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

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Boston Harbor, Massachusetts

Navigation Improvement Project and Berth Dredging Project

June 1995

US Army Corps
of Engineers
New England Division

Massachusetts
Port Authority
Maritime Department

FINAL
ENVIRONMENTAL IMPACT REPORT/ENVIRONMENTAL IMPACT STATEMENT
(FEIR/S)
Volume 3 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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APPENDIX A - SECRETARY'S CERTIFICATE

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street, Boston, 02202

June 30, 1994

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CERTIFICATE OF THE SECRETARY OF ENVIRONMENTAL AFFAIRS ON THE DRAFT ENVIRONMENTAL IMPACT REPORT

PROJECT NAME	: Boston Harbor Navigation Improvement Project and Berth Dredging Project
PROJECT LOCATION	: Boston
EOEA NUMBER	: 8695
PROJECT PROPONENT	: Massport
DATE NOTICED IN MONITOR	: April 25, 1994

The Secretary of Environmental Affairs hereby determines that the Draft Environmental Impact Report submitted on the above project adequately and properly complies with the Massachusetts Environmental Policy Act (G. L. c. 30, s. 61-62H) and with its implementing regulations (301 CMR 11.00).

Introduction

The Boston Harbor Navigation Improvement and Berth Dredging project (BHNIP) is a major infrastructure betterment project that has been linked to this region's economic vitality. The proposed dredging project will help facilitate the movement of goods by improving navigational efficiency and safety, and minimizing double-hauling of cargos in the 47 square mile Port of Boston, which handles more than 25 million tons of cargo, worth more than seven billion dollars annually.

The BHNIP includes deepening of two areas in the Main Ship Channel (the Inner Confluence and the mouth of the Reserved Channel) and dredging of three tributary channels (the Reserved Channel, the Mystic River Channel, and the Chelsea Creek Channel). Approximately 3.4 million cubic yards (c.y.) of marine sediment needs to be dredged, including 1.32 million c.y. of unconsolidated silty material that lies above 2.02 million c.y.

of uncontaminated clay material and 0.132 million c.y. of rock.[1] Boston Harbor was last dredged in 1983. The project has two proponents: Massport and the U.S. Army Corps of Engineers (USACOE). Accordingly, the documents reviewed are both a federal Draft Environmental Impact Statement (DEIS) and a state Draft Environmental Impact Report (DEIR). The project is scheduled to begin early in 1996.

The DEIR points out an overriding problem with dredging projects, including the BHNIP: "(t)he lack of suitable disposal alternatives have (sic) delayed port improvements not only in New England but nationwide." Recognizing this, I have made dredging issues a priority within the Executive Office of Environmental Affairs and my staff are developing a long-term management plan for dredging, dredged material reuse and disposal in the Commonwealth. There is a concerted and ongoing effort among the EOEA sister agencies to work with Massport and the USACOE by providing guidance and technical support on the BHNIP dredging project during the MEPA review.

Finding acceptable reuse opportunities and disposal areas for 3.4 million c.y. of marine sediments from the BHNIP - plus the 50 year maintenance dredging requirement for an additional 1.8 million from the tributaries and 4.4 million c.y. from the improvement project - is an enormous undertaking.[2] This is illustrated by the fact that the volumes of the BHNIP alone would fill a football field to the height of about 1725 feet, or the equivalent of a 120 story building. The problem is compounded because a significant portion of the sediment is considered contaminated and will require special handling and disposal to ensure that the potential to damage the environment during the dredging operations and at the disposal site is minimized.[3]

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[1] The actual volumes are lower than the expansion volumes, which have been described; they are as follows: 1.1 million c.y. of contaminated silt, 1.68 million c.y. of parent or uncontaminated material, 88,000 c.y. of rock.

[2] No estimates were provided for the future dredge volumes from the berthing areas.

[3] To simplify the magnitude of the problem somewhat, the scope requirements have assumed, and this Certificate still assumes, that it is acceptable to dispose of uncontaminated dredged material not earmarked for beneficial use at the Massachusetts Bay Disposal Site (MBDS). The 2 million c.y. of clay material meets the existing

The Draft Environmental Impact Report (DEIR)/Draft Environmental Impact Statement (DEIS) has already proved to be a useful resource document and has facilitated many thoughtful comments from agencies and the public. The report has fostered a high level of cooperation among the divergent interests represented in the comments, which has yielded a productive dialogue that will enhance sound decision-making concerning the reuse and disposal alternatives. The DEIR also helps to define the direction of the FEIR/FEIS, the Section 61 Finding, and permitting processes. Although this first review step has taken three years, significant progress has been made.

The Working Group (WG) participation process established by Massport has contributed to the success of the DEIR/DEIS. Through the efforts of the WG participants, the site identification and selection process has proceeded in an open and balanced forum. I commend Massport and the USACOE for this process and ask that the Working Group be reengaged during the preparation of the FEIR. This group will provide valuable technical assistance and guidance with permitting issues. Overall, the WG will continue to be a useful resource in answering questions, and developing and reviewing information and possibly scopes for potential pilot or demonstration projects.

FEIR Review Process

The goals for the FEIR are twofold. First, the report must provide additional information to describe the practicable disposal alternatives and their potential impacts more completely and at a consistent level of detail. Second, it will be necessary to expand upon the analysis of the environmental impacts of the preferred disposal alternative(s). These goals can be divided into four discrete tasks, including: (1) reconsideration of certain criteria used to identify practicable alternatives and, depending on the result, revisions to the list of disposal option alternatives; (2) comparative analysis of environmental impacts of the disposal option alternatives; (3) more detailed analysis of the preferred alternative(s), contingency alternative, and least impact alternative; and (4) development of a Dredging Management and Monitoring Plan. Later sections of this Certificate provide specific guidance on these tasks.

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standards for disposal at the MBDS.

The DEIR/DEIS indicates that the final selection of a preferred disposal option(s) will be made based upon agency and public comments. The comments, however, indicate that there is not yet sufficient analysis of the potential environmental impacts of all of the disposal option alternatives at this point to support selection of disposal options and demonstrate that they are both environmentally sound and consistent with the other project requirements. Moreover, reconsidering and reapplying the screening criteria could result in an expansion of the list of practicable sites. Consequently, the FEIR must provide additional information about several of the disposal option alternatives (See "Practicable Alternatives" and "Potentially Practicable Alternatives" below) to ensure a truly comparative analysis of impacts at as consistent a level of detail as possible.

The Final EIR must explain clearly how the final site selection process was accomplished. The criteria applied and the site selection process should be discussed in sufficient detail to allow the reviewer to independently confirm that the selection has been based on the established criteria and that the criteria used are defensible.

The report must also provide a more in-depth analysis of the potential impacts of the preferred alternative(s), and possibly other alternatives, which are described in the Preferred Disposal Option section of this Certificate. It must be shown that environmentally acceptable solutions for the reuse and disposal of contaminated sediments are being proposed. Lastly, the FEIR needs to address the outstanding issues identified in the comments and in this Certificate concerning a Dredging Management and Monitoring Plan.

Taking into consideration the breadth of the requirements for the FEIR, it may become necessary to divide the remaining impact analysis and review in two phases. For example, the FEIR could provide information about all of the disposal option alternatives, the final screening analysis, and identification of a preferred disposal alternative. A Supplemental FEIR (SFEIR)/Section 61 Finding could then evaluate the preferred alternative in greater detail and a Dredging Management and Monitoring Plan could be developed as part of this second installment (or afterwards). The comment from the Massachusetts Coastal Zone Management Agency (MCZM) explains how issues could be treated in the FEIR and SFEIR, respectively.

While this two step final review process is not an absolute requirement, it may be the best way to ensure that a more complete understanding of the alternatives and their environmental impacts will be developed before the preferred alternatives are selected, and also to help the agencies reach consensus sooner, rather than later. This approach may also minimize the possibility of proceeding too far with an alternative that may ultimately be unacceptable or infeasible. In short, I believe this approach will provide the most predictability and efficiency.

Project Description

Characterization and quantification of the sediments is an essential requirement of the proposed dredging project. Understanding what this project is will establish basic requirements of the disposal site. According to the DEIR, the quantities of sediment affect the duration of dredging, the duration of the turbidity plume, the amount of habitat affected, and the duration of interference with navigation. As part of the comparative analysis of the alternatives, the FEIR should provide a better understanding of the impacts and explain the differences between the alternatives.

Through the EIR review it will be important to keep track of the changes in volumes of contaminated materials or those considered to be unsuitable for open ocean disposal, because of the critical balance that must be achieved between environmental impacts and project cost in the disposal site selection process. The larger issue of finding a disposal site for this project and the future maintenance dredging required by this project has been confronted in the DEIR. Future maintenance dredging over the 50 year life of the project has been estimated at 6.2 million c.y. of silt, exclusive of dredging that will be required for the berthing areas. While the proponent agencies have not made it a goal of this project to find a disposal alternative(s) that will accommodate both present and future dredging volumes, the DEIR has identified and considered potentially practicable alternatives for the future dredge disposal requirements. To the extent that it is possible, the future maintenance dredging and disposal needs should be taken into account in the FEIR analysis of disposal alternatives.

According to Massport and the USACOE, the estimated volumes of dredged materials should not change significantly from the estimates in the DEIR. Even so, the proposed project has been modified somewhat from the project described in the Environmental Notification Form (ENF) and, according to the DEIR, "It is anticipated that a number of these minor reductions and possible enlargements to the project will occur as the design is finalized." Originally, about 29 berths were to be dredged (about 0.8 million c.y.) In Appendix C, Table 1, 18 berths are now listed for dredging, with a total of about 570,796 c.y. of material.[4] Has the DEIR accounted for the maximum volumes of sediments from the berthing areas?

Furthermore, the DEM, Division of Waterways has recommended that the channel modifications identified in Appendix D should be incorporated into the project. What increase in volumes would result? There is also a possibility that the dredge profile in the Chelsea Creek could be expanded if the Chelsea Street Bridge is replaced by the City of Boston. According to the DEIR, "There is an interest in reviewing the navigation channel to consider widening and deepening to accommodate larger vessels." If possible, estimates of the increase in dredged sediment volume should be provided in the FEIR. By providing this information, it may be possible to avoid a separate Notice of Project Change review. Would it be necessary to retest the sediments for an expansion of the Chelsea Creek dredge?

The project proposal includes a 0.5 foot overdredge, while many other projects plan for a 1 foot overdredge. The FEIR must demonstrate why a lesser depth is acceptable. If this is not possible, the FEIR must evaluate the implications of increasing overdredge in terms of project volumes and impacts.

Lastly, according to the DEIR, the project description could be changed to maintenance dredging only (excluding the deepening of the navigation channels in the Mystic River, Chelsea Creek and Reserved Channel), if for some reason it was decided not to proceed with the improvement dredging. The DEIR has not considered this alternative in any detail, however. Consequently, many questions are left open relating to matching the reduced project to a disposal site. Because this is not the primary plan, further analysis can be deferred at this time. Should this alternative be pursued at a later date, it will require the filing of a Notice of Project Change, in accordance with 301 CMR 11.17.

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[4] The DEIR reports both 15 and 18 berth areas. It is not clear which number of berths is accurate. However, testing appears to cover 15 sites.

Sediment Characterization

The marine sediment characterization was based on a three tiered evaluation of the materials to determine the acceptability of the dredged materials for open water disposal. Regulatory thresholds, based on sediment criteria, have not been established for in-harbor or coastal containment. Therefore, in the absence of separate, scientifically-based sediment criteria for disposal in coastal areas (including borrow pits, in-channel trench-and-cover, and filling and bulkheading for the creation of new (fast) land, the testing protocols for open water disposal have been used. These protocols, as more fully described in the DEIR and MCZM comment, are acceptable for the purposes of this MEPA review. However, throughout the planning and decision-making, a conservative approach should be taken with respect to environmental protection to provide for the possibility that, at some point, more stringent sediment quality standards could be established for nearshore locations.[5] Consistent with that approach, and with the recommendations of MCZM, EPA and others, all of the silt material should be considered contaminated sediment, particularly for in-harbor and coastal containment disposal site alternatives. Moreover, for these alternatives it must be shown clearly that the disposed materials will be isolated from the ambient environment, that water quality would be acceptable, and that these conditions can be maintained over time.[6]

Disposal Site Screening

Overall, the initial phase of the screening analysis has accomplished its objectives, the screening criteria appear to have been applied evenly and there is no apparent bias for or against any of the practicable disposal alternatives in the text. Moreover, the universe of sites evaluated was broad and representative; land-based sites including inland, coastal and landfill sites were considered as well as aquatic sites, which

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[5] The DEP comment indicates that maximum contaminant limits will be considered in the development of the Comprehensive Dredging Regulations in order to keep risks of containment failure at a minimum.

[6] For upland reuse disposal, DEP regulations and policies may require additional analysis.

include shoreline facilities, subaqueous depressions, borrow pits, in-channel trenches, and open water disposal sites. The DEIR has thus provided a useful model that may be applicable to other dredging projects. That being said, this review would be less than rigorous if it did not raise questions about the criteria, the process of selecting among options, and the results of that process.

Potentially practicable sites, evaluated against the screening criteria, were eliminated based on either a failure to meet the minimum of 200,000 c.y. capacity and/or the comparative cost exceeding 4 times the cost per cubic yard as compared to ocean disposal (ES-7). Based on comments received, these screening criteria need to be reconsidered.

In the selection of the preferred disposal alternatives, sites with capacities less than 200,000 c.y. were dropped. However, as the DEP and the MCZM comments point out, some of the shoreline filling and bulkheading alternatives could possibly meet this criterion when the volume between mean low water and mean high water or fast land is included. These alternatives also appear to be promising because the wetlands resource performance standards are less restrictive in a Designated Port Area, in which a number of these sites are located. Therefore, the FEIR should reconsider those alternatives that would meet the minimal volume requirements by the creation of new land. Alternatively, the FEIR should reconsider whether this is the appropriate lower limit for the disposal needs of the project.

Cost is a key screening criterion in the disposal site screening analysis. Sites with disposal costs greater than four times the cost of capping at the Massachusetts Bay Disposal Site (MBDS) were considered excessive (p. 3-26). However, as has been pointed out in the DEP comment, there may be a more appropriate basis for establishing baseline costs. Specifically, the DEP recommends that the cost standard should be based on a potentially acceptable disposal option (rather than the unacceptable unconfined ocean disposal option used in the chart or confined ocean disposal option used in the text). This could result in a significantly different conclusion as to which options are practicable. The FEIR must address this issue.

To address these issues, the potentially practicable sites must be reconsidered in the FEIR.

Disposal Site Alternatives

The disposal site screening steps outlined in the DEIR have yielded a short list of "practicable" alternatives, which have been defined as alternatives that, "(a)re available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes" (CFR 230.10 (a)(2)).

The key objective of the EIR review process is to ensure that the environmental impacts of the project will be avoided or minimized to the greatest degree possible. So as the FEIR proceeds, the focus should be on a comparative analysis of potential environmental damage among the practicable alternatives (including alternatives that may yet be deemed practicable in accordance with comments) that yields a preferred disposal alternative which will have minimal effects on the environment.

Several clear directives have emerged from the public comments with respect to the disposal options under consideration for contaminated sediments. Overall, these comments offer guidance in developing goals for arriving at an environmentally acceptable solution for the disposal of the sediments from this project.

The public has generally ranked highly the disposal options that will return the contaminated sediments to less pristine environments, near the point of origin, most notably the in-channel trench and cover option. There is also an interest in pursuing the alternative of using dredged sediments to cover benthic areas that have been impacted by the disposal of oil and hazardous materials and/or radioactive waste. However, the commenters have expressed caution about the Boston Lightship alternative, a known site for waste disposal, because of the difficulty in locating the barrels or clusters of barrels. Regarding open ocean areas supporting rich commercial fisheries and undisturbed marine habitats, commenters ranged from being unsure about the viability of those alternatives to outright opposition. It can reasonably be concluded that the public has rated those alternatives low. Regarding the Massachusetts Bay Disposal Site (MBDS), the only designated disposal site, there was strong sentiment that this alternative should not be pursued further.

The discussion that follows summarizes the concerns of the EOEA agencies with respect to the practicable alternatives identified in the Draft EIR, including: the Meisburger #2 and #7 sites, the in-channel trench and cover options, the Spectacle Island CAD, the Boston Lightship site, the MBDS with capping, and the bulkheading options.

Generally, the FEIR analysis of the site specific impacts at the disposal site alternatives should expand the understanding of the potential for habitat loss or alteration, water quality degradation, migration of contaminants from the disposal site, and land based impacts on traffic, the built environment, and land use.

Practicable Alternatives

The six practicable alternatives identified in the DEIR all have sufficient capacity to accept the total volume of dredged material, except for the in-channel, trench and cover alternative. This alternative was not carried forward as a preferred alternative because it was determined to have insufficient capacity. However, there is sufficient public interest in this alternative to warrant further consideration.

All of the disposal alternatives propose to release the contaminated silts from barges and then cover those sediments with uncontaminated parent material which is primarily Boston Blue Clay. The difference in properties between these two classes of sediments raises questions relating to the technical feasibility of covering adequately the finer-grained and less consolidated silt materials with cohesive, dense clays. In addition, what period is required to ensure that the silts have settled and how will that be factored into the project design? To what extent will the crude operation of dumping clay destabilize and displace the silts? How will this be addressed in the project design? The FEIR should provide documentation to deal with these questions and to support the plan that is proposed.

Massachusetts Bay Disposal Site

Although this is the only officially designated dredged material disposal site under consideration, there are certain conditions for dredged material at the MBDS that will affect the BHNIP proposal to dispose of the contaminated materials at this site. Specifically, contaminated materials must be capped or covered with suitable dredged materials and, before that can be approved, a pilot project must be undertaken to demonstrate the feasibility of the capping technique at the MBDS.

The comments indicate that this alternative is widely disfavored, and many have suggested that it be dropped altogether. Although I am not making that recommendation at this point, because of the potential utility of a pilot study in addressing some of the more difficult, generic, and unanswered questions about dredged material disposal, this alternative does not appear to be promising.

If Massport and the USACOE pursue a pilot or demonstration study of capping at the MBDS, a proposed scope for that effort must be prepared and circulated for comment to those who participated in the Working Group and also to the commenters listed at the close of this Certificate.

Boston Lightship

Capping has been proposed at the Lightship, as well as the MBDS. However, the feasibility of capping at the Boston Lightship site, with depths of about 50 meters appears to be questionable and needs to be demonstrated, if this alternative is pursued. There is evidence that the rate of sediment transport may be significant during severe storm events, with a 1-5 year frequency, in the vicinity of the Boston Lightship site.[7] This raises questions about the long term effectiveness of capping due to erosion impacts.

If this alternative is pursued, the FEIR must, at a minimum, provide documentation and data from comparable capping projects to support the proposed plan (see also the MCZM comment) and expand on the analysis in the referenced study to provide more information about the effects and feasibility of capping at the Lightship site. The FEIR should also consider whether there are ways to design the project so as to ensure that the contaminated sediments would be isolated. Mitigation measures, contingencies, and monitoring could also be considered to demonstrate long term stability of the capped dredged material. An assessment of potential impacts should be provided, assuming (1) that the project succeeds as proposed and, (2) conversely, that the

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[7] Chimin Chian, Open-Water Disposal and Capping of Contaminated Dredged Material at the Boston Lightship Site (n.p.:n.p.,n.d.)

project is not successful, i.e. contaminants are not isolated at the disposal site. What contingencies can be incorporated in the project design for scenario (2)?

While the Boston Lightship site may hold some promise because of the potential to use the dredged materials as a cover over contaminated areas where hazardous materials or radioactive wastes were disposed decades ago, this opportunity is off-set by concerns about impacts to the marine environment; these concerns will need to be dealt with in the FEIR. Specifically, the area supports commercially important fisheries resources, which would be adversely impacted by the selection of this disposal alternative. If this alternative is pursued, a thorough analysis of potential impacts to these resources will be required. Comments from MCZM and others can be of assistance in providing scoping guidance. In addition, a detailed scope of work must be developed by the proponents in consultation with the WG and EOEA agencies. Such a scope should include a bathymetric survey of the existing waste materials, in order to optimize the environmental benefits of capping waste materials at the proposed site. It will also be necessary to pinpoint a specific location where it will be possible to minimize harm to marine resources. The comment from the Division of Marine Fisheries indicates that comprehensive benthic and contaminant studies should also be done.

In-Channel, Trench and Cover

The option to dispose of contaminated materials within channels that have been overdredged and then backfilled and capped with uncontaminated parent materials has been well received, in concept. However, the logistics and technical feasibility of accomplishing this alternative are quite complex, and there appears to be significant opportunity for damage to the environment.

The multiple steps, which include dredging of contaminated and parent materials, stockpiling of those sediments in order to sequentially dispose of the contaminated silts to ensure isolation of these sediments will require exacting precision in the dredging operations and careful timing to avoid environmental impacts. Realistically, the analysis of this alternative should probably factor in a certain degree of environmental damage in acknowledgement that this alternative will be difficult to accomplish without impacts. Is there a point at which the potential impacts of this alternative would be unacceptable? How will potential impacts be mitigated?

Impacts of barge traffic on existing boat traffic in the harbor also need to be considered. Opportunities to manage the project so as to minimize navigation conflicts should be explored.

If this alternative is pursued, a more detailed scope of work, including a more in-depth assessment of impacts will need to be developed. The WG would be a reasonable forum for addressing the scope issues. State agencies will assist by providing guidance as well.

Spectacle Island CAD

This disposal alternative is a shallow subtidal borrow pit. Based on the comments from EOEA agencies, this alternative should not be carried forward. Due to the shallow depths of the site, storm-wave impacts to harbor resources is a significant concern. There is also a potential for impacts to the seawall and dike being constructed as part of the Central Artery landfill closure project at Spectacle Island. The artificial reef project could also be impacted by this disposal alternative.

Meisburger Sites #2 and #7

Two areas off Deer Island have been proposed as borrow pit disposal sites. This alternative would require dredging at the site to create the borrow pit, reuse or disposal of the silts, sand and gravel from the site, disposal of contaminated materials in the pit, and covering of those materials with uncontaminated parent material. Based on the preliminary information, this alternative is considered promising. A borrow pit appears to offer an effective way of isolating contaminated sediments. Moreover, the sites are shallow enough to allow controlled placement of the materials, but deep enough to reduce erosional effects. This option would provide sand and gravel materials that could be used to renourish beaches, and ultimately the site would be restored to pre-existing conditions.

However, the Division of Marine Fisheries has serious concerns about the acceptability of these alternatives because of likely impacts on fisheries. That agency is concerned that these alternatives have been carried forward because of the lack of fisheries sampling data in the area. Therefore, impacts on marine resources must be evaluated in the FEIR, including the effects on ground fish and commercial lobstering. More detailed information will be required if this alternative is pursued, as explained in the Division of Marine Fisheries comment. What mitigation options are available to minimize damage to fisheries resources?

The comment from the MCZM also lays out the issues that will need to be addressed more fully in the FEIR, if this alternative is selected. Existing information on borrow pits, additional site data, and borrow pit design criteria should be developed to better assess the feasibility of this alternative. Environmental impacts should be assessed. Furthermore, the scoping guidance given above for analyzing impacts to resource areas at the Boston Lightship site should also be used for the borrow pit sites. The FEIR must also consider the potential effects on the MWRA ocean outfall system and the monitoring program for that system.

Potentially Practicable Alternatives
(for future maintenance dredging)

As explained earlier in this Certificate, the screening criteria need to be reconsidered. As a result, certain alternatives may have to be reclassified from potentially practicable to practicable. The FEIR should address this issue fully.

Landfills

It is the opinion of the DEP that the landfill alternative scenario which involves use of dredged material for grading, daily cover, and/or capping (in accordance with approved closure plans) should be carried forward. As indicated in the DEP comment, "Contaminated sediments going for ocean disposal are not necessarily "contaminated" when put on the land" under current DEP guidelines.

The DEIR also acknowledges that the benefits of using marine sediments at landfills are relatively high. However, it also indicates that the dredged material would only be suitable as daily cover if mixed with clean materials (p. 3-7). Based on the DEP comment, the FEIR should reconsider whether, and under what conditions, the dredged materials would be acceptable for specific uses.[8] The requirements for daily cover material were only provided for the Fitchburg/Westminster and Plainville/Laidlaw landfills.[9] Are there other landfills that could accept this material?

The GCR landfill site was screened out. Given that recent Notice of Project Change filings with MEPA indicate that there are plans to extend the life of the landfill, this alternative may be worth reconsidering. More information is needed on the Wrentham site, as well.

Dewatering options and dewatering sites must be studied in greater detail in the FEIR. Details on a dewatering facility at Mystic Pier or the North Jetty should be provided. An assessment of dewatering technologies should focus on demonstrating that the material will be acceptable for reuse in landfills. The impacts of increased truck traffic in the traffic corridor serving the dewater site should be analyzed also. In addition, the FEIR should address how the applicable water quality standards (314 CMR 3.00) will be met.

Lastly, if monofills or landfill cover alternatives are to be pursued further, more site specific information will be required and a scope of work will need to be developed. The WG and EOEA agencies should be included in that scoping process.

Bulkheading and Filling of Shoreline Sites

The alternative of filling and bulkheading to create new (fast) land may be promising. Although yet to be confirmed in a revised screening, it appears that if the total fill alternative was considered for the Little Mystic and Reserved Channel, these disposal alternatives would have sufficient capacity to accommodate significant volumes of dredged material and the costs associated with these sites could potentially be offset. These alternatives should, therefore, be reconsidered and compared with others in the FEIR.

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[8] The DEP comment indicates that there is uncertainty whether sediments with PCB levels greater than 2 ppm would be approved for daily cover.

[9] The estimate for the Plainville/Laidlaw landfill should be 500 c.y./day according to the DEP comment.

The DEP regulatory requirements for construction and use of this type of site are being reconsidered and will probably be changed in the Comprehensive Dredging Regulations that are being developed by DEP. Until that time, however, as the DEP comment points out, off-site disposal of dredged materials not at a 21E site or an existing solid waste landfill would be regulated under Beneficial Use Determination procedures and the Division of Solid Waste Management siting and plan approval process. With respect to the latter, siting requirements are quite rigorous.

The potential impacts of disposal of contaminated materials nearshore must be addressed. In addition, neighborhood impacts, including odor, noise, and traffic, must also be assessed. In areas outside DPAs, consideration should be given to land use opportunities for created land that would improve the quality of life in affected neighborhoods. The environmental equity issue must be addressed, where applicable.

An analysis of the potential impacts to fisheries, including anadromous fish runs in the Mystic River, and benthic environment due to changes in the tidal prism, flushing and water quality should also be provided in the FEIR. Further, as noted in the DEIR, inshore alternatives such as this will require mitigation to minimize the turbidity plume. An analysis of the plume before and after mitigation should be supplied in the next report.

If this alternative is selected, more detailed study will be required as indicated in the comments. Again, a scope for that study must be developed with agency guidance.

Two alternatives were not identified in the DEIR under the category of nearshore filling and bulkheading. They are: Fort Point Channel, the upper reach, which may become a more attractive alternative as a result of potential changes to the Third Harbor Tunnel project in this area; and Conley Terminal, in areas where work may be proposed under the pier decking. These two alternatives appear to warrant further consideration and analysis of impacts for the disposal of contaminated dredged materials.

Innovative Treatment Technologies

While significant questions need to be answered, innovative technologies hold promise, especially for highly contaminated sediments, for stabilization of contaminants, and for volume reduction of dredged materials. Thus, potentially practicable treatment technologies should be pursued further in the FEIR and the following recommendation from the MCZM should be advanced, "The FEIR should identify a practicable remedial technology that can be implemented as at least a demonstration project. The USACOE and Massport should work closely with Commonwealth agencies to identify a funding mechanism to support this element of the BHNIP."

Disposal Option Alternatives

In developing the disposal options, volume, sediment quality, environmental impact, and practicability were considered. Many of the disposal options described (p. 3-11 through 3-17) included more than one disposal site alternative. However, as it turned out, when the disposal options were screened further, based on capacity, environmental benefits, and cost, only one disposal option with multiple disposal sites was deemed to be a "practicable alternative".

There is considerable support among the EOEA agencies for reuse of the materials in landfills, new land creation, and innovative technologies. These additional disposal option alternatives must be reconsidered in the FEIR to determine whether they meet the criteria established for "practicable alternatives." Specifically, the information provided in the DEP comment about potential landfill capacity and additional reuse opportunities should be used in the reconsideration of Option A1. The shoreline containment areas in Option B1, and possibly Option B5, should also be reconsidered because evidence has been provided that there may be sufficient capacity at the shoreline sites for disposal of significant volumes of dredged material. With respect to the Land-Based Aquatic Combinations under option category 'C', it is unclear whether a combination of landfills and aquatic shoreline sites would now meet the criteria established for "practicable sites." While I am not advocating the inclusion of many additional sites, I believe that various combinations of disposal alternatives may offer flexibility and new disposal option combinations may present themselves, which achieve the necessary cost benefit requirements while satisfying environmental protection standards. For this reason, it may ultimately be wiser to carry forward an alternative(s) in this category into at least the final screening step. The FEIR should address this issue.

Preferred Disposal Option

If the preferred disposal option selected has not been ranked as having the "least environmental impacts" from among the final list of "practicable alternatives", then the FEIR must carry forward, for comparative analysis purposes, both the preferred and the "least environmental impact alternative." To the extent possible, the FEIR must also show that the impacts of the preferred option will not be greater than the impacts of the "least environmental impact alternative," taking into account mitigation measures and any potential environmental benefits of the chosen plan.

It may also be prudent to carry forward a back up alternative disposal option plan. To a great extent, the decision to do so would be based on the significance of the outstanding issues following further assessment of the disposal option alternatives.

For the disposal option plan selected, a Draft Section 61 Finding should be provided to show that the impacts of the chosen alternative(s) will be addressed in the project design, in dredge management, or through mitigation, and damage to the environment will be minimized to the greatest extent feasible.

Dredging Management and Monitoring Plan

The DEIR indicates (ES-5) that procedures will be developed in greater detail for the preferred disposal alternative once the type and location of the preferred site(s) is identified. The Plan must demonstrate that impacts to the environment from the dredging project will be avoided and minimized. The comment from the MCZM should provide guidance for addressing this issue. That comment also considers the requirements of a monitoring plan that should be included in the FEIR.

Dredging Impacts on Water Quality

The following issues should be considered in the FEIR in order to demonstrate that the project design, and dredge management techniques will be utilized to minimize water quality impacts:

o The rigorous turbidity controls identified for the Meisburger borrow pit sites should be explained in greater detail.

o Consideration should be given to a clamshell dredge bucket (Cable Arm 100E) that has been shown to control turbidity during dredging effectively.

Dredging Impacts on Marine Environment

The FEIR should examine the timing of the dredge more closely with respect to sensitive fish reproductive and juvenile growth periods. Is dredging of the Mystic Channel the only area that will be subject to restricted time periods? What problems cause scheduling delays, and what is the likelihood that these delays could cause the dredge operations to be pushed into the restriction period? Are there contingencies available?

To minimize the blasting impacts on fisheries resources, consideration should be given to the "startle system" which has been used successfully in Boston Harbor.

Dewatering and Handling Issues

The following issues need to be addressed as part of the dredging management plan:

o The potential odor problems during excavation, dewatering, handling/transporting, and disposal; and

o The opportunity to reduce the volume of material for reuse/disposal by means of mechanical dewatering techniques; if the volumes can be reduced as indicated in the DEP comment, it is possible that some disposal alternatives could become more viable or attractive.

<u>Cost</u>

The cost data for the disposal option alternatives should be expanded in the FEIR to include environmental costs. Consideration should be given to, at least, the cost associated with a loss or temporary loss of resource areas, mitigation costs, and monitoring costs. The environmental costs associated with the preferred disposal option plan(s), any back-up plan, and the "least environmental impact alternative" should be compared in the FEIR.

Supplemental Comments

The following is item-by-item commentary.

Figure 2-2. The text (2-3) states that the southern channel limit would be relocated inward by 32 feet from the confluence along Conley Terminal. However, the figure seems to show this area as part of the dredge. This figure could be clearer.

page 2-10. The Tier II, Federal Channel Sediment Testing Program results found total Hepta-cholorodibenzo dioxins and total Octa-chlorodibenzo dioxins above detection limits. Although dioxins are known carcinogens, the only conclusion drawn was that these compounds are not considered "as toxic" as other dioxin compounds. Relative toxicity without background data on the range of toxic effects is meaningless. This concern should be addressed in the FEIR.

page 2-11. There appears to be some discrepancy between the number of berthing sites that were tested (15) and the number of berthing sites identified as part of the proposed dredging project (18). If the plan is to dredge 18 berths, why wasn't sampling and testing done at all of the berthing sites?

Table 2-4. The table should include a legend to explain that the superscripts 2 and 3, which are given with bulk sediment data, refer to Category II and III sediments.

Table 2-6. Likewise, the prefix 'J' to the PAH data should have been in the legend for lay persons reviewing the document.

page 3-12. How is the "cost for mobilization" defined?

page 4-9. There appears to be an error because silt or clay fractions are measured at less than .06 mm and so are sand particles.

June 30, 1994
DATE

Trudy Coxe, Secretary

Comments received:

5/17/94	International Longshoremen's Association
5/12/94	North Shore Recycled Fibers
5/16/94	Rexham
5/17/94	City of Everett, Office of the Mayor
5/18/94	Cape Cod Commission
5/17/94	Frank Mirarchi
5/19/94	Containership Agency, Inc.
5/19/94	I.T.O. Corporation of New England
5/23/94	Boston Water and Sewer Commission
5/26/94	Jeffrey Hopkins
5/19/94	Dr. Paul F. Murray
5/26/94	Decorative Specialties International Inc.
6/1/94	Marine Fisheries Commission
6/13/94	C. H. Powell Company
6/13/94	Boston Harbor Docking Pilots
6/14/94	Boston Towing and Transportation Company
6/14/94	Maersk Inc
6/15/94	Nedlloyd Lines
6/15/94	P&O Containers
6/15/94	Bev Carney
6/16/94	Patterson, Wylde & Co., Inc.
6/17/94	Sea-Land
6/17/94	Town of Swampscott, Conservation Commission
6/17/94	Nahant SWIM, Inc.
6/20/94	Town of Nahant, Board of Selectmen
6/20/94	LADS System, Inc.
6/20/94	Boston Redevelopment Authority
6/20/94	Massachusetts Highway Department, CA/T
6/21/94	GreenWorld Inc.
6/21/94	Massachusetts Bays Program
6/21/94	S.T.O.P.
6/21/94	Massachusetts Sierra Club
6/21/94	Center for Marine Conservation
6/21/94	Coastal Advocacy Network
6/21/94	CLF
6/21/94	Save the Harbor/Save the Bay
6/21/94	Coastal Zone Management

Late Comments:

6/20/94 John T. Clark and Son
6/11/94 Cetacean Research Unit

P:bosdredg.dei
TC/NB/nb

APPENDIX B - TRANSCRIPTS OF PUBLIC HEARINGS AND MEETINGS

APPENDIX B

Transcripts of Official Public Hearings and Meetings

O'Neil Federal Building, Boston, Mass. - May 17,1994, 1:00 p.m. and 6:00 p.m.

Tara Hyannis Hotel, Hyannis, Mass. - May 19, 1994, 1:00 p.m. and 6:00 p.m.

Nahant Town Hall, Nahant, Mass. - July 28, 1994, 7:00 p.m.

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In The Matter Of:

U.S. Army Corps of Engineers N. E. Division &
Massachusetts Port Authority

May 17, 1994

BPA REPORTING
295 DEVONSHIRE STREET
BOSTON, MA 02110
(617) 423-0500

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Word Index included with this Min-U-Script®

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Page 1

U.S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DIVISION
424 Trapelo Road
Waltham, Massachusetts 02254-9149
and
MASSACHUSETTS PORT AUTHORITY
Transaportion Building
10 Park Plaza
Boston, Massachusetts 02116
BOSTON HARBOR NAVIGATION IMPROVEMENT PROJECT
PUBLIC MEETING & WORKSHOP
1:00 p.m. and 6:00 p.m.
Tuesday, May 17, 1994
Auditorium, O'Neill Federal Building
10 Causeway Street
Boston, Massachusetts
and
1:00 p.m. and 6:00 p.m.
Thursday, May 19, 1994
Tara II Ballroom
Tara Hyannis Hotel
West End Circle
Hyannis, Massachusetts

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Page 3

INDEX (Continued)

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MR. ROSENBERG: Our workshop tables are open. The Corps and Massport is to the rear of the room. Save the Harbor/Save the Bay and the Conservation Law Foundation to my left. The federal agencies' and the state agencies' table is to my right. And they'll be more than happy to answer any questions about any information you may need. The formal proceedings will start at 1:00 o'clock.

(Off the record.)

MR. ROSENBERG: Good afternoon. I'd like to welcome you here today to the O'Neill Federal Center for this jointly sponsored public meeting and workshop to discuss the draft environment impact statement and report on the Boston Harbor Navigation Improvement Project.

I'd also like to thank you for involving yourself in this process. We're hosting these workshops and public meetings here and in Hyannis to listen to your comments, to understand your concerns and provide you an opportunity to formally appear on the record should you care to do so. This workshop is yours.

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I do ask that during the formal discussion period, which we've just entered, that you hold your questions until the end of each presentation, at which time you will be heard.

The rules tonight are fairly simple. If you've got a question, ask it. If you've got something to say, say it. If you wish to go on the record, please. And lastly, if you want to involve yourself in this process, not just today but in the future, talk to any member at these tables sitting around the edge on some of these panels, and they will help you get involed.

These tables are hosted by the Corps of Engineers, MassPort in the rear; several federal agencies to my right; the Commonwealth of Massachusetts also to my right; and two of the many public interest groups that are involved in this project, Save the Harbor/Save the Bay and Conservation Law Foundation, to my left.

We've all been working together for over the past year to get to where we are today. Now we need your help. Yes, thank you very much for coming.

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I'd like to go through the agenda for just one moment. We're going to start off with an opening statement and an overview of the project by Colonel Brink Miller, the Commander and Division Engineer of the New England Division of the Corps of Engineers. He'll be followed by Mr. Ralph Cox, Director of Maritime for Massport. And then our Project Officer at the Corps, Mr. Peter Jackson, will explain the project in detail. He'll be followed by Ms. Janeen Hansen from MassPort, who is their Project Manager.

We will then go into the various roles of the public interest groups and how they feel about the process and where they stand on the process, and we'll start off with Ms. Joan LeBlanc from Save the Harbor/Save the Bay, followed by Ms. Grace Perez from Conservation Law Foundation.

Following that we will ask Catherine Demos to come up, and she's our Project Officer for the environmental impact statement for the Corps, and she will give you a brief overview of that and the NEPA requirements and

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the statutes. She'll be followed by, Norm, I hope I pronounce the name right, Norman Faramelli, who works at MassPort and is very involved in this process. We will then hear from Ms. Nancy Baker who works for the Commonwealth of Massachusetts. And then we'll have a small panel discussion with Norm and Catherine, and they will discuss what's next and where we're going.

This evening we will have a wrapup discussion with members of all the workshop tables.

Once again, I would like to thank you all for coming night.

First, I'd like to introduce Colonel Brink Miller, the Division Engineer, U.S. Army Corps of Engineers, New England. He assumed command of the New England Division on July 7, 1992. He manages the Corps' responsibility in the 6-state New England area. He supervises a work force of over 600 and an annual budget of approximately $170 million.

He came to New England following a 3-year assignment as Commander and District Engineer for our Galveston, Texas District. He

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was on the staff of the U.S. Army Command and General Staff College at Fort Leavenworth where he served as chief of the Doctrine Division, Department of Tactics.

He is a graduate of the U.S. Military Academy at West Point, the U.S. Army Command and General Staff College and U.S. Army War College, the Engineer Officers' Advanced Course and has served in the Military Engineering Division in the Office of the Chief of the Army Engineers. After receiving his Master's Degree in theoretical and applied mechanics from the University of Illinois, he was assigned to West Point as a course director and assistant professor.

Colonel Miller and his wife Sandy have three children and reside in Natick. Ladies and gentlemen, Colonel Miller.

OPENING REMARKS BY COLONEL BRINK MILLER

COL. MILLER: Thanks, Larry. I'd like to talk about my three children but that's not why I'm here.

I'd like to add my welcome to this session. You know, the U.S. Army Corps of

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Engineers is charged with the responsibility by the Congress of maintaining the Boston Harbor Project and planning, designing and executing the Boston Harbor Navigation Improvement Project. That's why we're here.

We're here today with our sponsor, Massport, who is the sponsor for this project, to listen to what you all have to say about the draft environmental impact statement that's been issued, to understanding what your concerns are with the project, and to make sure that we take into account all the various interests of the various elements of the public with care who care about the Boston Harbor Project.

Let me introduce a couple of folks that are here today so that you know who they are in order to address them with any specific questions or issues you may have. My Project Manager is Pete Jackson. Bill Hubbard and Cathy Demos are here from my Impact Analysis Division, that's the environmental folks. Jeff Walkers from the Regulatory Division, way in the back. And Larry Rosenberg and Sue Douglas. You met Sue coming in. She's at the table where you signed

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in. Larry you just heard from.

In addition, there are folks here from MassPort. I want to make sure you know who they are. Janeen Hansen is the Project Manager. Norman Faramelli was mentioned. He's sitting back there in the middle of the audience. He's the Director of Transportation and Environmental Planning for Massport.

We have Joan LeBlanc here from the Save the Harbor/Save the Bay. She's going to talk to you in a little bit. And Grace Perez from the Conservation Law Foundation will also be talking to you. She's also at the table back there.

The project that we're going to discuss today will be explained to you in great detail for those of you who don't understand what the project is, but I think it will become clear immediately that the major impacts from the project are the issue of dredging the material from the channels and then depositing the dredge material somewhere. There is clean material out there, and there is contaminated material out there. So the issues really are, the dredging of

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the material, both contaminated and clean, and then disposal of the material, both contaminated and clean. Those are the issues which we'll focus on primarily in the environmental impact statement as far as the impacts to the environment are concerned.

We have about 3 million cubic yards of material that needs to be dealt with. And the issue then is how are we going to deal with that material in order to execute this project. We'd like to hear from you about how you feel about that. There are a number of alternatives that have been presented in the draft environmental impact statement, and we'd like to hear how you feel about those alternatives.

Feel free to bring up any issues that you have with respect to this project. I know there are folks here that are going to talk about the economic necessity for the project, and there are others who will talk about the environmental impacts of executing the project, and we want to hear from everyone about how they feel about the particular project and what issues

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may not have been address that you want to make sure that we do address. We're also doing this, not only in a session where we'll receive public input from you to hear what you have to say but also in a workshop setting where the various agencies are identified around the the room at tables. And once we finish the formal proceedings, you'll have the opportunity to go see those folks and talk to them eyeball to eyeball and let them know how you feel about things.

Ask questions, get your questions answered to insure that we don't go any further in the project without receiving the very important input from you folks. After all, all of the work that we do, Corps of Engineers and Massport, is to benefit the public. So we want to hear from you, know what you think and what's going to benefit your business.

With that, I'll turn the podium back over to Larry. Larry.

MR. ROSENBERG: Thank you. This may take a little extra time, but I want you to know who is involved in this project.

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Our next speaker is Mr. Ralph Cox. He's the Maritime Director for MassPort, and he's responsible for the Port of Boston. In particular, he develops both long-term and short- term strategies for the development, marketing, operation and maintenance of the Port's public marine terminals.

Prior to joining MassPort, Mr. Cox was the Executive Director of the Massport Office of Business Development. Additionally he represented the Commonwealth on trade missions to China, Singapore, Hong Kong, England and Canada. Mr. Cox also represents the state as a board director of the Massachusetts Industrial Finance Agency which issues over a hundred million dollars in bond transaction each year.

Mr. Cox holds a busines degree from the University of New Hampshire and lives in Newbury, Massachusetts, with his wife and two children. Mr. Cox.

STATEMENT BY RALPH COX,

MARITIME DIRECTOR FOR MASSPORT **MR. COX:** Thank you, Larry. It's great to see so many people

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coming out on a rainy afternoon and talk about dredging. I didn't know everybody was as passionate about it as I am.

I guess I'd like to start off quickly with a brief story, and then I have about five minutes and then get on to what I see as the economic necessity of this project. I don't think, being in the position I am, it is a tremendous responsibility, but it's a very enjoyable one. I think a lot of us share that with other people who work around the Port and make their living and have for many, many years around the Port that are here today.

I don't think a project like this could move forward if there weren't a number of people who weren't passionate about seeing the Port of Boston survive, and more than that, really grow.

My family, my father started working on the Boston waterfront back in the mid-50s, and I remember as a young boy wanting to spend more time with him. I would go with him on some of his weekend junkets up to the ships and he actually worked on some of the oil ships that

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came into Boston. So then my career went off in different ways, playing hockey in Europe. I never thought I'd find myself in this position of sort of being in charge or leading a charge to really save the Port and to encourage growth. That's, quite frankly, where I find myself today. And I want to make it clear that I am passionate about wanting to see this project come to fruition.

I grew up on Cape Cod and spent, I would like to say 90 percent of my time fishing and crabbing and really living in a serene environment. It's at times difficult to be painted as a person on the opposite side of the environmental community because I'm equally passionate about seeing our economy and our companies grow and expand in an environmentally sound way. And I think that's all that we are truly trying to accomplish with this project.

A couple of fact, just so everybody knows. We have roughly 17 million tons of cargo that comes into the a Port of Boston today. A far cry from what it used to be as the world's number one port, but still it's a healthy

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sum, and we have ways of growing as the economy improves, only if we protect the infrastructure that sort of guides that, that economy.

Roughly, general cargo, the container cargo, we have about 150 TEU's — TV's, shoes, food, clothing, beverages. And I've sort of promised my ILA colleagues that we would work to move that over 200,000, and I know they're going to keep my hand to the fire trying to make that come true. There was a day when there was over 3,000 longshoremen workers in the Port of Boston. Today there's about 260. Some of that is the economy. Some of that is not sort of paying attention to the Port itself and the infrastructure and keeping it connected to the New England.

We have cars, plywood, salt. We have 90 percent of the petroleum products that service all of New England, our housing, our commercial entities come through the Port of Boston. 94 percent of all international trade moves via waterborne carriers. 70 percent of trade that comes in and out of New England on an international basis comes through the Port of

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Boston.

I bet if we had a map of the world and it showed tradelanes in green and said Show us the choke points, the danger points in red, you would circle many of the major ports, including Boston, in the United States.

As port directors, our number one issue is dredging at the moment. As our national society moves forward in communication with Secretary Penia and President Clinton, they have recognized that ports are such an integral part of international trade that they have to be looked upon as a part of the total intermodal system — highways, rails and the ports.

Boston quite frankly is in danger. We are not trying to the save the day here. We're sort of losing ground. By not having this project really already completed, we are behind.

We have the Vessel Sharing Agreement made up of five of the largest carriers in the world to call in the Port of Boston each week. It's recently had to bypass because of tides weren't right. They go down to New York.

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They sent thing up by truck or by barge, and the consumers paid a little bit extra for that. They said that's going to be much stronger issue as we move forward in the coming months, not in the coming year. It's an increase in cost that we all pay for in our products that we ware and drive in every day.

Lifeline, another part of transportation, another shipping company that calls in Boston, wanted to call in Boston, we couldn't accommodate them at one of our terminals. We had expedite one portion of it at Moran Terminal where fortunately we could work with the state agencies, and they understood the need, and we did expedite. We brought in that new line of service that now comes in again. The first port of call, which is the best service you can ask as Port Director, inbound, and it goes out to Mexico, opens up a new market for many Massachusetts and Canadian companies.

Also on another part of its service is our last port of call on the East Coast going outbound to Europe. Again, a port couldn't ask for better service than what

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lifelines provides for us.

It couldn't accommodate them without dredging. Their ships, they're ordering larger ships that should be in line within the next 18 months to 2 years. When that happens, if our dredging is not in place, we're in danger of not being able to keep them. That's just a fact.

NSC, another shipping company, brings in more cargo to the Port of Boston than any other carrier, about 12,000 containers a year. They're ordering larger ships. They're going to be on line this summer.

Companies that do business in international markets, they don't have large warehouses any more. They want more of the product, manufacture it, bring it over in a ship and get it into the distribution center. They need the products on time and in demand. They can't wait to have a ship standing out in the harbor waiting for a high tide or low tide or medium tide to get under the bridge or through the harbor. Real situations. Potential problems.

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Today we have Revere Sugar, a maritime property over in Charlestown. We have a several users, potential users of that property that will come in with a product via water. It's not deep enough. The channel is not deep enough. The berth is not deep enough. It's part of this project. It's a missed opportunity that may not come back to us.

Everybody hears about the port as an economic catalyst for New England, and it is quite frankly. Transportation is the way we all do business. The way many of us get jobs provided by it. A couple of figures. We have a $6.6 billion economic impact to the region via the Port of Boston. Roughly 6,000 jobs are directly and indirectly affected by what goes on in the port. For a small port, that's a massive number. If you took that off the radar screen in New England, we'd spiral into a recession that we may never come out quite frankly in my opinion.

I think if we want to keep our companies competetve, New England, Massachusetts, this is a New England issue, quite frankly. It's not just Massachusetts. We have an obligation to

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a greater a citizenship and constituency. We have to keep the Port open, alive and moving. This dredging process really is an integral part of that.

We're spending $40, $50 million over at Connelly Terminal because we believe in the future of New England as a port to make it more efficient. We're working like the dickens to bring rail freight back into the Port with double stack. The Governor is considering spending close to $200 million. Again, if we don't have dreding and all of these things happening simultaneously in the next couple of year, we are going to be in an economic fix.

I've been around. I spoken to most of the people in this room, all the different constituencies since I've been Maritime Director. You know, I really haven't seen anybody who is opposed to dredge. No one's really saying, "Forget it. We're not going to let it happen." I think we're all saying the same thing, let's just do it in an evnironmentally, sound, economically feasible fashion. Partly we benefit from the generosity

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of the Federal Government, which we should take care. If we don't benefit from it, it won't happen.

I guess as a public servant, which many of us are, I see this as truly our obligation to work together as we been for the last couple of years and to not drop the ball. People have been talking about dredging Boston Harbor for 25 years. It's been in the process for the last six.

So I want you to know that I am passionate about it. I plan to see it through. I plan to work as closely as I can with the state, federal and other groups on the environmental side. I don't see it as good versus evil. I see it as a necessity to all of us, and I do truly look forward to working with all of you to see it happen in an environmentally, economically feasible fashion. I think we owe it to ourselves and all the people of New England. Thank you.

MR. ROSENBERG: Our next speaker is Mr. Peter Jackson. He is the NED Project Manager for Boston Harbor Navigation Improvement

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Project. Mr. Jackson joined the New England Division in February of 1978 after ten years of service with the Corps of Engineers in San Francisco.

He holds a Bachelor of Arts Degree from Lycoming College, a Bachelor of Science in civil engineering from the University of Pennsylvania and a Master's of Science in civil engineering from Sanford University. He is a member of American Society of Civil Engineers, and Mr. Jackson is also a member of the Conservation Commission in Harvard, Massachusetts, where he and his wife and their two children live. Mr. Jackson. STATEMENT BY PETE JACKSON, NED PROJECT MANAGER MR. JACKSON: Good afternoon. I have a chance of using these electronic implements which are going to help me, I hope.

Ralph Cox just, I think, very dramatically presented the need for the project. I'm not going to get into that. I might touch on it a little bit. My job here right now is to give the overview of the project as authorized, to try to trigger what the next series of people

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are going to talk about. That's the disposal options. So what I want to do is walk through a presentation of what we have arrived at. This is a new condensed version, so if you'll be real patient, I'll get through it.

The Federal navigation system of Boston Harbor is a result of over 20 Congressionally authorized improvement projects carried out over about the last 170 years. Again, the existing project consists of a series of channels, anchorages and other items which I'll touch on as we go through the presentation.

I'm going to start with the outer harbor. This is the existing project. There's a series of three entrance channels coming in from deep water, the deepest one being in dark blue. All the dark blue areas are the 40-foot depths. The lighter blue is less than 40 feet. Primarily 35 feet in this area. Then there's a 30-foot and a 27-foot channel. This is the way the vessels get into the harbor. Deer Island, for your vantage point, is right here.

What we propose to do in this project is to make the following improvements to

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this outer harbor area. As you can see, we've designated a channel through this naturally deep area, which has not been done, and the anchorage area in this area, existing 40-foot anchorage will be slightly expanded by redrawing the lines. This particular part of the project includes no dredging. This is merely changes in the markers so that navigational people can find designated channels where there aren't designated channels now. No impacts associated with this, other than improvement in the operation, and it show up in the navigation charts when they're revised. The Coast Guard is working with us on this remarking operation.

The more interesting part of the project is in the inner harbor. I want to briefly go through the existing inner harbor navigation system.

This slide shows the existing channels in the inner harbor, and the darker blue represents the deeper 40-foot channels and the lighter blue, the 35-foot channels. All these channels were built, most of them in the mid- to late 60s. And about 1969 Congress asked the

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Corps of Engineers to take a look at this existing system, look at in terms of modern-day use and see if there is an economically feasible way of improving it if the opportunity exists.

In 1988 the Corps of Engineers came out with a feasibility study which proposed the following plan.

Like the previous slide, this shows the inner harbor. The yellow areas are the areas where we propose improvements. What I'd like to do is to walk through each individual channel, starting with the Reserve Channel in South Boston. This is a 35-foot channel which will be deepened to 40 feet, with the exception of this upper end. There is no active terminals there that would need 40 feet, so we will cut the channel off at the upper end of the yellow area.

At the mouth of the Reserve Channel, there is a series of funny shapes here which are the result of the need to turn vessels in that area. Basically they turn the vessel, inbound vessel and back it into the berth. So it's essentially a rotary, a turntable to turn. So that assures that on this side of the 30-foot

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channel, they'll have a 40-foot spot in which to rotate the vessels.

Going up to the inner confluence area, this inner confluence area that actually is the opening to both the Mystic River and Chelsea Creek, is also used for turning vessels. Primarily the LNG tanker is probably the critical vessel that turns in that area.

We also propose to deepen a sliver of this 35-foot channel to 40 feet, because that gives a wide access into the Mystic River. This is all based on testing we did in real-time simulation testing with the pilots in Newport, Rhode Island. So they've actually had a chance to practice with these vessels.

Going on to the Mystic River, again, we'll deepen that yellow area to the 40-foot depth from its current 35-foot depth, with the exception of this upper area which does not require 40 feet. There's certain beneficiaries up there like Prolerized Scrap Metal, Distrigas and Moran Terminal, in that area. That's one of MassPort's key terminals which we recently dredged, that Ralph Cox spoke

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about.

Up in the Chelsea Creek, the green area, it's green because we are not going to go to the 40 feet. We're going only to 38 feet in that channel. We're going to stay within the existing boundary of the channel. We're going to shorten it. We're not going to widen it at this point. In essence, that's the project in terms of a map approach to the project.

One of the things that might be coming up that we have to be considering is that in the Chelsea Creek there's the Chelsea Street Bridge. This is looking upstream towards the Chelsea Street Bridge. Some of you will probably say those tank don't exist any more. That's right. This is an old picture. But it does show that there's a major restriction in this area.

The City of Boston owns this bridge and they're currently working with the Coast Guard to replace that bridge with a wider structure. If that happens, we may be reformulating this part of the project. We're following and coordinating with the City of Boston and the Coast Guard at this time, so we're

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keeping in touch with that.

What I want to do is begin to go into the cost factors and the cost sharing. What you're going to hear in a few minutes is some discussion about disposal sites. What I want to do is review the volumes that we have to deal with in this project. A version of this diagram is in the back, and it's also in some of the handouts. It might look a little different, but I would like to walk through this, because I think there are some critical things on this graph.

On the left side of this is what we consider the unsuitable material. This is otherwise called contaminated. There are other words that I've heard used that I don't want to repeat here. This material has been tested by the Corps and Massport, and it's been found by the Corps' and EPA's testing protocol to be unsuitable for unconfined ocean disposal.

If you look at the bottom part of this block here, this is the channel material, it's 361,000 cubic yards. On the top in the purple is the berth material that's considered

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unsuitable. And it totals about 1.1 million cubic yards. This is the problem, this material here that we have to deal with.

On the right side — and again, this material is what has to be cleaned up before we get down to the deepening. This is to get us down to the 35-foot depth that we currently have.

On the right side is the clean material. The material that sits underneath this maintenance material. It's primarily Boston blue clay. It's been tested over and over again and found suitable for unconfined ocean disposal. We're talking about 1.6 million cubic yards of channel material and an additional 133,000 cubic yards of berth material.

The reference to Prudential Tower is 750 feet high. If this were a football size field stacked up, this is how it would stack up compared to the Prudential Tower. Every time I drive into Boston, I see that, and it reminds me what my job is here. That graph is in the back and we'll discuss that later.

As every project we work on, there

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is a cost associated with it. The navigation improvement part of this project is really that clean material, for all practical purposes. This cost here, which you see in various forms, is the removal of that clean material on the right side of the previous diagram. Prior to doing this deepening project, the Corps of Engineers, a hundred percent Corps cost, will deepen the channel through its own budget program. In other words, we'll have to clean our house first before we get into remodeling.

Again, I am going to remind you, probably through other discussions in the back, that this cost here is to remove that clean material, with the exception of the berth material. This little item here does include some contaminated material.

Now, in the Corps' cost-sharing process as authorized by Congress, general navigation features, which in this project is deepening the channels, is $31.9 million. The berth area deepening, which is a nonfederal cost, is $2.4 million. Utility relocations, which are all in the Chelsea Creek, are $980,000.

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Remarking the channels by the Coast Guard is a federal cost of $15,000.

And at the bottom you see the breakdown based on the Corps' cost, the Coast Guard's cost and the nonfederal cost, $35.3 million.

Again, I'm going to go back to the ONM material, the so-called contaminated material. Based on the options that we're discussing on disposal of the contaminated material, that cost will be about $15 million roughly on the average. $15 million will not be part of this. It will be part of our ONM budget of the Corps of Engineers.

This is a quick overview of the schedule, and I don't want to get into any details. I can talk to you about this later. It shows when we did our testing back in 1990. The project was actually authorized by Congress in the end of 1990. This purple line here is what we call preconstruction engineering and design. This is all the testing and and all the design work and engineering work that has to take place, which ends when we sign the project cooperation

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agreement with MassPort, which is the legal binding agreement which says you're going to pay this and we're going to pay that.

The yellow bar here is the environmental review process, the permit process. And if you look real hard, you'll note that this slide is probably a month old, and we got this draft EIR/EIR out in April rather than March or February which shows here.

At the end of '95 when we sign this project cooperation agreement, we'll start the process of advertising and going out for construction. And you see about a year and a half construction period here for the dredging and disposal of the material. And as you can see, we have two dredges working at all times. And we have an environment window we have to deal with. So you will see multiple channels being dredged at the same time.

I think that's about all I want to cover in this. I'd rather spend the rest of the time answering questions later and talking to you in the back. I know some of you know a lot more than what you see here and others may need more

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information, and I'll be happy to answer your questions.

MR. ROSENBERG: Thank you Pete. Our next speaker is Janeen Smith Hansen. She's the Project Manager for the Massport Maritime Division for this project. Ms. Hansen has nine years experience with project management at MassPort, and she has successfully overseen the renovations and transformation of Commonwealth Pier into the World Trade Center, and she's worked on many other related projects.

Her work includes environmental and transportation and air quality monitoring for the National Commission of Air Quality, analysis of fuel consumption for the U.S. Department of Energy and numerous other successful environmental projects and programs on the state and federal levels.

Ms. Hansen holds her Master's Science in city and regional planning from Harvard University and a Batchelor of Arts in social science from Michigan State University. Ms. Hansen. Project Manager for the Massport Maritime Division

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MASSPORT ROLE IN BOSTON HARBOR

NAVIGATION IMPROVEMENT PROJECT

MS. HANSEN: Thank you, Larry. In the interest of full disclosure, I feel obligated to tell you I have two children and a husband.

The reason I'm here this afternoon is to answer the question: What is the Port Authority doing in the dredging business? Heretofore port authorities have not gotten involved in dredging. Dredging was an activity carried on by the Corps of Engineers, both for the commercial navigation purposes and national security reasons. But the 1986 Water Development Act changed all of that. It created the possibility and opportunity of the Corps having so-called local sponsors, and for the Boston Harbor Project, Massport became the designated local sponsor.

Part of the notion here was that those who are interested in the Port ought to have a greater say in what goes on in the Port, but I think more importantly, from the federal perspective, they wanted local entities to have a

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greater share in the funding of these project. So we are here as project proponent, partner with the Corps of Engineers and primary as cost sharers.

Massport was clearly the appropriate party to be the local sponsor for the Boston Harbor Project because of our role in maritime commerce and because we operate the two public terminals on the harbor.

We began in 1991 with the MEPA process, having the project scoped by then Secretary — and actually I can't tell you who the Secretary was in 1991 — Sue Tierney, scoped the project for us. We proceeded then to hire consultants to help us do the sediment analysis, the criteria selection for disposal sites and to conduct a dredging advisory committee process, because we wanted input from all parties who were interested in this project from the very early beginnings of the project.

Normandeau Associates has been our consultant in this role, and I know many of you have worked with Normandeau with the Corps and with MassPort over the past couple of years as we

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put this advisory process together, and we've really been pleased with the work that they have done for us. I would note that they are here in the audience today, and if people have questions specifically about the DEIR/S, Normandeau as well as the Corps are here to answer questions.

The reason we convened the dredging advisory committee is that we realized from the beginning that there was not complete agreement about how this project should happen or even whether this project should happen. And MassPort has benefited, as has the Corps, just enormously from the participation of people from many perspectives on this project. I just want to say thank you to all of you who have put in many, many hours just to get us to the starting line on this project.

The dredging advisory committee was comprised of environmental interest groups, regulatory agencies an representatives of the maritime industry. And many of them are here in the room today, and many of them are at the tables so you can speak with them afterwards to get their perspective on this project.

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Again, I would just reiterate what Colonel Miller said and what Larry said, we're here to listen and hear comments from all of you.

MR. ROSENBERG: Thank you, Janeen. Our next speaker is Ms. Joan LeBlanc from Save the Harbor/Save the Bay. She is the Policy Director for Save the Harbor/Save the Bay. And that's a nonprofit organization dedicated to preserving and promoting the harbor. Save the Harbor/Save the Bay supports dredging to maintain the shipping lanes and the berths and is an advocate for safe dredging and safe disposal. Ms. LeBlanc.

STATEMENT BY JOAN LeBLANC,

SAVE THE HARBOR/SAVE THE BAY

MS. LeBLANC: Thanks, Larry. Appreciate your giving us this opportunity to make comments. I just want to say a couple of words about Save the Harbor/Save the Bay, who we are and how we've been involved in the process to start. And also thank everyone at Massport as well as the Army Corps for setting up these public comment periods and for giving us the

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opportunity to work with them over the past couple of years in the preliminary planning for the project, and we look forward to working with them in the future to come up with solutions that we can all agree on.

Now, Save the Harbor/Save the Bay is a nonprofit organization. We're basically working to protecft and promote Boston Harbor and Massachusetts Bay. Our overall goal in terms of the Boston Harbor dredging project is to find ways of dredging and dealing with contaminated sediments that will benefit both Boston Harbor and Massachusetts Bay as economic resources and also as natural resources.

I'll give you a little outline of what I plan to cover. I hope it's not too long, but my formal comments here today are also for the record as testimony in response to the dredging plan. And I did want to mention that the timing of the hearing, this hearing today is basically in the middle of the comment period. The comment period for evaluating this very complicated plan goes to the end of June, I believe, and I was speaking with Larry and he

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suggested that they would be willing to have another hearing later towards the end of June. I think that would make sense, because it's a heck of a document to get through as anyone who has looked at it can tell. So there may be additional issues to be raised later, and you should make sure those are part of the public record.

I'll be discussing some broad issues related to this project and dredging in general. Then I'll be looking at disposal options in general, what are the various types and where we stand on them, and hopefully you'll get more details from the experts after I speak. Then the DEIS basically presents several options for dealing with the contaminated and clean sediments. And I'd like to outline some of my comments on those options.

And then finally I'll be talking about a little bit about the dredging process itself, and what we'll be looking for in terms of monitoring, i.e., who's going to watching to make sure what goes on is basically done right. We know that there was some dredging at the Moran

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Terminal last year, and the permit in that project were really good. However, the reality doesn't often match the permit. With any new construction type project, there are going to be problems that come up along the way, and we have to make sure that we're looking at not just how the project looks on paper but how it happens in reality, what problems come up that weren't planned for, what we can do to address those problems as they come up.

I want to make a couple of comments about Boston Harbor. Our view of Boston Harbor is that it is clearly a working port, and we are supportive of the dredging project. We think that we certainly need to maintain the shipping lanes for the economic vitality of the area. We also are concerned about the Boston Harbor as a natural resource, and we see the harbor as it's busy, it's an economic boon to the area. It's one of our best natural resources. So there are a lot of different ways to keep looking at this project.

The project does pose some dangers as well as opportunities. Dredging PCB's and

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PAH's and heavy metals is risky business, especially when we're spending millions of dollars to clean the harbor. And I believe there will be some scientists testifying today, and they can talk more about what those contaminants actually mean to the marine environment. I'm not a scientist myself, so I won't elaborate too much on that.

Boston Harbor is complicated, especially right now. There's so many different projects going on that it's really tough to keep track of what's what. Is dredging part of the cleanup? That's a question that I get all the time, and it isn't. But the Boston Harbor cleanup is going on, and it's taking place in several areas of the harbor. And that's something that needs to be coordinated with this project. We'll be work with the MassPort and the Army Corps to help them make sure that these decisions fit in with the other work taking place.

There's also the Central Artery Third Harbor Tunnel Project, which people probably know about. And there's Some work on

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Spectacle Island where they're taking some of the sediment that's being brought up from that project, disposing of it on Spectable, turning that area into a park and doing some mitigation under water under the proposed disposal sites for this project. That's just another project to keep in mind in terms of coordination.

Another interesting facet of Boston Harbor is that there are several hot spots. The Boston Lightship area, which is one of the proposed disposal sites, has radioactive barrels scattered over the area. I'll talk more about that in a few minute.

Just another point of caution. We need to be worried about all the different hot spots like radioactive waste and highly contaminated areas of sediment throughout the harbor while we're doing this. We should try and have a creative goal here, a goal that looks for disposal options and ways of dealing with the clean and contaminated sediment that will result in a broad benefit for the harbor. There are some ways that we can end up doing the dredging, finding a place to put the sediment and improving

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things along the way. So that's kind of where we're coming from on this.

One final note about just background. Fisheries are very strained right now, so when we're looking at disposal options, we need to very much consider what is the impact on the benthic community in terms of lobster resources and the other fisheries that are already limited in the area.

I want to talk a minute about the cost-benefit analysis that was used in this project. I have some concerns about it basically. The budget figures that Pete used, I think that the bottom line was 35 million, and you can correct me if I'm wrong, but I believe that that assumes disposal of all of the sediment at the Mass. Bay Disposal Site or some ocean site with capping or without capping?

MR. JACKSON: Again, that project is 35 million only for clean material. That's the improvement part. Again, on the contaminated materials primarily, and I'm not going to say all but about 99 percent of it is maintenance material. The 35 and a half or 35.3 million

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dollars is really related to the clean material that we're dredging. That small amount there for the berth area. There's a couple a hundred thousand cubic yards that will have to go somewhere. For that small amount, the berth areas, that assumes ocean disposal with capping.

That 200,000 cubic yards of berth material that's contaminated, that is part of the 35 million. But the cost share, the part that has the benefit-to-cost ratio equation in it is the 35,3 million more than 90 percent of that is clean. 1.1 million which is not part of the 35 million.

MS. LeBLANC: That's the state share.

MR. JACKSON: The part the benefit-to-cost ration equation is the 35 million, which is over 90 percent, is that clean material that is going out to the Mass. Bay Disposal Site.

MS. LeBLANC: I won't talk about the overall budget because I'm not fully clear on what the state share is and what the federal share is. But there are other costs that have

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been allocated to this specific disposal option, because part of the way to make the decision on what are we going to do to dispose of this material is how much does it cost and what can we afford to do.

The analysis takes several things into consideration but it doesn't take any resource questions into consideration. I'll give an example. One of the disposal option is a plan to construct a borrow pit near Spectable Island, and that's an area that has some very active fisheries, including lobsters. There are lots of lobster pots in the area. The cost factors for that don't include what's the loss to the economy of having to shut that area down to fishermen for over a year, the timing on that project.

So I just want to present to you that the cost is not simple, and I'm not saying that we should spend months and months trying to quantify how much one fishery closed for one year is worth, but we certainly need to take those facts into consideration when we make our decision.

The Mass. Bay disposal option

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doesn't include any cost for monitoring, and that area is close to Stellwagen Bank, and it's an area we're very concerned about. And part of the argument is that that's the cheapest option, and there's been a lot of pressure to move in that direction. And in my mind it's certainly not the cheapest environmentally, and even the cost analysis doesn't include the cost, because monitoring will be very necessary. I don't know what the cost would be, but certainly it would have to be a part of it where it's so close to Stellwagen Bank.

So people have been asking for a more broad cost analysis over the past few months, yet we haven't seen one. Again, I'd like to say that it's time to do a real cost estimate of what broad resource questions are here and weigh things as they really are and not just look at the cost of the technology and the barges.

Another issue that hasn't been addressed but it came to my attention in looking at this draft plan, and that is, the Boston Harbor project versus long-term dredging in Massachusetts and future maintenance needs. And

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I just want to clarify something for the record because I was a little bit confused. It's my impression that the draft EIS/R, or I'll call it the draft plan, is to make decisions on the Boston Harbor project. However, we do want to use this process, learning from this process, so that we can move much faster in the future in dealing with maintenance dredging and other regional dredging. What we don't want to see is a decision made based on information this project automatically used for projects in the future before the sediment are analyzed. So I guess what I'm saying is this plan that we're reviewing for the Boston Harbor Project, there is some information in there that made me a little bit concerned about, well, are we making decisions on 6 million cubic yards of contaminated material, which is twice as much, because that was mentioned in the plan. And I would suggest that we're not, and we need to be clear about that, and we're going to need a full environmental analysis of those other projects when them come up. And hopefully someone can clarify that later, because I was a little confused.

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I want to spend a minute talking about the general disposal options and where we stand on them. First of all, you've heard clean versus contaminated. That's really a tough question. What's clean? What's contaminated? And it's really hard to tell, and MassPort and the Army Corps have spent a lot of money doing analyses of the sediments, and we're in the process of looking at those to make sure the definitions are appropriate. We're going to be doing very different things with what's called clean than we will with what we call contaminated. Because clean is basically suitable for ocean disposal, which means we assume it's not going to damage fisheries and other marine resources. So that's something we're in the process of looking at.

In terms of dealing with what's defined as clean, there are a few different options. Our preference is as much of that material be used beneficially as possible. Open-ocean dumping of the clean material wouldn't damage marine resources, and we don't have a problem with that at the Mass. Bay site as long

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as it's monitored and coordinated with marine resources, and there's some sort of a reasonable plan for it. We're not opposed to that. But we'd certainly much, much prefer them using that material wherever possible to upgrade other hot spots around the harbor. It makes much more sense to try to stabilize some of the contaminated areas in the inner harbor than to barge this material out into Mass. Bay and dispose at the Mass Bay Disposal Site. It's also closer, so maybe it's technically easier. I don't really know about that.

We would encourage MassPort and the Army Corps to look first at creative beneficial reuse, and then secondly, open-ocean dumping of the clean material.

Contaminated sediments are a more complicated story, and that's, I think, probably why we're all here today and why we have so many concerns. Open-ocean dumping, which I believe is not part of the plan, is something that we would be very opposed to, and I think that the leaders at MassPort and the Army Corps have also been very strong in not proposing that, so I want to

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thank them for that, because that has taken place in some other places around the country.

Another option — and I can see there a chart in the back. I can't read the words but I can see there's sort of two half moons. The half moon on the right is basically dumping with capping. What you do is you dump the contaminated sediment down and then you cap them over with clean, and you end up with a mound. Another option is the borrow pits, which I believe is the one right next to it, where you go out and you physically dig a hole in the bottom of the ocean, dump the contaminated sediments down and cover them over with clean.

Our very basic, not expert, opinion is that borrow pits for dealing with contaminated sediments are better than caps. And the reason is that you leave the geography of the area the same way it was. If you're creating a mound, so to speak, at the bottom of the ocean, what you're doing is you're changing the geography, and the currents that are already at work in that area are going to continue to be at work. So they naturally will be eating away at

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that mound. So we sort of generally like to see borrow pits before capping.

Other options that have been proposed, just in general before getting into the specific sites, in-channel disposal. That's something that I don't know a whole lot about, but the basic premise is that there you're dredging certain of the channel, which you've heard about and I think you'll hear more about, and this proposal is to dredge deeper, put the contaminated sediment under and then cover it over with clean. So that you end up at the level you're looking for in terms of depth for the shipping, but you still have the contaminated sediments below. That is an option that we think is a good one for a couple of reasons.

The first reason is it minimizes other areas of the harbor that you have to disturb. You're already dredging there. You already have to surface the contaminated sediments, so you already have to contain the area. It's much better to deal with it all right there then go through a whole separate process of shipping it somewhere else, digging your borrow

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pit or whatever else. It certainly seems easier technically and from an environmental standpoint you're dealing with a smaller resource area. So we'll be looking at that as a good possibility.

Near-shore containment facilities, I believe, have been ruled out of the first category of options. I should back up. I wish you had the experts go first because they can give you all these categories, but they've narrowed the disposal options to several different categories. The first is called practicable. That means that they — I have the definition here. Maybe someone can help me with that.

FROM THE FLOOR: Engineeringly feasible and capable of being done, taking into account logistics and cost and environmental concerns, out of the Clean Water Act.

MS. LeBLANC: So that's that one category. I don't know if everybody heard it. Environmental, cost, logistics and technology. So they have looked through all these components and narrowed many, many sites down to a few. We don't necessarily agree with their definition of

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practicable for all of the sites, and I'll get into that in a minute, but just so you know that is the definition.

Near-shore containment facilities had proposed early on, and those we generally don't think are a good idea. The water-front space is very, very limited right now. There aren't a whole lot of areas where you can actually do this technically. And also the amount and intensity of storms has been increasing over the years. And basically setting up something like this on the shoreline of Massachusetts is probably not the best idea in terms of public access and also in terms of safety. It's not really an option right now.

Land filling is the most expensive in the entire spectrum of disposal options, and in general, we also agree it's too expensive. We believe that we want to keep land filling on the table for certain hot spot areas. There may be some small amount of contaminated sites that are too toxic to go anywhere. And so we would say, Leave the land filling on the table in a very limited way.

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And finally, remediation of contaminated sediments is something that hasn't been talked about a lot in this draft plan. We have been talking with some of the officials, and we got a preliminary commitment with Steve Tocco to look into innovative technologies for remediating toxics. I don't see anything in this plan that does that, so we'll be working with the public officials to try and figure out what we actually can do in terms of coming up with ways to reduce the toxicity of the worst sediments.

Let me get into a little bit of the disposal sites. I'm sorry for the length of the comments, but I won't be testifying after this presentation. This is considered my testimony.

The Mass. Bay Disposal Site, this is something that we basically have a lot of problem with the way it was addressed in the plan. One issue is inconsistency. In the executive summary of the plan, the Mass. Bay Dispose Site is identified as a practicable — and you just heard the definition — practicable alternative for dealing with all the sediment,

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clean and contaminated.

Now practicable says that you've looked at the technology, you've looked at the logistics, and you've reviewed the environmental and cost factors. We all seem to agree that capping is not possible in 300 feet of water. In fact, the designation of the Mass. Bay foul area — there's a map over on the left there with a red dot, shows where the foul area is. It's adjacent to the National Marine Sanctuary, Stellwagen Bank. The designation for that area says that you can't — capping is not feasible at this time. There's no technology proven to do it in that depth of water. Our concerns are that the marine santuary is right there. What you have is a basin and then an upwelling. I'm not a marine ecologist. I admit it, but I know that the basin feeds up into Stellwagen Bank, which is one of our richest resources. And we are completely opposed to any contaminated sediments going out there.

And I'm also very confused. When I talk to some of the people from MassPort and the Army Corps, they have said this isn't an

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option, and yet I read it very clearly in the summary that it is and that it's been called practicable, which means they have already proved the logistics. But then other places in the document, they say, well, we can't do it until we prove the logistics. So I have a couple of questions. Which is it, for one thing? And we don't support it, and that's one option that nobody has supported, and there has been testimony after testimony, year after year on that issue. And I just hope we can take it off the table so we can move ahead and find a solution that will work and that we can agree on. I think you'll be hearing from some of the scientist who know more about the marine resources in that area and why it's such a problem.

Another area that's been proposed for dealing with contaminate sediments is called the Boston Lighship area. I don't have a map of that area, but the reason it's significant is because between the 1940s and the 1970s, many radioactive waste barrels were dumped in that area. Now, the EPA started looking at that. I

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don't remember the year. A few years ago they started evaluating that. Unfortunately, they stopped short figuring out where the barrels are and what the extent of them is in the area. So what I would like to propose to MassPort and the Army Corps and EPA — I don't know if there's anyone here from the EPA today — that all those agencies need to work together. We need to push the EPA to do that evaluation very quickly, which I think is data they have. They have the basic data. All they need to do is get in a boat and get out there and do a little evaluation, figure out where the barrels are, and think what would be the impact of putting a large amount of contaminated and/or clean sediment in that area, and would that actually be a benefit.

Does it make sense to try to cap over these radioactive waste barrels that are rotting in place with the sediments with this project? That's a creative possibility. It's one that needs to be coordinated. We can't just go out there and say, All right, we're going to use the Boston Lightship area do dump these sediments. It's a huge area. We don't know

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where the barrels are.

If it's not coordinated with the EPA, what could happen is you could have the radioactivity problem, which we already do have, and then you could also have uncapped contaminated sediments next to it. What we want to see is, is there a way to solve the radioactive waste problem and deal with the contaminated sediments at the same time. That's a possibility, but it's one that's not going to happen unless there's some real coordination and commitment from the EPA and the Army Corps and MassPort to work with EPA. So that's something that we're working for and believe it could be a very positive solution for dealing with two problems.

A third major disposal site is off of Spectacle Island, and that's an area where they're proposing doing borrow pits, which I mention in the back. And we're basically looking at that area right now and talking to some scientists. I know that it is a resource area. There are a lot of fisheries there. There's lobster pots. And certainly that's and issue. I

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don't know fully what the extents of the resources are in that area or what the damage would be. But that's something that we're in the process of assessing.

If work were to go forward in that area, it would certainly need very good monitoring, and we would need to have containment going on.

I wanted to mention something that's going on with the Central Artery Project in the same area. I mentioned there's work at Spectacle Island. The Central Artery Project is also constructing a reef which is very close to this disposal site identified in this dredging plan. So, again, here we have a complicated situation where if the MassPort and the Army Corps want to go forward in this area, they need to coordinate with the Central Artery Project because of the reef that's being constructed as part of the mitigation effort, and certainly we wouldn't want to have dredged-up contaminated sediments going on after the reef construction. There'd have to be sort of a timing element there. Maybe the reef construction can be

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delayed or whatever, but that's an important thing that needs to be coordinated.

The two other sites being proposed in Mass. Bay for borrow pits are called Meisburger sites. I don't know where that name come from, probably some scientist who evaluated the area. One thing I do know about that area is that both of these sites are located very close to the outfall, the proposed outfall, which is part of the Boston Harbor Cleanup Project. And what's going to happen is beginning in 1996, the date's been switched because of the usual construction delays, but beginning probably 1996, you're going to have treated wastewater coming out at the outfall site. And there's an intensive, near-shore monitoring plan going on there to figure out what's going to be the impact of these nutrients on Mass. Bay. That's just one aspect.

But the other interesting point is the reason why that site was chosen for the outfall location. It was chosen because it's an area where the currents — Judy Peterson can probably talk about why that site was chosen for

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the outfall more than me. She's a scientist. But I know that it was chosen because it's a mixing area, which means there's a lot of different currents. So my question to MassPort and the Army Corps is, why are we looking at this site for disposal of contaminated sediments when it's an area we chose for the outfall because it has the best dispersal effect? And I think what we're looking at in terms of the borrow pit locations is exactly the opposite. So we need to look at that more closely and potentially identify some other sites for borrow pitting in Mass. Bay.

I talked a little bit about in-channel disposal as an option, and there are some other options, I won't go through the whole laundry list but just out of the ones proposed that seem like they could still be on the table. One idea was to put some of the contaminated sediments in some area of the inner harbor that are highly contaminated now. The goal is basically, you've got these hot spots, and we have some contaminated sediments we have to deal with. Why not put them in certain areas and

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cover them over with clean, and your net result would be an improvement on some of these areas in the inner harbor. We think generally that that's a very good idea.

A couple of specific areas where that's been proposed are the Mystic River and Revere Sugar, and we're in the process of looking at the specific plans for that, but we see that as something that should stay on the table. It's not in the practicable list right now. It's in the potentially practicable. I'm not really sure what that means, whether it means it's off the table or could be on the table, but we would just like to say it makes sense to look at doing that sort of thing.

I mentioned a little bit about innovative technology to remediate contaminated sediments. It's not MassPort's responsibility, but I just want to mention that there's the Green Ports legislation right now that's been proposed by Congressman Menendez. That is something where Massachusetts could be eligible to get some funding for doing pilot remediation projects. So I would hope that the officials at MassPort and

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the Army Corps could push for that and also try to position Massachusetts to get some of those funds. Steve Tocco has said that he is committed to doing this type of thing, so this may be a channel to get some funds in Massachusetts for that.

I want to just make a couple of summary comments on the disposal sites. It's really complicated. I know I just sort of said a lot, some positive, some negative. What does it mean? Basically our posistion is we don't want to see any contaminated sediments going out into the Mass. Bay Disposal Site, which I mentioned. We think borrow pits are a better idea than capping in general. Yet there are some problems with the borrow sites. So we'll be working with the agencies to either identify those sites or potentially other sites depending.

The Boston Lightship area does seem like an area that could be used for this project and maybe even future projects. There's a lot of potential there, certainly a lot of capacity as well. Unfortunately, like the rest of Boston Harbor, it's complicated. You've got

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the radioactive waste there, and that is something that needs to be coordinated. If people are willing to work together on it, that could be a big solution for this project.

And then in-channel disposal is a first priority, although it has less capacity. You can't deal with all the sediments with that kind of an option, but it's better, I think, than most of the other options if it can be done properly because you're limiting the area that you're dealing with. You don't have to go dig a borrow pit somewhere else and remove the entire benthic community in that area.

So in-site solutions first, because you limit the area you're dealing with, and then looking for outside solutions and trying to find solutions that will actually have a broader benefits, like the lightship area.

I want to say a couple of words about the dredging process and monitoring, and then I'll finish up. Dredging technology — you'll probably hear a lot about dredging technology, and there are a lot of different aspects to it. There's the barge. There's the

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dredge that actually goes down and picks up the contaminated sediments and puts them on the barge. There are containment barriers like silt curtains to use to keep contaminated sediments in an area, keep them from spreading around to other resources that are near there. And then there's a whole slew of other technology, which I probably don't understand.

What I do want to say is that there is a lot of dredging that went forward last year at the Moran Terminal, and we had looked at the permits for that project. The permits looked really good. They were using the environmentally best technology in every area. The reality was a little bit different. The dredging at the site had a lot of problems. The silt curtains weren't really working. The environmental bucket wasn't working properly. All kinds of things. There was debris, old pilings in the area that hadn't been expected, and you know, the list goes on.

The bottom line is that you don't always know what to expect. And so what happened at Moran was a lot of probems came up, but nothing really happened to fix them until the

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work was all done and it was too late. We don't want to see that situation happen with the rest of the projects. And I think probably a couple of sort of simple things could happen to help that along, and those things are related to the permitting and monitoring situations. Basically what we could do is, hopefully Mike Leone could help with the legal aspects of it, but in the permit we could put instead of just outlining the technology — in other words, we are going to use this type of bucket or that type of bucket — we could outline performance standards — here's what we want to see happen and here's the technology we're using. If you have the standards there and the goals in terms of the process, then you'll be able to know whether or not things are working well, and you'll have some sort of baseline to know, do we need to stop, re-evaluate and do things a little bit.

It certainly needs to have some sort of independent monitoring happening at the area. Whatever the monitoring plan was at Moran, it seemed to break down. There was no process for when so-and-so sees something, what happens?

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That process wasn't in place. So there needs to be some kind of contingency plan written into the permit that says that if you see problems such as this laundry list happen, then here's what's going to happen. It's going to be stopped. We'll immediately look at those, do something different, and then move along and continue with the dredging. That's something we want to see happen.

In summary, I just want to say that we are in the process of looking at this very complicated plan. Our comments today are a summary of the major issues we've seen so far, and certainly we'll probably be doing a more full analysis of all the sites and maybe bringing up some additional issues. In the future I hope that there will be another hearing, because it's important that we have adequate time to review this plan. I don't know if you've seen it. It's about this big. It seems this big. It's fairly dense for those of us who aren't scientists, and we basically want to have another opportunity to give our comments after we had a full chance to review the plan.

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In summary, I just want to say Save the Harbor/Save the Bay is committed to Boston Harbor as both an economic resource and a natural resource. Again, we are supportive of the dredging project. We're spending a lot of time working with everybody in this room to find ways to move this project along so that we can all benefit, the harbor can benefit, the economy can benefit and the resource won't have to be sacrificed along the way.

Dredging is messy. It's needed for the economy, and it's potentially dangerous for the environment. With those facts in mind, we'll be working to push for creative combinations of disposal sites that will cause good rather than harm to the resource.

Thanks again for letting me make these comments, and we look forward to hearing from the rest of the staff.

MR. ROSENBERG: Thank you. Following our next speaker, those individuals who signed up for public comment will be called, and then we'll get back into the formal agenda.

The next speaker is Ms. Grace

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Perez, Conservation Law Foundation. She's a science fellow working on contaminated sediment at CLF.

STATEMENT BY GRACE PEREZ,

CONSERVATION LAW FOUNDATION

MS. PEREZ: Good afternoon, everyone. I'd like to thank the U.S. Army Corps of Engineers for inviting me to be here today to speak with you. Like Save the Harbor/Save the Bay, the Conservation Law Foundation or CLF is not a government agency. We're a nonprofit, 8,000-member, environmental advocacy group working in the New England region.

CLF has monitored the progress of the Boston Harbor dredging project over the past several year. For the past 12 months or so we've become increasingly active, mostly by attending meetings of the advisory committee, the disposal options working group and other groups working in the planning process of the project. This participation wouldn't have been possible without the cooperation of the Corps of Engineers and of MassPort, which has provided us with project documents and information and have welcomed us

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into the scoping and planning process.

CLF would like to thank these organizations for taking a positive approach to environmental issues, to the environmental issues raised by the project. And we look forward to continued collaboration in the future.

Some of you may be aware that CLF was a key player in the litigation that led to so-called cleanup of Boston Harbor that's going on right now. I say so-called because the term implies a lot more than what is really happening. Partly as a result of CLF's actions, the MWRA has stopped discharging sewage sludge and scum — that's the stuff that sticks to the bottom and the stuff that floats to the top in the water — into the harbor. And as many of you know, the MWRA is building a sewage treatment plant on Deer Island for secondary treatment of sewage.

These actions are important ones and will help move the Boston Harbor to becoming a cleaner harbor. But they alone will not make the harbor totally clean, because sewage is not the only thing that determines how clean this

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area is. This brings us to why CLF has an interest in this project and why we're here today.

At the bottom of the harbor, due not only to historic sewage discharge but also to input from urban runoff, rivers, combined sewer overflows and even automobile exhaust that are carried and deposited in our waters, are sediments that are contaminated with carcinogenic and toxic substances.

I want to say a few words about what the effects of these sediments are because it's a very important issue, and even though I was trained in science, it's the wrong kind of science. So although I'm a scientist, I look forward to the comments that are going to made by some of the scientists here today.

According to a Oceanographic and Atmospheric Administration study a few years back, Boston Harbor sediments are among some of the most contaminated in the country, having elevated levels of heavy metals such as chromium, lead, mercury and zink as well as PCB's and PAH's.

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There was a study that looked at previous work, at all the previous work that had been done on the effects of contaminated sediments on marine organisms, and then ranked over 200 sites nationwide, coastal sites that had been studied in terms of its potential to cause damage to the organisms that were exposed to those sediment. Unfortunately Boston Harbor sites ranked number 2 and number 6 out of the 200 national sites. This again is for adverse biological impact.

Sediments that were tested during the course of this project also echoed the results that NOAA had found previously. Many of the sediments, including lead, chromium, zink, PCB's and other contaminants, were in concentrations greater — and this is in the materials that are to be dredged — were concentrations greater than those known to have adverse effects on organisms. And by adverse effects, this generally means death.

There's an entire rogues gallery of potential effects from exposure to contaminated sediments. Chronic diseases,

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tumors, eroded fins, impaired reproduction and accute toxicity, death, are some of the potential effects of exposure. In Boston Harbor there have been some very real effects that have already been documented. Winter flounder has been studied to a great extent. They live and feed on the harbor bottom, and they have been found by researchers to have tumors on their mouths and to have carcinogenic liver lesions. These have been linked directly to pesticides and PAH's in the sediment.

Now, these substance that I'm talking about are very persistent in the environment. Some of them degrade slowly while others, the metals, are essentially with us forever. As they rise through the food web, they accumulate. Reaching higher and higher levels in the organisms towards the top of the web, humans being among them. The human link has already been made in Boston Harbor.

In 1988 an EPA study of Quincy Bay found such a high incidence of disease in soft- shelled clams and winter flounder, as well as high PCB levels in lobster tomalley from the

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harbor that they recommended that a human health advisory be announcement. And a little known one remains in effect for Boston Harbor. It warns against eating lobster tomalley from the harbor, and particularly warns pregnant women and young children to avoid eating lobster from the harbor.

So I've talked about the effect these contaminants can have as they are in place on the harbor bottom. Now, some of these contaminants remain somewhat isolated when they sit on the harbor bottom and others may, as I said, may enter the food web. But a physical process, such as tidal action or a dredging project, can re-release the contaminants into the environment, and if done improperly or carelessly, these contaminants can then be avaiable to potentially contaminate our food supply. This, of course, in Boston Harbor would have disastrous effects on the fishing and lobstering industries as well as both commercial and recreational.

Nevertheless the process of siltation that is what the Corps has been talking

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about today means that the navigation channels and berthing areas in the harbor have to be periodically dredged in order to be made viable, and failure to do so would result in the loss of jobs and commerce that we are unwilling to take.

But the main issue for CLF with respect to this project is, therefore, not that dredging is a bad thing and that it shouldn't happen, but rather that when it is necessary, dredging is done in a way that minimizes the impacts of the contaminants on the marine environment and, therefore, on our food supply. At a minimum this means that the project must meet the letter and spirit of existing environmental regulations.

I want to be clear that although I've been talking about the contamination problem here, the levels of contamination aren't as high as at some other sites. So we must keep things in perspective. For example, New Bedford Harbor is so contaminated with PCB's that it's an EPA Super Fund site. But nevertheless, the levels of contaminants that we've seen as a result of the testing for this project are substantially high

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and deserve careful examination and proper action as a result when dealing with dredging and disposal.

CLF is currently reviewing the draft EIS and because of the relatively early timing of these comment sessions — we received the two volumes two weeks ago — we don't yet have detailed comments ready. We'd like to touch on a few of the key issues that we will look at more carefully, and for those of you who are interested, we have a 2-page position paper at our table in the back of the room.

As has been said by every speaker this afternoon, the biggest single challenge related to the dredging project and to public health is the 1.1 million cubic yards that must be disposed of, dredged and disposed of, and I have to look at the chart back there more carefully to see if my numbers agree that this correlates with a 60-story building the size of a football field. So it's a lot of stuff. I think I'm going to start looking at the Prudential Building in a different light after today too.

Our first concern deals with what

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is determined to be clean versus unclean or unsuitable for unconfined ocean disposal. Because of the large spatial variation in contaminant concentration throughout the harbor and because of the results of the sediment testing that's been done as part of this project, we believe that the entire 1.1 million cubic yards of silty material is unsuitable for unconfined ocean disposal; that is, it should not simply be dumped in the ocean. The draft EIS uses this as a working definition, and we hope that this point will not be revisited.

The EIS lists five preferred alternatives for disposal in its executive summary. And I just have a few comments on these. Joan actually touched on some of our concerns. I'll go over them quickly. Generally speaking, four out of the five sites are used by area fishermen and lobstermen, and so this is one of the things we have to look at very carefully before we go either digging in the area or dumping and capping.

The Mass. Bay Disposal Site is 22 miles east of Boston and lies at approximately

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300 feet in depth. Capping is unlikely to work at these depths, and in fact, the original designation of the site states that only clean materials are to be disposed of there.

The other issue with the MBDS is that Stellwagen Bank and the National Marine Sanctuary is adjacent to it and is frequented by a number of threatened and endangered species as well as by area commerical fishermen. So therefore because of these reasons, CLF is opposed to dumping contaminated sediments at the Mass. Bay Disposal Site.

One of the other alternatives is Boston Lightship, and as Joan mentioned, this was an historic dumping ground for radioactive waste as well as other waste. And CLF believes that potentially this would be a good site for the disposal of probably clean but possibly contaminated and clean sediment in the future, with capping of course. Don't misunderstand what I'm saying.

There may be a way to help protect the radioactive contaminants from entering the food web, but until the Boston Lightship area is

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fully mapped and characterized, CLF is opposed to dumping silts there.

With respect to Spectacle Island, the studies of the harbor and bay bottoms by Harley Knebel working at Woods Hole, the USGS there, showed that the area immediately east of Spectacle Island where disposal is proposed is primarily erosional in nature. And we have questions about the implications of dumping contaminated sediment in an erosional area. So far we haven't seen anything in the EIS that addresses this point, but we are far from finished with reading the EIS. So perhaps it's already there.

In thinking about the disposal issue, it's easy to forget that environmental damage can occur during the active dredging as well as at the time of disposal. From the recent Moran Terminal experience, CLF has learned not only that the right equipment is required but that personnel must be knowledgeable about the techniques for dealing with contaminated sediment.

And equally important are

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restrictions imposed by the permit issued by Federal, State and Local agencies. The dredge operator, for example, must be educated on the permits relative to his or her function. If silt curtains are required, the operator should make sure that they are in place and working before commencing the dredging operation.

Another issue that's important and that affects both dredging and disposal is that there must be independent confirmation that the work is being done properly and according to permits. I'm sure that some of the fishermen here today have themselves seen or heard the practice of short dumping which was used in the past to get rid of dredge spoils prior to arriving at the designated disposal site. Presumably this was done for economic reasons.

Likewise at CLF we've heard of other dubious and illegal practices, such as the systematic overfilling of barges and the washing out of remaining contaminated sediment from barges while the barges are docked.

There's a host of environmentally related permits that will be issued as a result

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of this project, many with specific requirements and restrictions. We believe that there must be independent verification that permit requirements are being met during every step of the process. An on-site observer must be at the dredge site as well as on disposal runs and should have the authority to stop the work if he or she sees a violation. This is the only way that we can be sure that the project looks as good in reality as it does on paper.

I want to make a general comment and a recommendation that I believe has not been raised before. Part of it actually has. The first part is, since this project is expected to cause at least some environmental disruption — after all, anyone who has seen a dredging project knows that it isn't a clean, meticulous thing like brain surgery. We proposed that the Corps and/or MassPort take specific, positive action to mitigate or compensate for these effects.

As we stated in the past, CLF supports the on-going development and use of alternative technologies to render the contaminated sediments less harmful. We

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encourage MassPort and especially the Corps to take a leadership role by pursuing these possibilities and treating a portion of the silt with one of these technologies.

Another possibility is for the Corps to begin consultation with agencies not knowledgeable of harbor conditions to determine whether one or more localized areas, such as a contaminated hot sport, near the maintenance dredging sites and outside navigation channel boundaries would especially benefits from dredging as part of the maintenance project. This action would make optimal use of the resources deployed for the maintenance project and would be a beneficial step and a positive step in the cleanup of Boston Harbor.

Just a quick word on some of the wider issues that are raised by this project and that CLF is concerned about. The United States needs to develop a coherent contaminated sediment management strategy so that projects such as this one have better guidance on how to proceed. We also would like to see some effort at the federal level to develop a maritime

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strategy addressing the roles of invidual ports from a nationwide perspective. It's not clear that every port should handle the largest ships. And we're not saying that Boston Harbor should not, we need a national level strategy to guide the development of the ports and the dredging within the ports.

Finally, we've seen the beginnings of a State interagency effort to view the dredging needs of the Commonwealth over the next 50 years. CLF encourages these planning efforts, and we hope that public interest groups such as ours will not be excluded from the process.

To recap our position on the Boston Harbor Navigation Improvment Project, CLF is not opposed to dredging to maintain the viability of the harbor. The nature of the sediments, however, requires that significant effort be focused on preventing the contaminants being dispersed in the marine environment, both in the dredging and disposal sites.

CLF is currently reviewing the draft EIS and will prepare a detailed set of comments in response to it. I'll be at the

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public interest table over there during the rest of the session to answer your questions and to discuss these issues further with those who are interested. Thank you very much.

MR. ROSENBERG: Thank you, Grace. Just a word before we open up to public comment. After the public comment, we'll be taking about a 10-minute break, and then we'll get back to the formal agenda.

Before we start on those comments, I'd like to personally thank both the Conservation Law Foundation and Save the Harbor/Save the Bay. They were two of among many other public interest and environment groups, such as the Sierra Club and Audubon

Society, that have contributed their time and energy over the past year or so to get us where we are today. Originally there were over 300 disposal alternatives, and with their help, we got them down to where we are.

And I have a special word of thanks for Joan LeBlanc, who we're sorry to hear is leaving us and passing on the cane, if you will, to keep us in line, to Judy, and thanks for

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your insight and your common sense, your advice, and you were very helpful in getting us where we are today.

To start the public comments, please excuse me if I mispronounce your name, Mr. Alfred Frizelle.

STATEMENT BY ALFRED E. FRIZELLE,

BOSTON SHIPPING ASSOCIATION, INC.

MR. FRIZELLE: Good afternoon. My name is Al Frizelle. I'm the general manager and counsel for the Boston Shipping Association.

The Boston Shipping Association members include steamship lines, agents, stevedores, marine terminal operators and others whose daily business is shipping in the port of Boston. We urge that approval be given and that permits be issued to commence dredge in Boston Harbor.

A depth of mean low water of 40 feet is needed to accommodate the container ships and tankers that presently call at the port supplying goods and gas and petroleum products to the Commonwealth and the New England region. At present container ships schedule arrivals into

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and departures from the port around the tides because of inadequate depths. Delays resulting from such scheduling increases the container ships' operating costs and discourage many, many ships from calling at the port of Boston. Within the last two months container ships have bypassed Boston and sailed to New York because scheduled arrivals were at low water.

Importers and exporters in Boston cannot rely upon this type of service and need this new concept. They must have their goods here on time. As noted in the DEIR, more cargo would be need to be unloaded necessitating more trips at a higher cost, and also notes that cargo would be shipped via barge. A more likely scenario would be that containers would be delivered directly from New York or from Montreal, Canada, directly to the consignees bypassing Boston in total, leaving out the waterfront aspect completely.

By far as it appears from the comments that have been made today, the greatest concern is the prohibition of undefined dumping of contaminated sediment. We understand the need

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for sound environmental practices tempered by economic considerations.

After review of the numerous sites and technologies, the draft provides a list of reasonable alternative sites and technologies for ocean dumping of contaminated sediments with a cap. There appears to be no objections to ocean dumping for uncontaminated material. Although at this time we do not favor one site over the other, there are sites available for dumping in an economically and environmentally sound manner, and we urge you to consider those alternatives carefully.

We do favor ocean dumping of all of the materials, with limitations as noted, versus the upland disposal of material which is just economically unsound in our opinion.

The time frame that is noted in the project should be kept and must be kept. The cost in jobs alone estimated at approximately 6,000 in the region dictates that prompt action must be taken for the benefit of business and working men and women of the Commonwealth and the region. Thank you.

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MR. ROSENBERG: Thank you, sir. The next comment will be from Louis Zeppieri.

(No response.)

MR. ROSENBERG: William Robinson.

STATEMENT BY WILLIAM E. ROBINSON,

MASS. LOBSTERMEN'S ASSOCIATION

MR. ROBINSON: Good afternoon, ladies and gentlemen. My name is William Robinson. I'm a local lobster fisherman out of the port of Saugus. Before I get going on this, I'd just like to let you know I also have a wife and two children.

And I've been sent here as a representative of the Massachusetts Lobstermen's Association because Mr. Adler, our executive director could not be here. Fortunately he'll be at the hearing in Hyannis.

I'd like to tell you mainly what we're concerned with as fishermen along the Massachusetts coast. And that is exactly what everyone has been speaking about and that's the disposal sites. We do not know what type of impact it's going to have on our fishing.

Number one, the problem that we're

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having with PCB's up in Boston Harbor had bad publicity a few years ago, which was stated earlier. We take this material, take it outside. What type of effect is it going to have when it meets the media and you tell the public the contaminates are now spread out all over the bay? What type of impact is it going to have on our fishing?

Secondly, in the dredging mode that we know it as and the dump site, when the material was dumped, and what type of effect it has on the coverage of vegetation on the ground, the bottom of the ocean, affects different types of fishing different times of the year when the fish come to the area; in other words, what attracts them to this area, would that be dumped upon and would that change the topography of the bottom of the ocean which changes different grounds for us the most productive times of the year where we fish?

We're kind of concerned also with the different sites which are chosen. They kind of have an effect on different fishermen at different times of the year. Take the Spectacle

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Island dump site that you've chosen. At times of the year that's the most productive area for some Boston Harbor fishermen around that area. That's their key spot. Spots such as the Meisburger areas or the Boston Lightship area at certain times of the year, that's the hop spot or best spot for some fishermen to be fishing at certain times of the year. And to be closed off for one year or to have those areas not available to us could have a huge effect on our entire annual income.

Also another one of our concerns was travel to and from the dump site by the mode of transportation, such as the barges. At the Moran dredging and the Third Harbor Tunnel Project, which happened last year, some of the tugboats that were hired from New York and New Jersey, wherever, were going on different travel routes which was causing a large amount of damage to our lobster traps and fishing gear and so on.

We tried to report this through the Association and the Coast Guard, and they said, "Well, we'll try to get back to them, try and get better communication between you

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people." We came up and tried to approach the boats on our own and because of different weather conditions and the sea conditions or whatever, the tugboats had to take different directions at different times of the year to and from the dredging site, which caused a lot of damage to us. What it is is the cable that was being towed in between, as you all are familiar with, and they dropped it at a certain point, tightened the cable so they could maneuver back into the harbor and caused a massive amount of damage on the outer harbor to the fishermen, and to no avail. Until the project ended, we weren't compensated for anything. What we're looking for is we just want them to take one straight line. We'd like to bring that up as one of our concerns.

The other concern that we have is with the effect of everything. We're being faced with a magnitude of problems in the lobster industry and the finfish industry, and we just kind of went along with the diffuser project, which is taking place from Deer Island and the outfall sewage plant. We don't know the results of that yet. We were promised from the Cashman

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people when the project started that we were going to see a film from an Australian site which has a familiar type of sewage outfall. We were told we were going to see it. We were told we were going to get a chance to look at it. We were never shown anything.

So my point is, we haven't seen the effect yet from that on the fishing industry yet, and now to take these contaminated materials or other materials to be dumped in there, it all kind of is going to have a terrible effect on the fishermen. We'd just like to be informed and kept up on what the concerns are as one party, the fishermen in general, just to keep informed as to what's happening. Thank you very much.

MR. ROSENBERG: Thank you, sir. The next official comment will come from Mr. William McNamara.

STATEMENT BY WILLIAM R. McNAMARA,

INTERNATIONAL LONGSHOREMEN'S ASSOCIATION

MR. McNAMARA: Good afternoon. My name is William McNamara. I'm the International Vice President of the International Longshoremen's Association. I'm married. I have

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two children also.

I'm very honored to be here today representing the International Longshoremen's Association. We have 25 locals in the New England area. We have about 15,000 members.

My main interest today is the port of Boston. I have a delegation here from the port of Boston, many of the members who have serviced the port in over 50 years. Myself, I've been in the port for 38 years.

I have a letter here from my office, the Office of William R. McNamara, Internaitonal Vice President. It's addressed to Miss or Mrs. Trudy Cox, Secretary, Massachusetts Executive Office of Environmental Affairs, 100 Cambridge Street, Boston, Mass. 02202, dated May 17, 1994. Subject matter: Dredging of Boston Harbor.

"Dear Miss Cox: Attached is a petition from the International Longshoremen's Association, its affiliated Locals 799, 800, 805, 809, 1066 and 1604, ILA, Port of Boston.

"This petition is signed by over 300 members of the International Longshoremen's

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Association who work the waterfront terminals on a daily basis. We also have trucking companies, U.S. Customs, custom brokers, stevedoring companies, steamship agents, freight forwarders and many other companies who do business through the port.

"If dredging is not done soon in the Port of Boston or in Boston Harbor, the ships that service this port will look elsewhere to unload their cargos and thousands of jobs will be lost. Sincerely, William R. McNamara, International Vice President."

Thank you.

MR. ROSENBERG: Thank you, sir. Our next speaker to give comment is Mason Weinrich.

STATEMENT BY MASON WEINRICH,

CETACEAN RESEARCH UNIT

MR. WEINRICH: Thank you. First I'd like to thank the Corps and MassPort for giving us the opportunity to comment and for holding the hearing. I think it's a great information session and will probably help a lot of people get through about 1500 pages, which is

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very difficult to wade through.

First let give you a brief background as to who I am and where I come from. I'm the executive director of the Cetacean Research Unit, a private, non-profit organization, based in Gloucester, Massachusetts, with a membership of about 300 devoted to studying whales, dolphins and marine life off the New England coast and conserving it. So I am actually one of the scientists who has been referred to as one of many scientists who will be speaking later.

I'm also the chair of the Coastal Advocacy Network, a group that is part of the Massachusetts base program that coordinates groups such as Save the Harbor/Save the Bay, Conservation Law Foundation, Mass. Audubon Society, and the network represents approximately 75,000 citizens in Massachusetts.

I'm going to be speaking here on behalf of the Cetaceon Research Unit. I will say that the Advocacy Network is concerned with many of the issues I'm about to address and will be preparing comments, but it's obviously fairly

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early in the process. And they're not quite at the point where they have detailed those as yet, so you'll be hearing from that other half of mine, probably at the next hearing you have; if not, in writing.

First of all, I'm going to deal today with primarily one issue. It's one of the hot issues we've heard about so far, and that is the open ocean disposal of both contaminated and clean material. First of all, I want to give you an idea of why we think this is a critical issue. You heard mention that this area is right next to Stellwagen Bank National Marine Sanctuary. Certainly that is key. In and of itself, the Mass. Bay Disposal Site is also a very important habitat to marine life and endangered species. It's mentioned briefly in the document that the Mass. Bay Disposal Site is a general area of transient species, particularly large whales. However, in Bob Kenny's paper in 1985, published in Fishery Bulletin, based on the results of a 3-year aerial survey from 1979 to 1982, the 10-meter by 10-meter quadrant — rather the 10-degree by 10-degree quadrant that includes

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the Mass. Bay Disposal Site, listed among the top 10 percent for marine mammal and endangered species throughout the entire Northeast. So I think it has to be characterized as such.

Also there is shown sensitivity for animals on the top of the food chain, particularly endangered species and marine mammals. They have an extreme sensitivity to toxics. The highest concentrations of any of the toxins that have been talked about today, PCB's PAH's, organic chlorines, heavy metals, have all been found in the tissues of marine mammals.

The further work that we have been involved in doing in cooperation with scientists down at Woods Hole in the past few years and as yet unpublished but details and reports that were recently submitted to the Massachusetts Water Resources Authority indicates that some of the whales that spent a long time in the Stellwagen Bank region are showing increased levels of toxins in their blubber tissue, not at the point yet where it's something to be distressed or worried about but they're showing levels higher than that of animals in other areas. So it's

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something we certainly have to be concerned about and realize that.

First of all, regarding the contaminated silt, we congratulate you for most of the DEIS/R classifying all of the surface silt as contaminated. However, as Joan LeBlanc pointed out, there are inconsistencies in what that means and what that doesn't mean in the EIR, and we would ask that you look through that carefully, go through all the references to it and make that consistent, and we congratulate you for that designation and urge you to keep that and not look to reclassify any of it.

Second of all, it is mentioned numerous times in the DEIS/R that open-ocean disposal of these sediment might be feasible with a capping demonstration. There's no reason to expect that at a site such at Mass. Bay Disposal Site that capping would be effective. There has been one test that I've been able to find reference to, and I thank that John Kerlan for National Fisheries Service for helping me with this.

While I've not been able to get

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the original report, I have been able to get an annotated reference of R.W. Morton's 1984 Report on Dredge Material Disposal Operations for the Boston Foul Ground, June 1982 to February 1983. They looked at capping tests using both clamshell scow operations and also hopper barges, And they found in neither case was there a mound built up, and in both cases the sediment was distributed over a wide region in numerous directions.

Given that, given the depth that we're talking, the midwater currents as well as surface currents go through there, there would be no reason to think that capping could take place.

More worrisome to us was the suggestion several times in the DEIS/R that this project and the material generated by this project would make a sufficient test for capping. That to us represents a very dangerous thing which should be discarded immediately. When you would be talking about doing that, if testing with something like that, if the testing were to fail, and I just present it as a reason to think that test may fail, would leave you with

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potentially an environment mess. You would have to be dealing then with a remedial cleanup. You would have those contaminants exposed to the environment, and that should not be thought about in any way, shape or form for this project.

Secondly, in consideration of that, there are several times in which the Adams model is referred to as a justification for saying that there would be no long-term or short-term exposures to animals outside the immediate site of the dumping area. I would caution you on the use of a model to give you a predictive result. A mathematical model, as a scientist, I've dealt with many times, is designed to simplify reality to indicate to you where you should look to gather data to give you an answer. It is not designed to give you an answer. And to use that kind of a result to predict something like that is an inappropriate use of the model, and all references to that should be struck from the document.

So what then would we consider to be an appropriate test of capping for the area? I just told you one we would think would not be.

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We concur with the National Marine Fisheries letter generated to you at the Army Corps several weeks ago, where we feel that before you can even consider capping at the dump site, you would need a test where a marked, clean sediment was dumped and capped by a secondarily marked sediment. You would have to show not only that the cap worked short term but you would also have to show the integrity of the cap over a long term.

Clearly given the time constraints that there are for this, as we have heard from severl speaker already today, that is unfeasible. So our recommendation for the Massachusetts Bay Disposal Site is that all references to dumping any contaminated silt at the Massachusetts Bay Disposal Site should be removed from the document as a viable option with or without capping.

There are several other considerations that we think should be considered as well. What has been classified as clean sediment should be tested continually and thoroughly throughout the project. As a scientist, I know that the ocean environment is

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not uniform and varies over a microscale; in other words, you can have a habitat that is 10 meters away from another habitat. Because of different current flows, different topographies nearby and on the bottom, you can have different sediment deposits. There can be many differences. The fact that you test in one area and find a certain level does not necessarily mean that that will be the case very close to it. So if you're going to consider using a sensitive spot like the Mass. Bay Disposal Site at all, that testing needs to be continual and thoroughly.

Secondly, I was concerned that no consultation had taken place as yet with the manager of the Stellwagen Bank National Marine Sanctuary, Brad Barr, as designated by law. When Congress designated that site in November 1992, it mandated that any and all projects which had the potential to impact marine resources on Stellwagen Bank National Marine Sanctuary consult with the sanctuary manager. And the list of people to whom the document was sent, with whom consultation has taken place, there was no

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mention of that, and I would suggest that you start that consultation process immediately.

That is all I have for you today. I would just close by saying that we have no problems at all with the dredging of the harbor. We support the dredging project. I also, however, share many of the concerns that Joan LeBlanc and Grace Perez shared with you earlier. We'll be detailing those in written comments. We do hope to see the project go forward in a careful and environmentally safe way so we can all benefit. Thank you.

MR. ROSENBERG: Thank you very much.

Our next comment will come from Jay Wennemer.

STATEMENT BY JAY WENNEMER,

MANOMET OBSERVATORY.

MR. WENNEMER: My name is Jay Wennemer. I work for Manomet Observatory. My concerns basically involve the spreading of contaminated sediments throughout the marine environment. I believe that ocean disposal and capping is not workable. I do remember reading

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something about an open-ocean site off New Jersey that was capped, and the cap was consequently or subsequently peeled away by storms and current action and is now being considered for re-capping. I don't think that that's an advisable alternative in the Massachusetts Bay Disposal Site. I don't think it whould be spread anywhere in the environment.

My second concern is one of monitoring. I believe that any permit that any agency puts out is only as good as the compliance to that permit, and I believe part of the compliance has to be continuous and objective and careful monitoring of the processes and procedures.

I think history show us that mistakes can be made. I think the radioactive waste that's scattered outside of Boston Harbor is a good example of how good plans may go bad. I believe monitoring by people that are empowered to constrain the activity of the operation and by people who are conversant and educated in the spirit of the permits is a necessary part of insuring that the project is done as envisioned

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and as permitted. Thank you.

MR. ROSENBERG: Thank you. Our next speaker will be Ms. Vivien Li.

STATEMENT BY VIVIEN LI, THE BOSTON HARBOR ASSOCIAITON

MS. LI: Thank you. I'm Vivian Li, the executive director of the Boston Harbor Association. The Boston Harbor Association is a nonprofit public interest group founded in 1973 to promote a clean, alive and accessible Boston Harbor. We were one of the first public interest groups calling for the cleaning up of Boston Harbor in the early 1970s, and we've closely monitored the cleanup project for several years now.

We also support an alive and accessible Boston Harbor. People ask us what does alive mean. It means not only fish and shellfish swimming in the harbor, but it also means alive with people enjoying the harbor. We support activities such as the Tall Ships, which brought a lot of people to the water's edge, and we think that it won't be too long in the future

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before we have thousands of people swimming in the harbor on a hot summer day.

Likewise we support an active harbor and port that is full of economic activities. I was moved as I listened to the diverse opinions this afternoon to be reminded of what President Clinton said earlier this week when he announced the appointment of Judge Breyer for his nomination of Judge Breyer to the Supreme Court. He said at the time that if he could get both Orin Hatch and Ted Kennedy to support the same person, he must have made the right decision. So I hope that you find the Steven Breyer option as you go through this process.

As others, such as Ralph Cox and Al Frizelle have pointed out, there is more than 17 million tons of cargo that comes through the Port of Boston every year. And more than 80 percent of the goods which come through the port are petroleum products, and I guess it's now more than 30,000 cars annually move through the port's terminals. Clearly any of us who live in this region benefit by having a strong port area, and we feel that the port is key to the economic

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vitality of the region.

Given the size of modern tankers today, the Boston Harbor Navigation Improvement Project is necessary, A, to provide basic services and goods like fuel, like automobiles, like food, like clothing and such; and B, also to allow us to remain competitive with other ports in the country.

We've had a chance to briefly read the Draft EIS/EIR, and we'd like to offer the following comment: First, TBHA believes that dredging can and must be done in such a way as to limit the amount of toxic sediments that are released into the water column in the form of suspended solids. I think Save the Harbor/Save the Bay already discussed that. As many of you know, MassPort has had recent experience with dredging at the Moran Terminal, and MassPort found through that experience that the clamshell bucket which they used in the dredging process and which the Boston Conservation Commission and some of the other permitting agencies required, was not as effective as they had hoped due to the large number of piles and the amount of debris

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that got caught in the bucket which prevented it from closing tightly.

We support MassPort's efforts to develop a contingency plan to deal with this problem. I should state that I'm on the Boston Conservation Commission, and when this came before us at the commission, no one from the public really came forward to help us figure out what we should do environmentally. So working with our staff and the MassPort staff and also the technical information that we had available at the time, we thought that the clam bucket would be a good way to deal with the environmental concerns. And clearly having now had the experience of this smaller dredging project, I think that clearly we need to look at some contingencies as well. So I think we welcome people's suggestions about how we might deal with that.

I think the Conservation Law Foundation also mentioned that there's a need to do some monitoring throughout the course of the dredging by independent observers. And at our level, the City level, the Conservation

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Commission, we have staff who go out periodically to monitor projects like this.

On the Central Artery Project, we have staff that are full time monitoring the artery project. So as you go further into the permitting process, one of the things that we might want to consider is assigning full-time staff that would be paid by the project that is responsible to the Boston Conservation Commission that would monitor the dredging process so that everyone would have a better sense of security about the fact that there would be someone impartial looking at this. But I don't think that's an insurmountable problem. Certainly the experience with the artery project has indicated that it is possible to have impartial observers who would be monitoring the environmental requirements.

I think, as an additional matter, more attention needs to be given to new disposal and remediation alternatives. In other parts of the country alternative technologies have been developed which have been effective in the remediation of contaminated sediments. We

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commend MassPort for its efforts to explore the possible uses of these alternatives and encourage you to do so. Consistent with this, we support the Green Port legislation filed by Congressman Menendez from Elizabeth, New Jersey, resently, which provided funding for communities to incorporate alternative technologies into their dredging operations. And we urge that those of you who have connections with the Massachusetts Congressional delegation, that we get the delegation to work with their colleagues to get this legislation passed.

Looking around in this room, there are many of you who have strong ties or who know members in the Congressional delegation. When you go in and see them, it's important that you ask them to support this legislation and to get their colleagues in the U.S. Congress to support this legislation as well. We really need that in order to help fund some of the alternative technologies that many of us support.

Third, as to the practicable alternatives for disposal listed in the Draft EIR/EIS, we want to make the following

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observations: Unconfined ocean dumping of contaminated sediment is an historic practice for which we are paying the price environmentally is no longer permitted. And I think that the Draft EIS/EIR recognizes this reality.

The disposal of contaminated sediments at the Mass. Bay Disposal Site, even with capping, may pose some environmental problems given the depth of the site. I think you heard several speaker discuss that. It's clear that additional analysis and monitoring would be needed before the permitting agency would allow the Mass. Bay Disposal Site to be used for contaminated sediments. I think realistically this option would be most feasible for future harbor maintenance. We'd encourage you to begin to do the additional analysis and monitoring now so that appropriate supporting data will be available in the near future.

The Boston Lightship Site had previously been used for the disposal of radioactive waste, and we encourage further study of the radioactivity of the site before it is considered as a disposal site by this project.

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With regard to the combined in-channel locations, it is not clear whether the length of the dredging project would be extended with this option, and we recommend close coordination with the local communities, particular East Boston and other residential communities if you pursue this option.

We will be submitting more detailed comments between now and the end of the comment period. We thank you for holding this session.

MR. ROSENBERG: Thank you very much.

Mr. Louis Zappieri.

(No response.)

MR. ROSENBERG: We're going to take a 15-minute break right now. Following the break, we'll have discussion on the overall approach to the environment impact statement and report briefing from the Commonwealth and the panel discussion. And I invite everybody who gave comment if they wish to walk around, talk to the workshop groups. As you know, when comments are given, we do not interrupt, and we do not try

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to answer your questions. So please, seek out the advice. Maybe we have some insights for you. Thank you very much.

I have just been handed one more card. If you wouldn't mind sitting, we'll have Mr. Bruce Berman give his comment, then we'll take a 15-minute break and be back here at 3:30. Mr. Berman.

STATEMENT BY BRUCE BERMAN,

SAVE THE HARBOR/SAVE THE BAY BAYWATCH MR. BERMAN: I'll give you the capsule version. My name is Bruce Berman. I direct Baywatch for Save the Harbor/Save the Bay.

The reason I'm here is because I just came from Constitution Marina where I keep my boat the Shamrock. I just cleaned it down. We just caught about 75 herring, and I saw 25 striped bass caught, up to about 18 pounds. That's within a thousand yards of here. I want to just remind you folks, while I'm not qualified to talk about the technical issues which arise from the various disposal options that you're considering, that we are on the edge of a change

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in the sea. I guess George Bush would call it a sea change here in Boston. People are enjoying the harbor as never before. There's more than $5 million worth of boats in the water here, more than there were last year, and there'll be more next year. And we can't blow it.

What this means to me is that since dredging is a messy process, and television cameras are so portable and waterproof these days that in order to keep the positive focus, which everyone in this room cares about and which we've all worked so hard to achieve together, that we be honest with each other, and that we not just say that we're going to use the environmental dredge when we all secretly know that 50 percent of the materials or maybe up to 50 percent of the materials will certainly be resuspended on the way to the surface, and then re-suspended on the way to the bottom again if they're going to be put into some sort of containment under water.

The areas around Boston and in Boston Harbor itself are remarkably fertile. There's 10,000 lobster pots out there now, One of the largest commercial, in fact the largest

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commercial fishery in the state, I think. Of the 70,000 pounds of striped bass, which are allotted to Massachusetts for commercial harvesting this year, my guess is that, although fishermen don't always tell the truth, more than 20,000 pounds of the quota will to come from Boston Harbor. These are not just among the many economic issues that you have to balance when you're making decisions, because they are also symbols which are really powerful symbols, just like a whale or in the case of the harbor, maybe the harbor porpoise, which we see every time we go out there, or the harbor seals, which we see. These are symbols to the rate payers, the 41 cities and towns that things are getting better. In the same way as an accident with a barge or the failure to use the right technology will be symbols of the left hand not knowing what the right hand is doing.

In order to make this thing happen, I mean believe me I understand how important shipping is to our regional economy, how important the harbor project that we're discussing today is to the regional economy. Still I have to point out that recreational uses

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are coming back and they're rapidly growing. It's the largest growing sector of our economy, and that the key to having a multipurpose port is that we all tell each other the truth and balance these issues carefully.

I just wanted to say one more thing, a suggestion in that regard, that rather than specifying the technology that we're going to require people to use to dredge, because I don't know as much about dredge scoops as the next guy. I know Vivian and I talked about this a while ago. Perhaps we might consider a performance standard. And I'm not going to give a real number, so please don't consider this a real number, but for example, that it would be reasonable to assume that if we're going to take the stuff out of the marine environment, that a certain percentage, I'd like to see 99.99 and

44/100s, but I'm sure there are other people that have somewhat lower standards than that, that a certain percentage be required to come up and get into the barge. And you can easily check the cubic yards, make sure that those products aren't just sort of released back into the marine

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ecosystem where they'll lodge in the lobsters or lodge in the herring and then end up in the stripers and then end up in our consumer centers.

So I suggest a performance standard instead of specifying the technology, and I think maybe if you get to a certain point and even less than half of its going to come up, then we have to ask ourselves who are we fooling, and perhaps reassess or just get a big rake and rake the stuff, because unless we tell the truth about it, it's a very messy process. Thank you. That's all.

MR. ROSENBERG: Thank you, Mr. Berman. We'll take a 15-minute break and be back here at 3:30.

(A 15-minute break was taken.)

MR. ROSENBERG: We have one more comment before we entering into the formal presentation. If Captain A. Ross Pope would come up.

STATEMENT BY CAPTAIN A. ROSS POPE,

PATTERSON WYLDE & COMPANY, INC.

CAPT. POPE: I didn't want to

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comment before the break because I knew everybody was ready for a break. I thank you for changing the program around to give me an opportunity to say something.

My name is Ross Pope. I'm executive vice president of Patterson Wylde & Company, Inc. We're steamship agents in Boston. I'm also president of the Boston Shipping Association, of which Al Frizelle is the general manager and whose comments you heard earlier on.

I'm must say I'm very encouraged with what I'm hearing today because I sat through quite a few of the advisory committee meetings over the past two years, and I got the distinct impression that this just wasn't going to happen. From the comments I have heard today, I hear people saying that they are supportive of the dredging project, and they understand the economic impact on the Commonwealth of Massachusetts. Both the Save the Harbor/Save the Bay and the CLF seem to be very supportive of it, and I can agree that with restrictions on the disposal of contaminated material, the project should go forward.

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I was also encouraged to hear Pete when he was making his presentation of what we were going to do. That sounded very positive to me. No one seems to be opposed to the dredging project, understanding the economic benefits to the Commonwealth, and we all have to acquiesce to the scientific knowledge of those who have the authority and that knowledge in terms of helping us dispose of this contaminated material in an environmentally safe manner.

Bearing in mind that this is probably the most critical issue that the Port of Boston has had to face in decades, and indeed the Commonwealth of Massachusetts, because even today with the size of vessels, and somebody was talking earlier about why should we accommodate the largest size vessel. We're really talking about the average size vessel in today's international trade. So we're not trying to do better than any other port. We're just trying to keep pace with international water-borne transportation. And if we cannot accommodate those ships in this harbor, then we are indeed becoming one of those endangered species. It's

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not a case of just those of us who make our living on the waterfront either. It's a case of everybody who is a resident of the Commonwealth of Massachusetts or the New England region who is going to be adversely affected if it costs more to transport our imports and exports to and from their destinations. We'll wipe out an entire waterfront industry, will certainly affect related industries with international transportation.

And this dredging situation has become particularly important now because of the experience we've had of some container ships bypassing the port. Because it's making the people who are operating these ships realize that if they are faced with difficulty in trading through the Port of Boston, they can easily find a solution because of intermodalism. The technology in our industry is such now that a port is not the most necessary factor for anybody operating container ships. The containers can be discharged somewhere else and brought in by other means, with some cost adjustment acceptably. But by the same token, there are savings in other

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areas. And I don't think that this region can give anybody a reason to divert their business and trade in and out of the Commonweath other than through the Port of Boston.

So on behalf of the users of the port, members of the shipping association and others such as I responsible for providing services to keep these ships in the Port of Boston, we urge that the efforts that have been put forward now continue and that the spirit of cooperation which seems to exist continue and that those with the talents of making the decisions also continue with the process of solving the issues of disposal of the materials and that this project go forward in a timely manner. Thank you very much.

MR. ROSENBERG: Thank you, sir. Our next speaker will be discussing the overall approach to the draft environmental impact statement and an overview of the National Environmental Policy Act. Ms. Catherine Demos is the Project Officer for the environmental impact statement for the Boston Harbor Navigation Improvement Project for the New

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England Division of the Corps of Engineers.

Ms. Demos joined the New England Division in 1986, following receipt of a Master of Science Degree in coastal zone management biology from the University of West Florida. Ms. Demos also holds a Bachelor of Science Degree from the University of Massachusetts. She is responsible for the overall compilation of the EIS and has very successfully worked on many related projects and programs as an ecologist in our Impact Analysis Division.

Ms. Demos is a member of the Society of Wetland Scientists and resides in Concord. Ms. Demos.

STATEMENT BY CATHERINE DEMOS, PROJECT OFFICER FOR THE ENVIRONMENTAL IMPACT STATEMENT FOR THE BOSTON HARBOR NAVIGATION IMPROVEMENT PROJECT MS. DEMOS: Thank you, Larry, and good afternoon everyone. As Larry mentioned I'll be speaking briefly about the NEPA process and the environment impact statement.

The main points that the environment impact statement, EIS, covers is the purpose and need of the project, basically why

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are we doing this project and why do we need it; different alternatives for accomplishing the purpose of the project, in this case the Boston Harbor

Navigation Improvement Project. That will include the dredging and disposal alternatives.

In addition, the EIS also looks at the effected environment. What does the environment look like before we start the project, and then what are the environmental consequences from the alternatives that we're looking at? We look at alternatives that would have environmental impacts, both beneficial and adverse impacts. Mitigation for short-term or long-term impacts would also be discussed in the EIS.

Prior to the beginning of the preparation of the EIS, we held several scoping sessions. Basically that helps involve the public in determining what topics we should be including for analysis in the EIS. They include the types of issues and also the extent and the area of influence. The scoping session also can help narrow those issues down and eliminate or briefly discuss those issues which really are

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determined not to be that significant. The whole EIS process and NEPA process is there to help decision makers make their decisions and to involve the public in those decisions.

One of the issues that seemed to be common for many people is that dredging is needed in Boston Harbor. Right now, besides the improvement of the navigation in Boston Harbor, we also are faced with doing maintenance dredging. There is right now some areas in Boston Harbor which are shoaled, and the ships are having problems getting in and out of Boston Harbor, which you've heard. One of the benefits to this project is that it would provide its own capping material if that was one of the alternatives to go forward.

Other issues that were determined to be of concern that were incorporated into the EIS process is whether or not the material is suitable for upland or open-water disposal. What would happen to the disposal silt material at the Mass. Bay Disposal Site, and some of those concerns, as you heard earlier, were what would happen to the whales and other endangered species

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at Stellwagen Bank, which is located next to the Mass. Bay Disposal Site, and also whether or not capping is a feasible alternative at the site.

People wanted us to look at various alternatives. People want us to look at upland and open-water, remediation techniques for contaminated sediments and containment, and we did look at all those various issues. We also involved the public in the advisory committee meetings. And we also looked at ways to monitor and mitigate for impacts for the different alternatives that we would be looking at.

We also want people to understand that in the future for any future projects or future maintenance dredging, we would be going through the NEPA process again. This project, although it looks at future potential alternatives, is mostly dealing with the current project of deepening the harbor.

I also wanted to mention that we also have invited three federal agencies to help us with the ads, and they are over to my right. That's Jon Kurland from National Marine Fisheries Service and Kimberly Keckler from U.S. EPA and

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Vern Lang from the Fish and Wildlife Service. And they're here to help you with any questions you may have about the coordination process and the EIS process, how they helped with this EIS.

If EIS is reponsible for covering the navigation improvements to the federal channels and the berthing areas of the beneficiaries and nonbeneficiaries, and MassPort is also preparing an environment impact report, which you'll hear about a little bit later from Norm Faramelli. Because the NEPA and the MEPA process are very similar, it was decided to combine the EIR and EIS process to form a joint EIR/EIS.

As you heard before, the Draft EIR/EIS was released for public review on April 20th and that we provided the longest review and comment period, which is a 60-day comment period. Don't feel pressured that you have to give your comments here today. You have until June 21st for MEPA review and June 28th for the EIS NEPA review comments. They should be sent to Trudy Cox and Colonel Miller.

The draft looked at several

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alternatives, but we did not select a preferred final disposal alternative. We're waiting to hear from the people's comments and what their concerns are, and once we have looked at those, we will be reviewing those to help select preferred disposal sites. The final EIS is expected for review at the end of winter of '94, and the public will then have another 30-day period to review the final EIS.

Even though this process is on-going, we want people to feel free to comment. This process is not ended yet. Even though the Draft EIS is out on the street, your comments are important to us, and we do want to hear them.

MR. ROSENBERG: That you, Catherine.

Our next speaker is Mr. Norman Faramelli, Director of Transportation and Environmental Planning for MassPort. Mr. Faramelli has worked at MassPort since 1976, first as the Chief of Environment Management, then as the MassPort Director of Planning.

Norm is a graduate chemical

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engineer with experience in the petroleum industry, and he has several related graduate degrees. Prior to coming to MassPort, he worked as a consultant on social and environmental changes, effect of technological changes. Norm.

STATEMENT OF NORMAN FARAMELLI,

DIRECTOR OF TRANSPORTATION AND ENVIRONMENTAL PLANNING, MASSPORT MR. FARAMELLI: Thank you, Larry, and good afternoon. First let me thank all of those who offered comments. They were most instructive. It's very good to know that people have read the report. That's always a sobering thought. And it's always good to learn something new as we hear people give different perceptions on their view of this problem.

MassPort filed an ENF, Environment Notification Form, in 1991. It was an automatic EIR under the state law. And we expect to comply with the Secretary's certificate and also deal with the scope that was outlined. As expected, we did get a very well defined scope, well detailed, very comprehensive and we felt was also reasonable in terms of the parameters that we

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were to look at.

We focused primarily on two major areas. One is the sediment characterization, and with the group that Janeen had outlined earlier in the working group, we managed to develop and work on the Green Book protocol and to come up with a sampling protocol, chemical testing, biological testing, biological bioassays and bioaccumulation tests. And I think we actually got something that satisfied most of the participants, both in the environmental community and the regulatory community in terms of the test results themselves.

The next thing we did is looked at alternative analysis. I'd like to say it was not an exhaustive list but an exhausting list of around 300 alternatives that we narrowed down to around 24.

Now, let me tell you what we did because this has been alluded to earlier. We managed to break that down further into three kinds of lists. One had to do with practicable alternatives. And the practicable alternatives were those that were large enough to handle the

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material, were reasonable enough in terms of cost and also did not have an environmentally fatal flaw. That's what we call a practicable alternative, and we have a whole list of those in that first table.

The second thing we looked at was potentially practicable. Now, potentially practicable sites mean that there are no environmentally fatal flaws but they are limited by cost and capacity, but some of them might be good for future maintenance projects. We tried to consider each of these disposal site, what is good for this project and what is also good for future maintenance projects. This was brought up earlier, but we were very cognizant of the fact that this will not be the last bit of dredging done in Boston Harbor. So we're hoping that these results, while they don't automatically permit future maintenance dredging, we know better than that, we realize that the materials and the information that we got should be useful in terms of setting forth what future maintenance requirement might be.

Now, the third list were those

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that were dismissed as being potentially practicable either on the cost factor or the environmental flaw factor. Several of those alternatives, incidentally, were quite inexpensive but they were dropped because they automatically leeped out at us as having really serious environmental problems. So that was the nature of how we came up with those three lists.

We did not select a preferred alternative. We haven't selected a preferred alternative. We're going to ask you, those of you on the advisory committee and those of you who are interested in this project to join us as we develop preferred alternatives. Because we have several important tasks ahead of us.

Number one is we have an agreed protocol, sampling protocol, agreed test results. What we don't have is a common agreement in terms of what the test results mean. And I think it's important that we begin talking about a common framework for understanding those test results because not all the contaminated materials are equally contaminated, and it's important that we have

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that differentiation. And if we're going to have alternative technologies, which I really believe we have to look at with greater seriousness and also look at some possibility of pilot projects, how do we keep the amounts of material to a sufficiently low level that we can afford the per cubic yard costs with alternative technology. It's going to be very important that we do that.

The second thing we're going to have to do after we agree on a common understanding is to talk about mix and matching with the best suitable disposal sites. How do we look as those disposal sites with regard to different kinds of material and segregate those materials and come up with the mix and match that gives us a set of alternatives? I don't think there's going to be one preferred alternative. I think there will be preferred alternatives, and we're hoping between now and the preparation of the final, we'll be developing that. And we look forward to your cooperation.

If you would like to sit down with us at any time in terms of the reports and also the procedures, we'd be happy to do that, and

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feel free to call on us. Meanwhile, we look forward to your participation as we go on from here as we develop the final documents. Thank you very much.

MR. ROSENBERG: Thank you, sir. Our next speaker is Ms. Nancy Baker from the Commonwealth of Mass. She is currently in charge of the MEPA plan, the Massachusetts Environmental Policy Act unit. She is an environmental analyst. Her husband is an environmental analyst for ten years. She has a Bachelor of Science Degree in biology from the University of South Carolina and a Master of Science Degree in marine biology from UMass, North Dartmouth. Ms. Baker.

STATEMENT BY NANCY BAKER, ENVIRONMENTAL ANALYST, MASSACHUSETTS ENVIRONMENTAL POLICY ACT MS. BAKER: Hi. Thank you for persevering and staying late into this afternoon. I just briefly want to remind you that this is not only a federal review process but it's also a state review process. And I'm the staff person for the Executive Office of Environmental Affairs in the MEPA unit who will

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be reviewing and coordinating the comments that you make on this particular document.

The document is both an EIS, which is the federal environmental impact statement, and an environmental impact report, which is the state portion of the document. So we, too, are accepting comments on this particular document and would be happy to receive them as soon as possible, naturally, but certainly before June 21.

I want to point out the differences between our review and the NEPA review. If you look in Appendix A, there is a scope document which is listed as a Certificate of the Secretary of Environment Affairs. That is the map, the format, if you will, this we will be using to determine the adequacy of this particular document. So please try to take the time to look over the scope and think about the issues that we asked to be addressed in this document. That will help to guide us in our review. And your comments focused on scope issues will be very helpful.

With respect to the final, any

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comments that we do receive will be coordinated into the Certificate of the Secretary on the draft environment impact report, and that document will form the basis for the final environmental impact report, EIS. So that any comments we receive will be considered and included to the extent that we can in those documents.

Now, our mandate as a state agency when we review these documents is to insure, first of all, that they adequately address the issues; but secondly, that the environmental impact report has adequately demonstrated that they have avoided or minimized the impact to the environment. Those are the standards that guide us in our review process. So we'll be looking at how they mitigate an impact and how they've been able to avoid or minimize impacts to the environment.

That's pretty much all I wanted to say. Just to remind people again that there is a state presence, there is a state review process that's going on at the same time as the federal process is going on. We'll be happy to accept

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your comments. Thank you.

MR. ROSENBERG: Ms. Baker, thank you very much.

We're going to go into a little panel discussion right now. The four individuals up here are more or less running this show for the Corps and for MassPort. Catherine and Norm will be addressing the list of actions — what's next; where are we going from here. We invite comment. We invite questions. So I'll open it up to Catherine, please.

MS. DEMOS: As I mentioned earlier, we're probably about at the middle of the NEPA process, and we'll be looking forward to people's comments. We have until June 21st for the state-process and June 28th for the federal- process comment period. And at that time we'll be looking at the comments and finalizing the EIS and EIR, and we hope to have the final out sometime the winter of 1994.

In between that time, we're going to be looking for a lot of input. There will be meetings of the advisory committee again, and we look forward to a lot of input into how we

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direct, how we start directing the EIS/EIR from that point on.

One of the time constraints that we're looking at, we're looking at construction in January of 1996. If you back up from that, we need — I should turn this over to Pete to get a good idea of the schedule. There's a project coordination agreement that has to be signed three or four months before we go to construction. That means we need the permits in hand in late summer of '95.

So besides the EIS/EIR process, there is also the permitting process that's going to take place, that we also have to schedule for. So there's also opportunity for comments during that permit period for the alternatives we have to select for the project.

MR. FARAMELLI: The only thing I would add, we tried to schedule this meeting right in the middle of 60-day period. Normally under MEPA it's a 30-day review period. Rather than grant you a 30-day extension, we just put it up front to say 60 days. And we will have an opportunity to hear from you at that time.

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As I mentioned, if there are any sit-down sessions that you want to have on any of these things during this time, please feel free to get in touch with us, because we would like to answer any questions that you might have on these documents.

MR. ROSENBERG: One other thing, we're going to try to plan another formum of some sort to get comments at the very end.

Could I open this up to questions? Any questions?

(No response.)

MR. ROSENBERG: That's wonderful — yes, finally.

FROM THE FLOOR: Can you address the finances? Obviously there will be overruns. Can you make mention of the scheduling of seeking additional funds that will be necessary or may be necessary?

MR. ROSENBERG: First, we're the Corps of Engineers. We don't have overruns. I'll turn that over to Pete.

MR. JACKSON: We'll just speak about the $35 million part of the improvement

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project. There's some built in inflation in that. You will see probably each year a slight increase based on the prediction of the inflation for the period of construction. We're trying to predict what the inflation rate is going to be in 1996 and '97. You might see some adjustments. You may even see some go down. That will be a surprise.

I don't anticipate any cost overruns. There are contingencies in that figure, and I guess every project manager when he first stands up in the public says the cost will never go up are eating their words now. But we're being very careful inputting contingencies for the project.

And again, the disposal options we're talking about for the major part of this work is not part of the $35 million. That's the ONM project cost, and that person is not here. He's the one that's nervous. He's the one that's got to fund the unknown options that we're all talking about. The 1986 Act was very careful and said you're going to cost share but ONM is still a hundred percent federal cost. And when there's

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a project on the line, they're obligated to fund that. So the 35 million, I think, is going to stay fairly level. I don't see any major changes, but we are going to see off to the side this ONM cost. Much of it will be based on the selection of the option we're going to pick in the final EIS.

So in answer to your question, I don't think you're going to see major cost increases in that $35 million.

MR. ROSENBERG: Any other questions?

MS. HANSEN: I just want to make one comment about some of the treatment technologies that have been suggested here and in prior meetings. We're all very interested in pursuing some new alternatives for dealing with dredge material, and treatment technology is an option that is particular appealing to all of us becuase it's a way which might potentially remediate or otherwise reduce the toxicity of some of the contaminants we're talking about.

I believe it was Vivian Li who alluded to the Green Ports bill, which I don't

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think made it to the floor of the House of Representatives in this session of the Congress, but I expect it will be re-introduced at the fall session. And I would urge everyone to be in touch with the Congressional delegation to further support that avenue of funding.

And in addition, the Maritime Administration from the U.S. Department of Transportation is advocating a national dredging policy and is also interested in aquatic funding for alternative technologies. So it's coming but it's only going to come to us in sufficient time with a lot of pressure from a lot of people in this room and people who were here earlier. So I would urge everybody's action on that.

MR. ROSENBERG: Sir.

FROM THE FLOOR: Just one question going back to the fishing industry. If one of these dump sites is chosen, say, the Meisburger areas or the offshore areas, the Lightship area, what's going to happen if it's closed and construction is taking, say, a year to do or whatever? And these are their productive areas. What kind of answer do I give the other fishermen

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as far as that area being shut off? Is the answer just going to be, you can't go there, and that's it? Or what is going to be resolved when they ask me the question? If that's their predominant area and you've chosen that, what do I give them as an answer? Too bad, get out of there? Or you'll be compensated for the highlight of your season? Or what? I know you've evaluated the other cost factors. Does this come into the fishermen's cost factor?

MR. ROSENBERG: It's a great question. I would like to introduce Bill Hubbard. He's our head of Impact Analysis at our Environmental Branch. He's also a marine biologist, and he's one of the people that walks around with his Earth Day flag throughout the building. So, Bill, please.

MR. HUBBARD: That is a good question. That's a question of concern. It won't be closed. We will coordinate with the fisheries and the fishermen. You had mentioned the haul route and the gear area. Very commonly what we'll do, we will make known to you what the haul route will be, request your gear doesn't be

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deployed there. We've done this off the coast of Maine constantly.

We won't say no, you can't fish there. Obviously you're not going to want to deploy fixed gear in an area where we're dumping. We will clearly mark it, and we will keep it to a small area.

It's a conflicting use of resources and rights, your right to fish there, and certainly we'll never stop you. We want to warn you that we're going to take this spot here and put the dredge material in it, and that will be a temporary impact. But I think with good coordination, we can both coexist with that.

But I think we've talked already that we probably want to interact a little more with you, and certainly those views will go into this record and we invite them into the state record also.

Does that answer your question?

FROM THE FLOOR: A little bit.

MS. HANSEN: On behalf of the Port Authority, we will make an effort to work with you to minimize the impacts to your businesses.

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I think we can do that.

One of the things we did right in the Moran Terminal dredging project, I think, is scheduling it around both the winter flounder season and the junior Alewife running season. We held off the dredging until the 1st of November to avoid that.

FROM THE FLOOR: We truthfully understand the need for the project and what it could do for the area, but we also want you to understand the effects it's going to have on us. We're the ones that are going to receive this if it's deemed that you're going to go there because we're the ones that work that area. So we're the ones that are going to be hit with the brunt of this, if you know what I mean.

MR. ROSENBERG: Sir, one of the things you made plainly clear to all of us is that we need to establish a series of dialogue with your orgainzation here in Boston and on the Cape. During the break Bill Hubbard and myself decided we'll be getting in touch with you very shortly to start setting if not workshops, definitely not just questions and answers, just

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so we can sit down across the table. We can actually not only listen to your concerns but implement many of these concerns.

So be assured you will hear from somebody from the Corps of Engineers and from MassPort. And I'll make this plain also on Thursday in Hyannis.

Yes, sir.

FROM THE FLOOR: One question I'd like to ask you, who is going to be responsible for this project totally? Through the Mass. Water Resource and the Third Harbor Tunnel Project, I've been cooperating with them through all the projects right to the end when I even lost $3,000 per year for the past four years. They don't seem to recognize that we do belong there, that we are there, and that this is a financial loss to us every time these projects occur.

Who is the one that we can go to to say they are responsible, they are the ones who will tell us, yes, we are going to help you out; no, we're not going to help you out? Because when there are different agencies and

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different contractors involved, nobody seems to have the correct answer who wants to solve the problem, especially when it comes to the major word as far as we're concerned, compensation. That's something they don't want to discuss.

Now, we've gone through the Third Harbor Tunnel Project, the whole project, and we've gotten zero from it. This is another project that's going to cause us the same kinds of problems because of the barges and the traffic, which does happen to buoys, traps and goes into areas where you have no way of finding them. It ends up costing us in gear and time and effort trying to find them.

Is there going to be a designated agency as the one who is responsible for the project?

MR. ROSENBERG: Sir, I wish I could answer your question right now, but I can't. What we did is we put it on the record. The Corps of Engineers is responsible for the overall project. I think your question is a little bit more detailed than to get an answer like that. So if you could after this when we

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break for dinner, if I could get your name, your phone number and your address, we will have somebody get back to you as soon as possible, with some information we might be able to get by Thursday. Very good question. I thank you for that.

MS. BAKER: When the EIS was filed, I think there were many more berthing areas proposed for dredging. I think it was somewhere near 29. Now the number of berth areas seems to have been reduced. Can someone elaborate on that?

MR. JACKSON: I'll speak briefly on the berths that were part of the project's economic evaluation. There are berths in there that are kind of going along for the ride for disposal.

There were some changes, and I'm not sure of the time frame, but there are certain terminals that no longer qualify, that they would, let me say, would increase their economic efficiency from the project. I'm going to give you one example and that's Mobile Oil in Chelsea Creek.

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They're moving towards using barges rather than tankers, so they are no longer a project beneficiary. However, Eastern Minerals at the same time joined in. So there's some pluses and there's some minuses, and that's only speaking — then there's, I think, Coastal Oil has already dredged their berths. They are a beneficiary. They are still part of the benefit-cost ratio equation, but we don't have to deal with them in this because they are already deep enough.

Now, I'll turn it over to Norm for the other kinds of berths that are being dredged, and that number has changed.

MR. FARAMELLI: Some of them dropped out because they're just not going to do any dredging, they're not using it, and they don't want to be part of the process. And that we found out after the filing of the EIS. They understood the implications of their decision., But it's also a decision they had not reached in 1991. It was something that they reached afterwards.

MS. BAKER: Are we likely to see

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more added in the future?

MR. FARAMELLI: I don't think it's too like. We haven't heard from anyone. Have you heard from anyone? I don't think so. If anything, we wanted to start with a very large list, and it's gradually shrinking. And those that are staying on are people, agencies or groups who need, operations that need dredging. Some of them are just not going to do any dredging at all. Made that commitment.

MS. BAKER: You don't anticipate any change in the capacity of the disposal?

MR. FÀRAMELLI: Not for new entries, no.

MS. BAKER: Thank you.

MS. LeBLANC: One followup on the point brought up by the fishermen. It seems as though you'll probably work something out in terms of the traffic lanes for barges and of the routes, not coincidental with major fishing. You probably did do it, at least that's what it seems to me, looking at this document, is once you select the site, let's say for instance you select a site, that site is going to be in use

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for whatever the period is, a year or over a year, some of the estimates in here. So what I would suggest is in the analysis when you're choosing a different site, what you need to do is consider the cost to these gentlemen's and many other persons' livelihood in making those decisions. Because that's something you're not going to be able to do after the fact. And I know it's not included in the cost-benefit analysis or the analysis for choosing an option, but I think it should be considered.

MR. JACKSON: Joan, that's an excellent comment. It isn't in the benefit-cost ratio. When we do select a site, we will do whatever we can to put it into the equation. It's a good comment.

MR. FARAMELLI: Again, I think the point has already been noted, as Bill had mentioned and Janeen had mentioned, is a real effort to minimize any disruption. One of the things you don't want to do is to emphasize one part of the business for another part of the business, and to say, well, if we're going to accommodate vessels in the seaport, we have to

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pay a price out here. We're really cognizant of the fact this whole things hangs together. So we understanding that there are real fishery issues here, and it is not going to be a case where one has to trade off for something else.

MR. ROSENBERG: I'm going to stop the questions now because I don't want this to get into a situation where we may seem like the teacher. Please, bring your questions up to the federal agencies, to the people at the tables, to the state agencies, of course the Conservation Law Foundation and Save the Harbor/Save the Bay. If one thing is absolutely clear, it is everybody here is working together because we've acknowledged the problem. Now we must seek consensus to find that solution. We need everybody here to do that.

