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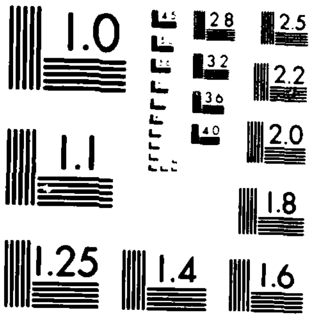

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SMALL NAVIGATION PROJECT

ISLAND END RIVER
CHELSEA, MASSACHUSETTS

DETAILED PROJECT REPORT
AND
ENVIRONMENTAL ASSESSMENT

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

JUNE 1980

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This study investigated navigation needs in Island End River, Chelsea, Mass., and to determine the advisability of providing navigation improvements for recreational boating. Results of analysis indicate the most feasible plan consists of a channel, 6 feet deep and 100 feet wide, from deep water in Mystic River Channel to a point off the proposed marina site for a total distance of 2500 feet. Plan is economically justified, a benefit-cost ratio of 5.8.

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SYLLABUS

This study investigated navigation needs in Island End River, Chelsea, Massachusetts, to determine the advisability of providing navigation improvements for recreational boating.

The paramount need is the provision of reliable and safe access to the upstream portions of the river. An adequate access channel will allow the city of Chelsea to develop marina facilities to help accommodate the continuing and growing demand for recreational boating facilities in the Greater Boston area.

Several alternatives were analyzed in an attempt to find the optimal improvement plan to meet the expected needs of recreational boaters. The results of this analysis indicate the most feasible plan of improvement at this time consists of a channel, 6 feet deep and 100 feet wide, from deep water in the Mystic River Channel to a point off the proposed marina site for a total distance of 2,500 feet.

Based on prospective waterway use, the selected plan is economically justified. Total cost would be $629,000 to be shared equally by the city of Chelsea and the federal government. Annual charges of $68,000 when compared to annual project benefits of $397,800 yield a benefit-cost ratio of 5.8.

It is expected that maintenance of the channel will be required every five years. Maintenance of the channel will be a federal responsibility, contiguous upon the availability of maintenance funds, the continuing justification of the project, and the environmental acceptability of subsequent maintenance dredging.

The Division Engineer recommends that, subject to certain conditions of non-federal cooperation, the foregoing plan of improvement to Island End River, Chelsea, Massachusetts, be adopted. The presently estimated first cost to the United States is $314,500. Non-federal interests will be required to pay $314,500 as well as provide suitable marine-related facilities to be utilized by prospective recreational boaters.

REVISED FEBRUARY 1981

ACKNOWLEDGEMENT AND IDENTIFICATION OF PERSONNEL

This report was prepared under the supervision and management of the following New England Division personnel:

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The study and report was developed by Steven Andon, Project Manager in the Small Navigation Projects Section. John Barry, Economist, Impact Analysis Branch, prepared the economics material; and Marita Yoder, Environmental Resource Specialist, prepared the Environmental Assessment.

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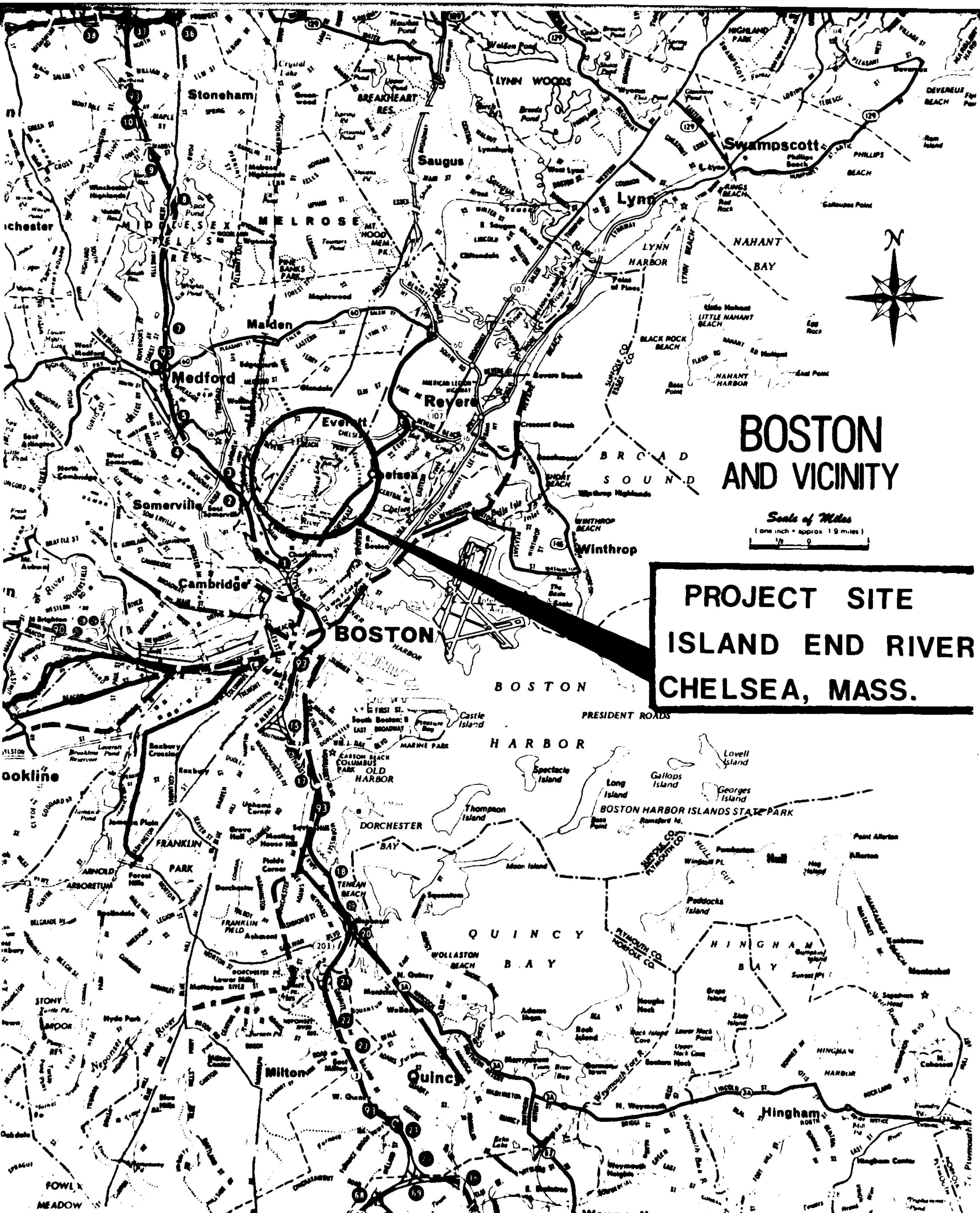

BOSTON
AND VICINITY
Scale of Miles
(one inch = approx. 1.9 miles)
PROJECT SITE
ISLAND END RIVER
CHELSEA, MASS.
N
Stoneham
Saugus
LYNN WOODS
BREAKHEART RES.
Swampscott
Lynn
NAHANT BAY
LYNN HARBOR
MELROSE
MIDDLESEX FELLS
Malden
Medford
Everett
Revere
Chelsea
Somerville
Cambridge
BOSTON
Winthrop
BROAD SOUND
BOSTON HARBOR
PRESIDENT ROADS
Castle Island
Spectacle Island
Long Island
Gallops Island
Lovell Island
Georges Island
Thompson Island
BOSTON HARBOR ISLANDS STATE PARK
DORCHESTER BAY
OLD HARBOR
QUINCY BAY
HINGHAM BAY
Hull
Brookline
FRANKLIN PARK
ARNOLD ARBORETUM
Milton
Quincy
Weymouth
Hingham
BLUE HILLS RESERVATION
FOWL MEADOW

ISLAND END RIVER
CHELSEA, MASSACHUSETTS

DETAILED PROJECT REPORT

Table of Contents

Table of Contents (Cont.)

List of Plates

List of Tables

List of Appendices

WATER RESOURCES IMPROVEMENT PROJECT

ISLAND END RIVER

CHELSEA, MASSACHUSETTS

DETAILED PROJECT REPORT

INTRODUCTION

This report is a detailed engineering and economic feasibility study of channel improvements for small recreational craft at the Island End River, Chelsea, Massachusetts. The Island End River is a tidal estuary approximately 3500 feet in length and averaging 500 feet in width. It forms a portion of the boundary between the cities of Everett and Chelsea. As indicated in Figure 1, the Project Area is located two miles north of downtown Boston. The proposed channel improvements would extend from the river's mouth to a proposed marina which is to be located approximately 1,500 feet upstream on the former Chelsea Naval Hospital site.

The Chelsea Naval Hospital served as a U.S. Navy installation since the early 1800's. In 1974, the property was declared surplus and was turned over the the General Services Administration for disposition. Since then, a redevelopment master plan has been prepared for the site and the City of Chelsea has taken steps to acquire portions of the property. The development of a marina and related facilities are key aspects of the redevelopment master plan.

If these plans are to be fully realized, improvements to the navigation channel in the Island End River are necessary. Previous studies by the New England Division of the U.S. Army Corps of Engineers set forth the preliminary findings and established the need for a more detailed study of channel improvements options. This report summarizes the detailed analyses of the feasible channel improvement alternatives.

In a letter dated December 11, 1978, the City of Chelsea concurred with the findings of the Reconnaissance Report and recommended that the Detailed Project Report be undertaken. The City of Everett concurred with this recommendation in a letter dated December 15, 1978.

During the course of this study, eight preliminary alternative plans setting forth various channel alignments and marina concepts were developed and evaluated. Four plans were selected for more detailed study. Plan B, which provides the maximum net benefits, has been designated the recommended plan of improvement. It involves construction of a 100-foot wide, six-foot deep navigation channel in the Island End River. This channel would extend 2500 feet upstream from the Mystic River.

STUDY AUTHORITY

This study was initiated by the New England Division of the U.S. Army Corps of Engineers at the request of the officials of the city of Chelsea. It was prepared under the provisions of Section 107 of the 1960 Rivers and Harbors Act, P.L. 86-645, as amended.

SCOPE OF THE STUDY

The scope of this study includes performance of a Comprehensive Water Resources Improvement Study and preparation of a Detailed Project Report consisting of:

1. Determining the navigational needs of the study area.
2. Developing alternative channel improvement plans.
3. Evaluating the economic, social and environmental impacts of the alternative plans.
4. Recommending channel improvements that are economically feasible, socially beneficial and environmentally acceptable.

Although this study is primarily oriented towards small craft, the needs of commercial shipping in the existing deep water channel were also considered.

The scope of study has generally limited itself to navigational parameters only, as other water and related land resources problems, needs, and opportunities are being addressed by a multi-agency planning and development effort. Appendix 1 contains a series of excerpts from the Development Master Plan and Feasibility Plan and Appendix 3, pages 3-45 and 3-46 outline the various facets to the Chelsea Naval Hospital Project.

STUDY PARTICIPANTS AND COORDINATION

Coordination with federal, state, and local government agencies formed an integral component of the study process.

At the federal level, coordination involved the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, the U.S. Coast Guard and the National Marine Fisheries Service.

At the state government level, major participants included the Office of Coastal Zone Management, the Division of Marine Fisheries, the Department of Environmental Quality Engineering and the Metropolitan District Commission.

The city of Chelsea was consulted throughout the course of the study. Those involved included the Mayor's office, the city engineer, the community development director and the city's consultant for the Chelsea Naval Hospital Redevelopment Project.

Appendix 3 contains a complete list of the government agencies consulted during the course of the study and a summary of their views and comments on the improvement plans.

STUDIES OF OTHERS

The impetus for the current project resulted from the decommissioning of the Chelsea Naval Hospital in 1974. When the property was declared surplus, several studies were undertaken to evaluate its conversion to civilian use.

A 1974 study entitled, A Recommended Plan for the Reuse of the Naval Hospital - Chelsea, Massachusetts, proposed construction of a marina on the Island End River.

Development of a marina and dredging of a navigable channel were evaluated further in the Development Master Plan and Feasibility Analysis - Chelsea Naval Hospital. In addition to housing and a waterfront park, it proposed that a portion of the Naval Hospital property be used for industrial and commercial development. A marina serving 250 boats and a site for related marine enterprises were the primary focus of the industrial/ commercial redevelopment area

The 1978 Reconnaissance Report by the Corps of Engineers was the first study to focus upon the proposed channel improvements.

THE REPORT

The initial steps in the study process included a comprehensive inventory of available information, performance of topographic and hydrographic surveys, and preparation of base plans. As indicated under Public Views, extensive efforts were expended to contact public officials and interested parties to provide information and to seek public input into the study process. Based upon available information, baseline conditions were determined to formulate planning objectives and constraints. Preliminary improvement plans were developed and evaluated. These were presented to local public officials and interested groups at a meeting on August 9, 1979. Based on comments received, four alternative plans were selected for more detailed study.

This Detailed Project Report consists of a Main Report and supporting appendices. The body of the Main Report is structured in accordance with the planning process followed during the course of the study. It is organized as follows: Problem Identification, Formulation of Preliminary Plans, Assessment and Evaluation of Detailed Plans, Comparison of Detailed Plans, and an Environmental Assessment.

The report has seven appendices: Appendix 1, Problem Identification, supplements the material in the first two sections of this report. Appendix 2 addresses the formulation, assessment and evaluation of alternative plans. Appendix 3 summarizes public views and responses. Appendix 4 contains supporting engineering data and analyses. Appendix 5 reviews natural, and cultural resources. Appendix 6 contains background information on benefit-cost studies. Appendix 7 evaluates the feasibility alternative plans for disposal of dredged material.

PROBLEM IDENTIFICATION

This portion of the report sets forth the nature and scope of the problems necessitating channel improvements, and establishes the planning objectives and constraints which give direction to subsequent planning tasks.

NATIONAL OBJECTIVES

Planning for channel improvements in the Island End River is based on the national objectives of National Economic Development (NED) and enhancement of Environmental Quality (EQ) as set forth in 1973 by the National Water Resources Council in Principles and Standards for Planning Water and Related Land Resources. The purpose of the Principles and Standards is to promote the quality of life by planning for the attainment of the following national objectives:

NED Objectives -

To enhance national economic development by increasing the value of the nation's output of goods and services and by improving national economic efficiency.

EQ Objectives -

To enhance the quality of the environment by the management, conservation, preservation, creation, restoration or improvement of certain natural resources, cultural resources and ecological systems.

EXISTING CONDITIONS

The Island End River is located approximately two miles north of downtown Boston in the heart of the Boston Metropolitan area. The river forms a portion of the boundary between the Cities of Chelsea and Everett, and coincidentally Middlesex and Suffolk counties. The Island End River flows into the Mystic River about one-half mile upstream of the confluence of the Mystic and Chelsea Rivers, in Boston's Inner Harbor.

Everett and Chelsea are small cities typical of older urban areas surrounding the City of Boston. While the population of the Boston Metropolitan area has increased in recent years, the populations of Everett and Chelsea have declined.

Median educational levels are lower in Chelsea and Everett than the average for the metropolitan area.

While the majority of workers in Chelsea and Everett are classified as white collar, the percentage of white collar workers is lower than the regional average. The percent of workers in the blue collar occupations, such as craftsmen, operatives and laborers, is forty-one percent in Chelsea, as compared to twenty-eight percent for the Boston Metropolitan area.

The major industries in Chelsea and Everett are diverse and include the manufacturing of metals, electrical machinery, stone, clay glass, paper, rubber and plastics, as well as the wholesaling and distribution of fruit and vegetable produce. These cities also serve as major storage and distribution centers for various petroleum products and natural gas.

In both Everett and Chelsea, land use is characterized by residential areas in the central and northern parts of these cities with industrial development to the south and along the waterfronts.

With the exception of the Chelsea Naval Hospital grounds, most of the waterfront along the Chelsea, Mystic, Island End, and Malden Rivers is devoted to industrial uses. Thus, the waterfront is generally inaccessible for recreational purposes. Land use along the shoreline of the Island End River is characterized by the intensively developed industrial area on the Everett side and by the relatively underdeveloped grounds of the former Naval Hospital on the Chelsea side. This underdeveloped land provides an opportunity for a much needed waterfront recreation area.

On the western shoreline at the mouth of the Island End River, an Exxon Corporation terminal fronts on both the Mystic River and Island End River. Berths for oil tankers are located along the Mystic River while berths for smaller barges extend about 350 feet north along the Island End River waterfront. Petroleum products including gasoline, fuel oil, and asphalt are transferred by pipeline to and from bulk storage facilities nearby.

The Exxon Corporation presently berths one hundred fifty vessels per year on the Island End River. The largest of these vessels is a barge with a capacity of 100,000 barrels and a draft of twenty-two feet. Exxon Corporation officials anticipate that barges having capacities of up to 150,000 barrels with drafts of thirty feet could be used in the future.

North of the Exxon Corporation terminal are the Marquette Cement Company and the Coldwater Seafood Corporation. These companies maintain berthing facilities on the Island End River that are used on a regular basis by barges and freighters.

The Marquette Cement Corporation presently uses a barge approximately three hundred feet in length with a twenty-two foot draft. Marquette receives two or three shipments per month.

Coldwater Seafood Corporation has an average of one refrigerated freighter docking per week. The largest ship is about 370 feet in length with a draft of twenty-two feet. Due to the narrowness of the existing channel, all of the ships using the Island End River are assisted by tugs.

North of the Coldwater Seafood Corporation abandoned wharves extend an additional 600 feet along the shoreline where land uses abutting the river consist of small industries that are not served by shipping. At the northern end of the river on the Everett shoreline, the river borders a parking lot behind a produce warehouse. A rail spur is situated on an easement along the wharves near the shore.

