boston Harbor are very limited.
Reduction of the space available for dewatering would result in lengthening the time needed to complete the upland disposal dredging. For example, dedicating only one dredge to upland silt disposal would cut the acreage needed in half, to 40 acres, but would increase the operational time of the dewatering facility to approximately 12-14 weeks for 200,000 cy. The environmental and practicability impacts relating to each option would need to be weighed in order to determine if a balance between area and schedule could be achieved.

For both dewatering methods, loaded barges would need to be brought by tug to a berthing area near the facility for off-loading. It is important that the dewatering area(s) have the following features in order to allow efficient material offloading, dewatering and offsite transport of dewatered material:

- be located in direct proximity to the Harbor
- have adequate water depth and berthing facilities for loaded barges
- have adequate land area (minimum of 2 acres for belt filter presses and 5 acres for air drying) for barge offloading, construction of a dewatering facility and operation of land based equipment

Odor may be a major issue for dewatering via air drying. Standard odor controls such as daily cover and chemical agents will be unsuitable because they function by interfering with air exchange and evaporation and would, therefore, impede the drying process. Other potential impacts from air drying include water quality impacts from stormwater runoff and removal of the surface water collected during the dredging process, and noise from the equipment operation.

Several representative waterfront areas were identified for potential dewatering sites. These sites are located near the areas requiring dredging.

The approximate capacities of several possible dewatering areas are as follows:

Conley:
25 acres (overall area)
75,000 cubic yards (air drying containment capacity)

Revere Sugar:
13 acres (overall area)
39,000 cubic yards (air drying containment capacity)

Mystic Piers:*
3-8 acres (overall area)
15-24,000 cubic yards (air drying containment capacity)

North Jetty:
15 acres (overall area)
45,000 cubic yards (air drying containment capacity)

*Range includes potential of utilizing adjacent space at Piers 48, 49 and 50.

These sites are representative. Their actual availability depends on lease agreements and other competing uses occupying the sites when they would be needed for dewatering.

4.1.1.2 Hauling

Transport of silt material to the land-based sites from the dewatering facility will require loading the dewatered silts from the containment cell into barges for hauling to Everett and possibly Squantum Point (there is some potential for dewatering directly at Squantum Point; however, barge access will still be required), or into trucks for all other proposed land-based sites. Rail is a possible option, although no active tracks lead to any inland site so that off-loading onto trucks would ultimately be required.

For barges to access either Squantum Point or Everett, dredging would be needed to create a berth for off-loading. An estimated 2,300 cy of shallow subtidal dredging would be necessary at Everett to increase the existing 5-foot depth to the needed depth of 10 feet (see Attachment 1). At Squantum Point, approximately 13,000 cy of subtidal and 6,500 cy of intertidal dredging would be necessary to gain shore access (Attachment 1). Some of the intertidal habitat impacted at Squantum Point may include salt marsh. These dredged sediments would need to be tested to determine what proportion, if any, required special handling.

Trucking considerations include traffic, noise, and roadwear in Boston and on the secondary roads leading from major highways to the Wrentham-495 and the Woburn sites, and landfills. Assuming a 20 cy capacity for the trucks, approximately 10,000 truckloads would be required to transport the material, which translates to a maximum of 238 truck trips per day at the highest dewatering rate.

4.1.1.3 Solid Waste Siting Suitability

Disposal at the inland coastal sites would require that the site meet DEP's solid waste siting criteria (310 CMR 16.40). This permit requirement clearly does not apply to the listed lined landfills. At all upland sites, site suitability for construction of a secure landfill would need to be determined. The siting and permitting of a new solid waste facility in the Commonwealth of Massachusetts is a lengthy process. Initially an application for the suitability of the site must be submitted to the Massachusetts Department of Environmental Protection. The application must include: 1) documentation that the selected site meets the suitability criteria; 2) the engineering design report; 3) the landfill operations and management plans; and 4) certification that the applicant has complied with the Massachusetts Environmental Policy Act. The application is then reviewed by the DEP and public hearings are held to obtain comments from the affected community. The entire process, including site investigations, landfill design and permitting, may require three to five years. The actual time required for the permitting of a facility may vary from this estimate, depending on the complexity of the site conditions and environmental constraints, time required by the DEP to review the documentation and the level of public concern.

Given the difficulty of siting and permitting a disposal site, the land-based options may be more suitable for future maintenance material.

4.1.2 Direct Impacts

This section describes the direct environmental impacts associated with the land-based sites. The impacts include permanent and temporary loss of federal or state resources and the permanent alteration of resources from the existing conditions to altered conditions after construction. The impacts discussed in this section are attributable to the upland inland and coastal sites only; no direct or indirect impacts would occur with use of the lined landfills because the facilities are currently constructed and operating.

4.1.2.1 Permanent Loss

Both inland sites, Woburn and Wrentham, have jurisdictional wetland habitat within their respective footprints. Construction of a disposal facility would permanently fill these resources and eliminate their associated functions (Table 4-1). At Woburn approximately 1 acre of forested wetland would be affected, and avoidance would be very difficult due to the physical configuration of the site. At Wrentham, most of the major wetland areas have been avoided in calculating the usable site acreage. New information provided by the DEP, since the DEIR/S, indicates a 15-acre area containing numerous isolated wooded wetlands. Avoidance of these wetlands reduces the available capacity of the site from the 785,000 cy stated in the DEIR/S to approximately 525,000 cy. No permanent loss of jurisdictional wetlands would occur at Everett or Squantum Point.

At all of the inland and coastal sites, construction of the disposal facility would result in the permanent loss of vegetation and wildlife habitat within the footprint of the facility. Current conditions at three of the sites, Squantum Point, Everett, and Woburn, are moderately to highly disturbed with predominantly bare or artificial substrates and early successional vegetation. At the fourth site, Wrentham, the habitat is predominantly undisturbed forest and shrubland, although sand and gravel operations have left the southern tip of the site highly disturbed. Wildlife habitat values are correspondingly low at Squantum Point, Everett and Woburn, although at Squantum Point, wildlife habitat value is relatively higher in spite of the site's disturbed condition because it provides open land on an urbanized harbor. At Wrentham, wildlife habitat values are considerably higher due to the site's large size and relatively low degree of disturbance.

4.1.2.2 Temporary Loss

Temporary loss is presumed to be a less serious impact than permanent loss because the functions attributed to the lost resource would be regained. In the case of wetland habitat, the Federal "no net loss" policy would be maintained. Temporary losses at the land-based sites would include channel dredging in the shallow subtidal areas of Squantum Point and Everett to allow barge access (Table 4-1). The maximum depth of dredging is anticipated not to exceed 6-8 feet, therefore the benthic community that re-established after dredging should be very similar in composition and structure to the original community. Also, at these two coastal sites, the use of the surrounding mudflats and beaches by shorebirds and waterfowl could be disrupted by on-site activities; however use should resume upon closure of the facility. The common terns observed in courtship on the abandoned pier at Everett will also likely avoid the site during disposal activities, but could return upon closure.

At the inland land-based sites, temporary impacts due to odor and noise may occur along trucking routes that pass sensitive receptors such as residential areas and schools. These impacts would likely be more obvious in the suburban roads of Woburn because at Wrentham, Green Road and Route 1A, are already used by quarry and asphalt trucks. Temporary odor impacts would cease upon completion of the silt disposal. Noise impacts would continue through capping and closure of the facility.

4.1.2.3 Permanent Alteration

At Squantum Point, permanent habitat alteration would occur with channel dredging for barge access in the 0.3-acre intertidal zone where mudflat, and possibly salt marsh, would be converted to subtidal land. This would result in changing the functions and values of the area from intertidal (primarily migratory bird resting and feeding habitat, intertidal productivity, water quality treatment and shoreline stability) to those of subtidal areas (primarily shellfish and finfish feeding and breeding habitats). This alteration could be mitigated at closure by restoring intertidal conditions to the affected areas.

<u>4.1.3 Indirect Impacts</u>

The primary indirect impacts would potentially occur at Wrentham, and include risk to a Zone II aquifer, forest fragmentation, and loss of tax base if a proposed industrial subdivision were precluded. The Zone II aquifer lies under the northernmost portion of the site. Avoiding the aquifer, in combination with avoidance of the wetlands (see Permanent Losses section) further reduces the capacity of the Wrentham site to 451,000 cy. Forest fragmentation would result because most of the portion of the site proposed for the containment facility (excluding the southernmost portion which is disturbed) is currently part of a large block of undeveloped shrub/forested land. Upon site closure, the facility would be capped and could be managed as natural habitat, but because penetrating roots are usually discouraged on permanent caps, it is unlikely that forested habitat would be allowed to develop. Loss of potential tax base to the Town of Wrentham could result if an industrial subdivision currently proposed at the northern end of the parcel were precluded by development of the disposal facility. However, because this portion of the parcel overlies the Zone II aquifer, and would likely be avoided by BHNIP, the two projects could potentially be developed concurrently.

At Squantum Point, indirect impacts would include a potential conflict with a proposed MDC park at the site. Park development plans could be feasible after closure and capping of the disposal facility.

Other indirect impacts that are common to all four land-based sites are noise and odor impacts to sensitive receptors, primarily residences, surrounding the sites. Noise could be partially mitigated by limiting operations to hours of the day that minimize the impact. Potential odor controls include use of chemical agents to mask or seal odors, or the application of a daily cover material. The need for daily cover could substantially reduce the capacity of the facility for silt disposal.

4.1.4 Identification of the Least Environmentally Damaging Land-Based Alternatives

Impacts to the lined landfills and the four upland alternatives evaluated herein are summarized in Table 4-1. The three lined landfills are treated together and obviously have the fewest environmental impacts because the facilities have already been constructed and are equipped to control any potential operational impacts such as odor or noise. Primary differences among the upland sites include impacts to freshwater wetlands (Woburn) and intertidal wetlands (Squantum Point), traffic and neighborhood issues, and impacts to non-wetland habitats. Based on these issues, the sites would be ranked (from least to greatest impact):

- Lined Landfills
- Everett
- Wrentham
- Woburn
- Squantum Point

These sites are subjected to the practicability screening in Section 4.4.

4.2 AQUATIC SITES

The short-list of aquatic sites presented in Chapter 3 includes sites from several

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categories. These sites are shown on Figure 4-1.

Shoreline

- Amstar
- Cabot Paint
- Little Mystic Channel
- Mystic Piers
- Reserved Channel
- Revere Sugar

Subaqueous Depressions

- Subaqueous B
- Subaqueous E

Borrow Pits

- Meisburger 2
- Meisburger 7
- Spectacle Island CAD

In-Channel Sites

- Chelsea Creek
- Inner Confluence
- Mystic River

Existing Disposal Sites

- Boston Lightship

The proposed disposal scenario would be unique to each type of site. Shoreline sites are aquatic areas contiguous to the Boston Harbor shoreline. The existing site boundaries are defined by man-made bulkheads and walls, with one side exposed to the Harbor. There are two fill alternatives proposed for the Amstar, Cabot Paint, Little Mystic Channel, Mystic Piers and Revere Sugar sites. The partial-fill alternative would result in a final elevation, including cap, of mean low water. The fast land alternative would result in filling to the elevation of the adjacent land. For both alternatives, a bulkhead would be constructed to isolate the site from the Harbor during disposal. The bulkhead would remain in place after disposal in the fast land alternative but be cut off at MLW after the cap was secured for the partial-fill alternative.

The alternative fill scenarios identified for the Reserved Channel involve partially filling different areas of the Channel upstream of the Summer Street bridge. Fill could be placed either in the entire area west of Summer Street or in the western end of that area. In either case, the western end would be filled to a final grade of +9 ft. MLW, a suitable elevation for establishing salt marsh vegetation. The eastern portion would be filled to a final elevation of -6 ft. MLW. Both areas would require bulkheading during disposal.

Use of the Outer Harbor Subaqueous sites B and E would rely on existing bathymetric conditions to keep disposed sediments in place. Sediments would be transported by bottom-dumping scow. After disposal of silt is complete, the area would be capped by depositing granular material over the sediments. The final elevation of each site would be no higher than the surrounding conditions.

Construction of any of the borrow pit sites, Meisburger 2, Meisburger 7 or Spectacle Island CAD, would require dredging existing sediments to create a pit in which to bury the silts from the BHNIP. In each case, a portion of the surface material present at the site would be retained to be placed over the BHNIP silts to isolate them from the water column and restore the substrate to preexisting

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conditions. Sediments dredged from the Meisburger sites would likely be suitable for beneficial uses such as beach nourishment or construction aggregate.

In-channel disposal would occur within portions of the footprint of the channels to be dredged under the BHNIP. These areas would be deepened by dredging additional parent material. Because of the character of the subsurface sediments, the additional deepening can be done in confined cells. Individual cells would be filled soon after construction and capped with granular material soon after being filled. The extra parent material that would be dredged would be disposed in the same manner as the parent material originating from the planned dredging project.

Disposal at Boston Lightship (BLS) would require no site preparation. Barges would dump silt at a designated location resulting in a mound. The mound would be capped at the conclusion of the disposal activities.

4.2.1 Direct Impacts

Direct impacts could include the permanent or temporary loss, or permanent alteration, of aquatic habitat in the footprint of the disposal operation. The 404 (b)(1) guidelines direct the project proponent avoid or minimize the loss of aquatic habitat. The Corps and EPA have also established a Memorandum of Agreement stipulating a goal of no net loss of wetland values and functions.

4.2.1.1 Permanent Loss [404 (b)(1) issues]

Of the aquatic disposal alternatives evaluated for the BHNIP, any site where disposal of dredged material would raise the elevation of the site above the high water elevation would result in a permanent loss of aquatic habitat and the associated functions. This has been proposed only for one scenario involving the shoreline sites, i.e. creation of fast land. Because each of these sites abuts a filled shoreline, disposal would eliminate both subtidal and intertidal habitat. The subtidal habitat at these sites is composed primarily of soft, fine-grained sediments, whereas the intertidal habitat consists primarily of vertical bulkheading, composed of wood, steel, concrete, or rock. Selection of one of the shoreline sites for fill to fast land could be contrary to the goal of avoidance of loss of aquatic habitat, particularly if other sites were available and practicable and would not result in permanent loss of aquatic habitat.

Disregarding the issue of site capacity and the ability to meet the disposal needs of the BHNIP, the aquatic sites differ with respect to the level of direct impacts. The first level of comparison is the permanency of the impacts. Filling the aquatic shoreline sites (Amstar, Cabot Paint, Little Mystic Channel, Mystic Piers, or Revere Sugar) to fast land would result in the permanent loss of aquatic habitat (Table 4-2.). Although these areas were found to have relatively low capacity for bottom habitat productivity, and their individual footprints are small, federal regulatory concerns focus on the fact that Boston Harbor has experienced thousands of acres

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of fill over the last two centuries. If this design was selected for disposal of the BHNIP sediments, it would require the filling of all the identified aquatic shoreline sites for a total permanent loss of 30.5 acres of subtidal estuarine habitat. Additional disposal alternatives would also be necessary because those sites could not hold all the project's silts. Individual sites range in size from 2.7 (Mystic Piers) to 15 (Little Mystic Channel) acres (Table 4-2).

4.2.1.2 Temporary Loss

Temporary loss of habitat is presumed to be a less serious impact than permanent loss because it minimizes the impact to aquatic habitat function. Habitat function in the footprint of disposal activities could be temporarily disrupted or lost under several scenarios. This concept assumes that it is possible to restore the affected substrate to (or near) its original character, so that biological activities could be re-established after disposal. This approach is proposed for the borrow pit sites, where material removed to create the pit would be stored adjacent to the pit, until construction of the final cap or closure of the site. This method ensures that both the physical and chemical composition of the surface sediments are restored. Construction of a borrow pit could also cause a temporary impact on an area adjacent to the pit because the cap material would likely be stored on the sea floor rather than on a barge. In the case of the offshore sites, dredging of the pits would be most easily accomplished with a hopper dredge, sidecasting material intended for use as a cap onto the adjacent substrate. Therefore, the adjacent substrate habitat would also be temporarily impacted. Storage of the cap sediments underwater, in the same conditions as the disposal site, could be beneficial to future recruitment of organisms to the cap.

4.2.1.3 Permanent Alteration

In some cases, although there would be no permanent loss of aquatic habitat, use of a site for disposal of dredged materials could alter the substrate in either of two ways, through a change in depth or a change in substrate character. At sites where little or no site preparation (e.g., the subaqueous sites in the Outer Harbor, and the shoreline sites under the partial fill scenario) would be required, disposal would reduce the site depth. The distribution of benthic organisms is not related strictly to depth, but more closely to physical features such as intertidal exposure, substrate texture (grain size) and current or wave regime. However, motile organisms associated with the substrate (e.g., winter flounder) seek out different depth strata over the course of their life cycles or in response to seasonal changes in environmental conditions. For instance, during periods of warm water temperatures, estuarine fish move into deeper areas to find cooler temperatures. This behavior is more prevalent in adult, rather than juvenile, fish.

Change in the physical or chemical character of the substrate is the other alteration that could occur. Sediment grain size distribution can have a significant effect on the distribution of benthic species

(Rhoads & Germano 1982), so a radical deviation from the conditions present at a disposal site could affect recruitment of benthos following capping. Presence of organics or contaminants in sediments could restrict the character of the benthic community to stress-tolerant, opportunistic species. The purpose of the cap at any of the potential aquatic disposal sites, however, would be to isolate these contaminated sediments from the surrounding environment. Any capping material used would need to meet all regulatory standards for unconfined, open water disposal and would, in fact, be of the same or better chemical quality than the present sediments at any disposal site. Therefore, the chemical quality of the sediment at the disposal site would not be compromised when capped.

Sites where capping could alter the physical character of the sediments include the in-channel sites, the Outer Harbor subaqueous sites and the partial-fill shoreline sites. The resulting chemical quality of the cap could be an improvement over existing site conditions at any of the in-harbor sites (e.g., in-channel or shoreline sites), although physical character could be different. Capping the dredged material with substrate similar to the existing substrate (if available) would increase the chance of returning populations to pre-dredge conditions. However, there is good reason to modify the existing substrate if the proposed substrate meets or exceeds the habitat productivity and diversity potential of the areas as they exist at present.

Direct impacts at all the other sites, as well as the partial fill scenario for the shoreline sites, would be temporary (Table 4-2). The sites can be compared on several criteria:

- the size of the impact area;
- physical changes to the site that could affect its functional value;
- the likelihood and rate that the benthic community, as an indicator of the functional value of the habitat, would return to pre-project conditions (a measure of the longevity of the temporary impacts)

A. Size of Impact

The comparison of impact size is appropriate only when placed in the context of whether the site has the capacity to fill the project's disposal needs. Even if all shoreline sites were partially filled for the BHNIP, their combined capacity would fall short of the disposal capacity needed. The total footprint altered would be about 47 acres, comparable to the footprint of the Spectacle Island CAD, which was designed to provide disposal capacity for the full volume of silt to be generated from the BHNIP. The In-channel alternatives (the Inner Confluence in combination with the Mystic and Chelsea Rivers) would be sufficient for all the BHNIP silts. Their combined footprint would be about 116 acres, although at any given time, the disturbed working footprint would be less than about 15 acres (two to six cells). In-channel disposal would occur only in the footprint of the channel deepening. Therefore, the in-channel alternative is the

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only one that will not increase the impact area of the project beyond that of the dredging. Subaqueous B (83 acres) and E (79 acres) would impact similar footprints, but, even combined, would not provide the capacity needed for all the BHNIP. Each of the offshore sites would have sufficient capacity for the BHNIP sediments. Estimated impact footprints at these sites would range from about 86 acres (Meisburger 2) to 121 acres (Meisburger 7) (Table 4-2).

Based on footprint of impact alone, the Spectacle Island CAD would appear to result in substantially lower total impact than any of the other sites, except in-channel disposal. However, the dredging and disposal sequence, as it relates to the portion of the site impacted at any one time, must be considered. Geological conditions at Spectacle Island make it unlikely that this site could be developed in small consecutive cells, whereas the Meisburger and in-channel sites could be. In addition, this assessment must be qualified by evaluating exactly what the impact entails. Specifically, these include whether there are permanent alterations in habitat conditions, and the likelihood that the subtidal community (as an indicator of habitat value) would return to pre-project or improved conditions.

B. Physical Changes

Many of the sites evaluated would require permanent alterations in depth. Under the partial fill scenario, five of the shoreline sites would require filling subtidal areas to intertidal elevations. The sixth shoreline site, Reserved Channel, would be filled in a gradient from shallow subtidal to high intertidal. This addition of atmospheric exposure could have a substantial effect on both the structure and abundance of the benthic community, in the high intertidal zone, although this would not necessarily be a deleterious impact. Intertidal habitat in Boston Harbor, once plentiful, is now primarily restricted to vertical faces of man-made materials. Few soft substrate intertidal flats remain in the Inner Harbor. Such habitats provide refuge and feeding habitat for juvenile finfish, as well as permanent habitat for sessile species such as soft-shell clams. Therefore, the partial fill scenarios could provide a beneficial increase in habitat diversity (particularly for finfish) in Boston Harbor.

Use of the Subaqueous B and E sites would also require raising the elevation of the substrate such that water depths would be shallower than existing conditions. In these cases, this could prove detrimental to finfish. In a shallow water environment, deeper areas are used to avoid temperature extremes. This is particularly true in the summer in Boston Harbor. Therefore, although the benthic impacts would cease after closure of either of these sites, impacts to finfish could be permanent.

Depth changes would also occur at Boston Lightship. In this case, the disposed dredged material and cap would form a mound on the substrate. Because the site is in deep water (150 ft), the height of the mound would be insignificant to surrounding substrate. It is unlikely that the height of the mound would affect finfish utilization of the site.

Substrate character could be permanently altered at some of the sites, including the shoreline sites, the in-channel sites, Subaqueous B, Subaqueous E and Boston Lightship. Closure or isolation of the disposed dredged materials at these sites would require capping with sediments not native to the disposal site. The three borrow pit areas, Spectacle Island CAD, Meisburger 2 and Meisburger 7, would each be capped using surface sediments from the excavated site.

The existing sediments within the shoreline sites are predominantly silty, and evidence suggests that they contain elevated concentrations of various organic and inorganic contaminants. The partial fill scenario would cover these sediments with dredged materials, isolating them from the Boston Harbor ecosystem in permanently. Dredged materials disposed at these sites would have to be confined to prevent their redistribution in the Harbor. A sand or clay cap would be used for this purpose. Sand would be more rapidly colonized by benthic infauna than would clay. Neither sediment would be particularly susceptible to adsorption of chemicals. Demersal finfish, especially winter flounder, would find a sand substrate more attractive than either silt or clay. Sand would also provide a more suitable habitat for *Crangon* (sand shrimp), an important food resource for finfish, that has been reported to occur in the Inner Harbor. These benefits would decline as silts from other sources settled out of the water column in these areas.

Use of a granular cap in the in-channel sites, or the two subaqueous sites, could be beneficial to finfish. Because the in-channel area appears to provide spawning and juvenile nursery habitat for winter flounder, this provision of preferred granular substrate would be especially beneficial. Those areas requiring armoring with rock, because of their vulnerability to vessel traffic, would be of reduced value to juvenile winter flounder but would increase benthic diversity which may be beneficial to other fish. Again, this benefit would diminish as sediments accumulated in the channels.

Capping of the disposal mound at Boston Lightship with sand would provide substrate similar to the natural conditions. A clay cap would be structurally different, and would probably provide a less valuable habitat than currently exists.

C. Subtidal Community Recovery

The likelihood that the structure of the bottom (subtidal benthic) community would re-establish is a function of the pre-project conditions and the types of alterations that would be made at the site. The benthic community at each site was selected as an identifier of site habitat quality because the organisms are sessile (and therefore site-specific) and are an important energy source for higher trophic levels. In general, areas that are in stressed environments prior to use as a disposal site have benthic communities adapted to that level of stress. As in the Inner Harbor, most benthic species in this type of environment are pioneers; they live in the surficial layers of the substrate. They also reproduce frequently (multiple

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generations per year) and prolifically. Larval development may follow two strategies within the same species, ie., direct (avoiding the dispersion of planktonic larval development) or planktonic (allowing initial recruitment to the area). These characteristics allow these species to colonize recently disturbed sediments quickly and to recover from intermittent stresses. All areas examined for use as a disposal site for the BHNIP had some pioneering species in their benthic communities. However, the benthos in the Outer Harbor and the offshore areas had proportionately higher numbers of later successional stage species composed of longer-lived, subsurface dwellers. These later successional communities take longer to develop and require a more stable physical and chemical environment.

The ability of a site to recover its pre-project bottom productivity can, therefore, be related to the proportion of pioneering species comprising the community. Sites in the Inner Harbor are predominantly pioneering communities, therefore recovery would be expected to be the most rapid. Sites in the Outer Harbor exhibited a mixture of pioneering and Stage II benthic species. Therefore, some recovery would be apparent in the short term, but a longer period would be required to complete the recovery. All three offshore sites supported benthic communities that were primarily Stage II species with few pioneering species. These communities would take the longest to recovery.

4.2.1.4 Summary

Based on all aspects of direct impacts, the potential aquatic disposal sites are ranked (from least to greatest impact):

- In-channel
- Shoreline/partial fill
- Spectacle Island CAD, Meisburger 2, Meisburger 7, Boston Lightship
- Subaqueous B, Subaqueous E
- Shoreline/fast-land

The in-channel alternative is ranked as having the least direct impact because this alternative would be confined entirely within the footprint of the navigation improvement dredging. Also, the proposed capping would improve the physio-chemical conditions of the substrate, and biological recovery would be expected to be rapid. While partially filling the shoreline sites would satisfy the last two concerns, their location outside the proposed dredge area would result in an increase in the total impact area for the project.

4.2.2 Indirect Impacts

Indirect impacts would encompass those effects that occurred beyond the boundaries of the disposal site (and mixing zone) as a result of the implementation of a particular disposal scenario. These effects include changes in water quality, or effects on marine biota or habitats.

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4.2.2.1 *Water Quality Effects*

Water quality impacts caused by the disposal of dredged materials were examined in several ways. The mixing zone is of primary regulatory interest under the Clean Water Act and the Water Quality Certification Regulations for both state and federally regulated waters, although it is not defined quantitatively in the regulations. Pollutant-transport and ADDAMS models were used to identify mixing zones for the potential disposal sites. In this analysis, for state-regulated waters, the mixing zone was identified as the area outside of which the chronic water quality standards are met. For sites outside of state-regulated waters, the mixing zone was defined as the site boundary outside of which water quality standards would be met four hours after a disposal event, the typical standard used for open-water disposal sites. For state water quality requirements, the mixing zone analysis focussed on the period immediately following each disposal event. The more typical water quality condition for this project is reflected in a scenario of multiple-day disposal events. Model results indicated that this scenario would cause steady state water quality conditions to be reached after an extended period of repetitive (daily) disposal events. Maximum concentrations based on this scenario were also modelled. Results of these analyses are detailed in Appendix F.

Disposal of silty dredged materials in aquatic systems tends to result in dispersion of about 5% of the sediments away from the point of disposal. Local hydrodynamics, operational schedules, and the volumes of material disposed determine whether repeated disposal events would result in an undesirable concentration of suspended sediments. This effect has been modelled using a pollutant transport model based on the ADDAMS model (STFATES); results are detailed in Appendix F. There is no regulatory criterion for Total Suspended Solids (TSS) against which to compare these results. However, other dredging projects in Boston Harbor have been required, through permit conditions, to prevent TSS from exceeding 50 mg/L (including ambient loads). A criterion of 50 mg/L was used to determine the TSS mixing zone for each potential disposal site for the BHNIP.

Physical handling of dredged materials can cause some chemical changes, particularly dissolution of contaminants bound to sediment particles. This effect is generally quite limited. Elutriate testing provides an indication of this effect. Elutriate tests performed on actual sediment samples from the channels proposed for dredging showed that mercury, copper and PCBs could be released from sediments descending through the water column at the disposal site. Concentrations of metal in addition to naphthalene (a PAH compound that represents PAHs most likely to be in the dissolved, as opposed to particulate, phase), that would result from the proposed disposal event schedule were modelled using the pollutant transport model described for TSS. Resulting concentrations were added to ambient concentrations and then compared to chronic-level water quality criteria (from USEPA 1986). Of these parameters, PCBs exhibited the greatest potential to be released into the water column. Model

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results indicate that the chronic water quality criterion for PCBs (0.03 ppb) would not be exceeded outside the TSS mixing zone at any aquatic site.

A third potential source of short-term water quality impacts is loss of sediments to the water column when the disposed "mass" of dredged materials encounters the substrate. The likelihood of sediment rebound was evaluated using STFATES (Appendix F). This effect could conceivably occur during each disposal event. The primary effect of sediment rebound would be release of additional silt into the water column. Model results indicated that the release of sediments back into the water column would be negligible.

Comparison of water quality effects among sites can be made based on the size of the mixing zone required to meet State standards for Water Quality Certification. The state standards require minimization of the mixing zone around a dredging or disposal operation and the avoidance of impacts to migration routes and other impacts to resources. Mixing zones for each of the potential aquatic disposal sites were identified for total suspended solids (which represents an absolute load to the water body) and PCBs (the parameter whose predicted levels from disposal alone, in addition to ambient levels, are closest to the chronic water quality criterion). For the in-channel locations, the models also included input of these parameters from nearby dredging operations; the only disposal alternative at which this combined effect could happen.

Mixing zone models assumed disposal would take place near high tide to avoid buildup of undesirable constituents (TSS, PCBs). This schedule restriction would be part of the dredge management plan. Because there has been no numerical standard established for total suspended solids, a value of 50 mg/L, based on other recent Harbor dredging projects, has been used in this analysis as the critical limit for the mixing zone. The PCB analysis used the federally-established chronic water quality criterion of 30 ng/L (0.03 ppb).

In each case, the mixing zone needed to meet total suspended solids concentration goals would be larger than for PCBs (Table 4-3). Under worst-case conditions (an anticipated 14-day period of 6,000 to 10,000 cy disposal per day), the area needed for mixing for the in-channel alternative would range from 12.4 (TSS, Mystic River) to 30.0 (TSS, Chelsea River) acres. In each case, the shape of the mixing zone would reflect tidal current characteristics. In general, the shape of the mixing zone would be oriented along the predominant ebb tide direction. Width would be controlled by current velocity. Mixing zones in the Inner Harbor areas would be elongated, while those in the Outer Harbor, reflecting the more open conditions, would be more square. This aspect is important in examining potential impacts in the Inner Harbor. Mixing zones in the Outer Harbor sites (7.7 - 10.4 acres) are similar to the offshore (about 10 acres) sites.

Typically, at open water disposal sites, the boundaries of the mixing zone are defined as the boundaries of the site. In waters

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under federal (Sec. 103) jurisdiction, the acute water quality criteria must be met outside the disposal site (i.e., the mixing zone) within four hours following a disposal event. The ADDAMS model results indicated that this condition could be met at the Meisburger 2 and 7 sites and the Boston Lightship site. The estimated footprints of these sites range from 86 to 121 acres; and the mixing zone would not extent beyond this area.

Modeling of repetitive disposal events (Appendix F) indicated that none of the aquatic disposal sites would experience chronic water quality violations over the duration of the disposal. Disposal activities at the shoreline sites, whether partially or totally filled, would not affect water quality during the construction phase.

The modeling results suggest that there would be spatial (size) differences in the mixing zones at each site, but that shoreline resources should not be exposed to contaminant levels that exceed chronic water quality criteria. It also appears that while some portion of the waterway would be disturbed during the disposal events, blockages of anadromous fish migratory routes would not likely be a problem. Comparing sites, based on the size of the mixing zone, would result in the following ranking (smallest to largest mixing zone):

- Spectacle Island
- Subaqueous E
- Meisburger 2, Meisburger 7
- Boston Lightship, Subaqueous B
- Mystic River
- Inner Confluence
- Chelsea River

4.2.2.2 Site Stability

The use of a site for disposal of dredged materials could have long-term impacts if the prevailing hydrodynamics (especially bottom currents) caused resuspension of the sediments. Normal tidal currents, wind or storm generated waves and vessel activity (propeller wash) can all affect the magnitude of bottom currents. The predominance of each of these factors varies among the sites being evaluated for disposal of dredged materials. Bottom currents in excess of 20 cm/sec (0.7 ft/sec) can resuspend and transport noncohesive silt (Gross, 1977). The cohesiveness of Boston Harbor surface sediments suggests that they would reach the bottom in clumps, and might require a slightly higher bottom current to induce resuspension (in the 30-50-cm/sec or to 1.6- ft/sec range). This effect was examined using the LTFATES model developed by the US Army Corps of Engineers Waterways Experiment Station (see Appendix F for details). Results were used to predict the likelihood of long-term transport of dredged material from the disposal site, and therefore the resulting need for a cap on the site to prevent such transport, and the likelihood that the cap would be successful.

Factors affecting site stability (as presented in Attachment 1 and Appendix F) are summarized in Table 4-4. The seriousness of each source of impact is a function of its frequency and magnitude, the likelihood of catastrophic failure, and the types of mitigative actions during and after construction that would be feasible at each site. Site design is also an important factor in determining site stability. This

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issue was evaluated for construction and post-construction phases for each site.

A. Project construction

During construction, only the shoreline fast-land and partial fill scenarios would be completely protected from potentially erosional forces because the bulkhead would isolate these areas from the Harbor. The sites that would be exposed to erosion from tidal currents would be at the greatest risk because of the frequency (as often as once to twice daily) and breadth of these forces. Propeller wash effects, on the other hand, could occur as frequently as one to several times per day, but in limited areas. Storm events would generally be of lower frequency (variable among sites from once to many times per year in susceptible areas) and therefore could be dealt with on a case-by-case basis. While a cap could be protected with armoring, in the long term it would generally be difficult to protect the site completely during construction.

Subaqueous B would be particularly vulnerable because it could be disturbed by tidal currents, ship passage, and one-year storm events. Both Subaqueous E and Spectacle Island CAD would be exposed to tidal currents and storm and wind generated waves. In fact, Spectacle Island CAD could be affected by storms much more frequently than once per year. Additional studies would be necessary to confirm the severity of this effect and to determine whether engineering solutions would be available. The three offshore sites, Meisburger 2, Meisburger 7 and Boston Lightship, would be susceptible to disturbance by storms (but not to other factors such as propellor wash) during construction. The potential to construct Meisburger 2 or 7 in cells would enhance the ability to implement protective measures such as interim capping to secure the site in response to predicted storm events. This would be less easily accomplished at Boston Lightship because the entire disposal mound would have to be secured, although the greater water depths at BLS indicate that a more severe, and less frequent, storm would be necessary to affect this site. Portions of the in-channel locations could be exposed to vessel-generated currents routinely. This situation could be minimized by construction management such as scheduling the use of the most vulnerable areas during periods of lowest ship traffic (i.e., avoid periods when liquified natural gas (LNG) tankers are expected), implementing navigational restrictions, and providing physical barriers such as silt curtains around the disposal site. Stability of the shoreline sites would not be affected by these factors during construction.

B. Post-Construction Cap Failure

Because of its mound configuration and frequency of potential weather events capable of affecting it, the Boston Lightship would be at a relatively high risk of failure. The higher frequency of weather events that could affect Spectacle Island CAD would place it at a similarly high risk for failure. Although weather disturbances would be less frequent at Subaqueous B and E, the frequency of potential disturbance by tidal currents in addition to the storm currents would increase the risk of site failure. Either site could be armored after closure if post-closure monitoring showed it was warranted.

The integrity of the partial fill shoreline sites would be dependent on being able to maintain sufficient geotechnical strength to prevent slumping after the bulkhead was cut off at MLW. While the slope would not be great at these sites, the disposed dredged materials would have a high water content that would initially be unstable. Stability would improve as the sediments became consolidated, although this could take a period of years. With the exception of the Reserved Channel, each of the shoreline sites is adjacent to a berth or channel and could be exposed to travelling or turning vessels. This would not be a problem for the fast land scenario.

The ability to construct the Meisburger 2 and 7 sites in multiple cells would reduce the risk of catastrophic failure during and after construction. Therefore, these sites are considered to be at lower risk of failure despite the potential for weather-related bottom currents to affect the substrate more than once a year.

Vessel traffic is the only factor that would be likely to disturb the substrate in the in-channel disposal sites. Because areas vulnerable to disturbance by propeller wash can be identified and armored, the in-channel areas face a lower risk of failure than other sites.

C. Summary

The risk of site failure differs among sites and between the construction and post-construction phases. During construction, the sites are ranked (from least to greatest risk):

- Shoreline-Fast Land or Partial Fill
- In-channel
- Meisburger 2, Meisburger 7
- Boston Lightship
- Subaqueous E
- Subaqueous B, Spectacle Island CAD

The shoreline sites would have the lowest risk of site failure during construction because the bulkhead would prevent exposure to erosive currents emanating from any source. In-channel locations were considered to have the next lowest risk because the only potential source of strong bottom currents (vessel traffic) would be limited to identifiable areas. Construction management techniques, including limiting the size of the exposed work face, to limit the period of exposure, can be implemented to minimize impacts.

The potential for post-construction failure (i.e., cap failure and release of disposed silts to the environment) would rank the sites (from least to greatest risk):

- Shoreline-Fast Land
- In-channel
- Meisburger 2, Meisburger 7
- Shoreline-Partial Fill
- Subaqueous E
- Subaqueous B
- Spectacle Island CAD, Boston Lightship

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The shoreline (fast-land) alternatives would experience the lowest risk of post-construction failure beacuse the bulkhead would protect the disposed sediments from the influence of all currents. Because the magnitude of the vessel traffic impacts in the Inner Harbor is more predictable than storm effects in other locations, protective measures are more easily identifiable and implementable for the in-channel locations than other sites; thus is ranked as having the record lowest risk.

4.2.2.3 Downstream Impacts

Use of aquatic disposal sites could impact downstream resources during site preparation, during disposal or after disposal. This analysis addresses the concerns of impacts during active site use and the potential impacts of post-construction cap failure at the site.

A primary mechanism for these impacts is the hydrodynamics of the disposal site. Because tidal currents predominate over other normal currents at all of the potential aquatic disposal sites for the BHNIP, "downstream" includes the areas influenced by either flood or ebb tides in relation to the disposal site. As indicated in the preceding section, hydrodynamics govern whether material (suspended sediments, including bound or dissolved contaminants) could be transported from the disposal site. Modeling done to evaluate impacts to water quality provides insight into the likelihood that biological resources and commercial users of water in the sphere of influence of the disposal site would be affected by use of the site.

Impacts arising during site preparation or disposal would constitute short-term effects. Impacts arising after closure of the disposal site would constitute long-term impacts.

A. TSS Concentrations

Environmental concerns about dredging and aquatic disposal events include the potential for increased total suspended solids (TSS) to interfere with the vital functions of aquatic organisms (e.g., clogging of gills) as well as seasonal movements (e.g., fish migrations). There is also concern that if concentrations of any contaminants released from the sediments exceeded chronic-level water quality criteria, organisms exposed to those waters could experience sublethal or toxic effects. Because they are sessile, benthic organisms would be at a greater immediate risk of this exposure than motile finfish.

The distribution of TSS around the disposal site is a function of both local hydrodynamics and the settling velocity of the suspended particles. Silt settles, in a static environment, at a rate of 0.01 ft/sec (0.3 cm/sec). Review of the STFATES model output can, therefore, provide an estimate of the areas most likely to experience sedimentation of the dredged material escaping the disposal site during descent. Excessive quantities of settling silt could smother sessile organisms such as soft-shell clams and attached (demersal adhesive) eggs of finfish species such as winter flounder. Confined silts would also return those contaminants adsorbed to the sediment particles to the local environment. Depending on the quality of the existing environment, this could increase the potential for contaminant uptake through dermal contact (e.g., winter flounder) or ingestion (by any benthic feeding species) or, alternatively, keep conditions or the level of risk the same if surrounding habitats reflect degraded sediment quality.

Downstream resources of concern can be categorized into two groups: biotic and human use. Based on site-specific investigations (see Attachment I), five biotic resources (anadromous fish, winter flounder, lobster, soft-shell clams and benthos) were identified among the 15 potential aquatic disposal sites. Three human uses (fishing grounds, water intake and swimming areas) were identified. Each potential disposal site was evaluated in terms of whether its use could affect any of these resources either during project construction or as the result of post-construction cap failure (Table 4-5). The silt dispersal from the site during each disposal event (vagrant silt) would be the primary source of these potential impacts.

Anadromous fish passage through the Inner Harbor could be affected by degradation of water quality, in particular increased suspended solids (TSS). Typical disposal operations in the In-channel sites would cause areas of temporarily elevated TSS, but these areas would extend only part way across the entire width of the channel. Therefore, it is unlikely that disposal would interfere with passage of anadromous fish through the Mystic River.

B. Project Construction

With the exception of the shoreline sites, only sediments deposited downstream would be detectable immediately adjacent to any disposal site during construction. Because all disposal at the shoreline sites would be behind bulkheads, shoreline sites would be unlikely to have any definable effect on downstream resources during construction.

The areas affected during each disposal event at all other sites would generally be directly seaward of the barge, assuming that disposal was restricted to periods around high tide to optimize the mixing zone size (see preceding section). The magnitude of dredging in the BHNIP and the design of each disposal site would necessitate frequent repositioning of the barge within the site, thereby reducing the likelihood that any specific downstream area would be subject to repeated sedimentation. Simple geometry dictates that the larger the footprint of the disposal site, the less frequently vagrant silt would settle outside the site boundaries. In the in-channel alternative, the sediments settling downstream of the disposal site would be similar to the existing sediments. Excessive siltation could increase mortality of organisms on the substrate, including winter flounder eggs in an area about 1.1 acres in size adjacent to each disposal cell. Site configuration determines, however, that the area downstream of most disposal cells, except those in the Inner Confluence, would be impacted either by the dredging or disposal aspects of the BHNIP. Therefore, downstream sedimentation would not expand the impact footprint of this alternative by a substantial amount.

Potential disposal sites located in the Outer Harbor or offshore would not be adjacent to areas otherwise impacted by the BHNIP. Therefore, any downstream sedimentation outside the disposal area would expand the impact footprint of the particular disposal alternative. In addition, sediments of the Outer Harbor and offshore sites contain lower levels of contaminants than those dredged from the Inner Harbor. Disposal at any of the Outer Harbor sites would cause sedimentation on *Ampelisca* beds, indirectly affecting winter flounder feeding habitat. The smaller footprint of Spectacle Island CAD would allow a relatively larger proportion of the vagrant silt to settle outside the site boundaries than either Subaqueous B or E. Sedimentation outside the boundaries of the Meisburger 2 or 7 or Boston Lightship sites could affect Stage II benthic communities and the groundfish and lobsters that they support. As with the Outer Harbor sites, the smaller the footprint of the disposal site, the more likely vagrant silt would be to settle outside the boundaries. Therefore, Meisburger 2 would be likely to affect a larger area outside its direct impact footprint than either Meisburger 7 or Boston Lightship.

C. Post-Construction Cap Failure

The preceding section on site stability addressed the factors that could influence cap failure at each disposal site. The severity of cap failure is a function of the likelihood that it could occur and the resources that could be affected if it did occur.

Using these criteria, the shoreline sites and the in-channel sites would have the lowest potential impact from post-construction site failure. Vessel activities would be the most likely cause of loss of site integrity. However, analysis of traffic patterns has been used to identify areas vulnerable to disturbance so that additional protective measures could be implemented (i.e., "armoring" of the substrate with project rock material). While the dispersal of disposed dredged materials from these sites should be avoided, it would not change the character of the downstream areas substantially.

The three potential disposal sites in the Outer Harbor would face a relatively high risk of cap failure after construction. Each, and particularly the Spectacle Island CAD, would be vulnerable to bottom currents generated by high-frequency (one-year or less return period) weather events. In addition, both Subaqueous B and E could be disturbed by normal tidal currents. Dispersal of BHNIP sediments disposed in any of these Outer Harbor sites into other areas of the Outer Harbor could have deleterious impacts on several biological or human use resources by introducing contaminant-bearing sediments into an area of improving environmental quality.

Because of their greater depths, the three offshore sites would have a reduced potential of experiencing cap failure than the Outer Harbor sites, although they could be affected by storm events. Like the Outer Harbor, however, release of BHNIP sediments from these disposal sites would introduce them into an area of

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higher sediment quality. The biological resources that are present at these sites reflect the physical and chemical quality of the sediments, and would, therefore, be more severely affected by contact with contaminated sediments than in the Inner Harbor.

D. Summary

Project construction would have limited impacts on downstream resources. The sites could be ranked into two categories under this effect (from least to greatest effect):

- all Inner Harbor locations
- all Outer Harbor and offshore locations

This ranking reflects the same rationale as the ranking for site stability with the additional factor that biota in the Inner Harbor are already adapted to the quality of the sediments proposed for disposal. Post-construction cap failure, in which project sediments were released into the local environment, could have broader impacts that would be more distinct among sites. This evaluation ranked the sites from least to greatest effect:

- In-channel, Shoreline - Fast-Land, Shoreline - Partial Fill

- Meisburger 2, Meisburger 7, Boston Lightship

- Subaqueous B

- Subaqueous E, Spectacle Island CAD

Again, this ranking reflects the rationale described for site stability and the exisitng character of the biota at the potential disposal sites.

4.2.2.4 Biological Exposure Potential

Exposure of organisms to contaminants, associated with (or dissociated from) the dredged materials disposed at any of the potential disposal sites, could occur through either water column or benthic routes. Exposure could occur within or beyond the disposal site boundaries, depending on site characteristics. Data from elutriate, toxicity and bioaccumulation testing were used in conjunction with pollutant transport modeling to evaluate the relative magnitude of these effects. Application of these results to each site must take into account the quality of the environmental conditions at or adjacent to the disposal site.

A. Water Column Exposure

Water column exposure is a function of areal extent, duration of exposure and contaminant load. A simple approach to evaluating water column exposure is an extension of the pollutant transport models described in the preceding section and applying these results to species of concern for each disposal site. The focus would be primarily on pelagic and suspension-feeding species. Because of the transient behavior of both water column biota and constituents released into the water column during the disposal process, the potential exposure would be limited. Although demersal finfish species and benthic

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surface deposit-feeding species would also be exposed to the water column, direct contact with contaminants in the substrate is likely of greater concern for these species.

Disposal of dredged materials through the water column is not expected to result in violations of chronic water quality criteria outside the mixing zone, regardless of the location of the disposal site. While there are differences in the size of the mixing zone for each site, differences among the sites, in terms of exposure of pelagic organisms to contaminants outside these zones, would not be expected.

B. Substrate Exposure

Exposure of bottom-dwelling (benthic) organisms can be viewed as a simple function of footprint of the disposal site, exposure duration and contaminant load (relative to existing conditions). Although population data are available for benthic communities, use of individual sites by finfish and other motile species is more difficult to quantify because many species exhibit both lifestage, seasonal and small-scale spatial differences in distribution. There are no regulatory criteria currently in place against which to evaluate the sediment concentrations.

The potential for toxicity and bioaccumulation of contaminants caused by exposure to the BHNIP sediments was evaluated for the DEIR/S (Appendix C of DEIR/S). Exposure to both berth and channel sediments resulted in increased mortality of the sensitive test species, *Ampelisca abdita* (amphipod) whereas both *Macoma nasuta* (clam) and *Nereis virens* (polychaete) exhibited no signs of increased mortality. By extension, then, it would be expected that if disposed sediments were left exposed, sensitive species (e.g. *Ampelisca abdita*) would be unable to colonize them, whereas potentially less sensitive (e.g. polychaetes and clams) species might. The COE/EPA tests were run with adult organisms, not larvae or juveniles, which are often more sensitive lifestages. These results are not completely representative of the actual environmental effects of the sediments, as subtidal areas in the Inner Harbor do support a variety of benthic infaunal species, occasionally including sensitive taxa such as *Ampelisca.*

Bioaccumulation was measured in clams and polychaetes. Test results indicated that benthic organisms that colonized exposed sediments dredged from berths would be likely to bioaccumulate metals (lead and mercury) and organic contaminants (PCBs and 12 of 16 priority pollutant PAHs) from the sediments, providing a route for ingestion by demersally-feeding finfish and epibenthic invertebrates. Exposure to channel sediments, however, would likely result in bioaccumulation of cadmium, chromium or lead, but not organics, by deposit feeders.

A similar analysis could be applied to downstream areas that would be expected to experience sedimentation of silts dispersed during the disposal events. The STFATES models were used to predict downstream areas that would experience sedimentation of the vagrant silt (i.e., that

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lost to the water column during a disposal event) and the thickness of the silt layer. Although hydrodynamic conditions could cause this layer to be resuspended and retransported, the areas identified by this analysis would be likely to experience sedimentation repeatedly during the disposal process. Areas predicted to receive a silt layer thicker than 1 cm after a single disposal event were considered to have the potential to expose biota to contaminants if the site initially had lower levels of contaminants than the BHNIP sediments. In sites where the benthic community was primarily surface dwelling, this quantity of siltation could smother the organisms.

The difference in potential biological exposure to contaminated sediments among the sites is a function of the footprint and the length of time the site is uncapped, as well as the sediment and benthic quality of the adjacent areas. Finfish would be less likely to forage in areas of relatively degraded sediment and benthic quality if better resources were typically available (i.e., if conditions caused by disposal contrasted markedly with the normal conditions). Beyond the site (i.e., downstream), potential biological exposure is a function of these factors and the likelihood that vagrant silt would settle.

C. Site Footprint

The potential disposal sites fall into three categories of footprint and exposure period during construction. The shoreline sites would be completely isolated from Boston Harbor during construction, resulting in no exposure to marine organisms. The in-channel and Meisburger sites could be constructed in cells, leaving only a portion of the total footprint exposed at any one time. This construction approach would create frequent disturbance in the cell footprint throughout its period of use, discouraging finfish from entering the area. If finfish were to spend time associated with the disposed silts, this would be more likely to occur at the in-channel locations because of the similarity between the BHNIP sediments and the natural conditions.

Development of the Subaqueous B, Subaqueous E, Spectacle Island and Boston Lightship sites in cells would be more problematic. Therefore, dredged material could be continuously exposed throughout the entire dredging project. The quantity of material to be disposed would require a large footprint at each of these sites. Therefore, although finfish would avoid the area where disposal was actively occurring, they could spend time in areas that had been filled but not yet capped. This likelihood would be offset by the fact that the disposed sediments would be dissimilar to the naturally-occurring sediments at Boston Lightship. Finfish seeking cooler temperatures during summer months could be attracted to the deep pit to be constructed at Spectacle Island. Since surface sediments near Spectacle Island contain quantities of silt, the differences between the BHNIP sediments and natural conditions might not be immediately distinct. Therefore, there is some risk of increased exposure to finfish near Spectacle Island. Finally, unless a the disposal site was decked over immediately, the shoreline/fast-land

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alternatives would resemble ponds along the waterfront. This could attract birds.

D. Downstream Impacts

With the exception of the shoreline sites, where virtually no silt would be lost to the water column during disposal, the aquatic sites would not differ in the total quantity of dredged material lost to the system (about 3-5% of the total released from the barges). The differences among the sites would lie in the dispersal of the vagrant silt. The volume of water (roughly represented by the depth of the site) available to dilute the sediments, and the typical current regime, determine the concentration of suspended materials, and the distance from the site this material is dispersed, before it reaches the substrate. Thus, deeper sites and sites with regularly fast currents would exhibit lower concentrations of suspended materials. These currents would cause sediments to be dispersed farther. Concentrations of sediments on the substrate where they would be deposited at these sites would be lower than at sites from which dispersion was reduced.

The in-channel, Subaqueous B and Subaqueous E sites would each be exposed to regular periods of elevated currents. In-channel sites would be exposed to ship traffic while Subaqueous sites would be exposed to tidal currents. These currents would tend to prevent permanent deposition of vagrant silts. Because of the layout of cells in the three channel areas, most material that dispersed from the actual disposal activities would settle on an area that had recently been dredged or was soon to be dredged. Therefore, there would be little increased downstream impact and little increase in biological exposure potential. Similarly, the dimensions of Subaqueous B and E would allow vagrant silt from a large portion of the disposal events to settle within the site boundaries.

The Meisburger, Spectacle Island and Boston Lightship sites would each have a higher potential for downstream biological exposure because typical currents would be more likely to allow sedimentation to occur, although most vagrant silts would settle within the disposal site footprint. As with the in-channel and subaqueous sites, the extent of downstream sedimentation would be limited by the dimensions of each site. The siltation is unlikely to be thick enough to smother existing benthic organisms. Finfish would not be deterred from foraging in these areas.

E. Summary

The likelihood of biological exposure to contaminated dredged materials in the water column would not differ much among the disposal sites, as indicated by the results of the water quality modeling. There would, however, be differences among the sites in terms of the potential for biological exposure to the substrate, resulting in the following ranking (from least to greatest potential):

- In-Channel, Shoreline-Partial Fill
- Meisburger 2, Meisburger 7, Shoreline/fast-land

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- Spectacle Island CAD
- Subaqueous B, Subaqueous E
- Boston Lightship

Biological exposure potential would be lowest under the in-channel and partial-fill shoreline scenarios because the character of the disposed sediments would be similar to existing conditions at and adjacent to these sites.

4.2.3 Identification of The Least Environmentally Damaging Aquatic Alternatives

Table 4-6 provides a summary of the relative severity of the impacts discussed in the preceding section at the potential disposal sites. The in-channel disposal alternative was consistently ranked among those alternatives having the least impact. The partial-fill shoreline alternative was ranked among the alternatives having the least impact in most instances. Therefore, in-channel disposal or partial filling of shoreline areas would constitute the least environmentally damaging alternatives for aquatic disposal of dredged material unsuitable for disposal at the MBDS.

The In-channel disposal option would offer a distinct advantage over other sites because it would confine the disposal of sediments to areas that would be disturbed by the dredging for the BHNIP. Other advantages include the minimal downstream impacts and potential for biological exposure. These are both due to the similarity of the sediments proposed for disposal to existing conditions within this portion of the Harbor. The two most critical drawbacks to the use of these areas would be the size of the mixing zone and the effects of vessel traffic on site stability. Proper management of the disposal activities would be necessary to minimize these factors.

Because of the proposal to have dredging and disposal, at times taking place simultaneously in two in-channel locations, the mixing zone would be the sum of that in each in-channel location. While this sum would cause the total area needed for mixing to be larger than that needed in the Outer Harbor, it would represent a relatively small portion of each section of the Harbor. Operational controls, such as confining disposal to periods around high tide, would be instituted to minimize the size and character of the mixing zone. This would ensure that the mixing zone did not move upstream or spread across the entire width of the Harbor.

The effects of vessel traffic on site stability in in-channel locations can be controlled by construction and site closure methods. Areas most vulnerable to disturbance by vessel traffic have been identified. Construction of cells in those areas would need to be scheduled to avoid the once to twice monthly passages of LNG tankers because these vessels require the entire channel width for passage. Other vessels can maneuver under more restricted conditions, enabling the use of silt curtains around the disposal site to help confine the descent of disposal material. Capping of these areas could include a layer of rock to armor the sand cap, preventing future erosion of the cap.

Partial filling of the shoreline sites, particularly those located in the Mystic and Chelsea Rivers, would also have relatively few environmental impacts. Drawbacks to use of these sites include the fact that they are located outside the proposed BHNIP dredging footprint, and therefore extend the total project impact area, and site stability at the edge of each site nearest to the Harbor. With the exception of the Reserved Channel site, each of the shoreline sites is located adjacent to either an active channel or an active marine terminal and would, therefore, be subjected to bottom currents associated with vessel maneuvering. Filling these sites would elevate the substrate so that it could be subjected to even higher velocities than occur at the bottom of the channels once the bulkhead was cut back to the top of the fill (MLW). While the portion of each site nearest to the Harbor could be armored with rock, the risk of site failure would be higher than at in-channel sites.

The other sites examined would have greater impacts associated with dredged material disposal, in particular the introduction of a large mass of contaminated sediments to relatively undisturbed (Meisburger sites) or recovering (Outer Harbor sites, Boston Lightship) areas. Each of these sites faces more substantial risks to site stability than the Inner Harbor because sites of the potential severity of weather-generated bottom currents and the greater difficulty securing the sites against these occurrences. Even without such an event, recovery of the aquatic resources at any of these sites would be prolonged.

4.3 PRACTICABILITY ANALYSIS

This section evaluates the practicability of using each of the potential disposal sites shortlisted through the site evaluation process (see Chapter Three) by examining the following issues:

- Availability
- Permitability
- Constructability
- Logistics
- Monitoring
- Conflicts
- Capacity
- Cost
- Future Use

These issues are defined and discussed in the following subsections. These issues are often inextricably linked with one another. However, we have attempted to distinquish sites using these practicability criteria. Information on each site is summarized on Table 4-7.

Practicability is defined by the 404(b)(1) Guidelines as "available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes." Under NEPA these factors may be included in the discussion for determining an agency(s)' environmentally preferable alternative. According to NEPA (40 CFR 1505.2(b)), "an agency may discuss preferences among alternatives based on relevant factors including economic and technical considerations and agency statutory missions."

The follow subsections discuss the short-listed sites in terms of the practicability concerns listed above.

4.3.1 Availability

4.3.1.1 Upland Sites

Availability is defined by ownership and jurisdictional control. It reflects whether a site is privately owned or within the public domain. Further, it considers whether use of each site is regulated primarily by state or federal regulations, or whether the site has special regulatory status. Sites privately or municipally-owned are considered to have low practicability because of the need to purchase the site. Sites within state or municipal jurisdiction are considered to have moderate practicability but may have complex permitting issues. Sites beyond state jurisdiction are considered to have high practicability because of somewhat less complex permitting. Special regulatory status could modify these ratings in either direction, although those sites whose special status reflected important environmental resources (e.g. ACECs) were eliminated earlier in the site selection process.

Of the upland (undeveloped) sites, Woburn and Squantum Point are owned by municipalities, Everett is owned by a public utility, and Wrentham is privately owned. For the lined landfills availability is not an issue since all have indicated a willingness to accept portions of the silt.

4.3.1.2 Aquatic Sites

In Massachusetts, coastal waters out to the three-mile limit are regulated by the Commonwealth. Use of these waters is controlled (through the Wetlands Protection Act, up to 80 feet below MLW) by the state and the municipality abutting them. Boston Lightship (and the Massachusetts Bay Disposal Site for parent material disposal) is the only site that falls strictly under federal jurisdiction. All other aquatic sites are within state waters, requiring review at the municipal, state, and federal level. Several of the shoreline sites (Amstar, Mystic Piers and Revere Sugar) and the in-channel sites (Mystic River, Chelsea River and Inner Confluence) are within the State's Designated Port Area, a status that supports water-dependent use (see Chapter Seven). The remaining aquatic sites are within State waters but have no additional regulatory classification. No distinction is made between the partial-fill and fast-land scenarios for the shoreline sites on this basis. Based on this criterion, the aquatic sites would be ranked for practicability, due to availability, as:

- Boston Lightship
- Amstar, Mystic Piers, Revere Sugar, in-channel (Mystic River, Chelsea River, and Inner Confluence)
- Little Mystic Channel, Reserved Channel, Subaqueous B, Subaqueous E, Spectacle Island, Meisburger 2, and Meisburger 7

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4.3.2 Permitability

4.3.2.1 Upland Sites

This issue evaluates the complexity of the permitting process. It is partially related to the potential for repeated use of a particular site beyond the BHNIP. For inland and coastal sites, permitability issues are mainly tied to the need for the proposed disposal site to undergo review through the state's Solid Waste Siting Review and Designation process. The siting and permitting of a new solid waste facility in the Commonwealth of Massachusetts is a lengthy process. Initially an application for the suitability of the site must be submitted to the Massachusetts Department of Environmental Protection. The application must include: 1) documentation that the selected site meets the suitability criteria; 2) the engineering design report; 3) the landfill operations and management plans; and, 4) certification that the applicant has complied with the Massachusetts Environmental Policy Act. The application is then reviewed by the DEP and public hearings are held to obtain comments from the affected community.

The entire process, including site investigation, landfill design and permitting, may require three to five years. The actual time required for the permitting of a facility may vary from this estimate, depending on the complexity of the site conditions and environmental constraints, time required by the DEP to review the documentation and the level of public concern. Thus the siting process for Solid Waste Facility designation for this project could be a serious limitation for the BHNIP given the proposed 1997 starting date.

Given the difficulty of siting and permitting a disposal site, the land-based options may be more suitable for future maintenance material. The upland sites therefore are considered to be low in practicability for the permitability criterion. Permitability is a relatively minor issue for the three lined landfills sites because the landfills are already permitted to receive special waste. All would need to have the silt characteristics reviewed by the State and municipalities prior to acceptance. Their rankings for upland sites for ther permittability criteria are:

- Lined Landfills
- Remaining Upland Sites

4.3.2.2 Aquatic Sites

For aquatic sites, their use may require further study that would extend the period needed for permitting. This factor would cause a site to have low practicability for the BHNIP (although it could still be practicable for future projects). Another issue would be whether use of a particular site would result in the loss of aquatic habitat. Since this loss would potentially be mitigable, such sites would be considered to have moderate practicability for the BHNIP and future projects. Sites likely to be suitable only for a one-time use, and not resulting in the permanent loss of aquatic habitat (whether or not mitigable), are rated as having higher practicability for the BHNIP.

Three sites, Meisburger 2, Meisburger 7 and Boston Lightship, have capacity well above that needed for the BHNIP and would be likely candidates for repeated use for disposal once approval for this use was given. Therefore, regulatory commenters on the DEIR/S have indicated that it would be necessary to conduct formal site designation investigations prior to granting permits. The formal site designation process for open water disposal sites is a minimum of two years long. Given the importance of these sites (the Meisberger sites, in particular) as commercial fishing habitat, this process could take significantly longer. These factors would place delays on the BHNIP that would jeopardize the necessary federal funding for the project.

The fast-land scenario for the five shoreline sites (Amstar, Cabot Paint, Little Mystic Channel, Mystic Piers and Revere Sugar) would result in the permanent loss of aquatic habitat, thus being a direct conflict with 404(b)(1) criteria and made more problemmatic by the lack of available compensatory resource areas for mitigation in the Harbor area. Permitting the remaining aquatic disposal scenarios is highly practicable.

Review of permitting issues results in the following ranking of aquatic sites (from high to low practicability):

- In-channel (Mystic River, Chelsea River, Inner Confluence)
- Partial-fill shoreline (Amstar, Cabot Paint, Little Mystic Channel, Mystic Piers, Reserved Channel, Revere Sugar), Subaqueous B, Subaqueous E, Spectacle Island CAD
- Fast-land shoreline (Amstar, Cabot Paint, Little Mystic Channel, Mystic Piers, Revere Sugar)
- Meisburger 2, Meisburger 7, Boston Lightship

4.3.3 Constructability/Complexity of Engineering

4.3.3.1 Upland Sites

The degree of complexity required to site, design, build and operate the dewatering facility is high for all of the upland sites. The primary engineering and operating constraint would be the dewatering system, which would need to be constructed on the Boston waterfront and used to treat the silt prior to hauling to any of the upland sites (See Section 4.1.1.1).

The sheer volume of material (200,000 cy proposed for upland disposal) is extreme for most dewatering technologies, with the exception of air drying, which has a large acreage requirement and is seasonally limited. The proposed belt filter presses, which could be used in combination with air drying, is standard technology, but is slow and maintenance intensive.

Additionally, a disposal facility constructed at any upland site would essentially equal a lined landfill with a liner; berms; underdrains; leachate collection system; pre-,mid-, and post-monitoring; capping; and a long-term site closure plan. Site-specific analyses to evaluate risks to the environment would be required, such as assessment of the stability and current contamination levels of the closed, partially capped landfill underlying Woburn, and the limits and hydrologic connections of the Zone II aquifer at Wrentham. For this practicability analysis, it is assumed that all four upland sites have a high degree of complexity, and therefore a low practicability for the Project.

The lined landfills are also rated low in practicability with respect to engineering complexity because of the need to dewater the silts at the Harbor prior to transporting

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to the landfill. However, all other construction and operation concerns are eliminated since the disposal facilities already exist.

4.3.3.2 Aquatic

Constructability or complexity of engineering concerned with the techniques needed to prepare and close sites, are generally rather simple for the aquatic sites. Site preparation could include dredging (in-channel and borrow pit sites); dike construction (subaqueous sites); bulkhead construction (shoreline partial-fill or fast-land scenarios with weir structures to allow drainage); or no site preparation needed at all (Boston Lightship).

All alternatives, except the fastland scenarios, would require capping in a submerged environment. While placing cap material in shallow conditions (e.g., in-channel, shoreline, subaqueous, and Spectacle Island sites) is a proven practice, commenters on the DEIR/S raised concerns about whether this could be successfully demonstrated at deeper sites (Meisburger 2, Meisburger 7, and Boston Lightship).

Compared to upland sites, practicability of site preparation and closure of aquatic sites would be high for shallow sites (i.e. In-channel, Spectacle Island, Subaqueous B and E) and lower for deep sites such as Boston Lightship, Meisburger 2 and 7).

4.3.4 Logistics

4.3.4.1 Upland Sites

Logistical concerns include the number of handlings of the material to be disposed, hauling distances, and rate of disposal as controlled by the slowest factor (e.g., trucking, dewatering, dredging, avoidance of sensitive receptors, etc.). For the upland sites, the material will be handled several times:

- off-loading for dewatering,
- working during the dewatering process,
- loading onto trucks for hauling,
- spreading at the disposal facility

Each handling step involves planning; incurs an increased cost in time and equipment; and represents a potential risk to the environment through accidents.

Hauling distance also affects the practicability of the upland sites. Two coastal sites are in close proximity to the BHNIP via barge. Everett is on the Mystic River, and Squantum Point is in Boston Outer Harbor at the mouth of the Neponset River. In contrast, use of the two inland sites, Woburn and Wrentham, would require truck round-trips of 1 and 2 hours, respectively. Depending on the size of the truck fleet used, the dredging or dewatering rate could be limited by the hauling rate. The size and speed of the truck fleet will be dependent on issues such as restricted operating hours (due to noise or air quality effects) in areas of sensitive receptors, existing traffic volumes, either in Boston or at the receiving town, and cost of operation.

Lined landfills have similar logistical issues as the upland inland sites, having both multiple handling needs and trucking requirements. Round-trip trucking times to the Plainville, Fitchburg/Westiminster, and E. Bridgewater landfills are estimated as 2, 3, and 1 hours, respectively.

The upland sites and lined landfills are rated relatively low in logistical practicability due to the multiple handling required as a result of dewatering and hauling. Woburn and Wrentham are especially problematic because their distances from the Harbor could ultimately slow the BHNIP dredging rate.

4.3.4.2 Aquatic Sites

The logistics of disposal operations at aquatic sites are simpler than with land-based sites because there is no need for dewatering prior to transport to the disposal site. Among the aquatic sites, handling is most complex for the shoreline sites because site configuration requires that silt be offloaded from barges by crane rather than dumped from the bottom of the scow. The sites that could be developed in cells (in-channel and Meisburger sites) or require no preparation (Boston Lightship) would experience the shortest delays before being available for disposal.

The proximity of the in-channel disposal sites to the dredging operation make this alternative the most highly practicable of those examined. On the other hand, the distance of the Boston Lightship and Meisburger sites from the dredging, while not enough to constrain the production rate, complicate their use logistically by necessitating the use of larger barges, traversing longer stretches of commercially used waterways, as well as the potential for more weather-related delays (and risks). Site preparation at sites such as Spectacle Island and Subaqueous B and E would be more extensive, potentially resulting in the need to stockpile silts temporarily. As these sites are located in the Outer Harbor, barges would need to traverse virtually the entire length of the Harbor's waterways.

Therefore, Boston Lightship, Meisburger 2 and 7, Subaqueous B and E and Spectacle Island are considered to be moderately practicable with respect to logistics. In-channel and shoreline sites are rated highly practicable.

4.3.5 Monitoring

4.3.5.1 Upland

Monitoring of the silt disposal process (for both upland and aquatic sites) will be required both during and after disposal to ensure that the silts are adequately contained and are posing no undue risk to the environment. For disposal at the upland sites, monitoring would likely be required at the dewatering facility as well as the disposal facility. For dewatering, monitoring would include Harbor and air quality monitoring and would cease at the end of the dewatering phase. At the disposal facility, monitoring would likely include groundwater and surface water sampling for leachate leakage, air quality, cap and berm stability and leachate characteristics. These monitoring needs are standard in the landfill industry and therefore represent no technological hurdles but are costly. Monitoring at Everett and Woburn may be somewhat complicated by potential contamination from an adjacent 21-E site at Everett and the closed on-site landfill at Woburn.

The lined landfills have monitoring programs currently in place for accepted wastes. Project monitoring needs for these sites would be limited to Harbor and air quality monitoring at the dewatering facility. This monitoring would cease at the end of the dewatering phase of the Project.

The practicability of monitoring at the upland sites is moderate due to the standard, but extensive nature of the monitoring that is likely to be required. At the landfill sites, the monitoring practicability is high because of the limited monitoring needs at the dewatering site.

4.3.5.2. Aquatic Sites

For disposal at aquatic sites, monitoring would likely be required to verify compliance with the projected mixing zone during disposal operations. Post construction monitoring would likely be required to confirm the integrity of the cap or bulkhead and to verify the recovery of biological resources.

The practicability of monitoring at the aquatic sites is moderate at the offshore and Outer Harbor sites because events that could affect the integrity of the cap would be infrequent, although potentially severe in nature. In addition, monitoring would be affected by the more complex structure of the existing biological resources at these sites indicating that the period of recovery would be prolonged. In contrast, the practicability of monitoring sites in the Inner Harbor would be high because the frequency of occurrence of factors that could influence site stability would be high (allowing rapid confirmation of cap integrity), and because existing biological resources are adapted to this stressed environment and would be expected to recover rapidly. Therefore aquatic sites are ranked with respect to monitoring as:

- High practicability - In-channel, shoreline (partial-fill and fastland)
- Moderate practicability - Boston Lightship, Meisburger 2, Meisburger 7, Spectacle Island, Subaqueous B and Subaqueous E

4.3.6 Conflicts with Other Activities

4.3.6.1 Upland

The upland sites are all located on inactive lands. No known projects are proposed at Everett or Woburn. There has been mention of a potential industrial park usage at the Wrentham site. The Town of Woburn has expressed possible interest for assistance by the BHNIP in permanently closing the partially capped landfill currently on the Woburn site. At Squantum Point, the Metropolitan District Commission has plans for a park on a portion of the proposed disposal site. The construction of the disposal facility would require coordination with the MDC to ensure the needs of both projects can be met. It is likely that a park can be accommodated on the site once the disposal facility was closed and capped.

Use of the lined landfills does not interfere with any known project.

There is a high practicability for all lined landfills, Everett, Woburn, and Wrentham; and moderate practicability for Squantum Point because of the proposed MDC park.

4.3.6.2 Aquatic Sites

There are three basic areas of potential conflict between aquatic disposal activities and other site uses: public works projects, fishing activities and navigation. Of these, there is the potential for long-term interference with public works projects at some sites that would require mitigative action. Two sites (Little Mystic Channel and Reserved Channel) have CSOs on site. Either the partial-fill or fastland scenario at the Little Mystic Channel site or the partial-fill scenario at Reserved Channel

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would require rerouting of these CSOs. There is concern that the Spectacle Island site could disturb the integrity of the closure of the Spectacle Island landfill and subsequent park development. Additional site investigations would be necessary to evaluate the likelihood that disposal activities would avoid conflict activities on Spectacle Island.

Water quality modelling (Appendix F; and Section 4.2) indicates that disposal would not affect the proposed artificial reef. The Meisburger sites are proximal to the MWRA sewage outfall currently under construction. There is concern, on MWRA's part, that the proximity of these activities could make interpretation of outfall monitoring results extremely difficult given the coincidence of dredging disposal with the early stages of the new outfall operation. The Meisburger sites would be considered to have low practicability for this criteria.

Interference with fishing activities would cease at the completion of the disposal operations, although recovery of the resource would extend for a longer period. Each of the offshore sites, Meisburger 2, Meisburger 7 and Boston Lightship, were found to support large standing stocks of fishable resources. Meisburger 2 and 7 are both heavily fished for lobster. Lobstering activity is variable in Boston Harbor, but is more focussed in the Outer Harbor. The Chelsea River provides habitat for juvenile winter flounder. Because of the current status of the fisheries resources and the fishing industry in New England, sites that would experience this type of conflict are also considered to have low practicability for the BHNIP unless mitigative actions are readily available.

Disposal activities at sites that are located within designated navigation channels (Mystic River, Chelsea River, Inner Confluence and Subaqueous B) could interfere with navigation during the period while disposal occurred. Interference would cease when the disposal was completed. The degree of interference could be minimized by careful management of disposal activities and administration of navigational restrictions. Navigational conflicts were considered to rank these sites as having moderate practicability.

The remaining sites, Amstar, Cabot Paint, Mystic Piers, Revere Sugar and Subaqueous E would conflict with other uses. Therefore, they are rated as having high practicability for dredged material disposal.

In terms of conflicts with other activities, the potential aquatic disposal sites would be ranked from high to low practicability:

- Amstar, Cabot Paint, Mystic Piers, Revere Sugar, Subaqueous E
- In-channel (Mystic River, Inner Confluence), Subaqueous B
- Little Mystic Channel, Reserved Channel, In-channel (Chelsea River), Spectacle Island, Meisburger 2, Meisburger 7, Boston Lightship

4.3.7 Capacity

Site capacity is an easy factor to quantify. However, direct comparison across sites, especially between upland and aquatic is not simple because many of the sites examined for the BHNIP could provide only a portion of the needed capacity. In the most simple terms, those sites that could provide the capacity needed for the entire volume of silt that would be dredged

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during the BHNIP would have the highest practicability. Those sites that could provide at least 30% (about 400,000 cy) of the needed capacity would have moderate practicability for the BHNIP. Those sites that could provide less than 30% of the needed capacity for the BHNIP would have low practicability. The short-listed sites fit these categories as follows:

- High - In-channel sites combined, Spectacle Island, Meisburger 2, Meisburger 7, Boston Lightship
- Moderate - Wrentham, Little Mystic Channel (fastland), Subaqueous B, Subaqueous E
- Low - Woburn, Squantum Point, Everett, lined landfills, fast-land shoreline sites (Amstar, Cabot Paint, Mystic Piers, Revere Sugar), partial-fill shoreline sites (Amstar,Cabot Paint, Little Mystic Channel, Mystic Piers, Reserved Channel, Revere Sugar)

The DEIR/S identified possible combinations of sites that could provide the required capacity for the BHNIP. These combinations are described in Section 3. Commenters on the DEIR/S favored combination options to achieve the capacity needs including A1 (all landfills); B1 (all aquatic shoreline sites); B5 (various combinations of aquatic sites); and C1-C4 (combinations of upland and aquatic sites).

It was determined in the DEIR/S that the landfills (Option A1) were incapable of accepting the total quantity of silt for disposal. Further investigations for the FEIR/S found that the silt from the BHNIP would require dewatering and may be unsuitable for daily cover and contouring at these landfills. Therefore, the landfill capacity continues to be inadequate for the BHNIP. Additionally, several of the comments received on the DEIR/S indicated a reluctance to see permitted landfills in the state used for large scale dredge material disposal. Smaller scale projects may be more suited to landfill disposal.

In the B1 combinations, it would take a minimum of four shoreline sites to accommodate the entire volume of silt generated by the BHNIP. A possible combination would include filling Little Mystic Channel, Amstar, and Revere Sugar to fastland (totalling 1,285,000 cy) and partially filling (35,000 cy) Mystic Piers. This would result in the loss of habitat at these locations without the benefit of readily available compensatory mitigation.

Option B5 could be developed in many ways. Use of two of the federal channels for disposal could be supplemented with a shoreline site (most likely Little Mystic Channel). Costs for this scenario could be minimized by distributing the disposal in the most cost-effective way. However, this would still be a more expensive alternative than some of the others. Combining two in-channel locations with either a subaqueous site or a borrow pit site would be less expensive than including a shoreline site because of the reduced infrastructure. Subaqueous E could be combined with the fastland scenario at Little Mystic Channel to attain the necessary volume. In this case, there would be some excess capacity. It might be appropriate to leave this at Little Mystic Channel for use in future use. The two subaqueous sites could be combined with a smaller shoreline site such as Mystic Piers (fastland) or Reserved Channel (partial fill). Either of these options would use virtually the full capacity of the three sites. A final combination could include the two subaqueous sites and a portion of one of the borrow pits. In this option, reserving excess capacity at the borrow pit sites could enable their use in the future.

The DEIR/S "C" options include combinations of land-based and aquatic sites. Because of constraints associated with dewatering, it has been assumed that only 200,000 cy could be designated for upland disposal from the BHNIP. Either Squantum Point or Wrentham could provide 200,000 cy or greater capacity.

The small capacity of Everett (37,000 cy) precludes practicable use of this site in the BHNIP. Its prime location may make it suitable for future, smaller projects, however, use of Squantum Point or Woburn in conjunction with a single, moderately sized aquatic site for the remainder of the silts would accommodate the BHNIP. Use of Wrentham for part of the BHNIP silts would leave a portion of that site (approximately 250,000 cy) available for future dredging projects.

Also, capacity alone is not a deciding factor in practicability analysis. As described in previous subsections, these are logistical, engineering, and permittability issues which complicate the capacity discussion.

The capacity of the various sites for projects other than the BHNIP cannot be fully projected here. Generally, it would be expected that a project proponent would attempt to identify a single site that would have sufficient capacity for the dredged material that could not be disposed in a designated disposal area.

4.3.8 Cost

A general comparison of the cost of using individual disposal sites can be made on a unit price (cost per cubic yard) basis. The costs listed on Tables in Chapter Three reflect use of the full capacity of each site except the Meisburger 2 and 7 and the Boston Lightship sites where costs are not linked directly to volume. Based strictly on unit cost, the sites would be ranked from highest to lowest practicability as follows:

- High - Boston Lightship ($16); Subaqueous B, Subaqueous E, Spectacle Island ($20);
- Moderate - In-channel (Mystic River, Chelsea River, Inner Confluence) ($30), Meisburger 2, Meisburger 7, Little Mystic Channel (fastland), Mystic Piers (fastland) ($30-39); Little Mystic Channel (partial-fill), Mystic Piers (partial fill), Amstar (fast-land), Squantum Point ($40-51);
- Low - Amstar (partial fill), Reserved Channel (partial fill), Revere Sugar (fast-land), Cabot Paint (fastland), East Bridgewater, Wrentham, Woburn, Everett ($60-80); Revere Sugar (partial fill), Plainville, Fitchburg/Westminster (>$90); Cabot Paint (partial fill) ($360)

4.3.9 Future Use

This issue is linked to capacity and permitability because it addresses the questions of whether a particular site could experience repeated use and whether the site would be available if it is not used for the BHNIP. Ranking the disposal sites for future use has no direct meaning for this

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current project. This is provided in accodance with the MEPA directive to consider future needs and provide a consideration of options.

4.3.9.1 Upland Sites

All of the upland sites may be more feasible for future use than for the BHNIP, due primarily to the potentially lengthy permitting process required for siting an upland lined disposal facility. The proximity of Everett and Squantum Point to Boston Harbor make these sites especially attractive for dredge disposal. Even other ports may find these more accessible than overland transport. The small size of Everett may preclude its feasibility for anything but a local small project. However costs and other design factors may eliminate upland monofills as reasonable options for smaller dredge projects. Again, dewatering, hauling and other related issues remain.

An advantage offered by upland sites over aquatic sites is the ease of construction of cells for repeated use by several dredge projects. The large size of Wrentham makes it especially attractive as a multiple use site, however costs of dewatering and construction may keep upland sites as impracticable.

4.3.9.2 Aquatic Sites

The in-channel sites are unique in that they would be available only when the channels are dredged, either for improvement or maintenance dredging. These sites would not be available for future dredging projects that are not directly linked to channel dredging. Several options were discussed in Section 4.3.7 that consider using a portion of the available in-channel capacity. If once of these options was identified as the least environmentally damaging practicable alternative (LEDPA), the remaining tributary could be available for future channel maintenance operations.

For the partial-fill shoreline alternatives, two factors combine to make multiple use of these sites impracticable. The construction costs are relatively high and would have to be incurred by the first user. In addition, interim closure of these sites (capping and cutting off of the bulkhead to restore tidal flow) would make reuse of the site logistically difficult.

One BHNIP combination option, involving Little Mystic Channel and Subaqueous E, could yield an excess capacity of about 111,000 cy. Underfilling Little Mystic Channel initially could allow limited future use, probably on a one-time basis. Without considering complex combinations of numerous sites, no other shoreline site would have the potential for repeated use.

The Subaqueous sites (B and E) would be suitable for a one-time use only. The dimensions of the perimeter dike and the cap needed to contain silt at these sites represent a significant portion of the total site footprint. Development in cells would result in further reductions in site capacity. This would preclude multiple uses of these sites.

While the geological conditions at the Spectacle Island CAD site suggest that it could not be developed in cells for the total BHNIP volume, it would likely be possible to construct cells of smaller volume without compromising the site's structural integrity. Thus two options that were described in Section 4.3.7 in which the Spectacle Island (as a representative borrow pit) site was combined either with the two Subaqueous sites or a combination of in-channel sites, could result in excess capacity at Spectacle Island that would be usable in the future.

The Meisburger sites each have the potential to provide capacity far in excess of the BHNIP needs. Because these sites would be developed as relatively shallow borrow pits over large footprints, there is limited concern for structural integrity between cells. If either of these sites was used for the BHNIP, it is highly likely that there would be interest in using them again in the future. The large capacity available would generate interest in repeated use. As stated in Section 4.3.2, however, use of either site would probably require a formal site designation study.

There are no known physical limitations to the capacity of the Boston Lightship site. As with the Meisburger sites, use for the BHNIP would not preclude future use and would likely encourage it, triggering the need for a formal site designation study. Again, even if this site is not used for the BHNIP, there may be further interest in using it for other projects. It would be a candidate for repeated uses.

4.5 IDENTIFICATION OF THE PREFERRED ALTERNATIVE FOR THE BOSTON HARBOR NAVIGATION IMPROVEMENT AND BERTH DREDGING PROJECT (BHNIP)

Selection of the preferred alternative must consider both environmental impacts (as addressed in Sections 4.2 and 4.3) and practicability (as addressed in Section 4.4) of the alternatives under review. Both NEPA and MEPA emphasize the concept of selecting the least environmentally damaging alternative (LEDA) that is practicable for the project proponent to construct. Thus, the sites that were identified as having the lowest levels of environmental impacts for the BHNIP disposal were examined for practicability.

The sites that would incur the lowest level of environmental impacts were identified in Sections 4.2 and 4.3. The LEDA sites are:

A. Land-based:
- lined landfills
- Everett
- Squantum Point
- Woburn
- Wrentham

B. Aquatic:
- Amstar (partial fill)
- Cabot Paint (partial fill)
- Little Mystic Channel (partial fill)
- Mystic Piers (partial fill)
- Reserved Channel (partial fill)
- Revere Sugar (partial fill)
- Mystic River in-channel
- Chelsea River in-channel
- Inner Confluence in-channel

These sites were reviewed in terms of cost and capacity (Table 4-7), as a first step in assessing their practicability. This review concluded that most of the LEDA sites were less desirable for the BHNIP because of high cost or low capacity. The surviving sites are Squantum Point, Little Mystic Channel (partial fill), Mystic River (in-channel), Chelsea River (in-channel) and Inner Confluence (in-channel).

In order to distinguish among these sites, the environmental impacts and practicability issues were reexamined. Squantum Point was eliminated at this stage because of intertidal dredging and

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wildlife habitat impacts (Table 4-2) and its low practicability for availability, permitting, ease of engineering and logistics (Table 4-7). Of the remaining four sites, use of 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 as more substantial environmental impacts. In addition, Little Mystic Channel was lower in practicability for most issues (availability, permittability, ease of engineering, and logistics; Table 4-7) than the in-channel sites.

The preferred alternative for the disposal of silts from the BHNIP is, therefore, in-channel disposal in the Mystic River, Chelsea River and Inner Confluence, within the footprint of the dredging project. Distinct advantages of using this alternative include confining disposal impacts to the areas impacted by dredging activities, anticipated rapid recovery of biological resources to preexisting status, ability to sequester dredged silts near their point of origin, and ability to compartmentalize the disposal operation.

4.6 FUTURE MAINTENANCE

The selection of the disposal site for future maintenance dredging must reexamine the environmental and practicability criteria discussed above. Factors such as sediment characteristics and volume of the dredging project will be critical in determining the suitability of the disposal sites. Sites such as Little Mystic Channel and Squantum Point would receive high priority in this review. Sites that were identified in this review as having lengthy permitting needs, but were otherwise reasonable, would also be reviewed carefully. The disposal site for future maintenance will be determined based on the appropriate environmental regulations and technical evaluations at that time. The New England Division Corps recommends, and will participate with the Commonwealth in, conducting an overall regional dredged material management plan for future maintenance of all of Massachusetts Bay's harbors.

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Boston Harbor Dredging Project EIR/S

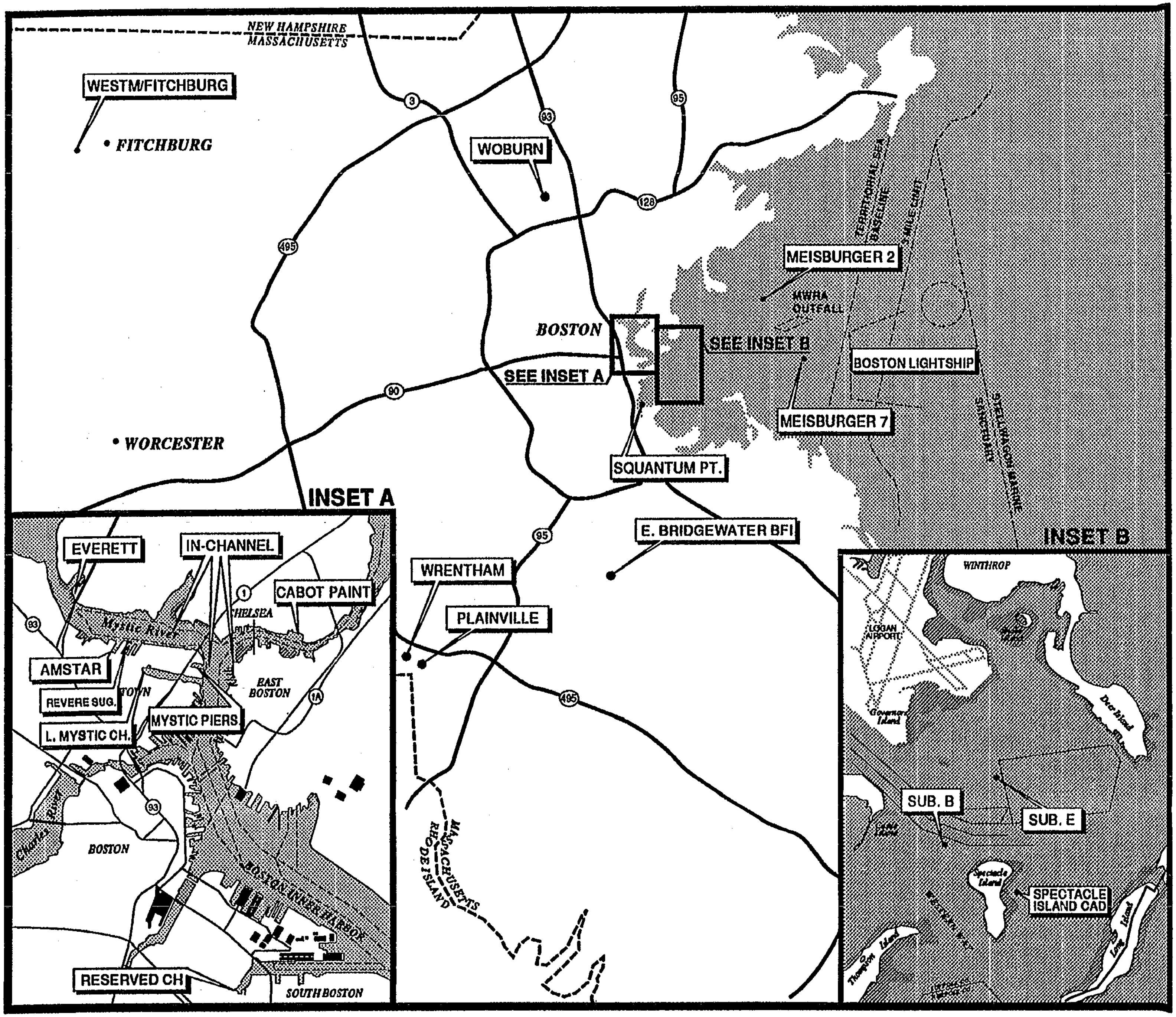

Figure 4-1. Locations of short-listed sites.

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Scale: 0 — 10
Approx. Scale in Miles

Source:
USGS Quadrangles
Revised by NAI to reflect pertinent site conditions.

TABLE 4-1. SUMMARY OF IMPACTS TO BHNIP LAND-BASED ALTERNATIVE DISPOSAL SITES.

Site	Capacity (cy)	Permanent Losses	Temporary Losses	Permanent Alteration	Indirect Impacts
All Lined Landfills	200,000	None	None	None	Odor and noise would be part of landfill operation
Everett	37,000	Highly disturbed vegetation and wildlife habitat.	Channel dredging in subtidal; shorebird use; common tern use.	Same as losses.	Odor and noise.
Wrentham	315,000	Large tract of forest and shrubland.	Odor and noise along trucking route.	Same as losses.	Forest fragmentation; tax loss; odor and noise.
Woburn	158,600	1 acre of forested wetland. Highly disturbed vegetation and wildlife habitat.	Odor and noise along trucking route.	Same as losses.	Odor and noise.
Squantum Point	210,000	Moderately disturbed vegetation and wildlife habitat.	Channel dredging in subtidal; shorebird use.	Channel dredging in intertidal wetlands.	Freshwater runoff; park plans' odor and noise.

TABLE 4-2. COMPARISON OF THE SIZE AND EFFECT OF DIRECT IMPACTS AT BHNIP ALTERNATIVE AQUATIC DISPOSAL SITES.

SITE		DIRECT IMPACT IN EXCESS OF DREDGED AREA	EFFECT OF IMPACT	EXISTING BENTHIC PRODUCTIVITY VALUE	POTENTIAL RECOVERY RATE
SHORELINE:	FILL TO FASTLAND				
	Amstar	3.5 acres	**Permanent loss** of benthic productivity and feeding and refuge habitat.	Low	No Recovery
	Cabot Paint	5.6 acres		Low	No Recovery
	Little Mystic Channel	15.0 acres		Low	No Recovery
	Mystic Piers	2.7 acres		Low	No Recovery
	Revere Sugar	3.7 acres		Low	No Recovery
SHORELINE:	PARTIAL FILL				
	Amstar	3.5 acres	**Temporary loss** of benthic productivity and feeding and refuge habitat. **Positive effects:** existing contaminated sediments capped; increased productivity in Reserved Channel. Permanent alteration in depth (subtidal to intertidal) and substrate.	Low	**Rapid**
	Cabot Paint	5.6 acres		Low	**Rapid**
	Little Mystic Channel	15.0 acres		Low	**Rapid**
	Mystic Piers	2.7 acres		Low	**Rapid**
	Reserved Channel	7.7-16.6 acres		Low	**Rapid**
	Revere Sugar	3.7 acres			**Rapid**
IN-CHANNEL					
	Mystic River	0 acres*	**Temporary loss** of benthic productivity concurrent with and in same footprint as improvement dredging of existing channels.	Low	**Rapid**
	Chelsea River	0 acres*		Low	**Rapid**
	Inner Confluence	0 acres*		Low	**Rapid**
SUBAQUEOUS DEPRESSIONS			**Temporary loss** of benthic productivity and feeding and refuge habitat. Permanent alteration of depth and substrate character. Permanent loss of cooler water refuge habitat.		
	Subaqueous B	83 acres		High	Moderate
	Subaqueous E	79 acres		High	Moderate
BORROW PITS			**Temporary loss** of benthic productivity within pit; undefined area for cap storage would experience temporary loss of benthic productivity; cap may require armoring leading to permanent change in substrate character and benthic community.		
	Spectacle Island	45 acres +		High	Moderate
	Meisburger 2	86 acres +		Moderate-High	Slow
	Meisburger 7	121 acres +		Moderate-High	Slow
DISPOSAL SITES			**Temporary loss** of benthic productivity; permanent change of depth and substrate character.		
	Boston Lightship	100 acres (est.)		Moderate-High	Slow

*The entire disposal footprint (about 56 acres in the Mystic River, 40 acres in the Chelsea River and 21 acres in the Inner Confluence) would be within the boundaries of the channel improvement dredging.

TABLE 4-3. SUMMARY OF SHORT-TERM WATER QUALITY EFFECTS FROM DISPOSAL AT BHNIP ALTERNATIVE DISPOSAL SITES.

SITE	MIXING ZONE		EXCEEDANCES OF CHRONIC WATER QUALITY CRITERIA OR STANDARDS
	Size (acres)[a]	Parameter of Concern	
SHORELINE: FILL TO FASTLAND			
Amstar	N/A		N/A
Cabot Paint	N/A		N/A
Little Mystic Channel	N/A		N/A
Mystic Piers	N/A		N/A
Revere Sugar	N/A		N/A
	N/A		N/A
SHORELINE: PARTIAL FILL			
Amstar	N/A		N/A
Cabot Paint	N/A		N/A
Little Mystic Channel	N/A		N/A
Mystic Piers	N/A		N/A
Reserved Channel	N/A		N/A
Revere Sugar	N/A		N/A
IN-CHANNEL			
Mystic River	12.4	TSS	None anticipated
Chelsea River	30.0	TSS	None anticipated
Inner Confluence	14.7	TSS	None anticipated
SUBAQUEOUS DEPRESSIONS			
Subaqueous B	10.4	TSS	None anticipated
Subaqueous E	8.9	TSS	None anticipated
BORROW PITS			
Spectacle Island	7.7	TSS	None anticipated
Meisburger 2	9.6	TSS	None anticipated
Meisburger 7	9.6	TSS	None anticipated
DISPOSAL SITES			
Boston Lightship	10.0	TSS	None anticipated

[a]In-channel: smaller mixing zone represents typical project disposal schedule; larger mixing zone caused by anticipated period of higher-than-average disposal rate.

TABLE 4-4. POTENTIAL SOURCES OF SITE DESTABILIZATION THAT COULD ARISE DURING AND/OR AFTER CONSTRUCTION AT BHNIP ALTERNATIVE DISPOSAL SITES.

SITE	TIDAL CURRENTS		STORM & WIND EVENTS		VESSEL ACTIVITY		OTHER	
	During	After	During	After	During	After	During	After
SHORELINE: FILL TO FASTLAND								
Amstar								
Cabot Paint								
Little Mystic Channel								
Mystic Piers								
Revere Sugar								
SHORELINE: PARTIAL FILL								
Amstar						X		
Cabot Paint						X		
Little Mystic Channel						X	CSOs	CSOs
Mystic Piers						X		
Reserved Channel							CSOs	CSOs
Revere Sugar						X		
IN-CHANNEL								
Mystic River					X	X		
Chelsea River					X	X		
Inner Confluence					X	X		
SUBAQUEOUS DEPRESSIONS								
Subaqueous B	X	X	X	X	X	X		
Subaqueous E	X	X	X	X				
BORROW PITS								
Spectacle Island	X	X	X	X				
Meisburger 2			X	X				
Meisburger 7			X	X				
DISPOSAL SITES								
Boston Lightship			X	X				

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TABLE 4-5. SUMMARY OF POTENTIAL IMPACTS TO DOWNSTREAM BIOLOGICAL AND HUMAN USE RESOURCES FROM BHNIP DISPOSAL SITE ALTERNATIVES.

SITE	BIOLOGICAL RESOURCES					HUMAN USE RESOURCES		
	Anadromous Fish	Winter Flounder	Lobster	Clams	Benthos	Fishing Grounds	Water Intake	Human Contact
SHORELINE: FILL TO FASTLAND								
Amstar	P	P	P		P		P	
Cabot Paint	P	P	P	P	P		P	
Little Mystic Channel	P	P	P		P		P	
Mystic Piers	P	P	P		P		P	
Revere Sugar	P	P	P		P		P	
SHORELINE: PARTIAL FILL								
Amstar	P	P	P		P		P	
Cabot Paint	P	P	P	P	P		P	
Little Mystic Channel	P	P	P		P		P	
Mystic Piers	P	P	P		P		P	
Reserved Channel		P	P		P			
Revere Sugar	P	P	P		P		P	
IN-CHANNEL								
Mystic River	P	D,P	P		D,P		P	
Chelsea River	P	D,P	P	P	D,P		P	
Inner Confluence	P	D,P	P		D,P		P	
SUBAQUEOUS DEPRESSIONS								
Subaqueous B		D,P	D,P		D,P	D,P		P
Subaqueous E		D,P	D,P	P	D,P	D,P		
BORROW PITS								
Spectacle Island		D,P	D,P	P	D,P	P		P
Meisburger 2		D,P	D,P		D,P	D,P		
Meisburger 7		D,P	D,P		D,P	D,P		
DISPOSAL SITES								
Boston Lightship		D,P	D,P		D,P	D,P		

D = during disposal
P = post-construction cap failure

TABLE 4-6. SUMMARY OF RELATIVE SEVERITY OF IMPACTS[a] OF POTENTIAL BHNIP AQUATIC DISPOSAL ALTERNATIVES.

DIRECT IMPACTS	SITE STABILITY		DOWNSTREAM IMPACTS		BIOLOGICAL EXPOSURE
	CONSTRUCTION	POST-CONSTRUCTION	CONSTRUCTION	POST-CONSTRUCTION	
• **In-channel**	• **Shoreline-partial,** fastland	• **In-channel,** shoreline-fastland	• **In-channel, shoreline-partial,** fastland	• **In-channel, shoreline-partial,** fastland	• **In-channel, shoreline-partial**
• **Shoreline-partial**	• **In-channel**	• Meis 2, Meis 7	• Spec Is, Sub B, Sub E, Meis 2, Meis 7, BLS	• Meis 2, Meis 7, BLS	• Meis 2, Meis 7, shoreline-fastland
• Spec Is, Meis 2, Meis 7, BLS	• Meis 2, Meis 7	• **Shoreline-partial**		• Sub B	
• Sub B, Sub E	• BLS	• Sub E		• Sub E, Spec Is	• Spec Is
• Shoreline-fastland	• Sub E	• Sub B			• Sub B, Sub E
	• Sub B, Spec Is	• Spec Is, BLS			• BLS

[a]Listed in order of least to greatest effect within each impact.