I thank you all for coming. This room will be open. We're going to start back up officially with the workshops again at 6:00 and the formal presentations again at 7:00, but I invite everybody to stay here for the next hour and a half and bang away at each other and bang away at us. Thank you very much.

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(Whereupon, at 4:15 p.m., the afternoon session was concluded.)

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EVENING SESSION OF BOSTON HARBOR

NAVIGATION IMPROVEMENT PROJECT

PUBLIC MEETING AND WORKSHOP

MR. ROSENBERG: We're going to deviate a bit from the schedule at this point, and bring back certain individuals that requested to comment on the record. We'll run through the indivduals, and then we'll take a 5-minute break, and we'll get back to the formal presentation where we will discuss the process of the draft environmental impact statement, the environmental impact review or report as required by MEPA, and the panel discussion on what's next and what's going to be happening.

(A short recess was taken.)

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MR. ROSENBERG: Again, we'll start making opening comments about 5 of 7:00. Those individuals who have asked to make comments, I will be calling you up in the order in which you signed in. If I could please have Mr. Jackson come up to the dais. And for those giving comments, Ms. Crystal Gardner from our Regulatory Agency is here in the back to hear your comments. Of course, Pete Jackson is our Project Officer for the New England Division of the Corps of Engineers. Janeen Hansen is the Project Officer for MassPort.

With that out of the way, our first person to make comment on the record will be Mr. Max Straham.

STATEMENT BY MAX STRAHAM, GREEN WORLD MR. STRAHAM: This is one of the advantages of showing up first. I have not had much extensive exposure to this project as I would want, but I have had a general overview of it, and I've many concerns as to exactly how it will be conducted, especially if the alternative is to actually dump the dredging material, the contaminated dredging material at the Mass. Bay

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Disposal Site.

The impact obviously concerns me. My concerns are on the endangered species of whales, especially the Northern Right whale, which I don't really find mentioned in any of these EIS materials. And being that the Northern Right whale by being so spectacularly endangered down to its last 200 members and declining and being Mass. Bay being the last place that the bay-dependant whale needs to survive as a species, if they lose the bay, we lose the whale.

The whole point is that this is just another thing, you know, and could be the straw that brakes the camel's back on this species. Outside of the chemical effects of the contaminated material, the fact that it will be lying naked at the bottom for a couple of years while the dredging is going on before the proposed capping occurs. I have a great concern which is not being addressed which is the impact of the actual physical activity — the boat dredging going back and forth on a daily basis, the noise generated by the boats and the material

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being deposited.

This whale, like many species of whales, is probably very sensitive to noise, and studies being done have never been done on the bay on the impact on the whales, yet consistently from one project to another where noise was reviewed on the impact on the whales' use of the bay, that areas would increase — vessel activity would increase, noise activity is characteristically accompanied by the abandonment of whales visitation from the use of that bay.

So the point is that the Right whale already being so depleted and Mass. Bay being already so tremendous developed and utilized commercially and recreationally diverting the whales from the use of the bay, that the whale may not be able to stand any more impact, especially a new and additional one such as this.

I say some of the considerations here, even an amendment on the activities to be concerned with, I don't think that, for instance, this is a give away. It is not appropriate even to have dredging occurring or the disposal of the

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dredging material when there are any Right whales in Mass. Bay at all. And I think a monitoring program that absolutely keeps track of the whales and where they are on a given day, and if there are any Right whales in the bay, there should be no dredging allowed. Plus the fact that there should be similarly with the boats, dredging barges, scows going back and forth that it's now the traditional practice to say, well, we'll just keep them a hundred feet away. We won't dump the dredging material unless the whales are 2 or 300 feet away, which occurs with the Central Artery Project and their disposal of waste. This is totally insufficient for the protection of the Right whale and other marine wildlife.

And the obvious issue also here is, this is particularly true of the Endangered Species Act, what is the point of this dredging project? Is it to increase vessel traffic in and out of Cape Cod Bay? And with vessel strikes being the number one killer of Right whales and other species of whales, obviously this project directly is going to enhance the destruction of the Right whale just by — it's as obvious as

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heck, which is to increase traffic. And increase the traffic of the very kind of vessels that kill Right whales, large vessels with propellers that can slice a whale in two with no problem whatsoever.

So the thing is I think that this very project is a death knell of the whale. The development of Boston Harbor is and inherently, and cannot not be removed, a violation of the Endangered Species Act and Marine Mammal Protection Act. Because if you're going to project 10, 20, 30 percent increase in vessel traffic in Cape Cod Bay, you can virtually guaranty an increase of 10, 20, 30 percent of the killing of Right whales in Cape Cod Bay with the increased level of traffic.

Now, how you are going to mitigate this is a problem that all these federal projects, which are now occurring with the Central Artery Project and the short term of the dredging of the disposal waste, but obviously the long term of the increased flow to Boston Harbor is that along with the MWRA disposal of 500 million gallons a day of pungent waste in the

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water which hurts the whale's food supply and everything else is there has to be a comprehensive federal program combined with the state to constantly track the whales and truly stop the killing of the Right whales and truly stop any harassment, disturbance or injury to these whales, because if the killing of Right whales doesn't stop now immediately, there's no probability of stopping this species from total extinction within the immediate future.

And I think that this project is going to be stuck with this as other projects have to be because of the fact that in this project you're absolutely trying to enhance the very threat that the whale is facing without any consideration of what your impact is going to be to alleviate that threat. And of course, this is obviously going to litigation, but we would like to see that — well, the Army Corps of Engineers is using this as a model for dealing with this in ports up and down the United States coastline, because next week we're probably going to file a lawsuit against the Coast Guard for allowing vessel traffic to occur without Section 7 review

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of federal traffic activity, and this is obviously going to be easily extended to this. But we would like to see this project deal with the reality, truly that the only way to deal with the environmental problems of the Right whale is to adopt a universal alleviation conservation program and not keep dealing in one little project at a time that can nitpick at the whale's survival, and in reality nobody spends any money on Right whales. The MWRA is not spending any money, the EPA is not spending any money, and neither are any federal agencies spending any money on the Right whale. How do you expect the whale to survive when every project like this which is enhancing the very activity that's killing the Right whale to spend billions to do that? That's it.

MR. ROSENBERG: Sir, thank you very much.

Our next person to make public comment on the record is Mr. John Lewis.

STATEMENT BY JOHN LEWIS,

SIERRA CLUB, NEW ENGLAND CHAPTER MR. LEWIS: I'm here for the New

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England Chapter of the Sierra Club, and we have some comments on the draft EIS/EIR. I will go through them quickly and pass in my papers.

To start off with, we're not very pleased about the preferred alternatives. They have clearly been chosen as the preferred alternatives because they are the least costly. The DEIS itself admits that the cost of preferred options must demonstrate at least a one-to-one benefit-to-cost ratio to quality for federal funding. The cost of restoring lost resources are not plugged into this calculation. So there is unfortunately a predetermined limit on the price tag for disposal options that is unrelated to the minimun need to protect natural resources.

We're not too pleased with the idea of dumping the sediments out there in the foul zone and then trying to cap it in deep water. While studies have been done on this, there's lots of aspects which make it a very difficult thing to do properly.

The other sites are all in the ocean, the other preferred alternatives, such as

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the so-called Meisburger pits, and the sites, the one at the Boston foul ground; and the one at Spectacle Island has another set of problems of interaction with the materials that's being dumped there now. That's sort of a summarization of that part.

The other aspect of it, too, that we're interested in, in that it was mentioned in the EIS/EIR that there was some study of the channel disposal option. We see nothing in there about doing a much more extensive in-the-channel disposal option, and we think it should be studied so as to have room to dispose of the berth sediments as well as the sediments from the channels themselves and for sediments in the future.

We're interested also in the rationalization of the capping needed on the in-channel sediments. There should be reasons about why that's necessary, how you do it and how much.

Another aspect is the whole harbor and the North Channel, out beyond the Deer Island system. As it is now, I believe it is a 40-foot

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limiting depth at low water in the North Channel. That includes Fins Ledge, which is very hard. That means that under certain conditions at low time when there is a swell, conditions aren't good, the draft limitations are very large of the shipping coming in. Obviously any kind of a touch of an anchor on Fins Ledge on the bottom would be a really large disaster, making Massachusetts look like big time idiots. There should be a study about that, because the ship maneuvering studies that were in the appendix were very interesting and very nice, but we wonder how the ships even got there in the first place, but they came in continuously at low tide from the ocean without stopping, coming in earlier and stopping at President Roads and then going in there.

Another thing we did not see at all is a source of contaminated sediments in the harbor. Obviously that's important to cut down on the amount of sediments coming in in the next 50 years, which is another 1.3 or 4 million cubic yards. We're curious about what could be done to slow that down. It's an interesting question

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because the harbor doesn't have any big rivers running into it. They're all dammed rivers with large bodies of water behind them going slowly or way over one side, one like Neponset River. There are various sources of sediments, maybe storm drains, might be the docks that actully should be looked into with an idea of perhaps limiting or reducing this.

Also dredging methodology is a very important issue here. There was nothing there, as far as I could see about that, in a practical sense because the Moran Terminal dredging methodology didn't work very well with the equipment used and the people that did it.

Another aspect that showed up or that we did not see in here is the amount of debris and junk located at the berth bottoms. I know at Moran there's a lot of cables, the remains of this's and that's, pallets. I don't know if there were any cars down there or not, but this stuff makes it very difficult to make a dredge bucket, mostly tied to environmental work, work very well. We didn't see anything about that either.

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Also, the cost analysis in there was kind of mixed up we thought. It sort of mixed economic considerations about lost time with the environmental stuff. It was hard for us to sort it out. We'd like to see it much more, shall we say, elucidated, much more separated out, and also the cost analysis of not being able to use the North Channel when there is a swell running. Conditions, for instance, at night are not very good out there. At low tide the draft limitation today is going to be severe coming into the harbor.

That's it. And I'll pass these in, and we'll expand on this in the written comments to the final part. Thank you.

MR. ROSENBERG: Sir, thank you very much.

We'll have one more person give comment for the record, then we'll take a 5-minute break and start the formal program.

Mr. Tom LoGrande.

STATEMENT BY TOM LoGRANDE,

GLOUCESTER FISHERMEN'S WIVES

MR. LoGRANDE: My name is Tom

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LoGrande. I'm a commercial fisherman from Gloucester, Massachusetts, and I wish I had more. This really just recently came to my attention. I would have liked to present something a little more formal, but I'd like to give my comments and some of my thoughts.

First off, when I saw where some of these areas were going to be the proposed sites, I became very alarmed. One of them is directly adjacent to Marine Sanctuary and also it is a juvenile fish protected area, Stellwagen Bank. And I know from experience this is a nursery ground for juvenile codfish, flounders, all type of different shellfish and lobsters and shrimps. I've seen that from years and years of experience.

I'm concerned that even dumping any type of material, even if it's just clean fill, is going to cause quite a devastating harm to that ecology. And I just went and I got a book from the library today, and I tried to get some documentation that I could read, and what I found is quite distressing. It says here, "If it comes to choosing the filthiest waters in the

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United States, that Boston Harbor will be a leading contender." And we're proposing to dump dredge material into a rich marine environment.

I noticed that some of the things were polyaromatic hydrocarbons found in some of the sediments of the harbor. And it say, "Many of them are cancer-causing agents. Their threat to fish and man is long term. In fish it manifests itself as abnormal development, deformities, impaired growth, genetic damage and tumors. And such fish from Boston Harbor show high incidents of cancerous lesions."

Also from experience I've seen winter founder. I know they've done studies on the cancerous lesions on them, and I've seen that myself from experience. The closer you work toward Boston Harbor, you see a direct correlation with an increase in that instances.

Just a few other things I want to bring to your attention. I was speaking with the man from the Corps of Engineers. He was saying that predominantly it's just uncontaminated dredge material that's going to be dumped. And it says here, "Even uncontaminated dredge

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material improperly handled can wipe out bottom communities." Just dumping on top is going to smother any life that's on the bottom in itself, not to mention anything that's going to drift with the tides, which we know as commercial fishermen, can be very strong different times of the year, and they go both ways, in and out and Stellwagen is right there.

And also I just want to say some of these number were startling to me. I'm not very versed in this, but it says, "Boston Harbor spoil is dumped in Mass. Bay and loads the bay with 4,400 tons of PCB's, 2100 tons of chlorinated hydrocarbons, 1760 tons of petroleum hydrocarbons and 88 tons of cadmium each year." And I think just adding on top of that is going to do no good at all.

Right now the federal government has imposed the strictest regulations in the fishing industry to help bring back the stocks. I don't think this on a rich nursery ground is going to help us at all. I think it's going to hurt the Massachusetts fishermen in particular, as well at the whole industry in general.

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Some of my thoughts would be to explore land dumping so that we wouldn't be contaminating the ocean. Why not dredge that material and put it on the side of the channel as you're going in? That would seem to me cheaper as far as you wouldn't have to transport the material and then dump it, as well as keeping contaminated material where the contamination is instead of bringing it out into a healthy marine environment. That's all I have to say.

MR. ROSENBERG: Sir, thank you very much.

We'll break now for five minutes, and we'll start our formal program. I really want to thank those who have given comment. Please stay because the purpose of this meeting is not just comments. It's to interact with one another, and please, stay. Thank you.

(A short recess was taken.)

MR. ROSENBERG: Good evening. I'd like to welcome you here tonight to the O'Neill Federal Center for this jointly sponsored public meeting and workshop to discuss the draft environmental impact statement and report on the

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Boston Harbor Navigation Improvement Project. I would also like to thank you, thank you for involving yourself in this process.

We're hosting these types of public meetings and workshops to listen to your concerns, to understand your comments and to provide you with an opportunity to formally appear on the record should you care to do so. This workshop is yours.

I do ask that during the formal discussion that you hold your question until the end of each presentation, at which time you will be heard. This I promise you.

The rules tonight are very easy, if you've got a question, ask it. If you've got something to say, say it. If you wish to go on the record, please. And lastly, if you want to involve yourself in this process, not just tonight but into the future, talk to any member of the workshop, whether it be at the front table, the Corps table or the tables on the sides of the room. These tables are hosted by the Corps of Engineers and MassPort at the rear, several of the federal agencies to my right, and

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several of the state agencies also to my right; and to my left, Save the Harbor/Save the Bay and the Conservation Law Foundation representing the many public interests groups that have been involved in this project from Day One.

We've all been working over the past year to get to where we are today, and now we need you. Yes, thank you very much for coming.

Our agenda is running very short. We're going to go for an overview of the project. MassPort will discuss their role in the project. We will hear from Save the Harbor/Save the Bay and Conservation Law Foundation. We'll also talk about the environmental impact statement, the draft environmental impact statement, the NEPA process and an overview of the statute itself.

The Commonwealth of Massachusetts will also be speaking on their role in this project. And lastly, we're going to have a small panel discussion where you'll hear about what's coming next, where we hope to go, how your comments and insights are needed in this process.

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(The formal portion of the Boston Harbor Navigation Improvement Project public meeting and workshop was held, including the introduction by Larry Rosenberg, Chief, Public Affairs; Boston Harbor Navigation Improvement Project overview by Colonel Brink P. Miller, Division Engineer; Janeen Hansen, MassPort Project Manager; and Peter Jackson, Corps Project Manager; the role of public interest groups by Joan LeBlanc, Save the Harbor/Save the Bay, and Grace Perez, Conservation Law Foundation.)

MR. ROSENBERG: We're going to deviate from the schedule at this point and bring back those individuals that have requested comments on the record. We'll run through the rest of the individuals, then we'll take a 5-minute break, and we'll get back to the formal presentation where we will discuss the process of the draft environmental impact statement, environmental impact review or report as required under NEPA and the panel discussion on what's

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next and what's going to be heppening.

Our next comment for the record is David Leveille.

STATEMENT BY DAVID LEVEILLE

MR. LEVEILLE: My name is David Leveille. I'm a fisherman in Gloucester, Massachusetts, and I'm very concerned with the dumping of this contaminated material in the Mass. Bay.

For 18 years I've earned my living in Mass. Bay along with many other fishermen from the City of Gloucester. I estimate on a daily basis anywhere from a hundred to 150 boats out of the port are fishing in that area. The majority of the boats fish there sometime during the year, some part of the year. There's very strong currents, and I don't believe that the sediments are going the stay in one position for a long time, especially if you're dumping in 50 fathoms, 300 feet, as proposed in the site next to the sanctuary in Stellwagen Bank.

The currents in this area are running in different directions at all times. So there is no one direction that this sediment is

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going to travel. I don't believe the estimates that only 5 to 10 percent or 3 to 5 percent of it, whatever they said, is going to be washed with the tide. I think it's going to be much greater than that. At that depth the tides are terrifically strong, especially in the springtime and near full moon.

Another concern I have is there is dumping done in the wintertime, we know what happened in the last two or three years. Northeast storms that we've had stirred the bottom up tremendously. A lot of fixed gear was lost by a lot fishermen during that time. That shows you the power of Mother Nature when a Northeaster roars up.

If dumping is being done during that time, what is going to happen to the sediment that's on the bottom? I know from experience that after a Northeaster — the water is blue under normal conditions, and after a Northeaster, the water is brown because the bottom is all stirred up. So these types of weather conditions can have a great effect dumping in that area.

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I also have a concern with the dumping so close to the sanctuary. Fishermen are going to great extents to preserve the fish in this area. Many juvenile fish — all of the Mass. Bay is unlike other fishing areas that I've fished in. It's more like a nursery. Many, many, many juvenile fish just live in this area, from dabs, winter founders, codfish. There's sand lance, herring, mackerel, striped bass, blue fish. Everything transits this area coming up the coast in the springtime, and many of the fish stay the yearround, especially codfish and dabs stay the yearround.

These fish are already endangered, and the fishermen are going to great extents to try and save these fish. I can't see dumping hazardous materials in this area and putting more strain on the environment with the sacrifice that we're making. It's like a step backwards.

Some other things I want to comment on is in the past as a fisherman, I have pulled out of the area of Mass. Bay aerial bombs, torpedoes, mines, depth charges, barrels with contents encased in cement, poisons of all types,

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and all types of containers. This area has been overtaxed with pollutants for the past, I don't know how many years. And fishermen have cleaned most of that area up. We've brought so much stuff out of there and dumped it and disposed of it in other areas where it's not going to be caught by us again.

I don't see why. There has to be a better way, a different site to dump this material. This place has been polluted and polluted. It has outfall pipes from every coastline community. It's a very prosperous place for fishermen to fish. I can't see dumping this contaminated material in this area. I think there should be another site than anywhere in the Mass. Bay, any other sites. I don't agree with any of them. Thank you.

MR. ROSENBERG: Sir, thank you very much.

Our next speaker is Agnela Sanfilippo.

STATEMENT BY ANGELA SANFILIPPO,

GLOUCESTER FISHERMEN'S WIVES

MS. SANFILIPPO: My name ia Angela

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Sanfilippo. I'm the president of the Gloucester Fishermen's Wives Associaiton, the vice-chaiman of the Gloucester Fishermen's Commission and a member of the board of directors of the Gloucester United.

We are here tonight and to speak on this issue. Unfortunately we have not read the EIS because we do not get a copy of it. We didn't get a notice. It took the Save the Harbor/Save the Bay and the Conservation Law Foundation to bring this issue to our attention.

Our organization has about 130 members. Most of them fishermen's wives. We've been in existence for 25 years. This year is our 25th anniversary, and throughout our years, many people know us as, you know, protecting the fish so people can fish. But our major role has been part of protecting the environment.

I just received one of the most prestigious awards from the Italian American community in Boston and my role in part has been representing environmentists. So I'm known such as well as a fisherman's wife.

We are very concerned about this

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issue, and we oppose any ocean dumping anywhere in the area. The Mass. Bay site is 12 miles out of Gloucester. We would be directly affected, not only for the fishing grounds but we spend millions of dollars in cleaning Gloucester Harbor. Many time during the summer with the southwest winds, anything that is dumped there will come into our harbor and will have a devastating effect on our beaches and our coastline.

In addition, I want to bring to your attention that in the Magneson Act that there is specific language that says that any time any species of fish is at its lowest level, fishing shall cease. So what I'm trying to say, no matter who does the damage to the spot, the fisherman are always the ones to pay the price. And so at the present time there has been extensive fishing by foreign fleets in the late 70s and early 70s and 60s. Today the fishermen in New England are paying the price for the conservation and the restoration of the fish stock.

It's ironic that the Mass. Bay

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site and all the other sites are within an area that specifically in Amendment 5 requires from March 1st to July 31st to use only 15 square mesh, which does conserve 50 percent of the catch. People are using that net, they are losing 50 percent of the usual catch, so that they can allow the fish to grow and become more economical for them to fish.

It's ironic that all this disposal, you know, that it's all contaminated and it is even being thought of being put in this area.

I'd like to ask you a question. Did you have anyone from the fishing industry on the advisory board that you spoke of tonight?

MS. HANSEN: We did actually. Tom Mills.

MS. SANFILIPPO: Well, he's not a commercial fisherman. He represents the pilot boat industry.

I have some other comments that I have to put my glasses on for. The other issue that we have, we are very concerned about traffic during this disposal off the barges. They are

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areas that are heavily fished by the Gloucester fishing fleet, and there are big boats and small boats, and we closed areas on Georges Bank for six months. Those boats depend on the inshore waters, and that is considered inshore waters, because it's close. So during the first six months of every year the fishing is done there because Georges Bank is closed.

In the summertime, starting in early spring to late summer, we will have bad weather conditions when we have the Northeasters in the fall weather, which is very impossible to see. Many times we hear from our husbands, "I cannot see the other man in the bow of the boat." That is a great concern of running into problems that will probably cause a bigger increase in our insurance policies. Right now we're very outraged at the moment. And I would like to bring that to your attention as well.

We are willing very much to work with you so that we can learn from each other, but we strongly want to go on the record that we're opposing any ocean dumping of this material. And we will submit a written statement

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within the period. Thank you.

MR. ROSENBERG: Thank you. Our next speaker for comment is Alex Gwefinkel.

STATEMENT BY ALEX GWEFINKEL,

INNOVOTECH ASSOCIAITON MR. GWEFINKEL: My name is Alex Gwefinkel. I represent here a group of scientists and professionals which will soon transfer itself into a small consulting group. This consulting company will be based on a project which we developed, a system, technology to convert containment of contaminated dredge sediment into useful material like materials which could be used in construction, for petroleum and metal and for normal landfill disposal.

This technology is based on a combination of mechanical, electromagnetic and microwave and temperature processes. I have with me samples of construction materials which were made from Boston Harbor sludge contaminants. This is a sample of a cement block, and this is a sample of light-weight construction material.

I came here to represent our group

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and to ask the Army Corps of Engineers to relay our project, our technology for possible implementation. Thank you.

MR. ROSENBERG: Sir, thank you very much.

We're going to take a 10-minute break here, and then we'll get back to the formal procedures. I'll see you all in ten minutes.

(A short break was taken.)

MR. ROSENBERG: We've gone through a great deal of the formal briefing for the second time. Most of the individuals that are now in attendance have heard the second part of the briefing, so if it is okay with everybody, we would like to forego that and just open the floor to any questions, any concerns that you may have regarding tonight.

(No response.)

MR. ROSENBERG: That's wonderful. I would like to keep this as informal as possible. This is not a classroom situation. Let's get down and dirty if we have to. Please, sir.

MR. LEWIS: Mr. Jackson, I have a

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question of anybody. The question goes like this. You're captain of a tanker which is anchored presently in the President Roads. The dredging project has been done. It's complete. It's 40 feet at the berths. The tanker is called Product Glory Number One, 800 feet long for example, and you want to berth at Coast Petroleum in the Reserve Channel.

The question is, the tide now is zero point zero; in other words, mean low water. You're the captain. How much draft would you take on that tanker to the terminal?

MR. JACKSON: Project is done?

MR. LEWIS: 40 feet.

MR. JACKSON: I think, and I'm not a pilot here —

MR. LEWIS: We know your ticket is very important to you. It's your livelihood. Now, how much draft would carry to the terminal?

MR. JACKSON: One or two foot under the keel clearance, so 38 feet.

MR. LEWIS: Actually you probably want to go for 37. You have to allow for automobiles and other objects in the channel that

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are going to roll under the ship.

MR. JACKSON: You said the project is done.

MR. LEWIS: The project is finished but somebody has done their thing that they do. Okay. Now, the scenario is now different. The project has been done, however, the conditions are as they have been the last few days, as it is tonight, for example. You're coming into Boston from Aruba, same ship, and it's zero point zero. The swell is 8 feet, winds out of the East. Now, it's the East today, the swell is ten feet. You want to come into Boston on this 800-foot ship, coming in at mean low tide again. How much draft would you dare carry going into Boston, into the President Roads outer sea?

MR. JACKSON: That's beyond my expertise.

MR. LEWIS: Take a guess.

MR. FARAMELLI: Less that 37 feet.

MR. LEWIS: Less than 37, but what we're trying to do here is we're trying to be practical about this whole thing to see what's

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really going on here, what the limitations really are and have 24-hour service of all stages of the tide in different weather conditions, not every weather condition but under different weather conditions, like lately.

The answer is probably 30 feet or less because you have two things to allow for. One, the ship is going to need 8 and a half knots coming into the harbor to maintain steerage to stay in the 40-foot channel. That's going to make the ship squat probably several feet into the water, the phenomenon about that.

The second thing is the swell out of the Northeast may be 10 feet. That would cause the ship to go down and dive somewhat, even an 800 footer, another few feet. Just to be comfortable, you'd want to save your ticket, not have a grounding on Fins Ledge. You want to have plenty of water under that vessel. So you're probably talking probably 10 feet of allowance, or maybe a little more.

Actually where I get this from is the Boston pilots, the ones that do the outer ship work, not the inner docking pilot. So what

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we have here, the thing is all done, and yet the limiting factor here under these conditions is probably a 30-foot draft, if you want to come into the harbor at all times. So you have to ask yourself, you know, where should the work be done, and what are we doing here anyhow?

MR. JACKSON: There's a very simple answer to that question, in that the answer is that in the economic feasibility for this project, we looked at the current use of the vessels and loading and limitations that we have. Then we compared that with 35 down to 40 feet, what improvements in the efficiency of the operation there are. So if they have limitations in 35 feet with storms and all these factors, then they will have the same limitations, but now they will have five more feet to deal with. So there is an improvement.

MR. LEWIS: Right, but that's the inner harbor.

MR. JACKSON: Yes, that's the inner harbor.

MR. LEWIS: See, the inner harbor is easy. You don't have these two phenomenon,

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number one, the squatting caused with the speed. You're not going that fast, I hope.

MR. JACKSON: Even so. The economics you want for every terminal operator.

MR. FARAMELLI: I am going to ask you a question.

MR. LEWIS: Sure.

MR. FARAMELLI: You're saying the project isn't ambitious enough? We should be going down deeper? Is that what you're saying?

MR. LEWIS: I'm just simply saying that this whole thing is a system. It starts out in the ocean and ends up in the head of Chelsea Creek or the Mystic or wherever. We didn't see the whole thing as a system. We sort of pieced the system, considered Deer Island inward. We didn't see all the rest of it, especially your economic analysis we suspect is maybe a little less than you think.

Like in that container ship analogy that you made that went by Boston. I'd love to know what the guy's draft was, what the conditions were, and the tide stage that he did that. I have a suspicion he did it out of fear

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of the North Channel rather than the inner channels, because the container ships usually don't draw that kind of water even when loaded. That's my suspicion.

MR. JACKSON: I think that was looked at in the feasibility report that was complete in '88. They looked at every channel inside and outside the harbor to see what improvements would be economically justifiable. The project you see here is the result of all the studies. They looked at Fins Ledge. They looked at the outer harbor. They found that there was not enough economic benefits to justify the cost.

MR. LEWIS: Okay, that's like transferring a part of the EIS/EIR back to an earlier thing, which obviously I didn't see because it wasn't in it. And I was drawing that, yes, that that be included in it so we can do it as a complete thing. This is important because this is the justification for the job, moving ships at any tide, I believe. That's one of our things.

The other thing is, something

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completely different, as a member of the Boston Conservation Commission, as you are and the other conservation commissioners, you have a lot to do with dredging over the years, particularly the sediments from the Third Harbor Tunnel operation. And I would simply say that sorting out sediments into a less and more contaminated area turned out to be exteremely difficult even under good conditions with an excellent contractor, never mind doing it in harbor conditions. That's why, for the organization I'm talking for, the Sierra Club, we don't want to see any of the sediments, which are defined as materials deposited on top of the parent earth, disposed of in the ocean at all. That's what's in back of that experience.

MR. FARAMELLI: Are you saying it shouldn't be disposed of in the ocean at all, or it shouldn't be an unconfined disposal?

MR. LEWIS: Not in the ocean at all, because we're not too happy about the so-called confined scenario. We've been looking at the research down at Long Island Sound and other areas, and we think the conditions were

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somewhat different. And I think the point by the fishermen who are not here now about the currents there is well taken, and we have 300 feet of water, a hundred meters of water there and tough conditions.

And the other problem, of course, is dredging methodology. I'll re-accent that. Our experience with the present dredging companies in Boston Harbor is not that heartening in terms of sticking to their contract or doing anything else. In fact, at the Moran Terminal they'd have done just as well to thrown everything in the air, the darn stuff. They went through an incredible process, the commission I was on, to see that it was done right. And indeed, some of it was done very well, once it got to the barge beside the dock and the water taken out. But leading up to that was just something else, and how to prevent that from happening is very important.

MR. ROSENBERG: Thank you. We have come to the close of tonight. I would like to state for the record —

MR. STRAHAM: Could I make one

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comment?

MR. ROSENBERG: Sure. One quick comment.

MR. STRAHAM: I'll be short. It's fundamental. I obviously agree with the Sierra Club's position. We would pretty much oppose any dumping in the ocean of any material, contaminated material, any material in fact. But like what I addressed earlier, and I'd just like to get some feedback from the peole who have been doing it is the issue that has been overlooked, I think, in the scope of the EIS/EIR and in every aspect of this process, especially now that the biological assessment has been turned in, which is the impact of the vessel traffic on the whales.

Now, the reality is that every scientist is restudying now, dealing with Northern Right whales, say one dead whale is too many whales dead. And if you're going to increase traffic, it's not going to hook. There's no mitigation; that is, the guts of the project is to increase vessel traffic and to maintain vessel traffic where otherwise it would

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be degraded over the years.

So I'm asking, I guess, the people, that you consider this equal to sedimentation and other problems, contamination in the ocean, and would you be willing to reopen the EIS process to include as either a supplemental EIS, et cetera, and to reconsider the biological assessment for its impact on vessel traffic increase or vessel traffic, period, on the Northern Right whale and other endangered species, whales and marine wildlife that are going to be simply impacted by this traffic by being killed and injured in a very horrible way if not also being disturbed?

MR. ROSENBERG: That's a very detailed question, and I don't think anybody here can give you anything but a simple answer, and I don't think that's what you're looking for.

MR. STRAHAM: Oh, yes I am. I want a very simple, yes.

MS. HANSEN: The process is not closed. The process is open. By your raising it here tonight, it will be addressed in the final EIS.

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MR. STRAHAM: Well, what do you feel about this question? What do you feel about this subject?

MS. HANSEN: I think it's a legitimate question to be looked at.

MR. FARAMELLI: It has to be looked at, Max, but I can't give you an answer.

MR. STRAHAM: I just want to know that you consider it an open question.

MS. HANSEN: That's why we're here.

MR. STRAHAM: Because if I submit a petition to do a supplemental EIS on this subject, I don't want to spend hours preparing it and then have the door slammed in my face arbitrarily on the issue because you're already prejudiced against it being an issue, either that you don't consider it substantial either on meritorious grounds or you're politically disposed to ignoring it because you don't want to deal with it. You know what I'm saying?

MR. ROSENBERG: Once again, thank you for the comment. To restate it, the reason for these meetings is not to have the Corps and

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MassPort and our partners and the people involved in the advisory committee preach but to receive your comments to identify areas that we may have not looked at and to look a your insight and to take them very seriously.

So, sir, the last question for the evening.

MR. TRENZ: My name is Jim Trenz, and I've been involved with some research using microbes to degrade, chilling hydrocarbons and PAH's.

I would like to see some funds readily available for some more research into that end to degrade the hydrocarbons either in situ or have a low cost method of treating the chilling hydrocarbons, PAH's, PCB's, so that we can render these contaminants innocuous or relatively innocuous, less toxic so we can have a low cost solution for the silt that is the main problems of the disposal.

MR. FARAMELLI: Let me start on that, then I'll let Janeen pick up. We are clearly going to be looking at alternative technologies more so in the final than we did in

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the draft. We're very clear about that.

With regard to the funding, that is yet to be determined. One plug is the proposed green harbor legislation, which would allow some of that to happen. I think it really is essential that work be done on this. We'll do what we can.

MS. HANSEN: I would second that comment, and in the earlier tests, we did talk a little bit about the Green Ports legislation, which I believe did not make it to the floor of the House of Representatives in this session of Congress, but may well be introduced again in the fall. But this is the time to contact the Massachusetts Congressional delegation and any other delegations that you can think of to let your Senators and Congressman know that this is a priority issue to you, that there ought to be some funding for treatment technologies for dredge disposal. It's beginning to be talked about in Washington, but if they don't hear a hue and cry from their districts, it won't go anywhere.

MR. TRENZ: If they're not talking

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about doing anything until the fall session, we're missing a treatment season as we're upon it right now. Given that the temperature has increased, we increase biological activity in that season. We will have missed another year, and we will be further behind in any kind of research along these ends. And if we don't have some fast-track method for getting some funds soon, we're going to miss this season. We're not going to be able to supply and institute solutions for treatment for the '96 dredging target date.

MR. LEWIS: Here's a question. How close are you to inventing something that works on sediment from dredging that contains petroleium materials?

MR. TRENZ: I've already gotten a preliminary crude bench skill study performed and completed, and we're looking for a more rigorous test with full scientific laboratory testing with a control, some other testing at the end of the testing period so that we can prove that we don't have the toxic affects that we have for the contaminants beforehand.

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MR. LEWIS: You're looking for a test bed here of some sort?

MR. TRENZ: That's correct, and some funds that would take us through to that.

MR. LEWIS: It's an interesting proposal.

FROM THE FLOOR: Can you do these tests on actual Boston Harbor silt?

MR. TRENZ: Yes, I did.

FROM THE FLOOR: So it's not clear until you can do the toxicity test whether even biodegrading these organics successfully will sufficiently reduce the toxicity, for example, associated with heavy metals that are also present to make the difference between the clean —

MR. TRENZ: That's right. The toxicity tests are very expensive, but we're willing to do the tests, do whatever rigorous scientific studies that are needed to prove that the technology is working. We recently treated a gasoline station that had two inches of floating gasoline in it less than a month ago, and now it's got total effect levels of 2 EPB. So that's

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drinking water quality.

MR. LEWIS: Gasoline is nasty toxic stuff. This wouldn't affect heavy metal obviously.

MR. TRENZ: Well, there's studies that do suggest the metals are bound as opposed to being leachable. You have mine tailing studies that have been done by EPA out West where they have combined some materials with mine tailings, and you've bound up the metals, and you prevent it leaching, although you don't reduce the contamination level in metals. You do access the straight lines.

MR. LEWIS: You want some experimentation of the saltswater confinement obviously.

MR. TRENZ: That's correct. And these are live marine micro-organisms so they can take salinity up to 18 percent.

MR. LEWIS: The organics that the metals bind to are going to be biodegraded under the technology we're talking about, couldn't that increase the mobility and toxicity of the metals?

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MR. TRENZ: Will it be bound to organic or will it be bound to soils?

MR. ROSENBERG: Thank you. I'd like to ask Colonel Miller to come up, although he's not on the agenda, and give us some closing remarks. Sir.

COLONEL MILLER: Very closing remarks. Thank you all for coming. Please, if you have comments that are specific, put them in writing so we can respond to them in writing, make sure that we know exactly what your concerns are.

Thanks for coming. Hope you got something out of the evening. See you at the next one.

(Whereupon, at 9:10 p.m. The meeting was closed.)

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Thursday, May 19, 1994 Tara Hyannis Hotel & Resort (The formal portion of the public meeting and workshop on the Boston Harbor Navigation Improvement Project was held, including the introduction by Larry Rosenberg, Chief, Public Affairs; Boston Harbor Navigation Improvement Project overview by Colonel Brink P. Miller, Division Engineer; Janeen Hansen, MassPort Project Manager; and Peter Jackson, Corps Project Manager; the role of public interest groups by Grace Perez for the Conservation Law Foundation, and for Save the Harbor/Save the Bay.

MR. ROSENBERG: Thank you, Grace. The next part of the program is our public comments. These are taken in the order in which they were received, with the exception of one gentleman who must leave early. He will be our first speaker. Mr. Dennis Finn from the Cape Cod Commission. Mr. Finn.

STATEMENT BY DENNIS FINN,

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CAPE COD COMMISSION

MR. FINN: Thank you. I have a statement that I'd like to read to Colonel Miller from Amando Cardinale, Executive Director of the Cape Cod Commission.

"The staff at the Cape Cod Commission, a regional land-use planning and regulatory agency serving 15 towns in Barnstable County, have reviewed the draft environmental impact report, environmental impact statement for the Boston Harbor Navigation Improvement and Berth Dredging Project and offer the follow comments. for your consideration.

"The Commission staff believes it is important to make navigational improvements to Boston Harbor that will help insure safe passage for marine vessel traffic. This is particularly important given the fact that much of New England's petroleum supply is shipped into and out of the Port of Boston. At the same time, the project should be conducted in an environmentally sound manner and the disposal locations for the dredge material should be chosen based primarily on environmental costs and benefits.

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"The Commission staff believes that the dredge materials from the Boston Harbor Project, almost one half of which has been identified as being contaminated silts, should be disposed of in-harbor or as close to the harbor as possible. This will decrease the possibility of transporting contaminants into the larger Massachusetts and Cape Cod Bays system.

"The bays support resources of national and state significance, not the least of which is the federally designated Stellwagen Bank National Marine Sanctuary. The conservation and management of these resources should not be compromised by the Boston Harbor Project. At the present time neither the federal nor state environmental agencies has factual information on the stability of capped contaminated sediments in oceanographic dynamic sites.

"For these reasons, the Commission staff recommends that the Massachusetts Bay's disposal site and the Boston Lightship site be dropped from further consideration for disposal of dredge material from the Boston Harbor Project.

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"The Commission staff recommends the Army Corps of Engineers and MassPort more fully evaluate the in-harbor and near-harbor disposal options.

"The staff recommends that the final EIR/EIS evaluate the options of containment and near-shore disposal sites, as well as more fully evaluate the use of the inner-harbor borrow pits as a disposal option for contaminated materials from the Boston Harbor.

"The Commission staff recommends that the federal and state regulatory agencies work cooperatively on identifying the legal and policy issues which need to be addressed to allow one or more contained disposal sites within Boston Harbor.

"Finally the Cape Cod Commission staff recommends that the final EIR/EIS include an analysis of the management monitoring needs for the preferred disposal sites. This information is needed to fully evaluate the environmental costs and the benefits of each of the alternatives."

MR. ROSENBERG: Sir, thank you

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very much.

The next speaker for the record is Mr. Wayne Bergeron.

STATEMENT BY WAYNE BERGERON,

BAYS LEGAL FUND

MR. BERGERON: I thank you, the members, for inviting me to speak today and allowing me to go out of order, and my apologies to those who are behind me. I have about four meetings today, and I want to have a chance to speak. I want to thank also Grace Perez, Conservation Law Foundation, for notifying me of the meeting and staying on top of me to be here. Thank you, Grace.

My name is Wayne Bergeron. I am the chairman of the Bays Legal Fund, which is an advocacy group for the Massachusetts and Cape Cod Bays. We are a governmental arm, if you will, of Barnstable County. We represent the towns of Dennis, Yarmouth, Oleans, Eastham, Provincetown, Barnstable, Sandwich, Mashpee, Brewster and Harwich, most of the Cape.

We have been involved recently in a lawsuit regarding the Boston Harbor outfall

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tunnel, which is yet to be resolved to everybody's satisfactory. And of course, the Army Corps of Engineers is one of the litigants involved in that particular situation.

I'm going to be mercifully brief on this because having had a number of these, you're going to hear the same things over and over. I'll begin by saying, of course, that the Bays Legal Fund supports many of the issues put forth by both Save the Harbor/Save the Bay and also by Conservation Law Foundation as they have been address. We will submit in depth written testimony in the future regarding this particular issue.

It is our position with the Bays Legal Fund that under no circumstances should contaminated sediments be disposed of at the Mass. Bay Disposal Site, including capping with clean sediment, a technology that we believe is unfeasible to the current depths and lack of more advanced technology to be used. It has been mentioned that the National Marine Sanctuary is in that particular area close to the disposal site. Of course, that is true.

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What I would like to point out to you that has not been mentioned is that the Mass. Bay Disposal Site falls in the perimeter of the proposed North Atlantic Right whale sanctuary area. The North Atlantic Right whale is the most endangered of all marine mammal spcies. There are approximately 350 left at this point in time, coming, by the way, from three females. So their genetic diversity is very slow in evolving and susceptible to many problems.

You've heard talk already about bioaccumulation potentials, which we also hear concerns about. North Atlantic Right whales eat masses of zooplankton, and they may be impacted through the food web, and that's a big concern for us, of course.

I would suggest it would be to the Army Corps' of Engineers extreme advantage if they were to make the unfortunate decision to wish to dump in the Mass. Bay Disposal Site, that they involve the Endangered Species Act and do a Section 7(A)(2) review. Section 7(A)(2) of the Endangered Species Act simply states that any federal agency must assure that their actions are

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not likely to jeopardize the continued existence or be any threat to endangered species or degrade their habitat. We would like, of course, that to be done prior to the dumping as opposed to after.

Another concern is that we ask simply, we're well aware of the situation that cod, haddock and other ground species are right now in our bays. Some of the advanced theories we have heard recently is that due to contamination, fish larvae are not surviving. We do not need to have a situation where we have more contamination being dumped into our bays and making that situation worse potentially than it is right now.

We're also concerned simply, and I think Grace addressed this very well, about accumulative impact of having the outfall tunnel as now proposed in the discharge area that it is and having more sediment being discharged in the Mass. Bay Disposal Site that's contaminated. Those two together are doubly frightening. They are almost doubly frightening to the people at Bays Legal Fund.

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I will leave you with those thoughts. I will give you, as I said, a much more in-depth review, but I did want to go over and adrress them briefly to you. I would simple say for your consideration that while we have been involved in a lawsuit with the Army Corps of Engineers, we would like to have a positive relationship in working through the situation now and in the future, but where we have gone to court once on this issue, we will not hesitate a second time.

I'm hoping that we can continue to communicate with each other and find the best feasible solution for what we see is necessary dredging, but of course, for these particular channels. Thank you very much.

MR. ROSENBERG: Our next speaker is Dr. Paul Atmurray.

STATEMENT BY DR. PAUL ATMURRAY

DR. ATMURRAY: I just have a brief comment. I just came to the meeting and reviewed the material, and the problem I have with the disposal sites is not enough information to ask relevant questions. I wish there was more

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information about the locations, the cost and the environmental factors surrounding each of the disposal sites so that the public knows more about it.

MR. ROSENBERG: Thank you, sir, for your information. We have copies of the environmental impact statement. We'll make sure you get one before you leave.

DR. ATMURRAY: I have one.

MR. ROSENBERG: Our next speaker is Ms. Dorothy Kiersteae.

STATEMENT BY DOROTHY KIERSTEAE

MS. KIERSTEAE: My name is Dorothy Kiersteae, and I'm from the town of Dennis. My concern is, as Mr. Bergeron has stated, about the after effects of the sediment that is to be dumped, and if alternate places could be considered rather than where they have proposed. It would be in the best interest of the fish and the animals that have to live in the ocean. Thank you.

MR. ROSENBERG: Thank you very much. And our last speaker for the record at this time is Mr. William Adler.

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STATEMENT BY WILLIAM ADLER

MR. ADLER: My name is William Adler. I'm the executive director of the Massachusetts Loberstermen's Association, which represents approximately about 1100 lobstermen in the state of Massachusetts and quite a few, probably 500, that are in the area of which we are speaking.

I wanted to bring to your attention several ideas here on this project. We're not, by the way, opposed to the project itself, the dredging. We understand the need for that. However, we've been cleaning Boston Harbor and trying to clean the ocean of contaminants and oils, plastics, toxics, et cetera, and it seems like here we have the opportunity to dump some right back in to where we've been cleaning. A lot of money and time has been spent in the method of trying to clean it.

Also the government agencies, the United States Coast Guard, are all over us with rules about not dumping any type of stuff in the ocean, and yet the government here is dumping stuff in the ocean, and I'm particularly

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concerned that it's contaminated. I spent over a year on the EPA Hazardous Waste Disposal Advisory Committee in Boston where we were looking for barrels that were out in these areas that were dumped 20, 25 year ago with holes shot in them. They contained various toxic wastes, nuclear waste, atomic waste. And we had subs going around down there. We had sonar scans going on. We had been raising dead men's records as to when they dumped it 25 years ago. All because we were concerned about something that was dumped 25 years ago and could be hot spots out there in areas similar to where we were — actually some of the areas we're talking about now.

And so we were very concerned about these things that were dumped 25 years ago. And rather than progressing onward and trying to not, at least not put more out there, this project seems to propose putting more contaminants out there.

Speaking of the area's lobstermen, 6.5 million pounds. 9.5 million pounds of lobsters landed from the territorial waters of Massachusetts. 6.5 million come from this

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general area just south of Gloucester to just the northern section of the South Shore. It's a very big lobstering area with many ports scattered between Gloucester and, let's say, Cohasset, and many, many fishermen earning their living out in the outer areas here of Boston Harbor and also just beyond the territorial sea. Many of these or just about all of these proposed sea dumping sites are in or near where lobster fishermen work. And they are very concerned that this material would get loose and would therefore make the bottom contaminated and make the lobster and fish also contaminated.

You just can't move. In your executive summary you indicated that fisheries would be affected, and we'd have to move. And I think it needs to be remembered the lobstermen, unlike other type of fishermen, they are more or less confined to a certain area. You don't go move your traps over into Gloucester. You just don't do that. You have sort of an unwritten area which is your little world of lobstering. So it's not like, well, why don't you for a year and a half just go off to Maine to do lobstering

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and then come back. It just won't work that way. And I think that needs to be remembered. You talk about a year and a half of disruption, and that would be, of course, very serious.

Also the space and the traffic involved in this is also of concern, since there will be a lot of barge traffic, more than there already is and there already is a lot, which of course damages their gear by taking the buoys with them and therefore their trawls and traps are scattered all over the place and lost. Contamination of the area and lobsters would ruin these fishermen and their families and certainly would spawn lawsuits against the agency for this damage.

We might also say that this question of containment using covers or baggies or barrels or coffins, and this goes back to those days with the coffins, barrels that were already out there, will it work? And we don't think it will. And I don't think you could guarantee that there will be no ooze, which of course would cause the contamination of the bottom and thereby the creatures.

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We would suggest that you look serious at something like Fort Point Channel, also the end of the Reserve Channel, options that I think were listed as a possible place to put this stuff, because much of that area has already got this stuff. And the ideal thing, of course, which is probably very farfetched, but I just have to throw it in here, is why can't we take it to Nevada?

There's a track out at the end of the Moran Terminal there, they can put in hopper cars, hundreds of them, and just maybe you could pay Nevada to take it and put it into one of their big holes that they have out there, and maybe some day somebody will find a use for this stuff, and we could mine it all over again and take it somewhere. And I'll end on that. Thank you very much, and I have a letter for the Colonel. Thank you.

MR. ROSENBERG: Thank you very much.

The next part of the agenda is an overall approach to what's been going on with regard to the draft environmental impact

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statement and the draft environmental impact report.

(Panel discussion on overall approach to the draft environmental impact statement with Catherine Demos, Corps EIS Project Officer, Norman Faramelli, MassPort Director of Transportation and Environmental Planning, and Nancy Bakerm MEPA, Commonwealth of Massachusetts.)

MR. ROSENBERG: I'd like to open it now to any questions, concerns, advice, love letters. Sir.

FROM THE FLOOR: I was wondering, one of things expressed was the large volume of materials that are involved for maintenance dredging, and I was wondering if there is any viable solution over the long term, for example, of reducing the volume of sediments that have to be involved in maintenance dredge or sources of contaminants that contaminate them.

MR. ROSENBERG: Pete, want to start off and then Mr. Hubbard, Chief of our

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Environmental Branch, can jump in.

MR. JACKSON: You had two questions. One, could we reduce the sediments that have to be dredged for maintenance. Boston Harbor is a low-sediment type harbor, unlike where they have maintenance every year, maintenance frequency on the order of about ten years rather than annually.

These sediments come from different rivers and streams that enter the harbor that comes from urban runoff, sand and runoff from streets. It moves around the harbor. It doesn't escape. There isn't a lot of supply coming in either, so the little bit we get is mostly urban runoff, outfalls, that sort of thing. Hopefully the MWRA cleanup on line should clear this up.

Some of these sources are nonpoints sources and come from just normal drains that come from the city and the industrial harbor that it is. That is very difficult to treat. I don't think anywhere in the country have they been able to economically address that problem. You can't capture any one place and

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treat it and then let it go. The Corps of Engineers is committed for the future maintenance of this project, and those other examples that I showed you. So that federal cost, that's part of the project. I don't know of any trick to minimize the amount of maintenance dredging. I really don't have a good answer. If anybody does, please see me.

MR. HUBBARD: I agree, Pete, on the amount of nonpoint sources. Especially in the last two administrations a lot of money has been put forward for government programs to examine this. Massachusetts has some programs also in reducing contaminants, if you noticed the amount of material that's licensed to go out the pipe, so to speak. Every year it gets a little more stringent, as does the Clean Air Act. They don't want to lock up industry. As the decades go by, you'll probably see a reduction in the contamination into the system.

A lot of Boston Harbor is going to slosh around in the system for a while. When it sloshes around, it does settle in the near channel. They've got to get it out of the

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harbor.

Long term, over the next 25 years we're all hoping to see a reduction. I think we've seen it in the last 20 years as a result of the Clean Water Act. It's gotten better. It's going to take a little while.

FROM THE FLOOR: I'm wondering about the state of the art as far as this Boston Harbor Project. I'd like to remind the Army Corps of Engineers about the straightening of the Kissimmee River, what they have done in the Everglades, and I think they are precipitating a real tragedy as far as the environment is concerned and so far as Cape Cod is concerned. Because the U.S. geological surveys shows that the tides come down clear around Cape Cod Bay in July, and we don't know what the tides will bring down to Cape Cod, and we're very worried about that, not only for the pollution of our beaches but also pollution of our water supply, which is quite dependent upon the marshes in Cape Cod Bay.

MR. ROSENBERG: Any other questions or concerns?

FROM THE FLOOR: I just have a

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question for the MassPort folks. Could you say something about any projections you might have about how many more ships are expected to call in Boston Harbor as a result of this project, or conversely, how many you will not lose as a result of this project?

MS. HANSEN: I'd be happy to address that question. At this point the Port of Boston is fighting for life as we know it. We'd like to keep the vessels calling that we currently have. The possibility of attracting additional vessels is probably not a likely outcome. Because the fact of the matter is the vessels are getting larger. So they come more heavily loaded and not as frequently as perhaps in past years when vessels were smaller with more regular ports of call.

I would actually like to take this opportunity to mention that we had a ship diverted about three weeks ago coming inbound from Northern Europe fully loaded. The first port of call was supposed to be Boston. The vessel was delayed in the middle of the Atlantic by a storm, and as a result it did not arrive on

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schedule as anticipated when it embarked. As they got closer to Boston, they realized they did not have time to wait for high tide, so they left containers waiting on the dock at Connelly Terminal, and the ship went directly to New York. The Massachusetts customers had to wait for the containers to be barged up from New York. Vessels are getting larger, drawing more water.

MR. FARAMELLI: The only thing I would say is we are not talking about accommodating the larger vessels. We're talking about improving the ship lanes and accommodating the average size vessels essentially of the Port of Boston so we don't have a recurrence of what Janeen talked about. The ships are getting larger above all. We have a lot of lightering going on. The ships have to remove some of the cargo before they come in rather than risking grounding, and on petroleum products, that's quite an expensive undertaking to take the petroleum off the ship onto the barge. That's double handle costs. And we're going to have more and more of that in the future. That's the

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kind of thing we're trying to avoid.

FROM THE FLOOR: The second point of my question, do you have any projections how many ship you'll lose as a result of not doing this project?

MS. HANSEN: Eventually we'll probably be served by barge and truck traffic from New York or possibly Montreal.

MR. ROSENBERG: Any other questions?

Before I recess the formal part of this afternoon's session, I'd like to remind you of the last rule; that is, if you want to involve yourself in this process, get involved. We need you in order to get to the end, which is to finally select an alternative.

We also ask that you work with these workshops, the workshop tables in the rear here. If you have concerns, please express them. Beat us into submission if you need to. This is a unique way of communicating projects to the public, and the only way this is going to work is if the public communicates back to us.

I really want to thank you for

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coming here today. I would also like to thank Mr. Adler from the Massachusetts Lobstermen's Association who has extended a welcome to us so we can start setting up discussion groups with the lobstermen in Massachusetts with regard to this project and others.

Please stay involved. Keep us on our toes. And I'd like to recess now the formal part of the session until 6:00 o'clock. Thank you.

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EVENING SESSION

(The formal portion of the public meeting and workshop on the Boston Harbor Navigation Improvement Project was held, including the introduction by Larry Rosenberg, Chief, Public Affairs; Boston Harbor Navigation Improvement Project overview by Colonel Brink P. Miller, Division Engineer; Janeen Hansen, MassPort Project Manager; and Peter Jackson, Corps Project Manager; the role of public interest groups by Grace Perez, Conservation Law Foundation, and for Save the Harbor/Save the Bay.)

MR. ROSENBERG: Thank you, Grace.

At this time in the program, we're asking those who have asked to put their comments on the records to come forward. If you give me 30 seconds, I'll raise the mike, and our first person to give comments on the record will be Mary Loebig. STATEMENT BY MARY LOEBIG, STOP THE OUTFALL PIPE.

MR. LOEBIG: Thank you for this

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opportunity to comment. I had some questions first. Is that possible?

MR. ROSENBERG: Hold the questions. There's a period for uninterrupted comments. When you give these comments, we'll put them on the record and we will respond to them within the final environmental impact statement.

MS. LOEBIG: My name is Mary Loebig. I represent Stop The Outfall Pipe. And I'm a high school teacher, and I haven't had a lot of time this week to review the DEIR/DEIS. I'll be doing so before the final time period is up. But until then I did want to enter some comments, general comments in the record.

On October 4th, 1992 we offered a comment to the designation of the Mass. Bay Disposal Site because we were very concerned that even though they're only talking about clean spoils, that the fact they had not designated where the dredge spoils from Boston Harbor were going to be going, it was felt that it would eventually be considered for this. And unfortunately it looks like that is what has

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happened here.

We were assured by the agencies at that time that the MBDS was to be utilized for clean spoils only. And then as now, our concern was that establishing this prior to the Boston Harbor dredging project being finalized, that it was being done for the purpose of providing an opportunity for those spoils to be disposed of at the MBDS.

Now these agencies are back, of course, with their plans for dredging the harbor. We're not opposed to the dredge of the shipping lanes. We are, however, opposed to the dredging of the lanes at the expense of the marine ecosystem throughout Boston Harbor and Mass. Bay. The alternative of disposing of the sediments at Mass. Bay Disposal Site or the Meisburger sites near the proposed discharge site for the MWRA outfall found in this document is one more solution that is in direct opposition to their reported goal of preserving, protecting the environmental integrity of the marine ecosystem. When will we wake up to the cumulative impact of all the insults we continue to perpetuate against

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these bodies of water?

Under no circumstances should the MBDS be considered a suitable site for any contaminated spoils. Capping should not be considered a mitigation measure as it is not a proven technology particularly given the depth of these sites. Given their proximity to the many endangered species that live on Stellwagen Bank and Stellwagen's stature as a national santuary, even disposal of clean sediment at these sites should required the strictest oversight by National Marine Fisheries and NOAA.

We're also concerned about how these spoils are going to eventually be designated, and we hope that there will be some independent oversight of that process.

Section 4.5.1 of this document dwells on studies which imply that various groups of pollutants are not as great a threat to biological systems as previously believed I would suggest that much of this research was performed by those invested in current dredging technology and would like to remind the Corps of the many studies which suggest that, to the

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contrary, these toxics seriously impair many biological functions in marine ecosystems. As Ms. Perez pointed out, the flounders in Boston Harbor are ample proof that there is a problem here.

There's another study that was just released in '91 from the National Marine Fisheries Service called "Pollution and Development Abnormalities of the Atlantic Fishes." In that study, it indicates that chromosomal abnormalities brought on by many of these toxics may account for significant amounts of larval mortalities in the fisheries which now thrive in Massachusetts Bay.

Throughout this document, reference is made to the economic benefits that will be derived from the dredging project, and in fact, maintaining the harbor as a viable shipping port is important. But to consider only those immediate costs incurred by the dredging without considering its long-term impact on natural resources, the environmental integrity of the bay and human health is to be penny-wise and pound-foolish. The cost of $18 per cubic yard

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for disposal of silt at the MBDS is one of the lowest costs cited in the document, which makes me very nervous. Yet it does not reflect the potential harm to other industries and ecosystems from the collection of bioaccumulative toxics at this site.

We urge the Army Corps to redraft the economic formulas upon which decisions of this nature are made to accurately reflect their long-term impacts on the marine environment. It would seem imperative, with the valuable resources of Boston Harbor and Massachusetts Bay being placed at risk, that consideration of innovative treatment and dredging technologies would be the truly economical solution to the problems of dredging and disposal.

Dumping these spoils at the MBDS or the Meisburger sites will be one more example of the out-of-sight, out-of-mind mentality that continues to dominate their approach to waste problems. We should recognize from past experience that these types of solutions are shortsighted and short term.

MR. ROSENBERG: Our next speaker

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for the record is Etta Goodstein.

STATEMENT BY EDDTA GOODSTEIN,

STOP THE OUTFALL PIPE MS. GOODSTEIN: Now that Mary Loebig has given the formal statement for Stop The Outfall Pipe, I want to say that I'm most grateful that I had the opportunity to hear the comments from Save the Harbor/Save the Bay and the Conversation Law Foundation this evening as well.

Basically we're all saying the same thing. We're here to urge the Corps of Engineers to take the language that would consider the Mass. Bay disposal area, just take it out. We don't want to get reassurance, "We're really not going to use that for contaminated soil from this dredge material."

We think in the best interest of the environment as a whole, this is the time now for you just to remove it as a possibility so that we can assure that the goals that we have to preserve and protect Massachusetts and Cape Cod Bays and work towards environmental policy that make more sense in Massachusetts is something

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that can happen, and the thing you can do now to help us is to remove that language. Thank you.

MR. ROSENBERG: Thank you. That concludes the formal comments from the public. At this time on the agenda we have set aside what we were going to call the panel discussion, where we were going to tell you all about the overall approach, have some of our experts sit up here. What I would propose to the four of you is that we sit down and we talk. I think many of the questions that have come up in both of your official comments can be addressed.

Nobody here will ask you today to judge us on what we're going to say, but judge us on the actions that we're going to take over the next year or so.

So if that's okay with you, we could skip the rest of the formal presentation, and we could just sit down with you and talk. I think it would be much easier. You might get much more from us, and we will have the opportunity to gain a little from your expertise and your insights. But I'll leave that up to you.

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Let me tell you about the people that are up here you haven't met yet. I like reading bios. It's my lot in life actually.

Catherine Demos is the Project Officer for the EIS. She works in our Impact Analysis Division, and she's been working with the Corps in New England since 1986. She has a Master's of Science in coastal zone management and biology from the University of West Florida. She also holds a Bachelor of Science from the University of Massachusetts.

She is solely responsible, not solely but she's responsible for putting together the entire documentation for not only the draft, which is what's out there, but the final, which is what we're work towards right now.

She's a member of the Society of Wetlands Scientists and resides in Concord.

Sitting to her left is Mr. Norman Faramelli. Norm is the Director of Transportation and Environment Planning at MassPort. He has worked at MassPort since 1976. First as Chief of Environmental Management and then at MassPort Director of Planning. He's a

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graduate chemical engineer with experience in the petroleum industry and has several graduate degrees. And prior to coming to MassPort, he worked as a consultant on the social and environmental effects of technological change.

What I would like everybody to do is stand up, and let's go over there and talk. That concludes tonight's session. Thank you.

(Whereupon, at 8:08 p.m., the session was concluded.)

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BOSTON HARBOR

NAVIGATION IMPROVEMENT PROJECT

NAHANT PUBLIC FORUM
TOWN HALL
NAHANT, MASSACHUSETTS
July 28, 1994
7:00 p.m.

BEFORE:

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ALSO PRESENT:

Robert Forman, Chairman,
Nahant Board of Selectmen
Richard Lombard, Vice Chairman,
Nahant Board of Selectmen
Robert McIlveene, Secretary
Nahant Board of Selectmen

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PROCEEDINGS

SELECTMAN FORMAN: Good evening. Can we get started. I know we delayed a little bit to try to improve the acoustics of the room. One of the things that we have heard from the Selectmen's meeting we ran from six o'clock to seven o'clock is this room, as we all know, is not great for acoustics, especially as the Town body is concerned. I think we all need to make sure tonight that we speak into the microphones. We are going to ask everyone to come up here to the mike to speak so that people tend to hear what is going on. There is a lot of people at home that are watching what we think the Town of Nahant's hearing is all about.

So I would like to just start by opening the meeting and introducing Mr. Larry Rosenberg, the Chief Public Affairs Officer of the Corps of Engineers. It is really their meeting tonight. We asked them to come here to Nahant and to explain the project and to allow us to provide our input and our concerns on this -- the navigation project, improvement of

Boston Harbor and supposedly the use of a site to dump the material off the Town of Nahant.

We have a lot of people here tonight who want to speak. Mr. Rosenberg will go and explain the process that will certainly give people a chance to speak.

And I think without saying any more, I can turn it over to Mr. Rosenberg and start the entire process.

Thank you very much.

MR. ROSENBERG: Thank you, Mr. Forman.

Good evening. I am Larry Rosenberg. I am the Chief of Public Affairs for the Army Corps of Engineers in New England, and I would like to welcome you here tonight to this public gathering -- forum where we, together with your non-Federal partners from Massport, will receive your comments and your insight on the Draft Environmental Impact Statement for the Boston Harbor Navigation Improvement Project.

I also would like to thank you for involving yourself in this environmental review process. You see, we are here tonight to listen to your comments, to understand your concerns and

to provide you an opportunity to formally appear on the record, should you care to do so. This forum is yours.

With me tonight are members of the Corps' division staff: Mr. Pete Jackson, our Project Manager; and Mr. William Hubbard, the Chief of our Environmental Branch. Excuse me.

In addition, we are very pleased to have Captain Jeffrey Monroe, the Deputy Port Director for Massport; along with Ms. Janeen Hansen, Massport's Project Manager; and Mr. Norman Faramelli, Massport's Director of Transportation and Environmental Planning, all of whom are here tonight to listen to you.

The project under discussion deals with more than just improving the navigation capability of Boston Harbor. It deals with the disposal of over one million cubic yards of silt materials, which need to be disposed of in an environmentally sound manner, and our purpose for this session tonight is to gather comments from you prior to a joint decision regarding that final disposal site for the dredged material.

It's very important that you know that

no decision -- no decision has been made with regard to where the material will be disposed of. Furthermore, we are not here tonight to defend any of the alternatives listed in -- listed for consideration in the final -- in the Draft Environmental Impact Statement. We are here to listen to what is on your mind concerning those disposal alternatives. Before any decision is made, we must take into consideration both the environmental concerns and the issues that are of concern to you, the residents of Massachusetts.

What we will do tonight is describe both the project and the environmental project to date. Then we are going to open the floor to statements so that you can make your views known to us. Feel free to bring up any and all concerns, which you feel need to be discussed in the final document to be prepared. Please try to limit your formal statement to five minutes. There are some exceptions to that, and there were four individuals who were speaking to the Town Meeting, and we will allow them a little bit more. There is much to be discussed tonight, and that is why we want to limit it to five minutes.

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After the formal statements are concluded, you are invited to continue this dialogue with the general members who again are here solely just to listen to you.

The rules for this forum tonight are: If you have got a question, ask it; if you have got something to say, say it; if you want to go on the record, come on up and please go on the record. Lastly, if you want to involve yourselves in this process not just tonight, but into the future, let us know. We can accommodate that. We want to accommodate that.

You know, as a direct result of having this kind of open process, we have been able to overcome many of the difficulties other major metropolitan areas face when preparing for large navigation improvement projects. Although we are here tonight to discuss the Draft E.I.S., we need your input throughout the entire process. Your involvement is not only requested, it is necessary if we are going to find an acceptable solution for the dredged material disposal problems that we are facing here. You see, we have been working hand-in-hand with many Federal and State agencies,

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local businesses, elected representatives and public interest groups such as the Conservation Law Foundation, Save the Harbor/Save the Bay for over the past year to identify approximately 300 disposal sites that are available for this project, but also to narrow these disposal sites to the most economical and most environmentally safe alternative. Thankfully with the assistance of those individuals and public interest groups, we have successfully accomplished that part of the process. Now we need you, especially those of you who are impacted directly or indirectly by the project to assist us in this environmental review process.

Once again, we need to know your concerns. We need your advice, and we need your expertise.

Yes. Thank you very much for coming here tonight.

I would like to introduce --

WILLIAM COFFEY: Could you -- can I ask you one question, please?

MR. ROSENBERG: Absolutely.

WILLIAM COFFEY: My name is

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Bill J. Coffey from SWIM, and I am wondering if you could have the courtesy that at the end of the hearing or before the speakers speak there may be some questions. There may not be that many. There may be just comments. But if there are questions, since this is an information meeting, and we are going to be giving out information without those speakers, there may be new information. And I am wondering if any questions come up according to that information might we be able to respond to those questions?

MR. ROSENBERG: Absolutely. Better yet, sir, I invite you to join the panel discussion at the end. Your opinion is not only valued, but important in this process that is going to eventually identify the final disposal permanently placed. We are not at a point where we can make that decision yet, and your voice is needed if we are going to get through this process together. Okay.

Once again we will have an open question and answer session at the end of all the comments and an open panel. No question is out of bounds, and you are always welcome to participate

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in any manner really.

I would now like to introduce Captain Jeffrey Monroe. He is the Deputy Port Director for the Massachusetts Port Authority.

Captain Monroe.

CAPTAIN MONROE: I want to thank everybody for the opportunity to come up and give us the opportunity to speak with you and keep this forum alive, because what everybody has to recognize is that there are no done-deals here. This isn't something that we inform everybody. This is still an interaction part of the process, and I want everybody to understand that in the course of letting me do that, the voices that are heard or for that matter no opinion is nonspecific.

You know, there is a tendency when we talk about the Port of Boston to think of the port as just serving that specific city, but actually ports no longer do that. They serve the region. All of your food, your wine, clothing, the oil that heats your homes, the gasoline that you put in your vehicles all move through the port, and we compete on a global scale with other ports, not

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only in the Western Hemisphere, but around the world. These ports that collect cargo, and they move it onto ships or onto ground base transportation systems.

To remain competitive, we must overcome two very important forces. The first one is nature, and the second one is technology. The harbors that we work all silt up because of the flow of rivers, the ebb and flow of the tides. Now unless we maintain those harbors, they become too shallow for normal water travel, but technological advances also have an impact on us. For example, the size of the ships have increased considerably. Today, the largest container ships in the world, some of which will call in the Port of Boston are nearly a thousand feet long and carry over 4,000 tractor trailers on them. The reason they are so big is because on economies of scale, they can move this cargo in and out faster, very similar to the air system that we have in this country. Smaller vessels, larger remaining ports like Boston and New York is then put onto larger ships, and these larger ships take it to other larger ports where it is then disbursed in

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the same manner.

When the port gets shallow, the ships can't come in. When the ship can't come in what happens is they will bypass the port once, twice, and then they will stop coming back. All that cargo will go to someplace like New York where it will then be put on trains. It will be put over the roads, and what happens is that the direct impact then becomes those of us who live here in Eastern Massachusetts and Western Massachusetts and the surrounding states wind up shelling more out of our pocket for the goods that we are now paying for. Not only that, but it has a direct impact on the local economy, and that local economy extends well up into Eastern Massachusetts at both the southern side and the northern side where it affects our jobs, employment and everything else.

The economy will head down if we cannot remain a competitive port. If we cannot continue to bring ships in, it's going to affect us all, whether we think we have an interaction with the seaport or not. We always do. We have to dredge. And where the question now remains is

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what do you do with the dredge spoil once you take them out of the harbor, and that is what we are going to try to answer tonight.

There has been no decision made. All right. You are participating in this public forum, because it is exceedingly important that those of us on the State level and the Federal level understand the concerns of everybody that this can potentially affect you.

Now I would like to introduce my partner in crime here, Janeen Hansen, who is the Project Director for Massport and who has been working very closely with the Federal Government and Army Corps of Engineers to go through the dredging process, and she has done an outstanding job; but the one thing that impressed me most about Janeen in working with her is that she really has taken every opinion into consideration.

So Janeen.

Thank you.

JANEEN HANSEN: Thank you, Jeff.

I wanted to take just a minute this evening to explain a little about Massport's involvement in this project and also to bring you

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up to date on the project's schedule.

Historically, navigational presence has been done by the Corps of Engineers, a 100 percent Federal project. So what is Massport doing in the dredging business all of a sudden? This came about in 1986 as a result of the Water Resources Development Act, which required that navigation improvement projects now have a local sponsor. So for the first part of this, the Corps lends us the money to help pay for the project. It's no longer 100 percent Federally funded.

The second aspect is that we were the logical partner, because we own and operate many public container terminals in the ports. The first is Moransa over in Charlestown, and the second is Conley Terminal in South Boston. These two terminals together handle over 100,000 containers a month. So from that perspective, Massport is one of the important players in the Port of Boston.

The schedule historically began Massport's involvement in 1991 when we filed an Environmental Impact Notification Form with the Secretary of Environmental Affairs. She in turn gave us the scope of work for an Environmental Impact Report, which began in October of 1991. We selected a consultant to work with us, and in the spring of 1992, we convened an advisory panel. This committee was comprised of regulators and resource agencies and environmental groups, the maritime industry and others interested in supporting present projects. Slowly by the end of the summer, we not had as conclusive evidence as we could have, and we would at this time like to extend to the Committee in the Town of Nahant to formally participate in the Dredging Advisory Committee. I will be speaking a little later about that.

The Dredging Advisory Committee has sat through many, many meetings that have flung off on a larger group, two groups. One was interested primarily in sediment characterization, which is the group that helped us with the testing of the dredge material, the sampling, the analysis of what is in the materials, and the second group helped us define disposal alternatives, including the criteria used that evaluated these alternatives.

We are here tonight as part of the

public information process to get the public's comment on the project and about disposal alternatives.

We filed the Draft Environmental Impact Report or Statement in April. We will be gathering comments throughout the summer. We will begin to do some analysis of marine life and fish habitat on some of the sites that look more promising, and we expect to file a Final Environmental Impact Report and Statement in late December.

And now Pete Jackson from the Corps of Engineers will talk a little bit about the specifics of the project.

PETER JACKSON: Now for the show. All of us are here tonight to discuss the project and to hear your comments, and so I am going to make this as short as possible.

And first of all, can everybody see that?

AUDIENCE PARTICIPANTS: No.

PETER JACKSON: We will get some of these lights out.

The Port of Boston is the largest

seaport in New England, and its importance to New England has just been described to you by Massport, so I won't reiterate that, but I do want to emphasize that the purpose of this project is to improve navigation of fishing industries. While the project removes contamination from the harbor, that is not the project's purpose, and we do not get a benefit to that.

Federal navigation systems of Boston Harbor are a result of over two dozen congressionally authorized projects that have been built over the last 170 years. During its history, the port has experienced many changes, including the ships that turned away from the main Port of Boston to the three tributary channels that serve the Grand Terminal, Conley Terminal and the tank farm in the Chelsea Creek. However, there has been a shift in also the bulk carriers, the container division and also the smaller vessels to larger vessels, as Jeff mentioned. In order to accommodate these changes, shippers delays, they have to lighten the ships, they have to lighten the loads or other inefficient methods of transportation.

In April, container vessels from Northern Europe that were Boston bound bypassed the Port of Boston, because it was not going to wait for the tide to rise sufficiently. So it went on to New York, and that's material like Jeff said that arrived by train and truck after this.

In 1988, the Corps of Engineers did a feasibility report and recommended that E.P. increase the tributary channels taking the benefits derived from reducing these Federal delays, reducing lightening practices. The project is a prerequisite of Massport's long-term strategy, which includes improvements to their container terminals and participation encouraging rail lines to the Midwest and Canada.

On this slide is the existing major channels in the inner harbor. The darker area represents the 40-foot deep main ship channel that enters from the ocean into this area. That darker blue is the 40-foot channel. This is presently underutilized. When originally constructed during the first half of the century, it accessed most of the port's activity, as I mentioned, the ports along the main waterfront. In fact, you can see the outlines of some of those old piers and docks, some of which are now condominiums.

The feasibility report found limited depth available in the tributary channels, which were located in the Mystic River, the Chelsea River and the Reserve Channel in South Boston. As you can see, all three of these are 35 feet. Ideally, maritime interests would want to go into these terminals without Federal restrictions, schedule their activities in the most efficient manner. And, also, they don't want to be limited along with investment capital or economic evaluation potentially all these factors, which are very different. The conservative approach to the Corps of Engineers justified the economics of dredging this project as compared to the benefits of making commerce more efficient.

What we have proposed. There is some changes sitting here that I am not going to mention tonight that are right off the slide, but they are moving slowly in remarking the channels. So I am going to emphasize the work shown in yellow and in green.

In the inner harbor, the project calls

for deepening the ports of three principal tributary channels and the turning areas. Starting at the South Boston Reserve Channel here, this was last seen at 35 feet in 1960. It provides access to six active facilities, including the Conley Terminal to Massport. Under this project, it will be deepened for most of it, its length to 40 feet. That is a deepening of five feet.

In order to represent the next new channel on the new turn, the confluence of the Reserve Channel will be modified as shown. This includes deepening a portion of the 35-foot existing channel as shown on the slide to accommodate turning vessels in that area.

During this entire study process, we used the State of New York as a simulation to optimize the design and minimize the amount of dredging while still maintaining the safety. The 35-foot deep intercoastal channel, this area right here (indicating), provides access to both the Mystic River on the left and the Chelsea Creek on the right. This area will be deepened to 40 feet to accommodate turning vessels down either at the

Mystic or the Chelsea Creek. Part of the expansion includes deepening of a portion of the 35-foot channel in that area for a wide turn in the Mystic River, which is the current practice.

The lower Mystic River channel was last deepened in 1958 to its present 35-foot depth. It provides access to the port's widest variety of terminal facilities, including the marine container port, oil companies, liquid natural gas, the liquefied natural gas terminal and other facilities. The areas upstream are polluted, which do not have active terminals as shown here, do not require dredging so it's just that yellow area that is deepened five feet to 40 feet.

The Chelsea Creek Channel to the right shown in green was last seen at 35 feet in 1966.

There is nine other ports and 11 petroleum terminals that are loading along this channel, and it goes by the airport. You can see all those tank farms over there. These terminals provide the majority of what we need for petroleum products. In fact, 90 percent of the cargo in and out of the port are petroleum products. The

project includes deepening within the path of the existing channel almost to 38 feet. Project depths greater than 38 feet is not economically feasible, because of major utility costs, including the Boston Gas site, which is too expensive to relocate, so the project is 38 feet.

In addition to the Federal channel deepening, the project includes deepening berths; in other words, to get the depth from the channels you can see there over from the shore line to the dock. These areas in here will be deepened to the same depth as the channel.

In dredging, we will first remove all materials that have been laid into the channels. As I said, the last major dredging on most of these channels was in the early '80s. Maintenance amounts to about 860,000 cubic yards. That is this lower of the blue here (indicating). That is silty material that has accumulated since 1983. The cost of maintenance dredging will be borne by the Federal Government. Non-federal interest may have to be contributed depending on the disposal method.

Silts from the berth amounting to

240,000 cubic yards will require removal. That is this area (indicating), the purple area on top. The total amount of maintenance material is 1.1 million cubic yards. This material has been determined to be unsuitable to be disposed, and therefore must be managed in some way.

We have proven by quite a bit of data as far as dredging and disposal of these materials will be required to deepen the channels. That is the green material on the right, which has been determined to be suitable for up to five years of disposal. This apparent material from the channels amounts to about 1.6 million cubic yards. This material has never been measured. Deferred to that is an additional 133,000 cubic yards. That is the dark area on the top for a total of 1.8 million cubic yards of clean material.

I want to emphasize that the improvement project does not -- if the improvement does not move forward, this material will have to be taken out of Boston Harbor sooner than later, because this is maintenance. In other words, we have to take that much material out just to keep it at 35 feet. And roughly speaking, that is the

amount of material that has accumulated since 1983. This is required for safe and efficient navigation. Some areas of the harbor have not been dredged for over ten years and need to be dredged now. Other areas probably could wait a couple of years, but this maintenance material is unsuitable for disposal. The advantage -- the advantage of the improvement project is that there will be significant volumes of this clean material in which we can properly dispose of the unsuitable material.

When we initiated the design of this project in 1989 before the E.P.A., this was a new testing protocol for sediments. Testing in the channel for all 1990 maintenance was unsuitable for disposal. Prior to 1990, this material would have been suitable under the requirements for disposal.

For the purposes of this project, we are assuming that all the material on the left is unsuitable. The quality of the maintenance material is typical of an American harbor. It has a chemical consistency similar to the sediment that was taken in past sites, and it's unmanaged.

The underlying apparent material primarily was clay, as I mentioned. It has been tested extensively and found to be clean and suitable for disposal. In addition to the chemical analysis of the testing, protocol required biological testing. There are worms and clams and arthropods that were exposed to this material. The worms and clams survived it, but there were arthropods that did not. It was not survival at a sufficient rate.

Massport began the State environmental process in 1991. In 1992, the Corps decided to go beyond its environmental assessment and prepared an E.I.S. During the same time, Massport convened the Advisory Committee, which Janeen talked about, and for about a year and a half that committee guided us through the environmental process through various subcommittees to the point where we are tonight.

In April of this year, the Corps' management filed a combined E.I.S. and E.I.R. to cover all the impacts associated with the project in which to focus on.

This committee helped us narrow down a list of over 300 options to a list of 21 that I

will mention next. This chart may be hard to see, but I have them up here, so after if any of you have questions you can come up and read it. That is the best I can do. I am going to point a few features out here.

Disposal options to be evaluated to match general categories on the top are aquatic disposal sites and land-based disposal sites. We also considered new technologies for the treatment of dredge material. We found that land-based disposal was not cost-effective and particularly for the volume rate of production on this project. Also land-based options range from about six to almost 15 times the cost of straight ocean disposal. This chart shows on the left relative costs starting from one time up to 14 times the cost of taking it out to the ocean and dumping it. And these various alternatives, I think there is about 24 of them, you can see that the cost in the aquatic sites are generally less expensive, and the costs in the upland sites are generally more expensive, because of the extra handling and transportation and extra treatment making it part of it.

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Despite disposal option costs ranging of about one and a half times to about five and a half times straight unconfined ocean disposal, two aquatic sites were over 30 times more extensive given the site. These are the ones sitting up here. Again, this chart is much easier to read, if you would like to come up and look at it. The disposal site map is also shown to the left here. The six preferred alternatives were described in the E.I.S. Those are shown in blue on this chart and shown in blue on the previous chart. These blue sites were judged on environmental impact, navigation, capacity and cost. These sites include Boston Lightship, the former disposal site located here; deep channel disposal, which is located within the channels that we are dredging; the designated Massachusetts Bay disposal site located here with packing, two sites east of the harbor. That is the Meisburger sites here and here, and the M.W.R.A. outfall is right there for reference; and there is a small site at Spectacle Island, which is located here (indicating), off shore of Spectacle Island. I want to emphasize that none of these sites have been selected.

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After reviewing the public comments on the previous public hearings, all the letters that we receive, which now stack higher than the E.I.S., we will begin the selection process. To assist us we plan to collect some data this summer on each of the aquatic sites. The data will be fish counts, sediments and ocean bottom sampling. We plan to convene the Advisory Committee again and have their assistance in narrowing down the choices to their selective claim. We are also addressing mitigation of two areas that we read in the E.I.S. There will be a restricted period of measuring the significant accomodation of fish links, the strength and due to concerns expressed during our dredging of Massport's Grant Terminal, we have identified the use of the work site clamshell bottom for the chemical dredging. Use of all systems and other measures are going to be considered to reduce the turbidity of the committed site.

Under no set of circumstances will we propose a site that will be harmful to the environment. Whatever we propose as site selection of the proposed dredging, the disposal

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process will meet environmental permits. We are also considering the proposal by the Conservation Law Foundation and Save the Harbor/Save the Bay, who are on our advisory committee to have an independent monitor oversee the project. Long-term monitoring of the disposal site will also be required to ensure that the containment of the sediment continues to work over a long period of time.

I just want to touch on the project costs and the project schedule and get right into discussion.

This slide shows the project on the right. The green bar that I showed you on the clean material involves the dredging of about 1.6 million cubic yards of contaminated spoil. Together with the private working with the Federal, it will cost us $35.3 million.

As you can see, Massport is going to be required to cost share about 13.6 million, and the Corps of Engineers will -- through Congress will share $21.7 million. The cost of maintenance, that is 860,000 cubic yards on the left side of unsuitable material, will be funded

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through the Corps' Maintenance Program. The cost of maintenance, dredging and disposal will not be considered until they have a final site. This cost is just clean material. I would estimate that the cost of the 860,000 cubic yards of unsuitable material will be in the vicinity of $15 million and up.

The project schedule, I don't want to spend a lot of time on this, but if you were to look at the history, you would see that everything came to a screeching halt until we got into the environmental aspects of it. That delayed the project about two years in order to accommodate the Advisory Committee, the requirements of the E.I.R. and the E.I.S. I did want to point out that we would expect to have a Final E.I.S. in December of this year. Another key point is that construction could begin in the spring of 1996. That will take about one and a half years to complete.

In closing, I want to emphasize again that no decision has been made on the disposal plan. We have resisted -- I have resisted the temptation of eliminating options until we have heard everybody, until we have done our studies and collected the data. At that point, we will consider elimination to be made and consider additions of options that are currently on the second list.

We have been also reviewing new technology. There is a lot of treatment methods out there that we have considered. At this point in time, there is no feasible treatment method. These methods were for small scale hazardous waste sites. We are talking about 4,000 cubic yards a day. They can handle a couple hundred cubic yards a day, but we are still going to have those people come in and listen to their sales pitch. We are going to consider as lengthy as possible future maintenance options, but we are not shutting the door to treatment technology. We are also looking at things such as fabric containment and other unique methods of disposal. In fact, we have even listened to a person who proposed putting this material on train cars and shipping it to Utah. I haven't heard the cost of that.

It has become very apparent from this project process that a project theme that there

has to be a long-term maintenance plan for the State of Massachusetts. If proven, a project such as this one may have the resources to go through this long involved process. Future maintenance on the smaller projects do not have this advantage. The State itself has to come to some solution so that a small project as well as large projects can continue to keep the port open, can continue to keep the port efficient and maintain the projects that currently exist.

That is my little spiel.

MR. ROSENBERG: Thank you, Pete.

That will conclude the federal and Massport portion of the program.

At the request of the Selectmen of Nahant, we have been asked to allow three -- four speakers to speak for the town. Prior to doing that, I would like to open the floor for about five minutes for questions, if you have any of Mr. Jackson or Massport before we start the formal presentation from the city.

Yes, ma'am.

AUDIENCE PARTICIPANT: Yes. Has the comment period for this project ended, or has it

been extended; and if it's been extended, to what date?

MR. ROSENBERG: The microphone, please.

WILLIAM HUBBARD: Tell me if you can't hear me. Any time a public request in the involvement in the State process and particularly the Clean Water Act are requesting a public hearing tonight, we would be more than happy to take comments for the next 30 days.

AUDIENCE PARTICIPANT: After this meeting?

WILLIAM HUBBARD: Yes, we would appreciate that time frame. If it's 35, and frankly if it's 45, we understand. We will address all comments. The Draft E.I.S. is up for review now. The final is not going to be out in 30 or 60 days. At the moment, we are not setting a date until we finish these rounds of questions. So we appreciate any comments you have in writing; and, folks, if you would like to get the address, there is, I believe it's an off grey pamphlet, an informational pamphlet outside. If not, you can get the address from anyone of us.

MR. ROSENBERG: We have the Boston

Harbor Highlights, and it's a little magazine, eight pages that outlines the project. We have a copy for public members, and a summary from the E.I.S. is available.

Two more questions before we go to the Town representatives.

SELECTMAN FORMAN: Excuse me. People should come to the microphone, because the questions being asked are not being heard by the television audience unless they come with microphones.

MR. ROSENBERG: That is a very good point. Thank you.

The next speaker will be Joseph Ayers, Director of Northeastern University.

(Applause.)

JOSEPH AYERS: I'm the Director of Northeastern University and also a member of the Conservation Commission.

What I would like to talk about is what I consider probably the most dangerous aspect of this project, especially to the local fisheries, which is the effect on lobsters.

The lobster, the only source of new

lobster to the population is born looking like this (indicating). They swim around in the water column. They are caught typically in the plankton pools around the water in this area. This is an area of profusion, and they go through several stages where they finally settle to the bottom of the ocean. And, in fact, this is the most vulnerable period in the life of a lobster. They are subject to predation by all sort of fishes, other crustaceans, and they really have only the defense to be able to hide in public habitat.

One of the things that I am very concerned about in this project is that the capping material, the clay will just eliminate all the habitat. Simply, where this goes the habitat of the water lobsters need to live in will go.

I think that the potential impact of this on the fishery at this point is very critical to estimate; but as you probably know, the fish are in this area, based on the silt insult from the M.W.R.A. outfall and the use of dragging in the area, which is certainly the habitat in this project.

Now I think this issue of destruction

of habitat and siltation is only part of the problem. The problem that, as I suggest is even more disturbing is that this material which has been labeled as unsuitable for ocean dumping is probably lethal to all the lobsters. These are the figures that indicate danger levels for these materials on marine animals, and these are generally categorized into Type 1, which is apparantly okay; type 2, which is borderline on the part of the animals; and anything in the Type 3 category is deleterious to the life of them.

Now if you look at this, there is two materials, and these are materials that were provided for us in the Environmental Impact Report, which are lead and mercury.

Now in developing organisms one of my areas of research is on the development of the nervous system in larger lobsters. One of the most toxic materials are heavy metals at this time when the connection between neurons and the nervous system are being formed. And, of course, lead and mercury are two of the most dangerous materials. If you look at the level of mercury, which has toxic effects, it's about 1.3 parts per

million.

AUDIENCE PARTICIPANT: We can't see it, Joe.

JOSEPH AYERS: Excuse me.

AUDIENCE PARTICIPANT: We can't see it.

JOSEPH AYERS: It's about 1.3 parts per million, and where it's dangerous to animals is about .5 to .05 parts per million. Now if you look at the mercury levels on this chart, this row here where it says H.G., you will see that most of these are in the danger level, that the mercury levels of this material are toxic. If we look at lead, the level of which it's considered toxic is about 200 parts per million. In fact, if you look at lead right here, we have got a reading of 283 parts per million. So the material is toxic both in lead and in mercury.

Now these are the results we heard. I can also include PCBs. I don't mean to get into this, but PCBs in this material is also considered toxic.

But the real take-home message I want to get across here is these are the results of

testing these materials on three different types of organisms, worms, clams, and then on arthropods. The arthropods are small arthropods that grow almost into animals like lobsters. Now if you look at the test results from the sediments here, you can see that we get down to as low as 14 percent survival. In other words, 80 percent -- 86 percent of the animals were put in this sediment during the test, so the stuff is lethal for arthropods. There is a note that this data is unreliable due to the test procedures. So it was replicated, and again we got back as low as 17 percent survival in these materials. I think this material is just absolutely unacceptable to be put in what is in effect a nursery area for this lobster fishery. I am sure Mike Gambale will give us some idea of the importance of this fishery area.

I would like to also show a short videotape. We were kind of interested in what the bottom looked like on this site, whether it is good lobster habitat. So we took our research vessel out and made a video of the bottom, and I would like to show that tape. We also did a similar tape of the bottom of the Chelsea River so you get an idea of what the two sites are.

(Whereupon, there was a videotape presentation.)

JOSEPH AYERS: Okay. This is R.O.V. This is romote operated video camera. It's an effective robot submarine that has got lights on it, and this is quite a short tape. This is the Meisburger 2 site. You can see there is each point. It's really quite close. This is prime habitat for larvae lobsters. And, in fact, much of this material you see floating by, the plankton, may also contain larvae lobsters.

Here is an example of the crab in the site.

This is the predominant bottom we see in this area. It's sort of a muddy bottom, worm tubes, white material. It's a perfect habitat for small lobsters in the harbor. This is again some of the typical property habitat, which is ideal. I think we are going to fly over a lobster trap here right now. When we were out there, which is not the typical time of the season to be fishing for lobsters in that area, we saw plenty of tackle. There was clearly some gill netting and

lobstering going on in that area. This is a fairly sandy bottom habitat that is there.

Okay. This is now the Chelsea River site. We will first pan around so you can see where we took the video from. Okay. This is right in the middle of the Chelsea River.

Okay. This is the bottom here. It's very flocculent. When you are flying R.O.V., it's very hard to get around without stirring it up. There are a lot of fish and some crabs in this area, and there is a lot of flounder. It's an escort. I mean this is where these animals and evolution normally when to grow up, and they go into it. I think most of the test results we have seen on animals from these source of slides show that they are diseased. They have lesions from living in the material that's out there. But you will notice it's very heavily silted in. It's a very different habitat. Okay.

Again, these are the results at the different sites, Chelsea, Mystic River, the Reserve Channel, survival of arthropods compared to the number of bars, which would be full numbers. So at least it's not material at all.

(Applause.)

MR. ROSENBERG: Okay. Thank you very much for presenting that data from our E.I.S. in such a very easy manner and really putting in perspective some of the problems we are facing in trying to find an alternative here; and as Pete said earlier, we are collecting data this summer on various sites, and if we could get a copy of that tape, that would really help us.

JOSEPH AYERS: We will be making court transcripts.

MR. ROSENBERG: Our next speaker is Mr. Mike Gambale.

(Applause.)

MICHAEL GAMBALE: Thank you.

I first would like to thank the Nahant Selectmen for organizing this forum.

I also would like to thank the various elected public officials for being here tonight. I will be as brief as possible.

I notice a lot of my colleagues here. I am sure they will have some things to say. I represent the Swampscott Fishing Alliance as well as other commercial area fishermen, and we support

the Mass. Lobster Association's position regarding this proposed dredging project.

I speak for myself when I oppose the dumping of any material which comes from this project in the open waters of Mass. Bay. I particularly oppose the dumping site referred to as Meisburger 2. I refer to this area, and I fish in this area, and I am more familiar with some of the other areas. And with what Joe just said, I couldn't agree with him more about the habitat. It is prime lobster habitat for a couple of reasons. Joe got into the lobster larvae, which we are very concerned about. One point is it's -- you may or may not know, we are under a Federal plan, a Federal and State proposal, Amendment 5, to further regulate our industry in an effort to recruit more egg-bearing female mature lobsters. It's not for us to land more lobsters, but in order to recruit egg-bearing lobsters, we are going to be restricted in many ways on where, when and how we are going to fish in order for this to work. It seems to me to be kind of ridiculous for us to be conserving and trying to promote female egg-bearing lobsters only

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to release them, which may be caught at least in this area; and based on what Joe just told us, I don't think their survival rate is going to be very good. So that was suggested to me somewhat.

Also, this area is also a habitat for lobsters to shed in and to migrate. Lobsters migrate. They travel great distances, and even though you don't see too much -- many lobsters traps here in this area at this point, it is because of a few reasons. The reason is they shed, and they bury themselves, and we can't find them, or they haven't gotten there yet, but there are times of the year when you cannot find a piece of that body, set a trap on them, because it's so dense in here because it is prime fishing area. Statistics show that Massachusetts is the second largest leading -- it's the second largest state for remaining lobsters in this country, 50 percent of which are landed between Gloucester and Cohasset, and 50 percent of that figure and more than 50 percent of the landings land in this area. To give you an idea, that is approximately 200,000 traps of fish between Boston and Cohasset in that area. Like I said earlier, I know there

are a lot of fisherman here that probably are making points. I could babble on all night, but I just wanted to go on record as being opposed to dumping of any material in here in any way suitable or unsuitable for disposal. And in closing, I wish you would eliminate Meisburger 2 and all the other sites who threaten disposal.

Thank you.

(Applause.)

MR. ROSENBERG: Thank you very much.

Our next speaker is Mr. Kevin Jangaard from SWIM.

(Applause.)

KEVIN JANGAARD: I have a couple of boards here I would like to use.

I would like to thank you for this opportunity to speak. You understand how this project is important to Boston. It's also for the lobstermen and recreation here and what we have at Nahant.

AUDIENCE PARTICIPANT: Mike. Use the mike.

KEVIN JANGAARD: Our main concern is the proximity of Meisburger 2 to Nahant and to the

sewage outflow that is being constructed. Where we are sitting here today, it is about three miles from Meisburger 2. We are also about three miles from the trash facility where you come into town to give you an idea of how close we are to this location.

On the map here, this is the location of the outflow. Here is Meisburger 2, and here is Nahant. When we look at the effects of the outflow on Nahant, we look at several conditions. On this board here, which was the site we evaluated during that process this site here was the initial proposal of the M.W.R.A., which is where Meisburger 2 is. The one in the middle is close to where the outflow is now, and the one on the far side is the location where the terminal closes out.

The tan area is the plume that comes out of the outfall, and this is very much like the smoke out of a smokestack. This is almost a continuous flow of the effluent coming out of the outfall. Sometimes it will go to the north; sometimes it will go to the south; sometimes it will come into shore or go out to sea.

This green line here is the tidal reach. Basically, that is how far the water will come in and out to shore. And you can see how close Meisburger 2 is to the tidal reach. We are very concerned with the process that they are proposing in dumping this material along here during the year and a half that it would be done and how this will affect the water. We are also concerned with what it is going to do to the bottom as has been explained earlier.

Another concern we have is with the heavy metals and the other pollutants that will be found in this area at Meisburger and beyond when the outflow is in place.

This chart was taken from material provided by the M.W.R.A. and was prepared with their Environmental Impact Statement. You can't read it from a distance, but basically it lists a series of heavy metals and other pollutants, mainly pesticides, which exceed human health criteria for carcinogens and aquatic life toxicity levels. The site they selected was somewhere between four and five. During the primary treatment, which is the period where this project is planned to take place, it will be replaced by a secondary treatment sometime around the turn of the century.

During this earlier period, we have some heavy metals and pesticides, which range from maybe 20 times what is allowed up to 200 times the criteria that the E.P.A. puts down in their bulletin. So we are concerned with the heavy metals and the upper effluents and any foreign pesticides and the material that they are going to be dredging and putting them out in proximity to the outflow of the proposal we are going to be including in our work.

Thank you.

(Applause.)

MR. ROSENBERG: Thank you, sir. Once again, if we can get copies of your charts, we would appreciate it.

Our next speaker is Ms. Polly Bradley from SWIM.

(Applause.)

POLLY BRADLEY: You have heard from Joe Ayers what the top six biological poisons if you dredge Chelsea Creek and Boston Harbor would

do to our environment to the baby lobsters. You have heard from Kevin Jangaard what the poisons from the Boston sewage outfall will do to our environment. Put these two together, and you get the combined poisons of dredging and sewage together near Nahant, an outrageous proposal.

You have heard from Mike Gambale that there really are fish and lobsters here in Nahant. SWIM insists that you study the resources near Nahant. Study species, abundance and diversity, what is there and how many. Study in all seasons: fall, winter, spring, summer. And SWIM insists that you study the combined effects of dredging and sewage on the fish and lobsters and on our children who play on the beach, swim in our rivers and eat the fish and lobsters.

As Joe explained to you, baby lobsters are more easily poisoned than adult lobsters. It's also true that baby people are more easily poisoned than adult people. Actually, those that eat it, just drop the idea of putting contaminated dredging spoil with Boston sewage outfall.

(Applause.)

POLLY BRADLEY: Well, I guess that

about says it.

(Laughter.)

POLLY BRADLEY: Clean up Boston Harbor, but really Massachusetts Bay.

(Applause.)

MR. ROSENBERG: Thank you very much.

(Laughter.)

MR. ROSENBERG: If you would, I would like you to join our advisory group and add your voice to the voices from all over Massachusetts for trying to get a grip on this project.

(Applause.)

MR. ROSENBERG: Mr. Forman, before we open this up to public comment, would you like to say something?

SELECTMAN FORMAN: I think we all recognize that we are very fortunate in the Town of Nahant to have this very talented and successful watchdog group of waterways and potential threats to the town.

(Applause.)

SELECTMAN FORMAN: And so what I would like to do, for the record, is just read a prepared statement from the Board of Selectmen on

our concerns on this project.

And as you know, we are a town that is totally surrounded by water. As was pointed out, we do not know the impact of the sewer outfall. We have lobsters, and fishing is our only business. And importantly in the statement that we prepared, which I want to read this. I hope I can pronounce some of the words right, because they sound very threatening. I am not sure I can do it exactly correct.

It pointed out that Boston Harbor has some of the most contaminated sediments in the Northeast. And the reference there is the National Oceanographic and Atmospheric Administration and Status and Apprentice Board from 1987 to the present. In particular, Boston ranks high in the levels of petroleum, hydrocarbons, specifically P.A.H., which are naturally found and are by-products of combustion and enter from spills, run-offs, atmospheric depositions and other point services. Many are contaminating, or they are metabolics. They are known to be cacinogenic, mutagenic, detrogenic both to humans or animals. Historically, the areas where sediments have been the highest of P.A.H. are in Chelsea and the Mystic River; whereas, reserve channels and tidal areas in the high concentrations of metal and polychlorinated biphenyls, PCBs. So we know what we have out there, and it just seems unconscionable that we would think about putting it in in Nahant, and especially with all the information we have presented here tonight.

So we as a Board of Selectmen are going to endorse what our technical experts have been telling us and go on record that we are against consideration of this site, this adopted site, and that material.

Thank you very much.

(Applause.)

MR. ROSENBERG: Thank you.

Our first speaker is Mr. Michael Armini. He is from Congressman Torkildsen's office.

(Applause.)

MICHAEL ARMINI: Thank you very much. My name is Mike Armini. I am an aide to Congressman Torkildsen, and I handle environmental and other issues for the Congressman.

First, I just want to apologize that he could not be here in person tonight. He had -- the U.S. House is not adjourned, so he is still in Washington. I have a prepared statement by the Congressman that I would just like to read for the record briefly.

I would like to begin by thanking Colonel Miller of the New England Division of the Army Corps of Engineers for granting this hearing. Any time there is an issue with the potential to affect the quality of many peoples' lives, it is important for government agencies to be available and listen to concerned citizens.

The issue in question today is not the proposed maintenance dredging of Boston Harbor. I do not believe that anyone has expressed opposition to the dredging itself. The issue we are addressing today is the proposal to drop the dredging material into a location known as Meisburger 2 off the coast of the Massachusetts North Shore.

One of my primary concerns as a Representative in Congress for the Sixth District is the quality of marine life, especially fish and lobsters. The commercial fishing and lobster

industries are an important part of the Sixth District economy. In addition, these industries are currently facing enormous challenges as a result of dwindling stocks and federal restrictions on fishing. The last thing anyone wants to see happen is the imposition of more hardship on the commercial fishing and lobster industry.

I am aware of biological assessment, which has been performed to assess the potential impacts dumping could have on, quote, threatened or endangered species; however, as the Massachusetts Lobsterman's Association has pointed out just because lobsters are neither threatened or endangered does not mean we should dump material into a known lobster habitat. This is one example that may need further study.

I urge the Corps of Engineers and all Federal agencies with jurisdiction over this project to carefully consider the testimony of the interested parties here today. I know that several local groups have done their own research on issues and have ideas on possible alternatives to the current proposal. Their research and

suggestions deserve a full and fair public hearing.

Thank you.

(Applause.)

MR. ROSENBERG: Thank you, sir.

Our next speaker for the record will be Representative Doug Peterson.

(Applause.)

REPRESENTATIVE PETERSON: Thank you, all of you for being here this evening and giving us this opportunity to talk to you.

Pete, nice to connect with your face. We have talked on several times over the telephone in the last several weeks.

I want to be brief, because I am sure there is a lot of people who want to talk here. I really just want to express three major points. One is that I am concerned, as I have been listening. I have been out on that boat last week when we went out to the Meisburger site and visited Chelsea Creek, and I guess I am concerned about the impact of this project with the outfall pipe project occurring at the same time. I would hope that you would give that sort of dual experiments, and as we talked and as I have talked with people from C.C.N. and other agencies, a lot of the technologies we are thinking about in terms of this ocean dumping are not largely long-tested technologies. And so there is going to be risks, and I think everyone would acknowledge that. And I think there is some merits to the argument that we already have a risk imposed by the outfall line. We don't know exactly what is going to happen when that effluent starts to pour out of that pipe. And I think it's a very, very valid argument to have a study, to have a study that looks at the disturbance in Meisburger 2 along with the outfall pipe and the effect that it has.

Secondarily, I talked with -- I think the arguments about the habitat area are also ones that are very salient, and I think it has moved me, and I would just want to remind the Army Corps, we had a dredging project in Swampscott, one that was very frustrating for us, frankly, and one that I am trying to get the Department of Environmental Protection back involved with. One of the problems that they continually cited is the fact that we have eel grass in the swamps and

harbor, and the problem that I think the Army Corps objection to dredging that area, because it's a habitat area for aquatic life. If indeed that is the case, and if indeed that has been the policy of the Army Corps, I would hope that that same policy would extend itself to other habitat areas.

(Applause.)

REPRESENTATIVE PETERSON: It's simply that that be given the same kind of consideration, whether it's Meisburger 2, Meisburger 7 or any of the other sites that we have already talked about, Pete.

And finally, I think my third concern is simply a political one. The various areas that we have talked about, Pete, and the various areas I have talked with C.C.N. about, and other people, there is a great deal of science, and I am happy about that, and my conversations with you have been very very enlightening as well as very reassuring in many ways, but there is a lot of disagreement here it seems, and I have a feeling that in the end there will be a number of sites that will present themselves with a variety of the

risks and a variety of benefits.

The primary beneficiary of the harbor dredging is the City of Boston. I know we all benefit in many ways, but the City of Boston is the immediate, let's say, beneficiary; however, the costs of the project are not borne by that immediate beneficiary or borne by Massport for that matter, at least directly. So that I am hopeful or I would hope that somehow in this process you can guarantee to all of us that political considerations don't enter into what I hope and what I trust thus far has been a very academic process. There are very powerful leaders on our party and the opposite party that occupy, if you wish, some of the proposed sites that I have heard, and I would just hope that in the end that those political interests don't take over when the ultimate site is chosen.

So thank you very much for coming here.

(Applause.)

MR. ROSENBERG: Our next speaker is Representative Chip Clancy.

(Applause.)

REPRESENTATIVE CLANCY: Good evening

and thank you for giving me the opportunity to address you tonight and also thank you for coming to the lovely Town of Nahant so that each of us can have the opportunity of addressing this issue directly.

I believe that Senator Boverini is going to try to be here, but he had another engagement also tonight.

First of all, I want to state my strong, unequivocal and unalterable opposition to the disposing of contaminated dredge material in our North Shore waters.

(Applause.)

REPRESENTATIVE CLANCY: I think the underlying premise of disposing of all of this newly dredged up waste material in an area where the water is as clear and pristine as it can be in an area located near the shore makes absolutely no sense.

(Applause.)

REPRESENTATIVE CLANCY: Number two, the communities that are most affected by this, Nahant, Lynn, Swampscott and Marblehead and the Town of Saugus have already done what they were supposed to do many years ago, and that is construction of a secondary wastewater treatment plant so that the effluent that is being discharged from their plant, their wastewater, is not contaminating the ocean.

(Applause.)

REPRESENTATIVE CLANCY: And with all due respect to any potential or tangential economic benefit that may occur to the City of Boston and maybe incidentally to the North Shore, that is the price that the people of the Town of Nahant and the surrounding communities should not have to pay.

(Applause.)

REPRESENTATIVE CLANCY: Even if, and as I just said, I don't agree, but even if an economic indicator was to be the primary judge of the worthiness of this project, certainly those who would be entitled to the first protection would be the lobstermen, the other commercial fishermen and others that have for literally hundreds of years been a viable part of our community here on the North Shore.

(Applause.)

REPRESENTATIVE CLANCY: And also the tourism and other aspects. I don't want to belabor this, and I am sure many people want to speak. I don't want to go on, but I just want to emphasize that I represent the Town of Nahant. It's been a joy to having had this privilege and opportunity for the last four years, and I just want to tell you that no matter what has to be done, either legislatively or otherwise, every single thing is going to be done to protect the Town of Nahant and the waters of your community.

Thank you very much.

(Applause.)

MR. ROSENBERG: Our next speaker is Representative Jeffrey Hayward.

(Applause.)

REPRESENTATIVE HAYWARD: I want to thank you for the opportunity for allowing the public input into the process. And I want to believe you that the decision has not been made; but having worked in government for the last 10 years, I have heard it before.

(Laughter.)

REPRESENTATIVE HAYWARD: I would

question your decision that it might be based on cost or what is in the budget and not what is actually the best interests of the agriculture in the area. I would also question the impact in the fishing and lobster industry. Several speakers before us have said that the economy in this area depends greatly on the fishing industry. We are dealing with Amendment 5 right now, which is placing extreme burdens on the fishing industry; but compared to what the impacts this could bring, Amendment 5 looks like child's play, because Amendment 5 will end at a time certain, and the fishermen will continue to fish. They will then go out into the oceans and fish as often they would like instead of the 80 days that are limited now, because what you are actually saying is something that is irreversible. We heard tonight that capping is not a feasible option, because it's too deep, and I could only assume that once you do drop that into the ocean, it is then irreversible, because it is too deep. You have already placed -- the Federal Government has already placed the burden on the fishing industry and the lobster industry. I ask that as small

business people our lobstermen and our fishermen, who have already put them close to out of business that you not continue that process and put them out of business permanently, because with the environmental and the economic damage that could be done, they clearly would be out of business permanently.

Somebody also said tonight nobody is questioning the dredging of the harbor. I would ask that you take a look at the last few issues of Boston Magazine, as they have gone into detail and have built a scenario around that if we continue to bring in bigger boats with deeper drafts that the Big Dig of the Third Harbor Tunnel is not going to be in position to be able to handle what could be a catastrophe. And being very brief, Boston Magazine went through an in-depth analysis, and they took a look at all the other tunnels throughout the world, and usually they are much deeper. Usually they have as much as 20 feet of concrete on top of them; and yet the Big Dig in the Third Harbor Tunnel will end up with five feet of concrete. And the Big Dig was described as having in Boston Harbor a scenario where a barge sinks. And because the tug boat might not have insurance or might not want to deal with the paper work, that the barges have sunk and have stayed on the bottom of the ocean and gone unreported. It has happened before, and this has drafted a scenario that it could happen again. By bringing in deeper boats, you run the risk of bringing that scenario into reality. I would ask that you do step back and you do take a look at the impact of the Big Dig; you take a look at the impact of them compounding that by digging that channel deeper, and you take a look at the boats that are getting bigger and bigger as the ships come down that channel.

I want to go on record tonight as opposed through your actions of dumping under the ocean. I represent the City of Lynn right along the waterfront, up here from Red Rock right up to the Nahant rotary. It's my suggestion, as Pauline Bradley says, that you scratch this as an option, you go back to the drawing board, and you seek other alternatives.

Thank you.

(Applause.)

MR. ROSENBERG: Our next speaker for record in this hearing is Ms. Deborah Smith Walsh, Councillor-at-Large from Lynn.

(Applause.)

DEBORAH SMITH WALSH: Thank you very much. I also would like to thank you for coming on such a warm night, and thanks to the Nahant Selectmen for hosting this evening and --

(Applause.)

DEBORAH SMITH WALSH: -- for the record, I am here tonight to register my opposition to the proposed plan by Massport and the U.S. Army Corps of Engineers. The plan to dispose of sludge containing toxic chemicals, including arsenic and lead barely two miles off the shores of Nahant, Lynn, Swampscott and Marblehead is short-sighted, dangerous, and economically detrimental to Massachusetts taxpayers and residents of the North Shore.

The dumping of the toxic material and poisonous sewage will destroy our fishing and tourism industries while benefiting such private companies as Gulf Oil, Eastern Minerals and Exxon. Our tax dollars will be used to fund the

dredging of these companies for years, a project which is neither justified nor necessary as it stands.

The sea is the livelihood of many Nahant residents. Those who live near and make their living on the sea know that it has its own set of rules. They follow in respect its tides, its storms and its winds. The residents of Nahant deserve similar respect. Massport and the Army Corps of Engineers should re-examine their hastily-researched plan.

Thank you very much.

(Applause.)

MR. ROSENBERG: Our next speaker is Mr. Joseph Ayers from the Nahant Conservation Commission.

JOSEPH AYERS: I already spoke.

(Applause.)

MR. ROSENBERG: Mr. James Walsh, Town of Nahant Selectman.

(Applause.)

SELECTMAN WALSH: It's difficult to know that it's our night, but you hear when you talk about projects that they are necessary. How

many people here have heard of Love Canal? Anybody heard of Love Canal? Somebody thought that that was economically necessary, that it had to be done that way.

We heard tonight that it is necessary to dredge Boston Harbor, and one of the justifications for that was the story of an ocean-going container ship coming from Europe, arriving off the shores of Boston, and because they couldn't wait for the tide to change, they turned and went 300 miles down to New York City. Now the original goal was to come to Boston. This must have been -- the guy who is the captain of that ship must have been drinking the same stuff that the Captain of the Exxon Valdez was drinking --

(Laughter.)

SELECTMAN WALSH: -- because it doesn't make any sense to the captain.

I guess in discussions of this project one of the interesting things is that the hole that they intend to dig two miles off shore is as deep as the Hancock Tower is tall. Now we all remember what the Hancock Tower looked like when they did that the first time. We had a plywood palace there. Why? Because when the world-renowned architects didn't get it right the first time they put up all this plywood, waited awhile, and then they fixed it. The story, because I don't know how many know, but two weeks ago another window popped out of the 57th floor.

So now we have the Army Corps of Engineers. They say we are going to dig a hole in the ocean that deep. The question I have is if it goes wrong are they going to put the plywood down there?

(Laughter.)

SELECTMAN WALSH: The point I am trying to make is this. We have a technology that is not proven, as far as I know, and we cannot afford to have anyone blow it the first time, because there will not be a second chance.

(Applause.)

MR. ROSENBERG: Thank you.

Our next speaker is Mr. Paul Genest from Swampscott, and he is the Chairman of the Conservation Commission.

(Applause.)

PAUL GENEST: Thank you for allowing me to speak tonight. I will speak for the Conservation Commission, our local fishermen and the recreational users of our coastal region.

What we perceived is a situation that includes shipping and aiding the clean up of the pollution in Boston Harbor. However, if that tends to tear an iceberg through, it could very easily result in the spread of its contamination along the North Shore in an area which already has its problems. It has been stated that various forms of contamination are there, including arsenic, lead and mercury and PCBs, which are persistent toxic and cancer causing. The presence of these chemicals poses a real threat to fisheries and the recreational use of our coastal region. This problem is compounded by the fact that currents in this area could result in the widespread contamination of the North Shore.

In conclusion, we have proposed that an alternative site be chosen or a different technology be implemented, and we have sent a formal letter to this effect.

Thank you.

(Applause.)

MR. ROSENBERG: Thank you, sir.

The next speaker is Mary Sherber from here in Nahant.

(Applause.)

MARY SHERBER: I have been asked to make a statement. A memorandum to Save the Harbor and Save the Bay. It was written by Joseph Sugarman, the policy director.

We are very sorry that we cannot be at the Nahant public forum. Save the Harbor and Save the Bay are non-profit efficacy organizations committed to the protection of the Boston Harbor and Massachusetts Bay. We support regular Boston Harbor shipping routes and berths to preserve the port's economic vitality, but we have many concerns about the project, particularly regarding the safe disposal of contaminated dredging spoil.

In April of this year, Massport and the Army Corps of Engineers released a Draft Environmental Impact Statement. Attached is a copy of our comments on this document. Of particular concern to Nahant is the fact that Massport and the Corps identified Meisburger sites

2 or 7 located off the coast of Nahant as a preferred disposal alternative. These sites are also located adjacent to the Mass. Water Resources Authority plant nine and a half mile outfall pipe from the Deer Island Sewerage Treatment Plant. This site was chosen for the outfall pipe specifically because they have strong current disbursal.

Recently, at a meeting with Massport, the Corps and the Gloucester Fisheries Reliance Center, fishermen confirmed the existence of strong currents at this site. We believe, therefore, that Meisburger 2 and 7 may not be safe enough for disposal of contamination sediments. Further, millions of dollars is being spent and invested in long-term programs at the M.W.R.A. outfall pipe located in disposal sites for contaminated sediments so close to the outfall main area for the long-term efforts. Should a problem arise, it may be difficult to decipher whether it was caused by the outfall or the disposal site. Our overall goal is to work with Massport off shore to ensure that the dredging process and disposal of dredged soils is environmentally safe and that Boston Harbor's navigation improvement project benefits Boston Harbor and the Massachusetts Bay as both an environmental and economic resource. Please do not hesitate to contact me to determine further questions.

I just have one further thing that I would like to say, and it's a question more than a statement. And I don't know if questions are allowable at this point, but it's food for thought, and I do understand that it was said by the Army Corps of Engineers that Boston Harbor was dredged in 1983, and I was just wondering at that time where they disposed of the spoil.

PETER JACKSON: Massachusetts Bay disposal site 1983, uncapped.

MR. ROSENBERG: In 1983, the disposal was done in Mass. Bay disposal site uncapped. At that time the E.P.A. protocol said that -- they called it clean. The protocols have changed. They changed in 1990. And I can tell you they are going to get tougher every year.

(Applause.)

MR. ROSENBERG: Thankfully they will

get tougher. We are going to take a ten-minute break right now. Save the Harbor/Save the Bay, their position statement is outside for your pleasure. You may take a copy of it. We are going to reconvene at exactly nine o'clock.

Thank you very much.

(Applause.)

(There was a short break taken.)

MR. ROSENBERG: Ladies and gentlemen, please take your seats. We have a lot of people to hear from this evening.

Ladies and gentlemen, we have many people who wish to speak. Would you please come into the gym.

Thank you. Thank you for returning. I was asked a question during the break. I was asked a question during the break, and the question was there are six people at the table, and we are defending ourselves. The fact is we are not here to defend ourselves. We are here to listen to you. We are employees of the Federal Government, and we are public servants, and part of our duty is to sit here and listen to the people we supposedly serve. Now to some that

sounds cynical, but to the people up front they would like to be taken real seriously. And with that in mind, the reason we are not defending ourselves is we are listening to you. And this floor is yours, and everything that you are saying tonight is being put on the record for the Draft E.I.S., and it carries as much weight from any letter from any Congressman, State Representative or Senator. As a matter of fact, because it's coming from the members of the public, we make sure it gets a little bit more weight.

Our first speaker in the -- entering the second half is one of our partners on the Advisory Council, and her name is Grace Perez, and she is with the Conservation Law Foundation.

(Applause.)

GRACE PEREZ: Thank you, Larry.

First of all, I want to commend Lynn, the people of Nahant and the officials in Nahant for giving us such a tremendous showing here tonight. This has truly been the most populated comment session, and I am really impressed that everyone is here tonight.

As Larry said, I am with the

Conservation Law Foundation, and we have been working on this project under budget and otherwise over the past few years looking at its progress. Now we have already come out with our formal statements on it, on the project; and any of you who are interested in looking at the formal comments, I have a few copies here, and I can have them send them to you if you are interested or to answer any questions you have about how we feel about this project and what we think are the important issues.

I just want to say one quick thing. The Draft Environmental Impact Statement lists five preferred disposal alternatives, the Mass. Bay disposal site, Boston Lighthship, Meisburger 2, Meisburger 7 and Spectacle Island, a site right off Spectacle Island. This last site is the only one that is in Boston Harbor, and for a variety of reasons we oppose that site as a disposal area. All the other sites are in Massachusetts Bay. Very simply the Conservation Law Foundation believes that Boston Harbor's contaminated sediment should not be exported into Massachusetts Bay.

(Applause.)

GRACE PEREZ: The E.I.S. lists some other alternatives for disposal, as were mentioned earlier, and we would prefer, of course, to go up land, to go on land where they can be very carefully monitored and contaminants can be isolated. If that is not possible, we very much would prefer that the contaminants stay within Boston Harbor, such as the in-channel disposal option and another option which involves putting the contaminants between key areas and then sealing those areas off. So those are the preferred alternatives as we see it. And if you have any questions, I will be here the rest of the evening. So feel free to ask any questions.

Thank you.

(Applause.)

MR. ROSENBERG: Thank you very much.

Our next speaker is Mr. Richard Lombard. He is on the Board of Selectmen for the Town of Nahant.

Richard.

JOSEPH AYERS: Richard is in a meeting. Can we put him back a little, please.

MR. ROSENBERG: Our next speaker is Mr. Kevin Jangaard.

KEVIN JANGAARD: Already spoke.

MR. ROSENBERG: You have spoken?

KEVIN JANGAARD: Yeah. Can I ask a question. Grace Perez just mentioned the option about putting this dredged material in this area. If you take a look at the exhibit over here, you see a lot of little fingers coming out from Charlestown, East Boston and Chelsea. These are the old break out piers that are obselete and no longer in use. I see no reason why this dredged area couldn't be put in a lined, capped landfill behind the bulkhead line and the pier line that exists, which is in the area that is up from the channel. In talking to John (inaudible) and Captain Monroe, he said that some other people who presented with this opportunity said, well, we have got a lot of fish breeding ground along the old piers. The other point is the cost of the dredging disposal. I understand it's only $17 a cubic yard. I don't know if there is any contractors in the audience, but that is cheap, but the very least disposal, I think you ought to

spend a couple more bucks to do it right.

(Applause.)

MR. ROSENBERG: Thank you.

Once we get through with the rest of the speakers tonight, we will have an open discussion and talk about all sorts of different options.

Our next speaker is Bill Coffey from Nahant.

(Applause.)

WILLIAM COFFEY: I don't want to get nasty, but the point is I just want the people here who are making, and I want to make an issue or challenge. We heard from some pretty good people tonight, but I want to make a challenge to the Army Corps. It's been raised that this is the most dangerous location of all the sites based on how close it is to man and how close the outfall is to this site. There have been literally no studies done on the effects of the outfall and the effects of Meisburger 2. It has been ignored. So the challenge is to do this well and to do the study.

Thanks.

(Applause.)

MR. ROSENBERG: Our next speaker is Mr. Michael Gambale from Swampscott.

AUDIENCE PARTICIPANT: He is the fisherman that spoke.

MR. ROSENBERG: Oh. Mr. James Bartlett from Danvers.

AUDIENCE PARTICIPANT: He left.

How about his brother Thomas Bartlett from Beverly?

AUDIENCE PARTICIPANT: They left together.

MR. ROSENBERG: And his other brother Bill Bartlett.

(Laughter.)

AUDIENCE PARTICIPANT: They left together.

MR. ROSENBERG: The court transcript will stipulate they are recently departed.

Ms. Bradley, your card is here. Would you like to speak again?

POLLY BRADLEY: No.

MR. ROSENBERG: Mr. Michael Meagher from Nahant.

(Applause.)

MICHAEL MEAGHER: Thank you for giving me the opportunity to speak tonight.

I think a lot of the earlier speakers identified many of the concerns of Nahant about this particular project. You heard the concerns about the 1.3 million yards of silt that is proposed to be disposed. You heard the concerns about the chromium, the mercury, the lead that is contained in these sediments.

One of the issues that struck me is that we are not talking about 1.3 million cubic yards from my perspective. In looking at this, I think you are not looking down towards the reality. One of the items that separates Meisburger 2, for example, from the other sites, if you look in the particular handout that is entitled Executive Summary Draft Environmental Impact Report, and you look at the last page, the next to last page, and the last page, you will see that there is a chart that shows the various options. You will see in the little footnote at the bottom of the page, it talks about future harbor maintenance, and it says future harbor maintenance consists of maintenance

dredging for approximately 4.4 million cubic yards. This is going to occur over a 50-year life of this project. Let me suggest to you that we are not talking about a one and a half-year project. We are talking about 50 years of disposal from this project. You can be sure if there is approval for this project in one and a half years, they are going to be back in another 50 years dumping contaminated sediments off the shores of Nahant.

Thank you.

(Applause.)

MR. ROSENBERG: Mr. James -- and I am going to spell the last name -- P-A-S-S-A-N-I-S-I.

JAMES PASSANISI: My question has been answered.

AUDIENCE PARTICIPANT: His question has been answered.

MR. ROSENBERG: Thank you. Andrew Weiss.

ANDREW WEISS: I am all set. I would like to say that those names you mentioned before, the Bartletts, they are all fishermen, representatives for us.

MR. ROSENBERG: Off the record we had met with them in Gloucester last Friday. So we are very well aware of their position. We met with them.

Ms. Rachel Tose, T-O-S-E.

RACHEL TOSE: Thank you.

Hi. I am Rachel Tose. I am the past president of the Lynn Fair Share, and approximately ten years ago I spoke against the water and sewage outfalls off the Nahant coast and, you know, we were concerned then, and we are still concerned. And I want to thank SWIM especially for bringing these issues to our attention, because we wouldn't know if there wasn't a group like SWIM out there, you know, bringing this up.

You know, Nahant is a unique town. Somebody already said that, because, you know, it's surrounded by water, and because of that it's in a unique position to appreciate the ocean and also to be concerned about safeguarding the ocean. You know, I think it was very interesting that listening to the first speakers the big thing was economy and cost-effectiveness. And, you know, we are looking at a short-term situation

here in terms of what they are speaking of as far as the economy and as far as the cost effectiveness; but as everybody here is aware, it's much, much more important than the next five years or the next ten years or even the next 50 years, you know, and I want to speak for my grandchildren. My grandchildren would like to thank SWIM, even though they haven't been born yet. They would like to thank SWIM for bringing this up, because these are the issues that are going to affect their lives, the quality of their lives living in Nahant. Nahant Beach is still going to be able to have children swimming in it, you know, when they are bringing up their children, you know, or they are going to be able to eat lobsters. Maybe there won't be any lobsters any more. Maybe they will all be dead. You know, it's so important to watch out for this.

I am completely against dumping anything toxic into the ocean, and if we do, we certainly can't do it as close to the shore as what is being proposed here. I mean if you send it to Utah -- I mean I really don't think we

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should send it to Utah either. My first thought is that we just don't do it. Just don't do it. But if we have to do it, don't dump it in the ocean. We don't need any more lead and chromium and mercury and garbage like that affecting our fish and our beaches. I just want to say again I am dead set against it, and thank you.

(Applause.)

MR. ROSENBERG: Our next speaker is Emily Potts from Nahant.

(Applause.)

EMILY POTTS: When I speak before you, you know I am really concerned, because this is something that I never do. And I am very concerned about some of the contaminants that I have listened to here tonight being dumped in our waters. I am concerned about not only are they close to Nahant, but in the waters anywhere.

Water is one of our most important commodities, and it's becoming more and more precious. We have all seen pictures of the Valdez and beaches. We have followed the expensive costly clean up, and this clean up has only been partially successful.

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I would like to ask if good technology exists to remove the dredging should it become necessary. I think that it's only a matter of time until the courts will order a clean up of Massachusetts Bay just as we have of Boston Harbor.

I would like to know (1) Can we do it? What would be the spillage? How would we transport it, and again what would be the spillage during the transportation? I would like to know where would be the non-water site where it will eventually be stored; and how much will it cost to do it all twice instead of doing it the first time correctly?

(Applause.)

EMILY POTTS: If this project has to be done, I would ask that you please use a non-water storage site, and then when technology is available for decontamination of this stuff that it would be cleaned so that it won't saddle our children and our children's children with contaminated resources and dangerous waters.

Thank you.

(Applause.)

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MR. ROSENBERG: Our next speaker is Mr. Joseph Farrell from Lynn.

(Applause.)

JOSPEH FARRELL: Hello. I am a fisherman out of Lynn. I have a boat out of Marblehead, but I do it part-time. I have been doing it part-time for about 20 years now, and I can see both sides of the story. I mean we need it dredged, but we don't need to be dumping the waste, the hazardous waste, out here at that number two site.

What has happened over the years is my other job, my full-time job is at General Electric in Lynn. And if you have been really concerned about hazardous waste, we have got all sorts of environmental fines. I am an all-around machinist. I do a lot of development work. We spill plenty of oil. We deal with speedy dry hazardous waste barrels, and off it goes to Clean Harbors, and I think it costs them in the price range of $750 a drum to get rid of. Okay.

Now here these guys at Massport are talking about moving hazardous waste out of the channels of Boston Harbor and dumping it on the

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lobster beds. I am definitely opposed to it. The farmers and all the fishermen are definitely opposed to this. And if you are going to do it, do it right. Set up the railroad system and cart it someplace Upstate New York, wherever they treat this stuff. Treat it and get rid of it once and for all.

Thank you very much.

(Applause.)

MR. ROSENBERG: Ms. Dorothy Allen from Nahant.

(Applause.)

DOROTHY ALLEN: I am a little nervous. For many years I have been bringing up children. Prior to that, I was working for 10 years with the Federal Government in making Environmental Impact Statements, and I have never heard of a public hearing where I couldn't receive a Draft Environmental Impact Report to take home and to look at. I remember we used to spend hours and hours to bring them, bring boxes to the meetings so that people would have these reports to take back with them so they would be able to make very informed comments to you.

I just recently moved back here from New York, and I was told about this meeting yesterday so I didn't prepare comments, but there was a previous speaker that said that this material sludge -- and maybe some of you people misspoke -- this material is essentially sludge. I don't think there is very much sediment going down the rivers. I know that there is hundreds of combined sewer outward flows from Boston and surrounding communities that discharge daily. Raw wastewater, industrial wastewater has not been shown where it's released. Also, there is sludge that was dumped out of that sewer treatment plant for many years, and much of the problem is it back tides, and that is what is the sediment down there. I thought that the Corps had given up on ocean dumping, which is off the Continental Shelf of New York or New Jersey, but apparently the Board hasn't given up. This material is essentially sludge. We are dumping over two miles of land, and I find that outrageous. We have got to stop doing that. At least take it to the landfill the stuff or burn it. It does not belong back in the ocean.

Thank you.

(Applause.)

MR. ROSENBERG: Our next speaker is Charles Hansell from Nahant.

(Applause.)

CHARLES HANSELL: Thank you.

I want to thank the Corps. I have sat at that side of the table a few years, and I enjoy not being there for the last two years. I have been previously employed by various power plants, the Love Canal, one of them. So I appreciate some of your efforts, the timelines, the costs and environmental concerns on both sides. Let me get to the heart of my concerns.

My concern is one that very little is related to the expediency of cost, the expediency of let's get this project before the regulations get stricter and more expensive. A reminder that even the landfill business, it's not many years ago, 25, 30 years ago, the proper engineering thing to do was in the landfills. You go out, and you find low value land. It's usually wetlands, swamp areas, and we fill them in. Today we would throw them in jail, call it a hazardous waste

site. We spend millions of dollars to clean them up.

I am opposed to any of this dumping in the ocean until you really know what you are doing. You know, I heard it said here that the regs. changed in '90. And unsaid here was that if the regulations changed in '90, we wouldn't be here today. You would be dumping. The project would be going ahead. And I am hearing also that the regulations are getting tougher. Well, this year, we are paying for secondary treatment. We are paying for acid gas scrubbers in our plant in Saugus. We are paying the price of living under the best available technology. And now we have the Federal Government and the State Government coming to us saying, we don't want to live up to the same best available technology and the best environmental scientific guidelines that we impose on you every day. We are going to try to get ahead of maybe the '98 regs. and get this stuff going now at a lower cost. I think it's bad policy.

(Applause.)

MR. ROSENBERG: There are four more

speakers, maybe five. The next speaker will be Michael Manning from Nahant.

(Applause.)

MICHAEL MANNING: I have to say that after the more I listened to tonight, I am more than a little bit confused. The topic we are addressing has to do with whether or not -- which is the best environmentally acceptable site to put this waste is. And I have to agree with Mr. Hansell that in terms of policy, it makes my head swim to even think about starting this process; but the reason I am here is to talk a little bit about, I guess, the term floating around a couple of years ago was voodoo economics. And I have some questions about economics, because why do we even think about doing something like this in the first place?

It's my understanding that the concept of having it here on the environmental impact of a large-scale project is to make sure that someone doesn't run off and do something that is counterproductive to a large number of people immediately around the project causing adverse effects on both how it affects the environment per se, but also the workplace, the living area, the entire vitality of the region, in which that project is taking place.

And I have some serious questions about this project in particular relative to the benefit to the public welfare in the economy of the region. There are several options that have been outlined, and I think both Paul and some of the other people who just spoke mentioned that there was one that wasn't discussed, and that was how about doing nothing? Is that really so bad? And I think there are a number of issues here that really would tend to make one think that that is not such a bad idea.

Anybody who has gone down to the shore beach on a Saturday afternoon and watched the kids do what they always do, which is drive their pail and shovel and dig a small hole in the sand know that it's amusing for awhile, but after a short period of time, the tide starts to come in, and before you know it, the side walls get a little ify, and things tend to flow back in toward the middle. And that is, I think, kind of the origin of an old Yankee phrase that talks about a process

that starts in futility, something about shoveling the sand against the current. You are there forever. It doesn't end. You spend a lot of time and effort, and you get a little.

We are listening to a project where we are going to dig a deeper channel in some spots so that it is the tide that saunters in and out. It will fill in faster, and maybe instead of doing it every ten years, we will do it every eight. Hence, you need a much bigger place in which to put all of this stuff, and so you get something that is the size of an inverted manhole.

I think you ought to back up a second and say why do you want to start in the first place? Who is really going to benefit from all of this stuff? What is it that we are really trying to promote? Well, there are a number of organizations that have a stake in all this. There is Massport, some shipping interests, and the Corps of Engineers regulates what they do and don't do and how they do it, and you know, they are all tied up in there together. Heaven knows it doesn't work. They can all go out of business, and that would be terrible.

If we look at the economics of the process, we have to not be fooled by having microscopic vision. We are told that one of the reasons that we have to act now is that we have to maintain the competitive nature of the Port of Boston. The concept of the tanker that comes over, you know, might not want to hang around for a tide shift to me as an ex-Navy officer is absolutely ludicrous. I mean I go out and sit and watch as a L.N.G. tanker drops anchor off of East Point and sits there often for a number of days before it goes into the Port of Boston. I don't think the difference in a six-hour tidal change is really going to alter the behavior of a captain on a tanker waiting to come into port. As a matter of fact, I can remember standing several watches on the bridge of a ship steaming back and forth in front of the approaches to the harbor, because we weren't due in until 7:00 a.m. anyway.

But I think the other thing we have to look at is what are the global economics? What happens if Boston is a more competitive port? Think of all of the huge financial interests generating all of the jobs that are dependent on

the marine transportation out of Boston Harbor. All of you know lots of major Massachusetts corporations are tied to that as the way to get their products out. They don't send it out by air freight. They just don't send it to the West Coast by railroad. They don't truck it. They are really dependent on the fact that we really need more traffic through the container terminals on the north side and the south side of Boston Harbor. But we could take a provincial attitude and say we really have got to maintain those container terminals, because they are vital to the economy. And I might ask: Is that really the best way to do it? You don't have to go back too far in history to realize that is why taxation for import duties were first imposed to support local industries that weren't cost competitive, to put in artificial price structures that keep the most cost-efficient port from being the port of choice. Well, if that is the disadvantage, we as taxpayers can spend Federal money so that someone can continuously dredge the harbor to make it competitive and hence put a tax on the nation as a whole to maintain that port to support the shipping there, or maybe we can do something else and say wait a minute, what is so bad that that captain goes down to New York for a port. Maybe it's easier to dredge that harbor than it is to dredge Boston Harbor. Maybe the approaches to that harbor are more open than what you can see from looking at an ordinary map.

We are cutting back right here on the military as the Cold War has ended, and we are even abandoning military facilities. There is a full Navy port not more than an hour and a half from here and certainly a very short railroad jog from here in the Town of Newport. The rate at which such sites have been closed is fairly quick. As a matter of fact, the economy in Massachusetts was also impacted as we closed an airport in Ayer. The first question that came up was should we be using this as a second airport instead of Logan to take traffic in and out of Massachusetts by air freight. Should we dredge Boston Harbor and dispose of the contaminated materials in this area in order to prop up our harbor here, or maybe it would be better to maintain the harbor in New York or one in Newport

or use another facility at another location here. It's not clear to me that there is any net economic benefit to the plan that is proposed here in terms of the preservation of jobs and economic vitality to this area. And as a matter of fact, I would say there is prima facia evidence of that. All you have to do is look at the rest of Boston Harbor. Where there is an aquarium now there used to be piers. Where there is the financial center and a Boston Harbor hotel, there used to be piers. The Boston Harbor hotel supports a number of ships that maintain the vitality of the town as a convention center, that take people on cruises around Boston Harbor, that go on whale watching cruises, all of them on shallow draft boats. Why do we want to spend all this money and stir up all this muck in order to make sure that we can get deep draft boats into Boston Harbor is beyond my comprehension. I think we ought to go back to the beginning and take a look at why you are starting to do this in the first place and see whether or not the economic benefits we think are really there are real or imagined.

Thank you.

(Applause.)

MR. ROSENBERG: Our next speaker is Mr. Richard Lombard, Board of Selectmen for the Town of Nahant.

SELECTMAN LOMBARD: Thank you. We covered a lot of material.

First of all, I would like to thank you very much, Massport and the Port Authority, for coming to the Town of Nahant. We appreciate you coming. It's very, very, very nice.

I want to thank Polly Bradley and Mr. Coffey here for setting this meeting up. We owe him greatly on behalf of the Board of Selectmen.

Thank you.

(Applause.)

SELECTMAN LOMBARD: As a member of the Board of Selectmen, we have been inundated in the last ten years. First we had the Salem outfall, the Lynn outfall, now the Boston outfall and now this. We have had enough. Please, I ask you please do not let this material into the North Shore area. That is all I am going to say.

Thank you.

(Applause.)

SELECTMAN LOMBARD: Two questions I have. Number one, I would like the Town of Nahant to receive on the list of the contract proposal so that we can review it and have our Town Counsel review it. The reason being is this. I would like to see if there is performance bonds put into these contracts. If we have economic loss to the North Shore and North Shore area so that we have recourse and all the North Shore areas have recourse to go after the individual contractors, Massport and the Army Corps. Is that possible?

(Applause.)

MR. ROSENBERG: To just try to answer your question. The decision would be the alternative to where we are going to dispose of it. I don't think you would want to see the contract if indeed a different disposal option is chosen. I think when we get to that point, if indeed this is the selection, you will be notified in advance of that selection.

SELECTMAN LOMBARD: And the performance bonds --

MR. ROSENBERG: I don't have that

information with me.
SELECTMAN LOMBARD: But you will consider putting these contracts, the performance bonds to cover the economic loss for the lobstermen and the fishermen surrounding our bay?
MR. ROSENBERG: That is a question for the Massachusetts Lobstermen's Association, and our division counsel is now looking into that. Like I said, to be sure, we could start, disposal site on a list of 300.
AUDIENCE PARTICIPANT: If this site would be selected, you would notify us within a year or two is that the process?
MR. ROSENBERG: No, I said you would be well aware of our selection process months before the final selection came in.
Our next speaker is Mr. Mark Scaglione.
(Applause.)
MARK SCAGLIONE: I am a lobster fisherman. The same ideas now, and I don't know how they got the spot up there where they want to do this project. It's known to the fishermen. It's called Rosie's Hole. It's the biggest

lobster area when they hit and the biggest fishing area. If they do this project there, it's going to completely wipe out that whole area, because that is where they migrate to. They all end up going there. I think if they do have to go in, they have to go, they do they cover all that dirt, and you can find an area on land. There is plenty of dirt that's took out. It's all in the back of the Lynnway. Find a landfill. Bring it back on land. I think that is the best way to do that now. Rosie's Hole is not the place to do this whole project, and it's the type of thing where we are saying that we shouldn't do it. They can't do it. It definitely can't be done.
Thank you.
(Applause.)
MR. ROSENBERG: Mr. Jay Michaud from Marblehead.
JAY MICHAUD: My name is Jay Michaud. I am a commercial lobster fisherman from Marblehead, and I have been chosen by the Marblehead Fishermen's Group to speak for us. We are a loosely affiliated group, but there are about 25 lobster fishermen in Marblehead.

I happened to be thumbing through an old book that was on the shelf the other day, and it's called Lobstering Inshore and Offshore. I made three copies of page 20 for you. Anybody who wants it can take a look at it.
The book was written 25 years ago by a fellow by the name of Earl Dolimer (phonetic spelling), and interestingly enough, it was a kind of a snapshot of the Marblehead lobster fishing industry at that time. And on page 20 it shows a map or a chart, and the chart shows what is called the winter fishing grounds, spring and winter fishing grounds, and lo and behold, it's what you called Meisburger 2. The reason why I gave you that is because 25 years ago that was an active fishing area. That is how it was 25 years ago, and that is reporting back to the turn of the century.
My father-in-law is going to turn 83 years old on Saturday. A good guy. He is a lobster fisherman. He has been lobstering for about 63 years. What a crazy guy.
(Laughter.)
JAY MICHAUD: But he told me how prior

to World War II -- and I was born in 1943 so I figure I am an old guy -- they were lobstering out there, so it's been going on for a long, long, long time.
I am vehemently opposed to any dumping of anything in Meisburger 2, number 7, or the Lightship, because these are the areas that we depend on. I have heard people talking about impact on the economy, the economy of the area. I will tell you what the impact of the economy on me will be. Okay. Over the last four years, I have seen my income decline 40 percent. What used to be a very productive area for me, Salem Sound, is now the Bay of Poverty. There is nothing there. We don't know why. Maybe the thousands of gallons of chlorine that was put into the outfall at Salem. That might have something to do with it, maybe not. Maybe El Nino has something to do with it, maybe not, but I will tell you one thing, that once you start dumping at Meisburger 2, 7, or the Lightship, I don't care if there isn't one toxin in that. The mere fact that you will take millions and millions of cubic yards of material and cover that bottom means that you are going to

irreversibly destroy what we have right now, and that is the habitat. What you are going to do is you are going to give Massachusetts Bay a vasectomy. Okay.

(Laughter.)

JAY MICHAUD: On the surface everything looks great. You can still have a lot of fun, but production has decreased forever.

(Applause.)

MR. ROSENBERG: If you need a job, I think the public speakers (inaudible) --

(Laughter.)

MR. ROSENBERG: Our last speaker before we open up for comments, concerns, questions, and we have people standing up here.

Mr. Richard Adamo.

RICHARD ADAMO: Adamo.

MR. ROSENBERG: Adamo.

(Applause.)

RICHARD ADAMO: My name is Richard Adamo. I must say that is a tough act to follow.

Certainly with a last name that begins with "A", I am not accustomed to this treatment.

I'm usually at the beginning, but I find myself at the end of the meeting, and I will make my comments short.

I work for the Trial Court of the Commonwealth of Massachusetts. We are a free-registered government in Massachusetts. We run under 2 percent of the State budget for among other things, many political reasons. I am certainly aware of the constraints, financial constraints that agencies are under; however, I must say as I came in tonight, I saw a chart, and on the chart there were different costs, and I heard as I walked in that we were going to save taxpayers money by attempting to get one site or another. I find it highly illogical, and I think the people in Nahant have been very polite this evening to ask people -- to tell people that you are going to save them tax dollars at the expense of their livelihood. I find it highly illogical. I think the people of Nahant have been very polite this evening. I can't imagine that they would ever go along with it. I find it illogical. I find it almost infuriating to tell people you are going to save them tax dollars at the expense of

their own livelihood. That is all I have to say.

(Applause.)

MR. ROSENBERG: We are going to open to public dialogue, unless anybody has something they would like to come up and say.

Sir.

RICHARD BATCHELDER: Could I speak from here? Can everyone hear me? Richard Batchelder, a citizen of Nahant.

In the executive summary, there is a chart in the figure ES-3. Now the base line of all the costs are unconfined ocean disposal.

Now why has this not been considered if this is the cheapest way of doing this?

MR. ROSENBERG: It's not environmentally sound. It's not environmentally safe for much of the material. So you sometimes feel that as we have heard from many of the experts tonight, from SWIM and others, that there are toxic materials. We have P.C.B.s, PAHs, other chemicals. Much of it has come from household cleaners. When it breaks down into sediments, it becomes toxic. Petroleum products do not go over well with the environment. What we are here to do

tonight is to look at the clean environment. We can tell you. We didn't need -- we didn't need you to tell us the fatalities of chemicals of the site. We have marine biologists sitting here.

What we need -- what we are here for is the human part. We heard that point quite well that when we are starting to look at alternatives for the so-called material, whether it's clean or whether it's unsuitable, there is an impact to the human environment. Much of it is economic. The people in Nahant have been very, very nice to us when they are thinking this one disposal option is the only disposal option that is on the list. That is not quite true. There are a lot of disposal alternatives, but the list is 300 plus. The alternatives, they can take all of the materials, one group I believe is what, six or eight, and then there is combinations of disposal options. On one of the 300 plus options mandated by law -- mandated by the National Environmental Policy Act is the no alternative, which has also been brought up. You asked why don't we just go with the cheapest way, because it impacts on one woman's grandchildren.

RICHARD BATCHELDER: Well, if it's unsafe to dump it at sea, it certainly is unsafe to dump it closer to us.

(Laughter.)

MR. ROSENBERG: Well, I think we are feeding the fire.

RICHARD BATCHELDER: Okay. Thank you.

MR. ROSENBERG: Okay. So where do we go?

Yes, sir.

DARRYL FORGIONE: How are you doing?

MR. ROSENBERG: Okay.

DARRYL FORGIONE: My name is Darryl Forgione.

And I would like to thank the Corps of Engineers and Massport and the Selectmen and everybody that showed up for this. It's phenomenol.

I am a recreational fisherman. I love to fish. I have three children, who I am teaching them the love of fishing. We tend lobster traps, and things are real slow right now with the traps I have. Although recreational fishing is on the

increase, we have seen more stripers, more blues early in the season without giving away some good spots.

(Laughter.)

DARRYL FORGIONE: Seasonal fishing, we brought in over 150 pounds of mackerel we are talking about. We saw Bottle Nose Dolphins. We saw small whales in that area. We have had a pretty good start of the season, and we have enjoyed it, and we would like to continue to enjoy it.

One problem I have is the terminology in regards to dredging and what I would consider a hazardous hazard, a hazardous material. So you are not really dredging. You are dredging hazardous waste, and it's tough to go away. It can't go back into the sea. You can't put it 660 feet down. You can't visualize placing this material in a hole without having it spill back into our environment. My children love to swim. I have one son that dives so deep I think he has gills. So it's imperative that we look out for our future. We can't just continue this way.

AUDIENCE PARTICIPANT: Maintenance.

DARRYL FORGIONE: Maintenance. Thank you. Maintenance. Eleven years ago you dredged, and you have all this silt return. It's hazardous material. So you are not going to the source. You have to nip it off in the bud. You have to stop it from coming in. You have to stop it entering the harbor, or you keep continuing the process of having this stuff pile up in our laps, so you have got to stop the big business from dumping on us, and that is up to you guys. It's one thing to dredge and allow the ships to come in. It's another thing to dump it on our laps. The public has suffered from enough uncommon sense by big business and dumping.

(Applause.)

MR. ROSENBERG: Okay. And I heard two points. One is the continuing requirements of meeting this, and the other the continuing development of poisonous or unsuitable materials.

So, Bill, why don't you talk about that.

WILLIAM HUBBARD: I think first this is toxicity. It is material that is toxic to the

organisms, but it is not a hazardous waste, and we know it doesn't support the life that is in Boston Harbor. The photographs from Chelsea were, I think, optimistic. We worked an awful lot out there, and there are some pictures. It supports a little less life than we even saw in the videotape from Chelsea.

The Mystic River stuff is really pretty miserable. To that point, it shouldn't be left in place, and that is part of the no-action alternative. That will be an economic impact as time goes by. In Providence, you will see four and a half cents more a gallon, because they haven't dredged in a couple of decades.

We agree there is a risk in anything we do with it, and we are here very openly listening to all your concerns. We have been around the entire Mass. Bay area, and it's about someone is opposed to all of the sites, but we appreciate the weight of evidence you gave us here tonight, because that is certainly important for the record, and then we go back and analzye it.

We talked about toxicity in terms of some of the test results presented to you earlier. And, yes, the material supports claim in wildlife of retarded species, and we will take back with us a little more of an analysis on what it's going to do the fisheries in this area and what the potential fisheries are.

MR. ROSENBERG: And there was one other point you made. I guess you were pointing to new technology. What can we do to get rid of this.

A little earlier today I talked to somebody who mentioned shipping this stuff to Utah. Well, frankly, that is an alternative.

Pete, could you speak about the technology and some of the things that we are looking at.

PETER JACKSON: Well, there is number of new technologies that have come out, and I use the term, and I don't mean to criticize these technologies, but they come to me like slick oil salesmen. I have heard everything from microwaving stuff, to burning it, to cooking it in many different ways, broiling, frying, whatever. I have heard ideas of using some pretty brilliant technology, fire mediation technologies that they

use for hazardous waste sites. However, as I mentioned before, these technologies are very, very new. They are only -- if they are proven, they are only proven in very small quantities. Research done in the Midwest shows that -- also confirms that, but they are also very expensive, even at the lower levels.

We will continue to look at these technologies, but I won't make any promises that they will be fully available and practical for this project. At that time I don't think anybody in this world can afford the cost of some of these technologies. There are a few that are closer to reality, and we will probably put more emphasis on those and probably pick one and demonstrate that technology to make sure that if we want to use it that it will work. We don't want to pick a technology and have it fail. Some of the techniques that we have been showing here have been used elsewhere around the country, around the world and are proven. The last thing we want do is to put this -- treat this in some way, dump it somewhere and have it fail us. We have got to take very careful consideration of these

technologies before we pick one.

MR. ROSENBERG: On the subject of technology. Grace from the Conservation Law has been lobbying various Congressmen and working very hard.

Do you have anything to add to this technology?

GRACE PEREZ: Just that there are a couple of bills that are being pushed by a number of people in Congress that will hopefully allocate some money for research into new technologies and, therefore, demonstration projects and so forth, but nothing is certain at this point.

Janeen may have some more information along these lines, too.

JANEEN HANSEN: Just along what Grace said. One proposed amendment to the Defense Reorganization Bill is the so-called Green Ports Amendment, and this is put together by Congressman Mendenez from New Jersey, who also has dredging issues in his district, and part of this bill will be to create some funding for demonstration projects, one or more of these technologies. One of the sites characterized in the bill would be the

Boston Harbor Project, and we would be delighted to be able to do some demonstrations of one or more technologies, but at this point the funding isn't there yet, but we are lobbying hard to get it, and we are also working at the same time to try to figure out which among the many technologies we have seen actually are environmentally and cost effective.

MR. ROSENBERG: Thank you. Next question.

AUDIENCE PARTICIPANT: I just have two questions. One is how is Massport raising money to fund this project; and one is in the future could this be a maintenance project; and No. 2, why did Massport and the M.W.R.A. not get together prior to this to look at both projects and see how one outweighed the other?

(Applause.)

AUDIENCE PARTICIPANT: It is basically you are cleaning up hazardous material. It's not a maintenance program. In Chelsea you just built a garage on a hazardous site, the garage built in Chelsea for the airport.

JANEEN HANSEN: I am not aware that

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that is the case.
AUDIENCE PARTICIPANT: That was built on land that was not able to be sold because of the hazardous material.
NORMAN FARAMELLI: It's an industrial site in Chelsea.
AUDIENCE PARTICIPANT: Right.
NORMAN FARAMELLI: The garage isn't built on hazardous waste, but the space is being maintained by Massport. It was an industrial site. It was not a hazardous waste site.
AUDIENCE PARTICIPANT: But because it is industrial --
NORMAN FARAMELLI: It was similar to other industrial sites in Chelsea.
AUDIENCE PARTICIPANT: But how are you planning on raising the funds to fund this project?
JANEEN HANSEN: That is one of our next challenges, funding.
AUDIENCE PARTICIPANT: So we are talking about a project that is not even funded yet?
JANEEN HANSEN: That is correct.