North of the river, land uses consist primarily of industrial buildings and warehouses. A bank and a large Polaroid manufacturing plant are located immediately adjacent to the northern end of the river.

The easterly shore of the Island End River borders the Chelsea Naval Hospital site. This site, which is under the jurisdiction of the General Services Administration, contains sixty-eight vacant structures, including the main hospital building, living quarters and supporting facilities.

The Chelsea Naval Hospital property constitutes a significant cultural resource as signified by its nomination to the National Register of Historic Places.

The original main hospital building was completed in 1835 at the base of the hill facing the Mystic River. In 1836, land was turned over to the Bureau of Ordnance and two buildings were constructed as powder magazines on the western side of the property near the Island End River. Behind these two buildings, a pier was constructed in the Island End River. It is believed that the U.S.S. Constitution was among the ships that were stocked from these magazines; hence, they have come to be called the Constitution Magazine.

At one time the Island End River drained an extensive salt marsh which occupied presently developed areas of Everett and Chelsea. The river formerly followed a course which curved to the west from its present terminus and then in a semicircle back to the east to a location on the Naval Hospital site. Over the years, the marsh was filled to provide land for urban development, reducing the river to its present size. Most of the reclaimed land to the northwest of the river is relatively flat and lies at an elevation of fifteen to twenty feet above MLW.

To the east of the Island End River, the Naval Hospital site, occupies a glacial drumlin rising about one hundred twenty feet above MLW.

Subsurface conditions in the Island End River are variable east to west. Glacial till is found closer to the surface on the easterly side of the river.

The climate of the project site is affected by its proximity to the Atlantic Ocean. Average temperatures range from a low of twenty-eight degrees Fahrenheit in January to a high of seventy-one degrees Fahrenheit in July. The prevailing wind direction is northwest in winter months and southwest in summer months. Occasionally, hurricanes and other severe storms affect the site.

Mean tidal range in the Island End River is 9.5 feet with a spring range of approximately 11.0 feet. Storm water levels of up to three feet above mean high water (MHW) are likely to occur during storms.

Low tides of 2.0 feet below MLW occur regularly with the average yearly lowest tide of 3.0 feet below MLW.

Currents in the Island End River and the Mystic River are relatively gentle, attaining a maximum velocity of about 1.5 knots.

Due to short fetch length, wind driven wave heights are generally limited to less than two feet on the Mystic River and substantially less on the more sheltered Island End River. The most common wave action results from the wakes of passing vessels.

The Island End River is a tidal estuary approximately 3,000 feet long and about 400-500 feet wide at MHW, but narrowing to about 100 feet at the northern end of the river where two large corrugated steel arch culverts outfall.

A twenty-four foot deep (at MLW) channel varying from 100-250 feet in width extends from the Mystic River along the Everett shoreline for a distance of 1400 feet. It accommodates the barges and freighters serving the industries on the Everett shoreline.

To the east and north of the channel, the river bottom forms an exposed mud flat at low tide. To the north, the mud flat averages 400 feet in width and is divided by a meandering stream about twenty to thirty feet in width and two feet deep at MLW. To the east of the channel, the bottom rises gently for about two hundred feet across the river to a steep bank on the Chelsea shoreline.

South of the Coldwater Seafood facility, the shoreline of the river generally consists of wharves and bulkheads adjacent to the industrial enterprises. North of Coldwater Seafood the shoreline consists of deteriorated cargo wharves, timber retaining walls and banks of fill composed of rocks and rubble such as broken concrete and bricks.

The largely underdeveloped eastern shoreline borders the Naval Hospital site. It generally consists of a steep bank extending from a mud flat up to a level grassy area at an elevation of fifteen to twenty feet above MLW. This bank is retained by a seawall along the first several hundred feet of the shoreline near the river mouth. North of the seawall the unprotected steep bank extends for a distance of 500 feet. It is eroding and localized areas are being undercut between the high waterline and the top of the bank.

Upstream from the steep bank there is a one-hundred foot wide salt marsh at an elevation just above high water level.

Because the Island End River is polluted, the species found there tend to be pollution tolerant. Near its mouth at the Mystic River, where tidal flows provide a cleansing effect, a greater diversity of species is found.

Clamworms, which are pollution tolerant, were found in the intertidal zone throughout the river; however, they were found in higher concentrations in the upper part of the river. In the intertidal zone toward the mouth of the river, less pollution tolerant organisms such as softshell clams, blue mussels and barnacles were found. These conditions, both in the river and the adjacent shoreline, will be subject to change however, for the proposed navigation improvements to the Island End River is only one aspect of a comprehensive plan for redevelopment of the Chelsea Naval Hospital property.

The Master Plan for redevelopment of the hospital property estimates that $13 million of public funds will be committed along with $67 million of private investment. The City of Chelsea has applied to the Economic Development Administration of the U.S. Department of Commerce and to the U.S. Department of Housing and Urban Development for major funding grants. Using the funding provided by EDA and HUD grants, the City plans to acquire land, demolish buildings and improve roadways and utilities.

Construction of a twenty-six acre park along shores of the Mystic and Island End Rivers will be undertaken by the Metropolitan District Commission.

At the proposed marina site, the City plans to dredge the marina basin, make some repairs to buildings and provide the required bulkheads, rip-rap, piers, and floats. Private developers will be responsible for site grading, landscaping and restoration of the Constitution Magazine buildings. These buildings will be renovated for use by marina-related enterprises in accordance with historic architectural guidelines. The City will transfer the marina to the developer on a long-term lease providing that berthing space be made available on an equitable basis.

A boat launching ramp and marine service facility will be available to the general public.

CONDITIONS IF NO FEDERAL ACTION TAKEN

Without the proposed project, development of a small boat marina on the Naval Hospital grounds is not likely. The cost of dredging a marina basin and an access channel without federal assistance would probably be economically prohibitive to the city of Chelsea.

Plans for redevelopment of the Chelsea Naval Hospital would be adversely affected if improvements to the Island End River are not implemented. These plans call for a substantial townhouse development oriented toward the marina. Without the improvements to the Island End River and the construction of the marina with its related facilities, the marketability of the housing would be adversely affected. The Constitution Magazine building would probably not be restored since there would be limited incentive for private investment.

Development of the Metropolitan District Commission park will occur as planned if the federal improvements to the river do not take place. However, the potentially synergistic effects arising from the proximity of public open space and recreational boating would not occur.

Without the proposed project, conditions in the Island End River can be expected to remain essentially as they are today. It is possible that the commercial channel on the Everett side may be widened or deepened. It is unlikely that it will be extended further north as the industries already established upstream of Coldwater Seafood Corporation have no need for water access.

Water quality in the river can be expected to improve gradually in the future as measures to clean up the Mystic River and Boston Harbor are implemented. Species such as clams and mussels might slowly re-establish themselves in upstream portions of the Island End River, although the river would remain closed for shellfishing for the foreseeable future.

Without the proposed channel improvements a limited amount of recreational boating might be expected in the future. The boats could be moored offshore and allowed to ground at low tides. Use of the boats would obviously be restricted by tidal fluctuation.

PROBLEMS,NEEDS AND OPPORTUNITIES

The problems, needs, and opportunities of the study area are in most ways related to the efforts by the city of Chelsea to redevelop the former Naval Hospital property.

The problem of limited recreational facilities and waterfront access is the major concern of local officials. The city of Chelsea has only twenty-five acres of recreational space. In addition to the shortage of open space and recreational facilities, Chelsea residents have virtually no public access to their waterfront despite being bordered on three sides by water.

In considering the Greater Boston area, a shortage of recreational boat slips has become prevalent due to the increased demand for boating and the limited supply of suitable marina facilities. There also exists a shortage of boat repair and storage facilities within the Boston Harbor area.

Although there are several marinas within the harbor, shore facilities are apparently not as readily available as in suburban locations where waterfront land is more available for recreational use.

A final problem may be defined as the limited tax base and employment opportunities within the community. The city is relatively poor and geographically small. The tax base is still suffering from the effects of a devastating fire in 1973 that destroyed forty-five acres of industrial and residential property.

The needs of the community as developed through the identification of its problems is basically two-fold. Increase the available waterfront access and assist in the development of a project which will allow for increased water-related recreational activities within the study area.

The opportunities to meet the needs cited above can best be attained through close coordination and interaction with the Chelsea redevelopment plan.

PLANNING CONSTRAINTS

Planning constraints are those parameters which can place limitations on any proposed plan of improvement. As limitations, they are used to direct plan formulation and restrict impacts cutting across a broad spectrum of concerns. These concerns may include natural conditions within the project site, technological states of the art, economic limits, and legal restrictions.

This study has identified through consultation with government agencies and local businesses, a number of concerns, but only two issues which may be identified as constraints.

As the Island End River is located in a heavily urbanized and industrialized area, the quality of its bottom material has been affected. Therefore, any proposed project must minimize the removal of any toxic materials to reduce the adverse effects on marine life and alteration of the intertidal zone. As a corollary, minimal removal of any materials will significantly lessen any expected impacts associated with disposal of the dredged materials.

Ocean disposal of dredged material is controlled by federal regulations. Because the sediment has passed minimum federal bioassay standards for toxity to marine organisms, ocean disposal will be permitted. However, adverse impacts on water quality and marine organisms will be associated with the discharge of any type of sediment into the ocean.

Disposal for landfill at the site of the proposed Massport Container Facility at the former Naval Base in South Boston appears to be economically and environmentally feasible if coordination of project schedules can be achieved and if the material from the Island End River proves to be similar in nature to the other materials slated for disposal there. Land disposal also appears feasible, but it is less environmentally desirable and more costly than the other alternatives. Under state regulations, land disposal of dredged material must take place on sites approved by the local board of health. It must be confined by dikes or bulkheads and provided with facilities to control effluents. Because of the presence of pollutants, the Massachusetts Department of Environmental Quality Engineering felt that land disposal of the dredged material could be a problem. In addition to its toxic properties, the sediment has poor structural properties. Therefore, the material would not be acceptable as structural fill material beneath buildings or structures. Due to the large volume of dredged materials, a disposal site must be found near the shoreline to avoid adverse impacts associated with its transport.

The second constraint identified is to restrict any construction activities to the fall months. Said restriction will avoid suspension of water pollutants during the spring alewife run in the Mystic River.

In summary, planning constraints as identified are:

- Minimize removal of toxic materials.

- Restrict construction activities to the fall months.

As stated earlier in this section, consultations with interested parties determined a number of concerns should be identified and addressed.

Present commercial shipping activities are expected to continue in the Island End River for the foreseeable future. Due to the restricted dimensions of the existing channel and the maneuverability of large vessels under tow, conflicts between existing shipping and future recreational boating may develop. This potential problem would be most noticeable if recreational craft were required to use the existing channel.

Due to the possibility of an accident involving the volatile chemicals at the Exxon Corporation, the proposed recreational channel should be located at a reasonable distance from the existing commercial channel at the Exxon facilities. Construction of a channel immediately adjacent to the Exxon terminal could result in sparks or open flames occurring from dredging operations (short term) or from the operation of recreational small craft (long term). The 1973 Uniform Fire Code of the International Conference of Building Officials and the Western Fire Chiefs Association requires that smoking and open flames be prohibited within 50 feet of fueling operations.

The Metropolitan District Commission has proposed development of a twenty-six acre park along the edges of the Mystic and Island End Rivers. Since locating the marina within the proposed park may disrupt current plans, the marina facility must be located upstream on the Island End River.

Along the opposite bank of the river is the Everett shoreline which is highly developed and protected by timber bulkheads or riprap. Any changes to the Everett shoreline would likely require acquisition of property and would probably meet opposition from Everett property owners.

Because the extent of intertidal zone habitat is limited in the inner harbor, the National Marine Fisheries Service and the Massachusetts Division of Marine Fisheries have expressed concern over the possible impacts any improvements may have on the existing zone.

PLANNING OBJECTIVES

Planning objectives for this study were established after carefully analyzing the identified concerns regarding the use of water and related land resources in this study area. The purpose of these planning objectives is to translate identified needs, opportunities, and problems into specific objectives for the study. Planning objectives, as set forth herein, will be used in conjunction with planning constraints in the development of alternate plans that properly address study objectives and area needs. The establishment of clearly defined planning objectives is also essential in evaluating the various plans that have been studied. The relative merit of each plan is determined, in great part, by the degree to which it addresses and fulfills each planning objective.

Based on the discussions of problems, needs, and opportunities previously presented, two planning objectives have been identified as important guidelines to formulation and evaluation of plans to meet the area needs and study objectives.

- Contribute to navigation for recreational purposes in the Island End River during the 1980-2030 period of analysis.

- Contribute to the safety of navigation for commercial and recreational vessels in the Island End River during the 1980-2030 period of analysis.

Consideration of these objectives and planning constraints led to the formulation of resource management alternatives that will be presented in the following section.

FORMULATION OF PRELIMINARY PLANS

Systematic consideration of the problems, needs, and opportunities led to the formulation of alternative preliminary plans. These plans, designed to achieve the planning objectives stated previously, were developed in light of the planning constraints. State and local objectives were also paramount considerations in the evaluation of alternative plans.

MANAGEMENT MEASURES

As the basis for formulating alternative plans, a broad range of management measures can be identified to address the planning objectives. Management measures can generally be categorized as either structural or non-structural.

Structural measures would generally involve variations on dredging the Island End River to provide access to the marina site. Non-structural measures would principally involve the determination of achieving planning objectives by other means at lower costs.

Due to the constraints, concerns, and objectives placed on the project, there are no feasible means to accomplish the project goals by implementation of non-structural solutions.

Location of the marina further downstream on the Island End River or on the Mystic River is precluded by the intended use of the shoreline as a park. The city of Chelsea would like the marina to be operated by private industry on a long-term lease to generate revenue for the City. The marina is also intended to stimulate other tax revenue producing private development on shore, such as restaurants or marine-related industries, which would take land intended for park purposes. It is against Metropolitan District Commission (MDC) policy to locate such private facilities within their parks. Therefore, location of a marina and related shore facilities within the limits of a publicly-owned MDC park is incompatible with its intended function and with the management policies of the MDC. Even if the problem of disruption of the MDC park could be alleviated, the suitability of the Mystic River shore as a site for a marina would be limited. The pier bulkhead line, being close to the shore on the Mystic River, would cause the size of any marina facilities to be extremely limited.

PLAN FORMULATION RATIONALE

The first step in the formulation of alternative plans was to make projections of the number, type and size of boats expected to use the Island End River. The projected fleet characteristics are needed to establish the size and layout of the marina, the need for turning basins, and the dimensions of the access channels.

The projected recreational fleet characteristics were based upon a detailed survey of four marinas considered to be representative of conditions at the Island End River. Additional observations were made at marinas in the Boston area. The observed fleet dimensional characteristics were categorized separately for sail and motor craft. The proportion of sailboats in the projected fleet was increased over those observed due to anticipated long-term changes in the availability and cost of petroleum-based fuels. Due to the demand for marina facilities in the Boston area, the size of the projected fleet was determined by the capacity of marina facilities which could be economically provided in the Island End River.

The majority of the projected fleet is expected to be small power boats of less than 30 feet. Only 2 percent of the craft are expected to be longer than 40 feet. Appendix 6 contains the results of the marina survey and the characteristics of the projected fleet.

In the Master Plan for the Naval Hospital, a 250 boat marina was laid out in concept only. The Master Plan showed the use of the Constitution Magazine buildings for marina-related commercial enterprises. The existing stone pier behind these buildings was incorporated into the dock facilities. The Reconnaissance Report contained no assumptions about berthing configurations.

During this study, it became necessary to develop marina concepts in more detail to locate the channel and to establish slip capacity.

Two alternative marina plans were developed and are illustrated in Appendix 2, Figures 2-1 and 2-2. Marina 1 is based on the concept shown in the Master Plan. A boat launching ramp is located at the far upstream end of the marina, while docks extend 550 feet downstream and 700 feet upstream from the upgraded existing pier. Marina 1 does not include a turning basin.

Marina 2, shown in Appendix 2, Figure 2-2, is based on locating the marina facilities further upstream on a two-acre nonrectangular turning basin.

This study has found that the channel dimensions of 100 feet wide and 6 feet deep,as set forth in the Reconnaissance Report, are warranted and will provide an adequate width and depth for the types of craft expected to use the river. The width of 100 feet was found to be warranted based on the presence of commercial shipping in the lower part of the river and the lack of a turning basin next to the marina. Analysis of alternative channel widths and depths is presented in Appendix 6.

Alternative channel locations were developed in consideration of the planning objectives and constraints outlined in the previous section. In general, the channel locations may be described in relation to the commercial channel and the Chelsea shoreline. The alternatives that were developed generally consisted of a) using the existing commercial channel, b) widening the existing channel, or c) creating an entirely separate small boat channel.

PLANS OF OTHERS

The project which will have the greatest influence on the Proposed Water Resources Improvement Project will be the proposed redevelopment of the Chelsea Naval Hospital property by the City of Chelsea. The Island End River project should be considered an integral part of those plans. Development of the marina and alternative channel alignments have been based on careful coordination with City and MDC plans. These plans are presented in detail in Appendix 1.

ANALYSIS OF PLANS CONSIDERED IN PRELIMINARY PLANNING

DESCRIPTION OF PLANS

During the early stages of this project, eight alternatives were developed and analyzed. They involved different marina and turning basin options as well as various channel alignment alternatives.

Generally, two marina alternatives have been investigated. Marina 1 would allow for more recreational slips to be constructed than in Marina 2. In addition, Marina 2 would require the construction of a turning basin.