TABLE 4-7. SUMMARY OF FACTORS AFFECTING PRACTICABILITY OF ALTERNATIVE DISPOSAL SITES.

	Availability	Permitting	Ease of Engineering	Logistics	Ease of Monitoring	Compatibility with other Activities	Capacity [cy]	Cost
UPLAND SITES								
Lined Landfills	HIGH[1] [No purchase required]	MODERATE [Dewatering]	LOW [Dewatering facility]	LOW [Dewatering; Multiple handling; hauling distance]	HIGH [Dewatering only]	HIGH [No conflicts]	LOW	LOW
East Bridgewater	"	"	"	[1 hour trucking]	"	"	[200,000 cy]	$62
Plainville	"	"	"	[2 hours trucking]	"	"	[200,000 cy]	$94
Fitchburg/Westminister	"	"	"	[3 hours trucking]	"	"	[200,000 cy]	$108
Coastal Sites	LOW	LOW [Solid Waste siting; dewatering]	LOW [Monofill facility; dewatering facility]	LOW [Haul by barge; dewatering; double handling]	MODERATE [Groundwater; air quality; leachate; dewatering]			
Squantum Point	[Municipally owned]	"	"	"	"	MODERATE [MDC park plans]	MODERATE21 0,000 cy	MODERATE $51
Everett	[Privately owned]	"	"	"	[Complicated by adjacent 21-E]	HIGH [No conflicts]	LOW 37,000 cy	LOW $76
Inland Sites	LOW	LOW [Solid Waste siting; dewatering]	LOW [Dewatering; multiple handling; haul by truck]	LOW [Dewatering; multiple handling; haul by truck]		HIGH (No Conflicts)		LOW
Woburn	[Municipally owned]	"	[Former landfill]	"	[Complicated by existing closed landfill]	"	LOW 158,600 cy	$69
Wrentham	[Privately owned]	"	LOW	"	MODERATE	"	MODERATE 451,200	$62

	Availability	Permitting	Ease of Engineering	Logistics	Ease of Monitoring	Compatibility with other Activities	Capacity [cy]	Cost
AQUATIC								
Shoreline-Fastland	MODERATE	MODERATE [Aquatic habitat loss]	MODERATE [Bulkhead with drainage]	MODERATE [Double handling likely; close to dredge site]	MODERATE [Engineered structure]	HIGH	LOW	LOW
Amstar	Designated Port Area	"	"	"	"	[None]	241,000	$50
Cabot Paint	Designated Port Area	"	"	"	"	"	198,000	$65
Little Mystic Channel	LOW State Waters	"	"	"	"	LOW [CSOs]	MODERATE 840,000	MODERATE $47
Mystic Piers	MODERATE Designated Port Area	"	"	"	"	HIGH [None]	LOW 187,000	$38
Revere Sugar	"	"	"	"	"	"	204,000	LOW $61
Shoreline-Partial Fill								
Amstar	"	HIGH [No designation required]	MODERATE [Bulkhead, cap, partial removal of bulkhead]	MODERATE [Double handling likely; close to dredge site]	MODERATE [Engineered structure, resource recovery rapid]	HIGH	LOW 128,000	LOW $62
Cabot Paint	"	"	"	"	"	"	18,000	$362
Little Mystic Channel	LOW State waters	"	"	"	"	LOW [CSOs]	373,000	MODERATE $47

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	Availability	Permitting	Ease of Engineering	Logistics	Ease of Monitoring	Compatibility with other Activities	Capacity [cy]	Cost
Mystic Piers	MODERATE Designated Port Area	HIGH No designation required	MODERATE	MODERATE	MODERATE	HIGH [None]	98,000	$47
Revere Sugar	MODERATE Designated Port Area	" No designation required	"	"	"	HIGH [None]	86,000	LOW $93
Reserved Channel	LOW State Waters	"	"	"	"	LOW [CSOs]	186,000	$45
In-Channel	MODERATE	HIGH	HIGH	HIGH	MODERATE	MODERATE	HIGH	MODERATE
Mystic River	Federal Channel, DPA	"	Dredge cells, sand cap	Close to dredging, little need to stockpile, single handling	"		742,100	30
Chelsea River	"	"	"	"	"	LOW [Navigating fish]	332,400	30
Inner Confluence	"	"	"	"	"	MODERATE [Navigation]	245,900	30
Subaqueous Depressions	LOW	LOW (Designation required)	HIGH	MODERATE [Delay until dike material available, near dredge site but requires traversing entire ship channel]	MODERATE [Cap integrity, resource recovery [intermediate]	MODERATE	MODERATE	LOW
Subaqueous B	LOW State Waters	"	Dike [clay] + cap				562,000	$20
Subaqueous E	LOW	LOW	HIGH	MODERATE	MODERATE	MODERATE	MODERATE 591,000	LOW $19

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	Availability	Permitting	Ease of Engineering	Logistics	Ease of Monitoring	Compatibility with other Activities	Capacity [cy]	Cost
<u>Borrow Pits</u>	**LOW**	**LOW**	**HIGH**	**MODERATE** [Barging through entire harbor minimal delay for site prep.]	**MODERATE**	**MODERATE** Cap integrity, resource recovery, [intermediate]	**HIGH**	**MODERATE**
Spectacle Island	State Waters	No designation required	Dredge pit, self cap	"		"	1,320,000	$21
Meisburger 2	State Waters	**LOW** Disposal Site Designation Study	**MODERATE** Dredge cells [but marginal at this depth], self cap	"	**LOW** Cap integrity, resource recovery, [prolonged]	"	1,320,000+	$30
Meisburger 7	State Waters	"	"	"	"	"	1,320,000+	$33
<u>Disposal Sites</u>	**HIGH**	**LOW**	**MODERATE**	**MODERATE**	**LOW**	**MODERATE**	**HIGH**	
Boston Lightship	Federal Waters	(Site Designation Needed)	No site preparation; capping unconfirmed	Most distant aquatic site but distance would not constrain production rate			Unlimited [1,320,000+]	**LOW** $16

[1]HIGH = highly practicable for the specific criterion
MODERATE = moderately practicable for the specific criterion
LOW = low practicability for the specific criterion

Chapter Five: Dredging Management Plan

The Dredging Management Plan, described in this section, provides an overview of the dredging operation proposed for the improvement of Boston Harbor and related berth facilities. The key elements of the Plan include: a description of alternative dredging equipment and specific recommendations for this project; dredged material disposal operations; sequencing of the dredging and disposal operations; an overview of potential environmental impacts caused by dredging and proposed techniques and equipment to mitigate these impacts; establishment of dredging performance standards; a description of recommended monitoring plans during dredging and for long term post-construction monitoring; and a discussion of operational contingency plans which would be implemented to assure the safe and successful completion of the project. The Plan focuses upon those details of dredging and related operations as they may impact the environment.

5.1 SELECTION OF DREDGING METHOD

A broad range of dredging equipment types and operating techniques are available for the dredging of sediments and rock from Boston Harbor. Identification of the best dredging method for the BHNIP requires the consideration of the factors described in the following paragraphs.

5.1.1 Project Objectives

Approximately 2.8 million cubic yards of in-situ material will be removed as part of the BHNIP. This total volume includes an estimated 1.1 million cubic yards of contaminated silt, 1.6 million cubic yards of parent material, and 88,000 cubic yards of rock. As described in Chapter 2.0, an additional 1.8 million cy of parent material will be dredged to provide in-channel disposal volume for the silt.

Dredging and rock removal will take place in the existing authorized Federal channel and in berth facilities throughout the harbor area. The proposed project depth is -38 ft. (MLW) in the Chelsea River (known locally as Chelsea Creek) and -40 ft. (MLW) in sections of the Mystic River, Reserved Channel, and a portion of the Main Ship Channel. The maximum depth of dredging will typically be approximately -55 ft (MLW) with some areas reaching -70 ft. (MLW) to prepare the in-channel disposal facilities.

Boston Harbor is subject to a normal tidal range of approximately 9.5-ft. Peak tidal currents range from approximately 0.7-knots through the Inner Confluence to around 0.5-knots in both the Mystic River channel and the Chelsea Creek. The project site is subject to periodic northeast storms and seasonal hurricanes which can generate severe winds, waves, and extreme water surface elevations. Historic storm-related high water events, measured at the Commonwealth Pier, have exceeded 14 ft.

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(MLW). Such storm events will challenge the operating limits of personnel and equipment.

Dredging operations will be performed such that all of the identified contaminated silts are efficiently removed. The equipment used must remove the maximum amount of sediments with minimum cross-contamination of silt and parent material. This will require the use of equipment which can consistently dredge to a depth tolerance of less than 0.5 feet.

Project objectives also require that the selected dredge equipment be capable of accomplishing the task within time allotted while assuring a safe and environmentally responsible project. Dredge and material transport downtime must be minimized to avoid costly additional disposal. Over-dredging (removing more material than required) must be minimized. The dredging and support equipment must be able to efficiently reach each dredging site, for example, upstream of the Chelsea Street Bridge.

5.1.2 Physical Limitations

The project site is an active harbor with extensive commercial vessel traffic. About two deep draft commercial vessels per day transit the channel reaches, both entering and leaving the harbor. These vessels typically maintain minimum bottom clearances when transiting fully loaded. Water velocities, generated by the propeller wash of transiting vessels of this kind, and by that of assisting tugs, can be of sufficient magnitude to resuspend unconsolidated bottom sediments. Studies have shown the resuspended solids may move 300 - 400 feet during these events. It is anticipated that granular material will move much less and that in areas such as the Inner Confluence where there are the highest instances of propeller wash material to be blasted during the project may be used. Dredging operations will be performed at exposed open water locations as well as at confined nearshore berthing facilities. Floating equipment must minimally impact normal commercial vessel operations (being easily moved when required). Dredging equipment will be adequately sized to operate within confined berths.

Channel deepening, particularly within limited reaches of the Mystic River and Chelsea Creek, could affect the stability of bulkheads and pile supported structures situated along the edge of the channel section. Preliminary studies have indicated no stability concerns but the contractor will be directed to make his "box cut" (vertical sides) well inside the channel limits. In addition, the project site is characterized by numerous utility crossings. These facilities will be identified and protected during the dredging and rock removal operations. Dredging operations will be performed in the vicinity of commercial and residential structures. Construction noise is not anticipated to be a major problem.

5.1.3 Turbidity

There are three primary causes for turbidity levels to exceed those of background during the proposed dredging and material disposal operations:

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Turbidity generated by dredging operations is typically due to: (1) the impact and subsequent removal of the bucket from the bottom; (2) spilling fine sediments from the bucket as it is hauled through and out of the water column; and (3) from disposal and capping operations when the dredged materials are dumped from the transport scows into the disposal site.

Turbidity generated by the dredging operation can be minimized by the careful control of the rate of dredging. Minimizing the swing speed and cutter rotation speed of a hydraulic dredge will generate minimum resuspension of bottom materials. Mechanical dredges will be fitted with closed environmental buckets which minimize the quantity of material which is lost from the bucket as it is hauled through the water column. Slower bucket cycling rates will reduce the turbidity generated by mechanical operations. Use of sensors to confirm full bucket closure is also anticipated.

5.1.4 Trash and Debris Management

Dredging operations may encounter a variety of trash and debris especially in the berth areas. Removal of these materials will typically be performed by the on-site dredge. Small items such as rotted timber, miscellaneous wire rope, cables, crushed drums and barrels, and items typically smaller than the excavating bucket will be removed with the bottom sediments and placed into the dump scow. These materials will be placed at the designated disposal sites as part of the normal disposal operation. Larger materials, and any items which may demonstrate a potential health or safety issue, will be specially handled. Large timber piles, vessel hulks, discarded vehicles, unidentified drums, and similar materials will be segregated from the bottom sediments for eventual disposal at upland sites.

Floating debris, resulting from the dredging or debris removal operations, will be skimmed from the water surface and placed into containers on the dredge or support barge. The dredging contractor will be required to develop and administer a Corps approved *Debris Management Plan*. This plan will require that the designated landfill facility be approved and that all load manifests be submitted to the Corps Contracting Officer. Contingency plans will be developed for managing any excavated containers with unknown contents or identified hazardous materials.

5.1.5 Compatibility with Disposal

Contaminated silts, dredged from the project areas, will be placed at designated in-channel facilities. Suitable granular parent material if available or imported sand material will be used for in-channel capping of the silts. Parent material not suitable for capping will be disposed of at Massachusetts Bay Disposal Site (MBDS) and/or transported to marine facilities for off-loading by others to stockpiles for use such as daily cover for landfills, construction fill, or other beneficial uses. Presently, there has been no indication of possible quantities to be used at landfills. Excavated rock will be processed and used as a thin armoring layer (6 - 12") over the in-channel disposal facility sand cap where

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required due to high bottom velocities generated by propeller wash. Any surplus unprocessed rock will be transported to MBDS and/or to marine facilities for stockpiling and additional beneficial use. The transport distances for the parent material and rock will vary between several hundred yards to about 30 miles, depending upon the location of the disposal or off-loading sites.

Mechanical dredging will remove the bottom sediments with minimal change to the material water content. Transport of the mechanically dredged materials by bottom dump scows, and possibly barges for rock, will minimize the volume of water and material to be transported. Hydraulic dredging operations which would require the management and possible treatment of large volumes of water which would be transported through floating pipelines with the dredged materials. Rock would not typically be transported by hydraulic pipelines. Scow transport of the dredged material can accommodate the varying haul distances which are anticipated for the project.

5.1.6 Dredge Types

The proposed dredging will be performed only by proven equipment, utilizing demonstrated techniques. Three basic types of dredges are readily available. The following paragraphs briefly describe each.

5.1.6.1 Mechanical Dredge

Mechanical dredging uses equipment such as clamshell dredges, dipper dredges, draglines, grab buckets, as well as barge mounted excavators for the removal of bottom sediments and other materials. The dredged material removed by mechanical methods is typically high in solids content. Removal of the mechanically dredged material from the dredge site requires placement of the material in scows or on barges and transportation to the disposal area. The dredged material must be dumped, slurried, or mechanically re-handled for placement into the disposal facility. The mechanical dredge can leave an irregular bottom and typically generates relatively high levels of turbidity throughout the water column unless special closed "environmental" buckets are used and/or silt barriers are installed.

Mechanical dredges are rugged and highly reliable and capable of removing a broad range of materials, including unconsolidated silts, consolidated clays, sand, gravel, trash, and debris. Such equipment is able to operate in the open channel as well as within confined berth spaces. Barge or scow transport of the dredged material is efficient over long haul distances. Mechanical dredging productivity is generally low, when compared to hydraulic dredging operations, due to the depth of excavation and to scow loading operations. Such operations are subject to spillage and splashing, which allows sediments to resuspend in the water. Recent innovations in dredge bucket design have improved the ability to minimize turbidity caused by mechanical dredging operations.

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5.1.6.2 Hydraulic Dredge

Hydraulic dredges operate using a solids handling centrifugal pump to transport dredged sediments through a pipeline. The dredged materials are hydraulically transported as a slurry from the dredge to a disposal site. The slurry can also be placed in barges for removal to the disposal site. The simplest form of hydraulic dredge, the plain suction dredge, removes unconsolidated bottom sediments through a tube which extends from the suction intake of a barge mounted pump to the channel bottom. The dredged slurry is pumped via pipeline to a stockpile or disposal site. The most significant improvement to the plain suction dredge is the addition of a mechanical cutterhead on the intake side of the suction tube. On the cutter-suction dredge, the suction head is fitted with a rotating open basket which includes blades or cutting teeth to remove the bottom materials and facilitate intake into the suction tube. As the cutter rotates and mechanically removes sediments from the bottom, a high velocity water flow captures the sediments and carries them as a slurry into the dredge suction. The cutter-suction dredge is versatile and highly efficient, and is available in a broad range of sizes to meet the demands of various size projects.

The hydraulic dredge is typically moved into position by a tug or push boat and stabilized by a spud system. The dredge typically uses three spuds or legs which pass through the deck barge and can be raised and lowered to the channel bottom to firmly hold the horizontal position of the dredge. The dredging operation consists of a lateral swing, controlled by anchor cables, of the cutterhead as the dredge barge pivots on a single spud. As the cutterhead swings from side to side, bottom material is excavated and pumped by the dredge. The dredge advances through the dredging reach by lowering a second stern spud following completion of a lateral swing. The first spud is raised, and the dredge is pivoted on the lowered spud in a walking fashion.

Bottom materials, excavated by the cutterhead and entrained by the suction intake, are pumped through a hydraulic pipeline from the dredge to a disposal site. Hydraulic dredges are able to excavate a broad range of materials. Turbidity, generated by the cutterhead, is typically limited to the immediate vicinity of the bottom intake. Turbidity is managed by controlling the cutterhead rotation speed, the swing speed of the dredge, and by implementing operational controls. Hydraulic dredges require the use of a floating or partially submerged pipeline which can obstruct navigation and restrict channel use. Hydraulic pipelines typically require in-line booster pumps to extend pumping distances and are thus restricted by practical and economic constraints. Hydraulic pipeline transport of dredged materials requires the use and entrainment of large volumes of water, typically between 3 and 5 times the in-situ dredging volume. Management of this water typically requires extensive facilities for processing when dealing with contaminated sediments.

5.1.6.3 Hopper Dredge

Hopper dredges are self propelled floating ships which include an integral suction pipe or several suction pipes which are dragged along the channel bottom. The bottom materials are drawn through a suction head on the drag arms and passed through the suction pipe and centrifugal pump and deposited, as a slurry, in a large onboard hopper. After loading, the hopper dredge can sail to an offshore or other designated dump site and open bottom doors and discharge the dredged materials. Some hopper dredges have the capacity to off-load the dredged materials by pumping. Hopper dredges are able to operate in sea conditions which would severely restrict the safe operation of other types of dredges. In addition, hopper dredges present a minimum interference to other vessel operations when working in busy channels and are able to efficiently transport dredged materials over short haul distances. However, disposal of the dredged materials requires that the dredging process be temporarily suspended as the dredge travels to the disposal site.

Hopper dredges are typically more effective when dredging in deep channel projects and are not effective in restricted areas such as berths and docking facilities. Hopper dredges have high production characteristics when dredging loose alluvial soils and unconsolidated sands, but are severely restricted by stiff clays and similar bottom materials. Very fine silts are easily dredged by hopper vessels, but such materials do not readily settle in the onboard hoppers. This requires the dredge to carry only partial loads, with relatively high water content, to the disposal site.

5.1.7 Rock Excavation Equipment

The BHNIP will include the removal of about 88,000 cubic yards of rock from various locations throughout the project. Specialized equipment, in addition to that required for the dredging activities, will be required for rock removal. Removal of unweathered rock from those areas which require increased depths will require pre-treatment prior to removal. This will include drilling and blasting of the rock formations. After removal of the silt and parent material overburden by dredging, the rock will be drilled. Removal of the overburden will allow the blasted rock to expand and fracture. This will make excavation more efficient.

Drilling is typically performed by a series of barge mounted drilling rigs, which will bore holes of pre-determined diameter and depth and in a specific pattern in the rock formation. The drilling barge is moved by an assisting tug or push boat and held in position by an anchoring system. An ancillary barge will likely be used to carry and store explosive materials. The drilled holes will be packed with precise quantities of explosive, which will be detonated in order to fracture the rock and facilitate removal.

The fractured rock, broken into manageable size pieces by the blast, will be removed by traditional mechanical dredge equipment using special rock handling buckets. The dredged rock will be handled in the following three ways: (1)

loaded into scows or on to barges for transport to either MBDS, or; (2) used as armoring layer over the cap for in channel disposal, or; (3) transported to marine facilities for off-loading to an upland site if the contractor presents a plan to the Corps for approval of the upland site.

5.1.8 Recommended Dredging Equipment and Performance Criteria

The selection of dredging equipment required factoring in all of the above considerations to be certain equipment will be capable of performing as required. In addition, the dredging operation will be continuously monitored to assure that specific minimum performance criteria are met which also affect the selection of dredging equipment. Those criteria will include, but not necessarily be limited to:

- Verification of dredging depth by periodic digital hydrographic soundings performed in accordance with Corps Class 1 standards, requiring accuracy to 0.5-ft.
- Verification of dredging location by periodic surveys performed in accordance with Corps Class 1 standards, which will require horizontal accuracy to within 3.0-m.

It will be the responsibility of the dredging contractor to assure that these criteria are satisfied. Independent verification of compliance with the critical operating criteria by the Corps Contracting Officer will assure that the project will proceed in a responsible manner. Results of these compliance reports will be made available to designated third parties, as appropriate.

5.1.8.1 Recommended Equipment

Dredging will be performed throughout the BHNIP site by barge mounted mechanical equipment. This equipment will provide continuous and reliable service for the entire duration of the project. The mechanical dredge can be fit with different types of buckets to optimize dredge production in the various materials which will be encountered. This dredge plant will be capable of operating in both the open channel sites as well as within the restricted berth areas. Dump scows will be used for hauling and placement of the dredged materials. Scows will also be used for temporary storage of silts during the initial phase of construction, while in-channel disposal facilities are under construction.

Hydraulic or hopper dredging operations are not recommended for the BHNIP for a number of reasons. The hydraulic dredge was not the preferred alternative because it would require a long pipeline system which would be a potential obstruction to navigation. There is no readily available area for construction of a facility to dewater the silt material and manage the high volumes of entrained water. Hopper dredging operations are not recommended because of the restricted operating areas and the anticipated difficulty of dredging the consolidated parent material. However, the Corps will entertain a contractor's suggestions for limited use of either hydraulic or hopper dredging equipment particularly in regard to in-

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channel disposal where water entrainment would not be as great a concern.

Optimum production of the recommended mechanical dredge will require the use of as large a bucket as possible. Bucket size and type depend upon the available power on the dredge and the type of material to be excavated. Silts will be dredged using a sealed "environmental" bucket with a capacity of 15 - 22 cubic yards. The dredge crane will require between 1,500 and 2,000 horsepower. The "environmental" bucket has been successfully used to minimize turbidity in the immediate vicinity of dredge sites. The bucket is specifically designed to reduce sediment loss during closure, and rubber seals minimize the loss of fines as the bucket is drawn up through the water column. Parent material will be dredged using a heavier standard open bucket. The increased weight and digging teeth of a standard bucket will efficiently excavate these non-contaminated consolidated sediments with minimal loss of material through the water column.

Scows and barges will vary in size depending upon availability and location of the dredging operation. Dredged material scows typically range in size from 500 cy to 4,000 cy. It is anticipated that smaller scows will be used in the confined reaches of the project such as the berth areas. Larger scows will be used in the open channel reaches. The scows will be moved from the dredge sites to the disposal sites by tugs. Small harbor tugs, with on-board power of around 1,500 hp, would be used to transport the loaded scows to disposal sites within the channel area. Loaded scows, which transit exposed areas, will require the assistance of larger 3,000 hp ocean-going tugs.

The project volume is sufficiently large and the required work areas are so broadly spread out, that it is expected that the dredging Contractor will employ two (2) dredges. During the period when dredging is to take place in the Mystic River both dredges could work in different areas of the river and not interfere with each other. At other times, one dredge would work in the Reserved Channel and one dredge would work in Chelsea Creek.

Additional equipment which might typically be on site will include a fuel barge, a maintenance barge, and a small work tug to assist with moving the dredge and scows. Rock excavation will be initiated once the silt and parent material is removed and the rock is exposed. Special equipment associated with these operations is described in Section 5.2.4.

5.1.8.2 Operational Controls

The dredging operations, including the required drilling and blasting, can be managed sufficiently to minimize the associated environmental impacts. The principal objective of defining and implementing operational controls on the construction activities is to minimize sediment resuspension throughout the dredging process while maximizing operational efficiency. The drilling and blasting operations present an additional control challenge. Pressure wave propagation resulting from blasting can injure and kill fish. Specific blast control techniques must be incorporated into the dredging program. The specific control methods which are employed will be dependent upon the dredging techniques which are implemented. Control techniques, demonstrated on other sensitive dredging operations, may include the following:

- Restricting the bucket drop velocity and haul speed during mechanical dredging.

- Employ a sealed "environmental" bucket as described in previous sections.

- Employ fish behavioral and control devices to reduce exposure to blasting areas.

- Contractually require that the dredging, disposal, and blasting operations meet specific minimum environmental performance standards and environmental windows.

- Include, as part of the contract documents, the requirement for submittal and implementation of project specific: *Accident Prevention and Site Emergency Plan; Environmental Protection and Turbidity Control Plan; Quality Control Plan;* and *Diving Plan.*

- Require the dredge operator(s) to meet specific minimum competency and experience requirements.

- Notify lobster fishing interests of dredge movements.

*5.1.8.3 Contract and Specification Iss*ues

Contract documents are used to clearly and equitably define the expectations and requirements of both the Corps' Contracting Officer and the Contractor for the successful completion of any construction project. A similar effort is expected between private berth owners and their contractors. The BHNIP contract documents will define the quantities, locations, and types of materials to be dredged. The required location and elevations of the dredged material, after it is placed at the in-channel disposal facilities, will be clearly defined. Proper location, materials, and acceptable tolerances for the disposal facility capping system will be clearly defined in the drawings and specifications for this project.

The project will be executed by the dredging contractor under the terms of a performance based contract. This means that the operation must satisfy specific performance standards during all operations. Dredging must be performed to the lines and grades defined on the design drawings and must be performed in such a manner as to control turbidity levels. If these criteria or standards are not achieved, the Contracting Officer will be obligated by contract to require the Contractor to alter the method of operation or cease operations until the required standards are met. The contract documents will clearly identify the procedures to be implemented by the

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Contracting Officer in the event that the performance criteria are not met.

The Contracting Officer has the responsibility to enforce all terms of the contract and has the sole authority to direct the Contractor to alter or cease operations. It is anticipated that the Contracting Officer would secure the services of a qualified subcontractor to monitor the key performance criteria. It is likely that the dredging Contractor would simultaneously monitor those criteria to optimizing the operation and to demonstrate project quality assurance. Daily performance reports from the monitoring subcontractor will keep the Contracting Officer apprised of the operation performance. These reports would be available to interested parties.

5.2 DREDGING OPERATIONS

Orchestration of a large dredging project such as the BHNIP will require careful planning by a team made up of the US Army Corps of Engineers, Massport, State and Federal regulatory agencies, the dredging Contractor and critical Sub-Contractors, and public and commercial interests in and around Boston Harbor. The specific operations to be performed as part of the BHNIP are diverse, but all are directed at completing the project in an efficient and responsible manner. The following sections describe the specific operations.

5.2.1 Project Mobilization

Prior to the initiation of actual dredging, a number of preparatory tasks must be completed. The completion of these mobilization tasks will set the foundation for the efficient execution of the contract work.

5.2.1.1 Upland Support Requirements

Dredging and rock excavation operations will require an upland support area with direct access to the Harbor. It is anticipated that such a support facility can be provided at a Massport facility. It is possible that such sites could be used to support simultaneous activities in different parts of the Harbor. The upland support facility must provide sufficient vehicle parking for all of the project personnel. Temporary project trailers, including office facilities and enclosed material storage facilities will be placed at this site. Marine support equipment, such as personnel transports, survey vessels, tugs, and other craft will berth at this location. Repairs to both floating and support equipment will be performed at this staging area. These sites could also be used for temporary sediment dewatering facilities in the event that volume restrictions limit the quantity of material that can be placed at the in-channel disposal sites. However, neither of the dewatering sites would be large enough to handle the dewatering of all silt materials. Experience with dewatering of dredged material at Moran Terminal suggested use of thin lifts for air drying which would require acreages up to 80 acres.

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5.2.1.2 Navigation and Commercial Traffic

Scows of various sizes will be used to transport the dredged materials from the dredging sites to the disposal facilities. Silts will be disposed at in-channel locations throughout the Inner Confluence, Mystic River, and Chelsea Creek. The silts will be capped with suitable parent material or sand which will be hauled within the Harbor in scows (see paragraph. 5.2.2.4). Excavated rock will be processed and placed from barges or scows on top of the sand cap as armoring to resist resuspension of the sand by the propeller wash of passing deep draft vessels. It is anticipated that two dredges will be simultaneously working in various sections of the Harbor during the project term. Modeling has shown that Federal water quality standards would not be violated. All commercial and recreational marine interests in Boston Harbor must be fully informed of the potential interference with normal traffic by the dredging equipment. Vessels will be required to navigate safely around the equipment. Larger commercial vessels will require special procedures to coordinate movement of the dredging equipment and securing of the disposal operations to allow passage through the channel.

Blasting operations will be performed in the Mystic River channel, the Inner Confluence, at the mouth of the Reserved Channel, and in the Main Channel east of the Reserved Channel. Vessel operators must be warned of all blasting operations. Blasting schedules will be provided to all commercial operators. Vessel movements will be regulated by the US Coast Guard during actual blasting activities.

5.2.1.3 Structural Evaluation

Prior to dredging or blasting operations, a detailed survey of existing infrastructure will be performed. This survey will include a review and documentation of the harbor structures that may be impacted by the proposed activities. The location of critical structures will be determined and recorded on control documents. Structure condition will be described and a photographic record will be made. Pre-project conditions will be clearly identified. A condition report of each structure will be prepared by the blasting contractor and provided to each facility owner prior to any construction activities. A survey of the existing channel and berth areas included within the project bounds will be performed to identify and locate all submarine utilities. The survey will encompass a review of record drawings maintained by utility companies, including but not necessarily limited to: Boston Edison Company; Metropolitan District Commission (MDC) Water and Sewer Divisions; Boston Gas Company; Massachusetts Water Resource Authority; and private marine facilities. The survey will identify the location of all utility elements and will identify specific means for protection or relocation during the dredging and/or blasting operations.

5.2.1.4 Regulatory Constraints

All construction activities related to the dredging of silts and parent materials and

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the removal of rock from the project area and thin disposal will be performed under the conditions established within the permits issued for this work. These permit documents may identify specific environmental performance criteria which must be satisfied. Berth areas will require individual permits with a special condition that vessels moored at the berth shall not extend into the federal channel.

5.2.1.5 Seasonal Limitations

The movement of anadromous fish will require the limitation or stopping of dredging activities in the Mystic River and Inner Confluence during the spawning period between 1 February and 15 June. Blasting will also cease during that period. If agreeable to the State regulatory agencies, monitoring may be conducted to determine if dredging and disposal can continue during this time frame in the Mystic River and Inner Confluence.

5.2.2 Dredged Material Handling Procedures

The proper handling of dredged material will assure that potential impacts to the environment are minimized. The following sections characterize the general procedures which will be used throughout the project.

5.2.2.1 Monitoring Requirements

During dredging operations, activities of the contractor will be observed by the Corps on-site construction management staff. This staff will be directly responsible to the Contracting Officer. In addition to monitoring and verifying the dredge position (particularly important in areas of known utility crossings), this staff will also assure compliance with required permit conditions.

Specific comments to this DEIS/R requested independent monitors to be on the contractors vessels. While the Corps would not object to an onboard observer, there are safety and liability issues to be addressed. The Corps does not typically fund this type of activity although it does contract with a dredge inspection firm which verifies disposal locations for contract and permit compliance. The independent observer can alert the Corps inspector of any perceived permit violations. However only the Contracting Officer can modify or halt dredging and disposal operations.

5.2.2.2 Environmental Bucket

Dredging of the silt materials will be performed with an enclosed "environmental" bucket. The bucket is specifically designed to reduce sediment loss during closure and is provided with rubber seals to minimize loss of fines as the bucket is drawn up through the water column. There are several manufacturers of such buckets. The key features of these proven systems include those design innovations which minimize the generation of resuspended sediments during all phases of the bucket operation.

Traditional buckets remove a concave bowl shaped cut from the channel bottom, whereas some environmental bucket designs make a uniform horizontal cut in

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the sediments. This type of an environmental bucket enhances the ability of the operator to make a uniform cut of the channel bottom without performing secondary operations, such as dragging of the bucket to smooth any residual ridges, which tend to resuspend bottom sediments and increase turbidity. Modern environmental buckets include integral bucket covers which protect excavated sediments from being washed from the bucket as it is hauled through the water column. These covers are included with purge valves which reduce the effects of bucket impact during descent through the water and initial contact with the bottom, thus further reducing potential resuspension. Clamshell seal indicator switches are available to alert the operator when the bucket has not completely sealed.

5.2.2.3 Dredging Locations

Dredging will be performed in the Federal channel in the Chelsea Creek and in portions of the Federal channels in the Mystic River and Reserved Channel. Dredging of some private berths, adjacent to these channels, will also take place. In addition, several private berths located in the project area and located along the main ship channel will be taking advantage of the opportunity to dispose of silt material dredged from their berths at the disposal sites constructed as a part of the BHNIP. For a detailed description of the project, the reader should refer to Section 2.0 of this document.

5.2.2.4 Facility Construction

Construction of land-based facilities is not anticipated. Sand used as capping material, will be loaded at existing terminal facilities situated throughout the harbor or barged into the harbor depending on the contractor source of the sand. Off loading of trash and debris, which cannot be placed in the in-channel disposal cells, will require pier space for temporary storage and transfer to an approved landfill. It is anticipated that the trash transfer operation will be intermittent and require a relatively small area. In the event that contingency plans for upland disposal of a small portion of the silt materials is required, a dredged material dewatering operation would be temporarily established at a waterfront site. This would only be implemented if the in-channel disposal storage volume was not sufficient to contain all of the silt material and disposal of small volumes of material at the Little Mystic channel was not available. The dewatering operation would consist of either diking or of mobile mechanical equipment.

5.2.3 Dredging Sequencing

The following paragraphs identify the mechanism and rationale for determining the dredging priorities for the BHNIP.

5.2.3.1 Site Prioritization

The location for the start of dredging will be governed by the time of year that the project begins. For example, if the contractor were to get underway during the environmental restriction time period, they

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would be directed to work initially in the Chelsea Creek and Reserved Channel. If no restriction is in effect, the contractor will be directed to begin dredging in the Mystic River. Scheduling for the dredging and preparation of in-channel silt disposal cell facilities in the Mystic River is critical to ensure a sufficient number of cells available for disposal of contaminated silt from the Reserved Channel. If the Mystic River disposal cells are restricted or prohibited during dredging of the Reserved Channel, then the Chelsea Creek cells will be used until such time as the dredge plant operating in the Reserved Channel can be moved to the Mystic River or Inner Confluence. Use of the Mystic River in-channel disposal cells for material from the Inner Confluence and Chelsea Creek may be necessary to assure availability of cells for the Reserved Channel contaminated silt.

5.2.3.2 Material Prioritization

It is estimated that over 1.3 million cubic yards of dredged material storage volume will be created during the excavation of the in-channel disposal facilities. This volume was estimated by examining the seismic records made during November 1992 which indicate the subsurface composition. The depth of subsurface information was limited to -55 ft (MLW) in several locations. However, additional capacity may be realized if the contractor is able to dredge deeper than -55 ft (MLW).

To create the in-channel disposal cells, the contractor will be directed to dredge as deep into the exposed parent material as practical with the equipment available. Some areas will support excavation to as much as -70 ft (MLW). The practical limitations to the depth of dredging will be dictated by the geotechnical stability of the dredge cut and by the proximity and integrity of any adjacent structures. Dredging too close to a structure or dredging soils which will slough excessively may lead to undesirable structure movement.

It is estimated that the volume of silt to be dredged is approximately 1.1 million cubic yards and that it can be expected to expand to 1.3 million cubic yards as a result of dredging and handling. It appears that the in-channel disposal areas will accommodate the Federal channel silt and the material to be dredged from the berths which have been identified as direct project beneficiaries. Any significant increase in dredging volumes and/or required in-channel disposal volumes will require that additional disposal capacity be found during construction. Some of the remaining material dredged from the berths could be placed either in the Little Mystic Channel or sent to an upland site. This is discussed further in paragraph 5.6.2.3 of the Contingency Plan section of this document. Material dredged from these berths will receive preference over non-beneficiary facilities.

5.2.3.3 Schedule

As mentioned in previous sections, the schedule for dredging will depend upon the requirement to construct the in-channel disposal cells prior to dredging of silt materials. Scheduling of operations will

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include consideration of the restriction of activities in the Mystic River and Inner Confluence during 1 February to 15 June due to expected environmental limitations.

It is anticipated that Federal funding will allow the BHNIP contract to be bid during the winter of 1996-1997 with award and "notice to proceed" expected during the early spring of 1997. The contractor would be directed initially to construct in-channel disposal cells in the Chelsea Creek. A portion of that work will require the dredging and temporary storage of approximately 9,000 cy of silt in scows. Dredging of contaminated silt in the Reserved Channel would start as soon as the Chelsea Creek in-channel disposal cell(s) were available to receive material.

As soon as dredging is able to commence in the Inner Confluence and Mystic River, the contractor will be directed to transfer the dredging operations to those sites. Dredging must take place in the Mystic River and Inner Confluence throughout the entire available environmental "window". The contractor would proceed with dredging and construction of in-channel disposal facilities in the Mystic River and Inner Confluence until those reaches were completed. These operations would be terminated if they were not completed before the following environmental restriction period. It is possible that a dredge operating in the Mystic River or Inner Confluence would have to be moved to the Chelsea Creek to prepare in-channel disposal cells for use during the restricted period. These flexible operations may be necessary to maintain continuity and to keep the project on schedule. This would mean Chelsea silt would be disposed in the Mystic River rather than its own river bed, thus creating cells to be used later.

5.2.3.4 Limitations

Since in-channel disposal cells will be constructed by dredging silt and then parent material, an obvious limitation to the continuity of operations is that of not having in-channel cells available when needed for disposal. If silt can not be placed in the disposal cells, then parent material cannot be dredged, thus effectively stopping construction of disposal cells. The construction management team will be responsible for assuring that in-channel cells are always available for contaminated silt disposal. As a contingency, a limited quantity of silt material could be temporarily stored on scows until parent material can be removed and the disposal facilities made available. When working in the Chelsea Creek and Reserved Channel, each cell constructed above the Chelsea Street Bridge will store an average of 31,000 cy of silt. Approximately 9,000 cy of that material will have been dredged in the process of creating the disposal cell facility. Therefore, silt brought in from dredging of the Reserved Channel will require careful monitoring to avoid exceeding the cell capacity in the Chelsea Creek. It may be beneficial to delay dredging in the Reserved Channel until sufficient cell capacity exists in the Chelsea Creek.

Dredging operations will be performed in active commercial channels. The dredging Contractor will be required to accommodate the passage of vessel traffic. Since the Chelsea Creek channel is relatively narrow, the contractor will need to periodically shut down the dredging operation and move out of the channel to let traffic pass.

5.2.4 Blasting and Rock Removal

Significant volumes of rock will need to be removed from several areas for the BHNIP. Silt and parent material will first be removed by dredge from the specified areas to expose the underlying rock. Holes, drilled in the rock by barge mounted drill rigs, will be filled with explosives. Vessel traffic will be cleared from the area and the explosives will be detonated, resulting in loose fractured rock that will be dredged by mechanical means. The excavated rock will be placed in scows or on barges for transportation to an unconfined disposal site, used as an armor layer for the sand cap, or used for commercial purposes. If the rock is used for upland commercial purposes, truck traffic can be expected to be moderate since production of the blasted rock will occur at different periods during the construction of the project. At present, there is no known commercial use for the rock.

5.2.4.1 Locations

Approximately 88,000 in-situ cy of rock will be removed from the mouth of the Reserved Channel, the Inner Confluence, and from the Mystic River Channel. All of the rock is located within the Federal Channel reach. It is estimated that 34,000 cy of rock will be blasted and dredged from the maneuvering areas of the Main Ship Channel at the mouth of the Reserved Channel. The remaining 54,000 cy of rock will be taken from the Inner Confluence and Mystic River Channels.

5.2.4.2 Seasonal Limitations

The same seasonal limitations described in Section 5.2.1.5 apply to rock removal operation.

5.2.4.3 Mitigation

In addition to imposing seasonal restrictions upon the blasting operations, specific mitigation techniques will be employed to further reduce the potential impacts of blasting. Fish behavioral or other devices will be used to startle, frighten or deter fish from the blasting area during operations. Sonic startle devices or pneumatic bubble barriers will be evaluated as fish deterence devices to induce fish to leave the critical area and thus reduce mortality.

5.3 DREDGED MATERIAL DISPOSAL OPERATIONS

The following sections describe the general operations associated with disposal of the dredged materials. These descriptions focus primarily on the anticipated in-channel operations.

5.3.1 Equipment and Facilities

The basic equipment which a Contractor would use for in channel disposal

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operations will likely consist of a tug and nominal 3,000 cy scows. At least two (2) scows will be used to service each operating dredge.

Parent material will be transported by tug and scow to the MBDS. The tug must be of sufficient size to control a 3,000 or 4,000 cy scow on the open sea in all types of weather. A minimum of two (2) scows for each dredge will be required since the round trip time to the MBDS is about 8 - 10 hours. One scow will receive dredged material as the other is transported offshore for dumping. The disposal site will be identified by a buoy and each tug will have onboard a dredge inspector to verify disposal location.

5.3.2 Impacts on Dredging Operations

The difficult scheduling requirements created by the in-channel disposal option is expected to impact the dredging operation. The frequent changing of buckets will probably take place during the time scows are being shuffled and taken away for disposal. The dredge will need to cover the same area of channel at least twice - once for silt material and once for parent material. While dredging the parent material, the dredge will remain in one location longer because more parent material will be removed per area to create disposal space.

5.3.3 Weather Restrictions

Disposal operations will be affected by both weather conditions and environmental restrictions. Disposal of parent material at the MBDS requires exposure to the sometimes harsh New England weather particularly during the winter months when cold temperatures and Nor'easter storms confront the towing vessel's crew. Tug captains will have the final say as to whether they will risk making disposal trips in stormy weather although the Contracting Officer's representative may direct against venturing out in rough seas. Typically, contract specifications allow for weather related delays.

Another type of weather related restriction to the disposal process will be the volume of vessel traffic on the Mystic River and Chelsea Creek. Winter weather will bring an increase in fuel deliveries to distributors on both of these rivers. Dredging and disposal operations will need to move equipment to let tankers pass. Because of the relatively short time for disposal, the delay caused by increased vessel traffic is not expected to be as great on the disposal operation as it would be on the dredging operations.

5.3.4 Capping Operations

Capping will be employed to isolate the silt material placed in the in-channel sites. The cap will be designed to act as a barrier during future maintenance operations, preventing the dredge bucket from penetrating into the disposed material. The DEIR/S contemplated use of parent material for capping. During discussions with state agencies it became clear that use of the predominantly clay parent material for capping was unacceptable due to unresolved concerns over the ability of the highly cohesive clay to spread out over the cells to minimize voids in the cap. Another area of concern was the ability of the silts to support the clay cap. Finally, the constructability concerns regarding the ability to meet the tight tolerances required in the navigation channels (-42 feet MLW) with highly cohesive material, eliminated the use of clay as a capping material for the in-channel locations. Therefore, sand or granular parent material will be used for a cap.

The New England Division of the Corps has performed extensive capping projects and monitoring of capped disposal areas, primarily in Long Island Sound. An extensive capping and monitoring bibliography in included in this FEIR/S in the references section found in Chapter Nine. As part of their studies, the Corps obtained core samples from a variety of disposal sites in the Long Island Sound. Analysis of the split cores showed that the cap and contaminated material interface was easily discernable in most cores. More importantly, a mixing zone of less than 10 cm (approximately 4 inches) was observed. This zone was identified by a boundary signature appearing in the chemical analyses that were performed on the cores at 20 cm intervals. The contamination profile of the sediments below the cap abruptly changed at the cap/silt interface to below detection limits within the cap material (see Figures 5-1 and 5-2).

Although the contractor will be required to develop a specific method for placing a nominal 3-feet of granular capping material; it is generally understood that the cap material will be spread on individual cells as filling with silt is completed. Spreading the cap materials will be done by partially opening the doors on split hulled scows and gradually releasing sand as it moves over the cell. A survey of the trench will be required prior to placement of the cap. The contractor may be required to drag a heavy beam along the top of disposed silt prior to placement of the cap to prevent the cap from protruding above the -42 ft (MLW) datum and to maintain cap thickness as uniform as practicable. If imported sand is required, it will be loaded onto scows at a harbor facility. A final survey will be required after capping is completed to verify operating depths.

5.4 CONSTRUCTION SEQUENCING

5.4.1 Dredging and Disposal Sequencing

Construction of the BHNIP will require about 18 months. This will vary depending on the contractor awarded the job and the job and the equipment brought to the job. Because of the length of time over which the dredging will take place, the restricted dredging period (to protect anadromous fish runs) in the Mystic and Inner Confluence will impact on project scheduling. It is assumed that a contractor will use two dredging plants in order to minimize dredging time. However, this complicates the scheduling of dredging locations and production rates. A detailed example scenario using two dredges has been worked through and is included in Appendix J and is summarized on Figure 5-3. This scenario is only to serve as a guide and to show that the sequencing can work. A contractor will probably modify the sequencing to meet equipment and weather needs.

The primary goal of scheduling is to keep both dredge plants in full production at all times. Another objective is to minimize storing silt in scows/barges. Cells must be ready to accept silt material when silt material is being dredged. Initially silt will be stored in scows while the first cell is being prepared. Depending on the number of scows available for storage, the initial cell may be smaller than suggested in the scenario. However, as long as the storage cells are dug deep enough there will be adequate capacity for the silt removed from the top of the cell and several adjacent cells. Once a cell is prepared it typically will have capacity to store about three times the silt removed to create the cell. In this fashion, the contractor can "get ahead" or fill cells with material from another tributary or berth.

The example scenario which has been worked through, begins in April (year 1) when dredging is expected to be prohibited in the Mystic and Inner Confluence. A single dredge plant would begin just upstream of the Chelsea Street Bridge and begin creating cells progressing upstream. By early May, three cells should be prepared and a second dredge plant begins in the Reserved Channel. As the Chelsea dredge continues to create four more cells by mid-June, the Reserved dredge has alternated between dredging silt and parent material as cell capacity is created in the Chelsea.

In mid-June the dredge working in the Chelsea Creek moves to the Mystic River just upstream of the Tobin Bridge. Likewise, the dredge from Reserved Channel moves to the Inner Confluence. Silt produced by both dredges is initially sent to cells in the Chelsea Creek until cells are prepared in the Mystic and Inner Confluence. Once cells are established in the Mystic and Inner Confluence, the process of creating cells and disposing silt in these areas will continue until the end of January (year 2) in the Mystic and the end of November in the Inner Confluence. It should also be noted that berth owners must arrange to have the berths dredged at the appropriate time. This scenario assumes the owners will contract with the Corps' contractor who is on site and will be able to adjust berth dredging to accommodate disposal cell availability.

By the end of November, the dredge working the Inner Confluence has completed all cells and dredged all berthing areas of both silt and parent material, that dredge will then move back to the Reserved Channel and produce silt for cells in the Mystic. This dredge will be finished producing silt near the end of December and will proceed to remove parent material and rock from the Reserved Channel. This dredge will be demobilized when finished with the Reserved Channel early in March.

Meanwhile, in late January, the dredge working in the Mystic River will move back to the Chelsea Creek to continue where it left off and will ship its first cell's silt back to the Mystic. After completing the upstream cells, the dredge will move to the Lower Chelsea Creek. No cells would be created below the Chelsea Street Bridge during the initial improvement project.

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This area would be available for future maintenance dredging operations. It appears the dredge may finish in the Chelsea Creek about mid-May and cannot return to the Mystic until mid-June. Between mid-June and the end of October, the dredge will finish creating cells and dredge the berths in the Mystic and any rock removal necessary.

Since scheduling is subject to change daily due to weather conditions or equipment problems, there may be times when silt may have to be stored on scows as done during the initial dredging. Dredging may be required to slow down in order to meet an environmental requirement or it may become necessary, provided regulatory agencies permit it, to work into the environmental window in the Mystic and Inner Confluence.

5.4.2 Project Demobilization

Following completion of the dredging and disposal operations, all equipment and personnel will be demoblized from the site. A final survey will be performed to determine the post-dredging bottom conditions. Final drawings, which show the location and depth of all material placed at the in-channel disposal facilities, as well as the location and depths of the cap system, will be prepared. A post-construction survey of all potentially impacted infrastructure will be performed to determine the extent of damage which may have resulted due to the dredging and/or blasting operations. This survey will include a review of claims which may have been made by structure and utility owners. Any temporary utility relocation or protection works which may have been installed prior to dredging will be removed. If damage is detected, it will be the contractor's responsibility to repair the damage. The project must have been completed according to specifications before it will be accepted by the Contracting Officer.

5.5 SUMMARY OF CONSTRUCTION MITIGATION

This Plan has identified specific techniques to be employed during the various critical operations throughout the project which will minimize impacts of the project. The following sections summarize these recommended actions.

5.5.1 Dredging

Dredging operations will be required to meet specific performance criteria during all activities. Removal of contaminated silts will be performed with a closed "environmental" bucket with a capacity between 15-22 cy. which has been proven to reduce turbidity levels resulting from dredging operations. One of the most effective mitigation measures which could be implemented would be to require the dredge operator to meet minimum competency and experience criteria. Operator skill can be exploited to assure efficient and low impact dredging.

The "environmental" bucket has been successfully used to minimize turbidity in the immediate vicinity of dredge sites. The bucket is specifically designed to reduce sediment loss during closure and is provided with rubber seals to minimize loss of fines as the bucket is drawn up through the water

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column. Restricting the bucket drop velocity and haul speed will further minimize the potential for increased turbidity in the water column due to dredging. Silt curtains will be deployed around the dredging and disposal cells to further minimize turbidity in the immediate vicinity of the active work area.

All construction activities related to the dredging of silts and parent materials and the removal of rock from the project area will be performed under the conditions established within the permits issued for this work. It is anticipated that these permit documents will identify specific environmental performance criteria which must be satisfied.

5.5.2 Rock Excavation

Blasting of rock in the Mystic River and Inner Confluence areas where anadromous fish have been observed will not be performed between 1 February and 15 June. Also, appropriate fish deterence devices will be employed to minimize fish mortality during blasting.

5.5.3 Dredged Material Disposal

Dredged material disposal will require the dumping of dredged silts from scows into the prepared in-channel facilities. Disposal of parent materials will be at MBDS unless the material can be beneficially used at an upland site and the scow can be off-loaded immediately.

5.6 MONITORING DURING DREDGING AND DISPOSAL OPERATIONS

Monitoring during dredging and disposal may be required to comply with environmental permits. It will be the responsibility of the Contracting Officer to implement and execute these requirements. The monitoring program if required, will identify specific minimum performance criteria which must be satisfied to safely, effectively, and responsibly complete the required dredging and associated activities. Performance criteria may involve readily quantifiable and measurable parameters such as turbidity, depth and planar distribution of deposited sediments.

5.6.1 Dredge Performance

The critical performance parameters which will be continuously monitored during dredging operations will include specific production and performance data and position verification. Also monitored will be the amount of parent material mixed in with the silt. Too much clay will indicate a change in procedure may be needed to avoid filling the in-channel cells with clean material.

Dredge performance is quantified by continuously monitoring the volume of material removed as a function of time. An accounting of the number of cycles performed by the dredging bucket over a fixed period can form the basis for an estimate of dredged quantities, assuming the bucket removes approximately the same quantity in each cycle. A complementary technique requires maintaining a count of the numbers of scows which are filled to the load

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line and hauled to the disposal site. The volume of dredged material is approximated based on the displaced volume of the scow and the estimated specific weight and water content of the material. The estimated volume is typically factored to account for the increase in volume of the dredged material as compared to the in-situ volume.

The volume of each scow is documented and a cumulative estimated total of dredged volume is maintained by the Project Engineer. Periodic hydrographic surveys of the project site are typically performed to determine more precisely the quantities of material dredged from the project site. These surveys are performed in accordance with the standards established by the US Army Corps of Engineers, Engineering Manual No. 1110-2-1003, 28 February 1991. Specific procedures and acceptable quality control standards for surveys performed for construction administration, payment, and project acceptance are defined in this universally accepted manual. Volumes will be determined by a comparison of the pre-dredge hydrographic survey with the post-dredge survey. In-place volumetric differences within the payment prism will be computed as the difference between those surveys.

Positioning of the dredge during dredging operations and maintenance of horizontal and vertical control during hydrographic surveys are related critical issues. The US Army Corps of Engineers, New England Division, maintains a series of benchmarks throughout Boston Harbor which provide accurate references for elevation and position. These benchmarks, complemented by temporary control points which reference these benchmarks, will be used for all survey measurements. All horizontal positioning will be referenced to the State Plane Coordinate System and will be accurate to within 3.0 meters. Depth measurements shall be referenced to the National Geodetic Vertical Datum of 1929 (NGVD) and shall show the local Mean Low Water Datum (MLWD) as referenced to NGVD. All vertical depth measurements shall be limited to a standard error not to exceed 0.5-ft. These requirements meet the standards for Class 1 surveys.

Disposal activities, such as the positioning of a scow during dumping operations, will not ordinarily require the accuracy of a Class 1 survey. Positioning of those scows to within approximately 5.0 meters will be sufficient. Monitoring of potential movement of the dredged materials placed at the disposal sites will be performed to the more demanding accuracies required of a Class 1 survey, due to the need to accurately determine the fate of the placed materials.

The daily operations of the dredge will include repositioning of the dredge a number of times. In addition, the dredge bucket will be lowered to the bottom and material will be hauled from the bottom approximately once per minute. Positioning can be verified by several methods, all of which satisfy the accuracy requirements of a Class 1 survey. These methods include: positioning by pre-established and surveyed rangelines and reaches; location by land-based survey instruments to establish the range and azimuth of the dredge from a known benchmark; and positioning by satellite using a differential Global Positioning System (GPS). The depth of excavation will be continuously monitored by the dredge operator using a bucket mounted pressure transducer compensated for transducer position and bucket geometry. The operator will also mark and calibrate the bucket suspension and closing lines to provide a visual check of digging depth. The dredge operator will establish visual and electronic tide gauges to continuously compensate the digging depth for water surface elevation variations.

5.6.2 Environmental Impacts

Potential impacts to water quality will occur within a relatively constant distance from the dredging operations. An estimate of plume size based upon recent models (see Appendix F) is approximately 500-ft from the dredge.

Mechanical dredging operations can be expected to result in 3-5% of the total dredging quantity being brought temporarily into suspension. It is therefore possible that contaminants will be released to the water column as a result of this resuspension. The difficulty arises with variations across the project areas in current, water depths, fresh water input, CSO discharges, sediment physical characteristics, and other point sources which will all contribute to actual turbidity levels around the dredge site. In addition, dredging methodologies employed, such as production rate, barge overflow, and careful bucket operation, can have an even greater impact upon turbidity levels at the dredge site.

5.6.3 Accountability and Supervision

Contract documents will clearly define the levels of responsibility and lines of authority for the sponsor, Contracting Officer, and Contractor. The Contracting Officer will be designated by the US Army Corps of Engineers and will be responsible only to the project sponsor, Massport. The Contracting Officer will not be responsible for berth dredging or utility relocations, removals or production unless a special agreement is executed between the Corps and Massport. The Contracting Officer will be responsible for implementing all terms of the contract and for assuring that all conditions of the project permits are satisfied. The Contracting Officer will employ, at his/her discretion, various experts to assist with contract administration. For example, the Contracting Officer may designate a firm that specializes in environmental data acquisition to monitor water quality at the dredging and disposal sites. Other specialists, retained to support the Contracting Officer, could include licensed surveyors and/or hydrographers to monitor and verify all dredging depths, volumes, and critical disposal information and on-board inspectors to monitor dredge production and to verify that proper procedures are employed during disposal operations.

It is likely that other project experts will be directly responsible to the Contracting Officer. Critical mitigation tasks such as installation and operation of fish behavioral devices and pneumatic blast wave attenuation systems are not within the typical areas of expertise provided by construction contractors. Successful implementation of these critical systems can be more reliably assured if performed by specialized professional firms directly responsible to the Contracting Officer.

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All of the project personnel, including the dredging contractor, scientists performing monitoring, mitigation specialists, and others, will be responsible to the Contracting Officer. The Contracting Officer will maintain authority over work in the federal channels. Massport and/or private berth owners will be responsible for all work outside of the channels.

5.7 LONG TERM MONITORING OF DISPOSAL SITES

The long term monitoring program for the selected aquatic dredged material disposal will be based upon the tiered approach presented in the Disposal Area Monitoring System (DAMOS) protocol.[1] DAMOS evaluates impacts to specific targeted resources to establish a threshold of effects to the general environment.

5.7.1 DAMOS Monitoring Program and Parameters

The Disposal Area Monitoring System .(DAMOS) is a program begun in 1977 by Corps' New England Division (NED) to manage New England's regional dredged material disposal sites. The program's main objectives are to minimize and manage the potential impacts of dredged material disposal on the marine environment. DAMOS is the most extensive dredged material disposal site monitoring program in the world and has conducted numerous published investigations of dredged material behavior and effects.

Monitoring priorities are determined based on: 1) the nature and volume of sediments disposed at the various disposal sites; 2) relevant findings of prior monitoring; and 3) discussions with State and Federal resource agencies. Typically, the most heavily used sites are monitored on an annual basis, while the less heavily used sites may go several years between monitoring surveys.

Monitoring of dredged material disposal sites has four primary objectives: 1) assuring that disposal operations are completed, and comply with permitted performance standards; 2) verifying that disposal materials and the interaction of the benthic community behave as predicted during project design modeling; 3) providing information that will also optimize utilization of the disposal sites; and 4) assuring that disposal activities are in compliance with environmental laws and regulations.

To address these objectives, monitoring parameters must respond to, at a minimum, the following questions:

- What physical and chemical environmental effects are associated with the proposed dredged material disposal activities; and
- What biological responses are associated with those physical or chemical effects?

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1 Germano, J.D., and D.C. Rhodes, and J.D. Lunz, 1994. *An integrated tiered approach to monitoring and management of dredge material disposal sites in the New England Region*, Contribution No. 87, Report No. SAIC-90/7575&234. SAIC, Newport, R.I., pp.55 with appendices.

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Specific sampling plans must be designed within this context, and, the pre-existing environmental conditions of the disposal site(s), and any sensitive receptors and/or risk pathways associated with on-site resources and the user populations.

5.7.2 Sampling Plan

Typical monitoring at disposal site(s) will consist of a depth (bathymetric) and sediment profile camera survey (e.g. REMOTS). Monitoring of in-channel placement locations will be conducted as part of the project construction and will consist of depth surveys to assure that minimum navigation depths are not impacted. It is anticipated that the surveys will be used to document the placement of material at the site and to confirm the expected recovery of the benthic organisms after disposal ceases. Similar surveys at MBDS, following the disposal of material from the dredging for the Third Harbor Tunnel, indicated the continued development of a large disposal mound and healthy benthic recolonization.[2],[3]

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2 SAIC, 1994a. *Baseline Survey of the Massachusetts Bay Disposal Site: Final Designation, 14 September 1993*. Draft DAMOS Report, Submitted to the U.S. Army Corps of Engineers, New England Division, Waltham, MA.

3 SAIC, 1994b. *Monitoring Cruise at the Massachusetts Bay Disposal Site, August 1994*. Draft DAMOS Report, Submitted to the U.S. Army Corps of Engineers, New England Division, Waltham, MA.

REMOTS scanning will provide an opportunity to evaluate the as-built conditions of the disposal cells or mounds. Conditions such as visual grain size and/or re-colonization anomalies suggesting unanticipated disposal materials response can be easily determined. Based on visual estimation of the photographic anomaly, further action(s) may be determined if necessary (e.g. chemical or bioassay analyses).

REMOTS scanning also provides an opportunity to indirectly evaluate biological resource conditions using trend or surrogate means. This approach establishes a hierarchy of trend or surrogate measures that provides a foundation for resource evaluation. As an example, the enumeration of polycheate tubes at the sediment-water interface, is a surrogate measure for:

- Densities of opportunistic colonizing polycheate species, which is a surrogate measure for:

- The rate of benthic secondary production of prey species, which is a surrogate measure for:

- Life history impacts of commercially important demersal fishery species, which is a surrogate measure for;

- An early warning signal that disposal impacts may affect human health.

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Benthic surveys conducted to evaluate the site alterations show that conditions within the Mystic River, Inner Confluence and the Chelsea Creek are already of low benthic resource value, and therefore both biological and chemical monitoring is unwarranted. In the short term, the project will improve benthic conditions. However, should areal conditions (e.g. CSO discharges and runoff) remain unchanged, post-construction sediments should return to pre-project conditions. Because a granular cap is replacing the existing surface silt layer, a temporary shift in the benthic assemblage from silt-loving to sand-loving organisms and then back again when the silt returns should be expected. Also, this pre-project sediment condition is not isolated to the channel, rather the channel is reflective of the greater harbor.

5.7.3 Reporting Requirements

Results of the long term monitoring investigations conducted under DAMOS will be prepared in report form, reviewed, and published as a DAMOS contribution. The DAMOS contributions are distributed to regional State and Federal resource and permitting agencies for review and comment; the interested public, and many regional college and university libraries (such as UMASS Boston, Woods Hole Oceanographic Institute, etc.) as public information.

5.8 CONTINGENCY PLANS

A key element of the properly managed dredging operation for the BHNIP will be the identification and planning for anticipated problems which may develop. The following sections describe environmentally related contingencies, which could be implemented when such problems are encountered. It must be recognized that these identified contingencies do not necessarily exhaust all possible operating scenarios. It is anticipated that the Contractor will be required to develop a detailed Contingency Plan as part of the contractually required submittals. These contingencies would be identified in the *Accident Prevention and Site Emergency Plan and the Environmental Protection and Turbidity Control Plan.*

5.8.1 Project Delays

Any long term marine construction project may be subject to periodic delays resulting from any number of causes. Reasonable delays are typically factored into the overall schedule for the project. A detailed Project Schedule will be developed at the start of the project. The Corps, Massport berth owners and contractor will participate in the development, review, and approval of the schedule. The progress of the BHNIP will be continuously monitored by the Contracting Officer. Any prolonged delays which could impact critical milestones, such as meeting specific environmental milestones or permit conditions, will activate contingency plans. The cause of the delays will be critically reviewed and procedures will be implemented to eliminate those delays.

To assure that Contractor delays will not be extended and potentially threaten completion of the project, the Contracting Officer will have the authority to require the mobilization of additional equipment and personnel as may be required. The Contractor will be obligated to provide the proper equipment and labor, at his/her cost, to perform the contracted services within the established time schedule. Delays caused by conditions which are not within the control of the Contractor, such as weather related phenomena, water quality degradation due to a non-project related occurrences, or other uncontrollable conditions will be treated in a similar manner. The Contractor will be required to mobilize additional personnel and equipment, as may be required, but will be compensated for providing that contingency.

5.8.2 Operations Issues

There are many issues associated with the effective and successful execution of the dredging, blasting, disposal, and support operations for the BHNIP that may trigger contingency requirements. These are described in the following paragraphs.

5.8.2.1 Operator Qualifications

It is essential that the most qualified and experienced persons be employed in critical roles for all aspects of this project. One of the most crucial positions is that of the dredge operator(s). Experience has shown that the skills of the dredge operator will be fully exploited to ensure that bucket dredging is performed with minimal impact to water quality. The operators must be keenly aware that bucket impact on the channel bottom, closing speed during excavation, haul speed through the water column, surface breaching techniques, and scow loading operations are all potential sources of turbidity. Turbidity must be minimized during all project operations, but especially during the dredging of the silt layer.

The Contracting Officer will contractually require the Contractor to employ dredge operators with demonstrated exemplary skills. The Contracting Officer will reserve the right to require the Contractor to replace any operator that does not meet minimum skills or does not demonstrate an ability to satisfy the performance parameters demanded by this project.

5.8.2.2 Trash and Debris Management

It is recognized that the proposed activities will likely encounter various types of trash and debris on the channel bottom and in the berth facilities. The dredge plant will be capable of removing and managing most, if not all, of these materials.

Several contingencies must be considered. The Contractor will be required to contain and collect all floating debris which result from the dredging operation. Floating debris and solid trash will be collected and placed into containers which will be maintained on the dredge or support barge. This debris will be periodically offloaded and transported to an appropriate landfill for proper disposal. Dredging operations may periodically release petroleum products which are entrapped in the bottom sediments. During dredging these oils may be released and consequently collect on the water surface. The Contractor will be required to maintain sorbent booms and clean-up materials to immediately eliminate any such surface impacts.

While it is unlikely that unforeseen containers or drums containing unknown and possibly hazardous materials will be encountered, it will be prudent to include such occurrences in a contingency plan. The Contractor will be required to submit, as part of the *Accident Prevention and Site Emergency Plan,* a detailed procedure for handling and managing unknown containers. At a minimum, this contingency will include required response notification protocol, testing requirements, health and safety procedures, drum handling procedures, diving support as required, and disposal requirements.

5.8.2.3 Disposal Operations

The critical elements of the disposal operation include: construction of the in-channel disposal cells; placement of the dredged silts into the disposal cells; containment of turbidity which may result from the disposal operations; and installation of the cap system. Each of these tasks will be planned and executed with some inherent risk. The design process is specifically required to minimize risks. Development of contingency plans for those elements of risk which are difficult or impossible to quantify will further assure the successful completion of the project. The following paragraphs identify three disposal operation contingencies.

Design of the in-channel disposal facilities is constrained by the geotechnical properties of the parent material, the approximated stability of contiguous structures, and the assumed bulking properties of the silt materials. It has been estimated by the Corps that 1.1 million in-situ cy of silt will bulk to approximately 1.3 million cy requiring in-channel disposal. The available capacity of the in-channel facilities has been estimated by the Corps to be only slightly more than 1.3 million cy. It is clear that a modest variation in any of the factors affecting the disposal volume approximations could require alternative disposal plans. Because of the expected small quantity, upland disposal of these materials or use in an ecological improvement project in the Little Mystic River could accommodate those silts which might not fit into the available in-channel facilities. It should be clear, during the initial disposal phases of the project, if the volume allowances and bulking assumptions were adequate.

It may be effective to restrict scow dumping procedures to times of slack tide. Maximum tidal velocities through Boston Harbor occur approximately 3.5 hours after low water and about 4 hours after high water. Slack tide occurs at the time of high or low water. Migration of any turbidity plume, which may result from the dumping operation, would be minimized by avoiding times of peak tidal velocities.

5.8.2.4 Permit Conditions Exceeded

The BHNIP will be constructed under the conditions of the environmental permits dictated by the appropriate regulatory agencies. Significant exceedance of the allowable levels for turbidity and other possible monitoring parameters may require a modification of the operation which causes the exceedance. The first requirement of the project monitoring staff will be to quantify the exceedance and identify the specific source of the exceedance. If the source is not project related, dredging, disposal, and/or rock removal operations would continue. If the significant exceedance is clearly caused by the BHNIP construction operations, remedial action alternatives will be evaluated.

The Contracting Officer will identify the appropriate contingency to mitigate the exceedance. The Contractor will be required to immediately implement the required contingency.

In the event that no appropriate contingency plan is available, the Contracting Officer shall develop a specific procedure. If appropriate, that procedure will be reviewed with appropriate regulatory agencies and implemented with their approval. These agencies must recognize that an immediate response to such field modifications will be essential. Each agency should identify a responsible contact person, who will be available at all hours with authority to approve procedural changes.

5.8.2.5 Equipment Failure

Contractor equipment failure will not be allowed to impact the project schedule or affect the water quality conditions imposed as a part of the project contract. The Contractor will be required to immediately repair any failed equipment or to replace critical equipment to the satisfaction of the Contracting Officer.

5.8.3 Environmental Conditions

Any marine related construction activity is subject to the inclement weather. Responsible Contractors are experienced in dealing with weather related impacts. Project specific concerns include the possible effects of dredging related noise and odors on the areas in the immediate vicinity.

5.8.3.1 Weather Related Issues

Normal weather phenomenon do not typically impact dredging operations. Blasting activities may be sensitive to precipitation. However, extreme weather can significantly impact the proposed activities. The Boston area is subject to periodic severe northeast storms and to seasonal hurricanes. Extreme water surface fluctuations, high winds, and intense precipitation are characteristics of such events. The duration of these events rarely exceeds several days, with the most intense activities lasting a matter of hours. Modern forecasting techniques will typically provide adequate time to secure the construction equipment and to implement procedures for the protection of life and property. The approved *Accident Prevention and Site Emergency Plan* will identify specific procedures for evacuating personnel and for safely securing floating equipment in the event of such severe weather.

Stability of the dredging, disposal, and blasting work in-progress will be a great concern during extreme weather events. Blasting operations would be terminated as far in advance of the predicted event as possible. All explosive materials will be removed from the site and stored at secure upland facilities which are likely to be at Massport owned waterfront industrial site depending on the blasting location. As part of the normal daily procedures, the disposal and capping operations must be carefully coordinated. Capping of the placed silts must be done as soon after placement as possible. Severe storm activity could potentially generate waves which could resuspend uncapped silts. Resuspended silts could migrate to areas outside of the disposal cells.

Interim hydrographic surveys of the work sites should be performed if possible. These surveys would indicate the position of the placed silts, capping material, and extent of completed dredging before any storm effects. Post-storm surveys would be performed in the same areas to evaluate the effects on the work sites. These surveys would provide vital information to the Contracting Officer and allow for the proper planning of repairs to any damaged sections of the cap and identify areas which might require re-dredging.

Precautions to prevent "short dumping" of clean parent material prior to arrival at the MBDS include: monitoring of weather and sea conditions, prohibiting the scow from leaving the harbor, establishing a point of no return and employing dredge inspectors to verify the disposal location.

5.8.3.2 Noise

The proposed areas to be dredged are all located within the Designated Port Areas of Boston Harbor. Periodic dredging is a necessary and normal activity within these areas. Noise associated with dredging is characterized by sources common to Port activities and is expected to be minimal. Limited reaches of the proposed project are situated in the vicinity of commercial and residential structures. Typically, the dredge will not operate in one position for any extended time. Dredging is a progressive operation and will expose any specific location to the associated noise for only a matter of weeks. It is anticipated that the dredge will operate continuously (24 hours/day 7 days/week).

5.8.3.3 Odor and Air Quality

Dredged materials will normally contain traces of organic matter and can generate distinct odors when removed from the channel bottom and placed in scows. Such odors are typically associated with the release of hydrogen sulfide and methane. Dredging of typical channel sediments will not normally release these gases at concentrations that could be harmful.

The odor associated with even low concentration releases of hydrogen sulfide and methane can be obnoxious. Scows will typically have a thin layer of water which covers the majority of the load. This cover will tend to minimize gas release. Released gas will be readily dispersed in the atmosphere. While odor can be of concern, it is not typical for odor issues to persist at projects, such as the BHNIP, where the material is being placed in submarine facilities. Odor problems are most often associated in the vicinity of permanent upland storage facilities. This will not be typical of the BHNIP operations.

Figure 5-1. Cu and Zn Concentrations 11 Yrs. After Placement: Interface at 80 to 100 cm

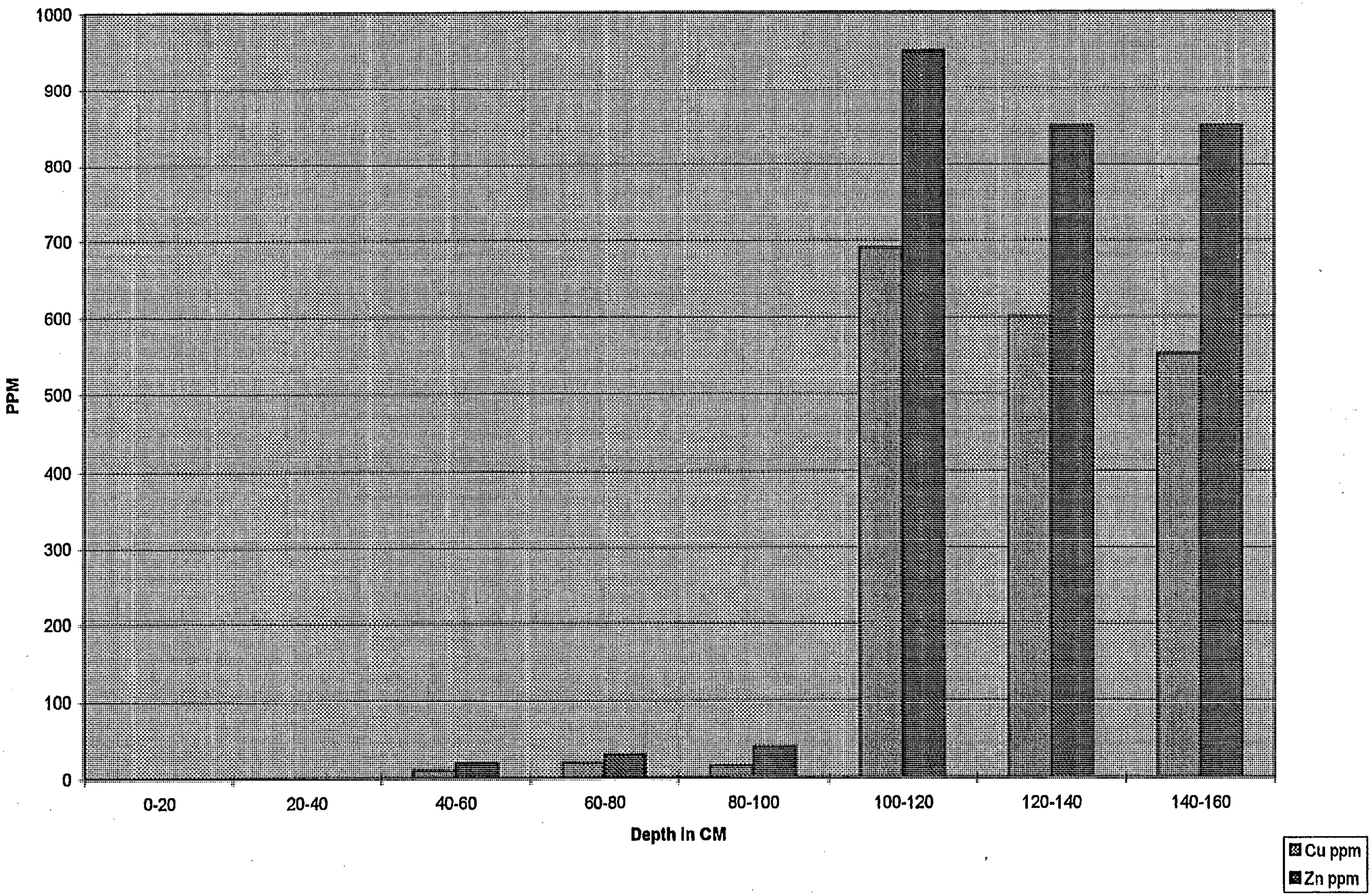

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Figure 5-2. PAH Concentrations 11 Years After Placement: Interface at 80 to 100 Cm

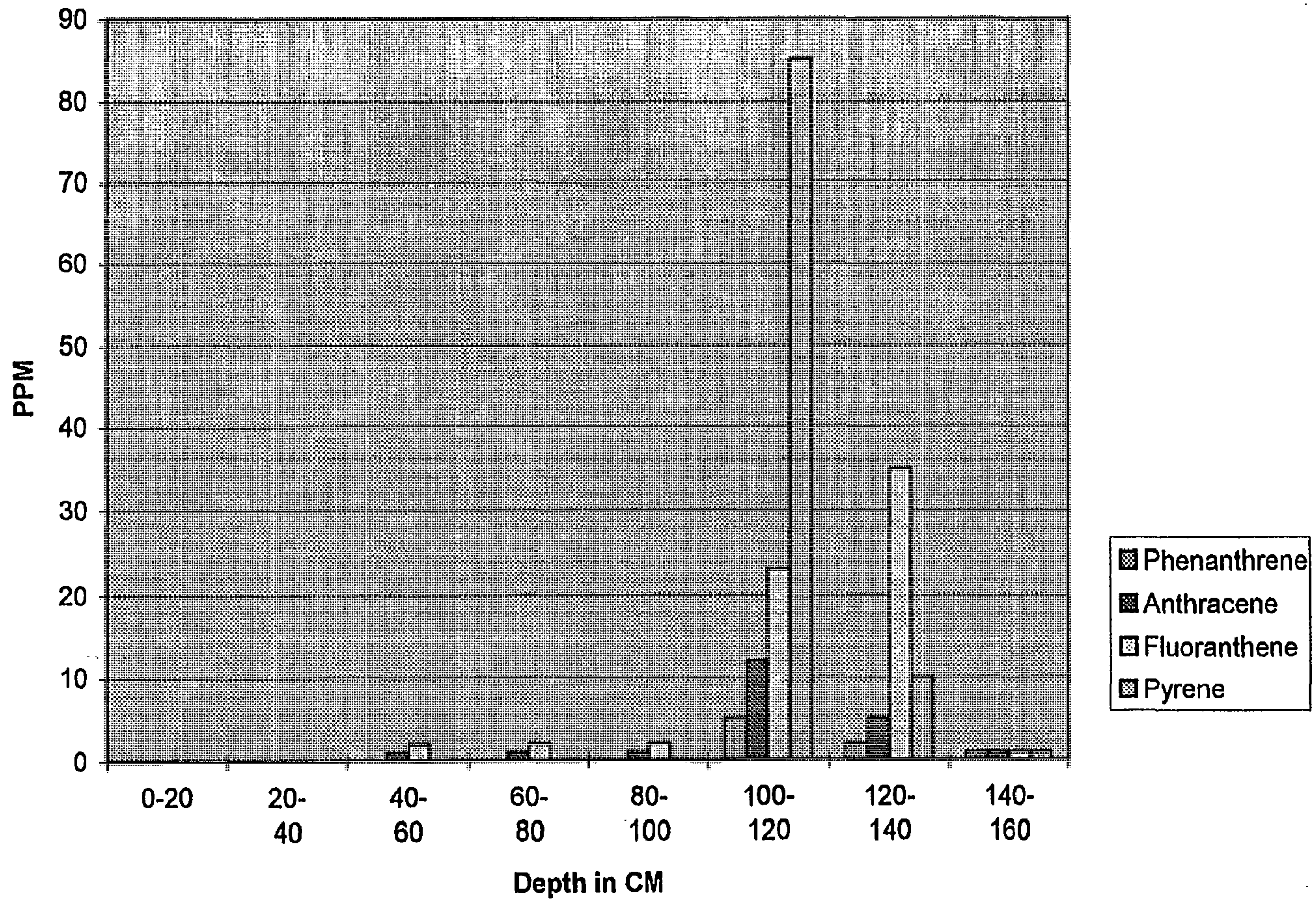

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Figure 5-3
Boston Harbor Navigation Improvement Project
Schematic Dredging and Disposal Sequence
In-Channel Disposal

C - Chelsea Cr cell.
M - Mystic River cell
IC - Inner Confluence cell

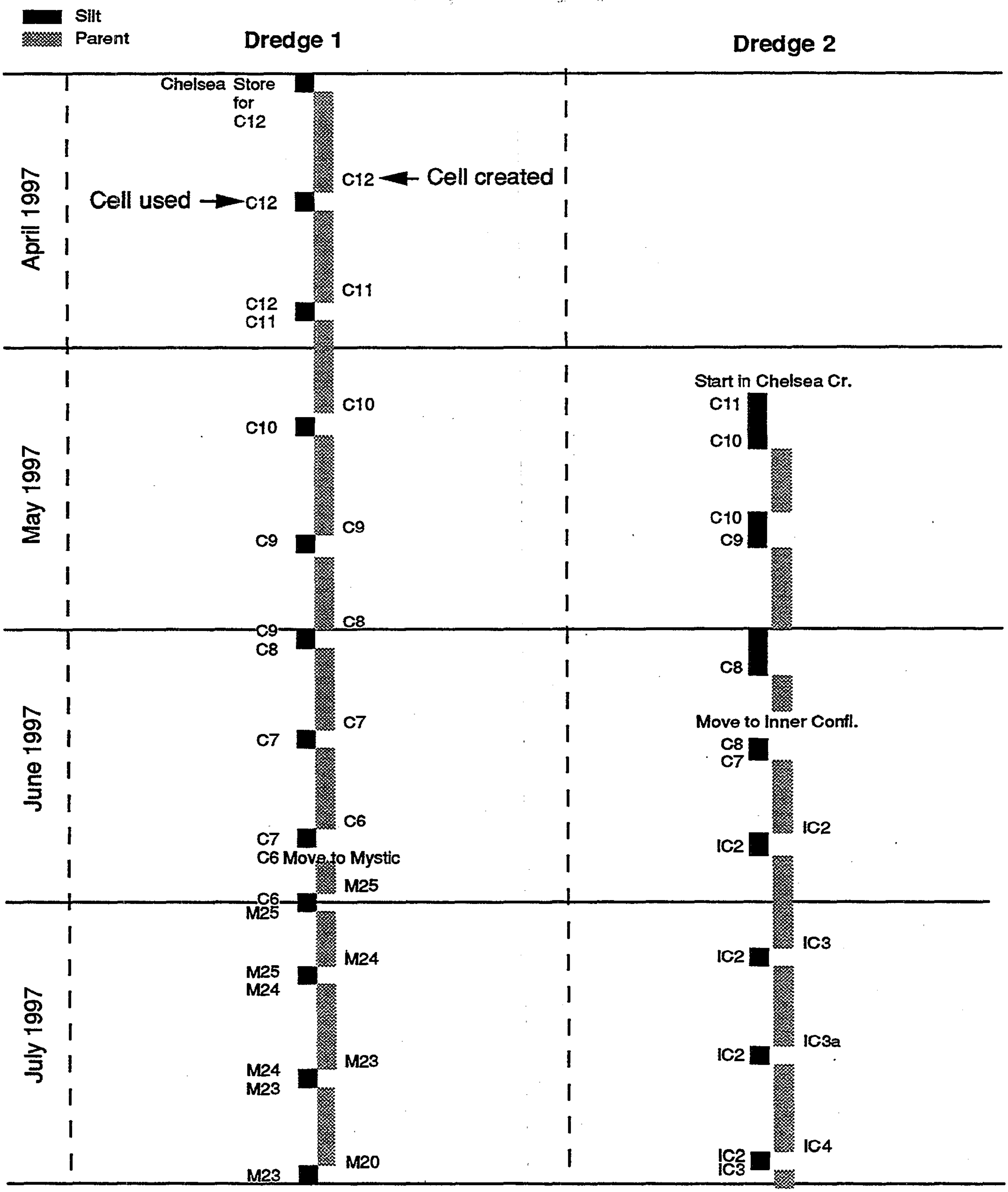

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Figure 5-3 (cont'd)

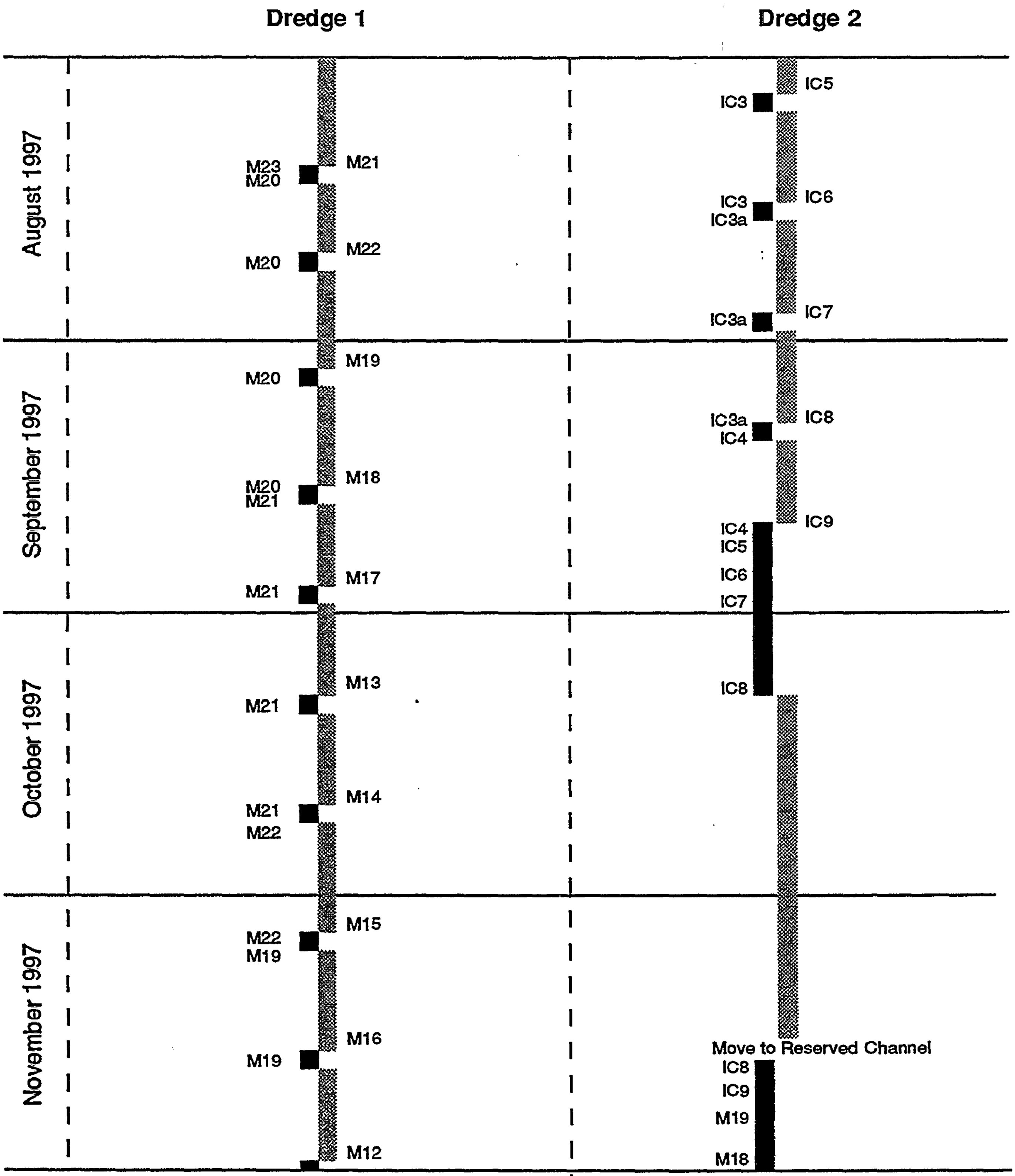

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Figure 5-3 (cont'd)

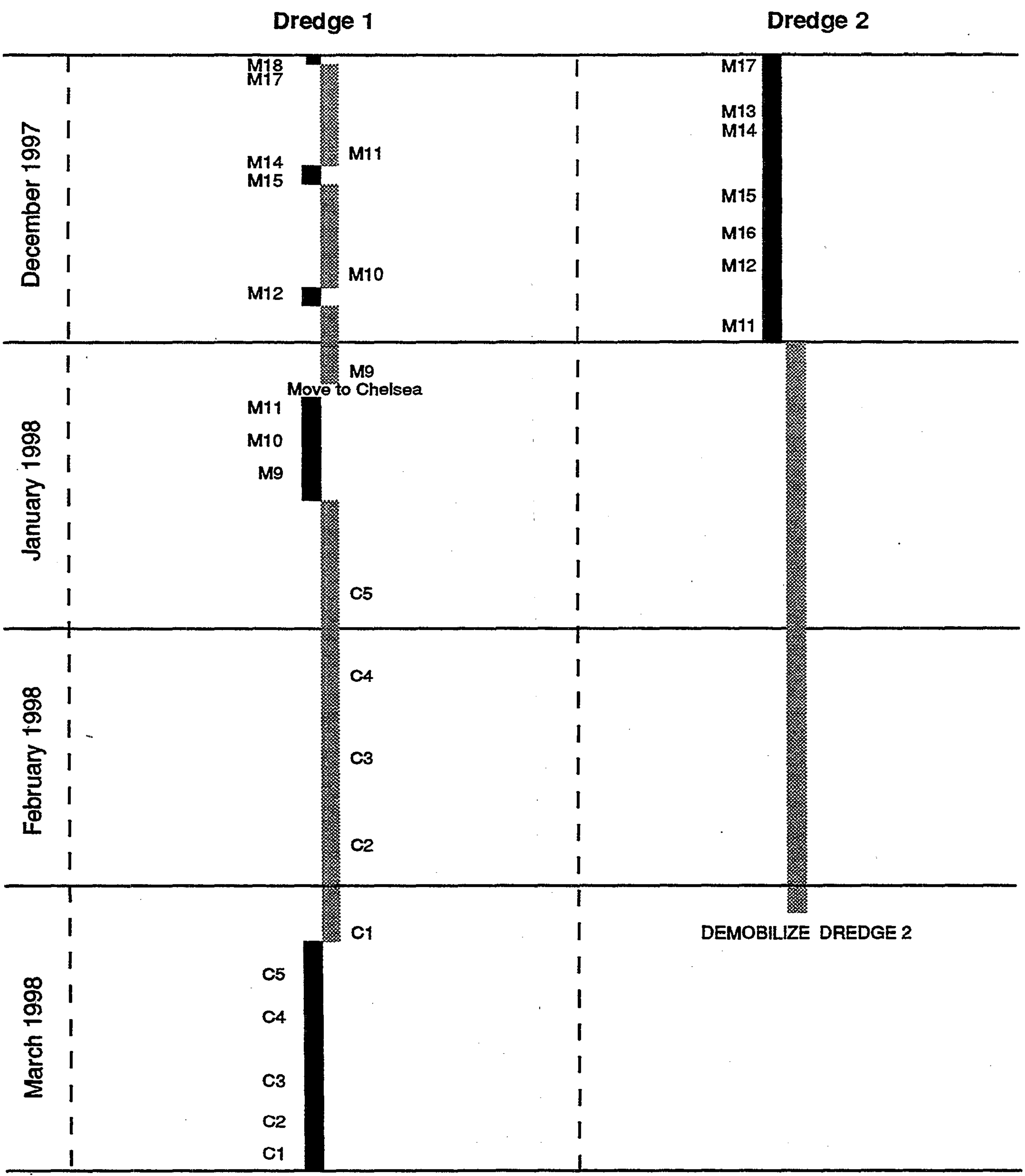

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Figure 5-3 (cont'd)

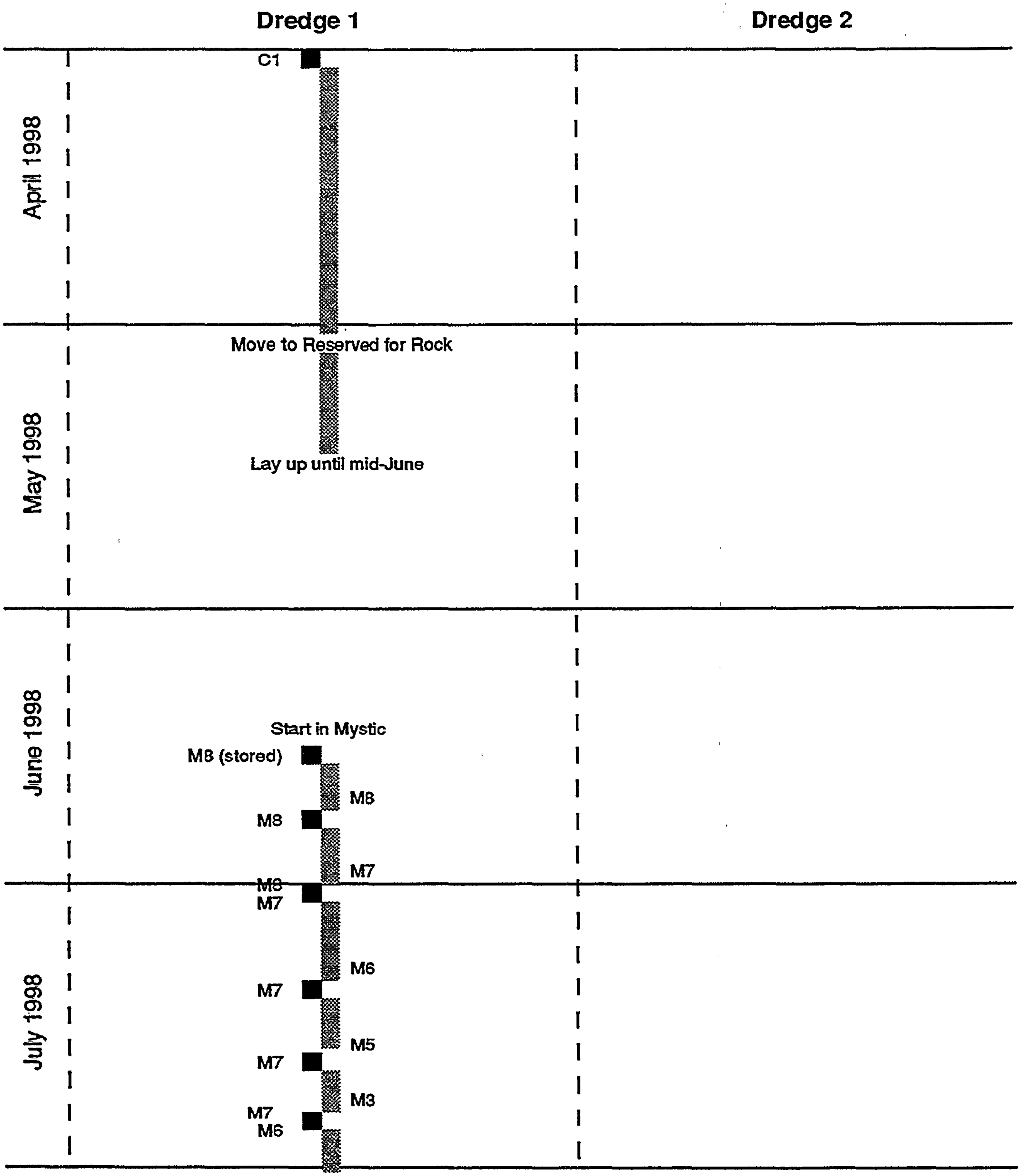

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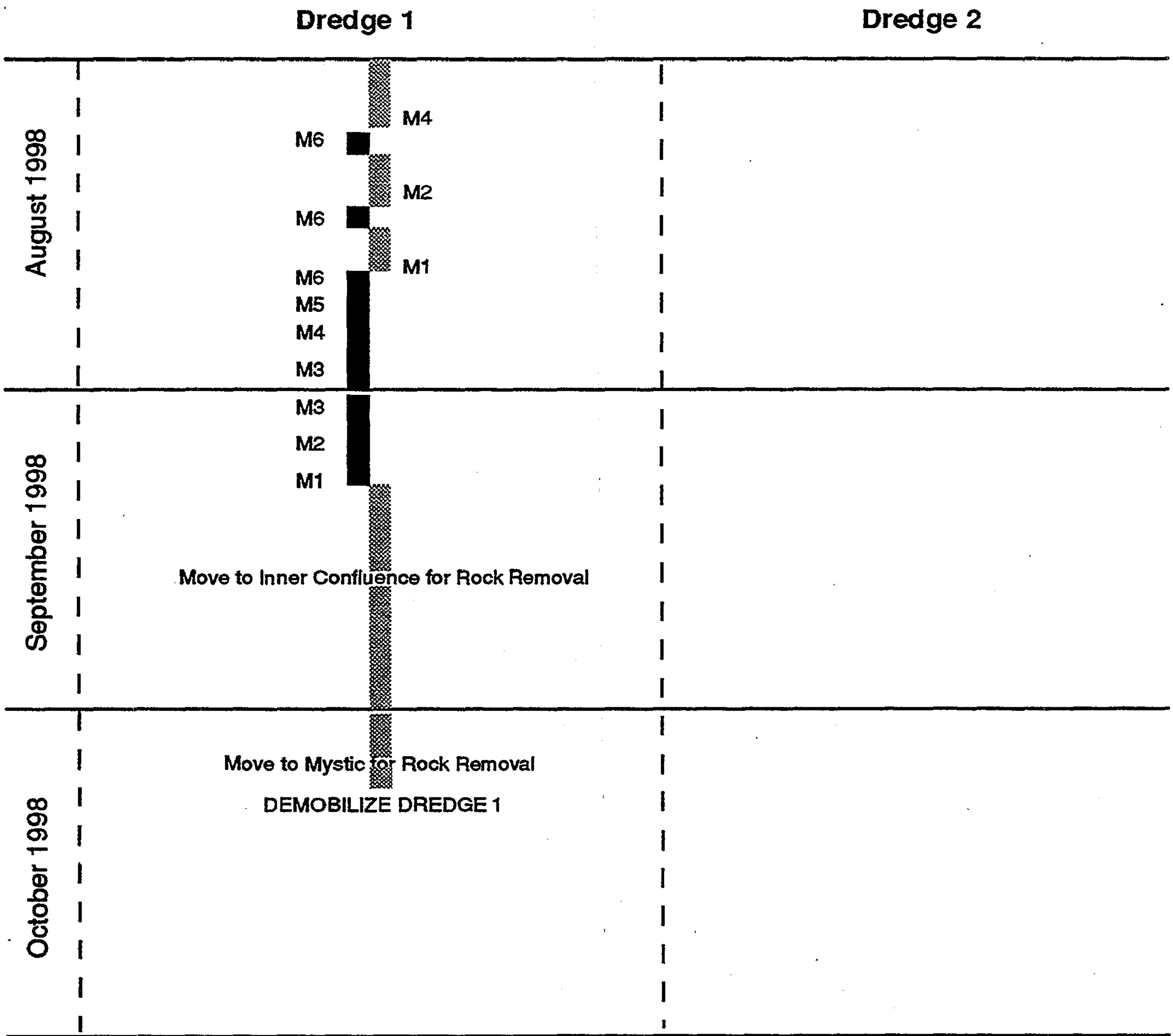
Figure 5-3 (cont'd)



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Chapter Six: Summary of Project Impacts and Mitigation Opportunities

This chapter of the FEIR/S summarizes the primary, secondary and cumulative impacts imposed by the Boston Harbor Navigation Improvement Project (BHNIP) and identifies potential mitigation opportunities which would offset these impacts.

Primary impacts are those that include physical disruption or displacement (temporary or permanent) caused directly by the proposed dredging or material disposal activities. Primary impacts also include such issues as turbidity/suspended solids, sedimentation, dissolved oxygen (DO) reduction, chemical release, noise and odor.

Secondary impacts include indirect effects such as land-based changes, increases in truck traffic and changes in vessel traffic, if any. Cumulative impacts include all long term effects of the BHNIP, in association with future maintenance dredging, and reasonably foreseeable long-range material disposal issues.

This chapter also identifies potential mitigation opportunities for these impacts within the framework of federal and state regulations. Section 6.1 summarizes and quantifies the primary, secondary and cumulative impacts caused by the preferred alternative identified in Section 4.0 of this FEIR/S.