NORMAN FARAMELLI: Massport is committed to it.
AUDIENCE PARTICIPANT: I understand, but we are talking about doing all this work, but you haven't done funding, so if something was wrong, how do you plan to fund clean up of the problem? I mean you haven't even got that funded.
JANEEN HANSEN: What we -- we are looking into limited fund alternatives, but frankly, until we know the disposal site, we won't know the true cost to fund it.
AUDIENCE PARTICIPANT: And why didn't Massport and the M.W.R.A. not get together?
JANEEN HANSEN: Actually, the Mass. Water Resource Authority does sit on our Advisory Committee, and we work quite well with them.
AUDIENCE PARTICIPANT: And what is their feeling on this particular site?
JANEEN HANSEN: Well, they would prefer that we would be further from their outfall. They support some of the other sites --
AUDIENCE PARTICIPANT: Oh.

JANEEN HANSEN: -- but there are other --
(Applause.)
AUDIENCE PARTICIPANT: That was not mentioned once here, Janeen.
MR. ROSENBERG: Yes, ma'am.
AUDIENCE PARTICIPANT: Yes, I have a question. I am duly opposed to any alternatives. The more I have listened to you to even the possibility of dredging, I have to agree with the gentleman that said why are you even spending money on this? I understand all sites of it, but parts of it, but it really opens up a whole new Pandora's box.
And my question is: During your whole process, your whole procedure, is everything that you open up to options? Are we able to see the different records, researches, the decisions that you are making? Why you have made those decisions prior to any final say? Do we the people have the final vote, or is it just the Federal and State Government and the legislature that says yes, and during the process before it gets there how can we be more aware? It is my understanding that we

need to be very open and aware of every step as we are going along; and as the public, I want to be aware of that, and I want to know if we are capable of that procedure.
MR. ROSENBERG: It's a great question, and I will try to put it in context.
I work for a Federal agency, the U.S. Army Corps of Engineers. On a credibility scale of one to ten, ten being the highest and one being the lowest, we are much higher than ten. We are all Federal agents. People on the North Shore section fishing have had regulators from the Federal Government, from the State Government, from the local government, from policy makers, from Denny's and every restaurant and everybody everywhere making decisions that affect their outcome. Those decisions come down, but there is no public discussion. There is a decision and an announcement and an agency. We did not make the decision. What the Corps of Engineers does mainly -- not that we don't want to make the decision. I am sure that somebody in Washington, D.C. says we want to make the decision. It's not for other people, just like the other, but we have

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laws that tell us how we are responsible. One of the ways that we must operate is in the open. You wanted information on this project. You can pick up a phone and call me. My phone number is all over almost every document you have there. Call me. I will get you that information. That is my job.

Bill's job description and Pete's job description, they also work for the Corps of Engineers. Part of their job description is to answer to you. Where are we now in the process? In that booklet, I want to make a note of that slide, and I kind of wish I did, you know. There is a little chart on one of the decision-making processes, the steps in making that decision. At two points we open up to public scoping, public hearing, where we do nothing but sit and listen, and I will tell you, it's not really nice sometimes to be called a liar and not being able to say anything. You wouldn't want to do it, but that is part of our mandate. That happened twice in this -- in this situation. Throughout the process there is your input. At any point, whether it's directly through the Advisory

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Council, through people that we designate to represent you, there is no doubt here that Polly represents a great deal of the opinion in this community. And when she is a member, she is if she wants to be of the Advisory Committee, she will have direct voice into that decision. You have direct voice in that decision not only from this process, but through the telephone, through me, through my office, which is in Waltham, and I listen. What other Federal agency in that most of the decisions have been made over the past three months have come to you and said beat me up before I make a decision. Here I am.

AUDIENCE PARTICIPANT: Larry, so you could assist us in beating you up. You mentioned a 35 and 30 day, 45-day review period where you would like to hear our comments. On the Technical Advisory Group for SWIM, we have lobstermen. We have marine biologists, engineers, mathematicians, geologists, chemists and a lot of other dedicated volunteers, who will be willing to look at the complete E.I.R. documents including all appendices. We would like to have that information now so we can start looking at it. Please bear in mind we

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are volunteering doing this after hours, and we would like to have this so, you know --

MR. ROSENBERG: I will assure you you get your own copy, but I should point out that SWIM responded to the first public comment period by letter on June 8th, and I have a copy of that here. It is signed the following, and it states your position quite candidly. So we have had the opportunity at this point to review the documentation, but I will be sure in turn that you get your own copy. If I am wrong, tell me I am wrong, and I think you can see I have a copy of it here. And everything is responded -- every issue is raised and circled and will be responded to and addressed in the environmental contract.

Anyone want to -- yes, Polly.

POLLY BRADLEY: I just wanted to comment that neither -- that although in some ways the process may have been somewhat open, neither the Selectmen of the Town of Nahant or the Selectmen of Hull were informed of this ahead of time. I talked to the Town Manager of Hull, and he asked me to, because we had informed the people of Hull who did not know about this. He has

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written now for a copy of the Environmental Impact Report, and we only found out about this, because we were going by the lobstermen. As I said, as Kevin said, we felt we work full-time in this, and we do our best to follow whatever we can is pertinent, but I think that you really need to -- you should not have proposed Meisburger 2 and Meisburger 7 without informing either the Selectmen of Nahant or the Selectmen of Hull.

I want to say that the Town Manager of Hull authorized me to say that the Selectmen and the Town Manager and citizens of Hull are very much concerned about Meisburger 7, because that also is close to affect them.

I also would like to make a comment on the comment about the bottom of Boston Harbor not being hazardous waste. Actually, that is just a matter of definition. I was an English major, and that's a matter of semantics. I mean we are talking what has been declared the dirtiest harbor in the country. I don't know whether it is the dirtiest or maybe the second or the third, or whatever, but anyway there is no question that this stuff is hazardous. If you don't want to call it hazardous, we'll call it something else. Let's just call it poison.

AUDIENCE PARTICIPANT: There you go.

(Applause.)

MR. ROSENBERG: Polly, you brought up a great point. I will take the second one, because I love the language, and you are right. We can call this anything we want. There was a great discussion not even six months ago on what to call the material. Should we call it dirty? Should we call it clean? Should we call it hazardous? Should we call it fragrant? You are right. The fact is that it's not environmentally sound materials that can be disposed of in open water without some impact, and I think we can all agree on that, correct?

Number two, the courts have a lot of trouble with this. I believe there are 124 newspapers from Portsmouth all the way down. I can't tell you why one Board of Selectmen in Nahant was able to get a request for a public meeting under the public notice and why the people in Hull didn't. What I would say to you --

POLLY BRADLEY: Because SWIM was

watching.

MR. ROSENBERG: Right. And -- that is exactly right. Because SWIM was watching. I would say to you that the people of Hull need an organization like you have here like SWIM to keep your representatives -- to keep their representatives on top of this as well.

POLLY BRADLEY: They did say that they would be asking for a public hearing, and I would request it as well that you have a public hearing in Hull, and we will make every effort to get there.

MR. ROSENBERG: That is another great point. Sometime in September for the North Shore. We are looking for a location now to have a complete open forum. Not this structure. I am going to teach you the disposal of dredging material 101. It will be an open forum with information. I think that is where we want to go. We have to look at the process. We can't look at the sailboats any more. We can't look at I don't want this, because it affects me. I hear that from people who live near. I hear it from people in Utah, and I hear it from people in

Nahant. We have to get some consensus. I can tell you it's unfair.

Yes, sir.

BOB MYERS: Bob Myers. I am a retired engineer, and I have been listening in great amazement. I visualize this process of being the sides of the Hancock building on its side, whatever. And as you first remember, you have to dig out as you are going to put in. Okay. It's piled somewhere. Do something with it. But I got to thinking. I said, I used to do disposal work for many years, and I visualize this hole that you are going to dump in, and you are going to have it all dumping into the hole, not just through the area, but if you don't, you know very well the fines to dispose it, you are going to lose about 1 percent, about 1 percent of the total burden into the area around your disposal site. It's going to make a lovely pancake all around there of poisonous or hazardous material.

Thank you.

AUDIENCE PARTICIPANT: You know, I have been visualizing this hole all night. This is one hell of a hole, what 67 stories down and

the size of a football field. I put the map out. Could you talk a little about exactly what that alternative is talking about, not the selective alternative, we understand that, but that alternative of that hole.

PETER JACKSON: Can you put that board up that shows -- I have been to a lot of public hearings recently, public meetings, small meetings, discussions, and this is the first town where we are accused of digging a hole 600 some feet deep. I think that is the confusion with the chart that we showed that shows the volume of the material. In fact, these bars on site will only be about 10 to 13 feet deep depending on whether it's Meisburger 2 or Meisburger 7. Instead of a football field, the size it might be on the order of a half a mile by a half a mile square. On the navigation chart that is just up on the board it shows the scale of that footprint. There will be no hole 600 something deep. I don't know how that could be achieved, but that would be an engineering feat. So they are talking about 10 to 13 feet, about 2,000 by 2,000 feet in rectangle squared or whatever.

The other question is I disagree with the gentleman that it is 1 percent loss. Generally it's 3 to 5 percent loss on the way down based on our model studies. So I want to make that correction, because it is higher than you mentioned.

MR. ROSENBERG: Yes, sir.

AUDIENCE PARTICIPANT: I would like to say one more thing.

MR. ROSENBERG: Anything you want.

AUDIENCE PARTICIPANT: Okay. They would never dump anything into Canadian waters. They would not dump anything in. Okay. They did a multi-billion dollar sewer project off Boston that they haven't even turned the switches on yet. We don't even know how much that is going to affect us. Now you get into a project that we don't know. We didn't want the switching in there, but they did it anyway. You don't even know what that is going to cost. They are pumping fresh water into this salt water ocean. I will tell you right there, that is going to be a problem. Drilling last year, we had the worst year in 20 years from the drilling. The

vibration. The lobster can't come in. You know what that is going to do. And you are already starting another project, and I just think -- my last thing I think you should do is put it on the back burner. Find out what this thing is going to do first, and then go on from there. Put it on the back burner. I don't even think you should do it. The other fellow said, why do it? Just don't do any more polluting in the Chelsea Creek. That would end it.

MR. ROSENBERG: That is a great point. That is a great point, but the fact is that the gentleman supposes that that alternative has been selected. That alternative has not been selected. That is one of many alternatives, and we don't know which one of those alternatives will be selected for this process.

Yes, sir.

AUDIENCE PARTICIPANT: Once you get a site somewhere in greater Mass. Bay, for how long would it be an active site?

MR. ROSENBERG: That is a good question. What we are talking about is a one-time site, but Pete -- I believe Pete and Janeen were

talking the State is trying to find or put together some sort of long-term plan.

Could you please address that.

WILLIAM HUBBARD: Just like everywhere else in New England, each state has, except for maybe Long Island Sound for the disposal of their material. Long Island Sound has three or four designated and fully monitored sites, areas where they have basically written that off for habitat in the immediate river due to the disposal. That is not the case in Massachusetts. That is not the case in Maine, not the case in Rhode Island. We have recommended in working with the State of Massachusetts for several years now and are trying to get a long-term management strategy for interpreter of disposal over the next 50 years.

Larry is right. This project is a one-time E.D.H. site. Find a site for this project, but you still have a problem that was evidenced in Gloucester. You are still closing your own port channel in Lynn, and it needs to be dredged. We don't have a place to put it. Saugus, the river, we have a positive project, and

27 lobstermen are sitting there. There is no place to put the dredged material. So although the Government will come in and dredge that harbor, we don't have a place to put it. So in this particular Environmental Impact Statement and Environmental Impact Report, we are only dealing with this solution to the larger project. After that, we are encouraging the State, and you also should look at it yourselves and say yeah, let's look at where we are going to put all that material for the next 50 years. I don't think it's fair to feed them into Saugus, and this is true around the State. It has to wait until low tide to get out of the Saugus River. So for the focus of the Town next week, and it's specific to this report, and this one project, but we are in the Town of Nahant looking at the long term.

AUDIENCE PARTICIPANT: Would the site of the disposal area for this particular project affect the long-term siting? Would it make that site more probable as being the disposal site for the next 50 years?

WILLIAM HUBBARD: No, it will probably fill up, because we have a capacity problem here.

Whatever site we do use here is going to come off the list in the next 50 years, because for the most part we don't have the capacity. One or two of the sites or combinations could be revisited, but what we are trying to get out of this series of public meetings is of all the sites, the 300 that are practical will work for this project; and in the context of the Environmental Impact Statement, we are talking about cumulative impacts and as we stated no long-term loss to the area. We won't designate officials or additional sites, but certainly the information we got here tonight will be part of the evidence of whether or not we are going to use the site in the future.

MR. ROSENBERG: Yes, sir.

AUDIENCE PARTICIPANT: I am more familiar with the air, and I don't want to put like 200 smokestacks in Nahant. I would need permits. I mean you probably go out and do the base line ambient studies, the air occurs in spring, summer, fall, winters, to do a proper computing of pollution.

Do you have a similar process for polluting the ocean? It's really a base line

study. Are you required to do that number one? And is there something that finally authorizes a permit to do this?

MR. ROSENBERG: Bill, if you would.

WILLIAM HUBBARD: With this class it has certainly gone on 20 years. D.I.S. formulation really started about in 1990 with several million dollars in tests for both the town and the Corps of Engineers.

As far as dredged material disposal and the technology nationally, several types of names. We have all the sites around the country. For this particular project, we are doing base line data, and of course we are incorporating the existing base line data, too, in Mass. Bay. The D.I.S. is incorporating existing information. The permitting process hasn't even begun. When I was with the Board of Selectmen recently, we are still in discovery. We are still in just gathering information. We will take that E.I.R. and the E.M.F. and the E.I.R. that has been published. We have received comments from the M.E.P.A. process. This is part of the M.E.P.A. and the 401 Clean Water Act process, and, yes, the myriad of permits

haven't been addressed yet, and they won't be until after a final E.N.F. and E.I.R. have been done.

AUDIENCE PARTICIPANT: In your initial siting studies has that process incorporated the projection of what the Boston outfall is going to do?

WILLIAM HUBBARD: The cumulative impacts, yes, they will need to be, but it's not a percentage. You are not going to get this is the answer on that.

POLLY BRADLEY: I would like to reply to that question, also.

MR. ROSENBERG: Okay. Norm.

NORMAN FARAMELLI: I think, you know, we learned and what happens is we will be using the information that we have in this preliminary way for the Final Environmental Impact Report together. Once we have an idea of the set of sites we are going to look at, we will do more extensive work on the sites. That is the intention to look at them and to find out information about fish habitat, find out what the benefit analysis is, the ocean bottom

characteristics. We will look at that in depth, and we have to create preferred alternatives. Then they have to go to a public review. We have to find on the State level and the Federal level in terms of whether this is an acceptable document, whether all the environmental effects have been adequately considered and so forth. Then we have the permitting process, and that permitting process occurs at both the State level as well as on the Federal level; but as Bill mentioned until the preferred alternative is selected, and that is at the end of the Environmental Impact Report and Impact Statement process, we can't talk about permits.

AUDIENCE PARTICIPANT: Not to be jaded, on land process, there is no local level permitting process; is that true?

NORMAN FARAMELLI: There is local conservation measures. In the jurisdiction where this occurs under the Wetlands Protection Act, we do need local additions and local conservation items where this dredging occurs.

POLLY BRADLEY: You keep talking about there being 300 sites, and nobody has decided anything, but having read the Draft Environmental Impact Report, it was narrowed down to some 20 sites or so, and of those five were preferred sites, and those were all the ones that were the master disposal site is the foul area. Meisburger 2 and 7, the Boston Lightship and Spectacle Island. It's very clear from the comments to the report from the Executive Office of Environmental Affairs that the foul area can be ruled out; and by the way, the foul area is terrible for this stuff to be dumped there. Anyplace in the ocean is. It's very clear that it is very quickly being narrowed down to Meisburger 2 and 7. And maybe -- well, we can always hope they are saying that 300 sites means that they are backing off from Meisburger 2.

MR. ROSENBERG: Okay. I have two questions. First, how do we come up and who was involved in the 300 sites, and how did those 300 alternatives get narrowed down to the 26 sites?

Who would like to -- Janeen.

JANEEN HANSEN: Right now our site lies in conjunction with the Advisory Committee,

and, in fact, we started a site list at M.W.R.A. and the central artery to put together some of their projects. The Dredgery Advisory Committee added the sites to that list and helped us develop the list of criteria, which we evaluated all of the sites. I think you are right in assuming that there are not still 300 sites on the table, but I figure there are more than 26.

MR. ROSENBERG: And one second. The other question gets back to, and I will get right to you, sir. You had brought up a little earlier in the evening somebody here said, why don't you just burn this stuff? What do you think our chances would be of siting an incinerator in Nahant? No. And what do you think the chances are of siting that same incinerator anywhere else in Massachusetts? Less than that. So there is a certain reality here as to what technologies are available and what it really actually influences, but there is a magic wand here. There is stuff that is in the water. Let's take care of it, if we are going to take care of it at all in a manner that is going to be environmentally safe. Environmental in Salem with little or no impact on

the environment and hopefully still where the material is still accessible should add the new technologies.

AUDIENCE PARTICIPANT: One of the basic rules of dealing with contaminated material is containment and not to spread around and make more contaminated material.

MR. ROSENBERG: Yes, sir.

AUDIENCE PARTICIPANT: I was just wondering. On the marine map years ago I was looking at there used to be an old nuclear waste disposal site right off the Cape, and I was wondering every once in a while you hear about a dredger getting tied up in one of those drums. If that would be an alternative site, where you could dump some of it out there and pad those barrels, and that wouldn't happen.

MR. ROSENBERG: That is a great point. I just had that discussion twice in the past ten days. And the first time was with some Massachusetts law communities, and the second time was with the fishermen in Gloucester; and prior to that, at a meeting in Hyannis, Save the Harbor had brought up well, maybe you can just use this

material to cap the stuff at Lightship, because that is where this is. That is where it is.

AUDIENCE PARTICIPANT: Is that where it is?

MR. ROSENBERG: Everything we do has two edges to it. Let's face it.

Yes, sir.

AUDIENCE PARTICIPANT: You were mentioning you wanted to just put the sludge in an area that you thought you might want to be accessible for future technology. Well, it seems to me -- I wind surf around Nahant a lot, and I wind surf on Long Beach, and I know from one day to the next the water temperature can go -- can drop about ten degrees, meaning the off shore waters have springs, silt and everything else. There is no way that you are going to be able to dump something and keep it there. It's just going to spread everywhere, you know, when we are on the beach in 24 hours until it gets cooler water. And I am sure if you have ever been to the beach on a nice hot summer day when it's 90 degrees out, there are several thousand people on that Long Beach, and I am sure, you know, whether you call it toxic, poisonous, hazardous waste they are going to be living in it.

MR. ROSENBERG: Well, you are absolutely right. Get back to the question of containment. And that is more or less what I was talking about. I think you should kind of contain this material. It would be accessible.

AUDIENCE PARTICIPANT: I was just working in school, and we had two oil tank leaks, and there wasn't much leakage, but there were E.P.A. standards equating to the amount of material that we had to remove from the ground. We almost bankrupt the school, because there was so much stuff that needed to be taken out. It was caused -- you know, it was called hazardous waste, but we had to remove it. $850 a ton, and there was 300 tons of it. You know, why doesn't this fall in the same classification? And why does the same type of treatment have to be done to it?

AUDIENCE PARTICIPANT: I think it is a long question and a big long answer. It's part of liabilities, and the other along the line is that that oil spill was in wetlands or habitats before putting it down as fine and usual.

MR. ROSENBERG: Yes, sir.

SELECTMAN LOMBARD: I don't know if it is appropriate or not, but on the agenda here, you have a last item that says conclusion, and I think we have presented a myriad of reasons tonight that we seem to get, you know, agreement on. This is not a good site. So I want to raise the question, and the conclusion is that the Corps of Engineers how can you assure us it is not going to happen, because I think we pointed out these things, conservative things, one of the reasons it might be selected, because we are not sure if it's going to work. And we want to get to it again. So I mean maybe it's time to ask the question what do we do. What do we need to do to have you take the site off the list? And I think that is what everyone wants to see. What do we need to do to take the site off the list?

(Applause.)

MR. ROSENBERG: A very good question, but you are not going to get an answer. And the reason you are not going to get an answer -- the reason we are not going to take it off the list has nothing to do with it being the only candidate

as was alluded to. The reason we are not taking it off the list is because there are other alternatives where other people in other communities feel as strongly as you do, and what is approved, it has to be objective in its pursuit. It cannot lean to any one alternative, and it's just a hard pill to swallow, but the fact is I invite you to write us letters. We are taking all your comments. Everything you said tonight is now part of the record. Everything you said tonight is part of the equation that comes up at that final decision; but as for the Corps saying because of what we heard tonight, we will no longer consider it, that is out of the question. We must be objective in the way we pursue this. Would you have us say to you we will not take you off a list, but we are taking them off a list.

PETER JACKSON: Let me tell you why. We are the only location where the outfall is going to have an impact. Number one, you cannot guarantee the secondary impact. Number two, you are going to be dumping this one time during the period where the environmental came recommended by

the M.W.R.A., and you don't know whether the secondary area is going to be complete. He has said there is complete. Every time there is a storm, they will be in violation in the water. When you put your notes and their notes together, it will be in constant violation of the Clean Water Act. You have not studied this. You have admitted that you haven't studied this. We have asked you to study this, and again of all the sites you pick, this is the most dangerous to the environment. Beyond this meeting, we will continue. We will be at the next meeting with you, and we appreciate it.

I would like to close. It's getting late. But politics enters into this, and that is the next step, and that is why we need this coalition thing. I think we should end the meeting now.

Thank you.

AUDIENCE PARTICIPANT: When do you come to a decision?

AUDIENCE PARTICIPANT: You have an overall plan. You have got to make a decision as to whether or not you are going to do the project, whether or not what site you are going to take. What are those dates?

AUDIENCE PARTICIPANT: Do you need a 60-day notice that it's going to go there?

AUDIENCE PARTICIPANT: You said we had so many days to come to you, but we were not involved in denying the decision.

MR. ROSENBERG: Good point.

Norman.

AUDIENCE PARTICIPANT: Until the plane goes over, please. We can't hear.

NORMAN FARAMELLI: We are in the process of trying to gather comments from all the groups. We are trying to put them together and to find out our next step in terms of preparing the Final Impact Report, the Environmental Impact Report and Environmental Impact Statement. That process is just beginning. The earliest it will be filed is around December of this year, maybe later, and it's going to take some time to come up with the third alternative. We are months away from that.

AUDIENCE PARTICIPANT: While you go through these different alternatives, and while

you go step-by-step, it is my understanding from the answer that you gave earlier that all of that information is public information, so that we get an idea as to which site you think is better or worse and what you are finding; is that true?

NORMAN FARAMELLI: Yes, this is the reason we would like to have your participation from the Advisory Committee. The Advisory Committee is set to address each step along the way. All the Advisory Committee members have this information each step along the way, every test result, what we are doing about it, the decision itself.

AUDIENCE PARTICIPANT: Thank you.

MR. ROSENBERG: One final --

AUDIENCE PARTICIPANT: I would like to just address Massport on a nonrelated issue. The planes that go over --

MR. ROSENBERG: Okay.

AUDIENCE PARTICIPANT: What are the planes around -- are the planes that are flying supposedly in the approved area corridor to avoid the noise going over Nahant?

I am glad to hear it.

MR. ROSENBERG: One final question, and then I will close.

AUDIENCE PARTICIPANT: When we went through the M.E.P.A. and M.E.P.A. process --

MR. ROSENBERG: We are in it now.

AUDIENCE PARTICIPANT: No, on the site at the Deer Island Treatment Plant. It was determined that the solids that were the by-products of primary treatment were inappropriate for dumping in ocean waters.

Has the composition of the materials that you are going to be dredging, the spoils, compare to the solids that are the by-products of primary treatment?

MR. ROSENBERG: Thank you for that question.

WILLIAM HUBBARD: We are analyzing that under the Ocean Disposal Act and the Clean Water Act. The testing protocol that was put up on the board by Joe Ayers from Nahant talked about Class 1, 2 or 3. That is the level of contamination, of which we are more conservative than I think it was alluded to. Anything that gets into Class 2, we begin biological testing.

That is for sediments on the bottom of the ocean. You are not dealing with that in a concentrated wastewater sludge. The levels are much higher. They are not --

AUDIENCE PARTICIPANT: Sludge or sediments?

WILLIAM HUBBARD: The sludge levels are much higher than the concentrated. They are still not for the most part over the limits of the Toxic Substance Control Act, so you wouldn't even call that hazardous waste, although the oil spill alluded to would be. So the levels in comparison are: You have got hazardous waste. You have got material in the oil spill range. Then you have got the sludge material. Below that is the marine sediments, and that kind of makes sense, because a lot of the contaminants going into the sediments used to be coming from the sludge which then would get diluted and spread thin. And that is the numbers that were put up today.

AUDIENCE PARTICIPANT: So it has less toxics and less heavy metal than environmental sludge?

WILLIAM HUBBARD: The problem with the

land application of this material is actually in the salt content. You don't want it taken in, and you will fertile all your agricultural lands.

MR. ROSENBERG: Okay. I would like to thank everybody for coming tonight. The process, I am sorry, I couldn't say you are off the list, but there are things -- we have to look at everything. And I really hope you stay involved, and this doesn't just turn out to be a rather, and you will stay involved, and we have SWIM as part of this Advisory Committee free to work hand in hand with C.L.S., Save the Harbor and the other environmentalists that are involved in this.

And I thank you very much.

(Whereupon, at 10:40 p.m., the hearing was adjourned.)

CERTIFICATE

I, Marianne Kusa-Ryll, Registered Professional Reporter, do hereby certify that the foregoing transcript of the Boston Harbor Navigation Improvement Project, Nahant Public Forum, is a true and accurate transcription of my stenographic notes taken on Thursday, July 28, 1994.

Marianne Kusa-Ryll, RPR

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APPENDIX D - TREATMENT TECHNOLOGY SURVEY QUESTIONNAIRE

REQUEST FOR INFORMATION ON NEW TECHNOLOGIES FOR DREDGED MATERIAL HANDLING, PRE-TREATMENT AND TREATMENT

SURVEY QUESTIONS

VENDOR NAME:

Technology Type:

Technology Trade Name:

Address:

City/State/Zip:

Contact:
Title:
Phone:
Fax:
Status (Conceptual, Lab, Pilot or Full Scale):

Please attach additional pages with answers to the following questions:

I. EFFECTIVENESS:

1. Demonstrated through-put in cubic yards per day
2. Estimated maximum through-put in cubic yards per day
3. Demonstrated or estimated (state which) effectiveness in eliminating or reducing PCBs, PAHs, and metals (see Table 1) to target levels (see Table 2).
4. Waste by-products of process: amount and expected concentrations of contaminants, estimated cost of disposal of contaminated remainder
5. Waste by-products of process: off-gasses, solvents, process water, etc. and cost of recycling and disposal
6. Effectiveness for marine dredged material and basis for answer (theory, lab, bench-scale mock-up, demonstration project)
7. Efficiencies in scale - demonstrated or theoretical
8. Minimum concentration of contamination (if any) required for process to operate
9. Processing time for dredged material and secondary waste streams (if any)

II. IMPLEMENTABILITY:

1. Pre-treatment requirements (removing debris, sizing, sorting, de-watering)
2. Mobilization and demobilization requirements (including long-lead time procurement) for handling, transport, storage and processing.
3. Space requirements (land-side, barges)
4. Traffic impacts (ship and land-side)
5. Logistics of locating storage for pre-treatment, treatment, stockpiling, transport
6. Special fabrication requirements for holding barges, rail, trucks or other containment vessels
7. Land-side building requirements including storage sheds, blow-down walls, weatherproofing or other structures and indicate whether they are temporary structures or can be made permanent to process future maintenance material.
8. Availability of technology (proprietary, lab-scale, commercial)
9. Number of handling events (double/triple handling or more) from point of material availability to final disposal of wastes including secondary wastes and process wastes
10. Environmental impacts of technology: provide estimated or demonstrated air, water and waste stream characteristics coming from process
11. Permittability: apply information from Question 10 to permit standards and list likely permit requirements.
12. Site safety requirements including public health risks and public nuisances in terms of explosion potential, odor, noise and other operational effects.
13. Environmental constraints, e.g. ambient temperature, humidity, etc.
14. Marketability of residuals, treatment by-product or treated material.

III. ESTIMATED PRICE RANGE

This is not a request for a cost estimate. A "ballpark" range is expected. Orders of magnitude differences in costs will be important in comparing technologies.

Estimate price range per unit of waste treated:

$______ to $______ per ______

Price estimates should include capital costs of technology, operating and maintenance costs, energy costs, monitoring costs, special handling or transportation costs. Price estimates should not include indirect costs associated with treatment such as dredging, permits or land acquisition. Unit costs for treating contaminated residuals should be estimated if known.

Factors that have a significant effect on unit price (1 is highest).

___ Initial contaminant concentration

___ Target contaminant concentration

___ Quantity of waste

___ Characteristics of residual waste

___ Labor Rates

___ Moisture content

___ Facility Preparation

___ Waste handling/preprocessing

___ Characteristics of material

___ Utility/Fuel rates

Others: ____________________
____
____
____

TABLE 1. BHNIP SILT CHARACTERISTICS FOR TECHNOLOGY ASSESSMENT

Bulk Chemistry:	Avg.	Low	High
Average Water Content (%)	51	16.8	74.7
Percent Gravel	4	0.1	22.7
Percent Mid/Coarse Sand	7	0.2	36.0
Percent Fine Sand	22	6.0	69.4
Percent Silt	46	22.5	84.7
Percent Clay	23	6.6	69.8
Percent Total Organic Carbon	4	0.3	14.0
Total Petroleum Hydrocarbons (IR) in ppm, dry wt.	2800	280	5860

Metals Concentrations in PPM, dry wt.:			
Arsenic	15	1.63	44.4
Cadmium	4	0.07	12.1
Chromium	156	10.6	395.0
Copper	168	7.04	341.0
Iron	41043	1610	173000
Lead	251	3.38	1120
Mercury	0.6	0.012	1.19
Nickel	43	8.04	132
Zinc	334	24.2	841

Source: Draft Environmental Impact Report (EOEA File No. 8695) and Draft Environmental Impact Statement, Volume 2 of 2 - Appendix; Boston Harbor, Massachusetts, Navigation Improvement Project and Berth Dredging Project; April 1994; Appendix C-3, Table 2.

TABLE 1.(CONT). BHNIP SILT CHARACTERISTICS FOR TECHNOLOGY ASSESSMENT

PAH Concentrations in PPM, dry wt:	Avg.	Low	High
Acenaphthene	.28	.02	2.08
Acenaphythylene	.27	.02	1.58
Anthracene	.90	.02	8.4
Benzo (a) anthracene	.98	.02	8.91
Benzo (a) pyrene	1.14	.02	6.68
Benzo (b) fluoranthene	1.4	.02	8.27
Benzo (g, h, I) perylene	.66	.02	2.63
Benzo (k) fluoranthene	1.28	.02	7.58
Chrysene	1.43	.02	6.56
Dibenzo (a, h) anthracene	.18	.02	1.06
Fluoranthene	2.81	.02	8.86
Fluorene	.79	.02	6.47
Ideno (1,2,3-cd) pyrene	.22	.02	1.20
Napthalene	.60	.02	8.1
Phenanthrene	1.28	.02	8.56
Pyrene	3.06	.02	9.53
Total PAH's	17.06	.02	68.17
PCB Concentrations in PPM, dry wt:	1.84	0.16	6.52
Pesticide Concentrations in PPM, dry wt:	0.01	BDL	BDL

Source: Draft Environmental Impact Report (EDEA File No. 8695) and Draft Environmental Impact Statement, Volume 2 of 2 - Appendix; Boston Harbor, Massachusetts, Navigation Improvement Project and Berth Dredging Project; April 1994; Appendix C-3, Table 2.

BDL: Below detection limit

TABLE 2. TARGET CONCENTRATIONS FOR BHNIP TECHNOLOGY ASSESSMENT

SET 1 - UNCONFINED OPEN WATER DISPOSAL:

Bulk Analysis (ppm unless noted):

Mercury	<0.5
Lead	<100
Zinc	<200
Arsenic	<10
Cadmium	<5
Chromium	<100
Copper	<200
Nickel	<50
Total PCBs	<0.5
Total PAHs	None Defined>Presence of more than
Total VOCs	None Defined>*de minimus* levels
Total PHC	None Defined>requires bioassays
Volatile Solids %	<5
Water Content %	<40
Silt/Clay%	<60
Oil & Grease %	<0.5

Source: Draft Environmental Impact Report (EOEA File No. 8695) and Draft Environmental Impact Statement, Volume 1 of 2; Boston Harbor, Massachusetts, Navigation Improvement Project and Berth Dredging Project; April 1994; Table 3-3.

TABLE 2. (CONT). TARGET CONCENTRATIONS FOR BHNIP TECHNOLOGY ASSESSMENT

SET 2 - IN-HARBOR BULKHEADED DISPOSAL AND UNLINED LANDFILLS

Bulk Analysis (ppm unless noted)

Mercury	<1.5
Lead	<200
Zinc	<400
Arsenic	<20
Cadmium	<10
Chromium	<300
Copper	<400
Nickel	<100
Total PCBs	<1.0
Total PAHs	<100
Total VOCs	<4
Total PHC	<500
Volatile Solids %	<10
Water Content %	<60
Silt/Clay%	<90
Oil & Grease %	<1.0

Source: Draft Environmental Impact Report (EOEA File No. 8695) and Draft Environmental Impact Statement, Volume 1 of 2; Boston Harbor, Massachusetts, Navigation Improvement Project and Berth Dredging Project; April 1994; Table 3-3.

APPENDIX E - OCTOBER 1994 SAMPLING REPORTS

ENVIRONMENTAL STUDIES FOR THE BOSTON HARBOR NAVIGATION IMPROVEMENT AND BERTH DREDGING ENVIRONMENTAL IMPACT REPORT/STATEMENT:

TASK 1: BENTHIC STUDIES

Prepared for

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R-13116.039

April 1995

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EXECUTIVE SUMMARY

Benthic habitat conditions of sites that were under consideration as potential disposal areas for silt dredged from Boston Harbor for the Boston Harbor Navigation Improvement and Berth Dredging Project (BHNIP) were evaluated in October and November 1994 using sediment profile imagery (SPI) and benthic infauna sampling. The SPI survey provided information on physical and biological characteristics that were interpreted to distinguish habitats at each site. These habitat distinctions formed the basis for stratifying sampling effort for benthic infauna. Benthic infauna sampling was used to confirm the interpretation of the sediment profile image analysis and to provide specific information on the character of the benthic community.

Sediment profile imagery is a photographic technique in which the camera penetrates the sediment and a color photograph is taken of the vertical profile. The photographs provide data on sediment texture (approximate grain size), compaction and water content, depth to which sediments are oxidized, subsurface biotic and abiotic features, and surface biological and physical features. The combination of these features provides a tool for estimating successional stage and the "organism-sediment index" which can be used to estimate the quality of benthic habitat.

Analysis of the SPI photographs collected at 60 stations in Boston Harbor and 71 stations in Massachusetts Bay identified eight distinct habitats, four of which were unique to the harbor and four to Massachusetts Bay. The habitats observed in Boston Harbor ranged from biologically dominated (Habitat I) to physically dominated (Habitat III). Outer harbor sites were grouped into two habitat types (I and II); both displayed surface amphipod crustacean tube mats and/or infaunal burrows, evidence of good habitat quality. Many inner harbor locations showed signs of physical and organic loading stress (Habitats III and IV). Several locations in the vicinity of the Inner Confluence exhibited physical, but not biological, characteristics of Habitat II.

Offshore, the sediment profile camera survey identified four habitats (V, VI, VII, and VIII) that were all composed of or dominated by coarse materials (sand, gravel and rock) and apparently current dominated. Although biological characters suggesting a successional stage II benthic community were observed in all habitats, they were most apparent in Habitat VII (hard sand substrate). The three offshore sites varied in the distribution of the four habitats. Habitat VII was the most frequently identified habitat at Boston Lightship. Habitats V (rock over silt and gravel) and VII were about equally represented at Meisburger 2. Meisburger 7 exhibited approximately even distribution of Habitats V and VI (gravel).

The survey of benthic infauna tended to support the observations that were made from the sediment profile survey. In general, the inner harbor locations were depauperate both in species richness (number of taxa) and total abundance. Species composition was predominantly pioneering species, those adapted to rapid colonization of stressed environments. The outer harbor locations exhibited high species richness and the highest total abundances of the survey, primarily because of the abundance of Ampelisca. Offshore locations exhibited diversity both in substrate conditions and benthic species composition. The largest number of taxa were recorded from the offshore locations. Total abundances were moderately high.

Results of the fall 1994 survey were compared to and tended to confirm historical data. Several trends are noteworthy. Abundances, but not species composition, likely exhibits seasonal patterns in the inner harbor. This is may be related to the stresses associated with hypoxic (low oxygen) conditions frequently observed in the late summer in the inner harbor. The benthic community in the outer harbor appears to be exhibiting a trend of increasing abundances and diversity, likely associated with the improvements in water quality through programs implemented by MWRA. Current data from the Massachusetts Bay locations confirm earlier observations of species-rich, successionally advanced benthic assemblages.

The areas sampled in 1994 were evaluated in terms of their potential value for fisheries resources, primarily winter flounder and lobsters. Biological surveys (finfish and lobster sampling) conducted in fall 1994, demonstrated that these species occur in all of these general locations (inner and outer harbors and Massachusetts Bay). The outer harbor and offshore locations appear to provide better food resources and, potentially, better spawning habitat for winter flounder than the inner harbor. Lobster utilize a broad range of habitats, most of which are represented in Boston Harbor and offshore. The Early Benthic Phase (EBP) lobster is the most critical lifestage and has specific habitat requirements. These conditions may be provided by some of the habitats observed offshore (most extensively at Meisburger 2 and 7).

1.0 INTRODUCTION

Characteristics of the substrate and benthic fauna of potential disposal sites for dredged material from Boston Harbor Navigation Improvement and Berth Dredging Project were evaluated using sediment profile imagery (SPI) and benthic infauna sampling. The biological and physical characteristics identified in the initial evaluation of the sediment profile imagery were used to distinguish habitats at each site. The habitat distinctions were the basis of the benthic infauna sampling.

This report details results of SPI camera and benthic infauna surveys conducted during October and November 1994.

2.0 MATERIALS AND METHODS

2.1 FIELD METHODS

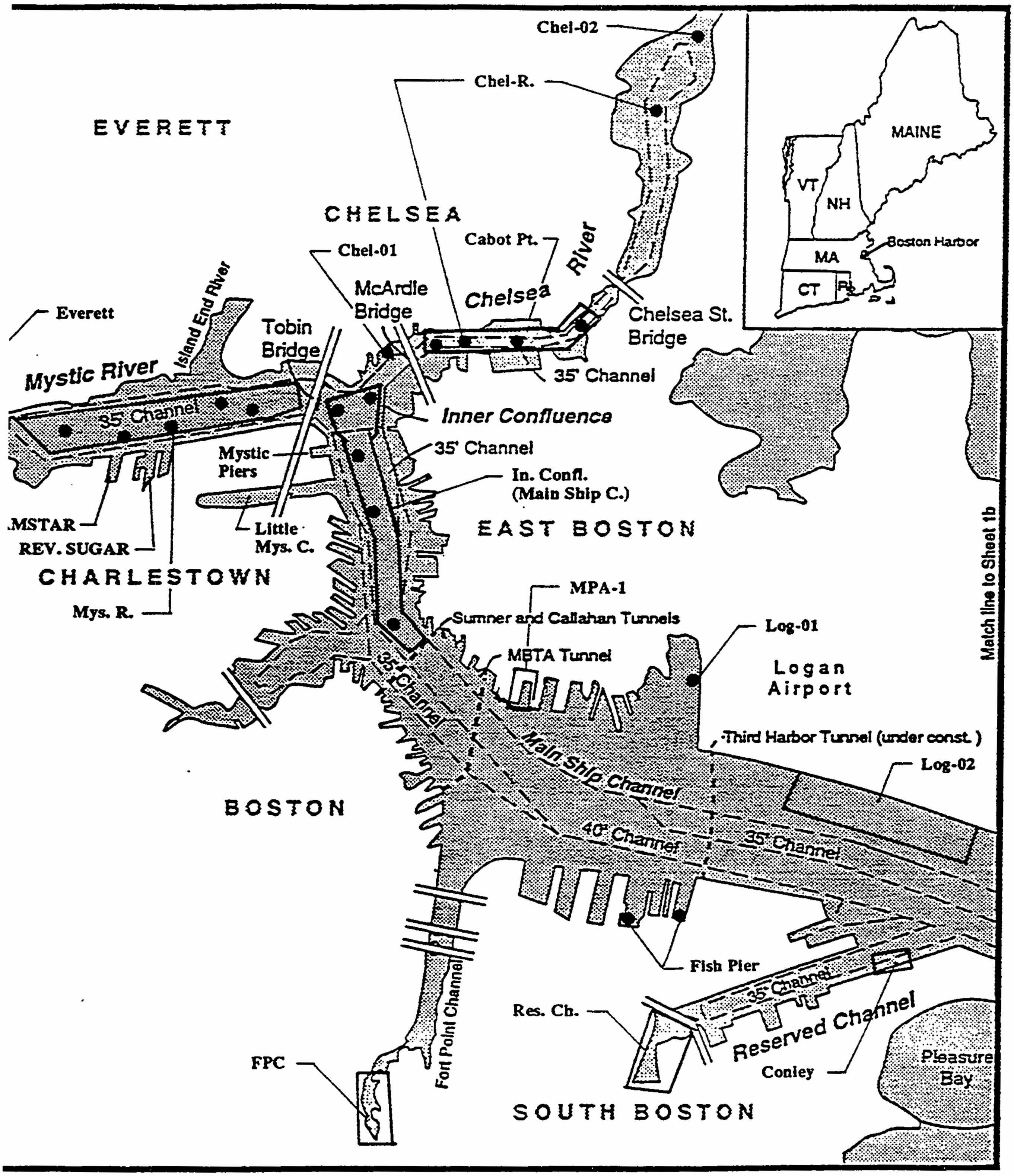
2.1.1 Sediment Profile Camera Survey

A total of 60 stations were sampled within the Boston Harbor area at 19 separate sites (Figs. 1a and 1b). A total of 71 stations were sampled within Massachusetts Bay at three separate locations (Fig. 2). At each station a Hulcher Model Minnie sediment profile camera was deployed twice (Camera specification in Appendix A). At nine of the Massachusetts Bay and one of the Boston Harbor stations only one deployment was successful. Appendix B contains a map and listing of all stations sampled. The profile camera was set to take two pictures, using Fujichrome 100P slide film, on each deployment at 2 and 12 seconds after bottom contact.

2.1.2 Benthic Infauna Sampling

Sampling stations for benthic infauna were determined following the initial analysis of sediment profile images that determined habitat conditions at each station. Each site that was sampled by sediment profile imagery was also sampled for benthic infauna. The number of benthic samples collected at each location was related to the habitat diversity and size of the site. An attempt was made to sample each habitat (although several stations where substrate was primarily gravel or cobble were unsampleable) at each site. Stations sampled at each site are listed in Table 2-1.

All samples were collected using a 0.04 m^2 Van Veen type grab. Samples were considered acceptable if the grab was fully closed and the surface of the sediment in the grab was intact and relatively level, with no appearance of having been washed. Samples were sieved through a 0.5 mm-mesh sieve in the field, placed in labeled containers and preserved with buffered formalin.



Boston Harbor Navigation Improvement Project	Figure 1a. Boston Harbor Locus Map. ==== Limits of Federal Channel
Scale: 0 2000' 4000' Scale in Feet	*Source:* New England Division, Corps of Engineers

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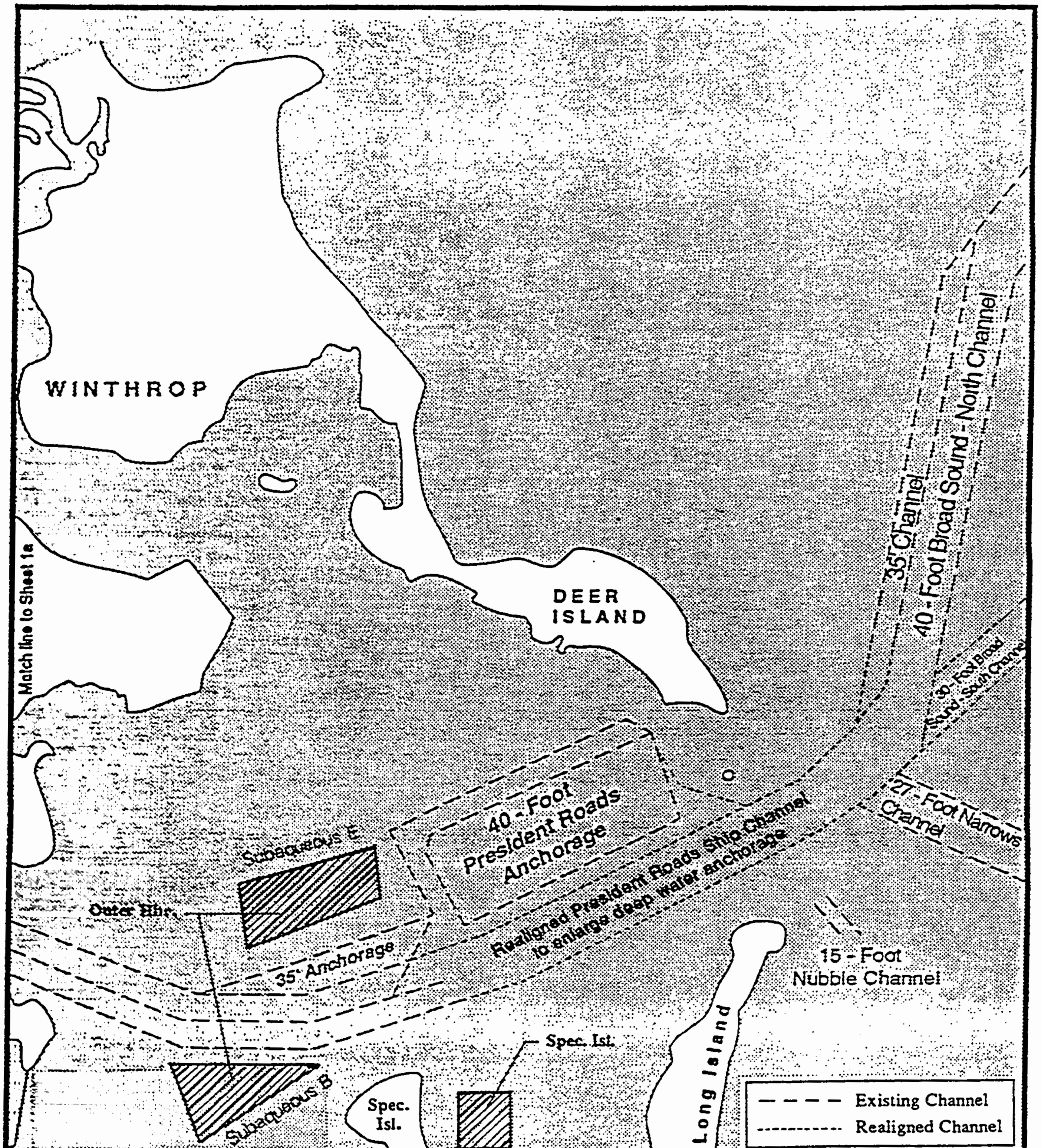

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Boston Harbor
Navigation Improvement Project

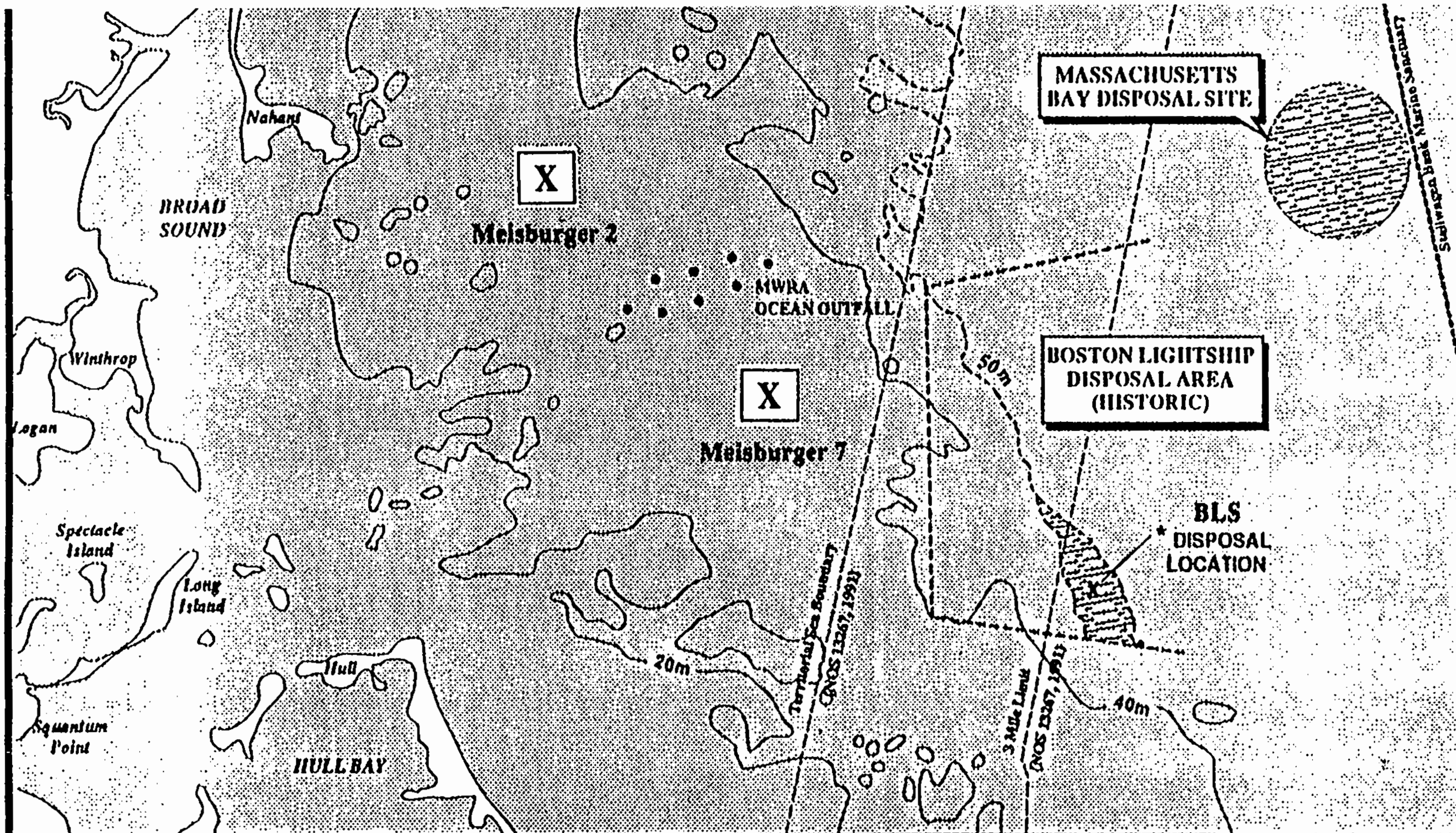
Figure 1b. Boston Outer Harbor Locus Map.

==== Limits of Federal Channel

N

Scale: 0 2000' 4000' Scale in Feet

Source: New England Division, Corps of Engineers



Depositional substrates within the disposal sites.

*BLDS approximate proposed disposal location = 42° 19' N 70° 40' W

Melsburger 2 approximate location = 42° 25' N 70° 50' W

Melsburger 7 approximate location = 42° 21' N 70° 47' W

Boston Harbor Navigation Improvement Project

Figure 2. Massachusetts Bay Locus Map.

Scale:

Source: Boston Harbor Navigation Chart

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TABLE 2-1. SAMPLING LOCATIONS FOR BENTHIC INFAUNA.

SITE	STATIONS[a]
Inner Harbor	
Inner Confluence	1,2,3,4,5
Chelsea Creek	1,2,3,4,5
Mystic River	1,2,3,4,5
Little Mystic Channel	2,4A,4B
Revere Sugar	1,3A,3B
Amstar	1A,1B,3
Chel 01	1,3
Chel 02	1,3
Cabot Paint	1,3
Everett	1,2
Conley	A
Mystic Piers	2A,2B,3A,3B
Reserved Channel[b]	1,2,3
Outer Harbor	
Spectacle Island	2,5,8,11,12
Subaqueous B	2A,2B,2C
Subaqueous E	1,2,3
Massachusetts Bay	
Boston Lightship	1,3,5,7,8,10,11,17,20,22,24
Meisburger 2	2,3,5,6,7,9,10,15,17
Meisburger 7	2,4,6,8,9,13,18,21,22

[a]Complete station identification includes an alphabetic prefix designating the site and a numeric suffix. Replicates, when collected, were labeled A, B or C.
[b]inaccessible for sampling by sediment profile imagery

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2.2 LABORATORY ANALYSIS

2.2.1 Sediment Profile Image Analysis

2.2.1.1 Preliminary Image Analysis

The sediment profile images were first analyzed visually by projecting the images and recording all features seen into a preformatted standardized spread sheet file (see Appendix A for example). The images were then digitized and analyzed using National Institute of Health program Image on a Macintosh computer. Steps in the computer analysis of each image were standardized and followed the basic procedures in Viles and Diaz (1991). Data from each image were sequentially saved to a spread sheet file for later analysis.

2.2.1.2 Image Data

In this section the importance and usefulness of the data produced from analysis of profile images is discussed. Details of how these data are actually obtained can be found in Kiley (1989) and in the standardized image analysis procedures of Viles and Diaz (1991). Data for each photograph are included in Appendix C.

Prism Penetration - This parameter provides a geotechnical estimate of sediment compaction with the profile camera prism acting as a dead weight penetrometer. The further the prism enters into the sediment the softer the sediments, and likely the higher the water content. Penetration is simply measured as the distance the sediment moves up the 22 cm length of the face plate. By taking two exposures per deployment at an 10 s interval, the camera can record overlapping photographs of the sediment as the prism penetrates. At station MPA1, which had unconsolidated muddy sediments, a total of 24.5 cm penetration was obtained using this technique. The first station MPA1 image taken after a 2 s delay had a penetration of about 20 cm. Ten second later when the second image was taken, the prism had penetrated another 4.5 cm for a total of 24.5 cm.

Apparent Color Redox Potential Discontinuity (RPD) Layer - This parameter is an important estimator of benthic habitat quality. It is the depth to which sediments are oxidized. The term apparent is used in describing this parameter because no actual measurement is made of the redox potential. An assumption is made that, given the complexities of iron and sulfate reduction-oxidation chemistry, reddish-brown sediment color tones (Diaz and Schaffner 1988), or in black and white images whiter or lighter areas of the image (Rhoads and Germano 1986), are indications that the sediments are toxic, or at least are not intensely reducing. This is in accordance with the classical concept of RPD depth, which associates it with sediment color (Fenchel 1969, Vismann 1991).

The apparent color RPD is very useful in assessing the quality of a habitat for epifauna and infauna from both physical and biological points of view. Rhoads and Germano (1986), Revelas et al. (1987), Day et al. (1988), Diaz and Schaffner (1988), and Valente et al. (1992) all found the depth of the RPD from profile images to be directly correlated to the quality of the benthic habitat in polyhaline and mesohaline estuarine zones. Controlling for differences in sediment type, habitats with thinner RPD's (mm's) tend to be associated with some type of environmental stress. Habitats with deeper RPD's (cm's) usually have flourishing epibenthic and infaunal communities. Exceptions occur in habitats where resuspension, accumulation or physical reworking of toxic sediments is rapid, as after a storm event. Evidence of resuspension/deposition events was seen at station CON 3, where the RPD layer was exceptionally deep (4 cm) for muddy sediments.

Sediment Grain Size - This parameter is a geotechnical feature of the sediments and is used to determine the type of sediments present. From grain size the nature of the physical forces acting on a habitat can be inferred. If sediments are coarse (sand size or greater) the habitat tends to be current or wave dominated. Fine grained sediment (silt size and smaller) tend to be net accumulation habitats. The sediment type descriptors used follow the Wentworth classification as described in Folk (1974) and represent the major modal class for each layer identified in an image. Sediment grain size from gravel, to sand, to silt, and clay can be accurately estimated from the images. Unconsolidated soft fine-grained sediments (mud) are also easily identified.

Surface Features - Those seen include; amphipod and worm tubes, amphipod tube mats, epibenthic organisms, macroalgae, microalgae, shells, mud casts, bedforms, feeding pits and biogenic mounds. Each gives a bit of information on the type of habitat and its quality for supporting benthic species. The presence of certain surface features is indicative of the overall nature of a habitat. For example, sand ripples (bedforms) are always associated with physically dominated habitats, whereas the presence of worm tubes or feeding pits would be indicative of a more biologically accommodated habitat (Rhoads and Germano 1986, Diaz and Schaffner 1988).

Subsurface Features - Those seen include; active infaunal burrows, water filled voids, gas voids, infaunal organisms, and shell debris. Subsurface features reveal a great deal about the physical-biological control occurring in a habitat. For example, the presence of methane gas voids has been found to be an indication of anaerobic metabolism (Rhoads and Germano 1986) and associated with high rates of bacterial activity. Muddy habitats with large amounts of methane gas are generally associated with areas of oxygen stress or high organic loading. On the other hand, habitats with burrows, infaunal feeding voids, and/or actual infauna visible are generally more biologically accommodated and considered "healthy" (Rhoads and Germano 1986, Diaz and Schaffner 1988, Valente et al. 1992).

Successional Stage - Sediment profile data have also been used to estimate successional stage of the fauna in a habitat (Rhoads and Germano 1986). Characteristics that are associated with pioneering or colonizing (Stage I) assemblages (in the sense of Odum 1969), such as dense aggregations of small polychaete tubes at the surface and shallow apparent RPD layers, are easily seen in sediment profile images. Advanced or equilibrium (Stage III) assemblages also have characteristics that are easily seen in profile images, such as deep apparent RPD layers and subsurface feeding voids. Stage II is intermediate to I and III, and has characteristics of both (Rhoads and Germano 1986).

Organism-Sediment Index - Rhoads and Germano (1982, 1986) developed the multi-parameter organism-sediment index (OSI), from data provided by the sediment profile images, to characterize benthic habitat quality. The OSI defines quality of benthic habitats by evaluating images for depth of the apparent RPD, successional stage of macrofauna, the presence of gas bubbles in the sediment (an indication of high rates of methanogenesis), and the presence of reduced sediment at the sediment-water interface which is an indication of low dissolved oxygen conditions in the bottom water. The calculation of the OSI is based on:

RPD (cm)		Successional Stage		Other	
0.00	= 0	Azoic =	-4	Gas voids	= -2
0.01-0.75	= 1	I =	1	Low D.O.	= -4
0.76-1.50	= 2	I/II =	2		
1.51-2.25	= 3	II =	3		
2.26-3.00	= 4	II/III =	4		
3.01-3.75	= 5	III =	5		
>3.75	= 6				

The OSI ranges from -10, poorest quality habitats, to +11, highest quality habitats. OSI values less than 5 for muddy sediments indicate the habitat is under some sort of stress. Values over 7 point to higher habitat quality supporting well developed benthic communities. The OSI has been used to map disturbance gradients (Valente et al. 1992) and to follow ecosystem recovery after disturbance abatement (Germano and Rhoads 1984, Day et al. 1988, Revelas et al. 1987).

2.2.2 Benthic Infauna Sample Analysis

Benthic samples were sieved through a 0.5 mm-mesh sieve, and all organisms were removed for identification. Most organisms were identified to species. Data were reported as No./0.04m^2 by sample (Appendix D). Mean abundances (no./m$^{2)}$ across stations within habitats identified through sediment profile imagery were calculated for each general location (Appendix E).

3.0 RESULTS

3.1 SEDIMENT PROFILE IMAGERY

Data from analysis of all sediment profile images are found in Appendix C.

3.1.1 Quick Look Procedures

The classification of stations into habitats was done "blind" with no information provided on station location prior to analysis. Initially, all images were evaluated and a habitat classification setup. A total of eight habitats was defined, as described below, and each station was placed into a habitat type. After this was done station location data were added (Tables 3-1 and 3-2) and the analysis completed (Appendix C).

3.1.2 Boston Harbor Habitats

Four basic benthic habitats were identified among the 60 Boston Harbor stations (Table 3-2, Appendix C). These habitats ranged from biologically dominated (Habitat I) to physically dominated (Habitat III). Each of the habitat types was further subdivided based on what appeared to be within-habitat heterogeneity. Examples of each of the habitat types can be seen in Figures 3 to 11.

Habitat I had homogeneous silty sediments that appeared heavily bioturbated with an apparent successional stage of II. The sediment surface was covered by mats of *Ampelisca* spp. tubes (Figs. 3 and 4). The Organism Sediment Index (OSI) at Habitat I stations had a median value of 7, highest of all habitats defined (Table 3-3). The other three habitats (II, III, and IV) had median OSI values of 3, except for the one Habitat IIc station (SUBE 1) which was a combination of an *Ampelisca* tube mat and *Mytilus* shell bed. The subdivision into habitats Ia and Ib was based on the appearance of the *Ampelisca* tubes and depth of the RPD layer. Habitat Ia had well formed tubes and slightly deeper apparent color RPD layers than

TABLE 3-1. DISTRIBUTION OF BENTHIC HABITAT TYPES AT BOSTON HARBOR AND MASSACHUSETTS BAY SITES.

AREA	BENTHIC HABITAT TYPE IA	IB	IIA	IIB	IIC	IIIA	IIIB	IVA	IVB
Boston Outer Harbor Sites:									
Spectacle Island	12	10	8	-	-	-	-	-	-
Subaqueous E	-	4	-	-	2	-	-	-	-
Subaqueous B	6	-	-	-	-	-	-	-	-
Boston Inner Harbor Sites:									
Logan 01	-	-	-	-	-	6	-	-	-
Logan 02	-	-	-	-	-	-	12	-	-
Massport-1-	-	-	-	-	-	4	-		-
Inner Confluence	-	-	6	-	-	4	-	-	-
Conley	-	-	-	-	-	6	-	-	-
Cabot Paint	-	-	2	-	-	-	4	-	-
Everett (Malden Br)	-	-	-	-	-	6	-	-	-
Fish Pier	-	-	-	-	-	8	2	-	-
Chel. 01	-	-	-	-	-	-	6	-	-
Chel. 02	-	-	-	-	-	-	6	-	-
Chelsea Creek	-	-	6	4	-	-	-	-	-
Little Mystic Channel	-	-	-	-	-	8	-	-	-
Mystic Piers	-	-	-	2	-	-	-	4	-
Amstar·	-	-	-	-	-	6	-	-	-
Revere Sugar	-	-	-	-	-	6	-	-	-
Mystic River Ship Channel	-	-	-	-	-	3	-	6	-

Area	V	VI	VII	VIII
Massachusetts Bay Sites:				
Boston Lightship	4	1	33	8
Meisburger 2	22	-	14	8
Meisburger 7	19	18	2	4

NOTE:
Both deployments at a station were used as replicates to include some estimate of small scale within habitat heterogeneity. See Table 2 for description of habitat types.

- = Habitat type not present.

TABLE 3-2. DESCRIPTION OF BENTHIC HABITATS CLASSIFICATIONS BASED ON THE OCTOBER-NOVEMBER 1994 SEDIMENT PROFILE IMAGING SURVEY OF SELECTED AREAS OF BOSTON HARBOR AND MASSACHUSETTS BAY.

Boston Inner and Outer Harbor:

Habitat I. Silty sediments, very uniform habitat with many animals, well developed community, sediments heavily bioturbated. Successional stage is II.
Ia Well formed *Ampelisca* amphipod tube mats, average RPD is 3.1±0.3 cm (±SE).
Ib Amphipod tube mats "older" in appearance and appear senescent, average RPD is 2.5±0.3 cm.

Habitat II. Heterogeneous sediments ranging from hard sand to shell and silts, some drift algae, some epifauna, successional stage likely II
IIa Sand to shelly silt, average RPD is 1.2±0.2 cm.
IIb Mixed silty sediments, average RPD is 1.0±0.1 cm.
IIc Mussel shell bed, RPD is 2.5 cm deep. Only one station with this habitat.

Habitat III. Homogeneous muddy sediments, do not appear to be bioturbated, sediment layering common, evidence of gas voids, successional stage indeterminate.
IIIa Very soft sediments, prism penetration over 22 cm, average RPD is 0.8±0.1 cm.
IIIb Soft sediments, prism penetration 16 to 22 cm, average RPD is 0.9±0.1 cm.

Habitat IV. Heterogeneous sediments ranging from mud, silts, to sand, with clay, successional stage likely I.
IVa Mixed muddy sediments, average RPD is 0.8±0.2 cm.
IVb Sandier mixed sediments, average RPD is 0.6±0.1 cm.

Massachusetts Bay:

Habitat V. Rock, both angular and rounded, Underlying sediments ranged from silts to gravel. Many of the rocks were colonized by epifauna. Penetration very limited and no RPD layers were seen.

Habitat VI. Gravel, pea to pebble sizes. Penetration very limited and no RPD layers were seen.

Habitat VII. Hard sand, little prism penetration. Average RPD is 2.0±0.2 cm. Habitat VII is only similar to II in that they both are sandy. VII had more surface fauna activity, with lots of tubes protruding form the sediment surface.

Habitat VIII. Heterogeneous sediments, including clay, silt, sand, and gravel. Average RPD is 1.5±0.2 cm. There were indications that several of the stations had dredged material.

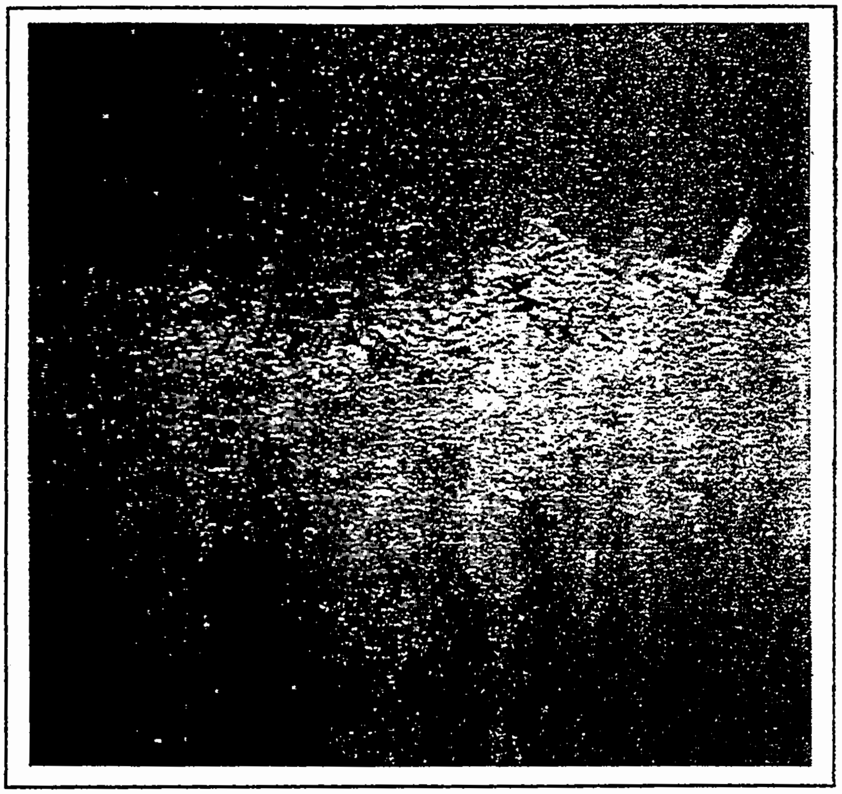

Figure 3. Sediment profile image from Habitat Ia (Station SPEC 1, Deployment B). Well developed *Ampelisca* spp. tube mat on the sediment surface.

0 1 2

Approximate Scale In cm

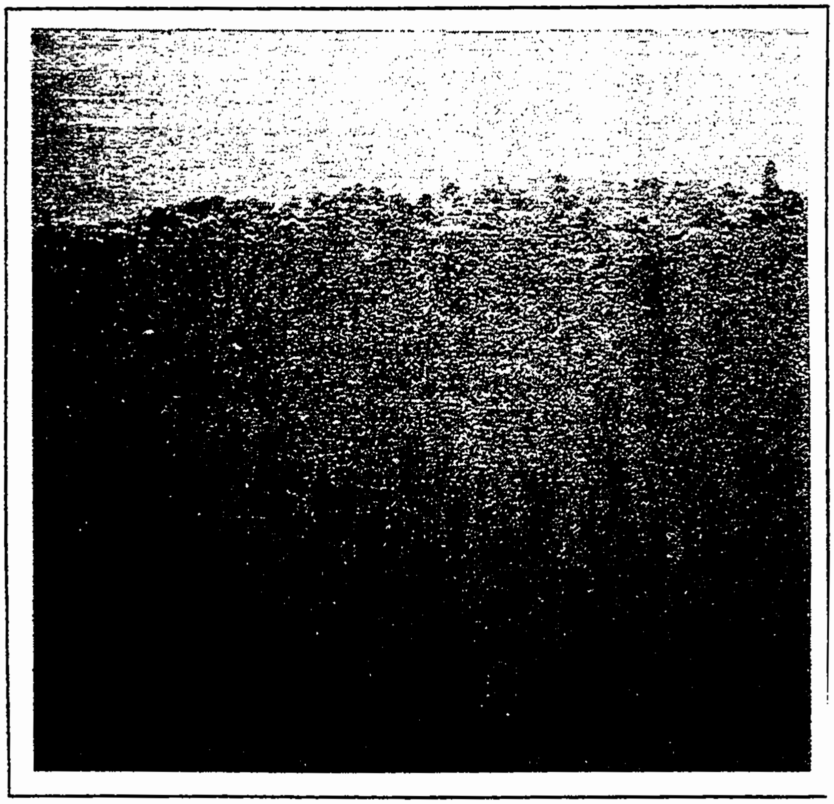

Figure 4. Sediment profile image from Habitat Ib (Station SPEC 11, Deployment B). Senescent *Ampelisca* spp. tube mat on the sediment surface.

TABLE 3-3. SUMMARY OF HABITAT CHARACTERISTICS FROM THE BOSTON HARBOR STATIONS.

Prism Penetration:

Habitat	N	Mean	SE[a]	Median	Min	Max
Ia	18	12.2	0.7	12.8	6.8	16.5
Ib	14	10.9	0.9	12.0	3.2	15.8
IIa	22	4.4	0.7	2.9	0.0	10.0
IIb	6	11.2	1.5	11.3	7.0	16.8
IIc	2	10.1	3.1	10.1	7.0	13.2
IIIa	41	18.2	0.7	20.5	7.0	24.5
	16	>22.0*				
IIIb	30	16.1	0.6	16.3	10.0	22.0
	1	>22.0*				
IVa	4	19.0	1.5	18.5	16.5	22.5
IVb	6	9.2	2.0	8.0	4.8	17.8

*-Images that over penetrated within 2 sec. of bottom contact.

Apparent Color RPD (only images with complete RPD layers)

Habitat	N	Mean	SE[a]	Median	Min	Max
Ia	16	3.2	0.3	3.1	1.5	5.0
Ib	14	2.5	0.3	2.2	1.3	4.8
IIa	16	1.2	0.2	0.9	0.5	3.5
IIb	6	1.0	0.1	1.0	0.6	1.3
IIc	1	2.5				
IIIa	40	0.8	0.1	0.8	0.2	4.0
IIIb	30	0.9	0.1	0.8	0.0	3.0
IVa	4	0.8	0.2	0.8	0.5	1.0
IVb	6	0.6	0.1	0.5	0.2	1.0

[a]SE=Standard Error

(continued)

TABLE 3-3. (Continued)

Organism Sediment Index (OSI):

Habitat	N	Median	Min	Max
Ia	16	7.5	5	9
Ib	12	7	5	9
IIa	16	3	2	8
IIb	6	3	2	5
IIc	1	7		
IIIa	39	3	1	4(7?)
IIIb	30	2.5	0	4
IVa	4	2.5	2	3
IVb	6	2.5	0	3

Cross-Classification of Habitats and Tubes:

Habitat	Relative Tubes Abundance					
	NONE	FEW	SOME	MANY	MAT	Total
6Ia	0	0	0	3	17	20
Ib	0	0	1	2	11	14
IIa	9	2	2	3	3	19
IIb	2	4	0	0	0	6
IIc	0	0	1	0	1	2
IIIa	24	14	0	0	0	38
IIIb	17	11	1	1	0	30
IVa	1	2	0	0	0	3
IVb	3	2	1	0	0	6
Total	56	35	6	9	32	138

(continued)

TABLE 3-3. (Continued)

Cross-Classification of Habitats and Successional Stage:

	Estimated Successional Stage				
Habitat	IND	I?	I	II	Total
Ia	0	0	0	20	20
Ib	0	0	0	14	14
IIa	6	4	10	4	24
IIb	0	1	6	0	7
IIc	1	0	0	1	2
IIIa	7	22	28	0	57
IIIb	0	10	20	0	30
IVa	0	0	4	0	4
IVb	0	1	5	0	6
Total	14	38	73	39	164

Cross-Classification of Habitats and Void type:

	Void Type			
Habitat	Oxic	Anoxic	Gas	Total
Ia	5	3	0	8
Ib	0	3	0	3
IIa	2	2	0	4
IIb	0	1	0	1
IIc	1	1	0	2
IIIa	0	6	4	10
IIIb	0	9	3	12
IVa	0	0	0	0
IVb	0	0	0	0
Total	8	25	7	40

NOTE:

Both deployments at a station were used as replicates to include some estimate of small scale within habitat heterogeneity. See Table 3-2 for habitat descriptions. A ? with successional stage indicates that there was insufficient data in the image to clearly assign a value. N for each of the parameters is the total number of images in each habitats that contained valid data.

Habitat Ib (Table 3-3). *Ampelisca* tubes in Habitat Ib were shorter and "older" looking than those seen in Habitat Ia. Prism penetrations was about 11 cm in both subhabitats.

Habitat II had heterogeneous sediments that ranged form hard sand, shell, to silts (Figs. 5, 6, and 7). Drift algae and epifauna were common (Fig. 5). The subdivision into Habitats IIa, IIb, and IIc was based on the prism penetration and the presence of tubes and shell. Habitat IIa had more surface fauna than Habitat IIb (Table 3-3). Habitat IIc was *Mytilus* shell beds mixed with *Ampelisca* tube mats and was found at only one station (Fig. 7).

Habitat III was depositional with homogeneous unconsolidated muddy sediments that appeared to not be bioturbated, sediment layering was common (Figs. 8 and 9). Apparent successional stage was I with no evidence of higher successional stages. Gas voids (Fig. 9) were present and indicate either rapid deposition or high inputs of organic matter, or both (Table 3-3). Muddy habitats with large amounts of methane gas are generally associated with areas of oxygen stress or high organic loading (Rhoads and Germano 1986, Diaz et al. 1993). The subdivision into Habitats IIIa and IIIb was based on differences in prism penetration, with IIIa having softer sediments. Habitat IIIb also had more surface fauna than IIIa (Table 3-3).

Habitat IV had heterogeneous sediments that ranged from sand to mud and clay (Figs. 10 and 11). Successional stage was I with little surface fauna (Table 3-3). The subdivision into Habitats IVa and IVb was based on slight differences in sediment type, with IVb having sandier sediments.

3.1.3 <u>Massachusetts Bay Habitats</u>

Four basic benthic habitats were identified among the 71 Massachusetts Bay stations (Table 3-2, Appendix C). Examples of each of the habitat types can be seen in Figures 12 to 15. All four of these habitats appeared physically dominated by currents. The median OSI was reasonably constant across Habitats V to VIII at 5.5 to 6.5, indicative of moderately stressful conditions (Table 3-4). Biological processes were most evident within Habitat VII, where large worm tubes (about 3 to 5 mm in diameter) were common. The

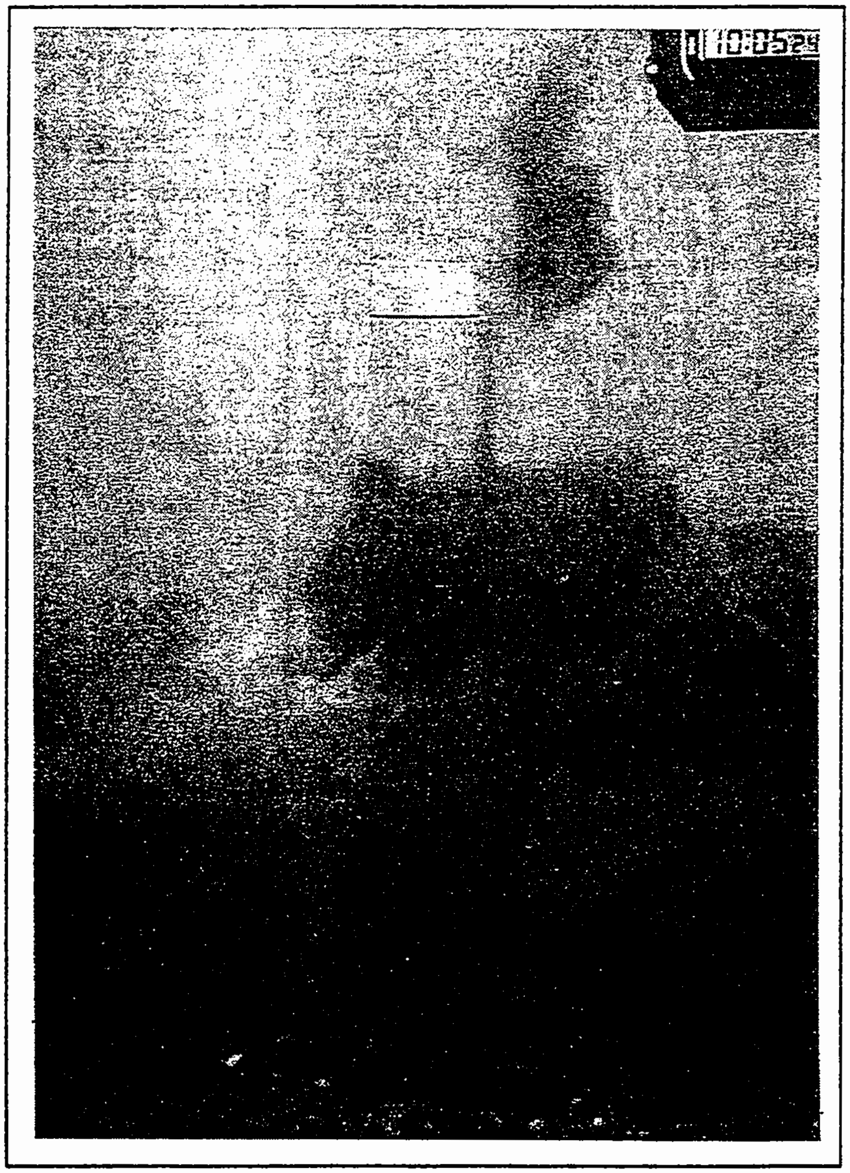

Figure 5. Sediment profile image from Habitat IIa (Station SPEC 8, Deployment B). Hard bottom with attached and drift algae.

0 1 2

Approximate Scale In cm

Figure 6. Sediment profile image from Habitat IIb (Station CHELR 2, Deployment B). Muddy sediment with thin apparent color RPD layer and a few worm tubes at the sediment interface.

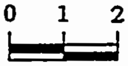

Figure 7. Sediment profile image from Habitat IIc (Station SUBE 1, Deployment B). *Mytilus* shell bed over soft sediments.

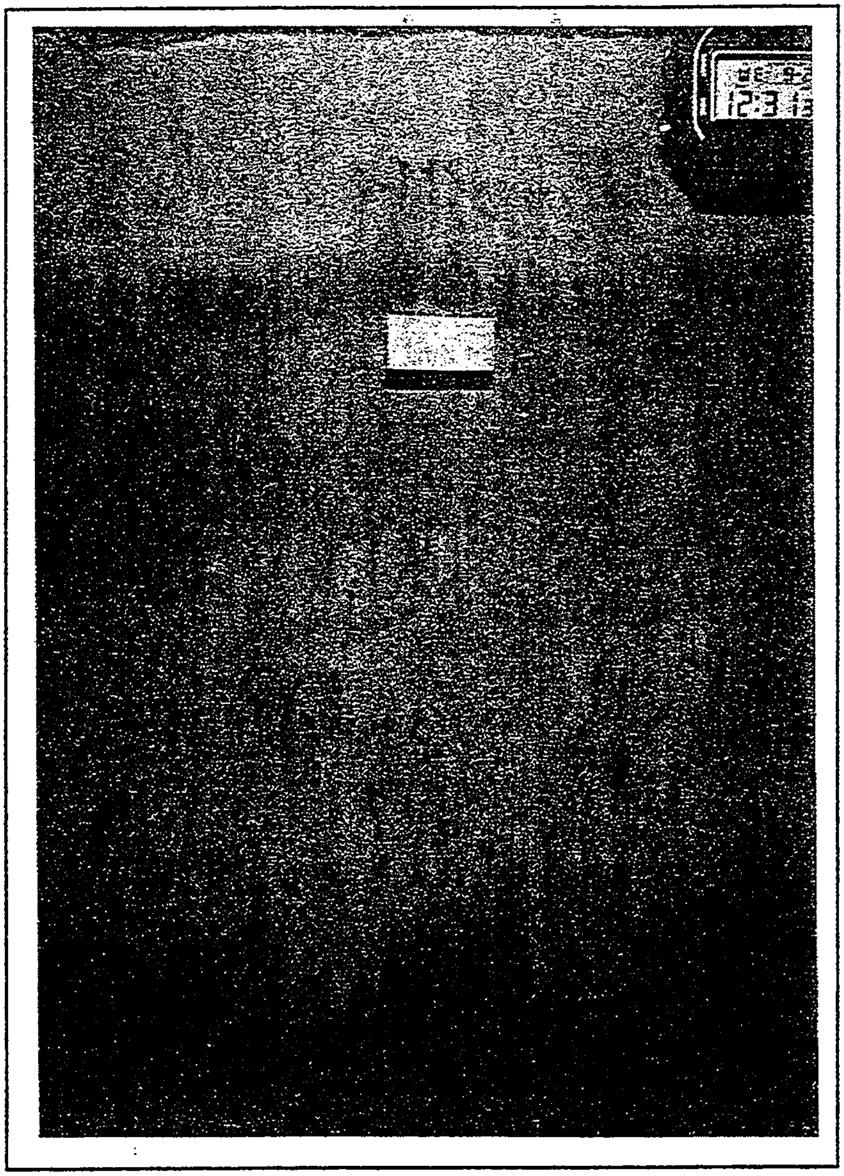

Figure 8. Sediment profile image from Habitat IIIa (Station FP 2, Deployment B). Very soft muddy sediments with no signs of infaunal activity. Three layers of anaerobic sediment are seen.

0 1 2

Approximate Scale In cm

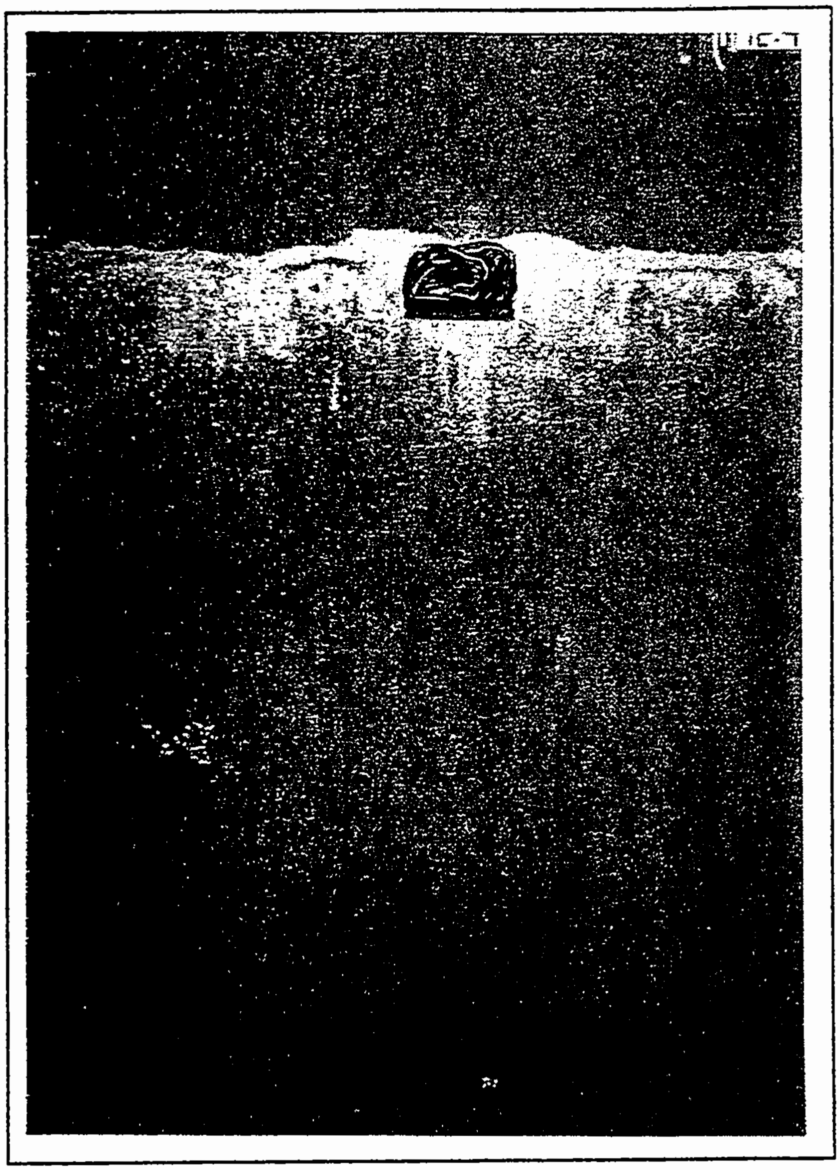

Figure 9. Sediment profile image from Habitat IIIb (Station LOG2 4, Deployment A). Soft muddy sediments with gas voids and two layers of anaerobic sediment.

0 1 2

Approximate Scale In cm

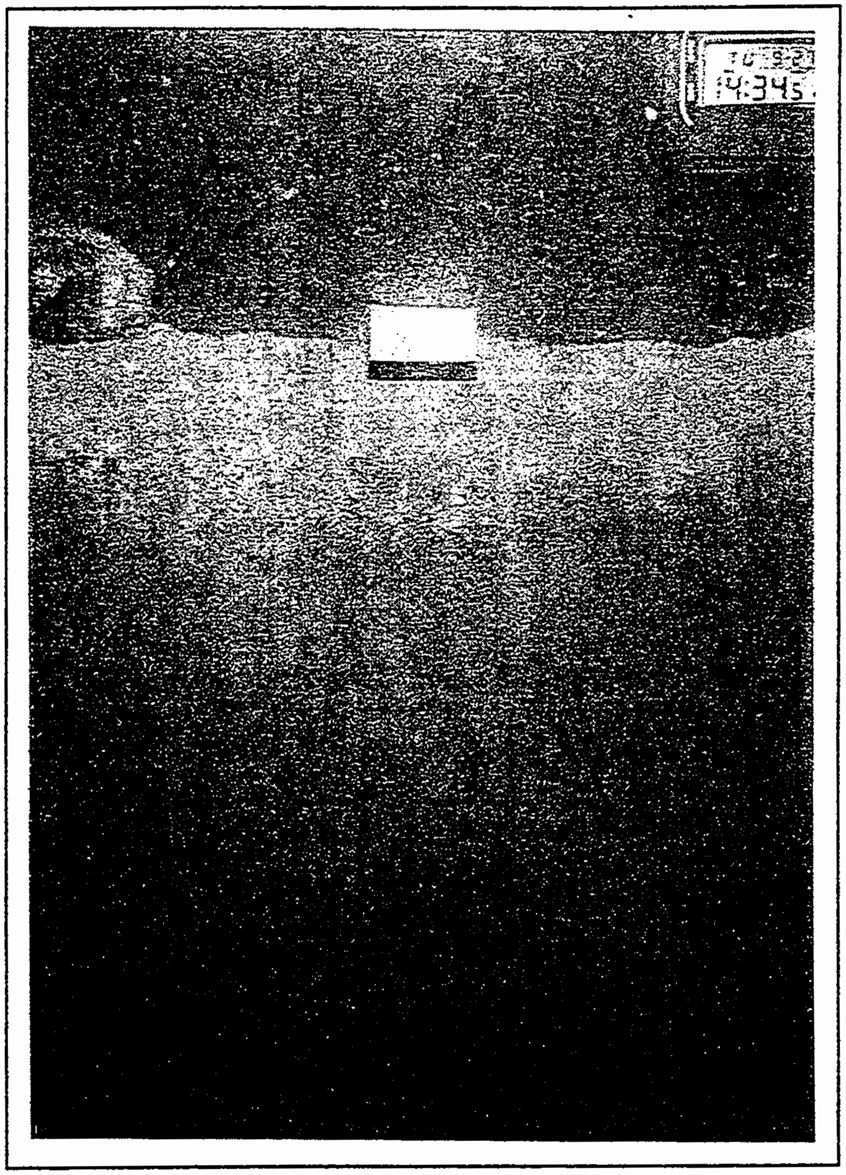

Figure 10. Sediment profile image from Habitat IVa (Station MP 1, Deployment A). Mixed muddy sediment with epifaunal organism on surface.

0 1 2

Approximate Scale In cm

Figure 11. Sediment profile image from Habitat IVb (Station MP 3, Deployment A). Muddy-sandy sediment with either a biogenic mound or bedform in the center of the image.

0 1 2

Approximate Scale In cm

Figure 12. Sediment profile image from Habitat V (Station BLS 16, Deployment B). Rounded rock covered by many small tube-like structures.

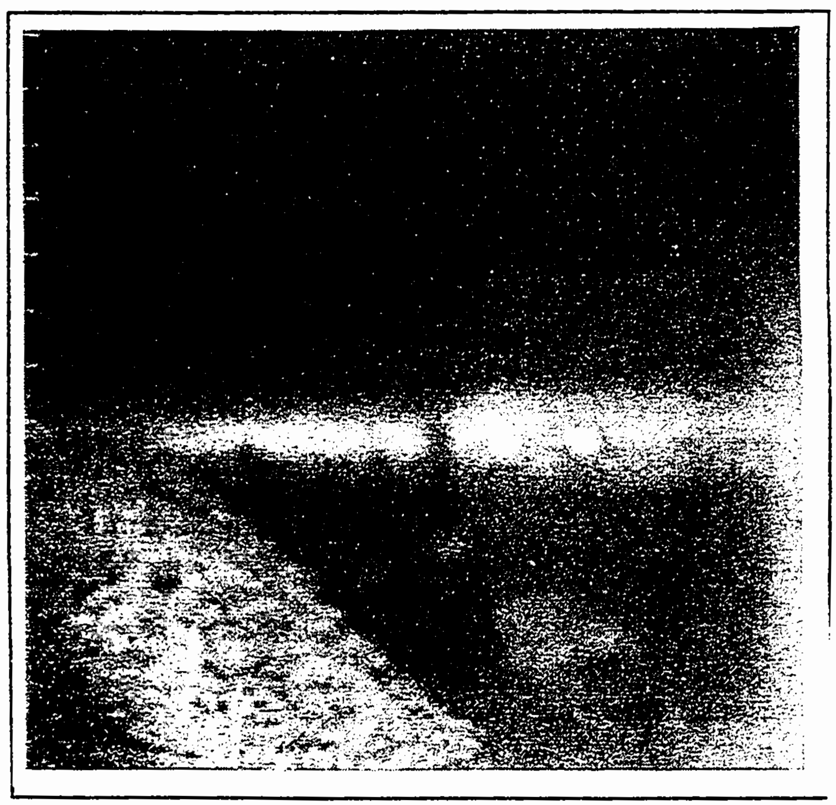

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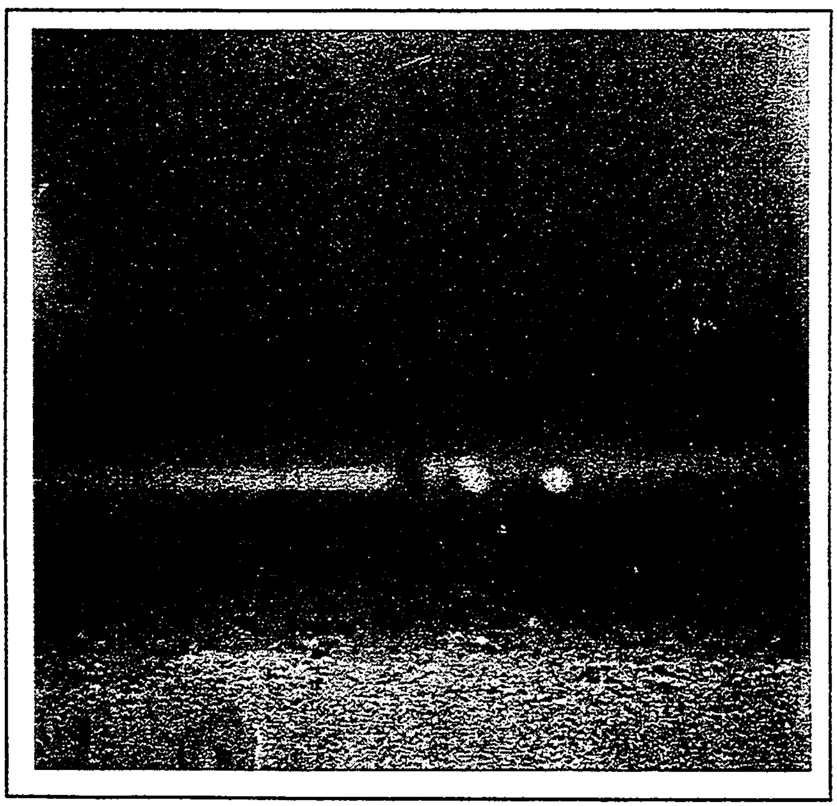
Figure 13. Sediment profile image from Habitat VI (Station M7 23, Deployment B). Loose gravel sediment.

0 1 2

Approximate Scale In cm



igure 14. Sediment profile image from Habitat VII (Station M2 3, Deployment A). Hard sandy sediment with many tubes protruding from the sediment surface.

Figure 15. Sediment profile image from Habitat VIII(Station BLS 17, Deployment A). Heterogeneous sediments with many tubes protruding above the surface. Light gray clay layer near the bottom of the image is likely relic dredged material.

0 1 2

Approximate Scale In cm

TABLE 3-4. SUMMARY OF HABITAT CHARACTERISTICS FROM THE MASSACHUSETTS BAY STATIONS.

Prism Penetration:

Habitat	N	Mean	SE[a]	Median	Min	Max
V	45	0.1	0.03	0.0	0	1.0
VI	20	0.6	0.4	0.0	0	8.0
VII	50	2.6	0.4	1.0	0	11.3
VIII	19	5.0	0.8	4.8	0	16.0

Apparent Color RPD (only images with complete RPD layers)

Habitat	N	Mean	SE[a]	Median	Min	Max
V	0					
VI	0					
VII	17	2.0	0.2	1.8	1.2	5.0
VIII	14	1.5	0.2	1.5	0.5	2.5

Organism Sediment Index (OSI):

Habitat	N	Median	Min	Max
V	2	6.5	5	7
VI	1	5		
VII	26	6	3	9
VIII	10	5.5	3	7

Cross-Classification of Habitats and Tubes:

	Relative Tubes Abundance				
Habitat	NONE	FEW	SOME	MANY	Total
V	25	4	5	9	43
VI	10	4	3	3	20
VII	1	2	26	21	50
VIII	7	2	3	6	18
Total	44	12	39	40	135

(continued)

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TABLE 3-4. (Continued)

Cross-Classification of Habitats and Successional Stage:

	Estimated Successional Stage				
Habitat	IND	I	II?	II	Total
V	45	0	0	0	45
VI	16	0	0	4	20
VII	7	0	2	41	50
VIII	9	1	0	9	19
Total	77	1	2	54	134

Note:

Both deployments at a station were used as replicates to include some estimate of small scale within habitat heterogeneity. See Table 3-2 for habitat descriptions. A ? with successional stage indicates that there was insufficient data in the image to clearly assign a value. N for each of the parameters is the total number of images in each habitats that contained valid data.

[a]SE=Standard Error

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apparent successional stage at most stations, when it could be determined, was II. Within habitat heterogeneity was low and habitat types were not subdivided.

Habitat V was primarily pebbles, angular and rounded, underlain by gravel or silts. Many of pebbles were colonized by epifauna (Fig. 12). Habitat VI was similar to V but was primarily gravels (Fig. 13).

Habitat VII was hard sand with median penetration of 1 cm (Fig. 14). Worm tubes were common at most stations (Table 3-4). This was the most biologically accommodated of the Massachusetts Bay habitats.

Habitat VIII had heterogeneous sediments ranging from gravel to clay. Several stations in the Boston Lightship area had sediments that appeared to be relic dredged material (BLS 8, 17, and 18, see Figure 15). Dredged material was also identified in profile images collected in this area by SAIC (1994).

3.2 BENTHIC INFAUNA

In this section, the benthic infauna data are grouped for analysis purposes by the biophysical habitats identified in the sediment profile camera survey described in Section 3.1. Comprehensive descriptions of the individual habitats appear in that section. Groupings are listed in Table 3-5.

3.2.1 Boston Inner Harbor Locations

Amstar

Habitat III, homogeneous muddy sediment, was found at both Amstar sample locations (Appendix Table E-1). Mean density of macroinvertebrates collected was 1,912.5/m^2. A total of 11 taxa was identified, most of them polychaete worms (5) and amphipod crustaceans (3). Most of the organisms collected were the polychaete worms

TABLE 3-5. DISTRIBUTION OF STATIONS SAMPLED FOR BENTHOS AMONG HABITAT TYPES.

SITE	HABITAT I	II	III	IV	V	VI	VII	VIII
INNER HARBOR								
Inner Confluence		1,2,5	3,4					
Chelsea Creek		1,2,3,4,5						
Mystic River			1,2	3,4,5				
Little Mystic Channel			2,4					
Revere Sugar			1,3					
Amstar			1,3					
Chel 01			1,3					
Chel 02			1,3					
Cabot Paint		1	3					
Everett			1,2					
Conley			A					
Mystic Piers		3		2				
OUTER HARBOR								
Spectacle Island	2,5,11,12	8						
Subaqueous B	2							
Subaqueous E	2,3	1						
MASSACHUSETTS BAY								
Boston Lightship							1,3,5,7,17, 20,22,24	8,10,11
Meisburger 2					6		2,3,5,7,15, 17	9,10
Meisburger 7					13,22	2,4,6,18	21	8,9

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Polydora cornuta (625.0/m^2) and *Streblospio benedicti* (412.5/m^2) and nematode worms (587.5/m^2). Combined, the amphipods represented only 5% (100.0/m^2) of the total abundance. No commercially or recreationally important species were collected.

Chelsea 01

Habitat III, homogeneous muddy sediment, was observed at both Chelsea 01 sample locations (Appendix Table E-1). Mean density of macroinvertebrates collected was 275.0/m^2. A total of 8 taxa was identified, one-half of them polychaete worms (4). Most of the organisms collected were polychaete (100.0/m^2) and nematode (87.5/m^2) worms. No commercially or recreationally important species were collected.

Chelsea 02

Habitat III, homogeneous muddy sediment, was identified at both Chelsea 02 sample locations (Appendix Table E-1). Mean density of macroinvertebrates collected was 37.5/m^2. Only two taxa were collected - nematode worms (25.0/m^2) and the bivalve *Mulinia lateralis* (12.5/m2). None of these taxa is commercially or recreationally important.

Chelsea Creek

Habitat II, a mixture of sand, silt, and shells, was observed at the five Chelsea Creek sample locations (Appendix Table E-1). Mean density of macroinvertebrates collected was 545.0/m^2. A total of 26 taxa was identified, most of them polychaete worms (12), gastropods (4), and bivalves (4). Most of the organisms collected were polychaete worms (360.0/m^2), especially *Polydora cornuta* (230.0/m^2). The gastropods *Crepidula* spp. occurred at an abundance of 95.0/m^2. No commercially or recreationally important species were collected.

Conley

Habitat III, homogeneous muddy sediment, was found at the single Conley sample location (Appendix Table E-1). Density of macroinvertebrates collected was $1{,}150.0/m^2$. A total of 16 taxa was identified, most of them polychaete worms (9). The remaining seven taxa represented a variety of phylogenetic groups. Most of the organisms collected were nematode ($450.0/m^2$), polychaete ($325.0/m^2$), and oligochaete ($200.0/m^2$) worms. No commercially or recreationally important species were collected.

Cabot Paint

Two different habitats were identified at Cabot Paint (Appendix Table E-1). Habitat II, a mixture of sand, silt, and shells, was present at Sample Location 1, whereas Habitat III, homogeneous muddy sediment, was observed at Sample Location 3.

Only one taxon was collected at Sample Location 1 - the polychaete worm *Polydora cornuta* ($25.0/m^2$). At Sample Location 3, density of macroinvertebrates collected was $375.0/m^2$. A total of 6 taxa was identified, most of them polychaete worms (4). Most of the organisms collected were polychaete worms ($300.0/m^2$), especially *Polydora cornuta* ($175.0/m^2$) and *Streblospio benedicti* ($75.0/m^2$). No commercially or recreationally important species were collected.

Everett

Habitat III, homogeneous muddy sediment, was found at both Everett sample locations (Appendix Table E-1). Mean density of macroinvertebrates collected was $362.5/m^2$. A total of 10 taxa was identified, one-half of them polychaete worms (5). Most of the organisms collected were polychaete worms ($262.5/m^2$). Only one commercially or recreationally important species was collected - the softshell clam, *Mya arenaria* ($25.0/m^2$).

Inner Confluence

Two different habitats were identified at Inner Confluence (Appendix Table E-1). Habitat II, a mixture of sand, silt, and shells, was present at Sample Locations 1, 2, and 5, whereas Habitat III, homogeneous muddy sediment, was observed at Sample Locations 3 and 4.

At Sample Locations 1, 2, and 5, mean density of macroinvertebrates collected was 1,649.8/m^2. A total of 26 taxa was identified, most of them polychaete worms (11), bivalves (6), and gastropods (4). Most of the organisms collected were polychaete worms (725.0/m^2), oligochaete worms (500.0/m^2), and gastropods (316.7/m^2). *Polydora cornuta* (417.5/m^2) was the most abundant polychaete; *Nassarius trivittatus* (250.0/m^2) was the most abundant gastropod. No commercially or recreationally important species were collected.

At Sample Locations 3 and 4, mean density of macroinvertebrates collected was much lower (37.5/m^2). Only two taxa were collected - the polychaete worms Nephtyidae (25.0/m^2) and *Polydora cornuta* (12.5/m^2). None of these taxa is commercially or recreationally important.

Little Mystic Channel

Habitat III, homogeneous muddy sediment, was observed at all three Little Mystic Channel sample locations (Appendix Table E-1). Mean density of macroinvertebrates collected was only 16.6/m^2. Only three taxa were collected - the bivalve *Mulinia lateralis* (8.3/m^2), the amphipod *Gammarus lawrencianus* (8.3/m^2), and the hydrozoan *Obelia* sp. (present, but not enumerated). None of these taxa is commercially or recreationally important.

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Mystic Piers

Two different habitats were identified at Mystic Piers (Appendix Table E-1). Habitat II, mixed silty sediment, was present at Sample Locations 3A and 3B, whereas Habitat IV, mixed muddy sediment, was observed at Sample Locations 2A and 2B.

At Sample Locations 3A and 3B, only one taxon was collected - the gastropod *Nassarius trivittatus* ($37.5/m^2$). Mean density of macroinvertebrates collected was only slightly higher at Sample Locations 2A and 2B ($62.5/m^2$), where five taxa were collected in equal density. None were commercially or recreationally important species.

Mystic River

Two different habitats were identified at Mystic River (Appendix Table E-1). Habitat III, homogeneous muddy sediment, was present at Sample Locations 1 and 2, whereas Habitat IV, mixed sandy mud, was observed at Sample Locations 3, 4, and 5.

Only one taxon was collected at Sample Locations 1 and 2 - the hydrozoan *Obelia* sp. (present, but not enumerated). Mean density of macroinvertebrates collected at Sample Locations 3, 4, and 5 was $58.2/m^2$. Most of the organisms collected were the polychaete worm *Polydora cornuta* ($33.3/m^2$), although three other taxa were collected. No commercially or recreationally important species were collected.

Reserved Channel

No sediment profile camera survey was conducted in the Reserved Channel. Therefore, no habitat description is available.

Mean density of macroinvertebrates collected at the three sample locations was $1,041.4/m^2$ (Appendix Table E-1). A total of 17 taxa was identified, most of them polychaete worms (12) and bivalves (4). Most of the organisms collected were polychaete worms

(799.8/m^2), especially *Leitoscoloplos robustus* (375.0/m^2). The only commercially or recreationally important species collected was the softshell clam, *Mya arenaria* (158.3/m^2).

Revere Sugar

Habitat III, homogeneous muddy sediment, was observed at all three Revere Sugar sample locations (Appendix Table E-1). Mean density of macroinvertebrates collected was 483.2/m^2. A total of 9 taxa was identified, most of them polychaete worms (5). Most of the organisms collected were polychaete (216.6/m^2) and oligochaete (183.3/m^2) worms. No commercially or recreationally important species were collected.

3.2.2 Boston Outer Harbor Locations

Spectacle Island

Two different habitats were identified at Spectacle Island (Appendix Table E-2). Habitat I, silty sediment with amphipod crustacean tube mats on the surface, was present at Sample Locations 2, 5, 11, and 12, whereas Habitat II, a mixture of sand, silt, and shell, was observed at Sample Location 8.

Mean density of macroinvertebrates collected at Sample Locations 2, 5, 11, and 12 was 64,870.6/m^2). A total of 59 taxa was identified, most of them polychaete worms (27) and amphipod crustaceans (15). Most of the organisms collected were amphipod crustaceans (41,556.7/m^2), especially *Ampelisca* sp. (36,537.5/m^2), and polychaete worms (20,275.0/m$^{2)}$, especially *Aricidea catherinae* (9,668.8/m^2) and *Polydora cornuta* (4,706.3/m^2). No commercially or recreationally important species were collected.

Density of macroinvertebrates collected at Sample Location 8 was 102,025.0/m^2. A total of 41 taxa was identified, most of them polychaete worms (28) and amphipod crustaceans (6). Most of the organisms collected were amphipod crustaceans (65,175.0/m^2), especially *Ampelisca* sp. (61,675.0/m^2), and polychaete worms (35,925.0/m^2), especially

Polydora cornuta (14,400.0/m^2) and *Streblospio benedicti* (11,800.00/m^2). No commercially or recreationally important species were collected.

Subaqueous B

Habitat I, silty sediment with amphipod crustacean tube mats on the surface, was identified at all three Subaqueous B sample locations (Appendix Table E-2). Mean density of macroinvertebrates collected was 115,149.6/m^2. A total of 60 taxa was identified, most of them polychaete worms (31) and amphipod crustaceans (10). Most of the organisms collected were amphipod crustaceans (101,083.2/m^2), especially *Ampelisca* sp. (94,358.3/m^2). No commercially or recreationally important species were collected.

Subaqueous E

Two different habitats were identified at Subaqueous E (Appendix Table E-2). Habitat I, silty sediment with amphipod crustacean tube mats on the surface, was present at Sample Locations 2 and 3, whereas Habitat II, a mussel shell bed, was observed at Sample Location 1. .

Mean density of macroinvertebrates collected at Sample Locations 2 and 3 was 50,987.5/m^2. A total of 51 taxa was identified, most of them polychaete worms (29), amphipod crustaceans (5), and bivalves (5). Most of the organisms collected were amphipod crustaceans (23,975.0/m^2), especially *Ampelisca* sp. (23,075.0/m^2), and polychaete worms (23,775.0/m^2), especially *Polydora cornuta* (9,300.0/m^2) and *Tharyx acutus* (6,025.0/m^2). The only commercially and recreationally important species collected were the softshell clam, *Mya arenaria* (25.0/m^2) and mussels, Mytilidae (150.0/m^2).

Density of macroinvertebrates collected at Sample Location 1 was 975.0/m^2. A total of 15 taxa was identified, most of them polychaete worms (8). Most of the organisms collected also were polychaete worms (525.0/m^2), especially *Nephtys ciliata* (200.00/m^2) and

Ninoe nigripes (150.0/m^2). Only two commercially or recreationally important species were collected - the softshell clam, *Mya arenaria* (25.0/m^2) and the mussel Mytilidae (50.0/m^2).

3.2.3 Massachusetts Bay Locations

Boston Lightship

Two different habitats were identified at Boston Lightship (Appendix Table E-3). Habitat VII, hard sand, was present at Sample Locations 1, 3, 5, 7, 17, 20, 22, and 24, whereas Habitat VIII, a heterogeneous mixture of clay, silt, sand, and gravel, was observed at Sample Locations 8, 10, and 11. Habitats V (rock) and VI (gravel), though identified by sediment profile imagery, were not sampleable.

Mean density of macroinvertebrates collected at Sample Locations 1, 3, 5, 7, 17, 20, 22, and 24 was 9,066.5/m^2. A total of 125 taxa was identified, most of them polychaete worms (73), bivalves (14), and amphipod crustaceans (13). Most of the organisms collected were polychaete worms (7,947.2/m^2), especially *Spio limicola* (4,268.8/m^2). Bivalves (465.0/m^2) were the next most abundant group, particularly *Thyasira flexuosa* (235.0/m^2) and *Yoldia* sp. (102.5/m^2). Two commercially or recreationally important species were collected - the softshell clam, *Mya arenaria* (6.3/m^2) and the ocean quahog, *Arctica islandica* (3.1/m^2).

Mean density of macroinvertebrates collected at Sample Locations 8, 10, and 11 was 4,732.7/m^2. A total of 76 taxa was identified, most of them polychaete worms (44), bivalves (10), and amphipod crustaceans (7). Most of the organisms collected were polychaete worms (3,433.1/m^2), especially *Spio limicola* (991.7/m^2) and *Maldane sarsi* (442.5/m^2). Only one commercially or recreationally important species was collected - the softshell clam, *Mya arenaria* (33.3/m^2).

Meisburger 2

Three different habitats were identified at Meisburger 2 (Appendix Table E-3). Habitat V, rocks underlain by silt, sand, and gravel, was present at Sample Location 6. Habitat VII, hard sand, was observed at Sample Locations 2, 3, 5, 7, 15, and 17. Habitat VIII, a heterogeneous mixture of clay, silt, sand, and gravel, was present at Sample Locations 9 and 10.

Density of macroinvertebrates collected at Sample Location 6 was 9,066.5/m^2. A total of 55 taxa was identified, most of them polychaete worms (35) and bivalves (8). Most of the organisms collected were polychaete worms (8,600.0/m^2), especially *Polydora quadrilobata* (1,225.0/m^2), *Prionospio steenstrupi* (1,125.0/m^2), and *Euchone elegans* (1,050.0/m^2), and amphipod crustaceans (1,775.0/m^2), especially *Unciola inermis* (1,250.0/m^2). Two commercially or recreationally important species were collected - the mussel Mytilidae (50.0/m^2) and the softshell clam, *Mya arenaria* (25.0/m^2).

Mean density of macroinvertebrates collected at Sample Locations 2, 3, 5, 7, 15, and 17 was 9,534.4/m^2. A total of 150 taxa was identified, most of them polychaete worms (71), amphipod crustaceans (22), other arthropods (9) and bivalves (18). Most of the organisms collected were polychaete worms (6,863.0/m^2), especially *Polydora quadrilobata* (991.7/m^2), *Aphelochaeta marioni* (858.3/m^2), and *P. socialis* (816.7/m^2). Mean abundance of bivalves was 1022.5/m^2, including *Crenella decussata* (250.0/m^2), *Thyasira flexuosa* (207.5/m^2), *Nucula tenuis* (167.5/m^2) and *Cerastoderma pinnulatum* (162.5/m^2). Amphipods (752.5/m^2) were represented primarily by *Unciola* spp. (217.5/m^2) and *Haploops tubicola* (212.5/m^2). Two commercially or recreationally important species were collected - the mussel Mytilidae (20.0/m^2) and the softshell clam, *Mya arenaria* (16.7/m^2).

Mean density of macroinvertebrates collected at Sample Locations 9 and 10 was 17,925.0/m^2. A total of 88 taxa was identified, most of them polychaete worms (58), amphipod crustaceans (10), and bivalves (9). Most of the organisms collected were polychaete worms (15,675.0/m^2), especially *Polydora quadrilobata* (4,025.0/m^2), *Euchone elegans* (2,437.5/m^2), *Aphelochaeta marioni* (1,950.0/m^2), and *P. socialis* (1,337.5/m^2). No commercially or recreationally important species were collected.

Meisburger 7

Four different habitats were identified at Meisburger 7 (Appendix Table E-3). Habitat V, rocks underlain by silt, sand, and gravel, was present at Sample Locations 13 and 22. Habitat VI, pea to pebble size gravel, was observed at Sample Locations 2, 4, 6, and 18. Habitat VII, hard sand, was present at Sample Location 21. Habitat VIII, a heterogeneous mixture of clay, silt, sand, and gravel, was present at Sample Locations 8 and 9.

Mean density of macroinvertebrates collected at Sample Locations 13 and 22 was 4,962.5/m^2. A total of 61 taxa was identified, most of them polychaete worms (39) and amphipod crustaceans (9). Most of the organisms collected were polychaete worms (4,137.5/m^2), especially *Polydora socialis* (787.5/m^2), *Euclymene collaris* (450.0/m^2) and *Ninoe nigripes* (450.0/m^2). No commercially or recreationally important species were collected.

Mean density of macroinvertebrates collected at Sample Locations 2, 4, 6, and 18 was 6,396.7/m^2. A total of 92 taxa was identified, most of them polychaete worms (54), amphipod crustaceans (14), and bivalves (12). Most of the organisms collected were polychaete worms (3,364.2/m^2), especially *Euclymene collaris* (575.0/m^2) and *Exogone verugera* (412.5/m^2), and amphipod crustaceans (2,381.7/m^2), especially *Unciola inermis* (1,618.8/m^2) and *U. irrorata* (550.0/m^2). One commercially important species was collected - the sea scallop, *Placopecten magellanicus* (6.3/m^2).

Density of macroinvertebrates collected at Sample Location 21 was 7,150.0/m^2. A total of 45 taxa was identified, most of them polychaete worms (27) and amphipod crustaceans (6). Most of the organisms collected were polychaete worms (6,225.0/m^2), especially *Spiophanes bombyx* (1,100.0/m^2), *Asabellides oculata* (975.0/m^2), and *Euclymene collaris* (975.0/m^2). No commercially or recreationally important species were collected.

Mean density of macroinvertebrates collected at Sample Locations 8 and 9 was 2,512.5/m^2. A total of 35 taxa was collected, most of them polychaete worms (24). Most of the organisms collected were polychaete worms (2,037.5/m^2), especially *Mediomastus* *californiensis* (237.5/m^2) and *Spio limicola* (237.5/m^2). No commercially or recreationally important species were collected.

4.0 DISCUSSION

This section compares the results of this survey with other studies in Boston Harbor and Massachusetts Bay. Benthic habitat and community characteristics are discussed in terms of the requirements of winter flounder and lobster to evaluate the importance of these areas in supporting fisheries resources.

4.1 BOSTON INNER HARBOR LOCATIONS

The sediment profile camera survey identified three habitats (II, III, and IV) present at the Boston Inner Harbor locations. Many stations within the inner harbor showed signs of physical and organic loading stress, particularly LOG1, LOG2 (Fig. 9), MPA1, CHEL1, CHEL2, CON, MAL, FP (Fig. 8), LMC, AM, and RS. Most of the locations contained Habitats II and/or III, with Habitat IV present only at Mystic Piers and Mystic River. Despite the physical differences upon which these habitats were distinguished, they did not appear to differ greatly in terms of biological characters. For example, epifauna was observed in Habitats II and IV, with none identified in Habitat III. In all cases, the benthic community was concluded to be Successional Stage I, a "pioneering" stage in which opportunistic species known for great reproductive capacity and rapid growth dominate. The apparent absence of a stable benthic community may be related to seasonal hypoxia ("August effect") previously identified in Boston Harbor (Hubbard and Bellmer 1989).

The grab sample data support the camera survey successional stage conclusion at all locations. Although a wide range of total macroinvertebrate population density was detected (0 at Mystic River - Habitat III to 1,912.5/m^2 at Amstar), all measurements are considered low. The same observation is true for the total number of taxa collected at each location (1 at Mystic River - Habitat III to 26 at Chelsea Creek and Inner Confluence - Habitat III). Many of the samples were dominated by such opportunistic species as the polychaete worms *Polydora cornuta* (Amstar, Chelsea Creek, Cabot Paint, and Inner Confluence) and *Streblospio benedicti* (Amstar, Chelsea 01, and Cabot Paint), nematode worms (Amstar, Chelsea 01, Chelsea 02, and Conley), and oligochaete worms (Conley, Inner Confluence, and Revere Sugar). Another opportunistic species. the bivalve *Mulinia lateralis*, was present in low numbers at several locations (Chelsea 02, Everett, Inner Confluence, Little Mystic Channel, and Reserved Channel).

Several noteworthy taxa were collected at a few locations. Only one commercially or recreationally important species, the soft shell clam, *Mya arenaria*, was collected at Reserved Channel (158.3/m^2). Another bivalve, the baltic clam, *Macoma balthica*, that is important as a food resource for diving ducks, was collected at Everett (12.5/m^2) and Reserved Channel (8.3/m^2). The sand shrimp, *Crangon septemspinosa*, was collected at Chelsea 01 (37.5/m^2), Chelsea Creek (10.0/m^2), and Revere Sugar (8.3/m^2). This species, which is important as a fish food resource, is more of a swimming than a benthic animal. Therefore, it was unlikely to be adequately sampled using a benthic grab and may, in fact, be present at the sample locations in different numbers than measured in this study.

Several Boston Inner Harbor locations standout in terms of total macroinvertebrate density and total number of taxa identified. Amstar, Inner Confluence, and Chelsea Creek samples contained the most macroinvertebrates and/or taxa, whereas Mystic River, Mystic Piers, Little Mystic Channel, Inner Confluence - Habitat III, Cabot Paint - Habitat II, and Chelsea 02 samples contained the fewest macroinvertebrates and taxa.

Benthic resources in the Mystic River, Chelsea River, Inner Confluence and Reserved Channels were sampled in July and November 1986 (reported in the DEIR/S). Abundances were higher in July than November 1986. While species composition was similar in fall 1986 and 1994, abundances were about 10 (Mystic River and Chelsea River) to 60 (Reserved Channel) times larger in 1994. The seasonal differences observed in the 1986 data suggest that the fall 1994 data under-represent the potential benthic productivity of the channels and may be attributable to a previously observed seasonal cycle of depressed oxygen concentrations (Hubbard and Bellmer 1989).

Data collected in April 1993 and reported (Table A1-2) in the Draft Environmental Impact Report and Draft Environmental Impact Statement (DEIR/S) are available for several Boston Inner Harbor (berth areas) locations. In general, taxonomic composition is similar to that observed in this study. However, population densities were much greater in April 1993.

The April 1993 data for Amstar were similar to those collected in this study - 10 taxa dominated by the opportunistic polychaete worm *Polydora cornuta*, nematode worms, and oligochaete worms. Macroinvertebrate mean density was 9,358.5/m^2, compared to 1,912.5/m^2 in this study.

In the case of Cabot Paint, composition of the dominant species is similar between both datasets (the opportunistic polychaete worms *Polydora cornuta* and *Streblospio benedicti*), except that oligochaete worm numbers were greatly reduced and nematode worms were not collected in this study. Macroinvertebrate mean density was 6,278.0/m^2, compared to 200.0/m^2 in this study (combination of Habitats II and III).

Species composition observed in April 1993 in Little Mystic Channel differed greatly from that collected in this study. A total of 30 taxa with mean macroinvertebrate density of 11,932.5/m^2 was reported in the DEIR/DEIS, although two taxa (oligochaeta and nematoda) accounted for 70% of this total and one station had a total density of 129/m^2. Only three taxa were collected with mean macroinvertebrate density of 16.6/m^2 in the 1994 study.

The April 1993 dataset for Mystic Piers also differed substantially from that collected in this study. A total of 13 taxa with mean macroinvertebrate density of 8,922.5/m^2 was reported in the DEIR/S. Only five taxa were collected with mean macroinvertebrate density of 50.0/m^2 in this study (combination of Habitats II and IV).

In the case of Reserved Channel, composition of the dominant species is similar between both datasets (the opportunistic polychaete worms *Polydora cornuta* and *Streblospio benedicti*, nematode worms, and oligochaete worms), except that the polychaete worm *Leitoscoloplos robustus* was relatively less important in April 1993. Macroinvertebrate mean density was 18,597.5/m^2, compared to 1,041.4/m^2 in this study. Mean density of the commercially/recreationally important softshell clam, *Mya arenaria*, was less in April 1993 (32.3/m^2) than in the present study (158.3/m^2). Differences could be partially attributable to the fact that sampling in 1993 was conducted west of the South Street bridge whereas collections were made just east of the bridge in 1994 because the sampling vessel was unable to sail under the bridge.

Species composition at Revere Sugar differed greatly between April 1993 and this study. Very large numbers of nematode worms and lesser, yet large numbers of the polychaete worm *Capitella capitata* dominated the April 1993 samples, resulting in a macroinvertebrate mean density measurement (87,662.7/m^2) greatly in excess of the number recorded in this study (483.2/m^2). In addition, 16 taxa were listed in the DEIR/S dataset, whereas only 9 taxa were identified in this study.

SAIC (1992) and Kropp and Diaz (1994) reported a distribution of benthic habitats in the inner harbor similar to the current study. There was a general improvement in benthic habitat conditions from 1992 to 1993, as evidenced by an increase in the depth of the RPD layer and in the OSI index. The lower densities observed in the fall 1994 compared to April 1993 may indicate that the benthic community had not yet recovered from the late summer hypoxia in 1994 when sampling was conducted.

4.2 BOSTON OUTER HARBOR LOCATIONS

The sediment profile camera survey identified two habitats (I and II) present at the Boston Outer Harbor locations. Both habitats displayed surface amphipod crustacean tube mats and/or infaunal burrows, evidence of benthic macroinvertebrate activity and good habitat quality. In particular, both habitats were determined to be supportive of macroinvertebrate communities in Successional Stage II, considered to be intermediate between or sharing characteristics of both Stage I (pioneering) and Stage III (advanced or equilibrium) communities. In general, Habitat I has been expanding in area in Boston Harbor since 1991 (Kropp and Diaz 1994).

The grab sample data support the camera survey findings at all locations. With exception of Subaqueous E - Habitat II (discussed later), the samples contained large numbers of organisms (50,987.5/m^2 at Subaqueous E - Habitat I to 115,149.6/m^2 at Subaqueous B) as well as many taxa (41 at Spectacle Island - Habitat II to 60 at Subaqueous B). The amphipod crustacean tube mats observed in the camera survey were reflected in the large numbers of *Ampelisca* sp. collected (23,075.0/m^2 at Subaqueous E - Habitat I to 94,358.3/m^2 at Subaqueous B. Although many other species were collected, some opportunistic species also were present, including the polychaete worms *Polydora cornuta*, *Streblospio benedicti*, and *Tharyx acutus* and nematode and oligochaete worms.

The single sample collected at Subaqueous E - Habitat II contained the least numbers of macroinvertebrates and taxa of all samples collected at the Boston Outer Harbor locations. This is a function of the substrate collected in this sample - a mixture of sand and shell hash containing no amphipod crustacean tube mats.

Several noteworthy taxa were collected. The commercially and recreationally important soft shell clam, *Mya arenaria*, was collected at Subaqueous E in Habitats I (25.0/m^2) and II (25.0/m^2). The Atlantic rock crab (*Cancer irroratus*) and/or the sand shrimp (*Crangon septemspinosa*) were collected in all of the habitats except Spectacle Island - Habitat II. These species are very motile. Therefore, they were unlikely to be adequately sampled using a benthic grab and may, in fact, be present at the sample locations in different numbers than measured in this study.

Benthic macroinvertebrate data collected in August 1992 and reported to the Massachusetts Water Resources Authority (Blake, Rhoads, and Williams 1993) are available for eight Boston Outer Harbor locations. In particular, data from samples collected at Locations T2 and T3 are considered most appropriate for comparison to those collected in this study due to geographic proximity and similar physical conditions.

Sediment grain size data for these locations are excerpted from Blake, Rhoads, and Williams (1993), Table 3 on page 15:

Station	% Gravel	% Sand	% Silt	% Clay
T2	21.3	47.6	19.1	12.1
T3	0.0	43.5	39.0	17.5

Although a gravel component (21.3%) was measured at Station T2, the sediment composition appears to be similar to that observed at the Boston Outer Harbor locations sampled in this study, with exception of Subaqueous E - Habitat II. Based on both sediment profile camera survey and grab sampling, Blake, Rhoads, and Williams (1993) considered the samples collected at Stations T2 and T3 to be representative of macroinvertebrate communities in Successional Stages I and II, respectively.

Station T2 was located closest to Subaqueous B and Subaqueous E. The following paragraph is quoted from Blake, Rhoads, and Williams (1993), page 27:

> Station T2 near Logan Airport also has several opportunistic species among the 10 most abundant. *Tubificoides* nr. *pseudogaster* was the most abundant species and represented about 33.3% of the total fauna. Other dominant species present that are usually associated with organically enriched environments include *Tharyx acutus*, *Streblospio benedicti*, *Polydora cornuta*, and *Tubificoides apectinatus*. *Polydora websteri* ranked ninth at this station.

Although Blake, Rhoads, and Williams (1993) data for Station T2 are somewhat similar to those collected at Subaqueous B and Subaqueous E - Habitat I in this study (i.e., importance of the polychaete worms *Tharyx acutus* and *Polydora cornuta*), they differ, also. Oligochaete worms (which would include *Tubificoides* nr. *pseudogaster*) and the polychaete worm *Streblospio benedicti* were not abundant taxa in this study. In addition, the very large numbers of the mat-building amphipod crustacean *Ampelisca* sp. that were collected in this study were not collected at T2 (Blake, Rhoads, and Williams 1993). Blake, Rhoads, and Williams (1993) data describe a benthic macroinvertebrate community in Successional Stage I, whereas Successional Stage II applies to the data collected in this study.

Station T3 (Blake, Rhoads, and Williams 1993) was located closest to Spectacle Island. The following paragraph is excerpted from Blake, Rhoads, and Williams (1993), page 27:

> Station T3 is on the north side of Long Island, near the site of a former sludge outfall. The amphipod *Ampelisca* spp., the polychaete *Polydora cornuta*, and the oligochaete *Tubificoides* nr. *pseudogaster* account for more than 75% of the total fauna. Four other amphipod species occur among the 10 most abundant species at this station.

The Blake, Rhoads, and Williams (1993) data are in good agreement with that collected in 1994 at Spectacle Island in both Habitats I and II. The same taxa, particularly the amphipod crustacean *Ampelisca* sp. and the polychaete worm *Polydora cornuta*, were dominant in both datasets. In addition, population densities of other important taxa are similar in both datasets. Both datasets describe benthic macroinvertebrate communities in Successional Stage II.

Several stations within the footprint of the potential disposal site were sampled in November 1988 (Battelle Ocean Sciences 1988). Although community structure was similar to recent observations, total abundances were substantially lower in 1988 (mean of 1453.3/m^2) than in 1994 (mean of 64,870.6/m^2 in Habitat I and 102,025.0/m^2 in Habitat II). In particular, abundances of *Ampelisca* sp. averaged only 702.2/m^2 in 1988 compared to 36,537.5-61,675.0/m^2 in 1994. Most other taxa that were dominant in 1988 also occurred in higher abundances in 1994. One exception was the surface-grazing gastropod *Nassarius trivittatus* whose abundance remained at similar levels. It is possible that these temporal differences in productivity may be a result of changes in MWRA's outfall at Deer Island. By 1992, MWRA had stopped discharging sludge (at a rate of 40 dry tons/day) into the outer Harbor (Alber et al. 1992); this action should have resulted in improved benthic conditions (i.e., less environmental stress) in this area of the Harbor.

4.3 MASSACHUSETTS BAY LOCATIONS

The sediment profile camera survey identified four habitats (V, VI, VII, and VIII) present at the Massachusetts Bay locations, all composed of or dominated by coarse materials (sand, gravel, and rock) and apparently current-affected. Although biological characters were observed in all habitats, they were most apparent as large numbers of worm tubes in Habitat VII, composed of hard sand. Despite uncertainty in several instances, the macroinvertebrate communities appeared to be in Successional Stage II.

Habitats in Massachusetts Bay (V and VI) were current dominated and mostly pebbles and gravels (Figs. 12 and 13). Benthic communities in sandy and silty sediments (Habitats VII and VIII) appeared to be well developed (Figs. 14 and 15). Similar habitat descriptions were made by Blake et al. (1993b) for the area around the MWRA Massachusetts Bay outfall located in between areas M2 and M7. Traces of relic dredged material were also seen in the Boston Lightship area (Fig. 15). Relic dredged material was also reported by SAIC (1994) in the same area.

The grab sample data support the camera survey successional stage conclusion at all locations, including confirming Successional Stage II determination where this was uncertain. The dataset indicates the presence of species-rich macroinvertebrate communities at all locations, communities that included deep burrowing, large, and long-lived taxa such as maldanid (*Euclymene collaris*, etc.) and terrebellid (*Polycirrus* spp., etc.) polychaete worms as well as opportunistic species. Although these latter species (*Polydora cornuta*, *Tharyx acutus*, etc.) were present, they were not present in great numbers.

Several noteworthy taxa were collected. The commercially and recreationally important soft shell clam, *Mya arenaria*, was collected at Boston Lightship - Habitats VII ($6.3/m^2$) and VIII ($33.3/m^2$) and Meisburger 2 - Habitats V ($25.0/m^2$) and VII ($16.7/m^2$). Also, the commercially important bay scallop, *Placopecten magellanicus*, was collected at Meisburger 7 - Habitat VI. The Atlantic rock crab, *Cancer irroratus*, and the long-clawed hermit crab, *Pagurus longicarpus*, were collected at Meisburger 7 - Habitat VI ($6.3/m^2$) and Meisburger 2 - Habitat VII ($4.2/m^2$), respectively. Because these species are motile, they were unlikely to be adequately sampled using a benthic grab and may, in fact, be present at the sample locations in different numbers than measured in this study.

Benthic macroinvertebrate data collected in August 1992 and reported to the Massachusetts Water Resources Authority (Blake, Hilbig, and Rhoads 1993) are available for 20 Massachusetts Bay locations. In particular, data from samples collected at Locations NF-5 and NF-6 and NF-3 and NF-19 are considered most appropriate for comparison to those collected at Meisburger 2 and Meisburger 7, respectively, in this study, due to geographic proximity and similar physical conditions.

Sediment grain size data for these locations are excerpted from Blake, Hilbig, and Rhoads (1993), Table C1, Appendix C:

Station	% Gravel	% Sand	% Silt	% Clay
NF-3	0.7	64.2	27.5	7.6
NF-5	0.5	77.3	14.6	7.7
NF-6	0.2	62.3	28.1	9.5
NF-19	8.8	84.9	4.3	2.0

This grain size distribution is in good agreement with this study's camera survey determination in Habitats VII and VIII.

Although total population densities were approximately 10 times greater in their study, the macroinvertebrate samples described by Blake, Hilbig, and Rhoads (1993) at Stations NF-3, NF-5, NF-6, and NF-19 were quite similar to those collected at all Meisburger 2 and Meisburger 7 habitats in this study. They may be characterized as species-rich assemblages dominated by polychaete worms in terms of numbers of species and individual organisms. The substantial disparity in population densities observed between the two studies probably was the result of use of 300 μ mesh to sieve the samples described by Blake, Hilbig, and Rhoads (1993), rather than the 500 μ mesh employed in this study.

Blake, Hilbig, and Rhoads (1993) reported that, with exception of Station NF-19 where no data were obtained, the macroinvertebrate communities present appeared to be in Successional Stage I at Station NF-5, and what they termed Stage I over Stage III at Stations NF-3 and NF-6. This finding is somewhat in agreement with this study's conclusion that the Meisburger 2 and Meisburger 7 communities were in Successional Stage II, that is displaying characteristics of both Stage I and Stage III communities.

Sediment profile camera data collected in August 1994 and reported to the U.S. Army Corps of Engineers (SAIC 1994) are available for Boston Lightship. However, no macroinvertebrate data from grab samples collected were reported.

SAIC (1994), page 18, paragraph 16, determined that:

Sediments (at Boston Lightship) contained a relatively robust benthic community. Infaunal communities were dominated by the Stage II-on-

Stage III class. Surface sediments at all stations were populated by stick-building amphipods (Family Podocerdiae). Sedentary polychaete tubes extended above the sediment-water interface at varying densities throughout the study area. Below the surface Stage II community, evidence of an abundant Stage III community was commonly observed as burrowing polychaetes and/or subsurface feeding voids. Pelletized sediments, indicative of actively feeding infauna, were found near the sediment-water interface as well as inside feeding voids. Infaunal species were not limited to polychaetes; a bioturbating caudate holothurian *Molpadia oolitica* was photographed at C2-10. In addition to infaunal species, several epifaunal species were observed including large mud anemones, hydroids, and bryozoans.

The camera survey and grab sample data collected in this study generally concur with SAIC (1994). Many worm tubes were observed on the surface of Habitat VII. In addition, deep burrowing polychaete worms and other burrowing species were present in the samples.

4.4 VALUE OF BENTHIC RESOURCES TO FISHERIES RESOURCES

Demersal finfish and epibenthic crustaceans utilize benthic resources for three basic purposes: food, refuge and spawning. The species composition and abundance of the benthic community may provide some indication of the type of predators (e.g., fish and lobsters) it can support. Information on feeding preferences by finfish species is not conclusive, but it tends to suggest that demersal finfish are opportunistic. The characteristics of the substrate, including grain size and apparent RPD can indicate whether demersal or epibenthic organisms would burrow into the sediment.

Winter Flounder

Although the inner harbor stations exhibited the lowest abundances and number of taxa of the areas examined in this survey, bottom-feeding finfish do occur in these areas. Winter flounder (ranging in length from 51 to 133 mm) and smooth flounder (47-56 mm long) collected on a tidal flat at the Schrafft Center just north of the Amstar pier were observed to have consumed polychaetes and other benthic species that are known to predominate in the inner harbor (NAI 1985). Because young-of-the-year winter flounder are thought to exhibit little lateral and cross-channel movement (generally less than 100 m; Saucerman and Deegan 1991), those juveniles found in the inner harbor probably were spawned there and would be expected to remain there for extended periods.

The areas examined in the outer harbor exhibited a substantially higher standing crop of benthic organisms than the inner harbor. *Ampelisca* has been identified as an important food resource for juvenile demersal fish (Hacunda 1981). This amphipod's life cycle strategy of two or more reproductive periods a year, high recruitment rate and high death rate (McCall 1977) suggest it is adapted to recovering from stresses such as predation. Therefore, the Spectacle Island CAD, Subaqueous B and Subaqueous E areas are presumed to have high potential for supporting demersal finfish, particularly juvenile stages.

The benthic community in the Massachusetts Bay locations exhibited somewhat lower abundances and higher species richness than the Outer Harbor. There was a higher proportion of deeper-burrowing species offshore, indicating a community in a somewhat later successional stage (less stressed) than in the harbor. Fish species (or size classes) that are capable of reaching into the sediment to feed may be able to utilize these deeper resources. In addition, the variety of substrate conditions increase the overall benthic species richness, and, potentially, predator richness.

Flounder occasionally burrow slightly into fine-grained (sand and silt) sediments. These sediments occur throughout the inner and outer harbor and many of the offshore stations. This activity would increase their exposure to sediment-borne contaminants, particularly PAHs. Exposure to sediment-borne contaminants has been linked to diseases such as finrot and liver disease (Metcalf and Eddy and USEPA-ERLN 1988). The inner harbor has been documented as containing elevated concentrations of various organic and inorganic contaminants. In contrast, the elimination of the discharge of sewage sludge from Deer Island in 1992 has led to demonstrable improvements in the contaminant loads in the outer harbor sediments. Contaminant concentrations at the Massachusetts Bay sites are likely to be relatively low.

Winter flounder spawn both within Boston Harbor and offshore. Although Bigelow and Schroeder (1953) identified sandy sediments as their preferred substrate for spawning, it appears that winter flounder are less selective. Winter flounder eggs are demersal adhesive, sticking to the substrate. In silty substrates, such as those occurring in the inner harbor, the eggs may experience higher rates of smothering or higher exposure to sediment-borne contaminants than eggs spawned in coarser sediments. Sediments in the outer harbor are primarily sandy silt, stabilized by *Ampelisca* tube mats (Hacunda 1981) and may provide better habitat for survival of attached demersal eggs than the inner harbor. The sediments at the offshore sites are varied, but include relatively high proportions of hardpacked sand (especially BLS) and gravel (M2 and M7) that may enable high egg success.

Lobster

Adult lobster prefer a varied habitat consisting of mud/silt, mud/rock, sand/rock, and bedrock/rock substrates (Cooper and Uzmann 1980). The most common habitat is sand substrate with overlying rocks and boulders. Lobsters will typically construct burrows into soft sediment with overlying rocks and boulders forming the roof or side of the burrow. In the absence of hard substrate they may construct a simple bowl-shaped depression in soft sediment. A solid object such as a rock or piece of debris may be found in the center of the depression.

The four main habitat types found in Boston Harbor could all provide some components of lobster habitat. The rock and boulder habitat component appears to be in shortest supply. However, pilings and discarded materials may provide some of the hard substrate habitat that appears to be lacking.

The Early Benthic Phase (EBP) has been identified as a critical developmental stage for lobsters (Wahle and Steneck 1991). EBP lobsters require shelter from predators and, therefore, prefer cobble substrate and are absent from featureless substrates (Wahle and Steneck 1991). Cobble substrates were not observed in the areas studied. Therefore, it is presumed that the potential disposal sites in the inner and outer harbor do not provide this habitat requirement. Some areas, notably, Habitats V and VI (a total of 16% of the Boston Lightship stations, 48% of the Meisburger 2 stations and 87% of the Meisburger 7 stations) were gravelly or pebbly in nature (see Figure 13). These areas may be suitable for EBP lobsters.

Adult and juvenile lobsters are omnivorous (Cooper and Uzmann 1980). Bottom invertebrates, crabs, polychaetes, mussels, periwinkles, sea urchins, and starfish are important food items. The contribution of prey items to the diet varies considerable and is probably based on the abundance of the prey item.

The benthic habitats in Boston Harbor appear to provide prey items for lobsters. Habitat I is probably the best lobster feeding habitat and consists of soft sediment and is heavily bioturbated and covered with mats of *Ampelisca* spp. tubes. Habitat I was present at the Spectacle Island, Subaqueous B and Subaqueous E sites. Habitat II consists of harder substrate with less biological activity. Habitat II was present primarily at the Inner Confluence and Chelsea Creek site. Habitat III may be the poorest lobster feeding habitat as it consists of very soft substrate with little evidence of biological activity and evidence of low oxygen stress. Habitat III was present primarily at the inner harbor sites. Habitat IV consists of heterogeneous sediments with little surface fauna. Habitat IV was present at the Mystic River and Mystic Piers sites.

The three offshore sites each provided varied substrate conditions and diverse benthic communities. The high lobster catches all three sites and the presence of large numbers of lobster traps at Meisburger 2 and Meisburger 7 in fall 1994 (NAI 1995a) indicate that these benthic resources provide suitable lobster habitat, at least seasonally.

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APPENDIX A

CAMERA SPECIFICATIONS

Appendix A

Technical specifications for the Hulcher Sediment Profile Camera, Model Minnie.

Pressure Housing: Camera and prism are stainless steel
Deployment Frame: Aluminum, 80 x 120 cm base and 150 cm high
Depth rating: 100 meters or 330 feet
Weight: 200 lbs. in air
Prism: Window 15 by 22 cm
Lens: UW-Nikkor 28 mm f/3.5 water corrected
Shutter: Capping with x-synchronization for electronic flash
Controls: Focus and aperture set manually
    Bottom contact delay variable from 1 to 32 seconds
    Exposures per deployment variable from 1 to 3
    Inter exposure timing variable from 1 to 5 seconds
    All controls directly accessible through end-cap
Film Frame size: standard 24 by 36 mm on 35 mm film
Film loading: Daylight loading using standard 36 exposure cassettes or
    100 foot bulk load film for approximately 800 exposures
Power: 12 volts DC rechargeable lead oxide batteries
Data logger: Day, hour, minute, second

Appendix A - Example spread sheet from image analysis   Boston Harbor, October-November 1994, SPI Analysis

Hab	Station	Time	(cm) Pene-tration	(cm) RPD	Sediment Type	Sediment Interface	Infauna Tubes	No.	Type	Bur-rows	Voids No.	Type	OSI Calculation Suc. Stage	S.S.	RPD	TOTAL OSI	Comments
Ia	SPEC 1 B	9:02	9.8	3.2	SI	MAT	MAT	0		1	0		II	3	5	8	Ampelisca mat
Ia	SPEC 1 C	9:12	12.8	3.5	SI	MAT	MAT	0		0	2	OX	II	3	5	8	Ampelisca mat old
Ia	SPEC 2 A	9:17	10	4.2	SI	MAT	MAT	1	WR	2	0		II	3	6	9	Ampelisca mat
Ia	SPEC 2 B	9:18	9.5	2.5	SI	MAT	MAT	1	WR	4	0		II	3	4	7	Ampelisca mat old, Stk. Amp.
Ia	SPEC 3 A	9:23	14.5	4.5	SI	MAT	MAT	0		5	1	OX	II	3	6	9	Ampelisca mat
Ia	SPEC 3 B	9:25	14.5	5	SI	MAT	MAT	1	WR	3	0		II	3	6	9	Ampelisca mat
Ia	SPEC 4 A	9:29	10	4	SI	MAT	MAT	0		2	0		II	3	6	9	Ampelisca mat
Ia	SPEC 4 B	9:30	16.5	5	SI	MAT	MAT	1	WR	5	0		II	3	6	9	Ampelisca mat
Ia	SPEC 5 A	9:36	12.8	3.5	SI	MAT	MAT	0		5	1	AN	II	3	5	8	Ampelisca mat, Stk. Amp.
Ia	SPEC 5 B	9:38	10.3	NA	SI	D	MAT	0		0	0		II	3	##	##	Ampelisca mat
Ia	SPEC 6 A	9:48	6.8	1.5	FS,SI	M,P	MANY	1	WR	1	0		II	3	2	5	
Ia	SPEC 6 B	9:50	8	1.5	FS,SI	M,P	MANY	0		2	0		II	3	2	5	
IIa	SPEC 7 A	9:55	2.5	0.5	FS,SI	M,P,SH	SOME	0		0	0		I	1	1	2	
IIa	SPEC 7 B	9:58	7.3	1.5	FS,SI	M,P,SH	MANY	1	WR	5	0		II	3	2	5	
IIa	SPEC 8 A	10:03	4.2	1.8	FS,SI	M,P,MAT		MAT		0		0	0		II	3	36Ampelisca mat old
IIa	SPEC 8 B	10:05	0.5	NA	S,GR	GR,AL	MANY	NA		NA	NA		IND	##	##	##	Tubes & algae on gravel
IIa	SPEC 9 C	10:12	10	3.3	SI	MAT	MAT	0		3	1	OX	II	3	5	8	Ampelisca mat old
IIa	SPEC 9 D	10:13	9.5	3.5	SI	MAT	MAT	0		4	1	OX	II	3	5	8	Ampelisca mat old
Ib	SPEC 10 A	10:21	10.8	4	SI	MAT	MAT	1	WR	5	0		II	3	6	9	Ampelisca mat old
Ib	SPEC 10 B	10:22	7.8	1.8	SI	M,P	MANY	1	WR	1	0		II	3	3	6	
Ib	SPEC 11 A	10:26	9.8	3	SI	D,MAT	MAT	0		3	0		II	3	4	7	Ampelisca mat
Ib	SPEC 11 B	10:27	10.5	2.5	SI	MAT	MAT	3	WR	1	1	AN	II	3	4	7	Ampelisca mat old
Ib	SPEC 12 A	10:34	13.5	2.8	SI	MAT	MAT	0		0	0		II	3	4	7	Ampelisca mat
Ib	SPEC 12 B	10:35	12	3	SI	MAT	MAT	0		1	2	AN	II	3	4	7	Ampelisca mat
Ib	SPEC 13 A	10:39	13	4.2	SI	MAT	MAT	0		3	0		II	3	6	9	Ampelisca mat
Ib	SPEC 13 B	10:40	13.5	4.8	SI	MAT	MAT	1	WR	1	0		II	3	6	9	Ampelisca mat
IIa	SPEC 14 A	10:44	3.3	1	FS,SI,SH	SH,AL	FEW	0		0	0		I	1	2	3	

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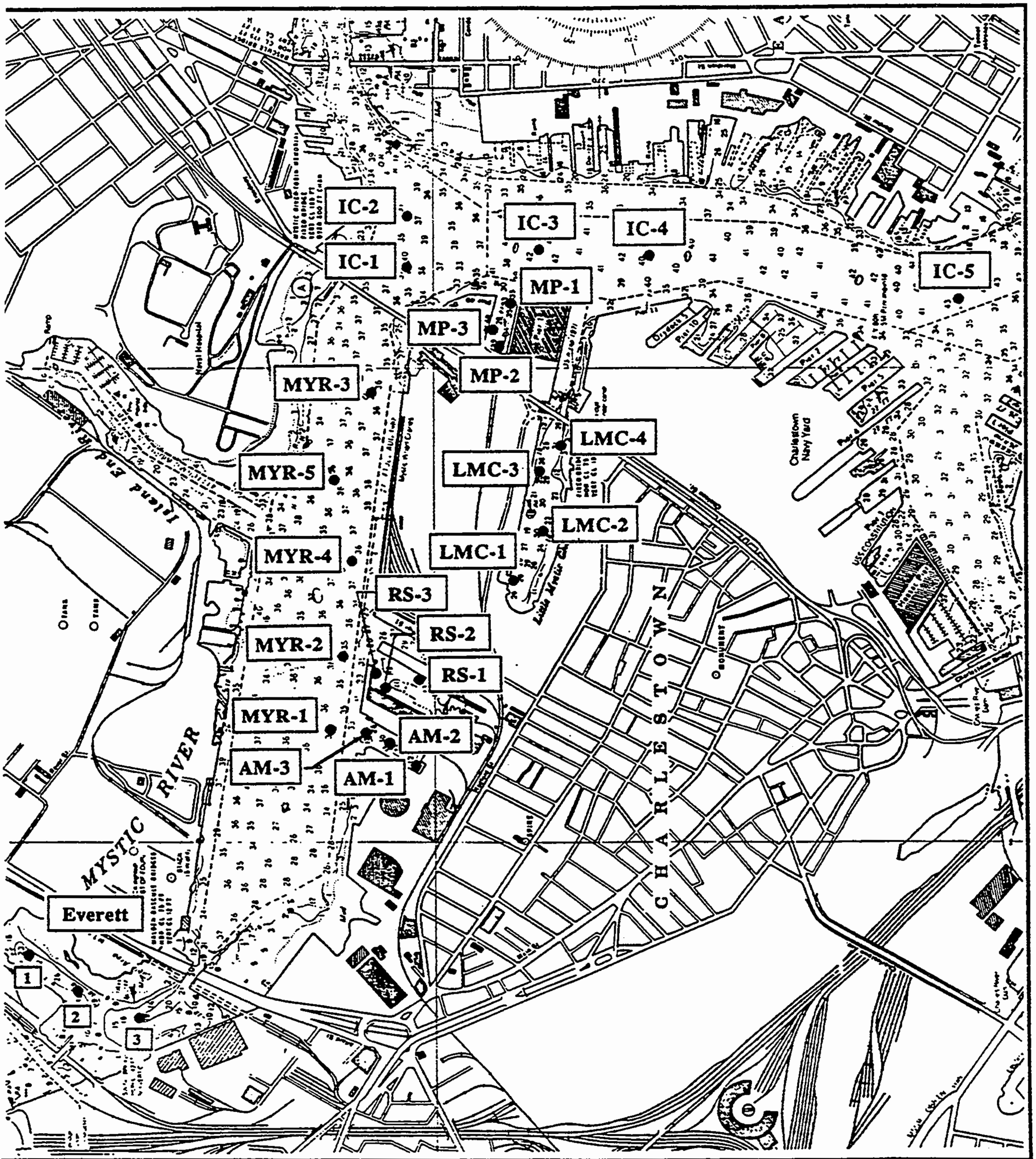
APPENDIX B

SAMPLING LOCATIONS
(maps)



Boston Harbor
Navigation Improvement Project

Figure B-1. Location of sediment profile imaging stations for Everett, Amstar, Revere Sugar, Mystic Piers,Little Mystic Channel, Mystic River and Inner Confluence.