The various channel alignments investigated include the following:

ALTERNATIVE A - The existing commercial channel is extended approximately 250 feet to the marina and runs approximately 1,200 feet adjacent to the Marina 1. The western edge of the channel bottom is located 100 feet from Everett shore high water line.

ALTERNATIVE B - This plan involves widening the existing channel for 100 feet and then extending it 250 feet to Marina 1, thus providing an adjacent small boat channel. The existing channel was considered to be 200 feet in width at the Mystic River near the end of the Exxon Terminal; then tapering to 120 feet at the end of the Coldwater Seafood docks.

ALTERNATIVE C - This alignment represents the closest that the channel can be located to the Chelsea shoreline without requiring extensive shoreline protection.

ALTERNATIVE D - The channel is located as close the Chelsea shoreline as possible at the lower part of the river using revetment at a 3:1 slope and maintains the top of the bank. The channel bottom is aligned along the pier/bulkhead line at the mouth of the river.

ALTERNATIVES E, F, G, and H follow the same channel alignments as A, B, C, and D, respectively. The major differences are that each channel would culminate in a turning basin. A turning basin is required due to the proposed configuration of Marina 2.

COMPARATIVE ASSESSMENT AND EVALUATION OF PLANS

An evaluation of the marina alternatives indicates that Marina 1 was preferable to Marina 2 for a number of reasons. In general, a turning basin requires an excessive amount of area within the tidal basin. Therefore, the cost of development for Marina 2 will be higher, because more extensive shoreline protection and a larger amount of dredging (for the marina area) will be needed. Assuming an upper limit on the per slip development cost of $4,000 and assuming that no pier construction would occur along the Everett shoreline, the reasonable berthing capacity of Marina 2 is 180 boats.

Marina 1 provides a lower development cost per slip and accommodates about 250 boats. Although a turning basin is not provided with Marina 1, most boats expected to use the marina will be power boats less than 40 feet in length. Because they are maneuverable, a turning basin is not considered a necessity. Elimination of the turning basin proposed in the Reconnaissance Report will improve the development advantages of the Marina 1, reducing the amount of dredged material and reducing overall project costs.

Comparison of the channel alternative alignments indicates that there is generally a tradeoff between project cost and boating convenience and safety.

The costs of the alternatives generally increase as the channel alignments are located closer to the Chelsea shoreline because greater amounts of dredging and shoreline protection are required. Although the channel alignments closer to the Chelsea shoreline increase boating safety, they have the disadvantages of creating a larger disposal problem interfering with marine life in the intertidal zone, and being more costly.

CONCLUSIONS

Based upon evaluation of the degree to which each alternative attained the planning objectives and conformed to the planning constraints, alternatives A, B, C, and D have been selected for further evaluation. These conclusions are further based on the selection of a marina 1 design, thereby permitting approximately 250 boats to utilize the recreational facilities provided.

ASSESSMENT AND EVALUATION OF DETAILED PLANS

This section contains an analysis of the four improvement alternatives selected for detailed study. Evaluation of the alternatives is based on their attainment of the project planning objectives. Although the marina is not a part of the federal project, its impact has been incorporated.

GENERAL ASSESSMENT AND EVALUATION OF IMPACTS

The general impacts of the proposed project which are common to all four alternatives are evaluated below. Impacts which are unique to each alternative are assessed and evaluated in subsequent sections of this report.

DREDGING IMPACTS - Dredging operations cause both short-term and long-term impacts including temporary air, noise and water pollution. The most serious impact is the effects of increased turbidity on shellfish and finfish. For these reasons, dredging of the Island End River will be scheduled to take place in the fall and thereby avoid adverse effects on the anadromous alewives in the Mystic River.

Long-term impacts of dredging include removal of existing benthic organisms from the river bottom, removal or alteration of marine habitats in the intertidal zone or elsewhere on the river bottom, and alteration of tidal currents.

The predominant marine species expected to be displaced by dredging of the Island River is clamworm. It is also expected that dredging will result in the removal of some soft-shell clams in the lower reaches of the river. Any long-term impacts on these species will be mitigated by natural repopulation of much of the area disturbed by dredging.

All four alternatives will affect the intertidal zone of the river, i.e., the portion of the river bottom between the low and high water lines. Impacts on the intertidal zone increase from Plan A (minimum) to Plan D (maximum). Construction of marina facilities by the City would require additional dredging and removal or alteration of the intertidal zone. However, the impacts are not direct impacts of the federal project.

The intertidal zone is eliminated when sections of the river bottom are dredged to a depth below MLW. It will be altered when dredging results in steepening existing bottom slopes between MLW and MHW. The area is a valuable source of organisms at the lower end of the food chain and also a potential habitat for shellfish. Although the intertidal area of the Island End River is currently polluted, shellfish could conceivably be harvested if long-term improvements in water quality occur.

The amount of dredging required ranges from 51,800 cubic yards for Plan A to 111,000 cubic yards for Plan D. Construction of the marina basin will require removal of an additional 65,000 cubic yards of material by the developers.

SHORELINE IMPACTS - None of the four alternative plans will impact the Everett shoreline. Minimizing involvement with this shoreline is one of the project planning concerns. In Plans C, and D, some shoreline protection such as a riprap revetment will be required along the Chelsea side of the river to facilitate construction of the channel.

The marina basin, common to all four alternatives, will require the construction of approximately 1,250 feet of revetment along the Chelsea shoreline.

IMPACTS ON NAVIGATION - At present, recreational boating in the river is limited to an occasional transient craft at intermediate and high tide levels. Apparently no boats are permanently moored in the river. Development of a 250 boat marina and a boat launching ramp will result in extensive recreational use of the river. Plan A, which requires joint use of the existing channel by recreational craft and large ships, will cause some disruption to navigation.

Plans B through D have less significant negative impacts on existing shipping in the river.

SOCIAL AND COMMUNITY IMPACTS - The proposed project will have a beneficial impact on the City of Chelsea's plans for redevelopment of the Chelsea Naval Hospital property. Full scale redevelopment of the Naval Hospital will in turn enhance the ability of the City to provide better community services through added revenues by increasing the limited tax base of the City. The project will also have the beneficial effect of increasing recreational opportunities for the residents of Chelsea and nearby communities.

ECONOMIC IMPACTS - Economic impacts of the proposed project have been evaluated by determining the estimated costs and benefits. The cost estimates are based upon consideration of numerous factors including: the quantities of dredge material, mobilization and demobilization, equipment costs and wage rates, anticipated dredging rates in cubic yards per hour, engineering, supervision, administration, and contingencies.

Equivalent annual costs have been calculated for the purpose of the benefit/cost analysis. These costs have been determined using the anticipated 1980 rate of 7 1/8 percent.

Benefits of the proposed project have been calculated on the assumption that a marina for 100 boats will be completed by 1982 and will be gradually expanded to a maximum of 250 boats by 1992. Calculation of project benefits is based on a procedure using the estimated annual return on the owner's investment in his boat, a measure of his "willingness to pay" for recreational facilities. The method of projecting the boat fleet and detailed benefit/cost calculations are contained in Appendix 6.

MITIGATION REQUIREMENTS

Mitigation measures would include steps to control the temporary noise, air and water pollution due to dredging equipment. Dredging would be scheduled to take place during the fall months so as to avoid suspension of water pollutants during the spring alewife run in the Mystic River.

IMPLEMENTATION RESPONSIBILITIES

COST ALLOCATION - One hundred percent of the cost of the project is allocated to the recreational channel. There are no other components in the federal project.

COST APPORTIONMENT - The federal government is responsible for 50 percent of the first cost of construction and 100 percent of the cost for all future maintenance as required. Local costs will include 50 percent of the first cost of construction and 100 percent of all necessary shoreline protection structures, construction of the marina basin and facilities and all public access roads and parking areas as required. Federal and local costs vary for each of the alternatives.

FEDERAL RESPONSIBILITIES - The federal project consists of dredging the access channel only. The federal project does not include any marina facilities, shoreline protection, or site work at any land disposal areas.

NON-FEDERAL RESPONSIBILITIES - The specific local requirements as contained in the Rivers and Harbors Act are as follows:

(1) Provide a 50 percent cash contribution toward construction costs, determined in accordance with existing policies for regularly authorized projects, in view of recreational benefits, land enhancement benefits or similar type special and local benefits expected to accrue.

(2) Provide, maintain and operate without cost to the United States, an adequate public landing with provisions for the sale of motor fuel, lubricants and potable water, open and available to the use of all on equal terms.

(3) Provide without cost to the United States all necessary lands, easements and rights-of-way required for construction and subsequent maintenance of the project including suitable dredged material disposal areas with necessary retaining dikes, bulkheads, and embankments.

(4) Hold and save the United States free from damages that may result from construction and maintenance of the project.

(5) Accomplish without cost to the United States alterations and relocations as required in sewer, water supply, drainage and other utility facilities.

(6) Provide and maintain berths, floats, piers, and similar marina and mooring facilities, as needed for transient and local vessels, as well as necessary trailer facilities, access roads, parking areas and other needed public use shore facilities, open and available to all on equal terms. Only minimum, base facilities and services are required as part of the project. The actual scope or extent of facilities and services provided over and above the required minimum is a matter of local decision. The manner of financing such facilities and services is a local responsibility.

(7) Assume full responsibility for all project costs in excess of the federal cost limitation of $2,000,000 under the Section 107 program.

(8) Establish regulations prohibiting the discharge of untreated sewage, garbage, and other pollutants into the waters of the harbor.

It should be noted here that although item number (6) above requires that local governments need provide only the basic, minimum facilities, the benefits estimated for this project are dependent on the extent of the mooring facilities provided by the City. This study has assumed that the City of Chelsea will provide marina facilities with a maximum capacity of 250 boats as stated in the Chelsea Naval Hospital Redevelopment Master Plan.

This study has found that although it will prove costly, construction of a 250 boat marina in the Island End River is feasible. The estimated cost for construction of the marina, exclusive of floats, piers, utilities and shore facilities is about $800,000, or over $3,200 per berth. Because revenues from leasing of berth space will probably not cover the City's initial cost, construction of the marina must be considered as a public investment.

The following sections of this report consist of an assessment and evaluation of impacts which are specific to the individual alternative plans.

PLAN A

PLAN DESCRIPTION

Plan A would involve the joint use of the existing channel near the river's mouth by recreational and commercial craft. The small craft channel would be dredged 1,300 feet beyond the upstream end of the existing commercial channel. The upstream channel would be 100 feet wide by 6 feet deep at mean low water. It would be located roughly 80 to 100 feet from, and parallel to, the Everett shoreline. Plans A, B, C and D are all based on the assumption that a marina and boat launching ramp will be constructed with the approximate configuration shown in Figure 2-1.

The area to be dredged for the channel generally follows the MLW stream bed. The present elevation of the river bottom in the area of the proposed channel ranges between 1 1/2 feet below to about 3 feet above mean low water.

IMPACT ASSESSMENT

DREDGING IMPACTS - Plan A requires that 51,800 cubic yards of material be dredged. Additionally, 2.2 acres of intertidal area would be removed and 1/2 acre of intertidal area would be altered for the federal access channel. Additional dredging and intertidal zone modification would be required for the marina basin, however, this is a local responsibility and not directly attributable to the federal project.

SHORELINE IMPACTS - The Plan A channel does not result in any shoreline changes.

IMPACTS ON NAVIGATION - Since Plan A involves the joint use of the existing channel for both commercial and recreational craft, it would have an adverse impact on existing shipping. Although there may be some minor delays to shipping, the larger less maneuverable ships have the right-of-way legally. Recreational craft would be forced to wait for the barges and freighters to be maneuvered in the narrow channel. Based on the number of shipping operations, it is estimated that the recreational benefits of Plan A would be reduced about 7 percent due to delays.

Safety factors are more difficult to quantify. The primary dangers of joint use of a channel by ships and small craft are those of collisions due to a small boat cutting across the path of a larger craft and the potential of a small boat coming too close to the turbulent wake produced by the large commercial tugs. These problems would be of greatest concern for inexperienced boaters who might be unaware of the dangers. It should be noted that shared use of channels by commercial ships and recreational boats is common in harbor areas.

Although no quantitative assessment of the safety impacts have been made, Plan A is considered to have an adverse impact in this regard.

ECONOMIC IMPACTS - Dredging disposal costs are based upon disposal at sea. If land disposal of dredged material is required, then the estimated costs would be subject to change.

The estimated first cost of Plan A is $518,000. The equivalent annual cost based on an interest rate of 7 1/8 percent is $53,000. The annual project benefit is estimated at $369,800.

Annual costs and benefits are shown below.

Annual Costs	Annual Benefits	B/C Ratio	Net Benefits
$57,000	$369,800	6.4	$312,800

EVALUATION AND TRADEOFF ANALYSIS

Plan A minimizes dredging requirements by utilizing the existing commercial channel. Therefore, this alternative has the lowest initial as well as annual maintenance cost. It also has the least impact on existing marine life in the river since no dredging will take place in the lower section of the river.

However, Plan A has an adverse impact on boating convenience and safety arising from shared use of the commercial channel. It also presents a secondary safety problem which is difficult to quantify. Plan A would require recreational craft to pass in close proximity to the Exxon terminal where large volumes of volatile substances are handled and stored.

Plan A would have virtually no impact on the existing environmental conditions downstream of the marina site, resulting in the maximum preservation of the intertidal areas. It would have no positive aesthetic impacts, however, as extensive mudflats would remain adjacent to the proposed waterfront park.

COST APPORTIONMENT

The local share of the costs of the federal project for Plan A is estimated at $259,000 plus a 100 percent share of related shore improvements which are not part of the federal project.

PUBLIC VIEWS

VIEW OF FEDERAL AGENCIES - The United States Coast Guard Office of Marine Safety recommended that the shared channel not be recommended due to potential safety problems. The U.S. Fish and Wildlife Service recommended that the plan be selected because it minimizes impacts on marine life. Appendix 3 contains copies of statements from these agencies.

VIEWS OF NON-FEDERAL AGENCIES AND OTHERS - Use of the existing commercial channel was generally not viewed favorably by the industries in Everett currently using the channel. The industries were generally more concerned with trespass problems rather than possible boating accidents. A representative of Exxon Corporation felt that the small boat channel should be separated from the commercial channel.

PLAN B

PLAN DESCRIPTION

Plan B involves construction of a separate channel for recreational craft parallel to and contiguous with the existing commercial channel. Upstream of the commercial channel, the alignment of the recreational channel would generally correspond to that in Plan A.

The boundary of the existing shipping channel is somewhat irregular. For the purposes of this study, the channel was considered to be 200 feet in width from the Mystic River to a point 400 feet upstream. It then tapers to 120 feet in width at the end of the Coldwater Seafood wharves. These dimensions provide for a channel slightly wider than the existing one. At present, the channel is somewhat restricted at low water, especially in the area of the Marquette Cement Corporation wharves. The dimensions described above will allow future widening of the existing commercial channel at its present 24 foot depth. This will allow vessels bound for the Coldwater Seafood Corporation wharves to maneuver past barges berthed at the Marquette wharves.

The small boat channel would be constructed by dredging a "shelf" along the edge of the deeper channel. Presently the western edge of the channel in Plan B is generally at or near the desired 6 foot depth. The eastern edge is generally at an elevation of 0 to 2 feet above MLW.

IMPACT ASSESSMENT

DREDGING IMPACTS - Plan B requires the dredging of approximately 64,100 cubic yards for the access channel. Plan B involves removal of 3.0 acres of intertidal area and the alteration of 1.0 additional acres. Construction of marina facilities by the city would require additional dredging and removal or alteration of the intertidal zone, however, the impacts are not direct impacts of the federal project.

SHORELINE IMPACTS - Plan B does not result in any changes to the existing shoreline.

NAVIGATION IMPACTS - Plan B would have minimal impacts on the existing industrial shipping operations. The small boat channel would be placed adjacent to the existing channel, allowing small boats to pass the larger craft more freely even at low tides.

The safety problems inherent in Plan A are greatly reduced but are not eliminated. Even though a separate channel would be provided for small boats, it is likely that some would stray into the existing channel. In addition, the wake generated by the large boats would generate waves in the small boat channel.

ECONOMIC IMPACTS - The initial cost of the federal project for Plan B is $629,000. The equivalent annual cost is estimated at $64,390 at an interest rate of 7 1/8 percent. Project benefits are estimated at $397,800 annually.

Annual Costs	Annual Benefits	B/C Ratio	Net Benefits
$68,000	$397,800	5.8	$329,800

EVALUATION AND TRADEOFF ANALYSIS

Construction of a separate, parallel recreational channel in the lower portion of the Island End River can be accomplished with a relatively modest increment in the quantity of dredging required by

Plan A. Much of the area within the proposed recreational channel in the lower portion of the river is already deeper than 6 feet at MLW and will therefore not require dredging. The modest additional amount of dredging will increase boating safety and convenience by providing a separate recreational channel. The industrial concerns would be free to utilize, modify, and maintain the existing channel within the limitation of existing laws, codes and regulations.

COST APPORTIONMENT

Local government would be responsible for payment of an estimated $314,500 which is 50 percent of the initial cost of the federal project. Local responsibility also includes a 100 percent share of related shore improvements which are not a part of the federal project.

PUBLIC VIEWS

VIEWS OF FEDERAL AGENCIES - The U.S. Coast Guard, Office of Marine Safety felt that a plan which widens the existing channel would provide the best solution.