6.1 PRIMARY IMPACTS OF PREFERRED PROJECT

6.1.1 Direct Impacts to Resource Areas

The primary impacts associated with dredging include direct disturbance of bottom sediments in the areas to be dredged. The preferred project alternative, termed the Full Project (see Chapter Two), will remove contaminated silt on 320 acres within the Boston Inner Harbor representing approximately 21% of the Inner Harbor area. This acreage is made up of the following individual areas:

Federal Project

- Reserved Channel: 44 ac.
- Main Ship Channel: 18 ac.
- Mystic River/Inner Confluence: 134 ac.
- Chelsea Creek: 68 ac.

Project Beneficiaries

- Prolerized/Distrigas Terminals: 6 ac.
- Moran Terminal: 1.5 ac.
- Eastern Minerals Terminal: 1 ac.
- Gulf Oil Terminal: 7 ac
- Conley Terminal: 14 ac.

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Non-Beneficiary Berths

- Revere Sugar Terminal: 1.5 ac.
- Mystic Piers Terminal: 3 ac.
- North Jetty Terminal: 3.5 ac.
- Army Base: 13 ac.
- Boston Edison Intake: 0.5 ac.
- Boston Edison Barge Berth: 0.5 ac.

Approximate total acreage of full project: 315.5 acres, rounded to 320 acres in this report.

The Full Project will remove about 1.1 million cy of silt, 1.7 million cy of parent material, and 88,000 cy of rock, all measured in place. Due to expansion during removal and handling, the corresponding bulked volumes required for disposal are approximately 1.4 million cy of silt, 2 million cy of parent material, and 132,000 cy of rock.

Based on chemical analyses and results presented in the DEIS/R, the parent material and rock is considered suitable for a variety of unconfined disposal options. As described in Chapter Three, several beneficial uses of this material are planned or under consideration. These include:

Parent Material

Open Water Containment Cap
Nearshore Containment Cap
Subbtidal/Intertidal Habitat Creation
Landfill Liner/Cap Closure Material

Rock

Fish Habitat Enhancement
Shoreline Protection
Containment Site Development
Upland Fill/Commercial Reuse
Armoring for Disposal Site

The disposal of the silt materials is a more complex issue. Based on the sediment analyses and results presented in the DEIR/S, the 1.4 million cy of silt generated by the Full Project is considered unsuitable for unconfined ocean disposal sites.

Chapter Four of the FEIR/S detailed the selection process for the preferred material disposal alternatives. In-channel disposal has been determined to be the LEDPA, and will handle the entire 1.4 million cy of material removed from within the dredging footprint based on design calculations performed by the Corps. The in-channel cells will occupy 116 acres.

While it is expected that in-channel disposal would provide sufficient capacity for all contaminated silts, excess capacity for contingency planning purposes, has been identified and evaluated as part of the FEIR/S in response to agency comments. As described in Chapter Four, Little Mystic Channel (LMC) could provide an additional 15 acres or 303,000 cy of confined capacity within the Mystic River Designated Port Area (DPA). This site also ranked fairly low in terms of severity of environmental impacts along with the other shoreline sites (see Table 4-6). It also rated, in general, moderately practicable in the practicability screening and was one of the least costly options (see Table 4-7).

In summary, the primary impact of the full project dredging and the in-channel

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materials disposal would include the temporary displacement of benthic substrate over approximately 320 acres in a DPA. Should the LMC be required as a contingency site, it would impact an additional 15 acres of benthic habitat in a DPA.

As part of project planning, the project team conducted a functions and values assessment. As presented in Appendix K, this assessment has been presented as a "Principal Valuable Function Evaluation" (PVF). The purpose of the PVF is to provide a process to compare real pre-project functional conditions against effects caused by the BHNIP. Based on this comparison, conceptual mitigation considerations (if necessary) can be developed to offset anticipated impacts. The PVF describes significant resource conditions during the pre-project phase and the dredging and disposal phases. The resulting substrates over the in-channel disposal areas will consist of clean granular material as opposed to the present condition of contaminated silts. Given the current trend of improvement in Boston Harbor water quality, the disposal and sequestering of contaminated silts should help to provide cumulative benefits to the BHNIP project area.

6.1.2 Dredging Impacts

6.1.2.1 Water Quality/Sediment Quality

A mechanical bucket dredge will be used to excavate the substrate. Only a relatively small percentage of the dredged material becomes suspended in the water column when the appropriate equipment (i.e., an environmental bucket for the silts) is used. More of the material would be released during dredging operations if large debris prevents the dredge bucket from closing. To minimize this, the environmental bucket will be fitted with a sensor to alert the operator if the bucket fails to close. Suspended material resulting from the dredging project is principally restricted to the silt or clay fraction ($\leq$.06 mm) with sand particles (>.06mm) settling out immediately after suspension. Grain size analyses of 18 stations in Channels identify the substrate as 86.5% clays and silt, 11.2% as sand, and 2.3% rock.

The organic material associated with the silt and clay materials could depress ambient oxygen concentrations. However, the chemical oxygen demand for all 18 stations sampled averaged 80,509 ppm for surficial samples, a moderate value. The clean parent material (approximately 62% of the material to be dredged) would not exert an oxygen demand on the water column because this material does not contain substantial organic materials. Increased turbidity would reduce light penetration, lessening primary productivity and possibly reducing oxygen release from photosynthetic processes. Finally, upon settling, the suspended sediment load, both sand and silt/clay, could cover non-motile organisms adjacent to the dredging areas.

All of these effects are expected to be spatially and temporally limited to the immediate area of the dredge and length of the activity. The benthic community in the Inner Harbor is dominated by opportunistic/pioneer species indicative of a disturbed environment. Shellfish species known to exist in the tributaries are not commercially harvested.

Monitoring results (EA, 1992) of dredging activities for the Central Artery/Third Harbor Tunnel Project (CA/T) indicated that Boston Harbor main ship channel dredge plume, generated during the tunnel trenching, was diffused and dispersed within 500 feet. Background (up-current) total suspended solids ranged from 8-20 mg/l and the plume (500-ft. down current) ranged from 8-34 mg/l. BHNIP would expect similar results. Additional modeling results are presented in Appendix F (ASA 1995). These results estimate that during dredging operations a small portion (~2%) of the dredged material is released into the water column (Tovalaro, 1984 cited in ENSR, 1991). This fraction accounts for both material suspended by the dredge (1.2%) and dredge scow overflow (0.8%). It is assumed that release from dredging operations will be continuous.

All of the effects associated with increased turbidity in Boston Harbor would occur in the immediate area of the dredge, be transported by currents, and settle rapidly. After completion of the dredging activity, these impacts will cease. The motile organisms should generally escape this downcurrent sedimentation by leaving or avoiding the area of activity. Sessile organisms will be impacted. However, sessile organisms inhabiting Boston Harbor are estuarine species that are tolerant of recurring turbidity stresses.

One of the functional characteristics of an estuarine system, such as Boston Harbor, is to serve as a nutrient retention area, increasing the productivity of its subcomponents. Nutrients are effectively "trapped" in the sediments where they are stored. This trapping and storage function also allows for the retention of pollutants in the same substrates, especially in fine grained sediment which have a larger surface area for pollutant adsorption. The physical removal of these sediments by dredging operations has the potential to release some of the sediment bound pollutants.

A review of the levels of sediment chemistry, the ambient water quality and the use of an environmental bucket or clamshell dredge, indicates that a low potential exists for substantial degradation of ambient water quality during dredging. After project completion, the benthic substrate of the Boston Harbor will be less contaminated in the dredged areas due to the removal of the surficial sediments which contain a majority of the contaminant load and placement of clean cover material, thus providing a beneficial effect.

6.1.2.2 Biological Resources

The primary impact of this project on biological resources will be the removal of benthic organisms inhabiting areas to be dredged. This impact could represent a low (29 organisms/m^2) to high (4,800 organisms/m^2) loss of benthic organisms, depending on the season and areas to be dredged. As described in Section 4.0, NAI conducted a fisheries, lobster and benthic survey within areas of the Harbor potentially affected by dredging and disposal activities. REMOTS data for the

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in-channel Mystic and Chelsea River resulted in an organism sediment index of 3.0, indicating moderate habitat value. The dredging of the channel will cause a short term loss of benthic productivity that will be rapidly offset through faunal recolonization. This recolonization potential has been recently demonstrated by MWRA studies of Harbor areas disturbed by the 1992-93 winter storms. These areas were extensively recolonized by opportunistic species such as *Ampelisca* sp. (J. Kelly, pers. comm. 1993).

Fishery resources associated with the Mystic River, Chelsea Creek and Inner Confluence should be considered moderately significant. Representative lobster catch data for the three reaches within the dredging footprint is calculated as Catch Per Unit Effort (CPUE) as follows:

Mystic River:	0.2
Chelsea River:	0.2
Inner Confluence:	0.9

Mystic River and Inner Confluence catch data are dominated by sublegal sized ($\leq$ 83mm) males, whereas Chelsea River data is equally distributed by size (legal/sublegal) and sex.

Representative BHNIP finfish data, based on 20-minute trawls, in the same study areas, is also calculated as CPUE as follows:

Mystic River:	21.8
Chelsea River:	25.0
Inner Confluence:	13.59

The Mystic River catch was dominated by winter flounder, atlantic tomcod and scup. The Chelsea River catch was also dominated by winter flounder and atlantic tomcod. At the Inner Confluence, the dominant species was winter flounder. These findings are comparable with previous finfish surveys in the area (e.g. Haedrich and Haedrich 1974).

Chemical signals essential for anadromous fishery migrations could become masked by the dredging operation's suspension of sediments and associated chemicals. Dredging will be scheduled to avoid impacting critical spawning runs of those species.

Sediment suspension will also displace motile species that will attempt to avoid gill abrasion, lower DO levels, and reduced sensory opportunities for predation (masked odors and low visibility) in the dredging area. These would be all temporary and the effects would not have long term detrimental impacts.

Mortalities of fish and invertebrates are most likely to occur during the explosive fracturing and mechanical removal of approximately 88,000 cubic yards of bedrock. Fish kill zones depend on rock density, anticipated explosive size during a single blast, open water fish kill research, and physical characteristics of the Harbor. BHNIP fish density data (two seasons of fish trawls and gill net collections) indicate the average density in Boston Harbor is approximately 10 fish/m^2. If at any given time the fish were present in the water column directly over the blast and orientated sideways to it, the maximum moralities may range from 300 to 14,000 fish per blasting operation. High end mortalities would be unusual. Monitoring of blasting operations during the navigational improvement project in Portsmouth Harbor in New Hampshire did not indicate fish kills close to these maximum ranges. However, the monitoring results recorded only the fish seen floating at the surface. Even if the number of fish killed per blast are high, they are similar to the range of fish killed in a commercial fish trawl.

Species of marine mammals which may occur in tidal waters in the vicinity of the project area, include harbor seals *(Phoca vitulina)*, harbor porpoises *(Phocena phocena)*, and grampuses *(Grampus griseus)*. However, their presence in the Boston Harbor system is uncommon (Cortell, 1990). Since most of the dredging impacts will occur well within the Inner Harbor where marine mammals are uncommon, the project is not likely to cause adverse impacts to these species.

6.1.2.3 Threatened and Endangered Species

The intertidal and subtidal areas, including and adjacent to the Federal channel, are not known to provide habitat for any Federal threatened and/or endangered species, or State rare species. Coordination with the U.S. Fish and Wildlife Service, the National Marine Fisheries Service and the State Natural Heritage Program have confirmed the lack of any threatened, endangered, or rare species in the dredging area.

6.1.2.4 Historical and Archeological Resources

Boston Harbor has been subject to navigation improvement projects since the mid-nineteenth century. The channels and rivers in and around the Harbor have been deepened, widened, and straightened. This activity has severely limited the historic and archeological potential of the Harbor.

The dredging portion of BHNIP will not adversely affect sites of historic, architectural or archeological significance, as defined by the National Historic Preservation Act of 1966. The Massachusetts Historical Commission reviewed the deep-draft navigation improvement project, including the berthing areas, and determined that dredging the previously maintained channels and berthing areas will not have an adverse impact on any historical or archeological resources.

The Chelsea Street Bridge is considered to be eligible for the National Register of Historic Places, as it is the only Strauss heel-trunnion bascule bridge known to survive in the Commonwealth. Navigation improvement dredging is not expected to impact this bridge.

6.1.2.5 Noise and Odor

Dredging with a mechanical bucket will produce noise from the engines lifting and lowering the dredge bucket. The noise produced will be similar to other diesel engine equipment in the area. Many of the receptors in the three tributaries are businesses. Residential areas only exist near the mouth of Chelsea Creek and near the Tobin Bridge. Noise may be greater during the warmer time of year when people are outside more frequently and windows are open. Although the dredges are expected to work 24 hours a day, the noise level will be masked by background noise from nearby transportation activity. Noise generated by this project should not be substantially different from other Harbor baseline noise levels.

In addition to the noise produced during the dredging operation, odor from dredged material placed on barges may occur. The odor impact, if any, would depend on the time of year and the direction of the wind. The number of barges that would be filled range from two to four per day based on the current dredging schedule (see Figure 5-3). Therefore the potential impact would be continuous while dredging the silt. Perception of odor would be minimal during the cold months of the year. This is due to the fact that more human activity would occur indoors and cold temperatures could keep the odor-causing bacteria count low. Generally, the dredging activity will be far enough away from population concentrations that mixing with ambient air is expected to be sufficient to dilute increased odors.

6.1.3 Disposal Impacts

6.1.3.1 Water Quality/Sediment Quality

Water quality modeling results (Appendix F) conclude that under continuous loading for the in-channel disposal option no constituents were found to exceed chronic water quality criteria, if material were released up to 6,000 cy/day. Instantaneous releases did not indicate any exceedence of chronic water quality criteria. It is important to note that chronic water quality criteria are the most stringent (very low levels) measure and much more stringent than the legally applicable state water quality standards.

6.1.3.2 Biological Resources

Downdrift harbor fauna should be tolerant to stresses associated with fluctuating turbidity levels and DO reduction. Given Boston Harbor hydrography, the mixing zone extends (based on TSS) over the following areas for each of the in-channel disposal sites:

Mystic River:	12.4 ac.
Chelsea Creek:	30.0 ac.
Inner Confluence:	14.7 ac.

Most of the episodic effects on biological resources will be triggered by the dredging itself. By locating the material disposal locations within the footprint of dredging limits the stresses associated with disposal.

6.1.3.3 Threatened and Endangered Species

There are no impacts anticipated, since the Federal channel and berthing areas are not known to provide habitat for any Federal threatened and/or endangered species, or any State rare species.

6.1.3.4 Historical and Archeological Resources

Historical and archeological resources are not anticipated to be impacted based on coordination with the Massachusetts Historical Commission and the Board of Underwater Archeology.

6.1.3.5 Noise and Odors

Impacts regarding noise and odors would be similar to, and part of, the actual dredging operation. Therefore noise and odors generated by the proposed material disposal operations, should not be perceivable beyond the actual dredging operations or the ambient air conditions. Noise and odor impacts may become more of an issue if excess capacity is needed in the LMC. Disposal and site grading at the LMC would be near to a housing development. Odors may be more noticeable, not only because of the proximity to sensitive receptors, but because the site will be graded to intertidal habitat, exposing the muds at low tide.

Odor controls, whether chemically applied treatments or operational controls such as observing wind direction in the disposal area, would be employed should the LMC site be needed. However, as stated earlier, the in-channel option is expected to provide sufficient capacity for the BHNIP silts.

6.2 SECONDARY IMPACTS

Secondary impacts consist of those affecting land-side issues, Harbor traffic and other socio-economic effects. The following subsections consider the identifiable secondary impacts of the preferred alternative.

6.2.1. Vessel Traffic

The BHNIP will not dramatically change operations in the Port of Boston. Vessel traffic is not expected to increase in number significantly. The current mix of vessel traffic will continue to include large container ships, barges and tankers. Some commentors expressed concern that the BHNIP will attract more ships thereby creating secondary impacts to marine mammals, ranging from disturbing normal behavior patterns to mortality from ship collisions. There are in place, Coast Guard regulations that are designed to deter interference with marine mammals in U.S. waters. The BHNIP is not designed to attract a vast array of new and larger ships. The Port geometrics, and service infrastructure, limit the eventual growth of the Port. Therefore, vessel traffic attributable to the BHNIP is not likely to have secondary impacts on navigation interests or marine mammals.

6.2.2 Terminal Improvements

The BHNIP will not dramatically change operations in the Port of Boston. Vessel traffic will continue to include a mix of large container ships, barges and tankers. The volume of cargo will not change noticeably as a result of dredging, since cargo volume depends on more than channel depth. Massport continues to upgrade its container handling facilities to provide "state of the art" off-loading and storage at Moran and Conley Terminals. Therefore dredging need not trigger additional landside improvements at these terminals.

6.2.3 Roadway Improvements

Inland transportation improvements to serve the Port of Boston have long been the subject of planning and investment. The Seaport Access system, which is part of the Central Artery/Tunnel Project will result in more direct and convenient connections for trucks between port terminals and the regional highway network. At the same time, through State and Massport effort, infrastructure changes to accommodate double-stacked trains are being promoted. This latter effort is separate from the dredging project. The BHNIP will not alter these efforts in any way.

6.2.4 Growth of Fort Devens

One of the comments on the DEIR concerned impacts of the BHNIP on Fort Devens and the surrounding area. The concern related to environmental impacts of increased activity at Fort Devens because of additional cargo volumes being handled at the "inland port". As stated heretofore, the BHNIP, alone, will not increase cargo volumes coming through the Port of Boston. Further, Fort Devens will not change significantly as an "inland port" without major investment in the railroad infrastructure serving the port.

Any project to improve rail infrastructure would be separate and distinct from the BHNIP. In 1994, 3% of containers handled in the Port of Boston were moved by rail. Of those containers, less than one third moved by rail between Moran Terminal and Ayer (Fort Devens) or beyond, with the rest going through the "inland port" facility at Fort Devens represented only 1% of the total container trade in the port of Boston. It is unlikely that this situation will change with the BHNIP. The rail route via Ayer is convenient for export cargo from New England and Canada, which represents only a small portion of the total cargo handled by the Port.

The region's imports substantially exceed the export cargo reflecting the nature of industry in the area. The New England textile and shoe industries, which traditionally exported high volume cargo through the Port, have given way to industries producing low volume, high value cargo which is generally shipped by air. The current export/import balance is expected to continue in the future regardless of the impact of dredging. Growth at Fort Devens will not be materially affected by import cargoes being carried by rail from Moran Terminal.

6.3 CUMULATIVE IMPACTS

Cumulative impacts include all long term maintenance requirements of the BHNIP in association with reasonably foreseeable long-ranged material disposal issues. These impacts also consider other actions in the Boston Harbor area that may have

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an impact on, or be impacted by, the project.

6.3.1 Maintenance Dredging

Currently, estimates indicate that BHNIP will need to dredge and dispose of 4.4 million cy of material in the 50-year project life scenario to maintain the ship channel.

The selection of the disposal site for future maintenance dredging must reexamine the environmental and practicability criteria discussed in Chapter Four. Factors such as sediment characteristics and volume of the dredging project will be critical in determining the suitability of the disposal sites. Sites that were identified in this review as having lengthy permitting needs, but were otherwise reasonable, would also be reviewed carefully. The disposal site for future maintenance will be determined based on the appropriate environmental regulations and technical evaluations at that time. The New England Division Corps recommends, and will participate with the Commonwealth, in conducting an overall regional dredged material management plan for future maintenance of all Massachusetts Bay's harbors.

6.3.2 Relationship to Other Projects

During construction of this project, additional barge traffic will occur in the shipping channels and at the open water disposal sites. Barge traffic from the BHNIP is not anticipated to interfere with barge traffic from the Central Artery/Third Harbor Tunnel (CA/T) project. Barge traffic to Spectacle Island is anticipated to be complete by the end of 1998. Barge traffic for the CA/T project will leave from Subaru Pier, north of Reserved Channel, during the summertime, May thru September. Additional small barge traffic will begin next summer in 1996 to transport material from the Fort Point crossing area. BHNIP activities will not be coincident with this work.

The MBDS is not receiving any more material from the CA/T project. Approximately 470,000 cubic yards of material from the CA/T project was disposed at the MBDS. No material was disposed at this disposal site from the Massachusetts Water Resources Authority (MWRA) project in Boston Harbor (the other large project in Boston Harbor). Other small dredging projects in the Massachusetts Bay area may dispose of materials at the MBDS. The draft and final EISs for the MBDS site designation discuss the cumulative impacts from disposal at the MBDS. However, because of the current designation restrictions to the MBDS, the likelihood of many projects being accepted for disposal there is slight.

Disposal of clean parent material at the MBDS is not expected to interfere with the monitoring efforts of the outfall pipe for the MWRA project. About 95 to 97% of the parent material will be deposited within the MBDS. Any suspended material that may leave the disposal site will be mixed and diluted with other suspended solids in Massachusetts Bay.

Beneficial cumulative impacts are expected with the dredging of silt material from the navigation improvement project. Silt

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material will be removed from the navigation channel and disposed in-channel and capped with coarse grained material which will sequester the contaminants. This will isolate the silt material, leave clean material in place, and will substantially increase the volume of clean substrate in the Inner Harbor. At the same time, the MWRA is controlling sludge and CSO's disposal into the harbor, and will have a new sewage treatment plant in operation. This will reduce the amount of contaminants released to the Harbor. The clean substrate in the Inner-Harbor and the reduced level of contaminants entering Boston Harbor will have an overall cumulative benefit.

6.3.3 Irreversible and Irretrievable Commitment of Resources

Construction of this project will result in the use of diesel engines on dredges used to remove material from the navigation channels and berthing areas, and to dispose of the material. Diesel fuel, which is an irreversible and irretrievable resource, will be used to operate this equipment. A minor temporary increase in air pollutants will occur as a result of this action.

In-channel disposal of silt material will eliminate the use of this area for future disposal of maintenance material. The contractor will be directed to dig as deeply as possible in the navigation channel to increase storage capacity. This will maximize the use of in-channel disposal and the use of parent material for beneficial use.

Disposal of clean parent material will reduce the capacity of MBDS by an incremental amount. The capacity of MBDS will be reduced by approximately two million cy (or less, if used beneficially). Although this is a large amount of dredged material, the MBDS will still have many more years of useful capacity.

6.4 MITIGATION FOR DREDGING AND DISPOSAL IMPACTS

Based on the preceding summary, several options for mitigating unavoidable impacts are described in this section. Critical to the understanding of mitigation planning is the regulatory framework that provides the underpinning for developing mitigation plans that not only address a specific impact but create long-term value to the impacted areas. This regulatory framework consists of local, state and federal interests.

An overriding principle is establishing mitigation concepts is the Council on Environmental Quality (CEQ) protocol for establishing and prioritizing mitigation measures incorporated into the Clean Water Act, Section 404 (b)(1) Guidelines, and the EPA/Corps Memorandum of Agreement on their implementation. The overall principals are:

- The avoiding of an impact altogether by not taking a certain action or part of an action;

- The minimizing of impacts by limiting the degree or magnitude of the action and its implementation;

- The rectifying of the impact by repairing, rehabilitating, or restoring the affected environment;
- The reducing or eliminating of the impact over time by preservation and maintenance operations during the life of the action; and
- The compensating for the impact by replacing or providing substitute resources or environments.

The following sections describe how the BHNIP complies with this hierarchy from project design through post-construction monitoring.

In addition to complying with specific conditions or policies as required by regulatory agencies, the BHNIP has incorporated design and operational mitigation actions to offset any adverse effects generated by the project. These include:

1. Capping with sand, with rock armoring in high-scour areas

2. Scheduling of dredging and disposal to fit environmental windows and to meet water criteria

3. Coordination with the U.S. Coast Guard to avoid interference between BHNIP activities and commercial traffic

4. Scheduling to avoid peak recreational Harbor usage (4th of July, other holidays)

5. Identification of significant structural features (bridge abutments, utility lines, bulkheads, moorings, buoys, etc.)

6. Dredging performance standards to meet environmental and permitting conditions as well as design controls

7. Use of environmental bucket to trap contaminated sediments during dredging and outfitting it with a sensor to detect closure problems due to debris

8. Use of silt curtains during disposal

9. Employment of fish deterrence systems during blasting

10. Requirement for contractor to provide an incident response plan to cover spills of dredged material, fuel, and machinery oil

11. Trash and debris management on separate scows with agreements to dispose of material in landfills

12. Contingency plans for reasonably foreseeable equipment failures, weather conditions, encounters with buried structures, and permit limit exceedences

The following paragraphs focus on resource mitigation requirements in terms of the CEQ mitigation protocol.

6.4.1 Avoidance

As described in Chapter Two, the Full Project alternative is the preferred project alternative to be implemented. The dredging footprint is unavoidable, but as described earlier, any disruption or displacement of benthic organisms is temporary.

As described in Chapter Four, the BHNIP proposes to dispose of the bulked volume of 1.4 million cy of contaminated silt using two LEDPA strategies. The first will dispose and sequester the silts in place by overdredging 54 cells into the underlying clean parent material. These cells will be located within the existing dredge footprint, avoiding additional spatial requirements.

Second, the clean parent material (clay) and rock, not expended in beneficial uses (e.g. landfill liner or capping material), will be disposed at a previously approved and permitted disposal area (MBDS). No BHNIP silt or parent material disposal will be conducted in significant offshore marine fisheries resources such as the Meisburger sites.

6.4.2 Minimization

When avoidance is not feasible, the BHNIP will be designed to minimize adverse effects to sensitive resources and interests. Minimization includes limiting the spatial extent of the proposed dredging footprint to meet the size and draft of the largest vessels transiting the proposed channel, thereby minimizing the volume of the dredge material required for disposal. Limiting project activities to areas within DPA's, minimizes impacts to areas designated to support water dependent industrial and maritime uses. Other elements minimizing impacts include the design and operational measures summarized above under Section 6.4.

6.4.3 Rectification

The BHNIP will be prepared to rectify any unexpected impacts, or impacts caused by temporary project elements (e.g. staging areas, piers, piles, etc.) after they have been used and removed from service. These activities are more fully described in the mobilization and demobilization sections of Chapter Five.

6.4.4 Reduction or Elimination

The use of in-channel cells to dispose and sequester contaminated materials reduces or eliminates future adverse effects of this material's continued exposure to aquatic resources and keeps the material close to its source and therefore does not "export" contamination to more pristine areas. This is also the case should use of LMC be required for contingency capacity. However, this contingency option would require compensation for lost benthic habitat.

6.4.5 Compensation

The mitigation protocol hierarchy places compensation for resource impacts as the lowest prioritized option. This means that avoidance, minimization, rectification or reduction of impacts should be exhausted first.

To establish compensation as a permittable mitigation option, the BHNIP must prove that the preceding mitigation alternatives (avoidance, minimization, rectification and reduction/elimination) are not completely practical or feasible to address all project impacts. Once established as a suitable mitigation option, compensation must be based on offsetting any adverse effects to protectable resources.

In an attempt to define the requirements for resource mitigation, the project team conducted a preliminary identification of potential sites and projects for mitigation consideration. Based on the PVF (Appendix K), the BHNIP should not be required to provide compensatory mitigation. These findings are summarized below:

6.4.5.1 Summary of PVF Conditions at the In-Channel Sites

Benthic Habitat: Pre-project conditions include an opportunistic and pioneer community of low abundance, over the entire 116 acres that will contain the 54 disposal cells. The disposal footprint is less than the 320 acres of dredging impact primarily since the Reserved Channel and its entrance from the Main Ship Channel, would not contain disposal cells. The project will establish 152± acres of clean granular material substrate and 50± acres of clean hard rock substrate. These project conditions will provide a more varied habitat (soft and hard substrates), and should support a more abundant and varied community (burrowing and epibenthic).

Shellfish/Lobster Habitat: Pre-project conditions include the area being mapped by EOEA (1978) as shellfish habitat, and yielded moderate CPUE catch data for lobster at 1.4 per trap day. The project will establish 152± acres of clean granular material substrate and 50± acres of clean hard rock substrate. Project effects should not alter EOEA's mapping of the shellfish resource. These conditions should enhance existing shellfish habitat, and attract hard substrate species (e.g. blue mussels); and improve existing feeding, resting, refuge and breeding habitat for lobster.

Finfish Habitat: Pre-project conditions indicate a low abundance of demersal and pelagic species typically found in the Boston Harbor area. An anadromous fish run exists through the Inner Confluence and Lower Mystic River portion of the in-channel area. Project activities may pose short-termed disruptions to existing finfish activities, but these should be limited in terms of time and location of activity and can be avoided by observing the environmental "window". The clean granular substrates should enhance finfish habitat following completion of the project.

Production Export: Production export does not exist in either the Pre-project evaluation scenarios. Parts of the 50± acres of rock cap may provide attachment for species, and any attached aquatic vegetation should provide some additional, but limited production export function, in the post project condition.

Sediment/Shoreline Stabilization: Sediment/Shoreline Stabilization occurs, and will continue to occur, in each of the evaluation scenarios. Areal bulkheads and wharves will not be adversely impacted by the project. Removal of contaminated silt and replacing the surficial layer with clean sand will also enhance this function.

Wildlife Habitat: Currently feeding habitat for waterfowl, dabbling and diving birds, and some roosting sites exist. Project activities may pose short-termed disruptions to existing wildlife activities, but these should be limited in terms of time and location. No enhancement of habitat conditions is anticipated.

6.4.5.2 Summary of PVF Conditions at LMC

As stated earlier, the project team has evaluated other disposal alternatives for capacity contingency purposes. The environmental and practicability screening described in Chapter Four indicates that Little Mystic Channel is the LEDPA for a contingency site. The following is a PVF evaluation for the LMC that is designed to help identify required mitigation actions should this site be required for excess capacity.

Benthic Habitat: Pre-project conditions include an opportunistic and pioneer subtidal community of low abundance, over the entire 15 acres. The project will change the entire site from contaminated subtidal substrate to clean intertidal substrate, and therefore should provide an opportunity for a more diverse and abundant benthic community structure.

Shellfish/Lobster Habitat: Pre-project conditions include the area being mapped by EOEA (1978) as shellfish habitat, and yielded moderate CPUE catch data for lobster at 1.1 per trap day. The project will establish up to 15 acres of clean soft granular material intertidal substrate. These conditions should enhance existing shellfish habitat for soft-shell clams and ribbed mussels, but will eliminate transient lobster habitat.

Finfish Habitat: Pre-project conditions indicate a low abundance of demersal and pelagic species typically found in the Boston Harbor area. The site is also adjacent to an anadromous fish run in the Lower Mystic River. Project activities convert the site from transient demersal and pelagic habitat to an intertidal fish habitat.

Production Export: The establishment of clean intertidal substrate should attract both rooted and attached aquatic vegetation, and should provide some additional, but limited, production export function.

Sediment/Shoreline Stabilization: The proposed intertidal conditions will continue to function as buffeting from wave and current energy.

Wildlife Habitat: Currently, feeding habitat for waterfowl, dabbling and diving birds, and some roosting sites, exist. Project activities may pose short-termed disruptions to existing wildlife activities, but these should be limited in terms of time and location. Proposed intertidal conditions should provide additional feeding habitat for wading and shorebirds. However, wildlife usage is highly dependent on areal land uses, and in this case, urban and maritime, may limit the amount of achievable enhancement.

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Endangered Species Habitat: Endangered species habitat does not occur at this site.

6.4.6 Resource Enhancement Concepts

Given the findings provided in the PVF, the BHNIP should pose only limited negative temporary effects to either the in-channel or Little Mystic Channel PVF's. In fact, the project as designed appears to provide significant on-site enhancement of project specific PVF's primarily through the sequestering of contaminated sediments and placement of clean substrate. Given these findings, no compensatory resource mitigation should be required under either federal or state wetland regulations for the in-channel option. Resource compensation may be required at the LMC for converting subtidal to intertidal habitat. Should this contingency site be required, consultation with the appropriate resource agencies will identify compensatory mitigation options. However, for the preferred alternative, no compensatory mitigation is required.

As local sponsor, Massport is willing to work with state resource agencies to identify resource enhancement opportunities in the Harbor Area. As examples, these can include supporting the development of an "urban fishing park" through rehabilitation of water access structures to enhance public use and access to functional, recreational fishing areas. In addition, Massport is willing to work with appropriate agencies to increase the number of vessel sewage pump-out facilities in the Harbor Area.

6.4.7 Summary

Massport will continue to explore resource enhancement options, if required, during the permitting of the project. The project as designed contains numerous operational mitigative measures. The preferred disposal alternatives meets the CEQ protocol for establishing and prioritizing mitigation measures, and is the least environmentally damaging alternative. The Draft Section 61 finding included as Chapter Eight, summarizes the mitigation actions proposed for the project and for meeting permit requirements identified in the next Chapter.

Chapter Seven: BHNIP Regulatory Status

The purpose of this section is to clearly outline a non-exhaustive list of anticipated permitting issues relative to mitigation, which will require project compliance; and the means by which the BHNIP currently complies, or how the BHNIP proposes to comply with all relevant jurisdictional requirements.

7.1 LOCAL JURISDICTION

Dredging and dredge material disposal activities will occur in three separate municipalities, which include the Cities of Boston, Everett and Chelsea. In telephone conversations with each city's conservation commission (ConComs), on January 23 and 31, 1995, it was reported that none of these cities have local wetland protection bylaws. Therefore they have no apparent mitigation jurisdiction beyond that which is designated to them through state law and regulation.

7.2 STATE JURISDICTION

The proposed dredging and disposal plan occur within Designated Port Areas (DPA's). This is significant to the application of the Chapter 91, and coastal zone management and state wetland programs having jurisdiction over this project. The DPA's are illustrated on Figure 7-1 and 7-2.

7.2.1 Massachusetts Waterways Licensing Program (MGL c.91 and 310 CMR 9.00)

The Massachusetts Waterways Licensing Program, dated October 4, 1990 (c. 91) defines DPA's as follows:

> "Those areas designated in 310 CMR 9.24 (2) and (3) of the Waterways Regulations promulgated in 1978 (MGL c. 91 and 310 CMR 9.00); and are almost completely developed areas where few or no natural land forms or vegetation remain. They tend to be paved, bulkheaded, and used for heavy industry so that they have virtually no significance to the interests of the Act, except for land under the ocean." (A Guide to the Coastal Wetlands Regulations of the Massachusetts Protection Act G.L. 131, s.40, Cooperative Extension Service, UMASS, Amherst, 1978, pg. 13)

As currently set forth in 310 CMR 9.04, the following geographic areas are subject to jurisdiction, relative to the BHNIP:

- all waterways, including flowed tidelands; and
- all filled tidelands, except for landlocked tidelands.

C. 91 also allows that the Massachusetts Port Authority (Massport) "in accordance with its Enabling Act, St. 1956 c. 465,

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may undertake certain activities within certain geographic areas without written authorization (emphasis added) in the form of a license or permit from the Massachusetts Department of Environmental Protection (MADEP) 310 CMR 9.03 (3). Except as provided in 310 CMR 9.03 (3)(b), Massport shall obtain a license or permit pursuant to c. 91 for any project consisting entirely of (emphasis added) uses other than water-dependent industrial uses." Privately owned berths to be dredged in the BHNIP may require individual compliance.

While Massport may be exempt from a requirement for written authorization, any project that includes dredging or dredged material disposal must comply with the following requirements relative to DPA's (310 CMR 9.40):

1) The design and timing of dredged material disposal activity shall be such as to avoid interference with anadromous/catadromous fish runs. At a minimum, no such activity shall occur in such areas between March 15th and June 15th of any year, except upon a determination by the Division of Marine Fisheries (MADMF) that such an activity will not obstruct or hinder the passage of fish.

2) The design and timing of dredging and dredged material disposal activity shall be such as to minimize adverse impacts on shellfish beds, fishery resource areas, and submerged aquatic vegetation. MADEP will consult with the MADFM regarding the assessment of such impacts.

Additional requirements for all dredging and dredge material disposal projects (310 CMR 9.36 (3-5)) include requirements for operations issues associated with dredging and disposal. These are considered in the Dredge Management Plan.

Finally, all projects under c. 91 jurisdiction must conform with all relevant federal, state and local environmental protection standards; municipal zoning and harbor plans; and must meet all standards to preserve water related public rights (310 CMR 9.33 through 9.35 et seq). Massport, and the Corps are not subject to zoning requirements. Individual, private berth owners, however, must comply.

7.2.2 Massachusetts Wetland Protection Act (MGL c. 131, § 40 and 310 CMR 10.00)

The Massachusetts Wetlands Protection Act and its implementing regulations describe the performance standards within DPA's.

Land under the ocean in DPA's plays a role in flood control, storm damage prevention, and the protection of marine fisheries. The additional functions in DPA's include support for coastal engineering structures, such as bulkheads, seawalls, revetments, and solid fill piers. This support contributes to its value for flood control and storm damage prevention.

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Since land under the ocean is considered the only resource impacted by the BHNIP, this limits protectable interests to storm damage prevention and flood control, and protection of marine fisheries. Activities which could affect these interests include:

- Dredging;
- Construction of Seawalls;
- Dredge Material Disposal;
- Bulkheads and Revetments; and
- Point Discharges;
- Piers, Docks, Wharves, Floats,
- Fill; Piles and Dolphins.

These activities are typically acceptable in DPA's. Table 7-1 lists those conditions which must be met, in order to obtain an Order of Conditions for these activities in DPA's.

Revisions to dredge material disposal compliance requirements are currently proposed by the MADEP, Division of Water Pollution Control (DWPC) in water quality certification regulations (314 CMR 9.07) effective March 1, 1995. Table 7-2 is a reproduction of Table III from 314 CMR 9.07. These revised regulations more clearly outline specific disposal opportunities for the dredge material.

The in-channel disposal option, with clean granular capping, is most closely represented by confined (bulk-headed) in-Harbor disposal and therefore may comply with these requirements. As stated earlier in this FEIR, portion of the BHNIP dredge material disposal program would be to dispose of up to 303,000 cy of silt material at LMC, as a contingency should the projected volume capacity of the in-channel cells be inadequate to handle the entire volume. This disposal alternative will displace up to 15 acres of subtidal estuarine resource. Chapter Four of the FEIR/S describes the biological/ecological resource quality as being degraded. Should the use of this site be required to provide additional disposal area for the silts, these materials will be completely sequestered from the remaining aquatic environment. As shown in Table 7-2, this activity may also be approvable with effluent control.

7.2.3 MCZM Jurisdictional Review and Policies Relative to DPA's (MGL c. 6a, § 2-7 and 301 CMR 20.00)

301 CMR 20.05 sets forth the regulatory and non regulatory policies adopted for the MCZM project review program. Of special significance to the BHNIP are regulatory policies 1, 4, 5 and 7 and non-regulatory policy 7.

Regulatory policy 1 is concerned with protecting ". . . ecologically significant resource areas (salt marshes, shellfish beds, dunes, barrier beaches and salt ponds) for their contribution to maritime productivity and value as natural habitats and storm buffers."

Regulatory policy 4 conditions construction in water bodies ". . . to minimize interference with water circulation and sediment transport and to preserve water quality and marine productivity . . ."

Regulatory policy 5 extends this concern to ensure that ". . . dredging and disposal of dredged material minimizes adverse effects on water quality, physical processes, marine productivity and public health."

Regulatory policy 7 encourages ". . . the location of maritime commerce and development in segments of urban waterfronts designated as port areas.

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Within these areas, prevent the exclusion of maritime dependent industrial uses that require the use of lands subject to tidelands licenses."

Non-Regulatory policy 7 encourages ". . expansion of water-dependent uses in DPA's and developed harbors, redevelopment of urban waterfronts and expansion of visual access."

The intent of these policies is to ensure that special physical and operational requirements of uses dependent on access to navigable channels are recognized while not compromising environmental resources. In addition, assigning priority to the use of DPA's for maritime dependent industrial development encourages such uses to locate there. These policies, therefore, minimize the need for dredging new deepwater channels elsewhere and maximize the use of prior public investments made in existing port facilities.

According to MCZM policy statement and guidance (310 CMR 20.99) all proposals for maritime-dependent industrial developments in DPA'S will be encouraged by MCZM and will be facilitated as much as possible by the EOEA agencies, unless the proposed use will seriously conflict with, or preempt other existing maritime-dependent industrial uses in that port, or other ports.

The BHNIP dredging and disposal plans appear consistent with their CZM policies.

7.2.4 Massachusetts Division of Water Pollution Control, Clean Water Act 401 Certification (314 CMR 9.00)

Under Section 401 of the federal Clean Water Act, an applicant proposing any activity requiring a federal permit that will result in a discharge to waters or wetlands subject to federal jurisdiction is required to obtain a state certification that the project will comply with state water quality standards. For purposes of Section 401, "discharges" include the filling of "waters of the United States" requiring a Section 404 permit under the Clean Water Act and discharges associates with dredging and dredged material disposal under Sections 9 and 10 of the Rivers and Harbors Act.

A 401 Water Quality Certification issued by the Department of Environmental Protection is a determination that the proposed activity will not violate the Massachusetts Surface Water Quality Standards, as implemented by 314 CMR 9.00. The Department may, during the course of its review of any project, attach conditions to ensure that water quality is protected, environmental damage is minimized, and all other applicable state requirements are satisfied. This certification is necessary for the federal permit to be valid, and any certification conditions become conditions of the federal permit.

The regulations also contain criteria for dredging and dredged material disposal. In addition to Section 404 permits for the discharge of dredged and fill material in wetlands, the Department must also certify permits issued by the Corps of Engineers to implement Sections 9 and 10 of the Rivers and Harbors Act of 1899 for structures or work in or affecting the course, location, condition or capacity of navigable waters of the United States. Under Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972, the Corps of Engineers regulates the transportation of dredged material by vessel or other vehicle for the purpose of dumping it in ocean waters at designated dumping sites. These activities also may require a Section 401 Water Quality Certification from the Department. Section 307(c) of the Coastal Zone Management Act of 1972 requires applicants to obtain a certification or waiver that the activity complies with the state's coastal zone management program for activities affecting a state's coastal zone.

The water quality certification application must demonstrate that the proposed action is the preferred, practicable alternative. Chapter Four provides a step-wise screening approach to determine that the in-channel option is the least environmentally damaging alternative. The application must also demonstrate that all practicable steps have been taken which will minimize potential adverse impacts.

Chapter Six presents a summary of design, operational, and resource enhancement options that are made part of the BHNIP to address these concerns. In addition a fate and transport model of all aquatic alternatives was prepared (see Appendix F) to compare impacts of dredging and disposal to stringent chronic water quality criteria. The model indicates that, with appropriate operational scheduling, the in-channel alternatives meets the most stringent chronic water quality criteria.

Based on the technical information presented in the Draft and Final EIR/S, the BHNIP preferred alternative will comply with the requirements for a water quality certification.

7.3 FEDERAL JURISDICTION

Permits will be required for various Massport activities and structures within Corps jurisdiction, including dredging of berth areas. The Corps administers Section 404 of the Clean Water Act and Section 10 of the River and Harbors Act of 1899 which regulates structures and work in navigable waters.

All permit applications will be evaluated by the Corps based on a public interest review of the probable impacts of the proposed activity and its use. 404(b)(1) Guidelines compliance must be demonstrated through "factual determination" before permit issuance. These Guidelines prohibit discharges into aquatic areas where less environmentally damaging practicable alternatives exist. Table 7-3 contains the factual determinations for all short-listed sites. These factual determinations are based on the findings of the current BHNIP environmental database and the PVF described in Chapter Six.

Once compliance is clearly demonstrated by the applicant, the Corps can proceed with an evaluation of public interest. The Corps considers the following criteria, among others in evaluating an application: the need for the project; practicability of reasonable alternatives and the beneficial and or detrimental effects.

The Federal portion of the project also requires compliance with the 404(b)(1) guidelines. This FEIR/S is intended to serve both the Massport berth dredging project and the Federal portion of the BHNIP.

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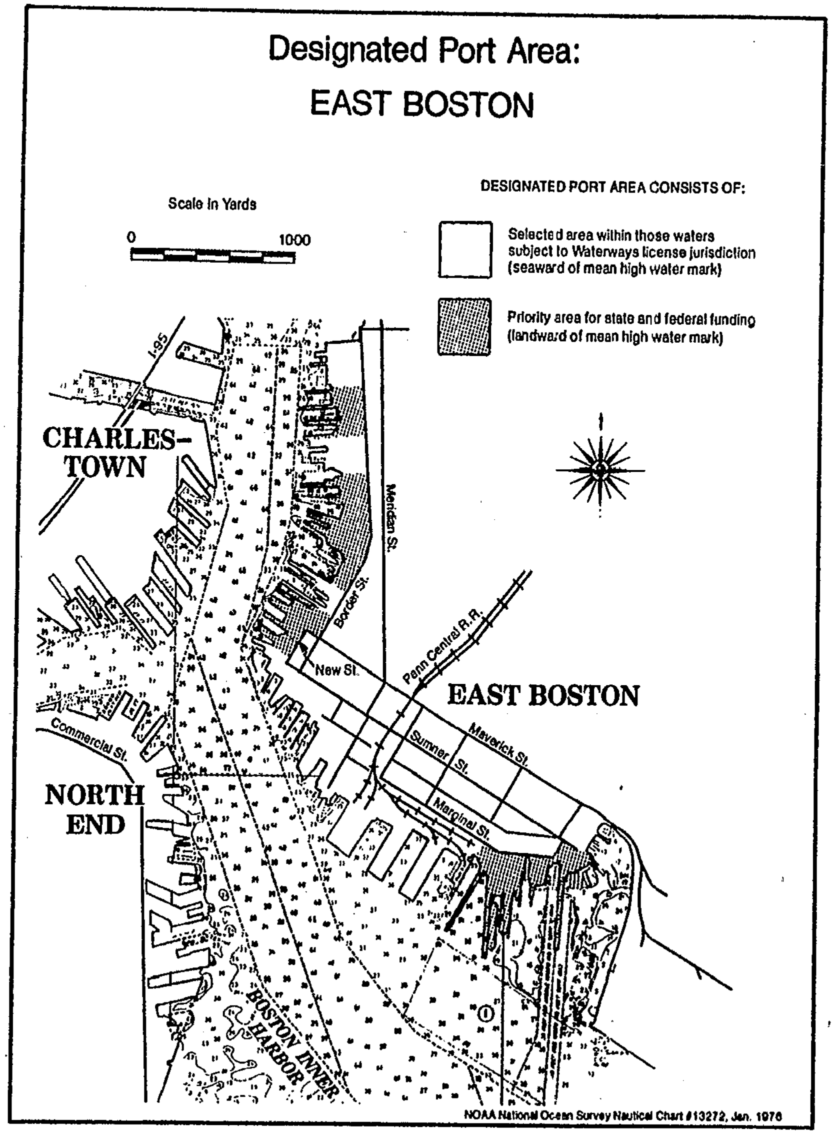

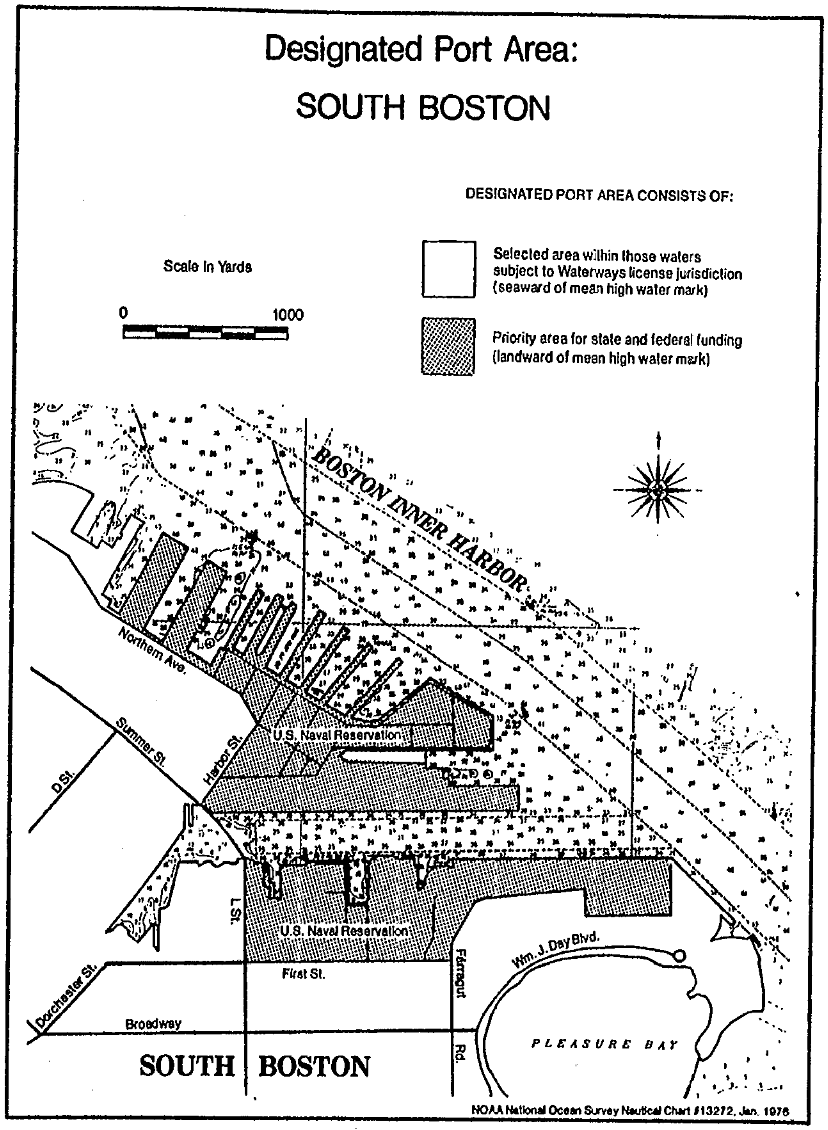

FIGURE 7-1: PROJECT SPECIFIC DESIGNATED PORT AREAS

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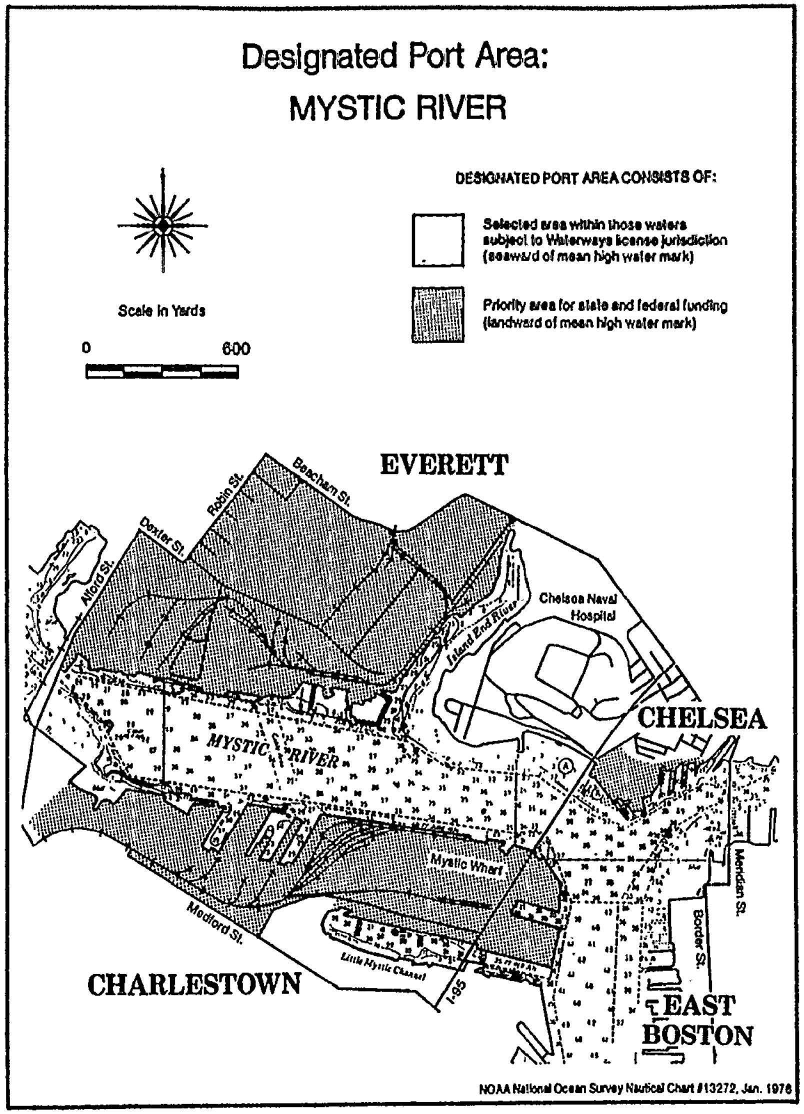

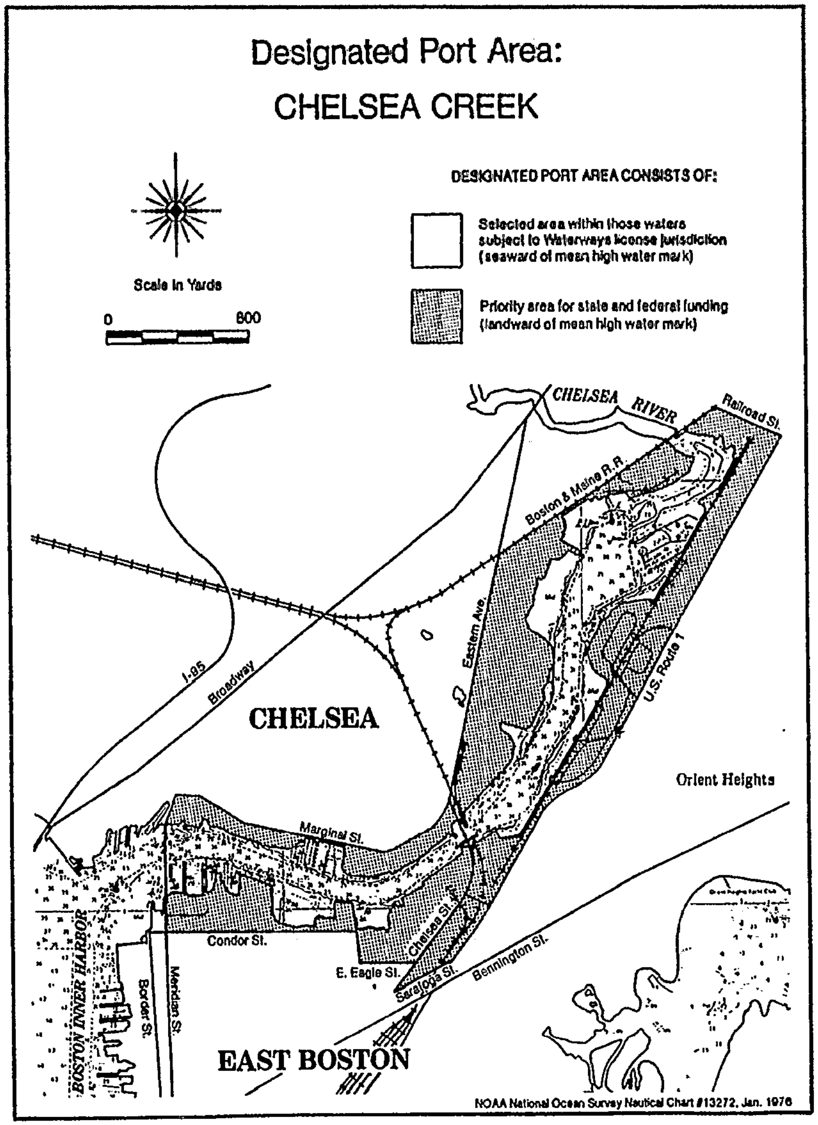

FIGURE 7-2: PROJECT SPECIFIC DESIGNATED PORT AREAS

TABLE 7-1: ACCEPTABILITY CONDITIONS FOR ACTIVITIES WITHIN DPA'S

Activity	Interest to be Protected	Adverse Effects to Interest	Conditions Required to Meet Performance Standards
Dredging	Protection of marine fisheries	• Dredging may adversely affect water circulation by creating areas of stagnation • Dredging may adversely affect water quality by changing dissolved oxygen, temperature, turbidity, or by stirring up pollutants in the bottom sediments. A high concentration of certain pollutants in the bottom sediments, such as PCB's or heavy metals, may preclude the possibility of dredging under the regulations of the Division of Water Pollution Control (DWPC).	• Dredge channel and port area so that all portions of them will be adequately flushed by the tides. • Complete the dredging operation as quickly as possible by using the most efficient and practical equipment. • Where possible, schedule dredging so as not to conflict with fisheries use. • Bottom sediment analysis and evaluation of dredging should be coordinated with the DWPC. • Minimize the amount of dredging.
	Storm damage prevention and flood control	• Extensive dredging of a port area may increase wave height, which may increase their potential destructive energy.	• Whenever possible, channel axis should not be parallel to direction of major storm waves.

TABLE 7-1: ACCEPTABILITY CONDITIONS FOR ACTIVITIES WITHIN DPA'S (continued)

Activity	Interest to be Protected	Adverse Effects to Interest	Conditions Required to Meet Performance Standards
Dredge Material Disposal	Storm damage prevention and flood control	• Disposal of dredged material may cause shoaling of nearshore land under ocean which will interrupt sediment transport processes, thereby affecting the volume and form of coastal beaches. • Disposal of clean dredged material may cause the shoaling of nearshore land under the ocean which can create areas of stagnation.	• Wave height at any point along the shoreline shall not increase by more than 10% by disposal of dredged material on nearshore areas of land under ocean.
	Protection of marine fisheries	• Disposal of clean dredged material can alter the distribution of sediment grain size. • Disposal of clean dredged material may bury eel grass beds.	• Disposal of spoil in discontinuous bands, interrupted at least every 250 ft. by 50 ft. breaks to provide for passage of water, nutrients and aquatic life. (These figures are guidelines only; the concept should be adjusted as necessary in the particular project). • Dredged material disposal on any portion of land under the ocean shall have a mean grain size distribution which does not differ from the existing land under the ocean sediment grain size by more than 50% . • Disposal of dredged material should avoid eel grass beds to the maximum extent possible.

TABLE 7-1: ACCEPTABILITY CONDITIONS FOR ACTIVITIES WITHIN DPA'S (continued)

Activity	Interest to be Protected	Adverse Effects to Interest	Conditions Required to Meet Performance Standards
Fill	Protection of marine fisheries	• The process of placing fill behind or within seawalls or bulkheads may cause turbidity and sedimentation. • Pollutants which may be present in the fill may be leached out into or resuspended in the water column.	• Fill must be contained within a seawall, bulkhead, or revetment permitted by the Regulations. • The area to be filled shall be dewatered prior to placement of the fill or a silt-ation curtain shall be placed immediate-ly around the retaining structure to contain the material suspended in the water displaced as the area is filled, where conditions permit. • Only clean fill may be permitted (see description of clean fill in the water-ways (c. 91) regulations.
Seawalls, Bulkheads, and Revetments	Protection of marine fisheries	• Construction of seawalls, bulk-heads and revetments are likely to adversely affect water quality by generating turbidity in the area.	• The construction should be accomplished as quickly as possible using the most efficient and practical equipment.
	Storm damage prevention and control	• The placement of seawalls, bulk-heads and revetments within the DPA's is not likely to have an adverse effect to storm damage prevention and flood , control.	• No conditions are necessary

TABLE 7-1: ACCEPTABILITY CONDITIONS FOR ACTIVITIES WITHIN DPA'S (continued)

Activity	Interest to be Protected	Adverse Effects to Interest	Conditions required to Meet Performance Standards
Point Discharges (de-watering)	Protection of marine fisheries	• Runoff from roads and parking lots or other paved surfaces contains pollutants such as oil, grease, heavy metals and particulate matter, thereby adversely affecting water quality.	• Sedimentation or catch basins as appropriate to the amount of runoff. • Gas traps. • Periodic maintenance and cleaning of the basins and traps. • Periodic cleaning of debris from paved surfaces.
	Storm damage prevention and flood control	• Headwall and support may interrupt sediment transport.	• Headwall and supports must be spaced so that sediment transport is not interrupted.
Piers, Docks, Wharves, Floats, Piles and Dolphins	Storm damage prevention and flood control	• Piers, piles, etc., are unlikely to have an adverse effect on storm damage prevention in DPA's.	• No conditions are necessary.
	Protection of marine fisheries	• Piers, piles, etc., which are too close together may alter water circulation and cause areas of stagnation, thereby adversely affecting water quality. • Installation of piles, piers, etc., may cause turbidity and sedimentation during the construction process.	• Space piles as far apart as practical for the structure being built, in no case less than 10 feet apart. • Construction shall be completed as quickly as possible to minimize the amount of turbidity and sedimentation.

Information contained in this table from:
A Guide to Coastal Wetlands Regulations of the Massachusetts Wetlands Protection Act G.L. 131, s.40, Cooperative Extension Service, UMASS, Amherst, 1978.

TABLE 7-2: NORMALLY APPROVABLE DREDGING HANDLING AND DISPOSAL OPTIONS									
Chemical Type (Table I)	Category One			Category Two			Category Three		
Physical Type (Table II)	A	B	C	A	B	C	A	B	C
DREDGING METHODS									
Hydraulic	X	X	X	X	X	X	X	X	X
Mechanical	X	X	X	X	X	X	X	X	X
DISPOSAL METHODS									
Hydraulic: Sidecast	X	X	O	O	O	O	O	O	O
Hydraulic: Pipeline	X	X	X	X	X	X	X	X	X
Mechanical: Sidecast	X	X	O	O	O	O	O	O	O
Mechanical: Barge	X	X	X	X	X	X	X	X	X
PLACEMENT									
Land or in-harbor disposal with bulk-heading	X	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Open ocean disposal at high energy, sandy sites	X	O	O	O	O	O	O	O	O
Open ocean disposal at low energy, sandy sites	O	X	(b)	O	(b)	(b)	(b)	(b)	(b)
Unconfined in-harbor	X	O	O	O	O	O	O	O	O
Beach Replenishment	X	O	O	O	O	O	O	O	O
OTHER CONDITIONS									
Timing and placement to Avoid Fisheries Impacts (spawning and running periods and areas)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)

Legend X = Normally approvable
O = Not normally approvable
(a) = Normally approvable but control of effluent will be required
(b) = Approvable only after bioassay, performed in accordance with established EPA procedures, indicates no significant biological impact. A statistically comparable project which has successfully passed the bioassay test may be substituted. If a significant biological impact is found, this material is unsuitable for open water disposal.
(c) = Required in all cases

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TABLE 7-3 FACTUAL DETERMINATION: IN-CHANNEL SITES

404(B)(1) GUIDELINES	*EXISTING CONDITIONS*	*SHORT-TERM CONDITIONS*	*LONG-TERM CONDITIONS*
SUBSTRATE	Contaminated silt overlying clean parent material (clay).	Post-dredge and disposal substrate will be clean parent and/or capping material (clay or sand).	Clean parent material will eventually be covered with new silts from point and non-point discharges.
WATER CIRCULATION, FLUCTUATION, AND SALINITY	150 billion gallon tidal prism.	No impacts anticipated.	No additional impacts are anticipated.
TURBIDITY/TSS	Class SB water (314 CMR 4.05-4.06), an urbanized estuarine condition.	≤ 700 mg/l @ surface for up tp 600 m, ≤ 1,100 mg/l @ bottom for up tp 1000 m, (LaSalle etal 1991); any plume should rapidly dissipate.	Should return to Class SB water in an urbanized estuarine condition.
CONTAMINANTS	Class SB water (314 CMR 4.05 -4.06), silts are considered contaminated, parent material and rock considered clean.	Low potential for substantial degredation of ambient water quality, substrate conditions should greatly improve with the removal of the contaminated silts.	As future siltation proceeds, the substrate condition will to deteriorate.
AQUATIC ECOSYSTEM	Opportunistic/pioneer benthic community, marginally significant transient fishery and a fish run.	Opportunistic/pioneer species should recolonize and rework new substrate material, transient aquatic macrofauna should return following dredging activities, there are some losses to finfish expected due to blasting of rock.	Opportunistic/pioneer species should recolonize and rework new substrate material, transient aquatic macrofauna should return following dredging activities, there are some losses to finfish expected due to blasting of rock.
MIXING ZONE	Open water site with no existing mixing zone.	During disposal activities, isolated with silt curtains/barriers, a vertical mixing zone will include the water column overlying the pit; localized and temporary turbidity events should dissipate rapidly.	No additional impacts are anticipated.
CUMULATIVE EFFECTS	Benthic substrate is currently degraded due to the on-going silting of the harbor and the contaminated point and non-point discharges to the harbor.	Dredging and capping of In-channel disposal cells will expose clean parent material as new substrate.	As future siltation proceeds, the substrate condition will continue to deteriorate.
SECONDARY EFFECTS	Contaminated silts will remain exposed as the bottom substrate in the inner harbor and berthing areas.	Creation of 116 acres of clean parent material intertidal habitat will replace degraded intertidal and subtidal conditions; opportunistic and pioneer species should naturally recruit to the area and rework new sediments; limited hard substrate habitat will remain; and finfish utilization will be limited to periods of inundation.	Biological communities and habitats should further improve with the on-going improvements to the Boston Harbor System and water quality.

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TABLE 7-3 (CON'T) FACTUAL DETERMINATION: AMSTAR SITE

404(B)(1) GUIDELINES	*EXISTING CONDITIONS*	*SHORT-TERM CONDITIONS*	*LONG-TERM CONDITIONS*
SUBSTRATE	Three types of existing intertidal substrate; hard substrate (pilings and seawalls), gravel/cobble beach, and boulders; also 3.5 acres of category III gray silty/clays.	Creation of 3.5 acres of clean parent material intertidal habitat will replace degraded intertidal and subtidal conditions; opportunistic and pioneer species should naturally recruit to the area and bioturbate new sediments.	Intertidal habitat should should be limited by surrounding conditions, no additional impacts are anticipated.
WATER CIRCULATION, FLUCTUATION, AND SALINITY	Circulation at Amstar influenced by tidal exchange.	Less exchange since bottom elevation will be increased, will remain intertidal.	No additional impacts anticipated.
TURBIDITY/TSS	Class SB water in an urbanized estuarine condition.	Localized and temproary impacts are anticipated during the disposal operation at Amstar, silt curtains should isolate turbid conditions to a limited area.	Siltation curtains and barriers should remain and be maintained until any turbidity plume dissipates, and poses little to no risk to receiving waters.
CONTAMINANTS	Class SB water in an urbanized estuarine condition.	Sequestering of 128,000 cy of silt should isolate contaminats from the Mystic River environment.	No additional impacts anticipated.
AQUATIC ECOSYSTEM	Existing conditons include barnacle, mussel, green algae and *Fucus sp.* on hard substrate; polychaetes, oligochaetes and nematodes in the soft substrate; and the protected waters within the berthing area provide finfish refuge and forage habitat.	Loss of subtidal substrates will displace existing benthic invertebrates (polychaetes and oligochaetes and nematodes), reduce productivity of barnacles, mussels and green algae; finfish utilization will also be altered, and limited to periods of tidal inundation.	Creation of 3.5 acres of clean parent material intertidal habitat will replace degraded intertidal and subtidal conditions; opportunistic and pioneer species should naturally recruit to the area and rework new sediments; limited hard substrate habitat will remain; and finfish utilization will be limited to periods of inundation.
MIXING ZONE	Abandoned berthing area with no existing mixing zone.	During disposal activities, isolated with silt curtains/barriers, a vertical mixing zone will include the entire and subtidal water columns within the site, and turbidity should settle and/or slowly be diluted by tidal circulation.	Siltation curtains and barrier should remain and be maintained until any turbidity plume dissipates, and poses little to know risk to receiving waters.
CUMULATIVE EFFECTS	Benthic substrate is currently degraded due to the on-going silting of the harbor system, and the contaminated point and non-point discharges.	Sequestering of 128,000 cy of contaminated silts over 3.5 acres of degraded benthic habitat, and a permanenet loss of 3.5 acres of subtidal habitat.	Creation of 3.5 acres of clean parent material intertidal habitat will replace degraded intertidal and subtidal conditions; opportunistic and pioneer species should naturally recruit to the area and rework new sediments; limited hard substrate habitat will remain; and finfish utilization will be limited to periods of inundation.
SECONDARY EFFECTS	Site remains in an abandoned, degraded condition; with a potential for future development.	Creation of 3.5 acres of clean parent material intertidal habitat will replace degraded intertidal and subtidal conditions; opportunistic and pioneer species should naturally recruit to the area and rework new sediments; limited hard substrate habitat will remain; and finfish utilization will be limited to periods of inundation.	Biological communities and habitats should further improve with the on-going improvements to the Boston Harbor System and water quality.

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TABLE 7-3 (CON'T) FACTUAL DETERMINATION: BOSTON LIGHTSHIP SITE (BLS)

404(B)(1) GUIDELINES	*EXISTING CONDITIONS*	*SHORT-TERM CONDITIONS*	*LONG-TERM CONDITIONS*
SUBSTRATE	Sedimentary and depositional environment dominated muddy sands and mud; historic disposal indicates that hazardous and low level radioactive wastes are present at the site.	Deposition of silt and clay should be compatible with existing substrate variability and character; unconfined disposal will compound historic contamination problems.	Unsecured contaminated silts may have limiting effects on individuals recolonizing the disposal area; risks are anticipated to be limited.
WATER CIRCULATION, FLUCTUATION AND SALINITY	Open ocean circulation influenced by tides and winds.	Changes in bottom contours should not alter existing surface water hydrology.	No additional impacts are anticipated.
TURBIDITY/TSS	Class SA water Quality, limited turbidity.	≤ 700 mg/l @ surface for up tp 600 m, ≤ 1,100 mg/l @ bottom up tp 1000 m, (LaSalle etal 1991); any plume should rapidly dissipate.	No additional impacts are anticipated.
CONTAMINANTS	Surface waters appear relatively free of contaminants, but sediments are suspected of being contaminated with hazardous and low-level radioactive wastes.	Project specific modelling (REFERENCE) indicates that limited water quality degradation should be anticipated during disposal, in the worst case, degredation should be limited and rapidly dissipated within hours of disposal.	Since BLS is suspected of containing unsecured wastes, the addition of contaminated silts from BHNIP should have little addtional effects to the area.
AQUATIC ECOSYSTEM	Sediments are dominated by an amphipod/polychaete, nemertean worm and burrowing anemone community; and both the lobster and finfish community are significant and representative of a typical Gulf of Maine fishery.	A portion of the benthic resources should be lost during disposal activities, but should rapidly recolonize following the activities, lobster and finfish resources should evacuate the area during operations and should also return following the cessation of activities.	As the regenerating ecosystem develops, the fishery community should also respond with greater abundance and diversity.
MIXING ZONE	Open water site with no existing mixing zone.	During open water disposal the vertical mixing you will include the water column overlying the target area, localized and temporary turbidity events should dissipate rapidly.	No additional impacts are anticipated.
CUMULATIVE EFFECTS	An area of potentially degraded sediments which is heavily fished commercially.	Disposal of -- cy of contaminated silt should have limited effects on areal water quality; these activities will cause short term reductions on fishery resources, abundances and diversity.	Unsecured contaminated silts may have limited, but continued effects on individuals recolonizing the disposal area; risks are anticipated to be limited.
SECONDARY EFFECTS	Availability of suitable disposal areas are limited, therefore non-use could limit future disposal options.	Current and documented fishing activities (commercial and recreational) would be interrupted during the disposal operations.	Use of the site for future maintenance dredge material disposal could periodically interrupt offshore fishing activities.

TABLE 7-3 (CON'T) FACTUAL DETERMINATION: LITTLE MYSTIC CHANNEL (LMC)

404(B)(I) GUIDELINES	*EXISTING CONDITIONS*	*SHORT-TERM CONDITIONS*	*LONG-TERM CONDITIONS*
SUBSTRATE	Fine grained silt/clay with elevated metal levels (Category II and III-314 CMR 9.00), and elevated levels of PAH's, TPH,s and PCB's.	Temporary loss of 153 acres of existing substrate, replaces with clean parent material capping and sequestering contaminated dredge material and existing substrate.	Cap material placed at the site should be quickly recolonized and reworked.
WATER CIRCULATION, FLUCTUATION AND SALINITY	Circulation in LMC is influenced by tidal exchange, six discharge pipes and a CSO.	No impacts are anticipated.	No additional impacts are anticipated.
TURBIDITY/TSS	Class SC water (314 CMR 4.05-4.06), an urbanized estuarine condition.	Localized and temporary impacts are anticipated during disposal operations in LMC, silt curtains should isolated turbidity within a limited area.	No additional impacts are anticipated.
CONTAMINANTS	Class SC water (314 CMR 4.05-4.06), an urbanized estuarine condition; depressed DO; and polyhaline.	Post disposal substrate will be clean parent and or capping material (clay or sand), over 15.3 acres of existing benthic substrate; contaminants should be sequestered.	No additional impacts are anticipated.
AQUATIC ECOSYSTEM	Benthic infauna include oligochaetes, polychaetes and nematodes; limited lobster; and several finfish are associated with the main ship channel, and should move in and out of LMC.	Benthic infauna impacts should be temporary and recolonization of opportunistic/pioneer species should occur in the capping material; motile species will evacuate the work area and those not limited by depth requirements should return post activity.	Creation of 15.3 acres of clean parent material intertidal habitat will replace degraded intertidal and subtidal conditions; opportunistic and pioneer species should naturally recruit to the area and bioturbate new sediments; limited hard substrate habitat will remain; and finfish utilization will be limited to periods of indundation.
MIXING ZONE	Open water site with no existing mixing zone, but adjacent to shore-based discharge/ CSO's.	During disposal activities, isolated with silt curtains/barriers, a vertical mixing zone will include the entire and subtidal water columns within the site, and turbidity should settle and/or slowly be diluted by tidal circulation.	Siltation curtains and barrier should remain and be maintained until any turbidity plume dissipates, and poses little to know risk to receiving waters.
CUMULATIVE EFFECTS	Benthic substrate and water quality are currently degraded due to the on-going silting of the harbor, and the contaminated point and non-point discharges to the harbor.	Disposal and sequestering contaminated silts and capping, over the existing degraded substrate will provide clean substrate for recolonization.	Creation of 15.3 acres of clean parent material intertidal habitat will replace degraded intertidal and subtidal conditions; opportunistic and pioneer species should naturally recruit to the area and rework new sediments; limited hard substrate habitat will remain; and finfish utilization will be limited to periods of indundation.
SECONDARY EFFECTS	Site remains in an abandoned, degraded condition; with a potential for future development.	Creation of 15.3 acres of clean parent material intertidal habitat will replace degraded intertidal and subtidal conditions; opportunistic and pioneer species should naturally recruit to the area and rework new sediments; limited hard substrate habitat will remain; and finfish utilization will be limited to periods of indundation.	Biological communities and habitats should further improve with the on-going improvements to the Boston Harbor System and water quality.

TABLE 7-3 (CON'T) FACTUAL DETERMINATION: MASSACHUSETTS BAY DISPOSAL SITE (MBDS)

404(B)(1) GUIDELINES	*EXISTING CONDITIONS*	*SHORT-TERM CONDITIONS*	*LONG-TERM CONDITIONS*
SUBSTRATE	A permitted open ocean disposal site with varying sediment characteristics and quality; subject of historic disposal, sandy silt and fine silt/clay ranging from low to high levels of various contaminants.	Continued variable texture and quality.	No additional impacts are anticipated.
WATER CIRCULATION, FLUCTUATION AND SALINITY	Open ocean circulation influenced by tides and winds.	Changes in bottom contours at this deep water site should not alter existing surface water hydrology.	No additional impacts are anticipated.
TURBIDITY/TSS	Open ocean water considered relatively clean, therefore limited turbidity.	$\leq$ 700 mg/l @ surface for up tp 600 m, $\leq$ 1,100 mg/l @ bottom for up tp 1000 m, (LaSalle etal 1991); any plume should rapidly dissipate.	No additional impacts are anticipated.
CONTAMINANTS	Surface waters appear relatively free of contaminants, but sediments contain levels ranging from low to high relative to various contaminants.	Project specific modelling (REFERENCE) indicates that limited water quality degredation should be anticipated during disposal, in the worst case, degredation should be limited and rapidly dissipated within hours of disposal; unsecured contaminated silts may have limited, but continued effects on individuals recolonizing MBDS, risks are anticipated to be limited.	Since MBDS contains unsecured wastes, the addition of unsecured or capped contaminated silts from BHNIP should have little additional effect to the habitats of this permitted disposal site.
AQUATIC ECOSYSTEM	Sediments are dominated by a variety of polychaetes and oligochaetes; both the lobster and finfish comminities are significant and representative of a typical Gulf of Maine fishery with some southern influences.	A portion of the benthic resources should be lost during disposal activities, but should rapidly recolonize following operations; lobster and finfish resources should evacuate the area during operations and should also return following the cessation of activities.	As the regenerating ecosystem develops, the fishery community should also respond with greater abundance and diversity.
MIXING ZONE	Open water site with no existing mixing zone.	During open water disposal the vertical mixing you will include the water column overlying the target area, localized and temporary turbidity events should dissipate rapidly.	No additional impacts are anticipated.
CUMULATIVE EFFECTS	An area of degraded sediments which is heavily fished commercially.	Disposal of clean parent materials should have limited effects on areal water quality; these activities will cause short termreductions on fishery resources, abundances and diversity.	Unsecured contaminated silts may have limiting effects on individuals recolonizing MBDS, risks are anticipated to be limited.
SECONDARY EFFECTS	Availability of suitable disposal areas are limited, therefore non-use could limit future disposal options.	Current and documented fishing activities (commercial and recreational) would be interrupted during the disposal operations.	Use of the site for future maintenance dredge material disposal could periodically interrupt offshore fishing activities.

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TABEL 7-3 (CON'T) FACTUAL DETERMINATION: MEISBURGER 2

404(B)(1) GUIDELINES	*EXISTING CONDITIONS*	*SHORT-TERM CONDITIONS*	*LONG-TERM CONDITIONS*
SUBSTRATE	Clean sand and gravel, appears suitable for beach nourishment and capping.	Material disposal would occur and be contained within a borrow pit and capped with clean parent material and the final cover would be a portion of the sand and gravel removed during the pit construction; and therefore would be similar to existing conditions.	No additional impacts are anticipated.
WATER CIRCULATION, FLUCTUATION AND SALINITY	Open ocean circulation influenced by tides, winds and major riverflow.	Underwater contours would be returned to pre-project conditions, with the final capping of sand and gravel.	No additional impacts are anticipated.
TURBIDITY/TSS	Class SA water quality, limited turbidity.	$\leq$ 700 mg/l @ surface for up tp 600 m, $\leq$ 1,100 mg/l @ bottom for up tp 1000m, (laSalle etal 1991); any plume should rapidly dissipate.	No additional impacts are anticipated.
CONTAMINANTS	Surface waters and sediments appear relatively free of contamination.	Project specific modelling (REFERENCE) indicates that limited water quality problems should be anticipated during pit construction and moreover, during disposal; in the worst case degedation should be limited and rapidly dissipated and diluted.	No additional impacts are anticipated.
AQUATIC ECOSYSTEM	Sediments dominated by amphipod/polychaete assemblage, lobster appear significant to the area, and the finfish community is significant and comprised of typical Gulf of Maine demersal and pelagic structure with some southern influences (NA 1995).	Benthic community will be completely lost during pit construction, but should recolonize the final cap after disposal operations are completed, lobster and finfish resources should evacuate the area during operations and should also return to the area followng the cessation of activities.	As the regenerating ecosystem develops, the fishery community should also respond with greater numbers and diversity.
MIXING ZONE	Open water site with no existing mixing zone.	During open water disposal the vertical mixing you will include the water column overlying the target area, localized and temporary turbidity events should dissipate rapidly.	No additional impacts are anticipated.
CUMULATIVE EFFECTS	An area relatively free of contaminants, which is heavily fished commercially.	Sequestering of 10^6 - 10^7 cy of dredged material and future maintenance material within the borrow pit, capped with clean parent material will have limited effects on areal water quality, which will occur only during project activites; these activities will cause short term reductions on fishery resources, abundance and diversity.	As the regenerating ecosystem develops, the fishery community should also respond with greater numbers and diversity.
SECONDARY EFFECTS	Availability of suitable disposal areas are limited, therefore non-use could limit future disposal options.	Current and documented fishing activities (commercial and recreational) would be interrupted during the disposal operations.	Use of the site for future maintenance dredge material disposal could periodically interrupt offshore fishing activities.

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TABLE 7-3 (CON'T) FACTUAL DETERMINATION: MEISBURGER 7

404(B)(1) GUIDELINES	*EXISTING CONDITIONS*	*SHORT-TERM CONDITIONS*	*LONG-TERM CONDITIONS*
SUBSTRATE	Clean sand and gravel, appears suitable for beach nourishment and capping.	Material disposal would occur and be contained within a borrow pit and capped with clean parent material and the final cover would be a portion of the sand and gravel removed during the pit construction; and therefore would be similar to existing conditions.	No additional impacts are anticipated.
WATER CIRCULATION, FLUCTUATION AND SALINITY	Open ocean circulation influenced by tides, winds and major riverflow.	Underwater contours would be returned to pre-project conditions, with the final capping of sand and gravel.	No additional impacts are anticipated.
TURBIDITY/TSS	Class SA water quality, limited turbidity.	≤ 700 mg/l @ surface up tp 600 m, ≤ 1,100 mg/l @ bottom for up tp 1000 m, (LaSalle etal 1991); any plume should rapidly dissipate.	No additional impacts are anticipated.
CONTAMINANTS	Surface waters and sediments appear relatively free of contamination.	Project specific modelling (REFERENCE) indicates that limited water quality problems should be anticipated during pit construction and moreover, during disposal; in the worst case degedation should be linited and rapidly dissipated and diluted.	No additional impacts are anticipated.
AQUATIC ECOSYSTEM	Sediments dominated by amphipod/polychaete assemblage, lobster appear significant to the area, and the finfish community is significant and comprised of typical Gulf of Maine demersal and pelagic structure with some southern influences (NA 1995).	Benthic community will be completely lost during pit construction, but should recolonize the final cap after disposal operations are completed, lobster and finfish resources should evacuate the area during operations and should also return to the area followng the cessation of activities.	As the regenerating ecosystem develops, the fishery community should also respond with greater numbers and diversity.
MIXING ZONE	Open water site with no existing mixing zone.	During open water disposal the vertical mixing you will include the water column overlying the target area, localized and temporary turbidity events should dissipate rapidly.	No additional impacts are anticipated.
CUMULATIVE EFFECTS	An area relatively free of contaminants, which is heavily fished commercially.	Sequestering of up to 19.5 million cy of material and future maintenance material within the borrow pit, capped with clean parent material will have limited effects on areal water quality, which will occur only during project activities; these activities will cause short term reductions on fishery resources, abundance and diversity.	As the regenerating ecosystem develops, the fishery community should also respond with greater numbers and diversity.
SECONDARY EFFECTS	Availability of suitable disposal areas are limited, therefore non-use could limit future disposal options.	Current and documented fishing activities (commercial and recreational) would be interrupted during the disposal operations.	Use of the site for future maintenance dredge material disposal could periodically interrupt offshore fishing activities.

TABLE 7-3 (CON'T) FACTUAL DETERMINATION: MYSTIC PIERS 49-50

404(B)(1) GUIDELINES	*EXISTING CONDITIONS*	*SHORT-TERM CONDITIONS*	*LONG-TERM CONDITIONS*
SUBSTRATE	Contaminated silt overlying clean parent material.	Displacement of 2.7 acres of contaminated silty substrate.	Sequestering of 98,000 cy of contaminated silts over 2.7 acres of degraded benthic substrate.
WATER CIRCULATION, FLUCTUATION AND SALINITY	Circulation influenced by tidal exchange.	Entire watersheet area lost to fastland.	No additional impacts are anticipated.
TURBIDITY/TSS	Class SB water in an urbanized estuarine condition.	Sheet pile bulkhead and dewatering, limited turbidity when the bulkhead is driven.	No additional impacts are anticipated.
CONTAMINANTS	Contaminated silt overlying clean parent material.	Sequestering of 98,000 cy of contaminated silts over 2.7 acres of degraded benthic substrate.	No additional impact are anticipated.
AQUATIC ECOSYSTEM	Areal opportunistic/pioneer benthic community, fairly significant transient and brood fishery, and fish run in adjacent river habitat.	Permanent loss of 2.7 acres of aquatic habitat.	Permanent loss of 2.7 acres of aquatic habitat.
MIXING ZONE	Abandoned berthing area with no existing mixing zone.	Mixing zone will be limited to any temporary or permanent dewatering outfall to the Mystic River; any plume should be limited and rapidly dissipated.	No additional impacts are anticipated.
CUMULATIVE EFFECTS	Benthic substrate is currently degraded due to the on-going silting of the harbor system, and the contaminated point and non-point discharges.	Sequestering of 98,000 cy of contaminated silts over 2.7 acres of degraded benthic substrate, and a permanent loss of 2.7 acres of aquatic habitat.	Permanent loss of 2.7 acres of aquatic habitat.
SECONDARY EFFECTS	Site remains in an abandoned, degraded condition; with a potential for future development.	Dewatering discharges.	On-going maintenance of bulkheading to eliminate potential of seeps or releases of sequestered materials.

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TABLE 7-3 (CON'T) FACTUAL DETERMINATION: RESERVED CHANNEL (RC) AREA A

404(B)(1) GUIDELINES	*EXISTING CONDITIONS*	*SHORT-TERM CONDITIONS*	*LONG-TERM CONDITIONS*
SUBSTRATE	Gray/black silt and clay, contaminated substrate (category II and III).	Temporary loss of 8.9 acres of existing substrate, replaced with clean parent material capping and sequestering contaminated dredge material and existing substrate.	Cap material placed at the site should be quickly recolonized and reworked.
WATER CIRCULATION, FLUCTUATION AND SALINITY	Circulation in RC is influenced by tidal exchange and three CSO's.	Sewer outfall would need to be relocated, no other impacts are anticipated.	No additional impacts are anticipated.
TURBIDITY/TSS	Class SC water (314 CMR 4.05-4.06), an urbanized estuarine condition.	Localized and temporary impacts are anticipated during disposal operation in RC, silt curtains should isolate turbid conditions to a limited area.	No additional impacts are anticipated.
CONTAMINANTS	Gray/black silt and clay, contaminated substrate (category II and III); class SC water (314 CMR 4.05-4.06), an urbanized estuarine condition.	Sequestering of 14,000 cy of silt should isolate contaminats from the areal environment.	No additional impacts are anticipated.
AQUATIC ECOSYSTEM	Piles, granite seawalls, floating docks and metal bulkheads support green algae, *Fucus sp.*, barnacles, and periwinkles; soft sediments contain oligochaetes, polychaetes and nematodes; finfish habitat is present, but appears limited to transient use, although flounder spawning habitat may be present.	Loss of subtidal substrates displacing existing benthic invertebrates (poychaetes, oligochaetes and nematodes), reduce productivity of barnacles, mussels and algae; finfish utilization will also be altered, and limited to periods of tidal inundation; any flounder spawning habitat will be lost.	Creation of 8.9 acres of clean parent material intertidal habitat will replace degraded intertidal and subtidal conditions; opportunistic and pioneer species should naturally recruit and bioturbate new sediments; limited hard substrates will remain; and finfish utilization will be limited to periods of tidal inundation.
MIXING ZONE	Open water site with no existing mixing zone, but adjacent to shore-based discharge/CSO's.	During disposal activities, isolated with silt curtains/barriers, a vertical mixing zone will include the entire intertidal and subtidal water columns within the site, and turbidity should settle and/or slowly be diluted by tidal circulation	Siltation curtains and barriers should remain and be maintained until any turbidity plume dissipates, and poses little to no risk to receiving waters.
CUMULATIVE EFFECTS	Benthic substrate is currently degraded due to the on-going silting of the harbor system, and the contaminated point and non-point discharges.	Sequestering of 14,000 cy of contaminated silts over 8.9 acres of degraded benthic habitat, and a permanenet loss of 8.9 acres of subtidal habitat.	Creation of 8.9 acres of clean parent material intertidal habitat will replace degraded intertidal and subtidal conditions; opportunistic and pioneer species should naturally recruit and rework new sediments; limited hard substrates will remain; and finfish utilization will be limited to periods of tidal inundation.
SECONDARY EFFECTS	Site remains in an abandoned, degraded condition; with a potential for future development.	Creation of 8.9 acres of clean parent material intertidal habitat will replace degraded intertidal and subtidal conditions; opportunistic and pioneer species should naturally recruit and rework new sediments; limited hard substrates will remain; and finfish utilization will be limited to periods of tidal inundation.	Biological communities and habitats should further improve with the on-going improvements to the Boston Harbor System and water quality.

TABLE 7-3 (CON'T) FACTUAL DETERMINATION: RESERVED CHANNEL (RC) AREA B

404(B)(1) GUIDELINES	*EXISTING CONDITIONS*	*SHORT-TERM CONDITIONS*	*LONG-TERM CONDITIONS*
SUBSTRATE	Gray/black silt and clay, contaminated substrate (category II and III).	Temporary loss of 7.7 acres of existing substrate, replaced with clean parent material capping and sequestering dredge material and existing substrate.	Cap material placed at the site should be quickly recolonized and reworked.
WATER CIRCULATION, FLUCTUATION AND SALINITY	Circulation in RC is influenced by tidal exchange and three CSO's.	Sewer outfall would need to be relocated, no other impacts are anticipated.	No additional impacts are anticipated.
TURBIDITY/TSS	Class SC water (314 CMR 4.05-4.06), an urbanized estuarine condition.	Localized and temporary impacts are anticipated during disposal operation in RC, silt curtains should isolate turbid conditions to a limited area.	No additional impacts are anticipated.
CONTAMINANTS	Gray/black silt and clay, contaminated substrate (category II and III); class SC water (314 CMR 4.05-4.06), an urbanized estuarine condition.	Sequestering of __ cy of silt should isolate contaminants from the areal environment.	No additional impacts are anticipated.
AQUATIC ECOSYSTEM	Steel bulkhead, granite seawall and sloping rip-rap supports a moderate growth of *Fucus sp.*, *Ulva sp.* and *Enteromorpha sp.* and barnacles; small gravel beach supports periwinkles; soft substrates support polychaetes, oligochaetes and nematodes; finfish habitat is present, but appears limited to transient use, although flounder spawning habitat may be present.	Loss of subtidal substrates displacing existing benthic invertebrates (polychaetes, oligochaetes and nematodes); reduced productivity of barnacles, mussels and algae; finfish utilization will also be altered, and limited to periods of tidal inundation; any flounder spawning habitat will be lost.	Creation of 7.7 acres of clean parent material intertidal habitat will replace degraded intertidal and subtidal conditions; opportunistic and pioneer species should naturally recruit and rework new sediments; limited hard substrates will remain; and finfish utilization will be limited to periods of tidal inundation.
MIXING ZONE	Open water site with no existing mixing zone, but adjacent to shore-based discharges/CSO's.	During disposal activities, isolated with silt curtains/barrier, a vertical mixing zone will include the entire intertidal and subtidal water columns within the site, and turbidity should settle and/or slowly be diluted by tidal circulation.	Siltation curtains and barriers should remain and be maintained until any turbidity plume dissipates, and poses little to no risk to receiving waters.
CUMULATIVE EFFECTS	Benthic substrate is currently degraded due to the on-going silting of the harbor system, and the contaminated point and non-point discharges.	Sequestering of __ cy of contaminated silts over 7.7 acres of degraded benthic habitat, and a permanenet loss of 7.7 acres of subtidal habitat.	Creation of 7.7 acres of clean parent material intertidal habitat will replace degraded intertidal and subtidal conditions; opportunistic and pioneer species should naturally recruit and bioturbate new sediments; limited hard substrates will remain; and finfish utilization will be limited to periods of tidal inundation.
SECONDARY EFFECTS	Site remains in an abandoned, degraded condition; with a potential for future development.	Creation of 7.7 acres of clean parent material intertidal habitat will replace degraded intertidal and subtidal conditions; opportunistic and pioneer species should naturally recruit and rework new sediments; limited hard substrates will remain; and finfish utilization will be limited to periods of tidal inundation.	Biological communities and habitats should further improve with the on-going improvements to the Boston Harbor System and water quality.

TABLE 7-3 (CON'T) FACTUAL DETERMINATION: REVERE SUGAR

404(B)(1) GUIDELINES	*EXISTING CONDITIONS*	*SHORT-TERM CONDITIONS*	*LONG-TERM CONDITIONS*
SUBSTRATE	Contaminated silt overlying clean parent material.	Displacement of 3.7 acres of contaminated silty substrate.	Sequestering of 85,000 cy of contaminated silts over 3.7 acres of degraded benthic substrate.
WATER CIRCULATION, FLUCTUATION AND SALINITY	Circulation influenced by tidal exchange.	Entire watersheet area lost to fastland.	No additional impacts are anticipated.
TURBIDITY/TSS	Class SB water in an urbanized estuarine condition.	Sheet pile bulkhead and dewatering, limited turbidity when the bulkhead is driven.	No additional impacts are anticipated.
CONTAMINANTS	Contaminated silt overlying clean parent material.	Sequestering of 85,000 cy of contaminated silts over 3.7 acres of degraded benthic substrate.	No additional impacts are anticipated.
AQUATIC ECOSYSTEM	Areal opportunistic/pioneer benthic community, fairly significant transient and brood fishery, and fish run in adjacent river habitat.	Permanent loss of 3.7 acres of aquatic habitat.	Permanent loss of 3.7 acres of aquatic habitat.
MIXING ZONE	Abandoned berthing area with no existing mixing zone.	Mixing zone will be limited to any temporary or permanent dewatering outfall to the Mystic River; any plume should be limited and rapidly dissipated.	No additional impacts are anticipated.
CUMULATIVE EFFECTS	Benthic substrate is currently degraded due to the on-going silting of the harbor system, and the contaminated point and non-point discharges.	Sequestering of 85,000 cy of contaminated silts over 3.7 acres of degraded benthic substrate, and a permanent loss of 3.7 acres of aquatic habitat.	Permanent loss of 3.7 acres of aquatic habitat.
SECONDARY EFFECTS	Site remains in an abandoned, degraded condition; with a potential for future development.	Dewatering discharges.	On-going maintenance of bulkheading to eliminate potential for seeps or releases of sequestered materials.

TABLE 7-3 (CON'T) FACTUAL DETERMINATION: SPECTACLE ISLAND CAD

404(B)(1) GUIDELINES	*EXISTING CONDITIONS*	*SHORT-TERM CONDITIONS*	*LONG-TERM CONDITIONS*
SUBSTRATE	Fine sand, silt and clay; Category I (314 CMR 9.00, generally clear of contaminants; high levels of arsenic in both surface and deep sediments.	Capping of the disposal pit with parent material, and final capping with on-site borrow material should preserve existing substrate conditions.	No additional impacts are anticipated.
WATER CIRCULATION, FLUCTUATION AND SALINITY	Tidal circulation dominates with wave heights ranging from 0.09-2.6 ft and wave powers of 0.1-412.9 ft lbs/sec.	Cap elevation will mimic existing bathymetry.	No additional impacts are anticipated.
TURBIDITY/TSS	Class SB water (314 CMR 4.05-4.06), influenced by raw sewage discharges, CSO's, various industrial discharges, and urban runoff.	≤ 700 mg/l @ surface for up to 600 m, ≤ 1,100 mg/l @ bottom for up to 1000 m (LaSalle etal 1991); any plume should rapidly dissipate.	Should return to Class SB water.
CONTAMINANTS	Fine sand, silt and clay; Category I (314 CMR 9.00, generally clear of contaminants; high levels of arsenic in both surface and deep sediments.	Capping of the disposal pit with parent material, and final capping with on-site borrow material should preserve existing substrate conditions.	No additional impacts are anticipated.
AQUATIC ECOSYSTEM	Benthic resources are dominated by amphipods, gastropods and nereid worms; EPB lobsters; and forage and predator finfish species.	After construction/and disposal activities, opportunistic/pioneer benthic resources should recolonize the site.	Benthic resources should continue to be dominated by amphipods, gastropods and nereid worms; EPB lobsters; and forage and predator finfish species.
MIXING ZONE	Open water site with no existing mixing zone.	During disposal activities, isolated with silt curtains/barriers, a vertical mixing zone will include the water column overlying the pit; localized and temporary turbidity events should dissipate rapidly.	No additional impacts are anticipated.
CUMULATIVE EFFECTS	The area has been affected by the historic Spectacle Island Landfill; however, this condition should be improving based on CA/T capping and securing of the island.	No impacts are anticipated.	No additional impacts are anticipated.
SECONDARY EFFECTS	Benthic resources are dominated by amphipods, gastropods and nereid worms; EPB lobsters; and forage and predator finfish species.	Benthic resources should continue to be dominated by amphipods, gastropods and nereid worms; EPB lobsters; and forage and predator finfish species.	Biological communities and habitats should further improve with the on-going improvements to the Boston Harbor System and water quality.

Chapter Eight: Draft Section 61 Findings

This chapter of the FEIR/S presents draft Section 61 Findings as required by M.G.L. c. 30 § 61. The MEPA regulations (301 CMR 11.01 (3)) require review and evaluation of projects to determine whether all feasible means and measures will be used to avoid or minimize damage to the environment. The draft evaluation required by M.G.L. c. 30 § 61 can be contained in the EIR and the required findings should be based on the EIR. No agency may act on a permit or commence a project until this finding is complete.

This chapter contains a Draft Section 61 finding to comply with Massport's responsibilities as the project's local sponsor. A final finding will be prepared by Massport after two key events occur. These are:

- The Secretary issues a certificate on the FEIR/S, and

- The results of a second and final confirmatory sampling round of fisheries, benthics and lobster resources, conducted in April/May 1995, are completed. This data will be made part of the Final Section 61 Finding.

As stated in 301 CMR 11.10, any agency which acts on a project for which an EIR has been prepared must make a finding. This requires DEP to prepare a Section 61 finding before it issues permits and certifications for the BHNIP. This Chapter therefore, also serves to provide a draft finding that the DEP may use as a basis for their required finding.

Section 61 findings typically consist of the following:

- project description;
- overall project impacts;
- specific impacts and mitigation measures for these impacts; and
- a summary of findings.

Section 8.1 contains Massport's draft finding and follows the outline described above. The information presented in each section may be repetitive with preceding information in other sections of this FEIR/S but is repeated as appropriate to complete the draft finding. Section 8.2 contains a model finding for the DEP agencies that will have permitting responsibility for portions of the project.