Scale: 0 1/2 *Approximate Scale in Nautical Miles*

Source: NOAA Navigation Chart #13272, Massachusetts Bay, MA

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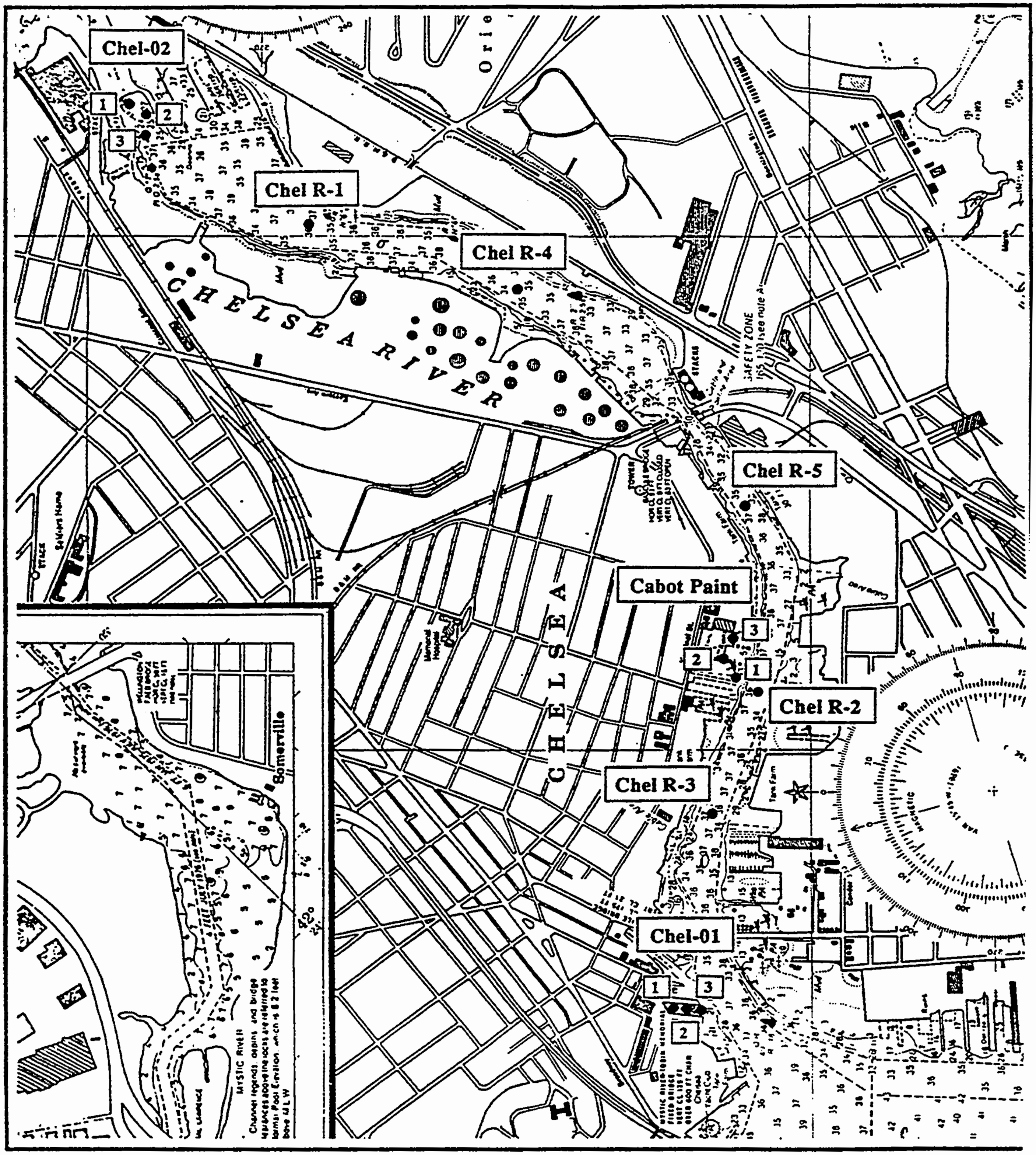

Boston Harbor Navigation Improvement Project	Figure B-2. Location of sediment profile imaging stations for Chel-01, Chel-02 and Chelsea Creek Channel (Chel R).
N — *Scale:* 0 — 1/2 *Approximate Scale in Nautical Miles*	*Source:* NOAA Navigation Chart #13272, Massachusetts Bay, MA

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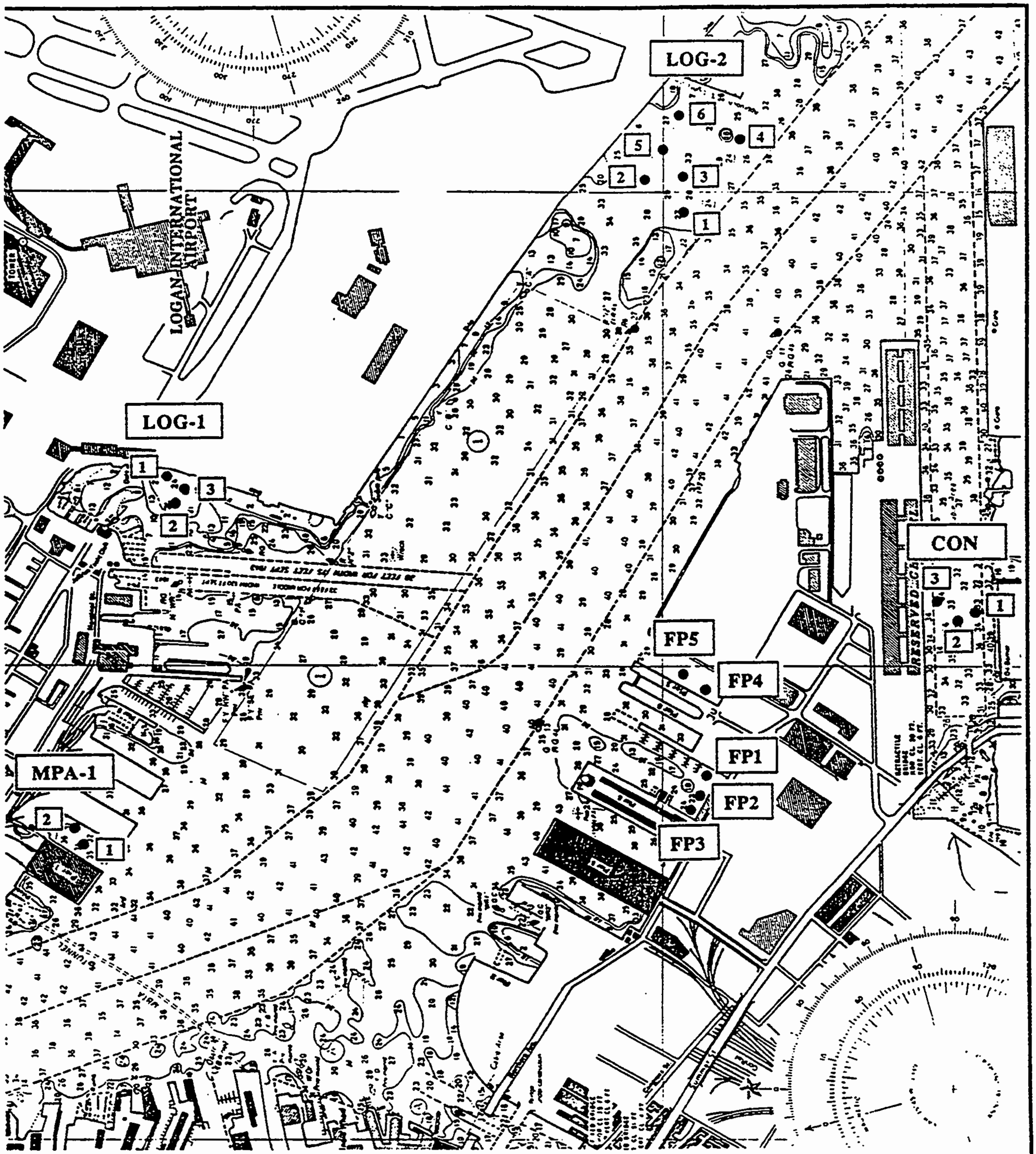

Boston Harbor
Navigation Improvement Project

Figure B-3. Location of sediment profile imaging stations for Logan 1, Logan 2, Massport 1, Conley and Fish Pier.

Scale: 0 1/2
Approximate Scale in Nautical Miles

Source: NOAA Navigation Chart #13272, Massachusetts Bay, MA

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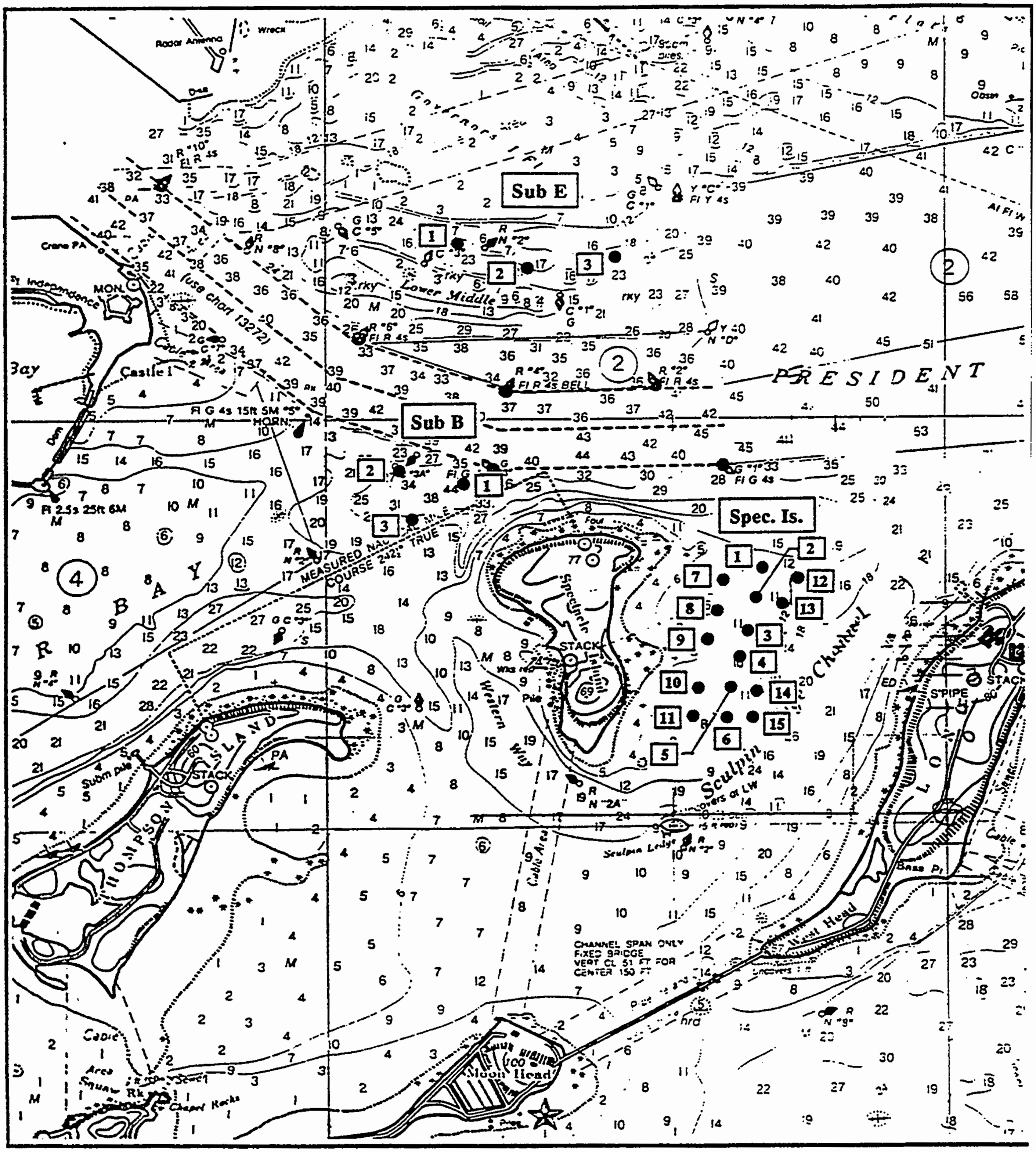

Boston Harbor Navigation Improvement Project	Figure B-4. Location of sediment profile imaging stations for Spectacle Island, Subaqueous B and Subaqueous E.
Scale: 0 — 1/2 *Approximate Scale in Nautical Mile*	*Source:* NOAA Navigation Chart #13270, Boston Harbor, Boston, MA

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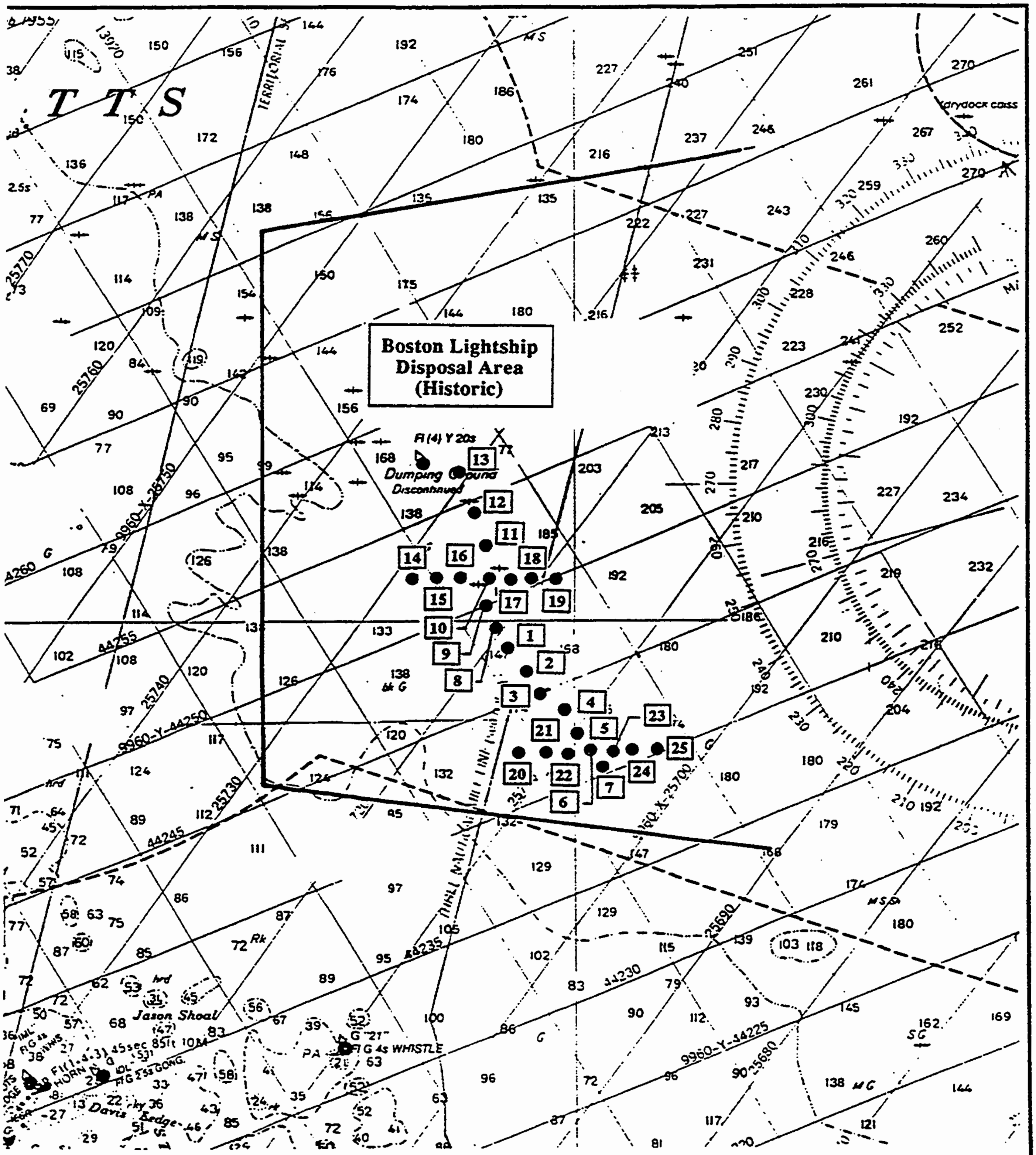
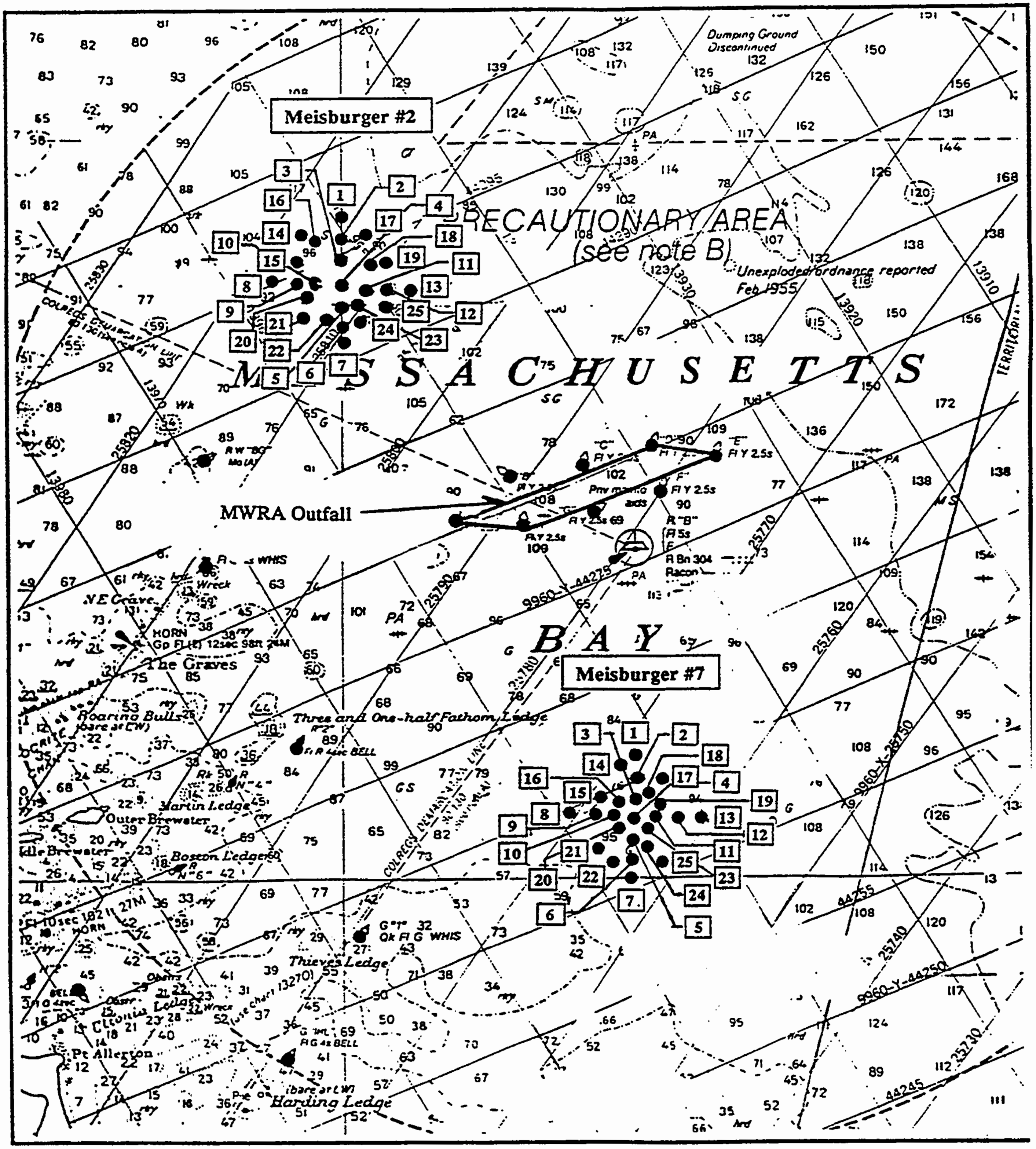


Boston Harbor **Navigation Improvement Project**	Figure B-5. Location of sediment profile imaging stations for Boston Lightship.
Scale: 0 1/2 *Approximate Scale in Nautical Miles*	*Source:* NOAA Navigation Chart #13267, Massachusetts Bay, MA



Boston Harbor
Navigation Improvement Project

Figure B-6. Location of sediment profile imaging stations for Meisburger 2 and 7.

Scale: 0 — 1/2
Approximate Scale in Nautical Miles

Source: NOAA Navigation Chart #13267, Massachusetts Bay, MA

APPENDIX C

SEDIMENT PROFILE IMAGERY DATA

APPENDIX C

Environmental studies for the Boston Harbor navigation improvement and berth dredging environmental impact report/statement: Sediment profile camera survey of benthic habitats:

SEDIMENT PROFILE IMAGE DATA

Abbreviations used in analysis of sediment profile images.

Stations:

BLS = Boston Lightship
M2 = Meisburger 2
M7 = Meisburger 7
SPEC = Spectacle Island
SUBE = Subaqueous E
SUBB = Subaqueous B
LOG1 = Logan 01
LOG2 = Logan 02
MPA1 = Massport-1
IC = Inner Confluence
CON = Conley
CP = Cabot Paint
MAL = Malden Bridges (Everett)
FP = Fish Pier
CHEL1 = Chel. 01
CHEL2 = Chel. 02
CHELR = Chelsea Creek
LMC = Little Mystic Channel
MP = Mystic Piers
AM = Amstar
RS = Revere Sugar
MYR = Mystic River Ship Channel

Pen. Depth:
Prism penetration depth

RPD Depth:
Depth of the apparent color redox potential discontinuity layer
> = Deeper than could be seen in the image

Sediment Type:

CL = Clay
FS = Fine Sand
GR = Gravel
MU = Mud, very soft
R = Pebble (small rock)
SH = Shell Hash
SI = Silt
S = Sand
FS/SI = Fine sand over silt

Surface Interface:

E = Even
M = Mound
B = Bedform
P = Pit
C = Clast
SH = Shell
R = Rock
GR = Gravel

Tubes at Surface:

- = None
FEW = 1 - 6
SOME = 7 - 24
MANY = >24
MAT = Tube Mat

Infauna:
Number and type of infauna
WR = WORM

Burrows:
Number of burrow structures

Voids:
Number and Type of voids

OX = Oxic
AN = Anoxic
GAS = Gas filled void

Successional Stage:
0 = Azoic
I = Pioneering
II = Intermediate
III = Equilibrium

OSI:
Organism Sediment Index of Rhoads and Germano (1986). See text for calculation.

General abbreviations:
D = Disturbed
IND = Indeterminate
NA = Not Applicable

SEDIMENT PROFILE IMAGE ANALYSIS FOR BOSTON HARBOR STATIONS, OCTOBER-NOVEMBER 1994. SEE TABLE 3-2 FOR DESCRIPTION OF HABITATS.

					Surface Features		Subsurface Features								
Habitat	Station	Time	Pen. Depth	RPD Depth	Sediment Type	Interface	Infauna Tubes	No.	Type	Burrows	Voids No.	Voids Type	Success. Stage	OSI	Comments
Ia	SPEC 1 B	9:02	9.8	3.2	SI	MAT	MAT	0		1	0		II	8	Ampelisca mat
Ia	SPEC 1 C	9:12	12.8	3.5	SI	MAT	MAT	0		0	2	OX	II	8	Ampelisca mat
Ia	SPEC 2 A	9:17	10.0	4.2	SI	MAT	MAT	1	WR	2	0		II	9	Ampelisca mat
Ia	SPEC 2 B	9:18	9.5	2.5	SI	MAT	MAT	1	WR	4	0		II	7	Ampelisca mat, Stick Amp.
Ia	SPEC 3 A	9:23	14.5	4.5	SI	MAT	MAT	0		5	1	OX	II	9	Ampelisca mat
Ia	SPEC 3 B	9:25	14.5	5.0	SI	MAT	MAT	1	WR	3	0		II	9	Ampelisca mat
Ia	SPEC 4 A	9:29	10.0	4.0	SI	MAT	MAT	0		2	0		II	9	Ampelisca mat
Ia	SPEC 4 B	9:30	16.5	5.0	SI	MAT	MAT	1	WR	5	0		II	9	Ampelisca mat
Ia	SPEC 5 A	9:36	12.8	3.5	SI	MAT	MAT	0		5	1	AN	II	8	Ampelisca mat, Stick Amp.
Ia	SPEC 5 B	9:38	10.3	NA	SI	D	MAT	0		0	0		II	IND	Ampelisca mat
Ia	SPEC 6 A	9:48	6.8	1.5	FS,SI	M,P	MANY	1	WR	1	0		II	5	
Ia	SPEC 6 B	9:50	8.0	1.5	FS,SI	M,P	MANY	0		2	0		II	5	
IIa	SPEC 7 A	9:55	2.5	0.5	FS,SI	M,P,SH	SOME	0		0	0		I	2	
IIa	SPEC 7 B	9:58	7.3	1.5	FS,SI	M,P,SH	MANY	1	WR	5	0		II	5	
IIa	SPEC 8 A	10:03	4.2	1.8	FS,SI	M,P,MAT	MAT	0		0	0		II	6	Ampelisca mat
IIa	SPEC 8 B	10:05	0.5	NA	S,GR	GR,ALGAE	MANY	NA		NA	NA		IND	IND	Tubes & algae on gravel
IIa	SPEC 9 C	10:12	10.0	3.3	SI	MAT	MAT	0		3	1	OX	II	8	Ampelisca mat
IIa	SPEC 9 D	10:13	9.5	3.5	SI	MAT	MAT	0		4	1	OX	II	8	Ampelisca mat
Ib	SPEC 10 A	10:21	10.8	4.0	SI	MAT	MAT	1	WR	5	0		II	9	Ampelisca mat
Ib	SPEC 10 B	10:22	7.8	1.8	SI	M,P	MANY	1	WR	1	0		II	6	
Ib	SPEC 11 A	10:26	9.8	3.0	SI	D,MAT	MAT	0		3	0		II	7	Ampelisca mat
Ib	SPEC 11 B	10:27	10.5	2.5	SI	MAT	MAT	3	WR	1	1	AN	II	7	Ampelisca mat
Ib	SPEC 12 A	10:34	13.5	2.8	SI	MAT	MAT	0		0	0		II	7	Ampelisca mat
Ib	SPEC 12 B	10:35	12.0	3.0	SI	MAT	MAT	0		1	2	AN	II	7	Ampelisca mat
Ib	SPEC 13 A	10:39	13.0	4.2	SI	MAT	MAT	0		3	0		II	9	Ampelisca mat
Ib	SPEC 13 B	10:40	13.5	4.8	SI	MAT	MAT	1	WR	1	0		II	9	Ampelisca mat
IIa	SPEC 14 A	10:44	3.3	1.0	FS,SI,SH	SH,ALGAE	FEW	0		0	0		I	3	
IIa	SPEC 14 B	10:45	6.8	0.8	FS,SI,SH	SH	MANY	0		0	1	AN	I	3	
Ib	SPEC 15 A	10:50	3.2	1.5	FS	M,P	SOME	0		0	0		II	5	
Ib	SPEC 15 B	10:51	5.0	1.3	FS	M,P,SH	MANY	0		0	0		II	5	
IIc	SUBE 1 A	11:08	13.2	2.5	SI	MAT,SH	MAT	2	WR	3	2	OX,AN	II	7	Ampelisca mat
IIc	SUBE 1 B	11:10	7.0	NA	SI,SH	D,SH	SOME	0		0	0		IND	IND	Whole Mytilus shells
Ib	SUBE 2 A	11:17	12.0	2.0	SI	MAT	MAT	0		0	0		II	6	Ampelisca mat
Ib	SUBE 2 B	11:19	15.8	1.8	SI	MAT,SNAIL	MAT	0		0	0		II	5	Ampelisca mat
Ib	SUBE 3 A	11:23	13.0	1.4	SI	MAT	MAT	0		1	1	AN	II	5	Ampelisca mat
Ib	SUBE 3 B	11:25	12.5	1.5	SI	MAT	MAT	1	WR	1	0		II	5	Ampelisca mat

(Continued)

Habitat	Station	Time	Pen. Depth	RPD Depth	Surface Features: Sediment Type	Interface	Subsurface Features: Infauna Tubes	No.	Type	Bur-rows	Voids No.	Type	Success. Stage	OSI	Comments
Ia	SUBB 1 A	11:34	13.3	2.4	SI	MAT	MAT	1	WR	3	2	OX,AN	II	7	Ampelisca mat
Ia	SUBB 1 B	11:36	16.0	2.0	SI	MAT	MAT	2	WR	2	4	OX,AN	II	6	Ampelisca mat
Ia	SUBB 2 A	:	16.5	IND	IND	MAT	MAT	IND		IND	IND		II	IND	Ampelisca mat, No flash
Ia	SUBB 2 B	12:02	14.4	3.0	SI	MAT	MAT	2	WR	2	0		II	7	Ampelisca mat
Ia	SUBB 3 A	12:08	10.9	2.8	SI	MAT	MAT	2	WR	2	0		II	7	Ampelisca mat
Ia	SUBB 3 B	12:11	13.3	3.0	SI	MAT	MAT	0		3	2	OX	II	7	Ampelisca mat
IIIb	LOG2 1 A	12:29	16.8	3.0	MU	P,C	-	0		0	2	GAS	I?	3	
IIIb	LOG2 1 B	12:31	20.0	0.8	MU	M,P	-	0		0	0		I?	3	
IIIb	LOG2 2 A	12:34	21.5	1.2	MU	M,P	FEW	0		0	0		I	3	
IIIb	LOG2 2 B	12:36	22.0	1.0	MU	M,P	-	0		0	0		I?	3	
IIIb	LOG2 3 A	12:40	18.4	1.2	MU	E	-	0		0	3	GAS	I?	1	
IIIb	LOG2 3 B	12:41	19.8	2.0	MU	M	-	0		0	2	AN	I?	4	
IIIb	LOG2 4 A	12:47	16.0	0.5	MU	M	FEW	0		0	2	AN,GAS	I?	0	
IIIb	LOG2 4 B	12:49	16.5	1.2	MU	M,P	-	0		0	2	AN	I?	3	
IIIb	LOG2 5 A	12:53	22.0	1.0	MU	M,P	-	0		0	0		I?	3	
IIIb	LOG2 5 B	12:55	22.0	1.5	MU	M,P	-	0		0	1	AN	I?	3	
IIIb	LOG2 6 A	12:58	18.3	1.5	MU	M,P	FEW	0		0	0		I	3	
IIIb	LOG2 6 B	12:59	16.3	0.5	MU	M,P	-	0		0	1	AN	I?	2	
IIIa	LOG1 1 A	13:18	17.8	1.0	MU	M,P	-	0		0	1	AN	I?	3	
IIIa	LOG1 1 B	13:19	20.5	1.0	MU	M,P	FEW	0		0	1	AN	I	3	
IIIa	LOG1 2 A	13:22	>22	IND	MU	IND	IND	0		0	0		I?	IND	
IIIa	LOG1 2 B	13:24	>22	IND	MU	IND	IND	0		0	0		I?	IND	
IIIa	LOG1 3 A	13:27	22.5	0.8	MU	M,P	-	0		0	0		I?	3	
IIIa	LOG1 3 B	13:27	18.0	0.4	MU	M,P	-	0		0	0		I?	2	
IIIa	MPA1 1 A	13:38	19.0	1.0	MU	M,P	-	0		0	0		I?	3	
IIIa	MPA1 1 B	13:41	24.5	1.0	MU	M,P	-	0		0	0		I?	3	
IIIa	MPA1 2 A	13:44	>22	IND	MU	IND	IND	0		0	1	GAS	I?	IND	
IIIa	MPA1 2 B	13:46	22.5	0.4	MU	E	-	0		0	0		I?	2	
IIIb	CHEL1 1 A	9:49	14.3	0.0	MU	E	FEW	0		0	0		I	1	
IIIb	CHEL1 1 B	9:51	10.0	2.0	S,SI	C,P,SH	-	0		0	0		I	4	
IIIb	CHEL1 2 A	9:58	12.8	1.5	SI	M,P	FEW	0		0	1	AN	I	3	
IIIb	CHEL1 2 B	10:00	14.0	0.8	SI	M,P	FEW	0		0	0		I	3	
IIIb	CHEL1 3 A	9:54	15.5	0.0	MU	C,D	-	0		1	1	AN	I	1	
IIIb	CHEL1 3 B	9:56	12.0	0.2	MU	M,P	-	0		0	0		I	2	

(Continued)

Habitat	Station	Time	Pen. Depth	RPD Depth	Surface Features: Sediment Type	Surface Features: Interface	Subsurface Features: Infauna Tubes	No.	Type	Burrows	Voids No.	Type	Success. Stage	OSI	Comments
IIIb	CHEL2 1 A	8:03	16.5	0.4	MU	M,P	SOME	0		0	0		I	2	
IIIb	CHEL2 1 B	8:05	14.2	0.5	MU	M,P	MANY	0		0	0		I	2	
IIIb	CHEL2 2 C	8:08	16.4	0.3	MU	M,P	FEW	0		0	0		I	2	
IIIb	CHEL2 2 A	8:10	16.0	0.2	MU	M,P	FEW	0		0	0		I	2	
IIIb	CHEL2 3 B	8:13	17.5	0.8	MU	M,P	-	0		0	0		I	3	
IIIb	CHEL2 3 A	8:14	19.0	1.0	MU	M,P	-	0		0	0		I	3	
IIa	CHELR 1 A	8:20	5.0	1.0	FS	M,P,SH	FEW	0		0	0		I	3	
IIa	CHELR 1 B	8:21	4.8	0.6	FS	M,P,SH	-	0		0	0		I	2	
IIb	CHELR 2 A	8:47	10.8	1.0	MU	M,P,C	FEW	0		0	0		I	3	
IIb	CHELR 2 B	8:49	7.8	1.0	MU	M,P	FEW	0		0	0		I	3	
IIa	CHELR 3 A	8:53	0.0	NA	R?	R?	IND	0		0	0		I?	IND	
IIa	CHELR 3 B	8:56	0.0	NA	R,S	R,SH	-	0		0	0		I?	IND	Starfish on rock
IIb	CHELR 4 A	8:26	13.2	0.6	MU	M,P	-	0		0	0		I	2	
IIb	CHELR 4 B	8:28	16.8	0.8	MU	M,P	FEW	0		0	0		I	3	
IIa	CHELR 5 A	8:39	5.8	1.3	FS	M,P,GR	-	0		0	0		I	3	
IIa	CHELR 5 B	8:41	3.5	0.8	FS	B	-	0		0	0		I	3	
IIa	IC 1 A	10:11	0.0	NA	GR?	GR?	IND	NA		NA	NA		IND	IND	
IIa	IC 1 B	10:13	0.0	NA	GR?	GR?	IND	NA		NA	NA		IND	IND	
IIa	IC 2 A	10:17	2.0	1.5	FS,GR	GR,SH	SOME	0		0	0		I/II	4	
IIa	IC 2 B	10:19	0.0	NA	S,GR	GR,SH	IND	NA		NA	NA		IND	IND	
IIIa	IC 3 A	10:23	7.0	1.0	SI	M,P	-	0		0	2	AN	I	3	
IIIa	IC 3 B	10:25	14.0	0.8	SI	M,C	FEW	0		0	0		I	3	
IIIa	IC 4 A	10:33	17.2	1.0	SI	M,P	FEW	0		0	3	AN	I	3	
IIIa	IC 4 B	10:35	9.8	1.3	SI	M,P	FEW	0		0	0		I	3	
IIa	IC 5 A	10:40	8.2	0.5	SI,GR	GR,SH	-	I	WR	0	I	AN	I	2	
IIa	IC 5 B	:	5.5	0.5	SI,GR	GR,SH	-	0		0	0		I?	2	
IIIa	CON 1 A	11:59	12.0	0.5	SI	M,P	FEW	0		0	0		I	2	
IIIa	CON 1 B	12:00	13.0	0.5	SI	M,P	-	I	WR	0	0		I	2	
IIIa	CON 2 A	12:03	20.0	0.5	MU	M,P	-	I	WR	0	0		I	2	
IIIa	CON 2 B	12:05	18.8	0.8	MU	M,P	-	0		0	I	GAS	I	I	
IIIa	CON 3 A	12:08	19.8	4.0	MU	M,P	-	0		0	0		I?	7?	Physically reworked layer
IIIa	CON 3 B	12:10	14.5	0.4	MU	C,P	-	0		0	0		I?	2	
IIa	CP 1 A	9:27	10.0	0.5	SI	C,MAT	-	0		0	0		I	2	Microalgal mat
IIa	CP 1 B	9:29	6.8	0.8	SI	MAT	-	0		0	0		I	3	Microalgal mat
IIIb	CP 2 A	9:22	12.3	0.3	SI	MAT	-	0		0	I	AN	I	2	Microalgal mat
IIIb	CP 2 B	9:23	13.2	0.5	SI	M,P	-	0		0	0		I	2	
IIIb	CP 3 A	9:12	12.8	0.5	SI	M,P	FEW	0		2	0		I	2	
IIIb	CP 3 B	9:13	12.0	0.5	SI	M,P	FEW	0		0	I	AN	I	2	

(Continued)

					Surface Features		Subsurface Features								
Habitat	Station	Time	Pen. Depth	RPD Depth	Sediment Type	Interface	Infauna Tubes	No.	Type	Burrows	Voids No.	Voids Type	Success. Stage	OSI	Comments
IIIa	MAL 1 A	13:38	>22	IND	MU,CL	IND	IND	0		0	1	AN	IND	IND	
IIIa	MAL 1 B	13:40	>22	IND	MU,CL	IND	IND	0		0	0		IND	IND	
IIIa	MAL 2 A	13:44	>22	IND	MU	IND	IND	0		0	0		IND	IND	
IIIa	MAL 2 B	13:45	>22	IND	MU	IND	IND	1	WR	0	0		I?	IND	
IIIa	MAL 3 A	13:50	15.0	0.8	SI	M,P	-	0		2	0		I	3	
IIIa	MAL 3 B	13:51	11.2	0.5	SI	C	-	0		0	0		I	2	
IIIa	FP 1 A	12:24	23.0	0.3	MU	IND	IND	0		0	0		IND	IND	
IIIa	FP 1 B	12:25	>22	IND	MU	IND	IND	0		0	0		IND	IND	
IIIa	FP 2 A	12:28	19.5	1.0	MU	M,P	-	0		0	0		I	3	
IIIa	FP 2 B	12:31	22.0	2.0	MU	M,P	-	0		0	0		I	4	
IIIb	FP 3 A	12:36	13.8	0.5	SI	M,P	-	0		0	0		I	2	
IIIb	FP 3 B	12:37	10.3	1.3	SI	M,P	FEW	0		0	0		I	3	
IIIa	FP 4 A	12:53	>22	IND	MU,CL	IND	IND	0		0	0		IND	IND	
IIIa	FP 4 B	12:55	>22	IND	MU,CL	IND	IND	0		0	0		IND	IND	
IIIa	FP 5 A	13:03	9.5	0.8	MU	M,P	-	0		0	0		I	3	
IIIa	FP 5 B	13:04	20.0	0.8	MU	M,P	-	0		0	0		I	3	
IIIa	LMC 1 A	14:11	22.5	0.2	MU	M,P	-	0		0	0		I?	2	
IIIa	LMC 1 B	14:12	10.5	1.0	MU	M,P	FEW	0		0	0		I	3	
IIIa	LMC 2 A	14:15	>22	IND	MU	IND	IND	0		0	0		I?	IND	
IIIa	LMC 2 B	14:17	22.5	0.8	MU	M,P	FEW	0		0	0		I	3	
IIIa	LMC 3 A	14:21	18.5	1.0	MU	M,P,C	FEW	0		0	0		I	3	
IIIa	LMC 3 B	14:22	20.5	0.4	MU	M,P	-	0		0	0		I?	2	
IIIa	LMC 4 A	14:26	>22	IND	MU	IND	IND	0		0	0		I?	IND	
IIIa	LMC 4 B	14:28	>22	IND	MU	IND	IND	0		0	0		I?	IND	
IVa	MP 1 A	14:35	16.5	1.0	MU	M,P	-	0		0	0		I	3	Object on surface
IVa	MP 1 B	14:37	16.5	0.5	MU	M,P	FEW	0		0	0		I	2	
IVa	MP 2 A	14:43	20.5	0.5	MU	M,P	FEW	0		0	0		I	2	
IVa	MP 2 B	14:44	22.5	1.0	MU	M,P	IND	0		0	0		I	3	
IIb	MP 3 A	14:48	7.0	1.3	FS,SI	M,P	-	0		0	0		I	3	
IIb	MP 3 C	14:54	11.3	1.3	SI	M,P	FEW	0		0	2	AN	I	3	Macroalgal pieces
IIIa	AM 1 A	15:10	>22	IND	MU	IND	IND	0		0	0		I?	IND	
IIIa	AM 1 B	15:12	18.0	0.8	MU	M,P	-	0		0	0		I	3	
IIIa	AM 2 A	15:14	21.0	0.2	MU	M,P	-	0		0	0		I	2	Macroalgal pieces
IIIa	AM 2 B	15:15	23.5	0.5	MU	M,P	IND	0		0	0		I?	2	
IIIa	AM 3 A	15:18	23.5	0.8	MU	M,P	FEW	0		0	0		I	3	
IIIa	AM 3 B	15:19	22.5	0.8	MU	M,P	FEW	0		0	1	AN	I	3	

(Continued)

Habitat	Station	Time	Pen. Depth	RPD Depth	Surface Features: Sediment Type	Interface	Subsurface Features: Infauna Tubes	No.	Type	Bur-rows	Voids No.	Voids Type	Success. Stage	OSI	Comments
IIIa	RS 1 A	15:27	17.9	0.8	MU	M,P	FEW	0		0	0		I	3	
IIIa	RS 1 B	15:28	18.2	0.2	MU	M,P	-	0		0	0		I	2	
IIIa	RS 2 A	15:32	>22	IND	MU	IND	IND	0		0	0		I?	IND	
IIIa	RS 2 B	15:34	>22	IND	MU	IND	IND	0		0	0		I?	IND	
IIIa	RS 3 A	15:37	18.9	0.5	MU	M,P	FEW	0		0	0		I	2	
IIIa	RS 3 B	15:39	18.2	0.2	MU	M,P	FEW	0		0	0		I	2	
IIIa	MYR 1 A	15:50	18.0	0.5	MU	M,P	FEW	0		0	0		I	2	
IIIa	MYR 1 B	15:52	18.5	0.5	MU	M,P	-	0		0	0		I	2	
IIIa	MYR 2 A	15:57	22.5	IND	MU	IND	IND	0		0	1	GAS	I?	IND	
IVb	MYR 2 B	16:00	17.8	0.5	MU	M,P	-	0		0	1	GAS	I?	0	
IVb	MYR 3 A	16:19	9.0	0.5	MU,CL	M,P	SOME	0		0	0		I	2	
IVb	MYR 3 B	16:22	5.5	0.8	MU,CL,S	M,P	FEW	0		0	0		I	3	
IVb	MYR 4 A	16:04	4.8	1.0	FS,SI	M,P	-	0		0	0		I	3	
IVb	MYR 4 B	16:07	11.0	0.5	MU,CL	M,P,C	FEW	0		0	0		I	2	
IVb	MYR 5 A	16:11	6.9	0.2	MU,CL	M,P,C	-	0		0	0		I	2	

SEDIMENT PROFILE IMAGE VISUAL ANALYSIS MASSACHUSETTS BAY, BOSTON LIGHT SHIP STATIONS, NOVEMBER 1994. SEE TABLE 3-2 FOR DESCRIPTION OF HABITATS.

					Surface Features			Subsurface Features							
Habitat	Station	Time	Pen. Depth	RPD Depth	Sediment Type	Surface Interface	Tubes	Infauna No.	Infauna Type	Burrows	Voids No.	Voids Type	Success. Stage	OSI	Comments
VII	BLS 1 B	13:11	2.5	>2.5	FS	M,P	MANY	4	WR	0	0		II	7*	
VII	BLS 1 C	11:51	3.0	>3.0	FS	M,P	MANY	0		0	0		II	8*	Small clam on surface
VII	BLS 2 A	12:02	1.5	>1.5	FS	C,P	MANY	0		0	0		II	6*	
VII	BLS 2 C	12:52	0.8	>0.8	FS	M,P,SH	MANY	NA		NA	NA		II	5*	
VII	BLS 3 A	13:19	0.3	NA	FS	B	MANY	NA		NA	NA		II	IND	
VII	BLS 3 B	13:28	1.0	>1.0	FS	M,P	MANY	NA		NA	NA		II	5*	Large clam on surface
VII	BLS 4 A	13:34	0.0	NA	SA	B	SOME	NA		NA	NA		II?	IND	
VII	BLS 4 B	13:39	4.3	>4.3	FS	M,P	MANY	5	WR	2	0		II	9*	
VII	BLS 5 A	13:46	5.3	5.0	FS	M,P,SH	MANY	4	WR	3	0		II	9	
VII	BLS 6 A	14:06	0.5	>0.5	FS	M,P	MANY	NA		NA	NA		II	3*	
VII	BLS 6 B	14:10	0.3	NA	FS	M,P	MANY	NA		NA	NA		II	IND	
VII	BLS 7 A	8:24	5.0	>5.0	FS	M,P	SOME	1	WR	4	0		II	9*	
VIII	BLS 8 A	10:05	7.2	2.5	FS/SL,CL	M,P	SOME	1	WR	0	0		II	7	
VIII	BLS 8 B	10:10	6.0	2.0	FS/SL	M,P,C	SOME	0		0	0		II	6	Cerianthid anemone
VIII	BLS 9 A	10:19	4.8	1.7	FS/SL	M,P	SOME	0		1	0		II	6	Worm on surface?
VIII	BLS 9 B	10:23	6.2	1.5	FS/SL	M,P	MANY	1	WR	1	1	OX	II	5	
VIII	BLS 10 A	10:30	8.5	2.3	FS/SL	M	MANY	0		1	0		II	7	
VIII	BLS 10 B	10:34	6.0	1.5	FS/SL	M,P	MANY	1	WR	3	1	OX	II	5	
VI	BLS 11 A	10:43	0.3	NA	S,R	M,R	MANY	NA		NA	NA		IND	IND	Worm tubes on rock
VIII	BLS 11 B	10:48	2.5	NA	CL	C,D	NA	NA		NA	NA		IND	IND	
VII	BLS 12 A	10:58	7.0	2.5	FS/SI	M,P,SH	SOME	0		0	0		IND	IND	
VII	BLS 12 B	11:03	0.3	NA	S	C	SOME	NA		NA	NA		IND	IND	
VII	BLS 13 A	11:12	6.5	1.8	FS/SI	M,P	MANY	1	WR	1	0		II	6	
V	BLS 13 B	11:16	0.0	NA	S,R	R	SOME	NA		NA	NA		IND	IND	Hydroids on rock
VIII	BLS 14 A	12:22	0.3	NA	S	IND	IND	NA		NA	NA		IND	IND	
V	BLS 14 B	12:25	0.0	NA	R	R	SOME	NA		NA	NA		IND	IND	Hydroids on rock

(Continued)

Habitat	Station	Time	Pen. Depth	RPD Depth	Sediment Type	Surface Features: Surface Interface	Tubes	Subsurface Features: Infauna No.	Infauna Type	Burrows	Voids No.	Voids Type	Success. Stage	OSI	Comments
V	BLS 15 A	12:14	0.2	NA	S,R	R	MANY	NA		NA	NA		IND	IND	Worm tubes on rock
VII	BLS 15 B	12:17	4.5	2.0	FS/SI	M,P	MANY	2	WR	2	0		II	6	
VII	BLS 16 A	12:04	3.5	2.5	FS	M,P	SOME	0		2	0		II	7	
V	BLS 16 B	12:07	0.0	NA	R	R	MANY	NA		NA	NA		IND	IND	Worm tubes on rock
VII	BLS 17 A	11:52	11.3	1.8	FS/SI/CL	M,P	SOME	2	WR	4	1	OX	II	6	
VII	BLS 17 B	11:57	9.5	1.5	SI/CL	C,M,P	SOME	0		0	1	OX	II	5	
VII	BLS 18 A	11:42	6.5	2.0	FS/SI,CL	M,P	SOME	0		0	0		II	6	
VII	BLS 18 B	11:46	7.8	2.0	FS/SI	M	MANY	1	WR	4	0		II	6	
VII	BLS 19 A	11:32	5.8	2.5	FS/SI	M,P	MANY	1	WR	0	0		II	6	
VII	BLS 19 B	11:36	5.5	2.0	FS/SI	M,P	MANY	2	WR	3	0		II	6	
VII	BLS 20 A	8:43	4.3	1.3	FS/SI	M,P,SH	MANY	1	WR	2	0		II	5	
VII	BLS 20 B	8:46	4.0	1.5	FS/SI	M,P	SOME	1	WR	0	0		II	5	
VII	BLS 21 A	8:56	1.0	>1.0	FS	M,P	MANY	NA		NA	NA		II	5*	
VII	BLS 21 B	8:59	2.0	>2.0	FS	M,P	MANY	0		0	0		II	6*	
VII	BLS 22 B	9:09	1.8	>1.8	FS	B,SH	MANY	0		0	0		II	6*	
VII	BLS 23 A	9:15	0.3	NA	FS	P	MANY	NA		NA	NA		II	IND	
VII	BLS 23 B	9:18	0.8	NA	FS	M,P	SOME	NA		NA	NA		II	IND	
VII	BLS 24 A	9:37	1.0	<1.0	FS	M,P	SOME	NA		NA	NA		II	4*	
VII	BLS 25 A	9:46	2.8	<2.8	FS	M,P	SOME	1	WR	0	0		II	7*	
VII	BLS 25 B	9:48	1.5	<1.5	FS	M,P,SH	SOME	0		0	0		II	4*	

For OSI the * indicates a conservatiove value calculated using the > value for the RPD.

SEDIMENT PROFILE IMAGE VISUAL ANALYSIS MASSACHUSETTS BAY, MEISBURGER 2 STATIONS, NOVEMBER 1994. SEE TABLE 3-2 FOR DESCRIPTION OF HABITATS.

Habitat	Station	Time	Pen. Depth	RPD Depth	Surface Features: Sediment Type	Surface Features: Surface Interface	Tubes	Subsurface Features: Infauna No.	Subsurface Features: Infauna Type	Burrows	Voids No.	Voids Type	Success. Stage	OSI	Comments
V	M2 1 A	9:09	0.0	NA	S,GR	GR	-	NA		NA	NA		IND	IND	
V	M2 1 B	9:11	0.0	NA	S,R	R	MANY	NA		NA	NA		IND	IND	TUBES ON ROCKS
VII	M2 2 A	9:01	0.5	NA	S,R	R	SOME	NA		NA	NA		II	IND	TUBES ON ROCKS
VII	M2 2 B	9:03	0.3	NA	FS	M,P	SOME	NA		NA	NA		II	IND	
VII	M2 3 A	8:53	2.3	1.7	FS	M,P	SOME	0		4	NA		II	6	
VII	M2 3 B	8:56	0.2	NA	FS	B	SOME	NA		NA	NA		II	IND	
V	M2 4 A	8:46	0.0	NA	S	IND	IND	NA		NA	NA		IND	IND	
V	M2 4 B	8:48	0.0	NA	R	R	MANY	NA		NA	NA		IND	IND	TUBES ON ROCKS
VII	M2 5 A	8:38	0.3	NA	FS	B	SOME	NA		NA	NA		II	IND	
VII	M2 5 B	8:40	0.3	NA	FS,R	R,B?	FEW	NA		NA	NA		IND	IND	
V	M2 6 A	8:31	0.0	NA	R?	R?	-	NA		NA	NA		IND	IND	
V	M2 6 B	8:33	0.0	NA	R?	R?	-	NA		NA	NA		IND	IND	
VII	M2 7 A	8:23	0.3	NA	FS	M,P	SOME	NA		NA	NA		II	IND	
V	M2 8 A	10:16	0.0	NA	S	M,P	SOME	NA		NA	NA		IND	IND	
V	M2 8 B	10:16	0.0	NA	R,SI	R	SOME	NA		NA	NA		IND	IND	
VIII	M2 9 A	10:08	5.0	1.0	FS/SI,GR	GR	-	0		0	0		IND	IND	
VIII	M2 9 B	10:11	0.0	NA	FS	M,P	FEW	NA		NA	NA		IND	IND	
VIII	M2 10 A	10:00	2.5	0.5	FS,GR,SI	GR,P	-	NA		NA	NA		IND	IND	
V	M2 10 B	10:03	0.5	NA	R,SI	R	-	NA		NA	NA		IND	IND	
V	M2 11 A	9:51	0.0	NA	R	R	FEW	NA		NA	NA		IND	IND	TUBES ON ROCKS
V	M2 11 B	9:54	0.5	NA	R,GR,SI	R,GR	-	NA		NA	NA		IND	IND	
VIII	M2 12 A	9:44	2.8	0.8	SI,GR	GR,P	-	NA		NA	NA		IND	IND	
VIII	M2 12 B	9:47	4.0	1.2	FS/SI	M,P	FEW	0		0	0		I	3	
VIII	M2 13 B	9:40	7.5	1.5	FS/SI,GR	GR	MANY	0		0	0		IND	IND	TUBES ON ROCKS
V	M2 14 A	10:34	0.2	NA	S,R	R	MANY	NA		NA	NA		IND	IND	TUBES ON ROCKS
VII	M2 14 B	10:36	0.0	NA	S	M,P	SOME	NA		NA	NA		IND	IND	

(Continued)

					Surface Features			Subsurface Features							
Habitat	Station	Time	Pen. Depth	RPD Depth	Sediment Type	Surface Interface	Tubes	Infauna No.	Infauna Type	Burrows	Voids No.	Voids Type	Success. Stage	OSI	Comments
VII	M2 15 A	10:24	2.6	1.2	FS,SI	M,P	MANY	0		4	0		II	IND	
VII	M2 15 B	10:27	0.5	NA	FS	M	SOME	NA		NA	NA		II?	IND	
VII	M2 17 A	11:18	5.3	1.3	FS,SI	M,P	SOME	0		1	0		II	IND	
VII	M2 17 B	11:20	5.5	2.0	FS,SI	M,P	SOME	0		5	0		II	IND	
VII	M2 18 A	11:33	0.0	NA	S	M,P?	-	NA		NA	NA		IND	IND	
V	M2 18 B	11:36	0.0	NA	R	R	-	NA		NA	NA		IND	IND	
VIII	M2 19 A	11:41	3.0	IND	R,SI	R,D	-	NA		NA	NA		IND	IND	
VIII	M2 19 B	11:45	1.0	>1.0	R,SI	R	-	NA		NA	NA		IND	IND	
V	M2 20 A	12:20	0.0	NA	R,GR	R,GR	-	NA		NA	NA		IND	IND	
V	M2 20 B	12:23	0.0	NA	R,GR	R,GR	FEW	NA		NA	NA		IND	IND	TUBES ON ROCKS
VII	M2 21 B	17:24	1.0	>1.0	FS	M,P	SOME	NA		NA	NA		II	5*	
V	M2 22 A	17:32	0.0	NA	R	R	-	NA		NA	NA		IND	IND	
V	M2 22 B	17:34	0.0	NA	R	R	MANY	NA		NA	NA		IND	IND	TUBES ON ROCKS
V	M2 23 A	11:52	0.0	NA	GR	GR	-	NA		NA	NA		IND	IND	
V	M2 23 B	11:54	0.0	NA	R,GR	R,GR	-	NA		NA	NA		IND	IND	
V	M2 24 B	12:03	0.0	NA	R,GR,SI	R,GR	SOME	NA		NA	NA		IND	IND	TUBES ON ROCKS
V	M2 25 A	12:11	0.0	NA	R,GR	R,GR	-	NA		NA	NA		IND	IND	STARFISH ON ROCK
V	M2 25 B	12:12	0.0	NA	R	R	MANY	NA		NA	NA		IND	IND	TUBES ON ROCKS

FOR OSI THE * INDICATES A CONSERVATIOVE VALUE CALCULATED USING THE > VALUE FOR THE RPD.

SEDIMENT PROFILE IMAGE VISUAL ANALYSIS MASSACHUSETTS BAY, MEISBURGER 7 STATIONS, NOVEMBER 1994.
SEE TABLE 3-2 FOR DESCRIPTION OF HABITATS.

Habitat	Station	Time	Pen. Depth	RPD Depth	Surface Features: Sediment Type	Surface Features: Surface Interface	Tubes	Subsurface Features: Infauna No.	Infauna Type	Burrows	Voids No.	Voids Type	Success. Stage	OSI	Comments
M7	1 NO DATA														
M7	2 NO DATA														
VI	M7 3 A	13:07	0.0	NA	GR	GR	-	NA		NA	NA		IND	IND	
VI	M7 3 B	13:09	0.0	NA	GR	GR	-	NA		NA	NA		IND	IND	
VI	M7 4 B	13:14	0.0	NA	GR	GR	-	NA		NA	NA		IND	IND	
V	M7 5 A	14:59	0.0	NA	R	R	-	NA		NA	NA		IND	IND	
V	M7 5 B	15:00	0.0	NA	R	R	MANY	NA		NA	NA		IND	IND	TUBES ON ROCKS
V	M7 6 A	15:05	0.0	NA	R	R	SOME	NA		NA	NA		IND	IND	TUBES ON ROCKS
VI	M7 6 B	15:06	0.5	NA	GR	GR	-	NA		NA	NA		IND	IND	
VI	M7 7 A	15:11	0.0	NA	GR	GR	FEW	NA		NA	NA		IND	IND	
VI	M7 7 B	15:13	0.5	NA	GR	GR	SOME	NA		NA	NA		IND	IND	
VIII	M7 8 A	16:25	6.0	2.5	SI	F,D	-	1	WR	0	1	OX	II	7	
VIII	M7 8 B	16:27	16.0	1.3	SI	P	MANY	2	WR	3	0		II	5	
VIII	M7 9 A	16:33	5.3	1.3	FS/SI	M,P	MANY	1	WR	3	0		II	5	
VIII	M7 9 B	16:35	0.5	NA	FS/SI	D	-	NA		NA	NA		IND	IND	
V	M7 10 A	16:40	0.0	NA	R	R	-	NA		NA	NA		IND	IND	
V	M7 10 B	16:44	0.0	NA	R	R	-	NA		NA	NA		IND	IND	
V	M7 11 A	16:50	0.0	NA	R	R	FEW	NA		NA	NA		IND	IND	TUBES ON ROCKS
V	M7 11 B	16:52	0.0	NA	R	R	MANY	NA		NA	NA		IND	IND	TUBES ON ROCKS
V	M7 13 A	17:04	0.0	NA	R?	R?	-	NA		NA	NA		IND	IND	
V	M7 13 B	17:08	0.0	NA	R?	R?	-	NA		NA	NA		IND	IND	
V	M7 14 A	16:12	0.0	NA	R	R	-	NA		NA	NA		IND	IND	
V	M7 14 B	16:15	0.0	NA	R,GR	R,GR	-	NA		NA	NA		IND	IND	
V	M7 15 A	16:21	0.0	NA	R	R	-	NA		NA	NA		IND	IND	
V	M7 15 B	16:24	0.0	NA	R,GR	R,GR	-	NA		NA	NA		IND	IND	

(Continued)

					Surface Features		Subsurface Features								
Habitat	Station	Time	Pen. Depth	RPD Depth	Sediment Type	Surface Interface	Tubes	Infauna No.	Infauna Type	Burrows	Voids No.	Voids Type	Success. Stage	OSI	Comments
V	M7 16 A	16:28	0.0	NA	R	R	-	NA		NA	NA		IND	IND	
V	M7 16 B	16:31	0.0	NA	R	R	-	NA		NA	NA		IND	IND	
VI	M7 17 A	16:39	0.3	NA	S,GR	B	SOME	NA		NA	NA		II	IND	
VI	M7 17 B	16:41	0.5	NA	S,GR	B	MANY	NA		NA	NA		II	IND	
VI	M7 18 A	16:48	0.3	NA	S	B	SOME	NA		NA	NA		II	IND	
VI	M7 18 B	16:51	1.0	>1.0	FS	B	MANY	NA		NA	NA		II	5*	
V	M7 19 A	17:13	0.0	NA	R	R	-	NA		NA	NA		IND	IND	
V	M7 19 B	17:16	0.0	NA	R	R	-	NA		NA	NA		IND	IND	
VI	M7 20 A	15:38	0.0	NA	GR	GR	FEW	NA		NA	NA		IND	IND	TUBES ON ROCKS
VI	M7 20 B	15:40	0.0	NA	R,GR	R,GR	FEW	NA		NA	NA		IND	IND	TUBES ON ROCKS
VII	M7 21 A	15:30	0.0	NA	S,GR	GR	FEW	NA		NA	NA		IND	IND	
VII	M7 21 B	15:32	0.5	NA	FS	M,P	SOME	NA		NA	NA		II	IND	
V	M7 22 A	15:18	0.0	NA	S,GR	GR	-	NA		NA	NA		IND	IND	
V	M7 22 B	15:19	1.0	NA	GR	GR	FEW	NA		NA	NA		IND	IND	
VI	M7 23 A	15:49	1.0	NA	GR	GR	FEW	NA		NA	NA		IND	IND	
VI	M7 23 B	15:55	8.0	NA	GR	GR	-	NA		NA	NA		IND	IND	
VI	M7 24 A	16:05	0.0	NA	GR?	GR?	-	NA		NA	NA		IND	IND	
VI	M7 24 B	16:07	0.0	NA	R,GR	R,GR	-	NA		NA	NA		IND	IND	
VI	M7 25 A	16:12	0.0	NA	R,GR	R,GR	-	NA		NA	NA		IND	IND	
VI	M7 25 B	16:14	0.0	NA	R,GR?	R,GR?	-	NA		NA	NA		IND	IND	

FOR OSI THE * INDICATES A CONSERVATIVE VALUE CALCULATED USING THE > VALUE FOR THE RPD.

APPENDIX D

BENTHIC INFAUNA
RAW DATA

TABLE 1. RAW COUNTS (NO./0.04 m²) FOR THE INNER HARBOR SAMPLING AREA

OUP	SPECIES	AMSTAR		CHEL 01		CHEL 02		CHELSEA CREEK	
		1A	1B	1	3	1	3	1	2
RIFERA	HALICHONDRIA PANICEA								
DROZOA	CLYTIA GRACILIS								
	OBELIA DICHOTOMA								
	OBELIA SP.								
MATODA	NEMATODA	2	45	2	5	2		2	
LYCHAETA	ANAITIDES SP.							1	
	ARICIDEA (ACMIRA)								
	CATHERINAE								
	CAPITELLA CAPITATA		4						
	CIRRATULIDAE								1
	ETEONE LONGA								
	GLYCERA DIBRANCHIATA								
	HEDISTE DIVERSICOLOR								
	LEITOSCOLOPLOS ACUTUS								
	LEITOSCOLOPLOS ROBUSTUS								
	LEITOSCOLOPLOS SP.								
	MALDANIDAE								
	MARENZELLERIA VIRIDIS								
	MEDIOMASTUS CALIFORNIENSIS								
	MICROPHTHALMUS ABERRANS								
	NEANTHES SUCCINEA								
	NEANTHES VIRENS								
	NEPHTYIDAE								
	NEPHTYS CAECA								
	NEPHTYS CILIATA								
	NEPHTYS INCISA								
	NEREIDAE								
	NINOE NIGRIPES								
	PARANAITIS SPECIOSA								
	PECTINARIA GOULDII	1		1					
	PECTINARIIDAE		1						
	POLYCIRRUS SP.								
	POLYDORA CORNUTA	13	37	1					1
	POLYDORA SOCIALIS								
	SPIO FILICORNIS								
	STREBLOSPIO BENEDICTI	10	23	4				1	
	THARYX ACUTUS			2					
IGOCHAETA	OLIGOCHAETA	2	5					1	
STROPODA	CREPIDULA FORNICATA								
	CREPIDULA PLANA								
	CREPIDULA SP.								
	LACUNA VINCTA								
	NASSARIUS TRIVITTATUS				2				
VALVIA	ANOMIA SP.								
	BIVALVIA							1	
	CERASTODERMA PINNULATUM								
	HIATELLA SP.								

NTINUED)

TABLE 1. RAW COUNTS (NO./0.04 m²) FOR THE INNER HARBOR SAMPLING AREA

GROUP	SPECIES	AMSTAR		CHEL 01		CHEL 02		CHELSEA CREEK	
		1A	1B	1	3	1	3	1	2
BIVALVIA	LYONSIA HYALINA								
	MACOMA BALTHICA								
	MULINIA LATERALIS						1		
	MYA ARENARIA								
	MYTILIDAE			1	1				
	TELLINA AGILIS								
	TURTONIA MINUTA								
CIRRIPEDIA	BALANUS CRENATUS								
MYSIDACEA	HETEROMYSIS FORMOSA								
AMPHIPODA	AMPELISCA ABDITA								
	COROPHIUM BONELLI		4						
	GAMMARUS LAWRENCIANUS								
	MICRODEUTOPUS GRYLLOTALPA	2	1						
	PONTOGENEIA INERMIS								
	UNCIOLA INERMIS		1						
DECAPODA	CRANGON SEPTEMSPINOSA			2	1				1
BRYOZOA	BUGULA TURRITA								
OPHIUROIDEA	OPHIUROIDEA								
ASCIDIACEA	ASCIDIA SP.	2							
ALL	ZSPECIES COMBINED	32	121	13	9	2	1	6	3

(CONTINUED)

TABLE 1. RAW COUNTS (NO./0.04 m²) FOR THE INNER HARBOR SAMPLING AREA

UP	SPECIES	CHELSEA CREEK			CONLEY	CABOT POINT		EVERETT	
		3	4	5	A	1	3	1	2
/ALVIA	LYONSIA HYALINA								
	MACOMA BALTHICA							1	
	MULINIA LATERALIS								2
	MYA ARENARIA								
	MYTILIDAE	1							
	TELLINA AGILIS	1			1				
	TURTONIA MINUTA			1					
?RIPEDIA	BALANUS CRENATUS								
SIDACEA	HETEROMYSIS FORMOSA								
?HIPODA	AMPELISCA ABDITA	5		1	5		1		
	COROPHIUM BONELLI								
	GAMMARUS LAWRENCIANUS								
	MICRODEUTOPUS GRYLLOTALPA								
	PONTOGENEIA INERMIS								
	UNCIOLA INERMIS								
CAPODA	CRANGON SEPTEMSPINOSA			1					
YOZOA	BUGULA TURRITA			P	P				
HIUROIDEA	OPHIUROIDEA							1	
CIDIACEA	ASCIDIA SP.								
L	ZSPECIES COMBINED	79	0	21	46	1	15	5	24

NTINUED)

TABLE 1. RAW COUNTS (NO./0.04 m²) FOR THE INNER HARBOR SAMPLING AREA

GROUP	SPECIES	INNER CONFLUENCE					LITTLE MYSTIC CHANNEL		
		1	2	3	4	5	2	4A	4B
PORIFERA	HALICHONDRIA PANICEA								
HYDROZOA	CLYTIA GRACILIS								
	OBELIA DICHOTOMA								
	OBELIA SP.					P			P
NEMATODA	NEMATODA		3						
POLYCHAETA	ANAITIDES SP.								
	ARICIDEA (ACMIRA)								
	CATHERINAE								
	CAPITELLA CAPITATA		1						
	CIRRATULIDAE								
	ETEONE LONGA	3	1						
	GLYCERA DIBRANCHIATA		1						
	HEDISTE DIVERSICOLOR								
	LEITOSCOLOPLOS ACUTUS								
	LEITOSCOLOPLOS ROBUSTUS								
	LEITOSCOLOPLOS SP.								
	MALDANIDAE		2						
	MARENZELLERIA VIRIDIS								
	MEDIOMASTUS CALIFORNIENSIS								
	MICROPHTHALMUS ABERRANS		2						
	NEANTHES SUCCINEA								
	NEANTHES VIRENS								
	NEPHTYIDAE		1	2					
	NEPHTYS CAECA		1						
	NEPHTYS CILIATA								
	NEPHTYS INCISA								
	NEREIDAE								
	NINOE NIGRIPES					2			
	PARANAITIS SPECIOSA								
	PECTINARIA GOULDII								
	PECTINARIIDAE								
	POLYCIRRUS SP.								
	POLYDORA CORNUTA	16	34		1				
	POLYDORA SOCIALIS								
	SPIO FILICORNIS								
	STREBLOSPIO BENEDICTI	1	19						
	THARYX ACUTUS	2	1						
OLIGOCHAETA	OLIGOCHAETA	3	57						
GASTROPODA	CREPIDULA FORNICATA								
	CREPIDULA PLANA		4						
	CREPIDULA SP.		2						
	LACUNA VINCTA		2						
	NASSARIUS TRIVITTATUS	7	22			1			
BIVALVIA	ANOMIA SP.								
	BIVALVIA		1						
	CERASTODERMA PINNULATUM		1						
	HIATELLA SP.		3						

(CONTINUED)

UP	SPECIES	INNER CONFLUENCE 1	2	3	4	5	LITTLE MYSTIC CHANNEL 2	4A	4B
ALVIA	LYONSIA HYALINA		1						
	MACOMA BALTHICA								
	MULINIA LATERALIS		1						1
	MYA ARENARIA								
	MYTILIDAE		1						
	TELLINA AGILIS								
	TURTONIA MINUTA								
RIPEDIA	BALANUS CRENATUS								
IDACEA	HETEROMYSIS FORMOSA		1						
HIPODA	AMPELISCA ABDITA								
	COROPHIUM BONELLI								
	GAMMARUS LAWRENCIANUS							1	
	MICRODEUTOPUS GRYLLOTALPA								
	PONTOGENEIA INERMIS		1						
	UNCIOLA INERMIS								
APODA	CRANGON SEPTEMSPINOSA								
OZOA	BUGULA TURRITA								
IUROIDEA	OPHIUROIDEA								
IDIACEA	ASCIDIA SP.								
.	ZSPECIES COMBINED	32	163	2	1	3	0	1	1

ITINUED)

TABLE 1. RAW COUNTS (NO./0.04 m²) FOR THE INNER HARBOR SAMPLING AREA

GROUP	SPECIES	MYSTIC PIERS				MYSTIC RIVER			
		2A	2B	3A	3B	1	2	3	4
PORIFERA	HALICHONDRIA PANICEA								
HYDROZOA	CLYTIA GRACILIS							P	
	OBELIA DICHOTOMA								
	OBELIA SP.					P			
NEMATODA	NEMATODA								
POLYCHAETA	ANAITIDES SP.								
	ARICIDEA (ACHIRA)								
	CATHERINAE								
	CAPITELLA CAPITATA								
	CIRRATULIDAE								
	ETEONE LONGA								
	GLYCERA DIBRANCHIATA								
	HEDISTE DIVERSICOLOR								
	LEITOSCOLOPLOS ACUTUS								
	LEITOSCOLOPLOS ROBUSTUS								
	LEITOSCOLOPLOS SP.								
	MALDANIDAE								
	MARENZELLERIA VIRIDIS								
	MEDIOMASTUS CALIFORNIENSIS								
	MICROPHTHALMUS ABERRANS								
	NEANTHES SUCCINEA								
	NEANTHES VIRENS								
	NEPHTYIDAE								
	NEPHTYS CAECA								
	NEPHTYS CILIATA								
	NEPHTYS INCISA								
	NEREIDAE								
	NINOE NIGRIPES								
	PARANAITIS SPECIOSA								
	PECTINARIA GOULDII								
	PECTINARIIDAE								
	POLYCIRRUS SP.								
	POLYDORA CORNUTA							4	
	POLYDORA SOCIALIS								
	SPIO FILICORNIS								
	STREBLOSPIO BENEDICTI	1							
	THARYX ACUTUS								
OLIGOCHAETA	OLIGOCHAETA								
GASTROPODA	CREPIDULA FORNICATA								
	CREPIDULA PLANA								
	CREPIDULA SP.								
	LACUNA VINCTA								
	NASSARIUS TRIVITTATUS		1		3				
BIVALVIA	ANOMIA SP.	1							
	BIVALVIA								
	CERASTODERMA PINNULATUM								
	HIATELLA SP.								

(CONTINUED)

TABLE 1. RAW COUNTS (NO./0.04 m²) FOR THE INNER HARBOR SAMPLING AREA

OUP	SPECIES	MYSTIC PIERS				MYSTIC RIVER			
		2A	2B	3A	3B	1	2	3	4
VALVIA	LYONSIA HYALINA								
	MACOMA BALTHICA								
	MULINIA LATERALIS								
	MYA ARENARIA								
	MYTILIDAE							1	
	TELLINA AGILIS								
	TURTONIA MINUTA								
RRIPEDIA	BALANUS CRENATUS		1						
SIDACEA	HETEROMYSIS FORMOSA								
PHIPODA	AMPELISCA ABDITA	1							
	COROPHIUM BONELLI								
	GAMMARUS LAWRENCIANUS								
	MICRODEUTOPUS GRYLLOTALPA								
	PONTOGENEIA INERMIS								
	UNCIOLA INERMIS								
CAPODA	CRANGON SEPTEMSPINOSA								
YOZOA	BUGULA TURRITA								
HIUROIDEA	OPHIUROIDEA							1	
CIDIACEA	ASCIDIA SP.								
L	ZSPECIES COMBINED	3	2	0	3	P	0	6	0

NTINUED)

TABLE 1. RAW COUNTS (NO./0.04 m²) FOR THE INNER HARBOR SAMPLING AREA

GROUP	SPECIES	MYSTIC RIVER	RESERVED CHANNEL			REVERE SUGAR		
		5	1A	2A	3A	1	3A	3B
PORIFERA	HALICHONDRIA PANICEA							
HYDROZOA	CLYTIA GRACILIS							
	OBELIA DICHOTOMA							
	OBELIA SP.							
NEMATODA	NEMATODA						2	6
POLYCHAETA	ANAITIDES SP.							
	ARICIDEA (ACMIRA)							
	CATHERINAE							
	CAPITELLA CAPITATA		7					
	CIRRATULIDAE						11	2
	ETEONE LONGA							
	GLYCERA DIBRANCHIATA							
	HEDISTE DIVERSICOLOR			2				
	LEITOSCOLOPLOS ACUTUS		1	2				
	LEITOSCOLOPLOS ROBUSTUS		8	15	22			
	LEITOSCOLOPLOS SP.		1					
	MALDANIDAE							
	MARENZELLERIA VIRIDIS			1				
	MEDIOMASTUS CALIFORNIENSIS							
	MICROPHTHALMUS ABERRANS							
	NEANTHES SUCCINEA							
	NEANTHES VIRENS			4	2	1		
	NEPHTYIDAE							
	NEPHTYS CAECA							
	NEPHTYS CILIATA							
	NEPHTYS INCISA							
	NEREIDAE			1				
	NINOE NIGRIPES							
	PARANAITIS SPECIOSA							
	PECTINARIA GOULDII			1				
	PECTINARIIDAE							
	POLYCIRRUS SP.							
	POLYDORA CORNUTA		3	12			2	1
	POLYDORA SOCIALIS							
	SPIO FILICORNIS			1				
	STREBLOSPIO BENEDICTI			11	2	2	2	2
	THARYX ACUTUS							3
OLIGOCHAETA	OLIGOCHAETA			3		1	8	13
GASTROPODA	CREPIDULA FORNICATA							
	CREPIDULA PLANA							
	CREPIDULA SP.							
	LACUNA VINCTA							
	NASSARIUS TRIVITTATUS							
BIVALVIA	ANOMIA SP.							
	BIVALVIA							
	CERASTODERMA PINNULATUM							

(CONTINUED)

TABLE 1. RAW COUNTS (NO./0.04 m^2) FOR THE INNER HARBOR SAMPLING AREA

GROUP	SPECIES	MYSTIC RIVER	RESERVED CHANNEL			REVERE SUGAR		
		5	1A	2A	3A	1	3A	3B
BIVALVIA	HIATELLA SP.							
	LYONSIA HYALINA							
	MACOMA BALTHICA			1				
	MULINIA LATERALIS			4	1			
	MYA ARENARIA		1	16	2			
	MYTILIDAE			1				
	TELLINA AGILIS							
	TURTONIA MINUTA							
CIRRIPEDIA	BALANUS CRENATUS							
MYSIDACEA	HETEROMYSIS FORMOSA							
AMPHIPODA	AMPELISCA ABDITA	1						
	COROPHIUM BONELLI							
	GAMMARUS LAWRENCIANUS							
	MICRODEUTOPUS GRYLLOTALPA						1	
	PONTOGENEIA INERMIS							
	UNCIOLA INERMIS							
DECAPODA	CRANGON SEPTEMSPINOSA					1		
BRYOZOA	BUGULA TURRITA							
OPHIUROIDEA	OPHIUROIDEA							
ASCIDIACEA	ASCIDIA SP.							
ALL	ZSPECIES COMBINED	1	21	75	29	5	26	27

TABLE 2. RAW COUNTS (NO./0.04 m²) FOR THE OUTER HARBOR SAMPLING AREA

GROUP	SPECIES	SPECTACLE ISLAND					SUBAQUEOUS B		
		2	5	8	11	12	2A	2B	2C
HYDROZOA	CLYTIA GRACILIS								
	EUDENDRIUM RUGOSUM								
	SERTULARIA CUPRESSINA				P	P	P	P	P
NEMERTINEA	NEMERTINEA	3	1		2	4	4	9	7
NEMATODA	NEMATODA	5		13	207		4	37	17
POLYCHAETA	AGLAOPHAMUS NEOTENUS			2					
	AMPHARETE ARCTICA	1							
	AMPHARETIDAE					1			
	ANAITIDES MUCOSA	21	1	12	44	38	85	77	87
	ANOBOTHRUS GRACILIS					1			
	APHELOCHAETA MARIONI								
	ARICIDEA (ACMIRA)								
	CATHERINAE	401	59	123	671	416	39	68	18
	ARICIDEA SP.						1		
	ASABELLIDES OCULATA	6		6	6	11	4		1
	CAPITELLA CAPITATA	4	1	1		8	2	10	1
	CIRRATULIDAE	119	59	18	52	56	12	10	36
	CIRRATULUS CIRRATUS								
	CLYMENELLA TORQUATA			8					1
	ENIPO TORELLI								2
	ETEONE LONGA	14	8	4	24	15	16	9	11
	EUCHONE ELEGANS			1					
	EULALIA VIRIDIS							1	
	GATTYANA CIRROSA			2			1		1
	HARMOTHOE IMBRICATA						3	1	1
	LEITOSCOLOPLOS ACUTUS								
	MALDANIDAE								
	MEDIOMASTUS CALIFORNIENSIS	25	14	8	16	36	27	22	15
	MICROPHTHALMUS ABERRANS			1					
	NEANTHES VIRENS							1	1
	NEPHTYIDAE		1						
	NEPHTYS CAECA			27		1			
	NEPHTYS CILIATA	7	7	13	5	14	3		
	NEPHTYS INCISA							1	
	NEREIDAE				2				
	NICOLEA ZOSTERICOLA						1		
	NINOE NIGRIPES	7	5	2	11	5	1	4	
	PARANAITIS SPECIOSA		1	1					
	PHERUSA AFFINIS						2	3	
	PHOLOE MINUTA	7	5		1	3	5	2	8
	PHYLLODOCIDAE								1
	POLYDORA CORNUTA	150	14	576	205	384	283	140	132
	POLYDORA QUADRILOBATA		2	74	2		1		
	POLYDORA SOCIALIS		3	47			1		
	POLYDORA WEBSTERI		1						
	PRIONOSPIO STEENSTRUPI				1				1
	SCOLELEPIS TEXANA			3					
	SCOLETOMA ACICULARUM			1					

(CONTINUED)

UP	SPECIES	SPECTACLE ISLAND					SUBAQUEOUS B		
		2	5	8	11	12	2A	2B	2C
.YCHAETA	SCOLETOMA HEBES						16	34	10
	SPIO FILICORNIS					1			
	SPIO LIMICOLA			1					
	SPIO SP.	4		1					2
	SPIO THULINI	1		7	2		3	5	
	SPIONIDAE			2					2
	SPIOPHANES BOMBYX			1					
	STREBLOSPIO BENEDICTI		1	472	4	8		1	1
	TEREBELLIDAE								
	THARYX ACUTUS	66	108	23	66	7	114	55	39
:GOCHAETA	OLIGOCHAETA	33	5	10	82	116	34	64	26
STROPODA	GASTROPODA	2			1	5	1	5	
	LACUNA VINCTA	2							
	NASSARIUS TRIVITTATUS			8					
/ALVIA	BIVALVIA					4		2	2
	CERASTODERMA PINNULATUM						1		
	LYONSIA HYALINA			1			2		2
	MYA ARENARIA								
	MYSELLA PLANULATA							1	
	MYTILIDAE			1		5	1		4
	TELLINA AGILIS			2					
RRIPEDIA	CIRRIPEDIA								1
SIDACEA	METERYTHROPS ROBUSTA				1				
	MYSIDACEA				1		2		1
	NEOMYSIS AMERICANA						4		
MACEA	DIASTYLIS SP.						1		
OPODA	CHIRIDOTEA SP.					1			
	CYATHURA POLITA					1			
	EDOTEA TRILOBA	1		2		5	8		6
PHIPODA	AMPELISCA SP.	1230	157	2467	1532	2927	4290	3124	3909
	AMPHIPODA					1			
	COROPHIUM BONELLI			3		112			
	COROPHIUM CRASSICORNE					9			
	COROPHIUM SP.					8			
	ERICHTHONIUS FASCIATUS		1						
	GAMMARUS SP.					14			
	JASSA MARMORATA			1		1			
	LEPTOCHEIRUS PINGUIS	62	7	124	53	78	68	39	119
	LEPTOCHEIRUS SP.								1
	LYSIANASSIDAE	1			4		9	4	
	ORCHOMENELLA PINGUIS					1			4
	PHOTIS POLLEX	5			3	5			2
	PHOXOCEPHALUS HOLBOLLI	76		5	100	154	134	61	147
	PHOXOCEPHALUS SP.								1
	UNCIOLA IRRORATA			7		59	99		87
	UNCIOLA SP.	23			17	9	5	15	12
CAPODA	CANCER IRRORATUS	1						3	1
	CRANGON SEPTEMSPINOSA					1	1		2

NTINUED)

TABLE 2. RAW COUNTS (NO./0.04 m²) FOR THE OUTER HARBOR SAMPLING AREA

GROUP	SPECIES	SPECTACLE ISLAND					SUBAQUEOUS B		
		2	5	8	11	12	2A	2B	2C
DECAPODA	DECAPODA				1				
BRYOZOA	BUGULA TURRITA						P		P
	MEMBRANIPORA MEMBRANACEA				P				
	PEDICELLINA CERNUA						P		
	SCRUPARIA AMBIGUA								
ALL	ZSPECIES COMBINED	2277	461	4081	3116	4525	5288	3808	4722

(CONTINUED)

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TABLE 2. RAW COUNTS (NO./0.04 m²) FOR THE OUTER HARBOR SAMPLING AREA

GROUP	SPECIES	SUBAQUEOUS E		
		1	2	3
HYDROZOA	CLYTIA GRACILIS		P	
	EUDENDRIUM RUGOSUM		P	
	SERTULARIA CUPRESSINA		P	P
NEMERTINEA	NEMERTINEA		1	1
NEMATODA	NEMATODA	2	119	42
POLYCHAETA	AGLAOPHAMUS NEOTENUS		1	1
	AMPHARETE ARCTICA			
	AMPHARETIDAE			
	ANAITIDES MUCOSA		44	6
	ANOBOTHRUS GRACILIS			
	APHELOCHAETA MARIONI		22	1
	ARICIDEA (ACMIRA)			
	CATHERINAE			
	ARICIDEA SP.			1
	ASABELLIDES OCULATA	1	9	8
	CAPITELLA CAPITATA		19	24
	CIRRATULIDAE	1	24	245
	CIRRATULUS CIRRATUS		1	
	CLYMENELLA TORQUATA			2
	ENIPO TORELLI			
	ETEONE LONGA		26	61
	EUCHONE ELEGANS			
	EULALIA VIRIDIS			
	GATTYANA CIRROSA			
	HARMOTHOE IMBRICATA		7	
	LEITOSCOLOPLOS ACUTUS	2		
	MALDANIDAE		2	1
	MEDIOMASTUS CALIFORNIENSIS		13	24
	MICROPHTHALMUS ABERRANS		1	
	NEANTHES VIRENS	1	1	5
	NEPHTYIDAE			
	NEPHTYS CAECA	1		
	NEPHTYS CILIATA	8	3	3
	NEPHTYS INCISA			1
	NEREIDAE			
	NICOLEA ZOSTERICOLA			
	NINOE NIGRIPES	6	1	3
	PARANAITIS SPECIOSA		1	
	PHERUSA AFFINIS			
	PHOLOE MINUTA		22	16
	PHYLLODOCIDAE			
	POLYDORA CORNUTA		373	371
	POLYDORA QUADRILOBATA			
	POLYDORA SOCIALIS		1	
	POLYDORA WEBSTERI			
	PRIONOSPIO STEENSTRUPI		3	3
	SCOLELEPIS TEXANA			
	SCOLETOMA ACICULARUM		1	1

(CONTINUED)

TABLE 2. RAW COUNTS (NO./0.04 m²) FOR THE OUTER HARBOR SAMPLING AREA

GROUP	SPECIES	SUBAQUEOUS E		
		1	2	3
POLYCHAETA	SCOLETOMA HEBES			
	SPIO FILICORNIS			
	SPIO LIMICOLA			
	SPIO SP.		1	1
	SPIO THULINI		5	16
	SPIONIDAE			
	SPIOPHANES BOMBYX			
	STREBLOSPIO BENEDICTI	1	34	10
	TEREBELLIDAE		1	
	THARYX ACUTUS		136	346
OLIGOCHAETA	OLIGOCHAETA	2	15	8
GASTROPODA	GASTROPODA		1	9
	LACUNA VINCTA		1	1
	NASSARIUS TRIVITTATUS	10	11	12
BIVALVIA	BIVALVIA		4	1
	CERASTODERMA PINNULATUM			
	LYONSIA HYALINA			
	MYA ARENARIA	1		2
	MYSELLA PLANULATA		3	
	MYTILIDAE	2	10	2
	TELLINA AGILIS		8	2
CIRRIPEDIA	CIRRIPEDIA			
MYSIDACEA	HETERYTHROPS ROBUSTA			
	MYSIDACEA			
	NEOMYSIS AMERICANA			
CUMACEA	DIASTYLIS SP.			
ISOPODA	CHIRIDOTEA SP.			
	CYATHURA POLITA			
	EDOTEA TRILOBA		1	1
AMPHIPODA	AMPELISCA SP.		1219	627
	AMPHIPODA			
	COROPHIUM BONELLI			
	COROPHIUM CRASSICORNE			
	COROPHIUM SP.			
	ERICHTHONIUS FASCIATUS			
	GAMMARUS SP.		1	
	JASSA MARMORATA			
	LEPTOCHEIRUS PINGUIS		40	11
	LEPTOCHEIRUS SP.			
	LYSIANASSIDAE			
	ORCHOMENELLA PINGUIS			
	PHOTIS POLLEX			
	PHOXOCEPHALUS HOLBOLLI		7	10
	PHOXOCEPHALUS SP.			
	UNCIOLA IRRORATA			
	UNCIOLA SP.		1	2
DECAPODA	CANCER IRRORATUS	1	1	
	CRANGON SEPTEMSPINOSA		3	

(CONTINUED)

TABLE 2. RAW COUNTS (NO./0.04 m²) FOR THE OUTER HARBOR SAMPLING AREA

GROUP	SPECIES	SUBAQUEOUS E		
		1	2	3
DECAPODA	DECAPODA			
BRYOZOA	BUGULA TURRITA			
	MEMBRANIPORA MEMBRANACEA			
	PEDICELLINA CERNUA			
	SCRUPARIA AMBIGUA	P		
ALL	ZSPECIES COMBINED	39	2198	1881

TABLE 3. RAW COUNTS (NO./0.04 m²) FOR THE OFFSHORE SAMPLING AREA

GROUP	SPECIES	BOSTON LIGHTSHIP							
		1	3	5	7	8	10	11	17
PORIFERA	SCYPHA CILIATA								
HYDROZOA	CLYTIA GRACILIS						P		
	EUDENDRIUM RUGOSUM								
	EUDENDRIUM SP.								
	SERTULARIA CUPRESSINA	P							
ANTHOZOA	ANTHOZOA								
	CERIANTHEOPSIS AMERICANUS					1			
	CERIANTHEOPSIS SP.								
	EDWARDSIA SP.					3		2	
NEMERTINEA	NEMERTINEA		1		4	3	2	1	2
NEMATODA	NEMATODA			5					
ARCHIANNELIDA	ARCHIANNELIDA								
POLYCHAETA	AGLAOPHAMUS CIRCINATA			1					
	AMPHARETE ACUTIFRONS		10	1		1			
	AMPHARETE ARCTICA	3	7	1	2	1	1	2	
	AMPHARETE SP.		3						
	AMPHARETIDAE	5		1	1	2			
	AMPHITRITE CIRRATA								
	ANAITIDES ARENAE								
	ANAITIDES MACULATA	3		1	2				
	ANAITIDES MUCOSA								1
	ANOBOTHRUS GRACILIS	11	7	3		25	18	9	9
	APHELOCHAETA MARIONI	13	1	1	5	26	7	4	22
	APHELOCHAETA MONILARIS								1
	APISTOBRANCHUS TULLBERGI				1				
	ARCTEOBIA ANTICOSTIENSIS		1		1	1			
	ARICIDEA (ACMIRA) CATHERINAE								
	ARICIDEA QUADRILOBATA								7
	ASABELLIDES OCULATA	9	62	3	12	10	1		1
	BARANTOLLA AMERICANA								
	CAPITELLA CAPITATA				2				
	CAULLERIELLA CF. KILLARIENSIS								
	CHAETOZONE SETOSA	2				1			2
	CHONE DUNERI								
	CIRRATULIDAE						1		
	CIRRATULUS CIRRATUS			1					
	COSSURA LONGOCIRRATA								1
	DRILONEREIS LONGA			1			2	2	
	DRILONEREIS MAGNA								
	ENIPO TORELLI		1	1			1		
	ETEONE LONGA	3		2	2				1
	EUCHONE ELEGANS								
	EUCHONE INCOLOR	1			1				
	EUCHONE SP.								
	EUCLYMENE COLLARIS								
	EULALIA BILINEATA								

(CONTINUED)

TABLE 3. RAW COUNTS (NO./0.04 m²) FOR THE OFFSHORE SAMPLING AREA

OUP	SPECIES	BOSTON LIGHTSHIP							
		1	3	5	7	8	10	11	17
LYCHAETA	EUSYLLIS SP.								
	EXOGONE DISPAR								
	EXOGONE HEBES								
	EXOGONE SP.								
	EXOGONE VERUGERA		1						
	GALATHOWENIA OCULATA	1		2		4	9	1	10
	GATTYANA AMONDSENI	2			1	1			
	GATTYANA CIRROSA								
	GLYCERA CAPITATA								
	GONIADA MACULATA		4	2	1				1
	HARMOTHOE IMBRICATA			1					
	HETEROMASTUS FILIFORMIS		1				1		
	LAGISCA EXTENUATA					1			
	LAONICE CIRRATA								
	LAONOME KROYERI	2	3		1	3		1	
	LEITOSCOLOPLOS ACUTUS		4		2		1	1	3
	LEVINSENIA GRACILIS	7	4	5	9	1	3		13
	LYSILLA LOVENI	1			3				
	MALDANE SARSI	7	1		2	32	20	1	6
	MALDANIDAE	9	1	8	1	4	2		8
	MARENZELLERIA VIRIDIS	1							
	MEDIOMASTUS CALIFORNIENSIS	14	18	21	34	1	3	1	11
	MICROPHTHALMUS ABERRANS								
	MINUSPIO CIRRIFERA	1							
	MONTICELLINA BAPTISTAE								
	MONTICELLINA DORSOBRANCHIALIS		1						
	MYRIOCHELE HEERI	1				1			2
	NEPHTYIDAE								
	NEPHTYS CAECA								
	NEPHTYS CILIATA								
	NEPHTYS INCISA	2	3	2	1	4	2	1	2
	NEREIS GRAYI								
	NEREIS SP.								
	NEREIS ZONATA								
	NINOE NIGRIPES	7	2	1	6	10	4	1	4
	OPHELINA ACUMINATA		1						
	ORBINIIDAE			1					
	OWENIA FUSIFORMIS						2		
	PARADONEIS LYRA								
	PARAPIONOSYLLIS LONGICIRRATA								
	PECTINARIA GRANULATA								
	PHERUSA AFFINIS								
	PHOLOE MINUTA	1	1			1			
	PHYLLODOCIDAE								
	POLYCIRRUS MEDUSA								
	POLYCIRRUS PHOSPHOREUS								1

ITINUED)

TABLE 3. RAW COUNTS (NO./0.04 m²) FOR THE OFFSHORE SAMPLING AREA

GROUP	SPECIES	BOSTON LIGHTSHIP							
		1	3	5	7	8	10	11	17
POLYCHAETA	POLYCIRRUS SP.		1				2		
	POLYDORA CAULLERYI								
	POLYDORA CONCHARUM						2		
	POLYDORA CORNUTA								
	POLYDORA QUADRILOBATA								
	POLYDORA SOCIALIS	4	2	1	7	1	3		
	POLYDORA SP.								
	POLYNOIDAE								
	PRAXILLELLA PRAETERMISSA					4			
	PRAXILLURA ORNATA	1		5					
	PRIONOSPIO STEENSTRUPI	6	18	29	38	6		2	3
	PROTODORVILLEA GASPEENSIS								
	RHODINE BITORQUATA	1		2					
	SABELLIDAE			1				2	
	SCALIBREGMA INFLATUM	1	12	7	10	4		1	1
	SCHISTOMERINGOS CAECA								
	SCOLETOMA ACICULARUM								
	SCOLETOMA FRAGILIS			1		4	1	3	3
	SCOLETOMA HEBES								
	SCOLOPLOS ARMIGER	1			2	1			
	SPHAEROSYLLIS SP.								
	SPIO FILICORNIS								
	SPIO LIMICOLA	97	237	128	300	50	50	19	67
	SPIO SETOSA								
	SPIO SP.	4	4		5	3			2
	SPIO THULINI								
	SPIONIDAE	2	1		4	2		1	1
	SPIOPHANES BOMBYX								
	SPIOPHANES KROYERI	3				2	5		
	STERNAPSIS SCUTATA	1					1		
	SYLLIDAE								
	SYLLIS (TYPOSYLLIS)ALTERNATA								
	TEREBELLIDAE		2			1			
	TEREBELLIDES ATLANTIS				1	1	1		1
	TEREBELLIDES STROEMI				1	3	2		
	THARYX ACUTUS		1	1					
	TRICHOBRANCHUS ROSEUS			1		1	2		
	TROCHOCHAETA MULTISETOSA				1				2
	TROCHOCHAETA SP.								
	TYPOSYLLIS SP.								
OLIGOCHAETA	OLIGOCHAETA			1					
GASTROPODA	ALVANIA EXARATA						1		
	BUCCINUM UNDATUM								
	COLUS PUBESCENS		1				1		
	COLUS SP.								
	CREPIDULA FORNICATA								
	GASTROPODA			1				1	

(CONTINUED)

TABLE 3. RAW COUNTS (NO./0.04 m²) FOR THE OFFSHORE SAMPLING AREA

OUP	SPECIES	BOSTON LIGHTSHIP							
		1	3	5	7	8	10	11	17
STROPODA	LACUNA VINCTA								
	LUNATIA HEROS								
	MARGARITES HELICINUS								
	NASSARIUS TRIVITTATUS								
	OENOPOTA DECUSSATA	1							
	RETUSA OBTUSA								1
	TURRIDAE								
LYPLACOPHORA	ISCHNOCHITON ALBUS								
VALVIA	ANOMIA SP.								
	ARCTICA ISLANDICA								
	ASTARTE BOREALIS								
	ASTARTE SP.								
	ASTARTE UNDATA			2	2	2	3	2	1
	BIVALVIA				3	1	1		1
	CERASTODERMA PINNULATUM			2		13			
	CRENELLA DECUSSATA		2			4	1		2
	CRENELLA GLANDULA								
	CRENELLA SP.								
	HIATELLA SP.								
	LYONSIA HYALINA								
	MUSCULUS NIGER								
	MYA ARENARIA		1			3		1	
	MYSELLA PLANULATA			1					
	MYTILIDAE								
	NUCULA SP.								
	NUCULA TENUIS		1	3		3			1
	PECTINIDAE								
	PERIPLOMA LEANUM						1		1
	PERIPLOMA SP.								
	PLACOPECTEN MAGELLANICUS								
	THRACIA MYOPSIS								
	THYASIRA FLEXUOSA	11	4	12	4	19	10	13	18
	YOLDIA SAPOTILLA	2	4	3	2	4			3
	YOLDIA SP.			8	1	3	1	1	2
RRIPEDIA	CIRRIPEDIA								
SIDACEA	MYSIDACEA			3					
MACEA	CAMPYLASPIS RUBICUNDA		1	1	2				
	DIASTYLIS ABBREVIATA		2						
	DIASTYLIS BISPINOSA			2	3				
	DIASTYLIS SCULPTA								
	EUDORELLA PUSILLA		1						
	PETALOSARSIA DECLIVIS								
OPODA	EDOTEA TRILOBA	2		1	3	4			
	JAERA MARINA								
	PLEUROGONIUM SPINOSISSIMUM					1			
	POLITOLANA CONCHARUM								
	PTILANTHURA SP.								
PHIPODA	AEGININA LONGICORNIS								

NTINUED)

TABLE 3. RAW COUNTS (NO./0.04 m²) FOR THE OFFSHORE SAMPLING AREA

GROUP	SPECIES	BOSTON LIGHTSHIP							
		1	3	5	7	8	10	11	17
AMPHIPODA	AMPELISCA MACROCEPHALA	4	2	1	2				
	AMPELISCA SP.								1
	AMPHIPODA			1					
	ANONYX LILJEBORGI			3	2				
	ANONYX SARSI								
	ARGISSA HAMATIPES								
	BYBLIS SERRATA		1					1	
	CASCO BIGELOWI								
	COROPHIIDAE						1		
	COROPHIUM CRASSICORNE								
	ERICHTHONIUS FASCIATUS		1						
	ERICHTHONIUS SP.								
	GAMMARUS LAWRENCIANUS								
	GAMMARUS SP.		2						
	HAPLOOPS SP.					2			
	HAPLOOPS TUBICOLA	1	3	4	1	14	4	3	2
	HARPINIA PROPINQUA		3	1		3			
	HIPPOMEDON SERRATUS	1						1	
	JASSA MARMORATA								
	LEMBOS WEBSTERI								
	LEPTOCHEIRUS PINGUIS			1	1	13			1
	LYSIANASSIDAE								
	MONOCULODES SP.								
	MONOCULODES TUBERCULATUS								
	OEDICEROTIDAE								
	PHOTIS POLLEX								
	STENOPLEUSTES SP.								
	SYRRHOE CRENULATA								
	UNCIOLA INERMIS								
	UNCIOLA IRRORATA				1				
	UNCIOLA SP.								
DECAPODA	CANCER IRRORATUS								
	PAGURUS LONGICARPUS								
SIPUNCULA	GOLFINGIA SP.							1	
	SIPUNCULA	1	2	2					
PHORONIDA	PHORONIS ARCHITECTA	1	3	3	1			2	
BRYOZOA	ANGUINELLA PALMATA								
	BUGULA TURRITA						P		
	CRISIA EBURNEA								
	ELECTRA PILOSA								
	EUCRATEA LORICATA	P							
	HIPPOTHOA HYALINA		P						
OPHIUROIDEA	OPHIOPHOLIS ACULEATA								
	OPHIURA ROBUSTA								
	OPHIURA SARSI		3	6	4	3	1		3
	OPHIUROIDEA								
ECHINOIDEA	STRONGYLOCENTROTUS DROEBACHIENSIS								

(CONTINUED)

UP	SPECIES	BOSTON LIGHTSHIP							
		1	3	5	7	8	10	11	17
RDATA	CHORDATA								
IDIACEA	APLIDIUM SP.						P		
	ASCIDIA SP.					1			
	CORELLA BOREALIS	1	1						
	ZSPECIES COMBINED	252	454	303	495	313	174	81	225

TINUED)

TABLE 3. RAW COUNTS (NO./0.04 m²) FOR THE OFFSHORE SAMPLING AREA

GROUP	SPECIES	BOSTON LIGHTSHIP			MEISBURGER 2				
		20	22	24	2	3	5	6	7
PORIFERA	SCYPHA CILIATA				3				
HYDROZOA	CLYTIA GRACILIS								
	EUDENDRIUM RUGOSUM					P			
	EUDENDRIUM SP.								
	SERTULARIA CUPRESSINA					P			
ANTHOZOA	ANTHOZOA			8	2				
	CERIANTHEOPSIS AMERICANUS					2		1	
	CERIANTHEOPSIS SP.								
	EDWARDSIA SP.			3		5		2	
NEMERTINEA	NEMERTINEA	3	4	6		4			4
NEMATODA	NEMATODA		2	16		3	1		
ARCHIANNELIDA	ARCHIANNELIDA								11
POLYCHAETA	AGLAOPHAMUS CIRCINATA						1	2	2
	AMPHARETE ACUTIFRONS		4	2					
	AMPHARETE ARCTICA	1	1	9		10		1	9
	AMPHARETE SP.								
	AMPHARETIDAE	1			1				
	AMPHITRITE CIRRATA				1				
	ANAITIDES ARENAE			1					
	ANAITIDES MACULATA		1	2	1	7		29	
	ANAITIDES MUCOSA		1			2	5	6	
	ANOBOTHRUS GRACILIS	4	6	5					
	APHELOCHAETA MARIONI	6	4	3	20	67	4		
	APHELOCHAETA MONILARIS					2			1
	APISTOBRANCHUS TULLBERGI								
	ARCTEOBIA ANTICOSTIENSIS			2					
	ARICIDEA (ACMIRA) CATHERINAE					4			
	ARICIDEA QUADRILOBATA		1	1					
	ASABELLIDES OCULATA	1	11	7		24	28	7	11
	BARANTOLLA AMERICANA								
	CAPITELLA CAPITATA					9			
	CAULLERIELLA CF. KILLARIENSIS								
	CHAETOZONE SETOSA		2	1				16	6
	CHONE DUNERI								
	CIRRATULIDAE			1	1	1		14	1
	CIRRATULUS CIRRATUS					1			
	COSSURA LONGOCIRRATA								
	DRILONEREIS LONGA		1			1			
	DRILONEREIS MAGNA								
	ENIPO TORELLI		1						
	ETEONE LONGA	2		4	1	5	2	4	2
	EUCHONE ELEGANS					2	1	42	10
	EUCHONE INCOLOR		1	1					
	EUCHONE SP.					3			27
	EUCLYMENE COLLARIS			4		9		19	32
	EULALIA BILINEATA								

(CONTINUED)

TABLE 3. RAW COUNTS (NO./0.04 m²) FOR THE OFFSHORE SAMPLING AREA

OUP	SPECIES	BOSTON LIGHTSHIP			MEISBURGER 2				
		20	22	24	2	3	5	6	7
LYCHAETA	EUSYLLIS SP.								
	EXOGONE DISPAR								1
	EXOGONE HEBES								
	EXOGONE SP.						1		1
	EXOGONE VERUGERA			1		3	2	6	2
	GALATHOWENIA OCULATA		1	1					
	GATTYANA AMONDSENI		1	1					
	GATTYANA CIRROSA				4				
	GLYCERA CAPITATA				1			2	3
	GONIADA MACULATA	1	1			1	1		
	HARMOTHOE IMBRICATA				1		3		
	HETEROMASTUS FILIFORMIS		1	1				1	
	LAGISCA EXTENUATA				1				
	LAONICE CIRRATA					1			
	LAONOME KROYERI		1	5		2		6	
	LEITOSCOLOPLOS ACUTUS	2		7		21		3	3
	LEVINSENIA GRACILIS	2	9	13			1		
	LYSILLA LOVENI	1							
	MALDANE SARSI			2			4		
	MALDANIDAE			3				4	
	MARENZELLERIA VIRIDIS								
	MEDIOMASTUS CALIFORNIENSIS	6	53	45	4	47	4	16	2
	MICROPHTHALMUS ABERRANS								
	MINUSPIO CIRRIFERA		1	1					
	MONTICELLINA BAPTISTAE								
	MONTICELLINA DORSOBRANCHIALIS					2		1	
	MYRIOCHELE HEERI								
	NEPHTYIDAE						1		
	NEPHTYS CAECA								
	NEPHTYS CILIATA								
	NEPHTYS INCISA	2	1	5		1			
	NEREIS GRAYI		1						
	NEREIS SP.			6		2			
	NEREIS ZONATA			1					
	NINOE NIGRIPES	7	6	5	13	12	4	1	
	OPHELINA ACUMINATA								
	ORBINIIDAE								
	OWENIA FUSIFORMIS								2
	PARADONEIS LYRA								
	PARAPIONOSYLLIS LONGICIRRATA								
	PECTINARIA GRANULATA				2	2			1
	PHERUSA AFFINIS								
	PHOLOE MINUTA			2	3	2		3	
	PHYLLODOCIDAE					4			
	POLYCIRRUS MEDUSA								
	POLYCIRRUS PHOSPHOREUS				1				

NTINUED)

TABLE 3. RAW COUNTS (NO./0.04 m²) FOR THE OFFSHORE SAMPLING AREA

GROUP	SPECIES	BOSTON LIGHTSHIP			MEISBURGER 2				
		20	22	24	2	3	5	6	7
POLYCHAETA	POLYCIRRUS SP.		1		2			2	
	POLYDORA CAULLERYI					1		2	
	POLYDORA CONCHARUM								
	POLYDORA CORNUTA								
	POLYDORA QUADRILOBATA					118	23	49	
	POLYDORA SOCIALIS	2	3	14		26	29	37	7
	POLYDORA SP.								
	POLYNOIDAE								
	PRAXILLELLA PRAETERMISSA					11			
	PRAXILLURA ORNATA		1	22					
	PRIONOSPIO STEENSTRUPI	8	35	35		24	12	45	8
	PROTODORVILLEA GASPEENSIS								
	RHODINE BITORQUATA		3	2				1	
	SABELLIDAE					1		4	
	SCALIBREGMA INFLATUM	4	18	12	1	10	9	6	1
	SCHISTOMERINGOS CAECA								
	SCOLETOMA ACICULARUM								
	SCOLETOMA FRAGILIS			1	1	4			
	SCOLETOMA HEBES	1							
	SCOLOPLOS ARMIGER	2							
	SPHAEROSYLLIS SP.								
	SPIO FILICORNIS				1		1	1	1
	SPIO LIMICOLA	88	148	301	1	71	35	2	6
	SPIO SETOSA								1
	SPIO SP.			3			4		1
	SPIO THULINI			1			8	4	8
	SPIONIDAE			8	2	1	3	1	2
	SPIOPHANES BOMBYX					1		1	2
	SPIOPHANES KROYERI			2					
	STERNAPSIS SCUTATA								
	SYLLIDAE								
	SYLLIS								
	(TYPOSYLLIS)ALTERNATA				5				
	TEREBELLIDAE	2	2						
	TEREBELLIDES ATLANTIS	1	2	2					
	TEREBELLIDES STROEMI	1	2	1					
	THARYX ACUTUS		1	2		4		4	
	TRICHOBRANCHUS ROSEUS								
	TROCHOCHAETA MULTISETOSA			1					
	TROCHOCHAETA SP.						2		
	TYPOSYLLIS SP.				1	2		2	
OLIGOCHAETA	OLIGOCHAETA				1				1
GASTROPODA	ALVANIA EXARATA								
	BUCCINUM UNDATUM				1				
	COLUS PUBESCENS		1	1					
	COLUS SP.			4					
	CREPIDULA FORNICATA								
	GASTROPODA								

(CONTINUED)

TABLE 3. RAW COUNTS (NO./0.04 m²) FOR THE OFFSHORE SAMPLING AREA

UP	SPECIES	BOSTON LIGHTSHIP			MEISBURGER 2				
		20	22	24	2	3	5	6	7
STROPODA	LACUNA VINCTA				1			1	
	LUNATIA HEROS								
	MARGARITES HELICINUS							2	
	NASSARIUS TRIVITTATUS				1			5	
	OENOPOTA DECUSSATA								
	RETUSA OBTUSA								
	TURRIDAE					1			
.YPLACOPHORA	ISCHNOCHITON ALBUS								
/ALVIA	ANOMIA SP.					2	1	1	2
	ARCTICA ISLANDICA		1						
	ASTARTE BOREALIS								
	ASTARTE SP.								
	ASTARTE UNDATA	2	3	1		5		1	2
	BIVALVIA								
	CERASTODERMA PINNULATUM		1		18	5	6	3	6
	CRENELLA DECUSSATA		1		2	20			4
	CRENELLA GLANDULA								6
	CRENELLA SP.							1	7
	HIATELLA SP.				3	2	1	1	
	LYONSIA HYALINA								1
	MUSCULUS NIGER				1	1			
	MYA ARENARIA		1			3	1	1	
	MYSELLA PLANULATA			2					
	MYTILIDAE			1		2	1	2	1
	NUCULA SP.							1	
	NUCULA TENUIS		1	1	1	26			
	PECTINIDAE								
	PERIPLOMA LEANUM								
	PERIPLOMA SP.								
	PLACOPECTEN MAGELLANICUS								
	THRACIA MYOPSIS		1	1					
	THYASIRA FLEXUOSA	6	7	13		11			
	YOLDIA SAPOTILLA	2		4		1			
	YOLDIA SP.		2			1			
RRIPEDIA	CIRRIPEDIA								
SIDACEA	MYSIDACEA						4	3	
MACEA	CAMPYLASPIS RUBICUNDA		1			1			
	DIASTYLIS ABBREVIATA								
	DIASTYLIS BISPINOSA		2	3					
	DIASTYLIS SCULPTA				1	1			
	EUDORELLA PUSILLA								
	PETALOSARSIA DECLIVIS								1
OPODA	EDOTEA TRILOBA		3	4		7		2	3
	JAERA MARINA			1					
	PLEUROGONIUM SPINOSISSIMUM				2				
	POLITOLANA CONCHARUM								
	PTILANTHURA SP.					4			
IPHIPODA	AEGININA LONGICORNIS						1		

NTINUED)

TABLE 3. RAW COUNTS (NO./0.04 m²) FOR THE OFFSHORE SAMPLING AREA

GROUP	SPECIES	BOSTON LIGHTSHIP			MEISBURGER 2				
		20	22	24	2	3	5	6	7
AMPHIPODA	AMPELISCA MACROCEPHALA		3	2		2			
	AMPELISCA SP.			1					
	AMPHIPODA								
	ANONYX LILJEBORGI			1		2	1		1
	ANONYX SARSI								
	ARGISSA HAMATIPES								1
	BYBLIS SERRATA								
	CASCO BIGELOWI								
	COROPHIIDAE								
	COROPHIUM CRASSICORNE						2	4	
	ERICHTHONIUS FASCIATUS		1		3		1		11
	ERICHTHONIUS SP.				1		1		
	GAMMARUS LAWRENCIANUS				1				
	GAMMARUS SP.								
	HAPLOOPS SP.						1		
	HAPLOOPS TUBICOLA	2	2	11	3	1			
	HARPINIA PROPINQUA		1	1					
	HIPPOMEDON SERRATUS			1			1		2
	JASSA MARMORATA								
	LEMBOS WEBSTERI						5	16	13
	LEPTOCHEIRUS PINGUIS			2	10	2	3	1	
	LYSIANASSIDAE								1
	MONOCULODES SP.		1						
	MONOCULODES TUBERCULATUS						1		
	OEDICEROTIDAE								
	PHOTIS POLLEX								1
	STENOPLEUSTES SP.					1			
	SYRRHOE CRENULATA								
	UNCIOLA INERMIS						8	50	23
	UNCIOLA IRRORATA		1				9		
	UNCIOLA SP.				11				
DECAPODA	CANCER IRRORATUS								
	PAGURUS LONGICARPUS								1
SIPUNCULA	GOLFINGIA SP.								
	SIPUNCULA				1		1		
PHORONIDA	PHORONIS ARCHITECTA		2	1		38		1	1
BRYOZOA	ANGUINELLA PALMATA				P				
	BUGULA TURRITA								
	CRISIA EBURNEA								
	ELECTRA PILOSA								
	EUCRATEA LORICATA					P			
	HIPPOTHOA HYALINA					P			
OPHIUROIDEA	OPHIOPHOLIS ACULEATA								
	OPHIURA ROBUSTA								1
	OPHIURA SARSI	2	2						
	OPHIUROIDEA	1	1		1	1			
ECHINOIDEA	STRONGYLOCENTROTUS								
	DROEBACHIENSIS						1		

(CONTINUED)

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TABLE 3. RAW COUNTS (NO./0.04 m²) FOR THE OFFSHORE SAMPLING AREA

UP	SPECIES	BOSTON LIGHTSHIP			MEISBURGER 2				
		20	22	24	2	3	5	6	7
RDATA	CHORDATA				1				
:IDIACEA	APLIDIUM SP.								
	ASCIDIA SP.								
	CORELLA BOREALIS						1		
	ZSPECIES COMBINED	163	371	638	138	675	240	443	258

ITINUED)

275

281

TABLE 3. RAW COUNTS (NO./0.04 m²) FOR THE OFFSHORE SAMPLING AREA

GROUP	SPECIES	MEISBURGER 2				MEISBURGER 7			
		9	10	15	17	2	4	6	8
PORIFERA	SCYPHA CILIATA								
HYDROZOA	CLYTIA GRACILIS								
	EUDENDRIUM RUGOSUM								
	EUDENDRIUM SP.				P				
	SERTULARIA CUPRESSINA			P					P
ANTHOZOA	ANTHOZOA				3				
	CERIANTHEOPSIS AMERICANUS			1					2
	CERIANTHEOPSIS SP.				4				
	EDWARDSIA SP.	5		9	2				
NEMERTINEA	NEMERTINEA	10	3	21	4	1	3	1	
NEMATODA	NEMATODA				18		3	1	
ARCHIANNELIDA	ARCHIANNELIDA						2		
POLYCHAETA	AGLAOPHAMUS CIRCINATA		3					1	
	AMPHARETE ACUTIFRONS								
	AMPHARETE ARCTICA	4	2	6	2			1	1
	AMPHARETE SP.								
	AMPHARETIDAE	6	1		6	1		4	
	AMPHITRITE CIRRATA								
	ANAITIDES ARENAE								
	ANAITIDES MACULATA	1	3	1		1		3	
	ANAITIDES MUCOSA						1		
	ANOBOTHRUS GRACILIS	2		7			1		
	APHELOCHAETA MARIONI	149	7	84	31		1	1	6
	APHELOCHAETA MONILARIS		6		4	1			
	APISTOBRANCHUS TULLBERGI								
	ARCTEOBIA ANTICOSTIENSIS	1			1				
	ARICIDEA (ACMIRA)								
	CATHERINAE	3		5	3	4	2	1	1
	ARICIDEA QUADRILOBATA								
	ASABELLIDES OCULATA	11	21	14	4	9	33	14	
	BARANTOLLA AMERICANA			1					
	CAPITELLA CAPITATA	14		3					
	CAULLERIELLA CF.								
	KILLARIENSIS						2		
	CHAETOZONE SETOSA		5						
	CHONE DUNERI	1						1	
	CIRRATULIDAE		8	1				3	
	CIRRATULUS CIRRATUS	1							
	COSSURA LONGOCIRRATA								
	DRILONEREIS LONGA								
	DRILONEREIS MAGNA								
	ENIPO TORELLI						1		1
	ETEONE LONGA	1						1	
	EUCHONE ELEGANS	1	194			9	1	32	
	EUCHONE INCOLOR								
	EUCHONE SP.						9		
	EUCLYMENE COLLARIS	2	56	7		32	17	26	
	EULALIA BILINEATA	1							

(CONTINUED)

TABLE 3. RAW COUNTS (NO./0.04 m²) FOR THE OFFSHORE SAMPLING AREA

ROUP	SPECIES	MEISBURGER 2				MEISBURGER 7			
		9	10	15	17	2	4	6	8
OLYCHAETA	EUSYLLIS SP.						1		
	EXOGONE DISPAR						1	2	
	EXOGONE HEBES		4					1	
	EXOGONE SP.		2				1	2	
	EXOGONE VERUGERA		15			5	24	29	
	GALATHOWENIA OCULATA				3				
	GATTYANA AMONDSENI		1	1	2				
	GATTYANA CIRROSA								
	GLYCERA CAPITATA					5	8	3	
	GONIADA MACULATA	1							
	HARMOTHOE IMBRICATA								
	HETEROMASTUS FILIFORMIS								
	LAGISCA EXTENUATA					1		1	
	LAONICE CIRRATA			1	2				
	LAONOME KROYERI		3						
	LEITOSCOLOPLOS ACUTUS	5	3	13				1	1
	LEVINSENIA GRACILIS				5	4	1		6
	LYSILLA LOVENI								
	MALDANE SARSI	3			70				
	MALDANIDAE		2				14	1	
	MARENZELLERIA VIRIDIS								
	MEDIOMASTUS CALIFORNIENSIS	46	18	55	32	2	5	2	1
	MICROPHTHALMUS ABERRANS			1					
	MINUSPIO CIRRIFERA						1		
	MONTICELLINA BAPTISTAE								
	MONTICELLINA								
	DORSOBRANCHIALIS	1		4			1	1	6
	MYRIOCHELE HEERI		1						
	NEPHTYIDAE								
	NEPHTYS CAECA		1						
	NEPHTYS CILIATA		4						
	NEPHTYS INCISA				1				5
	NEREIS GRAYI	1							
	NEREIS SP.	8	1	3	2				
	NEREIS ZONATA	2							
	NINOE NIGRIPES	19	1	22	9	1	9		15
	OPHELINA ACUMINATA								
	ORBINIIDAE								
	OWENIA FUSIFORMIS		2	1					
	PARADONEIS LYRA								
	PARAPIONOSYLLIS								
	LONGICIRRATA						1		
	PECTINARIA GRANULATA		1		1				
	PHERUSA AFFINIS	1	2						
	PHOLOE MINUTA			2	1	1		3	1
	PHYLLODOCIDAE								
	POLYCIRRUS MEDUSA								
	POLYCIRRUS PHOSPHOREUS								

CONTINUED)

TABLE 3. RAW COUNTS (NO./0.04 m²) FOR THE OFFSHORE SAMPLING AREA

GROUP	SPECIES	MEISBURGER 2				MEISBURGER 7			
		9	10	15	17	2	4	6	8
POLYCHAETA	POLYCIRRUS SP.			1	2				
	POLYDORA CAULLERYI		1		1			1	
	POLYDORA CONCHARUM								
	POLYDORA CORNUTA			1					
	POLYDORA QUADRILOBATA	168	154	95	2				
	POLYDORA SOCIALIS	59	48	133	1			7	
	POLYDORA SP.							1	
	POLYNOIDAE								
	PRAXILLELLA PRAETERMISSA								
	PRAXILLURA ORNATA								
	PRIONOSPIO STEENSTRUPI	11	54	13	3		1		
	PROTODORVILLEA GASPEENSIS						1		
	RHODINE BITORQUATA	6							
	SABELLIDAE		9	1		18		28	
	SCALIBREGMA INFLATUM	3	6	8	12				
	SCHISTOMERINGOS CAECA							1	
	SCOLETOMA ACICULARUM					1			
	SCOLETOMA FRAGILIS	3		1	1				1
	SCOLETOMA HEBES								
	SCOLOPLOS ARMIGER	4		2					
	SPHAEROSYLLIS SP.						2		
	SPIO FILICORNIS	2		2					
	SPIO LIMICOLA	16	38	16	1	1	4		6
	SPIO SETOSA								
	SPIO SP.							2	
	SPIO THULINI		4			2	1	7	
	SPIONIDAE	1	3	1	2		1		
	SPIOPHANES BOMBYX		3	1		1		1	
	SPIOPHANES KROYERI	1							
	STERNAPSIS SCUTATA								
	SYLLIDAE	1							
	SYLLIS								
	(TYPOSYLLIS)ALTERNATA			1	2				
	TEREBELLIDAE								
	TEREBELLIDES ATLANTIS								
	TEREBELLIDES STROEMI								
	THARYX ACUTUS		4	2		5	9	3	3
	TRICHOBRANCHUS ROSEUS								
	TROCHOCHAETA MULTISETOSA								
	TROCHOCHAETA SP.								
	TYPOSYLLIS SP.	3							
OLIGOCHAETA	OLIGOCHAETA				1		2	2	
GASTROPODA	ALVANIA EXARATA			1	2				
	BUCCINUM UNDATUM								
	COLUS PUBESCENS								
	COLUS SP.								
	CREPIDULA FORNICATA								
	GASTROPODA								

(CONTINUED)

OUP	SPECIES	MEISBURGER 2				MEISBURGER 7			
		9	10	15	17	2	4	6	8
STROPODA	LACUNA VINCTA				1				
	LUNATIA HEROS		1						
	MARGARITES HELICINUS								
	NASSARIUS TRIVITTATUS		2					1	
	OENOPOTA DECUSSATA								
	RETUSA OBTUSA								
	TURRIDAE								
LYPLACOPHORA	ISCHNOCHITON ALBUS								
VALVIA	ANOMIA SP.								
	ARCTICA ISLANDICA								
	ASTARTE BOREALIS						1		
	ASTARTE SP.								
	ASTARTE UNDATA	2	3	2		2			
	BIVALVIA	1	2	1		1			3
	CERASTODERMA PINNULATUM	1	4	1	3	4	7	8	
	CRENELLA DECUSSATA	10	4	8	26		8		
	CRENELLA GLANDULA					1	4		
	CRENELLA SP.				2			3	
	HIATELLA SP.						1		
	LYONSIA HYALINA								
	MUSCULUS NIGER	1							
	MYA ARENARIA								
	MYSELLA PLANULATA				1				
	MYTILIDAE	1			1		2		
	NUCULA SP.								
	NUCULA TENUIS	31		2	11				3
	PECTINIDAE								
	PERIPLOMA LEANUM								
	PERIPLOMA SP.								1
	PLACOPECTEN MAGELLANICUS						1		
	THRACIA MYOPSIS				1				
	THYASIRA FLEXUOSA	7		30	9				
	YOLDIA SAPOTILLA			3					
	YOLDIA SP.	2		1					1
RRIPEDIA	CIRRIPEDIA				1				
SIDACEA	MYSIDACEA		1				1		
MACEA	CAMPYLASPIS RUBICUNDA								
	DIASTYLIS ABBREVIATA		2						
	DIASTYLIS BISPINOSA								
	DIASTYLIS SCULPTA								
	EUDORELLA PUSILLA								
	PETALOSARSIA DECLIVIS								
OPODA	EDOTEA TRILOBA	4	2	2					
	JAERA MARINA								
	PLEUROGONIUM SPINOSISSIMUM								
	POLITOLANA CONCHARUM								
	PTILANTHURA SP.	7	2	2	8				
IPHIPODA	AEGININA LONGICORNIS			2	1				

NTINUED)

TABLE 3. RAW COUNTS (NO./0.04 m²) FOR THE OFFSHORE SAMPLING AREA

GROUP	SPECIES	MEISBURGER 2				MEISBURGER 7			
		9	10	15	17	2	4	6	8
AMPHIPODA	AMPELISCA MACROCEPHALA	2							
	AMPELISCA SP.					1		2	
	AMPHIPODA								
	ANONYX LILJEBORGI		1						
	ANONYX SARSI					1			
	ARGISSA HAMATIPES								
	BYBLIS SERRATA								
	CASCO BIGELOWI				1				
	COROPHIIDAE								
	COROPHIUM CRASSICORNE		13					2	
	ERICHTHONIUS FASCIATUS		12						
	ERICHTHONIUS SP.				1			2	
	GAMMARUS LAWRENCIANUS								
	GAMMARUS SP.								
	HAPLOOPS SP.								
	HAPLOOPS TUBICOLA	4	9	26	21				
	HARPINIA PROPINQUA		2	1	1				
	HIPPOMEDON SERRATUS								
	JASSA MARMORATA						1		
	LEMBOS WEBSTERI					1	2	6	
	LEPTOCHEIRUS PINGUIS		10				1		
	LYSIANASSIDAE		2						
	MONOCULODES SP.						1		
	MONOCULODES TUBERCULATUS					2			
	OEDICEROTIDAE						4		
	PHOTIS POLLEX		1						
	STENOPLEUSTES SP.								
	SYRRHOE CRENULATA							1	
	UNCIOLA INERMIS					86	11	95	
	UNCIOLA IRRORATA					16	35	14	
	UNCIOLA SP.		8		1	3	2		
DECAPODA	CANCER IRRORATUS					1			
	PAGURUS LONGICARPUS								
SIPUNCULA	GOLFINGIA SP.								
	SIPUNCULA								
PHORONIDA	PHORONIS ARCHITECTA	7		16	7	1			
BRYOZOA	ANGUINELLA PALMATA								
	BUGULA TURRITA								
	CRISIA EBURNEA				P				
	ELECTRA PILOSA				P				
	EUCRATEA LORICATA								
	HIPPOTHOA HYALINA		P		P				
OPHIUROIDEA	OPHIOPHOLIS ACULEATA				1				
	OPHIURA ROBUSTA								
	OPHIURA SARSI	1							
	OPHIUROIDEA								
ECHINOIDEA	STRONGYLOCENTROTUS								
	DROEBACHIENSIS						3		

(CONTINUED)

:OUP	SPECIES	MEISBURGER 2				MEISBURGER 7			
		9	10	15	17	2	4	6	8
IORDATA	CHORDATA								
;CIDIACEA	APLIDIUM SP.								
	ASCIDIA SP.								
	CORELLA BOREALIS								
.L	ZSPECIES COMBINED	659	775	639	338	225	249	323	64

INTINUED)

TABLE 3. RAW COUNTS (NO./0.04 m²) FOR THE OFFSHORE SAMPLING AREA

GROUP	SPECIES	MEISBURGER 7				
		9	13	18	21	22
PORIFERA	SCYPHA CILIATA					
HYDROZOA	CLYTIA GRACILIS					
	EUDENDRIUM RUGOSUM					
	EUDENDRIUM SP.					
	SERTULARIA CUPRESSINA					P
ANTHOZOA	ANTHOZOA				1	
	CERIANTHEOPSIS AMERICANUS	3	1		1	
	CERIANTHEOPSIS SP.					
	EDWARDSIA SP.				4	2
NEMERTINEA	NEMERTINEA	4	1			
NEMATODA	NEMATODA			1		
ARCHIANNELIDA	ARCHIANNELIDA					
POLYCHAETA	AGLAOPHAMUS CIRCINATA				12	
	AMPHARETE ACUTIFRONS					
	AMPHARETE ARCTICA	1	3		1	
	AMPHARETE SP.					
	AMPHARETIDAE				5	3
	AMPHITRITE CIRRATA					
	ANAITIDES ARENAE					
	ANAITIDES MACULATA					3
	ANAITIDES MUCOSA			2	3	1
	ANOBOTHRUS GRACILIS		1			
	APHELOCHAETA MARIONI		1		2	
	APHELOCHAETA MONILARIS					
	APISTOBRANCHUS TULLBERGI					
	ARCTEOBIA ANTICOSTIENSIS					
	ARICIDEA (ACMIRA) CATHERINAE	2	1	5	1	21
	ARICIDEA QUADRILOBATA					
	ASABELLIDES OCULATA	1		3	39	18
	BARANTOLLA AMERICANA					
	CAPITELLA CAPITATA	1			2	
	CAULLERIELLA CF. KILLARIENSIS					
	CHAETOZONE SETOSA			1	5	
	CHONE DUNERI					
	CIRRATULIDAE	9		1	3	16
	CIRRATULUS CIRRATUS					1
	COSSURA LONGOCIRRATA					
	DRILONEREIS LONGA					
	DRILONEREIS MAGNA					1
	ENIPO TORELLI					
	ETEONE LONGA	1				
	EUCHONE ELEGANS			11	7	9
	EUCHONE INCOLOR					
	EUCHONE SP.					
	EUCLYMENE COLLARIS			17	39	36
	EULALIA BILINEATA					

(CONTINUED)

TABLE 3. RAW COUNTS (NO./0.04 m²) FOR THE OFFSHORE SAMPLING AREA

GROUP	SPECIES	MEISBURGER 7				
		9	13	18	21	22
POLYCHAETA	EUSYLLIS SP.			1		
	EXOGONE DISPAR					3
	EXOGONE HEBES					
	EXOGONE SP.					4
	EXOGONE VERUGERA			8	1	23
	GALATHOWENIA OCULATA					1
	GATTYANA AMONDSENI					
	GATTYANA CIRROSA					
	GLYCERA CAPITATA			2		3
	GONIADA MACULATA					
	HARMOTHOE IMBRICATA			1		
	HETEROMASTUS FILIFORMIS					
	LAGISCA EXTENUATA			1		
	LAONICE CIRRATA					
	LAONOME KROYERI					
	LEITOSCOLOPLOS ACUTUS	4				
	LEVINSENIA GRACILIS	4	8	3		
	LYSILLA LOVENI					
	MALDANE SARSI	3	3			
	MALDANIDAE	1				
	MARENZELLERIA VIRIDIS					
	MEDIOMASTUS CALIFORNIENSIS	18	2	4	1	1
	MICROPHTHALMUS ABERRANS					
	MINUSPIO CIRRIFERA					
	MONTICELLINA BAPTISTAE	2				
	MONTICELLINA DORSOBRANCHIALIS		3	4		
	MYRIOCHELE HEERI					
	NEPHTYIDAE					
	NEPHTYS CAECA				1	
	NEPHTYS CILIATA					
	NEPHTYS INCISA		1			
	NEREIS GRAYI					
	NEREIS SP.				1	
	NEREIS ZONATA					
	NINOE NIGRIPES	41	36	2	1	
	OPHELINA ACUMINATA					
	ORBINIIDAE					
	OWENIA FUSIFORMIS					
	PARADONEIS LYRA				1	3
	PARAPIONOSYLLIS LONGICIRRATA					
	PECTINARIA GRANULATA					
	PHERUSA AFFINIS					
	PHOLOE MINUTA	1		1		3
	PHYLLODOCIDAE					
	POLYCIRRUS MEDUSA			1		
	POLYCIRRUS PHOSPHOREUS					

(CONTINUED)

TABLE 3. RAW COUNTS (NO./0.04 m^2) FOR THE OFFSHORE SAMPLING AREA

GROUP	SPECIES	MEISBURGER 7				
		9	13	18	21	22
POLYCHAETA	POLYCIRRUS SP.					1
	POLYDORA CAULLERYI					25
	POLYDORA CONCHARUM					
	POLYDORA CORNUTA					
	POLYDORA QUADRILOBATA				1	3
	POLYDORA SOCIALIS		2	3	16	61
	POLYDORA SP.					1
	POLYNOIDAE			1		
	PRAXILLELLA PRAETERMISSA			3		
	PRAXILLURA ORNATA					
	PRIONOSPIO STEENSTRUPI	1	1	1	4	
	PROTODORVILLEA GASPEENSIS					
	RHODINE BITORQUATA					
	SABELLIDAE				24	
	SCALIBREGMA INFLATUM					
	SCHISTOMERINGOS CAECA					
	SCOLETOMA ACICULARUM					
	SCOLETOMA FRAGILIS		1			
	SCOLETOMA HEBES					
	SCOLOPLOS ARMIGER				4	
	SPHAEROSYLLIS SP.					
	SPIO FILICORNIS					2
	SPIO LIMICOLA	13	11		27	1
	SPIO SETOSA					
	SPIO SP.	1				1
	SPIO THULINI			4	3	5
	SPIONIDAE	1				1
	SPIOPHANES BOMBYX				44	
	SPIOPHANES KROYERI					
	STERNAPSIS SCUTATA					
	SYLLIDAE					
	SYLLIS					
	(TYPOSYLLIS)ALTERNATA					
	TEREBELLIDAE					
	TEREBELLIDES ATLANTIS					
	TEREBELLIDES STROEMI					
	THARYX ACUTUS	4	3	15	1	3
	TRICHOBRANCHUS ROSEUS					
	TROCHOCHAETA MULTISETOSA					
	TROCHOCHAETA SP.					
	TYPOSYLLIS SP.					
OLIGOCHAETA	OLIGOCHAETA					2
GASTROPODA	ALVANIA EXARATA					
	BUCCINUM UNDATUM					1
	COLUS PUBESCENS					
	COLUS SP.					
	CREPIDULA FORNICATA			2		
	GASTROPODA					

(CONTINUED)

TABLE 3. RAW COUNTS (NO./0.04 m²) FOR THE OFFSHORE SAMPLING AREA

GROUP	SPECIES	MEISBURGER 7				
		9	13	18	21	22
GASTROPODA	LACUNA VINCTA					
	LUNATIA HEROS					
	MARGARITES HELICINUS					
	NASSARIUS TRIVITTATUS				2	
	OENOPOTA DECUSSATA					
	RETUSA OBTUSA					
	TURRIDAE					
POLYPLACOPHORA	ISCHNOCHITON ALBUS			1		
BIVALVIA	ANOMIA SP.			2		
	ARCTICA ISLANDICA					
	ASTARTE BOREALIS			2		
	ASTARTE SP.				1	
	ASTARTE UNDATA			1		
	BIVALVIA	4	2		5	
	CERASTODERMA PINNULATUM			4	3	3
	CRENELLA DECUSSATA		1	8		
	CRENELLA GLANDULA			10	1	1
	CRENELLA SP.			1		
	HIATELLA SP.			1		
	LYONSIA HYALINA					
	MUSCULUS NIGER			1		
	MYA ARENARIA					
	MYSELLA PLANULATA					
	MYTILIDAE			3		
	NUCULA SP.					
	NUCULA TENUIS	1	4			
	PECTINIDAE					1
	PERIPLOMA LEANUM					
	PERIPLOMA SP.					
	PLACOPECTEN MAGELLANICUS					
	THRACIA MYOPSIS					
	THYASIRA FLEXUOSA					
	YOLDIA SAPOTILLA					
	YOLDIA SP.					
CIRRIPEDIA	CIRRIPEDIA					
MYSIDACEA	MYSIDACEA					
CUMACEA	CAMPYLASPIS RUBICUNDA				1	
	DIASTYLIS ABBREVIATA					
	DIASTYLIS BISPINOSA					
	DIASTYLIS SCULPTA					
	EUDORELLA PUSILLA					
	PETALOSARSIA DECLIVIS					
ISOPODA	EDOTEA TRILOBA				4	
	JAERA MARINA			1		
	PLEUROGONIUM SPINOSISSIMUM					
	POLITOLANA CONCHARUM	1			1	
	PTILANTHURA SP.					
AMPHIPODA	AEGININA LONGICORNIS					

(CONTINUED)

TABLE 3. RAW COUNTS (NO./0.04 m²) FOR THE OFFSHORE SAMPLING AREA

GROUP	SPECIES	MEISBURGER 7				
		9	13	18	21	22
AMPHIPODA	AMPELISCA MACROCEPHALA					
	AMPELISCA SP.	11				1
	AMPHIPODA					
	ANONYX LILJEBORGI					
	ANONYX SARSI					1
	ARGISSA HAMATIPES				5	
	BYBLIS SERRATA					
	CASCO BIGELOWI					
	COROPHIIDAE					
	COROPHIUM CRASSICORNE				1	3
	ERICHTHONIUS FASCIATUS					
	ERICHTHONIUS SP.					
	GAMMARUS LAWRENCIANUS					
	GAMMARUS SP.					
	HAPLOOPS SP.					
	HAPLOOPS TUBICOLA					
	HARPINIA PROPINQUA					
	HIPPOMEDON SERRATUS				1	
	JASSA MARMORATA					
	LEMBOS WEBSTERI				1	4
	LEPTOCHEIRUS PINGUIS					2
	LYSIANASSIDAE					
	MONOCULODES SP.					
	MONOCULODES TUBERCULATUS					2
	OEDICEROTIDAE					
	PHOTIS POLLEX					
	STENOPLEUSTES SP.					
	SYRRHOE CRENULATA				1	2
	UNCIOLA INERMIS			67		4
	UNCIOLA IRRORATA			23	1	25
	UNCIOLA SP.	1		2		
DECAPODA	CANCER IRRORATUS					
	PAGURUS LONGICARPUS					
SIPUNCULA	GOLFINGIA SP.					
	SIPUNCULA					
PHORONIDA	PHORONIS ARCHITECTA	3	3	1	3	
BRYOZOA	ANGUINELLA PALMATA					
	BUGULA TURRITA					
	CRISIA EBURNEA					
	ELECTRA PILOSA					
	EUCRATEA LORICATA					
	HIPPOTHOA HYALINA					
OPHIUROIDEA	OPHIOPHOLIS ACULEATA					
	OPHIURA ROBUSTA					
	OPHIURA SARSI					
	OPHIUROIDEA					
ECHINOIDEA	STRONGYLOCENTROTUS DROEBACHIENSIS					

(CONTINUED)

TABLE 3. RAW COUNTS (NO./0.04 m^2) FOR THE OFFSHORE SAMPLING AREA

GROUP	SPECIES	MEISBURGER 7				
		9	13	18	21	22
CHORDATA	CHORDATA					
ASCIDIACEA	APLIDIUM SP.					
	ASCIDIA SP.					
	CORELLA BOREALIS					
ALL	ZSPECIES COMBINED	137	89	226	286	308

APPENDIX E

BENTHIC INFAUNA
MEAN ABUNDANCES BY HABITAT

APPENDIX TABLE E-1. MEAN ABUNDANCE (NO./m²) BY HABITAT OF BENTHIC INFAUNA RETAINED ON A 0.5mm-MESH SIEVE COLLECTED FROM INNER BOSTON HARBOR LOCATIONS, OCTOBER 1994.

GROUP	SPECIES	AMSTAR	CHEL 01	CHEL 02	CHELSEA CREEK	CONLEY	CABOT POINT		EVERETT
		HABITAT	HABITAT	HABITAT	HABITAT	HABITAT	HABITAT		HABITAT
		III	III	III	II	III	II	III	III
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			

(CONTINUED)

APPENDIX TABLE E-1. MEAN ABUNDANCE (NO./m²) BY HABITAT OF BENTHIC INFAUNA RETAINED ON A 0.5mm-MESH SIEVE COLLECTED FROM INNER BOSTON HARBOR LOCATIONS, OCTOBER 1994.

GROUP	SPECIES	AMSTAR	CHEL 01	CHEL 02	CHELSEA CREEK	CONLEY	CABOT POINT		EVERETT
		HABITAT	HABITAT	HABITAT	HABITAT	HABITAT	HABITAT		HABITAT
		III	III	III	II	III	II	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							
	PONTOGENEIA INERMIS								
	UNCIOLA INERMIS	12.5							
DECAPODA	CRANGON SEPTEMSPINOSA		37.5		10.0				
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
X PORIFERA	TOTAL				P				
X HYDROZOA	TOTAL					P			
X NEMATODA	TOTAL	587.5	87.5	25.0	25.0	450.0			25.0
X POLYCHAETA	TOTAL	1112.5	100.0		360.0	325.0	25.0	300.0	262.5
X OLIGOCHAETA	TOTAL	87.5			5.0	200.0		50.0	25.0
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	
X DECAPODA	TOTAL		37.5		10.0				
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

(CONTINUED)

APPENDIX TABLE E-1. MEAN ABUNDANCE (NO./m²) BY HABITAT OF BENTHIC INFAUNA RETAINED ON A 0.5mm-MESH SIEVE COLLECTED FROM INNER BOSTON HARBOR LOCATIONS, OCTOBER 1994.

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							

(CONTINUED)

APPENDIX TABLE E-1. MEAN ABUNDANCE (NO./m²) BY HABITAT OF BENTHIC INFAUNA RETAINED ON A 0.5mm-MESH SIEVE COLLECTED FROM INNER BOSTON HARBOR LOCATIONS, OCTOBER 1994.

GROUP	SPECIES	INNER CONFLUENCE HABITAT II	INNER CONFLUENCE HABITAT III	LITTLE MYSTIC-CHANNEL HABITAT III	MYSTIC PIERS HABITAT II	MYSTIC PIERS HABITAT IV	MYSTIC RIVER HABITAT III	MYSTIC RIVER HABITAT IV	RESERVED CHANNEL HABITAT NONE
GASTROPODA	NASSARIUS TRIVITTATUS	250.0			37.5	12.5			
BIVALVIA	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			
MYSIDACEA	HETEROMYSIS FORMOSA	8.3							
AMPHIPODA	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)

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APPENDIX TABLE E-1. MEAN ABUNDANCE (NO./m²) BY HABITAT OF BENTHIC INFAUNA RETAINED ON A 0.5mm-MESH SIEVE COLLECTED FROM INNER BOSTON HARBOR LOCATIONS, OCTOBER 1994.

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	

(CONTINUED)

APPENDIX TABLE E-1. MEAN ABUNDANCE (NO./m²) BY HABITAT OF BENTHIC INFAUNA RETAINED ON A 0.5mm-MESH SIEVE COLLECTED FROM INNER BOSTON HARBOR LOCATIONS, OCTOBER 1994.

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

APPENDIX TABLE E-2. MEAN ABUNDANCE (NO./m²) BY HABITAT OF BENTHIC INFAUNA RETAINED ON A 0.5mm-MESH SIEVE COLLECTED FROM OUTER BOSTON HARBOR LOCATIONS, OCTOBER 1994.

GROUP	SPECIES	SPECTACLE ISLAND		SUBAQUEOUS B	SUBAQUEOUS E	
		HABITAT		HABITAT	HABITAT	
		I	II	I	I	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)

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APPENDIX TABLE E-2. 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
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		

APPENDIX TABLE E-2. 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
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	ZTOTAL	59.0	41.0	60.0	51.0	15.0

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APPENDIX TABLE E-3. MEAN ABUNDANCE (NO./m²) BY HABITAT OF BENTHIC INFAUNA RETAINED ON A 0.5mm-MESH SIEVE COLLECTED FROM LOCATIONS OFFSHORE FROM BOSTON HARBOR, 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

APPENDIX TABLE E-3. MEAN ABUNDANCE (NO./m²) BY HABITAT OF BENTHIC INFAUNA RETAINED ON A 0.5mm-MESH SIEVE COLLECTED FROM LOCATIONS OFFSHORE FROM BOSTON HARBOR, OCTOBER 1994.

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)

APPENDIX TABLE E-3. MEAN ABUNDANCE (NO./m²) BY HABITAT OF BENTHIC INFAUNA RETAINED ON A 0.5mm-MESH SIEVE COLLECTED FROM LOCATIONS OFFSHORE FROM BOSTON HARBOR, OCTOBER 1994.

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

APPENDIX TABLE E-3. MEAN ABUNDANCE (NO./m²) BY HABITAT OF BENTHIC INFAUNA RETAINED ON A 0.5mm-MESH SIEVE COLLECTED FROM LOCATIONS OFFSHORE FROM BOSTON HARBOR, OCTOBER 1994.

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							
	TROCHOCHAETA 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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APPENDIX TABLE E-3. MEAN ABUNDANCE (NO./m²) BY HABITAT OF BENTHIC INFAUNA RETAINED ON A 0.5mm-MESH SIEVE COLLECTED FROM LOCATIONS OFFSHORE FROM BOSTON HARBOR, OCTOBER 1994.

GROUP	SPECIES	BOSTON LIGHTSHIP		MEISBURGER 2			MEISBURGER 7		
		HABITAT		HABITAT			HABITAT		
		VII	VIII	V	VII	VIII	V	VI	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	

APPENDIX TABLE E-3. MEAN ABUNDANCE (NO./m²) BY HABITAT OF BENTHIC INFAUNA RETAINED ON A 0.5mm-MESH SIEVE COLLECTED FROM LOCATIONS OFFSHORE FROM BOSTON HARBOR, OCTOBER 1994.

GROUP	SPECIES	BOSTON LIGHTSHIP		MEISBURGER 2			MEISBURGER 7		
		HABITAT		HABITAT			HABITAT		
		VII	VIII	V	VII	VIII	V	VI	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				
X NO. OF INDIV	TOTAL	9066.5	4732.7	11075.0	9534.4	17925.0	4962.5	6396.7	7150.0
X PORIFERA	TOTAL				12.5				
X HYDROZOA	TOTAL	P	P		P		P		
X ANTHOZOA	TOTAL	34.4	50.0	75.0	116.7	62.5	37.5		150.0
X NEMERTINEA	TOTAL	62.5	50.0		137.5	162.5	12.5	31.3	
X NEMATODA	TOTAL	71.9			91.7			31.3	
X ARCHIANNELIDA	TOTAL				45.8			12.5	
X POLYCHAETA	TOTAL	7947.2	3433.1	8600.0	6863.0	15675.0	4137.5	3364.2	6225.0
X OLIGOCHAETA	TOTAL	3.1			12.5		25.0	25.0	
X GASTROPODA	TOTAL	31.2	24.9	200.0	33.4	37.5	12.5	18.8	50.0
X POLYPLACOPHORA	TOTAL							6.3	
X BIVALVIA	TOTAL	462.6	716.6	275.0	1020.9	862.5	150.0	475.4	250.0
X CIRRIPEDIA	TOTAL				4.2				
X MYSIDACEA	TOTAL	9.4		75.0	16.7	12.5		6.3	
X CUMACEA	TOTAL	56.3			16.7	25.0			25.0
X ISOPODA	TOTAL	43.7	41.6	50.0	116.6	187.5		6.3	125.0
X AMPHIPODA	TOTAL	219.1	349.9	1775.0	746.1	800.0	550.0	2381.7	250.0
X DECAPODA	TOTAL				4.2			6.3	
X SIPUNCULA	TOTAL	15.6	8.3		8.3				
X PHORONIDA	TOTAL	34.4	16.7	25.0	258.3	87.5	37.5	12.5	75.0
X BRYOZOA	TOTAL	P	P		P	P			
X OPHIUROIDEA	TOTAL	68.8	33.3		16.7	12.5			
X ECHINOIDEA	TOTAL				4.2			18.8	
X CHORDATA	TOTAL				4.2				

(CONTINUED)

APPENDIX TABLE E-3. MEAN ABUNDANCE (NO./m²) BY HABITAT OF BENTHIC INFAUNA RETAINED ON A 0.5mm-MESH SIEVE COLLECTED FROM LOCATIONS OFFSHORE FROM BOSTON HARBOR, OCTOBER 1994.

GROUP	SPECIES	BOSTON LIGHTSHIP		NEISBURGER 2			NEISBURGER 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

(CONTINUED)

APPENDIX TABLE E-3. MEAN ABUNDANCE (NO./m²) BY HABITAT OF BENTHIC INFAUNA RETAINED ON A 0.5mm-MESH SIEVE COLLECTED FROM LOCATIONS OFFSHORE FROM BOSTON HARBOR, OCTOBER 1994.

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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APPENDIX TABLE E-3. MEAN ABUNDANCE (NO./m^2) BY HABITAT OF BENTHIC INFAUNA RETAINED ON A 0.5mm-MESH SIEVE COLLECTED FROM LOCATIONS OFFSHORE FROM BOSTON HARBOR, OCTOBER 1994.

GROUP	SPECIES	WEISBURGER 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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APPENDIX TABLE E-3. MEAN ABUNDANCE (NO./m²) BY HABITAT OF BENTHIC INFAUNA RETAINED ON A 0.5mm-MESH SIEVE COLLECTED FROM LOCATIONS OFFSHORE FROM BOSTON HARBOR, OCTOBER 1994.