VIEWS OF NON-FEDERAL AGENCIES AND OTHERS - At a review meeting on August 9, 1979, representatives of the Massachusetts Office of Coastal Zone Management and the Division of Marine Fisheries stated their preference for Plan A based on the related minimum dredging impacts. They agreed, however, that additional economic and environmental costs could be justified in order to provide the incremental safety benefits.

PLAN C

PLAN DESCRIPTION

Plan C involves construction of a channel for recreational craft on an alignment that is completely separated from the existing commercial channel. At the mouth of the river the small boat channel would be located about 280 feet from the Exxon Corporation wharves.

Upstream, the Plan C channel tapers towards the commercial channel. Two small bends are located in the channel, the second at the point where the proposed marina would begin.

The channel location in Plan C generally corresponds to that shown in the Reconnaissance Report. It is as near to the Chelsea shoreline as possible without requiring extensive revetment to provide shore protection.

IMPACT ASSESSMENT

DREDGING IMPACTS - Plan C requires the dredging of 89,700 cubic yards of material. Approximately 4.9 acres of intertidal zone area will be removed and an additional 1.9 acres will be altered. Additional dredging and intertidal zone impacts would result from constraints of the proposed marina. These impacts are only indirectly attributable to the federal project.

SHORELINE IMPACTS - Plan C would require revetment along 200 feet of shoreline to maintain the stability of the desired slopes.

NAVIGATION IMPACTS - Plan C provides a channel that is completely separate from the commercial channel. Although the project benefits of Plan C would be approximately the same as Plan B, a somewhat higher level of safety and convenience would be provided.

ECONOMIC IMPACTS - The estimated first cost of Plan C is $872,000. The equivalent annual cost is $88,980 at a 7 1/8 percent interest rate. Project benefits are estimated at $397,800 annually.

Annual Costs	Annual Benefits	B/C Ratio	Net Benefits
$95,000	$397,800	4.2	$302,800

EVALUATION AND TRADEOFF ANALYSIS

Plan C provides a separation zone between the commercial and the small boat channels at the expense of additional dredging, however, Plan C has a greater adverse effect on intertidal zones.

COST APPORTIONMENT

Local government would be responsible for 50 percent of the initial cost of the federal project at a cost of $436,000. Local responsibility also includes a 100 percent share of related shore improvements which are not part of the federal project.

PUBLIC VIEWS

VIEWS OF FEDERAL AGENCIES - The National Marine Fisheries Service believes that Plan C will produce an excessive impact on the intertidal zone.

VIEWS OF NON-FEDERAL AGENCIES - The Massachusetts Office of Coastal Zone Management and the Massachusetts Division of Marine Fisheries also believe that Plan C will have an excessive impact on the intertidal zone.

PLAN D

PLAN DESCRIPTION

In Plan D, the small boat channel is aligned as closely to the Chelsea shoreline as possible, providing the maximum separation zone between the small craft and commercial channels. The western edge of the proposed channel is separated from the Exxon terminal docks by approximately 380 feet. This alignment requires approximately 580 feet of revetment along the Chelsea shoreline.

IMPACT ASSESSMENT

DREDGING IMPACTS - Plan D would require the dredging of approximately 110,100 cubic yards of material, the removal of 6.2 acres of intertidal zone and alteration of an additional 2.3 acres of intertidal zone. In addition to the above, construction of marina facilities, which are not part of the federal project, will cause additional dredging and intertidal zone impacts.

Plan D has the greatest impact of any plan on the intertidal zones near the mouth of the river where marine life is to be found in greater diversity.

SHORELINE IMPACTS - Because the channel alignment in Plan D is so close to the shoreline, revetment would be required to maintain the channel side-slope stability. At locations where the revetment would be required the shoreline is presently suffering from erosion.

NAVIGATION IMPACTS - Plan D enhances safety and convenience by providing a maximum separation of the small boats and large ships. However, Plan D would leave potentially hazardous shoals between the small boat channel and the commercial channel.

Some of these points in the river bottom would expose rocky surfaces 2 to 4 feet above MLW. These shoals would be covered at interim tides. Although they would be outside of the small boat channel they could represent a hazard to boaters.

ECONOMIC IMPACTS - Plan D would have an initial cost of $1,058,000 and an equivalent annual cost of $107,800 based upon an annual interest rate of 7 1/8 percent. Annual benefits are estimated at $397,800.

Annual Costs	Annual Benefits	B/C Ratio	Net Benefits
$117,000	$397,800	3.4	$282,800

EVALUATION AND TRADEOFF ANALYSIS

Plan D has the maximum cost and requires the greatest amount of dredging and shorline protection. Although Plan D has the greatest environmental impacts, it is the plan most preferred by the City of Chelsea. The City prefers that the channel be located close to its shoreline as they desire to have open water as close to the park as possible.

COST APPORTIONMENT

Local government would be responsible for the payment of an estimated $529,000 which is 50 percent of the initial cost of the federal project. Local responsibility also includes a 100 percent share of related shore improvements which are not part of the federal project.

PUBLIC VIEWS

VIEWS OF FEDERAL AGENCIES - At the review meeting cited earlier, the National Marine Fisheries Service expressed the belief that Plan D has an excessive adverse impact on the intertidal zone.

VIEWS OF NON-FEDERAL AGENCIES - The Massachusetts Office of Coastal Zone Management and Massachusetts Division of Marine Fisheries also felt that Plan D will have a more substantial impact than the other alternatives. The City of Chelsea favors a plan that will result in a maximum dredging effort which they feel will enhance the aesthetic quality of the river by providing an increased area of open water at low tide. Representatives of the Exxon Corporation expressed an opinion in favor of having the small boat channel located as far as possible from their terminal. Thus, Plan D best fulfills the desires of the City of Chelsea and Exxon Corporation.

COMPARISON OF DETAILED PLANS

In general, there is a tradeoff between the increased separation between the recreational and commercial channels and the minimization of project economic and environmental costs. While all four plans have net benefits and B/C ratios significantly greater than one, these ratios decrease as the channel is moved closer to the Chlesea shoreline.

Although Plan A has the highest benefit/cost ratio, net benefits (benefits minus costs) are greater for Plan B than for Plan A. Net benefits for Plan C are lower than those of either Plan A or Plan B. Plan D has the lowest net benefits. Generally, environmental impacts increase in severity from Plan A to Plan D. Plan D has a significant adverse effect on the intertidal zone at the mouth of the river where a greater diversity of marine life currently exists.

Aesthetic impacts are considered most positive for Plans C and D due to the increase in open water area at low tide. The City of Chelsea considers increasing the area of open water to be an important factor for enhancing the appearance of the Island End River when viewed from the luxury housing or the waterfront park on the former Naval Hospital property. Plans C and D would eliminate the mud flats by bringing the low water line closer to the Chelsea shoreline. Plans A and B would have minimal impacts on areas close to shore, downstream of the marina.

Plan A has lower navigation benefits than Plans B, C, and D, due to delays encountered by recreational boats when passing by the industrial wharves and conflicting with commercial shipping. The navigational benefits of the other plans are essentially the same, although there is a difference in an unquantifiable safety factor. Plan B is considered significantly better than Plan A in this respect. Plans C and D provide few additional safety benefits beyond Plan B. Plan D introduces the potential safety problem of shoals between the commercial and recreational channels.

RATIONALE FOR DESIGNATION OF THE NED PLAN

Plan B has been designated as the NED plan based on the criteria of the highest net benefits.

RATIONALE FOR DESIGNATION OF THE EQ PLAN

None of the four plans considered in detail meet the criteria for designation as an EQ plan. However, Plan A has been designated as the EQ plan because it has the least overall environmental impacts. Plan A results in the lowest dredging requirements.

RATIONALE FOR SELECTED PLAN

Plan B is recommended for implementation. It provides maximum net benefits, while its environmental impacts are not significantly greater than Plan A. In the short term it will require only a 23 percent increase in the quantity of dredging above that required for Plan A. In the long term it will require an increase of only 36 percent on the area of intertidal zone to be removed above that required by Plan A. Plans C and D require substantially greater intertidal zone removal and dredging. Plan B enhances social well being. It affords greater safety benefits and minimizes potential interference and delays by providing a separate channel for small craft. Plan B is compatible with redevelopment of the Chelsea Naval Hospital site as are Plans A, C, and D. Long term positive impacts on regional development should also be comparable for all plans. Short term employment under Plan B will be greater than that provided by Plan A but less than that provided by Plans C and D. Secondary short term construction employment impacts for the marina and related shore facilities will be comparable under all plans.

CONCLUSIONS

As Division Engineer of the New England Division, Corps of Engineers, I have reviewed and evaluated in the overall public interest, all pertinent data concerning the proposed plan of improvement, as well as the stated views of other interested agencies and the concerned public relative to the various practical alternatives in providing navigation improvements in Island End River, Chelsea, Massachusetts.

The possible consequences of alternatives have been studied according to engineering feasibility, environmental impacts, economic factors of regional and national resource development and other considerations of social well-being in the public interest. The ramifications of these issues have been stated in detail in the formulation of this plan of improvement and in other sections of this report.

In summary, there are substantial benefits to be derived by providing the anticipated recreational boaters in the Island End River with reliable access to the river at all stages of tide.

The following Table 1, System of Accounts, is a general analysis relevant to plan selection. It presents the determinative factors that underly each final alternative by displaying the significant beneficial and adverse impacts. This system is utilized for the purpose of tradeoff analysis and final decision making.

It is noted that the improvement would cause a minor disruption of the environment during dredging and disposal operations. However, as those impacts are not considered significant, an Environmental Assessment has been performed in lieu of an Environmental Impact Statement. Due to the significant benefits attributable to the recreational boating industry, it is considered that this adverse environmental effect would be more than offset by improvement in the overall economic growth of the region.

I find that the proposed action, as developed in this report, is based on a thorough analysis and evaluation of various practicable alternative courses of action for achieving the stated objective, that, wherever adverse effects are found to be involved, they cannot be avoided by following reasonable alternatives and still achieve the specified purposes; that where the proposed action has an adverse effect, this effect is either ameliorated or substantially outweighed by other considerations. The recommended action is consistent with national policy, statutes, and administrative directives, and should best serve the interests of the general public.

TABLE 1
SYSTEM OF ACCOUNTS

A.		PLAN DESCRIPTION	Without Project N.A.	Plan A Shared Channel	Plan B Parrallel Channel	Plan C Separate Channel	Plan D Separate Channel
B.		IMPACT ASSESSMENT					
1.		NED					
	a.	Annual Benefits	0	$369,800	$397,800	$397,800	$397,800
	b.	Annual Const. Cost	0	38,200	46,300	64,200	77,900
	c.	Annual Maint. Cost	0	18,800	21,700	30,800	37,100
	d.	B/C Ratio	0	6.4	5.8	4.2	3.4
	e.	Net Benefits	0	$312,800	$329,800	$302,800	$282,800
2.		EQ					
	a.	Intertidal Zone Removal (Ac)	0	2.2	3.0	4.9	6.2
	b.	Intertidal Zone Altered (Ac)	0	0.5	1.0	1.9	2.3
	c.	Dredging Impacts on Water Quality	-	(1)	(2)	(3)	(4)
	d.	Shoreline Impacts Revetment (l.f.)	0	0	0	200	600
	e.	Aesthetics	-	(4)	(3)	(2)	(1)
	-	Project EQ Rank	-	(1)	(2)	(3)	(4)
3.		SWB					
	a.	Interference with Existing Shipping	-	Yes	Possible	Possible	Possible
	b.	Safety for Recr. Craft	-	(4)	(2)	(1)	(3)
	c.	Accident Potential Exxon Terminal	-	(4)	(3)	(2)	(1)
	d.	Impact on Naval Hospital Plan	Negative	Positive	Positive	Positive	Very Pos.
	e.	Active Recr.	-	(4)	(2)	(1)	(3)
	-	Project SWB Rank	-	(4)	(2)	(1)	(3)
4.		RD					
	a.	Employment & Growth	-	Positive	Positive	Positive	Positive
	-	Project RD Rank	-	(4)	(3)	(2)	(1)

[1] Minimum adverse impacts

[4] Maximum adverse impacts

TABLE 1
(continued)

	Without Project N.A.	Plan A Shared Channel	Plan B Parallel Channel	Plan C Separate Channel	Plan D Separate Channel
C. PLAN EVALUATION					
1. CONTRIBUTIONS TO PLANNING OBJECTIVES AND CRITERIA					
a. Compatible with Naval Hosp. Plan	No	Yes	Yes	Yes	Best
b. Compatible with MDC Park	No	Yes	Yes	Yes	Best
c. Compatible with Marina	No	Yes	Yes	Yes	Yes
d. Safety and Maneuverability	-	Restricted	Yes	Yes	Yes
e. Minimize Shipping Conflicts	-	No	Yes	Yes	Yes
f. Discourage Boats at Exxon Ter.	No	No	Yes	Yes	Yes
g. Good Channel Alignment	-	Yes	Yes	Yes	Yes
h. Min. Dredging	-	(1)	(2)	(3)	(4)
2. PLAN RESPONSE					
a. Plan Found Unacceptable	Chelsea	Exxon	-	*	*
b. City must Const. Marina	No	Yes	Yes	Yes	Yes
D. IMPLEMENTATION RESPONSIBILITY					
a. Federal Project	-	$259,500	$314,500	$436,000	$529,000
b. Local Share	-	$259,500	$314,500	$436,000	$529,000
3. Marina, Shore Fac. & Improvements					
a. Federal Share (%)	-	0	0	0	0
b. Local Share (%)	-	100	100	100	100

* National Marine Fisheries Service and the Massachusetts Division of Marine Fisheries

RECOMMENDED PLAN

The recommended plan for the Island End River, Chelsea, Massachusetts would provide recreational boaters with the following improvements: a 100-foot wide access channel extending from the Mystic River for a length of approximately 2,500 feet to the site of the proposed marina. The proposed plan would have to allow for an overall depth of 6 feet at mean low water.

ENVIRONMENTAL ASSESSMENT

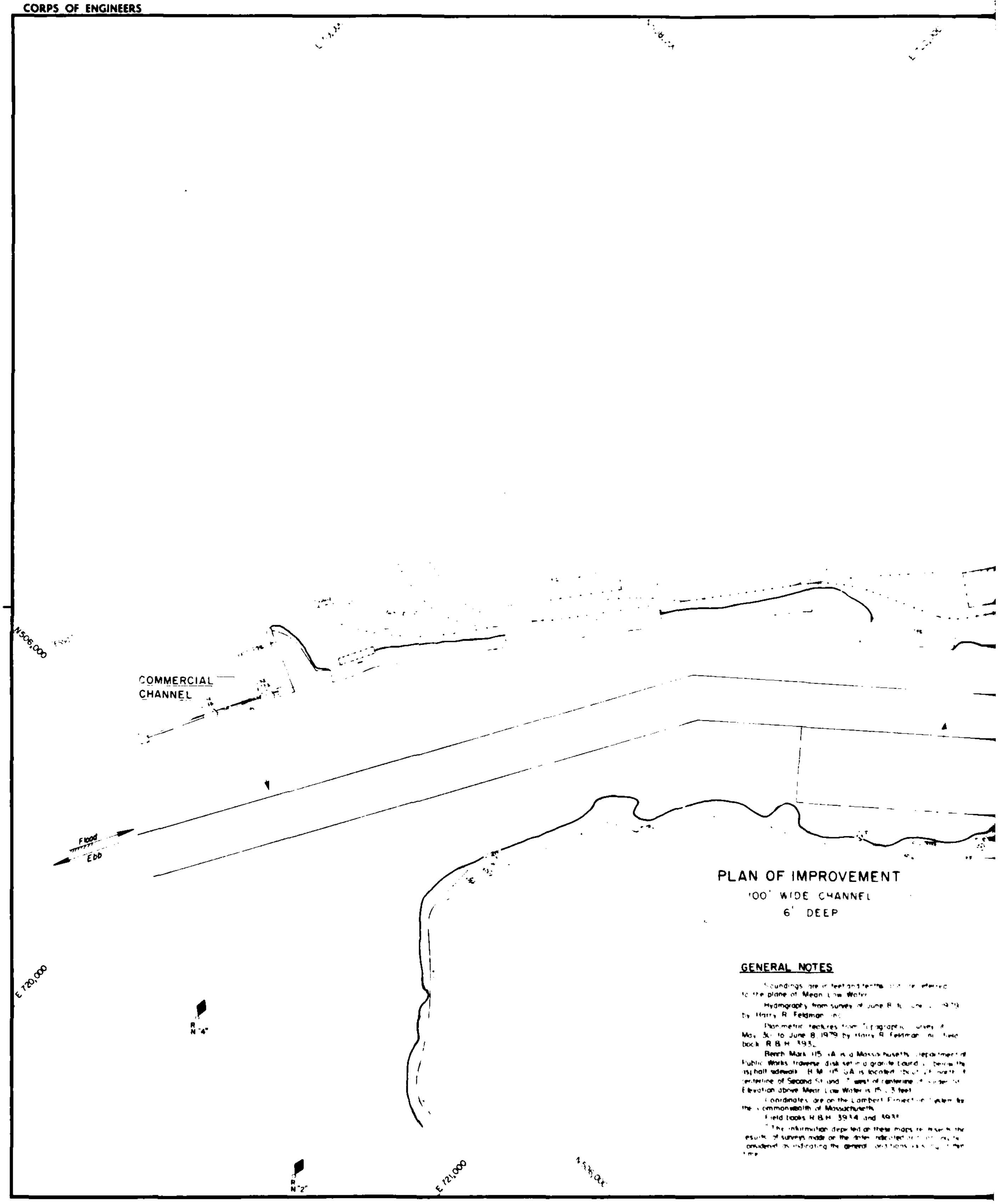
INTRODUCTION AND PROJECT HISTORY

In keeping with the National Environmental Policy Act of 1969, the New England Division, Army Corps of Engineers, has examined environmental values as part of the planning and development of the proposed action plan. Background environmental information was compiled for this report through interviews with various State and local interest groups and a search of published literature. This report provides an assessment of environmental impacts and alternatives considered.