8.1 DRAFT SECTION 61 FINDING FOR MASSPORT

8.1.1 Project Description

The Boston Harbor Navigation Improvement and Berth Dredging Projects (BHNIP) encompass the deepening of three tributary channels (Reserved Channel, Mystic River Channel and Chelsea Creek Channel) and two areas in the Main Ship Channel (Inner Confluence and the mouth of Reserved Channel) to provide sufficient ship maneuvering areas for the deepened channels; six berth areas that would benefit directly from the channel deepening (Conley 11-13, Prolerized, Distrigas, Moran, Eastern Minerals and Gulf Oil);

and six berth areas and one intake structure that would not benefit directly from (i.e., be connected to) the channel deepening (Boston Army, Boston Edison Intake, Boston Edison Barge, Conley 14-15, Revere Sugar, Mystic Piers 1, 2, 49 and 50). The President Roads Anchorage Area and adjacent channels would be re-marked to enlarge the deep water anchorage without additional dredging. Deepening of the channels to -40 ft MLW (except Chelsea Channel to -38 ft MLW) would allow greater use of the hitherto underutilized -40 ft MLW Entrance Channel and Main Ship Channel (see Figure ES-1).

The improvements to the three Federal channels were proposed as a result of a Feasibility Study completed by the Corps of Engineers in 1988. The three-channel project was selected as the economically and environmentally preferred project alternative. It was authorized by Congress in the Water Resources Development Act of 1990 (P.L. 101-640). The authorized project would allow the Port of Boston to maintain its competitiveness in the highly competitive national and international marine trade business by reducing the cost of transporting goods and thus improving efficiency.

Massachusetts Port Authority (Massport), as local sponsor of the project, submitted an Environmental Notification Form (ENF) to Massachusetts Executive Office of Environmental Affairs in April 1991. The Secretary's Certificate on the ENF required the preparation of an Environmental Impact Report (EIR) with three major areas of focus:

- sediment characterization,
- evaluation of disposal alterna tives, and
- a dredging management plan.

The Corps of Engineers, New England Division, committed to preparing an EIS in 1992 due to the cumulative impacts of Federal actions (maintenance dredging, navigation improvement dredging, and permitting of the associated berthing areas) and the significant public concern over disposal of dredged material. Because the channel improvement and berth dredging projects are intricately linked and interdependent and would be reviewed by the same regulatory audience, it was determined that preparation of a joint Environmental Impact Report/Statement (EIR/S) would be most efficient.

A Draft EIR/S was published in April 1994. The FEIR/S responded to comments received on the Draft including the Secretary's certificate dated June 10, 1994 and complied with the requirements for an FEIR as described in 301 CMR 11.07 (10). The document also met the requirements for an FEIS as specified in 40 CFR Part 1503.

The purpose of the BHNIP is to increase the navigational efficiency and safety of Boston Harbor for present types of deep draft vessels. This purpose was the basis for the 1988 Feasibility Report prepared by the Corps to conclude that the project was justified economically. There are also direct economic benefits that accrue to the Port from the BHNIP. These include: 1) increased navigational efficiency and safety by reducing the need to wait out tides or to decrease loads prior to entering the Harbor; 2) the ability to ship more tons of containerized cargo with fewer ships; 3) the ability to attract new shipping lines;

and 4) ability to maintain vital refined oil products facilities and allow for double-hulled tankers.

The BHNIP will result in removal of approximately 1.1 million cubic yards (cy) of silt (as measured in-place). The total quantity of silt requiring disposal is slightly higher, 1.4 million cy, which accounts for 0.5 feet of over-dredging into the underlying parent material and a 20% expansion factor due to dredging. An extensive sediment sampling and testing program was undertaken to characterize the dredged material. The surficial silt layer (or "maintenance" material) was found to contain varying concentrations of metals, polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and other organics. The sediment bulk chemistry data, in combination with test organism toxicity and bioaccumulation testing, indicated that the silt was generally unsuitable for unconfined open water disposal. The complete chemical and bioassary results are provided in Appendix C of the Draft EIR/S.

It was further determined that the underlying sediment (parent material) was composed of clay and sand/gravel and has low levels of metals and organics. The Corps initially determined that approximately 360,000 cy of silt was suitable for ocean disposal. Using the same data, however, the EPA determined that none of the silt was suitable for unconfined ocean disposal. In response, the Corps adopted the more conservative position and assumed that all silt from the project is considered unsuitable for unconfined ocean disposal.

The underlying parent material, composed primarily of Boston Blue Clay with gravel pockets, has been shown on this and other projects to be uncontaminated and suitable for unconfined open water disposal. The total volume of approximately 2 million cy of parent material (including the expansion factor) can be disposed at an unconfined open water site if no beneficial uses (e.g., landfill and/or capping) are identified. The final component of the dredged material is rock that would be removed from Mystic River Channel and two areas of the Main Ship Channel. Beneficial uses considered for the 132,000 cy (post-dredging volume) of rock included habitat enhancement or armoring disposal sites that are subject to high-energy hydrodynamics.

In addition to addressing the dredged material disposal needs for the BHNIP itself, disposition of the future maintenance of the deepened channels over the 50 year project life was addressed. The estimated 4.4 million cy of future maintenance material would be composed primarily of silt. For the purpose of the disposal alternatives analysis, it has been assumed that this material could contain elevated levels of contaminants. Under this assumption (which may or may not be the case), the material would have to be deposited in a confined disposal site yet to be determined. The BHNIP will not require federal maintenance dredging for an estimated ten years. The Corps has responsibility for maintenance dredging.

An environmental and practicability evaluation of options led to the identification of the in-channel disposal option as the least environmentally damaging and practicable alternative. Chapter Four of the FEIR/S provided the environmental and practicability screening of 24 potential disposal sites. The in-channel option combines three sites within the Harbor. This option disposes of silt

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within the dredging footprint of the Mystic and Chelsea Rivers and the Inner Confluence in cells constructed in the parent material that are capped with sand after filling. The in-channel option confines most impacts to the dredging footprint, and is rated the least environmentally damaging practicable alternative (LEDPA).

The FEIR/S also identified a secondary preferred alternative site for excess silt capacity should the preferred alternative fail to provide sufficient capacity after the project is underway. Based on the environmental and practicability screening process mentioned above, the Little Mystic Channel was identified as a secondary contingency site. This site would be filled to mean low water, changing approximately 15 acres from a subtidal, but degraded condition, to intertidal habitat with clean substrate. This option provides approximately 373,000 cy of contingency capacity. If this site is required for secondary capacity, mitigation for change in substrate will be discussed with the appropriate resource agencies when required.

8.1.2 Summary of Project Impacts

Certain short-term adverse effects of the dredging and in-channel disposal would be unavoidable. Some benthic organisms and demersal fish would be killed during dredging and blasting. Substrate in the areas dredged would be temporarily devoid of benthic organisms but would be recolonized in approximately one year, reforming habitat with prey suitable for fin fish. Turbidity would increase temporarily in the area of the dredge. Use of an environmental (closed) bucket will help minimize contaminant release. Other turbidity controls, such as silt curtains, will be assessed in terms of suitability depending on the location of the dredging operation. Close monitoring of the dredging operations, to identify problems and quickly seek corrective measures, will be undertaken.

The anticipated dredging rate would generate approximately two to four barges per day, depending on whether one or two dredges were operating and the size of the barges. Thus barge traffic should not noticeably impede normal ship traffic. Interference with navigation would be minimized by coordination with the Coast Guard.

Impacts due to disposal of dredged materials are temporary since they do not permanently alter the substrate of the in-channel areas. Also, in-channel disposal impacts remain within the footprint of the dredging so that resource areas outside the navigation channels are not impacted except for temporary turbidity impacts.

During the 1½ year dredging process non-motile benthic organisms utilizing the disposal areas would be buried. Recolonization should occur within one year after disposal operations are completed based on the existing benthic population of early successional stage organisms. Fin fish would tend to avoid the area during disposal due to noise and turbidity disturbances. The benthos and fish would eventually recolonize the dredge site and will benefit from the removal of contaminated silts. Important anadromous fish populations would be protected by suspending dredging and disposal in the Mystic River during the running season.

The water column in the vicinity of the disposal site would experience increased turbidity following each disposal event. Approximately three to five percent of the silt/clay fraction would be lost to the environment during the disposal descent phase. Disposal simulation model evaluations indicated that disposal will not cause adverse exposure (i.e., exceedances of water quality criteria). Based on Total Suspended Solids (TSS), a turbidity plume has been calculated based on fate and transport modeling. It will not interfere with fish passage and migration. Use of mitigation measures, such as silt curtains, to contain suspended solids and associated chemicals, are proposed as additional safeguards to minimize water quality impacts in the Harbor.

Secondary impacts of the project, consisting of land-side infrastructure impacts, Harbor traffic, and other socioeconomic interests, are minimal. The BHNIP is not expected to increase vessel traffic in the Harbor but will enhance navigational safety and maintain the competitiveness of the existing Port. Vessel traffic will continue to include a mix of large container ships, barges and tankers. The Seaport Access system, which is part of the Central Artery/Tunnel project, will result in more direct and convenient connections for trucks between port terminals and the regional highway network, thereby reducing traffic impacts on local neighborhoods. This roadway system is independent of the dredging project.

8.1.3 Specific Impacts and Mitigation Measures

Chapter Six of the FEIR/S provides a thorough description of the primary, secondary and cumulative impacts of the proposed project and the specific mitigation measures provided to minimize the impacts. The following subsections discuss each of the major impacts identified in the FEIR/S and the applicable mitigation proposed.

8.1.3.1 Impacts to Harbor Bottom

Dredging of the BHNIP will remove contaminated silt from approximately 320 acres of Harbor bottom. Disposal of the silt material will consist of placing the material in 54 cells excavated into the uncontaminated parent material. These cells occupy approximately 116 acres within the 320 acres impacted by dredging. The disposal cells will be capped by clean granular material to provide a substrate for re-establishment of the benthic population temporarily displaced by the dredging and disposal. Removal of contaminated silt and replacement of contaminated silts with clean substrate mitigates the impacts to the Harbor bottom.

8.1.3.2 Water Quality/Sediment Quality

Material suspended during the dredging process is principally restricted to the silt or clay fraction of the material with sand particles settling out immediately after suspension. Grain size analysis of 18 stations within the Channels identify the substrate as 86.5% clay and silt, 11.2% sand and 2.3% rock. Chemical oxygen demand from the suspension of silts is expected to be low to moderate. Biological oxygen demand may be temporarily impacted from increased turbidity. Water quality modeling results conclude that under continuous disposal at the in-channel locations, no constituents were found to exceed chronic water quality criteria if no more than 6,000 cy per day. Modeling of an instantaneous release scenario did not indicate any exceedance of chronic water quality criteria.

The use of an environmental closed bucket, and the application of silt curtains around the disposal cells, will mitigate for any temporary impacts to water quality from the dredging and disposal operations. Operational controls restricting the amount of material disposed per day, or disposed only at appropriate tides, will also be made part of the dredging operational control plans. Impacts have been determined to be short-lived, localized and controllable through standard dredge management practices.

8.1.3.3 Biological Resources

The primary impact of dredging will be the removal of benthic organisms inhabiting the 320 acres to be dredged. The dredging will cause a short-term loss of benthic productivity that will be rapidly offset through faunal recolonization demonstrated by Boston Harbor studies. Removal of contaminated silts over the dredged area would improve the maximization of faunal recovery. Dredging could also mask chemical signals used by migrating fish. This impact will be avoided by scheduling dredging so as to not coincide with migratory fish passage. Fish and invertebrates will be impacted in the short-term by blasting activities proposed for small sections of the BHNIP. Fish deterrence devices, such as sonic blasts or bubble screens, will be deployed to minimize fish mortality from blasting.

Disposal activities will have little or no effect on downstream Harbor fauna since they are characterized as tolerant to stresses associated with fluctuating turbidity levels and dissolved oxygen reduction. The use of silt curtains will minimize the downstream impacts; if any, on Harbor fauna.

8.1.3.4 Operational Controls, Contingencies and Mitigation

Impacts associated with the field operations of dredging and disposal were described in Chapter Five of the FEIR/S. Operational controls and mitigation strategies have been incorporated into the project design. These operational controls are:

- Capping the disposal cells with sand to maximize the potential for faunal recolonization with rock armoring in areas subject to vessel prop wash scouring;
- Scheduling of dredging and disposal to fit environmental window and to meet water quality criteria
- Coordinating with the U.S. Coast Guard to avoid interference between BHNIP activities and commercial traffic
- Scheduling activities to avoid peak recreational Harbor usage (4th of July, other holidays)
- Identification of significant structural features (bridge abutments, utility lines, bulkheads, moorings and buoys) to avoid negative impacts

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- Imposition of dredging performance standards to meet environmental and permitting conditions as well as design controls

- Use of environmental bucket to trap contaminated sediments during dredging and outfitted with a sensor to detect closure problems due to debris

- Use of silt curtains during disposal

- Requirement for contractor to provide an incident response plan to cover spills of dredged material, fuel and machinery oil

- Trash and debris management on separate scows with agreements to dispose of materials in landfills

- Contingency plans for reasonably foreseeable equipment failures, weather conditions, encounters with buried structures, and permit limit exceedances

- A recognition that the Corps will make parent material available for beneficial use

- A recognition that the in channel sites will be monitored by the Corps under the DAMOS program.

8.1.3.5 Resource Enhancement Activities

Based on the data provided in the FEIR/S, the preferred alternative will not require compensatory resource mitigation. As local sponsor, Massport is willing to work with state resource agencies to identify resource enhancement opportunities in the Harbor area. As examples these can include working with state and local resource agencies to identify potential resource enhancement options such as supporting the development of an "urban fishing park" through rehabilitation of water access structures to enhance pubic use and access to functional recreational fishing areas. In addition, Massport is willing to work with appropriate agencies to increase the number of vessel sewage pump-out facilities in the Harbor Area.

<u>8.1.4 Findings</u>

For the reasons stated above, Massport finds that, with implementation of the operational mitigation measures described, all practicable means and measures will be taken to avoid or minimize adverse impacts to the environment relative to Massport actions. It is anticipated that appropriate conditions will be included in environmental permits to be issued by the DEP to ensure implementation of said measures.

8.2 MODEL SECTION 61 FINDING FOR DEP AGENCIES

The BHNIP project will require permits and approvals from the following DEP agencies:

- Massachusetts Department of Environmental Protection
  - Water Quality Certification
  - Division of Wetlands and Waterways review of local Order of Conditions

- Massachusetts Office of Coastal Zone Management
  - Coastal Zone Consistency Review

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The following paragraphs provide a detailed outline of how the BHNIP complies with DEP regulatory policies for their permits.

8.2.1 Massachusetts Wetlands Protection Act (MGL c. 131, § 40 and 310 CMR 10.00)

The entire aquatic portion of the BHNIP will occur within the Mystic River, Chelsea Creek, East Boston and South Boston DPA's and as such, must address only one significant resource (land under ocean) relative to the Act and Regulations. This limits protectable interests to storm damage prevention and flood control, and the protection of marine fisheries. To comply with these interests, the BHNIP must fulfill specific applicable performance standards. The BHNIP fulfills these requisite conditions in the following manner:

1) Dredge channel and port area so that all portions of them will be adequately flushed by the tides.

BHNIP Compliance:

The proposed channel deepening should not alter the flushing rate of Boston Harbor appreciably, given the 150 billion gallon plus diurnal tidal prism that currently exists.

2) Complete the dredging operation as quickly as possible by using the most efficient and practical equipment.

BHNIP Compliance:

The proposed navigation improvement dredging is scheduled to occur over a 12 to 18-month time frame. Mechanical Dredging with limited blasting has been selected as the most feasible method to complete the BHNIP. An environmental bucket, determined to be the most feasible and least environmentally damaging methodology to dredge contaminated material, will be used to remove the silts.

3) Where possible, schedule dredging so as not to conflict with fisheries use.

BHNIP Compliance:

As required by regulation, the BHNIP will avoid any construction or disposal activity during the period of March 15 through June 15. In addition, the turbidity plume for the in-channel locations does not impede fish passage in any of the Channels

4) Bottom sediment analysis and evaluation of dredging should be coordinated with the DWPC.

BHNIP Compliance:

As stated in the DEIR/S, and based on the 3 tier analyses, the 2.9 million cubic yards of dredged material from the BHNIP will consist of approximately 1.7 million cubic yards of "clean" parent material including rock. The remaining 1.1 million cubic yards of silty material has been determined to be contaminated. Therefore, the BHNIP accepts the finding that all of the silt material is considered to be unsuitable for unconfined open water disposal. Further, all bulk chemistry, bioassay and biological evaluations have been planned and coordinated with federal and state regulatory authorities. Extensive water quality modeling studies have been performed for the in-channel options. Results indicate that the option meets DWPC regulations.

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5) Minimize the amount of dredging.

BHNIP Compliance:

The Full Project is the preferred, and congressionally-authorized alternative for the dredging project. In addition to the removal of all unconsolidated silts required for maintenance, parent material would be dredged to project depths. The purpose and need for the Full Project has been documented in the FEIR/S. It offers the greatest benefits to the Port of Boston. The impacts associated with the dredging are temporary. In the absence of improvement dredging, maintenance dredging of the channels and berths would be required to maintain navigational safety. The maintenance material, or silt, is the contaminated portion of the BHNIP dredged materials. Issues regarding silt dredging and disposal, are therefore, issues that require resolution regardless of the improvement project.

6) Whenever possible, channel axis should not be parallel to direction of major storm waves.

BHNIP Compliance:

The BHNIP is limited to the existing channel configuration.

7) Wave height at any point along the shoreline shall not increase by more than 10% by disposal of dredged material on nearshore areas of land under ocean.

BHNIP Compliance:

The BHNIP will not significantly alter surface water hydrology within the project area.

8) Dispose of spoil in discontinuous bands, interrupted at least every 250 ft. by 50 ft. breaks to provide for passage of water, nutrients and aquatic life.

BHNIP Compliance:

This does not apply to the BHNIP since disposal of the silt materials will occur and be sequestered within the in-channel cells.

9) Dredged material disposal on any portion of land under the ocean shall have a mean grain size distribution which does not differ from the existing land under the ocean sediment grain size by more than 50%.

BHNIP Compliance:

No dredge material disposal will occur on any unpermitted or undesignated land under the ocean. In-channel disposal will be fully contained, sequestered and capped beneath granular substrate material.

10) Disposal of dredged material should avoid eel grass beds to the maximum extent possible.

BHNIP Compliance:

There are no eelgrass beds located at the in-channel sites.

11) Sedimentation or catch basins as appropriate to the amount of runoff.

BHNIP Compliance:

Not applicable to the BHNIP project.

12) All drainage structures should have gas traps, with appropriate maintenance.

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BHNIP Compliance:

Not applicable to the BHNIP project.

13) Headwall and supports must be spaced so that sediment transport is not interrupted.

BHNIP Compliance:

Not applicable to the BHNIP project.

14) Space piles as far apart as practical for the structures being built, in no case less than 10 feet apart.

BHNIP Compliance:

Not applicable to the BHNIP project.

15) Construction shall be completed as quickly as possible to minimize the amount of turbidity and sedimentation.

BHNIP Compliance:

The BHNIP should be completed over a 12-18 month timeframe with dredging and disposal within the same footprint so that minimal additional areas would experience turbidity and sedimentation impacts.

8.2.2 Massachusetts Waterways Licensing Program (MGL c. 91 and 310 CMR 9.00)

While Massport is exempt from the requirement of an individual license, individual private berth owners are not. The BHNIP complies with c. 91 performance standards in the following manner:

1) Unless the project is located in a DPA, no dredging of channels, mooring basin, or turnarounds should occur below a mean low water depth of 20 ft. unless the waterway serves a commercial navigational purpose of jurisdictional significance and cannot be relocated to a DPA.

BHNIP Compliance:

The entire dredging and dredged material disposal program is situated in the Mystic River, Chelsea Creek, East Boston, or South Boston DPA's.

2) The design and timing of dredged material disposal activity shall be such as to avoid interference with anadromous/catadromous fish runs. At a minimum, no such activity shall occur in such areas between March 15th and June 15th of any year, except upon a determination by the Division of Marine Fisheries (MADMF) that such an activity will not obstruct or hinder passage of fish.

BHNIP Compliance:

The BHNIP avoids any construction/disposal activities during the period of March 15 through June 15.

3) The design and timing of dredging and dredged material disposal activity shall be such as to minimize adverse impacts on shellfish beds, fishery resource areas, and submerged aquatic vegetation.

BHNIP Compliance:

Given the nature of the current water and sediment quality of the project area, the opportunistic character of the benthic biota, and the lack of aquatic vegetation; the BHNIP does not permanently impact any of these biological resources. Any

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disturbance or displacement will be temporary, and the sediment quality of the post dredge substrate will be clean granular material.

4) Outline operational requirements for dredging and dredge material disposal, for review and approval.

BHNIP Compliance:

Chapter Five of the FEIR/S provided a comprehensive Dredge Management Plan outlining all proposed operational requirements that satisfy this performance standard.

5) Provide appropriate supervision of dredging and dredge material disposal.

BHNIP Compliance:

Chapter Five of the FEIR/S provided a comprehensive Dredge Management Plan, and details all proposed supervision and construction management plans sufficiently to meet this performance standard.

8.2.3 MCZM Policies Applicable to the BHNIP

1) Policy 1 states, "Protect ecologically significant resource areas (salt marshes, shellfish beds, dunes, beaches, barrier beaches and saltponds) for their contribution to maritime productivity and value as natural habitats and storm buffers."

BHNIP Compliance:

The BHNIP dredging and disposal plans will not impact resources identified in this policy.

2) Policy 4 states, "Condition construction in water bodies and contiguous land areas to minimize interference with water circulation and sediment transport and to preserve water quality and marine productivity..."

BHNIP Compliance:

Dredging and material disposal activities should have minimal temporary effect on water quality, marine productivity, and the designated fish runs. Appropriate scheduling of activities during periods of low productivity and environmental dormancy should serve to minimize adverse effects to biological resources. The in-channel disposal and sequestering of contaminated silts, and the disposal of clean parent material at designated and approved disposal sites, should help to balance both water and sediment quality. Also, biological resources will naturally re-establish themselves in the post project condition. Re-colonization is expected after one year following disposal.

3) Policy 5 states, "Ensure that dredging and disposal of dredged material minimizes adverse effects on water quality, physical processes, marine productivity and public health".

BHNIP Compliance:

Since the channel bathymetry will not be significantly lowered in the post dredging condition, there should also be no increase in flood erosion hazards or adverse effects on natural replenishment of beaches. Given the nature of the project area shoreline, sediment transport is not very significant within the project area. Turbidity will be a short-term phenomenon, and should pose no long lasting adverse effects. Contaminant stripping during dredge and dredge material disposal should be controllable. No chronic water quality thresholds will be exceeded during either continuous or instantaneous loadings, provided daily disposal volumes do not exceed 6,000 cy/day.

4) Policy 7 states, "Encourage the location of maritime commerce and development in segments of urban waterfronts designated as port areas. Within these areas, prevent the exclusion of maritime dependent industrial uses that require the use of lands subject to tidelands licenses."

BHNIP Compliance:

All facets of the dredging and dredge material disposal proposal are consistent with the DPA designation and consistent with existing usage. The deepening of the channel is necessary to make the DPA serviceable to the current shipping needs.

5) Non-Regulatory Policy 7, which deals with state financial assistance and direct state action states, "Encourage through technical and financial assistance expansion of water-dependent uses in DPA's and developed harbors, redevelopment of urban waterfronts and expansion of visual access".

BHNIP Compliance:

The proposed maintenance and improvement dredging is consistent with this policy.

<u>8.2.4 Section 401 Water Quality Certification</u>

The BHNIP must demonstrate that it complies with the 404(b)(1) guidelines (40 CFR 230.11) and 310 CMR 9.00 regulations for water quality certification. The following narrative demonstrates the BHNIP's compliance with these guidelines.

1) Physical Substrate Determination

BHNIP Compliance:

The BHNIP will remove both contaminated silt, clean parent material (clay), and/or rock from 320 acres federally designated channels and berthing areas exposing clean parent material (predominately clay with some ledge) throughout the project area. The resultant substrate should be clean and representative of the natural harbor substrate. Existing silts appear to be the result of continuous point and non point discharge to the Boston Harbor Environment.

In-channel disposal of the contaminated silt material will provide in-situ disposal opportunity of dredge material. The capping of the in-channel cells with the BHNIP parent material and/or sand would also provide suitable clean post-project benthic substrate. The disposal and sequestering of the silt material within the in-channel cells should provide an overall improvement in substrate conditions.

2) Water Circulation, Fluctuation and Salinity Determination

BHNIP Compliance:

The channel deepening and proposed dredge material disposal program will not alter the existing hydrology, flushing rate tidal prism.

3) Suspended Particulate/Turbidity Determination

BHNIP Compliance:

The dredging of the channel and berth areas will be performed in a manner to minimize the possibility of sediment release. A review of the levels of sediment chemistry, the ambient water quality and the use of an environmental bucket, indicates that a low potential exists for substantial degradation of ambient water quality during dredging.

Several factors may affect the characteristics of turbidity plumes associated with the project, including the discharge rate, character of the dredged material slurry, water depth, hydrodynamic regime, and the discharge configuration. Typically, the quantity of material re-suspended in the upper water column ranges from 1-5% of the total amount released.

The BHNIP modeling analysis presented in the FEIR/S indicates that no chronic water quality thresholds will be exceeded during either continuous or instantaneous loadings, provided daily disposal volumes do not exceed 6,000 cy/day.

4) Contaminant Determination

BHNIP Compliance:

The BHNIP modeling analysis included in the FEIR/S indicates that no chronic water quality thresholds will be exceeded during either continuous or instantaneous loadings, provided daily disposal volumes do not exceed 6,000 cy/day.

In-channel disposal, as proposed, concentrates both dredging and material disposal operations within the BHNIP footprint. This will minimize the project area and impacts involving additional remote sites.

5) Aquatic Ecosystem and Organic Determinations

BHNIP Compliance:

The Harbor benthic faunal communities are dominated by opportunistic deposit feeders. The Harbor is inherently stressful to benthic populations due to low DO levels and sediment contamination. The removal of this assemblage of organisms during dredging will have minimal impact on the ecological productivity of the Harbor as a system.

The dredging of the channel will cause a short term loss of benthic productivity that will be rapidly offset through faunal recolonization. Fishery resources associated with the Mystic River, Chelsea Creek and Inner Confluence are moderately significant based on a fisheries survey reported in the FEIR/S as Appendix E.

The Mystic River catch was dominated by winter flounder, atlantic tomcod and scup. The Chelsea River catch was also dominated by winter flounder and atlantic tomcod. At the Inner Confluence, the dominant catch species was winter flounder. These findings are comparable with previous finfish surveys in the area.

Chemical signals essential for anadromous fishery migrations could become masked by the dredging operation's suspension of sediments and associated chemicals. Dredging will be scheduled in non-sensitive areas of the Harbor and during appropriate periods to avoid impacting

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seasons of critical spawning runs of those species.

Sediment suspension will also displace motile species that will attempt to avoid gill abrasion, lower DO levels, and reduced sensory opportunities for predation (masked odors and low visibility) in the dredging area. These would be temporary and the effects would not have long-term detrimental impacts given the recommended mitigation practices.

Downdrift harbor fauna should be tolerant to stresses associated with fluctuating turbidity levels and DO reduction. Locating the material disposal locations within the dredging footprint limits stresses associated with the BHNIP from being exerted on remote communities. Most of the episodic effects on all biological resources will be triggered by the dredging itself. Motile organisms should evacuate the sites before and after filling or habitat displacement takes place. Sessile organisms will be lost.

Species of marine mammals which may occur in tidal waters in the vicinity of the project area, include harbor seals *(Phoca vitulina)*, harbor porpoises *(Phocena phocena)*, and grampuses *(Grampus griseus)*. However, their presence in the Boston Harbor system is uncommon. Since most of the dredging impacts will occur well within the Inner Harbor where marine mammals are uncommon, the project will not cause adverse impacts to these species.

The intertidal and subtidal areas, including and adjacent to the Federal channel area, are not known to provide habitat for any Federal threatened and/or endangered species, or State rare species. Letters from the U.S. Fish and Wildlife Service, the National Marine Fisheries Service and the State Natural Heritage Program have confirmed the lack of any threatened, endangered, or rare species in the area.

6) Disposal Site Determinations (Mixing Zone)

BHNIP Compliance:

For the in-channel site, the mixing zone will extend over several acres. Based on hydrographic variations, the following spacial extents were reported in the FEIR/S:

Mystic River: 12.4 acres
Chelsea Creek: 30.0 acres
Inner Confluence: 14.7 acres

Data reported in the FEIR/S and technical appendices indicate the mixing zone will not impact or impede fishery migration.

8.2.5 Findings

For the reasons stated above, the DEP finds that, with the implementation of the operational mitigation measures decribed, all practicable means and measures will be taken to avoid or minimize adverse impacts to the environment. It is anticipated that appropriate conditions will be included in DEP permits to ensure implementation of said measures.

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ATTACHMENT 1:

AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES EVALUATED FOR POTENTIAL DREDGING AND DISPOSAL SITES

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AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES EVALUATION AT POTENTIAL DREDGING AND DISPOSAL SITES

1.0 INTRODUCTION

The purpose of this Affected Environment and Environmental Consequences Evaluation is to provide more detailed descriptions of dredging sites and potential disposal sites, as summarized in Sections 2.0, 3.0 and 4.0 of this Environmental Impact Report/Statement (EIR/S). Described herein are the baseline environmental conditions, proposed site uses and potential environmental consequences from dredging or disposal at each site. This evaluation is designed to provide a description of both the "existing conditions" and "environmental consequences" at the potential sites, in accordance with the MEPA EIR and Federal EIS guidelines.

Although the full project, in its entirety, is sponsored by Massport, the dredging activities (and sites) are broken down into two components:

1) Federal Project: This includes deepening portions of the federal channels to 40 feet including areas within the:

   - Mystic River
   - Chelsea Creek (to-38 feet MLW)
   - Inner Confluence
   - Main Ship Channel
   - Reserved Channel

   This portion of the project is being administered by the Army Corps of Engineers-New England Division (ACOE NED).

2) Non-federal Project: This includes the dredging of several berth areas throughout the Inner Harbor, Mystic River, Chelsea Creek, and the Reserved Channel. This portion of the project is administered by Massport and includes the following sites:

   - Prolerized
   - Distrigas
   - Moran
   - Mystic Piers
   - Eastern Minerals
   - Gulf Oil
   - North Jetty
   - Army Base
   - Boston Edison Intake

- Boston Edison Barge Berth
- Conley

The project is described in Section 2.1, Volume 1 of the EIR/S. This evaluation focuses on the environmental conditions and impacts at the disposal sites.

2.0 ENVIRONMENTAL EVALUATION: DISPOSAL SITES

As part of this EIR/S process, an extensive site screening process (Section 3.0 in EIR/S) was undertaken to identify potential disposal sites for this project's dredged material. As a result of this process, 24 candidate sites were deemed potentially suitable for material disposal. They are grouped according to site type as follows:

Land-Based Coastal Sites
Squantum Point (QUI-03)
Everett (EVR-04)

Land-Based Inland Sites
Woburn (WOB-11)
Wrentham (WREN-495)
Plainville Sanitary Landfill
Fitchburg/Westminster Sanitary Landfill
BFI-Northern Disposal, Inc. (East Bridgewater)

Aquatic Sites
In-Channel Disposal (3 sites)
Subaqueous Containment Site B
Subaqueous Containment Site E

Nearshore Aquatic Sites
Mystic Piers (Massport 49 & 50)
Revere Sugar
Amstar
Cabot Paint
Little Mystic Channel
Reserved Channel

Borrow Pit Sites
Spectacle Island Confined Aquatic Disposal (CAD)
Meisburger Sites 2 and 7

Existing Open Water Sites
Massachusetts Bay Disposal Site
Boston Lightship Disposal Site

Locations of these potential sites are shown in Figure A1-1 and presented in more detail on figures contained in the following sections. The sites are described generally in the order given above; their order has no bearing on their status as an acceptable or preferred alternative.

The environmental evaluation process included a review of previous environmental studies and reports followed by site investigations to supplement and fill primary data gaps. Field groups comprised senior scientists in disciplines such as wetland ecology, wildlife ecology, marine ecology, estuarine ecology, water quality planning, and engineers experienced in environmental issues at landfills, materials disposal, site drainage, and site planning. During the in-field site investigations, these experts recorded their findings for baseline environmental conditions for each candidate site.

This evaluation examines impacts to each potentially sensitive resource at each of the candidate sites. Summaries of project impacts at each candidate site are presented in Section 3.0 of the EIR/S.

2.1 SITE EVALUATIONS: LAND-BASED COASTAL SITES

2.1.1 Squantum Point (QUI-03)

2.1.1.1 Existing Conditions

The Squantum Point site is located at the tip of Squantum Point in the City of Quincy (Figure A1-2). Formerly the Squantum Naval Air Station, the site is 44 acres in total area; however the eastern portion of the site has been developed into a staging point for the Deer Island wastewater treatment facility. The available area for the BHNIP containment facility is approximately 32 acres. The 100-year floodplain is 11 feet above MSL.

GEOLOGY/SOILS

The site appears to consist of historic tidelands that were filled for the construction of a small naval air station. The area is generally flat and surrounded on the shoreline perimeter by an eroded and dilapidated metal and concrete seawall. Soils in the project area are primarily Udorthents, which are classified as areas filled with excavated materials (SCS 1989a). Thickness of material is generally six feet or more, although the actual depth of fill at this site is unknown.

The type of bedrock underlying the site can only be inferred since no outcrops of bedrock are evident. Based on the mapping by Kaye (1980) this area may be underlain by conglomerate or by tuffaceous sediments. Depth to bedrock is unknown.

HYDROLOGY/WATER QUALITY

The hydrology of the site is not fully understood and is complicated by remains of the old airport's storm drain system (observed during site walks by project staff in November 1990 and May 1993). After a heavy rainstorm, water was observed in small pools in the upland

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areas, while the wetland did not appear to be storing any runoff. Closer observation revealed a graded storm drain on the edge of the wetland and an outfall pipe to Dorchester Bay that, at that time, was clearly discharging water. It is not known whether the wetland was the sole source of this storm water flow or if other storm drains contributed as well. Water in the wetland drain was later observed to have reversed direction, flowing back into the wetland. This indicates that the wetland area is hydrologically connected to Dorchester Bay and influenced by tides, although the wetland plant community reflects only mildly brackish conditions. The erosion behind the decayed seawall indicates that overland flow to the bay does occur, although the erosion is in part due to tide and wave action.

No information concerning groundwater resources at this site was available. However, groundwater appears strongly influenced by tides and could be highly saline. Any groundwater at this site would not be suitable for public water supply.

The Neponset River and Dorchester Bay are both classified as SB by the Massachusetts Department of Environmental Protection (MADEP), in the surface water regulations (314 CMR 4.00). This classification protects saline water bodies for the following uses: propagation of fish and aquatic life and wildlife, primary and secondary contact recreation, and shellfish harvesting with depuration. Abundant shellfish beds are present in the tidal flats off Squantum Point as noted during a site visit in October 1990. However, as these shellfish cannot be reliably depurated, Massachusetts Department of Marine Fisheries (MADMF) has closed the area for harvesting except for bait (Ralph Stevens, MADMF, 1993, personal communication).

Limited water quality data are available for the Neponset River at its confluence with Dorchester Bay; however, water quality in the river is likely influenced by combined sewer overflows (CSOs) and non-point source pollution (NAI 1990). Historical data have shown high variability in fecal coliform concentrations at the mouth of the Neponset River (NAI 1991a). Bacteria and dissolved oxygen are likely the two most limiting factors on water quality in Dorchester Bay, although a complete assessment of water quality cannot be made at this time.

AQUATIC RESOURCES

There are no freshwater streams or ponds on the Squantum Point site, although several depressions may intermittently retain surface water.

Marine resources are influenced by conditions in both the Neponset River and Dorchester Bay. Thus, although the intertidal area is broadly defined as tidal flat with a fringing, patchy salt marsh, substrate conditions vary dramatically, depending on exposure. The following description of intertidal communities is based on studies performed by NAI in 1990. Physical conditions appeared little changed in subsequent site visits by NAI in May 1993.

The intertidal zone was narrowest (65 feet) in the easternmost portion of the site, broadening to more than 1000 feet at the northwest corner. Salt marsh vegetation was patchy and best developed along the western side of the parcel. Sediments in the upper intertidal zone were predominantly sand, grading to pebbles and then silty sand within about 50 feet of the bulkheaded shoreline. At the northern end of the point, sandy sediments extended 100+ feet from the shoreline. Seaward, sediments were silty sand/sandy silt with large quantities of shell hash. There were extensive blue mussel (*Mytilus edulis*) beds in the lower intertidal zone along much of the northern border of the site.

Dominant benthic infauna of the northerly exposed tidal flat included the spionid polychaetes *Streblospio benedicti*, *Polydora cornuta* and *Pygospio elegans*; oligochaetes; soft-shell clam spat (*Mya arenaria*); and nematodes (NAI 1990). These species typically exhibit wide temporal fluctuations in abundance but represent potentially important food resources for higher trophic levels because of their high abundances. These same taxa were also abundant in the areas of intertidal sandy beach. The additional prevalence of the longer-lived maldanid polychaete *Clymenella torquata* in the beach community suggests that environmental conditions have exhibited consistent patterns in the recent past, allowing the establishment of a stable benthic community. A microfloral community appeared to be established along the north-facing tidal flat. The chlorophyll *a* concentrations indicated a moderate to high potential for utilizing nutrients contributed by the Deer Island treatment plant and other sources (NAI 1990).

The intertidal substrate along the western border of the site was primarily fine-grained sediments with large quantities of shell hash. Salt marsh broadened from about 5 to 15 feet moving south along the site. Mussel beds were extensive about 600-700 feet offshore. The benthic community along the western boundary of Squantum Point exhibited the typical opportunistic dominants, spionids and oligochaetes, as well as abundant soft-shell clam spat. Less abundant taxa add to the diversity and food-resource value of the flat (NAI 1990) and contribute substantially to the biomass available for consumption by foraging fish, megainvertebrate fauna and shorebirds. The sediment surface yielded high values for chlorophyll *a* (NAI 1990).

The tidal flats were described as productive clam beds by Chesmore et al. (1971). There continues to be a large soft-shell clam population in this area, averaging 16.5 clams/ft^2 (NAI 1990). Clams were sparsest along the northern boundary and most abundant at the northwest corner. Mean size was 5.3 cm with 62% of the clams being larger than 5 cm (harvestable size). Presently, harvesting of shellfish is prohibited except for bait because of contamination (Ralph Stevens, MADMF, 1993, personal communication). Live razor clams (*Ensis directus*) were also observed.

The blue mussel beds were dense aggregations with abundances averaging 58/ft^2, and over 90% alive (NAI 1990). Benthic infauna were very abundant in the vicinity of the mussel beds. Unlike the other parts of the intertidal zone, the mussel beds supported a variety of arthropods (mostly amphipods) and other mollusks, with soft-shell clams being numerically dominant. Dominant annelids were the same ubiquitous taxa. Few burrowing species were represented. Chlorophyll *a* values were moderate to high.

Finfish and epibenthic fauna were not investigated. The abundance and diversity of habitat available for benthic infauna indicate the suitability of the Squantum Point intertidal zone to provide trophic support for these consumers. Species such as green crabs (*Carcinus maenas*) and other crabs (*Cancer* sp.) are likely to forage among the mussel beds and open tidal flats and, in turn, be preyed upon by wading birds. Flounder and other demersal fish, particularly juvenile stages, use intertidal areas extensively for feeding. The MADMF officially recognizes the Neponset River as a spawning run for rainbow smelt. MADMF considered the anadromous fishery resource of the Neponset River to include a large smelt run, a limited shad run and a river herring (alewife and blueback) run (MADMF 1990, personal communication).

An area of potential concern in the vicinity of the Squantum Point site is a bed of submerged vegetation in the Neponset River that extends from Commercial Point to an area beyond Tenean Beach (MWRA 1987). The extent and character of this resource has not been determined.

The Squantum Point intertidal area was rated as having a high potential for aquatic diversity and abundance and a moderate-to-high potential for nutrient retention/transformation (NAI 1990). The extensive shellfish beds around the entire flat and fine sediments on the western shoreline suggest a high potential for sediment/toxicant retention. This site has a high potential for shellfish habitat as indicated by the variety of substrate conditions and mollusk species present. The large food resources in this tidally influenced area indicate a moderate-to-high potential for providing fish habitat. Similarly, the tidal flat resources are potentially important for migratory shorebirds. The breadth of the intertidal area offers sediment and shoreline stabilization, although the open exposure to the north and erosion behind the sheetpile wall indicate that storm tides reach the upland edge of the site.

VEGETATION

Random seed dispersal and tolerance of the degraded and artificial substrates remaining after past uses have influenced the type of vegetation that has developed on the site. Vegetation has not developed to the point of presenting well-defined classes with good structure and habitat, owing at least in part to the compacted fill substrate which serves as soil. Two broad upland vegetation classes currently exist within the confines of the seawall: early successional shrubland, approximately 10-15 feet tall; and old field encroaching on the abandoned runways and perimeter road.

Most of the site is covered by aggressive plant species, able to withstand disturbed conditions. The mixture of shrubs, grasses and forbs is dominated by sumac (*Rhus typhina*), bayberry (*Myrica pensylvanica*), poison ivy (*Toxicodendron radicans*) and multiflora rose (*Rosa multiflora*), making foot travel difficult. Grass species include quackgrass (*Agropyron repens*), upland bent (*Agrostis perennans*) and broom beardgrass (*Schizachyrium scoparium*), while the forbs are predominantly Eurasian invaders, including wild carrot (*Daucus carota*), mugwort (*Artemisia vulgaris*), heath aster (*Aster ericoides*) and tansy (*Tanacetum vulgare*).

WETLAND RESOURCES

The on-site and adjacent wetland areas described herein were field delineated by NAI in 1990 using the 1989 federal identification methodology (NAI 1990) and are those areas estimated to fall within the review of Section 404 of the Federal Clean Water Act. Also documented are those associated wetland resource areas, identified from published references or by field observation, that are protected under the jurisdiction of the Massachusetts Wetlands Protection Act (MGL c 131, s 40) and its implementing regulations (310 CMR 10.00). These include: 1) Land Under the Ocean, 2) Coastal Beach, 3) Salt Marsh, 4) Land Containing Shellfish, 5) Fish Run, 6) Land Subject to Coastal Storm Flowage, and 7) Bordering Vegetated Wetland. Also present is a regulated buffer zone extending 100 feet inland and/or upland of the coastal beach, salt marsh, and bordering vegetated wetland.

During the 1990 wetland delineation, on-site construction activities associated with the Deer Island staging facility continuously changed terrestrial site characteristics. Therefore, the team of wetland scientists had problems clearly identifying on-site conditions. The 1993 site visit, however, indicated more stable conditions. Existing fill soils and transitional vegetation greatly complicate wetland delineation. Should Squantum be chosen for final design a comprehensive wetland resource evaluation and boundary delineation will be required using the current state and federally approved methodologies.

Several acres of salt marsh are found on Squantum Point, outside and adjacent to the seawall. These are interspersed with areas of tidal flat and coastal beach. The largest band of salt marsh lies on the northwest corner, outside the wall, and runs southward beyond the site. This salt marsh band consists almost entirely of cordgrass (*Spartina alterniflora*), with minor amounts of sea lavender (*Limonium* cf. *nashii*) and seaside goldenrod (*Solidago sempervirens*), and has a substrate of sand and cobbles. The width of the marsh averages approximately 30 feet, with its upper limit coinciding with the high tide level. A strip of coastal beach approximately 10 feet wide included the apparent mean high tide line, above which beach grass (*Ammophila brevigulata*) dominated to the base of the seawall. Several small patches of salt hay (*Spartina patens*) were interspersed with beach grass.

Landward of the seawall, fills and disturbed surfaces dominate the area. The hydrology is very difficult to discern, owing to the presence of an old subsurface drainage system of unknown extent. At one culvert break along the northern wall, erosion has initiated a depression along 15 feet of the wall, now colonized by some beach and salt marsh species: cordgrass (*S. alterniflora*), reed (*Phragmites australis*), sea-blight (*Suaeda linearis*), seaside goldenrod (*S. sempervirens*) and saltwort (*Salicornia europaea*).

The northwestern shore supports a more patchy, irregular salt marsh which extended seaward from the base of the seawall. Dominated by cordgrass, this marsh was obviously situated in a high energy environment as indicated by the eroding peat on its seaward face, and the deteriorating condition of the seawall behind it.

A 1.0± acre brackish wetland with an ephemeral hydrologic connection with Dorchester Bay lies about 300 feet inside the seawall, and is surrounded by upland vegetation and soils. Appearing as an open herbaceous community, the plant species include a mixture of freshwater and salt-tolerant plants. It is dominated by red-top (*Agrostis alba*), rushes (*Juncus effusus* and *Juncus gerardi*), cattail (*Typha angustifolia*), three-square sedge (rush) (*Scirpus americanus*), purple loosestrife (*Lythrum salicaria*) and seaside goldenrod (*S. sempervirens*). This wetland drains to the northwest through a low-lying iron catch basin and culvert placed at such an elevation and slope that allows the highest spring and storm tides to back flow through the culvert, bringing salt water into the wetland's northwest corner. The wetland soil is mineral, and clearly hydric. It has some permeability but little or no organic content, as would be expected with recently formed soil. Immediately following a two-day, 2 to 4 inch rainfall, the wetland had no ponded waters, but the fill substrate was fully saturated. Approximately 0.1 cubic feet per second (CFS) was running out of the culvert. Other small areas of wetland may occur in slight depressions among early-succession shrublands and would require delineation if this site were selected for final design.

In 1990, the inland wetland was evaluated using the Hollands-Magee freshwater wetland model (NAI 1990). Results indicated that the wetland had a very low hydrologic and structural diversity, resulting in low biological value. Scores for nine of ten wetland functional elements using the Hollands-Magee model rated below median; only aesthetics rated above median, mostly due to the abundance of showy flowering plants. This means that this wetland ranks below most New England inland wetlands in the NAI database for all the Hollands-Magee values other than aesthetics.

WILDLIFE

The old-field portion of the site is somewhat diverse, with an intricate mix of shrub and herb layers providing habitat/edge conditions. The shrub layers form an interconnecting network, providing habitat for numerous ground animals, including cover and food for small to medium-sized mammals and resident, migratory and wintering bird species. Observed on-site mammal species included: muskrat, house cat, mouse (evidence); and several bird species: common grackle, ring-necked pheasant, northern flicker, American goldfinch, song sparrow, eastern kingbird, gray catbird, American robin, yellow warbler and short-eared owl. The tangles of poison ivy and multiflora rose provide cover and food (e.g., berries) for many of these species. Small trees, such as red cedar and poplar, provide nesting places for birds with substantial height requirements (e.g., American goldfinch, eastern kingbird), whereas the rose-ivy tangles are excellent for low nesters (e.g., song sparrow: Harrison 1975). Animal movement into and out of the area is restricted mainly to urban species, aquatic species, and birds because of the site's isolation from other wild or open areas.

Little wildlife value can be attributed to the inland wetland community, due to the low food value of the plants and low value for cover. Outside the seawall, however, the mixture of salt marsh, beach and tidal flats provides extensive habitat for migrating and resident shorebirds. These interspersed resources, combined with the high diversity of marine invertebrates, provide excellent food resources for birds such as turnstones, yellowlegs, sanderlings and smaller sandpipers. During field visits, double-crested cormorants were observed utilizing open water, with herring gulls, great black-backed gulls, ring-billed gulls, brant, greater yellowlegs, black-bellied plovers and mallard ducks in the beach and tidal flat areas.

THREATENED AND ENDANGERED SPECIES

The Massachusetts Natural Heritage and Endangered Species Program (MANHESP) records did not identify any protected species or habitats which occur on the site (MANHESP, letter dated March 1, 1993).

A short-eared owl was observed on-site during fieldwork on November 5, 1990. This owl is presumed to have been migrating from the more populated Canadian tundra breeding grounds or occupying a wintering ground at the time it was seen. Most short-eared owls in the east breed much farther north in open country and then winter from northern New England south to the Chesapeake Bay (Johnsgard 1988). This species may utilize any wet meadow habitat in the Boston Harbor area during the winter. The Squantum Point area is unlikely to provide suitable habitat for breeding, due to small size, urban setting and high present levels of disturbance. This species is listed by Massachusetts as an endangered breeding species. This species is of worldwide distribution. In New England, it is most commonly seen as a migrant and winter visitor in coastal fields, airports and salt marshes (Johnsgard 1988). It is known to actually breed in a very few locations in New England, mostly coastal. It prefers open grassland habitats where abundant small mammals are available as prey - especially meadow voles (*Microtus pennsylvanicus*). Brackish marshes connected to tidal flowage and wet grassland areas often have an abundance of such small mammals.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

Detailed information regarding historical and archeological resources on Squantum Point was obtained in 1990, when the site was under consideration for development (NAI 1990).

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For that study, documentary research for assessing possible historical and archeological resources included consultation of the State Register of Historic Places, files and materials at the Massachusetts Historical Commission (MHC), the Quincy Historical Society and the Boston Landmarks Commission as well as insurance atlases and maps. Data on known prehistoric sites were collected from the MHC, interviews with local archaeologists and individuals, and cultural resource management reports. USDA soil surveys were examined for stratigraphic data. A site walk was conducted to locate surface cultural remains and to assess the archeological sensitivity of the site. The 1990 study and a follow-up file review at MHC in 1993 revealed no known historic resources on the site or its environs.

Approximately 11 prehistoric sites are recorded from the Squantum area. These sites include shell middens as well as dog and human burial areas, which primarily date to the Late Woodland, Contact and Early Historic periods. No sites are recorded for the project area.

SOCIO-ECONOMIC/LAND USE

This former naval air station, a 44± acre site, is now owned by the Metropolitan District Commission (MDC), which intends to build a waterfront park as funds become available. Part of the site is used as a ferry docking facility to transport construction personnel to Deer Island for the Boston Harbor Clean-up Project (reference). This facility includes parking for 930 vehicles. The ferry facility will be made available to the MDC upon completion of the construction of the sewage treatment plant at Deer Island. The remainder of the site is a mixture of paved area and shrubs. To the east of the site is the Village at Marina Bay, a mixed-use development including residences, a marina, offices, restaurants and shops.

Quincy has a long history, beginning as a prosperous farming community and the home of two Presidents. Major industrial facilities including the former Fore River Shipyard now line its coast along with residential uses. Much of the land area in Quincy is devoted to park use. The population of 86,182 is 90% white and 6% Asian. The median family income is $44,184. Higher-income households have settled in Quincy with the development of new housing in and adjacent to Marina Bay.

Access to the subject site is via I-93 south to Neponset Circle, Route 3A to Quincy Shore Drive, an MDC parkway and from there, to a connector road to Commander Shea Boulevard. Existing mudflats around Squantum Point presently constrain marine access, therefore dredging would be required.

2.1.1.2 Environmental Consequences

In several respects, Squantum Point would provide the most suitable disposal option of the short-listed land-based sites. With its estimated capacity of 210,000 cy, the site could potentially accommodate the entire volume that could be reasonably dewatered for land-based disposal; it is currently in a disturbed state due to the presence of the abandoned runways, underdrains, and seawalls; and can be accessed by barge, although some dredging would be required, which would eliminate trucking related difficulties. The major limitations of the site include the dredging impacts and the site's proximity to the residences of the Village at Marina Bay.

DIRECT IMPACTS

Permanent Loss

Direct impacts at Squantum Point would include the filling of the shrublands and abandoned runways of the site. Although disturbed, this area currently provides wild open space on a heavily developed harbor. No unusual wildlife are known to breed at Squantum Point, although a short-eared owl (a Massachusetts breeding endangered species) was observed on the site in November 1990. This individual was probably overwintering or migrating through, feeding on the mice and voles that are common in such areas. Filling the site would destroy the current habitat, making it unavailable to any species during the dredging phase of the BHNIP. With completion of the dredging, the containment facility would be capped and landscaped. If desired, the plantings could be done to provide some habitat improvement for target species (e.g., open natural grasslands to attract birds of prey), thereby ultimately enhancing the site's ability to support wildlife.

Temporary Loss

Dredged material would most likely be delivered to the site via barge, requiring dredging of a 60-foot-wide channel from the Deer Island ferry channel to the northeast corner of the site. This dredging would impact approximately 1.4 acres (13,000 cy) of subtidal habitat, and 0.3 acres (6500 cy) of intertidal habitat, some of which may include a narrow band of salt marsh. Impacts to aquatic resources would include destruction of existing benthic communities in the dredged channel, although the new channel bottom, which would be an average of 6 feet deeper than present depths, would likely be re-colonized by benthic organisms similar to those impacted.

Permanent Alteration

Channel dredging in the 0.3± acre intertidal zone would result in the conversion of tidal flats and salt marsh to subtidal habitat. It is presumed that the tidal flats and salt marsh provide protection of wildlife habitat and of marine fisheries including shellfish. Other benefits include storm damage prevention, groundwater supply protection, flood control and pollution prevention. Primary functional losses would include a 0.3 acre reduction in migratory bird resting and feeding areas, intertidal productivity, water quality treatment and shoreline stability. Impacts to migratory bird habitat would include the permanent loss of the dredge channel area as well as temporary impacts in the vicinity due to disturbance from project activity. Loss of intertidal productivity would be greatest in the salt marsh area where primary productivity is highest. Nutrient transformation is significant in both tidal flat and salt marsh habitats, although the shallow subtidal dredge channel, when recolonized, would also perform that function to some extent. Shoreline stability would be affected by both loss of the buffering capacity provided by existing gentle grades, and the disruption of the erosion-resistant salt marsh peat that currently forms a continuous band along the northeastern (exposed) side of the site. Engineered protection against storm-driven waves and long-shore currents or refilling the access channel after disposal would possibly be required to minimize erosion.

The freshwater wetland currently known to exist on the site would not be impacted, however, should this site be selected for disposal, the wetlands should be remapped because of the disturbances and changing hydrology of the site.

INDIRECT IMPACTS

Increased turbidity and redeposition of suspended sediments during the dredging process could cause temporary impacts to adjacent benthic communities.

Upon closure of the project, freshwater runoff would be directed via swales to outfalls on the north and west sides of the site. The outfalls would open at the concrete/sheetpile seawall, and runoff would then cross the bands of salt marsh. During storm events, freshwater flow across the intertidal zone could impact infauna by creating osmotic stress. This would be most significant for species whose recruitment period is limited, such as soft-shell clams. Adults can isolate themselves from short-term perturbations by retracting their siphons. Spat are located at the sediment surface. Those located in the runoff path could die if freshwater runoff coincided with low tide. Runoff would reach mussel beds only during major storm events, due to the location of this resource in the lower intertidal zone. This would likely be of little impact due to the animal's ability to seal itself off, and to the short duration of exposure in each tidal cycle.

Loss of productivity on the tidal flat would depend on the design of the outfall and quantity of flow. The overall ability of the tidal flat to support finfish and shorebirds could be reduced by the intermittent loss of productivity in the runoff path, both by benthic microflora and invertebrates. However, this would likely be a minor impact since only a relatively small portion of the flat would be affected. Other functions of the intertidal area would be little impacted.

GEOLOGY/SOIL

The placement of 935,880 cy of dredged material (predominantly silts) should not severely impact the previously altered site geology and soil conditions. These silts would not be placed in or on any existing resources (e.g., wetlands), and would be placed with appropriate containment (capping) and sedimentation/erosion controls.

HYDROLOGY/WATER QUALITY

Groundwater impacts are difficult to anticipate due to the complex drainage system currently underlying the site, but would be expected to be minor because of the likely dominance of marine hydrology. Surface water from runoff would be directed so as to minimally alter current hydrologic budgets of surrounding lands and tidal flats. The site's flat topography would naturally limit impacts from altered runoff patterns.

Because the quality of groundwater resources at this site is unknown, potential impacts cannot be fully addressed. However, a liner would be required by the MADEP and should minimize leachate contamination of the groundwater.

AQUATIC RESOURCES

No freshwater ponds or streams occur on the Squantum Point site, so there would be no impacts on these resources.

WETLAND RESOURCES

The avoidance of any filling or other activity directly affecting protectable resource areas was established as one of the design criteria for the containment facility. Therefore, impacts would be limited to dredging a barge access route, and are described in the previous section. A

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detailed final investigation would be required to confirm that no other jurisdictional wetland resources occur in the shrub tangles on the site. No encroachment into the buffer zone associated with the Bordering Vegetated Wetland or Coastal Beach is proposed.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

Because there are no listed historical or archeological resources at or near the proposed Squantum Point site, no impacts are anticipated. However, the site is an artificially filled landform, and cultural or prehistoric resources could lie buried below. No adverse impact would be expected as long as no subsurface activity is conducted. If excavation were required, then machine-excavation with archeological monitoring would be recommended to determine the existence of potentially significant remains from either the Naval Air Station or small, isolated, intact prehistoric sites.

SOCIO-ECONOMIC IMPACTS

The site is proposed for development of a waterfront park by the MDC. Use of Squantum Point for dredged material disposal could delay and potentially alter these plans. Potential mitigation for loss of the planned park would be to design a park that would be compatible with the site after it was capped.

Odor and noise from the dredge disposal could affect residences and businesses in the Village at Marina Bay. Odor could be minimized by chemically treating or covering the disposal site daily with clean material. Noise impacts could be reduced by restricting usage during nighttime and other sensitive periods.

2.1.2 Everett (EVR-04)

The Everett site is approximately 23 acres in size in a "U" shaped parcel around a shallow inlet on the Mystic River (Figure A1-3). The Boston/Everett Corporate boundary bisects the parcel so that approximately two-thirds of the site lie in Everett and one-third in Boston. Boston Edison Company owns the Everett parcel. The Boston parcel is city-owned and currently has a MDC pumping station located on the southern side. This site discussion will focus on the 15-acre Everett parcel.

2.1.2.1 Existing Conditions

GEOLOGY/SOILS

Soils on the site consist primarily of Udorthents with a wet substratum. Udorthents are defined as fill soils over former tidal marshes, and other wetland resources (SCS 1989a, 1989b). The depth of fill ranges from 2 to 20 feet or more, with seasonal high groundwater ranging from 3 to 5 feet below the surface.

Based upon the mapping of Kaye (1980), the central portion of the site is underlain by bedrock consisting of sandstone or quartzite while the northern and southern portion of the site is underlain by sandstone argillite, with minor interbedded sandstone and/or quartzite. Bedrock has been mapped as outcropping near the site and the average depth to bedrock on site may be relatively shallow.

HYDROLOGY/WATER QUALITY

There are no surface waters on the site, so the hydrology is fairly simple. The topography of the site is flat, therefore most precipitation will infiltrate to the groundwater or be taken up through evapotranspiration. Any water that does run off most likely will run into the Mystic River.

The site consists of low-yield aquifers (<100 gpm) with half the site being classified as low and the other half as very low (MADEP Groundwater Overlay Maps). There are no wells on site or within 0.1± mile. Groundwater quality is influenced by tidal action and is probably saline in nature. Also, there are several hazardous waste sites near the site which may have an influence on groundwater quality. The site is not suitable as a drinking water supply. No data were available for groundwater quality at the site.

The Mystic River is classified as Class SC by MADEP. Waters under this classification are saline and designated for the protection and propagation of marine life and for secondary contact recreation. Water quality in the vicinity of the site is most likely influenced by several NPDES discharges into the Mystic River.

Water quality data for the Mystic River are available from sampling done by MADEP in 1982-1986 (Menzie-Cura and Associates 1991). Samples were taken downstream and near the confluence of Island End River. Results of this sampling indicate that the average concentrations for cadmium, copper, and lead exceeded the chronic criteria for aquatic life. The acute aquatic life criteria for cadmium, chromium, copper, lead, and zinc were exceeded on at least one occasion.

AQUATIC RESOURCES

The aquatic resources near the Everett site were not sampled; however, substrates appeared to be made up of fine-textured sediments in the exposed intertidal areas. It is likely that the subtidal communities are similar to those observed in the Mystic River and pier areas of Mystic Piers, Revere Sugar, and Amstar (as detailed in later sections). The intertidal areas may support soft-shell clams (*M. arenaria*), but are likely to have small populations due to the fine-textured substrates.

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VEGETATION

The upland portion of the site is flat and dominated by early-successional grasses, forbs and scattered saplings. Plant cover is sparse on approximately 50% of the site, where gravel and old asphalt dominate. These areas have poor quality rooting substrates and also appear to be periodically used by vehicles entering the site. The remainder of the site has better herbaceous cover: dominant species include several clovers (*Trifolium* spp.), grasses including broom beardgrass (*Schizachyrium scoparium*), mugwort (*Artemisia vulgaris*), goldenrods (*Solidago* spp.), milkweeds (*Asclepias* spp.) and bird's foot trefoil (*Lotus corniculatus*). Scattered saplings of cherries (*Prunus* sp.), trembling aspen (*Populus tremuloides*), gray birch (*Betula populifolia*), and staghorn sumac (*R. typhina*) occurred across the site, and are most prevalent on the western leg of the parcel. This leg in general appeared to be less disturbed, with better herbaceous and sapling cover.

Common reed (*P. australis*) occurred in patches around the periphery of the inlet at the top of the bulkheads. Because the bulkheads appear to be well above the high tide line, and would not impound freshwater, these stands of common reed appear to be opportunistic, occurring in upland settings. One exception may be the seaward edge of a small stand in the northwest corner of the inlet. In this area the fill behind the bulkhead has collapsed and may be exposed to tidal inundation during exceptionally high tides.

WETLANDS RESOURCES

No delineation of jurisdictional resources was performed at Everett; however, areas of tidal waters will fall within the purview of Section 404 of the Federal Clean Water Act. Massachusetts jurisdictional resources ((MGL c.131, s.40, and 310 CMR 10.00)) on the site include coastal bank, tidal flats, coastal beach and land under the ocean. A 100-foot buffer area, inland of the top of the coastal bank occurs on the east and west portions of the site. Small areas of coastal beach and coastal bank occur along the seaward end of the east and west portions of the site. These resources are composed of eroding fill, and have been partially reinforced by boulders and rubble.

With the possible exception of the seaward edge of the common reed stand as described in the previous section, no vegetated freshwater wetlands occur on site. During the site visit, a pool of standing freshwater was observed in an asphalt depression in the northeast corner of the site. The lack of requisite soils and vegetation preclude this as a wetland.

WILDLIFE

The paucity of vegetation and the surrounding urbanization limit the value of the Everett site for terrestrial wildlife. Animals typical of urban settings, such as rock doves, European starlings, house sparrows, and house mice might use the site, as would birds that nest on bare ground, such as killdeer. The western leg of the site, which is somewhat more densely vegetated, also would support species typical of herbaceous or "old field" habitats: for example, common yellowthroat, song sparrow, and meadow vole (DeGraaf and Rudis 1986). A song sparrow was heard in this area during 1993 site visits.

The intertidal flats and river bordering the site would be of more value to wildlife than would the site itself. Herring gulls and great black-backed gulls were observed feeding on the intertidal flat between the inlet and Route 99 on May 12, 1993. On May 25, 1993, a black-bellied plover, a semipalmated plover, and a killdeer were observed foraging on the intertidal flat along the Mystic River on the southwest corner of the project area. Common terns, a Massachusetts Species of Special Concern (321 CMR 10.60) were observed courting and apparently nesting on the dilapidated pier on the western side of the inlet. While only pilings remained for most of the length of the pier, the outermost section remained intact and formed an isolated platform on which the birds were seen. A great black-backed gull, a potential nest predator, also seemed to be sitting on a nest on the same platform on May 12, but a gull observed on May 25 exhibited no nesting behavior.

THREATENED AND ENDANGERED SPECIES

MANHESP records indicate that no protected species or habitats occur on the site (MANHESP, letter dated March 1, 1993).

Common terns feeding and courting were observed near the Everett site during two site visits in May 1993. As stated above, the common tern is a Species of Special Concern in Massachusetts. Four terns were sitting on the dilapidated pier in the inlet on May 12. One was seen to stand and pull material on the ground closer to itself. This activity and the posture of the birds suggested that they were sitting on nests on the old pier. During a subsequent field visit on May 25, six common terns were observed to exhibit nesting behavior. Terns were also observed foraging in the Mystic River near the site.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

There are no listed historical or archeological resources on the Everett site. A jackknife bridge was inventoried by MHC within 1000 feet upstream of the site. It has been for sale since 1990 and may have been dismantled (Mr. W. Smith, MHC, pers. comm.).

SOCIO-ECONOMIC/LAND USE

This site is a narrow basin abutting 28± acres of vacant land on the north side of the Mystic River in Everett. It is surrounded by industrial uses including a Boston Edison power station. A rail line abuts the western boundary of the site. There is a park and playground facility across Broadway and to the north of the site.

Everett was originally a territory of Charlestown, its neighbor across the Mystic River. A farming community for 150 years, Everett evolved into an industrial city with the advent of the railroads that facilitated transportation to Boston. Factories for brick manufacturing and the production of chemicals, located in Everett in the 19th century, have been joined by facilities for metal product fabrication and machinery in the past 100 years. The predominant land use in Everett is residential. Everett's population of 35,701 is predominantly white with a median family income of $37,397.

Land access to the site is from I-93 to Sullivan Square in Charlestown, and traveling north on Route 99 (Broadway) across the Mystic River. The parcel surrounding the basin abuts Route 99 to the east. Mud flats extend along the Mystic River edges, making access for vessels difficult. Some dredging would be required to accommodate barges related to the material disposal project.

2.1.2.2 Environmental Consequences

Everett is the smallest of the land-based potential disposal sites with an estimated capacity of 55,000 cy.

DIRECT IMPACTS

Permanent Losses

The site is a vacant lot in an urban setting, and as such offers habitat for typical urban species such as song sparrows, rock doves, and house mice. Most of this habitat would be impacted with the construction of the containment facility, and the resident animals displaced or destroyed. Upon capping and closure of the project, its value as open space in an urban setting would be restored, and most of the species currently using the site should return.

The placement of dredge spoils and the proposed containment facility would eliminate all existing vegetation within the disposal footprint. Upon completion of all on-site activities, natural recruitment and early stage succession of tolerant and opportunistic species should occur.

Temporary Loss

The preferred route to the site would be via barge which would require dredging to deepen the inlet channel to reach the existing granite bulkhead. This would result in the loss of approximately 0.3 acres (2300 cy) of subtidal habitat. The dredging process would destroy any benthic communities in the dredging corridor, although it is likely that similar benthos would re-establish in the deepened channel. Existing depths average 5.0 feet MLW, therefore dredging an additional 5.0 feet would be necessary to achieve a final 10.0 foot channel depth. Turbidity and redeposition of suspended sediments could cause temporary impacts to adjacent benthic communities during the dredging process, although these communities would be expected to recover quickly following completion of the dredging.

A second possible approach for barge traffic would provide access from the western leg of the site. However, this would require dredging of 0.2± acres (5000 cy) of intertidal and 0.03 acres (200 cy) of subtidal habitats. This approach would also impact an area of coastal beach, coastal bank and buffer. Because of the variety and extent of impacts to protected resources, this approach is considered a less desirable alternative than the inlet channel.

Activities during construction of the facility and dredged material disposal could discourage use of the adjacent tidal flats by shorebirds; however, this is a limited resource in terms of area and location, so the interruption would not be expected to be an adverse impact. Use of the site by these birds should resume after capping and closure.

Noise and disturbance during construction and operation of the containment facility could disrupt use of the dilapidated pier by nesting common terns (Massachusetts Species of Concern). The extent of use and success of these small, isolated, urban breeding sites is poorly understood, therefore impacts from adjacent construction activities are difficult to assess. It is likely that the birds would abandon the breeding site during project operation, and could return upon project closure.

GEOLOGY/SOILS

As with Squantum Point, the on-site udorthents represent an unnatural/altered site condition. Therefore, the placement of dredge spoils would not severely alter or change existing geological and/or soil conditions.

HYDROLOGY/WATER QUALITY

Because of the Everett site's proximity to tidal waters, impacts to hydrologic conditions from dredge material disposal, capping and closure would be minimal. Infiltration would be eliminated by the liner system required by MADEP, minimizing impacts to groundwater flow. Surface runoff would be directed to minimize alterations to the existing hydrologic budgets of surrounding lands and tidal flats.

INDIRECT IMPACTS

A playground is located a block away from the site, and a school is less than a half-mile away. Odor from the site and from trucks travelling to the site would be the greatest impact to these sensitive receptors. Daily cover or treatment of the dredged material may be required. Truck traffic already is heavy along Route 99, so the increase in safety hazard and noise caused by transportation of the dredged material may need to be evaluated, although increases over existing levels may not be noticeable. It is unknown to what extent any increase in truck traffic would result in additional traffic delays. If barges are used to transport material to the site, traffic impacts would be eliminated. Noise from industries and traffic already occurs in the area. Therefore, it is not expected that the increase in project noise would be a problem.

AQUATIC RESOURCES

No freshwater runoff impacts at site closure would be anticipated because runoff could be discharged directly into subtidal waters, therefore eliminating impacts to intertidal communities.

WETLAND RESOURCES

Under the preferred barge access route, no wetland resources other than Land Under Ocean would be impacted (see previous section). The containment facility footprint would not impact any protected resources.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

Because there are no identified historical or archeological resources at the Everett site, no impacts would be anticipated. The jackknife bridge upriver of the project would not be impacted.

2.2 SITE EVALUATIONS: LAND-BASED INLAND SITES

2.2.1 Woburn (WOB-11)

The Woburn site is a 59-acre parcel in the Town of Woburn adjacent to the Wilmington town line (Figure A1-4). The site is primarily owned by the town, but is bisected by a parcel owned by Boston Edison Co. High power transmission lines travel the Boston Edison parcel and are joined approximately half way up the site by a transmission line from the northeast along an easement corridor. These power lines effectively trisect the site into 3 parcels: a southern parcel approximately 18 acres in size, an eastern parcel of 13 acres,and a northern parcel estimated to be 24 acres. This assessment will concentrate on the northern parcel for use by the

BHNIP. It is dominated by a temporarily capped municipal landfill, with steep slopes approximately 10-25 feet in height.

2.2.1.1 **Existing Conditions**

GEOLOGY/SOILS

The topography of the Woburn site is irregular with rounded uplands separated by relatively flat lowlands. The topography of the site reflects the surficial and bedrock geology of the area. The surficial deposits at the site consist of stratified drift and glacial till. The low lying areas of the site are underlain by stratified drift which includes kame and kame terrace deposits of sand and gravel (Castle 1959). Portions of the lowlands have been mined to extract the sand and gravel for use as aggregate material. The upland portions of the site are underlain by dense, poorly sorted glacial deposits of silt, sand and gravel.

Outcrops of bedrock have also been observed (Castle 1959). The bedrock underlying the site has been mapped as Precambrian age metamorphosed mafic to felsic intrusive and volcaniclastic rocks (Zen 1983). These rocks are part of a large fault-bound block which trends northeast to southwest.

The majority of the soils on site are classified as landfill or udorthents (SCS 1989b). Two udorthents are distinguished: on the southern parcel is a sandy udorthent with 3-8% slopes; and on the eastern parcel is a udorthent with a wet substratum. The depth of fill over wetland material is unknown, and within the udorthent series can range from 2-20 feet. (SCS 1989b). Small areas of native soil occur on the northern boundary (Charlton-Hollis-Rock complex, 3-8% slopes) and adjacent to the stream in the southern parcel (Windsor loamy sands, 3-8% slopes).

HYDROLOGY/WATER QUALITY

The site is located in the Mystic River Basin immediately south of its drainage divide with the Ipswich River Basin. Runoff at the site appears to flow to a small stream in the middle of the property, which flows west to east across the site and then south into Hall's Brook (also known as Willow Brook). Locally, groundwater is recharged by the infiltration of precipitation into the surficial deposits. Groundwater appears to flow through the stratified drift deposits to the southeast and then discharge to the valley fill deposits of the Aberjona River.

Most of the site consists of low and very low yield aquifer with 20% of the site consisting of medium yield aquifer (100-300 gpm) (MADEP Groundwater Overlay Maps). There are no groundwater quality data available for the site. It is not known if water quality has been degraded by the existing landfill on the site. The Woburn residential areas near the site rely on Quabbin water through the MWRA, so no private drinking water wells are known to occur downgradient of the site.

At its northern boundary, the site is approximately 1200 feet away from the nearest boundary of the Wilmington Groundwater Protection District A. This district is designated to protect the "zones of contribution of the existing municipal supply wells" (Town of Wilmington 1990). The nearest Wilmington water supply well, the Town Park well, is over 0.8 miles to the north and upgradient of the Woburn site. Three other Wilmington municipal wells are within approximately 1.0 mile of the site.

The site is located in the upper portion of the Mystic River drainage basin. The only surface water on the site is a tributary of Halls Brook which is classified as a Class B waterway. Waters under Class B are freshwaters designated for the uses of protection and propagation of aquatic life and wildlife and for primary and secondary contact recreation. There are no surface water supplies downstream of the site. No water quality data exist for this brook, but as with groundwater, the on-site landfill may have the potential to influence water quality.

AQUATIC RESOURCES

No aquatic resources occur within the proposed footprint of the Woburn site. A stream tributary to Hall's Brook flows through the southwestern portion of the site. At the time of the site visit, the stream flowed very slowly in an easterly direction and was approximately 6-10 feet wide and 1 foot deep. A red brown floc coated many of the stream's bottom features, including the vegetation. No culvert was visible where the access road crossed the stream, although a slight current was apparent. It is assumed that the hydraulic crossing is that of a "farm drain" which allows flow through rock placed at the base of the road and permits flow through their interstices.

VEGETATION

The major portion of the site is a disturbed early-successional field and shrubland. Several small stands of hardwoods remain on the northern portion of the site, and along the small stream. Scattered shrubs, representative of disturbed-site species and most of Eurasian origin, have become established throughout the site.

On the northern parcel, dominant species on the closed landfill include mugwort (*Artemisia vulgaris*), alfalfa (*Medicago lupulina*), grasses (Two *Poa* spp. and *Bromus tectorum*), clovers (*Trifolium repens* and *T. pratense*), and goldenrods (*Solidago* spp.). Scattered small individuals of black locust (*Robinia pseudoacacia*), honeysuckle (*Lonicera tatarica*), and tree of heaven (*Ailanthus altissima*) have become established across the cap. On the steep slopes of the landfill, stands of trees approximately 30-40 feet in height occurred on the east and north sides. Common species included trembling aspen (*P. tremuloides*), gray birch (*B. populifolia*), and staghorn sumac (*R. typhina*).

The disturbed old field portions of the southwestern and eastern parcels support species similar to the plant community on the landfill cap in the northern parcel.

WETLAND RESOURCES

Several areas of freshwater wetlands which will fall within the purview of Section 404 of the Federal Clean Water Act were observed on the Woburn site. Wetland resources as protected by the Massachusetts Wetlands Protection Act and Regulations (MGL c.131, s.40, and 310 CMR 10.00) include Bordering Vegetated Wetlands, Isolated Land Subject to Flooding, Land Under Water Bodies and Waterways, and Banks. The following describes the various wetland resources from general observation. No jurisdictional wetland boundary delineations were performed since site access was limited.

Adjacent vegetation was primarily woody. On the eastern side of the access road, shrubs overhung most of the stream's length; species included common and European buckthorn (*Rhamnus cathartica* and *R. frangula*), red maple (*Acer rubrum*), willow (*Salix* sp.) and honeysuckle (*L. tatarica*). On the western side of the access road, small trees (20-30 feet in height) of red maple, mulberry (*Morus alba*), black willow (*Salix nigra*), and gray birch dominated the stream corridor.

Small isolated wetlands occur in depressions elsewhere on the site. Under the powerline, several herbaceous wetlands less than 0.1 acre in size were observed; along with considerable trash, common plant species included cattail (*T. angustifolia*), bluejoint grass (*Calamagrostis canadensis*), soft rush (*J. effusus*), and jewelweed (*Impatiens capensis*). Northwest of the on-site landfill, a small apparently isolated forested wetland occurred at the base of the landfill slope. Standing water in the middle open portion of the wetland was estimated to be 2.0± feet deep at the time of the site visit, and stagnant in appearance (heavy pollen accumulation, dark brown in color). Last year's herbaceous stems were visible well into the flooded zone, which suggests that water levels will drop significantly as the growing season progresses.

The canopy was quite open, and dominated by red maple, black willow and big-tooth aspen (*Populus grandidentata*), with willow and European buckthorn in the shrub layer. The herb layer contained limited species; a composite thicket condition formed a dense homogenous herbaceous cover in the flooded portion of the wetland. Along the edges, jewelweed and water horehound (*Lycopus* sp.) occurred, along with common reed (*P. australis*) and Japanese knotweed

(*Polygonum cuspidatum*) which crept down the slope of the landfill and encroached on the wetland.

A review of aerial photography revealed a small pond further to the north, occurring very close to the Woburn town line, and a more extensive forested wetland system in Wilmington in close proximity to the northern edge of the site. Neither area was visited during field work, but would not be impacted by the project design.

WILDLIFE

Mammal species typical of sites such as the closed landfill, with sparse herbaceous vegetation, include woodchucks and eastern cottontails. The scattered shrubs and adjacent forest also provided perches or nest sites for species such as indigo buntings, song sparrows and common grackles, all of which use open land or forest edge. Eastern kingbird, tree swallow, and hoary bat are examples of wildlife species that forage over open land and also use adjacent trees for perching, nesting or roosting (DeGraaf and Rudis 1986). The many rocks and other debris on the landfill top also provided good cover for species such as brown snakes and common garter snakes (Hunter et al. 1992).

The hardwood forest on the side slopes of the landfill area was young, with an open canopy (about 40-50% cover), and well-developed shrub and herbaceous layers. Species observed in the forest/shrub habitat included gray catbird, common yellowthroat, song sparrow, and yellow warbler. All of these species typically are associated with brushy habitats.

Several forested wetlands occurred in the area north of the landfill. Wildlife species most likely to occur in these wetlands would include those also able to use the adjacent landfill (e.g., common yellowthroat, song sparrow), adjacent developed sites (e.g., skunk), or the adjacent fragmented forest (e.g., coyote, raccoon). Some species typical of forested wetlands would be unlikely to use the smaller site (e.g., northern waterthrush and veery: DeGraaf and Rudis 1986, Robbins et al. 1989).

Wildlife species observed on the site on either May 12 or 27, 1993, include the following:

Common garter snake (*Thamnophis sirtalis*)
Red-tailed hawk (*Buteo jamaicensis*)
American kestrel (*Falco sparverius*)
Ring-necked pheasant (*Phasianus colchicus*)
Killdeer (*Charadrius vociferus*)
Northern flicker (*Colaptes auratus*)
Blue jay (*Cyanocitta cristata*)
American crow (*Corvus brachyrhynchos*)
American robin (*Turdus migratorius*)
Gray catbird (*Dumetella carolinensis*)
Northern mockingbird (*Mimus polyglottos*)
European starling (*Sturnus vulgaris*)
Yellow warbler (*Dendroica petechia*)
Common yellowthroat (*Geothlypis trichas*)
Rose-breasted grosbeak (*Pheucticus ludovicianus*)
Indigo bunting (*Passerina cyanea*)
Field sparrow (*Spizella pusilla*)
Song sparrow (*Melospiza melodia*)
Red-winged blackbird (*Agelaius phoeniceus*)
Common grackle (*Quiscalus quiscula*)
House finch (*Carpodacus mexicanus*)
American goldfinch (*Carduelis tristis*)
Rabbit (Leporidae family)
Woodchuck (*Marmota monax*)

THREATENED AND ENDANGERED SPECIES

The Mystic Valley Amphipod (*Crangonyx aberrans*) is a crustacean that occurs in cool, shallow, slow-moving or stagnant fresh water with leaf litter; and is only known to occur in New England (MANHESP 1991). It is a Species of Special Concern in Massachusetts. *C. aberrans* has been recorded south of the site in Hall's Brook (Lincoln 1993; MANHESP, letter dated March 1, 1993). The on-site tributary has several of the habitat characteristics required by the Mystic Valley Amphipod: shallow depth, sluggish velocity and leaf litter.

No search for *C. aberrans* was undertaken on the study area, but a 1991 survey sampled the tributary to Hall's Brook downstream of the study area (NAI 1991b). One immature *Crangonyx*, which could not be identified to species, and 17 *Crangonyx pseudogracilis* were collected at this sample point, but no adult *C. aberrans* were recorded at any sample point during the 1991 study. Since *C. pseudogracilis* typically occupy the same habitat as *C. aberrans* (Smith 1983 cited by NAI 1991), this survey reported no *C. aberrans* even in suitable habitat.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

There are no listed historical or archeological resources identified on or within 1000 feet of the Woburn site.

SOCIO-ECONOMIC/LAND USE

Woburn (11) is an 59± acre site containing a city landfill and vacant land. Boston Edison power transmission lines cross the site, dividing it into three pieces. People use the site for dirt-biking. The Boston and Maine Railroad tracks run in a north/south direction east of the site. Adjacent to this site is an office park to the east; another office park to the south, along with an industrial park and some residential use; general industrial and residential to the west; and general industrial to the north with some limited residential use.

Woburn, originally known as Charlestown Village, was settled in 1636 by people seeking relief from crowded conditions in Charlestown. Once a farming community, Woburn housed leather tanning and shoe manufacturing operations in the 19th century after the Middlesex Canal was built. These industries have been superseded by metal fabrication and the manufacture of electrical equipment. The predominant land use remains low-density housing. The population of Woburn declined 2% to 35,943 from 1980 to 1990 . The median family income in Woburn is $50,428.

2.2.1.2 Environmental Consequences

The Woburn site can potentially accommodate 158,600 cy of silt. A major engineering drawback of this site is the dome shape of the former landfill that currently dominates the site. The dome would require extensive regrading to construct the basin configuration of the dredge containment facility. The stability and condition of the landfilled material is currently unknown, and would require analysis to ascertain its status for construction. However, a long-term benefit gained by the use of this site would be the secure capping and closure of the landfill, which currently is loosely capped with a coarse mineral cover. Capping would eliminate the present infiltration and leaching from the portion of waste that is above the watertable. Any waste in contact with the groundwater would continue to leach.

DIRECT IMPACTS

Permanent Losses

The placement of dredge spoils and the proposed containment facility would eliminate all existing vegetation within the construction footprint. Upon completion of all on-site activities, early-stage succession of tolerant and opportunistic species should occur. A vegetation plan may be required for the landfill cap, since shallow-rooted species are generally preferable in maintaining cap integrity.

The preliminary design incorporates avoidance and minimization of all wetland resource impacts in its design criteria. As a result, most of the wetlands on the Woburn site and their buffer zones would not be impacted. The exception is a small 1.0± acre forested wetland on the northwest side of the site, in which fill would be placed to ensure adequate sideslope stability during closure of the existing landfill. More detailed site information would be necessary to further quantify surface area impacts to the wetland from any fill. The functions and values of this wetland have not yet been evaluated but due to its small size, isolation, and disturbed conditions, the wetland is expected to be of relatively low value for biological support, flood control, wetland wildlife habitat and water quality functions. Aesthetic, recreational, and educational values are also expected to be low because of its disturbed setting and lack of public access. Therefore, impacts to this area of wetland would likely be minor.

Construction of the containment facility would result in the loss of all upland wildlife habitat within the disposal footprint until capping and closure of the site were completed. Upon closure of the project, there would be an opportunity for natural recruitment and restoration and improved habitat quality by eliminating exposed trash and future dumping. As described above, a limited permanent wetland wildlife habitat loss would also occur, but is expected to be of minimal significance.

Temporary Losses

Travel to the site would be along secondary and local roads and would pass by residences. Truck traffic to the site could increase noise and odor levels and could create safety problems, particularly along Merrimac Street and New Boston Road. A new exit from Route I-93 and development of a proposed rail siding east of the site will not be completed in time for BHNIP's schedule.

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GEOLOGY/SOILS

On-site udorthents represent an unnatural and altered soil condition. Given the sandy gravelly deposits, placement of silty dredge spoils could change the surficial character of on-site soils not associated with the landfill. The dredge spoils could provide quality material for capping of the landfill area.

HYDROLOGY/WATER QUALITY

Because the quality of groundwater resources at the Woburn site is unknown, potential impacts cannot be fully addressed. However, a liner would be required by MADEP and would minimize leakage of contaminants from the dredged material into the groundwater. A potential benefit of using this site is that an unsecured landfill would be capped by the dredging project. This action could result in improvement of the groundwater quality by eliminating the present infiltration and leaching of that portion of the waste deposited above the water table. Any waste in contact with groundwater would continue to leach.

To avoid impacts from high chloride levels, the dredged material would be dewatered at Boston Harbor prior to transport to the Woburn site. Dewatering facilities are described in the dredge management plan (Section 3.0 of the EIR/S); monitoring requirements of MADEP would be in place to keep impacts from the dewatering process to an acceptable level in the surface waters of Boston Harbor.

No impacts to surface waters surrounding the disposal site are anticipated during the dredge disposal phase. The leachate collection system and the liner would be used to collect any excess water or contaminants. Leachate treatment would be controlled to prevent impacts to the surrounding environment. At the end of the dredge disposal phase (2± years), the site would be capped with an impermeable cover to prevent further infiltration or surface water runoff from the dredged material.

After the site has been capped and revegetated, runoff quality should resemble that of adjacent undeveloped land. Runoff quality should also improve because the currently sparse vegetation, steep slopes, exposed soils and trash are all likely to degrade existing runoff quality.

AQUATIC RESOURCES

Runoff into wetlands adjacent to the site would be controlled to keep sediments from entering the wetland during the dredge disposal phase. After site closure, runoff would be redirected to best approximate the pre-project water budget of these wetlands.

THREATENED AND ENDANGERED SPECIES

No known threatened and endangered species use the Woburn site; therefore, no impacts would be anticipated.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

There are no listed historical or archeological resources on or near the Woburn site; therefore, no impacts would be anticipated.

SOCIO-ECONOMIC/LAND USE

The site is an abandoned landfill, intersected by powerlines and a sewage pipe. The site is primarily owned by the City of Woburn, with a parcel owned by the Boston Edison Co. Use of this site for the project would not result in any loss of tax revenue to the City of Woburn, since no work would be done near the powerline. The powerlines and pipeline on the site would not be impacted by the project. Also, capping the site after project completion would save the City of Woburn the expense of capping the existing landfill.

The site is primarily industrial, with some nearby residences. Noise and odors from the site could affect some of these residences. Odors would possibly need to be controlled daily by covering the dredged material. Daily cover requirements would reduce the available site capacity. Noise and odor also would be lessened by prevailing winds. The direction of prevailing winds is from the west, and no residences occur immediately east of the site.

2.2.2 Wrentham (WREN-495)

The Wrentham site is approximately 181 acres in size, and is located at the intersection of US Route 495 and Route 1A (Figure A1-5). The site is undeveloped and is bordered primarily by I-495, open land and an active sand and gravel pit (Bardon Trimount Quarry and Asphalt Plant). Several single family residences lie within 500 feet on the east and west of the site; an abandoned railroad bed forms the eastern boundary. Privately owned by Simeone Corporation, the site is bisected by a power transmission line for which New England Power Company has an approximately 325 ft wide easement. The northern portion of the site currently has a proposal for a 23-acre sand and gravel operation in anticipation of an industrial subdivision (Landmark Engineering of New England, Inc., 1993). Because this site is private property, on-site access was not gained; observation are from the site borders, aerial photographs (black and white, 1:6000, dated December 11, 1991), and resource maps (1987 U.S.G.S. Franklin, MA topographic quadrangle and the 1989 SCS soil survey).

2.2.2.1 Existing Conditions

GEOLOGY/SOILS

The topography of the Wrentham site ranges from an upland area in the northeast portion of the property to several water filled depressions in the central and southern portions of the property. The upland areas are underlain by dense, poorly sorted glacial till and bedrock. The lowland areas in the central and southern portions of the property are underlain by stratified drift.

Portions of the stratified drift deposits in the southern portion of the property have been mined for sand and gravel.

Outcrops of bedrock are found in the upland portions of the property. Based upon the Bedrock Geological Map of Massachusetts (Zen 1983), the bedrock underlying the site consists of the Precambrian Age Dedham Granite. Dedham Granite is part of a structural block which trends northeast to southwest. In the vicinity of the property the Dedham Granite is traversed by a north to south trending normal fault.

Soils on the site are predominantly well drained and somewhat excessively drained outwash and till soils (SCS 1989a). Except for the level idorthents in the quarry areas, slopes range from 3-8% to 15-35%. The Charlton-Hollis-Rock Outcrop complex includes a dominant sandy till, but also included are till areas of Canton fine sandy loam, and outwash deposits of Hinckley fine sandy loam and Merrimac fine sandy loam. A linear unit of ponded Freetown muck, a very deep organic deposit, is associated with a small stream on the western edge.

HYDROLOGY/WATER QUALITY

The site is underlain by medium yield aquifer; approximately one-third of the site is designated as MADEP Zone II Wellhead Protection Area (MADEP Groundwater Overlay Maps). There are no municipal drinking water wells located on the site as the area is primarily serviced by a municipal piped system. No groundwater quality data were available for the site. There is a proposed municipal well approximately 0.15 miles west of the site. This proposed well location is in the Blackstone River basin, out of the watersheds of the project study site; however, actual groundwater divides may not coincide with surface watershed boundaries.

The north and west portions of the site are located in the Charles River basin while the south portion is in the Ten Mile River basin. There are several small ponds and a stream located on the site, but no water quality data were available. Surface waters on the site in both watersheds are classified as Class B waterbodies. Waters under Class B are fresh and designated for the uses of primary and secondary contact recreation and for the protection and propagation of aquatic life and wildlife. Several private wells are near the site for residences on portions of Green Street and Route 1A.

AQUATIC RESOURCES

Several small kettlehole ponds occur within the central project area. Most appeared to be steep sided; however, the largest pond (on the eastern side of the site) was shallow, with aquatic vegetation visible throughout. On the western edge of the site lies an unnamed stream which drains to Eagle Brook after flowing north through a series of off-site ponds. In June, the stream was approximately 4.0 feet wide and 6 to 8 inches deep, with a sand and detritus bottom and sluggish flow.

VEGETATION

Vegetation cover types and wetland identification were ascertained from stereo aerial photographs (black and white, 1:6000, dated December 1991), and ground truthed only peripherally from the old railroad grade, Green Street, and an improved gravel road bisecting the site. Should this site be selected, a more thorough site investigation would be required to determine jurisdictional wetland boundaries and more detailed vegetation descriptions.

The scrubland northwest of the active quarry area was on a low rolling dry plain bordered by several prominent rock outcrops. Based on vegetation composition and structure, the soil appeared to be well-drained poor sands with an average litter layer. The vegetation was dominated by a mixture of oaks, approximately 15 feet tall and many with multiple stems. Oak species included red oaks (probably *Quercus coccinea* and *Q. rubra*), scrub oak (*Q. illicifolia*) and white oak (*Q. alba*). Minor representatives of other tree species such as red maple (*Acer rubrum*), cherries (*Prunus* spp.) and gray birch (*B. populifolia*) were also observed. Tall snags of white pine (*Pinus strobus*) were scattered across the site. The understory was dominated by a lowbush blueberry (*Vaccinium* sp.), with sweet fern (*Comptonia peregrina*), meadowsweet (*Spirea latifolia*) and blackberry (*Rubus* sp.) also common. The herbaceous layer was sparse and indicative of dry site conditions: bracken (*Pteridium aquilinum*), Pennsylvania sedge (*Carex pensylvanica*) and haircap moss (*Polytrichum* sp.) were dominant species. Even a small swale running the length of the site appeared to be dominated by upland species, again supporting the SCS classification of well-drained soils on the site.

Shrublands elsewhere on the site were similar in structure and general species composition. Other common species included multiflora rose (*Rosa multiflora*), willows (*Salix* spp.), poison ivy (*T. radicans*), and tree-of-heaven (*A. altissima*). The forested portions of the site were hardwood-dominated with red oaks and white ash (*Fraxinus americana*) as the principal species. Other observed species include sassafras (*Sassafras albidum*), sugar maple (*Acer saccharum*), big-tooth aspen (*P. grandidentata*) and white pine. Understory species included white oak, gray birch, black cherry (*P. serotina*), poison ivy, and lowbush blueberry as well as canopy species. Structure was typical of second-growth forests of the area; canopy height was approximately 70 feet, with a maximum stem diameter at breast-height of about 18 inches, and an estimated 70% canopy closure.

Several small open areas of old field occurred. Soils were obviously poor and well drained, with many surface rocks and cobble. The vegetation was typically early-successional, dominated by forbs such as asters, goldenrods, yarrow (*Achillea* sp.), ragweed (*Ambrosia artemisiifolia*), wild carrot (*Daucus* sp.), grasses (*Poa compressa* and others), and sedges (*Carex brevior*). Scattered shrubs (willows, meadowsweet and sweet fern) were established.

WETLAND RESOURCES

Several areas of freshwater wetland occur across the Wrentham site will be subject to review under Section 404 of the Federal Clean Water Act. Jurisdictional resources under Massachusetts Wetlands Protection Act and Regulations (MGL c.131, s.40, and 310 CMR 10.00) on the Wrentham site include Bordering Vegetated Wetlands, Land Under Water Bodies and Waterways, Isolated Land Subject to Flooding, and possibly Banks.

In the northern and western portions, forested wetlands occurred either in isolated depressions on the landscape or associated with small ponds. On the far western edge lies an unnamed stream system which drains into Eagle Brook. The stream is bordered by a wide swath of wooded wetlands, except where it traverses a residential landscaped lot. The wooded wetland is primarily red maple (*A. rubrum*) with a minor element of white ash and other species. The understory was relatively dense with woody species such as red maple, swamp azalea (*R. viscosum*) and spice bush (*L. benzoin*). Herbaceous species included sensitive fern (*Onoclea sensibilis*), royal fern (*Osmunda regalis*), skunk cabbage (*Symplocarpus foetidus*) and sedges (*Carex* sp.). Immediately bordering the stream, the overstory opened up to a dense shrub swamp.

On the southern and eastern portions of the site, where the vegetation is predominantly low secondary growth, scattered shrub wetlands in isolated basins and in small drainages occur. Under the powerlines, vegetation is maintained by mowing or herbicides, and emergent/shrub wetlands were evident on the aerial photographs. Several small kettlehole ponds dot the central portion of the site. These ponds generally appear to be steep sided with few bordering wetlands. The largest pond was observed from the railroad tracks to have a narrow band of shrub swamp bordering its shores. The pond was shallow throughout, with pond lilies and emergent species dominating most open water areas. A narrow shrub swamp separated this pond from an adjacent smaller pond, but a surface hydrologic connection almost surely occurs at high water levels.

WILDLIFE

The scrublands could be expected to support many of the species typical of dry, brushy habitat (e.g., American redstart, gray catbird, New England cottontail: DeGraaf and Rudis 1986; redbelly snake: Hunter et al. 1992). The rufous-sided towhee, is typical of brushy habitat, forages in leaf litter (DeGraaf and Rudis 1986), which was abundant at this site.

The hardwood forest had a good vertical structure, with well-developed shrub and herbaceous layers. Wood thrush and woodland jumping mouse are typical of this forest type (DeGraaf and Rudis 1986). A well-developed layer of duff, a stonewall, and abundant logs would favor small animals requiring cover: for example, chipmunks, masked shrews, and redback salamanders (DeGraaf and Rudis 1986).

A small early successional field in the southern corner of the site contained sparse herbaceous vegetation, with some scattered shrubs and an occasional tree. Common yellowthroat, song sparrow and mourning dove would be expected in this habitat type. This habitat may be suitable for the northern hairstreak, a butterfly which is described in the "Threatened and Endangered Species" section.

The ponds appear to have poor interspersion of vegetation types and vegetation and water. Therefore, it is likely not to be important for waterfowl brood rearing. Canada goose scat was observed on the pond edge. These geese probably were feeding there.

The stream, moist soil and dense shrub layer in the red maple swamp would attract species such as veery, short-tailed shrew and yellow warbler (DeGraaf and Rudis 1986) as well as two-lined salamanders (Hunter et al. 1992), all of which would not occur in the other, drier cover types.

Some wildlife species may use a combination of habitats. For example, American kestrels may perch in the snags jutting above the scrubland and forage above the scrubland and in the adjacent early successional field (DeGraaf and Rudis 1986). White-tailed deer from the forest may browse on saplings and shrubs in the scrubland. Eastern kingbirds or eastern phoebes may hawk insects above the shrubs from perches at the forest edge or in the supercanopy snags.

The Wrentham site and its vicinity are intersected by a powerline, an interstate highway, several secondary roads, a dirt road, and a gravel mining operation. It is too fragmented to be used by species that breed in large tracts of unbroken forest (e.g., black-throated blue warbler: Robbins et al. 1989). However, wildlife species that use a variety of habitats and that have home ranges of a half-mile or more in diameter may use the site as part of their domain. Examples include red fox, striped skunk and raccoon (DeGraaf and Rudis 1986).

The following species of wildlife were observed on the project site on May 12 and June 21, 1993:

Bullfrog (*Rana catesbeiana*)
Canada goose (*Branta canadensis*)
Red-tailed hawk (*Buteo jamaicensis*)
Killdeer (*Charadrius vociferus*)
Rock dove (*Columba livia*)
Mourning dove (*Zenaida macroura*)
Eastern phoebe (*Sayornis phoebe*)
Eastern kingbird (*Tyrannus tyrannus*)
Blue jay (*Cyanocitta cristata*)
Tufted titmouse (*Parus bicolor*)
American robin (*Turdus migratorius*)
Gray catbird (*Dumetella carolinensis*)
Northern mockingbird (*Mimus polyglottos*)
European starling (*Sturnus vulgaris*)
Blue-winged warbler (*Vermivora pinus*)
Prairie warbler (*Dendroica discolor*)
Indigo bunting (*Passerina cyanea*)
Rufous-sided towhee (*Pipilo erythrophthalmus*)
Song sparrow (*Melospiza melodia*)
Common grackle (*Quiscalus quiscula*)
House finch (*Carpodacus mexicanus*)

THREATENED AND ENDANGERED SPECIES

Two species identified by the State of Massachusetts as of Special Concern occur adjacent to the site (MANHESP, letter dated March 1, 1993): and include the northern hairstreak butterfly (*Fixsenia ontario*), and Philadelphia panic grass (*Panicum philadelphicum*). Both species are typical of open ground.

The northern hairstreak occurs at disturbed sites that are dry, open and sparsely vegetated, such as power lines, railroad rights-of-way, and abandoned gravel pits (Hildreth, undated). The old fields and parts of the powerline right-of-way and abandoned railroad bed may provide appropriate habitat for this species. These areas would need more intensive investigation to determine whether they provide suitable conditions.

The Philadelphia panic-grass occurs in open areas or thin woods (Fernald 1950). In Massachusetts, it has been found in open wetlands, along the shores of water bodies, and in depressions (MANHESP 1992). The most likely place for it to occur on the study area would be in the wetlands within the powerline corridor and along the banks of open water throughout the study area.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

There are no listed historical or archeological resources on or within 1000 feet of the Wrentham site.