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)

APPENDIX TABLE E-3. MEAN ABUNDANCE (NO./m²) BY HABITAT OF BENTHIC INFAUNA RETAINED ON A 0.5mm-MESH SIEVE COLLECTED FROM LOCATIONS OFFSHORE FROM BOSTON HARBOR, OCTOBER 1994.

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	

(CONTINUED)

APPENDIX TABLE E-3. MEAN ABUNDANCE (NO./m²) BY HABITAT OF BENTHIC INFAUNA RETAINED ON A 0.5mm-MESH SIEVE COLLECTED FROM LOCATIONS OFFSHORE FROM BOSTON HARBOR, OCTOBER 1994.

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)

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APPENDIX TABLE E-3. MEAN ABUNDANCE (NO./m^2) BY HABITAT OF BENTHIC INFAUNA RETAINED ON A 0.5mm-MESH SIEVE COLLECTED FROM LOCATIONS OFFSHORE FROM BOSTON HARBOR, OCTOBER 1994.

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	

(CONTINUED)

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APPENDIX TABLE E-3. MEAN ABUNDANCE (NO./m²) BY HABITAT OF BENTHIC INFAUNA RETAINED ON A 0.5mm-MESH SIEVE COLLECTED FROM LOCATIONS OFFSHORE FROM BOSTON HARBOR, OCTOBER 1994.

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

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ENVIRONMENT STUDIES FOR THE BOSTON HARBOR NAVIGATION/IMPROVEMENT AND BERTH DREDGING ENVIRONMENTAL IMPACT REPORT/STATEMENT

TASK 2 LOBSTER SAMPLING

Contract DACW33-92-D-0004
Delivery Order #32, Task 3

Prepared for

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1.0 INTRODUCTION

In response to the Scope of Work (SOW) presented to Normandeau Associates (NAI) by the Corps of Engineers - New England Division (COENED), dated August 30, 1994, NAI conducted the following evaluation of lobster resources at several of the proposed dredged material disposal sites.

As stated in the SOW, much of Boston Harbor and Massachusetts Bay contain significant lobster habitat which is important to understand as it relates to the disposal of dredged material. The purpose of this lobster sampling effort is to generate information to describe the relative importance of various disposal sites as lobster resource. For the purpose of this evaluation, an understanding of general lobster habits, movements and growth is important.

Lobsters are invertebrates that inhabit both inshore and offshore marine habitats of unconsolidated sands and gravels to hard bottom substrates. Coastal lobsters are typically concentrated in rocky areas where shelter is available, although local concentrations occur in mud substrates suitable for burrowing (NMFS 1993). Tagging experiments on coastal lobsters suggest that small lobsters undertake a limited offshore migration in the winter and move back inshore in the summer. Larger individuals may travel more extensively (NMFS 1993). Lobsters, especially males, can exist in the salinity ranges typically associated with the lower portions of the estuarine environment (pers. conv. B. Estrella and M. Armstrong MADMF on November 23, 1994).

An understanding of the life stages of the lobster is important to evaluate potential impacts. Lobster spawn approximately once every two years and eggs generally hatch during late spring and early summer. The pelagic larvae, which are associated with the surface layer of the water, undergo four molts before attaining adult characteristics and settling on the bottom (NMFS 1993).

The following narrative on "early benthic phase" (EBP) lobsters is based on the work of Wahle and Steneck (1991). The newly hatched larvae are planktonic for three to five weeks or until they are 5 to 40 mm (0.2-1.4 inches) in carapace length (CL), when they sink to the bottom as the EBP form. The early benthic phase of a lobster represents the most vulnerable period in the lobster life cycle. EBP lobsters require shelter for early growth and survival. Larger individuals can survive in less protective habitats. EBP lobsters prefer cobble substratum and are conspicuously absent from featureless substrates. The presence of vegetation or mussels does not enhance the attractiveness of a soft bottom for EBP recruitment. However, the presence of mussels over a cobble substratum is attractive habitat to EBP lobsters. EBP lobsters live under the cover of rocks and stones in shallow waters and small inlets where they are out of reach of predators.

The adult lobster is a benthic resident and feeder and can move rapidly from place to place. Individual migrations typically are local and limited to random movements along shore. Lobsters generally migrate seasonally from cool deeper waters in winter to warmer inshore waters during the summer. Localized migration may also occur in response to available feeding resources. In late autumn they typically move offshore to avoid the severe cold inshore temperatures of winter (Burrill and Burrill 1981).

Lobsters are opportunistic feeders and may be considered cannibalistic. Their diets are based on fish (dead or alive) and fixed or slow moving benthic organisms. Seaweed has been found in lobster guts. Adult lobsters avoid light and reside in holes and crevices, or among rocks or in shady spots. Scientists believe that lobsters have limited neurological sensitivities. Aside from differentiation between light and dark, they appear to have limited sight. Lobsters appear sensitive to vibrations and pressure changes which trigger sensory hairs and appendages to respond.

2.0 METHODOLOGY

The trapping methodology employed by NAI included the placement of three baited lobster pots at nine inner harbor locations (Reserved Channel, Logan 02, Little Mystic Channel, Inner Confluence, Chelsea 01, Chelsea River, Mystic River, Revere Sugar (Figure 1) and Outer Harbor (Figure 2)). The Outer Harbor location is located at the Subaqueous E site.

Five baited lobster pots were placed at each of three offshore locations (Meisburger 2 Meisburger 7, and Boston Lightship, Figure 3) and one inshore location (Spectacle Island CAD). Pots were modified (escape vent closed) to collect sublegal as well as legal sized lobsters and remained in place for seventy-two hours. The traps were harvested every 24-hours and the weight, carapace length, sex, and reproductive state were recorded for each lobster. All lobsters were returned to the water after the data were recorded. Any other organisms collected in the traps were recorded and described (Appendix A). The lobster sampling effort occurred between October 13 and 15, 1994 and only represents inshore and offshore distribution for that period because lobsters are migratory and will move in response to thermal conditions and available feeding resources.

3.0 RESULTS

Catch data are presented in Tables 1 - 4. A summary description of each table includes the following:

- **Table 1:** Length frequencies presented by sex and size classification (sublegal and legal) for each location.
- **Table 2:** Catch per Unit Effort (CPUE) presented as number per trap-day for legal and sublegal catches by sex and location.
- **Table 3:** CPUE weight comparison (kg per trap-day) for legal and sub-legal catches, at each location.
- **Table 4:** Mean weight, number of lobsters and number of trap days for both legal and sublegal catches at each location.

In analyzing the BHNIP lobster resource data, the study sites were grouped as follows:

- River Stations - Located in the upper portion of the Project Area and include the following six (6) sites:

- Little Mystic Channel,
- Inner Confluence,
- Chelsea Ol,
- Chelsea River,
- Mystic River, and
- Revere Sugar.

- Harbor Stations extend from the Inner Harbor out to President Roads and include the Reserved Channel, Logan 02, Outer Harbor and Spectacle CAD.

- Offshore Stations include Meisburger 2, Meisburger 7, and Boston Lightship (BLS).

3.1 CPUE DATA

The CPUE data presented only provide an indication of abundance trends for the sampling period. The catch data were standardized to a consistent effort unit of "trap-day" because five traps were set each day at the Offshore stations and Spectacle Island CAD, and three traps were set each day at the rest of the Harbor stations and the River stations. A trap-day is the catch from one trap set for approximately 24-hours.

3.1.1 Sublegal Sized Lobsters

The majority of the lobsters captured at each station were sublegal, with the exception of the Little Mystic Channel (Table 1). Count data indicated that for sublegal lobsters (<83 mm or 3.25 in. CL), CPUE (no./trap-day) was highest at the Offshore stations for males, females and total counts (Table 2).

River Stations

Trap data for sublegal males in the River Stations ranged from 0.0 - 0.8 males/trap-day. Catches of males at upstream locations (Chelsea 01, Chelsea River, Mystic River and Revere Sugar) were less (0.0 - 0.2 males/trap-day) than the downstream river locations (Little Mystic Channel and the Inner Confluence) where catches ranged from 0.4 - 0.8 males/trap-day.

CPUE for females was less than males at the River Stations. CPUE ranged from 0.0 - 0.1 females/trap-day with no apparent trend toward upstream or downstream locations. Given the variability in male CPUE versus the consistent female CPUE, total sublegal trap data closely mimicked the upstream and downstream pattern depicted by the male trap data and ranged from 0.1 - 0.2 sublegal lobsters/trap-day (upstream) to 0.6 - 0.9 sublegal lobsters/trap-day (downstream). The total range of sublegal lobsters/trap-day at the River Stations was 0.1 - 0.9.

Harbor Stations

Catches of males were higher within the inner harbor sites (Reserved Channel and Logan 02) where CPUE was 0.7 males/trap-day, than in the outer harbor (Outer Harbor and Spectacle Island) where CPUE was 0.0 - 0.2 males/trap-day. Females were also more abundant in the inner harbor stations, where CPUE ranged from 0.1 - 0.6 females/trap-day. No females were captured in the outer harbor stations.

Total CPUE of sublegals at the Harbor Stations was 0.0 - 1.2 lobsters/trap-day. The Reserved Channel had the highest CPUE of sublegal lobsters at 1.2 lobsters/trap-day, and no sublegal lobsters were captured at the Outer Harbor station.

Offshore Stations

CPUE of both male and female sublegal lobsters was higher at the Offshore stations compared to the River or Harbor Stations (Table 2). Within the Offshore stations, CPUE of males, females and total CPUE was highest at Meisburger 2 followed by Meisburger 7 and BLS. Male CPUE ranged from 1.3 to 2.8 lobsters/trap-day and female CPUE ranged from 1.5 to 3.5 lobsters/trap-day. Total CPUE ranged from 2.8 to 6.3 lobsters per trap-day with the highest CPUE at Meisburger 2.

3.1.2 Legal Sized Lobsters

Only 5% (14/267) of the total catch was legal sized (Table 1). CPUE of legal sized lobsters was lower than sublegal lobsters at each station with the exception of the Little Mystic Channel where five sublegal and five legal lobsters were captured, and the Chelsea River where one sublegal and one legal lobster were captured.

River Stations

CPUE of legal sized lobsters ranged from 0.0 to 0.6 lobsters/trap-day with males more abundant (Table 2). CPUE was greatest at Little Mystic Channel and no legal sized lobsters were captured at the Inner Confluence, Chelsea 01 and the Mystic River stations (Table 2).

Harbor Stations

At the Harbor Stations, CPUE of legal sized lobsters ranged from 0.0 at Spectacle Island CAD and Outer Harbor to 0.2 at the Reserved Channel (Table 2). Males were more abundant than females.

Offshore Stations

CPUE of legal sized lobsters was uniformly low (0.1 lobsters/trap-day) at Meisburger 2, Meisburger 7 and the Boston Lightship. Male legal sized lobsters were more abundant than female legal lobsters.

3.2 BIOMASS DATA

3.2.1 Sublegal Sized Lobsters

CPUE of biomass (kg/trap-day) was similar to count CPUE (lobsters/trap-day). Biomass CPUE was highest at the Offshore stations (0.90 - 2.15 kg/trap-day) followed by the River stations (0.04 - 0.74 kg/trap-day) and the Harbor stations (0.00 - 0.46 kg/trap-day). Biomass CPUE was highest at Meisburger 2 than all other sites sampled. These results were consistent with count data.

3.2.2 Legal Sized Lobsters

CPUE of biomass for legal sized lobsters ranged from 0.0 - 0.21 kg/trap-day at all sites except for Little Mystic Channel, where biomass CPUE was 0.54 kg/trap-day (Table 3). The latter was a result of the capture of two legal sized males (0.7 and 1.0 Kg).

3.2.3 Total Biomass Catch per Unit Effort

Total biomass CPUE followed a pattern similar to the sublegal biomass CPUE. Total biomass CPUE was highest at the Offshore stations (0.97 - 2.19 kg/trap-day) followed by the River stations (0.04 - 0.74 kg/trap-day), and the Harbor stations (0.00 - 0.46 kg/trap-day). The results from the Harbor stations are heavily influenced by the capture of two large lobsters at the Little Mystic Channel.

3.3 MEAN BIOMASS RESULTS

The mean biomass (kg/lobster) are presented in Table 4. In contrast to total biomass CPUE, mean biomass was lower at the Offshore stations (0.28 -0.34 kg/lobster) compared to the Harbor stations (0.28 - 0.66 kg/lobster) due to the large number of small lobsters captured offshore. Mean biomass was intermediate at the Harbor stations (0.0 -0.32 kg/lobster).

3.4 SUBSTRATE CONDITIONS

Under a separate task required by the SOW, NAI evaluated substrate conditions using REMOTS technology at several of the proposed materials disposal sites. The general results include the following conditions:

River Stations

All River stations sampled for lobsters were also evaluated for substrate conditions. Sediments at the River stations were characterized as fine grained (mud and silts) substrate with limited cover, and limited evidence of tube or burrow development. REMOTS indicated that benthic communities were at a pioneer successional stage. These conditions appear to provide limited suitable lobster habitat. The presence of abandoned piers, especially at the Little Mystic Channel and Revere Sugar stations may have provided shelter for lobsters.

Harbor Stations

Three of the four lobster sampling locations were also evaluated for substrate conditions. These included Spectacle Island CAD, Outer Harbor (Subaqueous E) and Logan 02. The Reserved Channel was not evaluated. Logan 02 sediment conditions appeared to be similar to the River station substrates: muds, with few tubes and no burrows and the benthic community is at a pioneer stage. Both the Spectacle Island CAD and Outer Harbor were characterized by fine grained sediments (silts and fine sands), with limited sands, gravels and shell hash. These stations supported several tubes and burrows and exhibit an enhanced intermediate successional community.

Offshore Stations

Each of the Offshore stations sampled for lobsters were also evaluated for substrate condition. Each site appeared to have varying substrates and were characterized as follows:

> **Meisburger 2:** Fine sands to sand with silt, gravel and rock; several tubes and few burrows were evident. Over much of the site, community stage was indeterminant. Where the community stage was evident, an intermediate successional community was present.
>
> **Meisburger 7:** Rock with fine sands, silts and gravel, several tubes and some burrows were evident; and as with Meisburger 2, where evident, an intermediate successional community existed.
>
> **BLS:** Fine sands with silts and clays; many tubes and some burrows; and an intermediate successional community.

It would appear that the Spectacle Island CAD, Outer Harbor, and the Offshore Stations provided more varied, and somewhat enhanced substrate conditions and therefore better biological habitat than conditions at Logan 02 and the River stations. Sediments at the River stations and at Logan 02 appeared to provide limited or stressed biological resources.

4.0 DISCUSSION

These data represent a portion of the Boston Harbor lobster resource at a point in time, and therefore are best utilized in a relative framework. These data were collected during the annual offshore migration of lobsters in response to falling water temperatures, and can not present a year-round description of the lobster resource in Boston Harbor. However, despite these limitations, several finding are apparent:

(1) Lobster numbers and biomass is highest at the Offshore stations.

(2) Within the Offshore stations, abundance and biomass is highest at Meisburger 2 followed by Meisburger 7 and BLS.

3) Trap data for sublegal sized lobsters indicated the following:

- Females outnumber males at Offshore stations;

- Males generally outnumber females at the River and Harbor stations.

- CPUE of both males and females was lowest at the upstream River Stations, Outer Harbor and the Spectacle Island CAD sites.

4) CPUE of legal sized male lobsters was slightly higher than females throughout the BHNIP project area, except at Little Mystic Channel, where CPUE of males was much higher than females and legal males at all other locations.

5) Sublegal sized lobster CPUE exceed legal sized lobster CPUE trapped in all locations, except for Little Mystic Channel.

6) A greater proportion of the lobsters trapped at the River Stations, especially Little Mystic Channel, were legal sized, compared to either the Harbor or Offshore Stations; this was a function of finding fewer juveniles in the River stations.

The higher CPUE at the Offshore stations than at the Harbor or River stations could be a reflection of the seasonal pattern of lobsters migrating offshore in response to falling water temperatures inshore. Within the Offshore stations, the differences in CPUE were probably a response to localized habitat conditions. The overwhelming abundance of sublegal lobsters is not surprising. Legal sized lobsters are subjected to heavy fishing pressure that reduces their abundance as soon as they reach legal size (NMFS 1993).

One finding which was unexpected and found to be of particular interest was the abundance of lobsters at Little Mystic Channel and the Inner Confluence compared to other stations within this area of the harbor. Abandoned piers may provide additional habitat not present at other stations. Little Mystic Channel and the Inner Confluence are also proximal to combined sewer overflows and abundant organic matter and food may be available.

According to MADMF offshore lobster sampling database (Estrella and Armstrong 1993 and Estrella and McKiernan 1989), Boston Harbor CPUE results for marketable lobsters have been reported in several formats. These variable formats have been established over time to correct CPUE results based on the relationship between catch and immersion time (duration of trap set between fishing). MADMF uses the services of several local lobsterman who more than likely have variable schedules in fishing their pots. Therefore, the data collected during the MADMF sampling program was standardized for time. MADMF uses the corrected CPUE index CHT'_3 which translates to the catch per trap haul, standardized to three set-over-days. Estrella and McKiernan (1989) reports that CHT'_3 reduces the variability in trap results.

The lobster data from this study is reported as catch per 24-hour trap day as opposed to the MADMF data which is catch per three days. To be comparable with the MADMF data our data would have to be multiplied by a factor of 3 to obtain an adjusted CPUE that is comparable with the MADMF data. Furthermore, the traps used in this study were unvented which increased the catch of sublegal lobsters compared to the MADMF data which used vented traps. Therefore the only meaningful comparisons between our data and the MADMF data is for legal sized lobsters.

MADMF reports that CHT'_3 results for Boston Harbor have ranged between 0.7-0.8 for legal lobsters during the period of 1981-1992, with peaks during 1983, 1985-86, 1988 and 1990. No results were available for sublegal size lobsters.

Adjusted CPUE for legal sized lobsters in this study at River stations ranged from 1.8 at Little Mystic Channel to 0.0 at the Inner Confluence, Chelsea River, and Mystic River. This range encompasses the range of CPUE the reported by MADMF (0.7-0.8 CPUE). Adjusted CPUE for the Harbor stations ranged from 0.0 to 0.6 which is less than the MADMF data of 0.7-0.8 CPUE. Adjusted CPUE for legal lobsters at the offshore stations (0.3) were less than the MADMF results, at all locations.

In general, adjusted CPUE in this study was less than the CPUE reported by MADMF. The MADMF data were collected over three seasons during an 11-year period while the data from this study are from October 1994 only. It is difficult to compare the results from one seasonal sampling to a multi-year sampling effort because the single sampling effort does not integrate over any seasonal or annual differences in lobster abundance. With these limitations in mind, the results from our sampling effort are probably not substantially different from the MADMF data.

According to B/PB (1990) commercial lobster pot distribution to the north and east of Spectacle Island, and west of Long Island was fairly concentrated during the 1990 fishing season. In contrast, during informal discussions with local lobstermen at the time of the recent NAI sampling effort, NAI personnel were questioned as to why they were fishing in the area of Spectacle Island CAD and at the Outer Harbor sites during the sampling event, since according to the lobstermen, lobsters have not been present in these locations for several years. NAI field personnel also reported that during the sampling, NAI pots were the only gear at both locations, a condition which supports the CPUE trap results.

NAI has also included maps of the MADMF lobster trap sampling sites in Boston Harbor for 1991 through 1993. MADMF contracts the services of several Boston Harbor based lobsterman to conduct these annual sampling programs. Each map indicates the seasonal fishing grounds and patterns of the commercial fishery during each study year. The key to the symbols is as follows:

May, ⬡
June, △
July, +
August, ×
September, ◇
October, and ▽
November. ⊠

The maps also indicate that the Spring and Summer fisheries tend to be concentrated at the Harbor Stations and other inshore locations, while the autumn fishery extends into the offshore waters. Our results are consistent with this fishing effort pattern and anticipated migratory patterns. CPUE in our study was consistently higher at the Offshore stations.

Given the results of this present sampling program, and the locations of MADMF sampling stations, the data appear to concur with the existing harborwide database. Available data indicate that the entire project area contains some level of resource and habitat, and that the Offshore stations appear to provide a typical and active lobster resource. The Outer Harbor station, Chelsea 01, Mystic River and Spectacle Island stations appear to have the lowest habitat value for lobsters, and the three Offshore stations have the highest habitat value. Little Mystic Channel and Reserved Channel appear to have the highest habitat value among the River and Harbor stations. However, these generalizations are dependent on the time of year that sampling took place. The River stations are at the upstream extent of suitable estuarine conditions, and therefore would not be expected to be as productive as Harbor and Offshore locations.

The Outer Harbor, Chelsea 01, Chelsea River, Mystic River, and Spectacle Island stations had the lowest CPUE of lobsters. No lobsters were captured at the Outer Harbor station and lobstermen commented that both the Outer Harbor and Spectacle Island stations were generally not good areas for lobstering at any time of year. The Outer Harbor and Spectacle Island stations probably were the lowest quality lobster habitat. Dredge disposal at the Outer Harbor and Spectacle Island sites would probably have the smallest adverse effects on the commercial lobster fishing industry, among the areas investigated. Although CPUE was low at Chelsea 01, Chelsea River, and Mystic River stations, this is probably due to the time of year we conducted the sampling. Lobster CPUE at these inner harbor stations might be higher in the summer when lobsters migrate into these areas.

CPUE was highest at the offshore sites (Meisburger 2, Meisburger 7, and BLS). In addition, numerous commercial lobster traps were observed at Meisburger 2 and 7, with slightly fewer traps observed at BLS. Based on the data collected, impacts to the commercial fishing industry would appear to be greatest if these areas were used as dredge disposal sites.

Disposal of dredge material at the Revere Sugar, Little Mystic Channel, and Reserved Channel sites would require these areas to be filled and bulkheaded, and would result in the permanent loss of lobster habitat. Although commercial lobstering occurs in the vicinity of these sites, no lobster traps were observed directly in the footprint of these proposed dredge disposal sites. Dredge disposal at the other sites is anticipated to take place over an 18 month period. If any of the above areas (except Revere Sugar, Little Mystic Channel and Reserved Channel) are used for dredge disposal, the primary impacts would occur during that 18 month period. Long term impacts should be minimal, assuming that the capping procedure works as planned. During the 18 month disposal period lobsters will probably avoid the immediate area of disposal and be displaced to adjacent areas. During the 18 month disposal period the dredge disposal site will not be available as habitat for the settling of early benthic phase lobsters. Lobsters will return to the disposal area after disposal activities cease, assuming that the substrate is restored to its original condition.

While short-term impacts to the lobster resource may not be severe, individual lobstermen could be strongly affected during dredge disposal. Lobstermen have unofficial territories in which they can set their gear (B. Estrella, MADMF, pers. comm.). A lobsterman who traditionally uses a potential dredge disposal site may not be able to set gear in a different area without encroaching on the territory of a different lobsterman. This may result in a concentration of gear in a given area and potential conflicts between users of the resource.

5.0 LITERATURE CITED

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TABLES

MAPS

Table 1. Length Frequencies by sex for lobsters captured in Boston Harbor, October 1994.

SUB/LEGAL	LENGTH (mm)	LOCATION		
		BLS		
		MALES	FEMALES	TOTAL
SUBLEGALS	.	.	.	.
	51	.	.	.
	54	.	1	1
	56	.	.	.
	57	.	.	.
	60	.	1	1
	61	.	1	1
	62	2	.	2
	63	.	.	.
	64	.	.	.
	65	.	.	.
	66	2	.	2
	67	2	1	3
	68	2	1	3
	69	.	.	.
	70	2	.	2
	71	.	.	.
	72	2	3	5
	73	3	2	5
	74	.	2	2
	75	1	1	2
	76	1	2	3
	77	2	.	2
	78	1	2	3
	79	.	3	3
	80	.	1	1
	81	.	.	.
	82	.	1	1
	TOTAL	20	22	42
LEGALS	.	.	.	.
	84	.	.	.
	85	.	.	.
	86	1	1	2
	87	.	.	.
	88	.	.	.
	89	.	.	.
	95	.	.	.
	105	.	.	.
	109	.	.	.
	135	.	.	.
	TOTAL	1	1	2
SUB/LEGAL	TOTAL	21	23	44

Table 1. Length Frequencies by sex for lobsters captured in Boston Harbor, October 1994.

SUB/LEGAL	LENGTH(mm)	LMCh. MALES	LMCh. FEMALES	LMCh. TOTAL	InnerConf. MALES	InnerConf. FEMALES	InnerConf. TOTAL	Chel-01 MALES	Chel-01 FEMALES	Chel-01 TOTAL	Chel.Riv. MALES	Chel.Riv. FEMALES	Chel.Riv. TOTAL
SUBLEGALS	.	.	.	.	.	.	.	.	.	.	.	.	.
	51	.	.	.	.	.	.	.	.	.	.	.	.
	54	.	.	.	.	.	.	.	.	.	.	.	.
	56	.	.	.	1	.	1	.	.	.	.	.	.
	57	.	.	.	.	.	.	.	.	.	.	.	.
	60	.	.	.	.	.	.	.	.	.	.	.	.
	61	.	.	.	.	.	.	.	.	.	.	.	.
	62	.	.	.	.	.	.	.	.	.	.	.	.
	63	.	.	.	.	.	.	.	.	.	.	.	.
	64	.	.	.	.	.	.	.	.	.	.	.	.
	65	.	.	.	.	1	1	.	.	.	.	.	.
	66	.	.	.	.	.	.	.	.	.	.	.	.
	67	.	.	.	.	.	.	.	.	.	.	.	.
	68	.	.	.	.	.	.	.	.	.	.	.	.
	69	.	.	.	.	.	.	.	.	.	.	.	.
	70	2	.	2	.	.	.	.	.	.	.	.	.
	71	.	.	.	1	.	1	.	.	.	.	.	.
	72	.	.	.	.	.	.	.	.	.	.	.	.
	73	.	.	.	.	.	.	.	.	.	.	.	.
	74	.	.	.	.	.	.	.	.	.	1	.	.
	75	.	.	.	1	.	1	.	1	1	.	.	.
	76	.	.	.	.	.	.	.	.	.	.	.	.
	77	.	.	.	1	.	1	.	.	.	.	.	
	78	1	.	1	.	.	.	.	.	.	.	.	
	79	.	1	1	.	.	.	.	.	.	.	.	
	80	1	.	1	.	.	.	.	.	.	.	.	
	81	.	.	.	.	.	.	.	.	.	.	.	
	82	.	.	.	3	.	3	.	.	.	.	.	
	TOTAL	4	1	5	7	1	8	.	1	1	1	.	
LEGALS	.	.	.	.	.	.	.	.	.	.	.	.	
	84	2	.	2	.	.	.	.	.	.	.	.	
	85	.	.	.	.	.	.	.	.	.	.	.	
	86	.	.	.	.	.	.	.	.	.	.	.	
	87	.	.	.	.	.	.	.	.	.	.	.	
	88	.	.	.	.	.	.	.	.	.	.	.	
	89	.	.	.	.	.	.	.	.	.	.	.	
	95	1	.	1	.	.	.	.	.	.	.	.	
	105	1	.	1	.	.	.	.	.	.	.	.	
	109	.	.	.	.	.	.	.	.	.	.	1	
	135	1	.	1	.	.	.	.	.	.	.	.	
	TOTAL	5	.	5	.	.	.	.	.	.	.	1	
SUB/LEGAL	TOTAL	9	1	10	7	1	8	.	1	1	1	1	

(CONTINUED)

Table 1. Length Frequencies by sex for lobsters captured in Boston Harbor, October 1994.

EGAL LENGTH(mm)	LOCATION											
	MysticR.			RevSug.			ResCh			Log02		
	MALES	FEMALES	TOTAL	MALES	FEMALES	TOTAL	MALES	FEMALES	TOTAL	MALES	FEMALES	TOTAL
GALS .	.	.	.	.	.	.	.	.	.	.	.	.
51	1	.	1	.	.	.	.	.	.	.	.	.
54	.	.	.	.	.	.	1	.	1	.	.	.
56	.	.	.	.	.	.	.	1	1	.	.	.
57	.	.	.	.	.	.	.	.	.	.	.	.
60	.	.	.	.	.	.	.	.	.	.	.	.
61	.	.	.	.	.	.	.	.	.	.	.	.
62	.	.	.	.	.	.	.	.	.	1	.	1
63	.	.	.	.	.	.	.	1	1	.	.	.
64	.	.	.	.	.	.	.	.	.	.	.	.
65	.	.	.	.	.	.	.	.	.	.	.	.
66	.	.	.	.	.	.	.	.	.	.	1	1
67	.	.	.	.	.	.	1	.	1	.	.	.
68	.	.	.	.	.	.	.	.	.	1	.	1
69	.	.	.	.	.	.	.	.	.	.	.	.
70	.	.	.	.	.	.	.	.	.	.	.	.
71	.	.	.	.	.	.	1	.	1	1	.	1
72	.	.	.	1	.	1	.	.	.	2	.	2
73	.	.	.	.	.	.	1	.	1	.	.	.
74	.	.	.	.	.	.	.	1	1	.	.	.
75	.	.	.	.	1	1	.	.	.	.	.	.
76	.	.	.	.	.	.	1	.	1	.	.	.
77	.	.	.	.	.	.	.	1	1	.	.	.
78	.	.	.	.	.	.	.	1	1	.	.	.
79	.	.	.	.	.	.	.	.	.	1	.	1
80	.	.	.	.	.	.	.	.	.	.	.	.
81	.	.	.	.	.	.	.	.	.	.	.	.
82	1	.	1	.	.	.	1	.	1	.	.	.
TOTAL	2	.	2	1	1	2	6	5	11	6	1	7
LS .	.	.	.	.	.	.	.	.	.	.	.	.
84	.	.	.	.	.	.	.	.	.	.	.	.
85	.	.	.	.	.	.	.	.	.	.	.	.
86	.	.	.	.	.	.	.	.	.	.	1	1
87	.	.	.	.	.	.	2	.	2	.	.	.
88	.	.	.	1	.	1	.	.	.	.	.	.
89	.	.	.	.	.	.	.	.	.	.	.	.
95	.	.	.	.	.	.	.	.	.	.	.	.
105	.	.	.	.	.	.	.	.	.	.	.	.
109	.	.	.	.	.	.	.	.	.	.	.	.
135	.	.	.	.	.	.	.	.	.	.	.	.
TOTAL	.	.	.	1	.	1	2	.	2	.	1	1
LEGAL TOTAL	2	.	2	2	1	3	8	5	13	6	2	8

'INUED)

Table 1. Length Frequencies by sex for lobsters captured in Boston Harbor, October 1994.

SUB/LEGAL	LENGTH(mm)	OuterHbr. MALES	OuterHbr. FEMALES	OuterHbr. TOTAL	SpecIs. MALES	SpecIs. FEMALES	SpecIs. TOTAL	Meis#2 MALES	Meis#2 FEMALES	Meis#2 TOTAL	Meis#7 MALES	Meis#7 FEMALES	Meis#7 TOTAL
SUBLEGALS	.	.	.	.	.	.	.	.	.	.	.	.	
	51	.	.	.	.	.	.	.	1	1	.	.	
	54	.	.	.	.	.	.	.	.	.	1	2	
	56	.	.	.	.	.	.	.	.	.	1	1	
	57	.	.	.	.	.	.	.	.	.	.	1	
	60	.	.	.	.	.	.	.	1	1	2	.	
	61	.	.	.	1	.	1	1	.	1	1	1	
	62	.	.	.	.	.	.	.	.	.	1	2	
	63	.	.	.	.	.	.	1	.	1	3	1	
	64	.	.	.	.	.	.	.	.	.	1	4	
	65	.	.	.	1	.	1	1	.	1	4	3	
	66	.	.	.	.	.	.	1	2	3	.	.	
	67	.	.	.	.	.	.	1	1	2	1	.	
	68	.	.	.	1	.	1	2	4	6	1	1	
	69	.	.	.	.	.	.	1	4	5	2	2	
	70	.	.	.	.	.	.	3	1	4	1	3	
	71	.	.	.	.	.	.	2	4	6	3	.	
	72	.	.	.	.	.	.	4	3	7	1	4	
	73	.	.	.	.	.	.	2	1	3	2	1	
	74	.	.	.	.	.	.	1	6	7	4	3	
	75	.	.	.	.	.	.	3	2	5	1	2	
	76	.	.	.	.	.	.	8	8	16	2	3	
	77	.	.	.	.	.	.	3	6	9	.	.	
	78	.	.	.	.	.	.	3	3	6	1	1	
	79	.	.	.	.	.	.	3	5	8	.	2	
	80	.	.	.	.	.	.	1	1	2	2	1	
	81	.	.	.	.	.	.	1	.	1	.	1	
	82	.	.	.	.	.	.	.	.	.	.	1	
	TOTAL	.	.	.	3	.	3	42	53	95	35	40	
LEGALS	.	.	.	.	.	.	.	.	.	.	.	.	
	84	.	.	.	.	.	.	.	.	.	.	.	
	85	.	.	.	.	.	.	.	.	.	1	.	
	86	.	.	.	.	.	.	.	.	.	.	.	
	87	.	.	.	.	.	.	.	.	.	.	.	
	88	.	.	.	.	.	.	.	.	.	.	.	
	89	.	.	.	.	.	.	1	.	1	.	.	
	95	.	.	.	.	.	.	.	.	.	.	.	
	105	.	.	.	.	.	.	.	.	.	.	.	
	109	.	.	.	.	.	.	.	.	.	.	.	
	135	.	.	.	.	.	.	.	.	.	.	.	
	TOTAL	.	.	.	.	.	.	1	.	1	1	.	
SUB/LEGAL	TOTAL	.	.	.	3	.	3	43	53	96	36	40	

(CONTINUED)

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Table 2. Catch per unit effort (number/trap-day) by sex for sublegal and legal sized lobsters captured in Boston Harbor, October 1994.

GALS

	LOCATION												
	LMCh.	Inner-Conf.	Chel-01	Chel.-Riv.	MysticR.	RevSug.	ResCh	Log02	Outer-Hbr.	SpecIs.	Meis#2	Meis#7	BLS
S	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
LES	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
L	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

S

	LOCATION												
	LMCh.	Inner-Conf.	Chel-01	Chel.-Riv.	MysticR.	RevSug.	ResCh	Log02	Outer-Hbr.	SpecIs.	Meis#2	Meis#7	BLS
ES	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
LES	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
L	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

L

	LOCATION												
	LMCh.	Inner-Conf.	Chel-01	Chel.-Riv.	MysticR.	RevSug.	ResCh	Log02	Outer-Hbr.	SpecIs.	Meis#2	Meis#7	BLS
ES	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
ALES	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
AL	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 3. Catch per unit effort for weight (kg/trap-day) for sublegal and legal sized lobsters captured in Boston Harbor, October 1994.

LENGTH	LOCATION												
	LMCh.	Inner-Conf.	Chel-01	Chel.-Riv.	Mystic-R.	RevSug.	ResCh	Log02	Outer-Hbr.	SpecIs.	Meis#2	Meis#7	BLS
SUBLEGALS	0.20	0.31	0.04	0.03	0.06	0.07	0.37	0.22	0.00	0.04	2.15	1.40	0.90
LEGALS	0.54	0.00	0.00	0.12	0.00	0.21	0.09	0.06	0.00	0.00	0.04	0.04	0.07
TOTAL	0.74	0.31	0.04	0.15	0.06	0.27	0.46	0.27	0.00	0.04	2.19	1.43	0.97

Table 4. Mean weight, number of lobsters and units of effort (trap-days) for lobsters captured in Boston Harbor, October 1994.

	LOCATION												
	LMCh.	Inner-Conf.	Chel-01	Chel.-Riv.	Mystic-R.	RevSug.	ResCh	Log02	Outer-Hbr.	SpecIs.	Meis#2	Meis#7	BLS
MEAN WEIGHT	0.66	0.34	0.40	0.68	0.28	0.61	0.32	0.31	.	0.22	0.34	0.28	0.3[illegible]
NO. LOBSTERS	10	8	1	2	2	4	13	8	.	3	96	76	4[illegible]
NO. TRAP DAYS	9	9	9	9	9	9	9	9	9	15	15	15	1[illegible]

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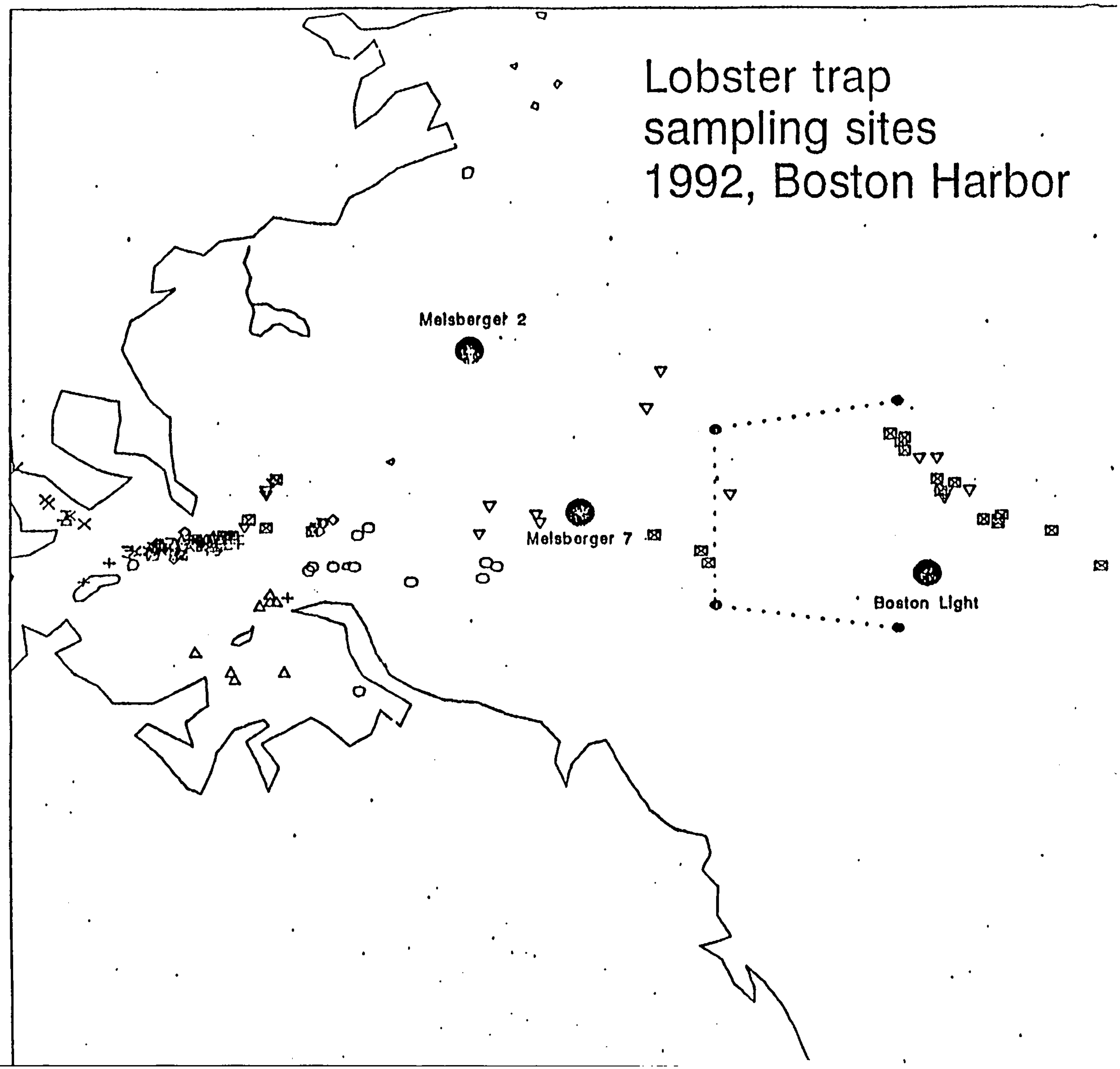
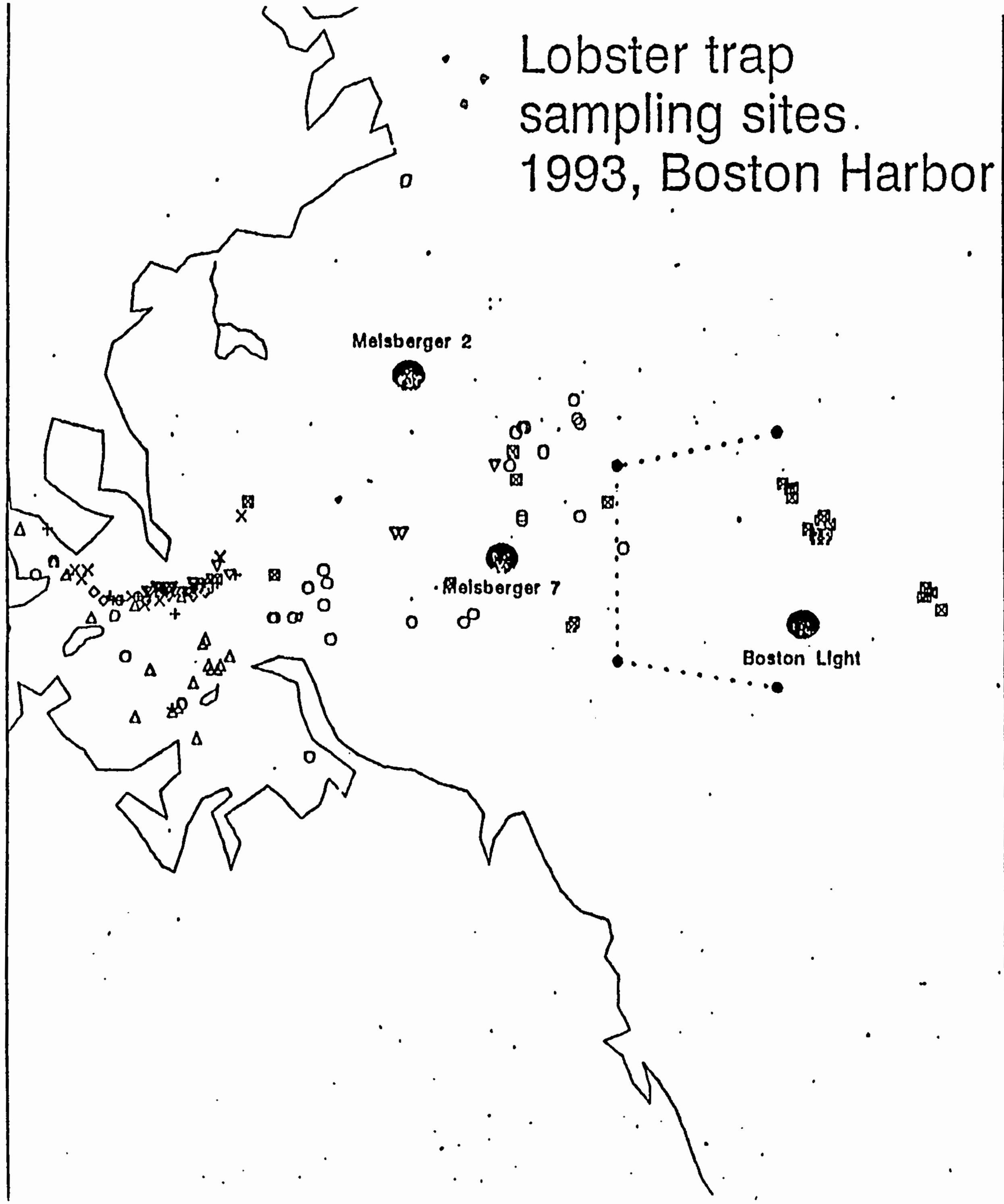

Lobster trap
sampling sites
1992, Boston Harbor
Melsberger 2
Melsberger 7
Boston Light


Lobster trap sampling sites 1993, Boston Harbor
Meisberger 2
Meisberger 7
Boston Light

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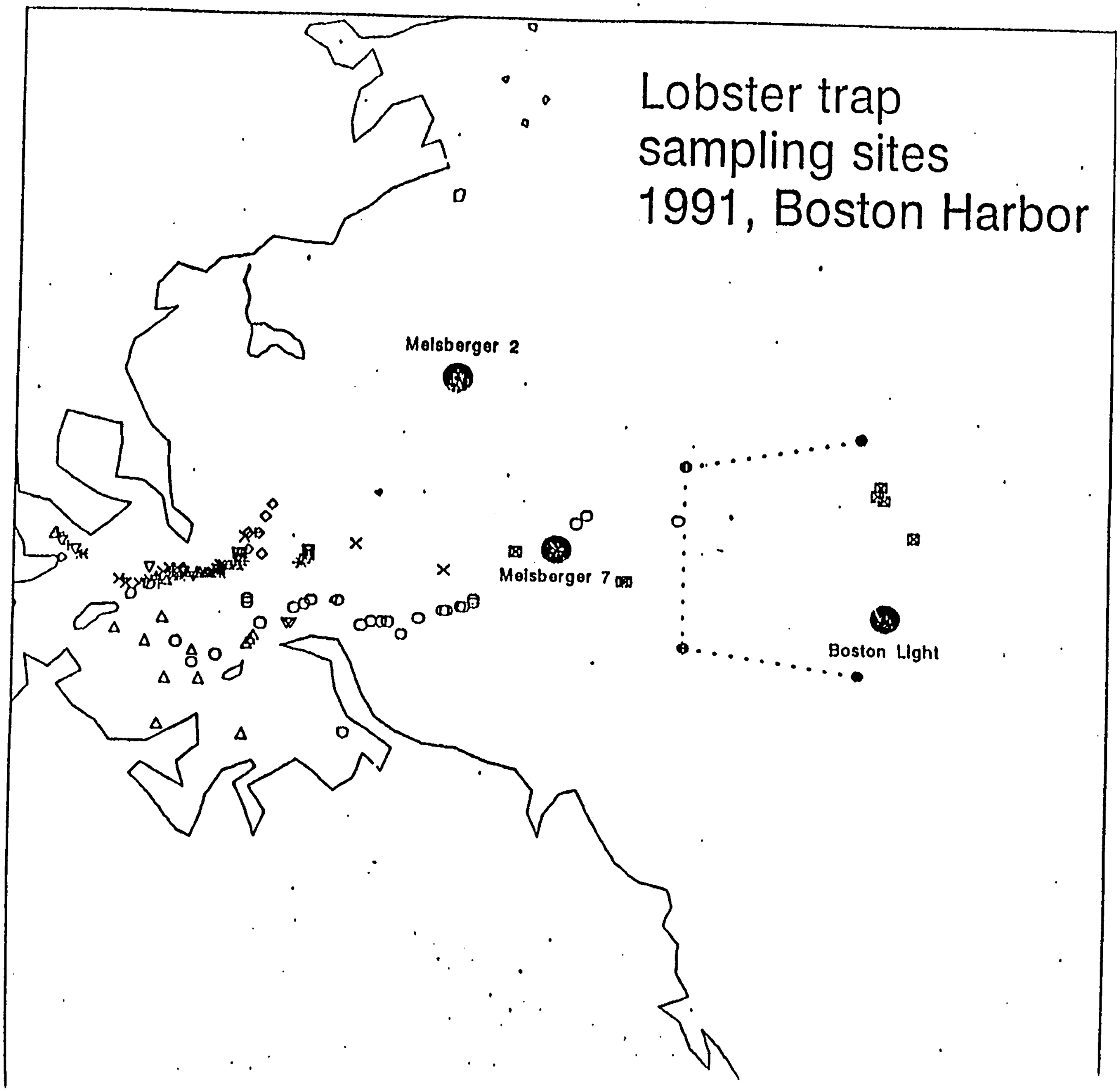
Lobster trap
sampling sites
1991, Boston Harbor
Meisberger 2
Meisberger 7
Boston Light

FIGURES

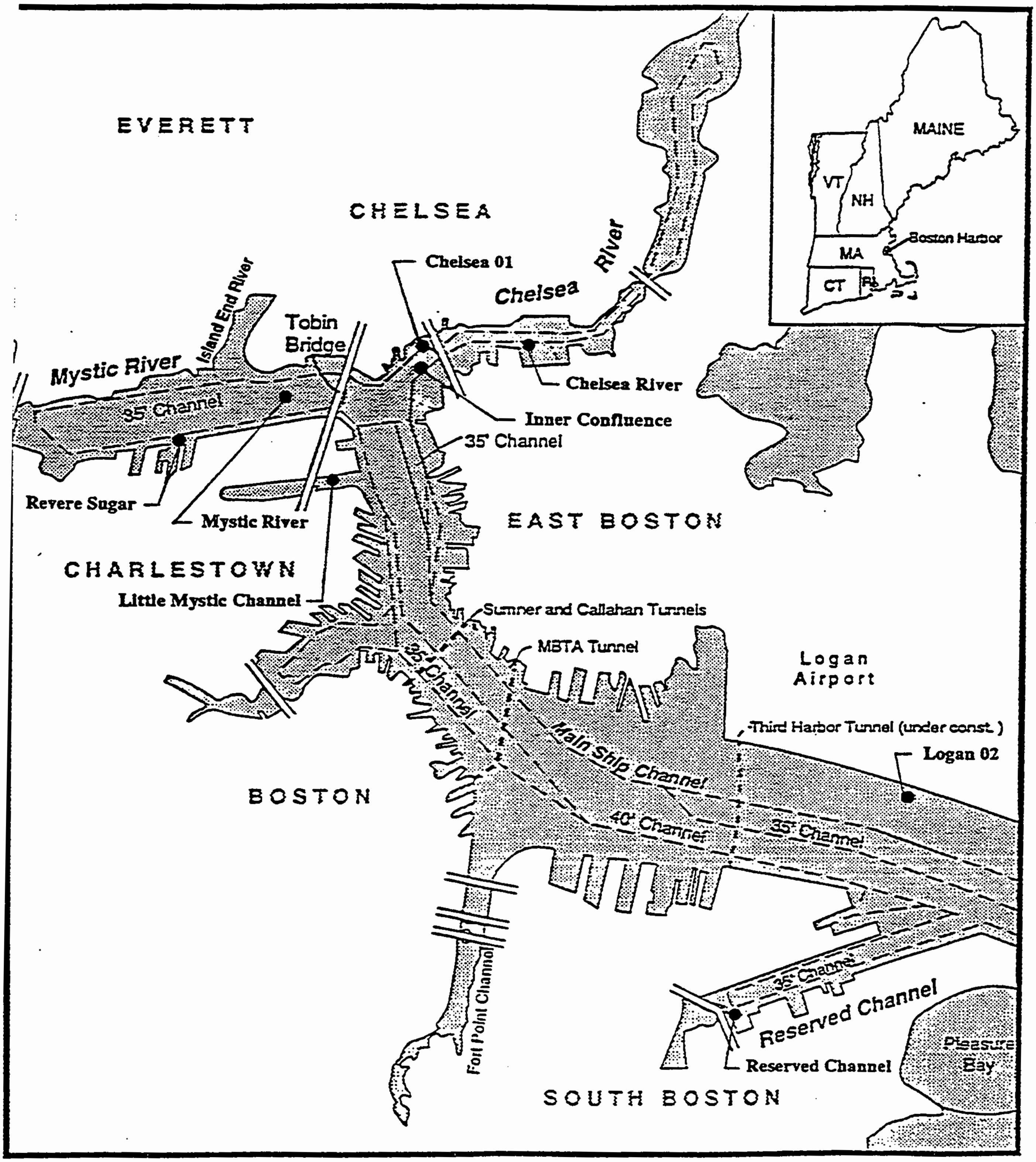

Figure 1. Lobster sampling locations in inner Boston Harbor, October 1994.

N

Scale: 0 2000' 4000'
Scale in Feet

Source: New England Division, Corps of Engineers

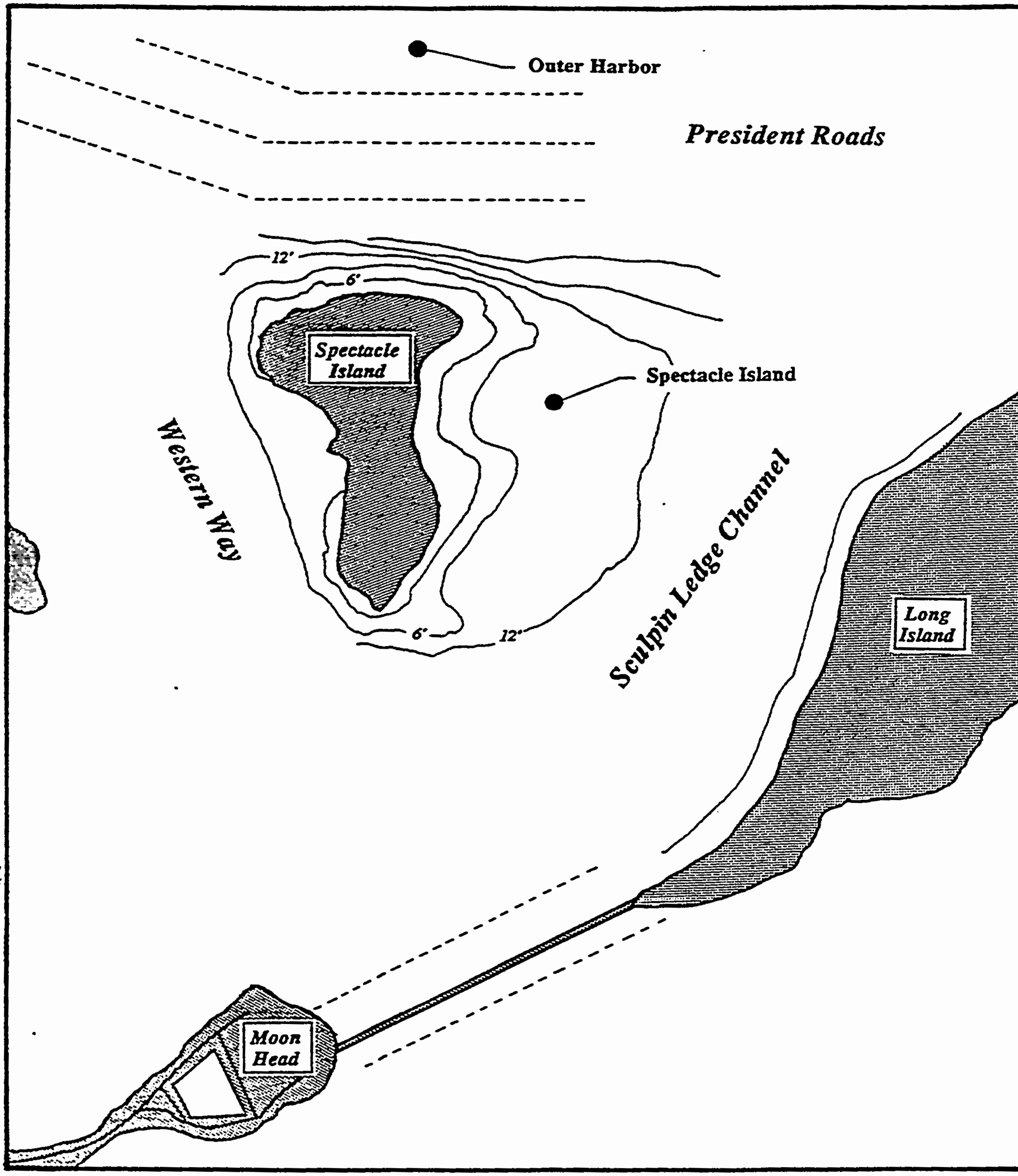

Figure 2. Lobster sampling locations in outer Boston Harbor, October 1994.

Scale: Scale in Yards 500 0 1000

Source: NOS Chart No. 13270 Sediment Classifications from Cortell 1990.

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APPENDIX A

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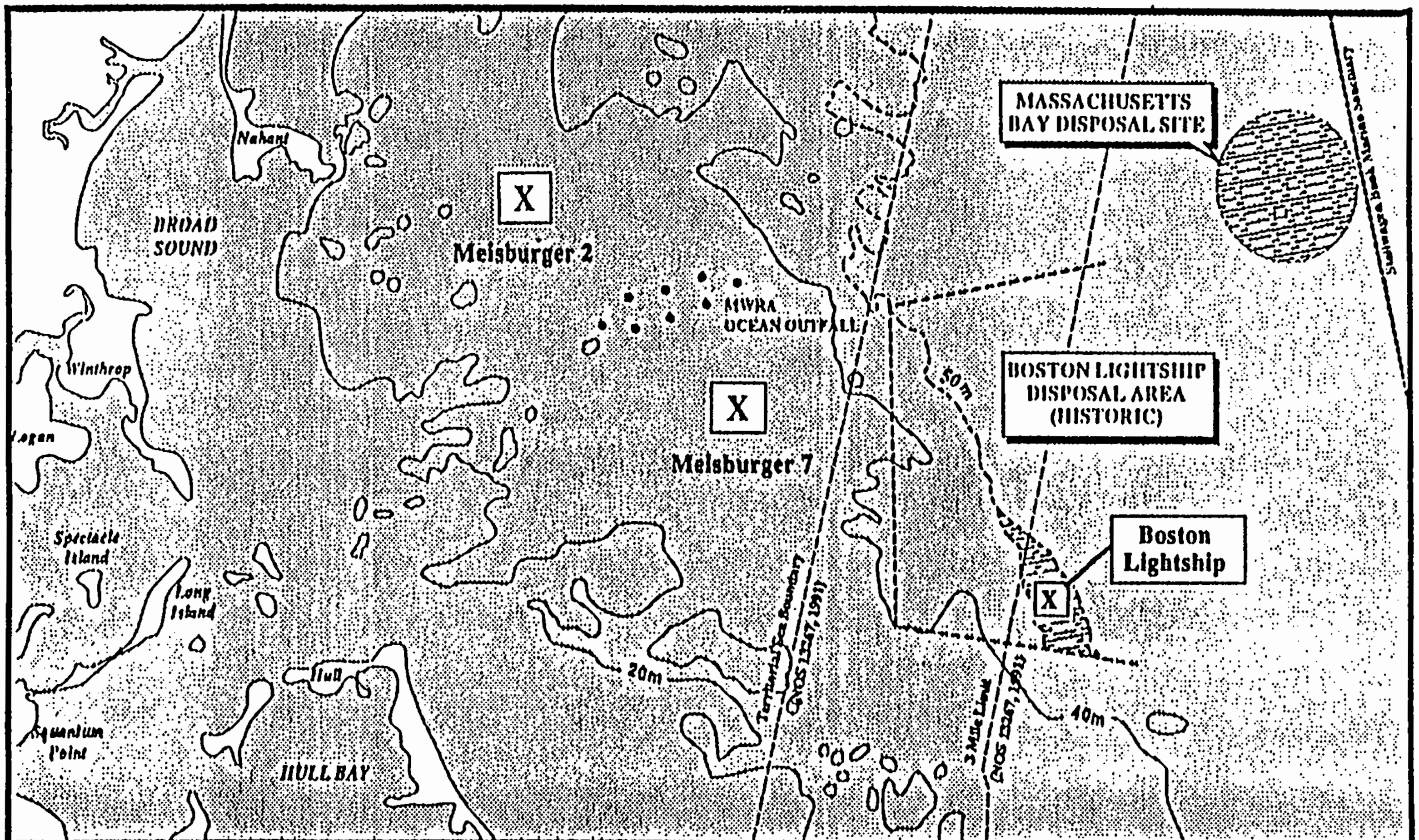

Depositional substrates within the disposal sites.

*BLDS approximate proposed disposal location = 42° 19' N 70° 40' W

Meisburger 2 approximate location = 42° 25' N 70° 50' W

Meisburger 7 approximate location = 42° 21' N 70° 47' W

Scale:

Figure 3. Lobster sampling locations in Massachusetts Bay, October 1994.

Source: Boston Harbor Navigation Chart

APPENDIX A. INCIDENTAL CATCH OF ORGANISMS IN LOBSTER TRAPS DURING BOSTON HARBOR LOBSTER SAMPLING EFFORT, OCTOBER 1994.

	SAMPLING DATE		
STATION	13 OCTOBER	14 OCTOBER	15 OCTOBER
Little Mystic Channel			
Inner Confluence		Cancer crabs	
Chelsea 01	Green crabs	Spider crabs, Cancer crabs, Green crabs	
Chelsea River	Green crabs, Spider crabs, Cancer crabs	Spider crabs, Green crabs, Cancer crabs, Horseshoe crab	
Mystic River	Green crabs, Spider crabs, Cancer crabs	Spider crabs, Cancer crabs, Green crabs	Cancer crabs, Spider crabs
Revere Sugar	Green crabs		
Reserved Channel			
Logan 02		Cancer crabs	Cancer crabs
Outer Harbor	Trap full of Cancer crabs	Spider crabs, Cancer crabs	Trap full of Cancer crabs
Spectacle Island	Trap full of Cancer crabs	Trap full of Cancer crabs	Trap full of Cancer crabs
Meisburger 2		Cunner in trap	
Meisburger 7			
Boston Lightship			

ENVIRONMENT STUDIES FOR THE BOSTON HARBOR NAVIGATION IMPROVEMENT AND BERTH DREDGING ENVIRONMENTAL IMPACT REPORT/STATEMENT

FINFISH SAMPLING AND DESCRIPTION
CONTRACT DACW33-92-D-0004
DELIVERY ORDER #32, TASK 3

Prepared for

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1.0 INTRODUCTION

In response to the Scope of Work (SOW) presented to Normandeau Associates (NAI) by the Corps of Engineers - New England Division (COE/NED), dated August 30, 1994, NAI prepared the following evaluation of finfish resources at several of the alternative dredged material aquatic disposal sites under consideration for the Boston Harbor Navigation Improvement Project (BHNIP).

Both Boston Harbor and Massachusetts Bay provide important habitats for fisheries resources. The principal finfish sought within Boston Harbor is the winter flounder *(Pleuronectes americanus)*. Outside Boston Harbor the principal species fished, in addition to winter flounder, include the yellowtail flounder *(Limanda ferruginea)* and cod *(Gadus morhua)*. Other species of commercial and recreational interest include alewives *(Alosa pseudoharengus)*, Atlantic herring *(Clupea harengus)*, American plaice *(Hippoglossoides platessoides)*, gray sole *(Glyptocephalus cynoglossus)*, haddock *(Melanogrammus aeglefinus)*, summer flounder *(Paralichthys dentatus)*, ocean pout *(Macrozoarces americanus)*, Atlantic mackerel *(Scomber scombrus)*, pollock *(Pollachius virens)*, rainbow smelt *(Osmerus mordax)*, red hake *(Urophycis chuss)*, silver hake *(Merluccius bilinearis)*, white hake *(Urophycis tenuis)*, and menhaden *(Brevoortia tyrannus)*, (MWRA 1988). Table 1 identifies a representative finfish species list for both the inshore and offshore areas (B/PB 1990).

Finfish can be divided into two major categories based on their habitat:

Demersal - sometimes referred to as groundfish, which reside close to the substrate.

Pelagic Fish - reside within the water column or near the surface of the water.

The finfish resource evaluation was established to evaluate both categories within the project area. Sampling was conducted to provide data specific to potential disposal sites and to serve as a comparative data set to previous studies.

2.0 METHODOLOGY

The SOW required three 20 minute otter trawls at each of the outer harbor (Spectacle Island CAD) and offshore disposal sites (Meisburger 2, Meisburger 7, and Boston Lightship). Three fish traps were to be deployed for seventy-two hours at each of the inner harbor disposal sites (Amstar, Little Mystic Channel, Mystic Piers, Reserved Channel, Revere Sugar). The catch from the fish traps would be processed every twenty-four hours. The species, weight, length, sex, age, and general overall appearance of the individuals were recorded and displayed in a tabular format. Given the transient nature of finfish communities in Boston Harbor and Massachusetts Bay, the data acquired through this sampling effort will depict instantaneous conditions.

Because of physical and fishing gear restrictions at the sampling sites, modifications to the SOW were required and coordinated with COE/NED. Three, 20-minute otter trawls would be conducted at Boston Lightship. Three, five minute trawls would be conducted at Spectacle Island (CAD), Chelsea River, Mystic River, the Inner Confluence and Subaqueous E. The five minute trawl duration was recommended due to the lack of fishable bottom to conduct a 20 minute trawl. Sampling locations are depicted on Figures 1, 2 and 3.

Otter trawls are designed to capture demersal species (Tait and DeSanto 1975). A 9 m footrope otter trawl with roller gear was used on this project. Specifications for this trawl were:

Head rope length	6.9 m
Foot rope length (Sweep)	9.0 m
Legs (between doors and net)	6.0 m
Approximate vertical lift	3.6 m
Doors (steel V-doors)	1.0 m
Net body length	5.2 m
Cod end section	2.3 m
Mesh - body of net	7.6 cm (stretch) mesh polypropylene; polypropylene; 3 mm diameter twine
- cod end	0.64 cm (stretch) mesh, knotless polypropylene; 3 mm diameter twine
Roller Gear	25.4 cm rollers spaced with 5 cm cookie disks

mb

Trawling occurred at the Boston Lightship on October 6, 1994, and occurred at the other sites during October 19 through 21, 1994.

Catch data is presented as the mean Catch-Per-Unit-Effort (CPUE) of three replicate trawls. Trawl duration was five minutes at all stations except for Boston Lightship where trawl duration was 20 minutes. The outer harbor station is most closely aligned with Subaqueous E, so for ease of labeling has been given this identification in this report. To allow meaningful comparisons between stations with different tow duration, the catch was standardized to a 20 minute tow. Stations sampled were:

Boston Lightship	Mystic River
Chelsea River	Spectacle Island CAD
Inner Confluence	Outer Harbor (Subaqueous E).

Boston Lightship was an offshore station, Spectacle Island CAD and Subaqueous E were outer harbor stations, and Chelsea River, Inner Confluence, and Mystic River were inner harbor stations.

A second modification to the SOW was required for sampling at both Meisburger 2 and 7. Trawling could not occur at either location due to the deployment of fixed gear by lobstermen. Therefore, gill nets were set at each site for a total of 72 hours with plans to fish the nets every 24-hours between November 9 and 12, 1994. Due to poor weather conditions, the nets were not hauled on November 11 so the catch from November 12 represents a 48-hour set.

Gill nets were also set in the Harbor (in lieu of traps) at Reserved Channel, Little Mystic Channel, Revere Sugar, Chelsea 01, and two representative shoreline main ship channel stations, identified herein as Logan 02 and the Fish Pier for ease of reference. This was done because gill nets were considered a more appropriate method for the fish being sought. These nets were set for three 24-hour periods between October 19 and 21, 1994. At all sites two multiple-mesh size gill nets were set, one at the surface and one just off the bottom.

Specifications for the gill nets were:

Total panels	4 per net
Panel dimensions	8.25 m x 3.03 m
Mesh sizes	2.5 cm in panel 1
	5.1 cm in panel 2
	10.2 cm in panel 3
	15.2 cm in panel 4
Total net dimension	30.3 m x 3.03 m

3.0 RESULTS

3.1 TRAWL DATA

There was a concern expressed by NMFS and DMF that fishing in the Harbor not be conducted until dissolved oxygen (DO) concentrations reach a level that could support fish life. During the October sampling, DO concentrations levels in the Mystic River Channel had reached an acceptable level (6.0-6.5 mg/l).

A comparison of standardized CPUE data indicates that total catches (including lobster) were highest at Subaqueous E, Chelsea River, Boston Lightship and Mystic River, followed by Inner Confluence and Spectacle Island (Table 2). The high CPUE at Boston Lightship is due partially to high catches of lobsters. When only finfish are counted, CPUE ranking was as follows:

(1) Subaqueous E, Chelsea River (2) Mystic River
(3) Inner Confluence (4) Boston Lightship
(5) Spectacle Island CAD

Winter flounder were the most numerous finfish at each station, although lobster surveys were conducted using other gear (see lobster report). Lobster were more abundant than winter flounder in trawls at the Boston Lightship site. Winter flounder CPUE was also highest over all stations combined. Following winter flounder in overall abundance were lobster, Atlantic tomcod, skate sp., rainbow smelt and scup. Lobsters were collected primarily at Boston Lightship, and were present at all stations except Mystic River. Atlantic tomcod was caught at only two inshore stations (Chelsea River and Mystic River). Skate sp. and rainbow smelt were collected at the inner harbor and outer harbor (Subaqueous E) sites. Neither were found offshore (Boston Lightship). Scup were collected only at Mystic River. Although Atlantic silverside and alewives were not among the six most numerous species, they were caught at four and three, respectively, of the six sites (both in-and offshore). Atlantic silverside were present at inner harbor and outer harbor stations, and alewives were present at inner harbor and offshore (Boston Lightship) stations. All other species were located at one or two stations and in relatively low numbers. A single striped bass was caught at the Subaqueous E site.

Length frequencies of the five most abundant fish species captured are presented in Tables 3 through 7. All fish were measured to total length in mm. Sizes of fish captured in the trawl are a function of the trawl mesh size. The otter trawl used for this sampling effort was designed to capture both adult and young-of-the-year (YOY) finfish. YOY fish were spawned during the year of capture and are designated Age 0. Age 0 fish can usually be identified in length frequency tables as a discrete modal group of smaller fish within the larger distribution.

The 147 winter flounder measured ranged in length from 65 to 384 mm (Table 3). Approximately 7% of the winter flounder measured were Age 0, assuming winter flounder less than 100 mm were spawned this year (Bigelow and Schroeder 1953).

Assuming that winter flounder less than 200 mm were either juvenile or YOY (Pearcy 1962), more juvenile and YOY winter flounder were found at the Chelsea River and Mystic River stations than any other station (Table 3). The lowest number of juvenile and YOY winter flounder were found at the Boston Lightship station. The occurrence of juvenile winter flounder in inner Boston Harbor is not surprising, because adults tend to spawn in inshore waters. Winter flounder do not move extensively in their first year (Saucerman and Deegan 1991). As water temperatures decrease in the winter, juvenile winter flounder will probably move to deeper water areas of Boston Harbor where temperatures will remain higher.

All Atlantic tomcod measured during this study were less than 188 mm (Table 4). It is difficult to make any generalizations regarding the age, however the majority of these fish were Age 0. This age estimate is based on a comparison of lengths of Boston Harbor Atlantic tomcod to Atlantic tomcod from the Hudson River that were aged using otoliths (Normandeau Associates 1994).

The 16 rainbow smelt captured ranged in length from 71 to 121 mm (Table 5). Rainbow smelt spawn in the early spring and are generally less than 70 mm by the autumn of their first year (Bigelow and Schroeder 1953). Therefore, the majority of the fish captured in this study were probably Age 1 or older fish.

A total of 22 skate sp. were measured ranging in length from 107 to 553 mm (Table 6). It is difficult to estimate the ages of these fish because the category "skate sp." comprises more than one species. However, it appeared that only one fish (4.5%) was Age 0 and the rest were yearling or older fish (Bigelow and Schroeder 1953).

Seven scup were measured during the study and their lengths ranged from 78 to 109 mm (Table 7). These fish were most likely Age 0 (Bigelow and Schroeder 1953; Finkelstein 1969).

3.2 GILL NET DATA

Gill net data are presented as the mean CPUE (catch per 24-hour set) for the two nets (surface and off-bottom) combined. Gill netting is generally considered a fishing method for pelagic species (Tait and DeSanto 1975).

Surface and off-bottom gill were set at the following locations:

Meisburger 2	Meisburger 7
Chelsea 01	Logan 02
Fish Pier	Reserved Channel
Little Mystic Channel	Revere Sugar

At the Meisburger 2 and Meisburger 7 sites, the first set was a 24-hour set while the second was a 48-hour set due to poor weather conditions during the collection period. Data from these collections were standardized to catch per 24-hour set.

Table 8 presents mean CPUE from the gill net sampling effort.
CPUE was highest in the Reserved Channel, primarily due to large catches of alewife and blueback herring. The Reserved Channel also provided the most number of species. CPUE from the Reserved Channel approached 50% of the CPUE from all stations combined.

Chelsea 01, Meisburger 7, Fish Pier, and Meisburger 2 followed the Reserved Channel in magnitude of CPUE (Table 8). CPUE at these stations represented 11%, 11%, 10%, and 9%, respectively, of the total gill net CPUE. Among these stations, rainbow smelt were the most common fish captured inshore (Chelsea 01, Fish Pier 1) while Atlantic mackerel predominated offshore (Meisburger 7 and Meisburger 2).

The lowest CPUE occurred at Logan 02, Little Mystic Channel, and Revere Sugar (Table 8). CPUE at these stations was 7%, 4% and 2% respectively of the total CPUE. As with the other inshore stations, rainbow smelt were the most common fish captured.

Over all stations combined, blueback herring (26%), rainbow smelt (25%), alewives (15%), and Atlantic mackerel (9%) were the most abundant species (Table 8). Although they were present at several sampling locations, the majority of the blueback herring (98%) and alewife (93%) were caught in the Reserved Channel. Similarly 98% of the total Atlantic mackerel catch occurred at the Meisburger sites (33% at Meisburger 2 and 65% at Meisburger 7). Rainbow smelt were present at all sampling locations except for the Meisburger (offshore) sites. Although limited in overall abundance, cunner, winter flounder, striped bass, and skate sp. were captured at several sampling locations.

Gill nets are a very size selective gear because the mesh in the panels will only retain individuals of a given size or larger. Therefore any estimates of age class distribution based on the lengths of fish captured in gill nets will be representative only of the fishes captured, and not of the population at large.

The following age class trends, based on age class descriptions reported by Bigelow and Schroeder (1953), were evident in the most abundant species caught in gill nets.

- **Blueback herring** - Of the 76 total individuals measured, 57% were between 125-137 mm. These appeared to be Age 0 fish.
- **Rainbow smelt** - Of the 127 total individuals measured, 76% ranged from 163-188 mm. This size class represented Age 1 and older age classes.
- **Alewife** - Of the 64 total individuals measured, 72% fell within 111-122 mm size class. These appeared to be Age 0 fish.
- **Atlantic mackerel** - Of the 56 total individuals measured, 41% fell within the 290-303 mm size class and 18% were between 30-31 mm size classes. The former size class appeared to be Age 1 or older, while the latter appeared to be Age 0.
- **Winter flounder** - Of the 21 total individuals measured, 38% fell within the 76-83 mm size class and would be considered Age 0 individuals.

4.0 DISCUSSION

4.1 FALL 1994 DATA

The demersal fish resources of Boston Harbor were primarily sampled by the otter trawl. Trawl CPUE was higher at Subaqueous E and Chelsea River than the single offshore station (Boston Lightship), and lowest at Spectacle Island CAD. The data presented here represent instantaneous conditions in October, 1994. It is recognized that scaling the five minute tows to 20 minutes to standardize CPUE could affect these results, but these are the constraints inherent in the Harbor sites. Twenty minute tows were not possible in the inner harbor due to the lack of fishable bottom. Therefore, trawl duration was limited to five minutes. Winter flounder were present at all stations and were the most abundant fish captured. Winter flounder were followed by skate sp., Atlantic tomcod, rainbow smelt and scup in relative abundance. Of these species, winter flounder is the most important commercial resource. Rainbow smelt is a recreationally important fish and is ecologically important as a forage fish. Neither Atlantic tomcod, scup or skates sp. have any important commercial or recreational significance in Boston Harbor (Bigelow and Schroeder 1953), but this does not diminish their ecological value.

CPUE for pelagic fishes was intermediate at the Meisburger 2 and Meisburger 7 offshore stations and at Logan 02 located in the outer harbor. The pelagic fish resources were primarily sampled by the gill nets. CPUE in the gill net samples was highest at the Reserved Channel followed by Chelsea 01, Meisburger 7 and the Fish Pier. The lowest gill net CPUE occurred at Little Mystic Channel and Revere Sugar.

Blueback herring were the dominant pelagic fish captured and the largest catches occurred in the Reserved Channel. Following blueback herring in abundance were rainbow smelt, alewife, and Atlantic mackerel. Blueback herring, rainbow smelt and alewife were primarily captured in the inshore stations, while Atlantic mackerel predominated at the offshore stations (Meisburger 2 and Meisburger 7).

Pelagic fishes inhabit the water column and many pelagic fishes travel in schools. They probably are not as closely linked to specific bottom habitats as demersal fish. The capture of a school of pelagic fish in a gill net is often a result of a random encounter between the school and the sampling gear. A short duration sampling effort may not indicate a significant association between a pelagic fish species and a given location. Therefore, the high CPUE for pelagic fish in the Reserved Channel, due to large catches of blueback herring, does not necessarily indicate that the Reserved Channel provides better habitat for pelagic species than other areas in the inner harbor. It is possible that this high CPUE could have occurred at other areas in the inner harbor.

Demersal fishes live in close association with the bottom and probably have more specific bottom habitat requirements than pelagic fishes. The occurrence of demersal fishes in an area is probably a better indicator of habitat preferences for a specific location than the occurrence of pelagic fish. Demersal fish resources as measured by CPUE was highest at Subaqueous E and Chelsea River followed by the remaining inner harbor stations (Mystic River and Inner Confluence) and Boston Lightship. CPUE was lowest at Spectacle Island CAD. As noted earlier, demersal fish could not be sampled at the Meisburger sites due to the extent of fixed commercial gear; lobster catches at these stations indicate their relative importance to the commercial fishing communities in this area.

HABITAT OF JUVENILE WINTER FLOUNDER

Winter flounder are one of the most commercially and recreationally important fishes found in New England waters. The following is a description of juvenile winter flounder habitat derived from the literature, and an application of that description to inner Boston Harbor.

Winter flounder spawn in New England north of Cape Cod from February through May (Klein-MacPhee 1978). The spawning habitat is not well described, but Bigelow and Schroeder (1953) state that winter flounder spawn over sandy bottom in water as shallow as 2 to 6 m. It is probable that they will spawn over other substrates also, but this is not documented in the literature. Winter flounder will also spawn in deeper water as evidenced by an offshore population on Georges Bank. Eggs are demersal and adhesive (Pearcy 1962). Larvae tend to orient to the bottom and are more common in the upper reaches of the Mystic River (CT) estuary early in the larval phase than in the lower estuary (Pearcy 1962). As winter flounder larvae mature and metamorphose into juveniles, they tend to move to the lower estuary (Pearcy 1962).

Juvenile winter flounder (<4 years old) are common in shallow waters along the New England coast. In Great Peconic and Shinnecock Bays on Long Island, Poole (1966) found that young-of-the-year (YOY) winter flounder were more abundant in shallow cove stations compared to paired open water stations. In Waquoit Bay on Cape Cod, YOY winter flounder did not exhibit any large scale movements (<100 m) within the estuary during the summer (Saucerman and Deegan 1991). As the season progresses, and water temperatures increase, juvenile fish will move to deeper and colder water (McCracken 1966; Howe and Coates 1975; Massachusetts Division of Marine Fisheries in Klein-MacPhee 1978). Juveniles will begin to move out of the estuary in the late fall and winter when water temperatures approach the yearly minimum (Pearcy 1962). Winter flounder tend to return to their natal estuary the following spring (Saila 1961; Howe and Coates 1975).

In summary, the generalized life history model for winter flounder north of Cape Cod starts with adults spawning in shallow estuaries during February through May. Eggs are demersal and adhesive and may be deposited on sandy substrate, but eggs are probably deposited on other substrates. Larvae move to the lower reaches of the estuary in the spring as they grow and mature. Juveniles may move to deeper portions of the estuary during the summer when water temperatures are maximum. Movements by juveniles appear to be on the order of 100 m (Saucerman and Deegan 1991). Juveniles and adults will leave the estuary during the winter as water temperatures reach the annual minimum. Movements of winter flounder north of Cape Cod appear to be localized.

Inner Boston Harbor appears to be habitat for juvenile winter flounder based on the results of this trawling study and Haedrich and Haedrich (1974). Winter flounder were the most common species captured by Haedrich and Haedrich (1974) and many of these were juveniles. Inner Boston Harbor substrate is generally very silty and the waters are near oceanic in salinity. This habitat does not fit the classic estuarine description of juvenile winter flounder habitat, (i.e. sand or silty sand) but the area is obviously used by juvenile winter flounder. If it is assumed that juvenile winter flounder do not move far from the spawning area, then inner Boston Harbor is probably spawning habitat also. Very little work has been done on the winter flounder habitat in urban estuaries, but it appears that winter flounder can use habitat that is markedly different from the classic, relatively undisturbed estuarine habitat described in the literature.

SEASONALITY

The Central Artery/Tunnel (CA/T) project conducted seasonal trawling in Boston Harbor at five stations in Boston Harbor in 1993 (Table 9). Three replicate samples were collected at each station using a 16 foot headrope and a mesh size of 1 3/8 inch throughout the net (ENSR 1992). CPUE in the winter was the lowest at each station except for the Reserved Channel station (Table 9). Spring CPUE increased over the low winter CPUE at each station. Summer CPUE was generally slightly higher or comparable to the spring CPUE, with the exception of the Reserved Channel when summer CPUE decreased to an annual low. Catch per unit effort (CPUE) was highest in the fall, except for the Spectacle Island Station when CPUE was slightly higher in the spring.

Winter flounder were generally the most numerous fish captured at each station, each season. In the fall, winter flounder were especially numerous as they made up the majority of the catch at the Reserved Channel, Aquarium, and Charles River stations.

The fall sampling in this study probably captured the annual peak in CPUE in Boston Harbor, based on the seasonal data from the CA/T project. The proposed spring sampling will capture the seasonal increase in CPUE from the low winter catches. CPUE in the summer is generally intermediate between the spring and fall, or slightly lower, with the exception of the Reserved Channel when CPUE was lowest in the summer.

4.2 OTHER STUDIES

The following is a narrative of several previous biological resource studies conducted with Boston Harbor, and Massachusetts Bay where finfish resources were evaluated.

MYSTIC RIVER FINFISH SURVEY (HAEDRICH AND HAEDRICH 1974)

Haedrich and Haedrich (1974) conducted trawl and gill net surveys in the Mystic River in four seasons (1972-1973). While they collected 23 species, only six occurred in more than one season. Winter flounder, rainbow smelt, and alewife occurred during every sampling period; ocean pout occurred in three sampling periods; blueback herring and Atlantic tomcod each occurred in two sampling periods. Winter flounder ranked first or second in abundance year round. Rainbow smelt was more abundant in late winter (March), and alewife was more abundant in late spring (June). Species richness was lowest in August and highest in November whereas standing crop (based on biomass) was lowest in June and similar in the other months. Spatial distribution of the fishes tended to be related to temperature. During the summer the fish were concentrated towards the mouth of the river. Haedrich and Haedrich

(1974) calculated pooled annual diversity and concluded that the Mystic River exhibited low finfish diversity. However, they did not compare total standing crop to other areas.

A tidal flat on the Mystic River adjacent to the Schrafft Center (Charlestown, MA) was sampled by seine in the summer of 1985 (NAI 1985). Results were generally consistent with the fish community observed by Haedrich and Haedrich (1974).

ESTUARINE LIVING MARINE RESOURCE PROGRAM (ELMRP), JURY ET AL. (1994)

The spatial distribution and relative abundance of finfish in several North Atlantic estuaries, including Boston Harbor and Massachusetts Bay were evaluated in this report based on a literature review. Relative abundance was evaluated for each of the major finfish life stages (e.g. adults, spawning adults, juveniles, larvae and eggs). The three most abundant finfish in the fall 1994 sampling, winter flounder, Atlantic tomcod, and skate sp., were classified as either abundant, or highly abundant in Jury et al. (1994). Atlantic silverside, winter flounder, and American plaice were the most common species in Massachusetts Bay, and Atlantic silverside, winter flounder, and mummichog were the most common species in Boston Harbor according to Jury et al. (1994).

DSEIS - BOSTON HARBOR WASTEWATER CONVEYANCE SYSTEM, USEPA AND COE/NED 1988

The DSEIS states that "understanding the population dynamics of fish in the Gulf of Maine as well as Massachusetts Bay is important because of the cosmopolitan and migratory nature of fish". Seasonal temperature variations influence fish migration. The geographic position of Boston Harbor and Massachusetts Bay place the BHNIP project area in a transitional area. Temperature conditions within the project area include the physical segregation of the cold waters of the Gulf of Maine from the warmer waters of the Mid-Atlantic Bight by Cape Cod. This creates a sharp temperature differential during the summer, but during the rest of the year, a temperature continuity exists.

USEPA and COE/NED (1988) report that winter flounder was the most abundant species at all depth intervals collected during sampling efforts in Massachusetts Bay. Sampling was conducted during May and September 1978 through 1986. Abundance consistently tended to decrease during the September sampling efforts.

Based on the catch data presented in USEPA and COE/NED (1988), the five most abundant species were winter flounder, butterfish, longhorn sculpin, ocean pout, and Atlantic cod. Winter flounder were abundant throughout Boston Harbor and appeared to dominate in the northern part of the Harbor (west of Deer Island). Demersal fish densities were high in the northern part of Boston Harbor but species diversity was low. In the southern part of Boston Harbor (in the vicinity of Nut Island), density of fish is lower than the northern harbor but diversity is higher. Pollock, cod, skate, and cunner were also relatively abundant in the southern portion of Boston Harbor. Haedrich and Haedrich (1974) reported that winter flounder dominated the fish population within the upper reaches of the inner harbor at the mouth of the Mystic River. In spring and early summer smelt and alewife were also abundant in this area. Both Boston Harbor and Massachusetts Bay fishing resources are clearly dominated by demersal species.

CENTRAL ARTERY/THIRD HARBOR TUNNEL PROJECT FISHERIES MONITORING PROGRAM

The Central Artery/Third Harbor Tunnel project monitored fish abundance at five stations in Boston Harbor (Table 10). Three ten-minute trawls were collected at each station using a trawl with a 16 foot headrope and a mesh size of 1 3/8 inch throughout the net (ENSR 1992). CPUE was highest at the Charles River station, located approximately 400 ft down-stream of the Charlestown Bridge, followed by the Reserved Channel station. CPUE was lowest at the Spectacle Island station located approximately 2,000 ft east of the southern tip of Spectacle Island. Winter flounder were the most numerous species caught at each station, with the highest abundances occurring at the Charles River station. Winter flounder abundance was lowest at the Spectacle Island station. Mean lengths of fish indicated that the majority of the winter flounder captured were young-of-the-year or yearling fish.

WINTHROP HARBOR BORROW PIT FISHERY SAMPLING PROGRAM, CHASE (1994)

MADMF used a shrimp trawl to sample demersal finfish in both Winthrop Harbor and Logan Borrow Pits (Chase 1994). Winter flounder were caught in the highest frequency of all finfish (73% of total catch). This was consistent with several early Boston Harbor finfish surveys. Several other species were caught in lesser abundances and included rainbow smelt, grubby, tomcod and yellowtail flounder.

Chase (1994) concluded that both sample areas contain a productive bottom community of finfish. Two fishes, winter flounder and rainbow smelt, were recreationally and commercially important.

MASSACHUSETTS DIVISION OF MARINE FISHERIES GROUNDFISH SURVEYS (1989-1992)

The Massachusetts Division of Marine Fisheries (MADMF) conducts a survey of the inshore groundfish resources each spring and fall. Data reviewed here is limited to the fall survey during the most recent five years available (1989-1993) to ensure comparability this survey. The survey encompasses the entire Massachusetts Coast, but for this review was subset to Massachusetts Bay as defined by the area north of the North River in Scituate, south of Marblehead, and west of a line approximately 2 nautical miles east of the Massachusetts Bay disposal site. The easternmost area sampled by MADMF was in the vicinity of Nahant, and no samples were taken by MADMF in Boston Harbor or at any of the offshore sites sampled in this study (Meisburger 2, Meisburger 7, Boston Lightship). However, the MADMF data do provide a description of the fishery resources of Massachusetts Bay.

The MADMF survey used a larger otter trawl than the trawl used in our study. The footrope dimension was 15.5 m, 42% larger than the 9 m footrope used in this study. Both trawls had the same mesh (0.64 cm) liner in the cod end. A smaller trawl was necessary to sample the Boston Harbor stations and using this gear consistently in this study allowed quantitative comparisons among all stations. The trawl duration was generally 20 minutes for the MADMF survey and in this study ranged from five minutes at the Boston Harbor stations to 20 minutes at the Outer Harbor and Boston Lightship stations. Due to its size, it was expected that the MADMF trawl would capture more fish and a greater number of species than the trawl used in this study.

Longfin squid, American plaice, lobster, butterfish and silver hake accounted for 83% of the organisms captured during the MADMF fall groundfish survey between 1989 and 1993. Longfin squid alone accounted for 34% of the total catch between 1989 and 1993, and most of these came from several large catches in 1993. Catches of American plaice were relatively consistent between 1989 and 1993, and this species ranked in the top four in abundance each year. Lobster catches varied widely. In 1990 it was the most numerous species captured, and other years it accounted for less than 3% of the total catch. Butterfish catch also varied greatly as it composed less than 1% of the catch in 1989 and as much as 28% of the catch in 1990 when 3,326 were captured. The wide variation in butterfish catches is to be expected for a semi-pelagic schooling species that may encounter the trawl in great numbers. Silver hake made up between 0.5 and 16.5% of the total catch with highest catches in 1992.

The MADMF catch data is different from the data collected in this study. With the exception of lobster, none of the five most abundant organisms captured in this study (winter flounder, lobster, Atlantic tomcod, skate sp., and rainbow smelt) were among the five most abundant species in the MADMF data (longfin squid, American plaice, lobster, butterfish and silver hake). However, with the exception of Boston Lightship, all the sampling done in this study was at inshore stations at depths less than 15 m, and the majority of the MADMF sampling was done at depths greater than 20 m. The differences in the species composition is primarily due to the different depth habitats sampled. The MADMF data is more similar to the catch at Boston Lightship (50 m) where lobster and silver hake were among the five most abundant species.

It is difficult to compare data among fisheries surveys quantitatively due to differences in gear and methods of sampling. Table 10 presents the catch data from the MADMF trawl survey for the six, 20-minute duration samples taken in Massachusetts Bay at locations less than 15 m deep. MADMF did not sample at any of the offshore sites sampled during this study. The catch per 20 minute tow (CPUE) in the MADMF data (Table 11) is much higher than the CPUE in the present study (Table 2). Without a gear comparison study it is unknown whether the larger CPUE in the MADMF data is due to the larger gear used, or due to differences in fish populations among the sites sampled.

DISPOSAL AREA MONITORING SYSTEM (DAMOS), COE/NED (1979)

Commercial draggers originating from areas between Boston and the New Hampshire border typically fished areas north of the Massachusetts Bay Disposal Site. Vessels from Scituate tended to fish east and southeast of the disposal site and boats out of Boston and Weymouth typically fished shoreward of the Boston Lightship.

Atlantic cod were caught through the winter and spring, or until driven off the grounds by spiny dogfish in the summer. American plaice and gray sole were caught through the spring and summer. Yellowtail flounder were caught to the north of both the Massachusetts Bay Disposal Site and Boston Lightship during the winter and spring, and silver hake were caught to the west of Stellwagen Bank from June through November.

DAMOS also reported that a disadvantage of fishing in the vicinity of any of the dumping grounds was the possibility of catching waste material which could include concrete containers and barrels of radioactive and chemical wastes.

5.0 CONCLUSION

A review of historical data indicate an overall consistency in inshore and offshore finfish community structure during the past 10-15 years. Winter flounder are the most important demersal fish species throughout the BHNIP project area. Other flatfish encountered in the project area include yellowtail flounder, American dab and windowpane flounders. In less abundance than the flatfish, cod family appears to be abundant, especially in the offshore area where the Atlantic cod, silver and red hake, and pollock were consistently present in all catch results.

Data from the present study indicated that among the areas investigated during the fall of 1994, abundance of demersal fishes was highest at Subaqueous E and Chelsea River followed by the Mystic River, Inner Confluence and Boston Lightship stations. CPUE was lowest at Spectacle Island CAD. Pelagic species located at the inner harbor areas included rainbow smelt, alewives and blueback herring. Several baitfish were also evident in all of the catch results of this and previous studies. These included the Atlantic silverside, mummichog, fourspine stickleback and the American sand lance.

Other species which were reported throughout all studies were skates sp., Atlantic mackerel, menhaden, ocean pout, butterfish, scup, grubby, cunner and longhorn sculpins. Of specific interest to the recreational fisherman, neither bluefish nor striped bass were abundant, but were present in some catches.

Data from our study indicated that abundance of pelagic fish resources was highest at some inner harbor stations and the offshore stations. Abundance of pelagic fish resources was lowest at the remaining inner harbor stations and the outer harbor stations.

The catch results from this sampling effort, and the findings reported in Haedrich and Haedrich (1974), NAI (1985) and USEPA and COE/NED (1988), indicated that the lower Mystic River and Inner Confluence areas have been identified as areas heavily used by finfish, and are designated fish runs (EOEA 1978). This compares favorably to the site ranking for trawl data (according to mean CPUE results), which indicated that the Chelsea and Mystic Rivers, and the Inner Confluence were relatively productive finfish sampling locations.

The relatively high CPUE at the Subaqueous E, Chelsea River, Mystic River and Inner Confluence stations may be influenced by the scaling factors used to standardize the five-minute tows at these stations to 20-minute tows. Carothers and Chittenden (1985) found that tow duration accounted for only a small proportion of the variability in otter trawl catches of demersal shrimp. Furthermore, although it is a standard practice, scaling CPUE from tows of shorter duration to a longer tow duration often overestimates the CPUE of the shorter tows (Carothers and Chittenden 1985). Therefore, the standardized CPUE from Subaqueous E, Chelsea, Mystic River, Inner Confluence, and Spectacle Island CAD stations may be overestimated.

With these limitations in mind, demersal fish habitat quality is probably greatest at Boston Lightship. REMOTS sampling indicated that this area has a well developed benthic community and is heavily bioturbated. The CPUE at Subaqueous E, Chelsea River, Mystic River and Inner Confluence stations may be an artifact of the scaling factors used; however, Chelsea River, Mystic River and Inner Confluence appear to provide habitat for juvenile winter flounder. REMOTS sampling indicated that the benthic community in these areas was in an indeterminate successional stage, with homogeneous muddy sediments and little bioturbation. Demersal fish CPUE was lowest at Spectacle Island CAD and Subaqueous E where the REMOTS sampling indicated that the benthic community was well-developed, similar to Boston Lightship.

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APPENDIX A

FIGURES

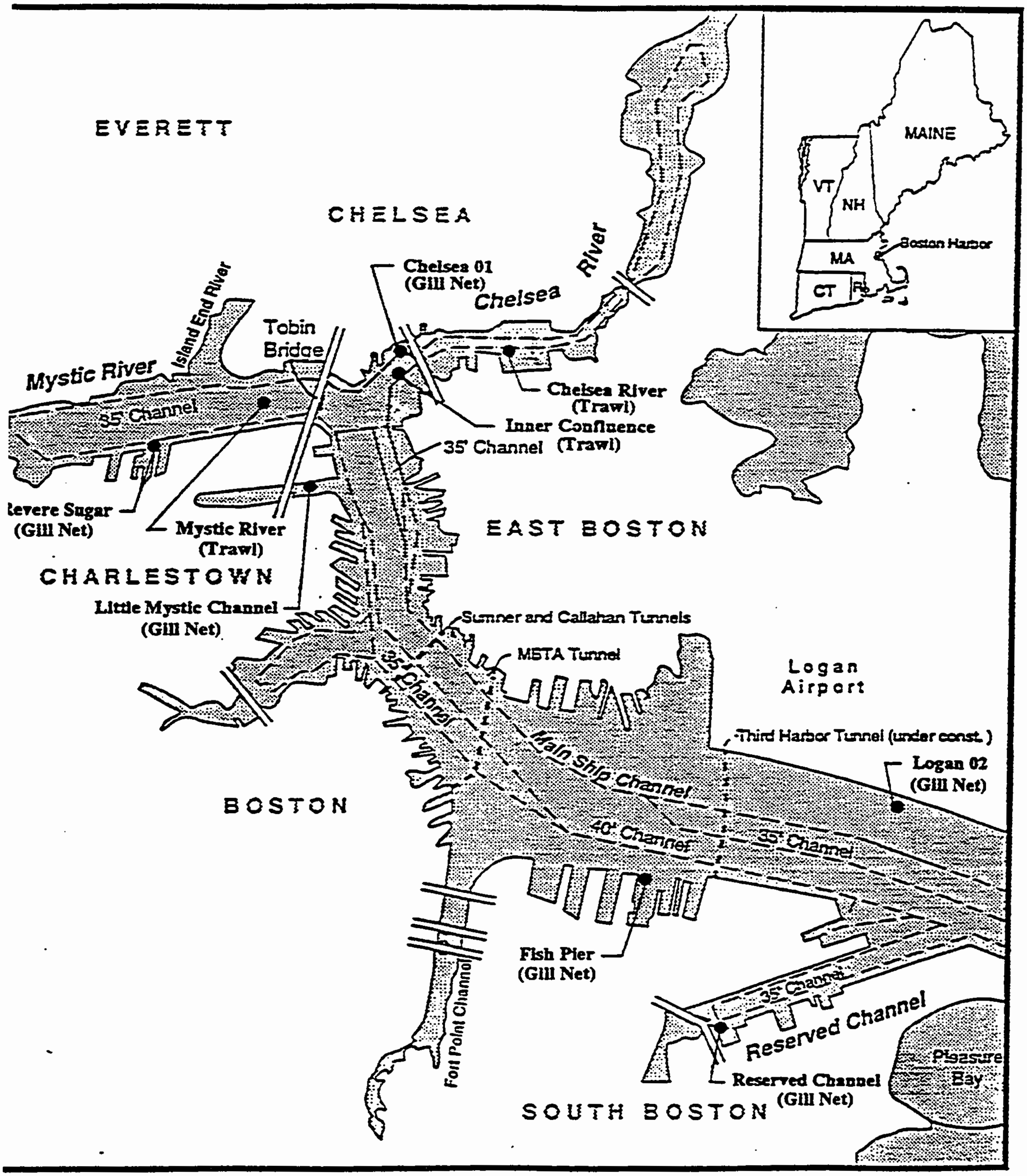

Figure 1. Finfish sampling locations in inner Boston Harbor, October 1994.

Source: New England Division, Corps of Engineers

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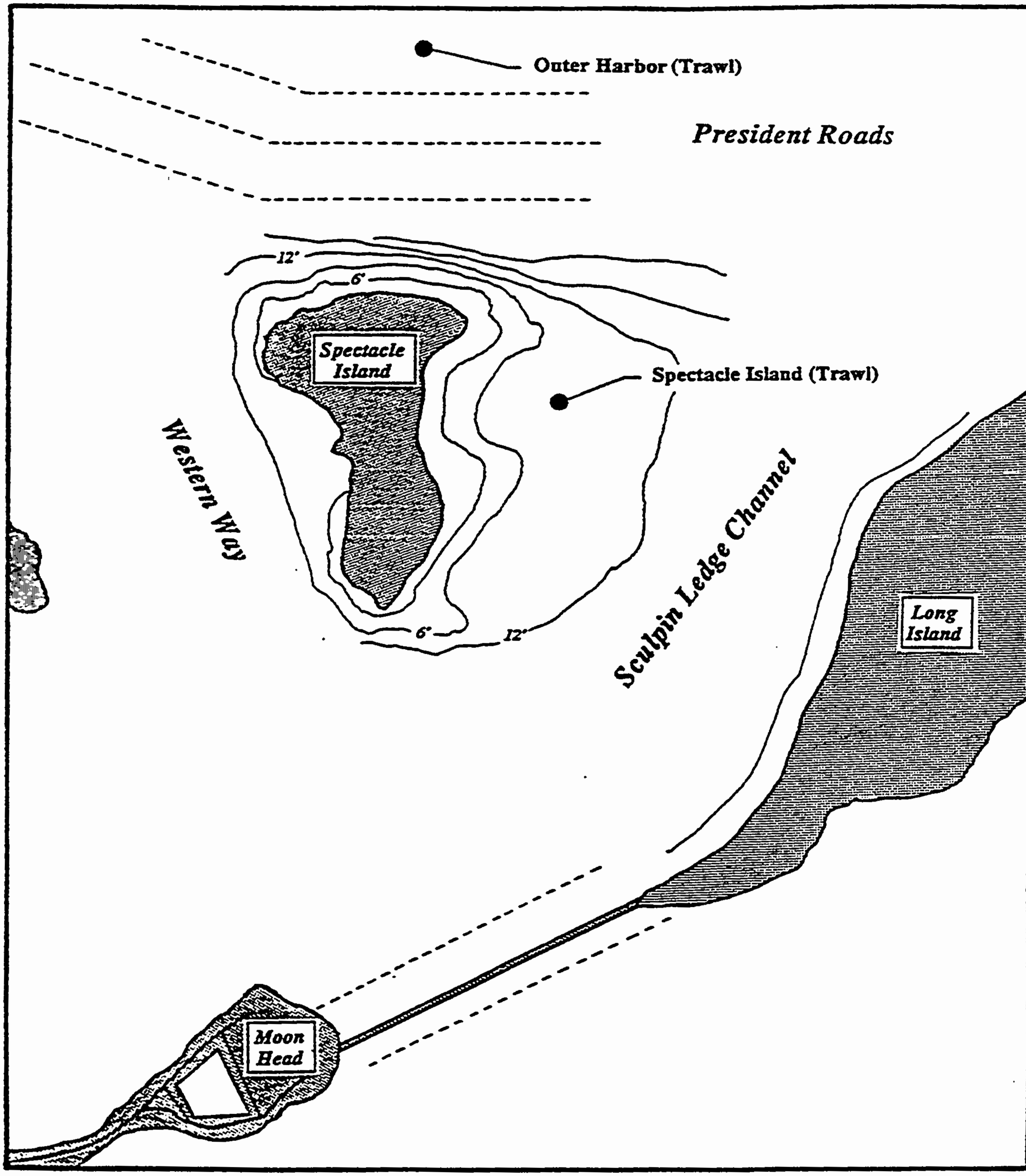


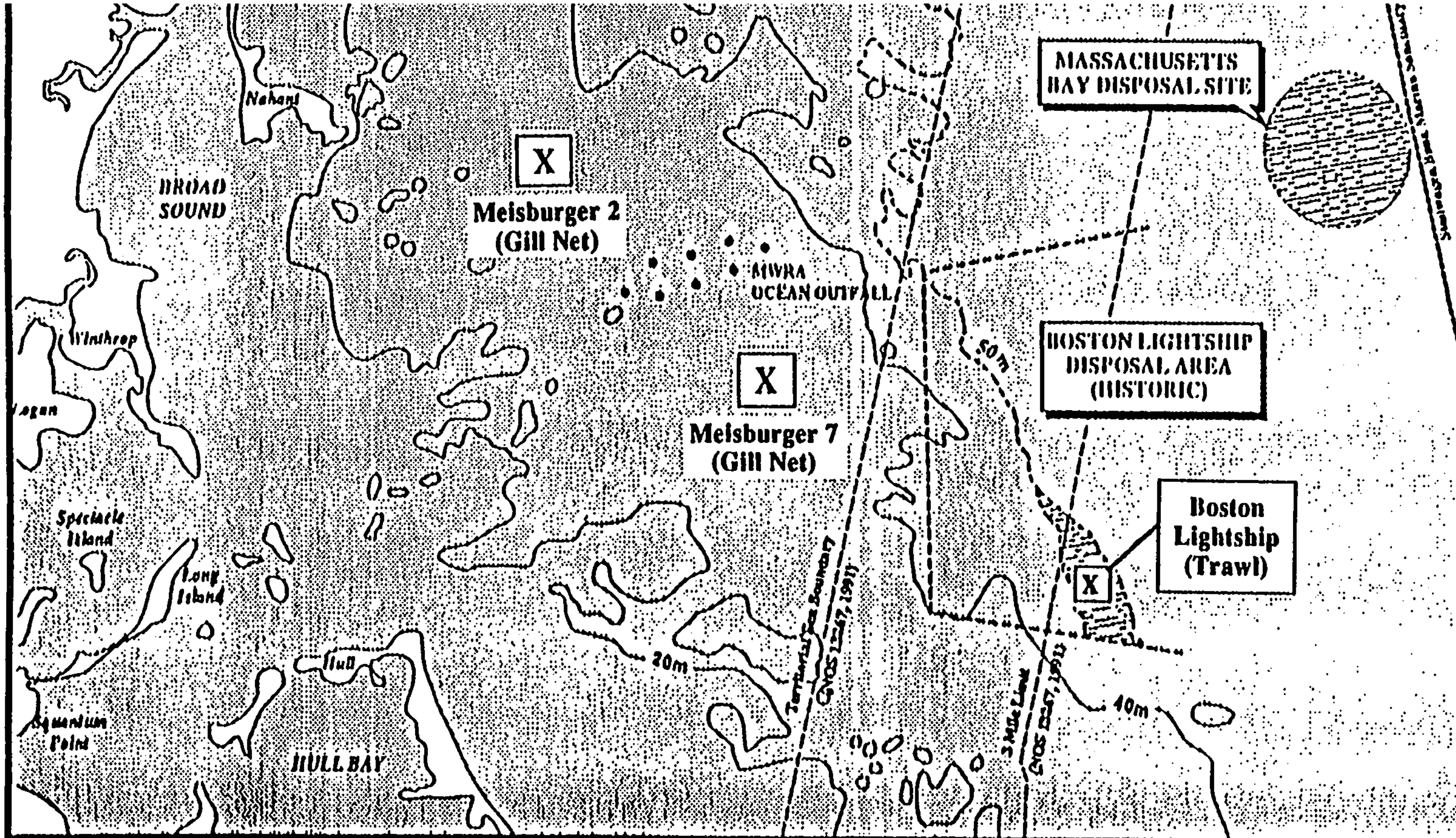
Figure 2. Finfish sampling locations in outer Boston Harbor, October 1994.

Scale:
Scale in Yards
500 0 1000

Source:
NOS Chart No. 13270
Sediment Classifications from Cortell 1990.

374

400



Depositional substrates within the disposal sites.

*BLDS approximate proposed disposal location = 42° 19' N 70° 40' W

Meisburger 2 approximate location = 42° 25' N 70° 50' W

Meisburger 7 approximate location = 42° 21' N 70° 47' W

Figure 3. Finfish sampling locations in Massachusetts Bay, October 1994.

Scale:

Source: Boston Harbor Navigation Chart

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APPENDIX B

TABLES

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TABLE 1. REPRESENTATIVE FINFISH SPECIES LIST BOSTON INNER AND OUTER HARBOR

Common Name	Scientific Name
Alewife	*Alosa pseudoharengus*
American eel	*Anguilla rostrata*
American sandlance	*Ammodytes americanus*
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*
Fourspine stickleback*	*Apeltes quadracus*
Grubby	*Myoxocephalus aeneus*
Hake	*Urophycis* sp.
Little skate	*Raja erinacea*
Longhorn sculpin*	*Myoxocephalus octodecemspinosus*
Lumpfish	*Cyclopterus lumpus*
Mummichog*	*Fundulus heteroclitus*
Ninespine stickleback*	*Pungitius pungitius*
Northern pipefish	*Syngnathus fuscus*
Ocean pout	*Macrozoarces americanus*

TABLE 1. REPRESENTATIVE FINFISH SPECIES LIST BOSTON INNER AND OUTER HARBOR (continued)	
Pollock	*Pollachius virens*
Rainbow smelt	*Osmerus mordax*
Red hake	*Urophycis chuss*
Sea snail	*Liparis atlanticus*
Sea raven	*Hemitripterus americanus*
Searobin	*Prionotus* sp.
Sculpin	*Myoxocephalus* sp.
Shad	*Alosa sapidissima*
Silver hake	*Merluccius bilinearis*
Smooth flounder*	*Liopsetta putnami*
Spiny dogfish	*Squalus acanthias*
Striped anchovy	*Anchoa hepsetus*
Striped bass	*Morone saxatilis*
Striped killifish*	*Fundulus majalis*
Threespine stickleback*	*Gasterosteus aculeatus*
Weakfish	*Cynoscion regalis*
Windowpane*	*Scophthalmus aqousus*
White perch	*Morone americana*
Winter flounder*	*Pseudopleuronectes americanus*
Winter skate	*Raja ocellata*
Yellowtail flounder*	*Limanda ferruginea*

* Indicates fish species that are most likely to frequent shallow water areas.

Source: Massachusetts Port Authority, March 1980 and modified by Jason M. Cortell and Associates Inc.

Table 2. 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	1.6
ATLANTIC COD	0.0	5.3	0.0	0.0	0.0	0.0	5.3	1.5
ATLANTIC MOONFISH	0.0	0.0	0.0	0.0	5.3	0.0	5.3	1.5
ATLANTIC SILVERSIDE	0.0	9.3	1.3	1.3	2.7	0.0	14.7	4.2
ATLANTIC TOMCOD	0.0	0.0	0.0	0.0	10.7	16.0	26.7	7.6
BUTTERFISH	4.0	0.0	0.0	0.0	0.0	0.0	4.0	1.1
CUNNER	0.0	0.0	0.0	0.0	1.3	0.0	1.3	0.4
GRUBBY	0.0	0.0	0.0	1.3	0.0	2.7	4.0	1.1
HAKE SP.	1.7	0.0	0.0	0.0	0.0	0.0	1.7	0.5
LOBSTER	37.7	14.7	6.7	2.7	0.0	4.0	65.7	18.8
LONGHORN SCULPIN	0.7	0.0	0.0	0.0	0.0	0.0	0.7	0.2
RAINBOW SMELT	0.0	10.7	4.0	4.0	2.7	0.0	21.3	6.1
SCUP	0.0	0.0	0.0	0.0	9.3	0.0	9.3	2.7
SHORTHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	1.3	1.3	0.4
SILVER HAKE	0.7	0.0	0.0	0.0	0.0	0.0	0.7	0.2
SKATE SP.	0.0	20.0	6.7	1.3	0.0	1.3	29.3	8.4
STRIPED BASS	0.0	1.3	0.0	0.0	0.0	0.0	1.3	0.4
WINDOWPANE	0.0	1.3	0.0	5.3	0.0	0.0	6.7	1.9
WINTER FLOUNDER	17.7	20.0	9.3	22.7	26.7	46.7	143.0	40.9
YELLOWTAIL FLOUNDER	1.7	0.0	0.0	0.0	0.0	0.0	1.7	0.5
STATION TOTAL	64.3	82.7	28.0	40.0	62.7	72.0	349.7	.
PERCENT STATION-COMPOSITION	18.4	23.6	8.0	11.4	17.9	20.6	.	100.0

* Five minute tows standardized to 20-minute tows.

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Table 3. Length frequency distribution for Winter flounder in Boston Harbor and Massachusetts Bay, October 1994.

LENGTH GROUP (mm)	STATION						
	BOSTON-LIGHTSHIP	SUBAQUEOUS-E	SPECTACLE-I. CAD	INNER-CONFLUENCE	MYSTIC-RIVER	CHELSEA-RIVER	SPECIES-TOTAL
65-69	.	1	.	.	.	1	2
70-74	.	1	.	.	.	.	1
75-79	.	1	.	.	.	.	1
80-84	.	1	.	1	.	.	2
95-99	.	1	.	.	.	.	1
100-104	.	1	.	.	1	.	2
105-109	.	.	.	.	.	1	1
115-119	.	1	.	.	.	1	2
120-124	.	.	1	.	.	1	2
125-129	.	.	.	.	.	1	1
130-134	.	1	.	.	2	2	5
135-139	.	.	1	.	1	.	2
140-144	.	.	.	.	1	1	2
155-159	.	.	.	1	.	1	2
160-164	.	.	.	.	.	1	1
170-174	.	.	.	.	.	1	1
175-179	.	.	.	1	.	1	2
180-184	.	.	.	1	.	.	1
185-189	.	.	.	.	1	3	4
190-194	.	.	.	1	3	1	5
195-199	.	.	.	1	1	1	3
200-204	1	.	.	1	.	1	3
205-209	2	.	.	.	.	3	5
210-214	2	.	.	1	1	2	6
215-219	2	1	.	4	2	3	12
220-224	4	.	.	1	1	.	6
225-229	1	.	.	1	1	2	5
230-234	4	.	.	.	1	1	6
235-239	2	.	.	1	1	2	6
240-244	2	.	.	.	.	.	2
245-249	5	.	.	.	.	.	5
250-254	1	.	.	.	1	.	2
255-259	3	.	.	.	1	.	4
260-264	3	.	.	.	.	.	3
265-269	1	.	.	1	1	2	5
270-274	4	.	.	.	.	.	4
275-279	2	1	.	.	.	1	4
280-284	3	.	.	.	.	1	4
285-289	3	1	1	.	.	.	5
295-299	3	.	.	.	.	.	3
300-304	.	.	1	.	.	.	1
305-309	2	3	.	.	.	.	5
310-314	1	.	.	.	.	.	1
320-324	.	.	1	.	.	.	1

(CONTINUED)

380

1106

Table 3. (Continued)

LENGTH GROUP (mm)	STATION						
	BOSTON-LIGHTSHIP	SUBAQUEOUS-E	SPECTACLE-I. CAD	INNER-CONFLUENCE	MYSTIC-RIVER	CHELSEA-RIVER	SPECIES-TOTAL
330-334	1	.	.	.	.	.	1
350-354	.	.	1	.	.	.	1
355-359	1	.	.	.	.	.	1
365-369	.	1	.	.	.	.	1
370-374	.	.	.	1	.	.	1
380-384	.	.	1	.	.	.	1
TOTAL	53	15	7	17	20	35	147
MEAN LENGTH	247	180	263	202	187	182	212
STANDARD DEVIATION	34	106	103	56	46	51	64

Table 4. Length frequency distribution for Atlantic tomcod in Boston Harbor and Massachusetts Bay, October 1994.

LENGTH (mm)	STATION		
	MYSTIC-RIVER	CHELSEA-RIVER	SPECIES-TOTAL
116	1	-	1
117	1	-	1
130	-	1	1
134	1	-	1
145	1	-	1
151	2	-	2
153	-	1	1
157	-	3	3
158	-	1	1
160	1	-	1
161	1	-	1
173	-	1	1
180	-	3	3
182	-	1	1
188	-	1	1
TOTAL	8	12	20
MEAN LENGTH	142	166	157
STANDARD DEVIATION	18	17	21

382

ILn8

Table 5. Length frequency distribution for Rainbow smelt in Boston Harbor and Massachusetts Bay, October 1994.

LENGTH (mm)	STATION				
	SUBAQUEOUS-E	SPECTACLE-I. CAD	INNER-CONFLUENCE	MYSTIC-RIVER	SPECIES-TOTAL
71	-	-	-	1	1
89	-	-	1	-	1
96	1	-	-	-	1
99	-	1	-	-	1
100	1	-	-	-	1
102	1	-	-	-	1
103	1	-	-	-	1
105	1	-	2	-	3
106	-	1	-	-	1
111	-	1	-	1	2
116	1	-	-	-	1
120	1	-	-	-	1
121	1	-	-	-	1
TOTAL	8	3	3	2	16
MEAN LENGTH	108	105	100	91	104
STANDARD DEVIATION	10	6	9	28	12

Table 6. Length frequency distribution for Skate sp. in Boston Harbor and Massachusetts Bay, October 1994.

LENGTH (mm)	STATION				
	SUBAQUEOUS-E	SPECTACLE-I. CAD	INNER-CONFLUENCE	CHELSEA-RIVER	SPECIES-TOTAL
107	1	.	.	.	1
337	1	.	.	.	1
394	1	.	.	.	1
440	1	.	.	.	1
460	1	.	.	.	1
479	1	.	.	.	1
489	1	.	.	.	1
495	.	.	.	1	1
499	1	.	.	.	1
505	.	.	1	.	1
509	.	1	.	.	1
511	.	1	.	.	1
512	.	1	.	.	1
513	.	1	.	.	1
525	.	1	.	.	1
526	1	.	.	.	1
533	1	.	.	.	1
536	2	.	.	.	2
542	1	.	.	.	1
546	1	.	.	.	1
553	1	.	.	.	1
TOTAL	15	5	1	1	22
MEAN LENGTH	465	514	505	495	479
STANDARD DEVIATION	117	6	.	.	98

384

410

Table 7. Length frequency distribution for Scup in Boston Harbor and Massachusetts Bay, October 1994.

LENGTH (mm)	STATION	
	MYSTIC-RIVER	SPECIES-TOTAL
78	1	1
81	1	1
82	1	1
90	1	1
95	1	1
102	1	1
109	1	1
TOTAL	7	7
MEAN LENGTH	91	91
STANDARD DEVIATION	12	12

ihl

Table 8. 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 9. SEASONAL CATCH PER UNIT EFFORT AT FIVE STATIONS IN BOSTON HARBOR DURING 1993.

	SPECTACLE ISLAND				GOVERNORS ISLAND				RESERVED CHANNEL			
	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall
Winter Flounder	0	10	11	3	5	7	9	10	3	67	1	116
Total Fish	1	26	19	19	7	10	15	26	16	70	1	205
Number of Tows	3	3	3	3	3	3	3	3	3	3	3	3
Total Catch per 10-Minute Tow	0.3	8.7	6.3	6.3	2.3	3.3	5.0	8.7	5.3	23.3	0.3	68.3

	AQUARIUM				CHARLES RIVER			
	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall
Winter Flounder	7	13	5	69	1	1	8	112
Total Fish	7	18	10	79	1	2	19	235
Number of Tows	3	3	3	3	3	3	3	3
Total Catch per 10-Minute Tow	2.3	6.0	3.3	26.3	0.3	0.7	6.3	78.3

Sources: ENSR (1993a, 1993b, 1993c, 1994a)

TABLE 10. FISHERIES DATA AT FIVE STATIONS IN BOSTON HARBOR ASSOCIATED WITH THE CA/T BOSTON HARBOR WATER-QUALITY MONITORING PROGRAM DURING 1993 AND 1994.

	STATION[a]					TOTAL
SPECIES	SI	GI	RC	AQ	CH	FISH
Alewife					7	7
Atlantic cod			2		2	4
Atlantic mackerel					2	2
Atlantic tomcod		28	4		9	41
Blueback herring			29		2	31
Fourspot flounder			1			1
Little skate	23	4	6	2		35
Longnose cusk eel			1			1
Lumpfish	4	4				8
Moustache sculpin		1				1
Ocean perch		1	1	1	2	5
Rainbow smelt	4		9	5	111	129
Red hake		1	18			19
Rock gunnel	2	9				11
Sea robin	8			1		9
Shorthorn sculpin	1	23	57	8	9	98
Tautog					1	1
Windowpane	6	2	9	8	5	30
Winter flounder	43	82	281	141	272	819
Total Fish Collected	91	155	418	166	422	1252
Number of Tows	18	21	21	21	21	
Catch per 10-Minute Tow	5.1	7.4	19.9	7.9	20.1	

[a]SI = Spectacle Island, GI = Governor's Island, RC = Reserved Channel, AQ = Aquarium, CH = Charles River.

Sources: ENSR 1993a,b,c; 1994a,b,c; 1995.

TABLE 11. NUMBER OF FISH, SQUID AND LOBSTERS CAPTURED, AND CATCH PER 20 MINUTE TOW, FOR THE SIX MASSACHUSETTS DIVISION OF MARINE FISHERIES FALL GROUNDFISH SURVEY SAMPLES TAKEN IN MASSACHUSETTS BAY WATERS LESS THAN 15 m DEEP, 1989 THROUGH 1993.

SPECIES	NUMBER PER YEAR		TOTAL NUMBER CAPTURED (1989-1993)	NUMBER PER 20 MINUTE TOW
	MINIMUM	MAXIMUM		
American Lobster	91	5,136	6,624	1,104.0
Atlantic cod	1	195	232	38.7
Atlantic herring	0	4	5	0.8
Atlantic mackerel	0	2	3	0.5
Blueback herring	0	4	4	0.7
Butterfish	0	739	897	149.5
Cunner	0	1	1	0.2
Little skate	24	400	850	141.7
Longhorn sculpin	0	5	6	1.0
Longfin squid	0	7,932	9,372	1,562.0
Lumpfish	0	1	1	0.2
Northern pipefish	0	1	1	0.2
Ocean pout	0	1	1	0.2
Rainbow smelt	0	71	109	18.2
Red hake	0	54	54	9.0
Rock gunnel	0	1	1	0.2
Sea raven	0	1	1	0.2
Silver hake	0	50	57	9.5
Spiny dogfish	0	1	1	0.2
White hake	0	5	6	1.0
Windowpane	1	97	203	33.8
Winter flounder	36	135	391	65.2
Winter skate	0	155	279	46.5
Yellowtail flounder	0	10	20	3.3
TOTAL			19,119	3,186.5

APPENDIX F - WATER QUALITY MODELING REPORT

Modeling Results to Assess Water Quality Impacts from Dredged Material Disposal Operations for the Boston Harbor Navigation Improvement Project

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asa

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1. INTRODUCTION

The U.S. Army Corps of Engineers (USCOE) and the project's local sponsor, the Massachusetts Port Authority, have proposed to dredge portions of Inner Boston Harbor to improve navigational conditions in the harbor. As part of the EIR/S process, Applied Science Associates (ASA) was tasked to estimate the water quality impacts of these operations through the use of computer models which predict the transport and fate of pollutants in the dredged material.

The proposed dredging plan encompasses four areas in the Inner Harbor: the Mystic and Chelsea Rivers, the Inner Confluence and the Reserved Channel area (Figure 1.1). Both channel and berth areas are to be dredged. Approximately 1.1 x 10^6 yd^3 (840,000 m^3) of maintenance (silt) material are scheduled to be removed after which the channel will be deepened to 40 ft (12.2 m). The modeling analysis deals with the transport and fate of the silt materials only.

Disposal of the dredged material is proposed to be at one or more alternative sites in Boston Harbor or offshore (Figure 1.2). One option is to overdredge the Mystic and Chelsea Rivers and the Inner Confluence to a depth from 45 ft (13.7m) to 70 ft (21.3 m), depending on the area, and place the silt material into the resulting disposal cells. Other alternatives include creating a subtidal borrow pit on the east side of Spectacle Island or disposal at one of the offshore sites: Meisberger 2 and 7. Filling subaqueous depressions in the outer harbor, at the subaqueous E and B sites, is also being considered. Disposal at the Boston Light Ship Disposal Site was addressed in the DEIS (with the ADDAMS model [Johnson, 1990]) but was not repeated for the FEIS.

The modeling effort uses three computer models. The first is the USCOE STFATE model, also known as the ADDAMS model (Johnson, 1990) which simulates single releases of material in an unbounded region with steady flow and tracks the evolution of the resulting plume as it sinks through the water column, contacts the bottom and is dispersed. The model is designed to predict bottom accumulation of material and to predict the size and extent of a tracer cloud of stripped material in open water.

The ASA WQMAP model system (Mendelsohn et al, 1995) estimates the far field distribution of pollutants based on time and space varying currents which occur at the harbor sites. The system consists of a hydrodynamic model which predicts the currents in Boston

Harbor as a result of tides and river flow and a pollutant transport model which predicts the concentration levels throughout the harbor over time. The model utilizes a settling velocity and loss rate depending on the specific constituent being modeled.

The USCOE LTFATES model system (Scheffner et al, 1994) estimates the long term stability of a dredged material mound on the ocean bottom. The model is driven by local wind and current conditions, either in a climatological or storm event mode. It handles both cohesive and noncohesive sediments. Model output consists of bathymetric changes over time.

This report summarizes the water quality concentration levels and mixing zones estimated from the model applications as a result of both dredging and disposal operations. The focus is on the results from the WQMAP system which predicts concentration levels over time in the water column of constituents from the dredged material. The constituents examined include total suspended sediment (TSS), copper (Cu), mercury (Hg), polychlorinated biphenyls (PCB) and a polynuclear aromatic hydrocarbon (PAH) congener, naphthalene. These parameters were chosen for a variety of reasons: elevated concentrations in the sediments compared with low water quality criteria (i.e. when in the dissolved phase), potential toxicity, or potential interference with natural biological processes (i.e. TSS).

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2. MODEL INPUTS

2.1 Model System Description

WQMAP predicts the far field levels of dredged material constituents and requires the use of two models: a hydrodynamic model to predict the currents and a pollutant transport model to predict the resulting concentrations of material. Both models use a boundary fitted finite difference approach which matches the model coordinates with the shoreline boundaries of the water body. This approach is consistent with the highly variable geometry of Boston Harbor. The boundary fitted method uses a set of coupled quasi-linear elliptic transformation equations to map an arbitrary horizontal multi-connected region from physical space to a rectangular mesh structure in the transformed horizontal plane (Spaulding, 1984). The three dimensional conservation of mass, momentum equations and constituent, with approximations suitable for lakes, rivers, and estuaries (Swanson, 1986; Muin and Spaulding, 1993) that form the basis of the model, are then solved in this transformed space. In addition an algebraic transformation is used in the vertical to map the free surface and bottom onto coordinate surfaces (Gordon, 1982).

The resulting hydrodynamic equations are solved using an efficient semi-implicit finite difference algorithm for the exterior mode (two dimensional vertically averaged) and by an explicit finite difference leveled algorithm for the vertical structure of the interior mode (three dimensional) (Madala and Piascsek, 1977; Swanson, 1986). The resulting constituent transport equations are solved using an explicit finite difference algorithm on the same grid and timestep as the hydrodynamic model. A detailed description of the models with associated test cases is found in Muin and Spaulding (1993).

Figure 2.1 shows the grid of quadrilaterals covering the entire Boston Harbor and Figure 2.2 shows the finer grid utilized for the Inner Harbor. Each model requires an input data set which is explained below. A third simple square grid was used to simulate the offshore site known as Meisberger.

The models are three dimensional but were run in a vertically averaged mode for this application for the following reasons. The observed stratification (DWPC, 1985; Dallaire, 1990), seen in the upper reaches of the harbor is due to the thin (~1 m) surface lenses of freshwater which do not appreciably affect the water column. The dredging operations would inject material from the bottom to the surface so the entire water column is effected at the same time. The disposal operation would inject material below this surface lense due to the draft of the barge.

2.2 Hydrodynamic Model

The hydrodynamic model calculates the currents and free surface elevation. For this application the vertically averaged currents were predicted. The model requires information on tidal forcing at the open boundary and river flow into the area since both influence flushing in the harbor.

The tidal constituents for the open boundary extending from Hull to Outer Brewster Island to Nahant are required. For this simulation a composite tide with a mean amplitude of 1.465 m (4.8 ft) and a period of 12.42 hrs (M_2) was used (NOAA, 1994).

The river flow used for this simulation consisted of the annual mean flows of the Mystic River (2.4 m^3/s), the Charles River (12.3 m^3/s) and the Neponset River (5.3 m^3/s) for a total average flow of 20 m^3/s (Alber and Chan, 1994).

A summary of input values is provided in Table 2.1.

Table 2.1 Model input parameters

Parameter	Value
Run Time	5 to 30 days
Time Step	465.75 to 621 sec
Quadratic Bottom Drag Coefficient	0.001
Horizontal Diffusity	0.10 m^2/s
Model Grid Dimensions	
Inner Harbor Grid	100 by 99
Greater Harbor Grid	59 by 98
Offshore Grid	21 by 101

2.3 Pollutant Transport Model

The pollutant transport model calculates the concentration of a pollutant on the same grid as the hydrodynamic model. The model requires information on the material source strength, the settling velocity, if any, and the loss rate, if any. Each input value is discussed generally and then, later in the section, specifically for each constituent. A summary of model parameters used for each model run is presented later in this section.

Source Strength

The source strength is the amount of pollutant entering the system on a rate basis (mg/s). The source strength can be assumed to be an instantaneous release to the water column, a constant release over time, or a variable release over time. Multiple locations can be input.

The instantaneous source can be assumed to be the amount of material released to the water column from one barge release. The constant source is the mean loading to the water column from multiple barge releases. The variable source is the time varying loading to the water column as individual barge releases occur according to a set time schedule.

The Corps of Engineers (COE) disposal plan estimates that over the entire construction period of 440 days, an average disposal rate of 3000 yd^3 per day will be necessary to dispose of all the silt dredged material. The parent (clay) material will be dredged during the same period and would need to average 4,200 yds^3 per day. Due to construction sequences to produce subaqueous disposal cells, an average disposal rate of approximately 6,000 yds^3/day for silt may be necessary to account for days when only clay is dredged or other construction activities are required.

The amount of pollutant released from the disposal of dredged material can be estimated based on the elutriate concentration (EPA, 1991). Elutriate testing results are reported on a mass of pollutant to volume of water basis (mg/L). Based on the COE SFATES modeling approach (EPA, 1991; Johnson, 1990), the amount of pollutant released is the triple product of the elutriate concentration, the liquid fraction of the sediment and the total sediment volume released. For instance, with an elutriate concentration of 10 ppb (10 µg/L), a typical liquid fraction of 0.55 and a 3000 yd^3 release, the amount of pollutant released is

$$M = (10.\ \mu g/L)\ (0.55)\ (3000\ yd^3)\ (10^3 L/m^3)\ (0.7646\ m^3/yd^3)\ (g/10^6 \mu g) = 12.616\ g$$

On a continuous loading basis the rate is

$$R = (12.616\ g/day)\ (day/86400\ s)\ (10^3\ mg/g) = 0.146\ mg/s$$

It should be noted that, for all parameters, dredge site water was utilized in the elutriate tests, so the elutriate concentrations include this "ambient" portion.

Fall Velocity

The fall velocity acts as a mechanism to remove suspended sediment from the water column. It varies with the type (cohesive or noncohesive) of material and particle size. For noncohesive sediments the following table shows fall velocity as a function of material type. This information was taken from the ADDAMS user's manual and shown in Table 2.2. For cohesive sediments the fall velocity is a function of the concentration of sediment in the water column. For natural detritus in the water column a typical range is 0.8 to 1.0 m/day (3.9 to 8.1×10^{-6} m/s).

Table 2.2 Fall velocities for various materials.

Material	Fall Velocity (ft/s)	Fall Velocity (m/day)	Fall Velocity (m/s)
Clumps	3.0	79000.	0.91
Sand	0.1	2600.	0.030
Silt	0.01	260.	0.0030
Clay	0.002	53.	0.00061
Natural Detritus	2.8×10^{-6}- 3.5×10^{-6}	0.8 - 1.0	3.9×10^{-6} - 8.1×10^{-6}

Loss Rate

A loss rate, defined as the rate of decay or transformation of a constituent, was calculated to account for loss of the constituent from the dissolved phase and ultimately it loss from the water column, to reflect natural conditions. This value is expressed in units of reciprocal time. The half life is the time it takes for a constituent to degrade to one half of its initial concentration. It is related to the loss rate by

$$\tau = 0.693/k$$

where τ is the half life and k is the loss rate.

2.3 Modeled Constituents

Total Suspended Sediment (TSS)

Material is released to the water column during both dredging and disposal operations. 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%). During disposal operations, most of the dredged material falls to the bottom relatively quickly with some small fraction stripped from the falling cloud. The ADDAMS model user's manual (Johnson, 1990) suggests that 3 to 5% of the sediment volume is stripped from the plume in water depths of 100 ft (30 m) or less.

The amount of TSS released to the water column can be estimated as:

M = (Dredged volume) (Solid fraction) (Released fraction) (Sediment density)

Table 2.3 summarizes the release amount of TSS under different volumes, released fractions and release times. The solid fraction of 45% is suggested by the USCOE NED (Tom Fredette, COE, personal communication) and the sediment density from the STFATE model description of sediment characteristics (Johnson, 1990). A typical barge volume is 3000 yds^3.

Table 2.3 TSS release rates as a function of dredged volume, solid fraction, released fraction, sediment density, release amount and release time.

Dredged Volume (yd^3)	**Solid Fraction (%)**	**Released Fraction (%)**	**Sediment Density (g/cm^3)**	**Release Amount (kg)**	**Release Time (s)**	**Release Rate (kg/s)**
3000	45	3	2.65	82061	-	-
3000	45	5	2.65	136768	-	-
6000	45	3	2.65	164122	-	—
6000	45	5	2.65	273536	-	-
3000	45	2	2.65	54707	86400	0.63319
6000	45	2	2.65	109415	86400	1.26637

For the model runs, it was assumed that the release from dredging operations was continuous. The fall velocity was chosen as either 3.048 x10^{-3} m/s (silt) or 6.096 x 10^{-4} m/s (clay (parent)] as shown in Table 2.2. For disposal operations of silt, two scenarios were assumed: that a continuous release occurs or that multiple instantaneous releases periodically occur.

Copper (Cu)

The calculation of Cu loading from dredged material disposal operations was based on the elutriate test results. Elutriate testing was performed on a series of samples taken from the Mystic and Chelsea Rivers and the Inner Confluence (COE, 1986). The results showed a maximum value of 3 ppb at Location B (rep R1) in the Reserved Channel. All other values were <1.0 ppb except for one value of 1 ppb. It was assumed that no settling occurs nor was there any loss rate.

Mercury (Hg)

The calculation of Hg loading was also based on the elutriate test results (COE, 1986). The test results showed a maximum value of 1.6 ppb at Location F (rep R1) in the Chelsea River. Other values ranged from <0.5 to 1.4 ppb.

A Hg loss rate was calculated based on a technical memo from Wade Research, Inc. (Appendix 1). A set of half lives for winter and summer months was calculated from the literature which were converted to loss rates shown in Table 2.4. No settling velocity was assumed.

Table 2.4 Variation of loss rate and half life for mercury (Hg) by season.

Season	Half Life (days)	Mean Half Life (days)	Loss Rate (sec^{-1})
Winter	10 - 20	15	$5.3472x10^{-7}$
Summer	2 - 3	2.5	$3.2083x10^{-6}$

Polychlorinated Biphenyls (PCB)

The calculation of PCB loads from dredged material disposal operations was also based on the elutriate test results from the Mystic and Chelsea Rivers and the Inner Confluence (COE, 1986). The results showed a maximum average value of 2.28 ppb from the Mystic River. This material includes approximately 278,800 yd^3 or 25% of the total silt material. The remaining 75% of the silt material (approximately 820,000 yd^3) was assumed to have a mean elutriate concentration of 0.15 ppb, based on results from the Chelsea River and the Federal Channel. No loss functions were assumed although some do exist.

Naphthalene

The calculation of naphthalene loads from dredged material disposal operations was based on the analysis performed by Wade (1995) relying on recent MASSBAY data as well as other published data. A water column concentration estimate was developed from measurements of sediment concentration.

Table 4 of Wade (1995) presented a set of calculated mean water column concentrations for naphthalene at six sites in Boston Harbor. These estimates were calculated from potential re-equilibration of the sediments with the surrounding water. The highest naphthalene concentration, 2.69×10^{-2} mg/L, was estimated to be found in the Federal Channel in the Chelsea River.

Table 2.5 summarizes the continuous and instantaneous release rates for the various constituents in the sediments. The Cu, Hg and PCB constituent loadings were based on elutriate concentrations. Naphthalene was based on a re-equilibration calculation and TSS was based on the actual solids volume release.

Table 2.5 Continuous and instantaneous release rates for various constituents based on 3000 yds^3.

Material	Elutriate Concentration (ppb)	Continuous Release Rate (mg/s)	Instantaneous Release Rates (mg)
TSS (dredging)	-	633.19	-
TSS (disposal)	-	-	136768
Copper	1.0	0.01460	63075.
Copper	3.0	0.04380	189227.
Mercury	0.5	0.00730	31538.
Mercury	1.6	0.02336	100921.
PCB	0.15	0.0000444	189.2385
PCB	2.28	0.0006658	2876.425
Naphthalene	26.9*	0.39279	169695.

* Based on re-equilibration calculation.

3. MODELING RESULTS

The model system was run for a series of constituents, release scenarios and disposal sites. Three sets of runs were made: a continuous loading scenario for all constituents and harbor sites, an instantaneous loading scenario for all constituents and harbor disposal sites and a mixing zone analysis using both continuous loading from dredging operations and instantaneous loading from disposal operations at all disposal sites for TSS and PCB. All results are presented as concentrations in excess of ambient levels. Ambient levels were derived from data reports and can be added to the "excess" values to derive a total predicted concentration.

3.1 Continuous Release Scenario

The first set of runs was a screening analysis using continuous loading. The disposal locations were chosen to be coincident to the four Boston Harbor disposal sites: the Inner Confluence, Spectacle Island, Subaqueous E and B. The model simulation time varied from 10 to 30 days, depending on how quickly the resulting concentration reached steady state.

A typical result is shown in Figure 3.1 for a TSS release in the Inner Confluence. The results show a thin ribbon of elevated concentration extending south from the site in the middle of the Inner Harbor channel and a more diffuse cloud north of the site extending into the confluence of the Mystic and Chelsea Rivers. Peak concentration was predicted to be 39 mg/L at this disposal site.

The results for all constituents and disposal locations are summarized in Table 3.1 which compares peak excess concentration (in the quadrilateral grid corresponding to the source location) to ambient conditions and chronic water quality criteria, if available. If material were to be released continuously (up to 3000 yd^3/day), no water quality criteria were predicted to be exceeded. This is shown by the final column which indicates no exceedance if the value is less than one.

3.2 Instantaneous Release Scenario

The next set of runs assumed that a 3000 yd^3 release of material occurred every noon. The disposal locations were again chosen to be coincident to the four Boston Harbor disposal sites: the Inner Confluence, Spectacle Island, Subaqueous E and B. The model simulation

Table 3.1 Modeled maximum excess constituent concentrations assuming a continuous source of dredged material disposed at the Boston Harbor alternative disposal sites compared with ambient concentrations and water quality criteria.

Material	Site	Maximum Excess Concentration[2]	Ambient (Shea, 1993) (pptr)	Water Quality Criteria (pptr)	Max + Amb / WQC
TSS	Inner Confluence	39 ppm[3]	8[5]	None	
TSS	Spectacle Island	15 ppm	8	None	
TSS	Subaqueous E	9.3 ppm	8	None	
TSS	Subaqueous B	7.3 ppm	8	None	
Cu	Inner Confluence	5.7 pptr[4]	300	2900 (acute)	0.105
Cu	Spectacle Island	1.1 pptr	300	2900 (acute)	0.104
Cu	Subaqueous E	0.69 pptr	300	2900 (acute)	0.104
Cu	Subaqueous B	0.56 pptr	300	2900 (acute)	0.104
Hg	Inner Confluence	3.2 pptr	4	25 (chronic)	0.288
Hg	Spectacle Island	0.83 pptr	4	25 (chronic)	0.193
Hg	Subaqueous E	0.46 pptr	4	25 (chronic)	0.178
Hg	Subaqueous B	0.37 pptr	4	25 (chronic)	0.175
PCB(75%/25%)[1]	Inner Confluence	0.71/11 pptr	7	30 (chronic)	0.257/0.600
PCB(75%/25%)	Spectacle Island	0.12/2.6 pptr	7	30 (chronic)	0.237/0.320
PCB(75%/25%)	Subaqueous E	0.096/1.5 pptr	7	30 (chronic)	0.237/0.283
PCB(75%/25%)	Subaqueous B	0.076/1.2 pptr	7	30 (chronic)	0.236/0.273
Naphthalene	Inner Confluence	86 pptr	0.4	2350000 (LOEL)[6]	3.7×10^{-5}
Naphthalene	Spectacle Island	24 pptr	0.4	2350000 (LOEL)	1.0×10^{-5}
Naphthalene	Subaqueous E	14 pptr	0.4	2350000 (LOEL)	6.1×10^{-6}
Naphthalene	Subaqueous B	12 pptr	0.4	2350000 (LOEL)	5.3×10^{-6}

1 25% is the Mystic River channel and berths silt volumes based on 2.28 ppb elutriate test results.
75% is the remainder of the project silt volumes based on 0.15 ppb elutriate test results.
2 Once steady state conditions are reached
3 ppm = parts per million = mg/L
4 pptr = parts per trillion = ng/L
5 Ambient TSS concentrations determined from Inner Harbor data reported in DWPC (1986) and Dallaire (1990)
6 Lowest Observed Effects Level

time varied from 10 to 30 days, depending on how quickly the resulting concentration reached steady state.

A typical time series of modeled concentrations is shown in Figure 3.2 for a TSS release in the Inner Confluence. The results show a narrow peak of elevated concentration which quickly drop down to a relatively low level. Peak concentration was estimated to be 1397 mg/L at this disposal site but dropped to a maximum of 3 mg/L after four hours.

The results for all constituents and disposal locations are summarized in Table 3.2 which compares modeled peak excess concentration after four hours to ambient conditions and acute water quality criteria, if available. No acute water quality criteria were predicted to be exceeded. This is shown by the final column which indicates no exceedance if the value is less than one.

3.3 Mixing Zone Analysis

The Massachusetts water quality certification process requires that a mixing zone, which defines the boundary where chronic water quality criteria are not violated, be established and that this zone not interfere with nor impact local natural resources. To address this issue a series of runs were made to determine the size of the mixing zone. This zone was calculated from model results by determining which model grids exceeded an excess concentration equal to greater than the appropriate water quality standard less the ambient water quality conditions.

Two constituents were identified for this analysis: TSS, since in high concentrations it can potentially interfere with natural biological processes, and PCB, which from the previous scenarios is the constituent most likely to exceed water quality criteria.

The ambient level of TSS was calculated from data (DWPC, 1986; Dallaire, 1990) to average 8 mg/L. The level of concern for TSS, although not an actual water quality criteria, was taken from previous projects as 50 mg/L. This leaves an allowable excess concentration of less than 42 mg/L. The ambient levels of PCBs were estimated by Shea (1993) to be 7 ng/L. Using a chronic criteria of 30 ng/L leaves an excess PCB concentration of less than 23 ng/L.

Release Scenario Description

A set of release scenarios was developed for the mixing zone analysis and are described below.

Table 3.2 Modeled maximum excess constituent concentrations from multiple instantaneous sources after four hours for each of the Boston Harbor alternative disposal sites compared with ambient concentrations and water quality criteria.

Material	Site	Maximum Excess Concentration After 4 hrs.	Ambient (Shea, 1993) (pptr)	Water Quality Criteria (pptr)	Max + Amb / WQC
TSS	Inner Confluence	13 ppm[2]	8[4]	None	
TSS	Spectacle Island	0.31 ppm	8	None	
TSS	Subaqueous E	0.70 ppm	8	None	
TSS	Subaqueous B	1.2 ppm	8	None	
Cu	Inner Confluence	26 pptr[3]	300	2900 (acute)	0.112
Cu	Spectacle Island	2.3 pptr	300	2900 (acute)	0.104
Cu	Subaqueous E	2.5 pptr	300	2900 (acute)	0.104
Cu	Subaqueous B	2.2 pptr	300	2900 (acute)	0.104
Hg	Inner Confluence	10 pptr	4	2100 (acute)	0.007
Hg	Spectacle Island	1.1 pptr	4	2100 (acute)	0.002
Hg	Subaqueous E	1.2 pptr	4	2100 (acute)	0.002
Hg	Subaqueous B	1.0 pptr	4	2100 (acute)	0.002
PCB(75%/25%)[1]	Inner Confluence	2.4/36 pptr	7	10000 (acute)	0.001/0.004
PCB(75%/25%)	Spectacle Island	0.24/3.6 pptr	7	10000 (acute)	0.001/0.001
PCB(75%/25%)	Subaqueous E	0.27/3.9 pptr	7	10000 (acute)	0.001/0.001
PCB(75%/25%)	Subaqueous B	0.22/3.2 pptr	7	10000 (acute)	0.001/0.001
Naphthalene	Inner Confluence	246 pptr	0.4	2350000 (LOEL)	1.0×10^{-4}
Naphthalene	Spectacle Island	20 pptr	0.4	2350000 (LOEL)	8.7×10^{-6}
Naphthalene	Subaqueous E	22 pptr	0.4	2350000 (LOEL)	9.5×10^{-6}
Naphthalene	Subaqueous B	19 pptr	0.4	2350000 (LOEL)	8.3×10^{-6}

1 25% is the Mystic River channel and berths silt volumes based on 2.28 ppb elutriate test results.
75% is the remainder of the project silt volumes based on 0.15 ppb elutriate test results.
2 ppm = parts per million = mg/L
3 pptr = parts per trillion = ng/L
4 Ambient TSS concentrations determined from DWPC (1986) and Inner Harbor data reported in Dallaire (1990)
5 Lowest Observed Effects Level

Dredging Scenario DSS

A portion estimated as 2% of the silt being dredged could be lost during the process of filling and raising the bucket through the water column (1.2%) and spillover from the scow (0.8%). This scenario was used in the analysis of the Central Artery dredging project (Tovalaro, 1984 cited in ENSR, 1991). The load was based on 6000 yd^3/day dredging and was assumed to be continuous since the dredging operation is continuous. A silt settling velocity of 0.003048 m/s was used.

Dredging Scenario DSC

This is the same as DSS except that a clay settling velocity of 0.0006096 m/s was used.

Disposal Scenario DS3000

This release scenario assumed that 3000 yd^3 was released at approximately every high tide. Since a tidal period is 12.42 hrs this works out to slightly less than two releases (i.e., 6000 yd^3) per day. This scenario was chosen after review of the USCOE draft dredging operations plan (Peter Jackson, personal communication).

Disposal Scenario DSMAX

Discussions with the USCOE determined that there would be periods when additional dredged material may have to be disposed. Periodically a two day period could occur where a total of 10,000 yd^3/day must be disposed. A worst case scenario was developed where 3000 yd^3 was disposed at each high tide (i.e., 6000 yd^3/day) for five days, then four subsequent 10000 yd^3/day releases of 6000 yd^3, 4000 yd^3, 6000 yd^3 and 4000 yd^3 all at high tide, then back to the 6000 yd^3/day release for seven days and finally two more days of 10,000 yd^3/day releases.

Total Suspended Sediments

The amounts of TSS for each release scenario areas follows:

DSS: A TSS silt loading rate of 1.26637 kg/s was used.

DSC: A TSS clay loading rate of 1.26637 kg/s was used.

DS3000: An instantaneous release at every high tide of 136767.8 kg (~6000 yd^3/day) of silt was used.

DSMAX: A variable instantaneous release was used based on 3000 yd^3 giving 136767.8 kg, 6000 yd^3 giving 273535.6 kg and 4000 yd^3 giving 182357.1 kg.

The mixing zone summary is given in Table 3.3 for the various scenarios and disposal sites. The peak concentration reported was that estimated immediately following the release at no time lag. The length and width of the mixing zone were maximum estimates scaled from the computer generated figures while the mixing zone area was automatically determined. It is seen that the dredging (Scenario DSC) operations create relatively small areas exceeding concern levels of 50 mg/L while disposal operations create larger zones.

Figures 3.3 through 3.9 show the areas exceeding 42 mg/L for the seven disposal sites: Mystic River, Chelsea River, Inner Confluence, Spectacle Island, Subaqueous E, Subaqueous B and Meisberger, respectively. In general the shape of the mixing zone is oriented along the predominate ebb tidal direction. Thickness of the zone is primarily a function of the strength of the currents: higher currents cause narrower zones.

The Mystic River and Inner Confluence are of special concern since fish passage is not to be interrupted by dredging or disposal operations. A finer model grid was developed to provide better resolution in these areas. Figure 3.10 shows the Mystic River under worst case scenario conditions (DSMAX + DSS). Approximately one half the river width exceeds 42 mg/L. Figure 3.11 shows the Inner Confluence under worst case scenario conditions (DSMAX + DSS). Here again, approximately one half the river width exceeds 42 mg/L. The patchiness in the contours is due to the fact that concentrations were saved only at one hour intervals.

Table 3.3 Summary of TSS based mixing zone attributes based on 42 ng/L (equivalent to concern level of 50 ng/L less 8 ng/L ambient).

Disposal Site	Scenario	Peak TSS Concentration (ng/L)	Mixing Zone Dimensions			Figure Reference
			Maximum Length (m)	Maximum Width (m)	Area (m^2) >42 mg/L	
Mystic	DS3000	518	285	125	33540	3.3
Chelsea	DS3000	818	300	95	25850	3.4
Inner Confluence	DS3000	1397	285	80	19550	3.5
Spectacle Island	DS3000	774	215	150	31250	3.6
Subaqueous E	DS3000	414	205	175	36080	3.7
Subaqueous B	DS3000	361	225	200	42250	3.8

Disposal Site	Scenario	Peak TSS Concentration (ng/L)	Mixing Zone Dimensions			Figure Reference
			Maximum Length (m)	Maximum Width (m)	Area (m²) >42 mg/L	
Meisberger	DS3000	345	350	110	38980	3.9
Mystic	DSC	43	140	125	17330	--
Chelsea	DSC	57	145	90	13040	--
Inner Confluence	DSC	50	95	80	6430	--
Mystic	DS3000	1476	280	185	50440	--
Mystic	DSS plus DS3000	2095	215	185	38690	--
Mystic	DSMAX	2952	480	185	50440	--
Mystic	DSS plus DSMAX	4137	355	185	38690	3.10
Chelsea	DSS plus DSMAX	6898	1190	140	121500	--
Inner Confluence	DSS plus DSMAX	10270	590	140	59530	3.11

Polychlorinated Biphenyls (PCB)

The amounts of PCB for each release scenario follows.