The proposed project provides for construction of an access channel to a marina that will be built by the city of Chelsea.

An existing, privately maintained commercial channel would be widened and extended to create a recreational channel approximately 2500 feet in length, and 6 feet deep at mean low water (MLW). Approximately 64,100 c.y. of silty-clay sediments would be removed by clamshell dredge and disposed of at the "Boston Foul Area". An additional 64,900 cubic yards, composed of similar material would be removed from the marina basin.

CORPS OF ENGINEERS



PLAN OF IMPROVEMENT

100' WIDE CHANNEL
6' DEEP

GENERAL NOTES

Soundings are in feet and tenths and are referred to the plane of Mean Low Water.

Hydrography from survey of June 8 to June [illegible] 1979 by Harry R. Feldman Inc.

Planimetric features from Topographic Survey of May 30 to June 8, 1979 by Harry R. Feldman Inc. field book R.B.H. 3932.

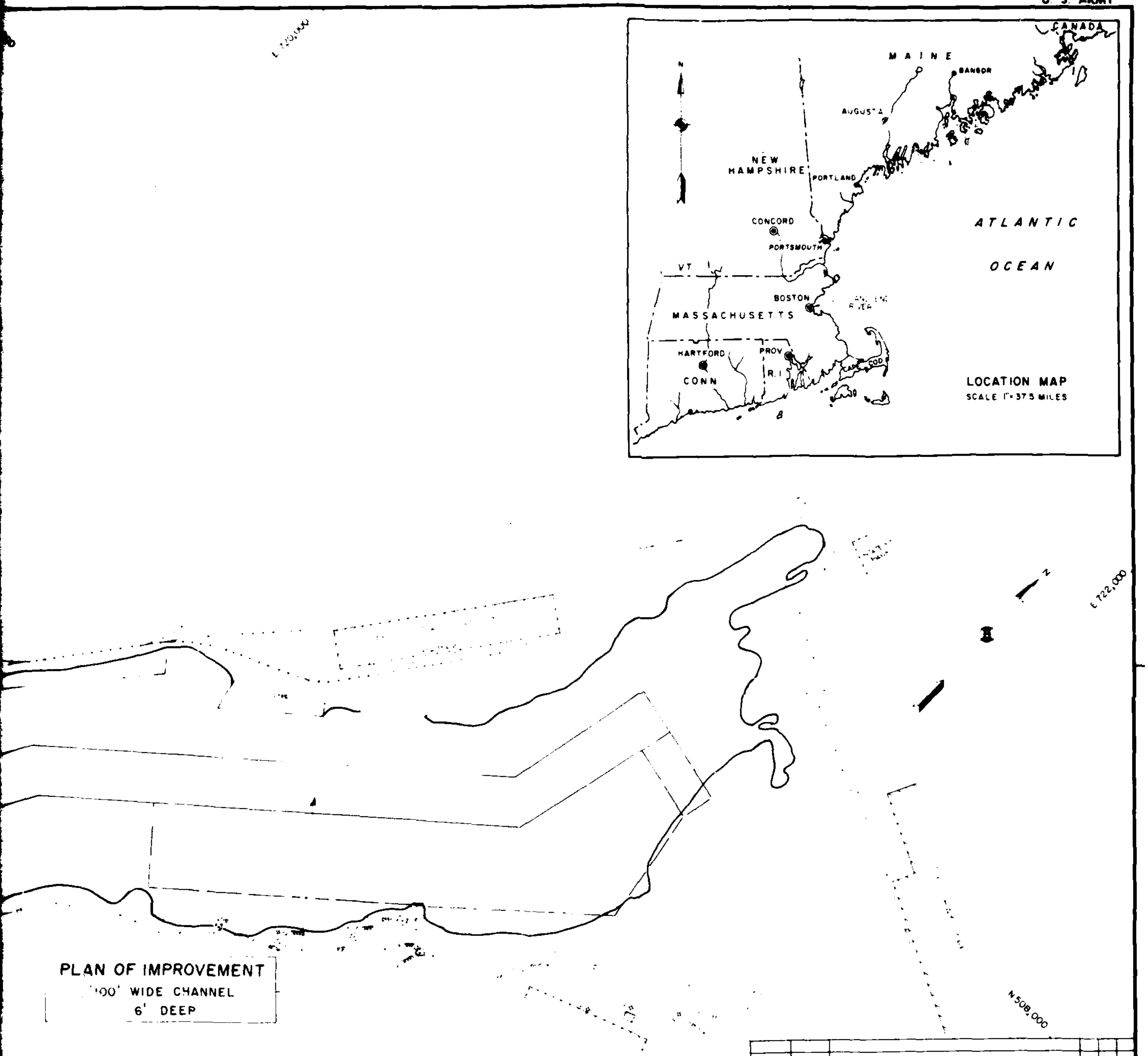
Bench Mark 115-6A is a Massachusetts Department of Public Works traverse disk set in a granite bound [illegible] below the asphalt sidewalk. B.M. 115-6A is located [illegible] north of centerline of Second St. and [illegible] west of centerline of [illegible]. Elevation above Mean Low Water is 15.[illegible]3 feet.

Coordinates are on the Lambert Projection System for the Commonwealth of Massachusetts.

Field books R.B.H. 3934 and 3935.

"The information depicted on these maps represents the results of surveys made on the dates indicated and can only be considered as indicating the general conditions existing at that time.

U. S. ARMY



PLAN OF IMPROVEMENT
100' WIDE CHANNEL
6' DEEP

GENERAL NOTES

Soundings are in feet and tenths and are referred to the plane of Mean Low Water

Hydrography from survey of June 8, to June 12, 1979 by Harry R Feldman, Inc

Planimetric features from Topographic Survey of May 30, to June 8, 1979 by Harry R Feldman, Inc, field book R & H 3932

Bench Mark 115 GA is a Massachusetts Department of Public Works traverse disk set in a granite bound 2" below the asphalt sidewalk B M 115 GA is located about 26' north of centerline of Second St and 17' west of centerline of Garden St Elevation above Mean Low Water is 15 03 feet

Coordinates are on the Lambert Projection System for the Commonwealth of Massachusetts

Field books R & H 3934 and 3935

" The information depicted on these maps represents the results of surveys made on the dates indicated and can only be considered as indicating the general conditions existing at that time

GRAPHIC SCALE

N 507,000

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS

DR BY | TR BY | CK BY

SUBMITTED
ARCHITECT ENGINEER
REVIEWED
CHIEF ... SECTION
APPROVAL RECOMMENDED
CHIEF TECH ... BRANCH
APPROVAL RECOMMENDED
CHIEF PLANNING BRANCH

WATER RESOURCES IMPROVEMENT STUDY
ISLAND END RIVER-CHELSEA, MA.
PLAN B
THE RECOMMENDED PLAN OF IMPROVEMENT

APPROVED
CHIEF ENGINEERING DIVISION
DATE

PLATE I

SCALE 100
SPEC NO DACW
DRAWING NUMBER
SHEET

1 2

PURPOSE AND NEED FOR ACTION

The Chelsea Naval Hospital, a U. S. Navy installation since the early 1800's, was declared surplus in December of 1974. Since then, the city of Chelsea has taken steps to acquire portions of the property for redevelopment, including both waterfront and land-based industrial, residential and recreational uses. The development of a marina and related facilities are key aspects of the redevelopment master plan. If, however, these plans are to be fully realized, improvements to the navigation channel in the Island End River must be made. At the request of the city of Chelsea, the New England Division Army Corps of Engineers initiated a study to determine the feasibility of providing an access channel to the proposed marina. The proposed plan of improvement is shown on Plate 1.

Dredging will be performed under a private contract with the Government. Approximately 130,000 c.y. of material will be removed by clamshell dredge and carried by barge to the Boston Foul Area for open water disposal.

The Boston Foul Area is an area 2 nautical miles in diameter, located at approximately the 280 foot contour line.

ALTERNATIVES: INCLUDING THE PROPOSED ACTION

During the course of developing a plan that would compliment the city of Chelsea's redevelopment effort and insure a safe boating channel, four alternative plans of improvement were evaluated.

Alternative A

This plan provides only for extension of the existing commercial channel to the proposed marina. Recreational boaters would be forced to share the existing channel with large tankers and tugboats. While this alternative is the least costly and causes the least disruption to the marine environment of Island End River, boating safety is jeopardized and delays to recreational boaters is likely.

Alternative B - The Proposed Plan

The proposed project, this plan calls for widening and extending the existing commercial channel. This plan keeps dredging, and consequently associated environmental impacts, to a minimum while still providing a separate channel for use by recreational boaters.

Alternative C

This plan is somewhat similar to Alternative B in channel alignment except that the new channel would be closer to the Chelsea shoreline, thus creating a distinct and separate recreational channel. While a greater degree of safety would be provided, additional material would have to be dredged and approximately 200 feet of shoreline revetment would be required. The construction costs for this alternative are substantially greater and environmental impacts due to removal of more substrate would be more extensive.

Alternative D

This plan calls for aligning the proposed channel as closely to the Chelsea shoreline as possible. This alignment requires approximately 600 feet of revetment. While maximum safety benefits are associated with this alignment in the sense of providing a separate channel at the greatest distance possible from the existing channel, potentially hazardous shoals would exist between the two channels. Environmental impacts would be greatest if this alternative were chosen since greater amounts of material would be removed, much of which would be intertidal.

Disposal Alternatives

The project as proposed requires the removal of 64,100 cubic yards of material from the access channel and [illegible],900 cubic yards of material from the marina basin. The dredged material will be disposed of at the Boston Foul Area, located approximately 24 nautical miles from the project site. This method of disposal was chosen due to the physical nature of the sediments found in the Island End River. The silty-clay composition makes this material unsuitable for beach nourishment, and land disposal has been determined to be infeasible, as the following paragraphs illustrate.

Land disposal alternatives determined that the economic, environmental, and social impacts were not acceptable for implementation. Presented in detail in Appendix 7, the analyses revealed the following constraints to this method of disposal. A land site, removed from the Island End River, is not considered feasible as the material contains contaminants. The Massachusetts Department of Environmental Quality has indicated that there is no area in Eastern Massachusetts approved to receive material similar in nature to that found in the Island End River. In addition, the transport of large quantities of material to a distant site would cause significant adverse impacts and be economically prohibitive.

As a corollary to the data presented above, land disposal at the Chelsea Naval Hospital site would encompass identical negative impacts associated with toxic substances. However, even assuming the material could be treated to meet the Massachusetts Department of Environmental

Quality disposal criteria, disposal of approximately 130,000 cubic yards of material would seriously disrupt the city's redevelopment plans. As the only site available is the proposed marina site, disposal at this location would severely impair the present construction plans and possibly negate the economic feasibility of constructing the marina and related onshore support facilities.

A final disposal option considered was to utilize the South Boston Container Terminal site being developed by the Massachusetts Port Authority. Communication with that agency revealed that the site would not be capable of receiving any material until 1983 and then could accommodate only 10,000 cubic yards out of a total of 130,000 cubic yards.

Based on the above data, it was therefore determined that ocean disposal was the only viable option for construction of the access channel and marina basin.

PROBABLE ENVIRONMENTAL IMPACTS

Dredging

The most direct biological impact of dredging is probably the physical removal of benthic organisms from the immediate area to be dredged. In the case of Island End River the predominant specie is the Capitella worm, whose presence is an indication of a stressed environment.

While most organisms within the work area are expected to be destroyed by dredging, it is thought that removal of polluted sediments may uncover "cleaner" material capable of supporting a healthier benthic community. Repopulation of the dredged area is expected to commence shortly after dredging is completed, with neighboring communities providing larva that may settle at the site.

Dredging is also expected to result in increased turbidity and suspended solids. While increased turbidity reduces the amount of sunlight available for phytoplankton photosynthesis, this effect is not considered significant because it is temporary. It does, however, lower aesthetics at the site. Again this would be temporary lasting only as long as dredging continues.

As with turbidity, increased suspended solids are not expected to have any significant impacts on the biological community since tidal flushing will help remove fine grain suspended material that might impair respiratory processes of estuarine biota.

Sediment samples from Island End River were collected for analysis in July 1979. Table 2 shows the results of the analysis while Figure 1, page 5-33, shows the location of the sampling stations.

Elutriate tests on Island End River materials were performed by the Corps of Engineers in July 1979. Results are presented in Table 3. While these results indicate that phosphorus, zinc, vanadium, cadmium and oil and grease are likely to be released, no clear cut impacts can be directly attributed to their presence. For example, while phosphorus has been known to stimulate algae blooms, the increased turbidity associated with both dredging and disposal results in decreasing the amount of sunlight available for photosynthesis and, consequently, may act to negate potential effects of high phosphorus concentrations. Overall, the release of heavy metals should not cause significant adverse impacts to the marine ecosystem since any increase would be quickly diluted to background levels. Those benthic organisms inhabiting the site have, by their very presence, demonstrated a tolerance to high concentrations of heavy metals. More mobile species such as fish are expected to avoid the area until dredging is completed at which time any constituents present would be diluted to background levels. In addition, the results also exhibited

TABLE 2
BULK SEDIMENT ANALYSIS
ISLAND END RIVER
JULY 1979

Parameter Tested (% Dry Weight)	Station 1	Station 2	Station 3
Liquid Limit	57	101	91
Plastic Limit	25	39	34
Plastic Index	32	62	57
Grain Size - % Fine	62.50	71.50	87.50
% Solids	32.20	43.20	41.70
Sediment pH	6.70	7.14	7.12
Moisture content	68.980	155.010	153.780
Chemical Oxygen Demand COD (ppm)	321,000.0	308,000.0	487,000.0
Total Kjeldahl Nitrogen TKN (ppm)	18,600.0	16,200.0	13,900.0
Oil & grease (ppm)	11,810.0	22,020.0	67,960.0
Mercury (ppm)	0.74	0.66	1.06
Lead (ppm)	214.0	390.0	111.0
Zinc (ppm)	320.0	323.0	449.0
Arsenic (ppm)	19.0	14.0	42.0
Cadmium (ppm)	6.5	6.2	11.0
Chromium (ppm)	110.0	63.0	87.0
Copper (ppm)	172.0	150.0	239.0
Nickel (ppm)	58.0	51.0	75.0
Vanadium (ppm)	1,300.0	670.0	550.0

a significant release of PCB's. The concentrate for PCB's shown in Table 3 exceed EPA's water quality criteria for freshwater and marine aquatic life and for consumers thereof (EPA Quality Criteria for Water, July 1978, p. 193-199). For ocean disposal, Section 103 of the Marine Protection, Research, and Sanctuaries Act 1972 prohibits the dumping of contaminated sediment if they would cause water quality criteria to be exceeded. However, dilution of the contaminants will allow for disposal of the material in an ocean environment.

TABLE 3
ELUTRIATE TEST
NEW ENGLAND DIVISION LABORATORY, CORPS OF ENGINEERS
JULY 1979

Constituent	Dredge Site Water (Background Levels)	Standard Elutriate Replicate 1	Replicate 2	Replicate 3
Nitrite (N) mg/l	0.008	0.010	0.010	0.009
Nitrate (N) mg/l	0.11	0.10	0.09	0.09
Sulfate (SO_4) mg/l	1840	2420	2300	2320
Oil & grease mg/l	<5	<7	<7	26
Phosphorus (P)				
Ortho mg/l	0.027	0.060	0.060	0.061
Total mg/l	0.057	0.131	0.129	0.129
Mercury (Hg) mg/l	<0.0005	<0.0005	<0.0005	<0.0005
Lead (Pb) mg/l	0.052	0.051	0.049	0.048
Zinc (Zn) mg/l	0.001	0.35	0.35	0.35
Arsenic (As) mg/l	<0.006	0.006	0.006	0.006
Cadmium (Cd) mg/l	0.001	0.002	0.002	0.002
Chromium (Cr) mg/l	0.10	0.09	0.10	0.117
Copper (Cu) mg/l	0.28	0.18	0.15	0.16
Nickel (Ni) mg/l	0.16	0.13	0.12	0.11
Vanadium (V) mg/l	0.09	0.20	0.21	0.20
Total DDT ug/l	<0.1	<0.1	<0.1	<0.1
Total PCB ug/l	12	26	12	13

Disposal

Disposal of dredge material will result in many of the same physical impacts associated with dredging. Dredge material will be point dumped at a designated location to insure dredge material is not released outside the disposal site. Some amount of material will be suspended in the water column and dispersed by local currents. However, most of the dredge material is expected to descend quickly to the bottom, with little loss to the water column, and form a mound. Benthic organisms inhabiting the disposal may be destroyed by burial. Again, repopulation is expected to commence shortly after disposal activities cease.

Bioassay

In order to determine possible adverse environmental impacts from disposing of dredged material in ocean water, EPA and the Corps of Engineers developed a manual for conducting bioassay tests. Bioassay tests subject sensitive marine organisms to dredged materials and any contaminants they may contain. There are three phases to the test - liquid, suspended particulate, and solid. Of these, the solid phase test is considered the most important.