SOCIO-ECONOMIC/LAND USE

This 181-acre site is predominantly open land, with an active quarry and asphalt plant at its southern tip. It is located immediately southwest of the Route 1A Interchange on Route I-495 and near the Wrentham State Forest. The vast majority of the site is undeveloped shrub and forestland containing some ponds and wetlands. There are some residences abutting the property.

Wrentham was first settled in 1669 and was considered part of Dedham. Industries that developed in the town during the 19th century included the production of straw hats and jewelry. The major employer in the town today is the State, reflecting the presence of a state school for the retarded. The population of Wrentham is 98% white. The median family income is $51,184.

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Access to the site is via I-93 south to Route I-95 south, and northwest on Route I-495 to Route 1A to High Street to Green Street and onto the site.

2.2.2.2 Environmental Consequences

The Wrentham site is the largest of the land-based potential disposal sites, with an estimated capacity of 785,000 cy. This size may be sufficient to accommodate all of the silts since the dewatering process is likely to reduce the volume of the silts to below the in-situ volume, however the extent of wetlands and MDEP Zone II Wellhead Protection Area greatly reduce the suitability of this site. Due to the permitting and design concerns these two resource areas raise, this site may be more suitable for consideration as a disposal area for future maintenance material.

DIRECT IMPACTS

Permanent Losses

The preliminary design of three containment structures within the site incorporates avoidance and minimization of impacts to wetland resources in its design criteria. As a result, most of the larger wetlands and wetland complexes would be avoided altogether (based on the restricted in-field wetland assessment and findings to date and wetlands as mapped on Massachusetts Bureau of Waste Site Cleanup Resource Maps). Several areas of wooded and shrub wetlands in the interior portions of the two parcels would be filled. Under the preliminary design presented in the DEIR/S, over 15.0 acres of identified wetland resources protected under the Federal Clean Water Act would be impacted. Under Massachusetts regulations, this acreage includes both Bordering Vegetated Wetlands and Isolated Land Subject to Flooding. Additional field surveys would be necessary to determine more accurately the extent and proportion of wetland in each resource category and to assess their functions and values. Reconfiguring the containment facility to avoid these wetlands would reduce the capacity of the site by approximately 45% to 430,000 cy.

Construction of the containment facilities would result in the loss of all wildlife habitat within the project footprint until capping and closure of the site was completed, and revegetation commenced. If managed as open space with natural vegetation, the site would likely regain much of its current value as wildlife habitat.

The on-site potential for use by the Philadelphia panic grass and Northern hairstreak should be verified, because both species have been recorded at nearby locations. The scrub-shrub wetlands and old-field areas are the most likely habitats in which to find these two species, respectively. These habitats occur throughout the southern portion of the site. Upon detailed field investigation by experts of these two species, impacts to areas identified as potential habitat would be avoided.

The placement of dredge spoils and construction of the proposed containment facility would eliminate all existing vegetation within the footprint. Being a disturbed site, the existing vegetative composition and structure is of a shrubland, scrubland, and forb dominated old field. Following capping and closure of the site, this type of vegetative character would likely return.

Temporary Losses

Green Road already is used heavily by quarry trucks. The project would increase truck traffic. Odors from dredged material along the truck route could be a concern.

INDIRECT IMPACTS

Much of the northern portion of the site is within a MDEP Zone II Wellhead Protection Area (Bureau of Waste Site Cleanup Resource Maps), which violates DEP's landfill siting suitability criteria (310 CMR 16.40:3(a)1). Although the proposed containment facility would be lined and have a leachate collection system, the potential risk of contamination of the aquifer through liner leakage or failure cannot be eliminated. Reconfiguring the containment facility to avoid the Zone II aquifer would reduce Wrentham's capacity to 710,000 cy.

Avoidance of both wetland and Zone II aquifer resources results in the elimination of the northern cell entirely, and an overall reduction in the capacity of the site by approximately 60% to 315,000 cy.

Construction of the facility would result in the fragmentation of a relatively large tract of undeveloped land which could discourage use by those wildlife species which require large areas. This impact would be expected to be moderate because the forest and shrub communities are common in the region, and the study area presently contains an active gravel and asphalt operation. Upon closure and revegetation of the site, the fragmentation effects would be minimized as the vegetation succeeds and matures.

GEOLOGY/SOILS

The site would require regrading prior to construction of the lined containment facility and deposition of the dredged silts. These activities could require extensive earthmoving of sandy/gravelly till and filling with silt, thus potentially changing general surface soil characteristics. Blasting or drilling could be required to remove all or a portion of the existing bedrock outcrops.

The site is presently worked, and represents an altered condition; therefore, the placement of the containment facility and dredge spoils would not adversely impact existing geologic and/or soil conditions.

HYDROLOGY/WATER QUALITY

As with the Woburn site, impacts to surface water would be minimized during the dredge disposal phase by a combination of dewatering the dredged material prior to transport to the site, and by maintenance of a liner and leachate collection system.

These actions would prevent chloride, sediment and any sediment-related contaminants from entering surface waters. Dewatering facilities are described in Section 4.0 of the FEIR/S; MADEP discharge and monitoring requirements would keep dewatering impacts to surface water quality within an acceptable range in Boston Harbor.

Runoff from capped portions of the disposal site would be controlled so as to minimize erosion risks prior to entering any surface water system.

AQUATIC RESOURCES

As described in the Water Quality section, the on-site stream and small ponds would be protected from contamination during the dredged material disposal phase by dewatering prior to on-site disposal, and by the liner-leachate collection system. Surface runoff from the project would be treated using appropriate erosion control methods and controlled to avoid directly entering aquatic habitats. After site closure, runoff from the project area would be redirected to best approximate the pre-project water budgets of surrounding aquatic habitats.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

Since there are no listed historical or archeological resources on or near the Wrentham site, no impacts are anticipated.

SOCIO-ECONOMIC ISSUES

Odor and noise from the site should not be a concern near the quarry and asphalt plant because they would not likely be distinguishable from existing noise and odor levels there. However, in the northern part of the project, which is farther away from the plant and closer to the residences, odor and noise could become a concern. Daily cover or chemical treatment of dredged material could be required to control odors.

The project site is owned by Simeone Corporation, which has proposed to extract sand and gravel from the portion of the site that abuts Route I-495 in preparation for an industrial subdivision (Landmark Engineering of New England, Inc. 1993). Use of the northern part of the site by the project would deprive the Town of Wrentham of existing tax revenue as well as the potential tax revenue from the subdivision. Use of the southwestern parcel would result in loss of existing tax revenues, as well as any potential for future development.

2.2.3 Landfill Sites - An Overview

Three private solid waste landfills within reasonable haul distance have been identified that could accept portions of the dredged silt material. These three sites include Laidlaw Waste Systems Sanitary Landfill at Plainville, BFI-Northern Disposal, Inc. in East Bridgewater and Fitchburg/Westminister Sanitary Landfill in Fitchburg. All are lined facilities with leachate collection systems. None have special waste permits but all are willing, within their MADEP Solid Waste Site Assignment restrictions, to accept dredged material pending MADEP and local board of health approval. Table A1-1 summarizes the features and constraints of each site for comparative purposes.

Use of a portion of the dredged material as daily and intermediate cover is also a possibility at all three sites. To be considered suitable for intermediate cover the material must meet the physical and chemical standards described under 310 CMR 19.00 and expanded on by MADEP. Use as final cover should also be considered, provided the material meets the 310 CMR 19.00 standards, including criteria for Toxic Characteristic Leaching Procedures (TCLP), pH, solids, and reactivity.

As required by 310 CMR 19.00, the introduction of a special waste to any of the candidate sites should not impact the public health, safety and the environment by comprehensively regulating the storage transfer process, treatment, disposal, use and reuse of solid waste. Protection of these issues generally requires a comprehensive site evaluation and/or assessment which evaluates on-site and offsite conditions and receptors relative to public health and environmental risk. Since these candidate landfill sites are lined and presumed suitable to receive "special wastes," all issues of public health and environmental risk have been addressed previously. Therefore, both existing and proposed condition narratives, as contained herein, are brief. Potential impacts for each candidate landfill site are summarized in Table 2.3.2-7 of the EIR/S.

2.2.3.1 Existing Conditions

PLAINVILLE SANITARY LANDFILL

Laidlaw Waste Systems' Landfill of Plainville is a double-lined RCRA facility, operated by Laidlaw Waste Systems, Inc. in Plainville, MA (Figure A1-6). Access is via Route I-495 to Route 1 N and Madison Street, with an approximate travel time of 1.0 hour from Boston Harbor (35± miles).

Although no dredged material has been landfilled at the Plainville site, they have accepted grit and screenings from MWRA sewage treatment projects. Plainville was considered for the disposal of dredged material from the Moran terminal on Boston Harbor but a different site was selected. The landfill can accept materials containing up to 1000 ppm total petroleum hydrocarbons. Materials must contain at least 40% solids. Laidlaw engineers must review bulk sediment test results, and materials for disposal must contain no free-standing water. Any further need for testing will be determined by the MADEP. Coordination with the Plainville Board of Health consists of submitting an information package about the proposed disposal to the Board for review.

The landfill is very concerned about odor control, because of a campground near the site. Deodorizing agents will be required after disposal should odor problems develop.

Plainville expects to exceed its permitted capacity in 1995, but has several expansion proposals in various stages of preparation. One of the proposals, currently undergoing MADEP review, would extend the site's capacity for approximately one year, if approved. Three other expansions could potentially provide disposal capacity until the year 2000.

FITCHBURG/WESTMINSTER SANITARY LANDFILL

Fitchburg/Westminster is a lined solid waste facility operated by Resource Control, Inc. in Fitchburg, MA (Figure A1-7). Access is gained via Princeton Road off Route 2, with an approximate travel time of 1¼ hours from Boston Harbor (45± miles).

The landfill has not received dredged material for disposal but has accepted petroleum-contaminated soil and wastewater treatment plant sludge. In addition to meeting 310 CMR 19.00 standards, waste disposal material must be at least 25% solids and contain no free-standing water upon arrival at the site. No nuisance materials can be accepted at the landfill, so disposal material must be odor-free. Local coordination with both the Westminister and Fitchburg Boards of Health is required.

Fitchburg/Westminster expects to exceed its permitted capacity in 1997. No expansions are currently proposed.

BFI-NORTHERN DISPOSAL, INC.

Northern Disposal, Inc. is a lined facility operated by Browning Ferris Industries in East Bridgewater (Figure A1-8). Access requires taking Route 24 to Route 27 onto Thatcher Street. Time of travel is estimated to be 45 minutes from Boston Harbor (25± miles).

This landfill has accepted dredged material from another project in the last three years, as well as small volumes of sewage sludge and petroleum contaminated soils. This landfill was selected for the disposal of dredged material from the Moran Terminal on Boston Harbor. The landfill can accept materials with no free-standing water and a minimum of 20% solids. Approval for disposal is required from both DEP and the Town of East Bridgewater Board of Health. Odor is a particularly sensitive problem as several residences are located very close to the landfill. Deodorizing agents will be required after disposal in the event that odor problems develop.

Northern Disposal, Inc. expects to exceed its current permitted storage capacity in 1996, although it may pursue a vertical expansion.

2.2.3.2 Environmental Consequences

The three landfills under consideration for disposal of the silt sediments are all constructed to handle the material so as to avoid impacts on the environment. They are all lined facilities and strictly regulated for waste-stream handling and disposal. Because of their similarities, they will be addressed together in terms of project impacts using landfills as disposal options.

GEOLOGY/SOILS

Geological and soil conditions at landfills are generally accepted to be severely altered from pre-landfill dumping activities. Landfills designated for waste or special waste disposal can readily accept several forms of waste which meet their specific designation. Therefore, specific impacts on geology/soil would not be an issue.

HYDROLOGY/WATER QUALITY

The dredged material would be dewatered at Boston Harbor prior to being trucked to a landfill site. Dewatering is required to eliminate standing water and to achieve the criteria for percentage of solids specified by each landfill. Dewatering at Boston Harbor would reduce the volume of dredged material and therefore the project truck traffic, and would minimize the problem of chloride handling in a freshwater environment. The dewatering facility described under the Dredge Management Plan (Section 4.0 of the EIR/S) would also be utilized for the landfill disposal option. As with the upland inland sites, no adverse water quality impacts to Boston Harbor are anticipated due to the MADEP permit requirements.

AQUATIC RESOURCES

No impacts to aquatic resources would occur at the landfill sites or Boston Harbor as a result of dewatering.

WETLAND RESOURCES

No impacts to wetland resources would occur at the landfill sites or Boston Harbor as a result of dewatering.

WILDLIFE

No impacts to wildlife would occur at the landfill sites or Boston Harbor as a result of dewatering.

THREATENED AND ENDANGERED SPECIES

No threatened or endangered species are known to occur at any of the landfill sites, or at the Boston Harbor dewatering facility, so no impacts would occur.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

No historical or archeological resources are known to occur at any of the landfill sites, or at the Boston Harbor dewatering facility, so no impacts would occur.

SOCIO-ECONOMIC/LAND USE

Each are existing and active landfills so that their individual or collective use should not pose any additional socio-economic/land use impacts on their respective communities.

2.3 SITE EVALUATIONS: NEARSHORE AQUATIC SITES

2.3.1 Existing Conditions

2.3.1.1 Mystic Piers (Massport Piers 49 & 50)

The site is depicted on Figure A1-9.

SEDIMENT CHARACTERISTICS

Like all of Boston Inner Harbor, the Mystic Piers site is a depositional environment (EG&G 1984), accumulating fine grained sediments (silts and clays). Sediment sampling along the harbor-face of Massport's Mystic Piers 1 (Station 1), 49 and 50 (Stations 1 and 2), adjacent to the proposed disposal site, revealed that the silt-clay component was 41-78%, averaging 60% (see EIR/S Section 2.2). Benthic grabs collected within the proposed disposal area contained predominantly silty sediments, although gravel was present in one sample.

No within-berth data were available for assessing sediment quality. However, all stations sampled to characterize berth-area dredged materials were within approximately 400 feet from the mouth of the proposed Mystic Pier disposal site and may be indicative of sediment quality. Assuming these data reflect conditions within the Mystic Pier site, the sediments are likely to contain moderate to high levels of metals and organics. Arsenic, chromium, copper and mercury likely occur in Category II levels; lead and zinc likely occur in Category III levels. Total PAHs concentrations are likely to be high (>10 ppm), with fluoranthene and benzo(g,h,i)perylene contributing the highest concentrations. Total organic carbon is likely to be 2-3% of dry weight, indicating a relatively high potential for bioaccummulation of contaminants.

WATER QUALITY AND CIRCULATION

The area of Boston Harbor adjacent to the Mystic Pier site has been classified as Class SB waters by the MADEP. This designates these saline waters for the propagation of marine life, primary and secondary contact recreation and shellfish harvesting with depuration. Water quality of Boston Inner Harbor is strongly influenced by the numerous discharges into the harbor, including CSOs, NPDES discharges and non-point source urban runoff. There is no site-specific water quality data for the Mystic Pier Site; however, water quality can be characterized by Boston Inner Harbor data which are described in Section 4.1.1 of the EIR/S. At the Mystic Pier site there is an outfall pipe, which is a minor discharge consisting of either stormwater, sanitary waste water or from a minor industrial discharge such as non-contact cooling of equipment (Menzie-Cura and Assoc. 1991).

The opening of the Mystic Piers site indicates that water exchange between Boston Harbor and the site is not restricted. Thus, water movement at the Mystic Pier site can be characterized by Boston Inner Harbor currents (described in Section 4.1 of the EIR/S) which are tidally diverse.

In general, water quality and circulation are driven by tidal cycles, and influenced by seasonal weather patterns. High summer temperatures have been reported to depress dissolved oxygen concentrations, often resulting in defaunation in the benthos in Boston Harbor (Hubbard and Bellmer 1989). This condition is commonly referred to as the "August Effect," and will be also referred to throughout this document.

AQUATIC RESOURCES

The site was visited during low tide on April 28, 1993, to evaluate habitat conditions. The intertidal zone is restricted to the tidal excursion vertically along the walls and pilings surrounding the Mystic Piers site, except in the southwest corner where rubble has accumulated in sufficient quantity to be exposed at low tide. Intertidal portions of the western and northern walls were covered extensively with algae (primarily *Fucus* sp. with some *Spongomorpha* sp.). The pilings along the southern perimeter were heavily covered with barnacles, blue mussels (*Mytilus edulis*) and green algae (*Spongomorpha* sp.) with algal cover increasing with distance from the mouth. Diatoms were present on the algae and rubble. Mussels and macroalgae both provide habitat for other organisms. These communities may be exploited for food or shelter by crustaceans and finfish.

Benthic Infauna

Two areas were sampled (in April 1993) for benthic infauna. Results (extrapolated to number/m^2) are reported on Table A1-2. Station MP-1, adjacent to the pilings, was nearly azoic (two taxa totalling 86 individuals/m^2) while Station MP-2, near the head of the site, contained 17,759 individuals/m^2 (11 taxa) of which 11,954/m^2 were nematodes. The total abundance at MP-2 was in the range observed by the Corps in the Chelsea Creek and Confluence Area in 1986. However, the channel stations were dominated by polychaetes (>70%) while the Mystic Pier station was dominated by nematodes (67%). *Capitella capitata* and oligochaetes comprised 85% of the remaining organisms. These predominant taxa are classified as pioneer taxa. Nematodes are early settlers in organically enriched sediments whose presence stimulates microbial degradation of organics (Tietjen 1982). Oligochaetes and *C. capitata* are typically associated with organically enriched, stressed environments. Its reproductive strategy enables *C. capitata* to colonize disturbed sediments rapidly. No amphipods or live mollusks were collected. The moderate abundance of infauna (17,759/m^2) in at least a portion of the site contributes to the productivity of Boston Harbor and these near-surface dwelling organisms are available as prey items for crabs and demersally feeding fish. Winter flounder (*Pleuronectes americanus*) have been documented as feeding on *C. capitata* in Boston Harbor (Haedrich and Haedrich 1974; NAI 1985), although their preferred prey includes amphipods and large worms.

Sediment profile camera sampling in October 1994 at three locations showed two types of benthic habitat (NAI and Diaz 1995). On the northern side of the site, sediments were muddy with pit and mound topography, indicative of a depositional environment. The Redox Potential Discontinuity (RPD) layer, an indication of the degree to which subsurface sediments are oxygenated, was located at 0.5-1.0 cm below the sediment surface, indicating poor oxygenation. There were a few infauna tubes at the sediment surface but no other indications of bioturbation. The information suggests the area is under environmental stress and characterized by a colonizing or pioneering benthic community. Benthic samples confirmed this assessment. Only one taxon, the surface-dwelling gastropod *Nassarius trivittatus*, was collected with a density of 37.5/m^2 (Habitat II, Table A1-3). Abundances were also low in this area in 1993 (MP-1, Table A1-2).

Sediment profile camera sampling on the southern border of the site revealed fine sand sediments overlaying silt, suggesting occasional erosional conditions. The RPD layer was located at 1.3 cm below the sediment surface, indicating greater sediment oxygenation than in the northern Mystic Pier area. Some indicators of bioturbation, including infauna tubes and anoxic voids, were observed. Benthic samples from this area revealed a slightly more diverse community (5 taxa/.08m^2, Habitat IV, Table A1-3). Total abundance was low (62.5/m^2), much lower than that in the same area (MP-2) in 1993 (17,329, Table A1-2). Dominants included the opportunistic polychaete *Streblospio benedicti*, the gastropod *Nassarius trivittatus,* and amphipod *Ampelisca abdita*, which together composed 60% of the total abundance. Numbers of taxa and total abundance were among the lowest of Inner Harbor stations. The benthic community in this area would still be considered pioneer or colonizing, but under slightly less environmental stress than in the northern area at Mystic Piers site.

Finfish

Finfish were not sampled at this site. However, recent finfish surveys in the Mystic River and Inner Confluence give an indication of the species that could move into this area. Haedrich and Haedrich (1974) observed 23 species in the Mystic River including winter flounder, rainbow smelt, and alewife. A fall 1994 trawl survey of demersal fish in the Mystic River and Inner Confluence collected winter flounder, Atlantic tomcod, windowpane, scup and rainbow smelt (Table A1-4). Scientific names for fish species are provided in Table A1-5. Gill netting in the Little Mystic Channel at the same time collected rainbow smelt and Atlantic tomcod (Table A1-6).

Characteristics of the Mystic Piers site may enhance the suitability of the habitat for finfish. The pilings and wharf, shading the area below, offer shelter from predators. The orientation of the site perpendicular to the main channel provides shelter from currents. Both subtidal and intertidal benthic resources in some areas could provide prey items. Soft substrate could support feeding by demersal species (e.g., winter flounder). Fish such as cunner, tomcod, and sculpins could feed on the fouling community on the walls and pilings (Edwards et al. 1982; Menge 1982; Ojeda and Dearborn 1990). Two species of particular concern are alewife and winter flounder. The anadromous alewife spawns above the head of tide of the Mystic River so reproductive adults migrate upriver past the Mystic Piers site between April and May (Whitlatch 1982). Adults descend the river during the summer, juveniles swim downriver past the site from late summer-fall (Loesch 1987). Another anadromous species, rainbow smelt, may also use this portion of the Harbor. Winter flounder is one of the most abundant species in Boston Harbor where it is considered to be a resident. It prefers to spawn on sand common in the outer harbor (Bigelow and Schroeder 1953).

WETLAND RESOURCES

Under the jurisdiction of the Massachusetts Wetlands Protection Act (MGL c.131, s.40 and 310 CMR 10.00) the Mystic Piers site is a Designated Port Area (DPA). DPAs are almost completely developed areas where few or no natural land forms or vegetation remain. They tend to be paved, bulkheaded, and used for heavy industry so that they have virtually no significance to the interests of the Act, except for Land Under the Ocean. Land Under the Ocean in DPAs are significant to flood control, storm damage prevention, and the protection of marine fisheries, as is Land Under the Ocean outside of DPAs. The major addition is that Land Under the Ocean in Designated Port Areas also provides support for coastal engineering structures, such as bulkheads, seawalls, revetments, and solid fill piers. The site is primarily Land Under the Ocean, potentially important to marine fisheries, storm damage prevention and flood control. Land Under the Ocean within the Mystic Pier provides food resources and shelter; however, the silty substrate is not preferred spawning habitat for winter flounder, nor are the saline conditions conducive to spawning of the anadromous alewife. Storm damage protection and flood control are provided by the vertical granite wall surrounding the perimeter of the site.

Under federal wetlands guidelines, the entire Mystic Piers site is defined as Tidal Waters. The fine-grained character of sediments at the site, as well as proximity to identified contaminants, suggest that the potential for retention of sediments, toxicants and nutrients exists. Abundance and diversity of the benthic fauna varied substantially in the site. Compared to other locations in the harbor, Mystic Piers exhibited moderate potential for supporting higher trophic levels. Construction activities could be more sensitive at this site due to its proximity to an anadromous fish run (in the Mystic River).

WILDLIFE

The aquatic area of Mystic Piers may be used by waterfowl that dive for food (e.g., bufflehead and common goldeneye), birds that hunt fish in the water (e.g., red-breasted merganser and double-crested cormorant), or those that hunt fish from the air (e.g., common tern and belted king fisher). Coastal areas are particularly important to waterfowl during the winter. Inland feeding areas usually freeze, so water-dependent birds such as American black ducks move to unfrozen waters on the coast.

Abandoned piers provide roosting sites for gulls and common terns. Norway rats are also commonly associated with waterfronts (DeGraaf and Rudis 1986). Harbor seals may

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occasionally occur since they generally feed in shallow water inshore (FAO Adv. Comm. 1976, cited by Chapman and Feldhamer 1982).

THREATENED AND ENDANGERED SPECIES

No federally or state-listed threatened or endangered species are identified or anticipated to occur within the boundaries of the Mystic Piers site (Lincoln 1993). Although common terns have been observed nesting within Boston Harbor, no evidence of nesting was present at the Mystic Piers site on April 28, 1993.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

There are no listed historical or archeological resources at the Mystic Piers site.

SOCIO-ECONOMIC/LAND USE

The inlet between the Mystic Pier No. 1 and Pier 49 is no longer used for cargo handling at Massport's Moran Terminal in Charlestown. Charlestown is a neighborhood within the City of Boston. Recreational vessels docking here in the late 1970s were removed to accommodate shipping activity. The recreational docking has not been reinstated even though the port-related shipping activity ceased to operate in the inlet. There are no residential areas abutting this property. The closest residential neighbors are across the Little Mystic Channel in the Charles Newtowne complex and in the former Navy Yard.

Charlestown, with a population of 14,731, is a dense residential community surrounded by industrial land use on the north and south edges. To the southeast, the former Boston Naval Shipyard has been redeveloped into a mixed use complex including residences, institutions, shops, offices and recreational facilities. The population of Charlestown is 95% white. From 1980 to 1990 the population shifted with a reduction in the percentage of children and an increase in the 25-44 year age group. This reflects the new condominiums and apartments constructed in the Navy Yard and along Main Street. The median family income is $41,638.

2.3.1.2 Revere Sugar

The site is depicted on Figure A1-10.

SEDIMENT CHARACTERISTICS

Benthic samples from the interior portions of the site revealed the sediments to be anoxic silts with an oily sheen. At the mouth of the site there was a thin oxygenated layer overlaying anoxic black silts. No samples were collected within the site boundaries for sediment characterization, but Stations 1 and 2 sampled along the Mystic River berth at Revere Sugar (Appendix C of the EIR/S) represent probable sediment conditions. Contaminant loads in these sediments were generally high: Category II levels of chromium and copper; Category III levels of arsenic, lead, zinc and PCBs; high levels of total PAHs (18-44 ppm) and total petroleum hydrocarbons. Individual PAHs exhibiting particularly high values (>5 ppm) were pyrene, phenanthrene, fluoranthene and chrysene. TOC values (3-3.6%) indicate that the potential for bioaccumulation is high.

WATER QUALITY AND CIRCULATION

Tidal flow and land-based discharges to the Mystic River influence the water quality of the Revere Sugar site, which is classified as Class SB waters. Dissolved oxygen experiences August Effect fluctuations at this site.

Circulation within the Revere Sugar site is governed by tidal flow and physical structures. The northeast corner of the site is likely to experience reduced flows or eddies during flood tide since the eastern boundary of the site is perpendicular to the primary flow. Similarly, the northwest corner would experience reduced flows or eddies during ebb tides. The pilings across the mouth of the site interrupt linear flow and can reduce current speed, enhancing the likelihood of sediment deposition. The even more numerous pilings along the western and southern edges of the site create the same effect in these areas.

AQUATIC RESOURCES

Habitat conditions were examined at the Revere Sugar site on April 28, 1993. The intertidal zone is restricted primarily to vertical excursion on pilings and walls. The wooden retaining wall along the eastern boundary and the abandoned pier on the southern side supported small quantities of macroalgae (predominantly *Fucus* sp. with some green algae). Barnacles and littorinid snails were present but not numerous. The barnacle cover increased along the western pilings towards the mouth. The granite wall behind the pilings supported some algae cover (*Fucus* sp. and green algae). Barnacle cover was heaviest on the metal pilings at the mouth of the site. Mussels were observed only at the northwest corner of the site.

Breaching of the retaining wall along the southeast portion of the site has allowed erosion into the aquatic zone, creating a small intertidal zone of rubble and fine-grained sediments.

Benthic Infauna

Benthic infauna was sampled in three locations in April 1993 (Table A1-2). Nematodes accounted for >80% of the abundance at Stations RS-1 and RS-2 (98% RS-1, 84% RS-2); *C. capitata* and oligochaetes were also numerically important components of the fauna. Abundances at RS-3 were low, made up primarily of the cirratulid polychaete *Tharyx acutus* and nematodes. Freshwater insects (chironomids, collembolans) were collected in low numbers. Species richness at RS-1, near the mouth of the site, indicates that, at least seasonally, benthic infauna can be relatively diverse in this site. The polychaetes present are primarily surface deposit feeders, indicative of the stressed sediment conditions. The tube dwelling amphipod *Microdeutopus gryllotalpa*, is commonly found associated with docks, algae and mussels (Bousfield 1973).

Its presence in the infauna suggests it is present among the fouling organisms on the pilings and bulkheads. The paucity of suspension feeders (e.g., bivalves) indicate that suspended particulates or siltation rates are higher than suitable.

Sediment profile camera sampling at three locations in October 1994 revealed all sites had homogeneous muddy sediments with some pit and mound topography, suggesting a depositional environment (NAI and Diaz 1995). There was little evidence of bioturbation (infaunal tubes, burrows, and voids). The Redox Potential Discontinuity (RPD) layer, an indication of the depth to which sediments are oxidized, was located at less than 1 cm from the sediment surface. These indicators suggest considerable environmental stress to the benthic community. Benthic infauna samples collected in October 1994 contained an average of 9 taxa per 0.12 m^2, and an average of 483.2 individuals/m^2, moderate in comparison to other Inner Harbor stations (Table A1-3). Oligochaetes, cirratulid polychaetes, and nematodes were the most abundant taxa, similar to previous collections. The epifaunal amphipod *Microdeutopus gryllotalpa* and the motile sand shrimp *Crangon septemspinosa* were also collected. The benthic infauna suggest the habitat is under environmental stress, with a pioneering or colonizing successional stage of benthic community.

Lobster

An assessment of the lobster population was made in October 1994 using experimental traps. A total of 0.2 CPUE (per trap-day) of sublegal-sized lobster (<83mm or 325 in CL) and 0.1 CPUE of legal-sized lobster were collected (Table A1-7). Males were twice as common as females (NAI 1995b). Lobster CPUE was among the highest of those in the Mystic and Chelsea Rivers, but an order of magnitude lower than offshore areas such as Meisburger 2 and 7 and Boston Lightship. This is as expected, since benthic and sediment profile sampling indicated a pioneer successional state with fine grained sediments and low densities of infauna. These less-than optimal conditions may be offset by the presence of abandoned piers, which may provide shelter for lobsters.

Finfish

As with Mystic Piers, finfish are likely to utilize the Revere Sugar site for shelter from currents and predators, and for feeding. Species feeding indiscriminantly on the bottom would encounter prey. Species that prefer to browse on hard substrates would find little food. while winter flounder could spawn in this area, their preferred spawning habitat (sand) may not occur at this site. Revere Sugar is located well below the head-of-tide, and so does not provide suitable conditions for anadromous species to spawn. A fall 1994 gill net survey collected predominantly rainbow smelt along with alewife, mackerel and winter flounder (Table A1-6). Total catch was lower than other Inner Harbor, Outer Harbor, and offshore stations (NAI 1995a).

WETLAND RESOURCES

The Revere Sugar site is located within the Mystic River DPA (310 CMR 10.00). Under Massachusetts wetlands regulations, most of the site would be designated as Land Under the Ocean and have the potential to be significant to marine fisheries, storm damage prevention and flood control. This site could provide both refuge (from currents and predators) and feeding opportunities (primarily for demersal feeders). It is unlikely to provide spawning habitat for either winter flounder, as it appeared to lack sandy sediments, or anadromous species (e.g., alewife), as it is located well below the head-of-tide. Storm damage prevention and flood control are enhanced at this site by the man made boundaries, although the seawall at the southern end of the site is in disrepair and offers limited protection against exceptionally high tides. The greatest potential for storm damage prevention and flood control occurs during low tides.

Intertidal resources include a debris strewn beach in the southeastern corner and the granite walls and pilings surrounding the site. The beach could be categorized as Coastal Beach but is not significant in the DPA. No natural intertidal features exist at this site.

Under federal regulations, the entire site is categorized as Tidal Waters. This resource provides two functions not specifically identified by Massachusetts for DPAs. The fine-grained character of the sediments indicates the potential for sediment/toxicant retention and for nutrient retention/transformation exists. Aquatic diversity/abundance is moderate at this site and appears to vary spatially, being highest at the mouth. Potential construction at this site may be more sensitive because of its location on a river that has an anadromous fish run.

WILDLIFE

Wildlife use of the Revere Sugar site is expected to be similar to that described for Mystic Piers (Section 2.3.1.1 of this evaluation).

THREATENED AND ENDANGERED SPECIES

No federally or state-listed threatened or endangered species are identified or anticipated to occur within the boundaries of the Revere Sugar site (Lincoln 1993). Although the state-listed common tern has been observed in Boston Harbor, no evidence of nesting activities of this species was seen during a site visit on April 28, 1993.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

There are no listed historical or archeological resources on or within 1000 feet of the Revere Sugar site.

SOCIO-ECONOMIC/LAND USE

Revere Sugar, a site containing 6.5± acres in Charlestown, is currently under lease from Massport by the MWRA which has constructed a water transportation facility for the ferrying of construction personnel to Deer Island. Construction personnel can park vehicles on the Revere Sugar property before boarding the ferry to Deer Island. The lease for the ferry operation runs to 1998. The dock is located on the west side of the property. The property is between two industrial sites and between the Mystic River and Medford Street. Across Medford Street are residences and a cemetery. Land side access to the site from Moran Terminal is via Terminal Street to Medford Street. These streets have mixed uses.

The neighborhood closest to Revere Sugar has a very low percentage of people below the poverty line and a high median family income compared to other locations in Charlestown.

2.3.1.3 Amstar

The site is depicted on Figure A1-11.

SEDIMENT CHARACTERISTICS

Benthic samples collected at Amstar contained odorless, grey silty sediments. No chemical analyses were performed on sediments from the Amstar site, but Station 3 from the Revere Sugar berth was located approximately 300 feet from the mouth of the site and is assumed to be representative of on-site conditions (see EIR/S Section 2.2). That station had a 73% silt-clay component (Category III). Chromium, copper and nickel all occurred at Category II levels; arsenic, lead, zinc and PCBs were Category III concentrations. Total PAHs were among the highest (46.41 ppm) observed during the 1992 berth area sampling. Benzo(b)fluoranthene, benzo(k)fluoranthene, fluoranthene and pyrene each contributed more than 5 ppm to the total concentration. Total petroleum hydrocarbons were 3540 ppm. Total organic carbon was 6.6%, among the higher values observed during the berth sampling, suggesting that potential for bioaccumulation of contaminants is lower at Amstar than other sites in Boston Harbor. Zinc and PAH uptake may be exceptions to this generalization, as these constituents were found at higher levels at Revere Sugar Station 3 than at other berths.

WATER QUALITY AND CIRCULATION

In general water, quality at this site is expected to be similar to conditions in the Mystic River since there are no obstructions to flow. Again, the water quality classification is Class SB. The character of the sediments observed within this site suggest that it may experience the late summer hypoxia (August Effect). Water quality on the site may also be influenced by two discharges on the southern and western banks which are most likely minor discharges consisting of stormwater. There is also a NPDES discharge from Cambridge Electric in the vicinity of the Amstar site (Menzie-Cura and Assoc. 1991).

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Amstar opens directly on the Mystic River with no obstructions. Like Revere Sugar, the northeast corner of the site may experience reduced flows or eddies during flood tides as currents are diverted around the end of the wharf. This phenomenon would occur during ebb tides at the northwest corner. The pilings supporting the eastern wharf and the floating dock slow currents and contribute to sedimentation under the wharf.

AQUATIC RESOURCES

There are three types of intertidal habitat that occur at the Amstar site. Pilings and vertical seawalls along the eastern side provide hard substrate that has been colonized by barnacles, mussels and green algae. Beneath the ramp to the floating dock is a small, gently sloping gravel-cobble beach. The cobble support green algae. The rest of the south boundary is a rip-rap slope comprised of boulders that are heavily covered with *Fucus* sp. There is little *Fucus* sp. on the western rip-rap slope except at the mouth of the site. Along the western boundary barnacles and periwinkles (*Littorina* sp.) were numerous; green algae was present above and below the barnacle zone.

Benthic Infauna

Most of the site is submerged continuously. Differences in species composition at the two sampling locations visited in April 1993 (Table A1-2) may reflect differences in circulation, exposure and adjacent substrate conditions. Species present at Station AM-1 (dominants: nematodes, *Polydora cornuta*, oligochaetes) are typically abundant harbor-wide. Total abundance (18,287/m^2) at AM-1 was moderate relative to other areas sampled. Station AM-2 supported low abundances of several species, two of which (*Crangon septemspinosa* and harpacticoid copepods) are motile. Sediment at this station was gelatinous, with an oily sheen.

Sediment profile camera sampling at three sites in October 1994 showed all had homogeneous muddy sediments with some pit and mound topography, suggesting a depositional or low energy habitat (NAI and Diaz 1995). The RPD layer was within 1.0 cm of the sediment

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surface, suggesting limited oxygenation of the sediments. There were few indicators of bioturbation, such as the presence of infaunal tubes, burrows, and voids. Benthic samples from one of the sites located near the 1993 sampling station AM-1 revealed abundance levels that were the highest of all Inner Harbor stations (1,912.5/m^2 Table A1-3) but an order of magnitude lower than 1993 sampling at AM-1 (Table A1-2). The dominant taxa were opportunistic polychaetes (*Polydora cornuta, Streblospio benedicti)* and nematodes, similar to AM-1; together these three taxa composed 85% of the infaunal population. The benthic community seems to be one under environmental stress, characterized by pioneering or colonizing benthic infauna.

Finfish

Finfish could utilize this area for refuge from predators, particularly among the pilings at any tide and among the *Fucus* sp. of the southern boundary during high tides. The entire site could provide refuge from peak currents due to its orientation perpendicular to the channel. Anadromous fish could use the site for this purpose. Subtidal regions could provide food resources for demersal browsers. Intertidal food resources are limited except for fish that browse green algae.

The Amstar site does not provide spawning habitat for anadromous species as freshwater input is limited to three drainage pipes. Winter flounder spawning opportunities are limited since the site's sediments are not sandy.

WETLAND RESOURCES

Amstar is located within the Mystic River DPA (310 CMR 10.00). The site is primarily Land Under the Ocean, under Massachusetts regulations, and is considered to be significant to marine fisheries, storm damage prevention and flood control. As described under Aquatic Resources, the Amstar site could provide both refuge (from predators and currents) to many fish species and feeding opportunities (primarily demersal species). It is unlikely to provide important spawning habitat.

Man-made features at Amstar were designed to contribute to storm damage prevention and flood control. Surrounding land elevations are several feet above mean high water. The rip-rap slopes along the southern and western boundaries are effective in dissipating currents and waves.

The intertidal area under the floating dock ramp could be categorized as Coastal Beach, but is not significant in the DPA.

The entire site is classified as Tidal Waters, under federal regulations. The fine-grained sediments found at this site, in conjunction with nearby sediment sampling, suggest that this site has the potential for sediment/toxicant retention and for nutrient retention/transformation. Benthic fauna were moderate in abundance and diversity compared to other sites examined. As anadromous fish species are known to transverse the Mystic River, it is possible that Amstar could be used by them as well.

WILDLIFE

Wildlife use of the Amstar site is expected to be similar to that described for Mystic Piers site.

THREATENED AND ENDANGERED SPECIES

No federally or state-listed threatened or endangered species are identified or anticipated to occur within the boundaries of the Amstar site. The state-listed common tern has been observed to nest in Boston Harbor. No nesting activities were observed during field investigations on this site on April 28, 1993.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

There are no listed historical and archeological resources on or within 1000 feet of the Amstar site.

SOCIO-ECONOMIC/LAND USE

Amstar is an industrial site containing approximately 20 acres in Charlestown. It is currently available for sale, although there are several industrial tenants. One tenant runs a sand and gravel operation and uses the dock for material transfer. The site is in the City's Maritime Economy Reserve Zone which is geared to water dependent activities. It is surrounded by industrial uses to the east and west. Across Medford Street from the site are residences and a park. Access to Amstar is the same as that to Revere Sugar. Demographic characteristics are similar to those described for Revere Sugar.

2.3.1.4 Cabot Paint

The site is depicted on Figure A1-12.

SEDIMENT CHARACTERISTICS

Benthic samples collected at Cabot Paint contained odorless, gray silty sediments. No chemical analyses were performed on sediments from Cabot Paint site, but Station 1 of Eastern Minerals was located approximately 2000 feet from the Cabot Paint site (see Section 2.2 of the DEIR/S). This station had a 66.5% silt-clay component; arsenic, chromium, lead, mercury, zinc and PCB concentrations all occurred at Category II levels. Total PAHs occurred at Category III levels (11.38 ppm), and benzo(b)fluoranthene contributed 3.67 ppm to the total concentration. Total organic carbon was 3.6%, suggesting that some bioaccumulation of contaminants may likely occur.

The ACOE conducted chemical sampling in 1986 (ACOE 1988) at eight (8) stations (A through H) in Chelsea Creek. Station G was located in the vicinity of the Cabot Paint site. It is assumed for this level of site evaluation that the chemical constituents at Station G should be similar to that of the Cabot Paint site. Station G had a sandy organic clay composed of 68% fine grained material with a moderate chemical oxygen demand (102,000 ppm). The only contaminant detected in high concentrations was lead at 283 ppm (Category III). Levels of mercury (1.14 ppm), zinc (276 ppm) and chromium (185 ppm) were present at Category II.

WATER QUALITY AND CIRCULATION

The Chelsea Creek is classified as SB waters by the MADEP. Cabot Paint opens directly into the Chelsea Creek, but the wooden pilings on the north of this site slow currents and contribute to some sedimentation in the vicinity of the pilings.

Dissolved oxygen readings collected in April 1993 ranged from 8.6 - 9.0 mg/L at water temperatures ranging from 6.6-8.2°C. Salinity data collected on that date ranged from 22.6-28.4 ppt at low tide, indicating the influence of freshwater inputs.

AQUATIC RESOURCES

The intertidal habitats within the Cabot Paint site vary and include 1) a sloping rip-rap embankment on the north side, 2) gravel beaches on the northeast and northwest sides, 3) the wooden pilings on the north side, 4) a wooden bulkhead and concrete slab on the northwest side, 5) an abandoned boat ramp on the northwest end, and 6) abandoned barges and boat on the northwest end. Microalgae cover (*Fucus* sp. and green algae) varied throughout the site's intertidal areas. Limited cover was observed on the rip-rap, while approximately 40% of the gravel beach was covered. The abandoned boat ramp was also covered with *Fucus* sp. The wooden pilings were completely covered with barnacles and *Fucus* sp. and the wooden bulkhead had some of these species.

Benthic Infauna

The composition of the benthic infauna from samples collected in April 1993 is shown in Table A1-2. The two sampling locations may reflect the differences in substrate conditions, circulation, and exposure. Station CP-1 was located in the vicinity of the submerged pilings, where the most abundant species were Oligochaeta, *S. benedicti*, and Nematoda. The total percentage composition of these three species was 59% at Station CP-1. Total abundance at this station (of 9,202 individuals/m^2) was moderate when compared with the other areas sampled. At station CP-2 (located in an open area between the pilings) the most abundant species were *S. benedicti* and Nematoda. This station had a total abundance of 3,354/m^2, low when compared with the other stations. The total percentage composition of these three species was 96% at Station CP-2. Species richness at both stations was low (5-9).

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Sediment profile camera sampling was conducted at three stations within the Cabot Paint site (NAI and Diaz 1995). Silty sediments with an RPD layer located at less than 1 cm from the sediment surface occurred at all three sites. These parameters indicate a low-energy habitat with reducing conditions near the sediment surface. Microalgal mats were observed at the sediment interface at the southern edge of the site (Station 1) and at one of the stations in the central portion of the site (Station 2). There was no indication of infauna inhabiting the sediment surface or at depth. A benthic sample from the southwestern part of the site collected one taxon. The opportunistic polychaete *Polydora cornuta* was the only organism collected, with an abundance of $25/m^2$. Results indicate this was one of the most depauperate areas of the Inner Harbor (Habitat II, Table A1-3). Mound and pit topography was observed in the southeastern portion of the site, indicating a low energy environment. Evidence of bioturbation (infauna tubes, burrows) occurred only in the central and northern portion of the site. A total of 6 taxa were collected in the $0.04m^2$ sample (Habitat III, Table A1-3). Opportunistic polychaetes *Polydora cornuta* and *Streblospio benedicti* were the most abundant taxa, and composed two-thirds of the total abundance. The total number of organisms, $375/m^2$, was low in comparison to other Inner Harbor Stations. All abundances in 1994 were an order of magnitude lower than those observed in 1993 (Table A1-2).

Finfish

The ACOE NED collected finfish samples by gillnet in July and November, 1986 during a 48-hour effort on two different sampling days in the Chelsea Creek. The dominant finfish species found in the July sampling effort were rainbow smelt and alewife. In the November sampling effort, no fish were caught. Given the limited amount of data for comparison, no real conclusions can be drawn at this time. Finfish could use the wooden pilings and *Fucus* sp. for shelter from predators during high tide. The sandy substrate in the Chelsea Creek may provide spawning habitat for winter flounder (ACOE 1988).

WETLAND RESOURCES

Cabot Paint is located within the Chelsea River DPA and primarily contains Land Under the Ocean, as defined under Massachusetts Wetlands Protection regulations (310 CMR 10.00). Land Under the Ocean is considered to be significant to marine fisheries, storm damage prevention and flood control. The sloping rip-rap embayment on the north side of the site was designed for storm damage prevention and control. The gravel beaches could be categorized as Coastal Beach, but this designation is not significant in the DPA.

Many species of marine fishes, including anadromous fish, may inhabit DPAs. Anadromous fish such as rainbow smelt and alewife are known to traverse the Chelsea Creek. As described in the Aquatic Resources section, the Cabot Paint site could provide both shelter from predators and feeding opportunities for these fish species. This site may also provide spawning habitat for winter flounder.

The entire site is classified as Tidal Waters under federal regulations. The fined-grained sediments and the results of the samples analyzed indicate that this site has the potential for sediment/toxicant affinity and nutrient retention. Benthic infauna species diversity was low-moderate and species richness was low at this site.

WILDLIFE

On-site wildlife resources appear limited, and very similar to the Mystic Piers site.

THREATENED AND ENDANGERED SPECIES

No federally or state-listed threatened or endangered species are identified or expected to occur within the vicinity of the Cabot Paint site.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

There are no sites or structures of historical, architectural or archeological significance as defined by MHC or the National Historical Preservation Act, as amended.

SOCIO-ECONOMIC/LAND USE

This site, containing 6.5± acres off Marginal Street in Chelsea, is a mixed use parcel, fully occupied by industrial tenants and a major car rental storage facility. The current owner has demolished some of the industrial buildings on site and adapted the remaining buildings to support several industrial uses. The wooden bulkhead along Chelsea Creek has deteriorated and currently poses navigation problems for vessels traversing Chelsea Creek. A commuter ferry service to Boston operated briefly out of this location during 1990 in an effort to reinstate ferry service from this site. The service was discontinued.

The City of Chelsea evolved from a summer resort community to a residential suburb of Boston. A major fire in 1908, in which over 17,000 residents were left homeless, changed the landscape permanently. The Chelsea which emerged from the fire was primarily commercial with manufacturing and shipping facilities. Several of the industries have closed in recent years succeeded by service and distribution operations. The population of Chelsea is 28,710 and is 70% white with a high percentage also reporting Hispanic origin. The median family income is $29,039. High end residential use has been developed on property surplused by the military, contrasting with more modest housing in densely populated sections of Chelsea.

Access to this site over land is via I-93 to the Tobin Bridge to Chestnut Street, and from Chestnut south to Williams Street, then east on Williams to Marginal Street.

2.3.1.5 Little Mystic Channel

The site is depicted on Figure A1-13.

SEDIMENT CHARACTERISTICS

No samples were collected within the site boundaries for sediment characterization, but Stations 2 and 3 at the Mystic Pier sites are in close proximity to the Little Mystic Channel and should represent probable sediment conditions. The sediment texture was predominately fine grained with a range of 76.3% - 78.4% silt-clay (Category II). Bulk sediment metals test results showed that at Station 2, arsenic, chromium, copper, lead, mercury, and zinc all occurred at Category II levels (Appendix C). At Station 3, arsenic, lead and zinc were found to be Category III, and cadmium, chromium, copper, and mercury were found to be Category II concentrations. Total PAHs ranged from 5.23 and 29.75 ppm at Stations 2 and 3 in Mystic Pier 1. Station 3 contained the highest levels of metals of the three stations at this site. At Station 3, benzo(a)-anthracene and benzo(a)pyrene, chrysene, fluoranthene and pyrene were present in concentrations above 4 ppm. But at Station 2, only fluoranthene was above 5 ppm. At Mystic Pier 1, total petroleum hydrocarbon concentrations were among the highest observed during the 1993 berth area sampling. At Mystic Pier 1, there have been approximately twelve minor oil spills (U.S. Coast Guard, Marine Safety Office, letter dated May 13, 1992). This may have influenced the concentration of PAHs and TPHs at this site. PCBs were present at Category III concentrations at Stations 2 and 3. Total organic carbon ranged from 2.1-4.9% at both stations. This is an average value, indicating that there are moderate levels of food resources for benthic deposit feeders, suggesting that some bioaccumulation of contaminants may be occurring.

WATER QUALITY AND CIRCULATION

The water quality of the Little Mystic Channel is influenced by tidal exchange, the six discharge pipes that were observed on the north side of the site, and a Combined Sewer Overflow (CSO). These storm drainage pipes add urban runoff pollutants (e.g., oil and grease, detergents etc.) into the Channel. There is one CSO, the Chelsea Street Extension outfall, which discharges directly to the Little Mystic Channel on the south shore. The currents in Little Mystic Channel are primarily tidally driven. The Little Mystic Channel is classified as SB water by the MADEP. Dissolved oxygen readings collected in April 1993 ranged from 9.0-9.4 ppm. As temperatures peak in August, available dissolved oxygen levels diminish within Boston Harbor and cause a corresponding depression in biological activity at the sediment water interface (August Effect). This oxygen depletion contributes to a significant faunal depletion on a cyclic basis (Hubbard and Bellmer 1989). Salinity data collected in April 1993 ranged from 16.8-28.9 % at low tide, indicating the influence of freshwater inputs to the Harbor. Little Mystic Channel flows directly into the Main Ship Channel, but the Mystic-Tobin bridge pilings slow currents and contribute to some sedimentation in the vicinity of the pilings.

AQUATIC RESOURCES

The intertidal habitats within the Mystic Channel vary and include, 1) vertical granite walls on the north and south side which contain approximately 80% *Fucus* sp. and a one-inch layer of barnacles; 2) sloping rip-rap embankment on the west side which is covered with *Fucus* sp. and green algae; 3) wooden bridge pilings on the eastern side which were covered with periwinkles (*Littorina* sp.), barnacles and green algae; 4) submerged logs and boat on the north side; 5) a metal bulkhead which was covered with *Fucus* sp., heavy barnacle settlement, and some mussels approximately 50 feet from the bridge; 6) a sandy/gravel beach on the south side which was sparsely covered with green algae; and 7) a rock ledge beach on the north side which was covered with *Fucus* sp.

Benthic Infauna

Composition of the benthic infauna at the site in April 1993 is shown in Table A1-2. The four sampling locations may reflect the differences in substrate conditions, circulation and exposure. Station LMC-2, located in the vicinity of the sloping rip-rap embayment, was most diverse in terms of species composition. The total abundance of organisms was 27,907 individu-

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als/m^2 at this station, a moderate level relative to other harbor areas sampled. Oligochaeta was the dominant taxon and had an abundance of 13,717/m^2. Station LMC-1 supported low abundance of two taxa, *Tharyx acutus* (86/m^2) and *S. benedicti* (43/m^2) at extremely low levels compared to all the other sites for these taxa. Station LMC-3 supported a low abundance of 10 taxa, the most abundant being Nematoda and *S. benedicti*. Station LMC-4 had a low abundance of six taxa, the most abundant being Nematoda. The sediment samples collected at this site for benthic infauna observations were fine and grayish-black in color with a mild sulfur odor.

Sediment profile camera sampling in 1994 at four locations showed homogeneous mud sediments throughout the area with evidence of mound and pit topography, indicating a depositional environment (NAI and Diaz 1995). The depth to the RPD layer ranged from 0.2-1.0 cm below the sediment surface, suggesting varying degrees of sediment oxygenation, and thus environmental perturbation, in the area. There were low numbers of infauna tubes at the sediment surface, but no other indicators of bioturbation. Benthic samples collected in October 1994 revealed a depauperate benthic community. Numbers of taxa (3/0.12 m^2) and total abundance (16.6/m^2) were among the lowest observed in the Inner Harbor (Table A1-3). The surface dwelling bivalve *Mulinia lateralis*, the hydrozoan *Obelia* sp., and amphipod *Gammarus lawrencianus* were the only species that were collected; none of these species was collected in the 1993 study (Table A1-2).

Lobster

A total of 0.6 sublegal lobsters and 0.6 legal-sized lobsters were collected per trap-day in the fall collection in 1994 (Table A1-7). The total CPUE was higher than that recorded from the Mystic and Chelsea Rivers, similar to that at Harbor Stations such as the nearby Inner Confluence and Logan 02, but much lower than offshore stations such as Meisburger 2 and 7. Males were more abundant than females (NAI 1995b). Little Mystic Channel had the highest recorded legal lobster catch (0.6 per trap day, all males) of all stations sampled. This may be a result of the presence of abandoned piers, which may provide shelter. Abundances of invertebrates were low to moderate, and were composed mainly of small worms such as oligochaetes and nematodes, which are not preferred lobster prey items.

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Finfish

The dominant finfish species recorded in the Main Ship Channel include winter flounder, rainbow smelt, and alewife (ACOE, NED 1988). There probably is movement of at least some of these species in and out of the Little Mystic Channel. Gill net collections in October 1994 in Little Mystic Channel captured low numbers of rainbow smelt, Atlantic tomcod, alewife, cunner and butterfish (Table A1-6). Trawls in the Inner Confluence area made at the same time collected moderate catches of winter flounder, windowpane, and rainbow smelt (Table A1-4). Finfish could use the wooden bridge pilings, submerged logs and boat and *Fucus* sp. for shelter from predators during high tide. The predominant sandy/silt sediment present at this site provides suitable habitat for winter flounder. There was also a fair supply of *C. capitata* in part of the channel in 1993 (1892/m^2 at Station LMC-2); these are consumed by winter flounder according to Haedrich and Haedrich (1974). However, 1994 sampling showed little evidence of food resources for higher trophic levels.

WETLAND RESOURCES

Little Mystic Channel is located within the Mystic River DPA (310 CMR 10.00). The site is primarily Land Under the Ocean, under the State regulations, and is considered to be significant to marine fisheries, storm damage prevention and flood control. The vertical granite wall on the north and south side, together with the sloping rip-rap embayment on the west of the site, were all structures designed for storm damage prevention and flood control. Significance to marine fisheries is discussed above.

Anadromous fish are known to traverse the Main Ship Channel and there may be movement into the Little Mystic Channel. As described in the Aquatic Resources section, the Little Mystic Channel could provide both shelter from predators and feeding opportunities for several fish species. This site might also provide spawning habitat for anadromous species.

The entire site is classified as Tidal Waters under federal regulations. The fined-grained sediments results of the samples analyzed at Mystic Pier, which is in close proximity to Little Mystic Channel, indicate that this site has the potential for sediment/toxicant affinity and nutrient retention. Benthic infauna were moderately diverse in species composition at one station and showed low abundance at the other three stations sampled at this site.

WILDLIFE

Wildlife use in the Little Mystic Channel is expected to be similar to that described at the Mystic Pier site.

THREATENED AND ENDANGERED SPECIES

No federally or state-listed threatened or endangered species are identified or expected to occur within the vicinity of the Little Mystic Channel.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

There are no listed historical or archeological resources at the Little Mystic Channel site.

SOCIO-ECONOMIC/LAND USE

This little-used channel in Charlestown is surrounded by a mixture of land uses including residential, recreational and maritime-industrial. Adjacent to the site are the Charles Newtowne public housing project, a City of Boston playground, the Charlestown High School recreational field and Mystic Pier 1. The channel provides a visual buffer between the residences to the south and the marine terminal to the north. A public boat ramp is located on the north side of the channel. However, this ramp has not received the use anticipated when it was installed in the early 1970s. Demographic characteristics of this area are similar to those described at the Mystic Pier site.

Marine access to this site is constrained by the 12 foot vertical clearance under the Little Mystic Channel Crossing at the mouth of the channel. Landside access to this site is via Terminal Street from Moran Terminal.

2.3.1.6 Reserved Channel

The site is depicted on Figure A1-14. Two areas in the Reserved Channel are being evaluated as candidate sites for disposal, Areas A and B, respectively.

Area A—This area is located at the mouth of the inlet on the inner side of the bridge (away from open water). It is approximately 8.9 acres in size with water depths ranging from 6 to 12 feet MLW. A floating dock and the yacht club are located in this portion of the site. The passage under the Summer Street Bridge is 40 feet in width. Northwest of the bridge is a vertical granite wall approximately 50 feet in length. Continuing west-northwest, the granite wall is replaced by a metal bulkhead. On the far northwestern end of the bulkhead are some abandoned wood pilings and an old floating dock. On the southwestern side of the site from the bridge is a sloping rip-rap embankment for approximately 50 feet. From this rip-rap toward the neck are discarded concrete slabs and trash material. West of the trash material are wooden pilings and behind the pilings is a vertical granite wall.

Area B—This portion of the site extends from the neck on the northwest toward the tip of the peninsula. It is approximately 7.7 acres in size with water depths ranging from 0 to 16 feet. A steel bulkhead extends for approximately 75 feet. Continuing along the western tip and along the southwestern side of the inlet is a sloping rip-rap embankment. Between the bulkhead and the rip-rap is a pile of rubble. On the southwestern side toward the neck the rip-rap is replaced by a granite wall, which is fronted by a rocky beach. In front of the rocky beach are one or two sunken boats and some abandoned pilings. In the middle of the tidal area is a floating lobster pot dock.

SEDIMENT CHARACTERISTICS

Benthic samples collected at the Reserved Channel contained odorless, gray-black clay/silt sediment. No chemical analyses were per formed on these sediments, but Station 3 of

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the Boston Edison Intake was located approximately 1000 feet from the Reserved Channel Area B (see Section 2.2 of the EIS). This station had a 66.2% silt-clay component (Category II) and indicated PCB and PAH levels at Category III. Fluoranthene, ideno(1,2,3-cd)pyrene, and pyrene contributed more than 50% to the total PAHs concentrations. Cadmium, Lead, and Nickel were found at Category II at this station. Total organic carbon was 13%, the second-highest value of all the sites analyzed for TOC. This indicates that the potential for bioaccumulation at the Reserved Channel Area B is lower than other sites in the Boston Harbor. The total petroleum hydrocarbon at this station was 4270 ppm.

The ACOE conducted chemical sampling during 1986 at four stations (A, B, C, and D) in the Reserved Channel. Station A was located in the western end of the Reserved Channel close to Area B. At Station A an 18-23 cm core section was analyzed. It had an 18.2 cm layer of black organic clay. This upper organic clay consisted of 93% fine grain material with a moderate chemical oxygen demand (79,000 ppm). Lead was the only chemical constituent present at Category III concentrations (221 ppm). Mercury (1.48 ppm), zinc (264 ppm), chromium (186 ppm), and nickel (58 ppm) were detected at Category II levels.

PCB samples were collected at 8 stations by Boston Survey Consultants in November 1982, from the Reserved Channel west of Summer Street Bridge within Area A (MADEP-Boston Files, 1983). PCB concentrations at all eight stations occurred at Category III and ranged from 1.0-34.5 ppm.

WATER QUALITY AND CIRCULATION

The water quality of the Reserved Channel is influenced by the three combined sewer overflows (CSO) observed approximately 700 feet northwest of Pappas Street, at Summer Street, and at I Street. These CSOs can add urban runoff pollutants (e.g., PAHs, nutrients, detergents, bacteria, etc.) into the Channel. Boston Edison has a NPDES discharge pipe in the vicinity of Summer Street; the NPDES permit limits the thermal influence on surface waters in the Reserved Channel.

The Reserved Channel flows directly into the Main Ship Channel. The Summer Street bridge pilings slow and deflect currents and contribute to some sedimentation in the vicinity of the pilings.

The Reserved Channel is classified as SB Water by the MADEP. In both Areas A and B, dissolved oxygen readings collected in April ranged from 8.4-8.7 ppm and 6.8-8.9 ppm respectively. As temperatures peak in August in Boston Harbor, available dissolved oxygen levels can diminish and cause a corresponding depression in biological activity at the sediment water interface (August Effect). This oxygen depletion contributes to a significant faunal depletion on a cyclic basis (Hubbard and Bellmer 1989). Salinity data collected in April 1993, ranged from 27.0-31.2 ppt at Area A and 23.4-33.4 ppt at Area B during low tide, indicating the influence of freshwater inputs to the Harbor.

AQUATIC RESOURCES

The intertidal habitats within the Reserved Channel include:

Area A: Wooden bridge pilings and a floating yacht club dock were sparsely covered with green algae. A vertical granite wall on the northwest side of Summer Street was covered with approximately 20% of algae. A metal bulkhead on the northwest side was covered with green algae and barnacles. Sloping rip-rap embankment on the southwest side was covered with *Fucus* sp., barnacles, *Littornia* sp., and green algae. Some concrete slab and trash material was present which had no visible growth; there were some abandoned wooden pilings and an old floating dock on the far northwestern side.

Area B: A steel bulkhead on the northwest side was approximately 90% covered with barnacles. A sloping rip-rap embankment on the western tip and southwestern side was moderately covered with *Fucus* sp., *Enteromorpha* (tubular green algae), and other green algae. A granite wall on southwestern side towards the narrow neck had moderate growth of *Fucus* sp., *Ulva* sp., and barnacles. A rocky beach in front of the granite wall was sparsely covered with *Littornia* sp., *Fucus* sp., and green algae. There were also sunken boats, abandoned pilings and a floating lobster dock present.

Benthic Infauna

The composition of the benthic infauna from 1993 collections is shown in Table A1-2. The four sampling locations may reflect the differences in substrate conditions, circulation and exposure. Stations RC-1 and RC-2 were located in Area A and RC-3 and RC-4 located in Area B.

Area A: Station RC-2 was located in the vicinity of the Granite wall on the southwestern side of Area A, had the most diversified species composition. Oligochaeta and *S. benedicti* was the two most abundant taxa (15,480/m^2 and 1548/m^2, respectively) of all the sites sampled. The total abundance was 21,156/m^2 at Station RC-2 which was moderate relative to other areas sampled. Station RC-1 supported low abundance of seven species, the most abundant being Oligochaeta (2451/m^2). Oligochaetes were moderately abundant at this site compared with all the other sites. The total abundance was 3,096/m^2 at Station RC-2, and was low relative to other areas sampled.

Area B: Station RC-3, located in the vicinity of the lobster dock, supported very low abundance of four taxa, the most abundant being *S. benedicti* (215/m^2). At Station RC-4 Oligochaeta (26,574/m^2), *Corophium insidiosum* (2580/m^2), and Nematoda (16,641/m^2) were the most abundant taxa. The first two taxa occurred in higher abundances at this site than any of the other sites sampled. The total abundance at Station RC-4 was 49,837/m^2, fairly high relative to the other areas sampled.

The sediment samples collected at this site for benthic infauna observations were odorless, clay/silt, and grayish black in color.

Samples were collected in October 1994 at one location in Area A and two locations in Area B. As there were no substantial differences among the three stations, abundances were averaged for the purpose of this assessment. A total of 1,041 individuals/m^2, representing 17 taxa in the three 0.04 m^2 samples was collected (Table A1-3). The species richness and abundance were among the highest in the Inner Harbor, although much lower than most of the stations sampled in 1993 (Table A1-2). The most abundant species were small, opportunistic polychaetes such as *Leitoscoloplos robustus* (375/m^2) and the soft-shell clam *Mya arenaria* (158/m^2); both were also collected in 1993 (Table A1-2).

Lobster

An assessment of the lobster population was made in October 1994 using experimental traps (NAI 1995b). A total of 1.4 lobsters per trap-day were collected, of which 1.2 were sublegals and 0.2 were of legal size (Table A1-7). The numbers of lobsters collected were moderate in comparison to other areas sample in Boston Harbor, higher than river habitats, but lower than offshore habitats. The wooden pier pilings may provide additional shelter for lobster. CSO outfalls may enhance nutrient concentrations, resulting in high abundances of food resources. However, the dominant benthic species were small, surface-swelling polychaetes, which are not a preferred food source.

Finfish

Gill net collections in October 1994 in the Reserved Channel were the highest of all stations sampled in Boston Harbor. An average of 96.7 fish were collected per 24-hour set, composed mainly of blueback herring and alewife (Table A1-6). Recreationally important species such as striped bass, American shad, bluefish and rainbow smelt were also collected in low numbers. These species are typical pelagic species, whose capture is more likely a random event rather than an indication of habitat value.

The dominant finfish species in the Main Ship Channel are flounder, rainbow smelt, and alewife. There may be movement of these species into the Reserved Channel. Finfish may use the wooden bridge pilings, floating dock, and *Fucus* sp. for shelter from predators during high tide. The Reserved Channel may provide spawning habitat for winter flounder, although it lacks the preferred substrate.

WETLAND RESOURCES

Areas A and B of the Reserved Channel are not located within a Designated Port Area (310 CMR 10.00). The site is primarily Land Under the Ocean under Massachusetts Wetlands Protection regulations (310 CMR 10.00); this classification is considered to be significant to the protection of marine fisheries, which are discussed above. Nearshore areas of Land Under the Ocean such as Areas A and B are likely to be significant to storm damage prevention and flood control. The vertical granite wall and bulkhead, together with the sloping rip-rap embankment at the site, were all structures designed for storm damage prevention and flood control. Nearshore areas of Land Under the Ocean also provide important food for birds; for example, waterfowl can feed on the algae. The sloping rip-rap embankment and the rocky beach (Coastal Beach) at this site were covered with algae.

The entire site is classified as Tidal Waters under federal regulations. The fined-grained sediment and chemical levels in the samples analyzed show that this site has had an affinity for toxicant and nutrient retention. Benthic infauna were moderately diverse in species composition at two stations and showed low abundances and species richness at the other two stations sampled at this site.

WILDLIFE

Wildlife use at the Reserved Channel is expected to be similar to that described for Mystic Piers (Section 2.3.1.1 of this evaluation).

THREATENED AND ENDANGERED SPECIES

No federally or state-listed threatened or endangered species are identified or expected to occur within the vicinity of the Reserved Channel.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

There are no listed historical or archeological resources at the Reserved Channel site.

SOCIO-ECONOMIC/LAND USE

This channel is generally surrounded by industrial and office uses in South Boston. There is a sewer outfall at the southerly end of the Channel which would require relocation if this area were to be filled. There is a yacht club immediately adjacent to the Summer Street Bridge, and a passive water viewing area has been created for the general public to use on the west side of the channel. This viewing area is not 6(f) land because it was not purchased or improved with funds from the Land and Water Conservation Act (16 USC 460). As noted earlier there is a floating lobster pot dock in the middle of Area B; the extent of its use is not known.

While the South Boston peninsula was settled early in Boston's history, much of the land area between the subject site and Boston Harbor was created by filling the tidal flats. The filled land supported maritime shipping and railroad terminal uses. The area to the south of the channel has traditionally been a densely populated, predominantly residential neighborhood. The population of South Boston is 29,464 of which 96% is white. The median family income in the subject area is $34,200.

Marine access to this site is restricted by the vertical clearance on the Summer Street Bridge over the Channel. That clearance is only 6 feet at high tide. The most direct landside access would be I-93 south to Summer Street and then east to the Reserved Channel.

2.3.2 Environmental Consequences of Use of Shoreline Sites for Dredged Material Disposal

Two different disposal scenarios have been evaluated for each of the shoreline sites. The former pier areas (Amstar, Cabot Paint, Mystic Piers and Revere Sugar) and Little Mystic Channel could be filled either to mean low water (including cap) or to fastland. Reserved Channel would be filled either only in the westernmost end (to +6 ft MLW) or west from the Summer Street Bridge (maintaining subtidal conditions in the area near the bridge). Disposal in these areas would require the construction of a bulkhead to isolate the disposal operations from the harbor waters. In the scenarios where final elevation would be mean low water, the disposed silt would be capped and then the bulkhead would be clipped off to mean low water.

For ease of presentation, the different types of impacts are discussed generically and site-specific information on shoreline sites is presented at the end of each subsection.

Direct Impacts

In either fill scenario, the dredged materials placed in shoreline sites would sequester existing sediments. Although the chemical constituents of the surface sediments at many of these sites have not been determined, areas adjacent to each site have been tested. It is likely that metals, PCBs and PAHs are elevated to undesirable levels in Amstar, Cabot Paint, Little Mystic Channel, Reserved Channel and Revere Sugar. Mystic Piers is likely to contain elevated levels of metals and PAHs. Covering these sediments would provide the benefit of preventing their reintroduction into the waters of Boston Harbor and would prevent further exposure of biota that might utilize these areas. It would not prevent reintroduction of contaminants from other sources in the partial fill scenario.

Partial fill. Under the partial fill scenario, subtidal habitat would be temporarily impacted and removed from productivity. Closure of the site would return it to aquatic habitat, but in an altered form. Both depth and substrate character would differ from existing conditions. The footprint of each site is listed on Table A1-8. The quantity of habitat affected would be the smallest for Mystic Piers, slightly higher for Amstar and Revere Sugar, higher for Cabot Paint and substantially higher for Little Mystic Channel and Reserved Channel. The cap, probably parent material from the channel deepening, would not be suitable for colonization by benthic organisms immediately. Dense clay does not generally support benthic infauna, but this area would be likely to experience sedimentation. Once the sedimentation took place, benthic infauna typical of the Inner Harbor would colonize the area. Conversion of the site from subtidal to intertidal habitat would be unlikely to increase its benthic productivity. Reduction in depth could make the area somewhat more useful for juvenile finfish as shallower conditions have been found to provide refuge from predators in the absence of other, preferred (e.g., salt marsh, eelgrass bed) refuge. Such shallow water refuge is limited within Boston inner harbor. This area would be available during most of each tidal cycle, except for a limited period around each low tide.

Fastland. Filling the Amstar, Cabot Paint, Mystic Piers or Revere Sugar pier area to the elevation of the adjacent land would result in the permanent loss of subtidal habitat (Table A1-8). The bulkhead enclosing the dredged material would replace a portion of the hard substrate habitat presently provided by pilings and bulkheads along the interior of each site. It is not proposed to fill any of Reserved Channel to fastland.

Indirect Impacts - Water Quality Effects

Construction of the bulkhead would require driving sheetpile into the existing substrate. While this activity would suspend some of the surface sediments into the water column, the effect on water quality is expected to be minimal.

Harbor water trapped behind the bulkhead would be pumped out before disposal of silts was initiated. Once most of the water was discharged back into the harbor, the remainder would be filtered to prevent mobilization of silts from the disposal site. Because the site would be enclosed before disposal took place, individual disposal events would not impact water quality with the exception of occasional minor spills as silt was transferred from the barge to the disposal site.

Indirect Impacts - Site Stability

Long-term water quality effects could arise from two sources - dewatering of the sediments and failure of the cap or bulkhead. In the partial fill scenario, no attempt would be made to dewater the silt in place, with the exception of the consolidation that was caused by placement of the cap. In the fill-to-fastland scenario, water would be drained from the site through wicks in the bulkhead. The wicks would filter particulate material, but would not completely control dissolved contaminants from being released into Boston Harbor. The elutriate tests on surface sediments from the channels conducted by the U.S. Army Corps of Engineers provide an approximation of the levels of contaminants that could be released through the wicks. These tests showed that mercury, copper and PCBs had the highest potential of being released.

Cap failure could occur at some of the sites adjacent to active piers. Although bottom currents in the inner harbor are of insufficient speed to resuspend a sand cap and waves do not develop sufficient height to affect the substrate in the inner harbor, cargo vessels making turns, docking and departing docks use more power than when underway in the shipping channels. These same conditions could affect the long-term stability of the bulkhead, although this effect would be taken into consideration during site design. This effect has the greatest potential to occur at Amstar, Revere Sugar (these two sites are adjacent to the active Revere Sugar terminal), Mystic Piers (adjacent to Mystic Piers 2, 49 and 50, as well as the bend at the Inner Confluence), and Cabot Paint (parallel to the main channel of Chelsea Creek). Little Mystic Channel could be exposed to activities at the active Mystic Pier 1, but site geometry would allow more flexible design considerations to avoid this effect. Reserved Channel would not be exposed to the effects of propeller wash, but unless moved or modified, the four CSOs discharging into this area could affect the cap integrity. Failure of either the cap or the bulkhead would allow release of the dredged materials back into the harbor system. At a minimum, a turbidity plume would likely be evident.

Indirect Impacts - Downstream Resources

Anadromous fish spawning runs in the Mystic River would be the downstream biological resource of greatest concern for Amstar, Revere Sugar, Mystic Piers and Little Mystic Channel. The Chelsea River supports winter flounder spawning and has several small intertidal flats that would be of concern with use of the Cabot Paint site. Barring catastrophic failure of the containment structure, the likelihood of impacting these resources would be limited.

Similarly, harbor water users (e.g., lobster pounds and the New England Aquarium) would be unlikely affected by the use of these sites.

Located near the mouth of the Inner Harbor, at the head of the navigational channel, the Reserved Channel site is closer to the biological resources of the Outer Harbor than the other shoreline sites. However, except in the event of cap or bulkhead failure, it is unlikely to influence these resources. Discharge of silt from the Reserved Channel containment area could affect the intake at Boston Edison; this would be likely only in the case of failure of the cap or bulkhead.

Indirect Impacts - Biological Exposure Potential

Filling of any of the shoreline sites would be conducted in complete isolation from the waters of Boston Harbor. No pelagic or benthic organisms would be exposed to the BHNIP silt after it had been disposed in one of the shoreline containment sites. In the partial fill scenarios, the final cap would be of sufficient thickness to ensure that it would not be breached either through bioturbation or physical forces. In the fastland scenarios, the site would remain isolated from Boston Harbor waters and their associated biota for perpetuity. However, if the fastland areas were left uncovered, with a lens of water on the surface, it is likely that they would be attractive to diving birds. This could pose some risk of exposure to contaminants. Although there would be little or nothing upon which to feed, birds that attempted to forage could ingest some sediments. Others could be exposed though skin contact with the water, although this is unlikely. Although individual birds would be unlikely to attempt to feed in the containment area

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for extended periods because of limited success, such an area could be attractive to birds for resting.

Other Issues

No federally or state-listed threatened or endangered species are identified or expected to occur within the vicinity of the Mystic Piers, Revere Sugar, Amstar, Cabot Paint, Little Mystic Channel or Reserved Channel sites.

The proposed project at the Mystic Piers, Revere Sugar, Amstar, Cabot Paint, Little Mystic Channel or Reserved Channel would have no effect upon any structure or site of historic, architectural or archeological significance as defined by MHC or the National Historic Preservation Act of 1966, as amended.

The disposal operations at most of the shoreline sites (Mystic Piers, Revere Sugar, Amstar and Cabot Paint) could be handled by barge transport, avoiding impact to traffic on public streets. Because of restricted passage under bridges, disposal activities at Little Mystic Channel and Reserved Channel would require transfer of material from barges to trucks and transport on public streets. Selection of Amstar for disposal of BHNIP materials would displace the MWRA water transportation facility and potentially displace a sand and gravel operation on the site. Use of the Cabot Paint site would tend to aggravate the existing concerns about navigation in that portion of the Chelsea River. Disposal of dredged materials in the upper Reserved Channel would require the relocation of existing CSOs and could interfere with an existing yacht club. There are no current uses of the Mystic Piers, Revere Sugar or Little Mystic Channel sites that would be affected by use of these sites for dredged material disposal.

2.4 SITE EVALUATIONS: IN-CHANNEL AREAS AND BORROW PITS

2.4.1 Existing Conditions

2.4.1.1 In-Channel Areas

The In-Channel disposal scenario is simply the placement and capping of dredged material within the channel/tributary from which it had been dredged.

Silt and sediments would be dredged from each channel, placed on a barge, a deeper trench would then be dug in the channel, and the silt and sediment placed within the trench and capped. The proposed use and methods are described in more detail in Section 3.0 of the EIR/S. Each channel/tributary would contain its own silt material and be capped therein. As the environmental resources and consequences for this disposal alternative are the same as for the dredging site, the existing conditions of the water and sediment quality, biological and socio-economic environment in each site are described in the Section 3.0 of the EIR/S.

2.4.1.2 Spectacle Island Confined Aquatic Disposal (CAD)

The site is depicted on Figure A1-15.

SEDIMENT CHARACTERISTICS

The CA/T project examined sediments in and near this area with ponar grabs and borings to characterize the surficial material and underlying sediments (Cortell 1990b) (Table A1-9). Surface sediments tended to form broad areas of uniform grain size. Fine sand (with some silt) predominated in a 500-foot band following the northeastern shoreline to about mid-island, 300 feet beyond MLW and recurred beyond the mussel bed several hundred feet further south.

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From mid-island and beyond the southern sand band, sediments were primarily silty, with some clay. Seaward of these areas, surface sediments were clay with some silt (Cortell 1990b).

Bulk sediment analysis of borings indicated that surface and near surface sediments offshore of the eastern shoreline of Spectacle Island were generally free of contaminants (Cortell 1990b). Three of the five borings (ST1-7, ST1-9, ST1-11; Table A1-9) in the area proposed were classified as Category I under the Massachusetts criteria for the classification of dredged materials, although volatile solids at ST1-11 were within the Category II range (7-9 ppm) (Table A1-9). Elevated levels of arsenic, a naturally occurring metal in New England soils, caused surface sediments at ST1-8 and ST1-12 to be classified as Category II (12-20 ppm); subsurface concentrations of arsenic resulted in Category III (>20 ppm) classification of sediments below one foot at ST1-8 (Appendix C-1; Table 2 of the Sampling Plan). Because of these findings, the proposed disposal location has been designed to involve only those areas where Category I sediments were recorded (see Figure A1-15).

WATER QUALITY AND CIRCULATION

The hydrodynamics around Spectacle Island were examined for the CA/T (Cortell 1990b). Circulation is dominated by tidal currents, affected by the distribution of islands and channels in the Outer Harbor. Ebb tide currents passing the east side of Spectacle Island can reach 0.6 knots on spring tides, while spring flood tides reach 0.4 knots. The broad shallow subtidal area off the eastern shore diverts currents toward the channels (President Roads to the north; Sculpin Ledge to the southeast). The area proposed for the CAD is subjected to lower tidal currents created by eddies. Waves in the vicinity of Spectacle Island are primarily storm driven. The maximum fetch for Spectacle Island is 7.1± nautical miles. Wave energy for the area was calculated for the Massport Logan Inclined Safety Area (ISA) EIR for storms with wind velocities from 10 to 50 knots. The wave breaker height near Spectacle Island ranged from 0.09 to 2.60 feet with wave powers of 0.1 to 412.9 ft-lb/sec.

The waters in the vicinity of Spectacle Island have been classified as Class SB waters. This classification protects saline waters for the propagation of marine life, primary and secondary contact recreation and shellfish harvesting with depuration. Water quality in the Outer Harbor area historically has been influenced by raw sewage discharges, CSOs, various industrial discharges, urban runoff and the pollutants flowing from the Inner Harbor system. However, as upgrades to treatment processes are completed, water quality in the Harbor has, and will continue to improve.

AQUATIC RESOURCES

Benthic Infauna

Benthic resources east of Spectacle Island were examined for the CA/T project (Stations 6, 7, 9, 10; Cortell 1990b). Comparison of stations (through cluster analysis) indicates that these stations were similar in terms of species structure (Battelle 1988). The faunal community was dominated by the tube dwelling amphipod *Ampelisca abdita* (37%) and the gastropod *Nassarius trivittatus* (20%), reflecting relatively clean, sandy sediments. Nephtyid polychaetes (*Nephtys caeca* and *N. ciliata*) were also numerically important at these stations. Total abundance (ranging from 653-3107/m^2) was low compared to other sandy areas (Massachusetts Bay) and silty areas of the Inner Harbor (up to 241,230/m^2). Station 10, off the northeast shoreline of Spectacle Island, had the highest abundance and number of taxa of the 11 stations sampled around the island. Larger fauna were evaluated qualitatively along transects swum for lobster investigations (Transects 3 and 4 reached the shoreward portions of the proposed CAD site; Cortell 1990b). In addition to *Nassarius* sp. and *Ampelisca* sp. the offshore portions of these transects supported nereid worms (sand worms), *Pagurus* sp. (hermit crabs), *Panopeus* sp. (mud crabs) and *Cancer irroratus* (rock crabs).

Sediment profile camera sampling on the east side of Spectacle Island in the area proposed for disposal revealed a well-developed benthic community intermediate between a pioneering or colonizing and equilibrium stage (NAI and Diaz 1995). The majority of the stations had silt sediments. The depth of the RPD layer ranged from 1.5-5 cm, indicating sediments were well oxygenated. The sediment surface was overlain with mats composed of *Ampelisca* amphipod tubes in varying stages of succession. Benthic samples showed that *Ampelisca* sp. was the dominant taxon, composing 56% of the total abundance. (Habitat I, Table A1-10). Secondary dominants included *Aricidea* (*Acmira*) *catherinae* (15%) and *Polydora cornuta* (7%). Total abundance, 64,870.6/m^2, representing 59 taxa, was intermediate among the Outer Harbor locations that were sampled, but at least an order of magnitude higher than that observed previously (Cortell 1990b). Slightly more than one third of the stations had silt sediments with a layer of fine sand; shell hash and gravel were also observed on the sediment interface, (indicating an erosional environment) along with *Ampelisca* sp. tube mats. In these areas, the depth of the RPD layer was closer to the surface (0.5-3.5 cm) than in other areas of Spectacle Island. Evidence of bioturbation was observed in all areas, including infaunal worms, burrows, and oxic and anoxic voids. Benthic samples revealed that *Ampelisca* sp. was the dominant taxon, composing 60% of the total abundance (Habitat II, Table A1-10). Total abundance, 102,025/m^2, representing 41 taxa, was nearly double the total abundance in other areas of Spectacle Island. Secondary dominants were similar to other areas of Spectacle Island with one exception. The opportunistic polychaete *Polydora cornuta* (22% of the total abundance) was joined by *Streblospio benedicti* (18%) and *Aricidea catherinae* (5%). Nephtyid polychaetes, an important food for lobster and demersal fish such as winter flounder, were collected in moderate numbers.

Lobster

A lobster transect survey was undertaken to quantify lobster use of the area and evaluate the substrate for use or potential use by early benthic phase lobsters, considered to be a vulnerable stage for this species because of limited habitat availability (Wahle and Steneck 1991). CA/T transects 1 (southernmost), 2, 3, 4 and 5 (northernmost) were located along the east side of Spectacle Island (Cortell 1990b); transects 3 and 4 were within the area proposed for the CAD. Free-living lobsters were most abundant off the north shore of Spectacle Island (Transect 5 yielded 0.0027/ft^2; Transect 6 yielded 0.0035/ft^2); Transect 3 yielded the third highest abundance (0.0022/ft^2). Abundances along Transects 1, 2 and 4 were low (0.0003-0.0004/ft^2). These average abundances, however, do not account for the fact that lobsters were concentrated towards the deeper end of all transects except Transect 3. Lobster pot markers were present in the proposed site during all three surveys in 1990. Pot markers tended to be most heavily concentrated off the

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northern shoreline of the island and farther east of the island in Sculpin Ledge Channel (Cortell 1990a).

During a lobster monitoring program run from early May to early July, 1992 in the Harbor, Cortell (1992) reported that an average of five lobsters (average catch per 3-day haul, all size classes) per trap were collected at a station just to the north of Spectacle Island, the southern side of the ship channel. This catch was typical of several other stations in this study. Other trawl sampling indicated that abundances were generally lower at a site (closest to Spectacle Island) just north of the Ship Channel in President Roads, compared with four other stations in the channel area. At the time, lobstermen fished this area along the edge of the channel between Spectacle and Long Island.

No early benthic phase (EBP) lobsters were found in samples collected along lobster transects. The preferred cobble substrate (Wahle and Steneck 1991) was common only along the nearshore portions of Transects 1 and 5. Mussel beds may also enhance substrate suitability (Wahle and Steneck 1991). Mussel beds occurred along the nearshore portions of Transects 2, 4 and 5. It was speculated that the anoxic sediments underlying these mussels would preclude use by EBP lobsters (Cortell 1990b). The borings collected offshore of these transects indicated that sediments were fine-grained, unsuitable for EBP lobsters (Cortell 1990b).

A lobster survey in October 1994 collected a total 0.2 lobsters per trap-day, all under the legal size limit (Table A1-7). The CPUE at this site was among the lowest of the stations sampled in Boston Harbor. No commercial lobster pots were observed in the area during the survey. Conversations with local lobstermen at the time of the survey indicated that they no longer fish in the area because of a lack of lobsters (NAI 1995b). Trawl sampling in October 1994 captured an average of 6.7 lobsters (based on 5 minute tow results standardized to a 20 minute tow), which was similar to that collected in the Chelsea River and Subaqueous E, and an order of magnitude lower than the lobster catch at Boston Lightship (Table A1-4).

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Finfish

A trawl survey of demersal fish in October 1994 collected a average of 21.3 finfish per 20 minute trawl, one of the lowest catches in the Boston Harbor area (Table A1-4). Winter flounder was the predominant species (9.3 CPUE), followed by skate sp., both of which are typically demersal. Rainbow smelt and Atlantic silverside, generally pelagic species, were also collected.

Based on the on-going development of the artificial reef design, as required by the Individual Permit—Landfill Closure and Maintenance at Spectacle Island for CA/T (ACOE no. 199202207; 2/16/93), target fish species in the Spectacle Island area include forage species such as Atlantic menhaden, Atlantic herring and rainbow smelt, and predator species such as winter flounder, striped bass, bluefish, pollock, Atlantic cod, tautog and cunner. The northeastern half of Sculpin Ledge Channel is the recommended location for the proposed terrace reef (NAI 1993).

WETLAND RESOURCES

The Spectacle Island CAD location is considered Land Under the Ocean under the Massachusetts Wetland Protection Act (310 CMR 10.00) and Tidal Waters under the Federal Clean Water Act (40 CFR 230). As Land Under the Ocean, the site is considered to be significant to the protection of marine fisheries, protection of land containing shellfish, storm damage prevention, flood control and protection of wildlife habitat. This area has been demonstrated to provide habitat for free-living, but not early benthic phase, lobsters and juvenile rock crabs (Cortell 1990b). Active use of the area by finfish has not been examined but is likely to occur to some degree for feeding (although benthic fauna is sparse) and passage. Waterfowl may feed in this area. Portions of the nearshore area of Spectacle Island are classified as Land Containing Shellfish (mussels). The proposed subtidal location of Spectacle Island CAD intercepts the tidal currents from the channels, reducing their intensity. This increases deposition offshore from the shellfish beds, protecting them from excess siltation. Shoreline erosion is reduced by the reduction in currents. Storm energy is dissipated by the shallow subtidal expanse east of the island. Because this is an open water area, however, the shore east of Spectacle Island provides little flood control.

Classified as Tidal Waters under federal regulations, Spectacle Island CAD was evaluated for its ability to provide the functions of sediment/toxicant retention, nutrient retention/transformation, recreation and uniqueness/heritage. Sediment sampling at this site revealed only low levels of chemicals and low-to-moderate levels of fine-grained sediments. However, reduced currents provide Spectacle Island CAD with greater potential for performing the functions of sediment/toxicant retention and nutrient retention/transformation than the adjacent channel areas. It is likely that recreational boaters with shallow-draft vessels cross this area. Human use of the island will increase once park development is underway.

WILDLIFE

Waterfowl, including great cormorant (*Phalacrocorax carbo*), herring gull (*Larus argentatus*), white winged scoter (*Melanitta deglandi*), common goldeneye (*Bucephala clangula*), bufflehead (*Bucephala albeola*), mallard (*Anas platyrhynchos*), black duck (*Anas rubripes*), merganser (*Mergus* spp.) and scaup (*Aythya* spp.) have been observed in the vicinity of Spectacle Island (Cortell 1990a). Each of these species feed on fish and invertebrates (Martin et al. 1951; Whitlatch 1982; DeGraaf and Rudis 1986) that occur in the area proposed for Spectacle Island CAD.

THREATENED AND ENDANGERED SPECIES

No federally or state-listed threatened or endangered species are identified or expected to occur within the immediate vicinity of Spectacle Island CAD. Common terns have nested on a dilapidated pier on the northwestern end of Long Island, approximately 0.6 miles away, across Sculpin Ledge Channel. All marine mammals are protected under the Federal Marine Mammals Protection Act. Harbor seals (*Phoca vitulina*), harbor porpoises (*Phocena phocena*) and grampuses (*Grampus griseus*) occur occasionally in the harbor. None of these species are listed as threatened or endangered. There are no natural occurrences of exposed ledge that would be suitable as seal haul-outs in the vicinity of Spectacle Island CAD.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

There are no listed historical or archeological resources at the Spectacle Island CAD site.

SOCIO-ECONOMIC/LAND USE

Activities at the subtidal area east of Spectacle Island would be visible from Spectacle Island, Long Island, and Deer Island as well as from vessels using Sculpin Ledge Channel and President Roads. Currently public access to Spectacle Island and Long Island is limited although park development on Spectacle Island is expected to begin in 1995. Vessels using President Roads are predominated by commercial ships, whereas Sculpin Ledge Channel is actively used by fishing vessels and pleasure boats.

This location is currently used only by fishermen and recreational boaters. The site is less than 1000 ft. from the proposed dike which the Massachusetts Highway Department intends to construct as part of its closure of the abandoned landfill at Spectacle Island.

2.4.1.3 Meisburger Sites 2 and 7

These sites are depicted on Figures A1-16 and A1-17.

SEDIMENT CHARACTERISTICS

The sand and gravel deposits that characterize these sites were first described by Meisburger (1976) from sub-bottom data. The sites are in approximately 100 ft of water (80-110 range). Sand and gravel form much of these irregularly shaped deposits and a layer of medium sand (up to three feet thick) may cover some of these areas locally. Because these sites are within the nearfield study area of the proposed MWRA outfall, they have received recent detailed inspection (Shea et al. 1991, Butman et al. 1992 and Blake et al. 1993). A 4 x 5 nautical mile area around the proposed outfall was characterized in detail by Butman et al., (1992) and the most common sediment type in the area surveyed was coarse sand and gravel (42%). These deposits lay between gravel and boulder covered drumlins which comprised 23% of the study area. Fine-grain sediments (6%) and a highly variable or patchy distribution of mud, sand and gravel (29%) made up the remainder of the cover. The areas described by Meisburger (1976) are predominately covered with sand and gravel although the boulder areas border some of the deposits in these areas. Results of other studies in this area (Blake et al. 1993; Shea et al. 1991) are generally consistent with the above findings although most of their data were collected from REMOTS images from representative data. Studies from this area point out that bottom sediments indicate higher energy areas in some locations while other areas appear to be depositional (silt, clay sediments), with sand underneath.

WATER QUALITY AND CIRCULATION

Again, because of the proximity of these site locations relative to the MWRA offshore outfall site, recent studies have focussed on this area and long-term monitoring of water quality and hydrography is planned (MWRA 1991). Although a 3-D hydrodynamic model of Massachusetts/Cape Cod Bays is still in development, intensive physical oceanographic surveys were conducted between April 1990 and June 1991 (Butman et al. 1992). Some of this long-term monitoring is located immediately adjacent to the MWRA outfall at Buoy "B". While the report should be referenced for the details of initial findings, some relevant findings to this assessment include:

- There is an absence of well-defined current in this area, but water and particle transport takes place by a variety of actions, including tides, winds and river flow;

- Maximum tidal currents 1.0 m off bottom are in the range of 6-8 cm/s in this area (the mean is in the 2-4 cm/s range), compared with much faster currents (18-20+ cm/s) at the mouth of Boston Harbor and somewhat slower currents (4-6 cm/s) at the MBDS. Mean water currents at 5.0 m at this site are typically in the 4-7 cm/s range;

- Maximum re-suspension of fine-grain materials coincides with storm events that show a 2-4 fold increase in suspended material in the water column compared to background (i.e. non-storm periods) in the winter.

The waters in this area have been classified as Class SA. This classification protects the saline waters for the propagation of marine life, primary and secondary contact recreation and shellfish harvesting without depuration in approved areas.

AQUATIC RESOURCES

Benthic Infauna

Recent studies (Blake et al. 1993) have involved benthic sampling adjacent to Meisburger 2 in areas shown by Butman et al. (1992) to have a patchy distribution of mud, sand and gravel or a mud or fine sand cover. The station nearest Meisburger 2 in Blake's study had 63% sand and gravel. Infaunal benthic densities averaged 83,325 per m^2 with the number of species totalling 67 (samples were collected through a 0.3 mm sieve). The community was composed mainly of a polychaete assemblage dominated by *Spio limicola*, *Polydora socialis*, and *Mediomastus californiensis*.

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Sediment profile camera sampling at both Meisburger 2 and Meisburger 7 in 1994 indicated several benthic communities were present. Approximately half of the stations at each site contained primarily rock sediments intermixed with sand and gravel, indicating a high-energy, erosional bottom habitat (NAI and Diaz 1995). Epifauna were observed colonizing the rocky substrate. No RPD layer was observed because sampling gear was not able to penetrate the substrate. Benthic fauna in this habitat (V) at Meisburger 2 had moderately high abundance (11,075/m^2) representing 55 taxa from one 0.04/m^2 sample (Habitat V, Table A1-11). The most abundant species was the tube-dwelling amphipod *Unciola inermis* (11% of the total abundance), followed by spionid polychaetes *Polydora quadrilobata* (11%), and *Prionospio steenstrupi* (Table A1-11). This community at Meisburger 7 had one of the lower abundances at offshore stations (4962.5/m^2), representing 61 taxa from 2 0.04-m^2 samples (Habitat V, Table A1-10). Polychaetes were the most numerous organisms. Dominants included the surface dwelling spionid *Polydora socialis*, deep dwelling maldanid *Euclymene collaris,* and lumbrinerid *Ninoe nigripes*. The presence of deep dwelling organisms is an indication of a healthy benthic community.

Approximately one third of the remaining areas at Meisburger 2 had sand substrate, in some cases with overlying silt (NAI and Diaz 1995). The RPD layer, when observed, ranged from 1.2-2.0 cm, indicating sediments were relatively well oxygenated. A moderate number of fauna tubes were observed at the sediment surface and on rocks. Infaunal burrows were observed in the cases where subsurface observations were possible. Benthic samples revealed a diverse community (150 taxa in the 6 0.04-m^2 samples) with moderately high abundance (9,534/m^2, Habitat VII, Table A1-11). Polychaetes predominated, including spionid *Polydora quadrilobata* (10% of the total abundance), and *Polydora socialis* (9%) and cirratulid *Aphelochaeta marioni* (9%). Many surface-dwelling crustaceans, including cumaceans, isopods, and amphipods, occurred in low numbers. Epifauna (taxa such as Hydrozoa, Bryozoa, and Ascidacea) were present. The remaining stations at Meisburger 2 had heterogenous sediments, mainly sand and gravel with some silt and rock. The depth to the RPD layer, when observable, ranged from 0.5-1.5 cm below the sediment surface. The total number of individuals, 17,925/m^2, was the highest of the offshore stations that were sampled (Habitat VIII, Table A1-11). Polychaetes such as spionid *Polydora quadrilobata* (23% of the total abundance), sabellid *Euchone elegans* (14%), and cirratulid *Aphelochaeta marioni* (11%), were the most abundant organisms. A total of 88 taxa were collected in the 2 0.04-m^2 samples.

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Most of the remaining stations at Meisburger 7 had a gravel substrate mixed with sand and/or rocks (NAI and Diaz 1995). The RPD layer, when observed, was within 1 cm of the sediment surface, with one exception (8.0 cm, station 23). Epifauna tubes were observed on the sediment surface. Observations of the subsurface area in many cases could not be made because the substrate was impenetrable. Silt sediments, in some cases with a layer of fine sand, were observed in a small area on the western edge of Meisburger 7. This area had evidence of well oxygenated sediments, as indicated by an RPD layer generally at a depth of at least 5 cm. There was evidence of bioturbation including oxic voids and burrows.

Lobster

A lobster survey using experimental traps was conducted in October 1994. Meisburger 2 had the highest CPUE of all stations visited in Boston Harbor, a total of 6.4 per trip-day, of which 0.1 met the legal size limit (Table A1-7). Meisburger 7 had second highest lobster catch of all sites, 5.1 per trip-day, of which 0.1 were of legal size. Lobsters were also collected in gill nets set at the Meisburger sites in October 1994 (Table A1-6). An average of 5 lobsters per 24 hour set was collected at Meisburger 2, and 4.3 lobsters at Meisburger 7. Lobsters were rarely collected in gill net collections at other sites in Boston Harbor. A review of the Massachusetts Division of Marine Fisheries data on the location of the lobster fishery fishing effort in 1991, 1992 and 1993 showed fishing traps in the vicinity of Meisburger 7, but no traps located near Meisburger 2 (NAI 1995b).

From a commercial fisheries perspective, these sites are within the area of greatest territorial harvest for the coastal lobster fishery (unpublished data, MADMF 1991). For example, Area #4 (which extends from Lynn to Cohasset) accounted for 41.1% of the 11,000,500 pounds caught (on coastal licenses) in Massachusetts territorial waters. Site-specific catch data for these disposal sites were not available.

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Finfish

Trawl data provided by the MADMF (1991-92 Resource Assessment/Surveys, unpublished data) for a station two nautical miles west of the new MWRA outfall indicated that three commercial finfish species (winter flounder, Atlantic cod and yellowtail) made up 40-60% (collectively) of the total catch (Table A1-12). The total catch (all fish) from two spring (May '91 and '92) collections were 655 (20 min. tow) and 685 (13 min. tow); a total of 17 and 60 lobsters were also collected from these same tows. Rock and Jonah crabs were found in small numbers. Total abundances of fish and lobster at this site were average to above average compared with 10 sampling events (in May and August 1991-92) distributed offshore from Nantasket Beach to the MBDS.

A gill net survey at Meisburger Sites 2 and 7 was conducted in October 1994. Gill net CPUE (fish only, per 24-hour set) averaged 12.3 at Meisburger 2 and 17.4 at Meisburger 7, moderate among the Boston Harbor stations where samples were collected (Table A1-6). Mackerel was the most abundant species collected. Longhorn sculpin, cunner, and Atlantic cod, all typically demersal species, were secondary dominants.

WETLAND RESOURCES

The Meisburger sites exist beyond the geographical and depth jurisdiction of the Massachusetts Wetlands Protection Act and Regulations (MGL c.131, s.40, and 310 CMR 10.00). These sites fall within the federal designation of tidal waters since they fall within the territorial sea of Boston Harbor, and the associated 3 mile limit of jurisdiction required for the discharge of dredged or fill material under Section 404 of the Clean Water Act.