DSS: For the Mystic River material (with an elutriate concentration (EC) of 2.28 ppb) a PCB loading rate of 0.0013316 mg/s was used. For the Chelsea River and Inner Confluence material (EC of 0.15 ppb) a PCB loading rate of 0.0000876 mg/s was used.

DSC: Parent (clay) material was assumed free of any PCB concentrations.

DS3000: For the Mystic River material (EC of 2.28 ppb) an instantaneous release at every high tide of 2876.425 mg was used. For the Chelsea River and Inner Confluence material (EC of 0.15 ppb) an instantaneous release at every high tide of 189.238 mg/s was used.

DSMAX: A variable instantaneous release was used based on 3000 yd³ giving 2876.425 mg, 6000 yd³ giving 5752.85 mg and 4000 yd³ giving 3835.32 mg.

The mixing zone summary is given in Table 3.4 for the various scenarios and disposal sites. The peak concentration reported was estimated immediately following the release at no time lag. The mixing zone length and width were maximum estimates over the entire simulation period scaled from the computer generated figures while the mixing zone area was automatically determined. It is seen that the dredging operations create relatively small areas exceeding concern levels of 23 ng/L while disposal operations create larger zones.

Figures 3.12 through 3.18 show the areas exceeding 23 ng/L for the eight disposal sites: Mystic River, Chelsea River, Inner Confluence, Spectacle Island, Subaqueous E, Subaqueous B and Meisberger, respectively. As with the TSS mixing zones, the shape of the mixing zone is oriented along the predominate ebb tidal direction. Thickness of the zone is primarily a function of the strength of the currents: higher currents cause narrower zones.

The Mystic River is of special concern since the sediments with higher PCB concentrations (2.28 ppb in the channel) are found there. The finer model grid was used to provide better resolution in this area. Figure 3.19 shows the Mystic River under mean conditions (DSS + DS3000). Less than one sixth of the river width was impacted. Figure 3.20 shows the worst case scenario conditions (DSS + DSMAX). Approximately one sixth the river width exceeded 23 ng/L but the maximum length doubled over mean conditions.

Table 3.4. Summary of PCB based mixing zone attributes based on 23 ng/L (equivalent to chronic level of 30 ng/L less 7 ng/L ambient).

Disposal Site	Scenario	Peak PCB Concentration (ng/L)	Mixing Zone Dimension			Figure Reference
			Maximum Length (m)	Maximum Width (m)	Area (m^2) >23 mg/L	
Mystic	DSS + DS3000 (2.28 ppb)	16	–	–	–	3.12
Chelsea	DSS + DS3000 (0.15 ppb)	1.9	–	–	–	3.13
Inner Confluence	DSS + DS3000 (0.15 ppb)	2.2	–	–	–	3.14
Spectacle Island	DS3000 (2.28 ppb)	16	–	–	–	3.15
Subaqueous E	DS3000 (2.28 ppb)	8.8	–	–	–	3.16
Subaqueous B	DS3000 (2.28 ppb)	7.8	–	–	–	3.17
Meisberger	DS3000 (2.28 ppb)	8.9	–	–	–	3.18
Mystic	DS3000 (2.28 ppb)	49.7	75	60	4425	–
Mystic	DSS plus DS3000 (2.28 ppb)	50.0	75	60	4425	3.19
Mystic	DSMAX (2.28 ppb)	93.7	150	60	8710	–
Mystic	DSS plus DSMAX (2.28 ppb)	94.0	150	60	8710	3.20

4. CONCLUSIONS

A series of analyses have been performed to determine the water quality impacts of the proposed dredging and disposal operations for the Boston Harbor Navigation Improvement Project. A model system, WQMAP, was used to estimate the water column concentrations of a series of constituents: TSS, Hg, Cu, PCBs, and naphthalene (PAH) known to be present in the sediments. The model simulated the transport and fate of these materials at the following disposal sites: Mystic River, Chelsea River, Inner Confluence, Spectacle Island, Subaqueous E, Subaqueous B, and Meisberger. Different release scenarios were developed and run: continuous loading, instantaneous loading and variable instantaneous loading.

The continuous loading runs were designed to provide a screening analysis to determine which constituents may potentially cause a water quality problem. No constituents were found to exceed chronic water quality criteria, under the tested scenario.

The instantaneous loading runs were designed to more closely simulate the actual disposal operations. A series of instantaneous releases were tracked to determine the maximum concentration four hours after release and then compared to acute water quality criteria, if available. No exceedances were found under these scenarios.

A analysis to determine the mixing zone based on TSS and PCB loadings was also conducted. Areas greater than the chronic water quality criteria less ambient concentrations were calculated from the model results. It was found that both the Mystic River and Inner Confluence mixing zones extend approximately one sixth the distance across their respective widths for the worst case disposal scenario (i.e., Mystic River).

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FIGURES

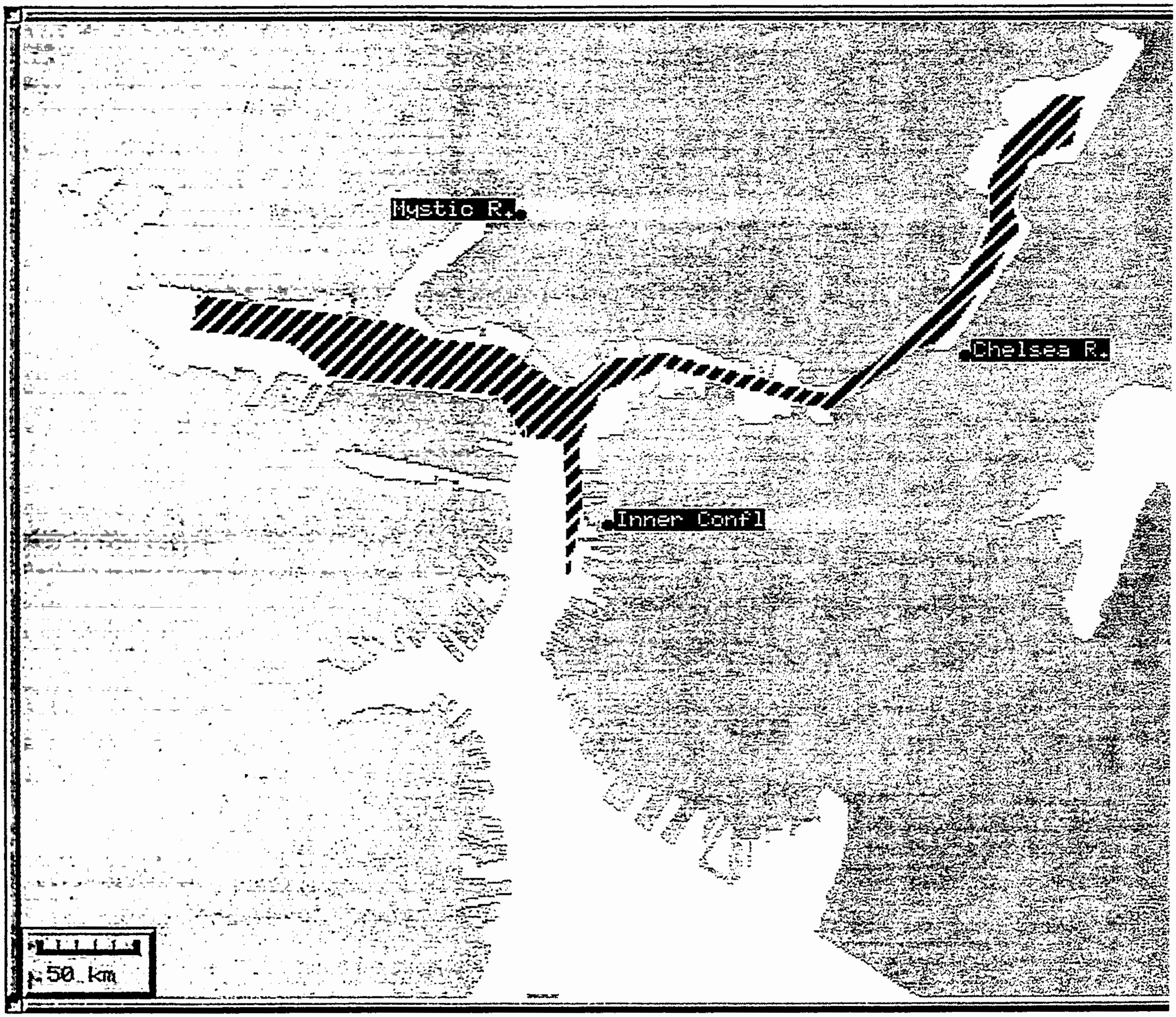

Figure 1.1 Proposed dredging sites in the Mystic and Chelsea Rivers and the Inner Confluence of Inner Boston Harbor.

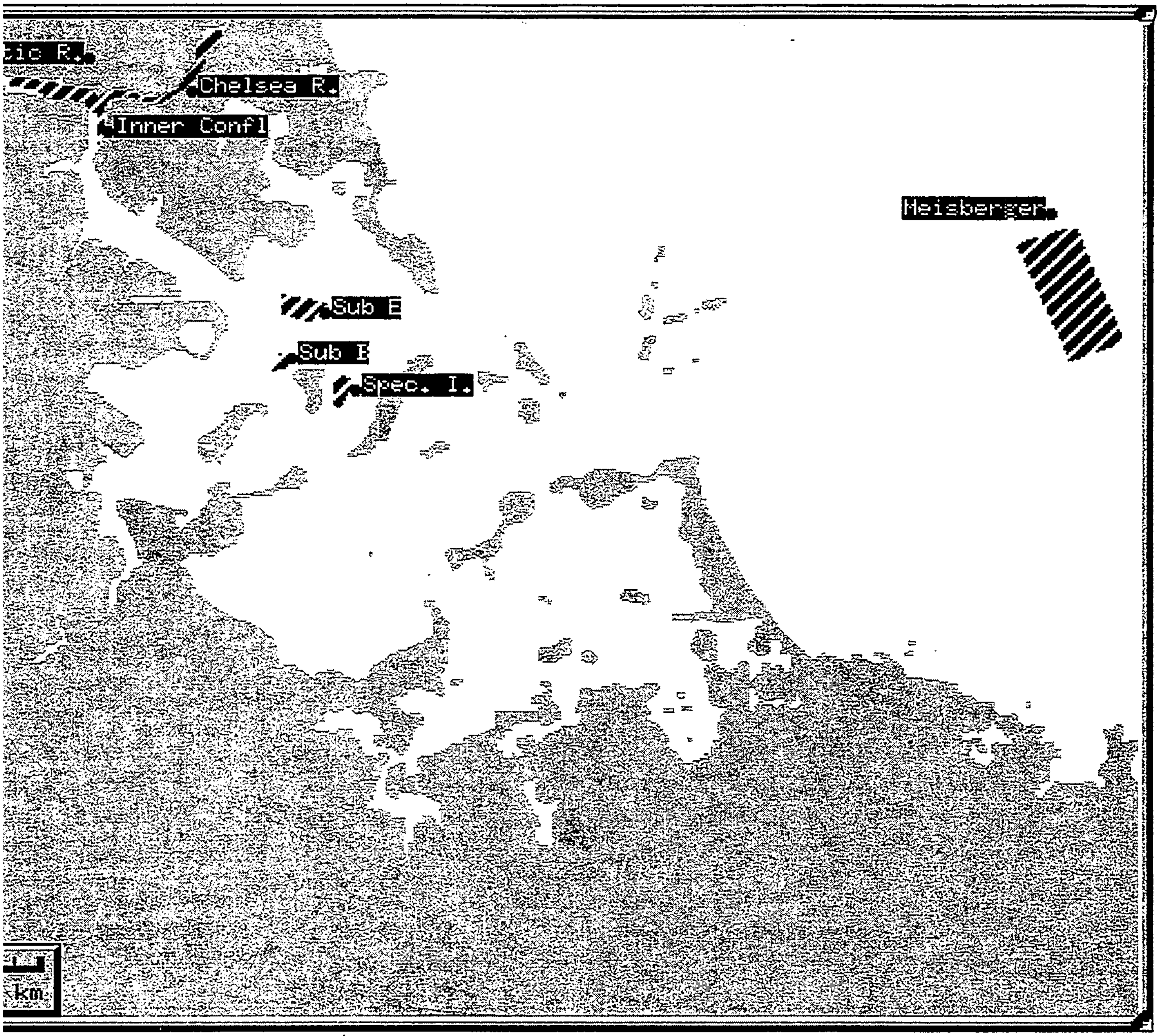

Figure 1.2 Disposal sites in the greater Boston Harbor area including offshore sites.

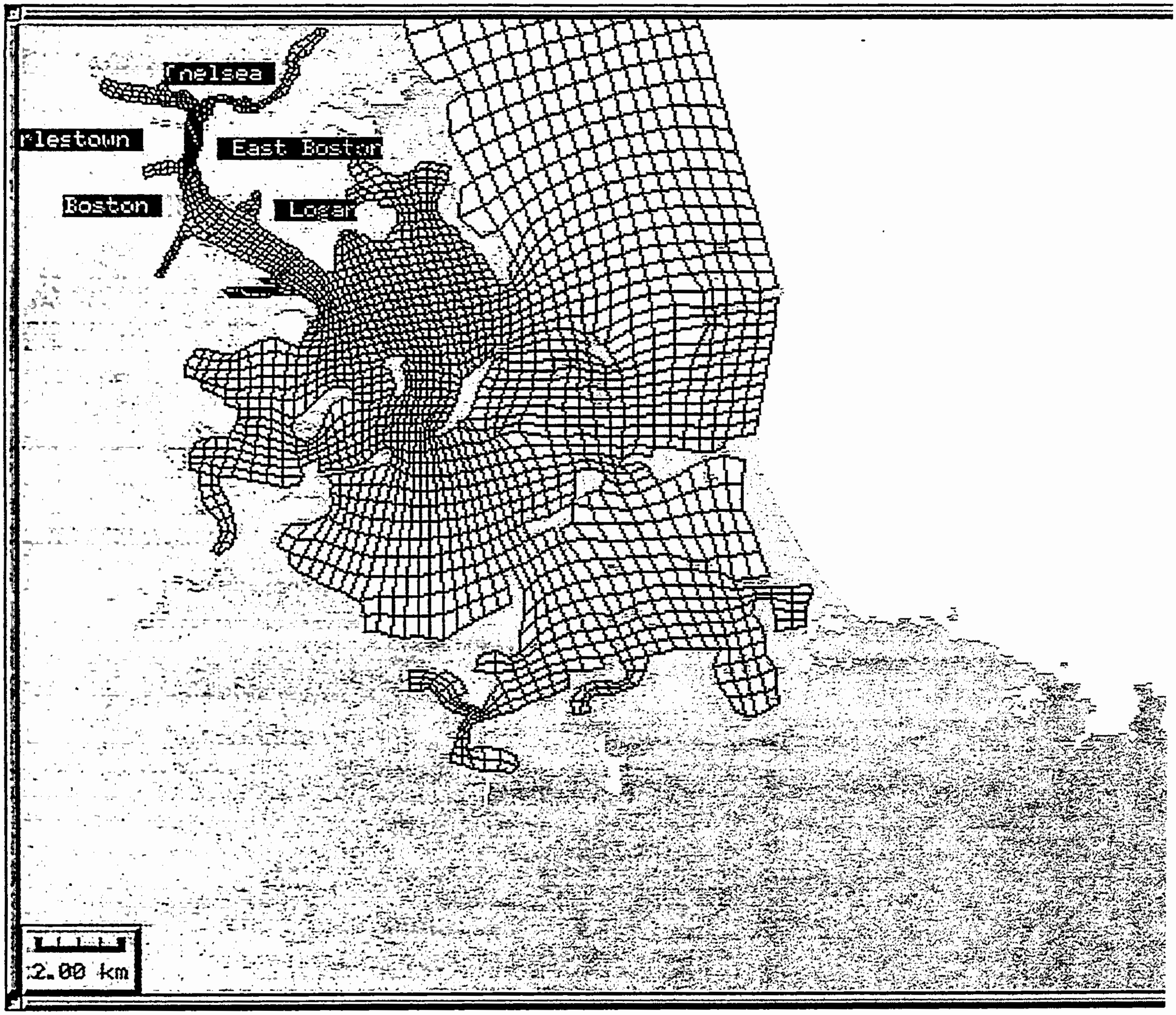

Figure 2.1 WQMAP grid of quadrilaterals covering the Boston Harbor area. Surface elevation, currents and constituent concentration are determined for each quadrilateral over time.

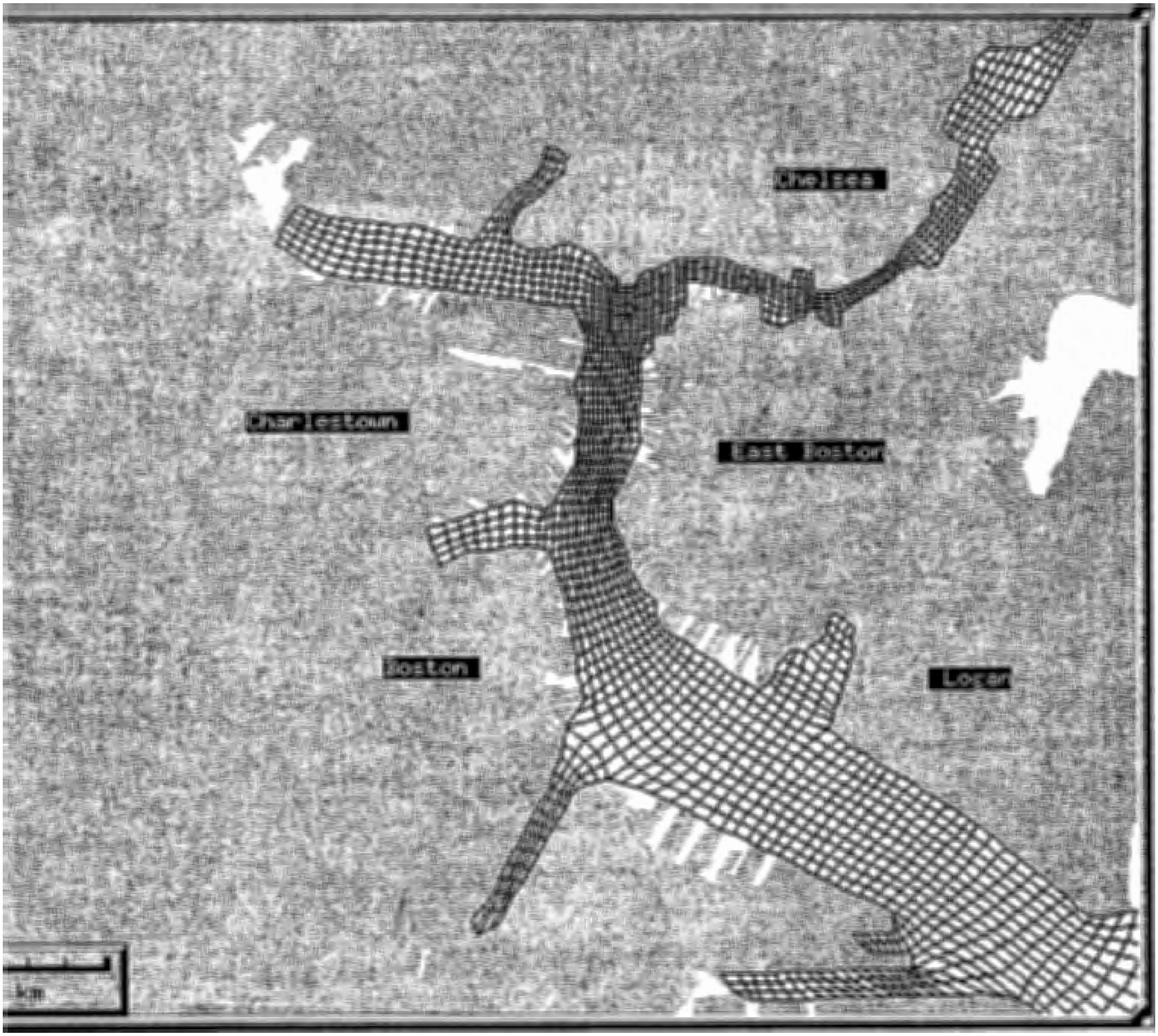

Figure 2.2 WQMAP grid covering the Inner Harbor area.

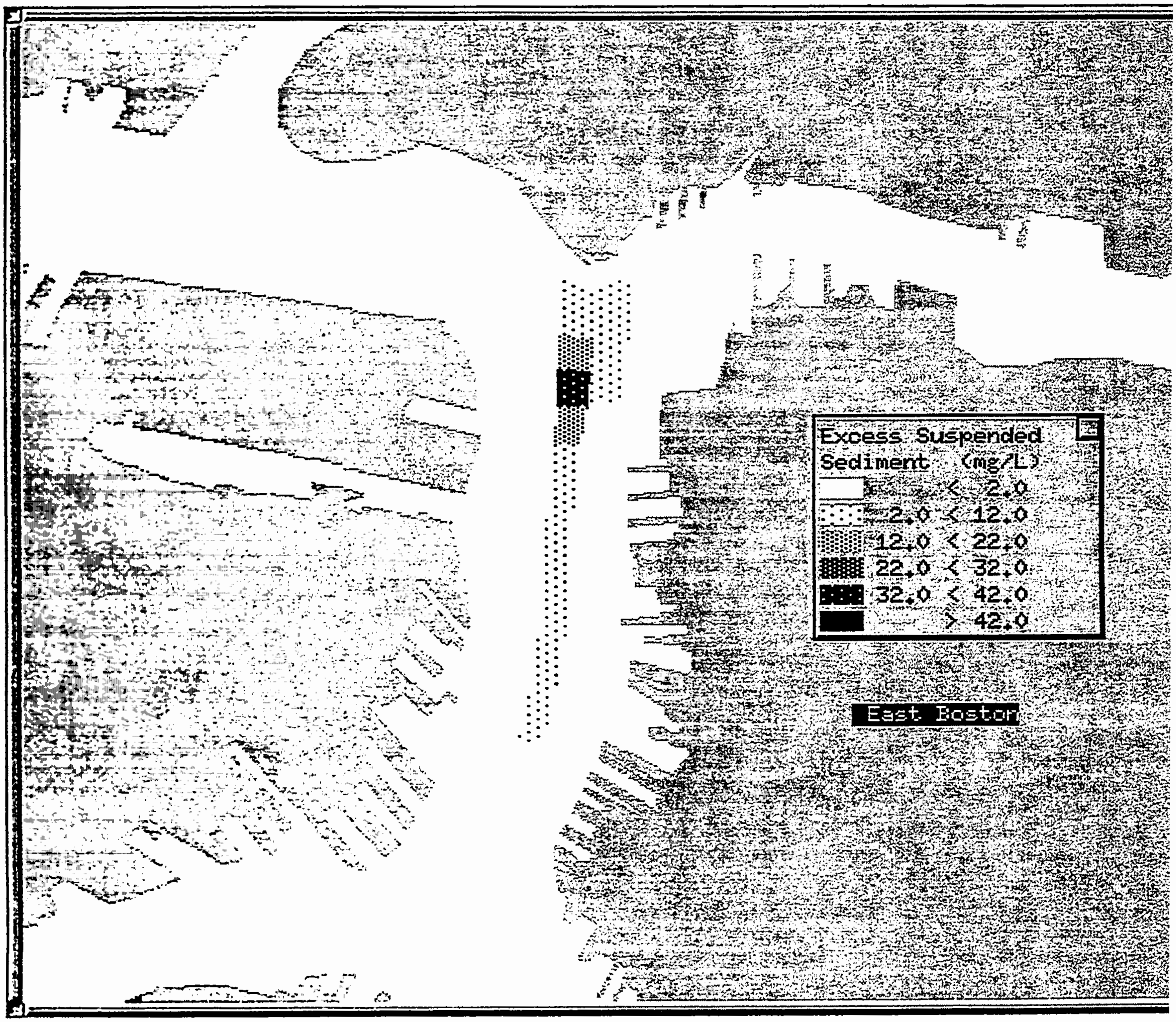

Figure 3.1 Maximum predicted concentrations of TSS based on a continuous release at the Inner Confluence disposal site.

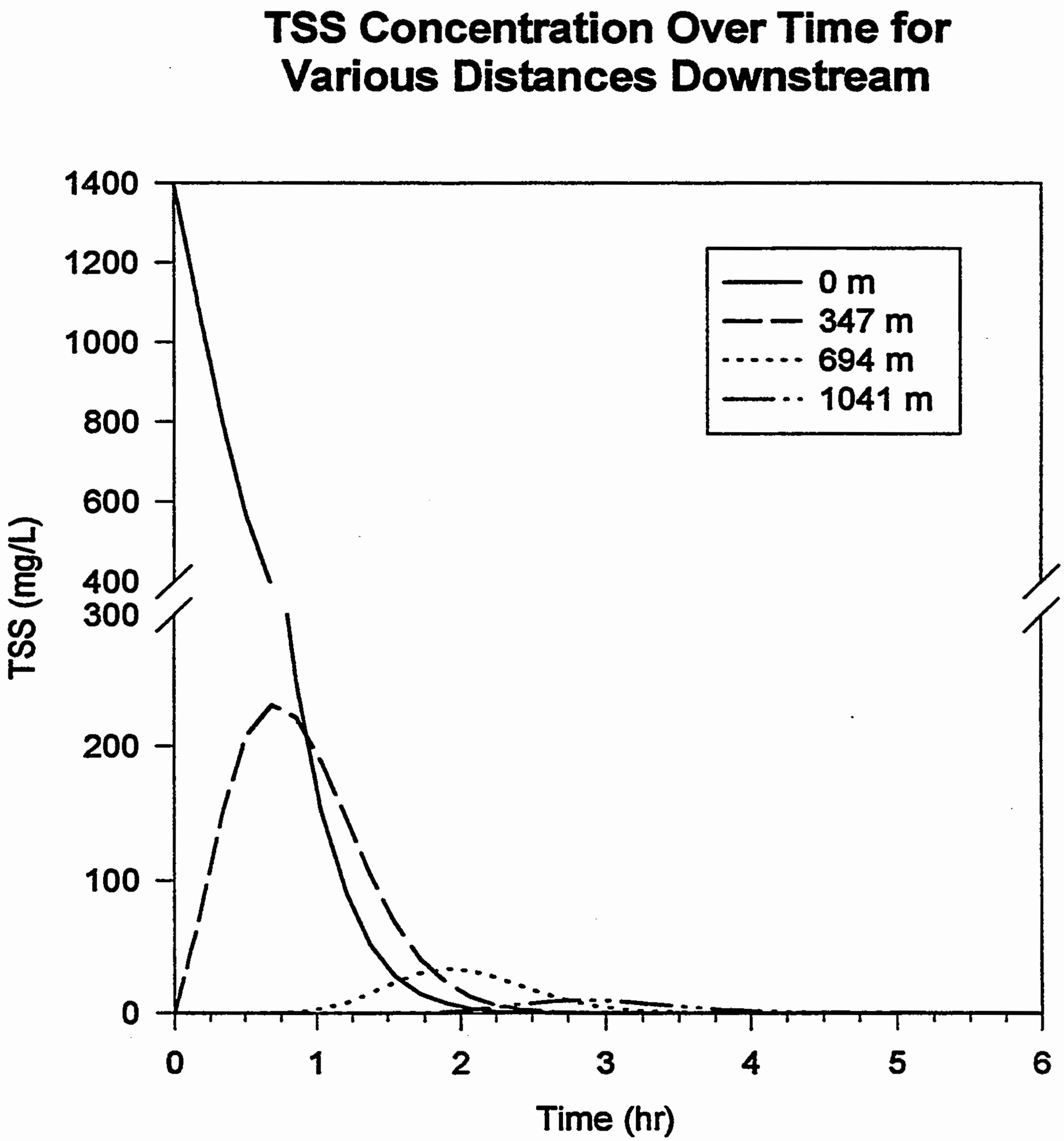

Figure 3.2 Time series of TSS concentrations based on a instantaneous release at the Inner Confluence disposal site

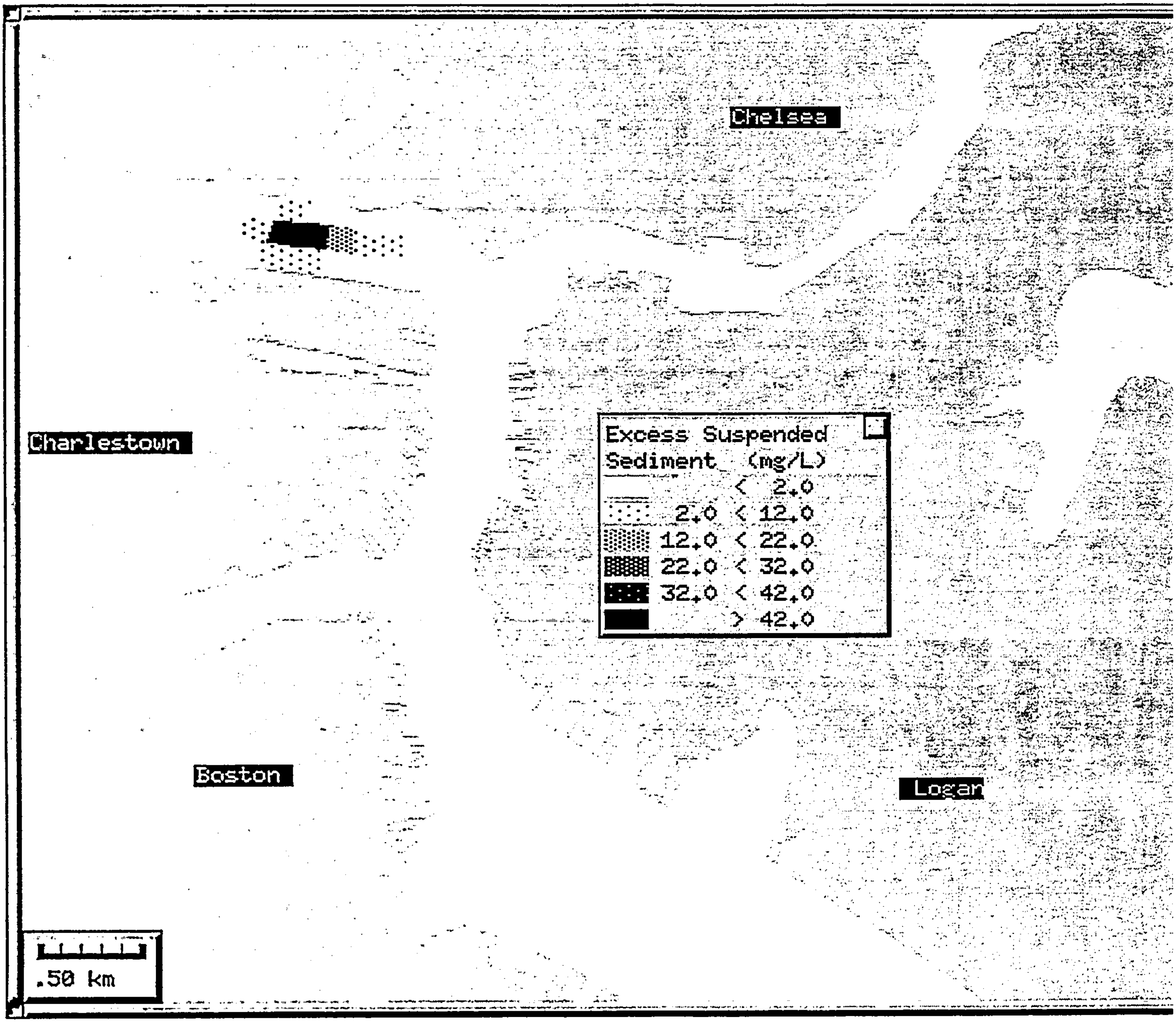

Figure 3.3 Maximum mixing zone (greater than 42 mg/L) for TSS based on a typical multiple instantaneous release scenario (DS3000 [~6000 yd^3/day]) at the Mystic River disposal site

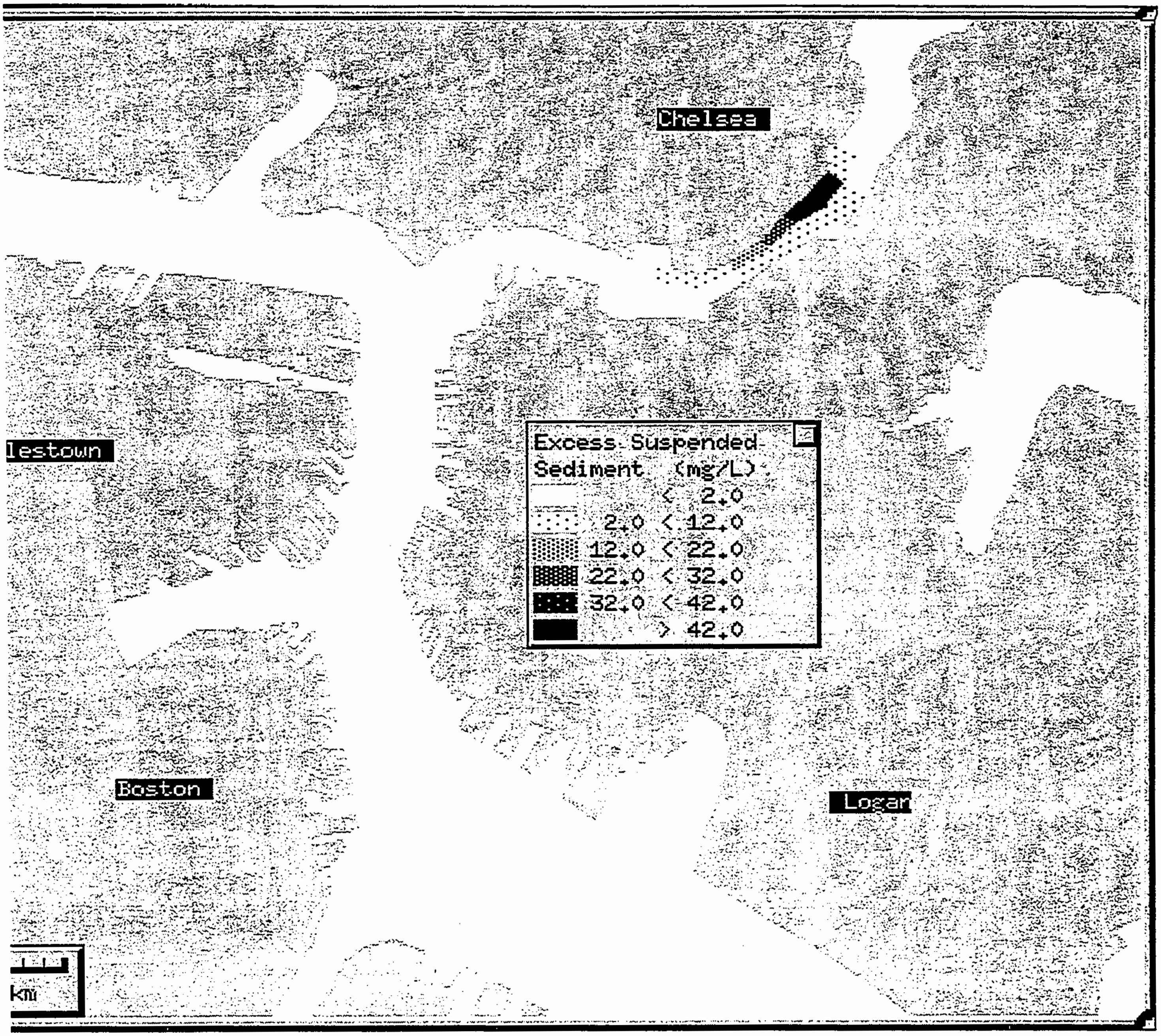

Figure 3.4 Maximum mixing zone (greater than 42 mg/L) for TSS based on a typical multiple instantaneous release scenario (DS3000 [~6000 yd^3/day]) at the Chelsea River disposal site

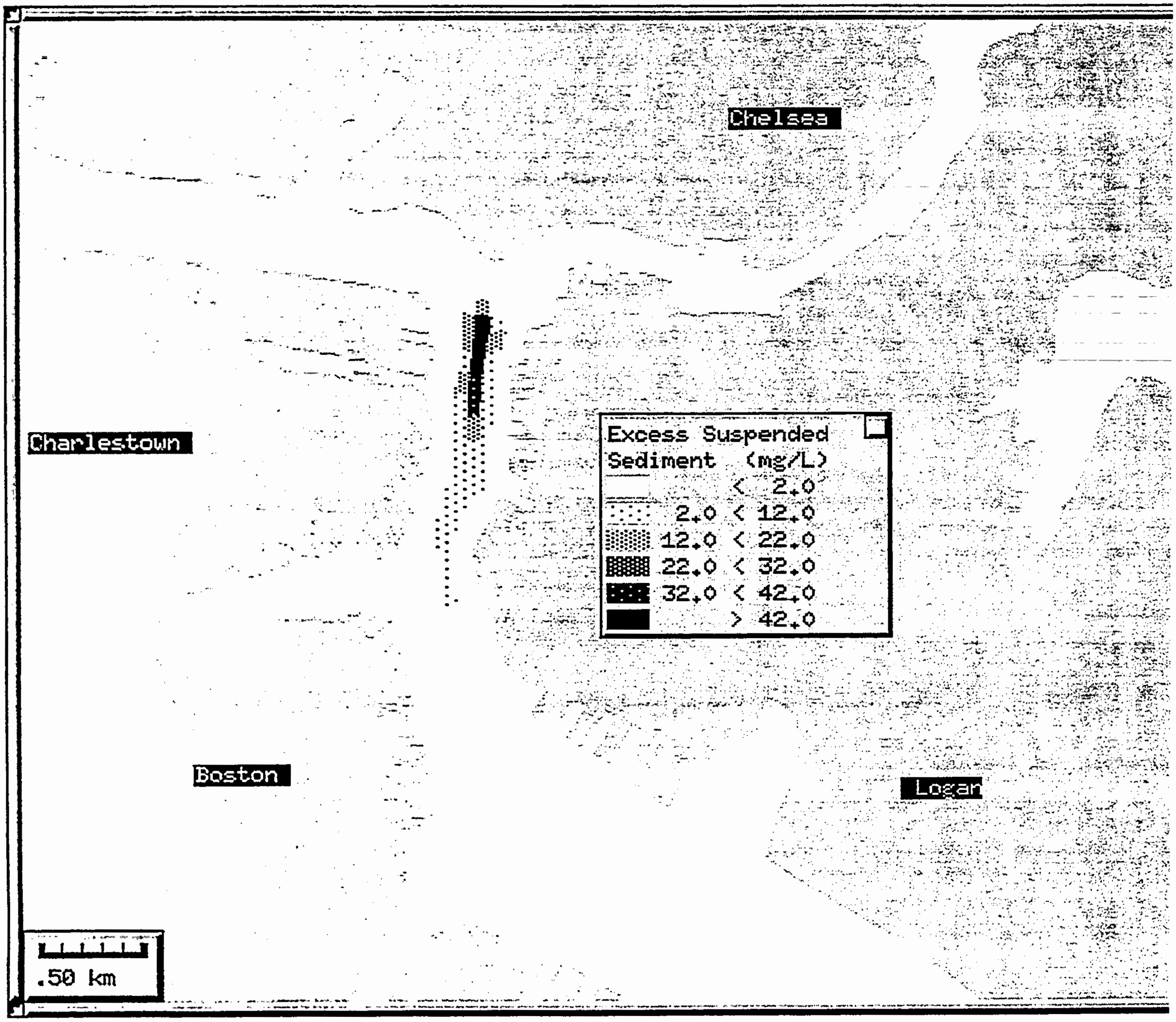

Figure 3.5 Maximum mixing zone (greater than 42 mg/L) for TSS based on a typical multiple instantaneous release scenario (DS3000 [~6000 yd^3/day]) at the Inner Confluence disposal site

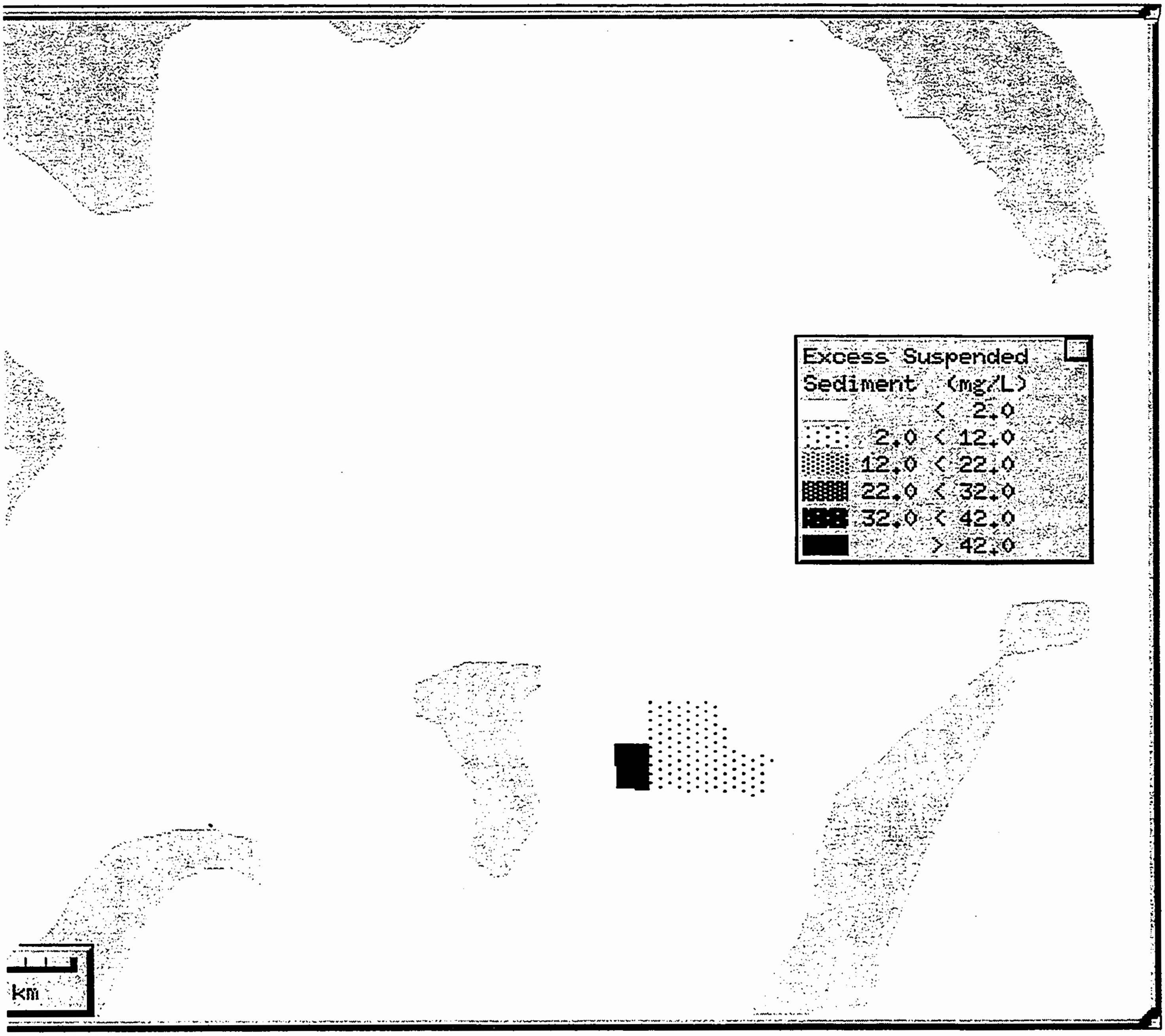

Figure 3.6 Maximum mixing zone (greater than 42 mg/L) for TSS based on a typical multiple instantaneous release scenario (DS3000 [~6000 yd^3/day]) at the Spectacle Island disposal site

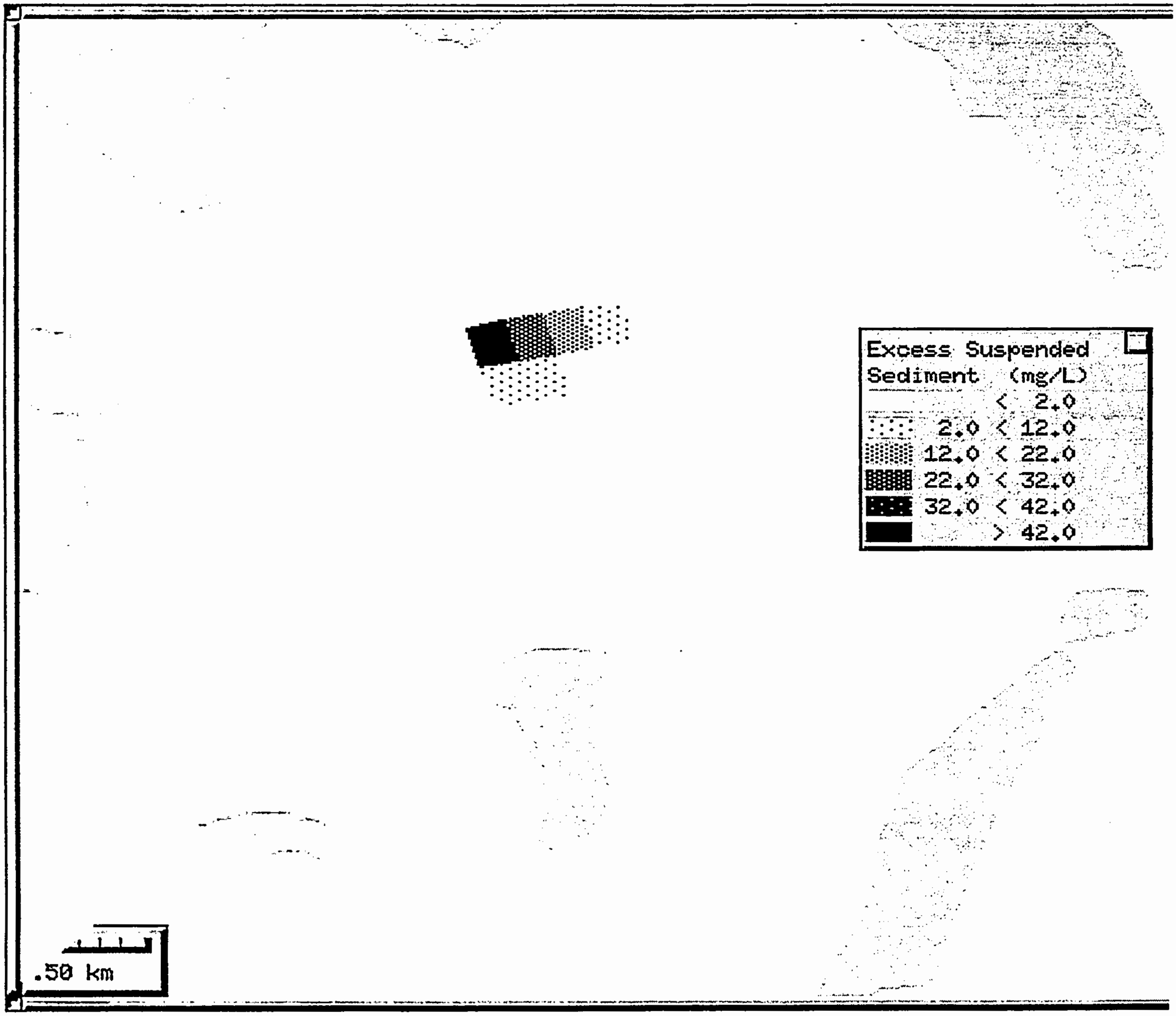

Figure 3.7 Maximum mixing zone (greater than 42 mg/L) for TSS based on a typical multiple instantaneous release scenario (DS3000 [~6000 yd³/day]) at the Subaqueous E disposal site

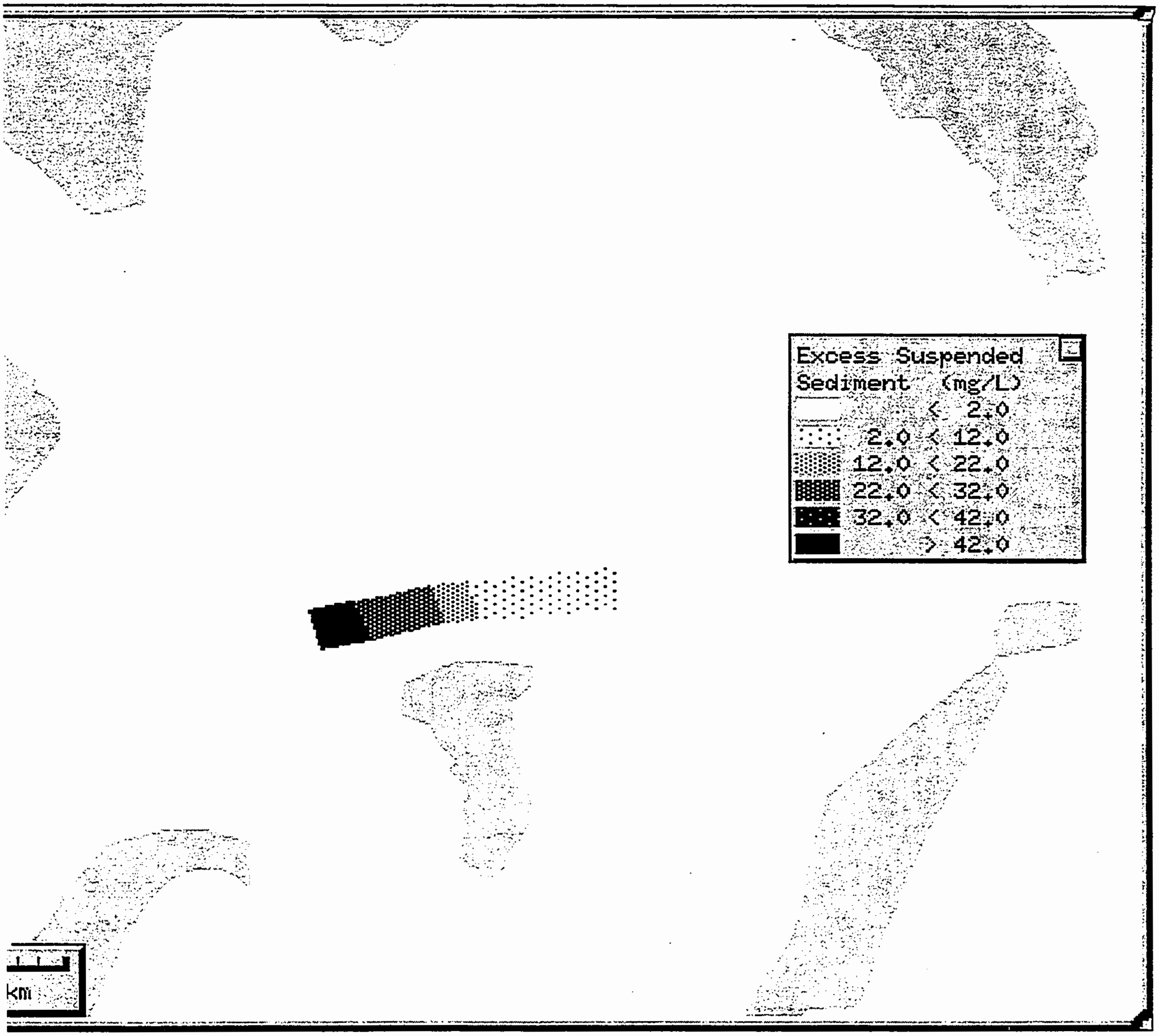

Figure 3.8 Maximum mixing zone (greater than 42 mg/L) for TSS based on a typical multiple instantaneous release scenario (DS3000 [~6000 yd^3/day]) at the Subaqueous B disposal site

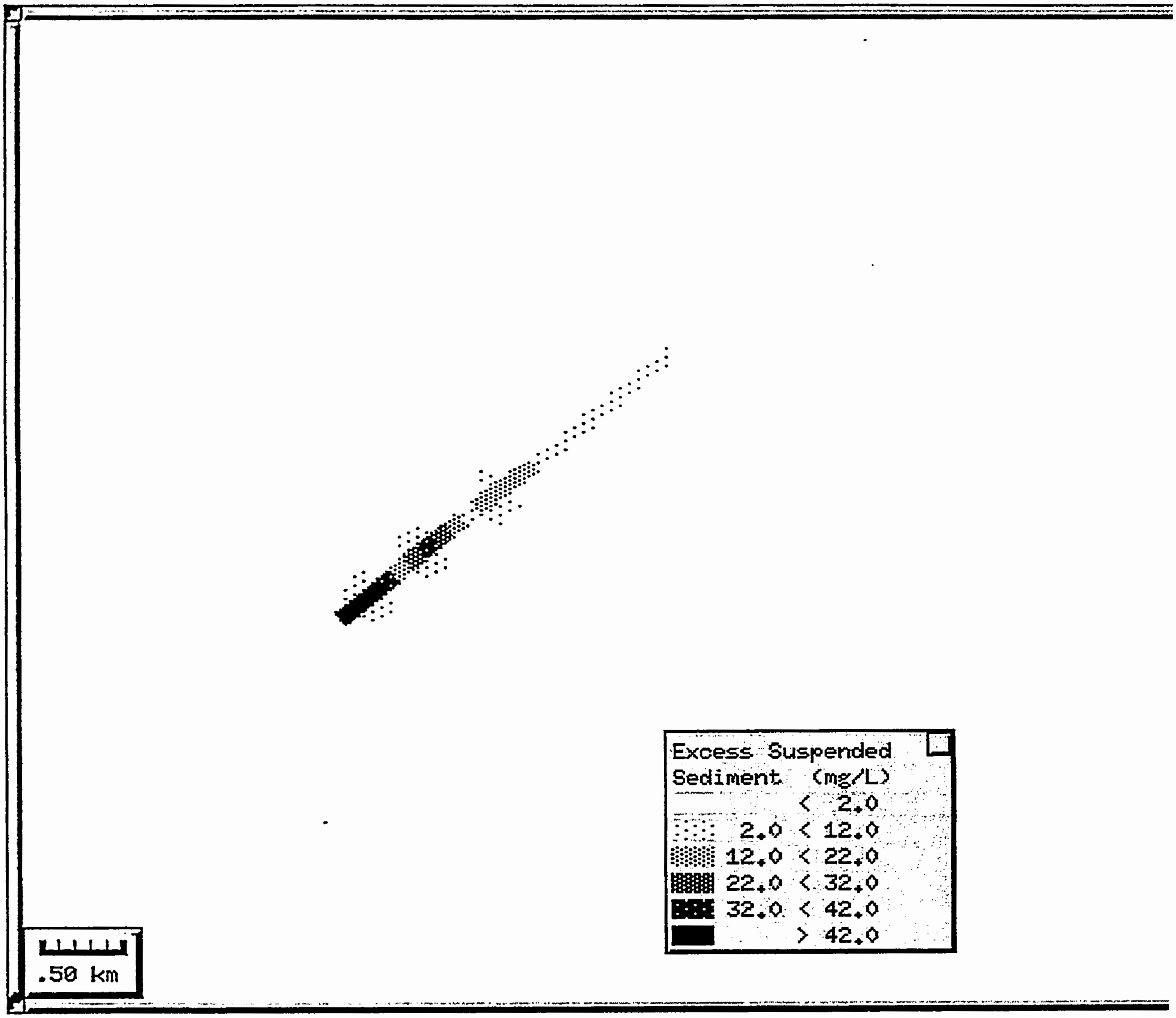

Figure 3.9 Maximum mixing zone (greater than 42 mg/L) for TSS based on a typical multiple instantaneous release scenario (DS3000 [~6000 yd^3/day]) at the Meisberger disposal site

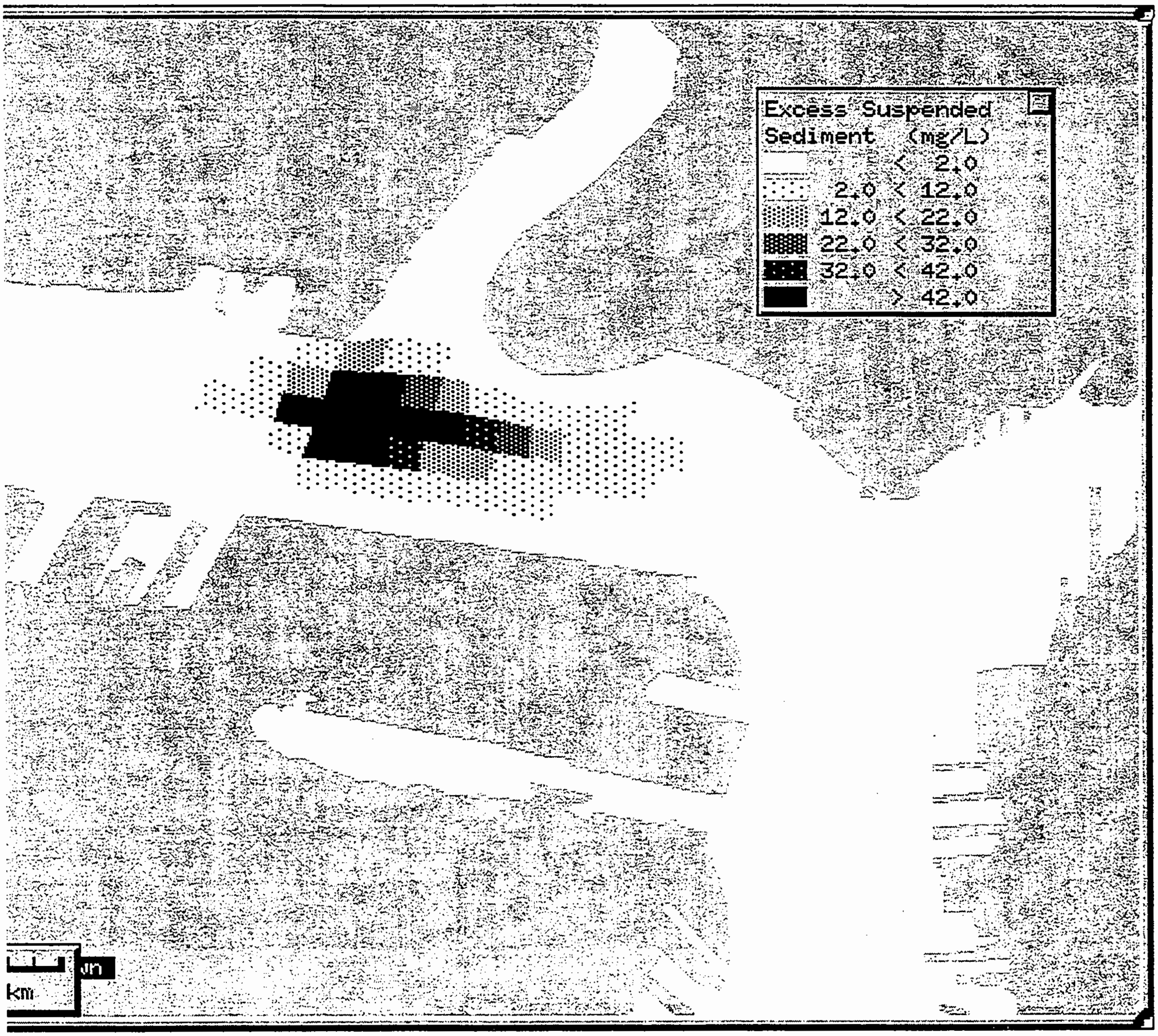

Figure 3.10 Maximum mixing zone (greater than 42 mg/L) for TSS based on a typical dredging and worst case multiple instantaneous release scenario (DSS + DSMAX [~10000 yd^3/day]) at the Mystic River disposal site

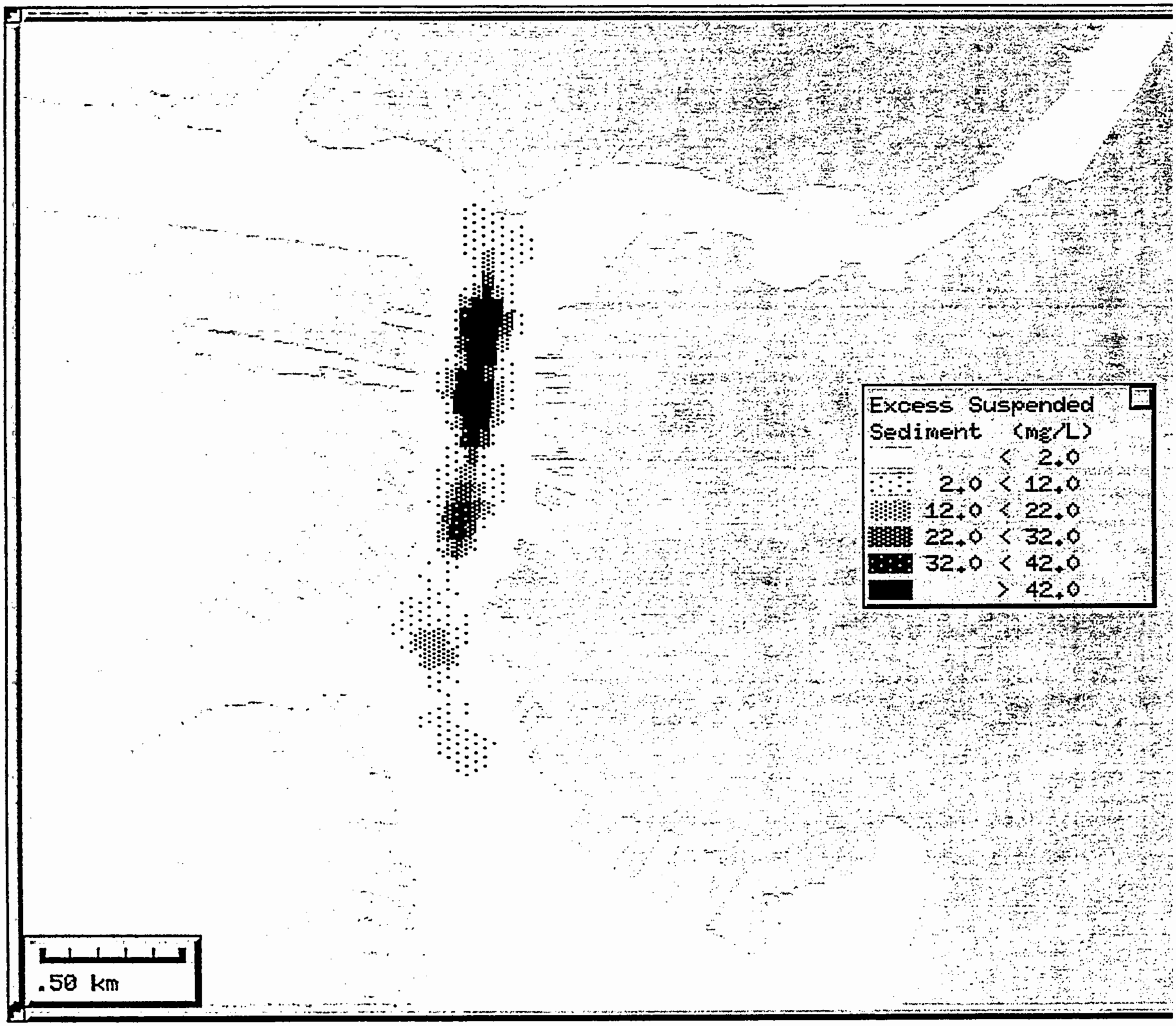

Figure 3.11 Maximum mixing zone (greater than 42 mg/L) for TSS based on a typical dredging and worst case multiple instantaneous release scenario (DSS + DSMAX [~10000 yd^3/day]) at the Inner Confluence disposal site

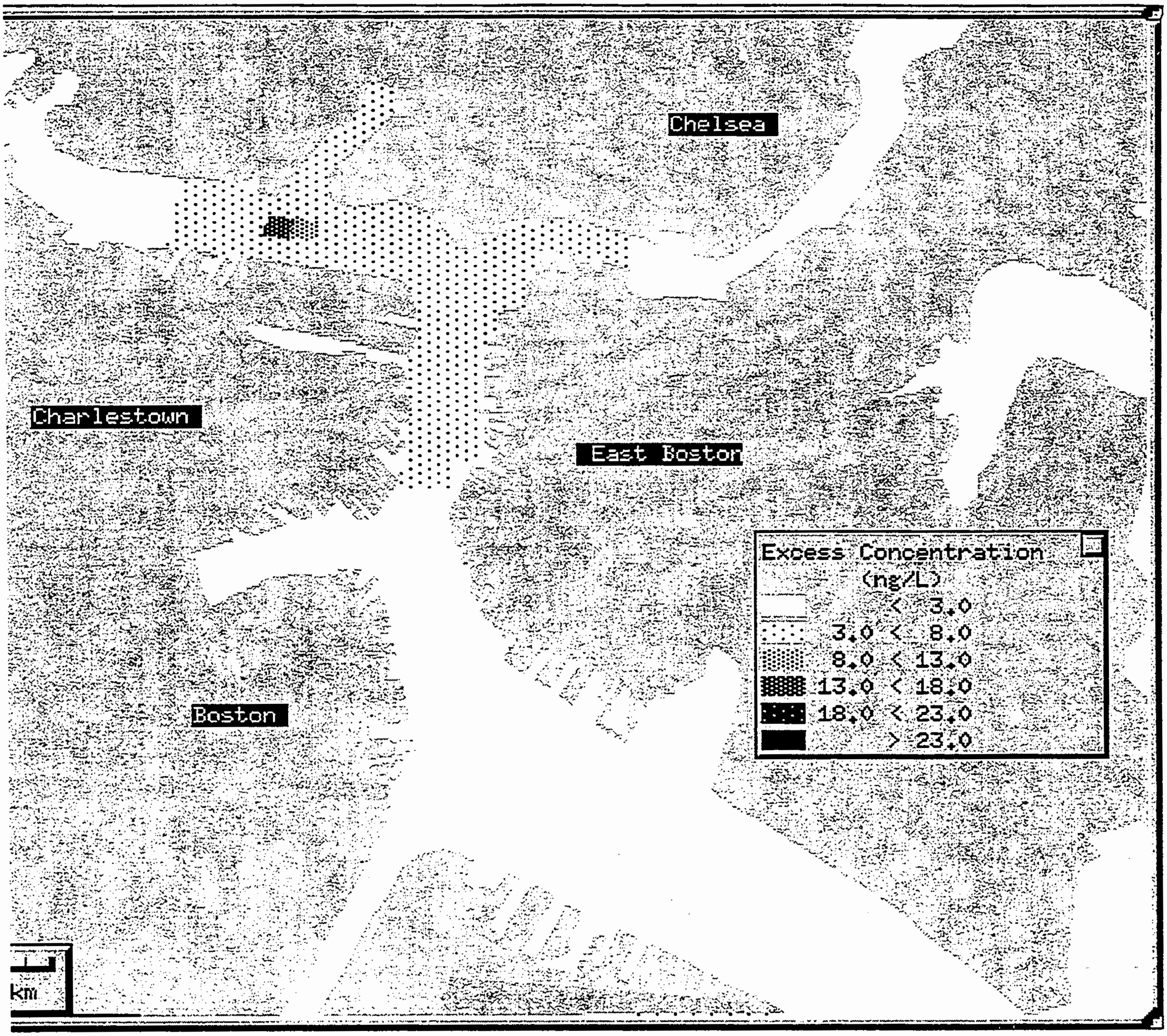

Figure 3.12 Maximum mixing zone (greater than 23 ng/L) for PCB for the highest 25% (2.28 ppb) of sediment based on a typical dredging and multiple instantaneous release scenario (DSS + DS3000 [~6000 yd^3/day]) at the Mystic River disposal site

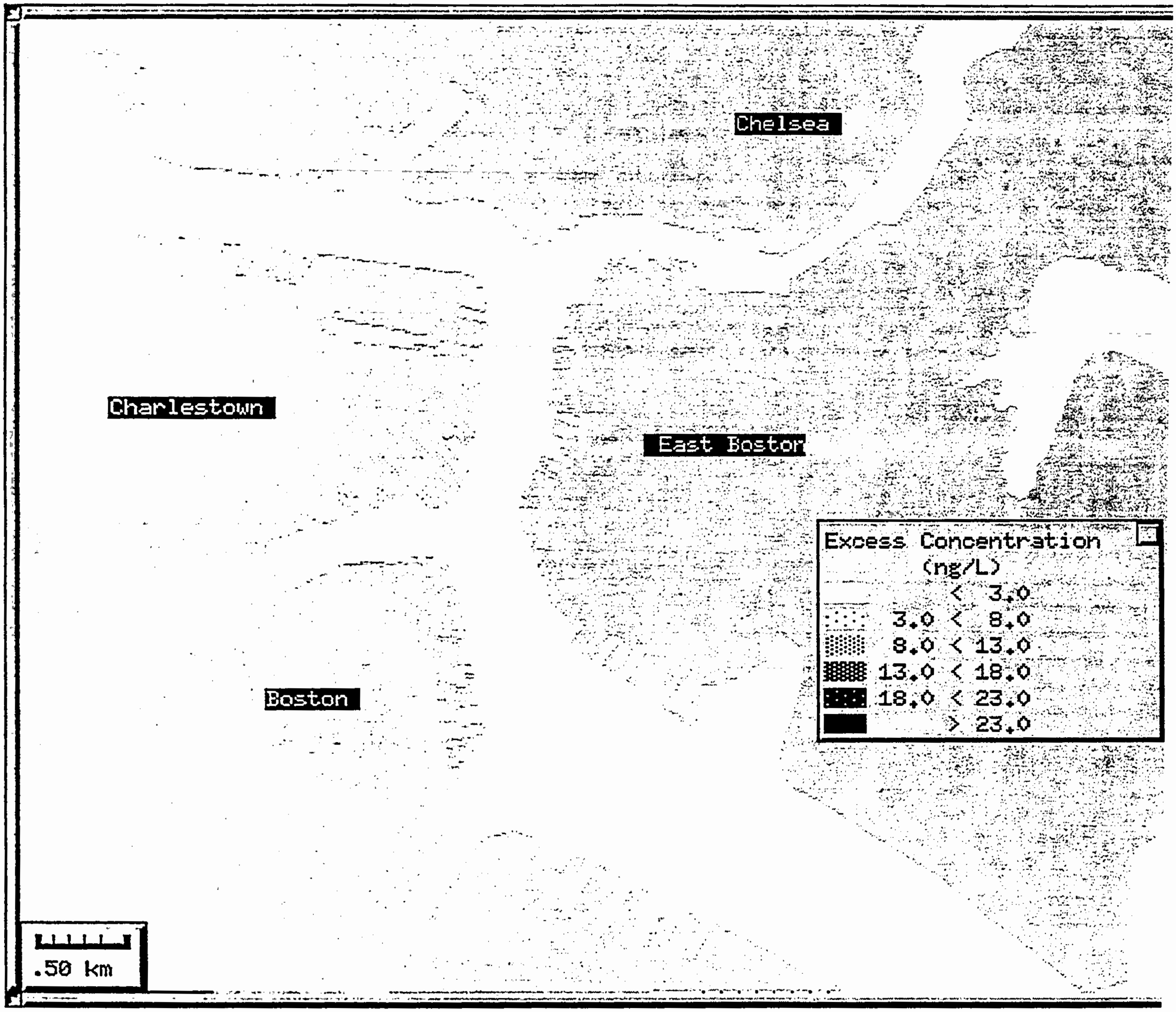

Figure 3.13 Maximum mixing zone (greater than 23 ng/L) for PCB for the lowest 75% (0.15 ppb) of sediment based on a typical dredging and multiple instantaneous release scenario (DSS + DS3000 [~6000 yd^3/day]) at the Chelsea River disposal site

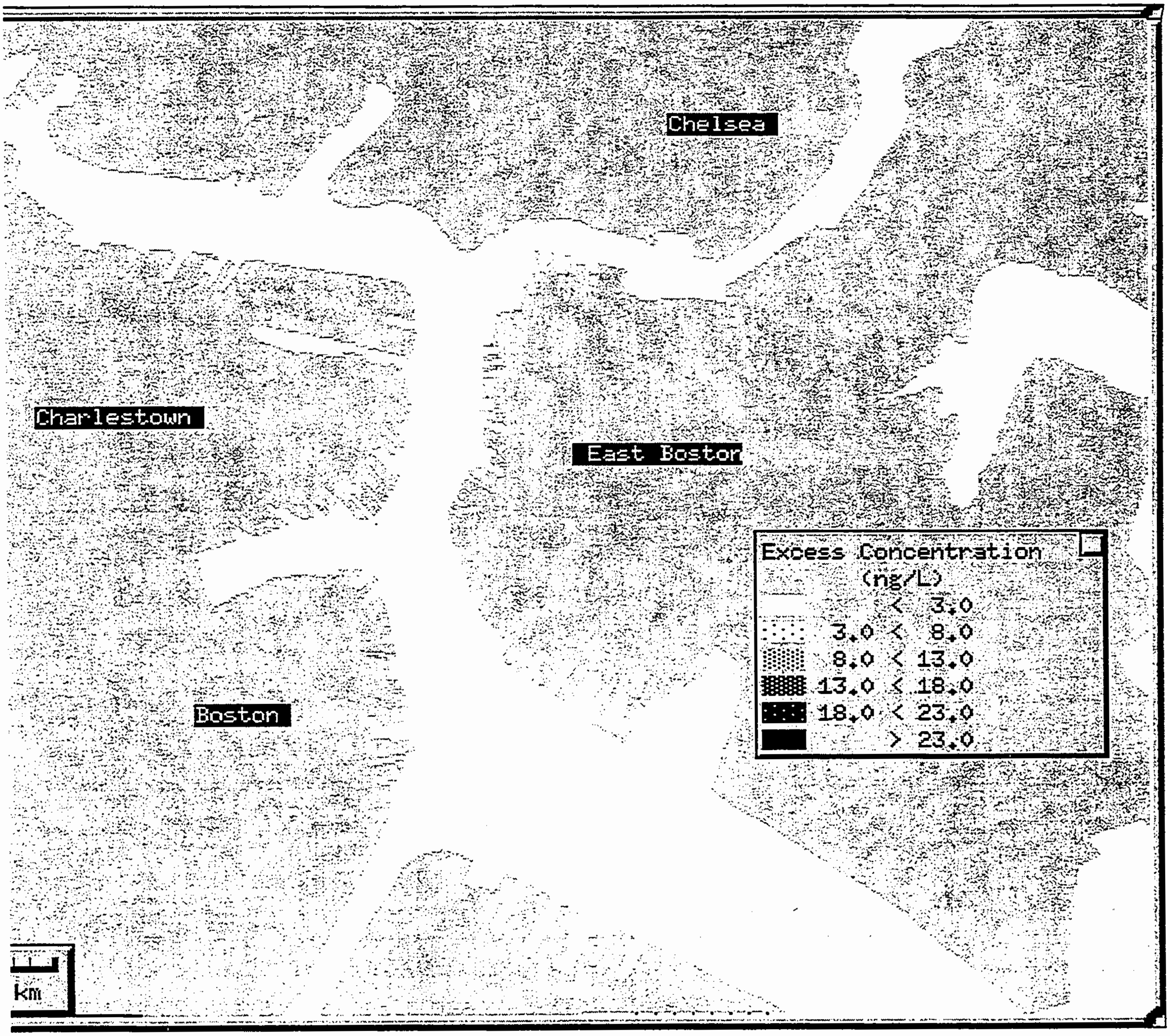

Figure 3.14 Maximum mixing zone (greater than 23 ng/L) for PCB for the lowest 75% (0.15 ppb) of sediment based on a typical dredging and multiple instantaneous release scenario (DSS + DS3000 [~6000 yd^3/day]) at the Inner Confluence disposal site

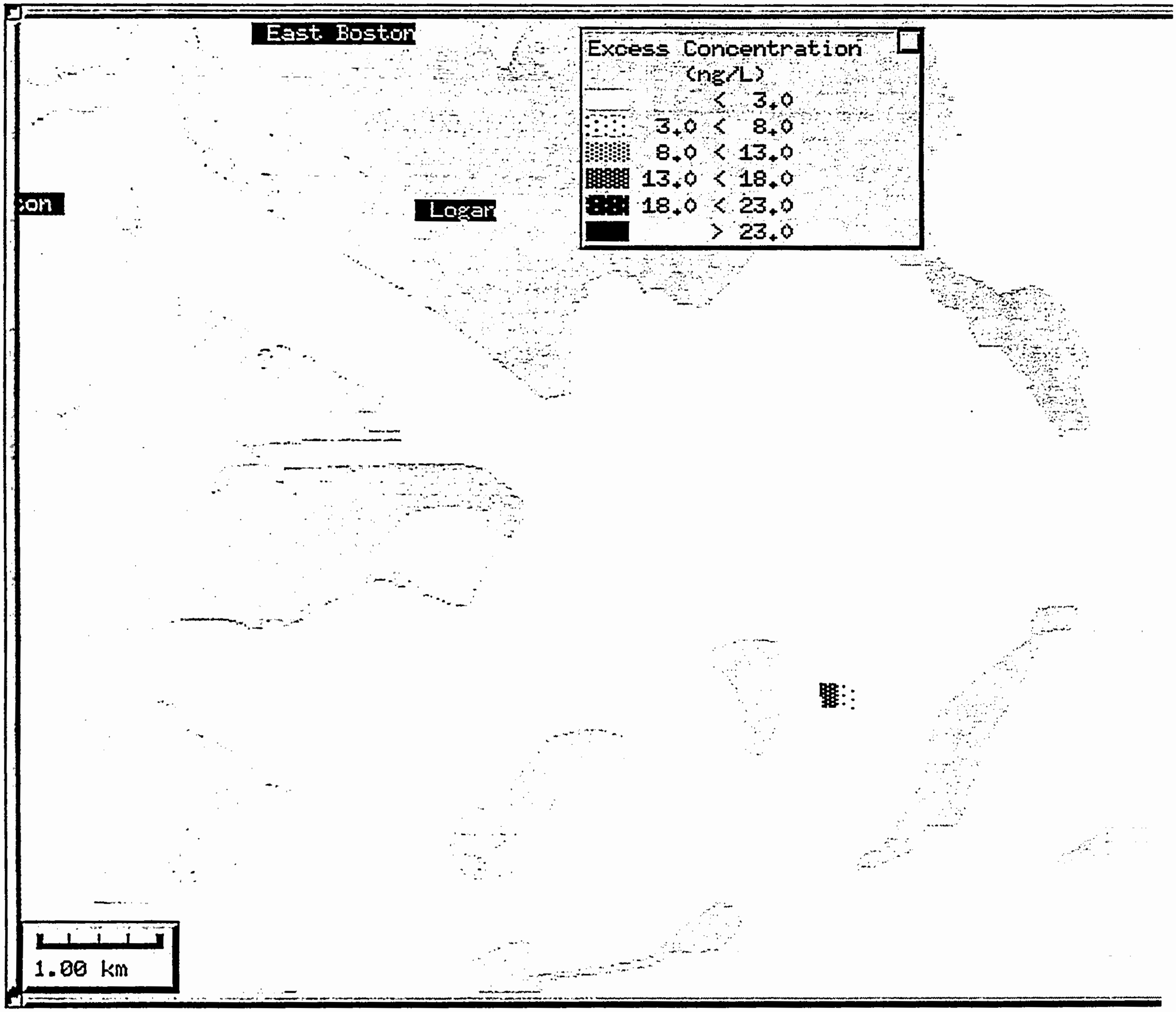

Figure 3.15 Maximum mixing zone (greater than 23 ng/L) for PCB for the highest 25% (2.28 ppb) of sediment based on a typical dredging and multiple instantaneous release scenario (DS3000 [~6000 yd^3/day]) at the Spectacle Island disposal site

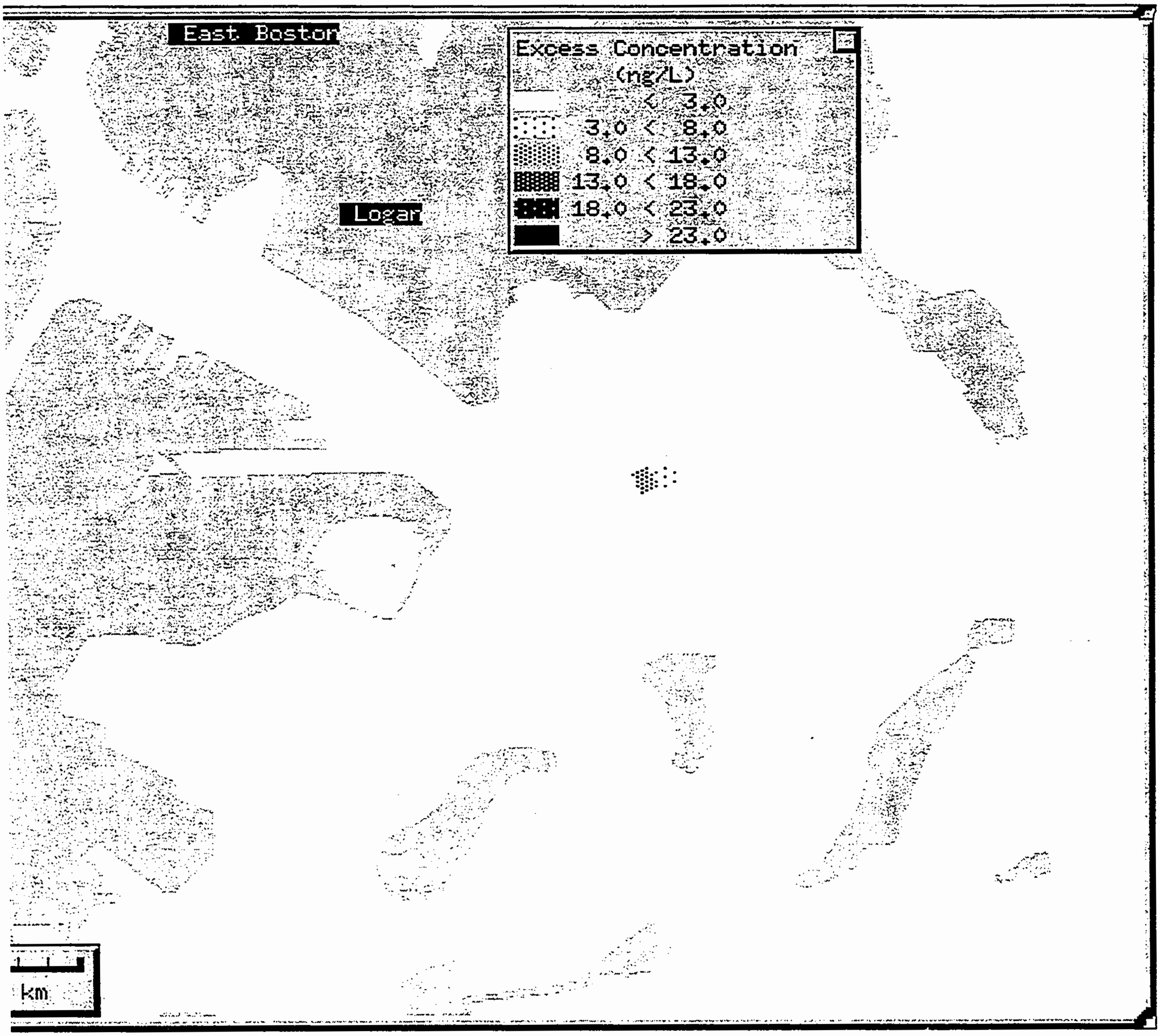

Figure 3.16 Maximum mixing zone (greater than 23 ng/L) for PCB for the highest 25% (2.28 ppb) of sediment based on a typical dredging and multiple instantaneous release scenario (DS3000 [~6000 yd^3/day]) at the Subaqueous E disposal site

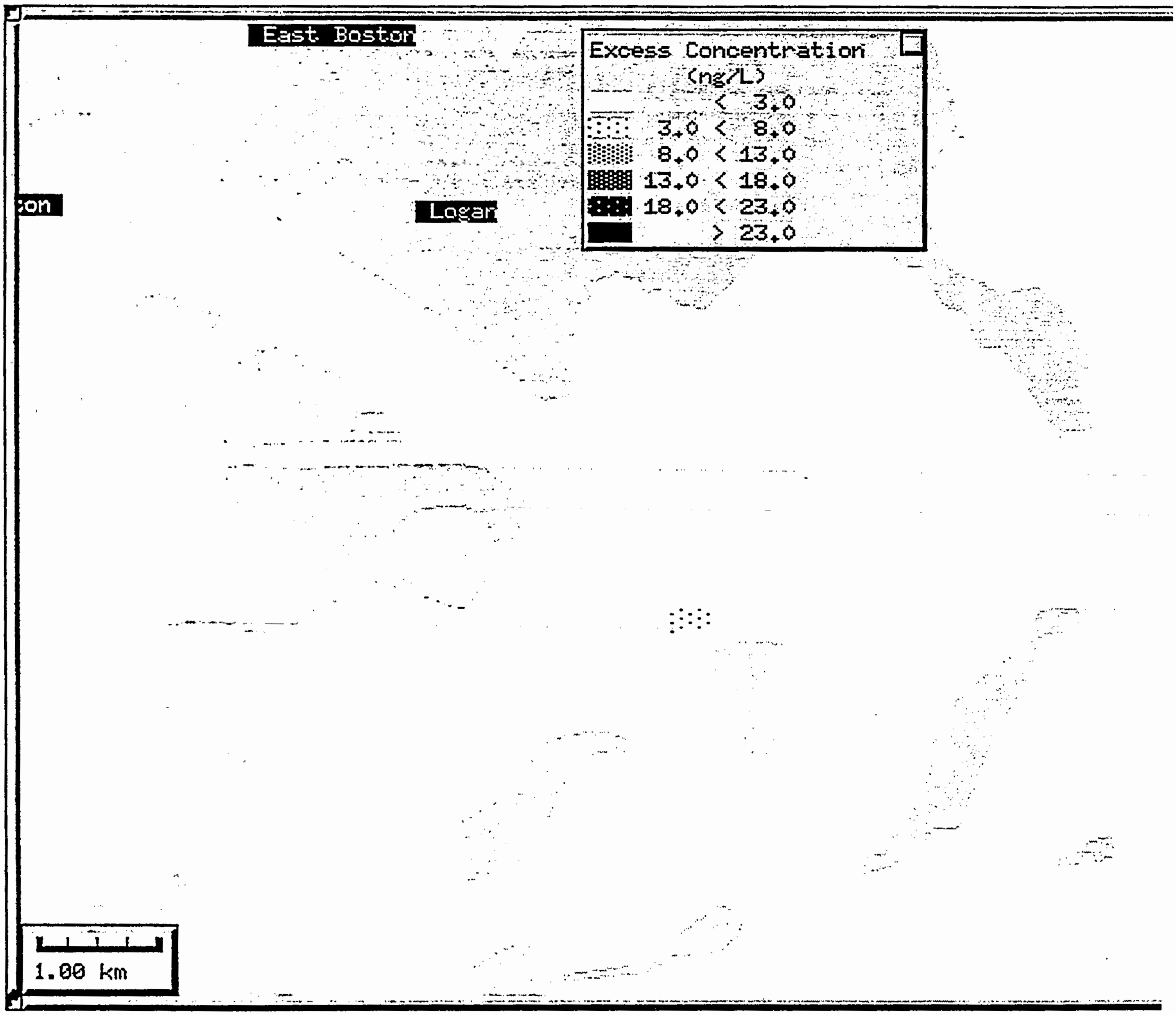

Figure 3.17 Maximum mixing zone (greater than 23 ng/L) for PCB for the highest 25% (2.28 ppb) of sediment based on a typical dredging and multiple instantaneous release scenario (DS3000 [~6000 yd^3/day]) at the Subaqueous B disposal site

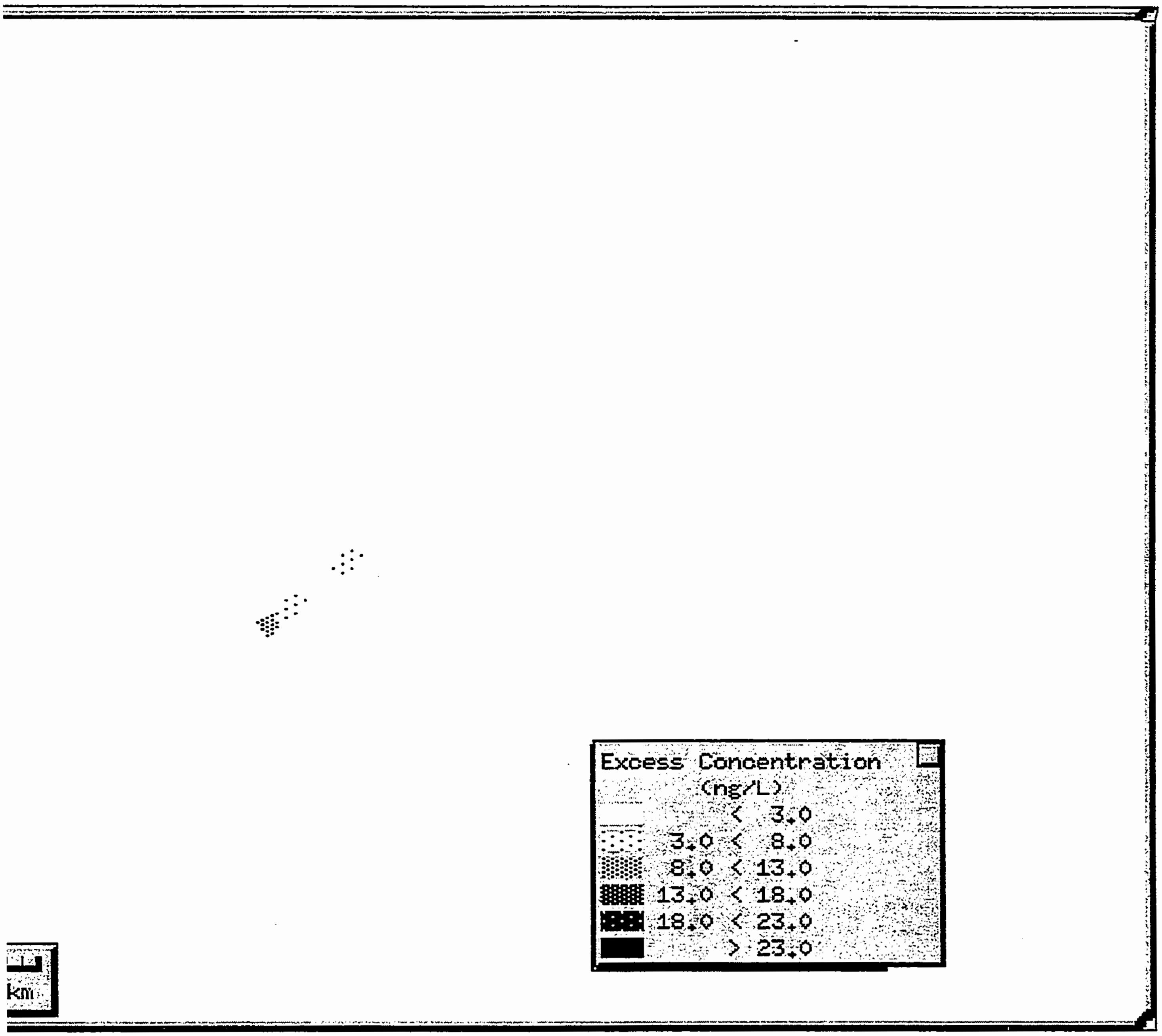

Figure 3.18 Maximum mixing zone (greater than 23 ng/L) for PCB for the highest 25% (2.28 ppb) of sediment based on a typical dredging and multiple instantaneous release scenario (DS3000 [~6000 yd^3/day]) at the Meisberger disposal site

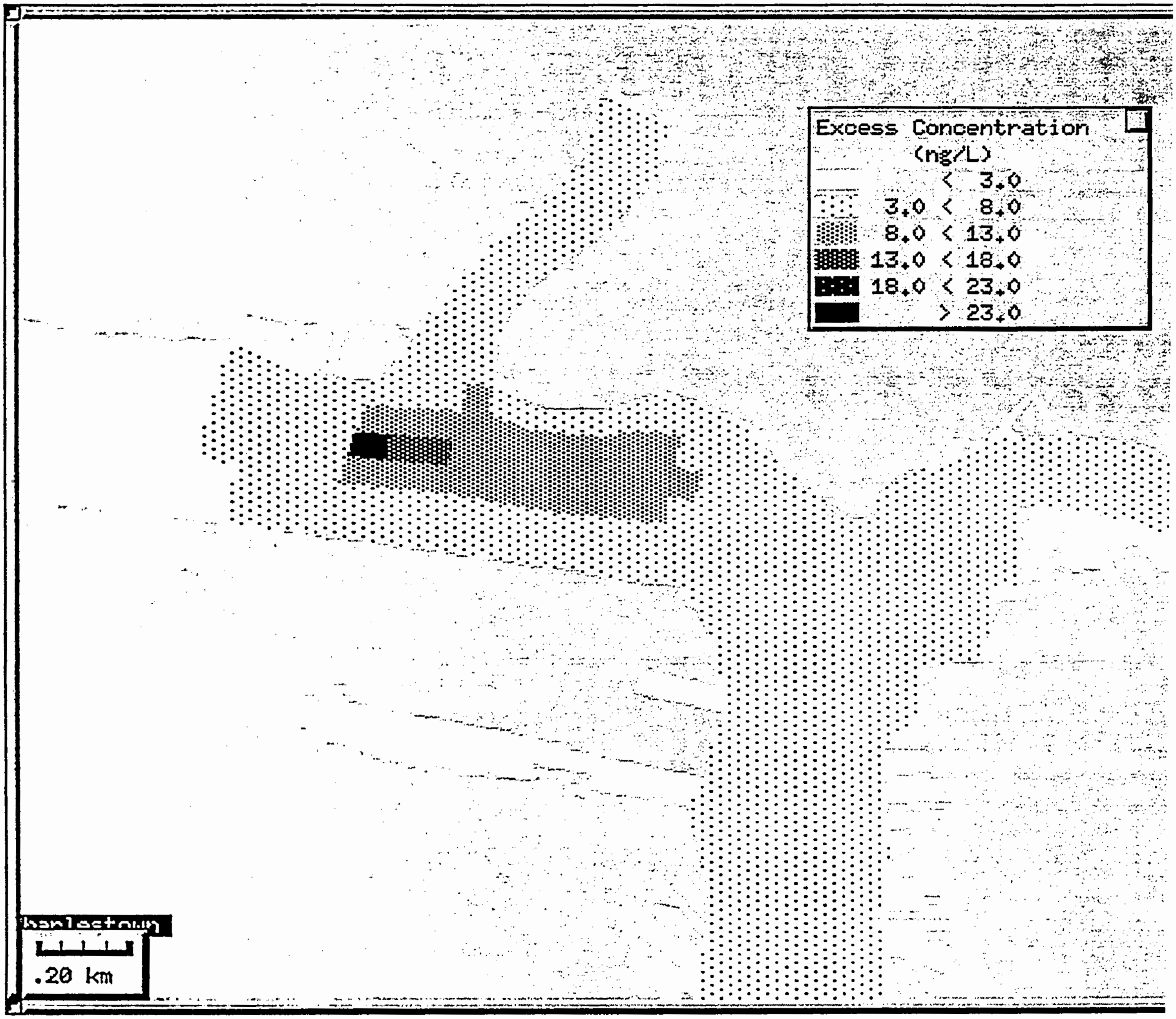

Figure 3.19 Maximum mixing zone (greater than 23 ng/L) for PCB for the highest 25% (2.28 ppb) of sediment based on a typical dredging and multiple instantaneous release scenario (DSS + DS3000 [~6000 yd^3/day]) at the Mystic River disposal site

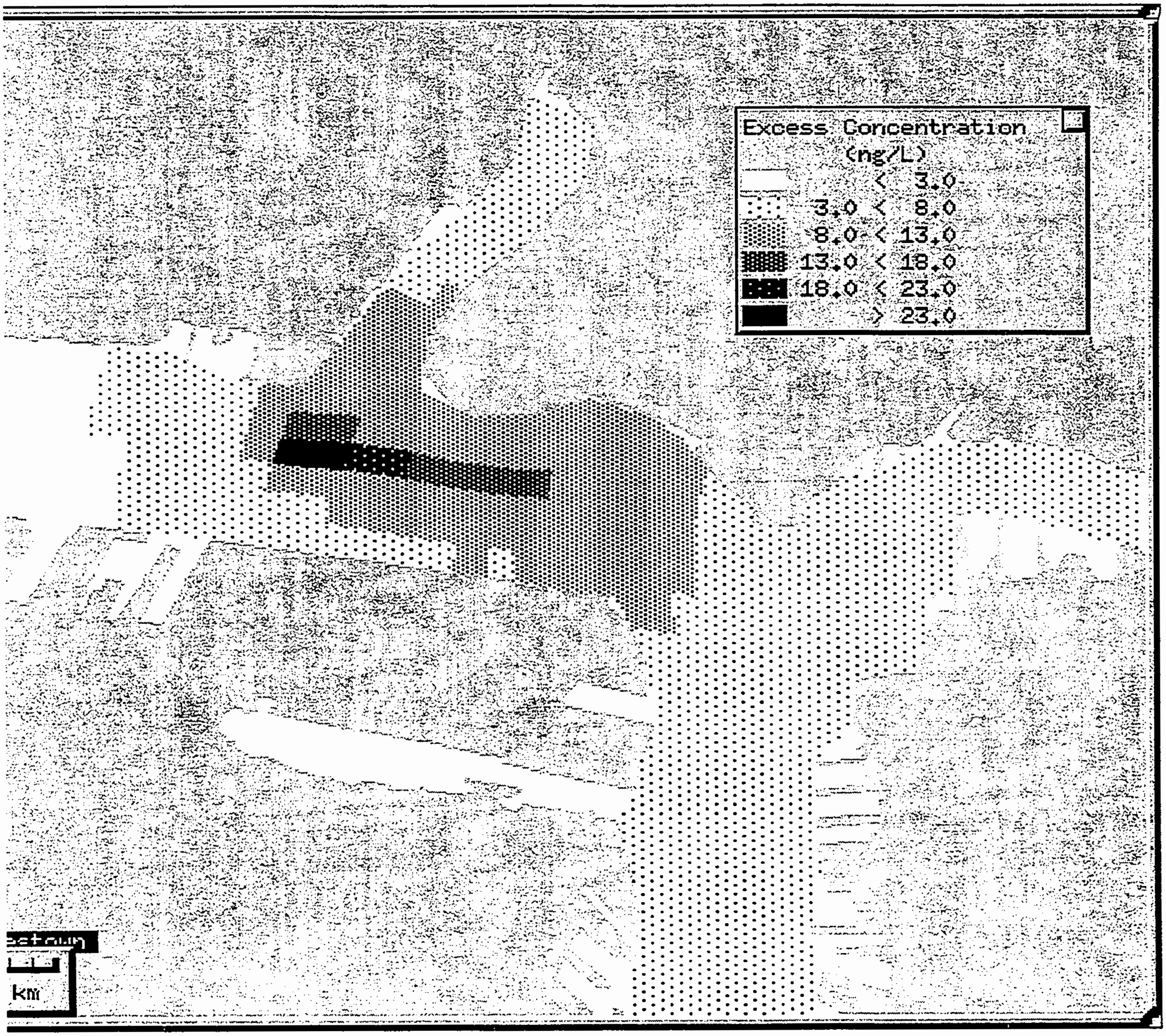

Figure 3.20 Maximum mixing zone (greater than 23 ng/L) for PCB for the highest 25% (2.28 ppb) of sediment based on a typical dredging and worst case multiple instantaneous release scenario (DSS + DSMAX [~10000 yd^3/day]) at the Mystic River disposal site

Appendix 1

Memorandum from Michael Wade, Wade Research Inc. (31 March 1995)

WRI Memorandum

To: John Shipman, NAI
From: Michael J. Wade, WRI
Date: March 27, 1995
Subject: U.S. Army Corps of Engineers/MassPort Boston Harbor Navigation Improvement Project; PAH Source Terms

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Enclosed are PAH source terms for various individual PAH and ΣPAH^{16} for the computer modeling related to disposal operations planned for the above-referenced project. These data come from the latest information available on the Massachusetts Bays Project, a joint project from the Commonwealth of Massachusetts and the U.S. Environmental Protection Agency. These specific data come from a paper that I presented at the American Chemical Society Summer Meeting in Boston in 1993, and can be referenced in other work. There are actually four different references that can be used for these data, as presented at the end of this memo.

These data include PAH data on rivers that discharge into either Boston Harbor and/or Massachusetts Bay. These are the Charles, Danvers, Merrimack, and Mystic Rivers. In addition, we can get data on MWRA's POTW Effluent as well as storm water data and CSO data for various inputs into Boston Harbor. However, the major sources are the rivers and MWRA's POTW effluent.

For the rivers, the detailed data are included in a separate attachment to this memo. Sampling points are important here as well. The sampling points were checked to ensure that they were only fresh water and did not include any salt water influence. Table 1 provides information on the sampling locations for river and POTW effluent. Appendix A includes all necessary data on the rivers and the POTW effluents for MWRA.

I have not included data for minor POTWs such as South Essex and Lynn, or from CSO and stormwater discharges into Boston Harbor. I can provide such data on short order, if necessary. The next subject that I will be working on is the issue of PAH degradation, focusing on the naphthalene problem. Thus far, I have expended as total of five (5) hours on selection evaluation of these MassBays data and the preparation of the submittal to NAI. If you have something from Craig Swanson or a list of source terms that he needs, I could use a copy of it to guide my work.

The PAH data included in Appendix A represent the best PAH data available to the scientific community at this time on this issue. Use of these data should obviate any criticism of the use of the much more imprecise data provided by previous loadings estimates from MWRA or the MassBays program. These data are simply the best available.

Table 1. Sampling Locations for River and POTW effluent from the Massachusetts Bays Program for Freshwater and Sewage Effluent PAH Data.

Rivers/Sources	Sampling Location
Charles	Immediately upstream of the Charles River Dam
Danvers	Sampled from a public pier, opposite the Route 107 Bridge, sampled on an outgoing tide out of the salt water lens
Merrimack	Immediately downstream of the City of Newburyport
Mystic	Immediately upstream of the Amelia Ehrhardt Dam
MWRA, Dear Island	Downstream of all treatment activities, upstream of final discharge opening
MWRA, Nut Island	Downstream of all treatment activities, upstream of final discharge opening

References

Wade, M.J. 1993. Questions on the Distribution of Chlorinated and Polynuclear Aromatic Hydrocarbons in Boston Harbor and Massachusetts Bay Sediments. Presented at the 23rd Northeast Regional Meeting of the American Chemical Society, June 22-25, 1993, Northeastern University, Boston, Massachusetts.

Menzie-Cura & Associates, Inc. 1994. Organic Loadings from the Merrimack River to Massachusetts Bay. Prepared for Massachusetts Bays Program. Massachusetts Executive Office of Environmental Affairs, Coastal Zone Management Office, U. S. Environmental Protection Agency - Water Management Division.

Menzie-Cura & Associates, Inc. 1995. Final Draft Report Nonpoint Source Runoff PAH Loading Analysis. Prepared for Massachusetts Bays Program. Massachusetts Executive Office of Environmental Affairs, Coastal Zone Management Office, U. S. Environmental Protection Agency - Water Management Division.

Wade, M.J., G.B. Gardner, D. Phinney, and J.J. Cura. 1995. Transport and Distribution of Polycyclic Aromatic Hydrocarbons, Chlorinated Pesticides and Polychlorinated Biphenyls from the Merrimack River to Massachusetts Bay USA. Submitted to Environmental Science and Technology.

Appendix A follows:

Calculation of PAH Means for
MassPort Source Modeling

Sample	Units	Napthalene	Acenaphythylene	Acenaphthene	Flurorene	Phenanthrene	Anthracene
CharlesRiver	ng/L	232.23	36.4	86.32	118.95	860.24	67.21
CharlesRiver	ng/L	16.21	9.14	0	5.2	23.78	8.17
CharlesRiver	ng/L	3.4	33	83	120	590	30
Mean	ng/L	84	26	56	81	491	35
DanversRiver	ng/L	27.48	7.84	7.68	9.17	73.47	12.16
DanversRiver	ng/L	44.91	4.01	6.67	4.63	13.2	0
DanversRiver	ng/L	12	0	0	0	5.6	0
Mean	ng/L	28	4	5	5	31	4
DeerIslPOTW	ng/L	1799	0	205.44	191.08	495.85	125.28
DeerIslPOTW	ng/L	860	46	99	35	190	0
DeerIslPOTW	ng/L	1500	42	170	190	290	34
Mean	ng/L	1386	29	158	139	325	53
Merrimack River, Freshwater	ng/L	7.1	0	0	0	3.7	0
Merrimack River, Freshwater	ng/L	23	0	0	0	5.3	1.4
Merrimack River, Freshwater	ng/L	39	0	0	0	5.5	0
Merrimack River, Freshwater	ng/L	0	0	0	0	29	0
Merrimack River, Freshwater	ng/L	123	2.8	3.2	3.3	72	2.7
Merrimack River, Freshwater	ng/L	32.46	6.9	5.76	4.98	18.43	6.91
Merrimack River, Freshwater	ng/L	31.26	5.92	5.92	3.43	15.55	5.99
Merrimack River, Freshwater	ng/L	58.05	5.21	0	4.35	9.41	0
Merrimack River, Freshwater	ng/L	58.51	8.46	0	3.07	14.7	6.29
Merrimack River, Freshwater	ng/L	40.21	6.96	4.78	0	12.47	5.34
Merrimack River, Freshwater	ng/L	28.75	0	5.17	0	6.98	3.18
Merrimack River, Freshwater	ng/L	88	1.9	3.6	2.8	58	0
Mean	ng/L	44	3	2	2	21	3

Calculation of PAH Means for
MassPort Source Modeling

Sample	Units	Napthalene	Acenaphythylene	Acenaphthene	Flurorene	Phenanthrene	Anthracene
MysticRiver	ng/L	62.62	15.28	39.12	39.23	217.31	28.04
MysticRiver	ng/L	36.5	14.93	7.4	8.32	27.28	15.44
MysticRiver	ng/L	15	5.8	0	0	7.7	10
Mean	ng/L	38	12	16	16	84	18
NutIslPOTW	ng/L	576.87	0	0	78.64	138.85	30.29
NutIslPOTW	ng/L	370	690	18	76	120	24
NutIslPOTW	ng/L	350	8.8	42	37	78	5.4
Mean	ng/L	432	233	20	64	112	20
Merrimack River, Saltwater	ng/L	9.8	0	0	0	0	0
Merrimack River, Saltwater	ng/L	19	13	0	0	26	0
Merrimack River, Saltwater	ng/L	71	0.93	0	0	49	0
Merrimack River, Saltwater	ng/L	9.28	0	0	0	2.76	0
Merrimack River, Saltwater	ng/L	10.65	0	0	0	7.11	0
Mean	ng/L	24	3	0	0	17	0
TSS, MassBays, Station2	ng/L	0.32	0.06	0	0	0.24	0.2
TSS, MassBays, Station4	ng/L	0.35	0	0	0	0.07	0
TSS, MassBays, Station5	ng/L	0.39	0	0	0	0	0
TSS, MassBays, Station6	ng/L	0.43	0	0	0	0.075	0
TSS, MassBays, Station6b	ng/L	0.13	0	0	0	0.049	0
TSS, MassBays, Station8	ng/L	0.31	0	0	0	0	0
Mean	ng/L	0.322	0.010	0.000	0.000	0.072	0.033

Calculation of PAH Means for
MassPort Source Modeling

Sample	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene
CharlesRiver	691.06	421.7	24.38	121.5	91.71	25.46
CharlesRiver	32.67	43.48	9.83	18.33	14.53	10.5
CharlesRiver	550	340	33	100	71	23
Mean	425	268	22	80	59	20
DanversRiver	84.51	56.08	10.23	24.92	23.6	7.32
DanversRiver	12.45	6.86	1.61	3.86	2.67	2.29
DanversRiver	24	20	7.7	8.9	11	3.8
Mean	40	28	7	13	12	4
DeerIslPOTW	240.7	266.2	91.79	0	71.61	58.91
DeerIslPOTW	0	0	0	0	27	0
DeerIslPOTW	86	95	25	32	23	13
Mean	109	120	39	11	41	24
Merrimack River, Freshwater	4.5	3.1	1.8	1.4	1.4	0
Merrimack River, Freshwater	7.6	5.7	3.4	4	3.1	0
Merrimack River, Freshwater	8.8	5.2	0	0	5.6	3.4
Merrimack River, Freshwater	52	38	0	0	38	15
Merrimack River, Freshwater	28	17	7.1	15	12	4.7
Merrimack River, Freshwater	36.96	31.75	16.91	20.25	16.42	16.21
Merrimack River, Freshwater	25.59	21.39	9.04	12.69	10.97	10.2
Merrimack River, Freshwater	12.54	9.08	2.67	5.13	3.68	3.72
Merrimack River, Freshwater	20.06	17.01	6.41	11.11	7.45	6.63
Merrimack River, Freshwater	17.49	13.99	6.5	9.07	6.69	6.6
Merrimack River, Freshwater	6.54	6.63	0	3.24	2.75	1.99
Merrimack River, Freshwater	15	6.6	3.2	7.1	6.1	1.6
Mean	20	15	5	7	10	6

Calculation of PAH Means for
MassPort Source Modeling

Sample	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene
MysticRiver	194.35	110.08	9.38	34.48	28.53	8.11
MysticRiver	55.27	47.23	10.86	21.59	15.93	15.09
MysticRiver	30	46	10	17	18	6.3
Mean	93	68	10	24	21	10
NutIslPOTW	42.4	46.36	0	0	9.69	10.99
NutIslPOTW	0	24	12	6.9	11	3
NutIslPOTW	37	31	8	12	12	4.3
Mean	26	34	7	6	11	6
Merrimack River, Saltwater			0	0	0	0
Merrimack River, Saltwater	44	30	12	21	23	15
Merrimack River, Saltwater	13	3.7	2.3	6.2	4.2	1.8
Merrimack River, Saltwater	2.41	1.86	0	0	0	0
Merrimack River, Saltwater	5.81	3.89	0	0	0	0
Mean	16	10	3	5	5	3
TSS, MassBays, Station2	0.33	0.23	0.21	0.19	0.15	0.14
TSS, MassBays, Station4	0.06	0.05	0.17	0.05	0.05	0.04
TSS, MassBays, Station5	0.07	0.05	0.11	0.06	0.05	0.04
TSS, MassBays, Station6	0.048	0.03	0.07	0.032	0.039	0.028
TSS, MassBays, Station6b	0	0.036	0.024	0.035	0.03	0.013
TSS, MassBays, Station8	0.05	0.04	0.13	0.03	0.03	0.03
Mean	0.093	0.073	0.119	0.066	0.058	0.049

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Calculation of PAH Means for
MassPort Source Modeling

Sample	Benzo(a)pyrene	Ideno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(ghi)perylene	TotalPAH16
CharlesRiver	14.1	22.77	4.29	21.52	2839.84
CharlesRiver	8.74	6.75	0	7.58	214.91
CharlesRiver	20	13	2.7	12	2024.1
Mean	14	14	2	14	1693
DanversRiver	6.32	10.93	2.35	10.83	374.89
DanversRiver	0	2.48	0	1.94	107.58
DanversRiver	7.3	3.3	0	4.3	107.9
Mean	5	6	1	6	197
DeerIslPOTW	0	0	0	45.64	3591.5
DeerIslPOTW	0	0	2.7	15	1274.7
DeerIslPOTW	9.7	15	0	0	2524.7
Mean	3	5	1	20	2464
Merrimack River, Freshwater	0	0	0	0	23
Merrimack River, Freshwater	2.3	0	0	1.7	57.5
Merrimack River, Freshwater	3.4	0	0	5.9	76.8
Merrimack River, Freshwater	18	17	0	23	230
Merrimack River, Freshwater	7.6	5.6	1.5	5.4	310.9
Merrimack River, Freshwater	17.19	11.8	2.29	12.35	257.57
Merrimack River, Freshwater	9.97	7.67	2.16	8.49	186.24
Merrimack River, Freshwater	3.42	0	0	0	117.26
Merrimack River, Freshwater	5	4.38	0	4.58	173.66
Merrimack River, Freshwater	5.3	4.71	0	4.43	144.54
Merrimack River, Freshwater	0	0	0	0	65.23
Merrimack River, Freshwater	1.6	1.5	0	2.3	199.3
Mean	6	4	0	6	154

Calculation of PAH Means for
MassPort Source Modeling

Sample	Benzo(a)pyrene	Ideno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(ghi)perylene	TotalPAH16
MysticRiver	5.8	9.62	1.94	9.77	813.66
MysticRiver	11.55	10.13	0	11.24	308.76
MysticRiver	11	8.2	0	7.6	192.6
Mean	9	9	1	10	438
NutIslPOTW	12.49	0	0	6.25	952.83
NutIslPOTW	7.6	12	0	6.1	1380.6
NutIslPOTW	9.6	8.1	0	6.7	649.9
Mean	10	7	0	6	994
Merrimack River, Saltwater	0	0	0	0	9.8
Merrimack River, Saltwater	12	14	0	21	250
Merrimack River, Saltwater	2.2	0	0	1.7	156.03
Merrimack River, Saltwater	0	0	0	0	16.31
Merrimack River, Saltwater	0	0	0	0	27.46
Mean	3	3	0	5	92
TSS, MassBays, Station2	0.15	0.13	0	0.13	2.48
TSS, MassBays, Station4	0	0.04	0	0	0.88
TSS, MassBays, Station5	0	0.05	0	0	0.82
TSS, MassBays, Station6	0	0	0	0	0.752
TSS, MassBays, Station6b	0.025	0.022	0.008	0.026	0.398
TSS, MassBays, Station8	0	0	0	0	0.62
Mean	0.029	0.040	0.001	0.026	0.992

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APPENDIX G - PROP WASH VELOCITY CALCULATIONS

BOSTON HARBOR NAVIGATION IMPROVEMENT PROJECT

CHARACTERIZATION OF NEAR BOTTOM WATER VELOCITIES GENERATED BY TYPICAL VESSEL OPERATIONS IN THE IMPROVED BOSTON HARBOR

Submitted To

NORMANDEAU ASSOCIATES INC.
25 Nashua Road
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March 21, 1995

Submitted By

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1.0 INTRODUCTION

As vessels transit the improved channels of Boston Harbor, the propeller slipstreams will generate extensive fields of relatively high velocity flows. These vessel induced flows could have significant impacts upon the sedimentation processes within the project reach. An analysis of these flow fields was developed for a range of typical vessels. These vessels included:

(1) LNG Tanker
(2) APL C8 Container Ship
(3) 41,000 DWT Tanker
(4) Ocean Tug
(5) Harbor Tug

The slipstream velocity field generated by each of these vessels was determined for a range of propeller shaft power levels by simulating the propeller slipstream as a submerged hydraulic jet. The specific magnitudes of water velocities were determined, in this two-dimensional numerical simulation, over the full range of water depth and at incremental distances from the stern of the vessels.

Typical vessel operating parameters, as described by active Boston Harbor pilots, are quantified. Actual observations of vessel slipstream impacts are summarized and critical channel reaches are identified. A spatial description of potential vessel induced, near bottom velocities throughout the project area is presented.

2.0 VESSEL SIMULATION

Vessel propeller slipstream velocities were approximated using an analogy with a submerged hydraulic jet emerging from an orifice with constant exit velocity (Blaauw, H.G. and Van de Kaa, E.J., 1978). The simulation is based upon several general assumptions: (1) vessels have little or no speed; (2) pressure is hydrostatically distributed; (3) the jet diffusion process is dynamically similar under all flow conditions; (4) the propeller thrust is equivalent to the delivered thrust; and (5) the axial velocity distribution is represented by the normal probability function. The formulation which was used to simulate the velocity fields for the various vessels is described in the accompanying computation sheets.

The vessel draft and installed power parameters, which were employed for these simulations, were based upon typical values for vessels which frequent Boston Harbor. No attempts were made to characterize the effects of multiple propellers or the influence of vessel hull geometry on the slipstream flow fields.

3.0 TYPICAL OPERATING CONDITIONS

Typical vessel transit procedures and tug operations within the channel ways of Boston Harbor were characterized by Messrs. Dave Galman, Docking Master, and George Lee, Tug Captain, of the Boston Docking Pilots Association. The following description is a synopsis of discussions with these vessel operations experts.

Assisting tugs can be provided with a range of onboard power. Typical tugs will have between 1,600 HP (1,225 kW) and 3,000 HP (2,300 kW) onboard. Tug draft is typically around 13'-6". Most new tugs are being delivered with twin propellers, although many single screw tugs continue to operate. In-bound vessels pick up the Pilot and all required and necessary assisting tugs prior to entering the channel. Large vessels may require as many as five (5) tugs to assist with both transit and berthing maneuvers.

Deep draft vessels, with tug assist, transit the inner channel ways at less than five (5) knots and typically utilize less than 25 % of the onboard power. These vessels will typically transit with no assist by the tugs. The Pilot will call for assist only as necessary and typically during turning and slowing. Tug assistance is normally required when turning a deep draft vessel into the Reserved Channel. Tugs also are utilized for maneuvering out of the Inner Confluence and into the Mystic River and Chelsea Creek. As noted, tugs may be used during slowing maneuvers while transitting the channel and for preparing the vessel for berthing. Slowing of the deep draft vessels will typically be accomplished by placing the power train at "half-a-stern" or putting 50 % power to the propeller shaft while turning in reverse. This maneuver likely generates the most potential for relatively high near bottom velocities.

The vessel transitting operations, including tug maneuvers, will typically generate turbidity plumes coincident with the propeller slipstream. Turbidity plumes have been observed throughout the channel reach and in most berths. The most highly impacted area is the Inner Confluence, and the channel reaches extending almost all the way up the Mystic River channel, and to just beyond the McArdle Bridge in Chelsea Creek.

4.0 SIMULATION RESULTS

Vessel slipstream velocity fields were simulated for each of the representative vessels. A fixed depth of 45 ft (13.72 m) was used for all of the simulations. Velocity fields corresponding to 20%, 40%, 60%, 80%, and 100% installed power levels were generated for each of the vessels. The detailed two-dimensional velocity fields are tabulated on the attached computation sheets and summarized on the following Table 1. This Table identifies the approximate maximum velocities experienced on the channel bottom and at the water surface, and the approximate distance from the propeller that these occur for each of the power levels and vessels simulated.

TABLE 1
Propeller Slipstream Velocity Summary

20 % Installed Power

Vessel	Maximum Surface Velocity, ft/s	Surface Distance From Propeller, ft	Maximum Bottom Velocity, ft/s	Bottom Distance From Propeller, ft
LNG Tanker	5.1	131	7.9	98
APL C8 Container Ship	4.5	131	6.2	98
41k DWT Tanker	3.8	131	5.9	98
Ocean Tug	4.6	65	1.2	197
Harbor Tug	3.7	33	0.9	197

40 % Installed Power

Vessel	Maximum Surface Velocity, ft/s	Surface Distance From Propeller, ft	Maximum Bottom Velocity, ft/s	Bottom Distance From Propeller, ft
LNG Tanker	6.3	131	9.9	98
APL C8 Container Ship	5.7	131	7.8	98
41k DWT Tanker	4.7	131	7.4	98
Ocean Tug	5.8	65	1.6	197
Harbor Tug	4.6	33	1.1	197

TABLE 1 (Cont'd)
Propeller Slipstream Velocity Summary

60 % Installed Power

Vessel	Maximum Surface Velocity, ft/s	Surface Distance From Propeller, ft	Maximum Bottom Velocity, ft/s	Bottom Distance From Propeller, ft
LNG Tanker	7.3	13.1	11.4	98
APL C8 Container Ship	6.5	131	8.9	98
41k DWT Tanker	5.4	131	8.5	98
Ocean Tug	6.7	65	1.8	197
Harbor Tug	5.3	33	1.2	197

80 % Installed Power

Vessel	Maximum Surface Velocity, ft/s	Surface Distance From Propeller, ft	Maximum Bottom Velocity, ft/s	Bottom Distance From Propeller, ft
LNG Tanker	8.1	131	12.6	98
APL C8 Container Ship	7.2	131	9.8	98
41k DWT Tanker	5.9	131	9.3	98
Ocean Tug	7.3	65	2.1	197
Harbor Tug	5.8	33	1.4	197

TABLE 1 (Cont'd)
Propeller Slipstream Velocity Summary

100 % Installed Power

Vessel	Maximum Surface Velocity, ft/s	Surface Distance From Propeller, ft	Maximum Bottom Velocity, ft/s	Bottom Distance From Propeller, ft
LNG Tanker	8.6	131	13.5	98
APL C8 Container Ship	7.7	131	10.6	98
41k DWT Tanker	6.4	131	10.1	98
Ocean Tug	7.9	65	2.1	197
Harbor Tug	6.3	33	1.5	197

These analyses do not reflect any modification to the slipstream flow field by the vessel hull, when the propeller and consequently the efflux jet direction is reversed.

5.0 SUMMARY

Maximum surface and near bottom velocities generated by typical transitting vessels were determined using a simulation technique which compared the two-dimensional vessel propeller slipstream with the velocity field generated by a submerged hydraulic jet. A review of typical vessel operating procedures demonstrated that deep draft vessels will rarely exceed 20-25% of onboard power during transit operations. These vessels do, however, utilize up to 50% power in reverse thrust during breaking procedures for berthing. Tug generated velocities resulting from shaft powers approaching 100% are typical throughout the upper harbor and most typical during vessel turning operations through the Inner Confluence, throughout the Mystic River Channel, and during all berthing maneuvers.

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Project:	Boston Harbor Navigation Improvements	Sheet No.	1	of	
		Job No.	94051.000000		
Subject:	Vessel Slipstream Velocities	Made By	JCR	Date	03-05-95
		Chkd. By		Date	

1.0 EVALUATION OF WATER VELOCITIES GENERATED BY TYPICAL VESSEL OPERATIONS IN THE IMPROVED BOSTON HARBOR

The vertical water velocity profiles generated by various typical vessels were produced using a simple two-dimensional numerical simulation, based upon momentum theory and representing the propeller slipstream as a submerged jet. Several general assumptions were made :

(1) Pressure is hydrostatically distributed throughout.
(2) The diffusion process is dynamically similar under all flow conditions.
(3) The longitudinal velocity component within the area of diffusion varies as the normal probability function over each vertical section.

The analyses were performed only over the zone of established flow and employed empirically determined (Ref. 1) constants which fit measured slipstream velocities to the Gaussian normal distribution.

Five distinct vessels were evaluated, including three (3) deep draft transports and two (2) tugs. Each vessel was evaluated at power output levels ranging from 20% to 100%. **IT SHOULD BE EMPHASIZED THAT THE POWER LEVELS OF THE DEEP DRAFT VESSELS WILL NOT LIKELY EVER EXCEED 20% WHEN TRANSITTING THE BOSTON CHANNEL REACHES.** The data is presented for information only and should be utilized as a comparison of vessel operations. Specific vessel power utilization should be verified with the Boston Docking Pilots, MASSPORT, or the USA COE.

Rev. No.
Made By Date

File Ref.: vesvel0.wk4

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OCEAN AND COASTAL CONSULTANTS, INC.

Project:	Boston Harbor Navigation Improvements	Sheet No.	2	of	
		Job No.	94051.000000		
Subject:	Vessel Slipstream Velocities	Made By	JCR	Date	03-01-95
		Chkd. By		Date	

2.0 Determination of Vessel Slipstream Velocity

This analysis employs empirically developed formulation, based upon simple momentum theory and uses an analogy with a three-dimensional jet.

References

(1) Blaauw, H.G. and Van DeKaa, E.J., "Erosion of Bottom and Sloping Banks Caused By the Screw Race of Manoevering Ships", Delft, Netherlands, Pub. No. 202, July 1978.

(2) "Draft EIR / EIS, Boston Harbor, Massachusetts, Navigation Improvement Project and Berth Dredging Project", US Army Corps of Engineers, NED, MASSPORT, Vol 2 of 2, Appendix D, Ship Simulation Study, April 1994.

2.1 Numerical Simulation

Computation of propeller axial efflux velocity (Ref. 1)

For ducted propellers : Vo = 1.17 * (Pd / (D^2))^0.33

For non-ducted propellers : Vo = 1.48 * (Pd / (D^2))^0.33

Computation of radial velocities (Ref. 1)

Vx / Vo = 2.78 * (Do / x) exp [-15.43 * ((z^2) / (x^2))]

Legend

Vo	Propeller axial efflux velocity
Pd	Installed engine power, kW
Vx	Axial veloxity, distance z from centerline
D	Diameter of vessel propeller
Do	Propeller slipstream diameter Do = 0.71 * D , For non-ducted propellers Do = D, For ducted propellers

Note : If the propeller diameter is not known, it can be approximated as 0.7 * (Loaded Vessel Draft)

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2.2 Vessel Characteristics

Reference (2) describes the various vessels which were considered for the development of the ship handling model simulation. The following Table identifies those vessels and the critical characteristics which were employed for the analyses which follow. Tug characteristics are referenced below.

Vessel	Draft, m	Length, m	Beam, m	Power,kW (Note)	Prop Dia,m
LNG	12.8	286.5	42.7	29,900	9.0
APL C8 Container	12.2	240.2	30.5	18,650	8.5
41K DWT Tanker	12.8	178.3	27.4	12,310	9.0
Ocean Tug	4.3	62.5	10.1	2,835	3.0
Harbor Tug	3.7	30.5	8.8	1,195	2.6

1 m = 3.2808 ft — Vessel Dimension Data in Table from Ref. (2)
1 kW = 1.3405 HP

Note: Vessel kW Rating Approximated - Typical Values From : Handbook of Ocean and Underwater Engineering ed. Myers, Holm & McAllister, McGraw-Hill, New York, 1969.

2.3 Environmental Conditions

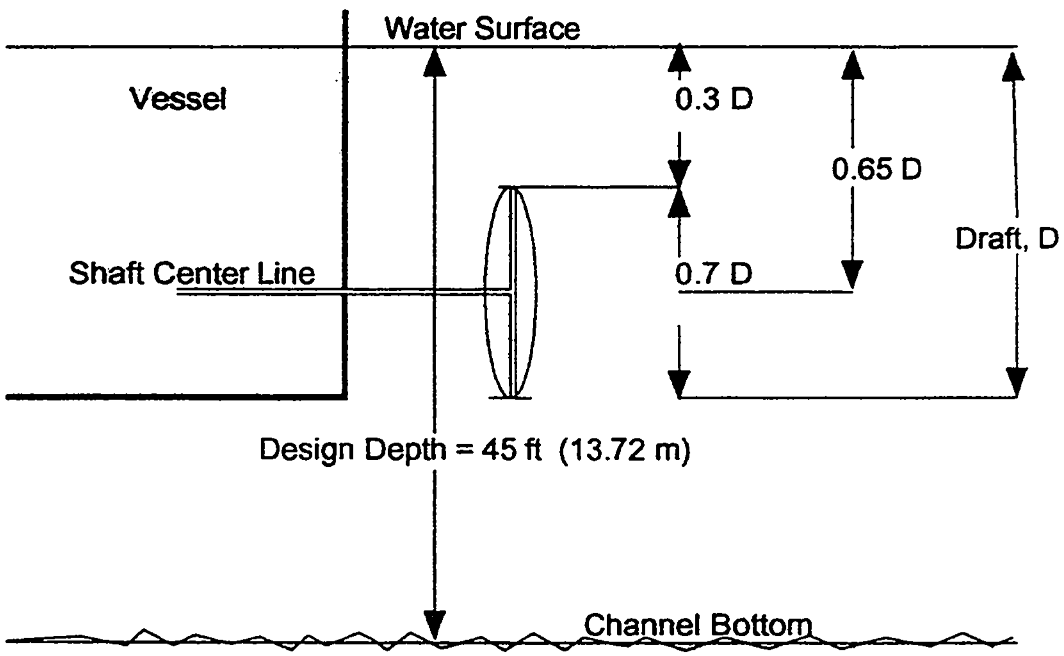
Vessel operating conditions were developed for fixed water depths of 45-ft. No consideration was given to the effects of wind, tidal, or other currents. The vessels were assumed to be very slow moving.

2.4 Computations

Velocity profiles, extending from the water surface to the channel bottom at -45-FT and computed at various distances from the propeller hub, were determined for each of the typical vessels described in the Table Section 1.2 of these analyses. Each vessel was evaluated at power output levels of 20%, 40%, 60%, 80 %, and 100% installed HP.

Propeller diameter was assumed to be 0.7 x Vessel Draft

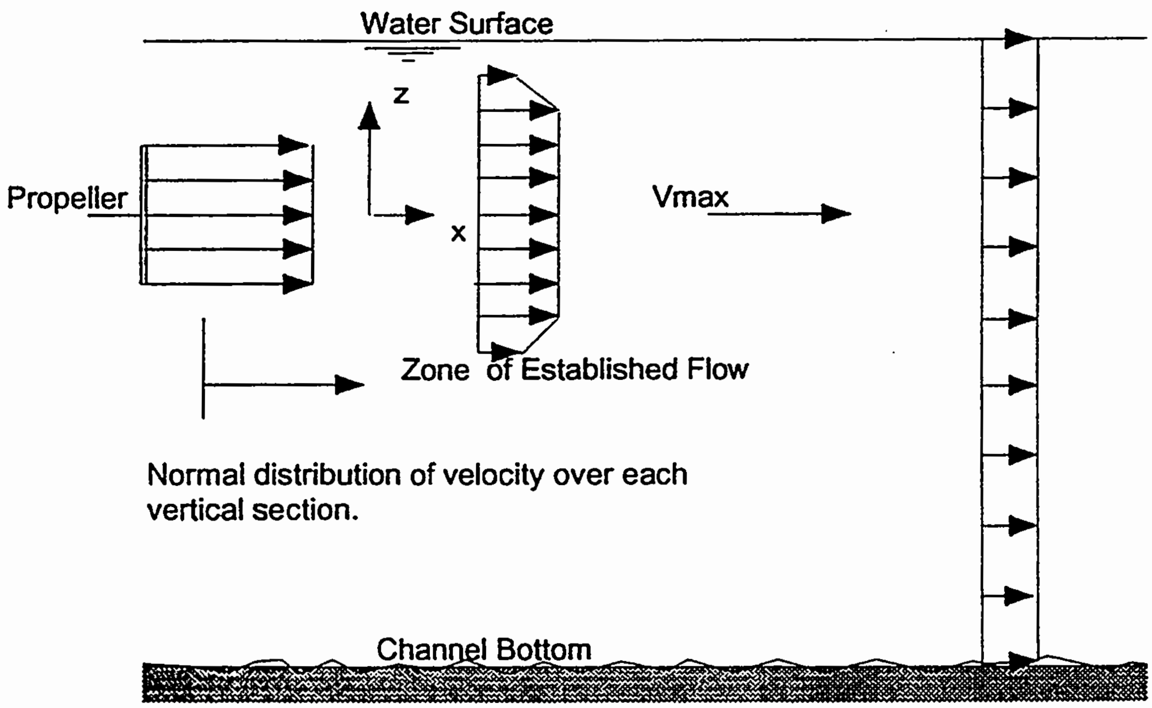
Propeller Hub , i.e. center line of efflux jet, was located, 0.65 x Vessel Draft , below the Water Surface.



VESSEL PROPELLER SCHEMATIC

2.5 Presentation of Numerical Results

The data is presented in tabular format, showing computed water velocities as function of : (1) water depth ; and (2) distance, x , from the propeller, for each of the four (4) vessels at five (5) distinct power output levels.



DEVELOPMENT OF VELOCITY PROFILE

The radial distance from the propeller center line, z, to the water surface and to the channel bottom will vary with the draft of each vessel. These maximum distances represent the limiting values for the numerical simulation.

Vessel	Draft,m	z max , surface , m	z max , bottom , m
LNG	12.8	8.320	5.400
APL C8	12.2	7.930	5.790
Tanker	12.8	8.320	5.400
OC Tug	4.3	2.795	10.925
Hrbr Tug	3.7	2.405	11.315

OCEAN AND COASTAL CONSULTANTS, INC.

Project: Boston Harbor Navigation Improvements
Subject: Vessel Slipstream Velocities

Sheet No. 6 of
Job No. 94051.000000
Made By JCR Date 03-04-95
Chkd. By Date

SIMULATION NO. 1
Induced Water Velocities, m/s
Vessel : 41K DWT Tanker
Power Level : 20 %

Installed kW : 12,310
Test Run kW : 2,462
Vessel Draft , m: 12.80
Water Depth , m: 13.72

Depth, m	x , Distance Behind Propeller, m										
	5	10	20	25	30	40	60	100	200	300	400
0.00	0.00	0.00	0.31	0.65	0.91	1.15	1.11	0.80	0.43	0.29	0.22
0.50	0.00	0.00	0.43	0.79	1.05	1.24	1.14	0.81	0.44	0.29	0.22
1.00	0.00	0.00	0.57	0.96	1.19	1.33	1.18	0.82	0.44	0.29	0.22
1.50	0.00	0.01	0.75	1.14	1.34	1.43	1.22	0.83	0.44	0.29	0.22
2.00	0.00	0.02	0.96	1.34	1.50	1.52	1.25	0.84	0.44	0.29	0.22
2.50	0.00	0.05	1.22	1.55	1.67	1.61	1.29	0.85	0.44	0.30	0.22
3.00	0.00	0.12	1.50	1.78	1.83	1.70	1.32	0.85	0.44	0.30	0.22
3.50	0.00	0.25	1.83	2.02	2.00	1.78	1.35	0.86	0.44	0.30	0.22
4.00	0.00	0.51	2.18	2.25	2.16	1.86	1.37	0.87	0.44	0.30	0.22
4.50	0.00	0.95	2.55	2.49	2.32	1.94	1.40	0.87	0.44	0.30	0.22
5.00	0.02	1.64	2.92	2.72	2.46	2.00	1.42	0.88	0.44	0.30	0.22
5.50	0.14	2.63	3.28	2.93	2.59	2.06	1.44	0.88	0.44	0.30	0.22
6.00	0.66	3.90	3.62	3.12	2.71	2.12	1.45	0.88	0.44	0.30	0.22
6.50	2.33	5.36	3.92	3.29	2.81	2.16	1.46	0.89	0.44	0.30	0.22
7.00	6.12	6.82	4.17	3.41	2.88	2.19	1.47	0.89	0.45	0.30	0.22
7.50	11.80	8.04	4.34	3.51	2.94	2.21	1.48	0.89	0.45	0.30	0.22
8.00	17.82	8.91	4.46	3.56	2.97	2.23	1.49	0.89	0.45	0.30	0.22
8.50	17.82	8.91	4.46	3.56	2.97	2.23	1.49	0.89	0.45	0.30	0.22
9.00	13.42	8.30	1.64	3.56	2.95	2.22	1.48	0.89	0.45	0.30	0.22
9.50	7.58	7.20	4.22	3.46	2.90	2.20	1.48	0.89	0.45	0.30	0.22
10.00	3.15	5.78	4.00	3.33	2.83	2.17	1.47	0.89	0.45	0.30	0.22
10.50	0.96	4.30	3.71	3.17	2.74	2.13	1.46	0.88	0.44	0.30	0.22
11.00	0.22	2.96	3.38	2.99	2.63	2.08	1.44	0.88	0.44	0.30	0.22
11.50	0.04	1.89	3.02	2.78	2.50	2.02	1.42	0.88	0.44	0.30	0.22
12.00	0.00	1.12	2.65	2.56	2.36	1.96	1.40	0.87	0.44	0.30	0.22
12.50	0.00	0.61	2.28	2.32	2.21	1.88	1.38	0.87	0.44	0.30	0.22
13.50	0.00	0.15	1.59	1.84	1.88	1.72	1.32	0.86	0.44	0.30	0.22
13.72	0.00	0.10	1.46	1.74	1.81	1.68	1.31	0.85	0.44	0.30	0.22

Rev. No.
Made By Date

File Ref.: bhnivel1.wk4

OCEAN AND COASTAL CONSULTANTS, INC.

Project:	Boston Harbor Navigation Improvements	Sheet No.	7	of	
		Job No.			
Subject:	Vessel Slipstream velocities	Made By	JCR	Date	03-04-95
		Chkd. By		Date	

SIMULATION NO. 2
Induced Water Velocities, m/s
Vessel : 41K DWT Tanker
Power Level : 40 %

Installed	kW :	12,310
Test Run	kW :	4,924
Vessel Draft , m:		12.80
Water Depth , m:		13.72

Depth, m	x , Distance Behind Propeller, m										
	5	10	20	25	30	40	60	100	200	300	400
0.00	0.00	0.00	0.39	0.82	1.15	1.44	1.39	1.01	0.55	0.37	0.28
0.50	0.00	0.00	0.54	1.00	1.32	1.56	1.44	1.02	0.55	0.37	0.28
1.00	0.00	0.00	0.72	1.20	1.50	1.68	1.49	1.03	0.55	0.37	0.28
1.50	0.00	0.01	0.94	1.43	1.69	1.79	1.53	1.04	0.55	0.37	0.28
2.00	0.00	0.02	1.21	1.68	1.89	1.91	1.57	1.05	0.55	0.37	0.28
2.50	0.00	0.06	1.53	1.95	2.10	2.02	1.62	1.06	0.55	0.37	0.28
3.00	0.00	0.15	1.89	2.24	2.30	2.13	1.65	1.07	0.55	0.37	0.28
3.50	0.00	0.32	2.30	2.53	2.51	2.24	1.69	1.08	0.56	0.37	0.28
4.00	0.00	0.64	2.74	2.83	2.72	2.34	1.72	1.09	0.56	0.37	0.28
4.50	0.00	1.19	3.20	3.13	2.91	2.43	1.75	1.10	0.56	0.37	0.28
5.00	0.03	2.06	3.67	3.42	3.09	2.52	1.78	1.10	0.56	0.37	0.28
5.50	0.17	3.31	4.13	3.69	3.26	2.59	1.80	1.11	0.56	0.37	0.28
6.00	0.82	4.91	4.56	3.93	3.41	2.66	1.82	1.11	0.56	0.37	0.28
6.50	2.93	6.74	4.93	4.13	3.53	2.71	1.84	1.11	0.56	0.37	0.28
7.00	7.69	8.57	5.24	4.29	3.62	2.75	1.85	1.12	0.56	0.37	0.28
7.50	14.83	10.10	5.46	4.41	3.69	2.78	1.86	1.12	0.56	0.37	0.28
8.00	22.40	11.20	5.60	4.48	3.73	2.80	1.87	1.12	0.56	0.37	0.28
8.50	22.40	11.20	5.60	4.48	3.73	2.80	1.87	1.12	0.56	0.37	0.28
9.00	16.87	10.43	0.34	4.01	3.70	2.79	1.86	1.12	0.56	0.37	0.28
9.50	9.53	9.05	5.31	4.42	3.65	2.76	1.86	1.12	0.56	0.37	0.28
10.00	3.96	7.26	5.03	4.18	3.56	2.73	1.84	1.12	0.56	0.37	0.28
10.50	1.21	5.40	4.67	3.99	3.44	2.68	1.83	1.11	0.56	0.37	0.28
11.00	0.27	3.72	4.25	3.76	3.30	2.61	1.81	1.11	0.56	0.37	0.28
11.50	0.05	2.37	3.80	3.50	3.14	2.54	1.79	1.10	0.56	0.37	0.28
12.00	0.01	1.40	3.33	3.21	2.96	2.46	1.76	1.10	0.56	0.37	0.28
12.50	0.00	0.77	2.87	2.92	2.77	2.37	1.73	1.09	0.56	0.37	0.28
13.50	0.00	0.18	2.00	2.32	2.36	2.16	1.67	1.07	0.55	0.37	0.28
13.72	0.00	0.13	1.83	2.19	2.27	2.12	1.65	1.07	0.55	0.37	0.28

Rev. No.
Made By Date

File Ref.: bhnivel2.wk4

OCEAN AND COASTAL CONSULTANTS, INC.

Project:	Boston Harbor Navigation Improvements	Sheet No.	8 of
		Job No.	94051.000000
Subject:	Vessel Slipstream Velocities	Made By	JCR Date 03-04-95
		Chkd. By	Date

SIMULATION NO. 3
Induced Water Velocities, m/s
Vessel : 41K DWT Tanker
Power Level : 60 %

Installed kW : 12,310
Test Run kW : 7,386
Vessel Draft , m: 12.80
Water Depth , m: 13.72

Depth, m	x , Distance Behind Propeller, m									
	5	10	20	25	30	40	60	100	200	300	400
0.00	0.00	0.00	0.45	0.94	1.31	1.65	1.59	1.15	0.62	0.42	0.32
0.50	0.00	0.00	0.61	1.14	1.51	1.78	1.64	1.17	0.63	0.42	0.32
1.00	0.00	0.00	0.82	1.37	1.71	1.92	1.70	1.18	0.63	0.42	0.32
1.50	0.00	0.01	1.08	1.64	1.93	2.05	1.75	1.19	0.63	0.42	0.32
2.00	0.00	0.03	1.38	1.92	2.16	2.18	1.80	1.20	0.63	0.42	0.32
2.50	0.00	0.07	1.75	2.23	2.40	2.31	1.85	1.22	0.63	0.42	0.32
3.00	0.00	0.17	2.16	2.56	2.63	2.44	1.89	1.23	0.63	0.42	0.32
3.50	0.00	0.36	2.63	2.90	2.87	2.56	1.93	1.24	0.63	0.43	0.32
4.00	0.00	0.73	3.13	3.24	3.11	2.68	1.97	1.24	0.64	0.43	0.32
4.50	0.00	1.37	3.66	3.58	3.33	2.78	2.01	1.25	0.64	0.43	0.32
5.00	0.03	2.36	4.19	3.91	3.54	2.88	2.04	1.26	0.64	0.43	0.32
5.50	0.19	3.78	4.72	4.21	3.73	2.97	2.06	1.26	0.64	0.43	0.32
6.00	0.94	5.61	5.21	4.49	3.89	3.04	2.09	1.27	0.64	0.43	0.32
6.50	3.35	7.70	5.64	4.72	4.03	3.10	2.10	1.27	0.64	0.43	0.32
7.00	8.79	9.80	5.99	4.91	4.14	3.15	2.12	1.28	0.64	0.43	0.32
7.50	16.95	11.55	6.24	5.04	4.22	3.18	2.13	1.28	0.64	0.43	0.32
8.00	25.61	12.80	6.40	5.12	4.27	3.20	2.13	1.28	0.64	0.43	0.32
8.50	25.61	12.80	6.40	5.12	4.27	3.20	2.13	1.28	0.64	0.43	0.32
9.00	19.28	11.93	0.06	3.72	4.23	3.19	2.13	1.28	0.64	0.43	0.32
9.50	10.90	10.34	6.07	4.63	4.17	3.16	2.12	1.28	0.64	0.43	0.32
10.00	4.53	8.30	5.75	4.78	4.07	3.12	2.11	1.27	0.64	0.43	0.32
10.50	1.39	6.18	5.34	4.56	3.94	3.06	2.09	1.27	0.64	0.43	0.32
11.00	0.31	4.25	4.86	4.29	3.78	2.99	2.07	1.27	0.64	0.43	0.32
11.50	0.05	2.71	4.34	4.00	3.59	2.91	2.04	1.26	0.64	0.43	0.32
12.00	0.01	1.60	3.81	3.67	3.39	2.81	2.01	1.25	0.64	0.43	0.32
12.50	0.00	0.88	3.28	3.34	3.17	2.71	1.98	1.25	0.64	0.43	0.32
13.50	0.00	0.21	2.29	2.65	2.70	2.47	1.90	1.23	0.63	0.42	0.32
13.72	0.00	0.15	2.09	2.50	2.60	2.42	1.88	1.22	0.63	0.42	0.32

Rev. No.
Made By Date

File Ref.: bhnivel3.wk4

OCEAN AND COASTAL CONSULTANTS, INC.

Project:	Boston Harbor Navigation Improvements	Sheet No.	9 of
		Job No.	94051.000000
Subject:	Vessel Slipstream Velocities	Made By	JCR Date 03-04-95
		Chkd. By	Date

SIMULATION NO. 4
Induced Water Velocities, m/s
Vessel : 41K DWT Tanker
Power Level : 80 %

Installed	kW :	12,310
Test Run	kW :	9,848
Vessel Draft , m:		12.80
Water Depth , m:		13.72

Depth, m	x , Distance Behind Propeller, m									
	5	10	20	25	30	40	60	100	200	300	400
0.00	0.00	0.00	0.50	1.03	1.44	1.81	1.75	1.27	0.69	0.46	0.35
0.50	0.00	0.00	0.67	1.26	1.65	1.96	1.81	1.28	0.69	0.46	0.35
1.00	0.00	0.00	0.90	1.51	1.88	2.11	1.87	1.30	0.69	0.47	0.35
1.50	0.00	0.01	1.18	1.80	2.12	2.25	1.92	1.31	0.69	0.47	0.35
2.00	0.00	0.03	1.52	2.11	2.38	2.40	1.98	1.32	0.69	0.47	0.35
2.50	0.00	0.08	1.92	2.45	2.63	2.54	2.03	1.34	0.69	0.47	0.35
3.00	0.00	0.18	2.38	2.81	2.90	2.68	2.08	1.35	0.70	0.47	0.35
3.50	0.00	0.40	2.89	3.18	3.16	2.82	2.13	1.36	0.70	0.47	0.35
4.00	0.00	0.80	3.44	3.56	3.41	2.94	2.17	1.37	0.70	0.47	0.35
4.50	0.00	1.50	4.02	3.94	3.66	3.06	2.21	1.38	0.70	0.47	0.35
5.00	0.03	2.60	4.61	4.30	3.89	3.17	2.24	1.38	0.70	0.47	0.35
5.50	0.21	4.16	5.19	4.63	4.10	3.26	2.27	1.39	0.70	0.47	0.35
6.00	1.04	6.17	5.73	4.93	4.28	3.34	2.29	1.40	0.70	0.47	0.35
6.50	3.69	8.47	6.20	5.19	4.44	3.41	2.31	1.40	0.70	0.47	0.35
7.00	9.67	10.78	6.58	5.40	4.56	3.46	2.33	1.40	0.70	0.47	0.35
7.50	18.64	12.70	6.86	5.54	4.64	3.50	2.34	1.41	0.70	0.47	0.35
8.00	28.16	14.08	7.04	5.63	4.69	3.52	2.35	1.41	0.70	0.47	0.35
8.50	28.16	14.08	7.04	5.63	4.69	3.52	2.35	1.41	0.70	0.47	0.35
9.00	21.20	13.11	0.01	3.20	4.66	3.50	2.34	1.41	0.70	0.47	0.35
9.50	11.98	11.37	6.67	4.48	4.58	3.47	2.33	1.40	0.70	0.47	0.35
10.00	4.98	9.13	6.32	5.25	4.47	3.43	2.32	1.40	0.70	0.47	0.35
10.50	1.52	6.79	5.87	5.01	4.33	3.36	2.30	1.40	0.70	0.47	0.35
11.00	0.34	4.68	5.34	4.72	4.15	3.29	2.28	1.39	0.70	0.47	0.35
11.50	0.06	2.98	4.78	4.39	3.95	3.19	2.25	1.39	0.70	0.47	0.35
12.00	0.01	1.76	4.19	4.04	3.73	3.09	2.21	1.38	0.70	0.47	0.35
12.50	0.00	0.97	3.60	3.67	3.48	2.98	2.18	1.37	0.70	0.47	0.35
13.50	0.00	0.23	2.52	2.91	2.97	2.72	2.09	1.35	0.70	0.47	0.35
13.72	0.00	0.16	2.30	2.75	2.85	2.66	2.07	1.35	0.70	0.47	0.35

Rev. No.
Made By Date

File Ref.: bhnivel4.wk4

OCEAN AND COASTAL CONSULTANTS, INC.