Bioassay tests were conducted using Island End River sediment samples in May, 1979. Based on criteria contained the EPA/Corps manual, the proposed oceanic discharge of dredged material from Island End River was judged ecologically unacceptable. While statistical analysis showed no significant difference in survival of the copepod (Acartia tonsa), the mysid shrimp (Mysidopsis bahia) and the Atlantic silverside (Menidia menidia) when exposed to Island End River sediments and control sediments for both the liquid and suspended particulate phases of the test, the total (combined) survival of the mysid shrimp (Neomysis americana), hard clam (Mercenaria mercenaria) and sandworm (Nereis virens) exposed for 10 days to control sediments in the solid phase of the dredged material was significantly different. The conclusion that dredged material from Island End River was ecologically unacceptable for ocean disposal was based solely on the low survival that characterized mysid shrimp (Neomysis americana) exposed to the solid phase of the material. It was thought the poor survival of mysid shrimp was, in great part, attributable to fine particulate matter in the dredged sediment, and therefore, test results were inconclusive. In an attempt to determine whether high mortalities were the result of fine particulate matter (physical death due to suffocation) or due to sediment toxicity (chemical-biological death), the solid phase only of the bioassay test was done again in October 1979. All features of this second trial duplicated the first effort except that sediments collected from the Boston Foul Area, the proposed disposal site, were used as the reference.

Results of the second solid phase bioassay tests showed no statistically significant difference in survival of the three test organisms when exposed to Island End River sediments and Boston Foul Area reference sediments. These results support the theory that high mortalities experienced in first test may have been due to fine particulate matter. Consequently, ocean disposal of dredge material from Island End River is considered ecologically acceptable. Results of both bioassay tests can be found in Appendix 5.

Threatened or Endangered Species

There are no known threatened or endangered species inhabiting the project area nor would the proposed project modify critial habitat of any species in such a manner as to jeopardize the continued existence of that species.

Archaeological and Historical Resources

Dredging is not expected to have any impact on known archaeological or historical resources.

AFFECTED ENVIRONMENT

The Island End River is a tidal estuary forming a portion of the boundary between the cities of Everett and Chelsea, and is located approximately two miles north of downtown Boston in the heart of the Boston metropolitan area. The Island End River enters the Mystic River about one-half mile upstream of the confluence of the Mystic and Chelsea Rivers, and about one and one-half miles upstream of Boston Harbor.

At present an industrial shipping channel is maintained along the Everett shoreline and is used by an Exxon Corporation terminal, the Marquette Cement Company and Coldwater Seafood Corporation. These companies maintain berthing facilities on the Island End River that are used on a regular basis by barges and freighters. North of Coldwater Seafood Corporation, land uses abutting the river consist of small industries, and warehouses.

The easterly shore of the Island End River borders the Chelsea Naval Hospital Site. This site is the location of an extensive redevelopment program involving housing, industrial/commercial development, a waterfront park and a marina serving 250 boats. This undeveloped land provides an opportunity for a much needed waterfront recreation area.

Water Quality

A uniform high level of water pollution exists in Boston Inner Harbor, of which the Island End River is considered a part. Major sources of water pollution include storm drain and sewer overflows, debris and refuse, wastewater treatment effluents, and commercial and recreational boats, and discharges. Boston Harbor carries an SC water use classification, such being the case, Inner Harbor uses are restricted to recreational boating, fishing and industrial processing and cooling. The area is also considered suitable for fish and wildlife propagation.

Water samples have been taken from the Mystic River on a seasonal basis over a period of years in conjunction with many Federal and non-Federal projects.

Dissolved oxygen concentrations are generally homogenous and range from 50% saturation in the Upper Mystic River to 75% saturation near the Mystic River Bridge. Repeatly high levels of inorganic nitrogen have been recorded while inorganic phosphorus is generally low. The source of nitrogen pollution in this area is thought to be from the Mystic Lakes or their drainage area (Stone and Webster, March 1977). pH ranges from 6.5 to 8.0 and Coliform bacteria is present in concentrations as high as 300,000 cells/100ml (Haedreck et al, 1972). Oil sheens are common on the water surface.

Wildlife

Birds are the most abundant form of wildlife found in the Boston Harbor area, especially on the Outer Harbor Islands. A wide variety of songbirds, shorebirds and migratory waterfowl can be found in the marshes, aquatic and upland habitats found in and around the harbor. Small mammals such as rabbits squirrels and skunks are common and may be found at the Chelsea Naval Hospital site.

Benthic Populations

Benthic sampling at Island End River was done on 30 May 1979. Five replicate sediment samples from two stations were collected with an Ekman dredge from within the limits of the proposed channel. All benthic macroinvertebrates were identified and counted.

The populations of organisms found in the samples are typical of those found in polluted marine ecosystems. Noteable characteristics of these populations are the relatively high density of polychaete worms and the absence or low density of molluscs or bivalves. Capitellidae, a pollution tolerant polychaete worm, was found in much higher density at Station 2 compared to Station 1 thus indicating a more polluted environment exists at the upstream end of the river. Table 4 presents results of benthic sampling.

TABLE 4

	STATION 1					STATION 2				
Benthic Organisms	Sample #1 No/Sq Ft	Sample #2 No/Sq Ft	Sample #3 No/Sq Ft	Sample #4 No/Sq Ft	Sample #5 No/Sq Ft	Sample #6 No/Sq Ft	Sample #7 No/Sq Ft	Sample #8 No/Sq Ft	Sample #9 No/Sq Ft	Sample #10 No/Sq Ft
Polychaeta Nereidae	2320	3152	2648	2688	2016	2800	1984	800	2240	928
Capitelledae	1872	1752	1024	2272	2768	5152	12,320	11,296	8640	13,216
Spionidae (Polydora)	496	760	320	544	752	352	80	48	64	32
Phyllodocidae	4	0	8	16	32	48	0	0	0	0
Sabillidae	16	16	0	0	0	272	208	0	32	16
Oweniidae	0	0	24	0	0	0	0	0	0	0
Other(egg cases)*	4	16	0	0	0	0	1	16*	0	64*
Nemotoda	8	256	40	80	368	16	0	64	0	32
Turbellaria	36	16	0	16	0	16	16	16	0	0
Hydrozoa	0	0	0	0	0	48	240	48	80	32
Crustacia Amphipoda	8	0	0	0	0	0	0	0	0	0
Mollusca Bivalve	0	0	8	0	0	0	0	0	0	0
TOTAL BENTHIC ORGANISMS	4764	5968	4072	5616	5936	8704	14,849	12,272	11,056	14,256

Fisheries

Sampling for finfish in Boston Inner Harbor and the Mystic River has been conducted in conjunction with many projects, both Federal and Non-Federal. Hardrick et al (1973) have conducted seasonal surveys of the fish in the Mystic River using trawls and gillnets. Twenty-three species were identified. Winter flounder was the dominant species, with alewives and smelts abundant on a seasonal basis. These three species were found throughout the year while other species occurrence varied seasonally. A list of those species identified is found in Table 5.

TABLE 5
FINFISH
(HAEDRICK AND HAEDRICK)

American eel	*Anguilla rostrata*
Blueback herring	*Alosa aestivalis*
Alewife	*Alosa pseudoharengus*
Shad	*Alosa sapidissima*
Menhaden	*Brevoortia tryannus*
Sea herring	*Clupea harengus*
Rainbow smelt	*Osmerus mordax*
Cod	*Gadus morhua*
Tomcod	*Microgadus tomcod*
Pollock	*Pollachius virens*
Squirrel hake	*Uraphycis chuss*
White hake	*Urophycis tenuis*
Ocean pout	*Macrozoarces americanus*
Sea robin	*Prionotus carolinus*
Grubby	*Myoxocephalus aeneus*
Four-spined stickleback	*Apeltes quadracus*
White perch	*Morone americana*
Striped bass	*Morone saxatalis*
Cunner	*Tautogolabrus adspersus*
Silverside	*Menidia menidia*
Mackerel	*Scomber scombrus*
Windowpane flounder	*Scophthalmus aquosus*
Winter flounder	*Psendopleuronectes americanus*

FINDING OF NO SIGNIFICANT IMPACT

The project as proposed calls for removing approximately 64,000 c.y. of silty-clay sediments by clamshell dredge and disposing of this material at the Boston Foul Area. Dredging will provide a safe access channel, 6 feet deep (MLW) and 100 feet wide, to a marina that will be built by the city of Chelsea.

The determination to prepare an Environmental Assessment, as opposed to an Environmental Impact Statement, was based on the following considerations:

The recreational nature of the project will complement and enhance local land use.

Successful bioassay test results indicating it is environmentally acceptable to dispose of Island End sediments at an open water site.

The availability of a suitable open water disposal site, i.e., the Boston Foul Area, where fine grain sediments will match those from Island End River.

The elutriate test results on Island End River sediments exceed EPA's "Red Book" water quality criteria for PCB's. However, it is likely that the PCB levels would be diluted to a level comparable to that presently found in the Boston Foul Area.

Coordination with appropriate Federal and State agencies to insure various concerns and suggestions were made known to the Corps so that these concerns could be addressed during project planning.

29 May 1980
Date

Max B. Scheider
MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

RECOMMENDATION

The Division Engineer recommends that a federal navigation project at Island End River, Chelsea, Massachusetts, be authorized by the Chief of Engineers under the provisions of Section 107 of the Rivers and Harbors Act of 1960, as amended.

The project would provide a channel, 6 feet deep below mean low water and 100 feet wide, from deep water in the Mystic River Channel to the proposed marina facility and boat launching ramp for a total length of 2,500 feet. The total project cost is estimated to be $629,000. Annual maintenance costs are estimated to be $21,700. The recommendation is made subject to the condition that local interests will:

- Provide a cash contribution of 50 percent of the cost of construction, presently estimated to be $314,500.

- Provide without cost to the United States all necessary lands, easements and rights-of-way required for construction and subsequent maintenance of the project including suitable dredged material disposal areas with necessary retaining dikes, bulkheads and embankments therefor.

- Hold and save the United States free from damages that may result from construction and maintenance of the project.

- Provide and maintain berths, floats, piers, and similar marina and mooring facilities as needed for transient and local vessels as well as necessary access roads, parking areas and other needed public use shore facilities open and available to all on equal terms.

- Establish regulations prohibiting the discharge of untreated sewage, garbage, and other pollutants in the waters of the harbor users thereof, which regulations shall be in accordance with applicable laws or regulations of federal, state, and local authorities responsible for pollution prevention and control.

ISLAND END RIVER
CHELSEA, MASSACHUSETTS

DETAILED PROJECT REPORT

PROBLEM IDENTIFICATION
APPENDIX 1

PREPARED BY THE

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

PROBLEM IDENTIFICATION

TABLE OF CONTENTS

TABLE OF CONTENTS
(Cont'd)

LIST OF TABLES

LIST OF PLATES

LIST OF EXHIBITS

PROBLEM IDENTIFICATION

SECTION A

ANALYSIS OF EXISTING CONDITIONS AND TRENDS

1. This appendix contains information supplementing the first two sections of the Main Report, Introduction and Problem Identification, describes previous studies and reports, describes the existing and projected future (without project) conditions, identifies problems and sets forth the national objectives, the planning objectives and constraints developed for this project.

PRIOR STUDIES AND REPORTS

2. The impetus for the current project resulted from the closing of the Chelsea Naval Hospital in 1974. When the Federal Government declared the property as surplus, several studies were undertaken to evaluate the conversion to civilian uses.

3. In 1974, a study for the city of Chelsea was prepared entitled, A Recommended Plan for the Reuse of the Naval Hospital Chelsea, Massachusetts, which proposed construction of marina facilities on the Island End River.

4. Marina development and dredging of a channel in the Island End River were evaluated further in the Development Master Plan and Feasibility Analysis - Chelsea Naval Hospital. This study was performed using funding from the Economic Development Administration of the U.S. Department of Commerce. In addition to housing and a waterfront park, the Master Plan proposed that a portion of the property be used for industrial and commercial development. A marina serving 250 boats and a site for associated industries were the primary focus of the industrial/commercial redevelopment area. Dredging of the Island End River to provide a navigable channel to the marina site was proposed in this report. Exhibits 1-1 through 1-11 which are excerpts from the Development Master Plan provide an overview of the redevelopment plans for the former Naval Hospital property.

5. In November, 1978, the New England Division of the U.S. Army Corps of Engineers prepared a Small Boat Navigation Project Reconnaissance Report to determine the need for further detailed study of navigation improvements in the Island End River. The Reconnaissance Report set forth a conceptual plan for an access channel and turning basin as illustrated in Figure 1-1. The proposed project consisted of a two-acre turning basin, approximately three hundred feet square located at a point two thousand feet upstream from the Mystic River. An access channel one hundred feet wide by six feet deep at MLW was proposed on an alignment generally following the center of the river. The Reconnaissance Report indicated the project would have a benefit-cost ratio of 10.2 and recommended that further detailed study be undertaken.

LOCATION

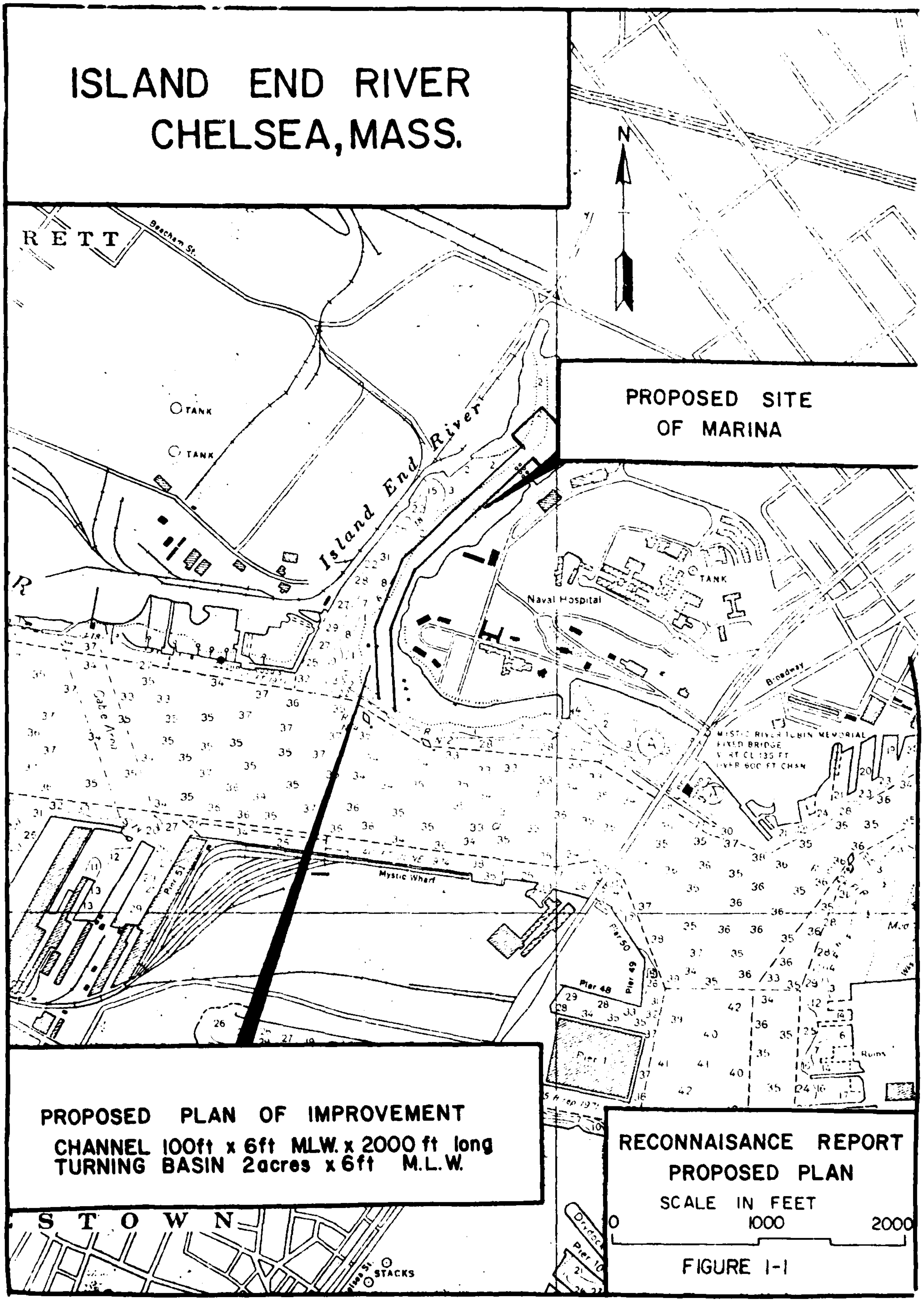
6. The Island End River is located approximately two miles north of downtown Boston in the heart of the Boston Metropolitan area. The river forms a portion of the boundary between the cities of Chelsea and Everett, and coincidentally Middlesex and Suffolk counties. The Island End River enters the Mystic River about one-half mile upstream of the confluence of the Mystic and Chelsea Rivers, and about one and one-half miles upstream of Boston Harbor.

POPULATION AND EMPLOYMENT

7. Chelsea and Everett are relatively small cities characteristic of older central urban industrial areas. Although the population of the Boston Standard Metropolitan Statistical Area (SMSA), in which both cities are located, has increased in recent years, the populations of Chelsea and Everett have declined. This negative growth trend is consistent with regional and national trends over the last three decades toward increased migration to suburban settings made possible by improved transportation systems outside the central city.

8. As indicated by Table 1-1, population decline in Chelsea and Everett has accelerated over the most recent decade. The figures shown translate to a decrease of 13.3% between 1950 and 1960 and 9.3% between 1960 and 1970 in Chelsea, and a decrease of 5.3% between 1950 and 1960 and 2.5% for the period 1960-1970 in Everett. The most recent available estimates from the U.S. Census for 1975 show a more rapid decline of 19.3% in Chelsea and 7.1% in Everett for the 1970-1975 period. The Metropolitan Area Planning Council anticipates continued decline, projecting a 1990 population of 23,000 in Chelsea and

ISLAND END RIVER
CHELSEA, MASS.