WILDLIFE

Approximately 35 species of marine mammals, 5 species of marine turtles and 40 species of seabirds occur within the Gulf of Maine. Aerial surveys were conducted for the ACOE to assess the use of the Massachusetts Bay Disposal Site (MBDS) by marine mammals, reptiles and seabirds (MBO 1987). The dominant species observed within the MBDS locale are typical of the offshore waters of Massachusetts (Meisburger and Boston Lightship sites).

Seabirds observed include northern fulmar (*Fulmanus glacialis*), shearwater (*Puffinus* sp.), storm petrels (Hydrobatrae), northern gaument (*Sila bacsaus*), Pomarine jaeger (*Steriovarius pomarinum*), gulls (Larinae) and Alcids (Alcidae). Dominant nonendangered mammals include minke whale (*Belasnoptera acutorostrata*), white-sided dolphin (*Lagenorhynchus acutus*), and harbor porpoise (*Phocena phocena*). Although five species of turtles potentially could occur on Massachusetts Bay, only the leatherback turtle (*Dermochelys coriacea*) is typical in the area.

THREATENED AND ENDANGERED SPECIES

The following threatened and endangered aquatic species can occur in the Western North Atlantic including parts of Massachusetts Bay (U.S. Department of the Interior 1991):

Cetaceans

right whale (*Eubalaena gracilis*) (Endangered)
humpback whale (*Megaptera novaeangliae*) (Endangered)
finback whale (*Balaenoptera physalus*) (Endangered)
sei whale (*B. borealis*) (Endangered)
sperm whale (*Physeter macrocephalus*) (Endangered)
blue whale (*B. musculus*) (Endangered)

Turtles

Kemp's ridley (*Lepidochelys kempi*) (Endangered)
leatherback (*Dermochaelys coreacea*) (Endangered)
hawksbill (*Eretmochelys imbricata*) (Endangered)

loggerhead (*Caretta coretta*) (Threatened)
green (*Chelonia mydas*) (Threatened)

Fish

shortnose sturgeon (*Acipenser brevirostrum*) (Endangered)

Studies have shown that the majority of local threatened and endangered whale sightings have been concentrated near the tip of Cape Cod in the northern and central areas of the Great South channel and north of Cape Cod along Stellwagen Bank and Jeffrey's Ledge (ADL 1992). The sightings offshore from Boston Harbor are typically concentrated eastward of the MBDS, within the newly designated Stellwagen Bank National Marine Sanctuary. The Meisburger sites are approximately half way between Boston Harbor and the MBDS and are not a reported area of concentration for these species. Whale watch cruises out of Boston Harbor do not attend these areas.

Of the five threatened or endangered turtles that could occur in this area, the leatherback, Kemp's ridley and the Loggerhead are the most regularly observed in Massachusetts and Cape Cod Bays. Of these species, the leatherback is the most frequently encountered, with the western North Atlantic estimated to support 16,000 individuals (Lazell 1980); however, it is primarily an oceanic species. The loggerhead may show the most common inshore occurrence, with 7,700 individuals estimated to be in north and middle Atlantic coastal water (CETAP 1982). The Kemp's ridley turtle would be the most rare, with the Atlantic population estimated to be less than 500 individuals (Carr and Mortimer 1980). There is nothing unique about the Meisburger 2 and 7 sites that would attract these species nor are we aware of any specific sightings for this area.

The shortnose sturgeon inhabits estuarine and freshwater areas along the eastern coast of the U.S. and Canada and would not be an inhabitant of these open water alternative disposal sites.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

There are no listed historical or archeological resources on the Meisburger 2 and 7 sites.

SOCIO-ECONOMIC/LAND USE

The Meisburger 2 and 7 sites are located in an area used for recreational boating and for commercial fishing. The sites are easily reached by barge during fair weather conditions. The sites are within one mile of the Massachusetts Water Resources Authority's Ocean Outfall, currently scheduled for completion in 1995.

2.4.2 Environmental Consequences of the use of In-Channel and Borrow Pit Sites for Dredged Material Disposal

In-Channel Sites

The areas of these channels that would be improved, as defined in Section 3.3, would be overdredged (to -48 to -70 ft in the Mystic River and Inner Confluence and -49 to -65 ft in the Chelsea River) to accommodate silt disposal. Disposal areas would be created in cells (Section 4.0), generally about 200 ft by 500 ft (2.3 acres) in size, for a total cell footprint of about 116 acres (Mystic River = 56 acres; Inner Confluence = 21 acres; Chelsea River = 40 acres). As cells are filled, a sand and rock cap would be placed over the disposed dredged materials.

Direct Impacts

Because all disposal activities would be limited to the footprint of the improvement dredging, there would be no additional direct habitat losses, either permanent or temporary, as a result of the disposal. Closure of the disposal trenches would alter habitat conditions, however.

A cap would be placed over the disposed silt to serve several purposes. Its primary purpose would be to isolate the dredged silts from the harbor, isolating them from further biotic activity or exposure. It has been demonstrated that a cap of 1.5 ft prevents the flux of contaminants from sediments into the overlying water (Fredette et al. 1992). The proposed 3-foot sand cap, armored where necessary with rock, would protect the silt from resuspension and downstream transport caused by propeller wash of cargo ships and tugs passing through the channels. The cap has been designed to be sufficient to prevent future maintenance operations from disturbing it and releasing the covered silts; the rock on the surface provides a substrate that would be easily identifiable by a dredge operator (either by "feel" or visually when the bucket was opened into the barge) in the future.

The cap would temporarily be virtually free of chemical contaminants, an improvement over the conditions currently present in the channels. Cap material would be highly unlikely to adsorb contaminants - characteristically, mineral sediments do not. However, the cap would probably not change the rate at which contaminated silt from other sources accumulated in the channels. On average, the Chelsea Channel has been estimated to accumulate sediments at a rate of about 1 inch per year. Sedimentation rates are much higher in the Mystic Channel; they have been estimated to average 3 inches per year. It is unlikely that sedimentation is evenly distributed throughout these channels, however.

Ships turning into the Mystic and Chelsea Channels from the Inner Confluence operate at higher speeds than in the rest of the channel and thereby generate bottom currents that are capable of resuspending silt on a regular basis. Therefore, this area may be kept swept clean of silt for an extended period of time. Propeller wash generated by vessels and tugs passing through the channels may be playing a major role in redistributing silts throughout the harbor. Bottom currents caused by ships travelling even at low speeds resuspend a sediment layer up to 0.2 m thick (OCC 1995). Most (95%) of this material is immediately redeposited, but about 5% is available for transport. Localized short-term turbidity plumes are evident behind vessels traversing the channels. The small-bodied, surface dwelling invertebrates that inhabit channel sediments are probably also resuspended when this occurs. This action creates a continually disturbed benthic environment in the channels. The cap material would not be resuspendable by these currents. Therefore, the cap could reduce the rate of resuspension and resedimentation from propeller wash.

Until the cap has been silted over, it could provide an improved habitat for survival of winter flounder eggs (and other demersal species), both by providing a more stable structure to which to attach and by creating an environment that is less stressed by siltation (resulting in reduced "smothering"). Juvenile winter flounder would use the sandy areas because it provides the granular sediments that this species burrows into. Flounder would not use the areas armored by rock.

Benthic fauna capable of inhabiting the are armored by rock would likely differ from the infauna present in the fine-grained sediments present now in the channels. The rock would provide suitable substrate for attachment of fouling organisms, such as are now present on the deeper portions of bulkheads and pilings around the harbor. These species could provide suitable food for browsing fish and lobsters. Interstitial spaces in the rock would fill with sand or silt and thus provide a more diverse habitat. This would tend to increase the species diversity and enhance the habitat.

Indirect Impacts - Water Quality Effects

Modelling done to evaluate impacts to water quality during the disposal operations (short-term impacts) is detailed in Appendix F. Conditions one hour after a single drop (after steady state was reached) were used to predict the mixing zone. In the case of these in-channel sites, the effects of nearby dredging were added to the disposal event. Conditions representing repetitive disposal events were modelled to describe more typical conditions.

The distribution of suspended sediments and PCBs released into the water column was modelled following an instantaneous release of silt from a barge in the Mystic River, the Inner Confluence and the Chelsea River to determine appropriate mixing zones for each area. Preliminary results indicated that disposal around high tide would prevent excessive buildup of TSS or contaminants. Therefore, the mixing zone analysis assumed that this restriction would be adhered to. In all three in-channel disposal locations, the mixing zone needed to meet the proposed TSS limit (Appendix F) would be larger than that for PCBs, assuming that all Mystic River sediments would be disposed in the Mystic River channel. In each case, the mixing zone would be a narrow, elongated area running along the axis of the channel and would not extend all the way across the width of the channel. The dimensions of the necessary mixing zones are listed on Table A1-13.

Modelling of repetitive disposal events is more indicative of the level to which constituents would accumulate in an area over the course of the project. It was predicted that disposal would cause some buildup of suspended sediments (reaching equilibrium within a few days) that would dissipate with distance from the disposal site, partially due to dilution with tidal waters and partially due to the natural tendency for the particles to settle out of the water column. Highest concentrations of suspended sediments (measured as total suspended solids or TSS) would occur in the immediate vicinity of the disposal site (Table A1-14). Background concentrations in the inner harbor were observed to be less than 5 mg/L prior to dredging the Third Harbor Tunnel in 1992 (EA 1992). Dredging the Third Harbor Tunnel resulted in concentrations of total suspended solids averaging about 21 mg/L 500 ft downstream of the dredge, with tidal stage having little influence on the concentration.

Elutriate testing indicated that metals such as copper and mercury could dissociate from the sediments and dissolve during disposal. Repeated discharges of dredged material would have the effect of allowing these parameters to build up in the water column (reaching equilibrium within about two months), particularly in the immediate vicinity of the disposal site. Dilution and transport by tidal action would be the main factor causing dissipation of these parameters. Most metals also have a high affinity for fine-grained sediments (e.g. silt); they would gradually be reabsorbed to the particles and tend to drop out of the system with the silt. The highest concentrations predicted for the dissolved metals (3.2 ng/L for mercury; 5.7 ng/L for copper; Table A1-14) are well below the chronic water quality criteria (25 ng/L for mercury; 2900 ng/L for copper) established by the USEPA (1986 UPDATE?).

Elutriate tests indicated that PCBs were likely to be released from sediments dropped from the barge. Mechanisms similar to those described for the metals would control dispersion of PCBs from the disposal site. Reparticularization is considered to be an important factor in partitioning PCBs between dissolved and particulate phases. PCB concentrations varied in the Harbor; a portion of the sediments proposed for dredging from the Mystic River had substantially

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higher bulk concentrations than the remaining sediments. Therefore, water quality models were run using two different elutriate values. Even under worst case conditions (i.e., Mystic River sediments), the PCB concentrations, including ambient, would be about 60% of the chronic water quality standards.

Because of their high carcinogenicity, the potential for release of PAHs, represented by naphthalene, was examined. Although PAHs were not measured in elutriate testing, concentrations of the 16 individual priority pollutant PAHs were estimated based on organic-water kinetics (see Appendix IV). Naphthalene was the most soluble of the 16 compounds in the sediments. Applying these values to the water quality modelling, it was predicted that PAHs would exhibit little accumulation in the water column. Naphthalene was predicted to occur at concentrations nearly five orders of magnitude lower than the LOEL (lowest observed effects level) water quality criterion of 2350 ppb (no chronic criterion has been established).

Indirect Impacts - Site Stability

Vessel traffic, particularly through the turns into the Mystic and Chelsea Rivers, resuspends sediments in a triangular zone of influence reaching to 40 m wide 170 m astern of an LNG tanker (the worst case). Vertically, the ship-induced velocities also dissipate with depth below the center of the propeller. However, none of the cells are projected to be deeper than the zone of influence. While the propeller wash would resuspend approximately a 0.2 m layer of sediments in this area, about 95% of this material resettles rapidly. A ship traversing the 800 m long turning area in the Inner Confluence would cause a net increase in suspended sediments of about 423 cy. Other cargo vessels would have slightly less impact on the substrate, but would also resuspend sediments. Ship traffic levels in Boston Harbor average about two cargo vessels per day. The largest vessels, LNG tankers, enter the Mystic River at a rate of 1 to 2 per month.

This effect is of concern for the use of the in-channel disposal sites both during the filling phase and following closure of the cells. During the filling phase (a period estimated to last up to 14 days) the disposed sediments could be resuspended from within any cell within the zone of influence of a passing vessel. The quantity of material resuspendable would increase as

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the cell was filled. While this effect would not differ from what normally occurs, it would be counterproductive for the dredging and disposal operations. Ideally, this effect could be minimized by careful scheduling of disposal to use the cells in the most vulnerable areas during periods when LNG tankers are not scheduled, and to restrict vessels from passing within 20 m of an open cell whenever safe navigational practices allow this.

Following closure of each cell, the cap could be susceptible to the erosional forces of the vessel traffic as well. In this case, the concern would focus on maintaining the integrity of the cap to prevent re-exposure of the disposed silts. Clearly it would be infeasible to restrict vessel traffic. Therefore, the emphasis would have to be placed on the strengthening of the cap itself. The ship simulation study (Appendix D in the DEIR/S) and geotechnical surveys in the channels were examined to determine areas likely to be scoured on a regular basis. These were identified as the areas most vulnerable to propeller wash effects. It is recommended that the caps on the cells in these areas be armored with rock.

Long-term monitoring of dredged material capping in Long Island Sound (Fredette et al. 1992) has indicated that no upward migration of contaminants through the cap would occur. Fredette et al. found that after 11 years, the chemical signature of dredged silt and an unengineered cap in Long Island Sound remained distinct. Migration of contaminants into the cap was limited to about 10 cm. In this boundary layer, metals concentrations were $\leq$ 5% of the dredged material and selected PAH concentrations were 0 - 10% of underlying sediments. The proposed rock layer on the surface of the cap at the in-channel disposal sites would armor and prevent resuspension of the underlying sand by propeller wash. Initially, there would be no fine sediments present on the surface, so turbidity caused by propeller wash could be reduced. It is likely that silts will eventually be transported into the channels from other sources, however, potentially negating this effect eventually.

Indirect Impacts - Downstream Resources

Downstream biological resources of concern include anadromous fish species (alewife, blueback herring and rainbow smelt) on their spawning runs up the Mystic River, spawning winter

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flounder (and their demersal eggs), and small intertidal flats (potential soft-shell clam habitat) in the Chelsea River. Geographical areas of concern are shown on Figure A1-22.

Downstream areas are expected to experience minimal impacts for several reasons. Dredging and disposal activities in the Mystic River and the Inner Confluence will be avoided during the period from February 15 to June 30 to prevent impacts to anadromous fish passage. Restriction of activities during this time period would also help protect winter flounder spawning areas. The primary concern for anadromous fish would be contact with elevated concentrations of suspended sediments and exposure to elevated levels of dissolved contaminants. A plume of elevated suspended sediments could deter the fish from entering the Mystic River prior to spawning or juveniles swimming downstream in the late summer and fall if the plume spread across the entire width of the channel, although Klauda et al. (1991) reported that the most susceptible lifestages (eggs and larvae) of alewife and blueback herring could survive exposure to suspended solids in concentrations as high as 500 - 1000 mg/L. In this unlikely event, the fish would probably congregate in a low current area until the changing tide reconfigured the plume, allowing passage. Because the concentrations of dissolved constituents that are expected to occur during the disposal would be below chronic water quality criteria, they would not impact anadromous fish or other pelagic organisms.

Because winter flounder are demersal in all except larval lifestages, contact with the substrate and exposure to increased sedimentation would be of greatest concern. Sedimentation of material dispersed into the water column during each disposal event would likely be most concentrated in an area about 240 ft (80m) north to 240 ft (80m) south of each cell for the period that the cell was being filled (about one to two weeks per cell). Each disposal event could contribute a layer of sediments about 1.4 cm (0.5 in) thick in this area, but build-up would be unlikely because this layer would have a high water content and be easily resuspended and transported. Mortality of winter flounder eggs subjected to sedimentation from this source would likely increase slightly over existing conditions if ship passage does not resuspend this silt. Because channel sediments represent the majority (78%) of the silt volume to be disposed, and, except for the Reserved Channel, dredged material would be disposed in the tributary from which it was dredged, this sedimentation would be unlikely to increase concentrations of contaminants.

Intertidal flats along the Chelsea River would be unlikely to experience detectable sedimentation. Sedimentation is most likely to occur parallel to the axis of the channel rather than towards the shoreline.

There are a number of water intakes along the waterfront that are also of concern. There are six lobster pounds and the New England Aquarium that draw water from the harbor to support live animals. These intakes are generally located outside the zone of highest concentration of TSS or contaminants anticipated for this disposal activity.

Indirect Impacts - Biological Exposure Potential

Water Column Exposure

None of the parameters that were suspected to be problematic in terms of water quality (based on elutriate values or ambient conditions) are anticipated to concentrate to levels exceeding the chronic water quality criteria. Highest concentrations would be restricted to a limited portion of the harbor. It is assumed, therefore, that exposure of biota to these levels would have no discernible effect. Water column exposure would be limited to the 1.5-year disposal period.

Substrate Exposure

Because of the relatively small size of each cell (8,000 to 42,000 cy silt capacity), dredged materials would be exposed only for a period of about 5 to 14 days, on average, prior to capping. This would be insufficient time to allow recruitment of a substantial benthic population and subsequent feeding by demersal fish. It is unlikely that finfish would linger in the disposal cells because of elevated turbidity, general activity and lack of food resources. Even if they did, exposure for one to two weeks would be unlikely to cause adverse effects for several reasons. Bioaccumulation is typically assumed to require about one month of exposure to reach equilibrium; most uptake would have to occur through dermal contact rather than ingestion. Each cell has a footprint of 2.3 acres or less, less than 2% of the available substrate in the Mystic River between the Tobin Bridge and the Amelia Earhart dam. And, finally, the chemical profile of the disposed sediments would not be substantially different from the adjacent substrate.

The small downstream areas subject to sedimentation may have a higher potential for exposing substrate-oriented organisms to contaminants. Based on the relative volumes of dredged material from the berths (22%) and the channels (78%), it is likely that downstream deposits would reflect the chemistry of the channels rather than the berths. Because the only downstream areas that are predicted to experience sedimentation because of disposal are in the channels, this action is unlikely to increase exposure to organisms substantially over what they experience now.

Other Issues

No federally or state-listed threatened or endangered species have been identified to occur in the channel and tributaries, so adverse impacts are not expected.

This disposal alternative would have no effect upon any structure of historic or archeological significance as defined by MHC or the National Historic Preservation Act of 1966, as amended.

BORROW PITS

There are three sites (Spectacle Island, Meisburger 2 and Meisburger 7) that could be used as borrow pits - sites where existing sediments would be dredged and removed to prepare the site for use. Of the three sites identified for this type of development, the two Meisburger sites have deposits of sediments that would be suitable for beneficial uses (beach nourishment or construction fill), while sediments at Spectacle Island would likely not. The Meisburger sites could be developed either as cells or in one large compartment. It is unlikely that the existing sediments near Spectacle Island would provide sufficient geotechnical strength to support construction of small cells because borrow pit construction would not penetrate into parent material at this site. The resulting cells or pit would be filled with silts from the BHNIP and capped with sediments that had been reserved during the initial site preparation or pit creation.

SPECTACLE ISLAND CAD

Spectacle Island CAD is located east of the island on a shallow tidal flat. Water depths range from -8 to -12 ft MLW. Substrate is primarily fine sand and silt. Disposal of silts from the BHNIP would require dredging one large containment cell over a footprint of 45 acres, to a bottom depth of 23 ft below the existing substrate. Silt would be filled to a depth three feet deeper than the surrounding substrate. Silt would be capped with sediment retained from pit dredging to a final depth equivalent to adjacent substrate.

Direct Impacts

There would be no permanent loss or alteration of habitat associated with the use of the Spectacle Island CAD. Dredging the cell would not impact areas outside the footprint, although the material retained for the cap would likely be stored on substrate adjacent to the cell. This would cause a loss of benthic productivity for the duration of the dredging project, about 1.5 years, in addition to the time needed for the storage area to recover, probably an additional year or more. Any remaining material dredged from the cell would be disposed at the MBDS. Benthic fauna would be unable to colonize the cell for the duration of the disposal activities (about 1.5 years). Because the benthic community presently at the site (and throughout the outer harbor) is dominated by the pioneering amphipod *Ampelisca*, it is likely that the cap would be at least partially recolonized within a year of closure of each cell. Tube-building habits of this organism plays a substantial role in stabilizing the sediments in the outer harbor.

If it becomes necessary to armor the self-cap with rock, the character of the benthic community would change dramatically. *Ampelisca* does not occur on hard bottoms. It is possible that the rock bottom, and interstitial areas where fine-grained sediments accumulated, could be as productive as the *Ampelisca* community. Rock could support macroalgae and a diverse macroinvertebrate community; interstitial areas could support many of the infaunal species observed in the area in fall 1994. Such a substrate could complement the Central Artery's artificial reef near the site in Sculpin Ledge Channel.

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Indirect Impacts - Water Quality Effects

The mixing zone required for the disposal of BHNIP sediments at the Spectacle Island CAD would be best defined by the area necessary to dilute total suspended solids to <50 mg/L. Concentrations of TSS at this location would not be influenced by BHNIP dredging activities in the harbor. Disposal at or around high tide would optimize the dissipation of vagrant sediments. Under these conditions, the mixing zone would require an area of about 18.0 acres (240m by 270m) and would be oriented towards Sculpin Ledge Channel (Appendix IV).

Pollutant transport modelling indicated there was little potential for short-term water quality impacts caused by the disposal of BHNIP silts in the Spectacle Island CAD (Table A1-15).

Indirect Impacts - Site Stability

Although its location is removed from the shipping channels where tidal currents peak in the Outer Harbor, the subtidal flat east of Spectacle Island could experience spring tidal flows as high as 0.7 to 1.0 ft/sec (21-31 cm/sec). While these flows are high enough to resuspend unconsolidated silts, existing *Ampelisca* beds probably stabilize these silts.

The shallow conditions east of Spectacle Island are generally avoided by most vessels except small recreational boats. Therefore it is unlikely that this area would be exposed to propeller wash that could resuspend sediments. The frequency of use by recreational boaters would likely increase, however, after the artificial reef developed as mitigation for the Central Artery project has been deployed. The anticipated date for this deployment is the summer of 1996, less than a year before dredging for the BHNIP is expected to begin.

The site for the Spectacle Island CAD is directly exposed to the Atlantic Ocean through the mouth of Boston Harbor. The shallow conditions present at this site would induce wave cresting and breaking. Wave-generated bottom-currents from a one-year storm could reach 5.8 ft/sec (>175 cm/sec), far in excess of the velocity needed to resuspend silt or sand. Therefore, it is likely that this area would be subjected to erosion from storms or high winds each year.

Eventually the wave activity would tend to consolidate the surface sediments, as they are presently. The location of this CAD away from the most exposed northern edge of this subtidal flat would tend to help dissipate the effects of the waves. As with the other sites discussed, armoring the surface with rock would prevent resuspension of the cap. However, this would prevent recolonization of the cap with the *Ampelisca*-dominated benthic community that is currently abundant in the area. It is unlikely that the *Ampelisca* could recolonize rapidly enough to stabilize the cap before a one-year storm occurred.

Construction of a submerged breakwater northeast of the proposed CAD would help reduce the impact of wave-induced bottom currents.

Indirect Impacts - Downstream Resources

Resources of concern beyond the footprint of the proposed Spectacle Island CAD that could be impacted include soft-shell clam beds, *Ampelisca* beds, winter flounder habitat (coincident with *Ampelisca* beds), lobster habitat, the Central Artery artificial reef and the swimming beach on the southern tip of Spectacle Island. Disposal activities could also present a visual impact to Spectacle Island park users.

Although all the intertidal areas in the vicinity of Spectacle Island are considered to be soft-shell clam beds, harvesting is prohibited on all potentially within the influence of the Spectacle Island CAD. With the elimination of sewage sludge discharge at the end of 1991, and the anticipated elimination of sewage effluent discharge in 1997, this status could change. The eastern shoreline of Spectacle Island is being bermed to protect the island from storm erosion; this area would no longer be able to support clams.

Most sediments dispersed from the disposal event would settle within about 80 m. Site configuration indicates that sediments dispersed from disposal events taking place in the central 18 acres of the CAD would settle primarily within the site boundaries. Vagrant silt from disposal events located in the 27 acres along the perimeter of the site could settle in detectable amounts in an area up to 80 m beyond the site boundaries, encompassing up to 38 acres. This would form a transient layer about 0.34 cm thick after each disposal event. The high water content in this layer would make it prone to resuspension, so accumulation of a thicker layer would be unlikely.

The distal ends of the sediment plume could reach the intertidal areas of the southeastern and southern sides of Spectacle Island and the northwestern side of Long Island, but at concentrations <0.5 mg/L above ambient.

Impacts to *Ampelisca* beds, winter flounder habitat and lobster habitat would be similar to those described for Subaqueous B, but located in the vicinity of the east side of Spectacle Island (Appendix F).

The proximity of the Spectacle Island CAD to the proposed artificial reef (in the middle portion of Sculpin Ledge Channel) and swimming beach (on the southern tip of Spectacle Island) being developed as part of the mitigation for the Central Artery/Third Harbor Tunnel project is of concern. Dredging is expected to start in 1997, about one year after the deployment of the artificial reef. Critical to the success of the artificial reef is its colonization by "fouling" organisms such as mussels and algae. A prolonged period of increased turbidity caused by elevated suspended sediments could affect the mortality rates of recently settled organisms. Water quality modelling indicated that it is unlikely that the reef would be exposed to elevated concentrations of suspended solids or dissolved contaminants.

The Central Artery project is closing the Spectacle Island landfill and creating a harbor island park. It is expected to be open to the public in 2000. Part of the park design includes a swimming beach at the sheltered southern tip of the island. The swimming beach could be exposed to slightly elevated concentrations of suspended solids (<0.5 mg/L above ambient), but it is unlikely that a plume would be visible. Most constituents modelled would have reached ambient concentrations at this distance from disposal operations. The PAH naphthalene could be present at levels from 1.0 to 2.0 ng/L above ambient in the vicinity of the beach. This is well below concentrations of concern for human health.

Indirect Impacts - Biological Exposure Potential

Water Column Exposure

Like Subaqueous B and E, hydrodynamics at Spectacle Island CAD create a dispersive environment. Water quality modelling predicted that there would be no excessive (i.e., above chronic water quality criteria) buildup of dissolved contaminants. Therefore, it is unlikely that pelagic organisms would be exposed to contaminant levels that would be deleterious to them during disposal operations at Spectacle Island CAD.

Substrate Exposure

As at Subaqueous B, the routine disposal events would tend to preclude colonization of BHNIP silts until the final cap has been put in place for each cell. The absence of food resources and the frequent disturbances at the site would be likely to cause finfish and epibenthic crustaceans from spending prolonged periods of time in a cell until the cell has been closed. Therefore, it is unlikely that organisms would be exposed to the BHNIP silts and their associated contaminants long enough to bioaccumulate contaminants.

Because the transport of resuspended sediments to downstream areas would be less dramatic than the descent of dredged materials, organisms would not be likely to avoid these areas. The sediment-bound contaminant loading described for Subaqueous B would also apply to this site. It is unlikely that hydrodynamic conditions would allow the creation of identifiable deposits of BHNIP silts released during disposal operations.

The temporary change in depth could increase the risk that finfish would enter the pit during the summer months in search of cooler water temperatures and, consequently, be exposed to contaminated sediments. However, monitoring for the Central Artery project and the fall 1994 sampling for the BHNIP suggest that the area around Spectacle Island supports a smaller finfish population than other parts of the Outer Harbor and the Inner Harbor. If this is true, this potential exposure route would present a minimal risk to finfish.

Other Issues

The disposal operations would involve approximately 660 barge trips. This would require Coast Guard coordination of barges with the commercial and recreational boat traffic using the harbor. Construction activities would have a minor adverse aesthetic impact, and result in slightly elevated noise levels.

If the filling is restricted to the depth of the surrounding area, there will be no permanent impact on recreational boating. However, the placement of the material may necessitate temporary restrictions on recreational boating. Because this is a shallow subtidal area, dredging would be required. This will necessitate testing and a determination of the appropriate disposal location for the sediments removed from this site.

The Massachusetts Highway Department (MHD) is currently constructing a dike adjacent to this proposed disposal site for the purpose of containing and closing the landfill at Spectacle Island. Lack of impacts from dredging the CAD on the integrity of the dike structure will need to be demonstrated to the MHD as well as to the owners of Spectacle Island, the City of Boston and the Massachusetts Department of Environmental Protection.

Part of the Spectacle Island Landfill Closure Plan also includes the installation of an artificial reef in the northeastern half of Sculpin Ledge Channel. Depending on the timing of the Project, the fill placement at the Spectacle Island CAD location may need to be coordinated with the construction and/or location of the fish reef to minimize interference and impacts. As mentioned above, if the fish reef is in place during the CAD construction/use, special mitigation measures may be necessary to prevent silt plume exposure to this facility.

MEISBURGER 2 AND MEISBURGER 7

Meisburger 2 is located 2.3 miles southeast of Nahant; Meisburger 7 is located about 7 miles off Boston Harbor. Both occur in water depths of about 80 to 105 feet and were identified as potentially minable sand and gravel deposits (Metcalf and Eddy 1992). Use of either site for dredged material disposal would require dredging a series of pits, storing the surface materials for future use in capping the BHNIP silts disposed there, and recovering the underlying sand and gravel deposits for beneficial use. From an environmental standpoint, creation of small cells for disposal is preferable to constructing one large pit. Small cells enable capping and isolation of disposed silts more quickly. Subsequent recolonization of the cap can also occur more quickly under this scenario. Because of the water depth, however, the site preparation would be more efficient if surface material was sidecast onto adjacent substrate for storage and then scraped back onto the cell. To minimize the extent of temporary impacts (i.e., smothering) to adjacent substrate, it would be advantageous to dig cells in a planned geometric sequence, placing cap material on top of the next cell to be excavated. This sequence would require that the hopper dredge remain at the site throughout the entire period that disposal of BHNIP sediments occurred.

The specific locations of the sand deposits within the Meisburger 2 and 7 sites would have to be identified prior to any final disposal plan. Because of expected variations in thickness of these minable deposits, it is estimated that the disposal site would encompass an 86-acre area (13 feet below existing substrate) at Meisburger 2 or a 121-acre area at Meisburger 7 (10 feet below existing substrate). Creation of these cells would provide sufficient capacity for 1.3 million cy of silt with a three-foot thick cap. Site bathymetry and surface substrate would be returned to preexisting conditions.

Direct Impacts

Use of Meisburger 2 or Meisburger 7 would result in no permanent loss of aquatic habitat. Benthic production would be temporarily halted during the use of each cell. The existing benthic communities at both sites are a complex array of species and lifestyles (pioneering and later successional stage species co-occur) that would probably take several years to reestablish.

Preexisting bathymetric and substrate conditions would be restored after each cell has been filled. Therefore, use of the site would cause no permanent alteration of the habitat.

The Meisburger 2 and Meisburger 7 sites were both observed to support large lobster fishing efforts in the fall of 1994. Use of either site would disrupt lobstering activities in the footprint and immediately surrounding areas during disposal. Disposal would likely cause lobsters to move out of the immediate area. Development of either site in cells would reduce the likelihood that lobsters or groundfish would move into the pits and be smothered by disposed dredged material. During construction activities, there would be disruption of fishing activities, with an associated economic impact to the fishermen who utilize that area.

Indirect Impacts - Water Quality Effects

The mixing zone required for the high tide disposal of BHNIP sediments at either Meisburger site to dilute total suspended solids to <50 mg/L would be an area of about 22.5 acres (900m by 100m). Concentrations of TSS at these locations would not be influenced by BHNIP dredging activities in the harbor.

Because of the large volume of water available for dilution, no short-term water quality impacts were predicted with the ADDAMS model reported in the DEIR/S. Although about 5% of the sediments from each barge load would be dispersed from either site, no water quality exceedances beyond the disposal site boundary were predicted after four hours under stratified conditions, consistent with Sec. 103 requirements.

Indirect Impacts - Site Stability

The relatively slow bottom currents at Meisburger 2 and 7 (maximum of 0.2 - 0.3 ft/sec [6 - 8 cm/sec]) are unlikely to resuspend silty sediments. Vessel traffic is primarily limited to fishing boats whose relatively shallow draft and low powered engines (compared to cargo vessels) are unlikely to affect the substrate.

However, no land masses protect either Meisburger 2 or 7 from the effects of high winds and storms. A one-year storm could generate bottom currents of 3.2 ft/sec (98 cm/sec) at

Meisburger 2 or 3.6 ft/sec (110 cm/sec) at Meisburger 7. Unconsolidated sediments, such as the silts proposed for disposal, could easily be resuspended under these conditions. Because of the mechanical disruption from dredging, the sediments retained during construction of the borrow pit to be used for the cap would be less compacted than in their original state and, therefore, somewhat more susceptible to resuspension. However, the proposed three foot cap thickness is expected to be sufficient to prevent future exposure of the buried dredged materials.

Indirect Impacts - Downstream Resources

Resources in the vicinity of the Meisburger 2 and 7 sites have been identified through lobster trapping and gill net fishing; demersal fish have not been sampled there because of the presence of fixed fishing gear. Important resources are likely to include lobster habitat, flounder habitat, exploited fishing grounds and the MWRA sewage outfall. The downstream benthic community is assumed to be similar to the conditions observed at Meisburger 2 and 7, that is, diverse and productive.

Discernable downstream impacts would most likely be limited to the immediate vicinity of the disposal site. Although suspended sediments would be transported away from the site during each disposal event, concentrations would be low and settlement would be dependent on prevailing currents at the time of the disposal. The area adjacent to the disposal activities would have the highest likelihood of experiencing increased sedimentation. Depending on the layout of the cells, some material would be likely to settle on other cells.

Lobster and bottom fish that were present at Meisburger 2 or 7 during disposal events would likely move away from the area of increased turbidity. All told, the motile organisms occupying the 86-acre footprint of the Meisburger 2 disposal site, or the 121-acre footprint of the Meisburger 7 disposal site, would be displaced onto adjacent substrate. This could stress the carrying capacity of the adjacent area, although the probability of this is unclear. Areas that also experienced sedimentation would most likely be stressed; benthic standing crop could be diminished.

About half of the area encompassed by Meisburger 2 was identified as having surface substrate conditions that could be appropriate for Early Benthic Phase (EBP) lobsters. Nearly 90% of the substrate observed at Meisburger 7 was gravelly or pebbly in nature, potentially suitable for EBP lobsters. This lifestage has specific habitat requirements, particularly in terms of shelter from predators, that may be the limiting factor in successful recruitment to harvestable lobsters (Wahle and Steneck 1991). Although no EBP lobsters were observed at either Meisburger 2 or 7, this could have been an artifact of sampling design. While it is unlikely that sediments dispersed from the disposal activities outside the disposal cell would blanket a given area thickly enough to destroy the character of the substrate, the increase in the quantity of unconsolidated fine-grained material could affect respiration of EBP lobsters by clogging their gills.

Depending on tidal and seasonal current patterns, effluent from the MWRA outfall and materials dispersed from the disposal activities could interact. Water quality modelling for each project predicts that farfield effects would be negligible. However, these models have yet to be validated. The MWRA outfall is projected to go on line in 1997, the same year that dredging would start in Boston Harbor. Interpretation of results of the stringent monitoring that will accompany the startup of the MWRA discharge offshore would be severely complicated by the presence of disposal activities in such close proximity.

Indirect Impacts - Biological Exposure Potential

Water Column Effects

The rapid dilution of dissolved constituents and suspended sediments following each disposal event would minimize the potential for pelagic organisms to be affected. No constituents are expected to reach concentrations in the water column that exceed the chronic level water quality criteria.

Substrate Effects

Existing sediments near Meisburger 2 (Transect D; MWRA 1988) contain PAHs at concentrations ranging as high as the levels observed in Boston Harbor channels. The sediments potentially proposed for disposal at Meisburger 2 probably contain substantially higher concentrations of contaminants than currently exist there. Therefore, during the relatively brief period that each cell would be uncapped, organisms that contacted the sediments could be affected by the contaminants. However, as described for the In-Channel disposal scenario, there would be several factors operating that would tend to reduce the likelihood of adverse impacts. It is extremely unlikely that benthic organisms would colonize the exposed BHNIP silts because of the relatively short period of exposure (because of construction in cells), the frequency of disturbance, and the character of the local benthic community which consists mostly of later-successional stage species (rather than pioneering species capable of rapid recruitment to disturbed substrates). Absence of food and frequency of disturbance would tend to deter bottom-feeding fish from lingering on the contaminated sediments.

Other Issues

The disposal operations would involve approximately 660 barge trips. This would result a level of traffic that would need to be closely coordinated by the Coast Guard with commercial and recreational boat traffic using the harbor. Construction activities would have a minor adverse aesthetic impact.

The disposal operation at the site would prevent fishing and recreational boating for the duration of the filling activity. A notice to fishermen warning them to avoid this area may be necessary as may be a Coast Guard hazards to navigation notice (due to the regular presence of barges). Although the project activity could provide a point of nuisance to fishermen for 1½ to 2 years, adverse impacts to their fish catch are not anticipated given the relatively small area affected compared to what is available for similar fishing ground. Long-term impacts to the fishery are not expected because the dredge material would be isolated and not exposed to benthos or fish. The proximity of the sites to the MWRA's ocean outfall assures some level of monitoring (by MWRA) before and during placement of material; any construction impacts from the filling operation could be evaluated from these data.

Use of these locations will entail dredging of existing sand and gravel prior to placement of material. Some of the sand might be suitable for ACOE beach nourishment projects provided it meets grain size, availability and suitability criteria for the specific beach nourishment project. The ACOE is working with the MDC on beach nourishment projects in the Commonwealth including Nantasket Beach, among others. "Piggybacking" projects in this manner is an acceptable strategy to the ACOE. However, costs which must be factored into this option include testing, processing and transporting the material, as well as alternate use or storage costs for that portion of the material not appropriate for beach nourishment.

2.5 SITE EVALUATIONS: SUBAQUEOUS AREAS

2.5.1 Existing Conditions

The site is depicted on Figure A1-18.

2.5.1.1 Subaqueous Containment Site B (Subaq B)

SEDIMENT CHARACTERISTICS

Boring sites ST1-14 and ST1-15, sampled by the CA/T program (Cortell 1990a) and presented in Table A1-16, were located off the northern side of Spectacle Island and represent the same exposure to currents, waves and storms as Subaq B. Surface sediments at ST1-14 and ST1-15 were predominantly sand (77-84%) and gravel (11-20%) with a small silt/clay component (3-5%). Bulk sediment analysis indicated that no parameters exceeded Category I limits.

WATER QUALITY AND CIRCULATION

Waters in the vicinity of the Subaq B site have been classified as Class SB waters by MADEP. Specific water quality data is presented in Section 3.0 for the Outer Harbor area. Typically the greatest impact to water quality in this area is from the numerous discharges and CSO's originating in the Inner Harbor areas. Water quality improves with increasing distance from the Inner Harbor.

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. The mouth of Dorchester Channel attains spring tide currents of 0.8 knots on ebb tide and 0.6 knots on flood tides (Cortell 1990a). Located near the edge of the Main Ship Channel, Subaq B may experience among the fastest currents.

Subaq B is exposed and vulnerable to northeasterly storms. The nearest sheltering landfall is Deer Island (2.0± miles across the harbor). Nearby sediment conditions indicate the area is occasionally scoured.

AQUATIC RESOURCES

Benthic Infauna

Subtidal benthic macrofauna in the vicinity of the northwest portion of Spectacle Island were examined during benthic infauna and lobster surveys (Cortell 1990a). As with other sampling locations around Spectacle Island, abundances of benthic infauna (retained on a 0.5 mm-mesh sieve) north of the island were low (1113 individuals/m^2). Nematodes, the gastropod *N. trivittatus* and the polychaete *N. caeca* predominated.

Sediment profile camera sampling at Subaq B just south of the shipping channel revealed a silty substrate covered with a mat of *Ampelisca* amphipod tubes (NAI and Diaz 1995). The depth to the RPD layer was more than 2.0 cm below the sediment surface, suggesting well oxygenated sediments. There were indications of subsurface bioturbation, including burrows, worm tubes, and oxic and anoxic voids. Results suggest a healthy benthic community in between pioneering and successional equilibrium stages.

Benthic samples revealed that the amphipod *Ampelisca* sp. predominated, composing 82% of the total abundance (Table A1-10) Total abundance was the highest of all Outer Harbor stations (115,149.6/m^2), and included 60 taxa. Other species such as spionid polychaete *Polydora cornuta* and the amphipod *Phoxocephalus holbolli* composed a small component of the benthic community. Results indicate the benthic community is healthy and diverse, intermediate between disturbed and equilibrium successional stages.

Sediment samples collected during the lobster survey were sieved through a 2.5 mm-mesh sieve and analyzed qualitatively. The polychaetes Nereidae and *Glycera* sp., *Nassarius* sp.

and post-larval crabs were the most frequently collected organisms. Soft-shell clam (*M. arenaria*) spat and razor clams (*E. directus*) were also encountered.

Lobsters

Lobster fishing activity in the vicinity of Subaq B was examined during the summer of 1990 for the CA/T project (Cortell 1990a). Pot markers were observed at Subaq B on each of the three dates examined. Despite being in a navigational channel, pot markers were as numerous at Subaq B as at other areas around Spectacle Island. Transects were swum by divers to document use of the substrate around Spectacle Island by lobsters, including EBP lobster. The greatest density of lobsters was observed off the northeast portion of Spectacle Island (0.0027-0.0035/ft^2). Lobsters occurred at about half that density (about 0.0012/ft^2) off the northwest portion of the island (near Subaq B); abundances elsewhere around the island were generally much lower. Most lobsters were observed at the deeper portions of the transects. No EBP lobsters were observed around Spectacle Island; little suitable habitat was encountered for this lifestage.

Recent lobster trapping surveys at Spectacle Island collected low numbers of lobsters (0.2 per trap-day), one of the lowest in Boston Harbor (Table A1-7). Fishing activity has dropped dramatically as a result of diminished numbers of lobsters. In the trawl survey, approximately 6.7 lobsters were collected per 20 minute tow, similar to that collected at Subaqueous E (Table A1-4).

Finfish

A recent trawl survey near Spectacle Island collected mainly winter flounder, along with skate sp., rainbow smelt, and Atlantic silverside (Table A1-4). The number of fish (21.3 per 20 minute tow) was among the lowest in Boston Harbor.

Based on the on-going development of the artificial reef design, as required by the Individual Permit—Landfill Closure and Maintenance at Spectacle Island for CA/T (ACOE no. 199202207; 2/16/93), target fish species in the offshore coastal waters and Boston Harbor areas include forage species such as Atlantic menhaden, Atlantic herring and rainbow smelt, and predator species such as winter flounder, striped bass, bluefish, pollock, Atlantic cod, tautog and cunner.

WETLAND RESOURCES

Subaq B is defined as Land Under the Ocean and falls under the jurisdiction of the Massachusetts Wetlands Protection Act (310 CMR 10.00). By definition, this resource is supposed to be significant to the protection of marine fisheries, protection of land containing shellfish, storm damage prevention, flood control and protection of wildlife habitat. Although food resources appear to be limited in this area (low benthic infaunal abundances), the area in the vicinity of Subaq B has been shown to support lobsters and is likely to support winter flounder. The sandy substrate may provide spawning habitat for winter flounder.

The closest significant shellfish resource to Subaq B is in the vicinity of Governors Island Flats across the Main Ship Channel to the north of Subaq B where soft-shell clams are harvested by Master Diggers. The Main Ship Channel influences currents substantially so that Dorchester Channel has little effect north to Governors Island Flats. The tidal flat on the southeastern side of Thompson Island also supports a substantial soft-shell clam resource (Cortell 1990b). Shallow bathymetric conditions between the islands and the configuration and orientation of Spectacle and Thompson Islands result in relatively slow currents passing from Subaq B to the Thompson Island Flats (0.2 knots, spring flood, Cortell 1990b). Spring flood currents through the deeper Dorchester Channel (passing north of Thompson Island) are about 0.5 knots.

Located at the mouth of the Dorchester Channel, Subaq B offers little storm damage protection because its depth is greater than surrounding areas. Storm waves would travel to shallower areas and crest before reaching land. Because it is in relatively open water, Subaq B also has little potential for storing flood water.

Dissipation of storm waves helps to protect shallower areas, such as the subtidal flat southeast of Pleasure Bay. Such shallows can be important feeding resources for waterfowl, including those species observed on and adjacent to Spectacle Island (see next section).

Subaq B is classified as Tidal Waters under federal regulations (33 CFR 328.4(b)). Tidal Waters may provide sediment/toxicant retention, nutrient retention/ transformation, recreation and uniqueness/heritage. Subaq B is not likely to contribute substantially to retention of sediments and toxicants, nor to retention or transformation of nutrients. Relatively swift currents prevent deposition of fine grained sediments that tend to absorb contaminants. Nearby sediments contained only low concentrations of metals and organic pollutants. Recreational vessels are among those using the channel.

WILDLIFE

Waterfowl, including great cormorant (*P. carbo*), herring gull (*L. argentatus*), white winged scoter (*M. deglandi*), common goldeneye (*B. clangula*), bufflehead (*B. albeola*), mallard (*A. platyrhynchos*), black duck (*A. rubripes*), merganser (*Mergus* spp.) and scaup (*Aythya* spp.) have been observed in the vicinity of Spectacle Island (Cortell 1990a). It is likely that these same species of waterfowl use the Subaqueous B site area for feeding and resting. Each of these species feed on fish and invertebrates (Martin et al. 1951; Whitlatch 1982; and DeGraaf and Rudis 1986) that occur in the area.

THREATENED AND ENDANGERED SPECIES

No threatened or endangered species listed by federal or state authorities are identified or anticipated to occur within the boundaries of Subaq B. Several marine mammals not listed as threatened or endangered, including harbor seals (*P. vitulina*), harbor porpoise, (*P. phocena*) and grampuses (*G. griseus*), occur occasionally in the area. These species are all protected under the Federal Marine Mammals Protection Act.

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HISTORICAL AND ARCHEOLOGICAL RESOURCES

Previous dredging and maintenance of the Main Ship Channel and the Dorchester Channel have likely disturbed any evidence of historic or archeological remains.

SOCIO-ECONOMIC/LAND USE

Subaq B is an entirely submerged aquatic site within view of Spectacle Island, Thompson Island, Fort Independence on Castle Island, Logan Airport and Deer Island. It lies within a presently marked navigational channel (Dorchester Channel) at its convergence with Western Way and the Main Ship Channel. Lobstermen fish this area.

This open water site is in the path used by the commuter boats to Boston. The site is within 1200 feet of Spectacle Island, an abandoned landfill which is being closed and capped by the Massachusetts Highway Department, and which will be the site of a park owned by the City of Boston and the Commonwealth Department of Environmental Protection. The site is more than one-half mile from the park at Castle Island, an MDC Park and 0.75 miles from Thompson Island.

2.5.1.2 Subaqueous Containment Site E (Subaq E)

The site is depicted on Figure A1-19.

SEDIMENT CHARACTERISTICS

No sediment data were available for the immediate vicinity of Subaq E. Samples collected off the end of Logan Runway 33L (Massport 1990) and from Stations E and F in the Main Ship Channel (ACOE 1988a) may be representative of local conditions. Composed of grey and black oily fine to medium sand, these sediments contained no constituents whose concentrations exceeded the range for Category I sediments. Surface material at Stations E and F in the Main Ship Channel, on the other hand, was ≥85% silt or clay. Bulk sediment analysis indicated that most constituents met Category I standards but lead, chromium and volatile solids occurred at Category II levels.

WATER QUALITY AND CIRCULATION

Water quality in the vicinity of Subaq E is classified as SB. When sampled in 1986, Class SB standards were met except for occasionally excessive bacterial concentrations (Massport 1990). As water quality conditions have been improving throughout the Harbor it is likely that this area will continue to meet SB criteria.

As with other sites in Boston Harbor, the hydrodynamics of Subaq E are governed primarily by tidal currents and secondarily by wind. Bounded to the north and south by shoals, and in close proximity to the Main Ship Channel, Subaq E is subject to relatively high current velocities (up to 1.0 knots flood and 1.3 knots ebb in spring tides). This area experiences a 1.0-mile northeasterly fetch, buffered only by Deer Island, and is exposed to easterly winds. The adjacent shoals crest waves rapidly. Greater depth offers protection to Subaq E.

AQUATIC RESOURCES

Benthic Infauna

Sediment profile camera sampling at Subaq E revealed two habitats. At 4 of the 6 stations, silt substrate was overlain with a matrix of *Ampelisca* sp. tubes (NAI and Diaz 1995). The depth of the RPD layer ranged from 1.4-2.0 cm are below the sediment surface, indicating a healthy degree of sediment oxygenation. There was some evidence of subsurface biological activity, including an occasional worm tube and anoxic void. Benthic sampling results showed the amphipod *Ampelisca* sp. was the dominant organism, composing 45% of the total abundance of 50,987.5/m^2 (Habitat I, Table A1-10). Spionid polychaete *Polydora cornuta* and cirratulid *Tharyx acutus* composed 18% and 12% of the total communities, respectively. The soft-shell clam *Mya arenaria* was collected in low numbers (25/m^2, Table A1-10). Two stations at Subaqueous E had silt substrate, covered either by a matrix of *Ampelisca* sp. tubes or a layer of *Mytilus* shell hash. Where observed, the RPD layer occurred at 2.5 cm below the sediment surface. Worm tubes and oxic and anoxic voids were observed underneath the *Ampelisca* mat, indicating bioturbation activities at depth. Benthic samples contained low numbers of organisms, (975/m^2, the lowest observed in the Outer Harbor area). The mud snail *Nassarius trivittatus* and polychaete *Nephtys ciliata* were the most numerous organisms collected, together composing nearly one half of the sample (Habitat II, Table A1-10). All benthic communities at Subaq E were intermediate between a disturbed or stressed community and an equilibrium community.

Benthic samples at Subaq E contained low numbers of soft shell clam (*M. arenaria*, Table A1-10), although this species tends to be most abundant at and slightly above mean low water. Subaq E is located within approximately 1 nautical mile of the intertidal mud flats, along the perimeter of Logan Airport, which are harvested by commercial clammers. These mudflats also support extensive beds of blue mussels (*M. edulis*), a species also capable of subtidal existence.

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Finfish

Subaqueous E

Otter trawl collections in October 1994 collected an average of 82.7 individuals per 20 minute tow, of which 14.7 were lobster (Table A1-4). These catches were the highest of all stations sampled. Winter flounder and skate sp. each composed approximately one third of the catch. Rainbow smelt and Atlantic silverside were secondary dominants.

WETLAND RESOURCES

Like Subaq B, Subaq E includes of Land Under the Ocean (under state jurisdiction) and Tidal Waters (under federal jurisdiction). The Massachusetts Wetlands Protection Act (310 CMR 10.00) assumes that this resource is significant to the protection of marine fisheries, protection of land containing shellfish, storm damage prevention, flood control and protection of wildlife habitat.

Differences in bathymetry and currents between Subaq E and adjacent areas are likely to make it attractive to finfish although it would require more energy to remain in the stronger currents of this channel. Regular tidal currents are likely to prevent anoxic or hypoxic conditions from developing during the summer, enabling finfish to use this area as a refuge from summer temperatures on the adjacent shoals.

The presence of the channel partially diverts tidal energy away from the adjacent shoals. The shoals of Governors Island Flats, in particular, are likely to provide soft shell clam habitat which contributes to the productivity of the area. The abrupt change in depth between Subaq E and Governors Island Flats makes the southern edge of the Flats susceptible to damage from waves generated by easterly and southeasterly winds, however winds from these directions are relatively rare. Governors Island Flats plays a substantial role in protecting intertidal resources and the shoreline from erosional forces by dissipating waves offshore. Like Subaq B, Subaq E is located in open water and has no capacity for storage of flood waters.

Classified as Tidal Waters under federal regulations, Subaq E was evaluated for its ability to provide the functions of sediment/toxicant retention, nutrient retention/transformation, recreation and uniqueness/heritage. Because tidal currents tend to be elevated in channels and keep fine-grained sediments in suspension, it is unlikely that Subaq E contributes to sediment/toxicant retention or nutrient retention/transformation. However, its proximity to commercial anchorages exposes Subaq E to potential spills and accidental discharges. This area is used by recreational boaters for passage into Boston Harbor.

WILDLIFE

Waterfowl, including great cormorant (*P. carbo*), herring gull (*L. argentatus*), white winged scoter (*Melanitta deglandi*), common goldeneye (*B. clangula*), bufflehead (*Bucephala albeola*), mallard (*A. platyrhynchos*), black duck (*A. rubripes*), merganser (*Mergus* spp.) and scaup (*Aytha* spp.) have been observed in the vicinity of Spectacle Island (Cortell 1990a). It is likely that these same species of waterfowl also use the Subaqueous E site for feeding and resting. Each of these species feed on fish and invertebrates (Martin et al. 1951; Whitlatch 1982; and DeGraaf and Rudis 1986) that occur in the general area.

THREATENED AND ENDANGERED SPECIES

No federally or state-listed threatened or endangered species are identified or expected to occur within the vicinity of Subaq E. All marine mammals are protected under the Federal Marine Mammals Protection Act, whether threatened/endangered or not. Three species, harbor seals (*Phoca vitulina*), harbor porpoises (*Phocena phocena*) and grampuses (*Grampus griseus*) occur occasionally in the harbor.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

There are no listed historical or archeological resources at the Subaq B or Subaq E sites.

SOCIO-ECONOMIC/LAND USE

Current use of Subaq E is for navigation between Winthrop Harbor and Boston Harbor (approximately 20 feet MLW). Although entirely submerged, disposal activities at Subaq E would be visible from Deer Island, Winthrop Harbor, Logan Airport, Fort Independence (Castle Island), Spectacle Island and Long Island during construction. Height restrictions may occur because of its proximity to Logan.

This open water site abuts General Anchorage Areas to the south and east and is in the path of the ferries carrying construction personnel to Deer Island during the Boston Harbor Clean-up Project. It is farther removed from the parks discussed with regard to the Subaq B site.

2.5.2 Environmental Consequences of using Subaqueous Containment Sites for Dredged Material Disposal

In order to use either Subaqueous B or E for disposal of silt from the BHNIP, berms (composed of parent material) closing off their open sides would have to be constructed. This berm construction would constitute the extent of site preparation. The nature of these sites would preclude the possibility of filling them in discrete cells. When disposal was complete, the entire area would be capped with sand.

SUBAQUEOUS B

Subaqueous B is located at the mouth of the Dorchester Channel. It is a triangular area with gradually sloping bathymetry to the west and south and open to the Main Ship Channel to the northeast. It has an estimated capacity of 609,000 cy. Including the proposed cap, use of this site for disposal of dredged materials from Boston Harbor would raise the substrate to a final depth of approximately -15 ft MLW.

Direct Impacts

Use of Subaqueous B would permanently cover an 83-acre footprint that was found, in the fall of 1994, to support high abundances of benthic infauna. The predominant organism present in the benthic community was a tube-dwelling amphipod (*Ampelisca* sp.) that is known to be an important prey item for juvenile flounder. This community would be covered and it is unlikely that these organisms could recolonize before disposal was complete. Assuming a sand cap were used to close the site, recolonization would occur. Although use of this site would result in a permanent reduction in depth, it is unlikely that this would have a major effect on the benthic community. It was observed in the fall of 1994 that the benthic community structure at Subaqueous B was very similar to that to the east of Spectacle Island (at Spectacle Island CAD), where water depth ranges from -8 to -12 ft MLW.

Alteration in bathymetric conditions at this site could affect finfish by reducing the bathymetric diversity. During warm summer months, finfish seek cooler waters in deeper areas. A change in depth of 10 feet could make a significant difference in water temperature in the summer at this location.

Either a sand or a clay cap would represent different sediment characteristics than are present at the site now. Because of the local hydrodynamics, it is unlikely that the cap would become heavily silted. Hydrodynamic conditions also indicated that armoring the cap with rock would be necessary. In this case, substrate conditions would change markedly from existing conditions. The rock would support a very different benthic community from that currently

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present. As hard substrate is rare subtidally in Boston Harbor, a rock armor would add to habitat diversity in the outer harbor. Shallow rocky subtidal habitat can be highly productive (as the existing habitat appears to be) and support finfish and epibenthic crustaceans. Interstitial spaces between the rocks would tend to accumulate any fine-grained sediments that were transported to the site. These micro-habitats could support soft-substrate benthic species.

Lobster pots were observed in this area in the summer of 1990 (Cortell 1990). Disposal activities would prevent use of the site for the duration of the BHNIP, but closure of the disposal area would allow lobstermen to fish the area in the future.

Indirect Impacts - Water Quality Effects

Analysis of the mixing zone requirements for disposal at Subaqueous B indicated that total suspended solids would be the limiting parameter. After steady state (achieved within about five days of repetitive disposal) is reached, a single disposal event at or around high tide would require a mixing zone of about 26.8 acres (555m by 195 m; Appendix F) before TSS reached a level of 50 mg/L. Disposal at high tide would cause the mixing zone to be oriented along the Main Ship Channel towards the mouth of the Outer Harbor. Dredging for the BHNIP would not interact with the disposal plume at this site.

Repetitive disposal events should have little impact on the water quality of the Outer Harbor (see Appendix F). Assuming daily disposal events, concentrations of total suspended solids and dissolved contaminants would increase for up to a 20-30 day period, and then reach equilibrium. A pollutant transport model analyzing daily disposal of silt at Subaqueous B indicated that, at equilibrium, the maximum concentration of all constituents of concern would be well below the chronic water quality criteria (Table A1-17).

Indirect Impacts - Site Stability

As described for the In-Channel disposal scenario, it is unlikely that upward migration of contaminants through the cap would occur.

Subaqueous B is exposed to erosional hydrodynamic conditions from several sources. Flood and ebb tidal currents exceed speeds of 1.0 ft/sec during spring tides (i.e., at least twice monthly), sufficient to erode silt or sand. Because this site is located within the Dorchester Channel and immediately adjacent to the Main Ship Channel, it is likely that the substrate is exposed to propeller wash from passing ships and boats on a frequent basis and that this would be sufficient to erode material either during disposal or after the cap has been placed. In addition, this site is exposed to storms from the east and northeast. It has been predicted that storms with a frequency of one year could produce bottom currents of up to 0.6 ft/sec (20 cm/sec), sufficient to resuspend silt or sand. Therefore, several hydrodynamic conditions combine to make the stabilization of this site difficult in the short or long term.

Indirect Impacts - Downstream Resources

Downstream biological resources of concern include soft-shell clams, *Ampelisca* beds, winter flounder (in particular, but all finfish occupying the Outer Harbor), and lobsters. Recreational areas include Pleasure Bay, Castle Island and Spectacle Island (the latter park is scheduled to open in 2000). Distribution of clam beds in Boston Harbor is shown in Figure A1-22. Most of the clam beds within one mile of Subaqueous B are currently closed to any type of harvesting, however, it is expected that this status may change with the continued clean up of the Harbor.

The pollutant transport model indicated that transport of silt into these intertidal areas would be unlikely. Silt released into the water column would be most likely to settle to the substrate within about 80 m of the point of disposal in a layer about 0.2 cm (0.5 in) thick. Because of the dimensions of the disposal site, most events would not result in deposition of substantial quantities of vagrant silt outside the disposal site footprint itself. Tidal flow would be likely to resuspend this material and prevent further accumulation. However, repeated disposal events could result in temporarily reduced benthic productivity in up to 36 acres (a 240-ft wide band surrounding the disposal site).

Recent surveys of benthic communities in the outer harbor have found that the tube-dwelling, mat-forming amphipod *Ampelisca* is a predominant species in most areas examined. Its high abundances appear to be a recent phenomenon that has been linked with the elimination of the sewage sludge discharge from Deer Island. Although this amphipod occupies silty sediments, it requires good water quality conditions. It is unlikely that the minor increase in suspended sediments (7 mg/L above ambient) would affect the existing population of *Ampelisca* or recruitment of juveniles to this area. Any effect would probably be temporary, limited to the disposal period and perhaps six months to a year afterwards (to account for the reproductive cycle of *Ampelisca*).

One of the critical functions that *Ampelisca* beds play is in providing food for juvenile winter flounder. Because juvenile winter flounder are thought to have very small ranges (on the order of 100 m or so), loss of a 36-acre area of *Ampelisca* bed could be deleterious to winter flounder during the project's construction phase. Finfish sampling has not been conducted in the immediate vicinity of Subaqueous B, although it is assumed finfish use is similar to that observed at Subaqueous E (an area of relatively high catches in fall 1994).

As an estuarine species, winter flounder does adapt to periods of high turbidity. Therefore, the dispersion of sediments released during dredged material disposal may have no immediate impact on the distribution of post-juveniles. However, if food resources are destroyed, those lifestages of greater mobility would be likely to move out of the area. If winter flounder spawned in the immediate vicinity of the disposal site, the eggs would potentially be subjected to higher mortality because of elevated sedimentation.It is unlikely that the minor increase in suspended solids would affect either lobsters or lobster fishing. A concentration of 7 mg/L or less would not be visible.

Various recreational activities occur or are planned in the vicinity of Subaqueous B. Pleasure Bay and Spectacle Island are the closest recreational areas to this disposal site. Pleasure

Bay has both a swimming beach and a sailing school. Spectacle Island is planned for general recreation, including swimming, fishing, picnicking and hiking. Disposal activities would be visible from these areas and Castle Island, although no plume would be apparent. Contact with PAHs is a concern for human activities. The most soluble compound, naphthalene, does not have known carcinogenic properties. Because its dissolved concentration is predicted to be < 2.0 ng/L in areas where human contact could occur (e.g. Spectacle Island swimming beach), it is unlikely that any dissolved PAHs would occur at levels of concern. It is unlikely that the disposal activities would interfere or pose any risk to recreational pursuits.

Indirect Impacts - Biological Exposure Potential

Water Column Exposure

Hydrodynamic conditions in the vicinity of Subaqueous B create a dispersive environment, conducive to rapid dilution and transport of water-borne contaminants. Water quality modeling of the material to be disposed indicated that none of the contaminants of concern would reach concentrations within an order of magnitude of the chronic water quality criteria. As ambient water quality in the Outer Harbor has improved substantially since elimination of the Deer Island sewage sludge discharge, it is unlikely that water quality conditions created by disposal of BHNIP silts at Subaqueous B would cause discernible effects in biota exposed in the water column.

Substrate Exposure

Because of the frequency with which disposal activities would take place (one to four times per day), it is unlikely that benthic organisms would be recruited to this disturbed substrate until disposal was complete. In particular, bioassay test results indicate that it is unlikely that *Ampelisca* recruited to the recently disposed sediments could survive. Therefore, there would be little or no opportunity for these infaunal organisms to accumulate contaminants. The absence of infauna, as well as the frequent disposal events, would deter benthic-feeding fish and crustaceans from spending extended periods associated with the disposed dredged material prior to isolation.

As with the In-Channel disposal scenario, the limited downstream areas subject to sedimentation could have a higher potential for exposing demersal organisms to contaminants. The hydrodynamic conditions in the vicinity of Subaqueous B would tend to cause recently deposited (i.e., uncompacted) sediments in downstream areas to become resuspended and redistributed frequently. Coupled with the fact that the size of the site would require that the dredged material be disposed at multiple locations, it is unlikely that dredged silts dispersed beyond the disposal site would build up on the substrate in a particular area. Sedimentation would not be apparent after cessation of disposal and capping of the site.

Organisms inhabiting the areas subject to temporary sedimentation could be impacted by the half-inch layer of vagrant silt. This layer would contain higher concentrations of contaminants than are presently in the proposed disposal area. Areas exposed to this deposition could experience contaminant-induced elevated mortalities of *Ampelisca* if the silt was present for at least several consecutive days. It is unlikely that this material would remain in place for a sufficient length of time to allow bioaccumulation by other infaunal benthic species. Winter flounder foraging in the area could ingest come sediment as they grazed on *Ampelisca.* In addition, their habit of burying themselves in the sediment would increase the likelihood that winter flounder could experience adverse effects caused by dermal contact, if they remained in the areas subjected to repeated sedimentation.

Other Issues

The proposed project should not adversely impact species considered threatened or endangered by the USFWS, NMFS or MANHESP. Several species that are protected under the Federal Marine Mammals Protection Act (e.g. harbor seals, harbor porpoise) occasionally do occur in this area; these also should not be adversely impacted by the Project.

The proposed project should have no effect upon any structure or site of historic, architectural or archeological significance as defined by MHC or the National Historic Preservation Act of 1966, as amended.

The disposal operations of silt material would involve approximately 450 barge trips. This would result in some delays to commercial and recreational boat traffic using the Harbor. Construction activities would have a minor adverse aesthetic impact, and result in slightly elevated noise levels. The proposed project would be unlikely to have a long-term impact on the soft-shell clam fishery in the vicinity of the site.

If filling is to an elevation below the surrounding bathymetry, there would be no permanent impact harmful to the recreational boaters in this area or to commuter boat traffic using this route to Boston's Inner Harbor. The act of placing the material may disrupt boating activity but only to the extent of requiring vessels to travel around the barge placing the sediments.

SUBAQUEOUS E

The proposed disposal site Subaqueous E is located north of the Main Ship Channel and west of Presidents Roads Anchorage. The site is a rectangular area that forms a depression between Governors Island Flats and Lower Middle. Subaqueous berms would have to be constructed along the east and west ends of the site to contain the silts during disposal. It has an estimated maximum capacity of 614,000 cy of silt. Including a cap, the site would be filled to a final depth of -8 ft MLW.

Direct Impacts

Direct impacts associated with use of Subaqueous E would be the same as those described for Subaqueous B. The 79-acre footprint of Subaqueous E supports an abundant and diverse benthic infaunal community, dominated by *Ampelisca* . Reestablishment of this community would be possible, because the final depth is within the range that was observed to support this community in the fall of 1994, but it would be dependent on the quality of the final cap. A clay cap could require an extended period of exposure and colonization by pioneering type species before it was suitable for colonization by later successional stages. A sand cap could be more quickly colonized, depending less on physical reworking than the clay cap. However, because of its exposure to tidal currents and storm wave effects, it could be necessary to armor the cap with rock. As with Subaqueous B, a rocky cap could increase the diversity of productive substrate in the outer harbor.

The reduction in depth at Subaqueous E would be unlikely to have an affect on the quality of the benthic community that could exist. It could affect finfish use because it would diminish the small-scale diversity in bathymetry that presently exists, eliminating a potential cooler water refuge during summer months.

Indirect Impacts - Water Quality Effects

The mixing zone around the disposal process at the Subaqueous E site would be best defined by the area needed to dissipate total suspended solids loads to <50 mg/L. Sediments dissipating from the disposal operations at this location would not commingle with sediments escaping the dredging process. Based on disposal at or around high tide, the necessary mixing zone would occupy about 18.0 acres (355m by 210m) and be oriented towards the mouth of the Outer Harbor.

Pollutant transport modelling indicated that released sediments and dissolved contaminants would be rapidly diluted and dispersed. Maximum concentrations predicted after 29 days of daily disposal are listed in Table A1-18.

Indirect Impacts - Site Stability

Subaqueous E would be developed as one large cell. Therefore, all silt disposed at this site would be exposed to prevailing hydrodynamic conditions until the final cap was placed, a period of about 18 months. As this site is outside of all designated channels, marine traffic is limited to small boats (fishing and recreational vessels) passing through this area in route to the Winthrop Harbor boat ramp and yacht club. These shallow-draft vessels are unlikely to create bottom currents capable of eroding sediments from this site. However, tidal currents at Subaqueous E are estimated to reach up to 2.2 ft/sec (67 cm/sec) on spring ebb tides (slightly lower on flood tides). Although Subaqueous E is located in the lee of Deer Island during northeasterly storms, it is exposed to storms from the east. A one-year storm from this direction could generate bottom currents as high as 0.9 ft/sec (30 cm/sec). Either of these conditions could resuspend and disperse dredged materials disposed at the Subaqueous E site. In fact, these conditions are sufficient to jeopardize the stability of either a sand or clay cap, presenting a long-term risk to the integrity of the disposal site. Therefore, it would be necessary to armor the cap with rock blasted during the dredging of an area at the mouth of Reserved Channel and in the Inner Confluence.

As with other sites described, it is unlikely that contaminants would migrate upwards through the cap. Therefore, since the rock armoring would ensure that the cap stays in place, containing the disposed silts, it is highly unlikely that there would be additional water quality impacts after the site is closed.

Indirect Impacts - Downstream Resources

Resources of concern in the vicinity of Subaqueous E include soft-shell clam beds, *Ampelisca* beds, winter flounder, lobster and recreational fishing. The extensive and highly productive soft-shell clam flats along the shoreline of Governors Island are conditionally open to harvesting (Master Diggers).

The pollutant transport model indicated that most vagrant silt would settle within 80 m of each individual disposal event and reach a maximum thickness of about 0.23 cm (0.6 in). Disposal events centered over about half (32 acres) the area of the site could result in detectable sedimentation outside the defined site footprint. Based on the site configuration, this could affect an area of about 50 acres beyond the footprint of the site. As with Subaqueous B, tidal currents could resuspend this material rapidly and prevent further build up, although, repeated disposal events could introduce sediments frequently enough to cause a temporary reduction in benthic productivity. These deposited sediments would have higher contaminant concentrations than existing sediments.

Impacts to *Ampelisca beds,* winter flounder and lobster would be the same as discussed for Subaqueous B, although, of course, the impacts would occur in the area in the vicinity of Subaqueous E. This area is shown on Appendix IV. It is unlikely that there would be detectable levels of sedimentation on the clam flats.

Presence of the disposal operation may deter recreational fishermen from fishing in the area whether or not there is visual evidence of disposal (i.e., any plume).

Indirect Impacts - Biological Exposure Potential

Water Column Exposure

Like Subaqueous B, hydrodynamics at Subaqueous E create a dispersive environment. Water quality modelling predicted that there would be no excessive buildup of dissolved contaminants. Therefore, it is unlikely that pelagic organisms would be exposed to contaminant levels that would be deleterious to them during disposal operations at Subaqueous E. Water quality at the clam beds would reflect ambient conditions.

Substrate Exposure

As at Subaqueous B, the routine disposal events would tend to preclude colonization of BHNIP silts until the final cap has been put in place. The absence of food resources and the frequent disturbances at the site would be likely to cause finfish and epibenthic crustaceans from spending prolonged periods of time at the site until the site has been closed. Therefore, it is unlikely that organisms would be exposed to the BHNIP silts and their associated contaminants long enough to bioaccumulate contaminants.

Because the transport of resuspended sediments to downstream areas would be less dramatic than the descent of dredged materials at Subaqueous E, organisms would not be likely to avoid these areas. The sediment-bound contaminant loading described for Subaqueous B would also apply to this site. It is unlikely that hydrodynamic conditions would allow the creation of identifiable deposits of BHNIP silts released during disposal operations.

Other Issues

The proposed project should not adversely impact any species considered threatened or endangered by the USFWS, NMFS and MANHESP. Several species that are protected under the Federal Marine Mammals Protection Act (e.g. harbor seals, harbor porpoise) occur occasionally in this area; construction activities should discourage them from frequenting the immediate project site, thus reducing potential impacts.

The proposed project would have no effect upon any structure or site of historic, architectural or archeological significance as defined by MHC or the National Historic Preservation Act of 1966, as amended.

The disposal operations would involve approximately 423 barge trips. This would result in some delays to commercial and recreational boat traffic using the harbor. Construction activities would have a minor adverse aesthetic impact, and result in slightly elevated noise levels. Any fishing (for lobster, etc.) in the immediate disposal area would have to be curtailed during the disposal period.

If filling occurs to the depths of the surrounding area, there will be no permanent impact on marine traffic. However, during the installation of the material, any marine vessels must circumvent this area to minimize interference with the placement operation.

2.6 SITE EVALUATIONS: EXISTING AQUATIC DISPOSAL SITES

2.6.1 Massachusetts Bay Disposal Site (MBDS)

This site is depicted in Figure A1-21.

2.6.1.1 Existing Conditions

SEDIMENT CHARACTERISTICS

The physical properties of the substrate near the disposal point is varying in composition, predominantly sandy silt, reflecting the various harbor dredging projects disposed here. The natural bottom covering the majority of MBDS (i.e. areas of the silt that have not received dredged material) is a fine silt/clay substrate (ACOE NED unpublished data). The composition of this natural material indicates the basin is a depositional area capable of containing the dredged material. If sufficient currents frequented this area of the basin, the fine grained material would be suspended and transported with the currents. Areas of high current velocities would therefore have a coarse grained (heavier than silt/clay) substrate, a substrate that is not typical of this basin, but is present in the shallow (approximately 60 meter deep) northeast quadrant of MBDS. This area is a rock/cobble/sand area, at the 60 meter isopleth relief west of Stellwagen Bank.

The EPA (1989) evaluated the sediment composition of the MBDS in their draft EIS to evaluate the continued use of the MBDS. The results of the metals analysis show that metal concentrations in the MBDS are either Class I (low) or Class II (moderate) according to the Massachusetts Division of Water Pollution Control guidelines for dredged material. In general these results were similar to levels found outside the disposal site in Massachusetts Bay (EPA 1989). Petroleum hydrocarbons were detected at a higher level within the MBDS than outside. However, polyaromatic hydrocarbons, a measure of the aromatic fraction of petroleum hydrocarbons, was more varied inside than outside the disposal site. Polychlorinated biphenyls

(PCBs) levels on dredged material are somewhat higher than ambient levels. PCB levels detected in dredged material in the vicinity of the MBDS are comparable to levels identified in other Massachusetts Bay studies (EPA 1989).

WATER QUALITY AND CIRCULATION

The oceanography of MBDS is influenced, in part, by the circulation of the Gulf of Maine (SAIC 1993). The Gulf of Maine circulation patterns in the vicinity of the MBDS are modified to a large extent by the presence of Stellwagen Bank on the eastern margin of the Massachusetts Bay. The bank interferes with the exchange of water at depth with the Gulf and the shelf beyond. Stellwagen Bank is a popular fishing and whale watching area. This area was designated as a National Marine Sanctuary on November 4, 1992. The MBDS is located outside the boundary of the Stellwagen Bank National Marine Sanctuary.

Results of MBDS oceanographic studies indicate that the site is located in a low energy, deep water environment, allowing containment of dredged material within the site. Physical oceanographic studies conducted by ACOE NED under the Disposal Area Monitoring System (DAMOS) program as well as those by other investigators have shown that the bottom current velocities at the disposal site are quite low, averaging less than 7 cm/s (Butman 1977; Gilbert 1975; SAIC 1987 and SAIC 1993). This is in general agreement with the current data collected for disposal of dredged material at the MBDS from the construction of the CA/T (EA Engineering, Science, and Technology 1992). Occasional higher velocities, near 20 cm/s in a westerly direction, have been observed in near bottom waters in response to easterly storm events that occurred in fall and winter. Near-bottom currents of this magnitude were not predicted to be strong enough to resuspend sediments at MBDS (EPA 1989).

The temperature/salinity cycle of Massachusetts Bay is characterized by seasonal variability, with maximum temperatures (18°C at surface) typically occurring in a stratified water column during August and September, and minimum temperatures (5°C) typically occurring in an essentially isothermal water column in January and February (SAIC 1987). Salinity values range from 31-33 ppt (SAIC 1987).

AQUATIC RESOURCES

Benthic Infauna

Sampling of the benthos at the MBDS (SAIC 1986) described three distinct community assemblages as occurring. These assemblages reflect the various sediment regimes within the site.

The northeast section of the site has an unimpacted coarse sand and gravel composition. The benthic community, when sampled in the fall of 1985, was numerically dominated by the Syllidae polychaete *Exogone verugera profunda* (907/m^2); the Paraonidae polychaete *Levinsenia gracilis* (350/m^2); and the Spionidae polychaete *Prionospio steenstrupi* (313/m^2). A total of 105 species averaging 4,433 organisms per square meter were recovered.

Rock from the CA/T project was deposited in the northern section of the MBDS. The rock was placed away from the main disposal activity to allow a benthic community to develop providing prey for finfish.

The western portion of the MBDS has been impacted by continued disposal of dredged material from the greater Boston region. Approximately three million cubic yards of dredged material has been disposed in this section of MBDS. This continual disturbance of the bottom maintains the community of benthic organisms in a dynamic equilibrium. The most adaptable species proliferate. Those species that reproduce rapidly and have high numbers of offspring (i.e., larvae) colonize the newly disposed dredged material (r-strategists of classical ecology) and biogenically rework the substrate. Given time, this pioneering community would alter the sediment character and allow a more mature community to develop. The frequent disposal activity maintains the resident population of the disposed material area as a pioneering sere. This assemblage at MBDS was dominated (in fall 1986) by oligochaetes (6,293/m^2); the Spionidae polychaete *Spio pettibonae* (4,607/m^2); the Cirratulidae polychaete *Chaetozone setosa* (2,160/m^2); and the Capitellidae polychaete *Metiomastus ambiseta* (1,757/m^2). A total of 78 species averaging 25,467 organisms per square meter were recovered.

The southeastern section of MBDS has an unimpacted silt/clay sediment make-up. The lack of physical disturbance (burial) by disposal of dredged material has allowed a mature benthic assemblage to become established. Interspecific competition within a mature community results in a presence of considerably lower densities of individuals (e.g. 8,390/m^2) than found in continually disturbed habitats (e.g. 25,467/m^2). The undisturbed southeastern section of MBDS was dominated by the Paraonitae polychaete *Levinsenia gracilis* (1,583/m^2); oligochaetes (1,050/m^2); and the Capitellidae polchaete *Mediomastus ambiseta* (693/m^2). The fall 1985 sampling in this section of MBDS recovered a total of 57 species averaging 8,390 individuals per square meter.

The August 1990 bathymetric and REMOTS sediment profile surveys conducted at MBDS confirmed that the dredged material formed a deposit one meter high at the mound center (SAIC 1993). Despite the large amount of material (over 340,000 cubic yards) deposited at the site since November 1988, the REMOTS photography indicate a steady recovery of the benthic ecosystem. This was indicated by a steady increase in Stage III taxa (large burrowing deposit feeders, i.e. climax community) (SAIC 1993).

Finfish

Various finfish species have been collected within the MBDS (SAIC 1986, SAIC 1985, EPA 1989). In the spring of 1985, the spiny dogfish was the dominant finfish recovered. This species migrates seasonally in large schools. Those sampled at MBDS were found to be feeding on flounder, sculpin, and anemones. Fall 1985 finfish collections were dominated by the witch flounder or grey sole and the dab or American plaice. The former was found to be foraging on polychaetes (e.g. *Chaetozone* sp.; *Spio* sp.; *Sternapsis* sp. and *Tharyx* sp.). The latter was found to be foraging on brittle stars (Ophiuroidea). Other important species include redfish, ocean pout, cusk, and Atlantic wolffish. Silver and red hake are abundant, commercially important seasonal migrants.

WETLAND RESOURCES

There are no protectable wetland resources subject to federal or state jurisdiction at MBDS.

WILDLIFE

Approximately 35 species of marine mammals, 5 species of marine turtles and 40 species of seabirds occur within the Gulf of Maine. Aerial surveys were conducted for the ACOE to assess the use of the Massachusetts Bay Disposal Site (MBDS) by marine mammals, reptiles and seabirds (MBO 1987).

Seabirds observed include northern fulmar (*Fulmanus glacialis*), shearwater (*Puffinus* sp.), storm petrels (Hydrobatrae), northern gaument (*Sila bacsaus*), Pomarine jaeger (*Steriovarius pomarinum*), gulls (Larinae) and Alcids (Alcidae). Dominant nonendangered mammals include minke whale (*Belasnoptera acutorostrata*), white-sided dolphin (*Lagenorhynchus acutus*), and harbor porpoise (*Phocena phocena*). Although five species of turtles potentially could occur on Massachusetts Bay, only the leatherback turtle (*Dermochelys coriacea*) is typical in the area.

THREATENED AND ENDANGERED SPECIES

MBDS is located in Massachusetts Bay, an area known to be utilized by various marine mammals, but outside (just west of) the boundaries of the Stellwagen Bank national marine sanctuary. Endangered whale species are known to congregate above the shallow (30 meter) Stellwagen Bank (U.R.I. 1981) when foraging for prey (e.g. sand lance *Ammontytes americanus*). These species also have been observed within the two nautical mile circular boundary of the MBDS. Endangered species identified as transients of MBDS include the finback whale *Balaenoptera physalus*; the sei whale *Balaenoptera borealis*; the humpback whale *Megaptera novaeangliae* and possibly the northern right whale *Eubalaena glacialis* (MBO 1987). The impact of the use of the MBDS on endangered species is currently being assessed by the ACOE NED. Use of the site to date has not indicated any impact to threatened or endangered species. Full coordination with the NMFS ensures compliance with the protection of endangered species and their habitats.

Cetaceans are transients of the disposal site, but are not likely to be to impacted by ocean disposal. Some threatened or endangered turtles (i.e., leatherback, Kemp's ridley and loggerhead) have been recovered in this region as well. If any transient endangered species entered the area during the project operation, they should be able to avoid the dredging or disposal activity. Disposal of dredged material at the MBDS is not expected to have an adverse impact on endangered species, their prey, or the habitat essential for their survival. Consultation with the NMFS under Section 7 of the Endangered Species Act of 1973 (as amended, 16 U.S.C. 1531 et seq), has been initiated to ensure this activity will not jeopardize any endangered or threatened species.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

The MBDS has been used for disposal of dredged material since the 1940's. No historical or archeological resources are expected to occur at the site. Consultation with EPA during the designation of the MBDS with the Massachusetts Board of Underwater Archeology indicated that no known historical shipwrecks exist at or near the site.

SOCIO-ECONOMIC/LAND USE

MBDS is an active disposal site that has been in use for several decades. Extensive shipping, fishing, recreational activities, and scientific investigations take place in Massachusetts Bay year around. There are no known interferences from disposal events on these activities (EPA ROD 1993). In addition, the availability of the MBDS for the vast majority of sediments from Boston Harbor provides an engineering, social, environmental, and economic solution for the disposal of such a large amount of material.

2.6.1.2 Environmental Consequences

SEDIMENT CHARACTERISTICS

MBDS has been extensively studied by the ACOE NED. Precision bathymetry, sediment grab sampling and REMOTS image analysis (sediment profiling) have characterized this site as a low energy environment suitable for dredged material disposal and containment. Additional oceanographic sampling has been conducted to designate MBDS as an ocean dredged material disposal site.

The MBDS is the only U.S. EPA designated dredged material disposal site in the Boston Harbor/Massachusetts Bay area. This site annually receives approximately 300,000 cubic yards of dredged material with the exception of this project. However, this figure is expected to decrease for two reasons. First, more stringent biological testing for open water disposal of dredged material means more material will not be acceptable for open water disposal. In addition, the recent designation of the MBDS by EPA states that no capping of unsuitable material is allowed at the MBDS until it can be demonstrated that capping can isolate unsuitable material from the benthic community. Until this can be demonstrated to the satisfaction of the EPA and other appropriate agencies, capping would not occur. Since much of the silt material dredged from the Boston Harbor area is unsuitable, this site would be used primarily for parent material. The ACOE NED has successfully completed many capping projects in New England and believes capping is a viable option at the MBDS. Although no capping of unsuitable material will occur for the Boston Harbor navigation improvement project at the MBDS, questions raised by EPA about capping are addressed in Appendix F. Future use of the site may be considered if the efficacy of capping can be demonstrated.

Approximately 2.0 million cubic yards of dredged material (parent material) could be disposed at the MBDS. The material dredged from the proposed channels will be placed on barges and transported (approximately 1500 trips) to MBDS. The disposal will occur by bringing the barge to a complete stop at the predescribed point. This disposal point will be marked by a buoy positioned by the ACOE NED. The discharge will occur in approximately 100 meters of water.

WATER QUALITY AND CIRCULATION

A turbidity plume will be created by the disposal of the dredged material. During descent, some of the fine-grained sediment separate from the plume and remain in suspension. The amount of material that is dispersed in the disposal plume is dependent upon the physical characteristics of the sediment, the volume of material disposed, and method of disposal, and typically ranges from 3 to 5% (WES 1986).

Recent studies (SAIC 1985) concluded that the concentration of suspended materials in the turbidity plume, following disposal, will be no greater than 5 to 12 mg/l forty minutes after disposal. These studies were conducted at the MBDS with hydraulically dredged material disposed in 100 meters of water. This method of dredging mixes the sediment with water to form a slurry. The disposal of this mixture represents the maximum possible suspension of material. The bucket dredging technique to be used for this project will maintain the disposal sediments in a cohesive mass, greatly reducing turbidity potentials.

Dredged material which settles on the bottom at MBDS can be expected to remain in place. Near bottom currents are low, averaging less than 7 cm/s (EPA, 1989). Resuspension from storm events is rare and typically results in resuspension of only 4% of the surficial material.

As the material descends through the water column, some of the chemicals adsorbed to the fine particulates may be eluted from the dredged material. The concentration values in the turbidity plume will be considerably less than the bulk chemistry concentrations in the dredged material, since most of the material will remain consolidated. Due to the low natural levels of metals and other chemicals in the clay, the water quality impact, if any, will be contained within the disposal site. EPA determined that water quality impacts from disposal events are temporary and limited to the period immediately following the disposal (EPA 1989).

Recent studies (EPA 1993) for the MWRA offshore outfall impacts evaluated water quality impacts at MBDS from the BHNIP, using the ADDAM's model with input assumptions and data from this study. In that report, EPA found no water quality criteria exceedances outside the mixing zone (disposal site) for the MBDS after four hours.

Physical parameters such as currents, waves, and tidal circulations have been closely monitored for the site (SAIC 1985). This area has contained dredged material on site and does not disperse sediment or chemicals to affect ambient environments. In general, the proposed disposal of an estimated 1.8 million cubic yards of material dredged from the project area will not significantly impact the disposal site given its physical, chemical and biological characteristics and general history of use.

AQUATIC RESOURCES

Benthic Infauna

The disposal site has been used for dredged material disposal for a number of years. Disposing sediments at site buries the organisms inhabiting the impact area. This burial process has been of sufficient frequency at MBDS to maintain a disturbed environment at the point of disposal. A specialized population of benthic species have successfully exploited this disturbed niche and rapidly provide biomass and bioturbation to the newly disposed material. These pioneering organisms are already established on the disposal site (SAIC 1985) and their action can quickly rework the newly deposited sediments. The disposal of dredged sediments would bury non-motile and larval/juvenile organisms at MBDS. The same pioneering species can quickly inhabit the newly disposed material by larval and adult recruitment. The overall process of maintaining a disturbed habitat would provide a productive benthic environment for organisms that rework the substrate. This biological mining of the substrates (bioturbation) homogenizes and oxygenates the upper few centimeters of the sediment. This can allow other organisms to begin inhabiting the substrate (colonization). Larvae settle and metamorphize and adults emigrate into the area, all contributing to restore benthic productivity.

Finfish

Disposal of dredged material will have a temporary impact on finfish at the site. Adverse impacts to individual organisms could occur but are not expected to be substantial considering the mobile nature of fish. Temporary impacts are expected to come from the temporary loss of benthic species for foraging. Due to the already disturbed nature of the site and the quick recolonizing ability of benthic organisms, recovery should occur in the short-term. Any changes in benthic community structure should be localized and, with respect to fisheries resources, have little effect on a baywide basis.

WETLAND RESOURCES

Since there are no regulated federal or state wetland resources associated with MBDS, no impacts will occur.

WILDLIFE

No impacts are anticipated to the existing wildlife at MBDS.

THREATENED AND ENDANGERED SPECIES

Several endangered whale and turtle species can occur in the Massachusetts and Cape Cod Bays. Endangered whale species have been observed within the two nautical mile circular boundary of the MBDS. The impact of the use of the MBDS on endangered species is currently being assessed by ACOE NED. Use of the site to date has not indicated any impact to threatened or endangered species. Full coordination with the NMFS ensures compliance with the protection of endangered species and their habitats.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

No impacts are anticipated, since no historical or archeological resources of record exist at MBDS.

SOCIO-ECONOMIC/LAND USE

Since MBDS is an active dredge material site, no additional impacts are expected to site usage or commerce than may presently exist.

2.6.2 Boston Lightship Disposal Site (BLDS)

The site is depicted on Figure A1-21.

BLDS is a historic area for dumping of various materials (e.g., barrels). Therefore, prior to any disposal of dredge materials at BLDS, surveys to determine where, if any, barrels occur in the disposal site, and hydrographic surveys of the area, are needed to determine if the site is stable. BLDS is an area for which previously collected sidescan sonar records are being analyzed by the United States Geological Survey to map acoustic patterns and related sedimentary environments (Butman et al. 1992).

2.6.2.1 Existing Conditions

SEDIMENT CHARACTERISTICS

Information collected under the DAMOS (1979a) program indicate that the heavy metal content of the sediments collected from the disposal site were among the highest found in the study between the two Massachusetts Bay Disposal sites. Even still, comparison of the sediment chemistry results with the Massachusetts Dredged Material guidelines show that the metal concentration would be classified as Class I (low).

WATER QUALITY AND CIRCULATION

Water quality and circulation conditions at BLDS are presumed to be similar to those at MBDS. Both the MBDS and Boston Lightship are reported to have extremely weak tidal current but could be subject to some wave motion (DAMOS, 1979a).

AQUATIC RESOURCES

Benthic Infauna

A summary of the benthic species collected at BLDS in December of 1977 and May of 1978 indicate a smaller number of individuals and species than at other disposal sites located in the Gulf of Maine (DAMOS 1979b). Dominant benthic species include the polychaetes *Sternapsis scutata, Nepthys incisa, Maldane sarsi, Lumbrineris fragilis, Ninoe nigrippes, Goniada maculata, Ampharete acutifronons*, nemertean worm *Micrura* sp., burrowing anemone *Edwardsia elegans*, and the amphipod *Hippomedon serratus* (DAMOS 1979a).

Mussels (*Modiolus modiolus*) were deployed at BLDS in 1978 to monitor temporal and spatial variations in ambient metal and other chemical concentrations in the sediments (DAMOS 1979b). Results indicated that the mussels at BLDS had metal concentrations which approximated those in animals at Halfway Rock, a reference site. Data indicates that the reference population at Halfway Rock, being closer to terrestrial sources of contamination, is probably exposed to similar or higher concentrations of some trace metals than the mussels held at the disposal site (DAMOS 1979b). However, subsequent samples taken from both the reference and disposal site showed increases of the disposal site concentrations over those of the reference station.

Sediment profile camera sampling at the Boston Lightship revealed a healthy benthic community. Nearly three-quarters of the areas sampled had predominantly fine sand substrate over silt (indicating a depositional environment), with a few areas that were solely sand or silt clay (NAI and Diaz 1995). The depth to the RPD layer was at least 1 cm, indicating sediments were well oxygenated. The sediment surface was diverse, and contained topographic features such as pits, mounds, bedforms, and clasts. Worm tubes were observed on the sediment surface; burrows were occasionally observed at depth. Total abundance of the benthic community was 9,066/m^2, moderately high among the offshore stations (Habitat VII, Table A1-10). The 125 taxa collected in the 8 samples were mainly opportunistic, surface-dwelling polychaetes. The most abundant species, *Spio limicola*, represented 47% of the total abundance. Secondary dominants included *Mediomastus californiensis* (7% of the total abundance) and *Prionospio steenstrupi* (6%). The benthic community at Boston Lightship could be considered to be at a successional stage beyond pioneering but not yet at equilibrium. Monitoring in August 1994 (SAIC 1994) noted a somewhat healthier benthic community, as indicated by deep-dwelling benthic fauna such as holothuroids, which were not collected in the October survey. The remaining stations mainly had fine sand sediments overlying silt with pit and mound topography. The depth of the RPD layer was 1.5-2.5 cm below the sediment surface. Other characteristics were consistent with the majority of the stations. The benthic community had one of the lowest total abundances ($4732.7/m^2$) of all Outer Harbor stations (Habitat VIII, Table A1-10). A total of 76 taxa were collected in the 3 $0.04\text{-}m^2$ samples. *Spio limicola* was the most abundant species, representing 21% of the total abundance.

Finfish

The Massachusetts Bay area is a productive fishery habitat. Fish reported to occur in the area of the disposal site include cod, dab and gray sole, yellowtail flounder, whiting, and Atlantic herring; all are caught near the vicinity of the Boston Lightship and the MBDS (DAMOS 1979a). Lobster and ocean quahogs are also reported in the area.

WETLAND RESOURCES

There are no protectable wetland resources subject to federal or state jurisdiction at BLDS.

WILDLIFE

Wildlife, including great cormorant (*P. carbo*), herring gull (*L. argentatus*), white winged scoter (*M. deglandi*), common goldeneye (*B. clangula*), bufflehead (*B. albeola*), mallard (*A. platyrhynchos*), black duck (*A. Rubripes*), merganser (*Mergus* spp.) and scaup (*Aythya* spp.) are likely to intermittently utilize BLDS for feeding and resting. Each of these species feed on fish and invertebrates (Martin et al. 1951; Whitlatch 1982; DeGraaf and Rudis 1986) that occur in the area.

THREATENED AND ENDANGERED SPECIES

BLDS is located in Massachusetts Bay, an area known to be utilized by various marine mammals, but outside the boundaries of the Stellwagen Bank National Marine Sanctuary. Cetaceans are transients of the disposal site, but are not likely to be impacted by ocean disposal. Endangered whale species are known to congregate above the shallow (30 meter) Stellwagen Bank (U.R.I. 1981) when foraging for prey (e.g., sand lance *Ammontytes americanus*). Endangered species presumed to be transients at BLDS include the finback whale *Balaenoptera physalus*; the sei whale *Balaenoptera borealis*; the humpback whale *Megaptera novaeangliae* and possibly the northern right whale *Eubalaena glacialis* (MBO 1987). Threatened or endangered turtles could transit this area as well. The impact of the use of Boston Lightship on endangered species is currently being assessed by ACOE NED. Boston Lightship is further removed from the prime threatened and endangered species habitat at Stellwagen Bank. Use of the site to date has not indicated any impact to threatened or endangered species. Full coordination with the NMFS ensures compliance with the protection of endangered species and their habitats.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

BLDS has historically been used for disposal of dredged material. No historical or archeological resources are expected to occur at the site.

SOCIO-ECONOMIC/LAND USE

Extensive shipping, fishing, recreational activities, and scientific investigations take place in Massachusetts Bay year round. There are no known interferences from disposal events on these activities (EPA ROD 1993). In addition, the availability of the BLDS for the vast

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majority of sediments from Boston Harbor provides a potential solution for the disposal of large amounts of dredged material.

2.6.2.2 Environmental Consequences

Boston Lightship (BLS) is the only previously-used dredged material disposal site being considered for the disposal of silts from the BHNIP. In addition to disposal of three million cubic yards of dredged materials from Boston Harbor through the 1970s, waste containers containing hazardous and low level radioactive materials, as well as construction debris and sunken vessels, have been dumped at this site. The EPA has conducted, and plans to continue to conduct, investigations on the nature and condition of the chemicals disposed at BLS. The EPA has expressed reservations about the use of this site for disposal of dredged materials until their investigations have been concluded and evaluated. The following analysis is based on the assumption that the conclusion of the EPA's studies will indicate that the material previously dumped at the site would pose no hindrances to future use for disposal of dredged materials. That is, the question of restrictions caused by the existing barrels will be deferred until the evaluation of practicability criteria. The discussion in this section will focus on the suitability of the natural physical and biological environment to support the proposed activity.

The site would require no preparation other than placing a buoy to mark the disposal location. Dredged material (silt) would be disposed from barges directly onto the unmodified substrate. The silt would be capped with parent material.

Direct Impacts

Because this site is in a depositional environment (Knebel 1993), it is expected that the disposed dredged material would settle onto the substrate in a mound. SAIC (1994) identified deposits of dredged materials dating back to at least the 1970s. The benthic resources in the footprint of the mound would be smothered. The existing character of the substrate is predominantly hard sand colonized by a diverse benthic infaunal community. Disposal of silts

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and capping with clay would alter this substrate in a way that, without modification (through biological activity or physical forces), would not be attractive to recruitment of benthic fauna immediately. It could eventually recover to support the same benthic infaunal community that exists now. SAIC (1994) identified extensive recolonization of old dredged material with late successional stage organisms.

Indirect Impacts - Short-term Water Quality Effects

Because Boston Lightship is located outside of state waters, use of the federal definition of the mixing zone (compliance with acute water quality criteria outside the boundary of the mixing zone within four hours of each disposal event) is appropriate for this site. For designated open water disposal sites, under Section 103, the established site boundaries mark the edge of the mixing zone. Sediment disposal simulations for the Boston Lightship site conducted with COE's ADDAM'S model showed that four hours after a 2,000 cy disposal event water quality criteria for copper were not exceeded outside the disposal site's boundaries (Table A1-19). Since this was true for the summer (stratified) condition, it would be safe to assume it would hold for winter (unstratified) conditions as well. Within the site, soluble copper concentrations in the water column were also estimated to be below the chronic water quality criterion. After a four hour period, the total volume of silt within the cloud was estimated to be equivalent to about 3.3% of the initial disposal volume. These results indicate that risks to marine resources would be minimal since water quality criteria would be met after two hours within the disposal site.

Indirect Impacts - Long-Term Water Quality/Site Stability

The typical bottom currents at Boston Lightship are about 0.5 ft/sec (15 cm/sec). These currents are sufficient to keep silt in suspension, although too low to erode consolidated silt. The extent of the hard sand substrate (>70% of the stations examined by Sediment Profile Imagery) at Boston Lightship is indicative of the regularity of this current regime. The water depths (about 50 m) and its location outside of normal shipping lanes make it unlikely that the substrate at Boston Lightship would be affected by vessel traffic.

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The Boston Lightship area faces an unlimited fetch from winds from all directions except west. The water depth is again beneficial in protecting this site from the wind-wave generated bottom currents. A one-year return storm event is estimated to produce nearbottom currents of 1.6 ft/sec (49 cm/sec), more than sufficient to erode unconsolidated silt or consolidated silt with little clay. Because silts disposed at Boston Lightship would be mounded, they would be more readily eroded than if placed in a depression.

Use of the Boston Lightship site would require interim capping in anticipation of wind or storm events that could disturb the bottom.