Project: Boston Harbor Navigation Improvements
Subject: Vessel Slipstream Velocities

Sheet No. 10 of
Job No. 94051.000000
Made By JCR Date 03-04-95
Chkd. By Date

SIMULATION NO. 5
Induced Water Velocities, m/s
Vessel : 41K DWT Tanker
Power Level : 100 %

Installed kW : 12,310
Test Run kW : 12,310
Vessel Draft , m: 12.80
Water Depth , m: 13.72

Depth, m	x , Distance Behind Propeller, m										
	5	10	20	25	30	40	60	100	200	300	400
0.00	0.00	0.00	0.53	1.11	1.55	1.95	1.88	1.36	0.74	0.50	0.38
0.50	0.00	0.00	0.73	1.35	1.78	2.11	1.95	1.38	0.74	0.50	0.38
1.00	0.00	0.00	0.97	1.63	2.03	2.27	2.01	1.40	0.74	0.50	0.38
1.50	0.00	0.01	1.27	1.94	2.29	2.43	2.07	1.41	0.74	0.50	0.38
2.00	0.00	0.03	1.64	2.27	2.56	2.58	2.13	1.43	0.75	0.50	0.38
2.50	0.00	0.08	2.07	2.64	2.84	2.74	2.19	1.44	0.75	0.50	0.38
3.00	0.00	0.20	2.56	3.03	3.12	2.89	2.24	1.45	0.75	0.50	0.38
3.50	0.00	0.43	3.11	3.43	3.40	3.03	2.29	1.46	0.75	0.50	0.38
4.00	0.00	0.87	3.70	3.83	3.68	3.17	2.33	1.47	0.75	0.50	0.38
4.50	0.00	1.62	4.33	4.24	3.94	3.29	2.37	1.48	0.75	0.50	0.38
5.00	0.04	2.79	4.97	4.63	4.19	3.41	2.41	1.49	0.75	0.50	0.38
5.50	0.23	4.47	5.59	4.99	4.41	3.51	2.44	1.50	0.76	0.50	0.38
6.00	1.11	6.64	6.16	5.31	4.61	3.60	2.47	1.50	0.76	0.50	0.38
6.50	3.97	9.12	6.67	5.59	4.77	3.67	2.49	1.51	0.76	0.50	0.38
7.00	10.41	11.60	7.09	5.81	4.90	3.73	2.51	1.51	0.76	0.51	0.38
7.50	20.06	13.67	7.38	5.96	4.99	3.76	2.52	1.51	0.76	0.51	0.38
8.00	30.31	15.15	7.58	6.06	5.05	3.79	2.53	1.52	0.76	0.51	0.38
8.50	30.31	15.15	7.58	6.06	5.05	3.79	2.53	1.52	0.76	0.51	0.38
9.00	22.82	14.12	0.00	2.66	5.01	3.77	2.52	1.51	0.76	0.51	0.38
9.50	12.90	12.24	7.18	4.16	4.93	3.74	2.51	1.51	0.76	0.51	0.38
10.00	5.36	9.83	6.80	5.66	4.81	3.69	2.50	1.51	0.76	0.50	0.38
10.50	1.64	7.31	6.31	5.39	4.66	3.62	2.48	1.50	0.76	0.50	0.38
11.00	0.37	5.04	5.75	5.08	4.47	3.54	2.45	1.50	0.76	0.50	0.38
11.50	0.06	3.21	5.14	4.73	4.25	3.44	2.42	1.49	0.75	0.50	0.38
12.00	0.01	1.90	4.51	4.35	4.01	3.33	2.38	1.48	0.75	0.50	0.38
12.50	0.00	1.04	3.88	3.95	3.75	3.20	2.34	1.48	0.75	0.50	0.38
13.50	0.00	0.25	2.71	3.14	3.20	2.93	2.25	1.45	0.75	0.50	0.38
13.72	0.00	0.17	2.48	2.96	3.07	2.86	2.23	1.45	0.75	0.50	0.38

Rev. No.
Made By Date

File Ref.: bhnivel5.wk4

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OCEAN AND COASTAL CONSULTANTS, INC.

Project: Boston Harbor Navigation Improvements
Subject: Vessel Slipstream Velocities

Sheet No. 11 of
Job No. 94051.000000
Made By JCR Date 03-04-95
Chkd. By Date

SIMULATION NO. 6
Induced Water Velocities, m/s
Vessel : LNG Carrier
Power Level : 20 %

Installed kW : 29,900
Test Run kW : 5,980
Vessel Draft , m: 12.80
Water Depth , m: 13.72

Depth, m	x , Distance Behind Propeller, m										
	5	10	20	25	30	40	60	100	200	300	400
0.00	0.00	0.00	0.42	0.87	1.22	1.54	1.48	1.07	0.58	0.39	0.30
0.50	0.00	0.00	0.57	1.06	1.40	1.66	1.53	1.09	0.58	0.39	0.30
1.00	0.00	0.00	0.76	1.28	1.60	1.79	1.58	1.10	0.58	0.39	0.30
1.50	0.00	0.01	1.00	1.53	1.80	1.91	1.63	1.11	0.59	0.39	0.30
2.00	0.00	0.03	1.29	1.79	2.02	2.04	1.68	1.12	0.59	0.40	0.30
2.50	0.00	0.07	1.63	2.08	2.23	2.16	1.72	1.13	0.59	0.40	0.30
3.00	0.00	0.16	2.02	2.38	2.46	2.28	1.76	1.14	0.59	0.40	0.30
3.50	0.00	0.34	2.45	2.70	2.68	2.39	1.80	1.15	0.59	0.40	0.30
4.00	0.00	0.68	2.92	3.02	2.90	2.50	1.84	1.16	0.59	0.40	0.30
4.50	0.00	1.27	3.41	3.34	3.10	2.60	1.87	1.17	0.59	0.40	0.30
5.00	0.03	2.20	3.91	3.64	3.30	2.69	1.90	1.17	0.59	0.40	0.30
5.50	0.18	3.53	4.40	3.93	3.48	2.77	1.92	1.18	0.60	0.40	0.30
6.00	0.88	5.23	4.86	4.19	3.63	2.84	1.95	1.18	0.60	0.40	0.30
6.50	3.13	7.18	5.26	4.40	3.76	2.89	1.96	1.19	0.60	0.40	0.30
7.00	8.20	9.14	5.59	4.58	3.86	2.94	1.98	1.19	0.60	0.40	0.30
7.50	15.81	10.77	5.82	4.70	3.94	2.97	1.98	1.19	0.60	0.40	0.30
8.00	23.88	11.94	5.97	4.78	3.98	2.99	1.99	1.19	0.60	0.40	0.30
8.50	23.88	11.94	5.97	4.78	3.98	2.99	1.99	1.19	0.60	0.40	0.30
9.00	17.98	11.12	0.17	3.94	3.95	2.97	1.99	1.19	0.60	0.40	0.30
9.50	10.16	9.65	5.66	4.58	3.89	2.95	1.98	1.19	0.60	0.40	0.30
10.00	4.23	7.75	5.36	4.46	3.79	2.91	1.97	1.19	0.60	0.40	0.30
10.50	1.29	5.76	4.98	4.25	3.67	2.85	1.95	1.19	0.60	0.40	0.30
11.00	0.29	3.97	4.53	4.00	3.52	2.79	1.93	1.18	0.60	0.40	0.30
11.50	0.05	2.53	4.05	3.73	3.35	2.71	1.91	1.18	0.59	0.40	0.30
12.00	0.01	1.50	3.55	3.43	3.16	2.62	1.88	1.17	0.59	0.40	0.30
12.50	0.00	0.82	3.06	3.11	2.96	2.53	1.85	1.16	0.59	0.40	0.30
13.50	0.00	0.19	2.13	2.47	2.52	2.31	1.78	1.15	0.59	0.40	0.30
13.72	0.00	0.14	1.95	2.34	2.42	2.26	1.76	1.14	0.59	0.40	0.30

Rev. No.
Made By Date

File Ref.: bhnivel6.wk4

OCEAN AND COASTAL CONSULTANTS, INC.

Project: Boston Harbor Navigation Improvements
Subject: Vessel Slipstream Velocities

Sheet No. 12 of
Job No. 94051.000000
Made By JCR Date 03-04-95
Chkd. By Date

SIMULATION NO. 7
Induced Water Velocities, m/s
Vessel : LNG Carrier
Power Level : 40 %

Installed kW : 29,900
Test Run kW : 11,960
Vessel Draft , m: 12.80
Water Depth , m: 13.72

Depth, m	x , Distance Behind Propeller, m										
	5	10	20	25	30	40	60	100	200	300	400
0.00	0.00	0.00	0.53	1.10	1.54	1.93	1.86	1.35	0.73	0.49	0.37
0.50	0.00	0.00	0.72	1.34	1.76	2.09	1.93	1.37	0.73	0.50	0.37
1.00	0.00	0.00	0.96	1.61	2.01	2.25	1.99	1.38	0.74	0.50	0.37
1.50	0.00	0.01	1.26	1.92	2.26	2.40	2.05	1.40	0.74	0.50	0.37
2.00	0.00	0.03	1.62	2.25	2.53	2.56	2.11	1.41	0.74	0.50	0.37
2.50	0.00	0.08	2.05	2.61	2.81	2.71	2.17	1.43	0.74	0.50	0.37
3.00	0.00	0.20	2.54	3.00	3.09	2.86	2.22	1.44	0.74	0.50	0.37
3.50	0.00	0.43	3.08	3.39	3.37	3.00	2.27	1.45	0.74	0.50	0.37
4.00	0.00	0.86	3.67	3.80	3.64	3.14	2.31	1.46	0.75	0.50	0.37
4.50	0.00	1.60	4.29	4.20	3.90	3.26	2.35	1.47	0.75	0.50	0.37
5.00	0.03	2.77	4.92	4.58	4.15	3.38	2.39	1.48	0.75	0.50	0.37
5.50	0.23	4.43	5.53	4.94	4.37	3.48	2.42	1.48	0.75	0.50	0.37
6.00	1.10	6.57	6.11	5.26	4.57	3.56	2.45	1.49	0.75	0.50	0.38
6.50	3.93	9.03	6.61	5.54	4.73	3.64	2.47	1.49	0.75	0.50	0.38
7.00	10.31	11.49	7.02	5.75	4.86	3.69	2.48	1.50	0.75	0.50	0.38
7.50	19.87	13.54	7.31	5.91	4.95	3.73	2.49	1.50	0.75	0.50	0.38
8.00	30.02	15.01	7.51	6.00	5.00	3.75	2.50	1.50	0.75	0.50	0.38
8.50	30.02	15.01	7.51	6.00	5.00	3.75	2.50	1.50	0.75	0.50	0.38
9.00	22.61	13.98	0.00	2.73	4.96	3.74	2.50	1.50	0.75	0.50	0.38
9.50	12.78	12.12	7.12	4.21	4.89	3.70	2.49	1.50	0.75	0.50	0.38
10.00	5.31	9.74	6.74	5.60	4.77	3.65	2.47	1.49	0.75	0.50	0.38
10.50	1.63	7.24	6.26	5.34	4.61	3.59	2.45	1.49	0.75	0.50	0.38
11.00	0.37	4.99	5.70	5.03	4.43	3.50	2.43	1.48	0.75	0.50	0.38
11.50	0.06	3.18	5.09	4.68	4.21	3.41	2.40	1.48	0.75	0.50	0.37
12.00	0.01	1.88	4.47	4.31	3.97	3.30	2.36	1.47	0.75	0.50	0.37
12.50	0.00	1.03	3.84	3.91	3.71	3.17	2.32	1.46	0.75	0.50	0.37
13.50	0.00	0.24	2.68	3.11	3.17	2.90	2.23	1.44	0.74	0.50	0.37
13.72	0.00	0.17	2.45	2.94	3.04	2.84	2.21	1.44	0.74	0.50	0.37

Rev. No.
Made By Date

File Ref.: bhnivel7.wk4

OCEAN AND COASTAL CONSULTANTS, INC.

Project:	Boston Harbor Navigation Improvements	Sheet No.	13 of
		Job No.	94051.000000
Subject:	Vessel Slipstream Velocities	Made By	JCR Date 03-04-95
		Chkd. By	Date

SIMULATION NO. 8
Induced Water Velocities, m/s
Vessel : LNG Carrier
Power Level : 60 %

Installed kW :	29,900
Test Run kW :	17,940
Vessel Draft , m:	12.80
Water Depth , m:	13.72

Depth, m	x , Distance Behind Propeller, m										
	5	10	20	25	30	40	60	100	200	300	400
0.00	0.00	0.00	0.60	1.26	1.76	2.21	2.13	1.54	0.84	0.57	0.43
0.50	0.00	0.00	0.82	1.53	2.02	2.39	2.20	1.56	0.84	0.57	0.43
1.00	0.00	0.00	1.10	1.84	2.29	2.57	2.28	1.58	0.84	0.57	0.43
1.50	0.00	0.01	1.44	2.19	2.59	2.75	2.35	1.60	0.84	0.57	0.43
2.00	0.00	0.04	1.85	2.58	2.90	2.93	2.41	1.61	0.84	0.57	0.43
2.50	0.00	0.10	2.34	2.99	3.21	3.10	2.48	1.63	0.85	0.57	0.43
3.00	0.00	0.22	2.90	3.43	3.53	3.27	2.54	1.64	0.85	0.57	0.43
3.50	0.00	0.49	3.52	3.88	3.85	3.43	2.59	1.66	0.85	0.57	0.43
4.00	0.00	0.98	4.19	4.34	4.16	3.59	2.64	1.67	0.85	0.57	0.43
4.50	0.00	1.83	4.90	4.80	4.46	3.73	2.69	1.68	0.85	0.57	0.43
5.00	0.04	3.16	5.62	5.24	4.74	3.86	2.73	1.69	0.85	0.57	0.43
5.50	0.26	5.07	6.32	5.65	5.00	3.98	2.76	1.70	0.86	0.57	0.43
6.00	1.26	7.52	6.98	6.01	5.22	4.07	2.80	1.70	0.86	0.57	0.43
6.50	4.50	10.32	7.56	6.33	5.41	4.16	2.82	1.71	0.86	0.57	0.43
7.00	11.78	13.14	8.03	6.58	5.55	4.22	2.84	1.71	0.86	0.57	0.43
7.50	22.72	15.48	8.36	6.75	5.65	4.26	2.85	1.71	0.86	0.57	0.43
8.00	34.32	17.16	8.58	6.86	5.72	4.29	2.86	1.72	0.86	0.57	0.43
8.50	34.32	17.16	8.58	6.86	5.72	4.29	2.86	1.72	0.86	0.57	0.43
9.00	25.84	15.99	0.00	1.62	5.68	4.27	2.85	1.71	0.86	0.57	0.43
9.50	14.61	13.86	8.13	3.23	5.59	4.23	2.84	1.71	0.86	0.57	0.43
10.00	6.07	11.13	7.70	6.40	5.45	4.18	2.83	1.71	0.86	0.57	0.43
10.50	1.86	8.28	7.15	6.11	5.28	4.10	2.80	1.70	0.86	0.57	0.43
11.00	0.42	5.70	6.51	5.75	5.06	4.00	2.77	1.70	0.86	0.57	0.43
11.50	0.07	3.64	5.82	5.36	4.81	3.89	2.74	1.69	0.85	0.57	0.43
12.00	0.01	2.15	5.10	4.92	4.54	3.77	2.70	1.68	0.85	0.57	0.43
12.50	0.00	1.18	4.39	4.47	4.25	3.63	2.65	1.67	0.85	0.57	0.43
13.50	0.00	0.28	3.07	3.55	3.62	3.32	2.55	1.65	0.85	0.57	0.43
13.72	0.00	0.20	2.80	3.36	3.48	3.24	2.53	1.64	0.85	0.57	0.43

Rev. No.
Made By Date

File Ref.: bhnivel8.wk4

OCEAN AND COASTAL CONSULTANTS, INC.

Project: Boston Harbor Navigation Improvements
Subject: Vessel Slipstream Velocities

Sheet No. 14 of
Job No. 94051.000000
Made By JCR Date 03-04-95
Chkd. By Date

SIMULATION NO. 9
Induced Water Velocities, m/s
Vessel : LNG Carrier
Power Level : 80 %

Installed kW : 29,900
Test Run kW : 23,920
Vessel Draft , m: 12.80
Water Depth , m: 13.72

Depth, m	x , Distance Behind Propeller, m										
	5	10	20	25	30	40	60	100	200	300	400
0.00	0.00	0.00	0.66	1.38	1.93	2.43	2.34	1.70	0.92	0.62	0.47
0.50	0.00	0.00	0.90	1.68	2.22	2.62	2.42	1.72	0.92	0.62	0.47
1.00	0.00	0.01	1.21	2.03	2.52	2.82	2.50	1.74	0.92	0.62	0.47
1.50	0.00	0.02	1.59	2.41	2.85	3.02	2.58	1.76	0.93	0.62	0.47
2.00	0.00	0.04	2.04	2.83	3.18	3.22	2.65	1.77	0.93	0.62	0.47
2.50	0.00	0.10	2.57	3.29	3.53	3.41	2.72	1.79	0.93	0.63	0.47
3.00	0.00	0.25	3.19	3.77	3.88	3.60	2.79	1.81	0.93	0.63	0.47
3.50	0.00	0.53	3.87	4.27	4.23	3.78	2.85	1.82	0.94	0.63	0.47
4.00	0.00	1.08	4.61	4.77	4.58	3.94	2.90	1.83	0.94	0.63	0.47
4.50	0.00	2.01	5.39	5.28	4.90	4.10	2.96	1.85	0.94	0.63	0.47
5.00	0.04	3.48	6.18	5.76	5.21	4.24	3.00	1.86	0.94	0.63	0.47
5.50	0.29	5.57	6.95	6.21	5.49	4.37	3.04	1.86	0.94	0.63	0.47
6.00	1.39	8.26	7.68	6.61	5.74	4.48	3.07	1.87	0.94	0.63	0.47
6.50	4.94	11.35	8.31	6.96	5.94	4.57	3.10	1.88	0.94	0.63	0.47
7.00	12.96	14.44	8.82	7.23	6.11	4.64	3.12	1.88	0.94	0.63	0.47
7.50	24.98	17.02	9.19	7.42	6.22	4.69	3.14	1.88	0.94	0.63	0.47
8.00	37.74	18.87	9.43	7.55	6.29	4.72	3.14	1.89	0.94	0.63	0.47
8.50	37.74	18.87	9.43	7.55	6.29	4.72	3.14	1.89	0.94	0.63	0.47
9.00	28.42	17.58	0.00	0.92	6.24	4.70	3.14	1.89	0.94	0.63	0.47
9.50	16.06	15.24	8.94	2.33	6.14	4.65	3.13	1.88	0.94	0.63	0.47
10.00	6.68	12.24	8.47	7.04	5.99	4.59	3.11	1.88	0.94	0.63	0.47
10.50	2.04	9.10	7.86	6.72	5.80	4.51	3.08	1.87	0.94	0.63	0.47
11.00	0.46	6.27	7.16	6.33	5.57	4.40	3.05	1.87	0.94	0.63	0.47
11.50	0.08	4.00	6.40	5.89	5.29	4.28	3.01	1.86	0.94	0.63	0.47
12.00	0.01	2.36	5.61	5.41	4.99	4.14	2.97	1.85	0.94	0.63	0.47
12.50	0.00	1.29	4.83	4.92	4.67	3.99	2.92	1.84	0.94	0.63	0.47
13.50	0.00	0.31	3.37	3.91	3.98	3.65	2.81	1.81	0.93	0.63	0.47
13.72	0.00	0.22	3.08	3.69	3.83	3.57	2.78	1.80	0.93	0.63	0.47

Rev. No.
Made By Date

File Ref.: bhnivel9.wk4

x95

OCEAN AND COASTAL CONSULTANTS, INC.

Project:	Boston Harbor Navigation Improvements	Sheet No.	15 of
		Job No.	94051.000000
Subject:	Vessel Slipstream Velocities	Made By	JCR Date 03-04-95
		Chkd. By	Date

SIMULATION NO. 10
Induced Water Velocities, m/s
Vessel : LNG Carrier
Power Level : 100 %

Installed kW :	29,900
Test Run kW :	29,900
Vessel Draft , m:	12.80
Water Depth , m:	13.72

Depth, m	x , Distance Behind Propeller, m										
	5	10	20	25	30	40	60	100	200	300	400
0.00	0.00	0.00	0.71	1.49	2.08	2.61	2.52	1.83	0.99	0.67	0.50
0.50	0.00	0.00	0.97	1.81	2.39	2.83	2.61	1.85	0.99	0.67	0.50
1.00	0.00	0.01	1.30	2.18	2.72	3.04	2.69	1.87	0.99	0.67	0.51
1.50	0.00	0.02	1.71	2.59	3.06	3.25	2.78	1.89	1.00	0.67	0.51
2.00	0.00	0.04	2.20	3.05	3.43	3.46	2.86	1.91	1.00	0.67	0.51
2.50	0.00	0.11	2.77	3.54	3.80	3.67	2.93	1.93	1.00	0.67	0.51
3.00	0.00	0.26	3.43	4.06	4.18	3.87	3.00	1.94	1.00	0.67	0.51
3.50	0.00	0.58	4.17	4.59	4.56	4.06	3.07	1.96	1.01	0.67	0.51
4.00	0.00	1.16	4.96	5.14	4.93	4.25	3.13	1.97	1.01	0.67	0.51
4.50	0.01	2.17	5.80	5.68	5.28	4.41	3.18	1.99	1.01	0.68	0.51
5.00	0.05	3.74	6.65	6.20	5.61	4.57	3.23	2.00	1.01	0.68	0.51
5.50	0.31	6.00	7.49	6.68	5.91	4.71	3.27	2.01	1.01	0.68	0.51
6.00	1.49	8.90	8.26	7.12	6.18	4.82	3.31	2.01	1.01	0.68	0.51
6.50	5.32	12.22	8.94	7.49	6.40	4.92	3.34	2.02	1.01	0.68	0.51
7.00	13.95	15.55	9.50	7.78	6.57	4.99	3.36	2.03	1.01	0.68	0.51
7.50	26.89	18.32	9.90	7.99	6.69	5.05	3.38	2.03	1.02	0.68	0.51
8.00	40.62	20.31	10.16	8.12	6.77	5.08	3.39	2.03	1.02	0.68	0.51
8.50	40.62	20.31	10.16	8.12	6.77	5.08	3.39	2.03	1.02	0.68	0.51
9.00	30.59	18.92	0.00	0.52	6.72	5.06	3.38	2.03	1.02	0.68	0.51
9.50	17.29	16.40	9.63	1.63	6.61	5.01	3.37	2.03	1.02	0.68	0.51
10.00	7.19	13.17	9.11	7.58	6.45	4.94	3.34	2.02	1.01	0.68	0.51
10.50	2.20	9.80	8.46	7.23	6.24	4.85	3.32	2.02	1.01	0.68	0.51
11.00	0.50	6.75	7.71	6.81	5.99	4.74	3.28	2.01	1.01	0.68	0.51
11.50	0.08	4.31	6.89	6.34	5.70	4.61	3.24	2.00	1.01	0.68	0.51
12.00	0.01	2.54	6.04	5.83	5.37	4.46	3.20	1.99	1.01	0.68	0.51
12.50	0.00	1.39	5.20	5.29	5.03	4.29	3.14	1.98	1.01	0.68	0.51
13.50	0.00	0.33	3.63	4.21	4.29	3.93	3.02	1.95	1.01	0.67	0.51
13.72	0.00	0.23	3.32	3.97	4.12	3.84	2.99	1.94	1.00	0.67	0.51

Rev. No.
Made By Date

File Ref.: bhnvel10.wk4

OCEAN AND COASTAL CONSULTANTS, INC.

Project:	Boston Harbor Navigation Improvements	Sheet No.	16 of
		Job No.	94051.000000
Subject:	Vessel Slipstream Velocities	Made By	JCR Date 03-04-95
		Chkd. By	Date

SIMULATION NO. 11
Induced Water Velocities, m/s
Vessel : C8 Container
Power Level : 20 %

Installed	kW :	18,650
Test Run	kW :	3,730
Vessel Draft , m:		12.20
Water Depth , m:		13.72

Depth, m	x , Distance Behind Propeller, m									
	5	10	20	25	30	40	60	100	200	300	400
0.00	0.00	0.00	0.45	0.86	1.15	1.38	1.28	0.91	0.49	0.33	0.25
0.50	0.00	0.00	0.61	1.04	1.31	1.48	1.33	0.92	0.49	0.33	0.25
1.00	0.00	0.01	0.80	1.24	1.48	1.59	1.37	0.93	0.49	0.33	0.25
1.50	0.00	0.02	1.03	1.46	1.66	1.69	1.41	0.94	0.50	0.33	0.25
2.00	0.00	0.05	1.31	1.70	1.84	1.80	1.44	0.95	0.50	0.33	0.25
2.50	0.00	0.11	1.62	1.95	2.03	1.90	1.48	0.96	0.50	0.33	0.25
3.00	0.00	0.24	1.98	2.22	2.22	1.99	1.51	0.97	0.50	0.33	0.25
3.50	0.00	0.50	2.37	2.49	2.40	2.08	1.54	0.98	0.50	0.33	0.25
4.00	0.00	0.94	2.78	2.75	2.58	2.17	1.57	0.98	0.50	0.33	0.25
4.50	0.01	1.65	3.20	3.01	2.74	2.25	1.59	0.99	0.50	0.33	0.25
5.00	0.10	2.70	3.62	3.26	2.90	2.32	1.62	0.99	0.50	0.33	0.25
5.50	0.54	4.07	4.01	3.48	3.03	2.38	1.63	1.00	0.50	0.33	0.25
6.00	2.05	5.68	4.36	3.67	3.15	2.43	1.65	1.00	0.50	0.34	0.25
6.50	5.74	7.35	4.65	3.83	3.24	2.47	1.66	1.00	0.50	0.34	0.25
7.00	11.83	8.81	4.87	3.94	3.30	2.49	1.67	1.00	0.50	0.34	0.25
7.50	17.96	9.78	4.99	4.01	3.34	2.51	1.68	1.01	0.50	0.34	0.25
8.00	20.06	10.05	5.03	4.02	3.35	2.51	1.68	1.01	0.50	0.34	0.25
8.50	16.48	9.57	4.97	3.99	3.33	2.51	1.67	1.01	0.50	0.34	0.25
9.00	9.97	8.44	4.29	4.00	3.29	2.49	1.67	1.00	0.50	0.34	0.25
9.50	4.43	6.89	4.58	3.92	3.21	2.46	1.66	1.00	0.50	0.34	0.25
10.00	1.45	5.21	4.27	3.62	3.12	2.41	1.65	1.00	0.50	0.34	0.25
10.50	0.35	3.65	3.90	3.42	3.00	2.36	1.63	1.00	0.50	0.33	0.25
11.00	0.06	2.37	3.50	3.19	2.86	2.30	1.61	0.99	0.50	0.33	0.25
11.50	0.01	1.42	3.08	2.94	2.70	2.23	1.59	0.99	0.50	0.33	0.25
12.00	0.00	0.79	2.66	2.68	2.53	2.15	1.56	0.98	0.50	0.33	0.25
12.50	0.00	0.41	2.26	2.41	2.35	2.06	1.53	0.97	0.50	0.33	0.25
13.50	0.00	0.09	1.53	1.88	1.98	1.87	1.47	0.96	0.50	0.33	0.25
13.72	0.00	0.06	1.39	1.77	1.89	1.82	1.45	0.96	0.50	0.33	0.25

Rev. No.
Made By Date

File Ref.: bhnvel11.wk4

OCEAN AND COASTAL CONSULTANTS, INC.

Project:	Boston Harbor Navigation Improvements	Sheet No.	17	of	
Subject:	Vessel Slipstream Velocities	Job No.	94051.000000		
		Made By	JCR	Date	03-04-95
		Chkd. By		Date	

SIMULATION NO. 12
Induced Water Velocities, m/s
Vessel : C8 Container
Power Level : 40 %

Installed kW :	18,650
Test Run kW :	7,460
Vessel Draft , m:	12.20
Water Depth , m:	13.72

Depth, m	x , Distance Behind Propeller, m									
	5	10	20	25	30	40	60	100	200	300	400
0.00	0.00	0.00	0.57	1.08	1.44	1.73	1.61	1.15	0.62	0.42	0.31
0.50	0.00	0.00	0.76	1.30	1.64	1.86	1.67	1.16	0.62	0.42	0.31
1.00	0.00	0.01	1.00	1.56	1.86	1.99	1.72	1.17	0.62	0.42	0.31
1.50	0.00	0.02	1.29	1.83	2.08	2.13	1.77	1.19	0.62	0.42	0.31
2.00	0.00	0.06	1.64	2.13	2.31	2.26	1.81	1.20	0.62	0.42	0.32
2.50	0.00	0.14	2.04	2.45	2.55	2.38	1.86	1.21	0.63	0.42	0.32
3.00	0.00	0.30	2.49	2.79	2.79	2.50	1.90	1.22	0.63	0.42	0.32
3.50	0.00	0.62	2.98	3.12	3.02	2.62	1.94	1.23	0.63	0.42	0.32
4.00	0.00	1.18	3.50	3.46	3.24	2.73	1.97	1.23	0.63	0.42	0.32
4.50	0.02	2.08	4.03	3.79	3.45	2.82	2.00	1.24	0.63	0.42	0.32
5.00	0.13	3.39	4.55	4.10	3.64	2.91	2.03	1.25	0.63	0.42	0.32
5.50	0.68	5.11	5.04	4.38	3.81	2.99	2.05	1.25	0.63	0.42	0.32
6.00	2.57	7.14	5.48	4.62	3.96	3.05	2.07	1.26	0.63	0.42	0.32
6.50	7.21	9.24	5.85	4.81	4.07	3.10	2.09	1.26	0.63	0.42	0.32
7.00	14.87	11.07	6.12	4.95	4.15	3.13	2.10	1.26	0.63	0.42	0.32
7.50	22.58	12.29	6.28	5.03	4.20	3.16	2.11	1.26	0.63	0.42	0.32
8.00	25.21	12.63	6.32	5.06	4.21	3.16	2.11	1.26	0.63	0.42	0.32
8.50	20.72	12.03	6.24	5.02	4.19	3.15	2.10	1.26	0.63	0.42	0.32
9.00	12.53	10.61	2.81	4.24	4.13	3.13	2.10	1.26	0.63	0.42	0.32
9.50	5.57	8.66	5.75	4.99	4.04	3.09	2.09	1.26	0.63	0.42	0.32
10.00	1.82	6.55	5.36	4.55	3.92	3.03	2.07	1.26	0.63	0.42	0.32
10.50	0.44	4.59	4.91	4.30	3.77	2.97	2.05	1.25	0.63	0.42	0.32
11.00	0.08	2.98	4.40	4.01	3.59	2.89	2.02	1.25	0.63	0.42	0.32
11.50	0.01	1.79	3.88	3.70	3.39	2.80	2.00	1.24	0.63	0.42	0.32
12.00	0.00	1.00	3.35	3.37	3.18	2.70	1.96	1.23	0.63	0.42	0.32
12.50	0.00	0.51	2.84	3.03	2.95	2.59	1.93	1.22	0.63	0.42	0.32
13.50	0.00	0.11	1.92	2.36	2.48	2.35	1.85	1.21	0.62	0.42	0.32
13.72	0.00	0.07	1.75	2.22	2.38	2.29	1.83	1.20	0.62	0.42	0.32

Rev. No.
Made By Date

File Ref.: bhnvel12.wk4

OCEAN AND COASTAL CONSULTANTS, INC.

Project:	Boston Harbor Navigation Improvements	Sheet No.	18 of
		Job No.	94051.000000
Subject:	Vessel Slipstream Velocities	Made By	JCR Date 03-04-95
		Chkd. By	Date

SIMULATION NO. 13
Induced Water Velocities, m/s
Vessel : C8 Container
Power Level : 60 %

Installed kW :	18,650
Test Run kW :	11,190
Vessel Draft , m:	12.20
Water Depth , m:	13.72

Depth, m	x , Distance Behind Propeller, m									
	5	10	20	25	30	40	60	100	200	300	400
0.00	0.00	0.00	0.65	1.24	1.65	1.98	1.84	1.31	0.71	0.48	0.36
0.50	0.00	0.00	0.87	1.49	1.88	2.13	1.90	1.33	0.71	0.48	0.36
1.00	0.00	0.01	1.15	1.78	2.13	2.28	1.96	1.34	0.71	0.48	0.36
1.50	0.00	0.03	1.48	2.10	2.38	2.43	2.02	1.36	0.71	0.48	0.36
2.00	0.00	0.07	1.88	2.44	2.65	2.58	2.07	1.37	0.71	0.48	0.36
2.50	0.00	0.16	2.33	2.80	2.91	2.72	2.12	1.38	0.71	0.48	0.36
3.00	0.00	0.35	2.85	3.18	3.18	2.86	2.17	1.39	0.72	0.48	0.36
3.50	0.00	0.71	3.40	3.57	3.45	2.99	2.22	1.40	0.72	0.48	0.36
4.00	0.00	1.35	4.00	3.96	3.70	3.12	2.26	1.41	0.72	0.48	0.36
4.50	0.02	2.38	4.60	4.33	3.94	3.23	2.29	1.42	0.72	0.48	0.36
5.00	0.15	3.87	5.20	4.68	4.16	3.33	2.32	1.43	0.72	0.48	0.36
5.50	0.77	5.84	5.76	5.00	4.36	3.41	2.35	1.43	0.72	0.48	0.36
6.00	2.94	8.16	6.27	5.28	4.52	3.49	2.37	1.44	0.72	0.48	0.36
6.50	8.24	10.56	6.68	5.50	4.65	3.54	2.39	1.44	0.72	0.48	0.36
7.00	17.00	12.66	6.99	5.66	4.75	3.58	2.40	1.44	0.72	0.48	0.36
7.50	25.81	14.05	7.18	5.76	4.80	3.61	2.41	1.45	0.72	0.48	0.36
8.00	28.82	14.44	7.23	5.78	4.82	3.61	2.41	1.45	0.72	0.48	0.36
8.50	23.68	13.75	7.14	5.74	4.79	3.60	2.41	1.44	0.72	0.48	0.36
9.00	14.32	12.13	1.51	3.75	4.72	3.57	2.40	1.44	0.72	0.48	0.36
9.50	6.37	9.90	6.58	5.25	4.62	3.53	2.38	1.44	0.72	0.48	0.36
10.00	2.09	7.49	6.13	5.20	4.48	3.47	2.37	1.44	0.72	0.48	0.36
10.50	0.50	5.25	5.61	4.92	4.31	3.39	2.34	1.43	0.72	0.48	0.36
11.00	0.09	3.40	5.03	4.59	4.10	3.30	2.31	1.42	0.72	0.48	0.36
11.50	0.01	2.05	4.43	4.23	3.88	3.20	2.28	1.42	0.72	0.48	0.36
12.00	0.00	1.14	3.83	3.85	3.63	3.08	2.24	1.41	0.72	0.48	0.36
12.50	0.00	0.59	3.24	3.46	3.38	2.96	2.20	1.40	0.72	0.48	0.36
13.50	0.00	0.12	2.20	2.70	2.84	2.68	2.11	1.38	0.71	0.48	0.36
13.72	0.00	0.08	2.00	2.54	2.72	2.62	2.09	1.37	0.71	0.48	0.36

Rev. No.
Made By Date

File Ref.: bhnvel13.wk4

OCEAN AND COASTAL CONSULTANTS, INC.

Project: Boston Harbor Navigation Improvements
Subject: Vessel Slipstream Velocities

Sheet No. 19 of
Job No. 94051.000000
Made By JCR Date 03-04-95
Chkd. By Date

SIMULATION NO. 14
Induced Water Velocities, m/s
Vessel : C8 Container
Power Level : 80 %

Installed kW : 18,650
Test Run kW : 14,920
Vessel Draft , m: 12.20
Water Depth , m: 13.72

Depth, m	x , Distance Behind Propeller, m										
	5	10	20	25	30	40	60	100	200	300	400
0.00	0.00	0.00	0.71	1.36	1.81	2.17	2.03	1.44	0.78	0.52	0.39
0.50	0.00	0.00	0.96	1.64	2.07	2.34	2.09	1.46	0.78	0.52	0.40
1.00	0.00	0.01	1.26	1.96	2.34	2.51	2.16	1.48	0.78	0.53	0.40
1.50	0.00	0.03	1.63	2.30	2.62	2.67	2.22	1.49	0.78	0.53	0.40
2.00	0.00	0.07	2.06	2.68	2.91	2.84	2.28	1.51	0.78	0.53	0.40
2.50	0.00	0.17	2.57	3.08	3.21	2.99	2.34	1.52	0.79	0.53	0.40
3.00	0.00	0.38	3.13	3.50	3.50	3.15	2.39	1.53	0.79	0.53	0.40
3.50	0.00	0.78	3.74	3.93	3.79	3.29	2.44	1.54	0.79	0.53	0.40
4.00	0.00	1.49	4.39	4.35	4.07	3.43	2.48	1.55	0.79	0.53	0.40
4.50	0.02	2.61	5.06	4.76	4.34	3.55	2.52	1.56	0.79	0.53	0.40
5.00	0.16	4.26	5.72	5.15	4.58	3.66	2.55	1.57	0.79	0.53	0.40
5.50	0.85	6.42	6.34	5.50	4.79	3.75	2.58	1.58	0.79	0.53	0.40
6.00	3.23	8.98	6.89	5.80	4.97	3.83	2.61	1.58	0.79	0.53	0.40
6.50	9.06	11.61	7.35	6.05	5.12	3.90	2.63	1.58	0.79	0.53	0.40
7.00	18.70	13.92	7.69	6.22	5.22	3.94	2.64	1.59	0.79	0.53	0.40
7.50	28.38	15.45	7.89	6.33	5.28	3.97	2.65	1.59	0.79	0.53	0.40
8.00	31.69	15.88	7.95	6.36	5.30	3.97	2.65	1.59	0.79	0.53	0.40
8.50	26.04	15.12	7.85	6.31	5.27	3.96	2.65	1.59	0.79	0.53	0.40
9.00	15.75	13.33	0.76	3.10	5.20	3.93	2.64	1.59	0.79	0.53	0.40
9.50	7.00	10.89	7.23	5.13	5.08	3.88	2.62	1.58	0.79	0.53	0.40
10.00	2.29	8.24	6.74	5.72	4.92	3.81	2.60	1.58	0.79	0.53	0.40
10.50	0.55	5.77	6.17	5.41	4.73	3.73	2.58	1.57	0.79	0.53	0.40
11.00	0.10	3.74	5.54	5.04	4.51	3.63	2.54	1.57	0.79	0.53	0.40
11.50	0.01	2.25	4.87	4.65	4.26	3.52	2.51	1.56	0.79	0.53	0.40
12.00	0.00	1.25	4.21	4.23	3.99	3.39	2.47	1.55	0.79	0.53	0.40
12.50	0.00	0.65	3.57	3.81	3.71	3.25	2.42	1.54	0.79	0.53	0.40
13.50	0.00	0.14	2.42	2.97	3.12	2.95	2.32	1.52	0.79	0.53	0.40
13.72	0.00	0.09	2.20	2.79	2.99	2.88	2.30	1.51	0.78	0.53	0.40

Rev. No.
Made By Date

File Ref.: bhnvel14.wk4

OCEAN AND COASTAL CONSULTANTS, INC.

Project:	Boston Harbor Navigation Improvements	Sheet No.	20 of
		Job No.	94051.000000
Subject:	Vessel Slipstream Velocities	Made By	JCR Date 03-04-95
		Chkd. By	Date

SIMULATION NO. 15
Induced Water Velocities, m/s
Vessel : C8 Container
Power Level : 100 %

Installed kW :	18,650
Test Run kW :	18,650
Vessel Draft , m:	12.20
Water Depth , m:	13.72

Depth, m	x , Distance Behind Propeller, m										
	5	10	20	25	30	40	60	100	200	300	400
0.00	0.00	0.00	0.77	1.46	1.95	2.34	2.18	1.55	0.84	0.56	0.43
0.50	0.00	0.00	1.03	1.77	2.23	2.52	2.25	1.57	0.84	0.56	0.43
1.00	0.00	0.01	1.36	2.11	2.52	2.70	2.32	1.59	0.84	0.57	0.43
1.50	0.00	0.03	1.75	2.48	2.82	2.88	2.39	1.61	0.84	0.57	0.43
2.00	0.00	0.08	2.22	2.89	3.13	3.05	2.45	1.62	0.84	0.57	0.43
2.50	0.00	0.19	2.76	3.32	3.45	3.22	2.51	1.64	0.85	0.57	0.43
3.00	0.00	0.41	3.37	3.77	3.77	3.39	2.57	1.65	0.85	0.57	0.43
3.50	0.00	0.84	4.03	4.23	4.08	3.54	2.62	1.66	0.85	0.57	0.43
4.00	0.00	1.60	4.73	4.68	4.38	3.69	2.67	1.67	0.85	0.57	0.43
4.50	0.03	2.81	5.45	5.13	4.67	3.82	2.71	1.68	0.85	0.57	0.43
5.00	0.18	4.58	6.15	5.54	4.93	3.94	2.75	1.69	0.85	0.57	0.43
5.50	0.91	6.92	6.82	5.92	5.16	4.04	2.78	1.70	0.85	0.57	0.43
6.00	3.48	9.66	7.42	6.25	5.35	4.13	2.81	1.70	0.85	0.57	0.43
6.50	9.76	12.50	7.91	6.51	5.51	4.19	2.83	1.71	0.85	0.57	0.43
7.00	20.13	14.98	8.28	6.70	5.62	4.24	2.84	1.71	0.86	0.57	0.43
7.50	30.55	16.63	8.49	6.81	5.68	4.27	2.85	1.71	0.86	0.57	0.43
8.00	34.11	17.10	8.55	6.84	5.70	4.28	2.85	1.71	0.86	0.57	0.43
8.50	28.03	16.28	8.45	6.79	5.67	4.26	2.85	1.71	0.86	0.57	0.43
9.00	16.95	14.35	0.38	2.49	5.59	4.23	2.84	1.71	0.86	0.57	0.43
9.50	7.54	11.72	7.78	4.81	5.47	4.18	2.82	1.70	0.85	0.57	0.43
10.00	2.47	8.87	7.26	6.16	5.30	4.10	2.80	1.70	0.85	0.57	0.43
10.50	0.59	6.21	6.64	5.82	5.10	4.01	2.77	1.69	0.85	0.57	0.43
11.00	0.11	4.03	5.96	5.43	4.86	3.91	2.74	1.69	0.85	0.57	0.43
11.50	0.01	2.42	5.25	5.01	4.59	3.79	2.70	1.68	0.85	0.57	0.43
12.00	0.00	1.35	4.53	4.56	4.30	3.65	2.66	1.67	0.85	0.57	0.43
12.50	0.00	0.69	3.84	4.10	3.99	3.50	2.61	1.66	0.85	0.57	0.43
13.50	0.00	0.15	2.60	3.20	3.36	3.18	2.50	1.63	0.85	0.57	0.43
13.72	0.00	0.10	2.36	3.01	3.22	3.10	2.47	1.63	0.84	0.57	0.43

Rev. No.
Made By Date

File Ref.: bhnvel15.wk4

OCEAN AND COASTAL CONSULTANTS, INC.

Project: Boston Harbor Navigation Improvements
Subject: Vessel Slipstream Velocities

Sheet No. 21 of
Job No. 94051.000000
Made By JCR Date 03-04-95
Chkd. By Date

SIMULATION NO. 16
Induced Water Velocities, m/s
Vessel : Tug
Power Level : 20 %

Installed kW : 2,835
Test Run kW : 567
Vessel Draft , m: 4.30
Water Depth , m: 13.72

Depth, m	x , Distance Behind Propeller, m										
	5	10	20	25	30	40	60	100	200	300	400
0.00	0.06	1.16	1.42	1.26	1.12	0.89	0.62	0.38	0.19	0.13	0.10
0.50	0.30	1.71	1.56	1.35	1.17	0.91	0.62	0.38	0.19	0.13	0.10
1.00	1.06	2.34	1.69	1.42	1.21	0.93	0.63	0.38	0.19	0.13	0.10
1.50	2.74	2.96	1.80	1.47	1.24	0.94	0.63	0.38	0.19	0.13	0.10
2.00	5.20	3.48	1.87	1.51	1.26	0.95	0.64	0.38	0.19	0.13	0.10
2.50	7.26	3.78	1.91	1.53	1.27	0.96	0.64	0.38	0.19	0.13	0.10
3.00	7.46	3.80	1.91	1.53	1.28	0.96	0.64	0.38	0.19	0.13	0.10
3.50	5.65	3.55	1.88	1.51	1.27	0.95	0.64	0.38	0.19	0.13	0.10
4.00	3.14	3.06	1.81	1.48	1.25	0.94	0.63	0.38	0.19	0.13	0.10
4.50	1.29	2.45	1.71	1.43	1.21	0.93	0.63	0.38	0.19	0.13	0.10
5.00	0.39	1.82	1.59	1.36	1.17	0.91	0.63	0.38	0.19	0.13	0.10
5.50	0.09	1.25	1.45	1.28	1.13	0.89	0.62	0.38	0.19	0.13	0.10
6.00	0.01	0.79	1.29	1.19	1.07	0.87	0.61	0.38	0.19	0.13	0.10
6.50	0.00	0.47	1.13	1.09	1.01	0.84	0.60	0.37	0.19	0.13	0.10
7.00	0.00	0.25	0.97	0.99	0.94	0.81	0.59	0.37	0.19	0.13	0.10
7.50	0.00	0.13	0.82	0.89	0.88	0.77	0.58	0.37	0.19	0.13	0.10
8.00	0.00	0.06	0.68	0.79	0.80	0.74	0.57	0.37	0.19	0.13	0.10
8.50	0.00	0.03	0.55	0.69	0.73	0.70	0.56	0.36	0.19	0.13	0.10
9.00	0.00	0.01	1.42	1.27	0.66	0.66	0.54	0.36	0.19	0.13	0.10
9.50	0.00	0.00	0.34	1.27	0.59	0.62	0.53	0.36	0.19	0.13	0.10
10.00	0.00	0.00	0.26	0.43	0.53	0.58	0.51	0.35	0.19	0.13	0.10
10.50	0.00	0.00	0.20	0.36	0.46	0.54	0.50	0.35	0.19	0.13	0.10
11.00	0.00	0.00	0.14	0.29	0.41	0.50	0.48	0.35	0.19	0.13	0.10
11.50	0.00	0.00	0.10	0.24	0.35	0.46	0.46	0.34	0.19	0.13	0.10
12.00	0.00	0.00	0.07	0.19	0.30	0.42	0.44	0.34	0.19	0.13	0.09
12.50	0.00	0.00	0.05	0.15	0.26	0.39	0.43	0.33	0.18	0.13	0.09
13.50	0.00	0.00	0.02	0.09	0.18	0.32	0.39	0.32	0.18	0.13	0.09
13.72	0.00	0.00	0.02	0.08	0.17	0.30	0.38	0.32	0.18	0.13	0.09

Rev. No.
Made By Date

File Ref.: bhnvel16.wk4

OCEAN AND COASTAL CONSULTANTS, INC.

Project:	**Boston Harbor Navigation Improvements**	**Sheet No.**	**22 of**
		Job No.	**94051.000000**
Subject:	**Vessel Slipstream Velocities**	**Made By**	**JCR Date 03-04-95**
		Chkd. By	**Date**

SIMULATION NO. 17
Induced Water Velocities, m/s
Vessel : Tug
Power Level : 40 %

Installed	**kW :**	**2,835**
Test Run	**kW :**	**1,134**
Vessel Draft , m:		**4.30**
Water Depth , m:		**13.72**

Depth, m	x , Distance Behind Propeller, m										
	5	10	20	25	30	40	60	100	200	300	400
0.00	0.08	1.45	1.78	1.59	1.40	1.12	0.78	0.48	0.24	0.16	0.12
0.50	0.38	2.15	1.97	1.69	1.47	1.14	0.78	0.48	0.24	0.16	0.12
1.00	1.33	2.94	2.13	1.78	1.52	1.17	0.79	0.48	0.24	0.16	0.12
1.50	3.44	3.72	2.26	1.85	1.56	1.18	0.80	0.48	0.24	0.16	0.12
2.00	6.53	4.37	2.35	1.90	1.59	1.20	0.80	0.48	0.24	0.16	0.12
2.50	9.13	4.75	2.40	1.92	1.60	1.20	0.80	0.48	0.24	0.16	0.12
3.00	9.38	4.78	2.40	1.92	1.60	1.20	0.80	0.48	0.24	0.16	0.12
3.50	7.10	4.46	2.36	1.90	1.59	1.20	0.80	0.48	0.24	0.16	0.12
4.00	3.95	3.85	2.28	1.86	1.57	1.19	0.80	0.48	0.24	0.16	0.12
4.50	1.62	3.08	2.15	1.79	1.53	1.17	0.79	0.48	0.24	0.16	0.12
5.00	0.49	2.28	2.00	1.71	1.48	1.15	0.79	0.48	0.24	0.16	0.12
5.50	0.11	1.57	1.82	1.61	1.42	1.12	0.78	0.48	0.24	0.16	0.12
6.00	0.02	1.00	1.62	1.50	1.35	1.09	0.77	0.47	0.24	0.16	0.12
6.50	0.00	0.59	1.42	1.37	1.27	1.05	0.76	0.47	0.24	0.16	0.12
7.00	0.00	0.32	1.22	1.25	1.19	1.02	0.74	0.47	0.24	0.16	0.12
7.50	0.00	0.16	1.03	1.12	1.10	0.97	0.73	0.47	0.24	0.16	0.12
8.00	0.00	0.08	0.85	0.99	1.01	0.93	0.71	0.46	0.24	0.16	0.12
8.50	0.00	0.03	0.69	0.87	0.92	0.88	0.70	0.46	0.24	0.16	0.12
9.00	0.00	0.01	1.78	1.59	0.83	0.83	0.68	0.45	0.24	0.16	0.12
9.50	0.00	0.00	0.43	1.59	0.75	0.78	0.66	0.45	0.24	0.16	0.12
10.00	0.00	0.00	0.33	0.54	0.66	0.73	0.64	0.44	0.24	0.16	0.12
10.50	0.00	0.00	0.25	0.45	0.58	0.68	0.62	0.44	0.24	0.16	0.12
11.00	0.00	0.00	0.18	0.37	0.51	0.63	0.60	0.43	0.23	0.16	0.12
11.50	0.00	0.00	0.13	0.30	0.44	0.58	0.58	0.43	0.23	0.16	0.12
12.00	0.00	0.00	0.09	0.24	0.38	0.53	0.56	0.42	0.23	0.16	0.12
12.50	0.00	0.00	0.06	0.19	0.32	0.49	0.54	0.42	0.23	0.16	0.12
13.50	0.00	0.00	0.03	0.12	0.23	0.40	0.49	0.40	0.23	0.16	0.12
13.72	0.00	0.00	0.02	0.10	0.21	0.38	0.48	0.40	0.23	0.16	0.12

Rev. No.
Made By **Date**

File Ref.: bhnvel17.wk4

OCEAN AND COASTAL CONSULTANTS, INC.

Project: Boston Harbor Navigation Improvements
Subject: Vessel Slipstream Velocities

Sheet No. 23 of
Job No. 94051.000000
Made By JCR Date 03-04-95
Chkd. By Date

SIMULATION NO. 18
Induced Water Velocities, m/s
Vessel : Tug
Power Level : 60 %

Installed kW : 2,835
Test Run kW : 1,701
Vessel Draft , m: 4.30
Water Depth , m: 13.72

Depth, m	x , Distance Behind Propeller, m										
	5	10	20	25	30	40	60	100	200	300	400
0.00	0.09	1.66	2.04	1.82	1.61	1.28	0.89	0.54	0.27	0.18	0.14
0.50	0.43	2.45	2.25	1.93	1.68	1.31	0.90	0.55	0.27	0.18	0.14
1.00	1.52	3.36	2.43	2.03	1.74	1.33	0.90	0.55	0.27	0.18	0.14
1.50	3.93	4.25	2.58	2.11	1.78	1.35	0.91	0.55	0.27	0.18	0.14
2.00	7.47	4.99	2.69	2.17	1.81	1.37	0.91	0.55	0.28	0.18	0.14
2.50	10.43	5.43	2.74	2.20	1.83	1.37	0.92	0.55	0.28	0.18	0.14
3.00	10.72	5.47	2.75	2.20	1.83	1.38	0.92	0.55	0.28	0.18	0.14
3.50	8.11	5.10	2.70	2.17	1.82	1.37	0.92	0.55	0.28	0.18	0.14
4.00	4.51	4.40	2.60	2.12	1.79	1.36	0.91	0.55	0.27	0.18	0.14
4.50	1.85	3.52	2.46	2.05	1.75	1.34	0.91	0.55	0.27	0.18	0.14
5.00	0.56	2.61	2.28	1.95	1.69	1.31	0.90	0.55	0.27	0.18	0.14
5.50	0.12	1.79	2.08	1.84	1.62	1.28	0.89	0.54	0.27	0.18	0.14
6.00	0.02	1.14	1.86	1.71	1.54	1.25	0.88	0.54	0.27	0.18	0.14
6.50	0.00	0.67	1.63	1.57	1.45	1.21	0.86	0.54	0.27	0.18	0.14
7.00	0.00	0.37	1.40	1.43	1.36	1.16	0.85	0.54	0.27	0.18	0.14
7.50	0.00	0.18	1.18	1.28	1.26	1.11	0.83	0.53	0.27	0.18	0.14
8.00	0.00	0.09	0.97	1.13	1.16	1.06	0.82	0.53	0.27	0.18	0.14
8.50	0.00	0.04	0.79	0.99	1.05	1.01	0.80	0.52	0.27	0.18	0.14
9.00	0.00	0.01	2.04	1.82	0.95	0.95	0.78	0.52	0.27	0.18	0.14
9.50	0.00	0.01	0.49	1.82	0.85	0.89	0.76	0.51	0.27	0.18	0.14
10.00	0.00	0.00	0.38	0.62	0.76	0.84	0.74	0.51	0.27	0.18	0.14
10.50	0.00	0.00	0.28	0.51	0.67	0.78	0.71	0.50	0.27	0.18	0.14
11.00	0.00	0.00	0.21	0.42	0.58	0.72	0.69	0.50	0.27	0.18	0.14
11.50	0.00	0.00	0.15	0.34	0.50	0.67	0.66	0.49	0.27	0.18	0.14
12.00	0.00	0.00	0.11	0.28	0.43	0.61	0.64	0.48	0.27	0.18	0.14
12.50	0.00	0.00	0.07	0.22	0.37	0.56	0.61	0.48	0.27	0.18	0.14
13.50	0.00	0.00	0.03	0.13	0.26	0.46	0.56	0.46	0.26	0.18	0.14
13.72	0.00	0.00	0.03	0.12	0.24	0.44	0.55	0.46	0.26	0.18	0.14

Rev. No.
Made By Date

File Ref.: bhnvel18.wk4

504

OCEAN AND COASTAL CONSULTANTS, INC.

Project: Boston Harbor Navigation Improvements
Subject: Vessel Slipstream Velocities

Sheet No. 24 of
Job No. 94051.000000
Made By JCR Date 03-04-95
Chkd. By Date

SIMULATION NO. 19
Induced Water Velocities, m/s
Vessel : Tug
Power Level : 80 %

Installed kW : 2,835
Test Run kW : 2,268
Vessel Draft , m: 4.30
Water Depth , m: 13.72

Depth, m	x , Distance Behind Propeller, m										
	5	10	20	25	30	40	60	100	200	300	400
0.00	0.10	1.83	2.24	2.00	1.77	1.40	0.98	0.60	0.30	0.20	0.15
0.50	0.48	2.70	2.47	2.13	1.84	1.44	0.99	0.60	0.30	0.20	0.15
1.00	1.68	3.69	2.67	2.24	1.91	1.47	0.99	0.60	0.30	0.20	0.15
1.50	4.32	4.68	2.84	2.32	1.96	1.49	1.00	0.60	0.30	0.20	0.15
2.00	8.21	5.49	2.95	2.38	2.00	1.50	1.01	0.60	0.30	0.20	0.15
2.50	11.47	5.97	3.02	2.42	2.01	1.51	1.01	0.60	0.30	0.20	0.15
3.00	11.79	6.01	3.02	2.42	2.02	1.51	1.01	0.61	0.30	0.20	0.15
3.50	8.92	5.61	2.97	2.39	2.00	1.51	1.01	0.60	0.30	0.20	0.15
4.00	4.96	4.84	2.86	2.34	1.97	1.49	1.00	0.60	0.30	0.20	0.15
4.50	2.03	3.87	2.71	2.25	1.92	1.47	1.00	0.60	0.30	0.20	0.15
5.00	0.61	2.87	2.51	2.15	1.86	1.44	0.99	0.60	0.30	0.20	0.15
5.50	0.14	1.97	2.29	2.02	1.78	1.41	0.98	0.60	0.30	0.20	0.15
6.00	0.02	1.25	2.04	1.88	1.69	1.37	0.97	0.60	0.30	0.20	0.15
6.50	0.00	0.74	1.79	1.73	1.60	1.33	0.95	0.59	0.30	0.20	0.15
7.00	0.00	0.40	1.54	1.57	1.49	1.28	0.94	0.59	0.30	0.20	0.15
7.50	0.00	0.20	1.29	1.41	1.38	1.22	0.92	0.58	0.30	0.20	0.15
8.00	0.00	0.09	1.07	1.24	1.27	1.17	0.90	0.58	0.30	0.20	0.15
8.50	0.00	0.04	0.87	1.09	1.16	1.11	0.88	0.58	0.30	0.20	0.15
9.00	0.00	0.02	2.24	2.00	1.05	1.05	0.86	0.57	0.30	0.20	0.15
9.50	0.00	0.01	0.54	2.00	0.94	0.98	0.83	0.56	0.30	0.20	0.15
10.00	0.00	0.00	0.41	0.68	0.83	0.92	0.81	0.56	0.30	0.20	0.15
10.50	0.00	0.00	0.31	0.56	0.73	0.86	0.78	0.55	0.30	0.20	0.15
11.00	0.00	0.00	0.23	0.46	0.64	0.79	0.76	0.55	0.29	0.20	0.15
11.50	0.00	0.00	0.17	0.38	0.55	0.73	0.73	0.54	0.29	0.20	0.15
12.00	0.00	0.00	0.12	0.30	0.48	0.67	0.70	0.53	0.29	0.20	0.15
12.50	0.00	0.00	0.08	0.24	0.41	0.61	0.68	0.52	0.29	0.20	0.15
13.50	0.00	0.00	0.04	0.15	0.29	0.50	0.62	0.51	0.29	0.20	0.15
13.72	0.00	0.00	0.03	0.13	0.26	0.48	0.61	0.50	0.29	0.20	0.15

Rev. No.
Made By Date

File Ref.: bhnvel19.wk4

OCEAN AND COASTAL CONSULTANTS, INC.

Project: Boston Harbor Navigation Improvements
Subject: Vessel Slipstream Velocities

Sheet No. 25 of
Job No. 94051.000000
Made By JCR Date 03-04-95
Chkd. By Date

SIMULATION NO. 20
Induced Water Velocities, m/s
Vessel : Tug
Power Level : 100 %

Installed kW : 2,835
Test Run kW : 2,835
Vessel Draft , m: 4.30
Water Depth , m: 13.72

Depth, m	x , Distance Behind Propeller, m										
	5	10	20	25	30	40	60	100	200	300	400
0.00	0.11	1.96	2.41	2.15	1.90	1.51	1.05	0.64	0.32	0.22	0.16
0.50	0.51	2.90	2.66	2.29	1.98	1.55	1.06	0.65	0.32	0.22	0.16
1.00	1.80	3.97	2.88	2.41	2.05	1.58	1.07	0.65	0.33	0.22	0.16
1.50	4.65	5.04	3.05	2.50	2.11	1.60	1.08	0.65	0.33	0.22	0.16
2.00	8.84	5.91	3.18	2.57	2.15	1.62	1.08	0.65	0.33	0.22	0.16
2.50	12.35	6.43	3.25	2.60	2.17	1.63	1.09	0.65	0.33	0.22	0.16
3.00	12.69	6.47	3.25	2.60	2.17	1.63	1.09	0.65	0.33	0.22	0.16
3.50	9.60	6.03	3.19	2.57	2.15	1.62	1.08	0.65	0.33	0.22	0.16
4.00	5.34	5.21	3.08	2.51	2.12	1.61	1.08	0.65	0.33	0.22	0.16
4.50	2.19	4.17	2.91	2.43	2.07	1.58	1.07	0.65	0.33	0.22	0.16
5.00	0.66	3.09	2.70	2.31	2.00	1.55	1.06	0.65	0.33	0.22	0.16
5.50	0.15	2.12	2.46	2.18	1.92	1.52	1.05	0.64	0.32	0.22	0.16
6.00	0.02	1.35	2.20	2.02	1.82	1.48	1.04	0.64	0.32	0.22	0.16
6.50	0.00	0.79	1.92	1.86	1.72	1.43	1.02	0.64	0.32	0.22	0.16
7.00	0.00	0.43	1.65	1.69	1.61	1.37	1.01	0.63	0.32	0.22	0.16
7.50	0.00	0.22	1.39	1.51	1.49	1.32	0.99	0.63	0.32	0.22	0.16
8.00	0.00	0.10	1.15	1.34	1.37	1.26	0.97	0.62	0.32	0.22	0.16
8.50	0.00	0.04	0.93	1.17	1.25	1.19	0.94	0.62	0.32	0.22	0.16
9.00	0.00	0.02	2.41	2.16	1.13	1.13	0.92	0.61	0.32	0.22	0.16
9.50	0.00	0.01	0.58	2.15	1.01	1.06	0.90	0.61	0.32	0.22	0.16
10.00	0.00	0.00	0.44	0.73	0.90	0.99	0.87	0.60	0.32	0.22	0.16
10.50	0.00	0.00	0.33	0.61	0.79	0.92	0.84	0.59	0.32	0.21	0.16
11.00	0.00	0.00	0.25	0.50	0.69	0.85	0.81	0.59	0.32	0.21	0.16
11.50	0.00	0.00	0.18	0.41	0.60	0.79	0.79	0.58	0.32	0.21	0.16
12.00	0.00	0.00	0.13	0.33	0.51	0.72	0.76	0.57	0.32	0.21	0.16
12.50	0.00	0.00	0.09	0.26	0.44	0.66	0.73	0.56	0.31	0.21	0.16
13.50	0.00	0.00	0.04	0.16	0.31	0.54	0.67	0.55	0.31	0.21	0.16
13.72	0.00	0.00	0.03	0.14	0.28	0.52	0.65	0.54	0.31	0.21	0.16

Rev. No.
Made By Date

File Ref.: bhnvel20.wk4

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OCEAN AND COASTAL CONSULTANTS, INC.

Project:	Boston Harbor Navigation Improvements	Sheet No.	26 of
		Job No.	94051.000000
Subject:	Vessel Slipstream Velocities	Made By	JCR Date 03-06-95
		Chkd. By	Date

SIMULATION NO. 21
Induced Water Velocities, m/s
Vessel : Harbor Tug
Power Level : 20 %

Installed kW :	1,195
Test Run kW :	239
Vessel Draft , m:	3.70
Water Depth , m:	13.72

Depth, m	x , Distance Behind Propeller, m										
	5	10	20	25	30	40	60	100	200	300	400
0.00	0.16	1.13	1.10	0.95	0.83	0.65	0.45	0.27	0.14	0.09	0.07
0.50	0.59	1.57	1.19	1.00	0.86	0.66	0.45	0.27	0.14	0.09	0.07
1.00	1.63	2.02	1.27	1.04	0.88	0.67	0.45	0.27	0.14	0.09	0.07
1.50	3.32	2.42	1.33	1.07	0.90	0.68	0.46	0.27	0.14	0.09	0.07
2.00	4.96	2.67	1.36	1.09	0.91	0.68	0.46	0.27	0.14	0.09	0.07
2.50	5.45	2.74	1.37	1.10	0.91	0.68	0.46	0.27	0.14	0.09	0.07
3.00	4.41	2.60	1.35	1.09	0.91	0.68	0.46	0.27	0.14	0.09	0.07
3.50	2.63	2.28	1.31	1.06	0.89	0.68	0.45	0.27	0.14	0.09	0.07
4.00	1.15	1.85	1.24	1.03	0.87	0.67	0.45	0.27	0.14	0.09	0.07
4.50	0.37	1.40	1.16	0.98	0.85	0.66	0.45	0.27	0.14	0.09	0.07
5.00	0.09	0.98	1.06	0.93	0.81	0.64	0.44	0.27	0.14	0.09	0.07
5.50	0.02	0.63	0.95	0.87	0.78	0.62	0.44	0.27	0.14	0.09	0.07
6.00	0.00	0.38	0.83	0.80	0.73	0.61	0.43	0.27	0.14	0.09	0.07
6.50	0.00	0.21	0.72	0.73	0.69	0.58	0.43	0.27	0.14	0.09	0.07
7.00	0.00	0.11	0.61	0.65	0.64	0.56	0.42	0.27	0.14	0.09	0.07
7.50	0.00	0.05	0.51	0.58	0.59	0.53	0.41	0.26	0.14	0.09	0.07
8.00	0.00	0.02	0.41	0.51	0.54	0.51	0.40	0.26	0.14	0.09	0.07
8.50	0.00	0.01	0.33	0.44	0.48	0.48	0.39	0.26	0.14	0.09	0.07
9.00	0.00	0.00	1.10	0.95	0.44	0.45	0.38	0.26	0.13	0.09	0.07
9.50	0.00	0.00	0.20	0.95	0.39	0.42	0.37	0.25	0.13	0.09	0.07
10.00	0.00	0.00	0.15	0.27	0.34	0.39	0.36	0.25	0.13	0.09	0.07
10.50	0.00	0.00	0.11	0.22	0.30	0.37	0.35	0.25	0.13	0.09	0.07
11.00	0.00	0.00	0.08	0.18	0.26	0.34	0.33	0.24	0.13	0.09	0.07
11.50	0.00	0.00	0.06	0.14	0.22	0.31	0.32	0.24	0.13	0.09	0.07
12.00	0.00	0.00	0.04	0.11	0.19	0.28	0.31	0.24	0.13	0.09	0.07
12.50	0.00	0.00	0.03	0.09	0.16	0.26	0.30	0.23	0.13	0.09	0.07
13.50	0.00	0.00	0.01	0.05	0.11	0.21	0.27	0.23	0.13	0.09	0.07
13.72	0.00	0.00	0.01	0.05	0.10	0.20	0.26	0.23	0.13	0.09	0.07

Rev. No.
Made By Date

File Ref.: bhnvel21.wk4

OCEAN AND COASTAL CONSULTANTS, INC.

Project: Boston Harbor Navigation Improvements
Subject: Vessel Slipstream Velocities

Sheet No. 27 of
Job No. 94051.000000
Made By JCR Date 03-06-95
Chkd. By Date

SIMULATION NO. 22
Induced Water Velocities, m/s
Vessel : Harbor Tug
Power Level : 40 %

Installed kW : 1,195
Test Run kW : 478
Vessel Draft , m: 3.70
Water Depth , m: 13.72

Depth, m	x , Distance Behind Propeller, m										
	5	10	20	25	30	40	60	100	200	300	400
0.00	0.20	1.42	1.38	1.20	1.04	0.81	0.56	0.34	0.17	0.11	0.09
0.50	0.74	1.97	1.50	1.26	1.08	0.83	0.57	0.34	0.17	0.11	0.09
1.00	2.05	2.54	1.60	1.31	1.11	0.84	0.57	0.34	0.17	0.11	0.09
1.50	4.17	3.04	1.67	1.35	1.13	0.85	0.57	0.34	0.17	0.11	0.09
2.00	6.23	3.36	1.71	1.37	1.14	0.86	0.57	0.34	0.17	0.11	0.09
2.50	6.85	3.44	1.72	1.38	1.15	0.86	0.57	0.34	0.17	0.11	0.09
3.00	5.54	3.26	1.70	1.37	1.14	0.86	0.57	0.34	0.17	0.11	0.09
3.50	3.30	2.87	1.64	1.34	1.12	0.85	0.57	0.34	0.17	0.11	0.09
4.00	1.45	2.33	1.56	1.29	1.10	0.84	0.57	0.34	0.17	0.11	0.09
4.50	0.47	1.76	1.46	1.24	1.07	0.83	0.56	0.34	0.17	0.11	0.09
5.00	0.11	1.23	1.33	1.17	1.02	0.81	0.56	0.34	0.17	0.11	0.09
5.50	0.02	0.79	1.19	1.09	0.98	0.79	0.55	0.34	0.17	0.11	0.09
6.00	0.00	0.47	1.05	1.00	0.92	0.76	0.54	0.34	0.17	0.11	0.09
6.50	0.00	0.26	0.91	0.91	0.86	0.73	0.53	0.34	0.17	0.11	0.09
7.00	0.00	0.14	0.77	0.82	0.80	0.70	0.52	0.33	0.17	0.11	0.09
7.50	0.00	0.06	0.64	0.73	0.74	0.67	0.51	0.33	0.17	0.11	0.09
8.00	0.00	0.03	0.52	0.64	0.67	0.64	0.50	0.33	0.17	0.11	0.09
8.50	0.00	0.01	0.41	0.55	0.61	0.60	0.49	0.33	0.17	0.11	0.09
9.00	0.00	0.00	1.38	1.20	0.55	0.57	0.48	0.32	0.17	0.11	0.09
9.50	0.00	0.00	0.25	1.20	0.49	0.53	0.46	0.32	0.17	0.11	0.09
10.00	0.00	0.00	0.19	0.33	0.43	0.50	0.45	0.32	0.17	0.11	0.09
10.50	0.00	0.00	0.14	0.28	0.38	0.46	0.43	0.31	0.17	0.11	0.09
11.00	0.00	0.00	0.10	0.22	0.33	0.42	0.42	0.31	0.17	0.11	0.09
11.50	0.00	0.00	0.07	0.18	0.28	0.39	0.40	0.30	0.17	0.11	0.09
12.00	0.00	0.00	0.05	0.14	0.24	0.36	0.39	0.30	0.17	0.11	0.09
12.50	0.00	0.00	0.03	0.11	0.20	0.32	0.37	0.29	0.17	0.11	0.09
13.50	0.00	0.00	0.02	0.07	0.14	0.26	0.34	0.29	0.16	0.11	0.09
13.72	0.00	0.00	0.01	0.06	0.13	0.25	0.33	0.28	0.16	0.11	0.09

Rev. No.
Made By Date

File Ref.: bhnvel22.wk4

OCEAN AND COASTAL CONSULTANTS, INC.

Project: Boston Harbor Navigation Improvements
Subject: Vessel Slipstream Velocities

Sheet No. 28 of
Job No. 94051.000000
Made By JCR Date 03-06-95
Chkd. By Date

SIMULATION NO. 23
Induced Water Velocities, m/s
Vessel : Harbor Tug
Power Level : 60 %

Installed kW : 1,195
Test Run kW : 717
Vessel Draft , m: 3.70
Water Depth , m: 13.72

Depth, m	x , Distance Behind Propeller, m										
	5	10	20	25	30	40	60	100	200	300	400
0.00	0.23	1.62	1.58	1.37	1.19	0.93	0.64	0.39	0.20	0.13	0.10
0.50	0.85	2.26	1.71	1.44	1.23	0.95	0.65	0.39	0.20	0.13	0.10
1.00	2.35	2.91	1.83	1.50	1.27	0.97	0.65	0.39	0.20	0.13	0.10
1.50	4.76	3.47	1.91	1.54	1.29	0.98	0.65	0.39	0.20	0.13	0.10
2.00	7.12	3.84	1.96	1.57	1.31	0.98	0.66	0.39	0.20	0.13	0.10
2.50	7.83	3.93	1.97	1.57	1.31	0.98	0.66	0.39	0.20	0.13	0.10
3.00	6.34	3.73	1.94	1.56	1.30	0.98	0.66	0.39	0.20	0.13	0.10
3.50	3.77	3.28	1.88	1.53	1.29	0.97	0.65	0.39	0.20	0.13	0.10
4.00	1.65	2.67	1.79	1.48	1.26	0.96	0.65	0.39	0.20	0.13	0.10
4.50	0.53	2.01	1.66	1.41	1.22	0.94	0.64	0.39	0.20	0.13	0.10
5.00	0.13	1.40	1.52	1.34	1.17	0.92	0.64	0.39	0.20	0.13	0.10
5.50	0.02	0.91	1.36	1.24	1.11	0.90	0.63	0.39	0.20	0.13	0.10
6.00	0.00	0.54	1.20	1.15	1.05	0.87	0.62	0.39	0.20	0.13	0.10
6.50	0.00	0.30	1.03	1.04	0.99	0.84	0.61	0.38	0.20	0.13	0.10
7.00	0.00	0.15	0.88	0.94	0.92	0.80	0.60	0.38	0.20	0.13	0.10
7.50	0.00	0.07	0.73	0.83	0.84	0.77	0.59	0.38	0.19	0.13	0.10
8.00	0.00	0.03	0.59	0.73	0.77	0.73	0.57	0.38	0.19	0.13	0.10
8.50	0.00	0.01	0.47	0.63	0.70	0.69	0.56	0.37	0.19	0.13	0.10
9.00	0.00	0.00	1.58	1.37	0.63	0.65	0.55	0.37	0.19	0.13	0.10
9.50	0.00	0.00	0.29	1.37	0.56	0.61	0.53	0.36	0.19	0.13	0.10
10.00	0.00	0.00	0.22	0.38	0.49	0.57	0.51	0.36	0.19	0.13	0.10
10.50	0.00	0.00	0.16	0.32	0.43	0.53	0.50	0.36	0.19	0.13	0.10
11.00	0.00	0.00	0.12	0.26	0.37	0.48	0.48	0.35	0.19	0.13	0.10
11.50	0.00	0.00	0.08	0.21	0.32	0.45	0.46	0.35	0.19	0.13	0.10
12.00	0.00	0.00	0.06	0.16	0.27	0.41	0.44	0.34	0.19	0.13	0.10
12.50	0.00	0.00	0.04	0.13	0.23	0.37	0.43	0.34	0.19	0.13	0.10
13.50	0.00	0.00	0.02	0.08	0.16	0.30	0.39	0.33	0.19	0.13	0.10
13.72	0.00	0.00	0.01	0.07	0.15	0.29	0.38	0.32	0.19	0.13	0.10

Rev. No.
Made By Date

File Ref.: bhnvel23.wk4

OCEAN AND COASTAL CONSULTANTS, INC.

Project:	Boston Harbor Navigation Improvements	Sheet No.	29	of	
		Job No.	94051.000000		
Subject:	Vessel Slipstream Velocities	Made By	JCR	Date	03-06-95
		Chkd. By		Date	

SIMULATION NO. 24
Induced Water Velocities, m/s
Vessel : Harbor Tug
Power Level : 80 %

Installed kW : 1,195
Test Run kW : 956
Vessel Draft , m: 3.70
Water Depth , m: 13.72

Depth, m	x , Distance Behind Propeller, m										
	5	10	20	25	30	40	60	100	200	300	400
0.00	0.25	1.78	1.73	1.50	1.31	1.02	0.70	0.43	0.22	0.14	0.11
0.50	0.93	2.48	1.88	1.58	1.36	1.05	0.71	0.43	0.22	0.14	0.11
1.00	2.58	3.20	2.01	1.65	1.40	1.06	0.72	0.43	0.22	0.14	0.11
1.50	5.24	3.82	2.10	1.70	1.42	1.07	0.72	0.43	0.22	0.14	0.11
2.00	7.83	4.22	2.15	1.72	1.44	1.08	0.72	0.43	0.22	0.14	0.11
2.50	8.61	4.32	2.16	1.73	1.44	1.08	0.72	0.43	0.22	0.14	0.11
3.00	6.97	4.10	2.14	1.72	1.43	1.08	0.72	0.43	0.22	0.14	0.11
3.50	4.15	3.60	2.07	1.68	1.41	1.07	0.72	0.43	0.22	0.14	0.11
4.00	1.82	2.93	1.96	1.63	1.38	1.06	0.71	0.43	0.22	0.14	0.11
4.50	0.59	2.21	1.83	1.55	1.34	1.04	0.71	0.43	0.22	0.14	0.11
5.00	0.14	1.54	1.67	1.47	1.29	1.01	0.70	0.43	0.22	0.14	0.11
5.50	0.02	1.00	1.50	1.37	1.23	0.99	0.69	0.43	0.22	0.14	0.11
6.00	0.00	0.60	1.32	1.26	1.16	0.96	0.68	0.42	0.22	0.14	0.11
6.50	0.00	0.33	1.14	1.15	1.08	0.92	0.67	0.42	0.22	0.14	0.11
7.00	0.00	0.17	0.96	1.03	1.01	0.88	0.66	0.42	0.21	0.14	0.11
7.50	0.00	0.08	0.80	0.92	0.93	0.84	0.65	0.42	0.21	0.14	0.11
8.00	0.00	0.04	0.65	0.80	0.85	0.80	0.63	0.41	0.21	0.14	0.11
8.50	0.00	0.01	0.52	0.70	0.77	0.76	0.62	0.41	0.21	0.14	0.11
9.00	0.00	0.01	1.73	1.50	0.69	0.71	0.60	0.41	0.21	0.14	0.11
9.50	0.00	0.00	0.31	1.50	0.61	0.67	0.58	0.40	0.21	0.14	0.11
10.00	0.00	0.00	0.24	0.42	0.54	0.62	0.56	0.40	0.21	0.14	0.11
10.50	0.00	0.00	0.18	0.35	0.47	0.58	0.55	0.39	0.21	0.14	0.11
11.00	0.00	0.00	0.13	0.28	0.41	0.53	0.53	0.39	0.21	0.14	0.11
11.50	0.00	0.00	0.09	0.23	0.35	0.49	0.51	0.38	0.21	0.14	0.11
12.00	0.00	0.00	0.06	0.18	0.30	0.45	0.49	0.38	0.21	0.14	0.11
12.50	0.00	0.00	0.04	0.14	0.25	0.41	0.47	0.37	0.21	0.14	0.11
13.50	0.00	0.00	0.02	0.08	0.18	0.33	0.43	0.36	0.21	0.14	0.11
13.72	0.00	0.00	0.02	0.07	0.16	0.32	0.42	0.36	0.21	0.14	0.11

Rev. No.
Made By Date

File Ref.: bhnvel24.wk4

OCEAN AND COASTAL CONSULTANTS, INC.

Project:	Boston Harbor Navigation Improvements	Sheet No.	30 of
		Job No.	94051.000000
Subject:	Vessel Slipstream Velocities	Made By	JCR Date 03-06-95
		Chkd. By	Date

SIMULATION NO. 25
Induced Water Velocities, m/s
Vessel : Harbor Tug
Power Level : 100 %

Installed kW : 1,195
Test Run kW : 1,195
Vessel Draft , m: 3.70
Water Depth , m: 13.72

Depth, m	x , Distance Behind Propeller, m										
	5	10	20	25	30	40	60	100	200	300	400
0.00	0.27	1.92	1.87	1.62	1.41	1.10	0.76	0.46	0.23	0.16	0.12
0.50	1.01	2.67	2.03	1.71	1.46	1.13	0.76	0.46	0.23	0.16	0.12
1.00	2.78	3.44	2.16	1.78	1.50	1.14	0.77	0.46	0.23	0.16	0.12
1.50	5.64	4.11	2.26	1.83	1.53	1.16	0.77	0.47	0.23	0.16	0.12
2.00	8.43	4.54	2.32	1.86	1.55	1.16	0.78	0.47	0.23	0.16	0.12
2.50	9.27	4.65	2.33	1.86	1.55	1.16	0.78	0.47	0.23	0.16	0.12
3.00	7.50	4.41	2.30	1.85	1.54	1.16	0.78	0.47	0.23	0.16	0.12
3.50	4.47	3.88	2.23	1.81	1.52	1.15	0.77	0.47	0.23	0.16	0.12
4.00	1.96	3.15	2.11	1.75	1.49	1.14	0.77	0.46	0.23	0.16	0.12
4.50	0.63	2.38	1.97	1.67	1.44	1.12	0.76	0.46	0.23	0.16	0.12
5.00	0.15	1.66	1.80	1.58	1.39	1.09	0.75	0.46	0.23	0.16	0.12
5.50	0.03	1.07	1.61	1.47	1.32	1.06	0.75	0.46	0.23	0.16	0.12
6.00	0.00	0.64	1.42	1.36	1.25	1.03	0.74	0.46	0.23	0.16	0.12
6.50	0.00	0.36	1.22	1.24	1.17	0.99	0.72	0.45	0.23	0.15	0.12
7.00	0.00	0.18	1.04	1.11	1.08	0.95	0.71	0.45	0.23	0.15	0.12
7.50	0.00	0.09	0.86	0.99	1.00	0.91	0.70	0.45	0.23	0.15	0.12
8.00	0.00	0.04	0.70	0.86	0.91	0.86	0.68	0.44	0.23	0.15	0.12
8.50	0.00	0.02	0.56	0.75	0.82	0.82	0.66	0.44	0.23	0.15	0.12
9.00	0.00	0.01	1.87	1.62	0.74	0.77	0.65	0.44	0.23	0.15	0.12
9.50	0.00	0.00	0.34	1.62	0.66	0.72	0.63	0.43	0.23	0.15	0.12
10.00	0.00	0.00	0.26	0.45	0.58	0.67	0.61	0.43	0.23	0.15	0.12
10.50	0.00	0.00	0.19	0.37	0.51	0.62	0.59	0.42	0.23	0.15	0.12
11.00	0.00	0.00	0.14	0.30	0.44	0.57	0.57	0.42	0.23	0.15	0.12
11.50	0.00	0.00	0.10	0.24	0.38	0.53	0.55	0.41	0.23	0.15	0.12
12.00	0.00	0.00	0.07	0.19	0.32	0.48	0.52	0.40	0.22	0.15	0.12
12.50	0.00	0.00	0.05	0.15	0.27	0.44	0.50	0.40	0.22	0.15	0.12
13.50	0.00	0.00	0.02	0.09	0.19	0.36	0.46	0.39	0.22	0.15	0.12
13.72	0.00	0.00	0.02	0.08	0.18	0.34	0.45	0.38	0.22	0.15	0.12

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File Ref.: bhnvel25.wk4

File Ref.: compeht

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Project:	MASSPORT	Sheet No.	Cover	of	
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Subject:	Alternative Disposal Sites Potential Wave Effects	Made By	JCR	Date	03-15-95
		Chkd. By		Date	

ANALYSIS OF WAVE INDUCED BOTTOM VELOCITIES

BOSTON HARBOR NAVIGATION IMPROVEMENT PROJECT

FIVE ALTERNATIVE DISPOSAL SITES

March 15, 1995

Ocean and Coastal Consultants, Inc.
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Trumbull, Connecticut 06611
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Project:	MASSPORT	**Sheet No.**	1	**of**	
		Job No.			
Subject:	Alternative Disposal Sites	**Made By**	JCR	**Date**	03-13-95
	Potential Wave Effects	**Chkd. By**		**Date**	

1.0 PROJECT SITE DESCRIPTION

1.1 Location: Five (5) potential in-water dredged material disposal sites located in outer Boston Harbor, designated as :

Site	Final Water Depth,MLW
Spectacle Island CAD	10-ft
Meisburger 2	95-ft
Meisburger 7	85-ft
Subaqueous B	15-ft
Subaqueous E	8-ft

Draft EIR/EIS, 1994

1.2 Water Surface Levels: Water surface elevations, based upon 19 year series of tidal observations by NOS (1978)

BOSTON OUTER HARBOR

Tidal Flood Frequency of Return (yrs)	Tidal Flood Elev. (ft) MLW
1	11.7
10	13.6
50	14.5
100	14.8

USACOE, New England Division
September 1988

The tabulated water surface elevation is a result of astronomical tides and storm surge. Does not include Wave Height or Wave set-up components.

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Project:	MASSPORT	**Sheet No.**	2	**of**	
		Job No.			
Subject:	Spectacle Island Disposal	**Made By**	JCR	**Date**	03-13-95
	Potential wave Effects	**Chkd. By**		**Date**	

1.3 Wave Conditions at Site

No historical Wave Climatology data exists for this site. Wind data, for maximum design conditions, fetch limitations, and shallow water conditions will be used for wave forecasting. The effect of shoaling and wave refraction will be quantified.

Design Wind Speed

From : "Handbook of Ocean and Underwater Engineering", ed. Myers, Holm & McAllister, McGraw-Hill, 1969.

Period Of Return (yrs)	Wind Speed (ft/s)
1	58
2	81
50	147
100	154

Wind Speed measured 30 - ft above surface

Duration Analysis

With no Wind Speed / Duration data for this site, analysis was based upon typical storm track passage; Assuming that Maximum wind speed would be associated with a large tropical disturbance or hurricane moving across Massachusetts Bay with forward speed, Vf and has a core radius of R.

t = time for storm passage = Wind Duration

t = R / Vf Where: R = 40 Naut. Miles
Vf = 15 Knots

t = R / Vf or t = 2.67 Hr

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1.3 Wave Conditions at Site (CONT'D)

Wind Generated Design Wave

As shown on the attached Figure, the Fetch Lengths for the predominant wind origin directions are summarized in the following Table.

FETCH LENGTHS

Site	Direction From True North (Degrees)	Distance (N.M.)
Spectacle Isl.	ENE (60)	160
Sub. B	E (80)	4.6
Sub. E	E (95)	4.0
M. 2	N/A	Unlimited
M. 7	N/A	Unlimited

These wind directions and fetch lengths were identified as maximum values for each site and do not represent the results of any statistical analysis of wind records.

Average Depth Over Design Fetch Reach
From NOS Chart No. 13267 and 13270

Spectacle Isl.	140-ft
Sub. B	45-ft
Sub. E	45-ft
M. 2	300-ft
M. 7	300-ft

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	Potential Wave Effects	**Chkd. By**		**Date**	

Wind Generated Design Wave (cont'd) **SPECTACLE ISLAND**

From: US Army Engineer, CERC, "Shore Protection Manual", 1973

H = (0.283*Uexp2 / g) * tanh [A] * tanh [B / tanh A]

Where: A = 0.53* (g*d / U^2) ^ 0.75

B= 0.0125* (g* F / U^2) ^ 0.42

d = 140.0 ft

F = 160 N.M.*6080 f 972,800 ft

U = 58 ft/sec **1-YR RETURN**

A = 0.66012
tanh A = 0.57844
B = 0.58063

H = 13.05 ft

T = (1.2*2Pi*U / g) * tanh [C] * tanh [D / tanh C]

Where: C = 0.833* (g*d / U^ 2)^ 0.375

D = 0.077* (g*F / U^ 2)^ 0.25

C = 0.92965
tanh C = 0.73043
D = 0.75639

T = 7.7 sec

SUMMARY OF DESIGN WAVE (DEEP WATER)

H =	13.05	ft
T =	7.7	sec

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Subject:	Alternative Disposal Sites	**Made By**	JCR	**Date**	03-13-95
	Potential Wave Effects	**Chkd. By**		**Date**	

Wind Generated Design Wave (cont'd) **Subaqueous B**

From: US Army Engineer, CERC, "Shore Protection Manual", 1973

H = (0.283*Uexp2 / g) * tanh [A] * tanh [B / tanh A]

Where: A = 0.53* (g*d / U^2) ^ 0.75

B= 0.0125* (g* F / U^2) ^ 0.42

d = 45.0 ft

F = 4.6 N.M.*6080 f 27,968 ft

U = 58 ft/sec **1-YR RETURN**

A = 0.28180
tanh A = 0.27457
B = 0.13078

H = 3.60 ft

T = (1.2*2Pi*U / g) * tanh [C] * tanh [D / tanh C]

Where: C = 0.833* (g*d / U^ 2)^ 0.375

D = 0.077* (g*F / U^ 2)^ 0.25

C = 0.60740
tanh C = 0.54229
D = 0.31146

T = 3.8 sec

SUMMARY OF DESIGN WAVE (DEEP WATER)

H =	3.60	ft
T =	3.8	sec

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OCEAN AND COASTAL CONSULTANTS, INC.

Project:	MASSPORT	**Sheet No.**	6	**of**	
		Job No.			
Subject:	Alternative Disposal Sites	**Made By**	JCR	**Date**	03-13-95
	Potential Wave Effects	**Chkd. By**		**Date**	

Wind Generated Design Wave (cont'd) **Subaqueous E**

From: US Army Engineer, CERC, "Shore Protection Manual", 1973

H = (0.283*Uexp2 / g) * tanh [A] * tanh [B / tanh A]

Where: A = 0.53* (g*d / U^2) ^ 0.75

B= 0.0125* (g* F / U^2) ^ 0.42

d = 45.0 ft

F = 4 N.M.*6080 f 24,320 ft

U = 58 ft/sec **1-YR RETURN**

A = 0.28180
tanh A = 0.27457
B = 0.12332

H =	3.42	ft

T = (1.2*2Pi*U / g) * tanh [C] * tanh [D / tanh C]

Where: C = 0.833* (g*d / U^ 2)^ 0.375

D = 0.077* (g*F / U^ 2)^ 0.25

C = 0.60740
tanh C = 0.54229
D = 0.30077

T =	3.7	sec

SUMMARY OF DESIGN WAVE (DEEP WATER)

H =	3.42	ft
T =	3.7	sec

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Subject:	Alternative Disposal Sites	**Made By**	JCR	**Date**	03-13-95
	Potential Wave Effects	**Chkd. By**		**Date**	

Wind Generated Design Wave (cont'd) **Meisburger 2**

From: US Army Engineer, CERC, "Shore Protection Manual", 1973

H = (0.283*Uexp2 / g) * tanh [A] * tanh [B / tanh A]

Where: A = 0.53* (g*d / U^2) ^ 0.75

B= 0.0125* (g* F / U^2) ^ 0.42

d = 300.0 ft

Assume F = 1000 N.M.*6080 f 6,080,000 ft

U = 58 ft/sec **1-YR RETURN**

A = 1.16914
tanh A = 0.82400
B = 1.25363

H = 22.14 ft

T = (1.2*2Pi*U / g) * tanh [C] * tanh [D / tanh C]

Where: C = 0.833* (g*d / U^ 2)^ 0.375

D = 0.077* (g*F / U^ 2)^ 0.25

C = 1.23720
tanh C = 0.84466
D = 1.19596

T = 10.2 sec

SUMMARY OF DESIGN WAVE (DEEP WATER)

H =	22.14	ft
T =	10.2	sec

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	Potential Wave Effects	**Chkd. By**		**Date**	

Wind Generated Design Wave (cont'd) **Meisburger 7**

From: US Army Engineer, CERC, "Shore Protection Manual", 1973

H = (0.283*Uexp2 / g) * tanh [A] * tanh [B / tanh A]

Where: A = 0.53* (g*d / U^2) ^ 0.75

B= 0.0125* (g* F / U^2) ^ 0.42

d = 300.0 ft

Assume F = 1000 N.M.*6080 f 6,080,000 ft

U = 58 ft/sec **1-YR RETURN**

A = 1.16914
tanh A = 0.82400
B = 1.25363

H =	22.14	ft

T = (1.2*2Pi*U / g) * tanh [C] * tanh [D / tanh C]

Where: C = 0.833* (g*d / U^ 2)^ 0.375

D = 0.077* (g*F / U^ 2)^ 0.25

C = 1.23720
tanh C = 0.84466
D = 1.19596

T =	10.2	sec

SUMMARY OF DESIGN WAVE (DEEP WATER)

H =	22.14	ft
T =	10.2	sec

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OCEAN AND COASTAL CONSULTANTS, INC.

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Subject:	Alternative Disposal Sites	**Made By**	JCR	**Date**	03-13-95
	Potential Wave Effects	**Chkd. By**		**Date**	

SUMMARY OF DEEP WATER WAVE CONDITIONS FOR RANGE OF RETURN PERIODS

Return Period, yrs	Wave	Site					
		Spec Isl	M. 2	M. 7	Sub. B	Sub. E	Note
1	Ht, ft	13.1	22.1	22.1	3.6	3.4	
	T, sec	7.7	10.2	10.2	3.8	3.7	
2	Ht, ft	18.0	32.1	32.1	5.1	4.9	
	T, sec	9.1	12.4	12.4	4.5	4.4	
50	Ht, ft	28.6	51.8	51.8	9.2	8.9	
	T, sec	11.9	16.6	16.6	5.9	5.7	
100	Ht, ft	29.5	53.3	53.3	9.6	9.3	
	T, sec	12.1	16.9	16.9	6.0	5.9	

These waves are unaltered by the effects of shoaling and refraction.

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Subject:	Alternative Disposal Sites	**Made By**	JCR	**Date**	03-13-95
	Potential Wave Effects	**Chkd. By**		**Date**	

Effects of Shoaling and Refraction **EXAMPLE COMPUTATION**

Depth At Structure: 10.0 ft (MLW) **Spectacle Island**
11.7 ft (1 - Yr Tidal Flood El., MLW)
0.0 ft (Correction NGVD to MLW Datum)

d = 21.7 ft at structure

Shoaling

SHOALING COEFFICIENT, Ks = H / Ho'

Where: H = Shallow Water Wave Height
Ho' = Wave Height in Deep Water If Unaffected by Refraction

Lo = 5.12 * T^2 For T = 7.7 sec
Lo = 303.6 ft

d / Lo = 0.0715

From: US Army Corps of Engineers, CERC, "Shore Protection Manual", 1973 TABLE C - 1, page C -5

Shoaling Coefficient Corresponding to d / Lo will be :

Ks = 0.9683

Refraction - By Bathymetry

Wave celerity is a function of water depth. Variation in the velocity of a wave along a wave crest, moving at an angle to the underwater contours, will cause the wave crest to bend toward alignment with the contours. This bending, or REFRACTION, is dependent upon the relation of water depth to wavelength.

Refraction, coupled with shoaling, determines the wave height in any specific depth of water and a given set of incident deepwater wave conditions.

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Subject:	Alternative Disposal Sites	Made By	JCR	Date	03-14-95
	Potential Wave Effects	Chkd. By		Date	

Refraction - By Bathymetry (Cont'd) **EXAMPLE REVISE**

From Table, pg. 27, at approximate design depth at structure (22 - ft), wave will be transitional [d/L = 0.1155].
Due to relatively small wave height and for CONSERVATIVE design, minor refraction effects will be realized.

REFRACTION COEFFICIENT, Kr = (bo / b) ^ 0.5

Where: bo = distance between wave orthogonals in deepwater

b = distance between wave orthogonals in shallow water after refraction

Refraction Coefficient will be:

Ref.: Attached Refraction Analysis

Kr =	0.9000

Design Wave Height at Site

H design = Ho' * Ks * K , Where :

Ho' = 13.10 ft
Ks = 0.9685
Kr = 0.9000

H design =	11.42	ft

Waves will impact the project site at an oblique angle. Approximate angle of incidence at the structure, based upon the refraction analysis, will be :

60 degrees east of north

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	Potential Wave Effects	**Chkd. By**		**Date**	

Refraction - By Bathymetry (Cont'd) **EXAMPLE COMPUTATION**

SPECTACLE ISLAND

REFRACTION ANALYSIS

HURRICANE GENERATED WAVE ORIGINATING FROM

East (80 Degrees From True North)

Deepwater Wave Conditions: T = 7.7 sec

Lo = 303.6 ft

d, (ft)	d/Lo	tanh (A)	C1/C2	C2/C1
140	0.4612	0.9941		
			1.0071	0.9930
120	0.3953	0.9871		
			1.0154	0.9848
100	0.3294	0.9721		
			1.0318	0.9691
80	0.2635	0.9421		
			1.0261	0.9745
70	0.2306	0.9181		
			1.0361	0.9651
60	0.1977	0.8861		
			1.0523	0.9503
50	0.1647	0.8421		
			1.0756	0.9297
40	0.1318	0.7829		
			1.1092	0.9015
30	0.0988	0.7058		
			1.1785	0.8485
20	0.0659	0.5989		

Note: A = 2 * (Pi) * d/L
From Table C - 1, US Army Corps of Engineers
CERC, "Shore Protection Manual", 1973

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Subject:	Alternative Disposal Sites	**Made By**	JCR	**Date**	03-15-95
	Potential Wave Effects	**Chkd. By**		**Date**	

SUMMARY OF WAVE CONDITIONS AT ALTERNATIVE SITES

Return Period, yrs	Wave Character	Site				
		Spec Isl	M 2	M 7	Sub B	Sub E
1	Design depth, ft	21.7	106.7	96.7	26.7	19.7
	Deep Water Ht, ft	13.1	22.1	22.1	3.6	3.4
	Deep Water Per., sec	7.7	10.2	10.2	3.8	3.7
	Shoaling Coefficient	0.9685	0.9182	0.9147	0.9671	0.9427
	Refraction Coefficient	0.9000	1.0000	1.0000	1.0000	1.0000
	Wave Ht at Site, ft	11.4	20.3	20.2	3.5	3.2
2	Design depth, ft	22.0	107.0	97.0	27.0	20.0
	Deep Water Ht, ft	18.0	32.1	32.1	5.1	4.9
	Deep Water Per., sec	9.1	12.4	12.4	4.5	4.4
	Shoaling Coefficient	1.0170	0.9154	0.9190	0.9357	0.9185
	Refraction Coefficient	0.9000	1.0000	1.0000	1.0000	1.0000
	Wave Ht at Site, ft	16.5	29.4	29.5	4.8	4.5
50	Design depth, ft	24.5	109.5	99.5	29.5	22.5
	Deep Water Ht, ft	28.6	51.8	51.8	9.2	8.9
	Deep Water Per., sec	11.9	16.6	16.6	5.9	5.7
	Shoaling Coefficient	1.1000	0.9582	0.9704	0.9131	0.9155
	Refraction Coefficient	0.9000	1.0000	1.0000	1.0000	1.0000
	Wave Ht at Site, ft	28.3	49.6	50.3	8.4	8.1
100	Design depth, ft	24.8	109.8	99.8	29.8	22.8
	Deep Water Ht, ft	29.5	53.3	53.3	9.6	9.3
	Deep Water Per., sec	12.1	16.9	16.9	6.0	5.9
	Shoaling Coefficient	1.1050	0.9619	0.9748	0.9130	0.9175
	Refraction Coefficient	0.9000	1.0000	1.0000	1.0000	1.0000
	Wave Ht at Site, ft	29.3	51.3	52.0	8.8	8.5

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EXAMPLE COMPUTATION - SPECTACLE ISLAND
MAXIMUM WATER PARTICLE VELOCITIES BENEATH DESIGN WAVE AT STRUCTURE

SITE CONDITIONS :

H wave =	11.4	ft	
T wave =	7.7	sec	
L wave =	188.9	ft	(See NOTE)
d, depth =	21.7	ft	

Depth, Ft	Umax, Ft/sec
21.7	5.88
20.0	5.89
18.0	5.93
16.0	5.99
14.0	6.08
12.0	6.19
11.0	6.26
10.0	6.33
9.0	6.42
8.0	6.50
7.0	6.60
6.0	6.70
5.0	6.81
4.0	6.93
3.0	7.06
2.0	7.19
1.0	7.33
0.0	7.48

Maximum Water Particle Velocities will occur in coincidence with the passing of the wave crest and / or trough. Design must consider the relative direction of the water particle motion.

NOTE : d / Lo { For Design Conditions} = 0.0715

Wavelength at Structure, L, can be determined from Tables Showing Functions of d / L for Increments of d /Lo.

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	Potential Wave Effects	**Chkd. By**		**Date**	

MAXIMUM
NEAR BOTTOM WAVE VELOCITIES, ft/s
ALTERNATIVE OPEN WATER DISPOSAL SITES - BHNIP

Return Period	Site				
	Spec Isl	M 2	M 7	Sub B	Sub E
1	5.8	3.2	3.6	0.6	0.9
2	8.9	5.7	6.3	1.2	1.6
50	15.1	11.2	12.1	2.9	3.5
100	15.5	11.7	12.6	3.0	3.7

Shaded quatitities indicate that the effects of wave refraction were approximated and may require revision, pending further needs assessment.

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Subject:	Alternative Disposal Sites	**Made By**	JCR	**Date**	03-13-95
	Potential Wave Effects	**Chkd. By**		**Date**	

Wind Generated Design Wave (cont'd) **SPECTACLE ISLAND**

From: US Army Engineer, CERC, "Shore Protection Manual", 1973

H = (0.283*Uexp2 / g) * tanh [A] * tanh [B / tanh A]

Where: A = 0.53* (g*d / U^2) ^ 0.75

B= 0.0125* (g* F / U^2) ^ 0.42

d = 140.0 ft

F = 160 N.M.*6080 f 972,800 ft

U = 81 ft/sec **2-YR RETURN**

A = 0.39998
tanh A = 0.37993
B = 0.43858

H =	17.95	ft

T = (1.2*2Pi*U / g) * tanh [C] * tanh [D / tanh C]

Where: C = 0.833* (g*d / U^ 2)^ 0.375

D = 0.077* (g*F / U^ 2)^ 0.25

C = 0.72364
tanh C = 0.61916
D = 0.64006

T =	9.1	sec

SUMMARY OF DESIGN WAVE (DEEP WATER)

H =	17.95	ft
T =	9.1	sec

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OCEAN AND COASTAL CONSULTANTS, INC.

Project:	MASSPORT	**Sheet No.**	10	**of**	
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Subject:	Alternative Disposal Sites	**Made By**	JCR	**Date**	03-13-95
	Potential Wave Effects	**Chkd. By**		**Date**	

Wind Generated Design Wave (cont'd) **Subaqueous B**

From: US Army Engineer, CERC, "Shore Protection Manual", 1973

H = (0.283*Uexp2 / g) * tanh [A] * tanh [B / tanh A]

Where: A = 0.53* (g*d / U^2) ^ 0.75

B= 0.0125* (g* F / U^2) ^ 0.42

d = 45.0 ft

F = 4.6 N.M.*6080 f 27,968 ft

U = 81 ft/sec **2-YR RETURN**

A = 0.17075
tanh A = 0.16911
B = 0.09878

H =	5.13	ft

T = (1.2*2Pi*U / g) * tanh [C] * tanh [D / tanh C]

Where: C = 0.833* (g*d / U^ 2)^ 0.375

D = 0.077* (g*F / U^ 2)^ 0.25

C = 0.47280
tanh C = 0.44046
D = 0.26356

T =	4.5	sec

SUMMARY OF DESIGN WAVE (DEEP WATER)

H =	5.13	ft
T =	4.5	sec

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Project:	MASSPORT	**Sheet No.**	11	of	
		Job No.			
Subject:	Alternative Disposal Sites	**Made By**	JCR	**Date**	03-13-95
	Potential Wave Effects	**Chkd. By**		**Date**	

Wind Generated Design Wave (cont'd) **Subaqueous E**

From: US Army Engineer, CERC, "Shore Protection Manual", 1973

H = (0.283*Uexp2 / g) * tanh [A] * tanh [B / tanh A]

Where: A = 0.53* (g*d / U^2) ^ 0.75

B= 0.0125* (g* F / U^2) ^ 0.42

d = 45.0 ft

F = 4 N.M.*6080 f 24,320 ft

U = 81 ft/sec **2-YR RETURN**

A = 0.17075
tanh A = 0.16911
B = 0.09315

H = 4.89 ft

T = (1.2*2Pi*U / g) * tanh [C] * tanh [D / tanh C]

Where: C = 0.833* (g*d / U^ 2)^ 0.375

D = 0.077* (g*F / U^ 2)^ 0.25

C = 0.47280
tanh C = 0.44046
D = 0.25451

T = 4.4 sec

SUMMARY OF DESIGN WAVE (DEEP WATER)

H = 4.89 ft

T = 4.4 sec

Rev. No.
Made By **Date**

naispi11.wk4

OCEAN AND COASTAL CONSULTANTS, INC.

Project:	MASSPORT	**Sheet No.**	12	**of**	
		Job No.			
Subject:	Alternative Disposal Sites	**Made By**	JCR	**Date**	03-13-95
	Potential Wave Effects	**Chkd. By**		**Date**	

Wind Generated Design Wave (cont'd) **Meisburger 2**

From: US Army Engineer, CERC, "Shore Protection Manual", 1973

H = (0.283*Uexp2 / g) * tanh [A] * tanh [B / tanh A]

Where: A = 0.53* (g*d / U^2) ^ 0.75

B= 0.0125* (g* F / U^2) ^ 0.42

d = 300.0 ft

Assume F = 1000 N.M.*6080 f 6,080,000 ft

U = 81 ft/sec **2-YR RETURN**

A = 0.70840
tanh A = 0.60968
B = 0.94694

H =	32.14	ft

T = (1.2*2Pi*U / g) * tanh [C] * tanh [D / tanh C]

Where: C = 0.833* (g*d / U^ 2)^ 0.375

D = 0.077* (g*F / U^ 2)^ 0.25

C = 0.96305
tanh C = 0.74563
D = 1.01202

T =	12.4	sec

SUMMARY OF DESIGN WAVE (DEEP WATER)

H =	32.14	ft
T =	12.4	sec

Rev. No.
Made By Date

naispi12.wk4

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OCEAN AND COASTAL CONSULTANTS, INC.

Project:	MASSPORT	**Sheet No.**	13	**of**	
		Job No.			
Subject:	Alternative Disposal Sites	**Made By**	JCR	**Date**	03-13-95
	Potential Wave Effects	**Chkd. By**		**Date**	

Wind Generated Design Wave (cont'd) **Meisburger 7**

From: US Army Engineer, CERC, "Shore Protection Manual", 1973

H = (0.283*Uexp2 / g) * tanh [A] * tanh [B / tanh A]

Where: A = 0.53* (g*d / U^2) ^ 0.75

B= 0.0125* (g* F / U^2) ^ 0.42

d = 300.0 ft

Assume F = 1000 N.M.*6080 f 6,080,000 ft

U = 81 ft/sec **2-YR RETURN**

A = 0.70840
tanh A = 0.60968
B = 0.94694

H =	32.14	ft

T = (1.2*2Pi*U / g) * tanh [C] * tanh [D / tanh C]

Where: C = 0.833* (g*d / U^ 2)^ 0.375

D = 0.077* (g*F / U^ 2)^ 0.25

C = 0.96305
tanh C = 0.74563
D = 1.01202

T =	12.4	sec

SUMMARY OF DESIGN WAVE (DEEP WATER)

H =	32.14	ft
T =	12.4	sec

Rev. No.
Made By Date

naispi13.wk4

OCEAN AND COASTAL CONSULTANTS, INC.

Project:	MASSPORT	**Sheet No.**		14	**of**
		Job No.			
Subject:	Alternative Disposal Sites	**Made By**	JCR	**Date**	03-13-95
	Potential Wave Effects	**Chkd. By**		**Date**	

Wind Generated Design Wave (cont'd) **SPECTACLE ISLAND**

From: US Army Engineer, CERC, "Shore Protection Manual", 1973

H = (0.283*Uexp2 / g) * tanh [A] * tanh [B / tanh A]

Where: A = 0.53* (g*d / U^2) ^ 0.75

B= 0.0125* (g* F / U^2) ^ 0.42

d = 140.0 ft

F = 160 N.M.*6080 f 972,800 ft

U = 147 ft/sec **50-YR RETURN**

A = 0.16360
tanh A = 0.16216
B = 0.26585

H =	28.56	ft

T = (1.2*2Pi*U / g) * tanh [C] * tanh [D / tanh C]

Where: C = 0.833* (g*d / U^ 2)^ 0.375

D = 0.077* (g*F / U^ 2)^ 0.25

C = 0.46281
tanh C = 0.43237
D = 0.47512

T =	11.9	sec

SUMMARY OF DESIGN WAVE (DEEP WATER)

H =	28.56	ft
T =	11.9	sec

Rev. No.
Made By Date

naispi14.wk4

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OCEAN AND COASTAL CONSULTANTS, INC.

Project:	MASSPORT	**Sheet No.**		15	**of**
		Job No.			
Subject:	Alternative Disposal Sites	**Made By**	JCR	**Date**	03-13-95
	Potential Wave Effects	**Chkd. By**		**Date**	

Wind Generated Design Wave (cont'd) **Subaqueous B**

From: US Army Engineer, CERC, "Shore Protection Manual", 1973

H = (0.283*Uexp2 / g) * tanh [A] * tanh [B / tanh A]

Where: A = 0.53* (g*d / U^2) ^ 0.75

B= 0.0125* (g* F / U^2) ^ 0.42

d = 45.0 ft

F = 4.6 N.M.*6080 f 27,968 ft

U = 147 ft/sec **50-YR RETURN**

A = 0.06984
tanh A = 0.06973
B = 0.05988

H =	9.21	ft

T = (1.2*2Pi*U / g) * tanh [C] * tanh [D / tanh C]

Where: C = 0.833* (g*d / U^ 2)^ 0.375

D = 0.077* (g*F / U^ 2)^ 0.25

C = 0.30238
tanh C = 0.29349
D = 0.19564

T =	5.9	sec

SUMMARY OF DESIGN WAVE (DEEP WATER)

H =	9.21	ft
T =	5.9	sec

Rev. No.
Made By Date

naispi15.wk4

OCEAN AND COASTAL CONSULTANTS, INC.

Project:	MASSPORT	**Sheet No.**	16	**of**	
		Job No.			
Subject:	Alternative Disposal Sites	**Made By**	JCR	**Date**	03-13-95
	Potential Wave Effects	**Chkd. By**		**Date**	

Wind Generated Design Wave (cont'd) **Subaqueous E**

From: US Army Engineer, CERC, "Shore Protection Manual", 1973

H = (0.283*Uexp2 / g) * tanh [A] * tanh [B / tanh A]

Where: A = 0.53* (g*d / U^2) ^ 0.75

B= 0.0125* (g* F / U^2) ^ 0.42

d = 45.0 ft

F = 4 N.M.*6080 f 24,320 ft

U = 147 ft/sec **50-YR RETURN**

A = 0.06984
tanh A = 0.06973
B = 0.05646

H = 8.87 ft

T = (1.2*2Pi*U / g) * tanh [C] * tanh [D / tanh C]

Where: C = 0.833* (g*d / U^ 2)^ 0.375

D = 0.077* (g*F / U^ 2)^ 0.25

C = 0.30238
tanh C = 0.29349
D = 0.18892

T = 5.7 sec

SUMMARY OF DESIGN WAVE (DEEP WATER)

H =	8.87	ft
T =	5.7	sec

Rev. No.
Made By **Date**

naispi16.wk4

OCEAN AND COASTAL CONSULTANTS, INC.

Project:	MASSPORT	**Sheet No.**	17	**of**	
		Job No.			
Subject:	Alternative Disposal Sites	**Made By**	JCR	**Date**	03-13-95
	Potential Wave Effects	**Chkd. By**		**Date**	

Wind Generated Design Wave (cont'd) **Meisburger 2**

From: US Army Engineer, CERC, "Shore Protection Manual", 1973

H = (0.283*Uexp2 / g) * tanh [A] * tanh [B / tanh A]

Where: A = 0.53* (g*d / U^2) ^ 0.75

B= 0.0125* (g* F / U^2) ^ 0.42

d = 300.0 ft

Assume F = 1000 N.M.*6080 f 6,080,000 ft

U = 147 ft/sec **50-YR RETURN**

A = 0.28976
tanh A = 0.28191
B = 0.57399

H = 51.75 ft

T = (1.2*2Pi*U / g) * tanh [C] * tanh [D / tanh C]

Where: C = 0.833* (g*d / U^ 2)^ 0.375

D = 0.077* (g*F / U^ 2)^ 0.25

C = 0.61592
tanh C = 0.54828
D = 0.75123

T = 16.6 sec

SUMMARY OF DESIGN WAVE (DEEP WATER)

H =	51.75	ft
T =	16.6	sec

Rev. No.
Made By Date

naispi17.wk4

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OCEAN AND COASTAL CONSULTANTS, INC.

Project:	MASSPORT	**Sheet No.**	18	**of**	
		Job No.			
Subject:	Alternative Disposal Sites	**Made By**	JCR	**Date**	03-13-95
	Potential Wave Effects	**Chkd. By**		**Date**	

Wind Generated Design Wave (cont'd) **Meisburger 7**

From: US Army Engineer, CERC, "Shore Protection Manual", 1973

H = (0.283*Uexp2 / g) * tanh [A] * tanh [B / tanh A]

Where: A = 0.53* (g*d / U^2) ^ 0.75

B= 0.0125* (g* F / U^2) ^ 0.42

d = 300.0 ft

Assume F = 1000 N.M.*6080 f 6,080,000 ft

U = 147 ft/sec **50-YR RETURN**

A = 0.28976
tanh A = 0.28191
B = 0.57399

H = 51.75 ft

T = (1.2*2Pi*U / g) * tanh [C] * tanh [D / tanh C]

Where: C = 0.833* (g*d / U^ 2)^ 0.375

D = 0.077* (g*F / U^ 2)^ 0.25

C = 0.61592
tanh C = 0.54828
D = 0.75123

T = 16.6 sec

SUMMARY OF DESIGN WAVE (DEEP WATER)

H = 51.75 ft

T = 16.6 sec

Rev. No.	
Made By	**Date**

naispi18.wk4

51.4

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OCEAN AND COASTAL CONSULTANTS, INC.

Project:	MASSPORT	**Sheet No.**	19	of	
		Job No.			
Subject:	Alternative Disposal Sites	**Made By**	JCR	**Date**	03-13-95
	Potential Wave Effects	**Chkd. By**		**Date**	

Wind Generated Design Wave (cont'd) **SPECTACLE ISLAND**

From: US Army Engineer, CERC, "Shore Protection Manual", 1973

H = (0.283*Uexp2 / g) * tanh [A] * tanh [B / tanh A]

Where: A = 0.53* (g*d / U^2) ^ 0.75

B= 0.0125* (g* F / U^2) ^ 0.42

d = 140.0 ft

F = 160 N.M.*6080 f 972,800 ft

U = 154 ft/sec **100-YR RETURN**

A = 0.15257
tanh A = 0.15140
B = 0.25566

H = 29.47 ft

T = (1.2*2Pi*U / g) * tanh [C] * tanh [D / tanh C]

Where: C = 0.833* (g*d / U^ 2)^ 0.375

D = 0.077* (g*F / U^ 2)^ 0.25

C = 0.44694
tanh C = 0.41938
D = 0.46419

T = 12.1 sec

SUMMARY OF DESIGN WAVE (DEEP WATER)

H =	29.47	ft
T =	12.1	sec

Rev. No.
Made By **Date**

naispi19.wk4

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OCEAN AND COASTAL CONSULTANTS, INC.

Project:	MASSPORT	**Sheet No.**	20	**of**	
		Job No.			
Subject:	Alternative Disposal Sites	**Made By**	JCR	**Date**	03-13-95
	Potential Wave Effects	**Chkd. By**		**Date**	

Wind Generated Design Wave (cont'd) **Subaqueous B**

From: US Army Engineer, CERC, "Shore Protection Manual", 1973

H = (0.283*Uexp2 / g) * tanh [A] * tanh [B / tanh A]

Where: A = 0.53* (g*d / U^2) ^ 0.75

B= 0.0125* (g* F / U^2) ^ 0.42

d = 45.0 ft

F = 4.6 N.M.*6080 f 27,968 ft

U = 154 ft/sec **100-YR RETURN**

A = 0.06513
tanh A = 0.06504
B = 0.05758

H = 9.61 ft

T = (1.2*2Pi*U / g) * tanh [C] * tanh [D / tanh C]

Where: C = 0.833* (g*d / U^ 2)^ 0.375

D = 0.077* (g*F / U^ 2)^ 0.25

C = 0.29201
tanh C = 0.28399
D = 0.19114

T = 6.0 sec

SUMMARY OF DESIGN WAVE (DEEP WATER)

H = 9.61 ft

T = 6.0 sec

Rev. No.
Made By **Date**

naispi20.wk4

OCEAN AND COASTAL CONSULTANTS, INC.

Project:	MASSPORT	**Sheet No.**	21	**of**	
		Job No.			
Subject:	Alternative Disposal Sites	**Made By**	JCR	**Date**	03-13-95
	Potential Wave Effects	**Chkd. By**		**Date**	

Wind Generated Design Wave (cont'd) **Subaqueous E**

From: US Army Engineer, CERC, "Shore Protection Manual", 1973

H = (0.283*Uexp2 / g) * tanh [A] * tanh [B / tanh A]

Where: A = 0.53* (g*d / U^2) ^ 0.75

B= 0.0125* (g* F / U^2) ^ 0.42

d = 45.0 ft

F = 4 N.M.*6080 f 24,320 ft

U = 154 ft/sec **100-YR RETURN**

A = 0.06513
tanh A = 0.06504
B = 0.05430

H =	9.26	ft

T = (1.2*2Pi*U / g) * tanh [C] * tanh [D / tanh C]

Where: C = 0.833* (g*d / U^ 2)^ 0.375

D = 0.077* (g*F / U^ 2)^ 0.25

C = 0.29201
tanh C = 0.28399
D = 0.18458

T =	5.9	sec

SUMMARY OF DESIGN WAVE (DEEP WATER)

H =	9.26	ft
T =	5.9	sec

Rev. No.
Made By **Date**

naispi21.wk4

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OCEAN AND COASTAL CONSULTANTS, INC.

Project:	MASSPORT	**Sheet No.**	22	**of**	
		Job No.			
Subject:	Alternative Disposal Sites	**Made By**	JCR	**Date**	03-13-95
	Potential Wave Effects	**Chkd. By**		**Date**	

Wind Generated Design Wave (cont'd) **Meisburger 2**

From: US Army Engineer, CERC, "Shore Protection Manual", 1973

H = (0.283*Uexp2 / g) * tanh [A] * tanh [B / tanh A]

Where: A = 0.53* (g*d / U^2) ^ 0.75

B= 0.0125* (g* F / U^2) ^ 0.42

d = 300.0 ft

Assume F = 1000 N.M.*6080 f 6,080,000 ft

U = 154 ft/sec **100-YR RETURN**

A = 0.27023
tanh A = 0.26384
B = 0.55199

H = 53.34 ft

T = (1.2*2Pi*U / g) * tanh [C] * tanh [D / tanh C]

Where: C = 0.833* (g*d / U^ 2)^ 0.375

D = 0.077* (g*F / U^ 2)^ 0.25

C = 0.59480
tanh C = 0.53334
D = 0.73396

T = 16.9 sec

SUMMARY OF DESIGN WAVE (DEEP WATER)

H = 53.34 ft

T = 16.9 sec

Rev. No.
Made By **Date**

naispi22.wk4

OCEAN AND COASTAL CONSULTANTS, INC.

Project:	MASSPORT	**Sheet No.**	23	**of**	
		Job No.			
Subject:	Alternative Disposal Sites	**Made By**	JCR	**Date**	03-13-95
	Potential Wave Effects	**Chkd. By**		**Date**	

Wind Generated Design Wave (cont'd) **Meisburger 7**

From: US Army Engineer, CERC, "Shore Protection Manual", 1973

H = (0.283*Uexp2 / g) * tanh [A] * tanh [B / tanh A]

Where: A = 0.53* (g*d / U^2) ^ 0.75

B= 0.0125* (g* F / U^2) ^ 0.42

d = 300.0 ft

Assume F = 1000 N.M.*6080 f 6,080,000 ft

U = 154 ft/sec **100-YR RETURN**

A = 0.27023
tanh A = 0.26384
B = 0.55199

H = 53.34 ft

T = (1.2*2Pi*U / g) * tanh [C] * tanh [D / tanh C]

Where: C = 0.833* (g*d / U^ 2)^ 0.375

D = 0.077* (g*F / U^ 2)^ 0.25

C = 0.59480
tanh C = 0.53334
D = 0.73396

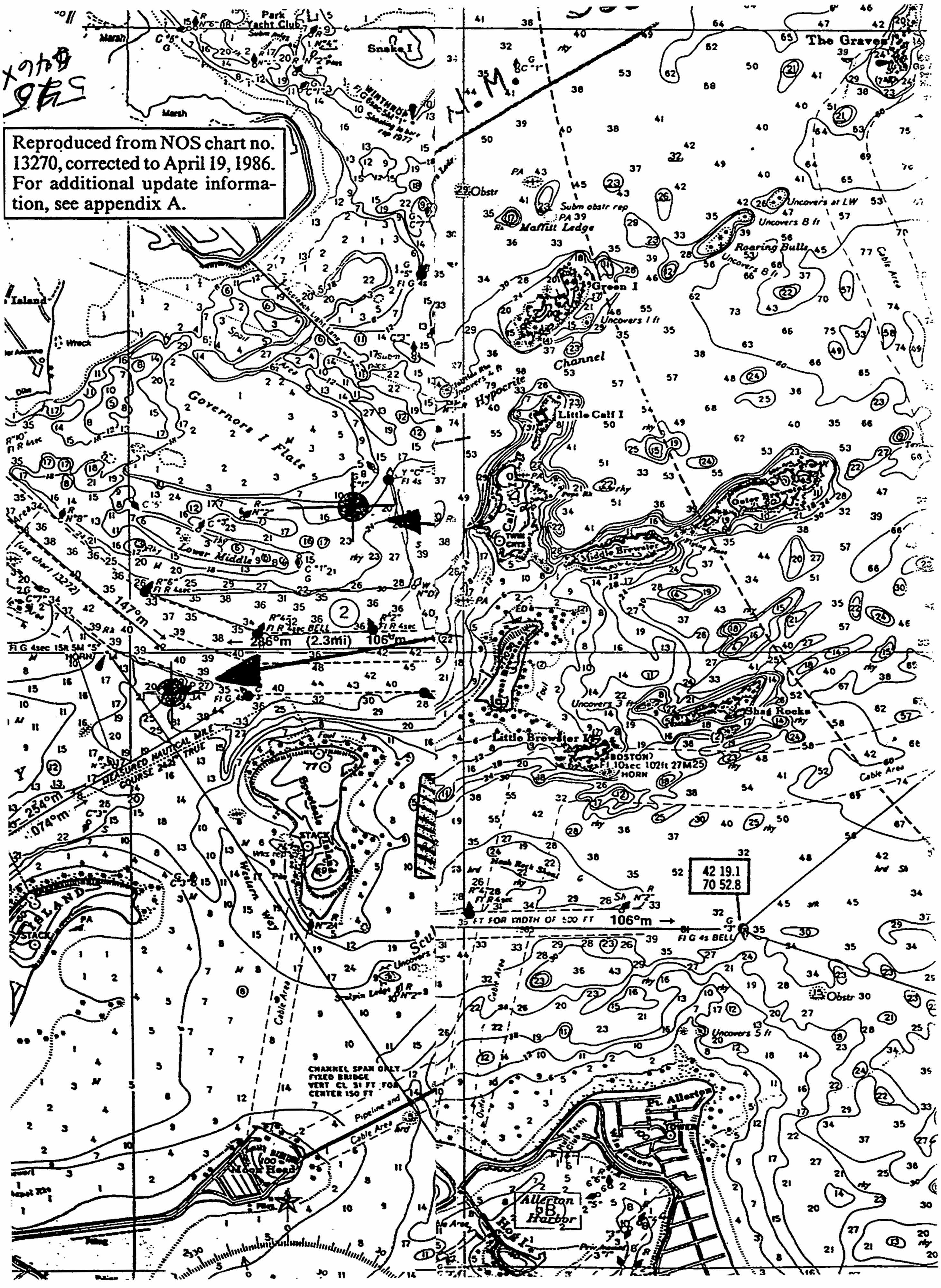
T = 16.9 sec

SUMMARY OF DESIGN WAVE (DEEP WATER)

H =	53.34	ft
T =	16.9	sec

Rev. No.	
Made By	**Date**

naispi23.wk4



Reproduced from NOS chart no. 13270, corrected to April 19, 1986. For additional update information, see appendix A.

APPENDIX H - CA/T LANDFILL CAPPING PROGRAM APPLICATION

GUIDE for COMPLETING the APPLICATION for SOLICITATION OF INTEREST for RECEIPT OF CLAY from the CENTRAL ARTERY/TUNNEL PROJECT

Please respond to every question. Failure to provide all necessary information may result in the application being rejected. Due to the short time frame available to review the applications received, there will not be an opportunity to supplement this application. Refer to the Guide prior to completing any of the questions in this Application.

I. Applicant Information

a. Give the address of the facility or the best locational description.

b. Give the name and title of the person filing the application and the Municipal Board/Authority that he/she represents.

c. Give the name and title of the contact person if different than b. and the Municipal Board/ Authority that he/she represents.

II. Project Information

A. Size of Landfill

1. Give the total acreage of the site which is site assigned under control of the municipality.

2. Give the total acreage (this may be greater than number 1.)

3. Total acres of waste deposited is the entire actual surface area of the landfill including all sideslopes.

4. Acres uncapped is the area that is currently uncapped. Uncapped means any area that has not received final cover in accordance with a DEP approved plan.

5. Give the area of the landfill capped according to an approved plan or certified as capped by the DEP. Please attach detailed description if portions of site were capped but not approved/certified.

B. Operational Status

1. a. Indicate whether the landfill still accepts municipal solid waste (MSW)

b. Indicate the date for ceasing to accept such waste

2. a. Indicate whether the landfill does not take MSW but continues to take DPW type waste, sludges, street sweepings, etc.

3. Identify as closely as possible when the landfill ceased to be active.

C. Other Information

1. a. Indicate if the site is partially capped.

   b. Indicate if the site will remain active while capping a portion which has reached or will reach capacity and explain the projected schedule and plan for capping.

2. Indicate the volume of capping material requested.

(Generally 3000 cubic yards of material per acre is estimated. If different, please explain.)

III. Regulatory Status

A. Assessment Status

The solid waste regulations require that an assessment, in accordance with 19.150, be done as part of the final closure of the facility. Preferably the assessment is completed prior to construction of the landfill cap, but it can also be conducted concurrently with or subsequent to construction of the cap. Indicate whether a report has been submitted, date submitted and DEP approval. Please provide documentation of the assessment status such as copies of any DEP approvals or documentation of the contract with a consulting firm hired to conduct the assessment.

[Note: A hydrological report was one developed or submitted prior to DEP development of Assessment Guidance]

B. Conceptual Closure Plan

A conceptual closure plan is required as one component of the permit application for an authorization to construct and/or operate a new, expanded or an existing landfill facility. Conceptual closure plans are preliminary since they were developed at the beginning of the landfill's life cycle and do not address all the the technical requirements needed to construct the cap at the completed landfill. Therefore a conceptual design plan is not a final design closure plan and can not be used as the plan to cap the landfill. Conceptual closure plans were required as part of the existing facilities permit submittals.

[Note 1: Final capping design plans are generally submitted six (6) months to one (1) year before the actual closure of the facility so that the technical requirements of the final capping plan reflect site specifics (such as final contours) and compliance with current DEP regulations and policies.]

C. Permits or Plan Approvals

1. Post 7/1/90 Permit/Approval

A final design closure plan is a plan that contains a full set of detailed drawings and specifications which have been approved or will be submitted for approval and which conform to the current regulatory requirements for a cap design. Indicate whether such plan has been completed, submitted and/or approved by DEP and provide documentation. Also indicate the consultant who has done or is doing the design.

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2. Pre 7/1/90 Plan

a. Identify whether a pre 7/1/90 plan was submitted and approved. Provide documentation of such approval.

b. Identify whether filling taken place beyond the boundaries of such plan so that the conceptual closure grades are no longer valid.

[Note 2: Any closure/capping plans approved and not implemented prior to July 1, 1990 (the effective date of new solid waste regulations) are no longer valid.]

D. Enforcement Actions

1. Has the municipality either signed a consent order or been issued an administrative (unilateral) order from the Department or a court order that requires the landfill to cease accepting waste and cap its landfill?

2. Identify the applicable dates and attach a copy of the order.

IV. Municipal Readiness to Undertake Project

A. Local Appropriations

Please provide documentation for the referenced funding information including a certified copy of the appropriation. Please attach a discussion as to whether debt exclusion or override will be required and the schedule for such action the schedule for such action. Please note whether this action has been accomplished.

B. Local Restrictions

*Contract agreements will be between municipality and contractor. Upon award of contract by MHD to the lowest qualified bidder, the contractor shall arrange individual agreements with municipalities identifying the terms and conditions for receipt of CA/THT Clay. Neither the DEP nor the MHD will be party to these agreements. Please note that MHD will identify in their bid proposal the minimum requirements which the contractor must adhere to for delivery and stockpiling of CA/THT Clay.

1. Hours of Operation

Please provide the hours of allowable clay delivery and stockpiling operations. Note that the contractors will be seeking landfills that receive clay during the late evening and early morning hours.

2. Haul Route

Please provide as a separate attachment a USGS map or equivalent indicating the acceptable haul routes through town to the landfill roads and bridges with weight restrictions should be indicated. Please note that an 18 wheeler with 22-24 cubic yards of clay may weigh up to 100,000lbs.

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3. See the requirements for a preliminary stockpiling plan included with the application. This stockpiling plan must be filed with the application. A more detailed plan may be required where erosion control, Wetlands Protection, Conservation Commission, DEP Wetlands or other permits are required. All submittals are subject to DEP approval.

4. Provide a detailed description of an other restrictions that the municipality intends to require as part of its agreement to receive the clay.

[Note: Restrictions that the contractor finds burdensome may decrease the likelihood of the municipalities to receive clay.]

V. Authorization and Certification

The application must be signed by the person duly authorized to represent the municipality in this regard. The signatory needs to attach the documentation from the municipality's governing body that shows he/she is authorized to sign for the municipality.

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SOLICITATION OF INTEREST and MUNICIPAL APPLICATION FOR RECEIPT OF CLAY from the CENTRAL ARTERY /TUNNEL PROJECT

se respond to every question. Failure to provide all necessary information may result in the application being rejected. to the short time frame available to review the applications received, there will not be an opportunity to supplement application. Refer to the Guide prior to completing any of the questions in this Application.

pplicant Information

a. City / Town ____________________

Location of Facility ____________________

b. Name of person filing Application ____________________

Title/Position ____________________

c. Name of Contact Person ____________________

Title/Position ____________________

Telephone Number ____________________

Project Description

A. Size of Landfill

1. Total Acreage of Site which is site assigned __________
2. Total Acreage of Site under control of the municipality __________
3. Total Acres of waste deposited __________
4. Acres Uncapped __________
5. Acres Previously Capped __________

B. Operational Status

1. a. Is Landfill currently receiving MSW? __________Yes __________No

   b. What is the projected date for ceasing to accept waste? __________

2. a. Is Landfill currently receiving waste such as sludge, DPW wastes, street sweepings, demo debris, etc. (but not MSW)

   __________Yes __________No

   b. What is the projected date for ceasing to accept such wastes __________

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3. Inactive Landfill
   When did Landfill cease accepting all wastes ____________________

C. Other Information

1. a. Is the site currently partially capped?
   __________ Yes __________ No

   b. Does the municipality intend to cap the whole site or to operate and partially cap?
   __________ Whole __________ Partial

   Provide a brief explanation of site status (see guide)

   ____

   ____

   ____

2. Volume of capping material requested ____________________ cubic yards

3. What is the anticipated date initiation capping will be undertaken? ________________________

III. Regulatory Status

A. Assessment Status

1. Has a Hydrological Report been submitted?
   ______ (Y/N) __________ Approved?(Y/N) __________ Date Submitted

2. Has an Initial Site Assessment been submitted?
   ______ (Y/N) __________ Approved?(Y/N) __________ Date Submitted

3. Has a draft Comprehensive Site Assessment been submitted?
   ______ (Y/N) __________ Approved?(Y/N) __________ Date Submitted

4. Has a final Comprehensive Site Assessment been submitted?
   ______ (Y/N) __________ Approved?(Y/N) __________ Date Submitted

(Provide documentation of above submittals and approvals.)

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B. Conceptual Closure Plan

a. Has a conceptual plan been completed?

_________ Yes _________ No

Date completed _________________

(Submit a copy of latest conceptual closure or final grading plan if previously submitted to DEP)

b. Has the conceptual plan been submitted to DEP?

_________ Yes _________ No

Date submitted _________________

c. Has the plan been approved by DEP?

_________ Yes _________ No

Date of approval letter _________________

(attach a copy of DEP approval letter)

C. Permits or Plan Approvals

1. Post 7/1/90 permits/approvals

a. Has a final design closure plan been completed?

_________ Yes _________ No

Date completed _________________

b. Has the final design closure plan been submitted to DEP?

_________ Yes _________ No

Date submitted _________________

(submit a copy of documentation)

c. Has the final design closure plan been approved by DEP?

_________ Yes _________ No

Date of approval letter _________________
(attach a copy of DEP approval letter)

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d. If a plan has not been done, has a local appropriation been made to do the plans?

_________ Yes _________ No

(provide documentation of local appropriation including date of appropriation amount)

e. Has a consultant done or been hired to do the design plans?

_________ Yes _________ No

Name and address of consulting firm _______________________

Name and number of contact at firm _______________________

2. Pre 7/1/90 plan approvals

a. Was there a closure plan approval prior to 7/1/90 for capping which has not been implemented to date?

_________ Yes _________ No

If yes, attach copy of the approval letter from DEP.

b. Has filling taken place beyond the boundaries of such plan so that the conceptual closure grades are identified in the the plan?

_________ Yes _________ No _________ Unsure

D. Enforcement actions

1. Is the municipality currently under an order to cease accepting waste and cap its landfill?

_________ Yes _________ No

2. If so, what are the dates required for the municipality to:

Deactivate the Landfill _______________

Undertake an Assessment _______________

Appropriate funds for closure _______________

Cap the Landfill _______________

(attach a copy of the order)

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ECU

SOLICITATION OF INTEREST and MUNICIPAL APPLICATION FOR RECEIPT OF CLAY from the CENTRAL ARTERY /TUNNEL PROJECT

Municipal readiness to undertake project

A. Local Appropriations

1. Have funds been appropriated for the following purposes:

PURPOSE	AMOUNT	DATE APPROPRIATED
Initial Site Assessment		
Final Design Closure Plan*		
Comprehensive Site Assessment		
Cap Construction		

ot a conceptual closure plan

(Please provide documentation for the above funding information including a certified copy of the appropriation. Please attach a discussion as to whether a debt exclusion or override will be required, or has been accomplished.)

B. Local Restrictions

1. Indicate the hours of operation and the days of the week that your municipality is willing to allow clay delivery and stockpiling operations.

____

____

____

____

2. Attach a map that indicates the acceptable haul routes. Indicate any restrictions (i.e. hauling through school zone).

________ Yes ________ No

3. A stockpiling plan stamped by a PE or RLS in accordance with guidance provided as part of the application package must be included. Has such a plan been submitted?

________ Yes ________ No

4. Attach a detailed description of any other conditions the municipality intends to require as part of its agreement to receive the clay.

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V. Authorization and Certification

I certify that I have personally examined and am familiar with the information submitted in this document and all attachments and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate and complete. I also certify that I am a duly authorized representative of the within named legal entity, as evidenced by the attached copy of the applicant's governing body.

(attach authorization to file by the executive authority in your municipality)

____
Print Name

____
Authorized Signature

____
Position/Title

____
Date

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ECL

REQUIREMENTS
FOR
CENTRAL ARTERY/THIRD HARBOR TUNNEL
CLAY MANAGEMENT AND STOCKPILING
AT
MUNICIPAL LANDFILLS
APRIL 15, 1994

This document discusses the requirements for temporary stockpiling of clay from the Central Artery/Third Harbor Tunnel (CA/T) project at municipal landfills in the Commonwealth of Massachusetts. A plan meeting these requirements must be submitted with the clay application. The requirements stated in this document are strictly for the purposes of stockpiling clay from the CA/T project. All DEP requirements for placement of the cap as stated in 310 CMR 19.000 and associated guidance must be adhered to.

1. PLAN PREPARATION

A conceptual stockpile/site plan shall be prepared and submitted with the application for CA/T clay. No unapproved stockpiling of CA/T clay will be allowed. The plan shall identify the location of the stockpile, , approximate property lines, recent topography, horizontal and vertical controls, estimated edge of waste and wetlands, an on-site haul route, any facilities on site (buildings, scales, composting operations etc), and the location of proposed erosion control features. At a minimum, haybales and/or silt fencing shall be placed along the downgradient side of the stockpile area (see attached standard details). The plan scale shall be at or between plan scales of 1" = 100' and 1" = 20'. The plan must be stamped by a MA licensed PE or PLS.

Applicant must indicate that the proposed stockpiling location will not be within any of the locational restrictions noted below:

- Non site-assigned/landfill parcels
- Federally designated wetlands, or 100 year floodplain
- Within 100' of State wetland unless approved by the local conservation commission
- Within 50' of the Property line unless local zoning, existing site assignment, or other restrictions are more stringent
- Within areas designated by the State as containing rare and endangered species
- On top of capped portions of landfills, unless special approval has been granted by the Department.

To assist in planning for stockpile location the following clay volume estimates and stockpile dimensions assuming 2:1 sideslopes and a 15% front face are as follows:

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Landfill Size (acres)	Clay Volume (cubic yards)	Stockpile Dimensions (length x width x height)
4 acres	12,000 cy	150' x 200' x 20'
10 acres	30,000 cy	200' x 300' x 20'
25 acres	75,000 cy	250' x 400' x 40'
50 acres	150,000 cy	200' x 800' x 40'

No applicant may receive more clay than is necessary to cap the landfill. A maximum of 3,000 cubic yards per acre will be allowed.

2. **STOCKPILE CREATION REQUIREMENTS**

MHD and/or its Contractors will manage the clay as it is being delivered to the landfill. Management will include oversight of the trucks while they are on the landfill property, managing the clay loads as they are delivered and dumped, grading and shaping the stockpile, and providing and maintaining erosion controls as required, during the period when clay is being delivered to the landfill. Applicant will be required to continue to maintain clay stockpile once facility is turned over to the landfill owner. Applicant must indicate a commitment to cooperate with the operation of the stockpile including ensuring that access to the stockpile area be provided at all times acceptable to both parties. Applicant may elect to be responsible for grading and shaping the stockpile and providing and maintaining erosion.

3. **OTHER PERMITS**

The owner of the landfill shall be responsible to obtain any additional permits or approvals. The owner is advised to check with the applicable local agencies including the zoning board, planning board, and conservation commission to determine if these agencies have jurisdiction over any aspects of this activity. Increased stormwater runoff, road siltation, haul routes, cutting of trees, work within a wetlands buffer zone, height restrictions and noise restrictions may trigger local approvals not presently covered by the ongoing or deactivated solid waste operation. Applicants are advised that any interruption of clay deliveries which result from the applicants failure to obtain, or revocation of, necessary permits and approvals may result in MHD contractors halting all further clay deliveries to the site.

4. **PHYSICAL QUALITY CONTROL TESTING**

Physical quality control testing will be performed by MHD and or its contractors. Clay testing will not be required for the initial clay application, but will be required by the DEP prior to hauling and stockpiling. Please note the following special conditions:

- CA/T clay stockpiles shall not include stone sizes greater than 12" in any dimension. The Applicant must however understand that the DEP requirements for clay caps do not allow stone sizes greater than 3" and that the total percentage of coarse fragments must remain less than 10% by weight (retained on a #4 sieve). The Applicant must be prepared to screen the clay of possible stones greater than 3" (in diameter) prior to use as a cap material.

- Stockpiling of clay will not be allowed when the clay's moisture content exceeds 10% of its plastic limit or is within 5% of its liquid limit. Exceptions to this may be granted where the landfill owner has demonstrated in their plan submittal that adequate erosion control measures will be in place to handle a high water content clay.

CHEMICAL QUALITY CONTROL TESTING

Chemical quality control testing will not be required as part of this initial CA/T clay application. Chemical quality control testing will be performed by the Contractor and or MHD in accordance with DEP required sampling protocols. Please note that one clay sample will be tested for TPH, Chlorides (Cl), Arsenic (As), and permeability every 10,000 cy's.

CLAY COVERING REQUIREMENTS

If the clay stockpile is to remain exposed for more than three (3) months, and there are wetlands, streams or water bodies within 200 feet, the MHD and or its Contractors will either cover the stockpile with a plastic tarp (20 mil Poly or 10 mil nylon reinforced poly) and adequate anchoring or they will loam and seed the stockpile. The Applicant must commit to maintain the stockpile upon completion of the clay covering requirements indicated above. The Applicant must recognize that if the clay is exposed to sunlight (including under a tarp) for an extended period of time the top layer will desiccate and become unusable. The extent of desiccation will be a function of surface area exposure, length of exposure and weather conditions. Applicants may elect to perform stockpile covering or loaming and seeding themselves in place of the contractor. This must be indicated in the application.

COMPACTION

Kneading compaction (tamping foot compactors or sheepsfoot) shall not occur during the stockpile creation so as not to overwork the clay. Placement of the clay during capping of the landfill will however require significant quality control including compaction.

ATTACHMENT 3

CA/T CLAY DISTRIBUTION PROGRAM

APPROVED MUNICIPAL LANDFILLS

JULY 5, 1994

Acton
Andover
Ashby
Attleboro
Ayer
Barnstable
Bedford
Bolton
Boston
Bourne
Buckland
Chatham
Cohasset
Concord
Dartmouth
Dennis
Dunstable
Duxbury
E Bridgewater
Eastham
Easton
Fairhaven
Falmouth
Foxborough
Franklin
Freetown
Gloucester
Greenfield
Harwich
Haverhill
Holbrook
Kingston
Lakeville
Lee
Lowell
Marshfield
Mashpee
Mattapoisett
Merrimac
Middleborough
Middleton
Milford
Millis
Milton
Natick
Needham
New Bedford
New Salem
Newton
Norfolk
Norwood
N. Attleboro
Oak Bluffs
Orleans
Otis
Pepperell
Plymouth
Raynham
Reading
Rockland
Rockport
Rowley
Salisbury
Scituate
Seekonk
Sharon
Shirley
Southampton
Springfield
Sudbury
Sunderland
Sutton
Taunton
Topsfield
Walpole
Wendell
Westport
Weymouth
Winchendon
Woburn
Worcester
Yarmouth

APPENDIX I - DREDGED MATERIALS DEWATERING STUDY

BOSTON HARBOR NAVIGATION IMPROVEMENT PROJECT

DISCUSSION OF DRYING METHODS FOR DREDGED MATERIALS

INTRODUCTION

Unconfined open water disposal is typically the most cost effective method of disposing of dredged soils. However, based on conclusions cited in the Executive Summary, "the sediment bulk chemistry data, in combination with test organism toxicity and bioaccumulation testing, indicated that the silt was generally not suitable for unconfined open water disposal".

If land based disposal of the dredged material is required, the material would likely be loaded into scows and brought to shore for transfer to gasketed trucks. The trucks would deliver the material to one or more processing sites that would prepare the silts for disposal. Hydraulic dredging has been eliminated as an extraction method due to the potential for disturbing surrounding silts, therefore, an environmental clamshell bucket would probably be used to dredge the harbor.

Silt and clay dredged from Boston Harbor for the Navigation Improvement project, has a water content ranging from 19.8% to 74.7% with an average water content of 51%."

There are several different methods available to dewater the dredged materials, including air drying, heat drying, chemical treatment, mechanical drying and mixing with dry material. Each method has benefits and disadvantages that make it more or less practical than other methods for dewatering dredged materials for this project. These methods are described in more detail below.

AIR DRYING

Air drying involves spreading material, typically 1'-2' thick, within a diked containment area. The containment area would consist of an impervious bottom and surrounding berm with monitoring wells to detect breaching of the containment. A bituminous paved parking lot is a good site for preparation of a containment area and a surrounding berm. Stockpiled dredged material is allowed to air dry through evaporation. Material is "worked" daily to open the top layer for drying, using a sheepsfoot roller or a rubber-tired machine. The stockpile may be protected from re-saturation during inclement weather by "skinning over" the top surface prior to any forecasted rainfall. A loader or dozer back drags and smooths over the top of the stockpile creating a seal that prevents significant rainfall from re-saturating the material. Skinning also crowns the surface to direct and control runoff.

Drying time typically ranges from 2 to 7 days depending on the composition of the material, ambient air temperature, relative humidity and other atmospheric factors. Clay materials typically dry more quickly than silts. Once dredged material has reached the desired water content, it is collected and deposited in trucks for disposal using a clamshell or backhoe/loader if the containment area is on firm ground such as a paved area as discussed above.

This can be an economical method for dewatering the dredged material provided one or more satisfactory containment areas can be identified; however, containment areas should be large, easily accessible and reasonably close to the area being dredged, to minimize hauling costs which may be prohibitively expensive on the Boston waterfront. Assuming a five-acre site, material stacked two feet thick and a one week turnaround, a five acre site can handle 10,000 to 15,000 cubic yards of material per week, which is the approximate production for one dredge. Air drying can be augmented with chemical stabilization or mixing with dry material to accelerate the drying process. These methods are discussed in more detail later in this report.

A benefit of this process is that water is removed through evaporation, consequently no water effluent needs to be treated. A concern with this process is odor control. Nuisance odors may be generated during drying which can be controlled with chemical odor controls or daily cover, both of which can impede evaporation. Air pollution regulations should be reviewed in conjunction with other criteria mentioned above when reviewing possible containment sites.

HEAT DRYING

Heat drying of rock and soils is commonly used to remove moisture from aggregates in the production of bituminous and cement based concrete products. This same technology has been used in dredging operations with success.

An aggregate dryer consists of a rotary drum surrounded by an air space and a jacket. Heat is introduced to the area around the drum using an oil or gas burner. The drum rotates, mixing the aggregate inside, while heat is introduced causing the water in the aggregate to evaporate. Material is fed to the dryer through a hopper or conveyor.

This technology is typically used to dry rock and coarse gravel materials with a maximum amount of tines not exceeding 7-8% passing a #200 sieve. Material finer than this tends to cake on the sides of the drum. Sieve analysis of the dredged materials indicate that the bast majority of material is too fine to be processed using an aggregate dryer. This technology would be appropriate for processing blasted rock and any coarse gravel material obtained during dredging. Other dryer technologies exist within the clay industry to process finer silts and clays. Some segregation of material to separate fine from coarse material may be required if heat drying is considered.

A benefit of this method is that there is no water effluent to treat and dispose of, because water is evaporated and released to the atmosphere. The drying operation is also relatively mobile. Problems with this method may result, if the level of PCB and other contaminants escaping into the atmosphere during drying exceed the amounts allowed to be released. The cost of fuel consumption is also a major consideration. Compared to other dewatering processes, heat drying has a very low throughput, especially for finer textured materials such as the BHNIP silts.

CHEMICAL STABILIZATION

Chemical stabilization generally consists of adding lime or a limo derivative to the dredged material in a pugmill. Lime reacts with the water, generating heat and increasing the pH. This not only lowers the water content of the material, but also elevates the pH of the material. The higher pH kills micro-organisms that may be contained in the soil Once lime is added, material is stockpiled and allowed to "work" before transporting for disposal.

As a primary dewatering method, this procedure may not be practical due to the shear volume of material to be processed. Any free water segregated from the dredged material during transport to the pugmill would require collection and treatment, therefore this process is typically used in conjunction with a primary dewatering system. However, there may be benefits to using this procedure in conjunction with air drying, especially if increasing the pH is a benefit. Lime could be spread over the stockpile of dredged material to be air dried. The lime would then be mixed into the dredged material when the stockpile is mechanically disturbed to bring moist layers to the surface. The area necessary for this operation would be slightly less than that for normal air drying as noted above, because it can be stockpiled higher. This process relies less on surface contact with air for evaporation.

MECHANICAL DEWATERING

There are several different methods to dry material mechanically. Mechanical equipment generally consists of belt presses, plate and frame presses, clarifers, centrifuges and vacuum dewatering methods. In most cases, dredged material is pumped into the dewatering equipment. Water is then separated using mechanical force. The remaining "cake" is collected and transported to a disposal site. Pumping dredged material to any of this equipment can be a problem, because of the moisture content of the dredged material. The water content should be at least 90% for efficient pumping. Water would need to be added to the majority of dredged material to enable it to be pumped efficiently for dewatering.

Presses

a) Belt filter presses could typically reduce water content of treated material to 75-80%. That material with a high clay content as may be found in portions of the BHNIP silts and which already has a water content less than this may not be effectively dried using belt filter presses. These portions of the silts may be effectively dried by adding polymer to the press inflow stream.

b) Plate and frame presses take liquid with a water content of 92% or higher and reduce water content to 40-50%. This method may not effectively reduce the water content of the dim to the desired level of no free water. Operation of plate and frame presses is also labor intensive, since the remaining "cake" is usually removed from the press manually.

Clarifier technology is commonly used in design and construction of dredged material containment facilities to separate sediment from water by gravity techniques in dredging operations where a slurry is generated and the process water requires treatment prior to the discharge of water effluent. If hydraulic dredging was an option, this method may be practical as a primary step in separating water from the soils. The sediment collected from this process would require further treatment to remove excess water. Since the dredging method is limited to a gasketed clamshell bucket, this method would not be appropriate for this project.

Centrifugal dewatering utilizes centrifugal force to increase the speed of gravity sedimentation. Sediment is forced against the outside wall of a circulating drum, while water is skimmed off. Like clarifer technology, it is not likely that adequate drying of the sediment would be achieved without supplemental drying using some other method.