PROPOSED SITE
OF MARINA

PROPOSED PLAN OF IMPROVEMENT
CHANNEL 100ft x 6ft MLW. x 2000 ft long
TURNING BASIN 2acres x 6ft M.L.W.

RECONNAISANCE REPORT
PROPOSED PLAN
SCALE IN FEET
0 1000 2000

FIGURE 1-1

37,500 in Everett. The population trends in both cities contradict the trend toward continued positive growth in the Commonwealth of Massachusetts as a whole.

TABLE 1-1

Population Trends

	1950	1960	1970	1975
Chelsea	38,912	33,748	30,625	24,716
Everett	45,982	43,544	42,455	39,473
Boston SMSA	2,369,986	2,590,040	2,753,804	
Massachusetts	4,690,514	5,149,317	5,689,170	5,812,489

Source: U.S. Census Data

9. As in many older urban areas, median age is higher and educational levels are lower in Chelsea and Everett than the average for the metropolitan area. In 1970, sixty-five percent of the metropolitan area population over twenty-five completed high school while the corresponding figure for Chelsea was forty-one percent. Both cities have diverse ethnic populations with recent increases in the Hispanic and Portuguese communities.

10. While the majority of workers in Chelsea and Everett are classified as white collar, the percentage of white collar workers is lower than the regional average. The number of workers in the blue collar occupations, such as craftsmen, operatives and laborers, compose forty-one percent of the labor force in Chelsea, compared to twenty-eight percent for the Boston Metropolitan Area.

11. According to 1970 census estimates the most recent available, most workers in Chelsea and Everett are employed fairly close to their homes. In the city of Chelsea, approximately seven percent of the workers are employed in downtown Boston, twenty-six percent in other parts of the city of Boston and thirty-eight percent in other parts of Suffolk County, including Chelsea. Twenty percent of Chelsea workers walk to work, a proportion more than double the regional average. Few Everett and Chelsea workers have jobs outside of Suffolk and Middlesex counties.

12. The importance of manufacturing to the general economy of the area is highlighted by an analysis of employment by industry in Chelsea and Everett. As indicated by Table 1-2, the leading employment sector in Chelsea is wholesale and retail trade, followed closely by manufacturing and service industries. In Everett, manufacturing ranks first with service industries and wholesale and retail trade a somewhat distant second and third, respectively. Other major employment sectors and the percentage of total employment offered by each are shown in Table 1-2.

TABLE 1-2
Covered Employment By Industry

	Chelsea		Everett	
	#	%	$	%
Total Employment	8,761	100.0	11,563	100.0
Agriculture, Forestry, Fishing	4	.1	11	.1
Mining	0	0	0	0
Contract Construction	181	2.1	836	7.2
Manufacturing	3,273	37.4	3,972	34.4
Trans., Comm, Utilities	482	5.5	720	6.2
Wholesale & Retail Trade	3,402	38.8	2,124	18.4
Finance, Insurance, Real Estate	406	4.6	333	2.9
Services	1,014	11.6	2,396	20.7
Not Classified			1,171	10.1
Total # of Firms	625		598	

Note: Covered employment by industry includes all employment reported to the Division of Employment Security in thier annual survey.

Source: Compiled with 1977 data obtained from the Massachusetts Division of Employment Security.

13. Unemployment in Chelsea and Everett tends to fluctuate, as expected, with statewide and national trends. In 1978, the unempolyment rate averaged 6.2% in Chelsea and 7.5% in Everett, the latter significantly higher than either the State average of 6.1% or the national average of 6.0%. The unemployment rate in both cities has decreased slightly according to data available for the first eight months of 1979, as summarized in Table 1-3.

TABLE 1-3
Unemployment Rates (%)

	1978	1979 (Eight Months)
Chelsea	6.2	5.9
Everett	7.5	7.1
Massachusetts	6.1	5.7
United States	6.0	6.0

Source: Massachusetts Division of Employment Security.

14. Per capita income in Chelsea and Everett, as shown in Table 1-4, has not reached the level for the State as a whole, with Chelsea ranking among the State's lowest.However, the rate of growth of this indicator between 1969 and 1974 was approximately equal to that of the State in Chelsea, and exceeds that of the State in Everett.

TABLE 1-4

Per Capital Income

	1969	1974	% Change
Chelsea	2,846	3,957	39.0
Everett	3,160	4,489	42.1
Massachusetts	3,407	4,755	39.6

Source: U.S. Bureau of the census.

15. Median family incomes in the two cities are also lower than State and regional averages. In 1970, median family income was $8,973 in Chelsea and $10,086 in Everett, compared with $11,449 in the Metropolitan area. In Chelsea, eleven percent of family incomes were below the poverty level as compared with six percent in the Boston Metropolitan area. By contrast, the city of Everett has a lower percentage of families at the poverty level than the regional average, with a total of 5.8%.

16. ECONOMY

The major industries in Chelsea and Everett are manufacturing and wholesale trade. the area serves as an important production and distribution center serving markets throughout the Boston area and beyond. Because Chelsea and Everett are employment centers, a fairly large number of persons are employed in these cities relative to the resident population.

17. In the city of Chelsea, manufacturing concerns provide more than fifty percent of the city's 11,000 jobs. The principal industries include metals, electrical machinery, stone, clay, glass, paper and rubber and plastics. These cities also serve as a major storage and distribution center for various petroleum products and natural gas. The Exxon Corporation has a major terminal facility in the area. A liquified natural gas terminal is located in Everett on the Mystic River between the Tobin Memorial and Broadway bridges. The LNG facility docks some 18 tankers per year or an average of one every twenty days.

In recent years, the cities of Chelsea and Everett have become an important wholesaling and distribution center for fruit and vegetable produce.

18. LAND USE

Land use in both Everett and Chelsea, is characterized by residential areas in the central and northern parts of the city and industrial development to the south and along the waterfronts. In both cities commercial areas and municipal land uses tend to be found near the principal north-south streets.

19. With the exception of the Chelsea Naval Hospital grounds, most of the waterfront along the Chelsea, Mystic, Island End and Malden Rivers is devoted to industrial uses. As shown in figure 1-2, land use along the developed industrial area on the Everett side and by the relatively undeveloped grounds of the former Chelsea Naval Hospital on the Chelsea side. This undeveloped land provides an opportunity for a much needed waterfront recreation area.

20. On the western shoreline at the mouth of the Island End River, an Exxon Corporation terminal fronts on the Mystic and Island End Rivers. Berths for oil tankers are located along the Mystic River while berths for smaller barges extend about 350 feet north along the Island End River waterfront. Petroleum products including gasoline, fuel oil and asphalt are transferred by pipeline to and from bulk storage facilities nearby.

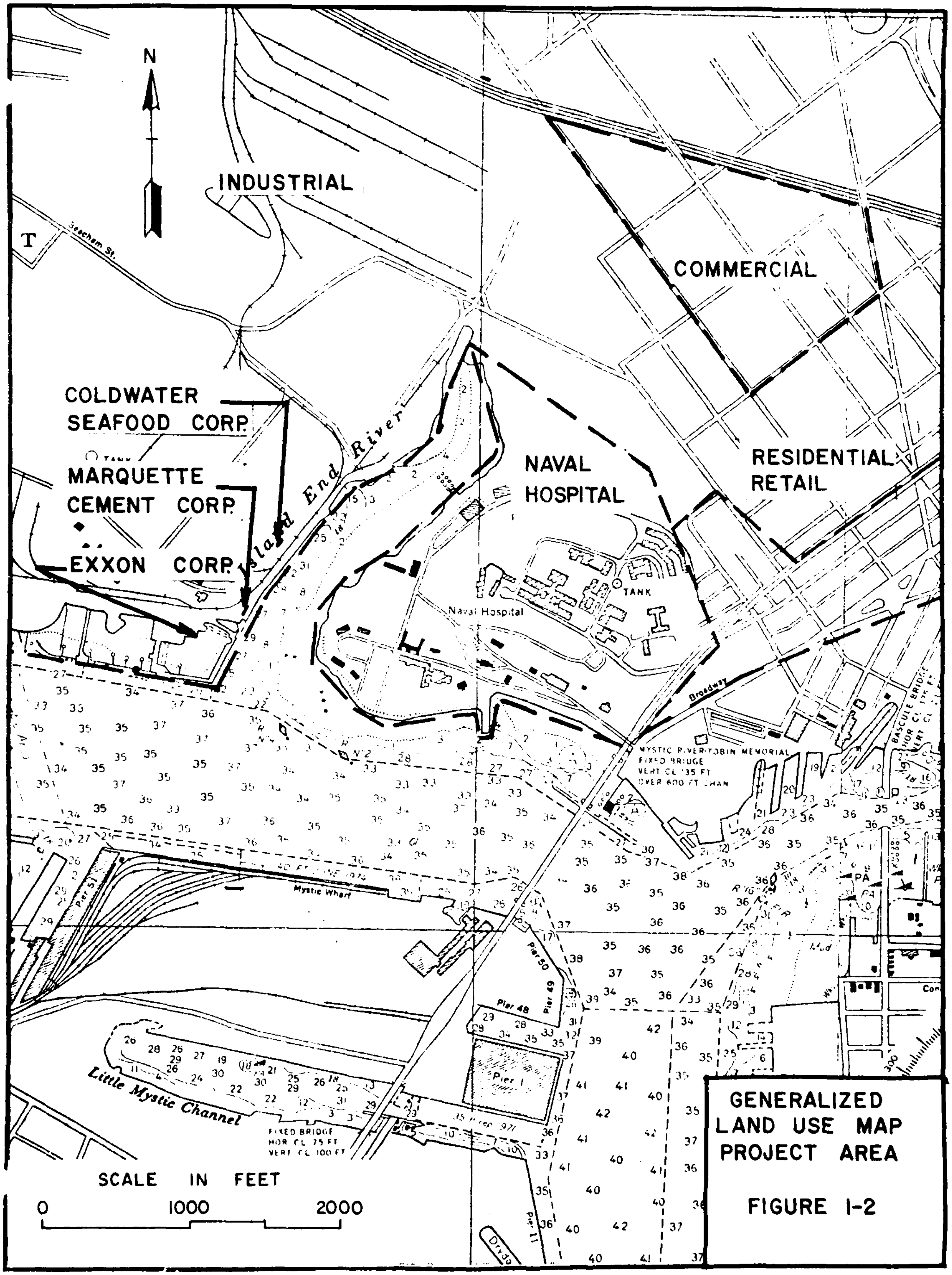
21. North of the Exxon Corporation terminal are the Marquette Cement Company and the Coldwater Seafood Corporation. These companies maintain berthing facilities on the Island End River that are used on a regular basis by barges and freighters.

22. North of the Coldwater Seafood Corporation, land uses abutting the river consist of small industries. Abandoned wharves extend an additional six hundred feet north along the shoreline. At the northern end of the river on the Everett shoreline, the river borders a parking lot behind a produce warehouse. A rail spur extends along the shoreline of the wharves between the end of the Exxon Corporation property and the produce warehouse.

23. North of the river, land uses consist primarily of industrial and warehouse structures with some commercial facilities intermixed. A bank and a large Polaroid manufacturing plant are located immediately to the north of the river. The easterly shore of the Island End River borders the Chelsea Naval Hospital site. The site contains sixty-eight vacant structures, including the main hospital building, living quarters, storage buildings, a maintenance shop, a garage, laboratories and supporting facilities. The property is under the jurisdiction of the General Services Administration until conversion to civilian use can be completed.

PRESENT NAVIGATION

24. Three industrial firms use the Islanad End River. The Exxon Corporation presently handles one hundred fifty vessels per year at their berths on the Island End River. These vessels are primarily barges with the capacity of 60,000 to 70,000 barrels and with maximum drafts of seventeen to eighteen feet. The largest barge now using



GENERALIZED LAND USE MAP PROJECT AREA

FIGURE 1-2

the river has a capacity of 100,000 barrels with a draft of twenty-two feet. Exxon Corporation officials do not predict an increase in the number of vessels using the river, but do anticiapte that larger barges will be used in the future. Exxon Corporation officials said that barges up to 150,000 barrels with drafts to thirty feet could be used in the future.

25. Marquette Cement Corporation presently uses a barge approximately three hundred feet in length overall by sixty feet in breadth with twenty-two feet of draft. Marquette receives two or three shipments per month. Coldwater Seafood Corporation has an average of one ship docking per week. The ships are refrigerated freighters ranging in size from 1,000 to 5,000 DWT. The largest is about three hundred seventy feet long with a beam of sixty feet and a draft of twenty-two feet. All of the ships using the Island End River are tug assisted. At the present time, recreational boating use of the Island End River is minimal.

FUTURE CONDITIONS WITHOUT THE FEDERAL PROJECT

26. Five possible scenarios were considered to represent the future conditions in the Island End River if the Federal project is not undertaken. All of the scenarios take the following three conditions as given.

> The three existing industries presently using the Island End River for shipping will continue to do so in the future. They are well established and continued use of the river is essential for their operation.
>
> The Metropolitan District Commission park will be constructed as planned. Acquisition of the property by the MDC is pending.
>
> The Chelsea Naval Hospital property will be developed for housing and other uses as currently planned.

ALTERNATIVE FUTURES WITHOUT PROJECT

27. The following five scenarios represent possible futures that might occur if the Federal project is not undertaken.

SCENARIO 1

28. Future industrial development requiring water access would occur on the Everett shoreline upstream of the Coldwater Seafood Corporation. This would require extension and expansion of the existing

commercial channel. Development of the marina would not occur as planned on the Chelsea side of the river.

SCENARIO 2

29. The city of Chelsea and private developers would undertake dredging of a recreational channel without Federal funds. Under this scenario, the project would proceed as planned with a mixture of private and local government funding. No expansion of commercial shipping would occur in the river.

SCENARIO 3

30. Without the Federal project, marina plans would be abandoned and the proposed marina site would be considered for industrial uses. An industrial zone would extend from the existing Polaroid building to the northern edge of the proposed MDC park. Under this scenario, no dredging of the river would occur. Recreational use of the river would be extremely limited.

SCENARIO 4

31. Without the Federal project, marina plans would be abandoned and the marina site would be used for industrial purposes. The demand for mooring marina space for recreational craft would result in the construction of a limited amount of mooring facilities along the Everett shoreline, north of the Coldwater Seafood Coorporation. Sufficient depth presently exists there for a distance of about three hundred fifty feet upstream. Approximately thirty recreational boats could be moored there. No dredging of the river would occur.

SCENARIO 5

32. Under this scenario, the marina plans would be abandoned and no mooring facilities would be constructed on the Everett side. The proposed marina site would either be left undeveloped or incorporated into the proposed MDC park. No dredging or filling of the river would occur.

EVALUATION

33. Future expansion of industries requiring water access, as in Scenario 1, appears to be relatively unlikely. The Everett shoreline is fully developed and there is no undeveloped land available. The existing industries upstream of the channel have no need for water access and the existing wharves already are deteriorating.

34. Dredging of the channel without Federal funding as in Scenario 2 is unlikely due to the substantial cost of the project and the fact that the city is relatively poor and has a limited tax base. Although the project would eventually serve to increase the tax base, the city would probably be unable to provide sufficient funds for the initial capital improvements.

35. Extensive industrial development along the Island End River as set forth in Scenario 3 would not be compatible with the historical constitution Magazine structure, the proposed MDC park or the adjacent upper income housing.

36. Scenario 4 assumes that property owners on the Everett shoreline would be willing to commit a portion of their land to the shore-related marina facilities such as parking lots. Although it appears possible that mooring space could be provided in the river along the Everett side without dredging, provision of land access would be difficult. A rail spur running along the shoreline beetween the Exxon Corporation terminal and the Boston Fruit Auction is in active use. Provisions for parking and pedestrian access would be difficult due to the existing land use pattern in the area.

MOST PROBABLE FUTURE

37. Scenario 5 is considered to be the most probable future if the Federal project is not undertaken. Conditions in the Island End River would remain essentially the same as they are today. No major dredging, filling or alterations of the shoreline would probably occur.

38. Plans for redvelopment of the Chelsea Naval Hospital would not be adversely affected if improvements to the Island End River are not implemented. Some 1500 units of luxury housing are proposed for the Naval Hospital site. Some of these units will be oriented to view the proposed marina. The presence of an onsite marina is also considered to be an added amenity for prospective occupants. There would therefore be some reduction in the marketability of the housing if the proposed marina facilities are not constructed. The restoration of buildings two and three would probably be limited. Public rather than private funds would probably be required as there would be limited incentive for private investment.

39. Development of the MDC park would occur as planned if the Federal improvements to the river did not take place. However, the potentially synergistic effects arising from the proximity of the public open space to the recreational boating facilities would not occur.

40. With visual access to the shoreline of the Island End River along the MDC park property and with the presence of a residential population on the former hospital grounds, it is likely that there would be some public pressure to clean up the river.

41. Water quality in the river could be expected to improve gradually in the future as measures to clean up the Mystic River and Boston Harbor are implemented. Species such as clams and mussels might slowly reestablish themselves in upstream portions of the Island End River, although the river would remain closed for shellfishing or the foreseeable future.

42. Recreational boating in the Island End River is expected to remain limited in the future. Occasional transient craft may enter the lower portions of the river at interim and high tidal conditions. A few boats might be moored offshore and allowed to ground at low tides. While this type of mooring arrangement has been observed in other parts of the Boston area, the restrictions placed on boat usage by tidal fluctuations make this arrangement unacceptable to most small craft owners.