Indirect Impacts - Downstream Resources

Biological sampling in the fall of 1994 revealed the presence of a diverse benthic community of moderate abundances. Lobster catches were relatively high (lower than the Meisburger sites, but substantially higher than any Boston Harbor locations). Trawl samples (Table A1-4) were dominated by lobsters (59% of the catch) and winter flounder (28% of the catch). Total catch was similar to that in Boston Harbor, although the relative abundance of lobsters was higher in the offshore catch.

The COE estimates that disposal of silt at Boston Lightship would result in the dispersion of about 5% of the material from the site through water column transport. The water depths indicate that it would take less than 5 hours (less than 0.5 tidal cycles) under nonstratified conditions for this vagrant silt to reach the substrate. The area where vagrant silt from an individual disposal event reached the bottom would vary with the tidal stage, but over the course of the project, the silt could be deposited in a concentric circle around the point of disposal. The unconsolidated nature of the silt would make it highly susceptible to resuspension, therefore, it is unlikely that it would be detectable in future monitoring.

It is this area of silt deposition, however, that could be identified as the downstream area of concern. The benthic community observed in the fall of 1994 was composed of a mixture of surface and burrowing species. The surface-dwelling species and sessile suspension and surface deposit-feeders would be more susceptible to the effects of smothering than the burrowing species.

Indirect Impacts - Biological Exposure Potential

Water Column Effects

The depth at which Boston Lightship is located provides a large volume of water to dilute dissolved contaminants and suspended sediments following each disposal event. No constituents are expected to reach concentrations in the water column that exceed the chronic water quality criteria. Therefore, the potential for pelagic organisms to be affected by disposal activities is negligible.

Substrate Effects

While the Boston Lightship area has been used for disposal of dredged material and other material in the past, the extent of contamination in the substrate is not well defined. Because all areas examined in fall 1994 were characterized by granular (sandy) or rocky substrate, it is unlikely that contaminants are widespread, although there may be localized pockets in the vicinity of earlier disposal activities. Creation of a mound of silty material from Boston Harbor would create an approximately 100-acre area of elevated concentrations of organic and inorganic contaminants until it was capped. The frequent disposal activity in the area from the BHNIP would continuously disturb the site, likely preventing colonization by any but the most opportunistic species. Absence of food and frequency of disturbance would tend to deter bottom-feeding fish from lingering on the contaminated sediments.

Should sediments accumulate adjacent to the mound, there would be a greater risk of exposure to demersal finfish. Because accumulation could occur without smothering the benthic organisms, food would continue to be available for bottom-feeders. The potential for ingestion and dermal contact would be higher than on the disposal mound itself. However, the ephemeral nature of this siltation would counteract this potential.

<u>**Other Issues**</u>

Cetaceans may transient the disposal site, but are not likely to be to impacted by ocean disposal. This area is about 9 nautical miles west of the Stellwagen Bank; and thus sufficiently removed from their main area for feeding and congregating so that problems from disposal activities should not occur. Disposal of dredged material at BLDS is not expected to have any substantial adverse impact on endangered species, their prey, or the habitat essential for their survival. Consultation with the NMFS under Section 7 of the Endangered Species Act of 1973 (as amended, 16 U.S.C. 1531 *et seq*), has been initiated to ensure this activity will not jeopardize any endangered or threatened species.

BLDS is in an area deemed "sensitive" by the Board of Underwater Archeological Resources because of the number of shipwrecks that have occurred there over time or because historic disposal sites may contain material of archeological interest. However, discussion with the staff of the Board suggests there may not be resources at the specific disposal site. This will be confirmed by the staff upon review of the Board's files about the proposed sites.

BLDS is an inactive disposal site. Extensive shipping, fishing, recreational activities, and scientific investigations take place in Massachusetts Bay year around. There are no known or anticipated interferences from disposal events at this site except the uncertainty surrounding conditions created by previous disposal of miscellaneous wastes. If these uncertainties can be resolved, the use of the site could provide a solution for the disposal of large amounts of unsuitable material by capping and sequestering the contaminants in the future.

3.0 ENVIRONMENTAL EVALUATION - DREDGING SITES

3.1 OTHER PROJECT CONSIDERATIONS

The majority of the environmental and socio-economic information concerning Boston Harbor, and the areas to be dredged for the navigation improvement project, are discussed in EIR/S Sections 2.0 and 4.0. Therefore, only additional information is covered here.

Besides the navigation improvement project, a 9.5 mile long sewage outfall tunnel is currently being constructed from Deer Island underneath the seafloor into Massachusetts Bay for the MWRA project. Completion of the outfall pipe is expected in 1995. The Third Harbor Tunnel will cross the main ship channel from South Boston to Logan Airport in East Boston. Dredging for the tunnel was completed in 1993. Placement of the tunnel sections for the Third Harbor Tunnel was completed in 1993. In addition, barge traffic will be hauling dredged and excavated materials removed from the Central Artery to Spectacle Island.

Interference between construction of the above two projects and the associated dredging of the navigation improvement project is not expected to occur. Construction of the navigation improvement project is not expected to begin until 1996. No interference with the MWRA project is expected. Barge traffic from this project is expected to be minimal. Potential disposal site locations would not interfere with the construction of the outfall tunnel.

Deepening the Federal channels may involve relocating buried utilities. The deepening in the Chelsea River was limited due to the expense involved with relocating the gas siphon. Utilities that were identified include a powerline running generally down the center of the Reserved Channel, telephone cable across the Inner Confluence, a water tunnel, electrical cable and bridge cables across the lower Chelsea River and two water tunnels, a sewer siphon, a gas siphon, electrical cable and fire alarm cable across the upper Chelsea River. Table A1-20 lists the known utilities and expected depths.

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In most cases, the utilities will be relocated by burying them deeper under the channel. The gas siphon is a special case and will have a protective layer of rip-rap placed over the line rather than actually relocating the siphon.

The deepening of three harbor tributaries will require particular care to avoid damaging utilities crossings. During November 1992 field data were collected using side scan sonar and an array of geophysical instruments which enhanced existing knowledge of buried utilities. While the information obtained does not precisely locate the depth of utilities, it does show either the trench or changes in bottom material densities indicating existence of trench excavation and fill. This information has not been published yet, but some data are currently available.

The berthing areas and bulkheads adjacent to the navigation channels will be investigated to ensure that dredging a deeper channel will not undermine the integrity of the bulkheads. Surveys conducted to date have not revealed evidence of this type of problem.

3.2 DREDGING AREAS - ENVIRONMENTAL RESOURCES

3.2.1 Water Quality

The dominant currents in the harbor are tidal in origin, although wind driven currents occur during storms. Freshwater 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 input is several orders of magnitude greater than freshwater input. Tidal flows average 320,000 cubic foot per second (CFS) for a six hour period with 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). Approximately 73.3 billion gallons are exchanged through three channels linked with the President Roads area and one channel linked with Nantasket Roads. In addition, 265 million gallons per day of waste water is released into the Harbor system from the Boston regional wastewater treatment plant on Deer Island.

The average tidal range in Boston Harbor is 9.5 feet with spring tidal ranges often in excess of 11 feet. Average current velocities for the Inner Harbor are less than 0.5 knots. Tidal currents in other portions of the Harbor vary greatly in speed because of the irregular bottom topography and the large number of islands (Knebel, et.al., 1991). In general, maximum near-bottom current speeds are greatest (> 10 knots) in constricted channels and depressions, are intermediate (3-6 knots) at locations sheltered by islands and points of land, and are weakest (< 3 knots) over the shallow subtidal flats (Bumpus, et.al., 1951; U.S. Coast and Geodetic Survey, 1953; Mencher, et al, 1968; National Ocean Survey, 1977; Signell and Butman, 1990 in Knebel, et.al., 1991). Maximum current velocities during spring tide in the areas to be dredged are as follows: 0.1 knots in the Mystic River, 0.2 knots in the Chelsea Rivers and 0.7 knots in the Main Ship Channel vicinity (N.O.A.A., 1986).

The quality of water in Boston Harbor has been the target of considerable expenditures of Federal, State and private funds. For the most part, raw sewage and untreated industrial discharges are being rectified by the Massachusetts Water Resources Authority (MWRA) under a court order aimed at cleaning-up Boston Harbor. A new primary sewage treatment plant is currently under construction on Deer Island, including relocation of the ocean outfall from the island to nine miles offshore. The construction of the first battery of secondary treatment upgrades is to begin shortly. Disposal of sewage sludge into Boston Harbor ceased in 1992. This has resulted in a rapid and measurable increase in water quality (MWRA, 1993). Water quality is expected to improve further when the secondary treatment facility on Deer Island is in full operation in the year 2000 (MWRA, 1993). The history of contamination from these and other sources in Boston Harbor can be found in the harbor sediments.

Water quality in Boston Harbor has been found to vary both spatially and temporally. The Feasibility Study provided a general seasonal summary of previously available data. A more recent data set for June through October 1985 (MDWPC, 1986 and New England Aquarium, 1990) is also within the ranges listed on this summary.

Barring localized effects around thermal outfalls from power generating stations, the temperature regime in the Harbor is under normal climatic and estuarine controls. The enrichment level in the outer harbor is generally considered to be at a mesotrophic scale without excessive primary production (National Commission on Water Quality, 1976). The inner harbor is also enriched from combined sewer outflows and the high level of nutrients in the river system feeding the harbor.

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Vertically averaged dissolved oxygen levels (MDWPC, 1986) exhibit values ranging as low as 4.5 ppm in the project area. These values represent summer biological activity in conjunction with organic enrichment of the ecosystem. Oxygen depletion is a substantial problem in many estuaries during times of thermal stratification of the water column. The strengthening and deepening of the water column thermocline limits the circulation and oxygen exchange in the nearbottom waters. As temperatures peak (often in August), available dissolved oxygen levels decrease and cause a corresponding depression in biological activity at the sediment water interface. This "August Effect", as it is commonly referenced, is a major environmental factor in structuring biological communities in the project area.

The Massachusetts Water Resources Authority (MWRA) and the New England Aquarium have measured dissolved oxygen throughout Boston Harbor. MWRA (1992) measurements of bottom waters in the Inner Harbor frequently show DO below the standard 5.0 mg/l, with occasional measurements below 2 mg/l. Low oxygen conditions are much rarer in surface waters, and tend to occur in restricted channels with high combined sewer overflows (CSO) input, such as Fort Point Channel and the Reserved Channel (MWRA, 1992). Dissolved oxygen in the Outer Harbor and Dorchester Bay measured by MWRA and the Aquarium monitoring programs are nearly always above the 5 mg/l standard for Class SB waters. The water chemistry of the project area, in particular the organic load and its subsequent chemical oxygen demand, is a substantial factor in the ecology of Boston Harbor.

Salinity data indicate the Outer Harbor is well mixed, while the various regions of the inner harbor are under the influence of freshwater inputs. Essentially, the mouth of the Harbor is considered stenohaline and the Inner and Outer Harbor areas are euryhaline. Oil pollution has created problems in many harbor areas and a permanent oil boom is maintained at the mouth of Chelsea Creek to protect the remainder of the Harbor from potential spills in the main tanker terminal areas.

Coliform bacteria counts have been collected by several agencies for several decades. Bacterial counts have decreased 10 to 100-fold over the past 50 years in the Inner Harbor, near Deer Island, Nut Island, Governors Island, President Roads, Nantasket Roads, Moon Head, and Dorchester Bay (MWRA, 1992). These improvements are related to the construction of treatment plants. Bacterial counts in the Inner Harbor were lower in the 1980s compared to the 1960s. The extreme violations of fecal coliform water quality measured near Deer Island by the New England Aquarium have not been found since 1988, and water quality near Nut Island has been good since 1987. This improvement in offshore bacterial water quality has been associated with more reliable chlorination of the wastewater treatment plants (MWRA, 1992).

Water quality in the Outer Harbor varies greatly. In 1989 and 1990, MWRA sampling showed that Carson Beach, Pleasure Bay and Northern Dorchester Bay generally met water quality standards. Samples taken near Calf Island in the outer harbor were all within swimming standards. Southern Dorchester Bay, at the mouth of the Neponset River, generally showed poorer water quality. This area is affected by the Neponset River, storm drains outflow, CSOs and possibly sludge. Samples collected at Dorchester Bay beaches in 1991 by MDC indicate a decrease in the number of postings at the two beaches in Southern Dorchester Bay: Tenaean and Malibu. The decrease in postings at these areas can probably be attributed to the operation of new disinfection facilities at Fox Point and Commercial Point sewer outfalls.

In Boston Harbor productive clam beds cover about 4,700 acres (Figure A1-22) (MWRA 1992). None of these beds are open for recreational clamming because sewage indicator bacteria counts are too high (MWRA, 1992). About 2,900 acres of clam beds are restricted to harvesting only by "Master Diggers". These licensed diggers must take all clams harvested to a depuration facility, where the shellfish are held in clean water for two days to cleanse themselves of bacteria.

The Massachusetts Division of Marine Fisheries monitors shellfish growing water as well as the clams themselves for bacteriological safety. Some areas of Boston Harbor, especially in Quincy Bay and Hingham Bay, are often conditionally opened, while other areas, like Dorchester Bay, are virtually never open (MWRA, 1992). Clam beds in the Inner Harbor are prohibited from harvest.

Levels of trace metals in the inner harbor have been related to the sewage discharges, CSOs, urban runoff, and the metals contributed by the major rivers. In the Outer Harbor, higher levels of metals have been found around the sewage outfalls. The U.S. Environmental Protection Agency has developed water quality criteria designed to protect aquatic organisms from the adverse effects of environmental contaminants. Boston Harbor generally meets the water quality

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criteria for toxic contaminants (MWRA, 1992). There has been a four-fold decrease in the amount of metals discharged to the Harbor by the MWRA between 1981 and 1991. Results of bioaccumulation studies conducted by MWRA (1992) in 1991 and other studies indicate or suggest that improvements in MWRA discharges are being reflected in improvements in water quality. Although the quality of discharge from MWRA treatment plants is improving, and is expected to improve, various levels and types of contaminants are still released into the aquatic system. These discharges combined with riverine and direct urban runoff represent a degradation of the Boston Harbor water quality.

3.2.2 Sediment Characteristics

General Site Environment

The United States Geological Survey (USGS) currently is conducting studies in Boston Harbor, Massachusetts Bay and Cape Cod Bay to define the geological framework of the region and to understand the transport and accumulation of sediments (Butman, et.al., 1992). One of the goals of the USGS study is to develop a sediment data base. The levels of contaminants vary throughout the Harbor predominantly depending on hydrology and substrate type. In general, metal and organic levels are relatively high in the Inner Harbor and decrease seaward. The surficial sediments represent fine grained material with associated chemicals deposited since the area was last maintained. The results of the chemical sampling reflect the normal sedimentological trends of increased chemical levels with those substrates of higher total organic carbon and silt-clay content (Boehm et al. 1984). The Mystic River (sampling stations A and B) exhibited the highest contaminant levels and was also the most recently dredged. The material accumulated at these stations represents the highest levels in the harbor, apparently derived from the Mystic River drainage area. In contrast, the least contaminated material in the harbor is also found in the Mystic River at Station C. This station is typical of the pristine lean clay layer of the deeper sediments without deposition of a recent silt/clay overburden.

An acoustic impedance survey of the Federal channels to be dredged was performed by ACOE in November 1992. This survey was conducted to locate and determine the amount of silt (maintenance layer), clay, and rock. This survey was also used to assist in locating utilities.

The surface sediments in the federal channels and the berth areas are subject to resuspension during virtually every ship passage. Appendix G presents an estimate of the bottom velocities that are generated by the various types of cargo vessels and tugs that operate in Boston Harbor. Silt, the predominant grain-size of the surface sediments, can be resuspended by currents as slow as 0.2 m/s. Bottom velocities generated by cargo vessels passing at slow speeds through the harbor (according to the traffic patterns described in the Shiphandling Simulation Study provided in the DEIR/S) can exceed this value up to 400 m astern of the vessel. Tugs can generate bottom velocities above this value up to 200 m astern. These velocities dissipate rapidly as the vessels traverse the channel. Sediments resuspended by these currents settle back to the substrate after being transported relatively short distances. Turning areas are particularly susceptible to this influence. Portions of the confluence of the Mystic River, Chelsea River and Main Ship Channel showed evidence of scour in the acoustic impedance study; parent material is exposed in these areas.

Upland Disposal Testing

The Massachusetts Department of Environmental Protection requires information on additional parameters (total petroleum hydrocarbons) and toxic characteristic leaching procedure (TCLP) in order to evaluate the suitability of dredged material for upland disposal. Chemical testing was also performed for sodium and chlorides at the request of the interagency work group members and because both sodium and chloride can have an impact on ground water if the sediment is disposed of upland and leaching occurs (at unlined sites).

The averages for total petroleum hydrocarbon (TPH) concentrations and Total Organic Carbon (TOC) for all sites tested are presented in Table A1-21. The highest average concentrations of TPH was found at the Mystic Pier 1 site and the lowest average concentration of TPH was found at the Conley 11-13 site. The highest average concentration of TOC occurred at Edison Barge Intake and Edison Barge Berth (13.0% and 10.2% respectively) and the lowest average concentration of TOC occurred at the Gulf Oil site (1.7%).

Toxic Characteristic Leaching Procedure (TCLP)

If the bulk chemical concentration in the sediment tested equaled or exceeded the Massachusetts Department of Environment bulk soil concentration for TCLP analysis, then there is a mathematical chance that the TCLP test could exceed threshold limits. In order to know if the parameter of interest would exceed the EPA regulatory limit, a TCLP test must be performed in order to verify if the sediment has hazardous characteristics. Only chromium and lead exceeded the mathematical thresholds for requiring TCLP analysis. Table A1-22 is a summary of the Massachusetts DEP Bulk Soil Concentration limits along with the lead and chromium bulk and TCLP concentrations in relation to the regulatory limits. In all cases the TCLP results were orders of magnitude below the regulatory levels. Therefore, none of the sediments to be dredged in Boston Harbor show hazardous characteristics.

Table A1-23 shows the concentration of sodium and chloride found at each site tested. The highest concentration of sodium occurred at Eastern Minerals (40140 mg/kg) and the Mystic Piers had the highest percent of chloride (2.0%).

3.2.3 Biological Resources

In July and November 1986 benthic biological sampling was conducted at thirteen (13) stations in the proposed dredging area. Finfish samples and water column parameters were also obtained at various locations. In general, the benthic population in Boston Harbor is described below, based on results from thirteen (13) stations randomly located throughout the project area and sampled in two seasons. The sampling program used a 0.04m Van Veen grab and screened samples through a 0.5mm sieve. Additional details can be found in the 1988 Environmental Assessment.

All three tributaries of the Boston Harbor navigation improvement project contained on average a high number of organisms per square meter (4,798; S.D. = 8623.2) in July. The average number of species recovered in July was eight (S.D. = 8.4). The dominant organisms were the polychaetes *Capitella capitata* (54.8 %, S.D. = 28.3); *Polydora ligni* (15.3%, S.D. = 7.1); and *Polydora aggregata* (12.3%, S.D. = 11.7).

The Inner Harbor rivers and the Reserved Channel undergo remarkable reductions in densities between seasons. Theoretically, a population can rebound from nearly an azoic state (induced by low dissolved oxygen levels) through adult recruitment. Between July and November, a statistically significant ($p < 0.005$) reduction in benthic population densities and diversity occurred. The November population contained on average a much lower number (29; S.D. = 71.5) of organisms per square meter and number of species (0.4; S.D. = 0.7). The dominant organisms were the polychaetes *Polydora ligni* (20.0%; S.D. = 11.5); *Streblospio benedicti* (17.9%, S.D. = 16.8); the sand shrimp *Crangon septemspinosa* (11.0%, S.D. = 19.0); and the amphipod crustacean *Ampelisca abdita* (6.7%, S.D. = 11.5).

This tremendous reduction in benthic productivity is not uncommon in urban estuaries where the cumulative effects of high organic load, vessel wakes, increasing water temperature, reduced wind mixing, and increased water column stratification combine with microbial activities that peak in late summer to reduce dissolved oxygen levels. The dissolved oxygen stress is often severe enough to eliminate non-motile benthic populations -- the so-called "August effect".

Given the cyclic (annual) nature of low dissolved oxygen levels in Boston Harbor, the benthic inhabitants are well adjusted to colonizing and recolonizing azoic substrates annually. This type of pioneering species assemblage can be expected quickly to recolonize a dredged area with minimal disruption in benthic productivity.

The polychaetes *Capitella capitata* and *Streblospio benedicti* are the dominant benthic organisms present in the project area. Both of these species are tolerant of physical and chemical stresses that are characteristic of urban harbors such as Boston. Each of these species are "r - strategists," i.e. species whose life history is characterized by small body size, short generation times and high reproduction (r) rate (Grassle and Grassle, 1984). *Capitella capitata* has shown generation times as short as three weeks (Tenore and Chesney, 1985). These life history attributes allow the proliferation of this species within the project area on a cyclic basis. High densities of *Capitella capitata* were found in July but not in November. This cycle of proliferation and die-off keeps the benthic population in a state of dynamic equilibrium. Project areas which were azoic in both sampling periods may have a sufficient additional stress of sulphidic or petroleum compounds accumulating in the substrate so that it is intolerable to even these species (James and Gibson, 1980). This cycle of recolonization by the benthos can be expected to allow rapid biogenic reworking and recolonization of the newly exposed clay layers in the post dredging phase.

The soft shelled clam *Mya arenaria* is the most common commercial shellfish within the Boston Harbor area (Figure A1-22). Blue mussels *Mytilus edulis* and duck clams *Macoma balthica* are also found in shellfish beds but are not harvested. Densities of shellfish beds have been documented by Jerome et al. (1966), Chesmore et al, (1971) and Iwanowicz et al. (1973) and these data can be referred to for detailed information.

As described in the previous section, waters overlying the shellfish beds are contaminated by wastes from sewage outfalls, resulting in the presence of coliform bacteria in the shellfish. The beds are under the jurisdiction of Massachusetts Department of Environmental Protection and are closed to commercial and noncommercial harvesting, except by Master Diggers who must have the clams depurated at a purification plant.

Most of the productive soft shelled clam beds near the proposed dredging project are closed except for restricted areas near Logan Airport and a seasonal area in Pleasure Bay, the latter located immediately southwest of Castle Island. Logan Airport beds are one nautical mile north of President Roads and the beds at Pleasure Island are about two nautical miles west of President Roads. Shellfish beds open to Master Diggers are predominantly within the lower bays and are distant from the shipping channels and project areas.

The limited amount of lobstering within the Boston area takes place primarily in Quincy, Dorchester, and Hingham Bays. Lobstering is minimal or nonexistent in the areas to be primarily affected by the proposed work.

Fisheries resources of the Inner and Outer Harbors have been inventoried by previous studies. These studies include the MES (1972, 1972 a, b, c; 1973; 1976 a, b; 1977 a, b) and

Haedrich and Haedrich (1974) studies which developed information in the Lower Mystic River. Data in the Outer Harbor were developed by Jerome et al. (1966), Chesmore et al. (1971) and Iwanowicz et al. (1973).

The studies on the lower Mystic River were concentrated in the area between Amelia Earhart Dam and the Mystic River (Tobin) Bridge. Haedrich and Haedrich (1974) found that the seasonal species composition was similar to other northeast harbor communities. Winter flounder, smelt and alewives are found in the river throughout the year and are, therefore, considered residents. Ocean pout and blueback herring are summer residents, whereas sea herring is considered a winter resident. With the exception of ocean pout, these residents were identified in the 1986 NED biological sampling effort.

In fall 1994 finfish were sampled in the Mystic River, Chelsea River and Inner Confluence using an otter trawl. Results are presented in Table A1-4. Winter flounder was the most abundant species collected in each area.

Finfish sampling identified anadromous finfish, resident finfish and lobster as occurring in the project area. In a recent report by the National Oceanic and Atmospheric Administration (N.O.A.A. 1984), anadromous finfish species were identified as being of special concern in the project area.

Information on spawning species, numbers and quality of spawn and their significance to regional resources is imprecise and sketchy. Since the principal streams discharging into the Inner Harbor rivers have dams located on them, tidal spawns of smelt and alewives are unlikely. In addition, it is not known if winter flounder use Boston's Inner Harbor for spawning as well as an area of local feeding. From the habits of these fish and from their behavior in the Mystic River channel area, they appear to stay in particular resident areas within the Inner and Outer harbors. Larval contribution to the eventual recruitment of these fish in other areas is not known.

In summary, a spring/summer movement of anadromous finfish occurs through the project area as they move into spawning (freshwater) tributaries. Lobsters and flounder are generally in the Outer Harbor (areas of high productivity) preferring cool waters. In summer, as water temperatures rise, productivity in benthic habitats sharply decline in response to low

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dissolved oxygen in the near bottom water column, restricting fauna to the Outer Harbor (Main Ship Channel) areas. By fall, the Inner Harbor has juvenile flounder feeding on sand shrimp while waters are cooling toward winter spawning temperatures. In winter, finfish, except for the cold water spawning flounder, and lobster move offshore as harbor water temperatures decrease. This fall/winter water cooling allows a balance of the oxygen depletion that occurred in the warmer seasons. High organic load freshwater inputs and warming water temperatures initiate the complex cycle in the spring.

Offshore and longshore areas of the Harbor were trawled for finfish in the studies done by the Massachusetts Division of Marine Fisheries. Atlantic silverside, mummichog and Atlantic tomcod were the predominant species found in the longshore trawls. Some of the offshore sampling sites yielded high densities of winter flounder, Atlantic tomcod, fourspine stickleback, and rainbow smelt. The highest densities of finfish were taken during the months of September and October, with Atlantic silverside and winter flounder the predominant species. The densities of finfish dropped during the winter months of December through March as the fish moved offshore to winter feeding grounds.

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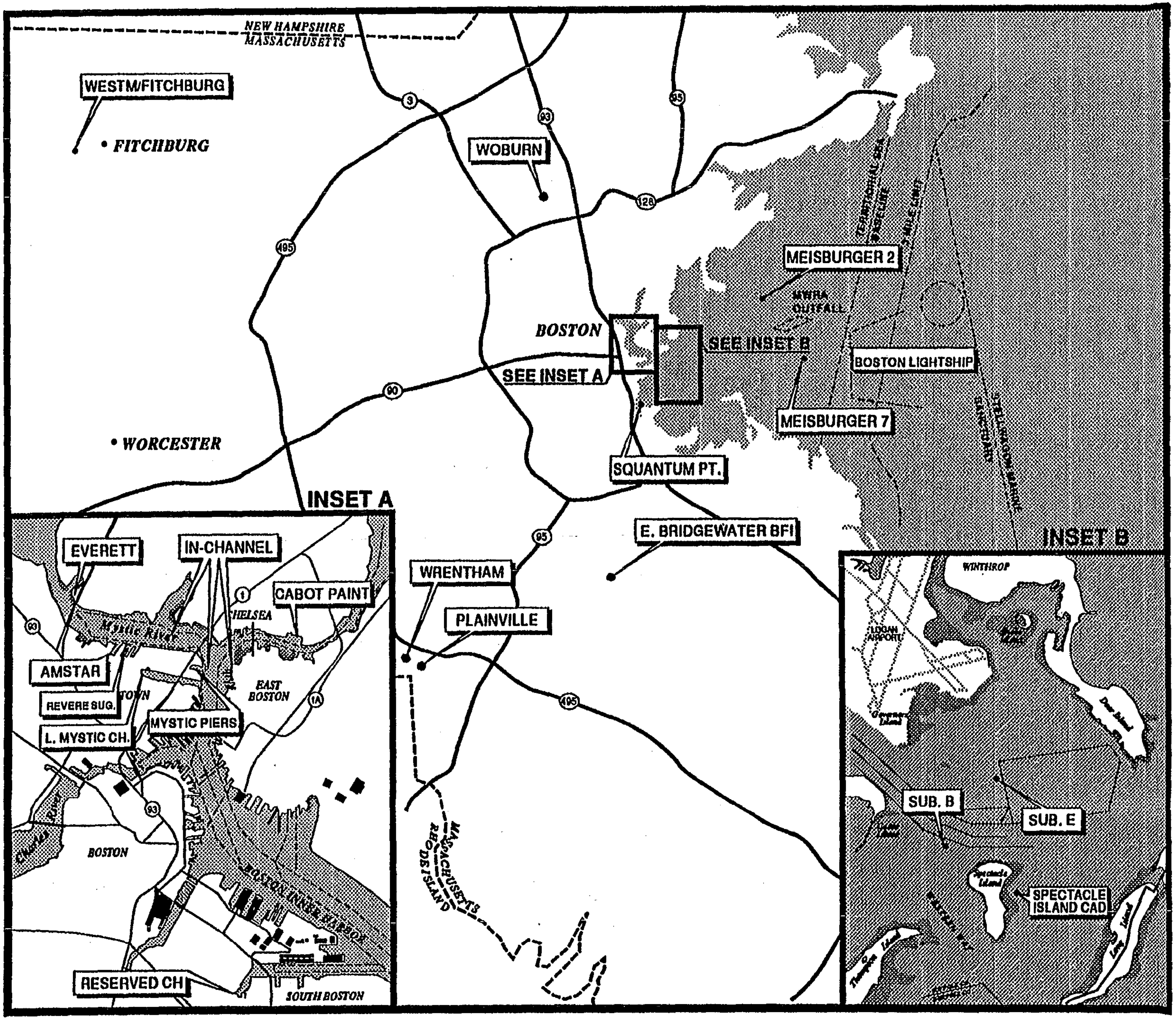

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Boston Harbor Dredging Project EIR/S

Figure A-1. Locations of short-listed sites.

Scale: 0 10

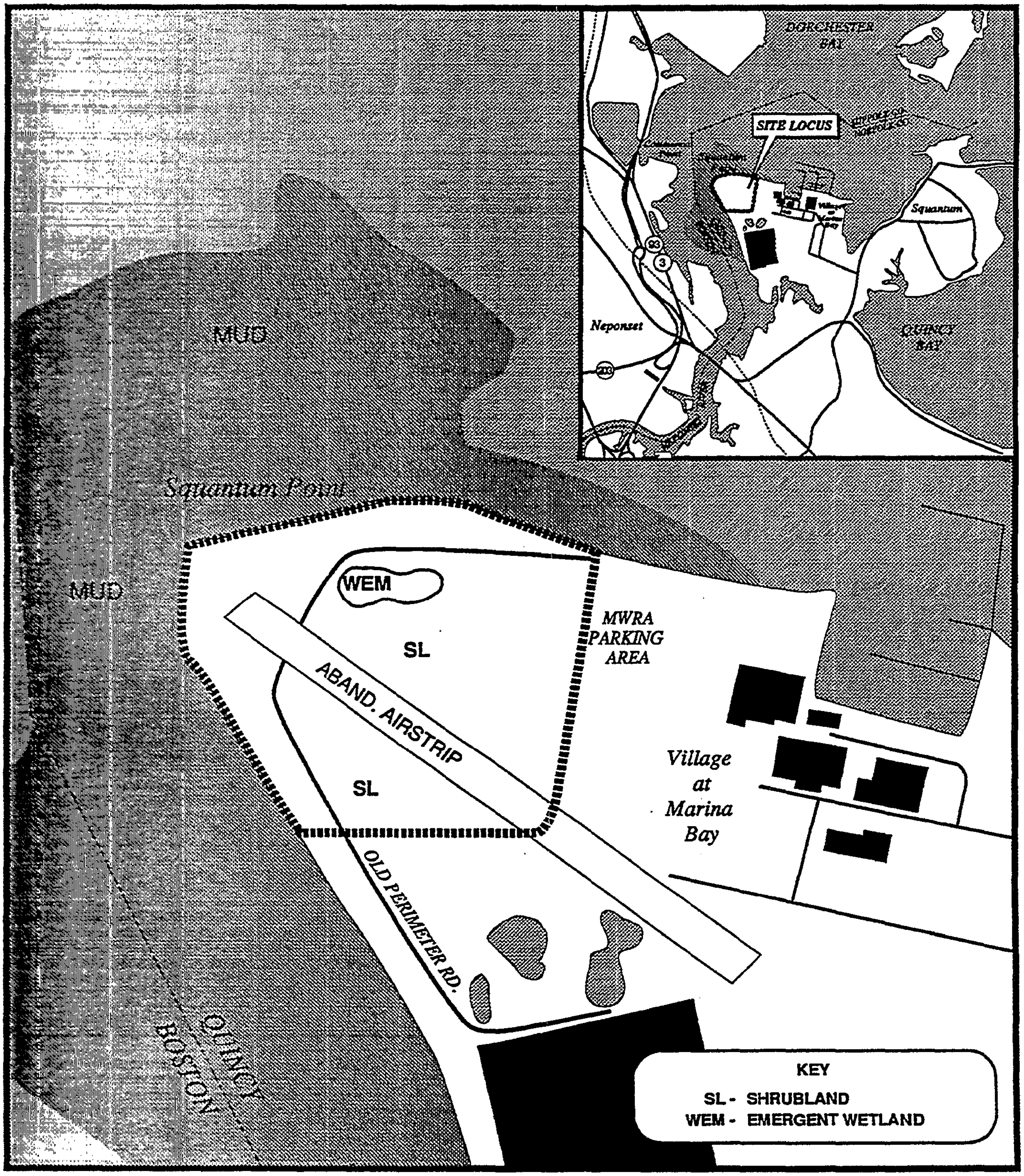
Approx. Scale in Miles

Source:

USGS Quadrangles
Revised by NAI to reflect pertinent site conditions.

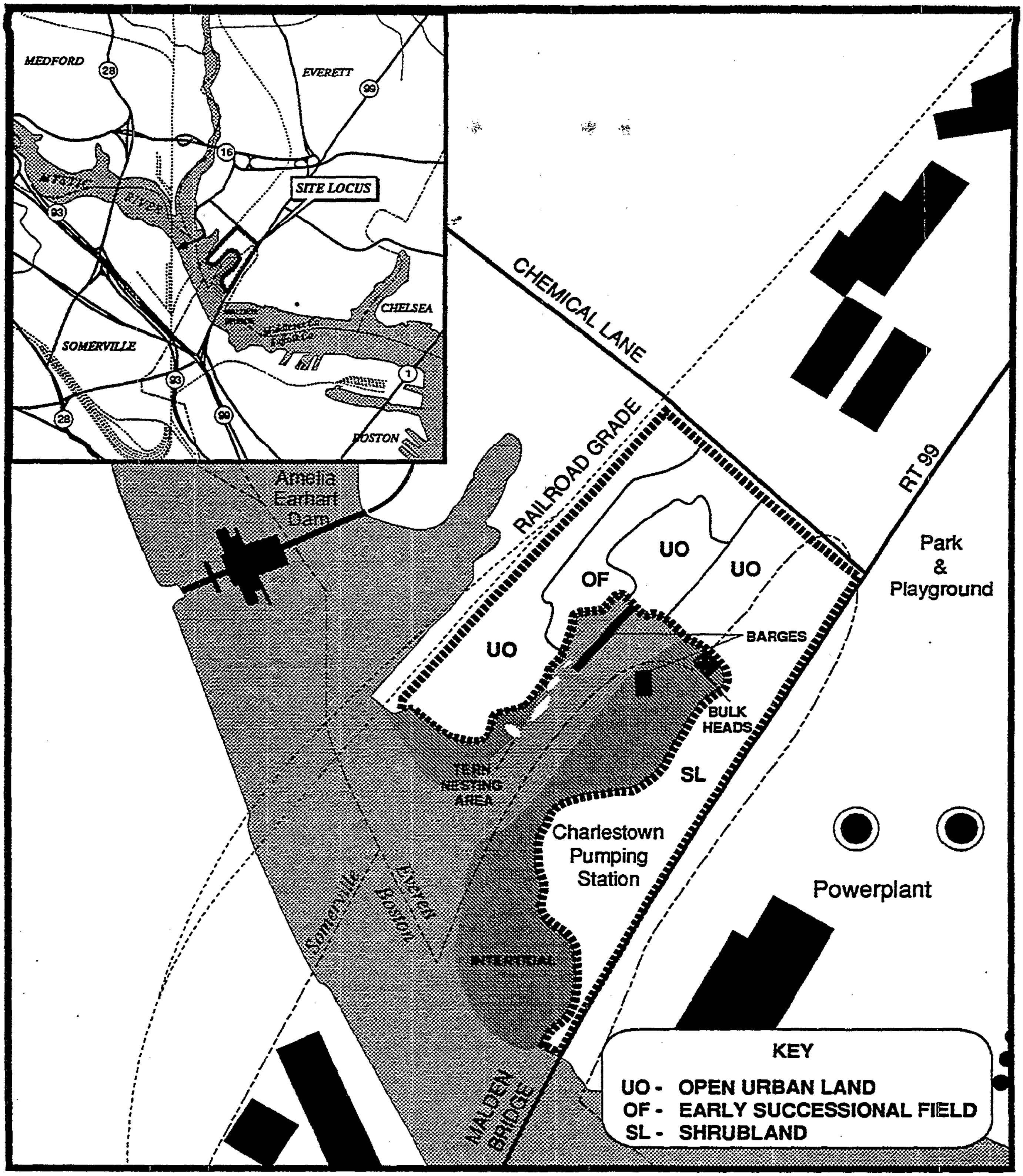
A1-199

593

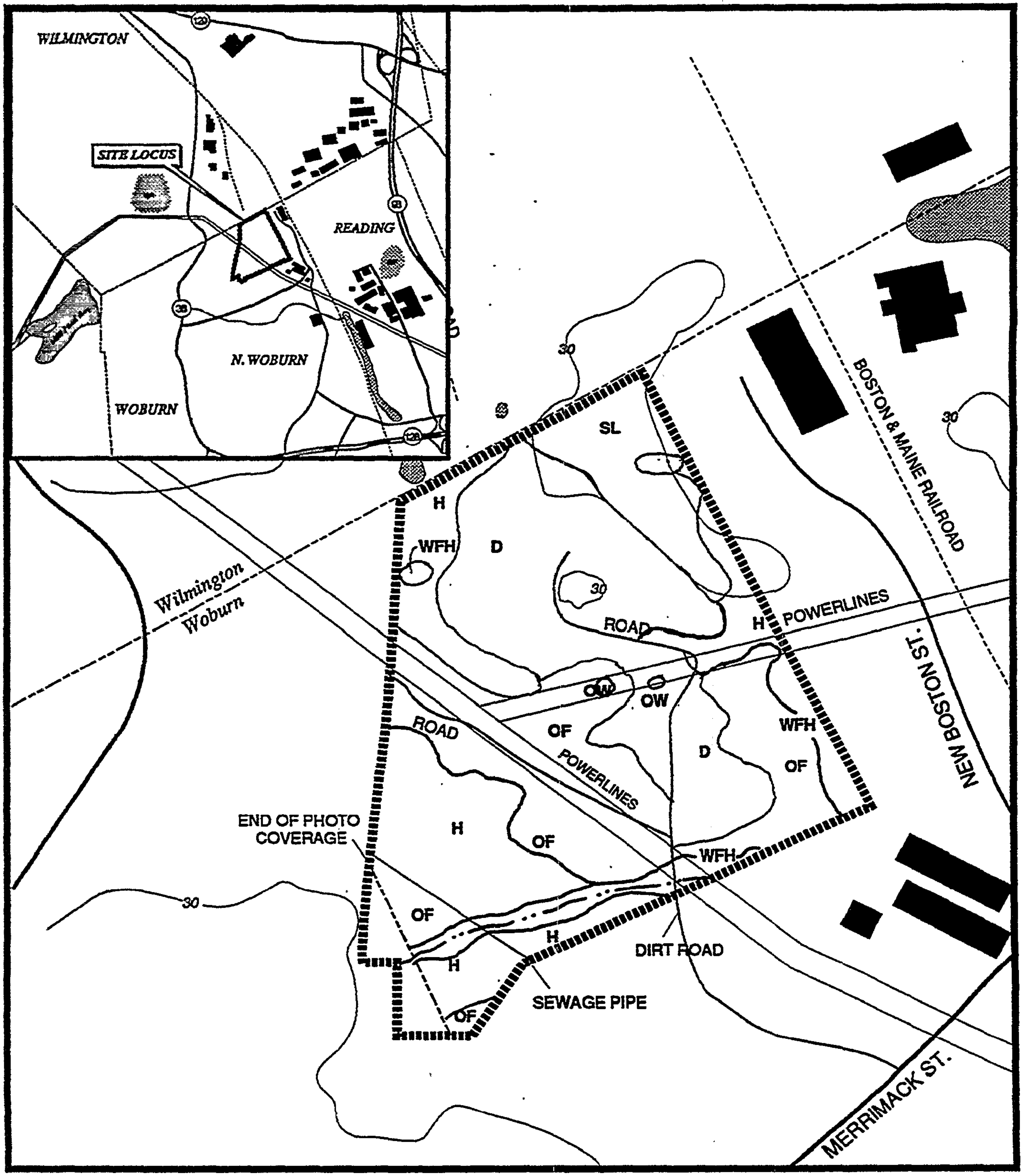


Boston Harbor Dredging Project EIR/S	Figure A1-2. Site map for potential disposal site, Quincy-03 (Squantum Point).
N *Scale:* 0 100 200 *Scale in Meters*	*Source:* USGS Quadrangle Boston South, MA, 1987 Revised by NAI to Reflect Pertinent Site Conditions

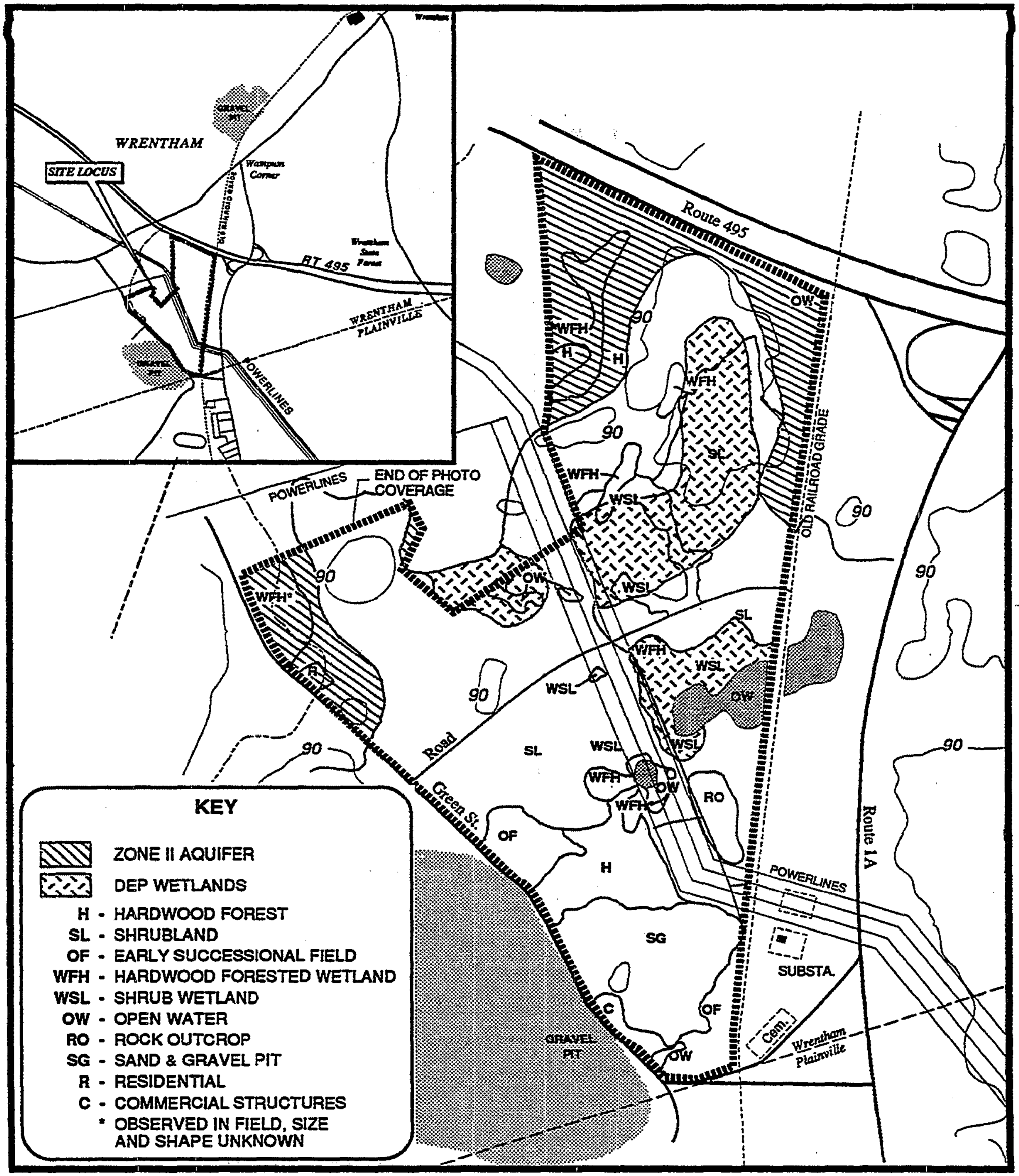
A1-200



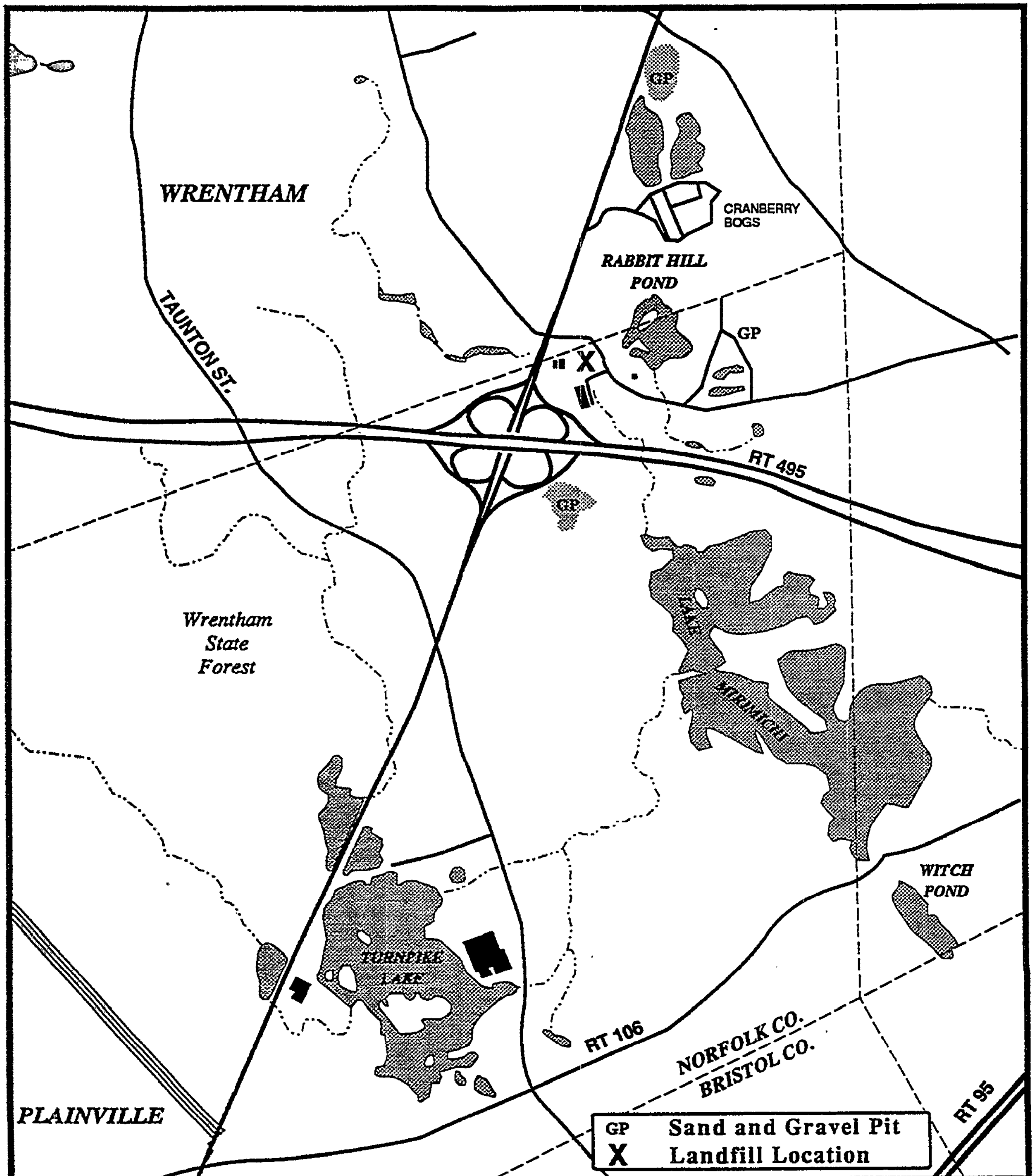
Boston Harbor Dredging Project EIR/S		Figure A1-3. Site map for potential disposal site, Everett.
N	*Scale:* 0 100 200 *Scale in Meters*	*Source:* USGS Quadrangle North Boston, MA, 1985 Revised by NAI to Reflect Pertinent Site Conditions



Boston Harbor Dredging Project EIR/S	Figure A1-4. Site map for potential disposal site, Woburn-11.
N — *Scale:* 0 100 200 *Scale in Meters*	*Source:* USGS Quadrangle Reading, MA, 1987 Revised by NAI to reflect pertinent site conditions



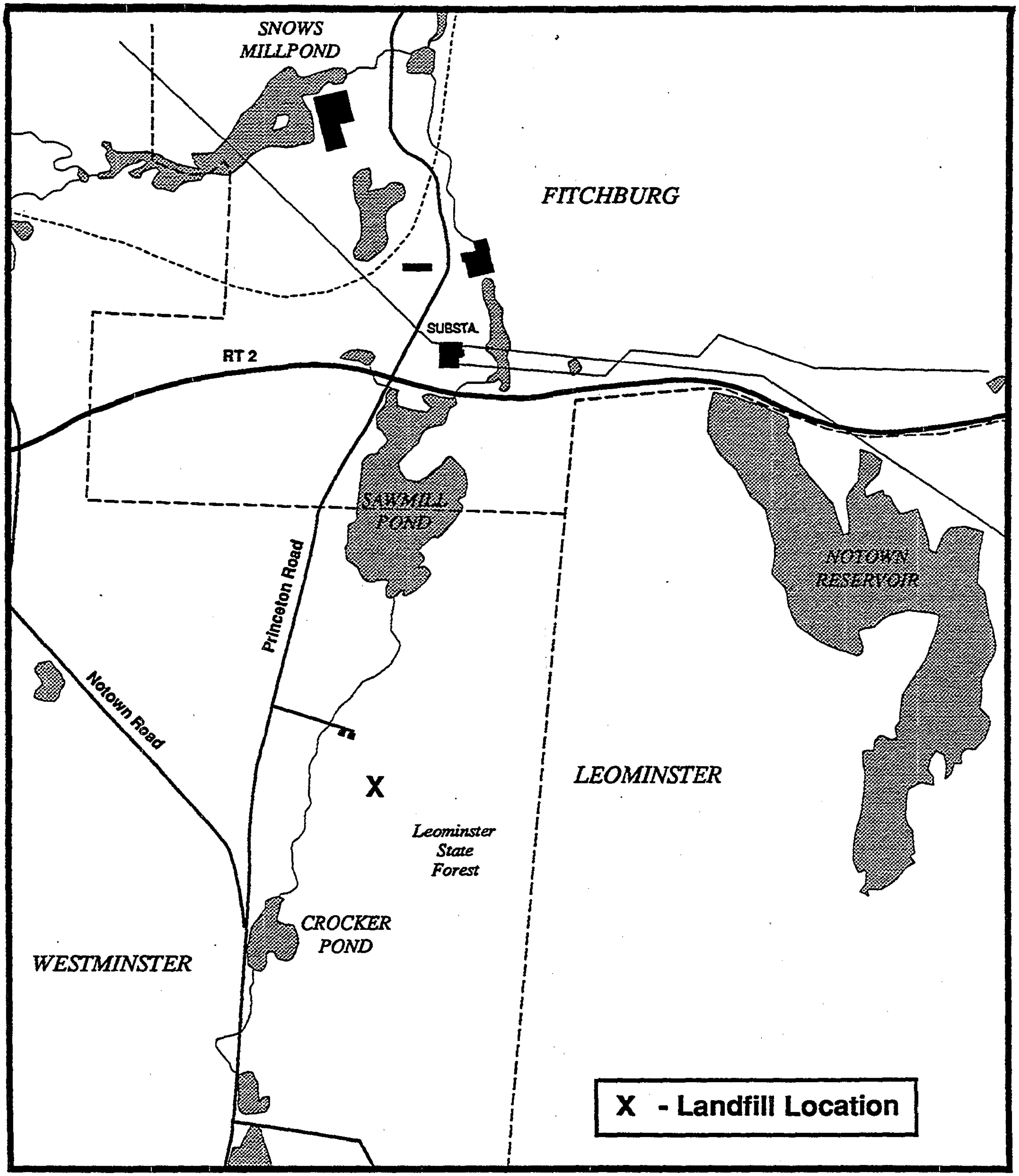
Boston Harbor Dredging Project EIR/S	Figure A1-5. Site map for potential disposal site, Wrentham-495.
N — *Scale:* 0 100 200 *Scale in Meters*	*Source:* USGS Quadrangle Franklin, MA 1987 Revised by NAI to reflect pertinent site conditions.



Boston Harbor Dredging Project EIR/S	Figure A1-6. Site map for the Plainville Landfill site.
N — *Scale:* 0 1000 2000 *Scale in Feet*	*Source:* USGS Quadrangle Franklin, MA 1987 Revised by NAI to reflect pertinent site conditions.

A1-204

598

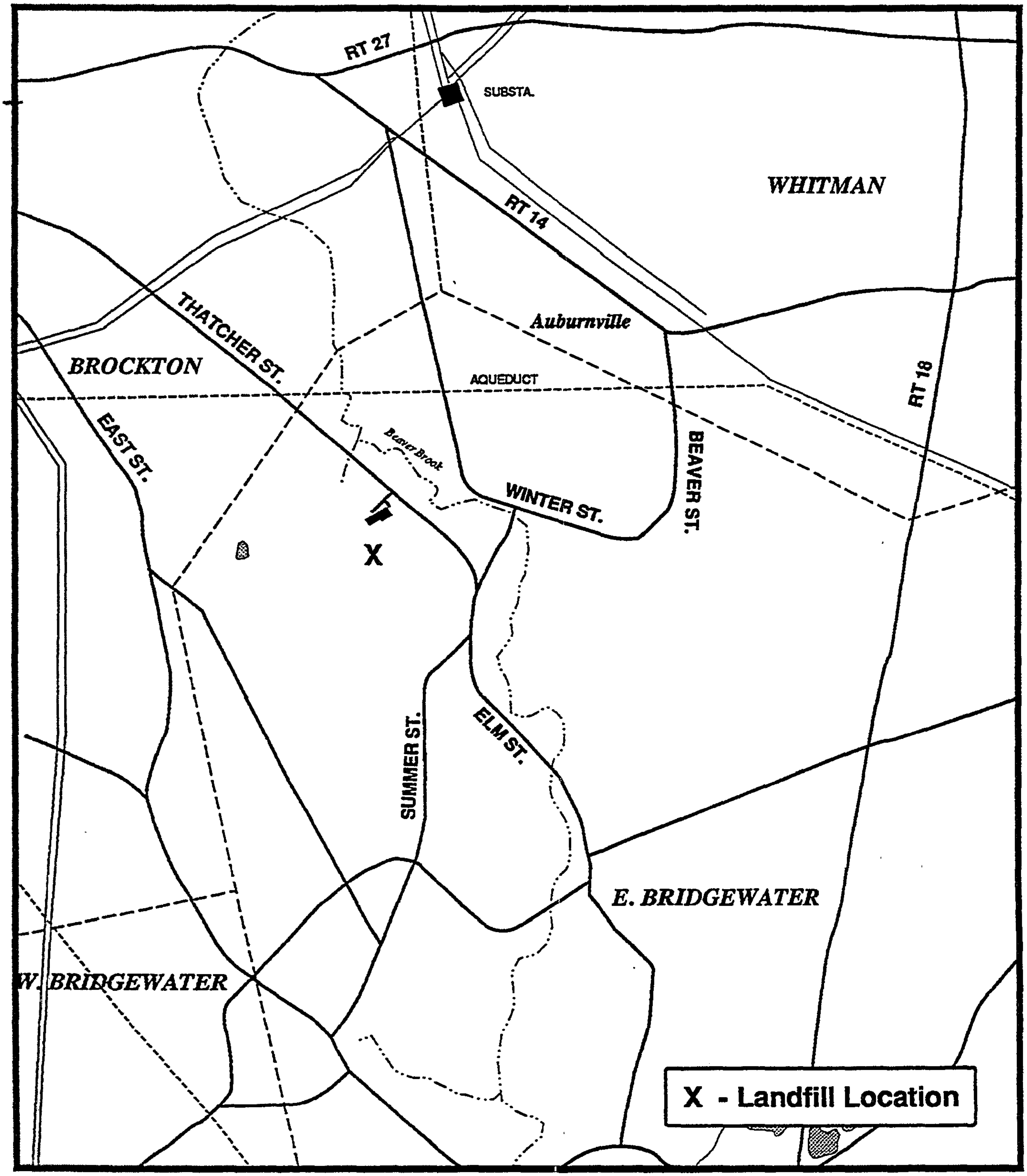


Boston Harbor Dredging Project EIR/S

Figure A1-7. Site map for the Fitchburg/ Westminster Landfill site.

Scale: 0 1000 2000 *Scale in Feet*

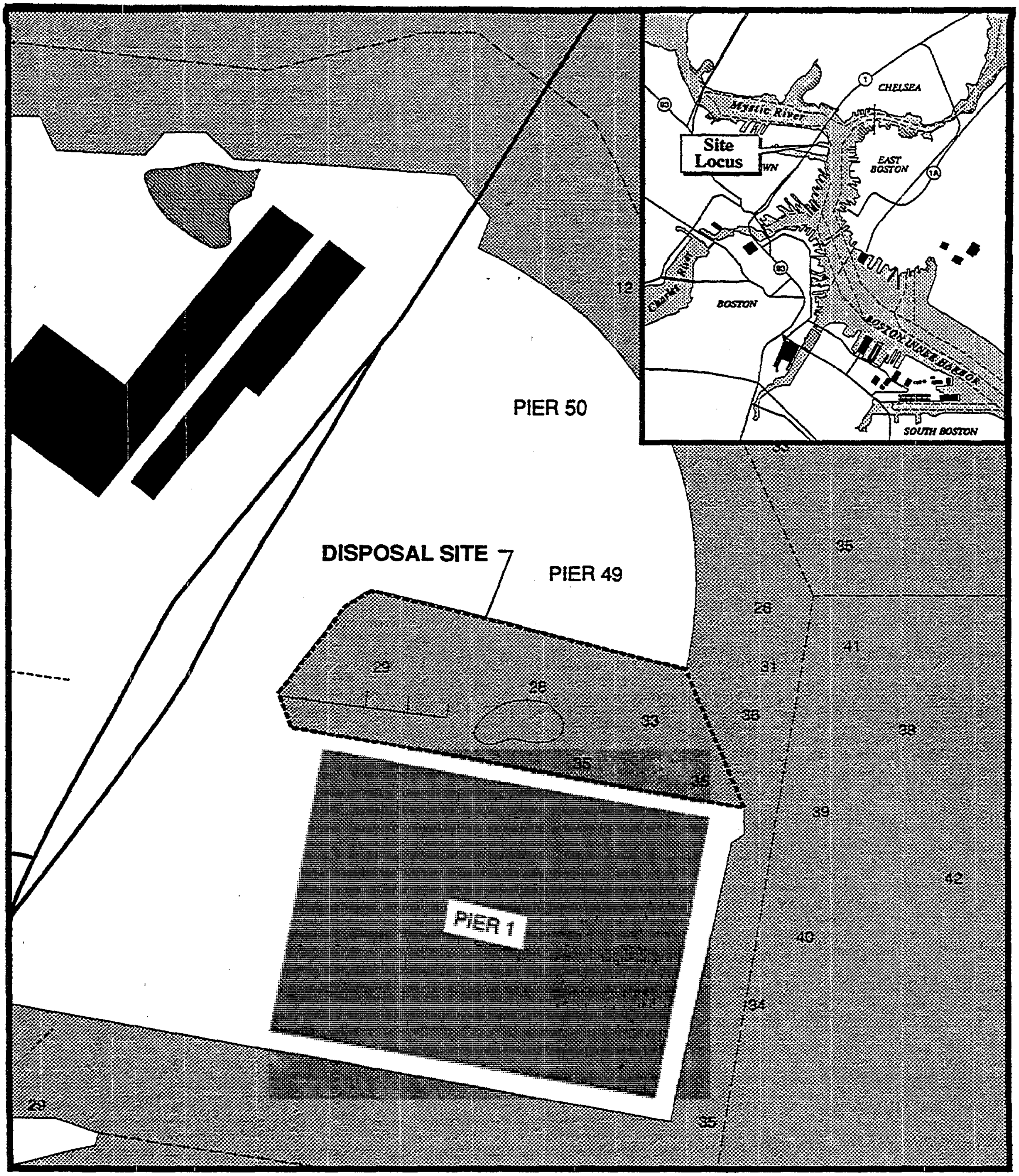
Source:
USGS Quadrangle Fitchburg, MA 1988
Revised by NAI to reflect pertinent site conditions.



Boston Harbor Dredging Project EIR/S		Figure A1-8. Site map for BFI Northern Disposal Inc. (E. Bridgewater) Landfill site.
N	*Scale:* 0 1000 2000 *Scale in Feet*	*Source:* USGS Quadrangle Whitman, MA 1977 Revised by NAI to reflect pertinent site conditions.

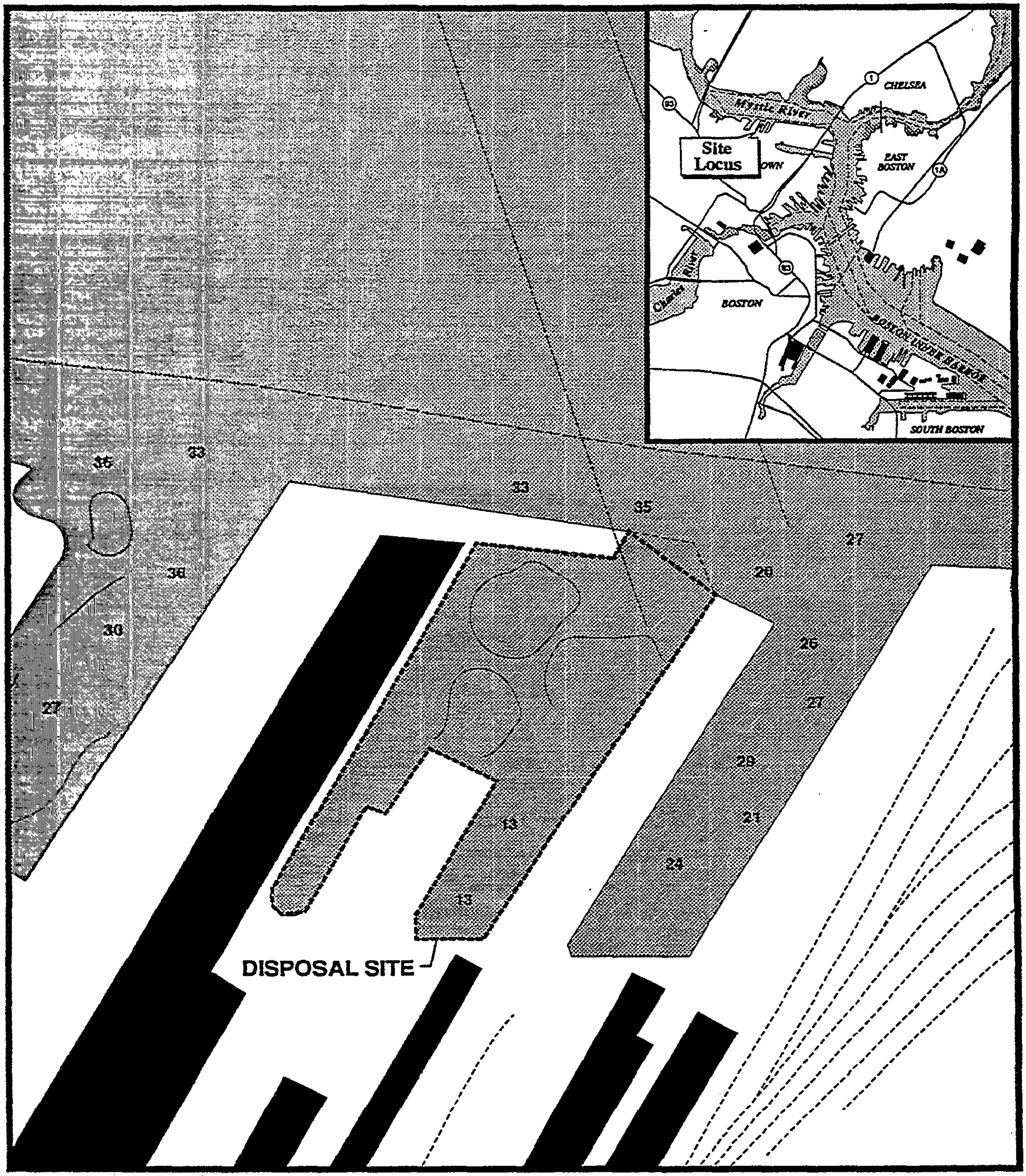
A1-206

600

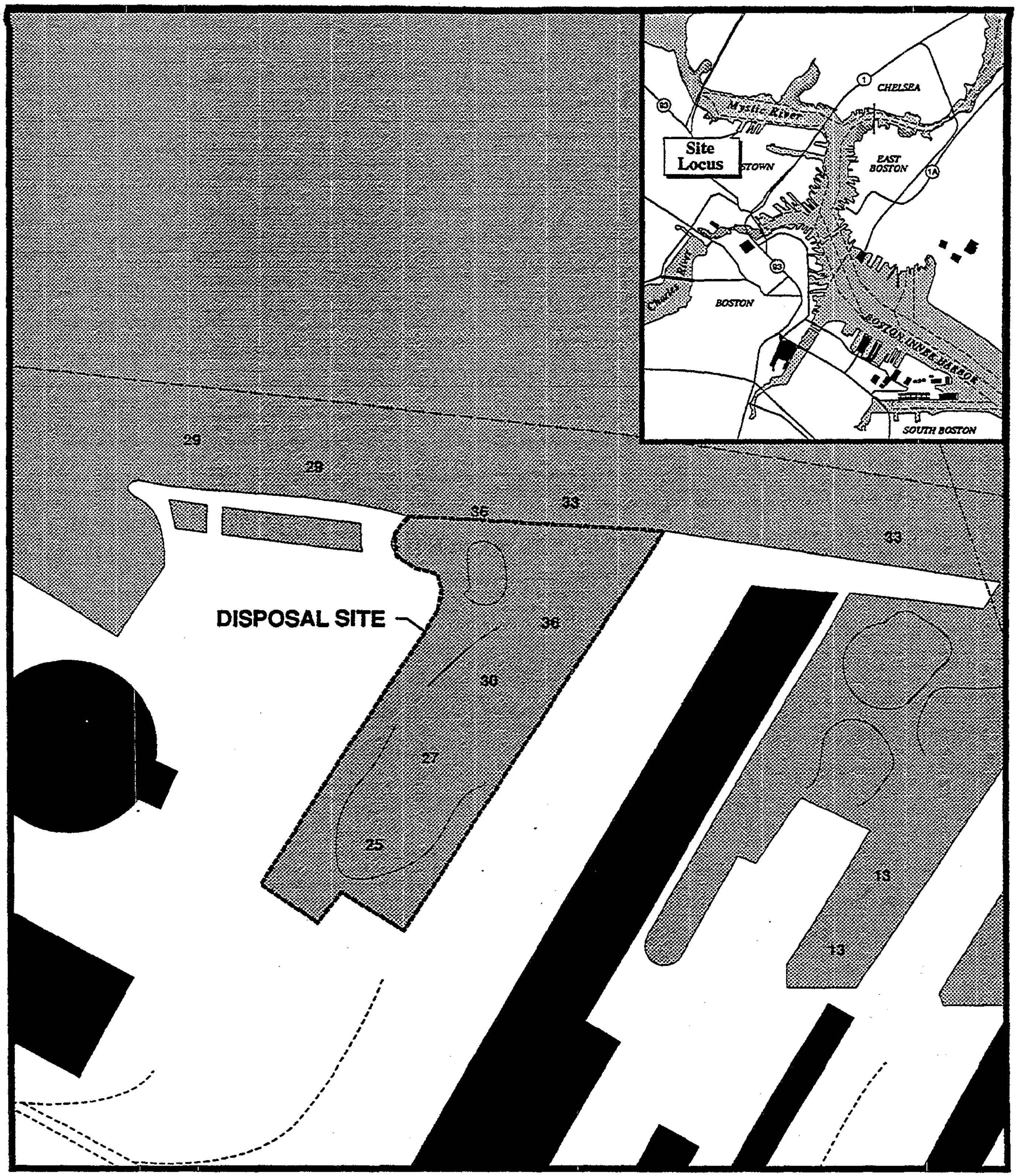


Boston Harbor Dredging Project EIR/S	Figure A1-9. Site map for Mystic Piers site
N — *Scale:* 0 50 100 *Scale in Yards*	*Source:* Boston Harbor Navigation Chart

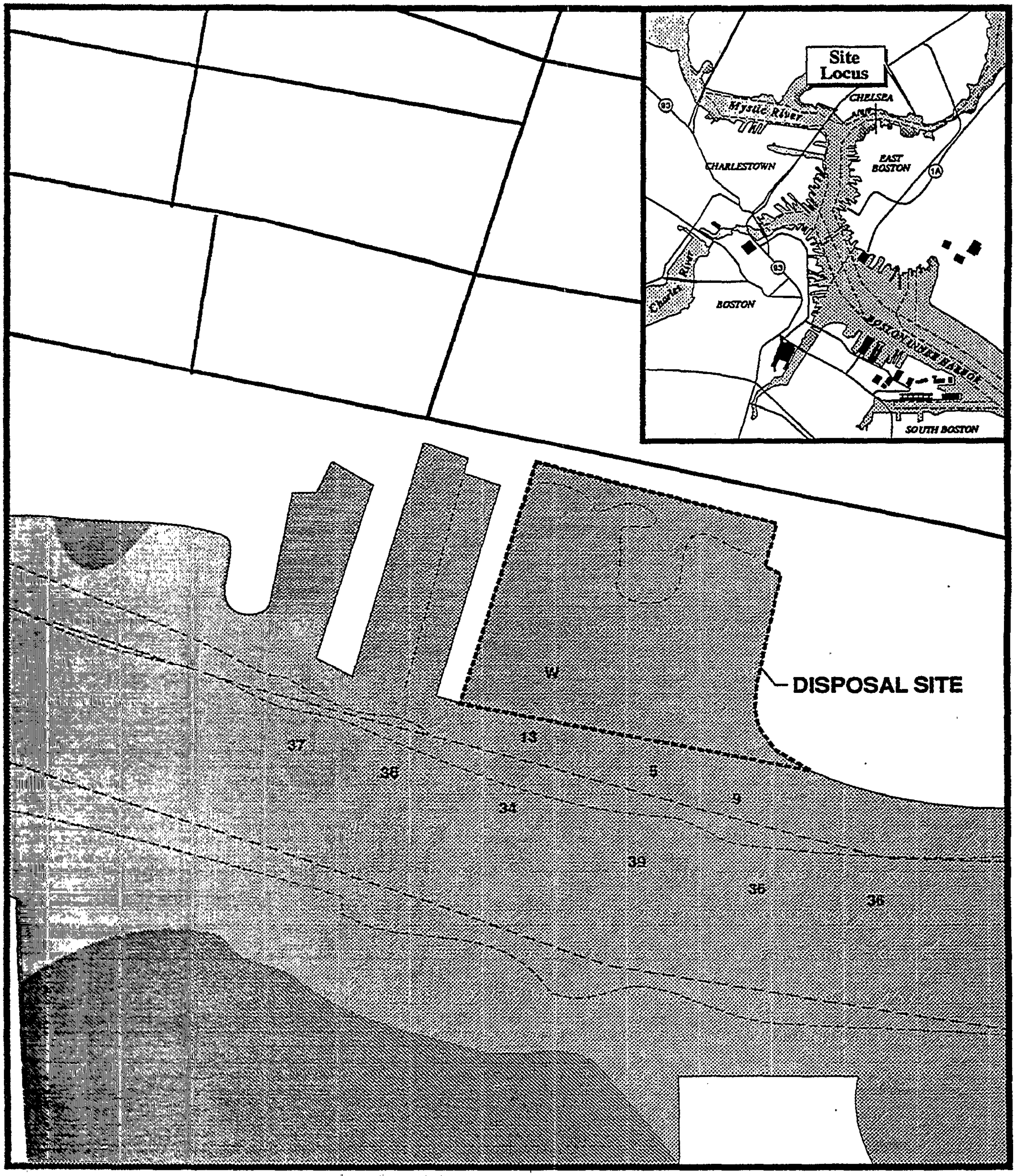
601



Boston Harbor Dredging Project EIR/S	Figure A1-10. Site map for Revere Sugar site
N — *Scale:* 0 50 100 *Scale in Yards*	*Source:* Boston Harbor Navigation Chart

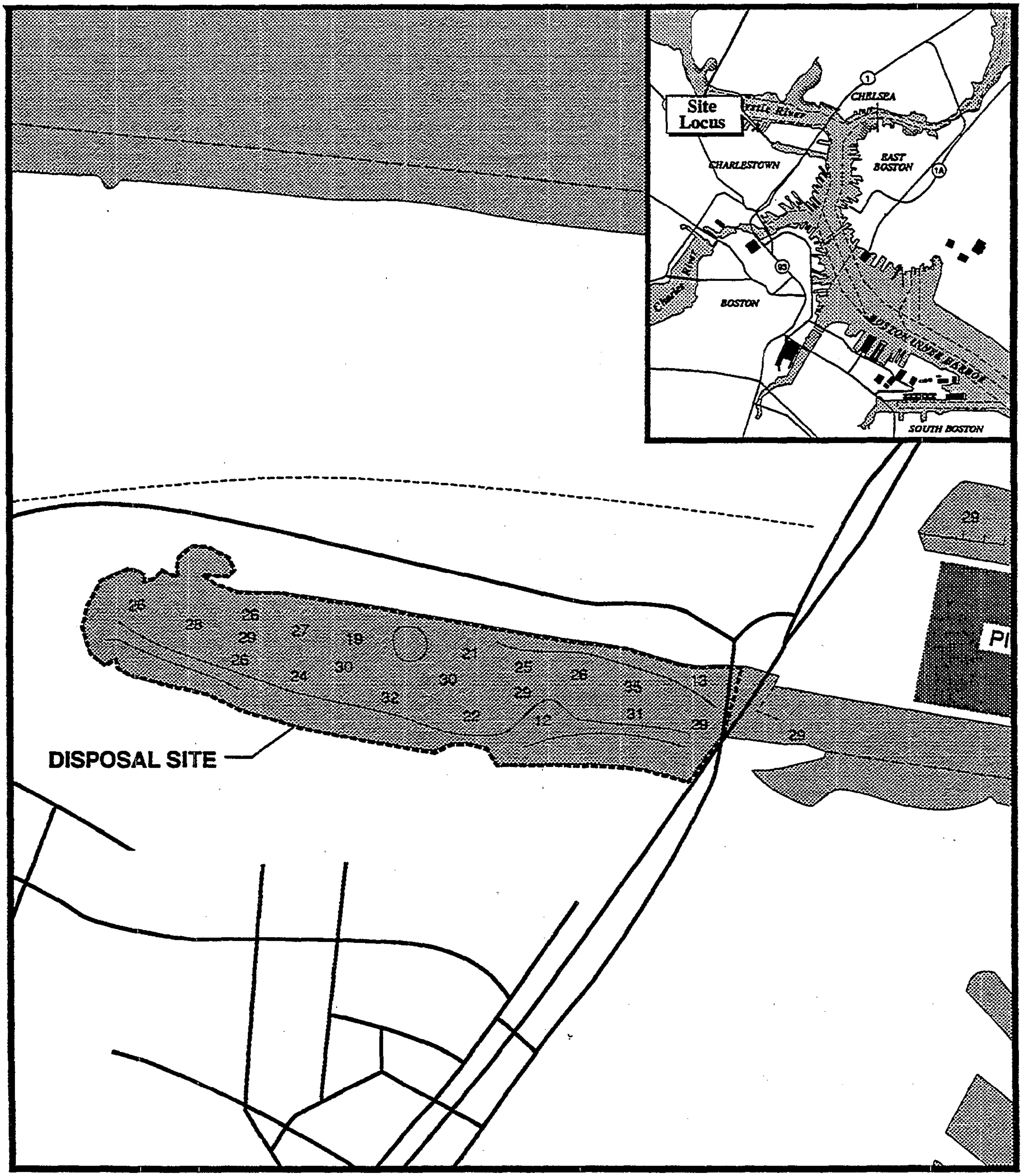


Boston Harbor Dredging Project EIR/S	Figure A1-11. Site map for Amstar site
N · *Scale:* 0 50 100 *Scale in Yards*	*Source:* Boston Harbor Navigation Chart

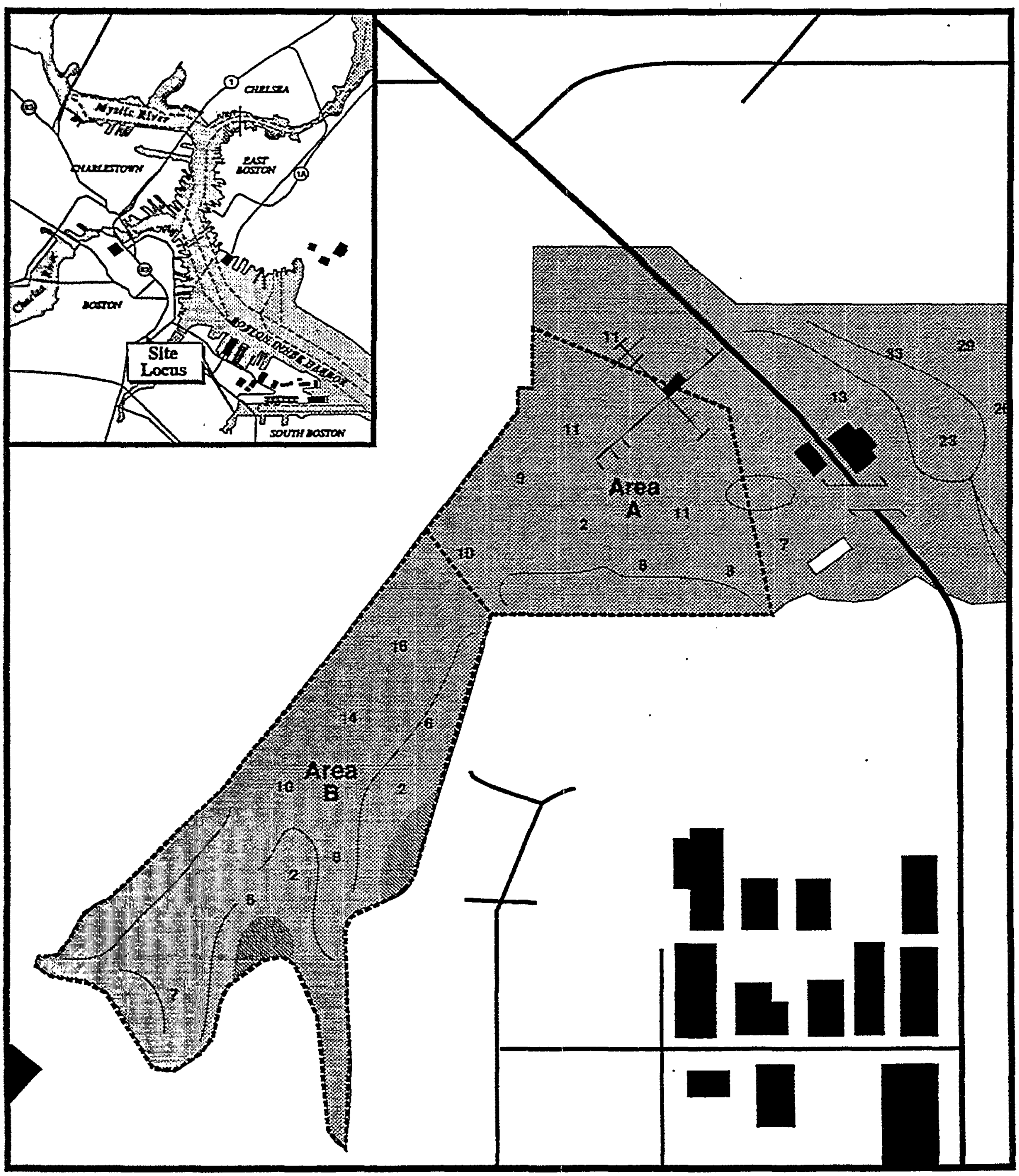


Boston Harbor Dredging Project EIR/S	Figure A1-12. Site map for Cabot Paint site.
N — *Scale:* 0 50 100 *Scale in Yards*	*Source:* Boston Harbor Navigation Chart

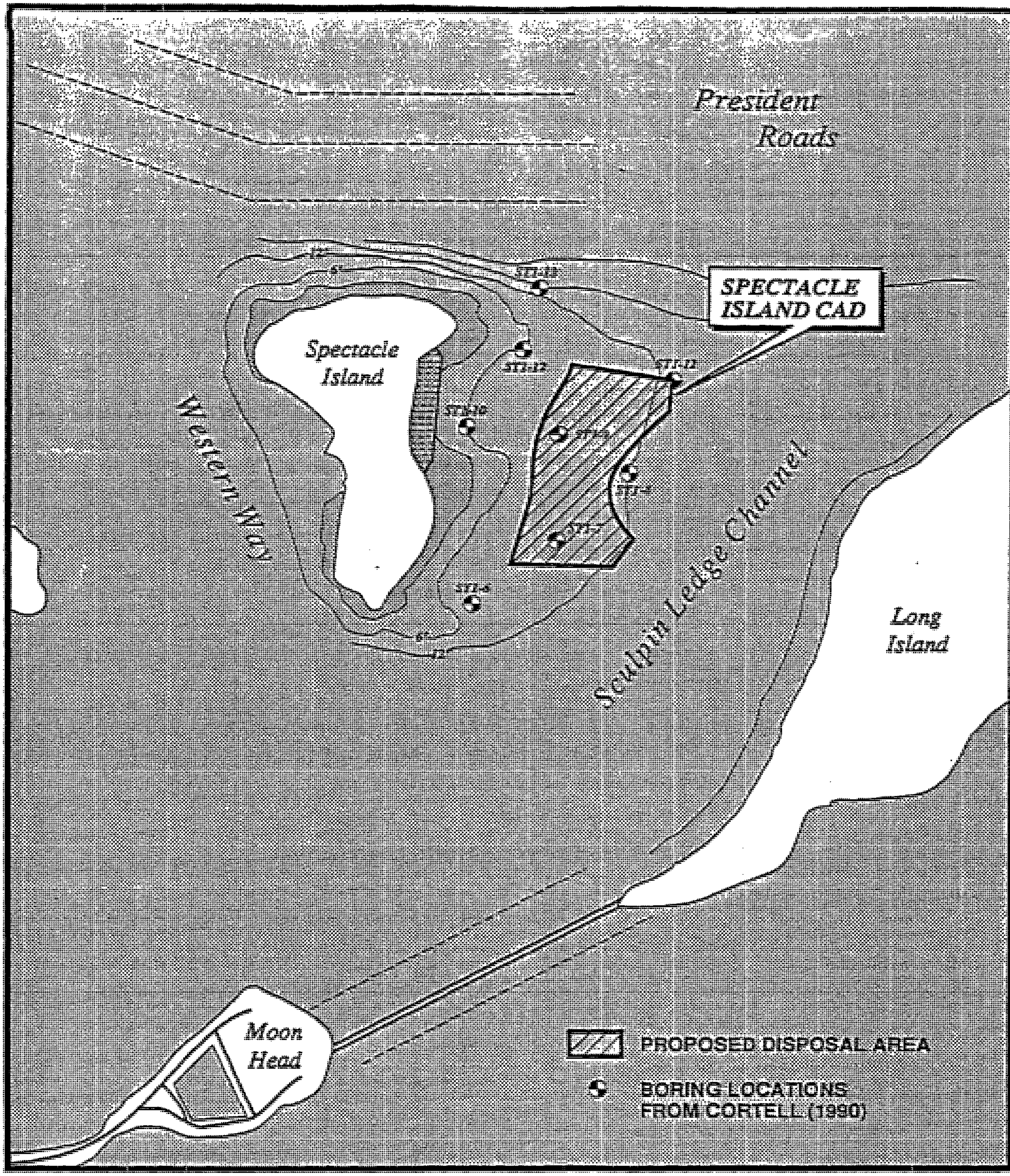
604



Boston Harbor Dredging Project EIR/S	Figure A1-13. Site map for Little Mystic Channel site.
N — *Scale:* 0 100 200 *Scale in Yards*	*Source:* Boston Harbor Navigation Chart

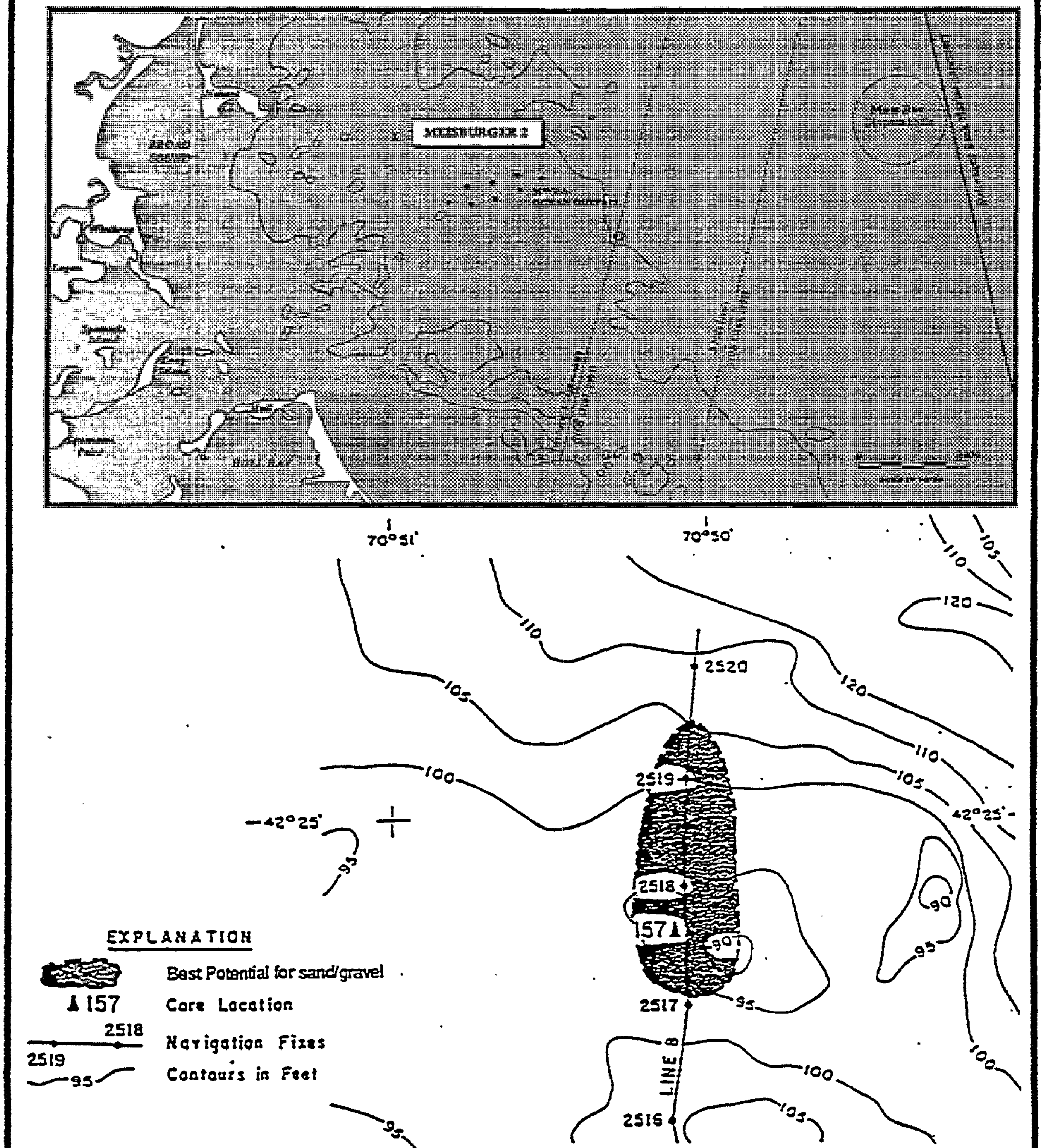


Boston Harbor Dredging Project EIR/S	Figure A1-14. Site map for Reserved Channel site.
N — *Scale:* 0 100 200 *Scale in yards*	*Source:* Boston Harbor Navigation Chart

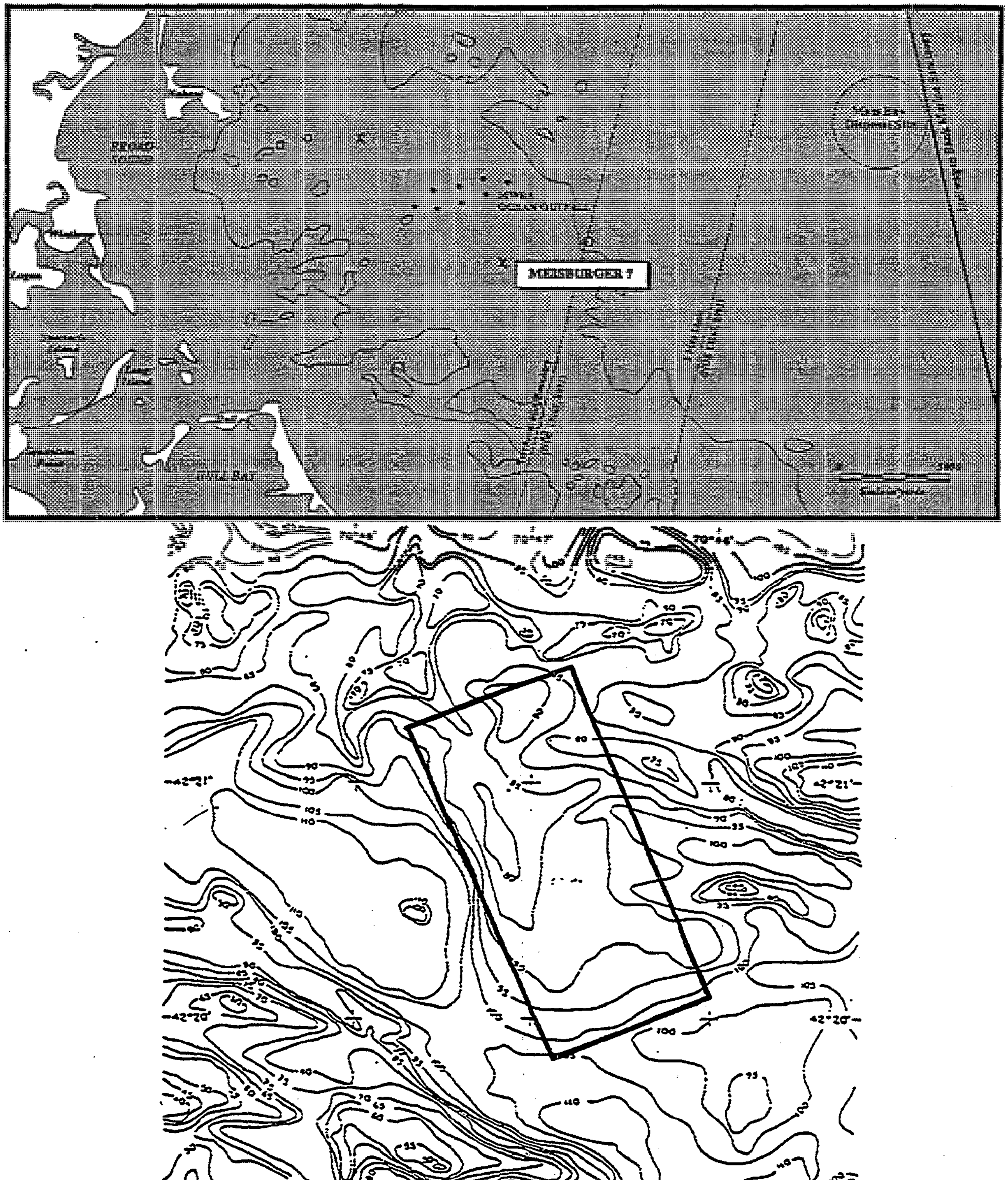


Boston Harbor Dredging Project EIR/S		Figure A1-15. Site map for Spectacle Island CAD site.
N	*Scale:* Scale in Yards 500 0 1000	*Source:* NOS Chart No. 13270 Sediment Classifications from Cortell 1990

A1-213



Boston Harbor Dredging Project EIR/S	Figure A1-16. Site map for Meisburger 2 site.
Scale: Scale in Yards 500 0 1000	Source: Metcalf & Eddy Inc., 1992



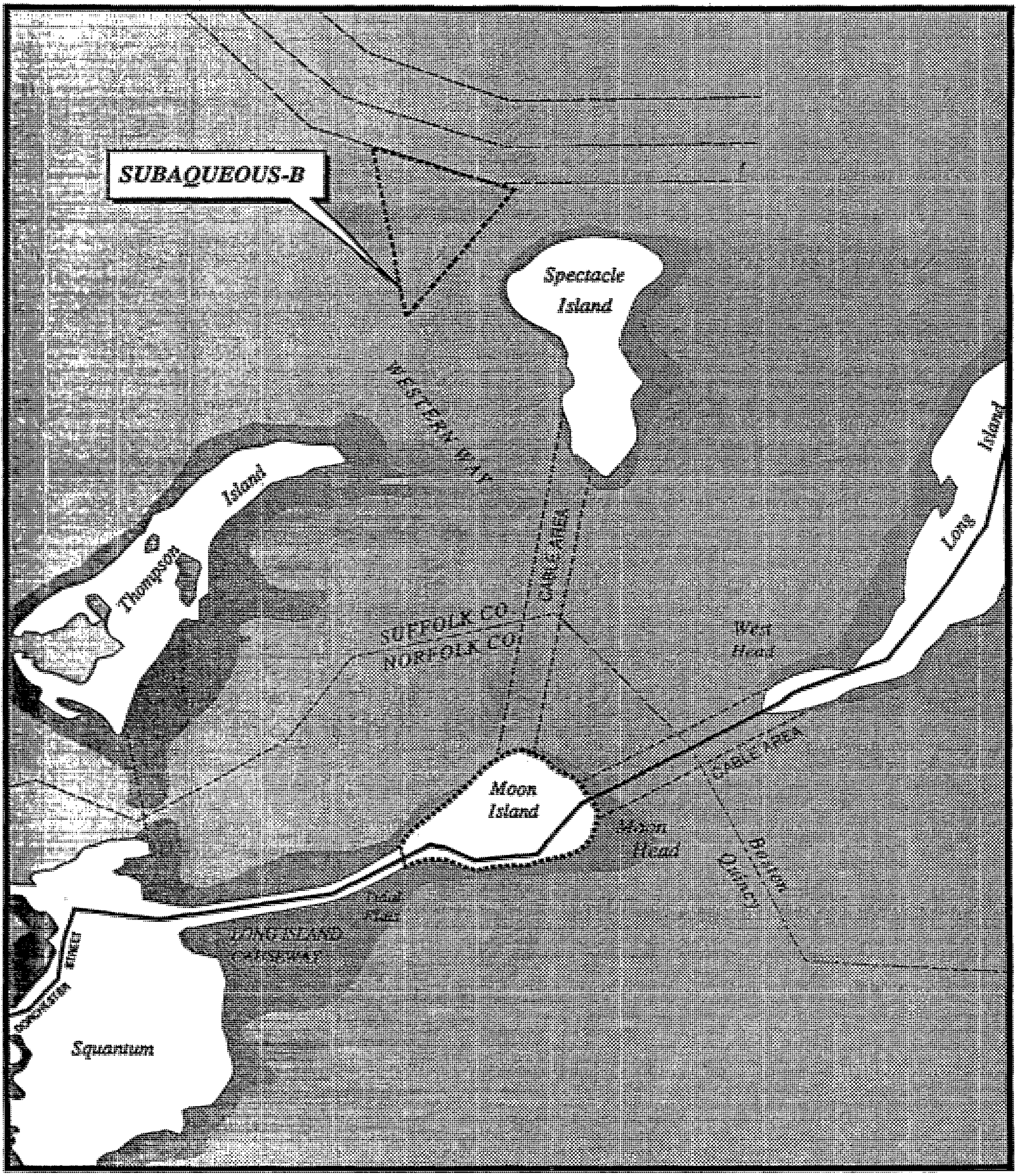
Boston Harbor Dredging Project EIR/S

Figure A1-17. Site map for Meisburger 7 site.