Vacuum dewatering technology introduces a vacuum pressure that increases the speed of evaporation. This technology is relatively new and untested for dewatering dredged materials. Throughput rates are unknown since these methods have not been field tested. A benefit to this technology is that it is relatively portable. Disadvantages include very high energy costs for operation and questions concerning reliability because of limited experience using this technology for dewatering dredged material.

MIXING WITH DRY MATERIAL

Mixing wet material with dry material is another commonly used method for dewatering. A dry sand or other readily available and inexpensive material is purchased and combined with the dredge material, in a pug mill or by stockpiling together and mixing with a backhoe or loader. The proportions will vary depending on the type of material used and how well it will mix with the dredged material, but a one to one ratio can be anticipated.

A benefit of this method is that it dilutes the level of contaminants in the final product by increasing volume without contributing to the level of contaminants in the dredged material.\

This option would be practical on a small scale, or if space if tight, drying time must be minimized, dry material is readily available and inexpensive and disposal costs are not a major cost factor. However, due to the large quantity of material to be dredged, it is likely to be cost prohibitive as a primary method of dewatering. Not only is sand or other material purchased to mix with the dredged material, but the volume of material that needs to be disposed of when dry is increased by the amount of material added.

CONCLUSIONS

Based on the sediment characteristics of the material to be dredged, it is apparent that some form of dewatering will be required to reduce water content to a level that makes it economical to handle and dispose of the dredged material. Heat drying, chemical stabilization and mixing with dry material are all methods that can be used, however, due to the shear volume of material to be handled, it is likely that air drying is the most practical and economical option. Air drying, mechanical dewatering or a combination of the two may be practicable depending on productivity requirements and costs. Air drying, though technically feasible is limited in BHNIP due to the large area needed. Regardless of the system selected, careful consideration must be made to air and water pollution control requirements for both air and water discharge from the drying process.

Refer to the attached exhibit for a matrix analysis of each method described above and the associated merits and disadvantages of each method.

Footnotes: (1) The source of this data is the Draft Environmental Impact report (EOEA File No. 8695) and Draft Environmental Impact Statement, Volume 2 of 2 - Appendix; Boston Harbor, Massachusetts, Navigation Improvement Project and Berth Dredging Project; April 1994; Appendix C-3, Table 2.1

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BOSTON HARBOR

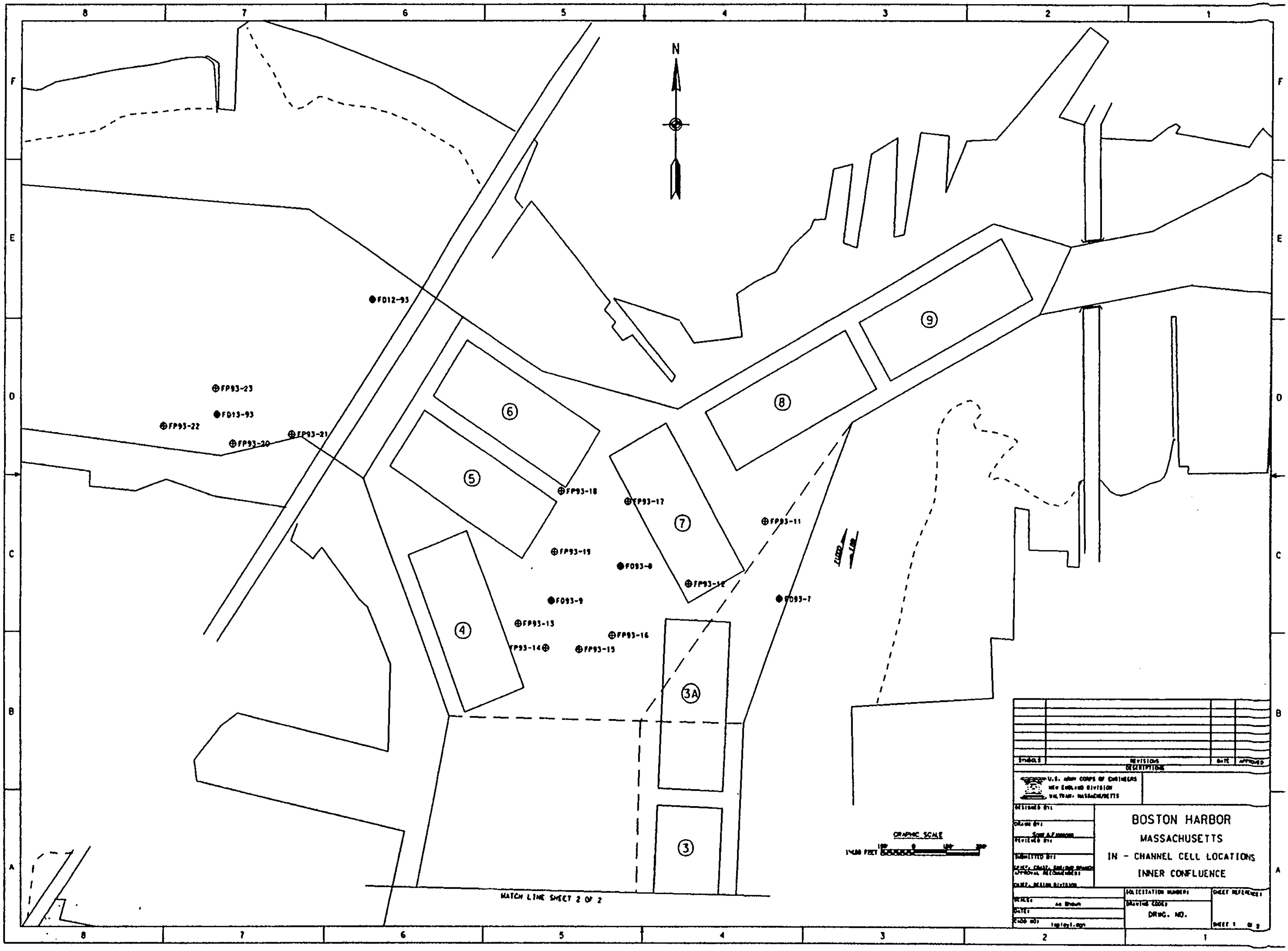
NAVIGATION IMPROVEMENT PROJECT

MATRIX ANALYSIS
DRYING METHODS FOR DREDGED MATERIALS

Evaluation Criteria	Air Dry	Heat Dry	Chem. Stab.	Belt Press	Plate Press	Clarifier	Centrifuge	Vacuum	Mix Dry Material
Can Achieve Realistic Water Content	+	+	+	+	+	-	0	+	+
Can Handle Large Volumes	+	0	+	+	-	-	-	0	-
Low Energy Consumption	+	-	+	-	-	-	-	-	+
Minimal Labor Required	+	0	+	-	-	-	-	0	0
Minimal Air Emissions	+	-	0	+	+	+	+	0	+
Requires Additional Water	0	+	0	-	-	-	-	+	0
Satisfactory Processing Rate	+	0	+	-	-	-	-	-	+
Minimal Space Requirements	-	+	-	+	+	+	+	+	-
Process is Mobile	-	+	0	+	+	+	+	+	-
Can Handle Silts	+	-	+	+	+	+	+	+	+
Can Handle Clays	+	0	+	+	+	+	+	+	+
Doesn't Increase Disposal Vol	+	+	-	+	+	+	+	+	-

Symbols Legend
+ Positive
0 Neutral
- Negative

APPENDIX J - IN-CHANNEL DISPOSAL OPTION SEQUENCING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INNER CONFLUENCE
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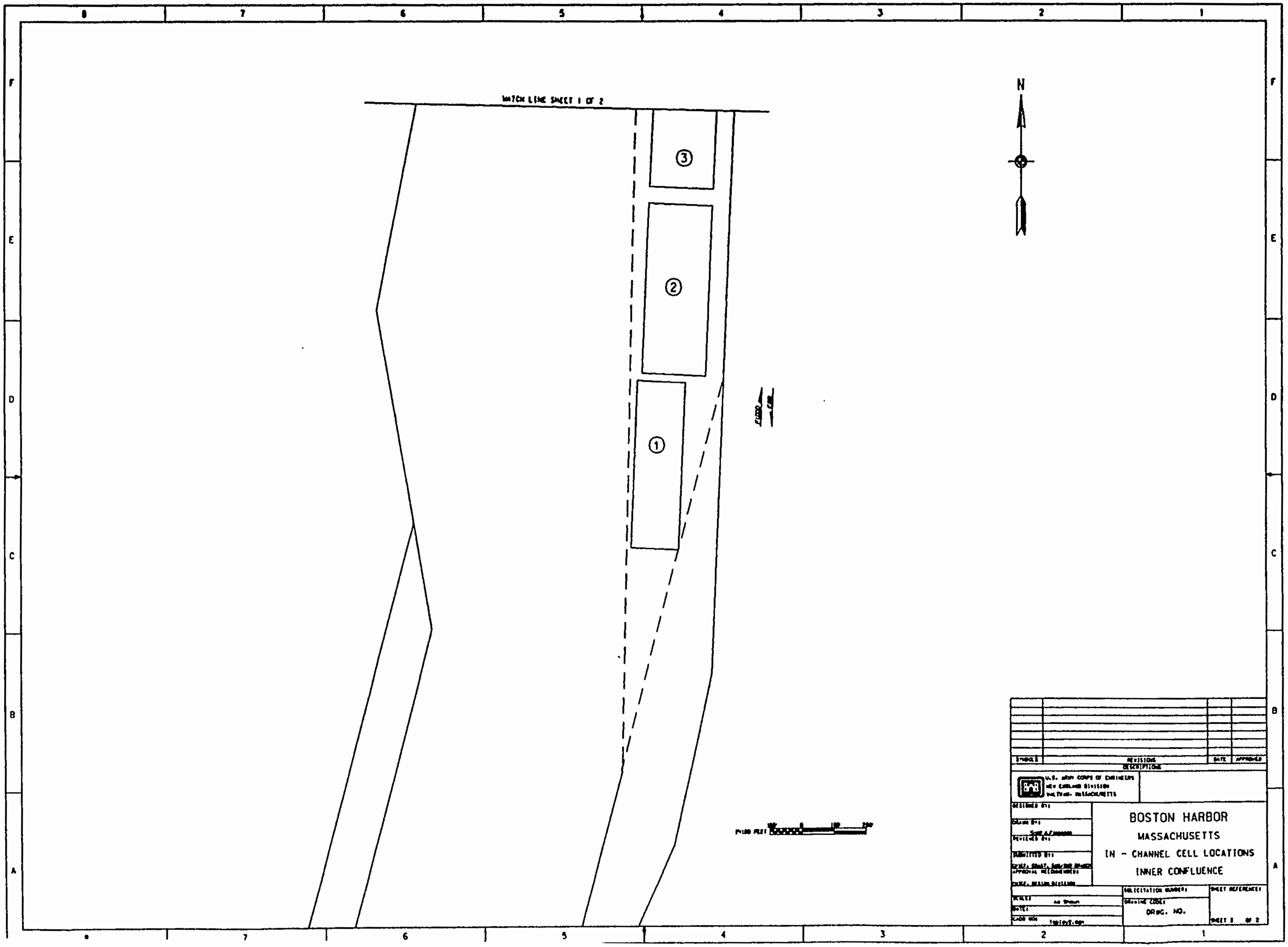

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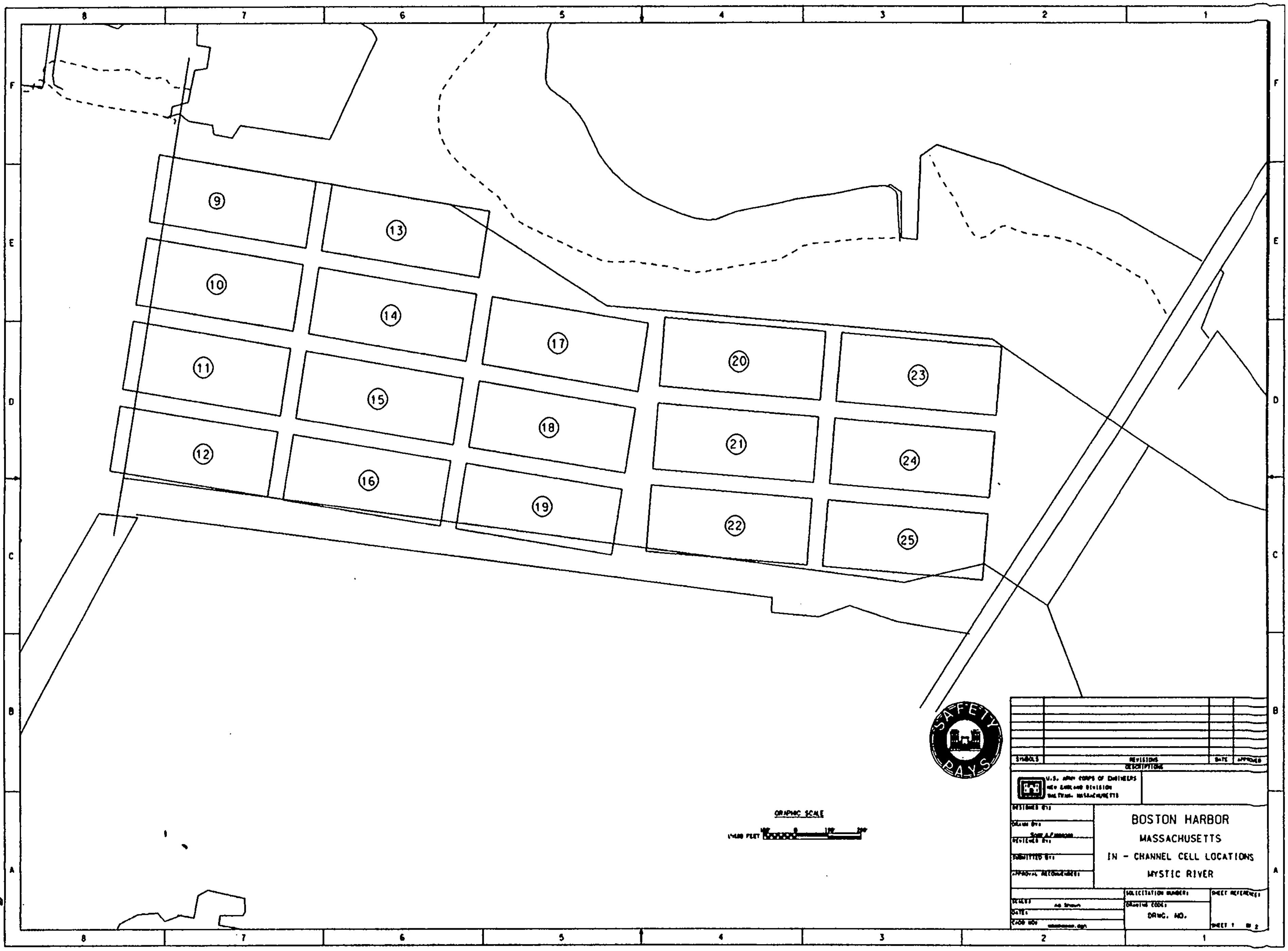
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WALTHAM, MASSACHUSETTS
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GRAPHIC SCALE
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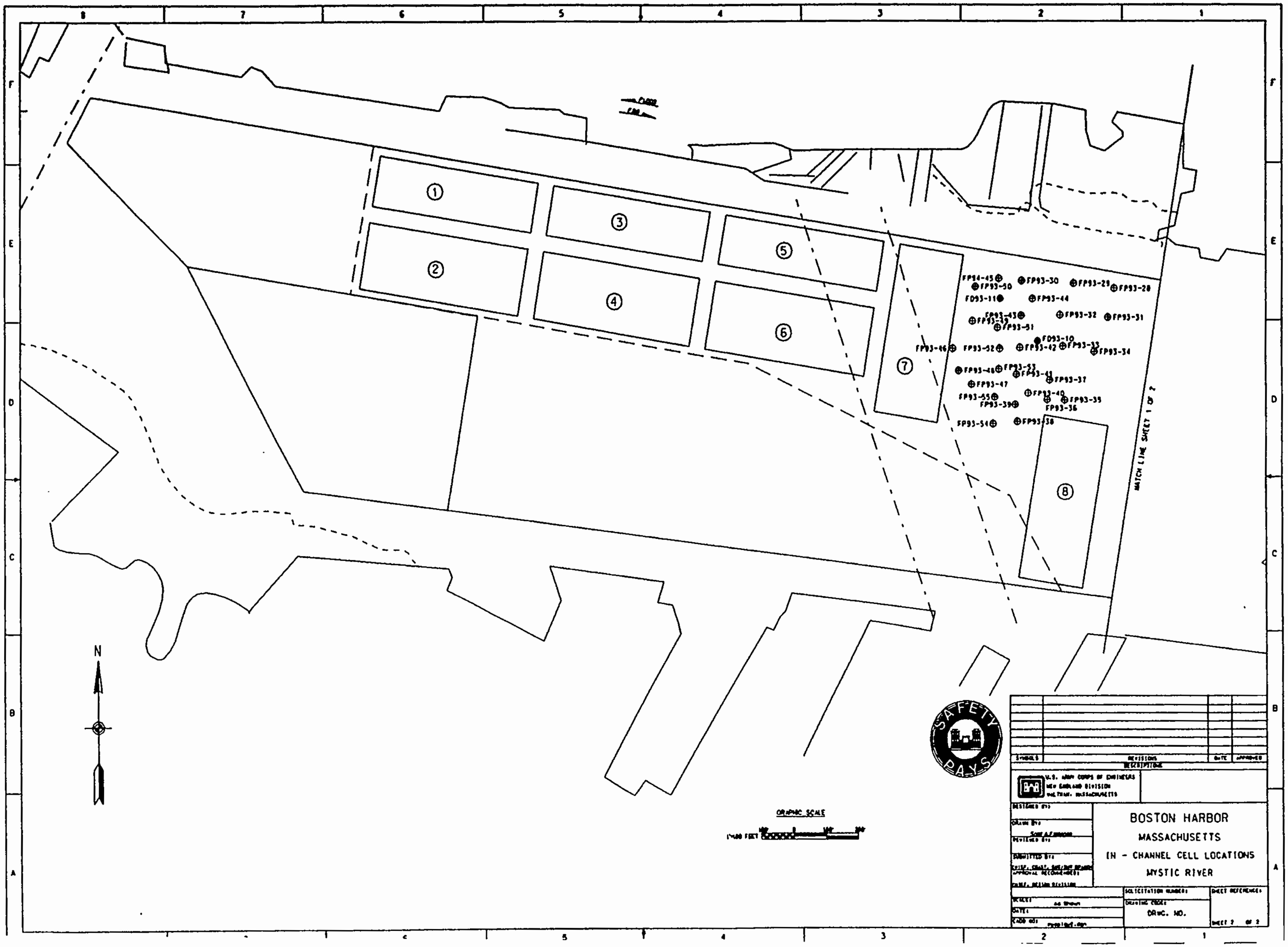

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BOSTON HARBOR
MASSACHUSETTS
IN - CHANNEL CELL LOCATIONS
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REVIEWED BY:
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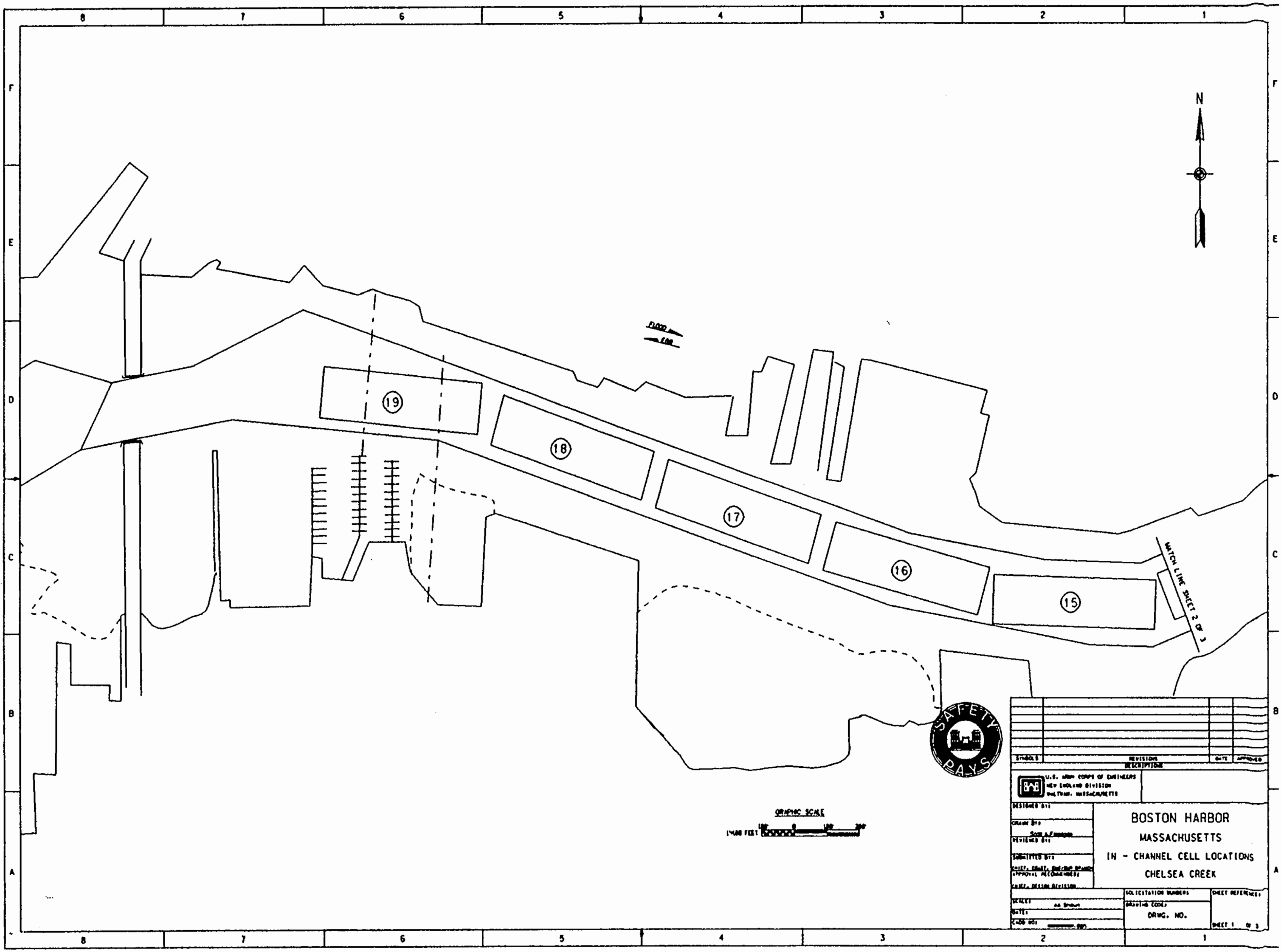
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DESCRIPTIONS
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APPROVED
U.S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DIVISION
WALTHAM, MASSACHUSETTS
DESIGNED BY:
DRAWN BY:
REVIEWED BY:
SUBMITTED BY:
BOSTON HARBOR
MASSACHUSETTS
IN - CHANNEL CELL LOCATIONS
CHELSEA CREEK
SCALE:
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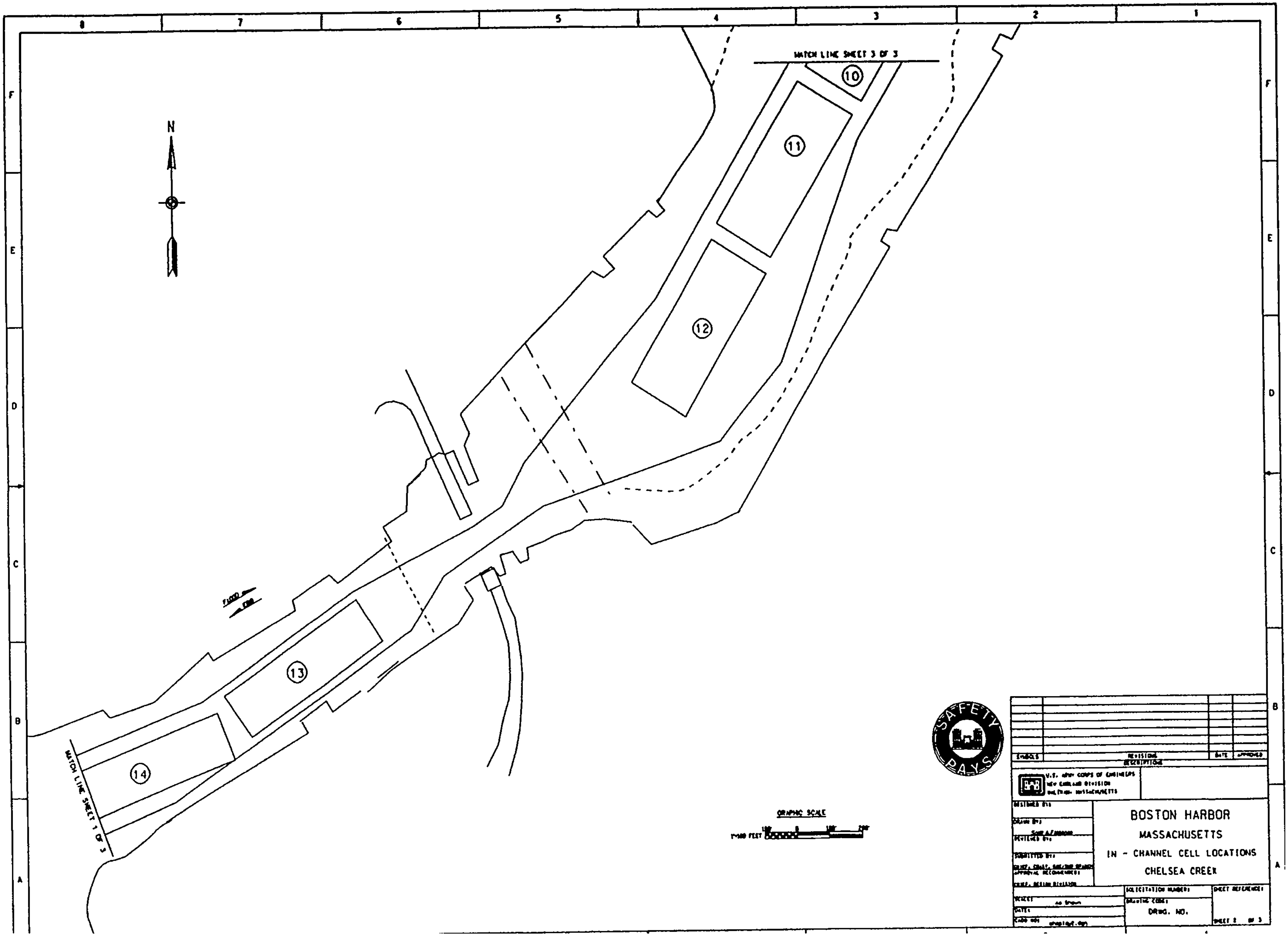
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SAFETY PAYS
REVISIONS
DESCRIPTIONS
SYMBOLS
DATE
APPROVED
U.S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DIVISION
WALTHAM, MASSACHUSETTS
BOSTON HARBOR
MASSACHUSETTS
IN - CHANNEL CELL LOCATIONS
CHELSEA CREEK
DESIGNED BY:
DRAWN BY:
REVISED BY:
SUBMITTED BY:
APPROVAL RECOMMENDED:
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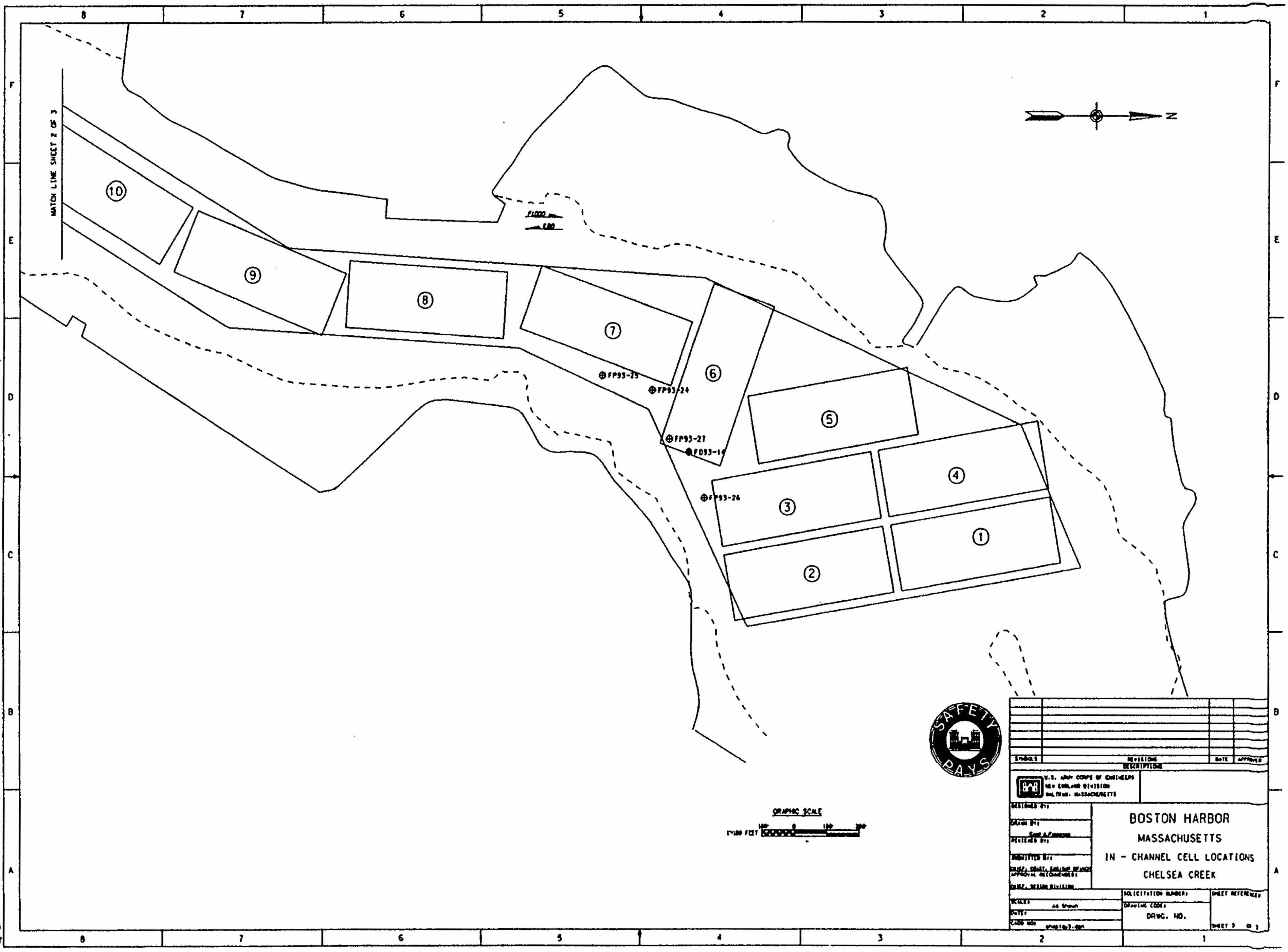

MATCH LINE SHEET 2 OF 3
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FP93-26
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DESCRIPTIONS
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APPROVED
U.S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DIVISION
WALTHAM, MASSACHUSETTS
DESIGNED BY:
DRAWN BY:
REVISED BY:
SUBMITTED BY:
SCALE:
As Shown
DATE:
BOSTON HARBOR
MASSACHUSETTS
IN - CHANNEL CELL LOCATIONS
CHELSEA CREEK
SOLICITATION NUMBER:
DRAWING CODE:
DRWG. NO.
SHEET REFERENCE:

Dredge Sequence Database

06/07/95
09:23 AM

Chelsea River

Cell No.	Assumed Depth	Silt Removed	Parent Removed	Extra Parent Removed	Silt Capacity	3'Cap Required	Days to Dredge Silt 6000 CY/Day	Days to Dredge Parent 6000 CY/Day
1	60	9,300	16,100	44,000	33,600	10,400	2	10
2	58	9,300	16,100	41,100	30,700	10,400	2	10
3	56	9,300	16,100	37,800	27,400	10,400	2	9
4	56	9,300	16,100	37,800	27,400	10,400	2	9
5	58	9,300	16,100	41,100	30,700	10,400	2	10
6	55	9,300	16,100	36,000	25,600	10,400	2	9
7	55	9,300	16,100	36,000	25,600	10,400	2	9
8	55	9,300	16,100	36,000	25,600	10,400	2	9
9	65	9,300	16,100	49,400	39,000	10,400	2	11
10	65	9,300	16,100	49,400	39,000	10,400	2	11
11	58	9,300	16,100	41,100	30,700	10,400	2	10
12	58	9,300	16,100	41,100	30,700	10,400	2	10
13	49	7,300	12,200	16,100	8,400	7,700	1	5
14	49	7,300	12,200	16,100	8,400	7,700	1	5
15	49	7,300	12,200	16,100	8,400	7,700	1	5
16	49	7,300	12,200	16,100	8,400	7,700	1	5
17	49	7,300	12,200	16,100	8,400	7,700	1	5
18	49	7,300	12,200	16,100	8,400	7,700	1	5
19	49	7,300	12,200	16,100	8,400	7,700	1	5

Inner Confluence

Cell No.	Assumed Depth	Silt Removed	Parent Removed	Extra Parent Removed	Silt Capacity	3'Cap Required	Days to Dredge Silt 6000 CY/Day	Days to Dredge Parent 6000 CY/Day
2	60	9,300	16,100	44,000	33,600	10,400	2	10
3	55	9,300	16,000	36,000	25,600	10,400	2	9
3a	55	9,300	16,000	36,000	25,600	10,400	2	9
4	60	9,300	16,100	44,000	33,600	10,400	2	10
5	48	9,300	16,100	19,500	9,100	10,400	2	6
6	55	9,300	16,000	36,000	25,600	10,400	2	9
7	60	9,300	16,100	44,000	33,600	10,400	2	10
8	60	9,300	16,100	44,000	33,600	10,400	2	10
9	55	9,300	16,000	36,000	25,600	10,400	2	9

Mystic River

Cell No.	Assumed Depth	Silt Removed	Parent Removed	Extra Parent Removed	Silt Capacity	3'Cap Required	Days to Dredge Silt 6000 CY/Day	Days to Dredge Parent 6000 CY/Day
1	55	7,300	12,300	24,900	17,200	7,700	1	6
3	70	7,300	12,300	30,900	23,200	7,700	1	7
5	60	7,300	12,300	29,200	21,500	7,700	1	7
2	55	9,300	16,100	36,000	25,600	10,400	2	9
4	70	9,300	16,100	52,500	42,100	10,400	2	11
6	70	9,300	16,100	52,500	42,100	10,400	2	11
7	55	9,300	16,100	36,000	25,600	10,400	2	9
8	55	9,300	16,100	36,000	25,600	10,400	2	9
9	56	9,300	16,100	37,800	27,400	10,400	2	9
10	65	9,300	16,100	49,400	39,000	10,400	2	11
11	60	9,300	16,100	44,000	33,600	10,400	2	10
12	65	9,300	16,100	49,400	39,000	10,400	2	11
13	60	9,300	16,100	44,000	33,600	10,400	2	10
14	70	9,300	16,100	52,500	42,100	10,400	2	11
15	65	9,300	16,100	49,400	39,000	10,400	2	11
16	65	9,300	16,100	49,400	39,000	10,400	2	11
17	55	9,300	16,100	36,000	25,600	10,400	2	9
18	65	9,300	16,100	49,400	39,000	10,400	2	11
19	65	9,300	16,100	49,400	39,000	10,400	2	11
20	55	9,300	16,100	36,000	25,600	10,400	2	9
21	65	9,300	16,100	49,400	39,000	10,400	2	11
22	50	9,300	16,100	24,900	14,500	10,400	2	7
23	55	9,300	16,100	36,000	25,600	10,400	2	9
24	48	9,300	16,100	19,500	9,100	10,400	2	6
25	48	9,300	16,100	19,500	9,100	10,400	2	6

1,412,800

Boston Harbor In Channel Dredging/Disposal Sequence

April

Days	Dredge No. 1 Silt Removed	Silt to Cell	Parent Removed	Cell Created	Cell Silt Capacity	Remaining Capacity	Dredge No. 2 Silt Removed	Silt to Cell	Parent Removed	Cell Created	Cell Silt Capacity	Remaining Capacity
1	:											
2	9300 :	(c-12)										
3		stored	:									
4			:									
5			:									
6			:									
7			:									
8			:									
9			:									
10			:									
11			:									
12			57100 :	c-12	30700	30700						
13	:					19540						
14	9300 :	c-12				8380						
15			:									
16			:									
17			:									
18			:									
19			:									
20			:									
21			:									
22			:									
23			:									
24			57100 :	c-11	30700	39080						
25	:	c-12		6983								
26	9300 :	c-11		2317		27920						
27			:									
28			:									
29			:									
30			:									
Monthly Total	27900		114200		61400		0		0		0	
Cumulative Total	27900		114200		61400		0		0		0	

Boston Harbor In Channel Dredging/Disposal Sequence

May

Days	Dredge No. 1 Silt Removed	Silt to Cell	Parent Removed	Cell Created	Cell Silt Capacity	Remaining Capacity	Dredge No. 2 Silt Removed	Silt to Cell	Parent Removed	Cell Created	Cell Silt Capacity	Remaining Capacity
1												
2												
3												
4												
5												
6												
7			65400	c-10	39000	45320	18000	c-11				45320
8								c-11		5267		
9	9300	c-10				19760	12000	c-10		6733		19760
10												
11						5360	12000	c-10				5360
12												
13												
14												
15												
16												
17												
18									42000			
19								c-10		4467		
20			65400	c-9	39000	29960	12000	c-9		7533		29960
21												
22	9300	c-9				4400	12000	c-9				4400
23												
24												
25												
26												
27												
28												
29												
30												
31			52000	c-8	25600	30000			54000			
hly otal	18600		182800		103600		66000		96000		0	
lative otal	46500		297000		165000		66000		96000		0	

Boston Harbor In Channel Dredging/Disposal Sequence

June

Days	Dredge No. 1 Silt Removed	Silt to Cell	Parent Removed	Cell Created	Cell Capacity	Remaining Silt Capacity	Dredge No. 2 Silt Removed	Silt to Cell	Parent Removed	Cell Created	Cell Capacity	Remaining Silt Capacity
1	¦	c-9		3667		25600						
2	9300 ¦	c-8		5633		15700	¦					
3			¦				¦					
4			¦				¦					
5			¦			3700	12000 ¦	c-8				3700
6			¦						¦			
7			¦						¦			
8			¦						¦			
9			¦						12000 ¦			
10			¦				MOVE TO INNER CONFLUENCE					
11			52000 ¦	c-7	25600							
12	¦					0	¦	c-8		3700		0
13	9300 ¦	c-7				15733	9300 ¦	c-7		5600		15733
14			¦			6433			¦			6433
15			¦						¦			
16			¦						¦			
17			¦						¦			
18			¦						¦			
19			¦						¦			
20			¦						¦			
21			52000 ¦	c-6	25600				¦			
22	MOVE TO MYSTIC								¦			0
23	¦	c-7		6433		18466			60000 ¦	ic-2	33600	18466
24	9300 ¦	c-6		2867		9166	¦					
25			¦				9300 ¦	ic-2				18700
26			¦						¦			
27			¦						¦			
28			¦						¦			
29			35500 ¦	m-25	9100				¦			
30	¦								¦			
Monthly Total	27900		139500		60300		30600		72000		33600	
Cumulative Total	74400		436500		225300		96600		168000		33600	

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Boston Harbor In Channel Dredging/Disposal Sequence

July

	Dredge No. 1						Dredge No. 2					
ys	Silt Removed	Silt to Cell	Parent Removed	Cell Created	Cell Silt Capacity	Remaining Capacity	Silt Removed	Silt to Cell	Parent Removed	Cell Created	Cell Silt Capacity	Remaining Capacity
1	9300	¦c-6		9166		0				¦		
2		m-25		¦ 134		7449				¦		
3				¦						¦		
4				¦					52000	¦ic-3	25600	
5				¦				¦				
6				¦			9300	¦ic-2				9400
7			35500	¦ m-24	9100					¦		
8		¦m-25		7449		0				¦		
9	9300	¦m-24		1851		5732				¦		
10				¦						¦		
11				¦						¦		
12				¦						¦		
13				¦						¦		
14				¦						¦		
15				¦					52000	¦ic-3a	25600	
16				¦				¦				
17				¦			9300	¦ic-2				100
18			52000	¦ m-23	25600					¦		
19		¦m-24		5732		0				¦		
20	9300	¦m-23		3568		17765				¦		
21				¦						¦		
22				¦						¦		
23				¦						¦		
24				¦						¦		
25				¦						¦		
26				¦						¦		
27				¦					60000	¦ic-4	33600	
28				¦				¦ic-2			100	0
29			52000	¦ m-20	25600		9300	¦ic-3			9200	12133
30		¦								¦		
31	9300	¦m-23				8465				¦		
ly tal	37200		139500		60300		27900		164000		94100	
ative tal	111600		576000		285600		124500		332000		127700	

Boston Harbor In Channel Dredging/Disposal Sequence

August

Dredge No. 1

Days	Silt Removed	Silt to Cell	Parent Removed	Cell Created	Cell Silt Capacity	Remaining Capacity
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11			65400	¦m-21	39000	
12		¦m-23		8465		0
13	9300	¦m-20		835		20498
14						
15						
16						
17						
18						
19						
20			40900	¦m-22	14500	
21						
22	9300	¦m-20				11198
23						
24						
25						
26						
27						
28						
29						
30						
31						
Monthly Total	18600		106300		53500	
Cumulative Total	130200		682300		339100	

Dredge No. 2

Days	Silt Removed	Silt to Cell	Parent Removed	Cell Created	Cell Silt Capacity	Remaining Capacity
1						
2						
3						
4			35500	¦ic-5	9100	
5						
6	9300	¦ic-3				2833
7						
8						
9						
10						
11						
12						
13						
14						
15			52000	¦ic-6	25600	
16		¦ic-3		2833		0
17	9300	¦ic-3a		6467		14866
18						
19						
20						
21						
22						
23						
24						
25						
26						
27			60000	¦ic-7	33600	
28						
29	9300	¦ic-3a				5566
30						
31						
Monthly Total	27900		147500		68300	
Cumulative Total	152400		479500		196000	

Boston Harbor In Channel Dredging/Disposal Sequence

September

ays	Dredge No. 1 Silt Removed	Silt to Cell	Parent Removed	Cell Created	Cell Silt Capacity	Remaining Capacity	Dredge No. 2 Silt Removed	Silt to Cell	Parent Removed	Cell Created	Cell Silt Capacity	Remaining Capacity
1												
2			65400	m-19	39000							
3												
4	9300	m-20				1898						
5												
6												
7												
8									60000	ic-8	39000	
9								ic-3a		5566		0
10							9300	ic-4		3734		24266
11												
12												
13												
14												
15			65400	m-18	39000							
16		m-20		1898		0						
17	9300	m-21		7402		25098						
18												
19									52000	ic-9	25600	
20												
21							9300	ic-4				14966
22												
23								ic-4		14966		0
24							18000	ic-5		3034		4549
25								ic-5		4549		0
26			52000	m-17	25600		12000	ic-6		7451		13882
27												
28	9300	m-21				15798	12000	ic-6				1882
29								ic-6				0
30							12000	ic-7				17882
ly tal	27900		182800		103600		72600		112000		64600	
ative tal	158100		824200		442700		225000		591500		260600	

Boston Harbor In Channel Dredging/Disposal Sequence

October

Days	Dredge No. 1 Silt Removed	Silt to Cell	Parent Removed	Cell Created	Cell Capacity	Remaining Silt Capacity	Dredge No. 2 Silt Removed	Silt to Cell	Parent Removed	Cell Created	Cell Capacity	Remaining Silt Capacity
1			¦				¦					
2			¦				12000 ¦ic-7					5882
3			¦				¦ic-7			5882		0
4			¦				12000 ¦ic-8			6118		26382
5			¦				¦					
6			¦				¦					
7			¦				¦					
8			60000 ¦m-13		33600		24000 ¦ic-8					2382
9	¦						1200 ¦ic-8					1182
10	9300 ¦m-21					6498			¦			
11			¦						¦			
12			¦						¦			
13			¦						24000 ¦			
14			¦						¦			
15			¦						¦			
16			¦						¦			
17			¦						24000 ¦			
18			¦						¦			
19			¦						¦			
20			¦						¦			
21			68000 ¦m-14		42100				24000 ¦			
22	¦m-21			6498		0			¦			
23	9300 ¦m-22			2802		9281			¦			
24			¦						¦			
25			¦						24000 ¦			
26			¦						¦			
27			¦						¦			
28			¦						¦			
29			¦						24000 ¦			
30			¦						¦			
31			¦						12000 ¦			
Monthly Total	18600		128000		75700		49200		132000		0	
Cumulative Total	176700		952200		518400		274200		723500		260600	

Boston Harbor In Channel Dredging/Disposal Sequence

November

ays	Dredge No. 1 Silt Removed	Silt to Cell	Parent Removed	Cell Created	Cell Silt Capacity	Remaining Capacity	Dredge No. 2 Silt Removed	Silt to Cell	Parent Removed	Cell Created	Cell Silt Capacity	Remaining Capacity
1												
2												
3			65400	m-15	39000							
4		m-22		9281		0			24000			
5	9300	m-19		19		32481						
6												
7												
8									24000			
9												
10												
11												
12									24000			
13												
14												
15												
16			65400	m-16	39000				24100			
17							MOVE TO RESERVED CHANNEL					
18	9300	m-19				23181						
19								ic-8		1182		0
20							12000	ic-9		10818		10515
21								ic-9		10515		0
22						21696	12000	m-19		14850		21696
23												
24												
25						3696	18000	m-19				3696
26								m-19		3696		0
27						24196	12000	m-18		8304		24196
28												
29			65400	m-12	39000							
30						6196	18000	m-18				6196
ily tal	18600		196200		117000		72000		96100		0	
.ative tal	195300		1148400		635400		346200		819600		260600	

Boston Harbor In Channel Dredging/Disposal Sequence

December

Days	Dredge No. 1 Silt Removed	Silt to Cell	Parent Removed	Cell Created	Cell Silt Capacity	Remaining Capacity	Dredge No. 2 Silt Removed	Silt to Cell	Parent Removed	Cell Created	Cell Silt Capacity	Remaining Capacity
1	9300	¦m-18		6196		0						0
2		m-17		3104		18229						18229
3						0	18229	¦m-17				0
4												
5												
6												
7							24000	¦m-13		23771		
8						0		¦m-13		4000		0
9						27083	12000	¦m-14		8000		27083
10												
11			60000 ¦m-11		33600							
12		¦m-14		9083		9083	18000	¦m-14				9083
13	9300	¦m-15		217								
14						32283						32283
15						14283	18000	¦m-15				14283
16												
17						2283	12000	¦m-15				2283
18						0		¦m-15		2283		0
19						22783	12000	¦m-16		9717		22783
20												
21												
22								¦m-16		22783		
23						0	24000	¦m-12		1217		0
24			65400 ¦m-10		39000	31283						31283
25							12000	¦m-12				19283
26	9300	¦m-12				9983						9983
27						0		¦m-12		9983		0
28						19983	18000	¦m-11		8017		19983
29												
30												
31						1983	18000	¦m-11				1983
Monthly Total	27900		125400		72600		186229		0		0	
Cumulative Total	223200		1273800		708000		532429		819600		260600	

Boston Harbor In Channel Dredging/Disposal Sequence

January

ays	Dredge No. 1 Silt Removed	Silt to Cell	Parent Removed	Cell Created	Capacity	Cell Remaining Silt Capacity	Dredge No. 2 Silt Removed	Silt to Cell	Parent Removed	Cell Created	Capacity	Cell Remaining Silt Capacity
1						1983						
2												
3												
4			53800	¦m-9	27400							
5			MOVE TO CHELSEA									
6		¦m-11		1983		0						
7	9300	¦m-10	c-5	7317		25183						
8												
9	9300	¦m-10	c-4			15883						
10												
11	9300	¦m-10	c-3			6583						
12		¦m-10		6583		0						
13	9300	¦m-9	c-2	2717		20116						
14												
15	9300	¦m-9	c-1			10816						
16												
17	10816					0						
18												
19												
20												
21												
22												
23												
24												
25												
26												
27			57200	¦c-5	30700							
28												
29												
30												
31									186000			
ily otal	57316		111000		58100		0		186000		0	
.ative otal	280516		1384800		766100		484429		1053600		260600	

Boston Harbor In Channel Dredging/Disposal Sequence

February

Days	Dredge No. 1 Silt Removed	Silt to Cell	Parent Removed	Cell Created	Cell Remaining Silt Capacity Capacity	Dredge No. 2 Silt Removed	Silt to Cell	Parent Removed	Cell Created	Cell Remaining Silt Capacity Capacity
1										
2										
3										
4										
5			53900	c-4	27400					
6										
7										
8										
9										
10										
11										
12										
13										
14			53900	c-3	27400					
15										
16										
17										
18										
19										
20										
21										
22										
23								138000		
24			57200	c-2	30700					
25										
26										
27										
28								30000		
Monthly Total	0		165000		85500	0		168000		0
Cumulative Total	280516		1549800		851600	484429		1221600		260600

Boston Harbor In Channel Dredging/Disposal Sequence

March

ays	Dredge No. 1						Dredge No. 2					
	Silt Removed	Silt to Cell	Parent Removed	Cell Created	Capacity	Cell Remaining Silt Capacity	Silt Removed	Silt to Cell	Parent Removed	Cell Created	Capacity	Cell Remaining Silt Capacity
1				¦						¦		
2				¦						¦		
3				¦					18000	¦		
4				¦								
5				¦								
6			60000	¦c-1	33600							
7		¦					DEMOBILIZE DREDGE NO. 2					
8		¦										
9		¦										
10	24000	¦c-5				1583						
11		¦c-5		1583		0						
12	12000	¦c-4		10417		12416						
13		¦										
14	12416	¦c-4				0						
15		¦										
16	7300	¦c-3	c-13			15533						
17		¦										
18	7300	¦c-3	c-14			8233						
19		¦										
20	7300	¦c-3	c-15			933						
21		¦c-3		933								
22	7300	¦c-2	c-16	6367		19216						
23		¦										
24	7300	¦c-2	c-17			11916						
25		¦										
26	7300	¦c-2	c-18			4616						
27		¦c-2		4616								
28	7300	¦c-1	c-19	2684		25316						
29		¦										
30		¦										
31	18000	¦c-1				7316						
ily Total	117516		60000		33600		0		18000		0	
ative Total	398032		1609800		885200		484429		1239600		260600	

Boston Harbor In Channel Dredging/Disposal Sequence

April

Days	Dredge No. 1 Silt Removed	Silt to Cell	Parent Removed	Cell Created	Cell Silt Capacity	Remaining Capacity	Dredge No. 2 Silt Removed	Silt to Cell	Parent Removed	Cell Created	Cell Silt Capacity	Remaining Capacity
1		¦										
2	7316	¦c-1				0						
3			¦									
4			¦									
5			¦									
6			¦									
7			¦									
8			¦									
9			¦									
10			¦									
11			¦									
12			¦									
13			66000 ¦									
14			¦									
15			¦									
16			¦									
17			¦									
18			¦									
19			¦									
20			¦									
21			¦									
22			¦									
23			¦									
24			¦									
25			¦									
26			¦									
27			¦									
28			¦									
29			¦									
30			102000 ¦									
Monthly Total	7316		168000		0		0		0		0	
Cumulative Total	405348		1777800		885200		484429		1239600		260600	

Boston Harbor In Channel Dredging/Disposal Sequence

May

ays	Dredge No. 1 Silt Removed	Silt to Cell	Parent Removed	Cell Created	Cell Silt Capacity	Remaining Capacity	Dredge No. 2 Silt Removed	Silt to Cell	Parent Removed	Cell Created	Cell Silt Capacity	Remaining Capacity
1			6000 ¦									
2			MOVE TO RESERVED FOR ROCK									
3			¦									
4			¦									
5			¦									
6			¦									
7			¦									
8			¦									
9			¦									
10			¦									
11			¦									
12			¦									
13			¦									
14			¦	34100								
15												
16			LAY UP UNTIL MID JUNE									
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												
31												
ily otal	0		6000		0		0		0		0	
ative otal	405348		1783800		885200		484429		1239600		260600	

Boston Harbor In Channel Dredging/Disposal Sequence

June

Days	Dredge No. 1: Silt Removed	Silt to Cell	Parent Removed	Cell Created	Cell Silt Capacity	Remaining Capacity	Dredge No. 2: Silt Removed	Silt to Cell	Parent Removed	Cell Created	Cell Silt Capacity	Remaining Capacity
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15		¦										
16	9300	¦(m-8)										
17		stored		¦								
18				¦								
19				¦								
20				¦								
21				¦								
22			36000	¦m-8	25600							
23		¦				12033						
24	9300	¦m-8				2733						
25				¦								
26				¦								
27				¦								
28				¦								
29				¦								
30			36000	¦m-7								
Monthly Total	18600		72000		25600		0		0		0	
Cumulative Total	423948		1855800		910800		484429		1239600		260600	

Boston Harbor In Channel Dredging/Disposal Sequence

July

	Dredge No. 1						Dredge No. 2					
ays	Silt Removed	Silt to Cell	Parent Removed	Cell Created	Cell Silt Capacity	Remaining Capacity	Silt Removed	Silt to Cell	Parent Removed	Cell Created	Cell Silt Capacity	Remaining Capacity
1		¦m-8				0						
2	9300	¦m-7				14766						
3				¦								
4				¦								
5				¦								
6				¦								
7				¦								
8				¦								
9				¦								
10				¦								
11			52500	¦m-6	42100							
12		¦										
13	7300	¦m-7				7466						
14				¦								
15				¦								
16				¦								
17				¦								
18			29200	¦m-5	21500							
19		¦										
20	7300	¦m-7				166						
21				¦								
22				¦								
23				¦								
24				¦								
25			30900	¦m-3	23200							
26		¦m-7				0						
27	9300	¦m-6				25949						
28				¦								
29				¦								
30				¦								
ly tal	33200		112600		86800		0		0		0	
ative tal	457148		1860400		997600		484429		1239600		260600	

-1,9

Boston Harbor In Channel Dredging/Disposal Sequence

August

	Dredge No. 1						Dredge No. 2					
Days	Silt Removed	Silt to Cell	Parent Removed	Cell Created	Capacity	Cell Remaining Silt Capacity	Silt Removed	Silt to Cell	Parent Removed	Cell Created	Capacity	Cell Remaining Silt Capacity
1				¦								
2				¦								
3				¦								
4				¦								
5				¦								
6			52500	¦m-4	42100							
7		¦										
8	9300	¦m-6				16649						
9				¦								
10				¦								
11				¦								
12				¦								
13				¦								
14			36000	¦m-2	25600							
15		¦										
16	7300	¦m-6				9349						
17				¦								
18				¦								
19				¦								
20			24900	¦m-1	17200							
21		¦m-6		9349		0						
22	12000	¦m-5		2651		15266						
23		¦										
24		¦m-5		15266								
25	18000	¦m-4		2734		32349						
26		¦										
27		¦										
28	18000	¦m-4				14349						
29		¦										
30		¦m-4		14349								
31	18000	¦m-3		3651		15682						
Monthly Total	82600		113400		84900		0		0		0	
Cumulative Total	539748		1973800		1082500		484429		1239600		260600	

Boston Harbor In Channel Dredging/Disposal Sequence

September

	Dredge No. 1					Dredge No. 2				
Days	Silt Removed	Silt to Cell	Parent Removed	Cell Created	Cell Remaining Silt Capacity Capacity	Silt Removed	Silt to Cell	Parent Removed	Cell Created	Cell Remaining Silt Capacity Capacity
1		¦								
2		¦m-3			0					
3	18000	¦m-2			19015					
4		¦								
5		¦								
6		¦m-2			0					
7	24000	¦m-1			9348					
8		¦								
9	9348	¦m-1			0					
10			¦							
11			¦							
12			¦							
13			¦							
14			¦							
15			¦							
16			¦							
17			46800 ¦							
18			MOVE TO INNER CONFLUENCE FOR ROCK REMOVAL							
19			¦							
20			¦							
21			¦							
22			¦							
23			¦							
24			¦							
25			¦							
26			¦							
27			¦							
28			¦							
29			¦							
30			¦	36000						
hly otal	51348		46800	0		0		0	0	
lative otal	591096		2020600	1082500		484429		1239600	260600	

Boston Harbor In Channel Dredging/Disposal Sequence

October

	Dredge No. 1					Dredge No. 2				
Days	Silt Removed	Silt to Cell	Parent Removed	Cell Created	Cell Remaining Capacity Silt Capacity	Silt Removed	Silt to Cell	Parent Removed	Cell Created	Cell Remaining Capacity Silt Capacity
1			;							
2			;							
3			;							
4			;	12000						
5			MOVE TO MYSTIC FOR ROCK REMOVAL							
6			;							
7			;	6000						
8			DEMOBILIZE DREDGE NO. 1							
9										
10										
11										
12										
:3										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										
25										
26										
27										
28										
29										
30										
Monthly Total	0		0	0		0		0	0	
Cumulative Total	591096		2020600	1082500		484429		1239600	260600	

APPENDIX K - PRINCIPAL VALUABLE FUNCTIONS EVALUATION

PRINCIPAL VALUABLE FUNCTIONS EVALUATION AND CONCEPTUAL PLAN FOR JURISDICTIONAL RESOURCE MITIGATION

May 1995

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PRINCIPAL
VALUABLE FUNCTIONS EVALUATION
AND CONCEPTUAL PLAN FOR
JURISDICTIONAL RESOURCE MITIGATION

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PRINCIPAL
VALUABLE FUNCTIONS EVALUATION
AND CONCEPTUAL PLAN FOR
JURISDICTIONAL RESOURCE MITIGATION

1.0 INTRODUCTION

The purpose of the Principal Valuable Functions (PVF) Evaluation is to provide a process to assess real pre-project functional conditions at a universe of selected sites; and to compare impacts to those functional conditions caused by the Boston Harbor Navigational Improvement Project (BHNIP). Based on this comparison, conceptual on and off site mitigation considerations (if necessary) can be developed to offset anticipated impacts.

For the purposes of this report, PVF's are defined as those significant functions and values which currently exist or are being performed at one or more of the identified resources located within the Federal Channel (in-channel) at the Lower Mystic River (upstream to opposite the Prolerized Site), the Inner Confluence, the Chelsea Creek (upstream to opposite the Northeast Petroleum, Coastal Oil, Gibbs and Global terminals), and several nearshore and open water sites within the Boston Harbor system or Massachusetts Bay. Sites are identified in Section 3.0 and represent the short-listed locations for the recommended in-channel and remote site disposal of the 1.3 million cubic yards of contaminated dredge material (silt) generated during the BHNIP dredging. The recommended PVF's are identified in Section 2.2 of this report.

Recently, some questions have arisen on the appropriateness and/or suitability of traditional functions and values assessment methods (e.g. Wetland Evaluation Techniques 1.0 and 2.0) in clearly identifying relevant and appropriate project impacts to function and values and appropriate compensatory mitigation needs at coastal and marine sites. Given these concerns, the New England Division Army Corps of Engineers (the Corps) has begun to suggest that projects evaluate only selected and relevant functions and values at proposed project and mitigation sites.[1]

This report describes the BHNIP's PVF evaluation during the pre-project, project effect, and on-site resource mitigation scenarios. This analysis provides a database for existing PVF conditions and potential project impacts to actual and observed resource conditions and performance, and also guidance for compensatory on-site mitigation needs under the jurisdictional "no-net-loss" policy for wetland resource functions and values. State and local mitigation issues relative to presumptions of significance and protectable interests will also be addressed herein.

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1 e.g. Central Artery/Tunnel Project.

The results are presented in narrative form, and are addressed in "ecological terms" as opposed to the common generic rating system of most functions and values assessments (high, moderate and low). Summary tables are included as appendices, and illustrate existing PVF conditions, impacted PVF's, and on-site for compensatory mitigation.

1.1 Proposed BHNIP Project Actions

For the purpose of this PVF evaluation, the proposed project consists of the dredging and disposal of 1.3 million cubic yards (bulked volume) of contaminated dredge material (silts). Disposal of these materials is proposed to occur at 54 subaqueous cells located within the federal channel, and possibly in one or more remote aquatic locations.

The current design indicates that the entire volume can be disposed of within the in-channel cells. The BHNIP also proposes that limited filling to intertidal elevations, in the Little Mystic Channel, would serve as a contingency disposal site.

1.2 Jurisdictional Resources Evaluated at the Project Sites

The BHNIP has evaluated intertidal and subtidal water resources, which are protectable under federal jurisdiction; and land under the ocean, designated port areas, land containing shellfish and an anadromous fish run, which are protectable under state jurisdiction.

Under both jurisdiction specific functions and values (federal) or presumptions of significance (state) are assigned to the specific and identified protectable resources. Within federal jurisdiction, each aquatic site subject to project action contains Tidal Waters which are considered Waters of the United States subject to the ebb and flow of the tide (40 CFR 203.4). Characteristics significant to Tidal Water and relative to dredging, and dredge material disposal include the following:

- Substrate;
- TSS/turbidity;
- Water quality, circulation, and fluctuation;
- Salinity
- Wildlife;
- Threatened and Endangered species, and
- Food web and fisheries.

Also of concern are issues related to project effects on Special Aquatic Sites which include the following:

- Sanctuaries and refuges,
- Wetlands,
- Mudflats,
- Vegetated shallows, and
- Coral reefs.

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The FEIR/S details methods and means for dealing with specific characteristics and/or special resources as identified in the BHNIP project.

Within state jurisdiction, each aquatic site subject to project action contains some or all of the four resources listed below:

- Land Under the Ocean,
- Designated Port Areas,
- Land Containing Shellfish, and
- Anadromous Fish Run.

Presumptions of significance are assigned to each protectable coastal resource under the Massachusetts Wetlands Protection Act and implementing regulations (MGL c.131, s.40 and 310 CMR 10.00). Relative to the BHNIP, these presumptions of significance include the following:

- **Land under the Ocean: (nearshore areas)** — **Protection of marine fisheries (finfish and shellfish),**

  Protection of wildlife habitat,

  Storm damage protection.

- **Land under the Ocean:** — **Protection of marine fisheries (finfish and shellfish)**

Improvement dredging for navigational purposes affecting land under the ocean shall be designed and carried out using the best available measures so as to minimize adverse effects on such interests caused by changes in:

a) bottom topography which will result in increased flooding or erosion caused by an increase in the height or velocity of waves impacting the shore;

b) sediment transport processes which will increase flood or erosion hazards by affecting the natural replenishment of beaches;

c) water circulation which will result in an adverse change in flushing rate, temperature, or turbidity levels; or

d) marine productivity which will result from the suspension or transport of pollutants, the smothering of bottom organisms, the accumulation of pollutants by organisms, or the destruction of marine fisheries habitat or wildlife habitat.

- **Designated Port Area:** — **Protection of marine fisheries (finfish and shellfish),**

  Storm damage protection.

Projects shall be designed and constructed, using best practical measures, so as to minimize adverse effects on marine fisheries caused by changes in:

a) water circulation;

b) water quality, including, but not limited to, other than natural fluctuations in the level of dissolved oxygen, temperature or turbidity, or the addition of pollutants.

c) minimize adverse effects on storm damage prevention or flood control caused by changes in such land's ability to provide support for adjacent coastal banks or adjacent coastal engineering structures.

- **Land containing shellfish: Protection of marine fisheries (finfish and shellfish).**

Interests critical to land containing shell fish include:

a) species specificity,

b) water quality protection,

c) water circulation condition,

d) the natural relief and grain size distribution.

- **Anadromous Fish Run: Protection of marine fisheries.**

Interests critical to anadromous fish runs include:

a) species specifically,

b) accessibility to spawn areas,

c) water circulation and velocities,

d) spawning and nursery ground protection.

Functions and values evaluations serve to assess characteristics or resource features which may be synonymous with, or closely associated with resource value, presumed significance or interests (based on jurisdictional nomenclature). In this case, the PVF's recommended herein should serve to evaluate said values, significance and interests, as exists within the BHNIP project area.

Specific jurisdictional resources will be identified for each site evaluated under each scenario.

2.0 FUNCTIONS AND VALUES DESCRIPTION

Functions and values are traditionally evaluated using software-based modelling approaches which qualitatively rate the presumed functions and values of given wetland or water resources. At the federal level, and among several state agencies, a no-net-loss policy exists which is not strictly based on surface area, or in-kind mitigation, but on mitigation of impacts to provide compensatory functions and values (personal conversations with the Corps in 1990-91). The most common, and widely accepted, wetland modelling methods are those which predict and evaluate functional benefit or quality. During the planning process, the BHNIP commenced with several preliminary aquatic and fishery resource, and water quality evaluations. Traditional functions and values evaluations have been generally based on the Wetlands Evaluation Techniques (WET 1.0 and 2.0) developed by Adamus et al (1987). This methodology has been modified by the Corps and the BHNIP for this analysis to evaluate the aforementioned estuarine and marines resources; which are protectable under the definition of "Waters of the United States" (33 CFR 328 and 40 CFR 230), and are protectable wetland resource areas (310 CMR 10.00); and to reflect functions and values of concern in "ecological terms".

Traditional evaluations assess the following functions and values.

- Groundwater Recharge,
- Groundwater Discharge,
- Groundwater Supply,
- Flood Storage and Desynchronization,
- Sediment and Shoreline Stabilization,
- Nutrient Retention and Transformation,
- Surface Water Supply,
- Nutrient Export,
- Aquatic Diversity/Abundance,
- Shellfish Habitat,
- Fish Habitat,
- Wildlife Habitat, and
- Endangered Species.

These functions and values were developed for, are skewed toward land based or shoreline resource evaluations, and are not specifically representative of coastal, nearshore, or open water resource values. Therefore, several are clearly not applicable to an analysis of the BHNIP project conditions or sites.

2.1 Methodology

Below are the descriptions of the aforementioned functions and values traditionally evaluated for pre-project and impact conditions, and potential mitigation requirements. Also described is the rationale for evaluating each function and value.

Groundwater Recharge

Groundwater recharge is the downward movement of the surface water to groundwater. It is generally considered that tidal resources do not perform groundwater recharge functions and are, therefore, rated as non-functional. Resource areas capable of having high recharge values are those with no outlet, are perched above the surrounding terrain, and occur high in watersheds. Should at least one of these characteristics exist, the resource is considered to function moderately, and if none of the conditions exist, then the resource considered to be of low functional value.

Groundwater Discharge

Groundwater discharge is generally the vertical and/or lateral movement of groundwater to the surface. The primary importance of groundwater discharge is the maintenance of surface water flows. The maintenance of surface water base flow serves to both maintain wet areas, as well as serving to introduce nutrients from groundwater back to the surface. This criteria, therefore, includes both the likelihood that groundwater discharge occurs as well as the importance to maintenance of base flows and nutrient supply. Coastal waterbodies are generally considered to be of low functional value, since the hydrology is predominantly sustained by surface waters.

Groundwater Supply

The groundwater supply function applies to resource areas which contribute to groundwater quantity and/or quality. Tidal waters are assumed to not perform groundwater recharge functions.

Flood Storage and Desynchronization

Flood storage refers to the physical ability of a resource area to store flood waters. Storage can be either long term, when the resource area acts as a retention basin, or short term, when the resource area acts as a detention basin. Flood desynchronization refers to the alteration of flood peaks, which can be accomplished by either long term storage of flood waters, or by a more gradual release of flood waters than would happen if the resource area was not present. Important characteristics in determining the value of a resource area for this function are topography and hydrologic conditions, although size is also a consideration. Resources which occur in basins with restricted outlets and with recognizable floodplains are rated high. Isolated resources areas, i.e., areas into which flood waters enter but cannot exit, will also be rated high. Resource areas which are open to tidal action are generally rated low since their storage capacity is limited. The exception to this would be a coastal wetland resource, should it have considerable tidal creek/ditch basin area which may store flood waters, or serve to release flood waters at a slower rate.

Sediment and Shoreline Stabilization

This function refers to both the ability of a resource area to protect adjacent lands from storm damage and/or to nourish, through sediment transport to downgradient resources, to protect adjacent lands. Conditions which are critical include: the presence of vegetation which can bind the soils as well as reduce water flow velocity, the presence of obstructions which can also reduce water velocity, the presence of man-made barriers within the resource area which serve to stabilize the shoreline or the potential for resource sediments to be transported to downgradient landforms. Resource areas which have erosion protection structures such as man-made banks and bulkheads, are rated high for this function. Resources which are exposed to large bodies of open water, wave action, or high velocities will also be rated high. Resource areas which are not adjacent to potentially erosive water features will be rated low. All other resource areas will be rated moderate.

Sediment/Toxicant Retention

Resource areas may serve as settling basins which accumulate sediments, which can affect water quality of downstream areas. Toxicants are often adsorbed to sediment particles, such that the removal of sediments from the aquatic system would also serve to remove toxicants. Resource areas which are hydrologically isolated, (i.e., cannot release sediments into adjacent waters), and which have a sediment load are considered to be highly functional. Resource areas which have demonstrated abilities of sediment retention from water quality data will also be considered high functional as well as resource areas with flowing waters and a depositional environment. Large shellfish beds which may filter the surrounding water will be rated either high or moderate based on estimates of their effectiveness for filtration of adjacent waters.

Nutrient Retention/Transformation

Nutrient retention refers to the long or short term storage of nutrients, most particularly nitrogen and phosphorus in vegetation or sediments. Transformation of nutrients results from the conversion of nutrients from inorganic forms to organic or gaseous forms. Evaluation of resource areas for this function is similar to that for sediment/toxicant retention.

Surface Water Supply

This function relates to the presence and protection of surface water supplies. This includes both drinking water supplies, which would encompass entire inland resource areas, as well as use of water for industrial purposes. Resource areas which serve as surface water supplies are significant. Resource areas which may affect the quantity or quality of adjacent surface water supplies are moderately significant. All other resource areas are presumed insignificant.

Nutrient Export

Nutrient export is the movement of nutrients out of a resource area. These nutrients may represent an important component in the food chain of aquatic species. Only vegetated wetlands are considered highly functional; therefore, tidal waters are rated low. The only vegetated wetlands which will be rated high are those larger wetlands which are subject to fluctuating water levels, allowing for the accumulation and then dispersion of biomass available for export.

Aquatic Diversity/Abundance

This function was interpreted to relate to the aquatic benthic habitat for invertebrates. Aquatic invertebrate abundance data was used to evaluate resource areas. Substrate and water quality data can also be used to evaluate the ability of an area to support a diverse population of invertebrates.

Fish Habitat

This function pertains directly to the physical characteristics of a resource area which may make it suitable as a fish habitat. Habitat needs include feeding, nesting, shelter, resting and rearing. Therefore, tidal waters are generally rated high or moderate for this value. Vegetated wetlands with a minimum of open water or a constricted outlet to surface water, generally are considered of minimal significance.

Shellfish Habitat

This function pertains directly to the physical characteristics of a resource area which may make it suitable as shellfish habitat, including crustaceans and molluscs. Inland resource areas are assumed to not function as shellfish habitat. An exception to this would only be made if direct observations of fresh water mussels occur. Coastal resource areas with either mapped or documented shellfish beds are considered either high or moderate. All other areas are considered insignificant for shellfish habitat. Distinguishing characteristics are size and condition of the shellfish bed, location relative to other shellfish beds, and whether or not the beds are commercially valuable.

Wildlife Habitat

This function pertains directly to the physical and/or biological characteristics of a resource area which may make it suitable as wildlife habitat. Habitat needs include feeding, nesting, shelter, resting and rearing. Wildlife here is defined to include mammals, birds, reptiles and amphibians. Any resource area with an observed high wildlife diversity and abundance are rated highly. Where wildlife counts are not available, habitat characteristics become important. These include vegetation type and distribution, presence and distribution of open water, surrounding land use, and size. Generally, only vegetated wetlands with high vegetative diversity and at least one acre in size are significant.

Endangered Species

Endangered species functions relate to the ability of a resource area to provide important habitat, either seasonally or year-round, to an endangered or threatened species. Resource areas with observed or recorded endangered species use are rated high. Resource areas which may effect the quality of adjacent endangered species habitat are rated moderate. All other resource areas are rated low.

2.2 Selection of Principal Valuable Functions

Functions and values methods (e.g. WET 2.0 1987) qualitatively rate functions and values as being high, moderate or low and provide evaluation results in this same form. Recently, agencies, inclusive of the Corps and the Environmental Protection Agency-Region 1 have expressed concern that these very general and qualitative ratings do not provide enough detail to allow for any comprehensive analysis of compensatory mitigation proposals against proposed impacts under the jurisdictional no-net-loss policy. Also, such methods evaluate functions and values which may have little or no significance to the resources of concern.

In an attempt to streamline the process relative to the BHNIP, the Corps has selected only those functions and values which they have determined to be significant where proposed project activities may occur. As mentioned earlier in this report, these are referred as "Principal Valuable Functions" (PVF's).

Again, the purpose for such an analysis is to evaluate only those functions and values which display a significance in the identified jurisdictional resources of the proposed project sites, during the pre-project, project impact, and potential on-site mitigation. Pre-project PVF's have been evaluated for those sites which were short-listed during the BHNIP site selection process, as described in the FEIR/S. Both the project impact and on-site mitigation evaluations have been conducted only for the Least Environmentally Damaging Practicable Alternatives (LEDPA sites) for dredge material disposal recommended by the Corps. The LEDPA sites include both the in-channel subaqueous cells and Little Mystic Channel.

The Corps recommended the following PVF's, based on the findings of several aquatic resources evaluations prepared by Normandeau Associates (NA), under a current task order contract, and which are described in NAI (1995 a-d). These PVF's trend toward biological and public interest resources.

- Benthic Habitat,
- Shellfish/Lobster Habitat,
- Finfish Habitat,
- Production Export,
- Sediment/Shoreline Stabilization,
- Visual Quality/Aesthetics,
- Wildlife Habitat,
- Endangered Species Habitat,
- Education Scientific Value,
- Uniqueness/Heritage, and
- Recreation.

The BHNIP has reviewed the Corp's recommended PVF's and suggests that since the proposed project includes subtidal dredging and dredge material disposal in both an industrial/commercial harbor setting, and may include offshore locations, several of the Corp's recommended PVF's do not appear relevant. The BHNIP questions the applicability of several recommended PVF's, and presents the following arguments to remove them from consideration:

Visual Quality and Aesthetics

Both the dredging and material disposal processes will occur in subtidal conditions and in areas of heavy commercial shipping and industrial activity, or in remote offshore locations. Activities in nearshore areas (e.g. abandoned piers and watersheet areas) will serve to clean up and eliminate potentially unattractive and hazardous existing conditions. Actual construction processes and effects will be limited and isolated to only areas of activity.

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Education and Scientific Value

Given the locations of the proposed project activities, it would appear that the proposed sites do not provide any specific or unique attributes which are not evident in other areas of Boston Harbor or the Massachusetts Bay. The restricted and remote access also does not provide additional significance to any of these proposed project sites.

Uniqueness/Heritage

Again, given the locations of the proposed project activities, it would appear that the proposed sites do not provide any specific or unique or historic attributes, which are not evident in other areas of Boston Harbor or the Massachusetts Bay.

Recreation

The locations of the proposed project sites do not appear to provide any specific or unique recreational attributes, which are not realized in other areas of Boston Harbor or the Massachusetts Bay. Also, proposed project activities will be limited to small areas of the overall project area at any one time, therefore, as with navigation, recreation activities should not be impaired or interrupted.

Given this further review, the BHNIP proposes to evaluate the following revised PVF list, relative to the project:

- Benthic Habitat,
- Shellfish/Lobster Habitat,
- Finfish Habitat,
- Production Export,
- Sediment/Shoreline Stabilization,
- Wildlife Habitat, and
- Endangered Species Habitat.

The functional significance of the revised PVF's are described in narrative form and in "ecological terms" below. Again, summary tables are included in the Appendices of this report for reference and convenience.

3.0 PRINCIPAL VALUABLE FUNCTIONS EVALUATION

3.1 Principal Valuable Function Descriptions

PVF's included in the revised list proposed by the BHNIP are described as follows:

Benthic Habitat

Benthic habitat is defined as any bottom substrate (soft or hard) which is located in estuarine or marine conditions, and is suitable to supporting a benthic community. Recorded evidence of existing populations of specific species and their relative numbers will serve to enhance any sites particular level of function or value.

Shellfish/Lobster Habitat

Any benthic habitat specifically suited to supporting both soft substrate shellfish (e.g. soft-shelled clams), hard substrate shellfish (e.g. blue mussels); and substrates with suitable refuge and breeding sites for spawning, early benthic phase, sub-legal, and legal sized lobster; would be considered functional. Recorded evidence of existing populations of specific species and their relative numbers will serve to enhance any sites particular level of function or value.

Finfish Habitat

Any portion of the Boston Harbor or Massachusetts Bay water column specifically suited to supporting both resident and transient, demersal and pelagic finfish species; would be considered functional. Recorded evidence of existing populations of specific species and their relative numbers will serve to enhance any sites particular level of function or value.

Production Export

Production or nutrient export is the movement of nutrients out of a wetland or waterbody. These nutrients may represent an important component in the food chain of aquatic species. Only vegetated wetlands are considered highly functional; therefore, tidal waters are typically rated non-functional. The only vegetated wetlands which will be rated high are those larger wetlands which are subject to fluctuating water levels, allowing for the accumulation and then dispersion of biomass available for export.

Sediment and Shoreline Stabilization

This function refers to both the ability of a resource area to protect adjacent lands from storm damage and/or to nourish, through sediment transport to downgradient resources, to protect adjacent lands. Conditions which are critical include: the presence of vegetation which can bind the soils as well as reduce water flow velocity, the presence of obstructions which can also reduce water velocity, the presence of man-made barriers within the resource area which serve to stabilize the shoreline or the potential for resource sediments to be transported to downgradient landforms. Resource areas which have erosion protection structures such as man-made banks and bulkheads, are rated high for this function. Coastal resources which are exposed to large bodies of open water, wave action, or high velocities are considered significant. Coastal resource areas which are not adjacent to potentially erosive water features, and offshore features are not typically considered functional.

Wildlife Habitat

This function pertains directly to the physical and/or biological characteristics of a resource which may make it suitable as wildlife habitat. Habitat needs include feeding, nesting, shelter, resting and breeding resources. Wildlife is defined to include mammals, birds, reptiles and amphibians. Any resource area with an observed high wildlife diversity and abundance are rated highly. Where wildlife counts are not available, habitat characteristics become important. These include vegetation type and distribution, presence and distribution of open water, surrounding land use, and size.

Endangered Species Habitat

Endangered species habitats relate to the ability of a resource to provide important habitat, either seasonally or year-round, to an endangered or threatened species. Resource areas with observed or recorded endangered species use, or which may effect the quality of adjacent endangered species habitat are considered important.

3.2 Pre-Project Conditions

The pre-project PVF evaluation has been conducted on all of the proposed short listed disposal sites, developed from the BHNIP site selection process. These sites include:

- In-channel sites,[2]
- Mystic Piers (49-50),
- Revere Sugar,
- Little Mystic Channel (LMC),
- Reserved Channel, Areas A and B,
- Spectacle Island Confined Aquatic Disposal (CAD),
- Meisburger Sites 2 and 7, and
- Subaqueous Containment Sites B and E (Subaq B and E).

Cell locations within the Lower Mystic River, the Lower portion of Chelsea Creek, and the Inner Confluence.

These sites represent all of the potential options available to the BHNIP, and were the sites evaluated by the Corps, to identify the LEDPA sites.

Aside from the previously cited NAI (1995 a-d), this PVF evaluation relied on several additional technical resources as referenced herein. Pre-project PVF's results for each short listed site are presented in the following narrative, and in summary table contained in Appendix A.

3.2.1 IN-CHANNEL

The in-channel site includes 54 cell locations (200 x 500' or 150 x 500') within the Lower Mystic River, the Lower portion of Chelsea Creek, and the Inner Confluence. The overriding jurisdictional resources present at the in-Channel area include: Tidal waters under federal jurisdiction and designated port areas (DPA) under state jurisdiction. Water quality within the area is designated as SB waters. According to the surface water quality regulations (314 CMR 4.05). SB waters are defined as habitat for fish, other aquatic life and wildlife for primary and secondary contract recreation. In approved areas they shall be suitable for shellfish harvesting and depuration (Restricted Shellfish Areas). These waters shall have consistently good aesthetic value. Pre- project PVF conditions include the following:

Benthic Habitat

Sampling conducted in April of 1993 indicated that the benthic fauna was dominated by taxa classified as opportunistic and pioneer types. Each are early settlers and are typically associated with organically enriched, stresses environments. No amphipods or live molluscs were collected. Channel areas within the Lower Mystic River were dominated by Nematodes, Oligochaetes and *Capitella capitata*; and within the Chelsea Creek and Inner Confluence were dominated by Polychaetes. Sampling in October 1994 indicated two types of benthic habitat which included a muddy pit and mound topography (depositional), and fine sand overlaying silt (eroding). Polychaetes were again the dominant taxa, followed by oligochaetes, and limited bivalves and gastropods. Dominant species included *Polydora cornuta*, *Streblaspio benedicti* and *Nassarius trivittatus*.

Shellfish/Lobster Habitat

EOEA (1978) maps the site as contaminated waters, but is not specific to any shellfish resource. Limited molluscs were collected at this site. Catch data for lobster from October 1994 indicates limited CPUE[3] data. Trap data from the Mystic River yielded

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[3] CPUE - Catch per unit effort.

two sublegal males (51 and 82 mm.[4]). Trap data from the Chelsea Creek area yielded one sublegal male and female (74-75 mm., respectively), and one legal female (109 mm.). Inner confluence trap data was significantly higher and yielded 0.8 sublegal males (ranging from 56 to 82 mm.), and one sublegal female (65 mm.). CPUE trap data for lobsters is reported as number per trap day.

Finfish Habitat

Finfish surveys in the Mystic River and at the Inner Confluence indicate that several species could transit this area. A trawl survey of demersal fish during the fall 1994 collected winter flounder, Atlantic tomcod, windowpane, scup and rainbow smelt. These findings were consistent with those observed by Haedrich and Haedrich (1974). Species caught in Chelsea Creek were similar to those caught in the Mystic River and Inner Confluence. CPUE catch data for the 1994 sample trawls indicates highest catches in the Chelsea Creek, followed by the Mystic River and the Inner Confluence (25.03, 21.78, and 13.9, catch per 20 minute trawl, respectively).

Production Export

There is little evidence that any significant populations of rooted or attached aquatic vegetation exists in this location. Since the in-channel sites are subtidal, they would not be expected to provide significant function for production export.

Sediment/Shoreline Stabilization

The existing reinforced bulkheads and wharf structures throughout the area provide substantial shoreline reinforcement, and should buffet the shoreline from wave or current action. In-channel sediments probably are re-suspended and re-distributed frequently by currents and ship thrusts during docking maneuvers.

Wildlife Habitat

The aquatic area of Boston Inner Harbor may be useful to waterfowl that dive for food, birds that hunt fish in the water, or those which hunt fish from the air. Abandoned piers provide roosting sites for gulls and terns. Rodents are common in abandoned waterfront structures. Harbor seals could also transit the area.

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[4] Carapace length.

Endangered Species Habitat

No federally or state-listed threatened or endangered species are identified or are anticipated to occur within Boston Inner Harbor. Although, common terns have been observed nesting in the Boston Harbor area, no nests have been observed within the Inner Harbor area.

3.2.2 MYSTIC PIERS 49-50

Mystic Piers 49-50 and include 3.0 acres of subtidal area potentially available to fill with 130,000 cy of dredge materials to create fastland.[5] Jurisdictional resources include tidal waters (federal), and DPA (state). Even as a DPA, the overlay resource of the anadromous fish run, relative to the protection of marine fisheries, remains an issue. Water quality within the site is designated as SB (314 CMR 4.05). Pre- project PVF conditions include the following:

Benthic Habitat

Sampling conducted in April of 1993 indicated that the benthic fauna was dominated by nematodes (67%). *Capitella capitata* and oligochaetes were also found in significant numbers. These taxa are classified as opportunistic and pioneer taxa. Each are early settlers and are typically associated with organically enriched, stressed environments. No amphipods or live molluscs were collected. Sampling during October 1994 indicated two types of benthic habitat which included a muddy pit and mound topography (depositional), and fine sand overlaying silt (eroding). Some indications of bioturbation (infaunal tubes and anoxic voids) were present. The number of taxa were very limited (5) and total abundance were among the lowest in the harbor. *Nassarius trivittatus* was the most notable species present.

Shellfish/Lobster Habitat

EOEA (1978) maps the site as contaminated waters, but is not specific to any shellfish resource. No molluscs were collected at this site. CPUE data for lobster from October 1994 at the Inner Confluence yielded 0.8 sublegal males (ranging from 56 to 82 mm.), and one sublegal female (65 mm.).

Designation given to fill placed in structural shoreline features to create useable upland for marine industrial or maritime usage.

Finfish Habitat

Historic finfish surveys in the Mystic River and at the Inner Confluence indicate that several species could move into this area. A trawl survey of demersal fish during the fall 1994 collected winter flounder, Atlantic tomcod, windowpane, scup and rainbow smelt. These findings were consistent with those observed by Haedrich and Haedrich (1974). Pilings and wharf structures, and the physical orientation of the site perpendicular to the main channel currents should provide shelter. Both subtidal and intertidal benthic resources should provide prey items. The adjacent Mystic River also functions as an anadromous alewife fish run.

Production Export

There is little evidence that any significant populations of rooted or attached aquatic vegetation exists in this location.

Sediment/Shoreline Stabilization

The existing reinforced bulkheads and wharf structure should provide substantial shoreline reinforcement, and should buffet the shoreline from wave or current action.

Wildlife Habitat

The aquatic area of the Mystic Piers may be useful to waterfowl that dive for food, birds that hunt fish in the water, or those which hunt fish from the air. Abandoned piers provide roosting sites for gulls and terns. Rodents are common in abandoned waterfront structures. Harbor seals could also transit the area.

Endangered Species Habitat

No federally or state-listed threatened or endangered species are identified or are anticipated to occur within the boundaries of the Mystic Piers. Although, common terns have been observed nesting in the Boston Harbor area, no nests have been observed at the Mystic Piers.

3.2.3 REVERE SUGAR

The Revere Sugar site includes 3.7 acres of subtidal area potentially available to fill with 136,000 cy of dredge materials to create fastland. Jurisdictional resources include tidal waters (federal), and DPA (state). Even as a DPA, the overlay resource of the anadromous fish run, relative to the protection of marine fisheries remains an issue. Water quality within the site is designated as SB (314 CMR 4.05). Pre- project PVF conditions include the following:

Benthic Habitat

Sampling conducted in April of 1993 indicated that the benthic fauna was dominated by nematodes (80%). *Capitella capitata* and oligochaetes were also found in significant numbers. Again, these taxa are classified as opportunistic and pioneer taxa. Freshwater insects were collected in low numbers. No amphipods or live molluscs were collected. Sampling during October 1994 indicated a homogeneous benthic habitat of a muddy pit and mound topography (depositional). Polychaetes, oligochaetes, and nematodes were the most abundant taxa, similar to the 1993 collections. The epifaunal amphipod *Micodeutopus gryllotalpa* and the motile sand shrimp *Crangon septemspinosa* were also collected. The benthic infauna suggests that the habitat is under environmental stress.

Shellfish/Lobster Habitat

EOEA (1978) maps the site as contaminated waters, but is not specific to any shellfish resource. No molluscs collections were recorded at this site. Catch data for lobster from October 1994 indicates limited CPUE data for the Revere Sugar site. One sublegal male (72 mm.) and one sublegal female (74 mm.) were caught, and one legal male (88 mm.) was also caught.

Finfish Habitat

Finfish surveys (historic and current) in the Mystic River and at the Inner Confluence indicate that several species could move into this area. A gill net survey of demersal fish during the fall 1994 collected rainbow smelt, alewife, mackerel and winter flounder. Pilings and wharf structures, and physical orientation of the site perpendicular to the main channel currents should provide shelter. Species feeding indiscriminately should encounter prey. Species that prefer to browse on hard substrate would find little food resource, while winter flounder could spawn in this area. Revere Sugar is located well below the head of the tide so it would not provide spawning habitat for the anadromous fish run.

Production Export

There is little evidence that any significant populations of rooted or attached aquatic vegetation exists in this location.

Sediment/Shoreline Stabilization

The existing reinforced bulkheads and wharf structures should provide substantial shoreline reinforcement, and should buffet the shoreline from wave or current action.

Wildlife Habitat

The aquatic area of Revere Sugar may be useful to waterfowl that dive for food, birds that hunt fish in the water, or those which hunt fish from the air. Abandoned piers provide roosting sites for gulls and terns. Rodents are common in abandoned waterfront structures. Harbor seals could also transit the area.

Endangered Species Habitat

No federally or state-listed threatened or endangered species are identified or are anticipated to occur within the boundaries of the Mystic Piers. Although, common terns have been observed nesting in the Boston Harbor area, no nests have been observed at Revere Sugar.

3.2.4 LITTLE MYSTIC CHANNEL (LMC)

LMC includes 15 acres of subtidal area potentially available to fill with dredge materials and capped at an elevation suitable to create intertidal habitat. The site could handle up to 303,000 cy of material as proposed. Jurisdictional resources include tidal waters (federal), and DPA (state). Water quality within the site is designated as SB (314 CMR 4.05). Pre- project PVF conditions include the following:

Benthic Habitat

Composition of the benthic infauna sampled April 1993 indicated several taxa in low abundances. Oligochaeta was the dominant taxa followed by nematodes, *Tharyx acutus* and *S. benedicti*. These taxa indicating a stressed environment. Sediment samples at that time indicated a fine particulate grayish-black material (silt or mud), with a mild sulfur odor. Data from October 1994 indicated homogeneous mud sediments, with a mound and pit topography (depositional) throughout the area. Limited species abundances and indications of bioturbation revealed a poorly developed benthic community. Very limited observations of the surface dwelling bivalve *(Mulinia lateralis)*, the hydrozoan *(Obelia sp.)*, and the amphipod *(Gammarus lawrencianus)* were also made.

Shellfish/Lobster Habitat

EOEA (1978) maps the site as contaminated waters, but is not specific to any shellfish resource. A total of 0.5 sublegal and 0.6 legal-sized lobsters CPUE were collected during the fall collection 1994. Total CPUE was higher than that recorded from either the Mystic River and Chelsea Creek, similar to that recorded at the harbor stations, but lower than the offshore stations. Males predominated over females (NAI 1995c). LMC had the highest recorded legal catch per trap day 0.6, all males.

Finfish Habitat

Gill net collections conducted during October 1994 captured low numbers of rainbow smelt, Atlantic tomcod, alewife, cunner and butterfish. There is probably movement of finfish, some anadromous, and other species in and out of LMC. Finfish could use the wooden bridge pilings, submerged logs, a sunken boat hull, and *Fucus sp.* for shelter from predators. The sandy/silt substrate may provide suitable habitat for winter flounder.

Production Export

Fucus sp. is evident in LMC and may provide some very limited level production export to the Mystic River and the Inner Confluence.

Sediment/Shoreline Stabilization

The existing reinforced bulkheads and rip-rapped shoreline should provide substantial shoreline reinforcement, and should buffet the shoreline from wave or current action.

Wildlife Habitat

The aquatic area of LMC may be useful to waterfowl that dive for food, birds that hunt fish in the water, or those which hunt fish from the air.

Endangered Species Habitat

No federally or state-listed threatened or endangered species are identified or are anticipated to occur within the boundaries of LMC. Although, common terns have been observed nesting in the Boston Harbor area, no nests have been observed at LMC.

3.2.5 RESERVED CHANNEL AREAS A AND B

3.2.5.1 Reserved Channel Area A

Area A is approximately 8.9 acres in size. Area A is potentially available for filling with disposed contaminated dredge material (14,000 cy) and will be capped at an elevation suitable to create intertidal habitat and resource. Jurisdictional resources include tidal waters (federal), and land under the ocean and land containing shellfish (state). Water quality within Area A is designated as SB. Pre-project PVF conditions include the following:

Benthic Habitat

The composition of the Benthic infauna from 1993 indicated that Oligochaeta and *S. benedicti* were the two most abundant taxa at all sampling locations in Area A. Each are indicative of stressed environmental conditions. Species abundances relative to other sites sampled, were low.

Shellfish/Lobster Habitat

EOEA (1978) maps the site as contaminated waters, but is not specific to any shellfish resource. Limited numbers of the soft-shell clam were collected. Lobster CPUE in the Reserved Channel was moderate at 1.2 per trap day for sublegals, and evenly distributed between males and females; and 0.2 per trap day for legal males.

Finfish Habitat

Gill net collections during 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. Dominant species included blueback herring, and alewives. Other species caught included striped bass, American shad, bluefish, and rainbow smelt. These species are typically pelagic, and transient. Their capture is more likely random than indicative of habitat. Finfish could use the wooden bridge pilings, floating dock, and *Fucus sp.* for shelter from predators. The substrate may provide suitable habitat for winter flounder.

Production Export

Fucus sp. is evident in Area A and may provide some level production export to the Boston Harbor.

Sediment/Shoreline Stabilization

The existing reinforced bulkheads and rip-rapped shoreline should provide substantial shoreline reinforcement, and should buffet the shoreline from wave or current action.

Wildlife Habitat

The Area A watersheet may be useful to waterfowl that dive for food, birds that hunt fish in the water, or those which hunt fish from the air.

Endangered Species Habitat

No federally or state-listed threatened or endangered species are identified or are anticipated to occur within the boundaries of the Reserved Channel. Although, common terns have been observed nesting in the Boston Harbor area, no nests have been observed at Area A.

3.2.5.2 Reserved Channel Area B

Area B is approximately 7.7 acres in size. Area B is also potentially available for filling with disposed contaminated dredge material (185,000 cy) and will be capped at an elevation suitable to create intertidal habitat and resource. Jurisdictional resources include tidal waters (federal), and land under the ocean and land containing shellfish (state). Water quality within Area B is designated as SB. Pre-project PVF conditions include the following:

Benthic Habitat

The composition of the Benthic infauna from 1993 indicated that Oligochaeta and *S. benedicti* were the two most abundant taxa at all sampling locations in Area B. Each are indicative of stressed environmental conditions. Species abundance relative to other sites sampled, were low.

Shellfish/Lobster Habitat

EOEA (1978) maps the site as contaminated waters, but is not specific to any shellfish resource. Limited numbers of the soft-shell clam were collected. Lobster CPUE in the Reserved Channel was moderate at 1.2 per trap day for sublegals, and evenly distributed between males and females; and 0.2 per trap day for legal males.

Finfish Habitat

Gill net collections during 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. Dominant species included blueback herring, and alewives. Other species caught included striped bass, American shad, bluefish, and rainbow smelt. These species are typically pelagic, and are transient species. Their capture is more likely random than indicative of habitat. Finfish could use the wooden bridge pilings, floating dock, and *Fucus sp.* for shelter from predators. The substrate may provide suitable habitat for winter flounder.

Production Export

Fucus sp. is evident in Area B and may provide some level production export to the Boston Harbor.

Sediment/Shoreline Stabilization

The existing reinforced bulkheads and rip-rapped shoreline should provide substantial shoreline reinforcement, and should buffet the shoreline from wave or current action.

Wildlife Habitat

The Area B watersheet may be useful to waterfowl that dive for food, birds that hunt fish in the water, or those which hunt fish from the air.

Endangered Species Habitat

No federally or state-listed threatened or endangered species are identified or are anticipated to occur within the boundaries of the Reserved Channel. Although, common terns have been observed nesting in the Boston Harbor area, no nests have been observed at Area B.

3.2.6 SPECTACLE ISLAND CAD

Spectacle Island CAD provides a potential opportunity to dispose and sequester up to 1.45 million cubic yards of contaminated dredge material at a 50 acre subtidal open water location. Final subtidal elevations should remain consistent in both the pre- and post construction scenarios. Jurisdiction resources include tidal water (federal), and land under the ocean and land containing shellfish (state). Water quality is designated as SB. Pre- project PVF conditions are described as follows:

Benthic Habitat

Benthic resources were examined by the CA/T project (Cortell 1990b). The findings indicated that this area was dominated by the tube dwelling amphipod *Ampelisca abdita* and the gastropod *N. trivittatus*, reflecting relatively clean, sandy sediments. Nephtyid polychaetes were also numerically important at Spectacle Island CAD. Abundances were comparatively low as related to other sandy areas in Massachusetts Bay. The offshore portions of these transects also supported sand worms, hermit crabs, mud crabs and rock crabs. Sampling during the fall of 1994 confirmed a well developed benthic community, falling between a pioneering and equilibrium stage. Dominant species included polychaetes (*Aricidia catherinae* and *P. cornuta)*, and the amphipod *A. abdita*. The majority of the areas has a silt substrate, with some fine sand, shell hash and gravel. Bioturbation was also evident.

Shellfish/Lobster Habitat

EOEA (1978) maps the site as contaminated waters and soft shell clam resource. CA/T findings (Cortell 1990b) indicated the presence of soft-shell clam habitat and also observed mussel beds throughout the area. Several lobster transect surveys were also conducted around Spectacle Island related to CA/T work (Cortell 1990a and Wahle and Steneck 1991). Abundances of free-living lobsters were relatively low along the island's eastside (0.0003-0.0004/ft^2). Most lobsters were found farther offshore, at the deeper ends of the sampling transects. No early benthic phase (EBP) lobster were found at any of the transects. An additional lobster survey conducted during October 1994 collected

0.2 lobsters per trap-day, all were sublegal. This CPUE was among the lowest of the stations sampled during the entire sampling event.

Finfish Habitat

A trawl survey of demersal fish during October 1994 collected an average of 21.3 finfish per 20 minute trawl, one of the lowest catches in Boston Harbor. Winter flounder was the predominant species, followed by skate sp. Rainbow smelt and Atlantic silverside (pelagics) were also collected.

Production Export

There is little evidence that any significant populations of rooted or attached aquatic vegetation exists in this location. Since Spectacle Island CAD is an offshore and subtidal site, it is not expected to provide significant function for productive export.

Sediment/Shoreline Stabilization

Spectacle Island CAD is an offshore site, and should not provide any significant sediment/shoreline stabilization value

Wildlife Habitat

Waterfowl, including great cormorants, herring gulls, white winged scoters, common goldeneyes, buffleheads, mallards, black ducks, mergansers and scaup have been observed in the vicinity of Spectacle Island. Each if these species feed on fish and invertebrates.

Endangered Species Habitat

No federally or state-listed threatened or endangered species are identified or are anticipated to occur in the area of the Spectacle Island CAD. Although, common terns have been observed nesting on dilapidated piles on the northwestern end of Long Island, approximately 0.6 miles to the northeast of Spectacle Island CAD. Harbor seals, harbor porpoises and grampuses occur occasionally in Boston Harbor. These are protected under the Federal Marine Mammals Protection Act, but none are listed as threatened or endangered species. There is also no exposed ledge in the area which could be suitable as a seal haul out area.

3.2.7 MEISBURGER SITES 2 AND 7 (M2 AND M7)

M2 provides an opportunity to dispose and sequester up to 4.6 million cubic yards, and M7 also provides an opportunity to dispose and sequester up to 6.1 million cubic yards, of contaminated dredge material at either an 86 acre, and a 121 acre subtidal and remote open water location. Jurisdictional resources include tidal waters (federal) and land under the ocean (state). Pre-project PVF conditions include the following:

Benthic Habitat

Blake et al. (1993) indicates that the benthic community in the area of M2 was composed mainly of a polychaete assemblage dominated by *Spio limicola, Polydora socialis,* and *Mediomastius californiensis*. Sampling at both M2 and M7 in 1994 indicated moderately abundant communities of tube dwelling amphipods and spionid polychaetes. Several of the polychaete species observed were deep dwelling organisms indicative of a healthy benthic community. Approximately 50% of the sampling stations at M2 and M7 contain primarily rock sediments intermixed with sand and gravel, indicating a high-energy, erosional bottom habitat. One third of the substrate at M2 contains sand overlying silt. Most of the remaining substrate at M7 is a gravel substrate mixed with sand and rock. Dominant taxa included polychaetes, amphipods, and bivalve molluscs.

Shellfish/Lobster Habitat

EOEA (1978) does not map either M2 or M7 as shellfish habitat. Blue mussels and soft-shelled clams were evident at both sites. This is typical of offshore, deep water areas. A lobster survey was conducted in October 1994, and M2 had the highest CPUE of all stations sampled, and M7 had the second highest CPUE. A total of 6.4 lobsters per trap-day were collected at M2, of which 0.1 met the legal size limit (83 mm.); while M7 yielded 5.1 lobsters per trap-day, also only 0.1 met the legal size limit. Both M2 and M7 are situated within the area of greatest territorial harvest for coastal the Massachusetts lobster fishery.

Finfish Habitat

Trawl data provided by MADMF (unpublished 1991-92) for offshore areas near M2 and M7 indicated that winter flounder, Atlantic cod and yellowtail flounder comprised up to 60% of the total catch (655 fish) during 13 min tows. Rock and Jonah crab were found in small numbers. A gill net survey during October 1994 indicated CPUE results averaging 12.3 fish per 24 hour set at M2 and 17.4 at M7. These result were moderate as compared to other gill net and trawl surveys conducted during the period. Mackerel, longhorn sculpin, cunner and Atlantic cod, all demersal species were predominant.

Production Export

There is little evidence that any significant populations of rooted or attached aquatic vegetation exists in this location. Since M2 and M7 are offshore and subtidal sites, it is not expected that either should provide significant function for production support.

Sediment/Shoreline Stabilization

Offshore sites do not provide any sediment/shoreline stabilization value.

Wildlife Habitat

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 Corps to assess the use of the Massachusetts Bay Disposal Site (MBDS) by marine mammals, reptiles and seabirds (MBO 1987). The dominant species observed within Massachusetts Bay Disposal Site (MBDS) are typical of the offshore waters of Massachusetts (Meisburger and Boston Lightship sites). Seabirds observed include northern fulmar, shearwater, storm petrels, northern gaument, pomarine jaeger, gulls and Alcids. Dominant non-endangered mammals include minke whale, white-sided dolphin, and harbor porpoise. Although five species of turtles potentially occur in Massachusetts Bay, Kemp's ridley and the Loggerhead are the most regularly observed in the area.

Endangered Species Habitat

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 (Endangered),
humpback whale (Endangered),
finback whale (Endangered),
sei whale (Endangered),
sperm whale (Endangered), and
blue whale (Endangered).

Turtles

Kemp's ridley (Endangered),
leatherback (Endangered),
hawksbill (Endangered),
loggerhead (Threatened), and
green (Threatened).

Fish

shortnose sturgeon (Endangered).

Sightings offshore from Boston Harbor are typically concentrated eastward of the MBDS, within the newly designated Stellwagen Bank National Marine Sanctuary (ADL 1992). The Meisburger sites are approximately halfway between Boston Harbor and the MBDS and are not a reported area of concentration for these species. Of the five threatened or endangered turtles that may occur in this area, the leatherback, Kemp's ridley and the Loggerhead are the most regularly observed in Massachusetts and Cape Cod Bays. There is nothing unique about the Meisburger 2 and 7 sites that would attract these species. NAI is not aware of any specific sightings in this area. The shortnose sturgeon inhabits estuarine and freshwater areas along the eastern coast of the U.S. and Canada and would not inhabit these open water sites.

3.2.8 SUBAQUEOUS CONTAINMENT SITES

3.2.8.1 Subaqueous Containment Site B (Subaq B)

Subaq B provides an opportunity to dispose and sequester 609,000 cubic yards of contaminated dredge material at a 83 acre subtidal, open water location. Jurisdictional resources include tidal waters (federal), and land under the ocean and land containing shellfish (state). Water quality is designated as SB. Pre-project PVF conditions include the following:

Benthic Habitat

Sampling at Subaq B during 1994, and just south of the shipping channel revealed a silty substrate covered with a mat of *Ampelisca* amphipod tubes. Other species such as the spionid polychaete *Polydora cornuta* and the amphipod *Phoxocephalus holbolli* were evident. 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.

Shellfish/Lobster Habitat

EOEA (1978) maps the site as contaminated waters, but is not specific to any shellfish resource. However, soft-shell clam (*M. arenaria*) spat and razor clams (*E. directus*) were encountered during previous benthic sampling events. Lobster fishing activity in the vicinity of Subaq B was examined during the summer of 1990 (Cortell 1990a). Pot markers were observed 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. Lobsters occurred at an approximate density of 0.0012/ft^2) in the area of Subaq B. Most lobsters were observed at the deeper portions of the transects. No EBP lobsters were observed. Recent lobster trapping surveys around the Spectacle Island area collected low numbers of lobsters (0.2 per trap-day), one of the lowest in Boston Harbor. In the trawl survey, approximately 6.7 lobsters were collected per 20 minute tow.

Finfish Habitat

A recent trawl survey near Spectacle Island collected mainly winter flounder, along with skate sp., rainbow smelt, and Atlantic silversides. 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 CA/T artificial reef design (ACOE Individual Permit No. 199202207), target fish species in the area of Subaq B 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.

Production Export

There is little evidence that any significant populations of rooted or attached aquatic vegetation exists in this location. Since Subaq B is an offshore and subtidal site, it is not expected to provide production export.

Sediment/Shoreline Stabilization

Offshore sites do not provide sediment/shoreline stabilization value.

Wildlife Habitat

Waterfowl, including great cormorant, herring gull, white winged scoter, common goldeneye, bufflehead, mallard, black duck, merganser and scaup have been observed in the vicinity of Spectacle Island (Cortell 1990a). It is likely that these same species of waterfowl use Subaq B area for feeding and resting. Each of these species feed on fish and invertebrates that occur in the area.

Endangered Species Habitat

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, harbor porpoise, and grampuses, occur occasionally in the area. These species are all protected under the Federal Marine Mammals Protection Act.

3.2.8.2 Subaqueous Containment Site E (Subaq E)

Subaq E provides an opportunity to dispose and sequester 614,000 cubic yards of contaminated dredge material at a 79 acre subtidal, open water location. Jurisdictional resources include tidal waters (federal), and land under the ocean and land containing shellfish (state). Water quality is designated as SB. Pre-project PVF conditions include the following:

Benthic Habitat

Sampling at Subaq E during October 1994 revealed two habitats. At 4 of the 6 sampling locations, silt substrate was overlain with a matrix of *Ampelisca* sp. tubes, 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. Spionid polychaete *Polydora cornuta* and cirratulid *Tharyx acutus* composed 18% and 12% of the total communities, respectively. Two locating at Subaqueous E had silt substrate, covered either by a matrix of *Ampelisca* sp. tubes or a layer of *Mytilus edulis* shell hash. Worm tubes and oxic and anoxic voids were observed underneath the *Ampelisca* mat, indicating bioturbation occurs. 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. All benthic communities at Subaq E were intermediate between a disturbed or stressed community and an equilibrium community.

Shellfish/Lobster Habitat

EOEA (1978) maps the site as contaminated waters, but is not specific to any shellfish resource. Benthic samples at Subaq E contained low numbers of soft shell clam, although this species tends to be most abundant at slightly above mean low water. Blue mussels were somewhat more abundant. 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.

Finfish Habitat

Otter trawl collections during October 1994 collected an average of 82.68 individuals per 20 minute tow, of which 3.7 were lobster. 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.

Production Export

There is little evidence that any significant populations of rooted or attached aquatic vegetation exists in this location. Since Subaq E is an offshore and subtidal site, it is not expected to provide significant function for production export.

Sediment/Shoreline Stabilization

Offshore sites do not provide any significant sediment/shoreline stabilization value.

Wildlife Habitat

Waterfowl, including great cormorant, herring gull, white winged scoter, common goldeneye, bufflehead, mallard, black duck, merganser and scaup have been observed in the vicinity of Spectacle Island (Cortell 1990a). It is likely that these same species of waterfowl also use the Subaq E site for feeding and resting. Each of these species feed on fish and invertebrates that occur in the general area.

Endangered Species Habitat

No threatened or endangered species listed by federal or state authorities are identified or anticipated to occur within the boundaries of Subaq E. Several marine mammals not listed as threatened or endangered, including harbor seals, harbor porpoise, and grampuses, occur occasionally in the area. These species are all protected under the Federal Marine Mammals Protection Act.

3.3 Anticipated Project Effects

Based on the LEDPA evaluation using Pre-Project conditions, and current project design specifications, the Corps has determined that the disposal of the entire 1.3 million cubic yards (bulked volume) of contaminated dredge material should be completely handled, and sequestered with a cap, within the proposed 54 in-channel cells. Also included as a backup site, the LEDPA evaluation indicated that LMC should serve to provide an additional disposal volume of for 303,000 cy. The disposal volume is limited since the proposal for the use of LMC recommends to fill and cap within the entire waterbody footprint, and existing subtidal habitat, to a final elevation suitable to establish an intertidal condition. This proposal will allow for the aforementioned backup disposal volume, while maintaining, and potentially enhancing, an aquatic habitat; as opposed to permanent displacement of aquatic habitat.

Project effects related to substrate; TSS/turbidity; water quality, circulation and fluctuation; and salinity are discussed in section 6.0 of the FEIR/S. Design and operational mitigation is discussed and detailed in section 5.0, the proposed dredge management plan of the FEIR/S.

Project effects to PVF's can include several scenarios. The two major subdivisions for environmental effects are direct and indirect effects. Direct effects are those which occur within the actual project or activity footprint, whereas indirect effects are those which occur outside of the disposal footprint. Within the scope of these scenarios, both permanent and temporary effects are of concern. Anticipated project effects to the PVF's for each recommended LEDPA site are presented in the following narrative, and in summary tables contained in Appendix B.

3.3.1 IN-CHANNEL

Of the total in-channel acreage (202 acres[6]), 152± 75% acres will be filled with dredge material, and capped with clean soft sediments. In the areas where swift currents and potential erosive exposure from ship thrust may exist, the Corps proposes to fill with dredge material, cap with clean soft sediments, and armor the cells with rock generated during the project subaqueous blasting operations. It is anticipated that 50± 25% acres within the in-channel area will require armoring. All final cap elevations, clean soft sediment or rock cap, will be at -42 ft. mean low water (MLW) within the Lower Mystic River and the Inner Confluence; and -40 ft. MLW in the Chelsea Creek. It is anticipated that all final substrates will be either clean soft sediments or clean hard substrate. This should provide an opportunity to enhance existing aquatic ecology. However, any potential enhancement realized through the BHNIP project activities could be limited by areal harbor water quality, should proposed or on-going harborwide water quality initiatives fail to change existing water quality conditions.

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[6] Section 6.0 of the FEIR/S.

Benthic Habitat

The in-situ disposal of the dredge material within the in-channel cells should provide an opportunity to expose clean soft substrate parent material over 152± acres of presently stressed benthic habitat. Existing low species abundances, and opportunistic/pioneer taxa could develop further toward a more varied and abundant equilibrium community within this acreage. To provide suitable conditions for this to occur, the BHNIP must restore affected substrates to (or near) original conditions and depths. Any presence of contaminants in the post-disposal sediments could limit the re-colonizing benthic fauna to an opportunistic and pioneering community. The remaining 50± acres of the in-channel area will be capped/armored with rock, altering pre-existing soft bottom substrate conditions. Benthic fauna capable of inhabiting the rock cap would likely differ from the infauna present in the fine-grained sediments currently in place. The rock would provide suitable substrate for the attachment of fouling organisms, which are now present on the subtidal portions of areal bulkheads and pilings. Water quality in the immediate vicinity and downstream (ebb of flood) may temporarily be impacted by project activities, but this should be limited to a short-termed condition. No extensive or long-term project related degradation is anticipated.

Shellfish/Lobster Habitat

Following the disposal activities, the restored and clean soft sediments should provide suitable habitat for burrowing shellfish, and the rock cap should provide a additional opportunity to establish additional hard substrate communities (e.g. mussel beds). The project should not change EOEA's (1978) designation as non specific contaminated waters. The existing lobster habitat would temporarily be displaced by the dredging and disposal activities, but should return following the completion of the entire project, or at a minimum when work in specific in-channel areas is completed. The rock armoring should provide enhanced feeding, resting, refuge and breeding sites for the areal lobster community.

Finfish Habitat

Changes in the benthic habitat should have certain effects on the post-disposal finfish habitat. The placement of 50± acres of rock cap will partially displace winter flounder habitat. Until the rock is silted over, it should also serve as a fouling site (e.g. an artificial reef), a finfish feeding site, and may provide attachment sites for fish eggs. Construction activities will temporarily disturb finfish usage during the dredging and disposal activities. These effects will be localized and short-termed. Redistribution and re-suspension of sediments and contaminant constituents into the water column could temporarily degrade areal water quality, and affect current demersal and pelagic fish distribution, and more over effect one or more of the seasonal anadromous fish runs during and post construction. Also should transient fish bioaccumulate any constituent re-suspended during construction or shipping activities, there may be a an increased risk, be it minimal, to environmental and human health.

Production Export

No effects are anticipated since this a non-functional element in the pre-existing condition.

Sediment/Shoreline Stabilization

No effects are anticipated since no shoreline alterations are proposed. Armoring of a segment of the post-project channel substrate will stabilize a 50± acre portion of the channel bottom.

Wildlife Habitat

Construction activities will temporarily disturb wildlife usage during the dredging and disposal activities. These effects will be localized and short-termed. Should existing finfish usage remain relatively consistent there should be no effects or changes to existing wildlife usage.

Endangered Species Habitat

No effects are anticipated since this a non-functional element in the pre-existing condition.

3.3.2 LITTLE MYSTIC CHANNEL

LMC has been selected as a backup LEDPA site, should the in-channel disposal alternative not be able to contain and sequester the entire 1.3 million cubic yards of contaminated dredge material. As currently designed, LMC can handle 303,000 cy of material over a spatial area of 15 acres. The BHNIP has limited the total volume available for disposal since it is proposed to only fill and cap (with clean parent material) to an elevation suitable to develop an intertidal aquatic habitat (0-4.5 NGVD). Average tidal range within Boston Harbor is 9.5 ft. (White and White 1995). These conditions should be suitable for semi-diurnal inundation over the 24+ hr. tidal cycle. Inundation will occur during flood tide conditions following mid-tide conditions, and will recede on each ebb. The placement of the dredge material will permanently render the abandoned boat ramp, at the head of LMC useless.

Again, project effects related to substrate; TSS/turbidity; water quality, circulation and fluctuation; and salinity are discussed in sections 6.0 of the FEIR/S. Construction mitigation is discussed and detailed in section 5.0, the proposed dredge management plan, of the FEIR/S.

It is anticipated that the final substrates will be clean soft sediments. This should provide an opportunity to enhance existing aquatic ecology. However, any potential enhancement realized through the BHNIP project activities could be limited by areal harbor water quality, should proposed or on-going harborwide water quality initiatives fail to change existing water quality conditions.

Benthic Habitat

The disposal of dredge material at LMC will permanently displace an opportunistic and pioneer subtidal benthic community of low abundance. The final elevations of the proposed cap of clean parent material will be set within a suitable range to promote tidal flat/mudflat or vegetated conditions. The proposed post-project intertidal habitat could provide an opportunity to enhance the aquatic ecology of LMC.

Shellfish/Lobster Habitat

The disposal of dredge material at LMC will permanently displace limited shellfish habitat. The final elevations of the proposed cap of clean parent material will be set within a suitable range to promote tidal flat/mudflat or vegetated conditions. The proposed post-project intertidal habitat could provide an opportunity to enhance the shellfish ecology of LMC. The project should not change EOEA's (1978) designation as non specific contaminated waters. Changing the aquatic habitat from subtidal to intertidal conditions will eliminate existing lobster habitat. However, the existing habitat is not a current commercially utilized habitat and existing populations are more than likely transient.

Finfish Habitat

The disposal of dredge material at LMC will permanently displace limited demersal finfish habitat. The final elevations of the proposed cap of clean parent material will be set within a suitable range to promote tidal flat/mudflat or vegetated conditions. The proposed post-project intertidal habitat could provide an opportunity to enhance the intertidal forage fish ecology of LMC. The existing finfish habitat is not a current commercially utilized resource and existing populations are more than likely transient.

Production Export

The disposal of dredge material at LMC will not displace any production habitat. The final elevations of the proposed cap of clean parent material will be set within a suitable range to promote tidal flat/mudflat or vegetated conditions. This should allow for the natural recruitment of rooted and attached estuarine plant types (e.g. marsh grasses and alga).

Sediment/Shoreline Stabilization

Shoreline bulkheading will remain intact and intertidal conditions should further buffet any wave or current energies.

Wildlife Habitat

Proposed intertidal conditions should provide an additional feeding habitat for wading and shore species. Intertidal conditions will limit the period of existing feeding of waterfowl, dabbling and diving birds to only periods of tidal flooding.

Endangered Species Habitat

No effects are anticipated since this a non-functional element during the existing conditions evaluation.

3.4 Proposed On-Site Mitigation Conditions

Prior to the BHNIP proposing any off-site mitigation activities, an evaluation of enhancement activities within the scope of the proposed project is necessary. A review of the project effect PVF evaluation indicates that there are limited negative effects anticipated. These include:

- Conversion of 50± acres of soft substrate to hard substrate at the in-channel site;
- Conversion of up to 15 acres of subtidal conditions to the intertidal conditions at LMC;
- Displacement of up to 15 acres of unused lobster habitat at LMC;

- Conversion of up to 15 acres of subtidal finfish habitat to intertidal habitat at LMC, and

- Limiting feeding periods for waterfowl and waterbirds at LMC.

The proposed project includes several opportunities for enhancement as part of the dredging and disposal design. This section of the report will re-evaluate both the in-channel and LMC proposal and will highlight those areas of PVF enhancement which are anticipated. Results are described below and presented in summary tables in Appendix C.

3.4.1 IN-CHANNEL

Again, 152± 75% acres will be filled with contaminated dredge material, and capped with clean soft sediments. In the areas where swift currents and potential erosive exposure from ship thrust may exist, the Corps proposes to fill with dredge material, cap with clean soft sediments, and armor the cells with rock generated during the project subaqueous blasting operations. It is anticipated that 50± 25% acres within the in-channel area will require armoring. This proposed disposal alternative will place and sequester all contaminants in-situ. The BHNIP proposes to place the most contaminated materials in those cells where the rock armoring is proposed. This should insure that the most degraded of dredge materials will be permanently sequestered and secured. All final cap elevations, clean soft sediment or rock cap, will be at -42 ft. mean low water (MLW) within the Lower Mystic River and the Inner Confluence; and -40 ft. MLW in the Chelsea Creek. It is anticipated that all final substrates will be either clean soft sediments or clean hard substrate. This should provide an opportunity to enhance existing aquatic ecology. However, any potential enhancement realized through the BHNIP project activities could be limited by areal harbor water quality, should proposed or on-going harborwide water quality initiatives fail to change existing water quality conditions.

Benthic Habitat

The soft sediment capping material will provide 152± acres of clean substrate for the natural recruitment of benthic organisms and an enhancement of the benthic community and species abundance. Given the estuarine conditions of the in-channel area, the BHNIP would expect that the re-established benthic community could be comprised of surface and burrowing deposit/suspension feeding polychaetes, burrowing bivalves, and possibly urchins. The proposed 50± acres of hard substrate will provide additional surface area for fouling sites. The target community anticipated for the rock cap is a fouling community dominated by *Mytilus edulis*. Barnacles and macroalgae (e.g., *Chondrus crispus,* kelp), and to a lesser extent bryozoans, and sponges (Proifera) are also expected to occur. This target community is expected to be similar in abundance and species composition to the epibenthic community typically found throughout Boston Harbor.

Shellfish/Lobster Habitat

Shellfish and lobsters should naturally re-populate the remaining soft sediments of the in-channel area, however, given the enhanced sediment conditions, greater community development and diversity should occur. Soft-shell clams are more typically expected on tidal flats, but can exist in deep water conditions (Belding 1916). The project should not change EOEA's (1978) designation as non specific contaminated waters. The placement of 50± acres of rock capping will enhance shellfish diversity since the cap should attract additional species such as blue mussels. Also, the rock cap should significantly enhance lobster resource by creating greater feeding, resting, refuge and breeding habitat. However, these enhancements may be tempered by the degree in harborwide water quality improvements, and based on projects unrelated to the BHNIP.

Finfish Habitat

One hundred fifty two± acres of clean soft substrate and the conversion of 50± acres to clean hard substrate (rock capping) should provide greater diversity in finfish habitat; and create an artificial reef-like structure providing extensive surface area for benthic fouling. As stated above, the BHNIP would expect fouling organisms to include:

- Blue mussel,
- Barnacles,
- Macroalgae,
- bryozoans, and
- sponges (Porifera).

This fouling will provide an increase in finfish feeding resource within the open water area of Boston Inner Harbor, and the Lower portion of the Mystic River, an anadromous fish run; and the Chelsea Creek. Each of which currently support typical demersal and pelagic species.

Production Export

The placement of 50± acres of hard substrate will increase the surface area available for the attachment of deep water aquatic vegetation (e.g. red and brown alga). These species could minimally enhance production export from the area.

Sediment/Shoreline Stabilization

Armoring of the 50± acre portion of the post-project channel substrate will stabilize that area portion of the channel bottom.

Wildlife Habitat

Wildlife habitat is most greatly effected by the surrounding environment, and since the BHNIP will have no effect on areal environmental conditions, no enhancement of wildlife habitat is expected.

Endangered Species Habitat

Like wildlife habitat areal environment is the limiting variable in this case, so no enhancement is anticipated to this non-functional condition.

3.4.2 LITTLE MYSTIC CHANNEL

Should LMC be required for disposal, the BHNIP proposes to fill and cap (with clean parent material) up to 15 acres of subtidal habitat to an elevation suitable to develop an intertidal aquatic habitat (0-4.5 NGVD). This will permanently sequester and secure contaminated dredge material. Average tidal range within Boston Harbor is 9.5 ft. (White and White 1995). These conditions should be suitable for semi-diurnal inundation over the 24+ hr. tidal cycle. Inundation will occur during flood tide conditions following mid-tide conditions, and will recede on each ebb. The placement of the dredge material will permanently render the abandoned boat ramp, at the head of LMC useless. Also the proposed site usage will require the potential realignment and/or re-construction of fine storm drain discharges; and are combined sewer overflow (CSO).

It is anticipated that the final substrates will be clean soft sediments, and should provide an opportunity to enhance existing aquatic ecology. However, any potential enhancement realized through the BHNIP project activities could be limited by areal harbor water quality, should proposed or on-going harborwide water quality initiatives fail to change existing water quality conditions.

Benthic Habitat

The final elevations of the proposed cap of clean parent material will be set within a suitable range to promote tidal flat/mudflat or vegetated conditions. The proposed post-project intertidal habitat could provide an opportunity to enhance and vary the aquatic ecology of LMC. The BHNIP anticipates that the following intertidal community could develop on the clean parent material:

Vegetation (rooted)

- *Spartina alterniflora,*
- *S. patens,*
- *Distichlis spicata,* and
- *Zostera marina.*

Vegetation (attached)

- *Ulva lactuca,*
- *Fucus sp.*, and
- *Enteromorpha sp.*

Tidal/Mudflat Conditions (Infauna)

- Surface dwelling polychaetes,
- Burrowing polycheates,
- Suspension and deposit feeders,
- Ribbed mussel,
- Urchins,
- Burrowing bivalves, and
- Various estuarine crabs (fiddler, spider, and green).

However, any potential enhancement realized through the BHNIP project activities could be limited by areal harbor water quality, should proposed or on-going harborwide water quality initiatives fail to change existing water quality conditions.

Shellfish/Lobster Habitat

The proposed post-project intertidal habitat could provide an opportunity to enhance the shellfish ecology of LMC. Soft-shell clams could recolonize the area. The project should not change EOEA's (1978) designation as non specific contaminated waters. Changing the aquatic habitat from subtidal to intertidal conditions will eliminate existing lobster habitat. However, the existing habitat is not a current commercially utilized resource and existing populations are more than likely transient. Any potential enhancement realized through the BHNIP project activities could be limited by areal harbor water quality, should proposed or on-going harborwide water quality initiatives fail to change existing water quality conditions.

Finfish Habitat

The proposed post-project intertidal habitat could provide an opportunity to enhance the intertidal forage fish ecology of LMC. Species anticipated to inhabit the created intertidal habitat include, but not limited to:

- Mummichog,
- Sheepshead minnow,
- Sticklebacks, and
- Atlantic silversides.

The existing subtidal finfish habitat will be eliminated, is not a specifically current commercially utilized resource and existing populations more than likely transient in nature.

Production Export

The final elevations of the proposed cap of clean parent material will be set within a suitable range to promote tidal flat/mudflat or vegetated conditions. This should allow for the natural recruitment of rooted and attached estuarine plant types (e.g. marsh grasses and alga).

Sediment/Shoreline Stabilization

Shoreline bulkheading will remain intact and intertidal conditions should further buffet any wave or current energies.

Wildlife Habitat

Proposed intertidal conditions should provide an additional feeding habitat for wading and shore species. Intertidal conditions will limit the period of existing feeding for waterfowl, dabbling and diving birds to only periods of tidal flooding. However, wildlife habitat is more likely effected by the surrounding environment, and since the BHNIP will have no effect on areal environmental conditions, no enhancement of wildlife habitat is expected.

Endangered Species Habitat

Like wildlife habitat areal environment is the limiting variable in this case, so no enhancement is anticipated to this non-functional condition.

4.0 SUMMARY OF FINDINGS

Based on the findings of the BHNIP's site selection process, the existing PVF conditions were evaluated to develop a preliminary database of findings. The Pre-Project Conditions were evaluated for the following sites:

- In-channel sites,
- Mystic Piers (49-50),
- Revere Sugar
- Little Mystic Channel,
- Reserved Channel Areas A and B,
- Spectacle Island CAD,
- Meisburger Sites 2 and 7, and
- Subaqueous Sites A and B.

PVF conditions for each of these sites are presented in section 3.2 of this report, and in Appendix A. Since two LEDPA sites were selected from this short-list, the results for the remaining sites will serve solely as a backup database at this time, and have no significance to the proposed project as currently conceived.

Again, the Corps conducted a LEDPA evaluation of the aforementioned short-listed sites to establish a primary and backup site. Their conclusion was that the in-channel site shall serve as the primary disposal site, and LMC shall serve as the backup site, if needed. One objective of the LEDPA evaluation was to contain and sequester the entire dredge material volume at as few sites as possible. The current design suggests that the entire 1.3 million cubic yards of material can be disposed of, and sequestered at the in-channel site. LMC will provide an additional 303,000 cy of backup disposal volume. LMC's capacity represents 23% of the total bulked volume of the silts.

Therefore, the BHNIP has only carried the in-channel and LMC sites through the Pre-Project, Project Effects, and On-site Mitigation conditions evaluation. These findings are presented in sections 3.2-3.4, and Appendices A-C, and will establish the anticipated pre- and post project PVF conditions in ecological terms.

4.1 Summary of PVF Conditions at the In-Channel Site

Benthic Habitat: Benthic habitat exists in each of the evaluation scenarios. Pre-Project conditions include an opportunistic and pioneer community of low abundance, over the entire 202 acres. The project will establish 152± acres of clean soft parent 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: Shellfish/lobster habitat exists in each of the evaluation scenarios. Pre-project conditions include the area being mapped by EOEA (1978) as shellfish habitat, and yielded moderate CPUE catch data for lobster 1.4 per trap day. The project will establish 152± acres of clean soft parent 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: Finfish habitat exists in each of the evaluation scenarios. 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. The clean soft substrates and the fouling sites created by the 50± acres of rock cap should enhance finfish habitat following completion of the project.

Production Export: Production export does not exist in the Pre-Project and Project Effect evaluation scenarios. As part of the fouling community anticipated at the 50± acres of rock cap, 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 currently and will continue to stabilize the shoreline. The proposed rock cap will further stabilize 50± acres of soft channel bottom.

Wildlife Habitat: Wildlife habitat will exist in each of the evaluation scenarios. 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.

Endangered Species Habitat: Endangered species habitat does not, and is not anticipated to occur at this site.

Any anticipated enhancement of PVF conditions as at LMC may be limited by areal water quality, should proposed or on-going harborwide water quality initiatives fail to change existing water quality conditions.

4.2 Summary of PVF Conditions at LMC

Benthic Habitat: Benthic habitat exists in each of the evaluation scenarios. 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: Shellfish/lobster habitat currently exists in the Pre-Project condition. Shellfish habitat will continue to exist in each of the evaluation scenarios, but lobster habitat will be eliminated due to the project. Pre-Project conditions include the area being mapped by EOEA (1978) as shellfish habitat, and yielded moderate CPUE catch data for lobster 1.1 per trap day. The project will establish up to 15 acres of clean soft parent material intertidal substrate. Project effects should not alter EOEA's mapping of the shellfish resource. These conditions should enhance existing shellfish habitat for soft-shell clams and ribbed mussels, and again will eliminate transient lobster habitat.

Finfish Habitat: Finfish habitat exists in each of the evaluation scenarios. Pre-Project conditions indicate a low abundance of demersal and pelagic species typically found in the Boston Harbor area, and is 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 forage fish habitat.

Production Export: Production export should not exist in the Pre-Project and Project Effect evaluation scenarios. 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: Sediment/Shoreline Stabilization occurs, and will continue to occur in each of the evaluation scenarios. Areal bulkheads and rip-rap stabilize the shoreline. The proposed intertidal conditions will also provide additional buffeting from wave and current energy.

Wildlife Habitat: Wildlife habitat exists in each of the evaluation scenarios. 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, the urban and maritime usage may limit the amount of achievable enhancement.

Endangered Species Habitat: Endangered species habitat does not, and is not anticipated to occur at this site.

Any anticipated enhancement of PVF conditions at LMC above may be limited by areal water quality, should proposed or on-going harborwide water quality initiatives fail to change existing water quality conditions.

4.3 Conclusion

Given the findings provided herein, the BHNIP should pose only limited negative effects to either the in-channel or LMC PVF's, as established. In fact the project as designed appears to provide significant on-site mitigation (enhancement) of project specific PVF's. Given these findings, the BHNIP would conclude that the project, as proposed will provide limited negative effect, and compensate for those negative effects with project designed on-site mitigation.

Therefore, no offsite resource mitigation should be required under either federal or state wetland or waterbody jurisdictions.

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APPENDICES

APPENDIX A

SUMMARY TABLES
PRE-PROJECT PVF RESULTS

DISPOSAL SITE FUNCTION-VALUE ASSESSMENT FORM

Name of Site: In-Channel   Type of Site: Nearshore   Evaluation: Pre-Project

Body of Water: Boston Inner Harbor   Prepared by: NA (MJG)   Date: 4/28/95

Area of Disposal Site: 202 ac   Volume Capacity: 1.3 mcy   Bottom Type: Borrow Pit

Principal Valuable Functions	Occurrence Y	N	Comments
Benthic Habitat	X		Abundance low, taxa represent opportunistic and pioneer community.
Shellfish/Lobster Habitat	X		EOEA (1978) non specific contaminated water, lobster CPUE catch data 1.3 per trap day (sublegal males and females), and 0.1 per trap day (sublegal female).
Finfish Habitat	X		Trawl survey (1994) indicates typical demersal and pelagic finfish species (Boston Harbor) could move in and out from the site, adjacent to an anadromous fish run.
Production Export		X	No evidence of rooted or attached aquatic vegetation, and a predominately subtidal site.
Sediment/Shoreline Stabilization	X		Areal bulkheads and wharves should stabilize shoreline.
Wildlife Habitat	X		Feeding for waterfowl, dabbling and diving birds, some roosting sites.
Endangered Species Habitat		X	No identified or recorded federally and state-listed species.

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DISPOSAL SITE FUNCTION-VALUE ASSESSMENT FORM

Name of Site: Mystic Piers 49-50 **Type of Site:** Nearshore **Evaluation:** Pre-Project

Body of Water: Boston Inner Harbor **Prepared by:** NA (MJG) **Date:** 4/27/95

Area of Disposal Site: 3.0± ac **Volume Capacity:** 135,000 cy **Bottom Type:** Level

Principal Valuable Functions	Occurrence Y	N	Comments
Benthic Habitat	X		Abundance low, taxa represent opportunistic and pioneer community.
Shellfish/Lobster Habitat	X		EOEA (1978) non specific contaminated waters, lobster CPUE catch data 0.8 per trap day (sublegal males), and 0.1 per trap day (sublegal female).
Finfish Habitat	X		Areal trawl survey indicates typical demersal and pelagic finfish species (Boston Harbor) could move in and out from the site, adjacent to an anadromous fish run.
Production Export		X	No evidence of significant rooted or attached aquatic vegetation, and a predominantly subtidal site.
Sediment/Shoreline Stabilization	X		Bulkheads and wharves present, perpendicular orientation to currents.
Wildlife Habitat	X		Feeding for waterfowl, dabbling and diving birds, some roosting sites.
Endangered Species Habitat		X	No identified or recorded federally or state-listed species.

DISPOSAL SITE FUNCTION-VALUE ASSESSMENT FORM

Name of Site: Revere Sugar **Type of Site:** Nearshore **Evaluation:** Pre-Project

Body of Water: Lower Mystic River **Prepared by:** NA (MJG) **Date:** 4/27/95

Area of Disposal Site: 3.7 ac **Volume Capacity:** 136,000 cy **Bottom Type:** Level

Principal Valuable Functions	Occurrence Y	N	Comments
Benthic Habitat	X		Abundance low, taxa represent opportunistic and pioneer community.
Shellfish/Lobster Habitat	X		EOEA (1978) non specific contaminated waters, lobster CPUE catch data 0.2 per trap day (sublegal males), and 0.1 per trap day (sublegal female).
Finfish Habitat	X		Areal trawl survey indicates typical demersal and pelagic finfish species (Boston Harbor) could move in and out from the site, adjacent to an anadromous fish run.
Production Export		X	No evidence of significant rooted or attached aquatic vegetation, and a predominantly subtidal site.
Sediment/Shoreline Stabilization	X		Bulkheads and wharves present, perpendicular orientation to currents.
Wildlife Habitat	X		Feeding for waterfowl, dabbling and diving birds, some roosting sites.
Endangered Species Habitat		X	No identified or recorded federally or state-listed species.

DISPOSAL SITE FUNCTION-VALUE ASSESSMENT FORM

Name of Site: Little Mystic Channel **Type of Site:** Nearshore **Evaluation:** Pre-Project

Body of Water: Lower Mystic River **Prepared by:** NA (MJG) **Date:** 4/27/95

Area of Disposal Site: 15 ac **Volume Capacity:** 303,000 cy **Bottom Type:** Level

Principal Valuable Functions	Occurrence Y	N	Comments
Benthic Habitat	X		Abundance low, taxa represent opportunistic and pioneer community.
Shellfish/Lobster Habitat	X		EOEA (1978) non specific contaminated waters, lobster CPUE catch data 0.5 per trap day (sublegal males 0.4, and females 0.1), and 0.6 per trap day (legal males).
Finfish Habitat	X		Gill net survey indicates low numbers of typical demersal and pelagic finfish species (Boston Harbor) at the site, adjacent to an anadromous fish run.
Production Export		X	*Fucus sp.* may provide some minimal level of production export, although site is subtidal.
Sediment/Shoreline Stabilization	X		Bulkheads and rip-rapped shoreline present, perpendicular orientation to currents.
Wildlife Habitat	X		Feeding for waterfowl, dabbling and diving birds.
Endangered Species Habitat		X	No identified or recorded federally or state-listed species.

DISPOSAL SITE FUNCTION-VALUE ASSESSMENT FORM

Name of Site: Reserved Channel Area B **Type of Site:** Nearshore **Evaluation:** Pre-Project

Body of Water: Main Ship Channel **Prepared by:** NA (MJG) **Date:** 4/27/95

Area of Disposal Site: 7.7 ac **Volume Capacity:** 185,000 cy **Bottom Type:** Level

Principal Valuable Functions	Occurrence Y	Occurrence N	Comments
Benthic Habitat	X		Abundance low, taxa indicate a stressed environment.
Shellfish/Lobster Habitat	X		EOEA (1978) non specific contaminated waters, lobster CPUE catch data 1.2 per trap day (sublegal), and 0.2 per trap day (legal).
Finfish Habitat	X		Gill net survey (1994) indicates high numbers of typical demersal and pelagic finfish species (Boston Harbor) at the site, adjacent to an anadromous fish run.
Production Export		X	*Fucus sp.* may provide some minimal level of production export, although site is subtidal.
Sediment/Shoreline Stabilization	X		Bulkheads and rip-rapped shoreline present, perpendicular orientation to currents.
Wildlife Habitat	X		Feeding for waterfowl, dabbling and diving birds.
Endangered Species Habitat		X	No identified or recorded federally or state-listed species.

DISPOSAL SITE FUNCTION-VALUE ASSESSMENT FORM

Name of Site: Reserved Channel Area B | Type of Site: Nearshore | Evaluation: Pre-Project

Body of Water: Main Ship Channel | Prepared by: NA (MJG) | Date: 4/27/95

Area of Disposal Site: 7.7 ac | Volume Capacity: 185,000 cy | Bottom Type: Level

Principal Valuable Functions	Occurrence Y	Occurrence N	Comments
Benthic Habitat	X		Abundance low, taxa indicate a stressed environment.
Shellfish/Lobster Habitat	X		EOEA (1978) non specific contaminated waters, lobster CPUE catch data 1.2 per trap day (sublegal), and 0.2 per trap day (legal).
Finfish Habitat	X		Gill net survey (1994) indicates high numbers of typical demersal and pelagic finfish species (Boston Harbor) at the site, adjacent to an anadromous fish run.
Production Export		X	*Fucus sp.* may provide some minimal level of production export, although site is subtidal.
Sediment/Shoreline Stabilization	X		Bulkheads and rip-rapped shoreline present, perpendicular orientation to currents.
Wildlife Habitat	X		Feeding for waterfowl, dabbling and diving birds.
Endangered Species Habitat		X	No identified or recorded federally or state-listed species.

DISPOSAL SITE FUNCTION-VALUE ASSESSMENT FORM

Name of Site: Spectacle Island CAD **Type of Site:** Nearshore **Evaluation:** Pre-Project

Body of Water: Sculpin Ledge Channel **Prepared by:** NA (MJG) **Date:** 4/27/95

Area of Disposal Site: up to 50 ac **Volume Capacity:** 1.45 mcy **Bottom Type:** Borrow Pit

Principal Valuable Function	Occurrence		Comments
	Y	N	
Benthic Habitat	X		Existing benthic community indicates a relatively clean sandy environment, and a well developed community.
Shellfish/Lobster Habitat	X		EOEA (1978) maps soft-shell clam resource and non specific contaminated waters, lobster catch data was low (0.2 per trap day, all sublegal).
Finfish Habitat	X		The 1994 trawl survey collected a low abundance of typical demersal and pelagic fish.
Production Export		X	No evidence of rooted or attached aquatic vegetation, and a subtidal site.
Sediment/Shoreline Stabilization		X	Open water sites are non-functional.
Wildlife Habitat	X		Several species of waterfowl and water birds have been observed in the area.
Endangered Species Habitat		X	No identified or recorded federally or state-listed species. Common terns nest within 0.6 mi. of site.

DISPOSAL SITE FUNCTION-VALUE ASSESSMENT FORM

Name of Site: Meisburger Sites 2 and 7 **Type of Site:** Open Water **Evaluation:** Pre-Project

Body of Water: Massachusetts Bay **Prepared by:** NA (MJG) **Date:** 4/27/95

Area of Disposal Site: M2 86 ac/M7 121 ac **Volume Capacity:** 4.6 mcy/6.1 mcy **Bottom Type:** Borrow Pit

Principal Valuable Functions	Occurrence Y	N	Comments
Benthic Habitat	X		Existing benthic community indicates a relatively clean sandy environment, and a well developed community.
Shellfish/Lobster Habitat	X		Offshore areas not typically considered as regulated shellfish resource, lobster catch data was the highest at M2 (6.4 per trap day), and second highest at M7 (5.5 per trap day).
Finfish Habitat	X		The 1994 trawl and gill net surveys collected a moderate abundance of typical demersal and pelagic fish (Boston Harbor, Massachusetts Bay, and Gulf of Maine).
Production Export		X	No evidence of rooted or attached aquatic vegetation, and a subtidal site.
Sediment/Shoreline Stabilization	X		Open water sites are non-functional.
Wildlife Habitat	X		Several species of waterfowl and water birds have been observed in the area.
Endangered Species Habitat		X	Several federally and state-listed marine mammals and reptiles could transit the sites.

DISPOSAL SITE FUNCTION-VALUE ASSESSMENT FORM

Name of Site: Subaq B — Type of Site: Open Water — Evaluation: Pre-Project

Body of Water: Boston Harbor — Prepared by: NA (MJG) — Date: 4/27/95

Area of Disposal Site: 83 ac — Volume Capacity: 609,000 cy — Bottom Type: Borrow Pit

Principal Valuable Functions	Occurrence Y	N	Comments
Benthic Habitat	X		Abundance and community structure indicates a healthy benthic community approaching equilibrium.
Shellfish/Lobster Habitat	X		EOEA (1978) non specific contaminated water, soft-shell and razor clams have been evident, areal lobster trap data (1994) as CPUE was low (0.2 per trap day), finfish trawl (1994) collected 6.7 lobsters.
Finfish Habitat	X		Areal finfish trawl data (1994) indicated a low abundance of typical demersal species (21.3 fish collected per 20 minute tow).
Production Export		X	No evidence of rooted or attached aquatic vegetation, and a subtidal site.
Sediment/Shoreline Stabilization	X		Open water sites are non-functional.
Wildlife Habitat	X		Several species of waterfowl and water birds have been observed in the area.
Endangered Species Habitat		X	No identified or recorded federally and state-listed species.

DISPOSAL SITE FUNCTION-VALUE ASSESSMENT FORM

Name of Site: Subaq E
Type of Site: Open Water
Evaluation: Pre-Project

Body of Water: Boston Outer Harbor
Prepared by: NA (MJG)
Date: 4/27/95

Area of Disposal Site: 79 ac
Volume Capacity: 614,000 cy
Bottom Type: Borrow Pit

Principal Valuable Functions	Occurrence Y	N	Comments
Benthic Habitat	X		Abundance and community structure indicates a healthy benthic community approaching equilibrium.
Shellfish/Lobster Habitat	X		EOEA (1978) non specific contaminated water, blue mussels are evident, areal lobster trap data (1994) as CPUE was low (0.2 per trap day), finfish trawl (1994) collected 3.7 lobsters.
Finfish Habitat	X		Areal finfish trawl data (1994) indicated a low abundance of typical demersal species (82.7 fish collected per 20 minute tow).
Production Export		X	No evidence of rooted or attached aquatic vegetation, and a subtidal site.
Sediment/Shoreline Stabilization	X		Open water sites are non-functional.
Wildlife Habitat	X		Several species of waterfowl and water birds have been observed in the area.
Endangered Species Habitat		X	No identified or recorded federally and state-listed species.

APPENDIX B

SUMMARY TABLES
PROJECT EFFECTS PVF RESULTS

DISPOSAL SITE FUNCTION-VALUE ASSESSMENT FORM

Name of Site: In-Channel | Type of Site: Nearshore | Evaluation: Project Effects

Body of Water: Boston Inner Harbor | Prepared by: NA (MJG) | Date: 5/1/95

Area of Disposal Site: 202+ ac | Volume Capacity: 1.3 mcy | Bottom Type: Borrow

Principal Valuable Functions	Occurrence Y	Occurrence N	Comments
Benthic Habitat	X		Of the 202 acres of existing contaminated soft sediments, 152 acres will be converted to clean soft sediment (capping material) and 50 acres will be converted to clean hard substrate (rock), at proposed elevations of -40 to -42 MLW.
Shellfish/Lobster Habitat	X		Proposed 152 acres of clean soft substrate could enhance quality of shellfish habitat, rock substrate should enhance shellfish diversity and lobster feeding, resting, refuge, and breeding habitat.
Finfish Habitat	X		Construction activities will temporarily disturb finfish usage. Proposed 50 acres of rock substrate will displace a portion of soft bottom finfish habitat (e.g. winter flounder), however, will function as a fouling site and could enhance overall finfish habitat.
Production Export		X	No effects are anticipated.
Sediment/Shoreline Stabilization	X		Fifty acres of rock capping will stabilize a portion of the channel bottom.
Wildlife Habitat	X		Construction activities will temporarily disturb wildlife usage. No long-termed effects are anticipated.
Endangered Species Habitat		X	No effects are anticipated.

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DISPOSAL SITE FUNCTION-VALUE ASSESSMENT FORM

Name of Site: Little Mystic Channel **Type of Site:** Nearshore **Evaluation:** Project Effects

Body of Water: Lower Mystic River **Prepared by:** NA (MJG) **Date:** 5/1/95

Area of Disposal Site: 15 ac **Volume Capacity:** 303,000 cy **Bottom Type:** Level

Principal Valuable Functions	Occurrence Y	N	Comments
Benthic Habitat	X		An opportunistic and pioneer subtidal benthic community of low abundance will be converted to a clean substrate, intertidal habitat.
Shellfish/Lobster Habitat	X		An opportunistic and pioneer subtidal benthic community of low abundance will be converted to a clean substrate, intertidal habitat. Lobster habitat (non-fished) will be permanently displaced.
Finfish Habitat	X		A subtidal aquatic condition will be converted to an intertidal aquatic condition.
Production Export	X		Intertidal conditions should attract rooted and attached aquatic vegetation.
Sediment/Shoreline Stabilization	X		No effects are anticipated, possibly limited enhancement.
Wildlife Habitat	X		Wildlife usage could become more variable with the additional usage of wading and shorebirds, in addition to limited waterfowl and waterbird issues.
Endangered Species Habitat		X	No effects are anticipated.

APPENDIX C

SUMMARY TABLES
ON-SITE MITIGATION PVF RESULTS

DISPOSAL SITE FUNCTION-VALUE ASSESSMENT FORM

Name of Site: In-Channel **Type of Site:** Nearshore **Evaluation:** Mitigation (on-site)

Body of Water: Boston Inner Harbor **Prepared by:** NA (MJG) **Date:** 5/2/95

Area of Disposal Site: 202+ ac **Volume Capacity:** 1.3 mcy **Bottom Type:** Borrow

Principal Valuable Functions	Occurrence Y	N	Comments
Benthic Habitat	X		Project will provide 152 acres of clean, soft benthic substrate and 50 acres of clean hard substrate. Hard substrate will create more diverse benthic habitat conditions (burrowing and epibenthic communities).
Shellfish/Lobster Habitat	X		Clean, soft sediments should enhance existing shellfish habitat; clean, hard substrate should foul with blue mussels and enhance lobster habitat.
Finfish Habitat	X		Clean, soft substrate should enhance demersal finfish habitat and the hard substrate cap will serve as a fouling site for an epibenthic community and should enhance finfish habitat.
Production Export	X		Hard substrate will provide surface area for the attachment of deep water aquatic vegetation (e.g. red and brown alga).
Sediment/Shoreline Stabilization	X		Rock cap will further stabilize channel conditions.
Wildlife Habitat	X		No enhancement of wildlife habitat is anticipated.
Endangered Species Habitat		X	No enhancement of endangered species habitat is anticipated.

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DISPOSAL SITE FUNCTION-VALUE ASSESSMENT FORM

Name of Site: Little Mystic Channel **Type of Site:** Nearshore **Evaluation:** Mitigation (on-site)

Body of Water: Lower Mystic River **Prepared by:** NA (MJG) **Date:** 5/2/95

Area of Disposal Site: 15± ac **Volume Capacity:** 303,000 cy **Bottom Type:** Level

Principal Valuable Functions	Occurrence Y	N	Comments
Benthic Habitat	X		Intertidal conditions should provide an opportunity for a more diverse and abundant benthic community structure.
Shellfish/Lobster Habitat	X		Intertidal conditions should enhance soft-shell clam and ribbed mussel habitat, transient lobster resource will not be re-established.
Finfish Habitat	X		Changes in finfish resources should include elimination of subtidal transient habitat, and development of a resident estuarine forage fish environment.
Production Export	X		Intertidal conditions should be suitable for the establishment and/or increase in rooted and attached vegetation.
Sediment/Shoreline Stabilization	X		Intertidal conditions should further buffet any wave or current energies.
Wildlife Habitat	X		Wildlife usage could become more variable with the additional usage of wading and shorebirds, in addition to limited waterfowl and waterbird issues.
Endangered Species Habitat		X	No enhancement of endangered species habitat is expected.