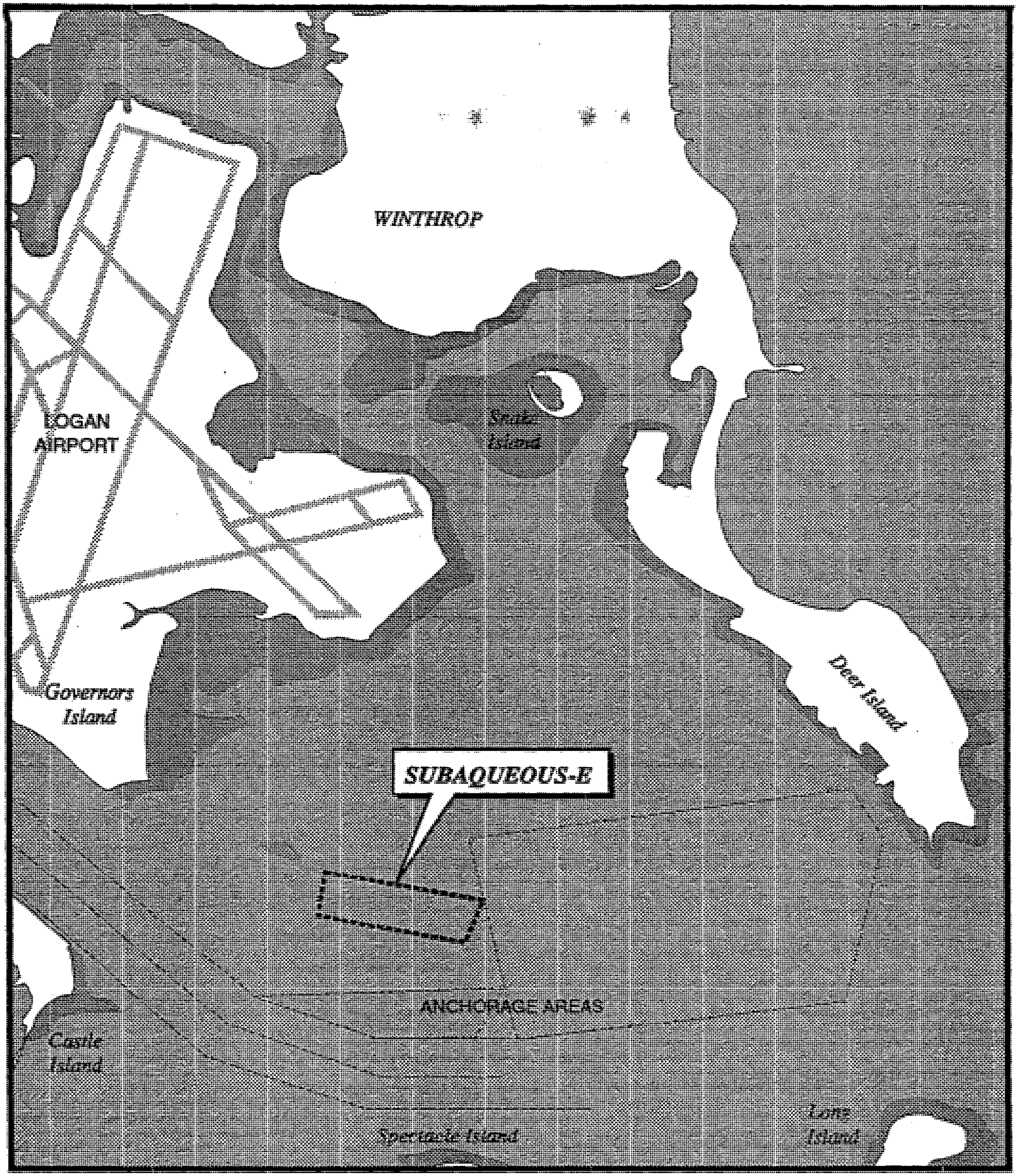
* GENERAL AREA WITHIN WHICH DISPOSAL SITE WOULD BE LOCATED.

Scale: Scale in Yards 0 1000 2000

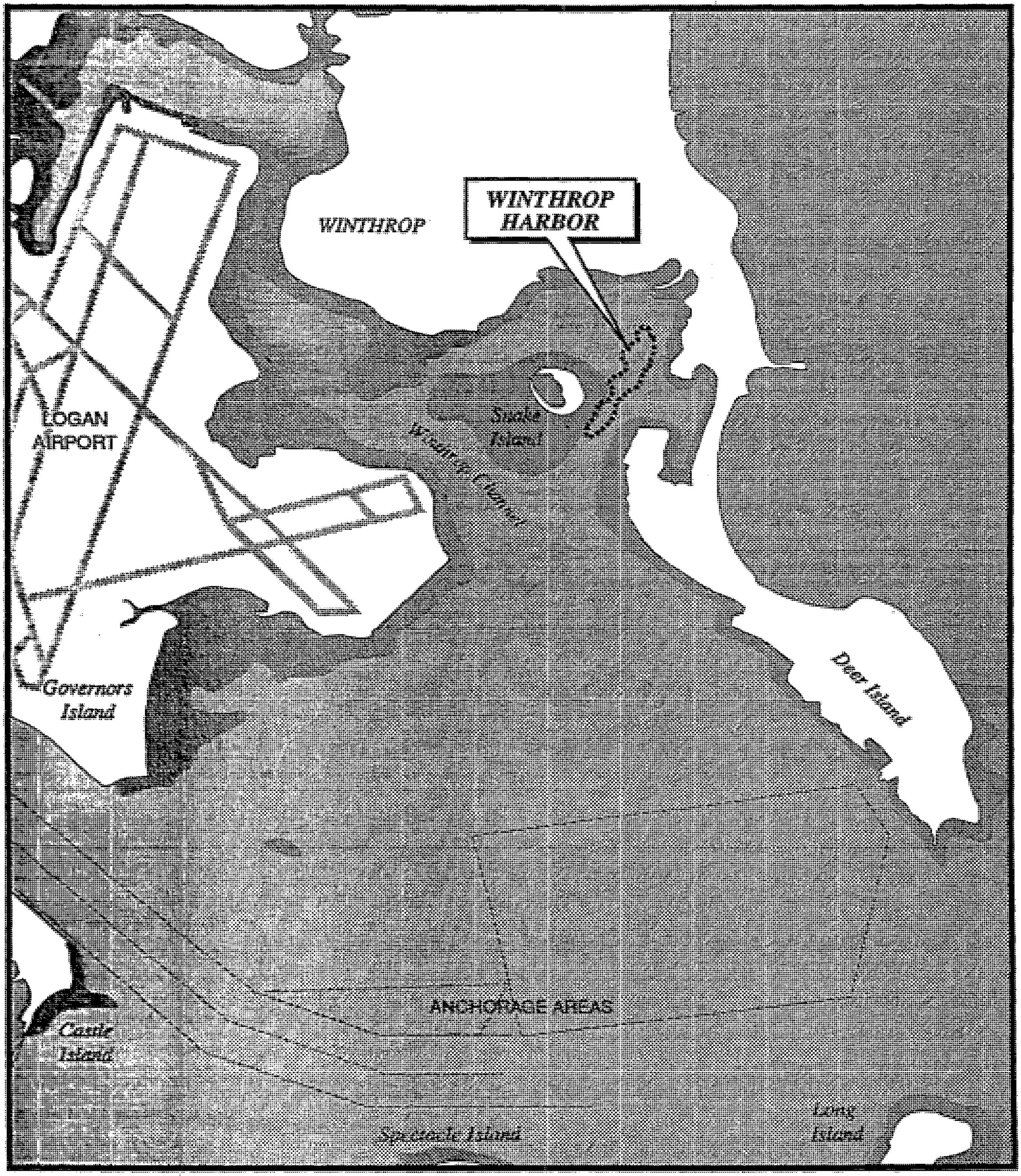
Source: Metcalf & Eddy Inc., 1992



Boston Harbor Dredging Project EIR/S	Figure A1-18. Site map for potential disposal site, Subaqueous-B
N — *Scale:* 0 1000 2000 Scale in Feet	*Source:* Boston Inner Harbor Navigation Chart



Boston Harbor Dredging Project EIR/S	Figure A1-19. Site map for potential disposal site, Subaqueous-E.
N / *Scale:* 0 400 800 Scale in Yards	*Source:* Boston Inner Harbor Navigation Chart



Boston Harbor Dredging Project EIR/S		Figure A1-20. Site map for potential disposal site, Winthrop Harbor.
N	*Scale:* 0 400 800 Scale in Yards	*Source:* Boston Inner Harbor Navigation Chart

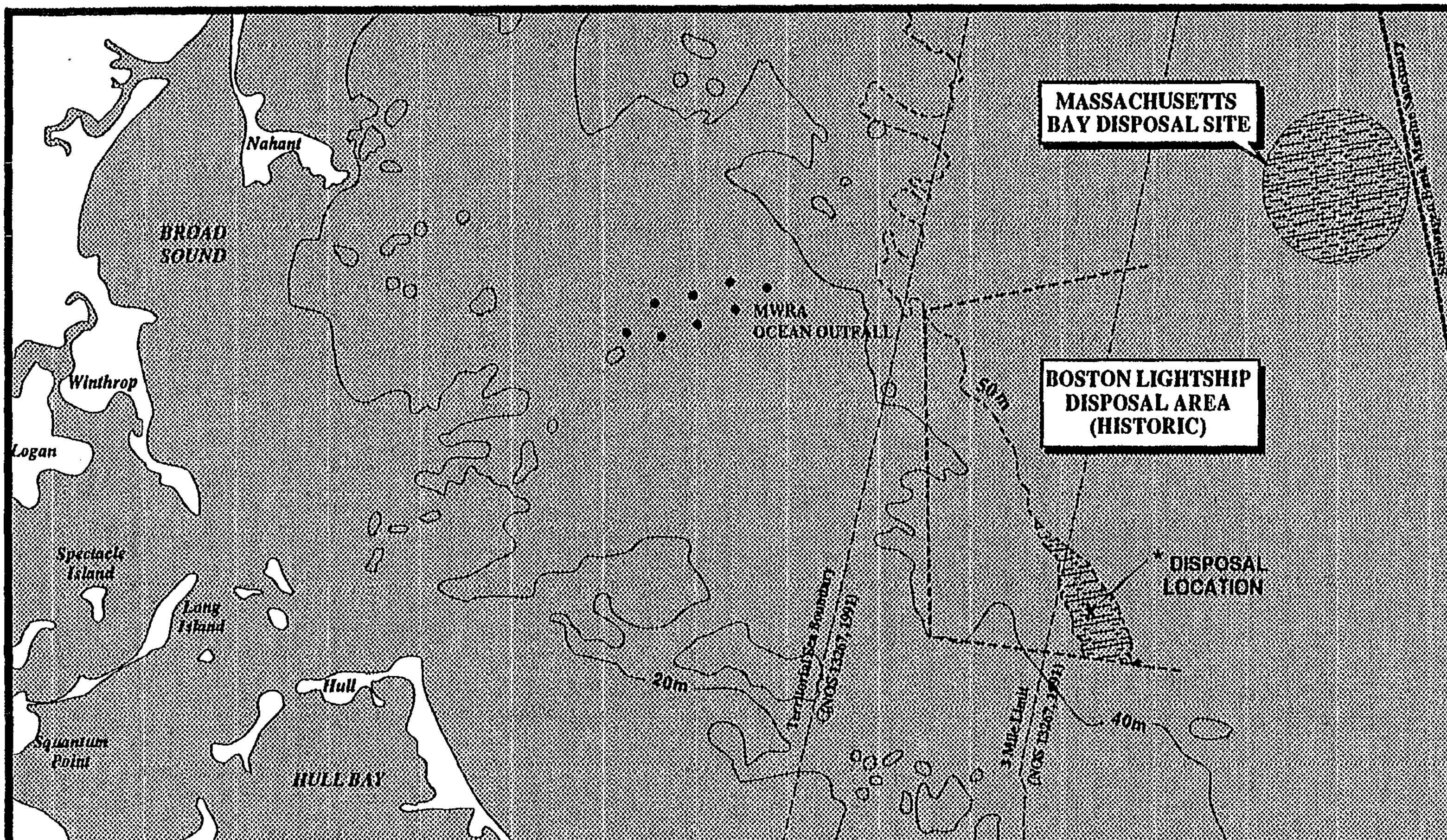
Figure A1-21. Site map for Boston Lightship and MBDS Sites.

Scale:

0 500

Scale in yards

Source: Boston Harbor Navigation Chart



Depositional substrates within the disposal sites.

* BLDS approximate proposed disposal location = 42° 19' 48" N
70° 37' 30" W

A1-219

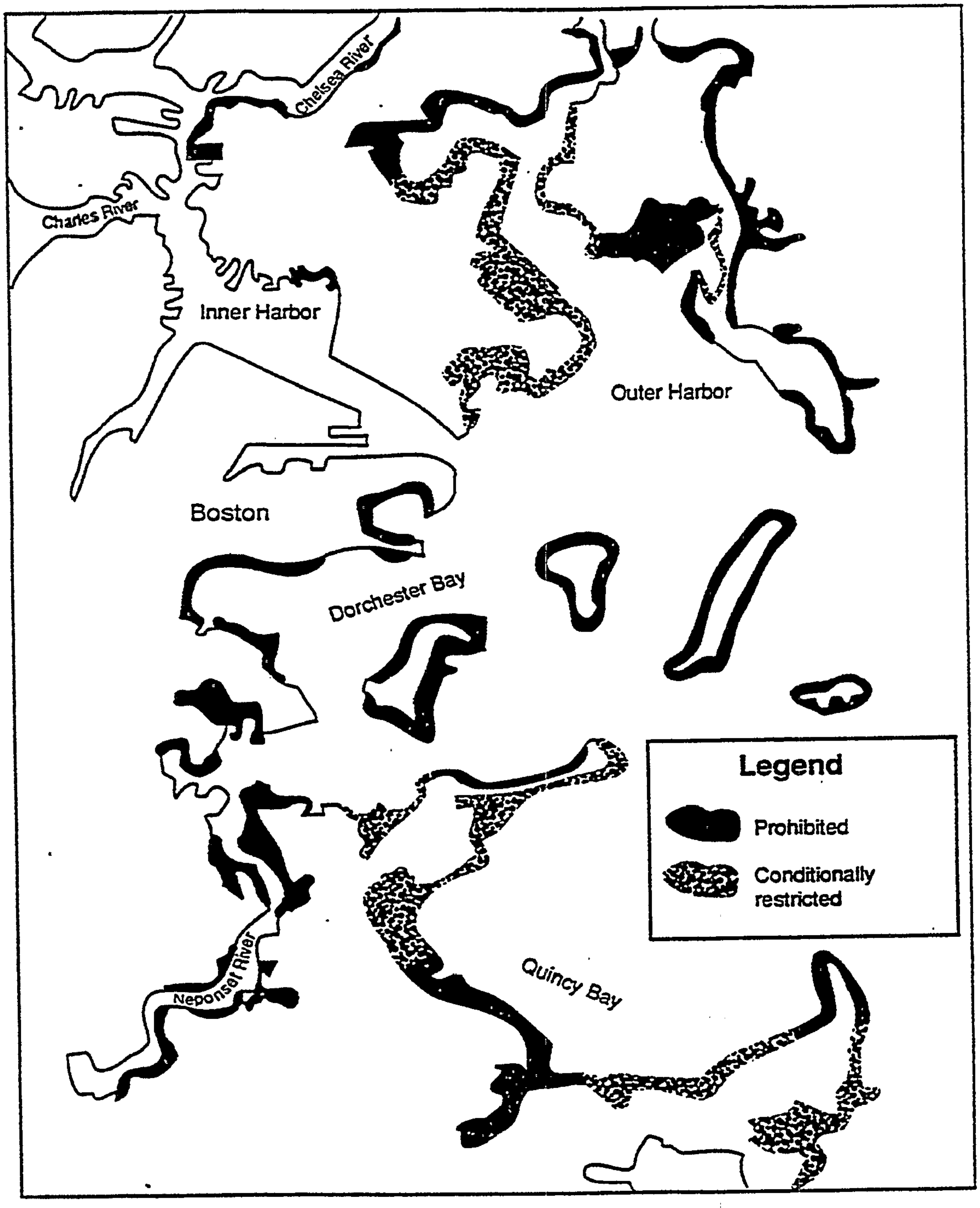


Figure A1-22. Prohibited and restricted clam beds in Boston Harbor. There are many acres of soft-shell clam beds in Boston Harbor, but none are open for unrestricted harvest.

(From MWRA "State of Boston Harbor:1991" report)

Lit

TABLE A1-1. LANDFILL CHARACTERISTICS

	PLAINVILLE	FITCHBURG/ WESTMINISTER	E. BRIDGEWATER
DAILY CAPACITY			
Total Waste Capacity	850-925 cy/day	350 cy/day	1075 cy/day
Available Waste Capacity[1]	150-200 cy/day	200 cy/day	75 cy/day
Cover Capacity	500 cy/day	250 cy/day	400 cy/day
Available Cover Capacity	100 cy/day	Unknown	Variable
ANNUAL TOTAL CAPACITY	350,000 cy/yr	100,000 cy/yr	250,000 cy/yr
STOCKPILING CAPACITY[2]		200,000 cy	8,000-10,000 cy
WASTE MATERIAL LIMITATIONS			
Dewatering	No free standing water	No free standing water	No free standing water
Solids	≥40% solids	≥25% solids	≥20% solids
Odor	Deodorizing suggested	Must have no odor	If odor, BFI will lime
COVER MATERIAL LIMITATIONS	Must meet DEP standards for TCLP[3], pH, solids, reactivity, ignitability.	Must meet 310 CMR 19 regulations.	Must meet DEP standards for TCLP, PCBs, reactivity, corrosivity, free liquid, solids. Odor must be inoffensive to community. No large boulders.
ESTIMATED CLOSURE DATE	1995, but proposed expansions would extend until 2000.	1997	1996
TOWN/BOARD OF HEALTH REQUIREMENTS	Verbal coordination needed	Coordination with 2 local boards	Coordination needed

(Continued)

A1-221

TABLE A1-1. (CONTINUED).

	PLAINVILLE	FITCHBURG/ WESTMINISTER	E. BRIDGEWATER
SPECIAL WASTE RECEIVED IN PAST	Waste water treatment plant grit and screenings	Wastewater treatment plant sludge.	Sewage sludge, petroleum contaminated soil.
TRUCKING LIMITATIONS			
Number/day	No limitations	No limitations	No limitations
Operating hours	7 AM - 3 PM	7 AM - 3 PM	7 AM - 3 PM
TIPPING FEE[4]	$56/cy	$70/cy	$28/cy
DISTANCE TO SITE	35 mi.	45 mi.	25 mi.

[1]Capacity available for project dredged material.
[2]Unlined cover material can be stockpiled.
[3]Toxic Characteristic Leaching Procedure. An EPA-derived test for hazardous characteristics.
[4]Approximate costs assuming an average ratio of 1.4 tons/cy; actual tipping fees are based on weight.

A1-223

TABLE A1-2. ESTIMATED ABUNDANCE (NO./m^2) OF BENTHIC INFAUNA (RETAINED ON A 0.5 mm MESH SIEVE) COLLECTED BY 0.023 m^2 PONAR GRAB FROM PROPOSED DISPOSAL SITES IN BOSTON HARBOR, APRIL 28-29, 1993.

	STATION																
TAXA	MP-1	MP-2	RS-1	RS-2	RS-3	AM-1	AM-2	CP-1	CP-2	LMC-1	LMC-2	LMC-3	LMC-4	RC-1	RC-2	RC-3	RC-4
Oligochaeta	43	817	473	172	172	559		1806	86		13717	258	86	2451	15480		26574
Asabellides oculata							43										
Capitella capitata		4171	2838	2967		215		43			1892				645		1677
Tharyx acutus					688				43	86	387		43				
Cirratulidae											258						
Cistenides hyperborea								43			43						
Dodecaceria sp.		43															
Eteone sp.											86						
E. heteropoda											86						
E. longa																	
Fabricia sabella		172	129								43						215
Polynoidae			172								43	43			43		
Lagisca extenuata			43												43		
Hesionidae															43		
Leitoscoloplos robustus														86	172		
Microphthalmus aberrans			473					215							129		
Nereidae														43			172
Hediste diversicolor								43							172		
Orbiniidae														258	215	43	
Paranaites kosteriensis																	
Pholoe minuta											43						
Polycirrus sp.															172		
Polydora sp.											43						
P. aggregata		258									731						
P. cornuta		86	43	43		2107		301	86		559	215			1419	43	129
Pygospio elegans																	

(Continued)

TABLE A1-2. (CONTINUED)

	STATION																
TAXA	MP-1	MP-2	RS-1	RS-2	RS-3	AM-1	AM-2	CP-1	CP-2	LMC-1	LMC-2	LMC-3	LMC-4	RC-1	RC-2	RC-3	RC-4
Spio cf. *limicola*															43		
S. thulini											86						
Spiophanes bombyx											43						
Streblospio benedicti					86	301	301	4902	1548	43	2709	2021	129		1548	215	
Chironomidae				43													
Collembola				43													
Ampelisca abdita														43			
Balanus crenatus											43						
Carcinus maenas			43														
Corophium sp.											86				43		215
C. acherusicum			43														
C. insidiosum											1333				43		2580
Crangon septemspinosa							43						43				
Diastylis sculpta																	
Dyopedos sp.												43					
Harpacticoida			86				43										
Microdeutopus sp.											258						
M. gryllotalpa			172			86		43			2322		43		688		1505
Ostracoda	43																
Pagurus longicarpus						43											
Semibalanus balanoides		43															
Crepidula sp.															43		
C. fornicata											86				129		
C. plana						43					43						
Nassarius trivittatus												43					
Hiatella sp.		D															

TABLE A1-2. (CONTINUED)

TAXA	MP-1	MP-2	RS-1	RS-2	RS-3	AM-1	AM-2	CP-1	CP-2	LMC-1	LMC-2	LMC-3	LMC-4	RC-1	RC-2	RC-3	RC-4
	STATION																
Littorina littorea											129						
Mya arenaria		D									43			86			43
Mytilidae		D	D	D													
Tellina agilis															86		
Ciona intestinalis		86										43					
Athecata												P					
Obelia dichotoma			P														
Nemertinea			43														86
Nematoda		11,954	236,672	17,329	215	9,933		1,806	1,591		2,838	13,932	2,752	129			16,641
Ascidian		43															
Molgula sp.		43															
Polycarpa fibrosa		43															
Total Abundance (no./m^2)	86	17,759	241,230	20,597	1,161	18,287	430	9,202	3,354	129	27,907	16,598	3,096	3,096	21,156	301	49,837
Total No. Discrete Taxa[a]	2	11	13	6	4	8	4	9	5	2	22	8	6	7	14	4	10
% Polychaeta	0	27	2	15	67	20	80	59	50	100	25	14	5	13	22	88	4
% Crustacea	0	1	<1	<1	0	1	10	2	0	0	15	1	11	1	4	12	9
% Bivalvia	0	0	0	0	0	0	0	0	0	0	0	0	0	3	<1	0	<1

P = present but not enumerable; D = dead individuals present; counts represent live animals only
[a]Higher phylogenetic categories (e.g. family, genus) were not included in total no. of discrete taxa when lower phylogenetic categories were present.

A1-225

TABLE A1-3. MEAN ABUNDANCE (NO./m²) BY HABITAT OF BENTHIC INFAUNA RETAINED ON A 0.5mm-MESH SIEVE COLLECTED FROM INNER HARBOR LOCATIONS, OCTOBER 1994.

GROUP	SPECIES	AMSTAR	CHEL 01	CHEL 02	CHELSEA CREEK	CONLEY	CABOT POINT		EVERETT	REV SU
		HABITAT	HABITAT	HABITAT	HABITAT	HABITAT	HABITAT		HABITAT	HAB
		III	III	III	II	III	II	III	III	I
NO. OF SAMPLES	TOTAL	2.0	2.0	2.0	5.0	1.0	1.0	1.0	2.0	
PORIFERA	HALICHONDRIA PANICEA				P					
HYDROZOA	CLYTIA GRACILIS									
	OBELIA DICHOTOMA					P				
	OBELIA SP.									
NEMATODA	NEMATODA	587.5	87.5	25.0	25.0	450.0			25.0	
POLYCHAETA	ANAITIDES SP.				5.0					
	ARICIDEA (ACMIRA)									
	CATHERINAE					25.0				
	CAPITELLA CAPITATA	50.0				75.0				
	CIRRATULIDAE				10.0					
	ETEONE LONGA				5.0					
	GLYCERA DIBRANCHIATA									
	HEDISTE DIVERSICOLOR								12.5	
	LEITOSCOLOPLOS ACUTUS									
	LEITOSCOLOPLOS ROBUSTUS									
	LEITOSCOLOPLOS SP.									
	MALDANIDAE									
	MARENZELLERIA VIRIDIS									
	MEDIOMASTUS CALIFORNIENSIS					25.0				
	MICROPHTHALMUS ABERRANS									
	NEANTHES SUCCINEA							25.0		
	NEANTHES VIRENS				15.0	25.0			37.5	
	NEPHTYIDAE					25.0				
	NEPHTYS CAECA				10.0					
	NEPHTYS CILIATA				5.0				25.0	
	NEPHTYS INCISA					25.0				
	NEREIDAE									
	NINOE NIGRIPES									
	PARANAITIS SPECIOSA				5.0					
	PECTINARIA GOULDII	12.5	12.5							
	PECTINARIIDAE	12.5								
	POLYCIRRUS SP.				5.0					
	POLYDORA CORNUTA	625.0	12.5		230.0	25.0	25.0	175.0	37.5	
	POLYDORA SOCIALIS				10.0					
	SPIO FILICORNIS									
	STREBLOSPIO BENEDICTI	412.5	50.0		25.0	50.0		75.0	150.0	
	THARYX ACUTUS		25.0		35.0	50.0		25.0		
OLIGOCHAETA	OLIGOCHAETA	87.5			5.0	200.0		50.0	25.0	
GASTROPODA	CREPIDULA FORNICATA				30.0					
	CREPIDULA PLANA				50.0					
	CREPIDULA SP.				10.0					
	LACUNA VINCTA									
	NASSARIUS TRIVITTATUS		25.0		5.0	25.0				

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TABLE A1-3. (Continued)

GROUP	SPECIES	AMSTAR	CHEL 01	CHEL 02	CHELSEA CREEK	CONLEY	CABOT POINT		EVERETT	REVERE SUGAR
		HABITAT	HABITAT	HABITAT	HABITAT	HABITAT	HABITAT		HABITAT	HABITAT
		III	III	III	II	III	II	III	III	III
BIVALVIA	ANOMIA SP.									
	BIVALVIA				5.0					
	CERASTODERMA PINNULATUM									
	HIATELLA SP.									
	LYONSIA HYALINA									
	MACOMA BALTHICA								12.5	
	MULINIA LATERALIS			12.5					25.0	
	MYA ARENARIA									
	MYTILIDAE		25.0		5.0					
	TELLINA AGILIS				5.0	25.0				
	TURTONIA MINUTA				5.0					
CIRRIPEDIA	BALANUS CRENATUS									
MYSIDACEA	HETEROMYSIS FORMOSA									
AMPHIPODA	AMPELISCA ABDITA				30.0	125.0		25.0		
	COROPHIUM BONELLI	50.0								
	GAMMARUS LAWRENCIANUS									
	MICRODEUTOPUS GRYLLOTALPA	37.5								8.3
	PONTOGENEIA INERMIS									
	UNCIOLA INERMIS	12.5								
DECAPODA	CRANGON SEPTEMSPINOSA		37.5		10.0					8.3
BRYOZOA	BUGULA TURRITA				P	P				
OPHIUROIDEA	OPHIUROIDEA								12.5	
ASCIDIACEA	ASCIDIA SP.	25.0								
X NO. OF INDIV	TOTAL	1912.5	275.0	37.5	545.0	1150.0	25.0	375.0	362.5	483.2
X PORIFERA	TOTAL				P					
X HYDROZOA	TOTAL					P				
X NEMATODA	TOTAL	587.5	87.5	25.0	25.0	450.0			25.0	66.7
X POLYCHAETA	TOTAL	1112.5	100.0		360.0	325.0	25.0	300.0	262.5	216.6
X OLIGOCHAETA	TOTAL	87.5			5.0	200.0		50.0	25.0	183.3
X GASTROPODA	TOTAL		25.0		95.0	25.0				
X BIVALVIA	TOTAL		25.0	12.5	20.0	25.0			37.5	
X CIRRIPEDIA	TOTAL									
X MYSIDACEA	TOTAL									
X AMPHIPODA	TOTAL	100.0			30.0	125.0		25.0		8.3
X DECAPODA	TOTAL		37.5		10.0					8.3
X BRYOZOA	TOTAL				P	P				
X OPHIUROIDEA	TOTAL								12.5	
X ASCIDIACEA	TOTAL	25.0								
NO. OF TAXA	ZTOTAL	11.0	8.0	2.0	26.0	16.0	1.0	6.0	10.0	9.0

(CONTINUED)

TABLE A1-3. (Continued)

GROUP	SPECIES	INNER CONFLUENCE		LITTLE MYSTIC-CHANNEL	MYSTIC PIERS		MYSTIC RIVER		RESERVED CHANNEL
		HABITAT		HABITAT	HABITAT		HABITAT		HABITAT
		II	III	III	II	IV	III	IV	NONE
NO. OF SAMPLES	TOTAL	3.0	2.0	3.0	2.0	2.0	2.0	3.0	3.0
PORIFERA	HALICHONDRIA PANICEA								
HYDROZOA	CLYTIA GRACILIS							P	
	OBELIA DICHOTOMA								
	OBELIA SP.	P		P			P		
NEMATODA	NEMATODA	25.0							
POLYCHAETA	ANAITIDES SP.								
	ARICIDEA (ACMIRA)								
	CATHERINAE								
	CAPITELLA CAPITATA	8.3							58.3
	CIRRATULIDAE								
	ETEONE LONGA	33.3							
	GLYCERA DIBRANCHIATA	8.3							
	HEDISTE DIVERSICOLOR								16.7
	LEITOSCOLOPLOS ACUTUS								25.0
	LEITOSCOLOPLOS ROBUSTUS								375.0
	LEITOSCOLOPLOS SP.								8.3
	MALDANIDAE	16.7							
	MARENZELLERIA VIRIDIS								8.3
	MEDIOMASTUS CALIFORNIENSIS								
	MICROPHTHALMUS ABERRANS	16.7							
	NEANTHES SUCCINEA								
	NEANTHES VIRENS								50.0
	NEPHTYIDAE	8.3	25.0						
	NEPHTYS CAECA	8.3							
	NEPHTYS CILIATA								
	NEPHTYS INCISA								
	NEREIDAE								8.3
	NINOE NIGRIPES	16.7							
	PARANAITIS SPECIOSA								
	PECTINARIA GOULDII								8.3
	PECTINARIIDAE								
	POLYCIRRUS SP.								
	POLYDORA CORNUTA	416.7	12.5					33.3	125.0
	POLYDORA SOCIALIS								
	SPIO FILICORNIS								8.3
	STREBLOSPIO BENEDICTI	166.7				12.5			108.3
	THARYX ACUTUS	25.0							
OLIGOCHAETA	OLIGOCHAETA	500.0							25.0
GASTROPODA	CREPIDULA FORNICATA								
	CREPIDULA PLANA	33.3							
	CREPIDULA SP.	16.7							
	LACUNA VINCTA	16.7							

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BLE A1-3. (Continued)

ROUP	SPECIES	INNER CONFLUENCE		LITTLE MYSTIC- CHANNEL	MYSTIC PIERS		MYSTIC RIVER		RESERVED CHANNEL
		HABITAT		HABITAT	HABITAT		HABITAT		HABITAT
		II	III	III	II	IV	III	IV	NONE
ASTROPODA	NASSARIUS TRIVITTATUS	250.0			37.5	12.5			
IVALVIA	ANOMIA SP.					12.5			
	BIVALVIA	8.3							
	CERASTODERMA PINNULATUM	8.3							
	HIATELLA SP.	25.0							
	LYONSIA HYALINA	8.3							
	MACOMA BALTHICA								8.3
	MULINIA LATERALIS	8.3		8.3					41.7
	MYA ARENARIA								158.3
	MYTILIDAE	8.3						8.3	8.3
	TELLINA AGILIS								
	TURTONIA MINUTA								
CIRRIPEDIA	BALANUS CRENATUS					12.5			
YSIDACEA	HETEROMYSIS FORMOSA	8.3							
MPHIPODA	AMPELISCA ABDITA					12.5		8.3	
	COROPHIUM BONELLI								
	GAMMARUS LAWRENCIANUS			8.3					
	MICRODEUTOPUS GRYLLOTALPA								
	PONTOGENEIA INERMIS	8.3							
	UNCIOLA INERMIS								
DECAPODA	CRANGON SEPTEMSPINOSA								
BRYOZOA	BUGULA TURRITA								
OPHIUROIDEA	OPHIUROIDEA							8.3	
ASCIDIACEA	ASCIDIA SP.								
X NO. OF INDIV	TOTAL	1649.8	37.5	16.6	37.5	62.5		58.2	1041.4
X PORIFERA	TOTAL								
X HYDROZOA	TOTAL	P		P			P	P	
X NEMATODA	TOTAL	25.0							
X POLYCHAETA	TOTAL	725.0	37.5			12.5		33.3	799.8
X OLIGOCHAETA	TOTAL	500.0							25.0
X GASTROPODA	TOTAL	316.7			37.5	12.5			
X BIVALVIA	TOTAL	66.5		8.3		12.5		8.3	216.6
X CIRRIPEDIA	TOTAL					12.5			
X MYSIDACEA	TOTAL	8.3							
X AMPHIPODA	TOTAL	8.3		8.3		12.5		8.3	
X DECAPODA	TOTAL								
X BRYOZOA	TOTAL								
X OPHIUROIDEA	TOTAL							8.3	
X ASCIDIACEA	TOTAL								
NO. OF TAXA	ZTOTAL	26.0	2.0	3.0	1.0	5.0	1.0	5.0	17.0

(CONTINUED)

TABLE A1-3. (Continued)

GROUP	SPECIES	REVERE SUGAR HABITAT III
NO. OF SAMPLES	TOTAL	3.0
PORIFERA	HALICHONDRIA PANICEA	
HYDROZOA	CLYTIA GRACILIS	
	OBELIA DICHOTOMA	
	OBELIA SP.	
NEMATODA	NEMATODA	66.7
POLYCHAETA	ANAITIDES SP.	
	ARICIDEA (ACMIRA)	
	CATHERINAE	
	CAPITELLA CAPITATA	
	CIRRATULIDAE	108.3
	ETEONE LONGA	
	GLYCERA DIBRANCHIATA	
	HEDISTE DIVERSICOLOR	
	LEITOSCOLOPLOS ACUTUS	
	LEITOSCOLOPLOS ROBUSTUS	
	LEITOSCOLOPLOS SP.	
	MALDANIDAE	
	MARENZELLERIA VIRIDIS	
	MEDIOMASTUS CALIFORNIENSIS	
	MICROPHTHALMUS ABERRANS	
	NEANTHES SUCCINEA	
	NEANTHES VIRENS	8.3
	NEPHTYIDAE	
	NEPHTYS CAECA	
	NEPHTYS CILIATA	
	NEPHTYS INCISA	
	NEREIDAE	
	NINOE NIGRIPES	
	PARANAITIS SPECIOSA	
	PECTINARIA GOULDII	
	PECTINARIIDAE	
	POLYCIRRUS SP.	
	POLYDORA CORNUTA	25.0
	POLYDORA SOCIALIS	
	SPIO FILICORNIS	
	STREBLOSPIO BENEDICTI	50.0
	THARYX ACUTUS	25.0
OLIGOCHAETA	OLIGOCHAETA	183.3
GASTROPODA	CREPIDULA FORNICATA	
	CREPIDULA PLANA	
	CREPIDULA SP.	
	LACUNA VINCTA	
	NASSARIUS TRIVITTATUS	

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TABLE A1-3. (Continued)

GROUP	SPECIES	REVERE SUGAR
		HABITAT
		III
BIVALVIA	ANOMIA SP.	
	BIVALVIA	
	CERASTODERMA PINNULATUM	
	HIATELLA SP.	
	LYONSIA HYALINA	
	MACOMA BALTHICA	
	MULINIA LATERALIS	
	MYA ARENARIA	
	MYTILIDAE	
	TELLINA AGILIS	
	TURTONIA MINUTA	
CIRRIPEDIA	BALANUS CRENATUS	
MYSIDACEA	HETEROMYSIS FORMOSA	
AMPHIPODA	AMPELISCA ABDITA	
	COROPHIUM BONELLI	
	GAMMARUS LAWRENCIANUS	
	MICRODEUTOPUS GRYLLOTALPA	8.3
	PONTOGENEIA INERMIS	
	UNCIOLA INERMIS	
DECAPODA	CRANGON SEPTEMSPINOSA	8.3
BRYOZOA	BUGULA TURRITA	
OPHIUROIDEA	OPHIUROIDEA	
ASCIDIACEA	ASCIDIA SP.	
X NO. OF INDIV	TOTAL	483.2
X PORIFERA	TOTAL	
X HYDROZOA	TOTAL	
X NEMATODA	TOTAL	66.7
X POLYCHAETA	TOTAL	216.6
X OLIGOCHAETA	TOTAL	183.3
X GASTROPODA	TOTAL	
X BIVALVIA	TOTAL	
X CIRRIPEDIA	TOTAL	
X MYSIDACEA	TOTAL	
X AMPHIPODA	TOTAL	8.3
X DECAPODA	TOTAL	8.3
X BRYOZOA	TOTAL	
X OPHIUROIDEA	TOTAL	
X ASCIDIACEA	TOTAL	
NO. OF TAXA	ZTOTAL	9.0

Table A1-4. Standardized mean catch per unit effort(catch per 20 minute trawl) by station in Boston Harbor and Massachusetts Bay, October 1994.

SPECIES	STATION							
	BOSTON-LIGHTSHIP	SUBAQUEOUS-E	SPECTACLE-I. CAD*	INNER-CONFLUENCE*	MYSTIC-RIVER*	CHELSEA-RIVER*	SPECIES-TOTAL	PERCENT-SPECIES-COMPOSITION
ALEWIFE	0.3	0.0	0.0	1.3	4.0	0.0	5.7	2.0
ATLANTIC COD	0.0	1.3	0.0	0.0	0.0	0.0	1.3	0.5
ATLANTIC MOONFISH	0.0	0.0	0.0	0.0	5.3	0.0	5.3	1.9
ATLANTIC SILVERSIDE	0.0	2.3	1.3	1.3	2.7	0.0	7.7	2.7
ATLANTIC TOMCOD	0.0	0.0	0.0	0.0	10.7	16.0	26.7	9.3
BUTTERFISH	4.0	0.0	0.0	0.0	0.0	0.0	4.0	1.4
CUNNER	0.0	0.0	0.0	0.0	1.3	0.0	1.3	0.5
GRUBBY	0.0	0.0	0.0	1.3	0.0	2.7	4.0	1.4
HAKE SP.	1.7	0.0	0.0	0.0	0.0	0.0	1.7	0.6
LOBSTER	37.7	3.7	6.7	2.7	0.0	4.0	54.7	19.0
LONGHORN SCULPIN	0.7	0.0	0.0	0.0	0.0	0.0	0.7	0.2
RAINBOW SMELT	0.0	2.7	4.0	4.0	2.7	0.0	13.3	4.6
SCUP	0.0	0.0	0.0	0.0	9.3	0.0	9.3	3.2
SHORTHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	1.3	1.3	0.5
SILVER HAKE	0.7	0.0	0.0	0.0	0.0	0.0	0.7	0.2
SKATE SP.	0.0	5.0	6.7	1.3	0.0	1.3	14.3	5.0
STRIPED BASS	0.0	0.3	0.0	0.0	0.0	0.0	0.3	0.1
WINDOWPANE	0.0	0.3	0.0	5.3	0.0	0.0	5.7	2.0
WINTER FLOUNDER	17.7	5.0	9.3	22.7	26.7	46.7	128.0	44.5
YELLOWTAIL FLOUNDER	1.7	0.0	0.0	0.0	0.0	0.0	1.7	0.6
STATION TOTAL	64.3	20.7	28.0	40.0	62.7	72.0	287.7	.
PERCENT STATION-COMPOSITION	22.4	7.2	9.7	13.9	21.8	25.0	.	100.0

* Five minute tows standardized to 20-minute tows.

TABLE A1-5. REPRESENTATIVE FINFISH SPECIES LIST, BOSTON INNER AND OUTER HARBOR.

Common Name	Scientific Name
Alewife	*Alosa pseudoharengus*
American plaice	*Hippoglossoides platessoides*
American shad	*Alosa sapidissima*
Atlantic wolfish	*Anarhichàs lupus*
Atlantic cod	*Gadus morhua*
Atlantic herring	*Clupea harengus harengus*
Atlantic mackerel	*Scomber scombrus*
Atlantic menhaden	*Brevoortia tyrannus*
Atlantic silverside	*Menidia menidia*
Atlantic tomcod	*Microgadus tomcod*
Bluefish	*Pomatomus saltatrix*
Blueback herring	*Alosa aestivalis*
Butterfish	*Peprilus triacanthus*
Cunner	*Tautoglabrus adspersus*
Cusk	*Brosme brosme*
Grey sole	*Glyptocephalus cynoglossus*
Hake	*Urophycis* sp.
Skate spp.	*Raja* spp.
Longhorn sculpin	*Myoxocephalus octodecemspinosus*
Ocean pout	*Macrozoarces americanus*
Pollock	*Pollachius virens*
Rainbow smelt	*Osmerus mordax*
Redfish	*Sebastes* spp.
Sculpin	*Myoxocephalus* sp.

(Continued)

TABLE A1-5. (CONTINUED)

Common Name	Scientific Name
Scup	*Stenotomus chrysops*
Spiny dogfish	*Squalus acanthias*
Striped bass	*Morone saxatilis*
Tautog	*Tautoga onitis*
Whiting/Silver hake	*Merluccius bilinearis*
Windowpane	*Scophthalmus aqousus*
Winter flounder	*Pleuronectes americanus*
Yellowtail flounder	*Limanda ferruginea*

(Continued)

Table A1-6. Standardized catch per unit effort(fish per 24-hour set) in gill net collections from Boston Harbor and Massachusetts Bay, October 1994.

SPECIES	STATION									
	RESERVED-CHANNEL	CHELSEA 01	FISH PIER	LOGAN 2	LITTLE-MYSTIC-CHANNEL	REVERE-SUGAR	MEIS-BURGER 2	MEIS-BURGER 7	SPECIES-TOTAL	PERCENT-SPECIES-COMP.
ALEWIFE	28.7	.	0.3	.	0.3	0.3	0.7	0.3	30.7	15.0
AMERICAN SHAD	0.7	.	.	.	.	.	.	.	0.7	0.3
ATLANTIC COD	.	.	.	.	.	.	.	1.3	1.3	0.7
ATLANTIC TOMCOD	0.7	.	0.3	.	1.0	.	.	.	2.0	1.0
BLUE RUNNER	0.3	.	.	.	.	.	.	.	0.3	0.2
BLUEBACK HERRING	52.0	0.3	0.7	0.3	.	.	.	.	53.3	26.1
BLUEFISH	3.7	0.3	.	.	.	.	.	.	4.0	2.0
BUTTERFISH	0.3	.	.	.	0.7	.	.	.	1.0	0.5
CUNNER	.	1.7	0.3	.	0.3	.	3.0	0.3	5.7	2.8
GREEN CRAB	.	2.0	.	.	.	.	.	.	2.0	1.0
GRUBBY	.	.	.	0.3	.	.	.	.	0.3	0.2
HAKE SP.	1.0	.	.	.	.	.	.	1.0	2.0	1.0
HORSESHOE CRAB	.	.	.	.	0.3	.	.	.	0.3	0.2
LOBSTER	.	0.3	.	0.3	.	.	5.0	4.3	10.0	4.9
LONGHORN SCULPIN	.	.	.	.	.	.	2.0	0.7	2.7	1.3
MACKEREL	.	.	.	.	.	0.3	6.3	12.3	19.0	9.3
MACKEREL SCAD	0.3	.	.	.	.	.	.	.	0.3	0.2
RAINBOW SMELT	3.3	15.3	18.3	6.3	4.7	3.0	.	.	51.0	25.0
SCUP	.	.	.	.	.	.	.	0.3	0.3	0.2
SILVER HAKE	.	.	.	.	.	.	.	0.3	0.3	0.2
SKATE SP.	1.0	.	.	1.7	.	.	.	0.7	3.3	1.6
SPIDER CRAB	1.0	.	.	.	.	.	.	.	1.0	0.5
STRIPED BASS	1.0	0.3	.	0.7	.	.	.	.	2.0	1.0
WINTER FLOUNDER	2.7	2.0	.	3.7	.	0.3	0.3	.	9.0	4.4
STATION TOTAL	96.7	22.3	20.3	13.7	7.3	4.7	17.3	21.7	204.0	.
PERCENT STATION-COMPOSITION	47.4	10.9	10.0	6.7	3.6	2.3	8.5	10.6	.	100.0

Table A1-7. Catch per unit effort (number/trap-day) by sex for sublegal and legal sized lobsters captured in Boston Harbor, October 1994.

SUBLEGALS

SEX	LOCATION												
	LMCh.	Inner-Conf.	Chel-01	Chel.-Riv.	MysticR.	RevSug.	ResCh	Log02	Outer-Hbr.	SpecIs.	Meis#2	Meis#7	BLS
MALES	0.4	0.8	0.0	0.1	0.2	0.1	0.7	0.7	0.0	0.2	2.8	2.3	1.3
FEMALES	0.1	0.1	0.1	0.0	0.0	0.1	0.6	0.1	0.0	0.0	3.5	2.7	1.5
TOTAL	0.6	0.9	0.1	0.1	0.2	0.2	1.2	0.8	0.0	0.2	6.3	5.0	2.8

LEGALS

SEX	LOCATION												
	LMCh.	Inner-Conf.	Chel-01	Chel.-Riv.	MysticR.	RevSug.	ResCh	Log02	Outer-Hbr.	SpecIs.	Meis#2	Meis#7	BLS
MALES	0.6	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.1	0.1	0.1
FEMALES	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1
TOTAL	0.6	0.0	0.0	0.1	0.0	0.1	0.2	0.1	0.0	0.0	0.1	0.1	0.1

TOTAL

SEX	LOCATION												
	LMCh.	Inner-Conf.	Chel-01	Chel.-Riv.	MysticR.	RevSug.	ResCh	Log02	Outer-Hbr.	SpecIs.	Meis#2	Meis#7	BLS
MALES	1.0	0.8	0.0	0.1	0.2	0.2	0.9	0.7	0.0	0.2	2.9	2.4	1.4
FEMALES	0.1	0.1	0.1	0.1	0.0	0.1	0.6	0.2	0.0	0.0	3.5	2.7	1.5
TOTAL	1.1	0.9	0.1	0.2	0.2	0.3	1.4	0.9	0.0	0.2	6.4	5.1	2.9

TABLE A1-8. SHORELINE SITE FOOTPRINT

SITE	FOOTPRINT (acres)
Amstar	3.5
Cabot Paint	5.6
Little Mystic Ch.	15.0
Mystic Piers	2.7
Reserved Channel	7.7-16.6
Revere Sugar	3.7

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TABLE A1-9. SEDIMENT CHARACTERISTICS IN THE VICINITY OF POTENTIAL DISPOSAL SITE EAST OF SPECTACLE ISLAND, 1988[a].

PARAMETER[a]	ST1-7 (0-2')[b]	ST1-8 (0-1')	ST1-8 (1-6.25')	ST1-9 (0-2')	ST1-11 (0-2')	ST1-12 (0-1.5')
Arsenic	9.2	14.8	27.8	3.8	2.5	13.1
Cadmium	0.7	0.8	0.8	<0.5	0.8	2.8
Chromium	16.0	19.2	25.3	12.1	19.1	20.9
Copper	8.7	18.0	17.1	5.3	22.4	14.1
Lead	7.5	14.4	10.1	9.5	16.1	11.7
Mercury	<0.01	0.06	<0.01	0.02	0.11	0.06
Nickel	15.5	15.8	23.5	10.5	20.1	22.8
Vanadium	22	23	39	17	20	37
Zinc	32.2	35.8	41.2	64.0	37.7	53.8
% Water	27	26	37	27.6	24	20
% Volatile Solids	3	2	2	0.8	9	2
% Oil and Grease	0.042	0.032	0.020	0.080	0.025	<0.010
Total Petroleum Hydrocarbons	<100	200	100	<100	<100	<100
% Total Organic Carbon	0.52	1.40	1.20	0.60	0.64	0.77
Polychlorinated Biphenyls	TR	0.02	ND	ND	TR	ND
% Silt/Clay	48	23	50	31	21	7
Classification	1A	2A	3A	1A	1B	2A

Source: Cortell 1990b
[a]All results in mg/kg (ppm) dry weight unless otherwise noted.
[b]Depth below sediment surface
TR = Traces below detection limit
ND = Not detected

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TABLE A1-10. MEAN ABUNDANCE (NO./m^2) BY HABITAT OF BENTHIC INFAUNA RETAINED ON A 0.5mm-MESH SIEVE COLLECTED FROM OUTER BOSTON HARBOR LOCATIONS, OCTOBER 1994.

GROUP	SPECIES	SPECTACLE ISLAND HABITAT I	SPECTACLE ISLAND HABITAT II	SUBAQUEOUS B HABITAT I	SUBAQUEOUS E HABITAT I	SUBAQUEOUS E HABITAT II
NO. OF SAMPLES	TOTAL	4.0	1.0	3.0	2.0	1.0
HYDROZOA	CLYTIA GRACILIS				P	
	EUDENDRIUM RUGOSUM				P	
	SERTULARIA CUPRESSINA	P		P	P	
NEMERTINEA	NEMERTINEA	62.5		166.7	25.0	
NEMATODA	NEMATODA	1325.0	325.0	483.3	2012.5	50.0
POLYCHAETA	AGLAOPHAMUS NEOTENUS		50.0		25.0	
	AMPHARETE ARCTICA	6.3				
	AMPHARETIDAE	6.3				
	ANAITIDES MUCOSA	650.0	300.0	2075.0	625.0	
	ANOBOTHRUS GRACILIS	6.3				
	APHELOCHAETA MARIONI				287.5	
	ARICIDEA (ACMIRA) CATHERINAE	9668.8	3075.0	1041.7		
	ARICIDEA SP.			8.3	12.5	
	ASABELLIDES OCULATA	143.8	150.0	41.7	212.5	25.0
	CAPITELLA CAPITATA	81.3	25.0	108.3	537.5	
	CIRRATULIDAE	1787.5	450.0	483.3	3362.5	25.0
	CIRRATULUS CIRRATUS				12.5	
	CLYMENELLA TORQUATA		200.0	8.3	25.0	
	ENIPO TORELLI			16.7		
	ETEONE LONGA	381.3	100.0	300.0	1087.5	
	EUCHONE ELEGANS		25.0			
	EULALIA VIRIDIS			8.3		
	GATTYANA CIRROSA		50.0	16.7		
	HARMOTHOE IMBRICATA			41.7	87.5	
	LEITOSCOLOPLOS ACUTUS					50.0
	MALDANIDAE				37.5	
	MEDIOMASTUS CALIFORNIENSIS	568.8	200.0	533.3	462.5	
	MICROPHTHALMUS ABERRANS		25.0		12.5	
	NEANTHES VIRENS			16.7	75.0	25.0
	NEPHTYIDAE	6.3				
	NEPHTYS CAECA	6.3	675.0			25.0
	NEPHTYS CILIATA	206.3	325.0	25.0	75.0	200.0
	NEPHTYS INCISA			8.3	12.5	
	NEREIDAE	12.5				
	NICOLEA ZOSTERICOLA			8.3		
	NINOE NIGRIPES	175.0	50.0	41.7	50.0	150.0
	PARANAITIS SPECIOSA	6.3	25.0		12.5	
	PHERUSA AFFINIS			41.7		
	PHOLOE MINUTA	100.0		125.0	475.0	
	PHYLLODOCIDAE			8.3		
	POLYDORA CORNUTA	4706.3	14400.0	4625.0	9300.0	
	POLYDORA QUADRILOBATA	25.0	1850.0	8.3		

(CONTINUED)

TABLE A1-10. (Continued)

GROUP	SPECIES	SPECTACLE ISLAND HABITAT I	SPECTACLE ISLAND HABITAT II	SUBAQUEOUS B HABITAT I	SUBAQUEOUS E HABITAT I	SUBAQUEOUS E HABITAT II
POLYCHAETA	POLYDORA SOCIALIS	18.8	1175.0	8.3	12.5	
	POLYDORA WEBSTERI	6.3				
	PRIONOSPIO STEENSTRUPI	6.3		8.3	75.0	
	SCOLELEPIS TEXANA		75.0			
	SCOLETOMA ACICULARUM		25.0		25.0	
	SCOLETOMA HEBES			500.0		
	SPIO FILICORNIS	6.3				
	SPIO LIMICOLA		25.0			
	SPIO SP.	25.0	25.0	16.7	25.0	
	SPIO THULINI	18.8	175.0	66.7	262.5	
	SPIONIDAE		50.0	16.7		
	SPIOPHANES BOMBYX		25.0			
	STREBLOSPIO BENEDICTI	81.3	11800.0	16.7	550.0	25.0
	TEREBELLIDAE				12.5	
	THARYX ACUTUS	1543.8	575.0	1733.3	6025.0	
OLIGOCHAETA	OLIGOCHAETA	1475.0	250.0	1033.3	287.5	50.0
GASTROPODA	GASTROPODA	50.0		50.0	125.0	
	LACUNA VINCTA	12.5			25.0	
	NASSARIUS TRIVITTATUS		200.0		287.5	250.0
BIVALVIA	BIVALVIA	25.0		33.3	62.5	
	CERASTODERMA PINNULATUM			8.3		
	LYONSIA HYALINA		25.0	33.3		
	MYA ARENARIA				25.0	25.0
	MYSELLA PLANULATA			8.3	37.5	
	MYTILIDAE	31.3	25.0	41.7	150.0	50.0
	TELLINA AGILIS		50.0		125.0	
CIRRIPEDIA	CIRRIPEDIA			8.3		
MYSIDACEA	METERYTHROPS ROBUSTA	6.3				
	MYSIDACEA	6.3		25.0		
	NEOMYSIS AMERICANA			33.3		
CUMACEA	DIASTYLIS SP.			8.3		
ISOPODA	CHIRIDOTEA SP.	6.3				
	CYATHURA POLITA	6.3				
	EDOTEA TRILOBA	37.5	50.0	116.7	25.0	
AMPHIPODA	AMPELISCA SP.	36537.5	61675.0	94358.3	23075.0	
	AMPHIPODA	6.3				
	COROPHIUM BONELLI	700.0	75.0			
	COROPHIUM CRASSICORNE	56.3				
	COROPHIUM SP.	50.0				
	ERICHTHONIUS FASCIATUS	6.3				
	GAMMARUS SP.	87.5			12.5	
	JASSA MARMORATA	6.3	25.0			
	LEPTOCHEIRUS PINGUIS	1250.0	3100.0	1883.3	637.5	
	LEPTOCHEIRUS SP.			8.3		

(CONTINUED)

TABLE A1-10. (Continued)

GROUP	SPECIES	SPECTACLE ISLAND		SUBAQUEOUS B	SUBAQUEOUS E	
		HABITAT		HABITAT	HABITAT	
		I	II	I	I	II
AMPHIPODA	LYSIANASSIDAE	31.3		108.3		
	ORCHOMENELLA PINGUIS	6.3		33.3		
	PHOTIS POLLEX	81.3		16.7		
	PHOXOCEPHALUS HOLBOLLI	2062.5	125.0	2850.0	212.5	
	PHOXOCEPHALUS SP.			8.3		
	UNCIOLA IRRORATA	368.8	175.0	1550.0		
	UNCIOLA SP.	306.3		266.7	37.5	
DECAPODA	CANCER IRRORATUS	6.3		33.3	12.5	25.0
	CRANGON SEPTEMSPINOSA	6.3		25.0	37.5	
	DECAPODA	6.3				
BRYOZOA	BUGULA TURRITA			P		
	MEMBRANIPORA MEMBRANACEA	P				
	PEDICELLINA CERNUA			P		
	SCRUPARIA AMBIGUA					P
X NO. OF INDIV	TOTAL	64870.6	102025.0	115149.6	50987.5	975.0
X HYDROZOA	TOTAL	P		P	P	
X NEMERTINEA	TOTAL	62.5		166.7	25.0	
X NEMATODA	TOTAL	1325.0	325.0	483.3	2012.5	50.0
X POLYCHAETA	TOTAL	20251.0	35925.0	11958.3	23775.0	525.0
X OLIGOCHAETA	TOTAL	1475.0	250.0	1033.3	287.5	50.0
X GASTROPODA	TOTAL	62.5	200.0	50.0	437.5	250.0
X BIVALVIA	TOTAL	56.3	100.0	124.9	400.0	75.0
X CIRRIPEDIA	TOTAL			8.3		
X MYSIDACEA	TOTAL	12.6		58.3		
X CUMACEA	TOTAL			8.3		
X ISOPODA	TOTAL	50.1	50.0	116.7	25.0	
X AMPHIPODA	TOTAL	41556.7	65175.0	101083.2	23975.0	
X DECAPODA	TOTAL	18.9		58.3	50.0	25.0
X BRYOZOA	TOTAL	P		P		P
NO. OF TAXA	TOTAL	59.0	41.0	60.0	51.0	15.0

TABLE A1-11. MEAN ABUNDANCE (NO./m^2) BY HABITAT OF BENTHIC INFAUNA RETAINED ON A 0.5mm-MESH SIEVE COLLECTED FROM OFFSHORE LOCATIONS, OCTOBER 1994.

GROUP	SPECIES	BOSTON LIGHTSHIP		MEISBURGER 2			MEISBURGER 7		
		HABITAT		HABITAT			HABITAT		
		VII	VIII	V	VII	VIII	V	VI	VII
NO. OF SAMPLES	TOTAL	8.0	3.0	1.0	6.0	2.0	2.0	4.0	1.0
PORIFERA	SCYPHA CILIATA				12.5				
HYDROZOA	CLYTIA GRACILIS		P						
	EUDENDRIUM RUGOSUM				P				
	EUDENDRIUM SP.				P				
	SERTULARIA CUPRESSINA	P			P		P		
ANTHOZOA	ANTHOZOA	25.0			20.8				25.0
	CERIANTHEOPSIS AMERICANUS		8.3	25.0	12.5		12.5		25.0
	CERIANTHEOPSIS SP.				16.7				
	EDWARDSIA SP.	9.4	41.7	50.0	66.7	62.5	25.0		100.0
NEMERTINEA	NEMERTINEA	62.5	50.0		137.5	162.5	12.5	31.3	
NEMATODA	NEMATODA	71.9			91.7			31.3	
ARCHIANNELIDA	ARCHIANNELIDA				45.8			12.5	
POLYCHAETA	AGLAOPHAMUS CIRCINATA	3.1		50.0	12.5	37.5		6.3	300.0
	AMPHARETE ACUTIFRONS	53.1	8.3						
	AMPHARETE ARCTICA	75.0	33.3	25.0	112.5	75.0	37.5	6.3	25.0
	AMPHARETE SP.	9.4							
	AMPHARETIDAE	25.0	16.7		29.2	87.5	37.5	31.3	125.0
	AMPHITRITE CIRRATA				4.2				
	ANAITIDES ARENAE	3.1							
	ANAITIDES MACULATA	28.1		725.0	37.5	50.0	37.5	25.0	
	ANAITIDES MUCOSA	6.3		150.0	29.2		12.5	18.8	75.0
	ANOBOTHRUS GRACILIS	140.6	433.3		29.2	25.0	12.5	6.3	
	APHELOCHAETA MARIONI	171.9	308.3		858.3	1950.0	12.5	12.5	50.0
	APHELOCHAETA MONILARIS	3.1			29.2	75.0		6.3	
	APISTOBRANCHUS TULLBERGI	3.1							
	ARCTEOBIA ANTICOSTIENSIS	12.5	8.3		4.2	12.5			
	ARICIDEA (ACMIRA) CATHERINAE				50.0	37.5	275.0	75.0	25.0
	ARICIDEA QUADRILOBATA	28.1							
	ASABELLIDES OCULATA	331.3	91.7	175.0	337.5	400.0	225.0	368.8	975.0
	BARANTOLLA AMERICANA				4.2				
	CAPITELLA CAPITATA	6.3			50.0	175.0			50.0
	CAULLERIELLA CF. KILLARIENSIS							12.5	
	CHAETOZONE SETOSA	21.9	8.3	400.0	25.0	62.5		6.3	125.0
	CHONE DUNERI					12.5		6.3	
	CIRRATULIDAE	3.1	8.3	350.0	16.7	100.0	200.0	25.0	75.0
	CIRRATULUS CIRRATUS	3.1			4.2	12.5	12.5		
	COSSURA LONGOCIRRATA	3.1							
	DRILONEREIS LONGA	6.3	33.3		4.2				
	DRILONEREIS MAGNA						12.5		
	ENIPO TORELLI	9.4	8.3					6.3	
	ETEONE LONGA	43.8		100.0	41.7	12.5		6.3	
	EUCHONE ELEGANS			1050.0	54.2	2437.5	112.5	331.3	175.0

(CONT

TABLE A1-11. (Continued)

GROUP	SPECIES	BOSTON LIGHTSHIP		MEISBURGER 2			MEISBURGER 7		
		HABITAT		HABITAT			HABITAT		
		VII	VIII	V	VII	VIII	V	VI	VII
POLYCHAETA	EUCHONE INCOLOR	12.5							
	EUCHONE SP.				125.0			56.3	
	EUCLYMENE COLLARIS	12.5		475.0	200.0	725.0	450.0	575.0	975.0
	EULALIA BILINEATA					12.5			
	EUSYLLIS SP.							12.5	
	EXOGONE DISPAR				4.2		37.5	18.8	
	EXOGONE HEBES					50.0		6.3	
	EXOGONE SP.				8.3	25.0	50.0	18.8	
	EXOGONE VERUGERA	6.3		150.0	29.2	187.5	287.5	412.5	25.0
	GALATHOWENIA OCULATA	46.9	116.7		12.5		12.5		
	GATTYANA AMONDSENI	15.6	8.3		12.5	12.5			
	GATTYANA CIRROSA				16.7				
	GLYCERA CAPITATA			50.0	16.7		37.5	112.5	
	GONIADA MACULATA	31.3			8.3	12.5			
	HARMOTHOE IMBRICATA	3.1			16.7			6.3	
	HETEROMASTUS FILIFORMIS	9.4	8.3	25.0					
	LAGISCA EXTENUATA		8.3		4.2			18.8	
	LAONICE CIRRATA				16.7				
	LAONOME KROYERI	37.5	33.3	150.0	8.3	37.5			
	LEITOSCOLOPLOS ACUTUS	56.3	16.7	75.0	154.2	100.0		6.3	
	LEVINSENIA GRACILIS	193.8	33.3		25.0		100.0	50.0	
	LYSILLA LOVENI	15.6							
	MALDANE SARSI	56.3	441.7		308.3	37.5	37.5		
	MALDANIDAE	93.8	50.0	100.0		25.0		93.8	
	MARENZELLERIA VIRIDIS	3.1							
	MEDIOMASTUS CALIFORNIENSIS	631.3	41.7	400.0	600.0	800.0	37.5	81.3	25.0
	MICROPHTHALMUS ABERRANS				4.2				
	MINUSPIO CIRRIFERA	9.4						6.3	
	MONTICELLINA BAPTISTAE								
	MONTICELLINA DORSOBRANCHIALIS	3.1		25.0	25.0	12.5	37.5	37.5	
	MYRIOCHELE HEERI	9.4	8.3			12.5			
	NEPHTYIDAE				4.2				
	NEPHTYS CAECA					12.5			25.0
	NEPHTYS CILIATA					50.0			
	NEPHTYS INCISA	56.3	58.3		8.3		12.5		
	NEREIS GRAYI	3.1				12.5			
	NEREIS SP.	18.8			29.2	112.5			25.0
	NEREIS ZONATA	3.1				25.0			
	NINOE NIGRIPES	118.8	125.0	25.0	250.0	250.0	450.0	75.0	25.0
	OPHELINA ACUMINATA	3.1							
	ORBINIIDAE	3.1							
	OWENIA FUSIFORMIS		16.7		12.5	25.0			
	PARADONEIS LYRA						37.5		25.0

(CONTINUED)

TABLE A1-11. (Continued)

GROUP	SPECIES	BOSTON LIGHTSHIP		MEISBURGER 2			MEISBURGER 7		
		HABITAT		HABITAT			HABITAT		
		VII	VIII	V	VII	VIII	V	VI	VII
POLYCHAETA	PARAPIONOSYLLIS LONGICIRRATA							6.3	
	PECTINARIA GRANULATA				25.0	12.5			
	PHERUSA AFFINIS					37.5			
	PHOLOE MINUTA	12.5	8.3	75.0	33.3		37.5	31.3	
	PHYLLODOCIDAE				16.7				
	POLYCIRRUS MEDUSA							6.3	
	POLYCIRRUS PHOSPHOREUS	3.1			4.2				
	POLYCIRRUS SP.	6.3	16.7	50.0	20.8		12.5		
	POLYDORA CAULLERYI			50.0	8.3	12.5	312.5	6.3	
	POLYDORA CONCHARUM		16.7						
	POLYDORA CORNUTA				4.2				
	POLYDORA QUADRILOBATA			1225.0	991.7	4025.0	37.5		25.0
	POLYDORA SOCIALIS	103.1	33.3	925.0	816.7	1337.5	787.5	62.5	400.0
	POLYDORA SP.						12.5	6.3	
	POLYNOIDAE							6.3	
	PRAXILLELLA PRAETERMISSA		33.3		45.8			18.8	
	PRAXILLURA ORNATA	90.6							
	PRIONOSPIO STEENSTRUPI	537.5	66.7	1125.0	250.0	812.5	12.5	12.5	100.0
	PROTODORVILLEA GASPEENSIS							6.3	
	RHODINE BITORQUATA	25.0		25.0		75.0			
	SABELLIDAE	3.1	16.7	100.0	8.3	112.5		287.5	600.0
	SCALIBREGMA INFLATUM	203.1	41.7	150.0	170.8	112.5			
	SCHISTOMERINGOS CAECA							6.3	
	SCOLETOMA ACICULARUM							6.3	
	SCOLETOMA FRAGILIS	15.6	66.7		29.2	37.5	12.5		
	SCOLETOMA HEBES	3.1							
	SCOLOPLOS ARMIGER	15.6	8.3		8.3	50.0			100.0
	SPHAEROSYLLIS SP.							12.5	
	SPIO FILICORNIS			25.0	20.8	25.0	25.0		
	SPIO LIMICOLA	4268.8	991.7	50.0	541.7	675.0	150.0	31.3	675.0
	SPIO SETOSA				4.2				
	SPIO SP.	56.3	25.0		20.8		12.5	12.5	
	SPIO THULINI	3.1		100.0	66.7	50.0	62.5	87.5	75.0
	SPIONIDAE	50.0	25.0	25.0	45.8	50.0	12.5	6.3	
	SPIOPHANES BOMBYX			25.0	16.7	37.5		12.5	1100.0
	SPIOPHANES KROYERI	15.6	58.3			12.5			
	STERNAPSIS SCUTATA	3.1	8.3						
	SYLLIDAE					12.5			
	SYLLIS (TYPOSYLLIS)ALTERNATA				33.3				
	TEREBELLIDAE	18.8	8.3						
	TEREBELLIDES ATLANTIS	21.9	16.7						
	TEREBELLIDES STROEMI	15.6	41.7						
	THARYX ACUTUS	15.6		100.0	25.0	50.0	75.0	200.0	25.0

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TABLE A1-11. (Continued)

GROUP	SPECIES	BOSTON LIGHTSHIP		MEISBURGER 2			MEISBURGER 7		
		HABITAT		HABITAT			HABITAT		
		VII	VIII	V	VII	VIII	V	VI	VII
POLYCHAETA	TRICHOBRANCHUS ROSEUS	3.1	25.0						
	TROCHOCHAETA MULTISETOSA	12.5							
	TROCHOCHÁETA SP.				8.3				
	TYPOSYLLIS SP.			50.0	12.5	37.5			
OLIGOCHAETA	OLIGOCHAETA	3.1			12.5		25.0	25.0	
GASTROPODA	ALVANIA EXARATA		8.3		12.5				
	BUCCINUM UNDATUM				4.2		12.5		
	COLUS PUBESCENS	9.4	8.3						
	COLUS SP.	12.5							
	CREPIDULA FORNICATA							12.5	
	GASTROPODA	3.1	8.3						
	LACUNA VINCTA			25.0	8.3				
	LUNATIA HEROS					12.5			
	MARGARITES HELICINUS			50.0					
	NASSARIUS TRIVITTATUS			125.0	4.2	25.0		6.3	50.0
	OENOPOTA DECUSSATA	3.1							
	RETUSA OBTUSA	3.1							
	TURRIDAE				4.2				
POLYPLACOPHORA	ISCHNOCHITON ALBUS							6.3	
BIVALVIA	ANOMIA SP.			25.0	20.8			12.5	
	ARCTICA ISLANDICA	3.1							
	ASTARTE BOREALIS							18.8	
	ASTARTE SP.								25.0
	ASTARTE UNDATA	34.4	58.3	25.0	37.5	62.5		18.8	
	BIVALVIA	12.5	16.7		4.2	37.5	25.0	6.3	125.0
	CERASTODERMA PINNULATUM	9.4	108.3	75.0	162.5	62.5	37.5	143.8	75.0
	CRENELLA DECUSSATA	15.6	41.7		250.0	175.0	12.5	100.0	
	CRENELLA GLANDULA				25.0		12.5	93.8	25.0
	CRENELLA SP.			25.0	37.5			25.0	
	HIATELLA SP.			25.0	25.0			12.5	
	LYONSIA HYALINA				4.2				
	MUSCULUS NIGER				8.3	12.5		6.3	
	MYA ARENARIA	6.3	33.3	25.0	16.7				
	MYSELLA PLANULATA	9.4			4.2				
	MYTILIDAE	3.1		50.0	20.8	12.5		31.3	
	NUCULA SP.			25.0					
	NUCULA TENUIS	21.9	25.0		166.7	387.5	50.0		
	PECTINIDAE						12.5		
	PERIPLOMA LEANUM	3.1	8.3						
	PERIPLOMA SP.								
	PLACOPECTEN MAGELLANICUS							6.3	
	THRACIA MYOPSIS	6.3			4.2				
	THYASIRA FLEXUOSA	234.4	350.0		208.3	87.5			
	YOLDIA SAPOTILLA	62.5	33.3		16.7				
	YOLDIA SP.	40.6	41.7		8.3	25.0			

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TABLE A1-11. (Continued)

GROUP	SPECIES	BOSTON LIGHTSHIP HABITAT VII	BOSTON LIGHTSHIP HABITAT VIII	MEISBURGER 2 HABITAT V	MEISBURGER 2 HABITAT VII	MEISBURGER 2 HABITAT VIII	MEISBURGER 7 HABITAT V	MEISBURGER 7 HABITAT VI	MEISBURGER 7 HABITAT VII
CIRRIPEDIA	CIRRIPEDIA				4.2				
MYSIDACEA	MYSIDACEA	9.4		75.0	16.7	12.5		6.3	
CUMACEA	CAMPYLASPIS RUBICUNDA	15.6			4.2				25.0
	DIASTYLIS ABBREVIATA	6.3				25.0			
	DIASTYLIS BISPINOSA	31.3							
	DIASTYLIS SCULPTA				8.3				
	EUDORELLA PUSILLA	3.1							
	PETALOSARSIA DECLIVIS				4.2				
ISOPODA	EDOTEA TRILOBA	40.6	33.3	50.0	50.0	75.0			100.0
	JAERA MARINA	3.1						6.3	
	PLEUROGONIUM SPINOSISSIMUM		8.3		8.3				
	POLITOLANA CONCHARUM								25.0
	PTILANTHURA SP.				58.3	112.5			
AMPHIPODA	AEGININA LONGICORNIS				16.7				
	AMPELISCA MACROCEPHALA	43.8			8.3	25.0			
	AMPELISCA SP.	6.3					12.5	18.8	
	AMPHIPODA	3.1							
	ANONYX LILJEBORGI	18.8			16.7	12.5			
	ANONYX SARSI						12.5	6.3	
	ARGISSA HAMATIPES				4.2				125.0
	BYBLIS SERRATA	3.1	8.3						
	CASCO BIGELOWI				4.2				
	COROPHIIDAE		8.3						
	COROPHIUM CRASSICORNE			100.0	8.3	162.5	37.5	12.5	25.0
	ERICHTHONIUS FASCIATUS	6.3			62.5	150.0			
	ERICHTHONIUS SP.				12.5			12.5	
	GAMMARUS LAWRENCIANUS				4.2				
	GAMMARUS SP.	6.3							
	HAPLOOPS SP.		16.7		4.2				
	HAPLOOPS TUBICOLA	81.3	175.0		212.5	162.5			
	HARPINIA PROPINQUA	18.8	25.0		8.3	25.0			
	HIPPOMEDON SERRATUS	6.3	8.3		12.5				25.0
	JASSA MARMORATA							6.3	
	LEMBOS WEBSTERI			400.0	75.0		50.0	56.3	25.0
	LEPTOCHEIRUS PINGUIS	15.6	108.3	25.0	62.5	125.0	25.0	6.3	
	LYSIANASSIDAE				4.2	25.0			
	MONOCULODES SP.	3.1						6.3	
	MONOCULODES TUBERCULATUS				4.2		25.0	12.5	
	OEDICEROTIDAE							25.0	
	PHOTIS POLLEX				4.2	12.5			
	STENOPLEUSTES SP.				4.2				
	SYRRHOE CRENULATA						25.0	6.3	25.0
	UNCIOLA INERMIS			1250.0	129.2		50.0	1618.8	
	UNCIOLA IRRORATA	6.3			37.5		312.5	550.0	25.0
	UNCIOLA SP.				50.0	100.0		43.8	

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ABLE A1-11. (Continued)

GROUP	SPECIES	BOSTON LIGHTSHIP HABITAT VII	BOSTON LIGHTSHIP HABITAT VIII	MEISBURGER 2 HABITAT V	MEISBURGER 2 HABITAT VII	MEISBURGER 2 HABITAT VIII	MEISBURGER 7 HABITAT V	MEISBURGER 7 HABITAT VI	MEISBURGER 7 HABITAT VII
DECAPODA	CANCER IRRORATUS							6.3	
	PAGURUS LONGICARPUS				4.2				
SIPUNCULA	GOLFINGIA SP.		8.3						
	SIPUNCULA	15.6			8.3				
PHORONIDA	PHORONIS ARCHITECTA	34.4	16.7	25.0	258.3	87.5	37.5	12.5	75.0
BRYOZOA	ANGUINELLA PALMATA				P				
	BUGULA TURRITA		P						
	CRISIA EBURNEA				P				
	ELECTRA PILOSA				P				
	EUCRATEA LORICATA	P			P				
	HIPPOTHOA HYALINA	P			P	P			
OPHIUROIDEA	OPHIOPHOLIS ACULEATA				4.2				
	OPHIURA ROBUSTA				4.2				
	OPHIURA SARSI	62.5	33.3			12.5			
	OPHIUROIDEA	6.3			8.3				
ECHINOIDEA	STRONGYLOCENTROTUS DROEBACHIENSIS				4.2			18.8	
CHORDATA	CHORDATA				4.2				
ASCIDIACEA	APLIDIUM SP.		P						
	ASCIDIA SP.		8.3						
	CORELLA BOREALIS	6.3			4.2				
NO. OF INDIV	TOTAL	9066.5	4732.7	11075.0	9534.4	17925.0	4962.5	6396.7	7150.0
PORIFERA	TOTAL				12.5				
HYDROZOA	TOTAL	P	P		P		P		
ANTHOZOA	TOTAL	34.4	50.0	75.0	116.7	62.5	37.5		150.0
NEMERTINEA	TOTAL	62.5	50.0		137.5	162.5	12.5	31.3	
NEMATODA	TOTAL	71.9			91.7			31.3	
ARCHIANNELIDA	TOTAL				45.8			12.5	
POLYCHAETA	TOTAL	7947.2	3433.1	8600.0	6863.0	15675.0	4137.5	3364.2	6225.0
OLIGOCHAETA	TOTAL	3.1			12.5		25.0	25.0	
GASTROPODA	TOTAL	31.2	24.9	200.0	33.4	37.5	12.5	18.8	50.0
POLYPLACOPHORA	TOTAL							6.3	
BIVALVIA	TOTAL	462.6	716.6	275.0	1020.9	862.5	150.0	475.4	250.0
CIRRIPEDIA	TOTAL				4.2				
MYSIDACEA	TOTAL	9.4		75.0	16.7	12.5		6.3	
CUMACEA	TOTAL	56.3			16.7	25.0			25.0
ISOPODA	TOTAL	43.7	41.6	50.0	116.6	187.5		6.3	125.0
AMPHIPODA	TOTAL	219.1	349.9	1775.0	746.1	800.0	550.0	2381.7	250.0
DECAPODA	TOTAL				4.2			6.3	
SIPUNCULA	TOTAL	15.6	8.3		8.3				
PHORONIDA	TOTAL	34.4	16.7	25.0	258.3	87.5	37.5	12.5	75.0
BRYOZOA	TOTAL	P	P		P	P			
OPHIUROIDEA	TOTAL	68.8	33.3		16.7	12.5			
ECHINOIDEA	TOTAL				4.2			18.8	
CHORDATA	TOTAL				4.2				

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TABLE A1-11. (Continued)

GROUP	SPECIES	BOSTON LIGHTSHIP		MEISBURGER 2			MEISBURGER 7		
		HABITAT		HABITAT			HABITAT		
		VII	VIII	V	VII	VIII	V	VI	VII
X ASCIDIACEA	TOTAL	6.3	8.3		4.2				
NO. OF TAXA	ZTOTAL	125.0	76.0	55.0	150.0	88.0	61.0	92.0	45.0

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TABLE A1-11. (Continued)

GROUP	SPECIES	MEISBURGER 7 / HABITAT / VIII
NO. OF SAMPLES	TOTAL	2.0
PORIFERA	SCYPHA CILIATA	
HYDROZOA	CLYTIA GRACILIS	
	EUDENDRIUM RUGOSUM	
	EUDENDRIUM SP.	
	SERTULARIA CUPRESSINA	P
ANTHOZOA	ANTHOZOA	
	CERIANTHEOPSIS AMERICANUS	62.5
	CERIANTHEOPSIS SP.	
	EDWARDSIA SP.	
NEMERTINEA	NEMERTINEA	50.0
NEMATODA	NEMATODA	
ARCHIANNELIDA	ARCHIANNELIDA	
POLYCHAETA	AGLAOPHAMUS CIRCINATA	
	AMPHARETE ACUTIFRONS	
	AMPHARETE ARCTICA	25.0
	AMPHARETE SP.	
	AMPHARETIDAE	
	AMPHITRITE CIRRATA	
	ANAITIDES ARENAE	
	ANAITIDES MACULATA	
	ANAITIDES MUCOSA	
	ANOBOTHRUS GRACILIS	
	APHELOCHAETA MARIONI	75.0
	APHELOCHAETA MONILARIS	
	APISTOBRANCHUS TULLBERGI	
	ARCTEOBIA ANTICOSTIENSIS	
	ARICIDEA (ACMIRA) CATHERINAE	37.5
	ARICIDEA QUADRILOBATA	
	ASABELLIDES OCULATA	12.5
	BARANTOLLA AMERICANA	
	CAPITELLA CAPITATA	12.5
	CAULLERIELLA CF. KILLARIENSIS	
	CHAETOZONE SETOSA	
	CHONE DUNERI	
	CIRRATULIDAE	112.5
	CIRRATULUS CIRRATUS	
	COSSURA LONGOCIRRATA	
	DRILONEREIS LONGA	
	DRILONEREIS MAGNA	
	ENIPO TORELLI	12.5
	ETEONE LONGA	12.5

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TABLE A1-11. (Continued)

GROUP	SPECIES	MEISBURGER 7 HABITAT VIII
POLYCHAETA	EUCHONE ELEGANS	
	EUCHONE INCOLOR	
	EUCHONE SP.	
	EUCLYMENE COLLARIS	
	EULALIA BILINEATA	
	EUSYLLIS SP.	
	EXOGONE DISPAR	
	EXOGONE HEBES	
	EXOGONE SP.	
	EXOGONE VERUGERA	
	GALATHOWENIA OCULATA	
	GATTYANA AMONDSENI	
	GATTYANA CIRROSA	
	GLYCERA CAPITATA	
	GONIADA MACULATA	
	HARMOTHOE IMBRICATA	
	HETEROMASTUS FILIFORMIS	
	LAGISCA EXTENUATA	
	LAONICE CIRRATA	
	LAONOME KROYERI	
	LEITOSCOLOPLOS ACUTUS	62.5
	LEVINSENIA GRACILIS	125.0
	LYSILLA LOVENI	
	MALDANE SARSI	37.5
	MALDANIDAE	12.5
	MARENZELLERIA VIRIDIS	
	MEDIOMASTUS CALIFORNIENSIS	237.5
	MICROPHTHALMUS ABERRANS	
	MINUSPIO CIRRIFERA	
	MONTICELLINA BAPTISTAE	25.0
	MONTICELLINA DORSOBRANCHIALIS	75.0
	MYRIOCHELE HEERI	
	NEPHTYIDAE	
	NEPHTYS CAECA	
	NEPHTYS CILIATA	
	NEPHTYS INCISA	62.5
	NEREIS GRAYI	
	NEREIS SP.	
	NEREIS ZONATA	
	NINOE NIGRIPES	700.0
	OPHELINA ACUMINATA	
	ORBINIIDAE	
	OWENIA FUSIFORMIS	

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TABLE A1-11. (Continued)

GROUP	SPECIES	MEISBURGER 7 HABITAT VIII
POLYCHAETA	PARADONEIS LYRA	
	PARAPIONOSYLLIS LONGICIRRATA	
	PECTINARIA GRANULATA	
	PHERUSA AFFINIS	
	PHOLOE MINUTA	25.0
	PHYLLODOCIDAE	
	POLYCIRRUS MEDUSA	
	POLYCIRRUS PHOSPHOREUS	
	POLYCIRRUS SP.	
	POLYDORA CAULLERYI	
	POLYDORA CONCHARUM	
	POLYDORA CORNUTA	
	POLYDORA QUADRILOBATA	
	POLYDORA SOCIALIS	
	POLYDORA SP.	
	POLYNOIDAE	
	PRAXILLELLA PRAETERMISSA	
	PRAXILLURA ORNATA	
	PRIONOSPIO STEENSTRUPI	12.5
	PROTODORVILLEA GASPEENSIS	
	RHODINE BITORQUATA	
	SABELLIDAE	
	SCALIBREGMA INFLATUM	
	SCHISTOMERINGOS CAECA	
	SCOLETOMA ACICULARUM	
	SCOLETOMA FRAGILIS	12.5
	SCOLETOMA HEBES	
	SCOLOPLOS ARMIGER	
	SPHAEROSYLLIS SP.	
	SPIO FILICORNIS	
	SPIO LIMICOLA	237.5
	SPIO SETOSA	
	SPIO SP.	12.5
	SPIO THULINI	
	SPIONIDAE	12.5
	SPIOPHANES BOMBYX	
	SPIOPHANES KROYERI	
	STERNAPSIS SCUTATA	
	SYLLIDAE	
	SYLLIS (TYPOSYLLIS)ALTERNATA	
	TEREBELLIDAE	
	TEREBELLIDES ATLANTIS	

(CONTINUED)

TABLE A1-11. (Continued)

GROUP	SPECIES	MEISBURGER 7 HABITAT VIII
POLYCHAETA	TEREBELLIDES STROEMI	
	THARYX ACUTUS	87.5
	TRICHOBRANCHUS ROSEUS	
	TROCHOCHAETA MULTISETOSA	
	TROCHOCHAETA SP.	
	TYPOSYLLIS SP.	
OLIGOCHAETA	OLIGOCHAETA	
GASTROPODA	ALVANIA EXARATA	
	BUCCINUM UNDATUM	
	COLUS PUBESCENS	
	COLUS SP.	
	CREPIDULA FORNICATA	
	GASTROPODA	
	LACUNA VINCTA	
	LUNATIA HEROS	
	MARGARITES HELICINUS	
	NASSARIUS TRIVITTATUS	
	OENOPOTA DECUSSATA	
	RETUSA OBTUSA	
	TURRIDAE	
POLYPLACOPHORA	ISCHNOCHITON ALBUS	
BIVALVIA	ANOMIA SP.	
	ARCTICA ISLANDICA	
	ASTARTE BOREALIS	
	ASTARTE SP.	
	ASTARTE UNDATA	
	BIVALVIA	87.5
	CERASTODERMA PINNULATUM	
	CRENELLA DECUSSATA	
	CRENELLA GLANDULA	
	CRENELLA SP.	
	HIATELLA SP.	
	LYONSIA HYALINA	
	MUSCULUS NIGER	
	MYA ARENARIA	
	MYSELLA PLANULATA	
	MYTILIDAE	
	NUCULA SP.	
	NUCULA TENUIS	50.0
	PECTINIDAE	
	PERIPLOMA LEANUM	
	PERIPLOMA SP.	12.5
	PLACOPECTEN MAGELLANICUS	
	THRACIA MYOPSIS	

(CONT

TABLE A1-11. (Continued)

GROUP	SPECIES	MEISBURGER 7 HABITAT VIII
BIVALVIA	THYASIRA FLEXUOSA	
	YOLDIA SAPOTILLA	
	YOLDIA SP.	12.5
CIRRIPEDIA	CIRRIPEDIA	
MYSIDACEA	MYSIDACEA	
CUMACEA	CAMPYLASPIS RUBICUNDA	
	DIASTYLIS ABBREVIATA	
	DIASTYLIS BISPINOSA	
	DIASTYLIS SCULPTA	
	EUDORELLA PUSILLA	
	PETALOSARSIA DECLIVIS	
ISOPODA	EDOTEA TRILOBA	
	JAERA MARINA	
	PLEUROGONIUM SPINOSISSIMUM	
	POLITOLANA CONCHARUM	12.5
	PTILANTHURA SP.	
AMPHIPODA	AEGININA LONGICORNIS	
	AMPELISCA MACROCEPHALA	
	AMPELISCA SP.	137.5
	AMPHIPODA	
	ANONYX LILJEBORGI	
	ANONYX SARSI	
	ARGISSA HAMATIPES	
	BYBLIS SERRATA	
	CASCO BIGELOWI	
	COROPHIIDAE	
	COROPHIUM CRASSICORNE	
	ERICHTHONIUS FASCIATUS	
	ERICHTHONIUS SP.	
	GAMMARUS LAWRENCIANUS	
	GAMMARUS SP.	
	HAPLOOPS SP.	
	HAPLOOPS TUBICOLA	
	HARPINIA PROPINQUA	
	HIPPOMEDON SERRATUS	
	JASSA MARMORATA	
	LEMBOS WEBSTERI	
	LEPTOCHEIRUS PINGUIS	
	LYSIANASSIDAE	
	MONOCULODES SP.	
	MONOCULODES TUBERCULATUS	
	OEDICEROTIDAE	
	PHOTIS POLLEX	
	STENOPLEUSTES SP.	

(CONTINUED)

TABLE A1-11. (Continued)

GROUP	SPECIES	MEISBURGER 7 — HABITAT VIII
AMPHIPODA	SYRRHOE CRENULATA	
	UNCIOLA INERMIS	
	UNCIOLA IRRORATA	
	UNCIOLA SP.	12.5
DECAPODA	CANCER IRRORATUS	
	PAGURUS LONGICARPUS	
SIPUNCULA	GOLFINGIA SP.	
	SIPUNCULA	
PHORONIDA	PHORONIS ARCHITECTA	37.5
BRYOZOA	ANGUINELLA PALMATA	
	BUGULA TURRITA	
	CRISIA EBURNEA	
	ELECTRA PILOSA	
	EUCRATEA LORICATA	
	HIPPOTHOA HYALINA	
OPHIUROIDEA	OPHIOPHOLIS ACULEATA	
	OPHIURA ROBUSTA	
	OPHIURA SARSI	
	OPHIUROIDEA	
ECHINOIDEA	STRONGYLOCENTROTUS DROEBACHIENSIS	
CHORDATA	CHORDATA	
ASCIDIACEA	APLIDIUM SP.	
	ASCIDIA SP.	
	CORELLA BOREALIS	
X NO. OF INDIV	TOTAL	2512.5
X PORIFERA	TOTAL	
X HYDROZOA	TOTAL	P
X ANTHOZOA	TOTAL	62.5
X NEMERTINEA	TOTAL	50.0
X NEMATODA	TOTAL	
X ARCHIANNELIDA	TOTAL	
X POLYCHAETA	TOTAL	2037.5
X OLIGOCHAETA	TOTAL	
X GASTROPODA	TOTAL	
X POLYPLACOPHORA	TOTAL	
X BIVALVIA	TOTAL	162.5
X CIRRIPEDIA	TOTAL	
X MYSIDACEA	TOTAL	
X CUMACEA	TOTAL	
X ISOPODA	TOTAL	12.5
X AMPHIPODA	TOTAL	150.0
X DECAPODA	TOTAL	
X SIPUNCULA	TOTAL	

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TABLE A1-11. (Continued)

GROUP	SPECIES	MEISBURGER 7
		HABITAT
		VIII
X PHORONIDA	TOTAL	37.5
X BRYOZOA	TOTAL	
X OPHIUROIDEA	TOTAL	
X ECHINOIDEA	TOTAL	
X CHORDATA	TOTAL	
X ASCIDIACEA	TOTAL	
NO. OF TAXA	ZTOTAL	35.0

TABLE A1-12. DOMINANT FISH SPECIES[a] AND LOBSTERS IN TRAWLS CONDUCTED IN AN AREA JUST WEST[b] OF THE MWRA PROPOSED OUTFALL BY MASSACHUSETTS DIVISION OF MARINE FISHERIES, 1991-92.

COMMON NAME	5/91	5/92
FISH	PERCENT COMPOSITION	
Ocean pout	35	15
Longhorn sculpin	21	19
Winter flounder	19	33
Atlantic cod	17	10
Yellowtail flounder	7	16
All other spp.	1	7
Total	100%	100%
	ABUNDANCE	
Total # Indiv.	655	685
Trawl length (min)	20	13
Total CPU[c] est. (20 min)	655	1054
AMERICAN LOBSTER (Count)		
Total # Indiv.	17	60
Total CPU[c] est. (20 min)	17	92

[a]Those making up > 10% of the catch
[b]Approx. 42°23' N, 70°49' W ("Rosie's Hole")
[c]Catch Per Unit

TABLE A1-13. MIXING ZONES FOR DISPOSAL AT IN-CHANNEL LOCATIONS.

SITE	TYPICAL			WORST CASE		
	MAXIMUM LENGTH (m)	MAXIMUM WIDTH (m)	AREA (acres)	MAXIMUM LENGTH (m)	MAXIMUM WIDTH (m)	AREA (acres)
Mystic River	285	125	8.3	480	185	12.5
Chelsea River	300	95	6.4	1190	140	30.0
Inner Confluence	285	80	4.8	590	140	14.7

Note: analysis includes effects of simultaneous dredging in the vicinity of disposal operations; PCB analysis assumes disposal of the Mystic River sediments (worst case for PCBs) in Mystic

TABLE A1-14. RESULTS OF POLLUTANT TRANSPORT MODELLING FOR IN-CHANNEL DISPOSAL SITES.

PARAMETER	MAXIMUM 29-DAY CONCENTRATION	AMBIENT CONCENTRATION	WATER QUALITY STANDARD[1]
TSS	39 mg/L	0-19 mg/L	---[2]
Mercury	3.2 ng/L	4 ng/L	25 ng/L
Copper	5.7 ng/L	300 ng/L	2900 ng/L
Total PCBs	0.7-11.0 ng/L[3]	7 ng/L	30 ng/L
Naphthalene	86 ng/L	04. ng/L	2,350,000 ng/L[4]

[1] chronic level unless otherwise stated; Cu, chronic level = acute level
[2] no water quality standard established
[3] higher value caused by Mystic River sediments (25% of total silt to be disposed)
[4] actute level, no chronic level established

TABLE A1-15. RESULTS OF POLLUTANT TRANSPORT MODELLING AT SPECTACLE ISLAND CAD

PARAMETER	MAXIMUM 29-DAY CONCENTRATION	AMBIENT CONCENTRATION	WATER QUALITY STANDARD[1]
TSS	15 mg/L		---[2]
Mercury	0.6 ng/L	4 ng/L	25 ng/L
Copper	1.1 ng/L	300 ng/L	2900 ng/L[4]
Total PCBs	0.1-0.2 ng/L[3]	7 ng/L	30 ng/L
Naphthalene	24 ng/L	0.4 ng/L	2,350,000 ng/L4

1 chronic level unless otherwise stated
2 no water quality standard established
3 higher value due to Mystic River sediments (25% of total silt to be disposed)
4 acute level, no chronic level established

TABLE A1-16. SEDIMENT CHARACTERISTICS IN VICINITY OF PROPOSED SUBAQUEOUS CONTAINMENT SITES B AND E AND WINTHROP HARBOR CONTAINMENT SITE.

	LOCATION		
	SUBAQ B[b]		SUBAQ E[c]
PARAMETER[a]	ST1-14	ST1-15	B-33-L
% Silt/Clay	3	5	--
As	3.3	4.8	9
Cd	0.6	1.0	4.9
Cr	12.8	30.7	57
Cu	10.5	47.7	105
Pb	11.6	32.7	62
Hg	0.06	0.22	0.34
Ni	16.2	30.6	18
Zn	40.4	81.7	142
PCBs	TR	TR	<0.05
% Volatile solids	1	1	--
Oil and grease	<100	600	0.40
Total petroleum hydrocarbon	<100	400	--
% Total organic carbon	0.2	0.3	--

[a] Results in mg/kg (ppm) unless otherwise noted; all values relative to dry weight.
[b] Cortell, 1990b
[c] Massport, 1990
[d] Army Corps of Engineers, (NED) 1992

TABLE A1-17. RESULTS OF POLLUTANT TRANSPORT MODELLING AT SUBAQUEOUS B.

PARAMETER	MAXIMUM 29-DAY CONCENTRATION	AMBIENT CONCENTRATION	WATER QUALITY STANDARD[1]
TSS	7 mg/L		---[2]
Mercury	0.3 ng/L	4 ng/L	25 ng/L
Copper	0.6 ng/L	300 ng/L	2900 ng/L[4]
Total PCBs	0.06-0.3 ng/L[3]	7 ng/L	30 ng/L
Naphthalene	12 ng/L	0.4 ng/L	2,350,000 ng/L[4]

[1] chronic level unless otherwise stated
[2] no water quality standard established
[3] higher value due to Mystic River sediments (25% of total silt to be disposed)
[4] acute level, no chronic level established

TABLE A1-18. RESULTS OF POLLUTANT TRANSPORT MODELLING AT SUBAQUEOUS E.

PARAMETER	MAXIMUM 29-DAY CONCENTRATION	AMBIENT CONCENTRATION	WATER QUALITY STANDARD[1]
TSS	9 mg/L		---[2]
Mercury	0.3 ng/L	4 ng/L	25 ng/L
Copper	0.7 ng/L	300 ng/L	2900 ng/L[4]
Total PCBs	0.07-0.3 ng/L[3]	7 ng/L	30 ng/L
Naphthalene	14 ng/L	0.4 ng/L	2,350,000 ng/L[4]

[1] chronic level unless otherwise stated
[2] no water quality standard established
[3] higher value due to Mystic River sediments (25% of total silt to be disposed)
[4] acute level, no chronic level established

TABLE A1-19. MAXIMUM CONCENTRATION (mg/l) OF COPPER AND SILT/CLAY IN THE WATER STRATIFIED COLUMN AT THE BOSTON LIGHT SHIP DISPOSAL SITE UNDER SUMMER CONDITIONS ESTIMATED BY THE ADDAM'S MODEL FOUR HOURS AFTER A SINGLE DUMP OF 2,000 CU. YDS.

	MAX. CONCENTRATION OUTSIDE THE MIXING ZONEa		MAX. CONCENTRATION WITHIN THE MIXING ZONE		
DEPTH (ft)	COPPER[b]	SILT/ CLAY[c,d]	COPPER	SILT/ CLAY	SILT/CLAY CLOUD DIA. (ft)
1	0.00036	5.2	0.00035	5.2	
50	0.00035	5.5	0.00036	5.5	
108	0.00051	NE	0.00066	NE	
145	0.00038	6.3	0.00042	7.9	2738

[a]Mixing zone = Disposal site boundary
[*]WQ criteria, Copper = 0.0029 Mg/L
[b]Background, Copper = 0.00035 Mg/L
[c]Background, Total Suspended Solids = 4.5 mg/L
[d]Conc. silt/clay = Background TSS (4.5) + concentration on grid above background

TABLE A1-20. UTILITIES LOCATED WITHIN TRIBUTARIES PROPOSED FOR DEEPENING.

UTILITIES	DEPTH (MLW)
MWRA Water Tunnel (McArdle)	38.5
N.E. Telephone Cable	45.0
Boston Edison Electrical Cable	40.0
City of Boston Bridge Cable (McArdle)	45.0
City of Boston Fire Alarm Cable	45.0
MWRA Water Tunnel (to be removed)	35.1
MWRA Sewer Siphon	50.8
MWRA Water Tunnel	45.0
Boston Gas Siphon	40.3
MBTA Electrical Cable	40.0

TABLE A1-21. AVERAGE CONCENTRATION OF TOTAL ORGANIC CARBON AND TOTAL PETROLEUM HYDROCARBONS. MASSPORT DREDGING PROJECT.

SITE	AVG. CONC. TOC (%)	AVG. CONC. TPH
Army Base 1-3	3.9	3233
Army Base 4-9	2.7	2390
Boston Edison Intake	5.4	2851
Conley 11-13	4.1	1310
Conley 14-15	3.1	3127
Distrigas	6.6	4393
Eastern Minerals	3.6	2425
Boston Edison Barge Berth	10.2	3650
Gulf Oil	1.7	1820
Moran	5.6	3035
Mystic 2, 49, 50	2.4	2175
Mystic Pier 1	3.7	4640
North Jetty	3.1	2627
Prolerized	5.0	3970
Revere Sugar	4.5	3000

TABLE A1-22. COMPARISON OF AVERAGE LEAD AND CHROMIUM CONCENTRATIONS (MG/L) WITH MASSACHUSETTS DEP BULK SOIL CONCENTRATIONS (MG/L) FOR TCLP ANALYSIS. MASSPORT DREDGING PROJECT.

SITE	MASS DEP BULK SOIL LIMIT FOR CR AND PB (MG/KG)	AVERAGE BULK SEDIMENT CONC. (MG/KG)		EPA REG. LEVEL FOR CR & PB (MG/L)	TCLP RESULTS (MG/L)	
		CR	PB		CR	PB
Army Base	100	146	111	5	ND	0.33
Boston Edison Intake	100		103	5		
Conley	100	188	140	5	ND	0.29
Distrigas	100	149	657	5	ND	0.41
E. Minerals	100	242	221	5	ND	0.23
Boston Edison Barge Berth	100	173	175	5	ND	0.35
Gulf Oil	100	135	156	5	ND	0.17
Moran	100	100	350	5	0.07	0.26
Mystic Piers	100	164	299	5	ND	0.31
North Jetty	100	189	321	5	ND	0.46
Prolerized	100	151	476	5	ND	0.47
Revere Sugar	100	178	501	5	0.16	0.39

TABLE A1-23. CONCENTRATION OF SODIUM AND CHLORIDE FOR MASSPORT DREDGING PROJECT.

SITE	SODIUM (MG/KG)	CHLORIDE %
Conley	3250	1.9
Army Base	3600	1.8
Moran	5930	2.1
North Jetty	5560	1.8
Eastern Minerals	40140	1.6
Mystic Pier	6560	2.0
Gulf Oil	10650	1.1