PROBLEMS AND NEEDS OF THE STUDY AREA

43. The problems and needs of the study area were identified through consideration of baseline conditions, development proposals for the Island End River and Chelsea Naval Hospital site and the concerns of agencies and interested parties.

THE PROBLEM OF A LIMITED TAX BASE AND EMPLOYMENT OPPORTUNITIES

44. The city of Chelsea is relatively poor and geographically small. The tax base still suffers from the effects of a deveastating fire in 1973 that destroyed forty-five acres of industrial and residential property. The tax base could be greatly expanded by private redevelopment of the now tax exempt Naval Hospital site. The marina is considered an important part of the redevelopment effort. It will generate tax revenue itself, will enhance the marketability of the housing and will encourage development of marina-related

enterprises such as restaurants, nautical supply stores, boat sales and repairs. The Federal project is considered vital to the successful development of the marina.

45. Because of their desire to create a compatible environment for the redevelopment of the Naval Hospital site, the city is also concerned with the aesthetic quality of the river. They would like to see an extensive dredging effort to remove the majority of the exposed tidal mud flat areas. They consider a more extensive open water area at low tide to be more visually attractive and they are concerned about potential odor problems from the exposed mud flats at low tide.

THE PROBLEM OF LIMITED RECREATIONAL FACILITIES AND WATERFRONT ACCESS FOR CHELSEA RESIDENTS

46. Chelsea, with a population of about 25,000, has only twenty-five acres of recreation space. According to the National Park and Recreation Association and the U.S. Department of Interior Standards, there should be one acre of open space for every one hundred residents, or approximately two hundred fifty acres in the city of Chelsea.

47. In addition to the shortage of open space and recreational facilities, Chelsea residents have virtually no public access to the waterfront. Although the city is abutted on three sides by water, extensive development of the shoreline for industrial purposes limits its accessibility.

THE PROBLEM OF INADEQUATE BOAT MOORING SPACE, BOAT REPAIR AND STORAGE FACILITIES IN BOSTON HARBOR

48. The greater Boston area suffers from a shortage of recreational slips due to the great demand for recreational boating and a limited supply of suitable marina facilities. Develoment of marinas is limited by a lack of available undeveloped shoreline areas next to sheltered waters and by environmental factors.

49. Some residents of the Boston area must travel great distances to a marina where they keep their boat. Others keep their boats on open moorings in unsheltered locations. Discussions with marina operators indicated that some have waiting lists of up to five years for space and have stopped taking applications.

50. According to the Master Plan there is also a shortage of boat repair and storage facilities for boats within the Boston Harbor area. Although there are several marinas in the harbor, shore facilities are apparently not as readily available as in suburban locations.

THE PROBLEM OF RESTRICTED NAVIGATION

51. Because of the shallow depths in the upper reaches of the Island End River, navigation cannot occur in much of the river during low tide and much of the ebb and flow period. Any proposed channel improvements must provide sufficient space so that all maneuvering can be accomplished within the channel limits.

PROBLEMS OF NAVIGATION

52. Many operators of small craft have limited experience in operation and navigation. Therefore, relatively straight channel alignments are desirable.

THE PROBLEM OF CONFLICTS WITH EXISTING SHIPPING

53. Present shipping activities are likely to continue in the Island End River for the foreseeable future. Due to the restricted dimensions of the existing channel and the restricted maneuvering capabilities of large vessels under tow, conflicts between existing shipping and future recreational boating may develop. This potential problem would be most noticeable if recreational craft were required to use the existing commercial channel.

THE PROBLEM OF SECURITY AT THE EXXON TERMINAL

54. Discussions with Government agencies and the industrial concerns located along the westerly shore of the Island End River in Everett

served to identify potential problems associated with use of the river by recreational craft. In general, representatives of the industries which use the Island End River felt that small craft in the river would cause little interference with operations. Some concern was expressed about accidents if small boats are to use the existing channel. Enforcement of boating safety regulations would help alleviate potential problems. They noted that commercial shipping already mixes with recreational boating on the Mystic River, although substantially more space is available for maneuvering.

55. Representatives of Exxon were more concerned with the potential for an accident with the volatile chemicals, such as gasoline or naptha handled at their terminal. They preferred that the recreational channel be situated at a reasonable distance from their terminal.

THE PROBLEM OF POOR WATER QUALITY

56. At present, water quality in the Island End River is poor. Bottom sediments in the river are polluted with heavy metals and petroleum residues, due to runoff from urban areas, leaching from solid wastes disposed of near the shore of the river and possible discharges from vessels and industrial activities on the shoreline of the river. The proposed project could impact water quality in several ways. In the short term, dredging will result in deterioration of water quality. However, it will also remove a portion of the polluted bottom sediments. Long term impacts of the project will be due to pollution produced by the recreational boats.

PROBLEMS WITH DISPOSAL OF DREDGED MATERIAL

57. Sediments in the Island End River are primarily organic silts and clays and are contaminated with heavy metals and petroleum products. If these materials were removed by dredging, both State and Federal regulations would control their disposal.

58. Ocean disposal of dredged material is controlled by Federal regulations. Because the sediment has passed minimum Federal bioassay standards for toxicity to marine organisms, ocean disposal will be permitted. However, adverse impacts on water quality and marine organisms will be associated with the discharge of any type of sediment into the ocean.

59. Under State regulations, land disposal of dredge material must take place in a site which is approved by the local board of health, and is confined in diked or bulkheaded sites with facilities to

control effluents. Because of the presence of pollutants, the Massachusetts Department of Environmental Quality Engineering felt that land disposal of the dredged material from the Island End River could be a serious problem. In addition to its toxic properties, the sediment has poor structural properties. Therefore, the dredged material would not be usable as a structural fill material beneath buildings or structures. Disposal at the site of the proposed landfill at the proposed Massport Container Port facility in South Boston is feasible. However, the schedules of the two projects would have to be coordinated and the dredged materials would have to be similar to the other materials to be involved in the landfill.

PROBLEMS WITH ALTERATION OF THE INTERTIDAL ZONE

60. The National Marine Fisheries Service and the Massachusetts Division of Marine Fisheries expressed concern over preservation of the intertidal zone. Because the extent of the intertidal zone habitat is limited in the inner Harbor, efforts should be expended to preserve remaining areas. Marine life in this zone serves as a food source for fin fish. The agencies felt that it may become a more important resource in the long term as water pollution is abated. Soft-shell clams were found in the intertidal zone near the mouth of the river. Although the Island End River is closed to shellfishing because of pollution, the existing shellfish population can help to repopulate other shellfish beds in Boston Harbor.

NEEDS

61. The needs of the community as developed through the identification of its existing problems are basically two-fold. The amount of waterfront access available to the community must be increased and development of a plan of improvement which will allow for increased water related recreational activities within the study area.

OPPORTUNITIES

62. The former Naval Hospital site presents an opportunity for the city of Chelsea to develop the property for a variety of civilian uses. The hospital site can be considered a unique land resource in that it provides eighty-eight acres of developable land on a scenic site only two miles from downtown Boston. Its undeveloped waterfront has a potential for recreational use in an area where most of the waterfront is used for industrial purposes. The availability of a marina site also presents an opportunity to address regional needs

for boat mooring and storage facilities, public access to the waterfront, and public recreation facilities.

SECTION B
PLANNING OBJECTIVES AND CONSTRAINTS

NATIONAL OBJECTIVES

63. Planning for channel improvements in the Island End River is based in part on national objectives of economic development and enhancement of environmental quality. Section 103 of the Water Resources Planning Act of 1965 directed the National Water Resources Council to establish principals and standards for planning Federal and Federally-aided water resource projects. In 1973, the Council published Principles and Standards for Planning Water and Related Land Resources which provide the broad policy framework for planning activities. The Standards provide for uniformity and consistency in comparing, measuring and judging the beneficial and adverse effects of alternative water resource improvement projects. The purpose of the Principles and Standards is to promote the quality of life by planning for the attainment of the following objectives:

> To enhance national economic development by increasing the value of the nation's output of goods and services and improving national economic efficiency.
>
> To enhance the quality of the environment by the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural resources, cultural resources and ecological systems.

64. These are termed National Economic Development (NED) and Environmental Quality (EQ) objectives. The NED and EQ objectives were fully considered in developing and evaluating the alternative improvement plans.

PLANNING CONSTRAINTS

65. Planning constraints are those parameters which can place limitations on any proposed plan of improvement. As limitations, they are used to direct plan formulation and restrict impacts cutting across a broad spectrum of concerns. These concerns may include natural conditions within the project site, technological states of the area, economic limits, and legal restrictions.

66. This study has identified through consultation with Government agencies and local businesses a number of concerns, but only two issues which may be identified as constraints.

67. As the Island End River is located in a heavily urbanized and industrialized area, the quality of its bottom material has been affected. Therefore, any proposed project must minimize the removal of any toxic materials to reduce the adverse effects on marine life and alteration of the intertidal zone. As a corollary, minimal removal of any materials will significantly lessen any expected impacts associated with disposal of the dredged materials.

68. Ocean disposal of dredged material is controlled by Federal regulations. However, adverse impacts on water quality and marine organisms will be associated with the discharge of any type of sediment into the ocean.

69. Disposal for landfill at the site of the proposed Massport Container Facility at the former Naval Base in South Boston appears to be economically and environmentally feasible if coordination of project schedules can be achieved and if the material from the Island End River proves to be similar in nature to the other materials slated for disposal there. Land disposal also appears feasible, but it is less environmentally desirable and more costly than the other alternatives. Under State regulations, land disposal of dredged material must take place on sites approved by the local board of health. It must be confined by dikes or bulkheads and provided with facilities to control effluents. Because of the presence of pollutants, the Massachusetts Department of Environmental Quality Engineeriing felt that land disosal of the dredged material could be a problem. In addition to its toxic properties, the sediment has poor structural properties. Therefore, the material would not be acceptable as structural fill material beneath buildings of structures. Due to the large volume of dredged materials, a disposal site must be found near the shoreline to avoid adverse impacts associated with its transport.

70. The second constraint identified is to restrict any construction activities to the fall months. Said restriction will avoid suspension of water pollutants during the spring alewife run in the Mystic River.

In summary, planning constraints as identified are:

- minimize removal of toxic materials.
- restrict construction activties to the fall months.

71. As stated earlier in this section, consultations with interested parties determined a number of concerns should be identified and addressed.

72. Present commercial shipping activites are expected to continue in the Island End River for the foreseeable future. Due to the restricted dimensions of the existing channel and the maneuverability of large vessels under tow, conflicts between existing shipping and future recreational boating may develop. This potential problem would be most noticeable if recreational craft were required to use the existing channel.

73. Due to the possibility of an accident involving the volatile chemicals at the Exxon Corporation, the proposed recreational channel should be located at a reasonable distance from the existing commercial channel at the Exxon facilities. Construction of a channel immediately adjacent to the Exxon terminal could result in sparks or open flames occurring from dredging operations (short term) or from the operation of recreational small craft (long term). The 1973 Uniform Fire Code of the International Conference of Building Officials and the Western Fire Chief Association requires that smoking and open flames be prohibited within 50 feet of fueling operations.

74. The metropolitan District Commission has proposed development of a twenty-six acre park along the edges of the Mystic and Island End Rivers. Since locating the marina within the proposed park may disrupt current plans, the marina facility must be located upstream on the Island End River.

75. Along the opposite bank of the river is the Everett shoreline which is highly developed and protected by timber bulkheads or riprap. Any changes to the Everett shoreline would likely require acquisition of property and would probably meet opposition from Everett property owners.

76. Because the extent of intertidal zone habitat is limited in the inner harbor, the National Marine Fisheries Service and the Massachusetts Division of Marine Fisheries have expressed concern over the possible impacts any improvements may have on the existing zone.

PLANNING OBJECTIVES

77. Planning objectives for this study were established after carefully analyzing the identified concerns regarding the use of water and related land resources in this study area. The purpose of these planning objectives is to translate identified needs, opportunities, and problems into specific objectives for the study. Planning objectives, as set forth herein, will be used in conjunction with planning constraints in the development of alternatie plans that properly address study objectives and area needs. The establishment of clearly defined planning objectives is also essential in evaluating the various plans that have been studied. The relative merit of each plan is determined, in great part, by the degree to which it addresses and fulfills each planning objective.

78. Based on the discussions of problems, needs, and opportunities previously presented, two planning objectives have been identified as important guidelines to formulation and evaluation of plans to meet the area needs and study objectives.

- Contribute to navigation, for recreational purposes, in the Island End River, during the 1980-2030 period of analysis.
- Contribute to the safety of navigation, for commercial and recreational vessels, in the Island End River, during the 1980-2030 period of analysis.

79. Consideration of these objectives and planning constraints led to the formulation of resource management alternatives that will be presented in the following appendix.

EXHIBIT 1-1

Development Plans Chelsea Naval Hospital

The following is a series of excerpts from the _Development Master Plan and Feasibility Analysis - Chelsea Naval Hospital_. These excerpts provide an overview of the development plans for the marina.

SUMMARY OF THE PROPOSED DEVELOPMENT PLAN

The program of development for the Hospital site includes the following elements:

- Waterside Public Park of 26 Acres.
- Residential Community of 1200 units including approximately:

  300 Duplex Townhouses
  570 Mid-Rise Market Rate Apartments
  Subsidized Elderly Apartments

- Marina for 250 Boats and Related Marine Commercial Uses.
- Fourteen Acres of Light Industrial Uses.

The Waterside Park is planned as a passive recreation area where residents from Chelsea and surrounding cities can picnic, play, and enjoy the views of harbor activity. The heavily landscaped park will be operated by the MDC and be open to the public. Though larger in size, it's use will be similar to the waterfront park in Boston.

The residential community, atop the hill to afford striking views of the Boston skyline, the harbor, and the outer suburbs to the north, is planned at a relatively low density to improve its marketability. The duplex townhouses will be built into the side of the hill affording ease of entry and privacy. The mid-rise, conventionally financed, apartments will include both new construction and the rehabilitation of historic structures. Ancillary commercial and community facilities will be located on the first floor and courtyard of the historic Marine hospital. This Town Centre will be the focal point for community activities, including tennis, swimming, meeting rooms and a health club. The elderly apartments will also be adjacent to this activity area.

The Island End River will be dredged to provide one of the few protected marinas for small boats in Boston Harbor. Townhouses will be constructed near the piers with boat storage and related marine commercial uses developed on the low land adjacent to the marina.

The plan also calls for other light industrial uses to be built on the flat land on the eastern side of the new access road connecting the site with newly reconstructed Spruce Street.

As indicated by an analysis of the Greater Boston housing market the apartments and townhouses should receive strong market acceptance because of the proximity of the site to downtown Boston and the views and amenities inherent in the proposed plan. Achievement of the development program is dependent, however, upon the availability of public funding for site clearance, roadway and utility construction, and a subsidy to defray the excessive costs of rehabilitating the historic structures for residential uses.

In the next stage of implementation, the site will be advertised for developers, environmental clearances obtained, and final acquisition negotations with GSA completed. Preliminary indications of support for Federal funding have been obtained, thus it is anticipated that the required BOR, EDA, and HUD grants will be received in the first half of 1978 with actual demolition and construction commencing in 1979.

DEVELOPMENT IMPACT ON THE CITY OF CHELSEA

Hopes for the rebirth of Chelsea rest with the accomplishments of this development program. When completed the project will produce over $1,000,000 per year in taxes on land previously tax exempt. This revenue amounting to approximately $18/1000 on the Chelsea tax rate, will afford the city an opportunity to better provide sorely needed services to its below average income population. Most importantly, however, the park, marina, and housing will signal to all that Chelsea has been reborn,that it can attract upper-income people back to the city, that it is not merely a declining industrial city. The impact of that change in preception will have far-reaching effects on the surrounding property throughout the city.

CHAPTER 3

HOUSING DEVELOPMENT PLAN

GENERAL DESCRIPTION

This Housing Development Plan is intended as a set of guidelines and constraints for the private development of those areas of the Chelsea Naval Hospital site not included in the proposed MDC Park and the marina development area. The Plan defines the range of feasible and desirable potential uses which a private developer or developers will be permitted to construct on the site, and describes the environmental goals that the design of the constructed units should attempt to achieve.

The Development Plan (see Exhibit 3-1) divides the private development portion of the site into Development Zones, and for each defines the types and numbers of units, heights of construction, environmental characteristics and amenities recommended for that zone. These zones should be understood as general areas of the site, as their defining characteristics will suggest, and not as parcels with rigid boundaries. Furthermore, the unit types and characteristics recommended for each zone are not intended as unquestionable restrictions; rather, some mixture and variation upon the guidelines may be appropriate. The Development Plan is designed to permit a range of solutions, setting only the predominant character for the development of each area of the site.

The description of the Development Plan is accompanied by an Illustrative Site Plan (Exhibit 3-2) and companion photographs of a site model (Exhibit 3-3). These designs illustrate one potential solution that typifies and complies with the housing Development Plan guidelines. This is not intended to suggest that the design is the only acceptable solution; rather, this Illustrative Site Plan should assist the reader in understanding and imagining the reasons for and implications of the Development Plan guidelines.

Overall Character

The design approach to the site should attempt to utilize and preserve the natural assets of the site - its visible hilltop, slopes and well-developed vegetation. The image of the whole site that the viewer approaching on the Mystic River Bridge has should be that of the dominance of the topographic features and vegetation, rather than of the buildings placed upon the site.

Development is projected of approximately 1200 units of housing on the site, to be developed in stages as described below (see Phasing Proposal). Of that total, roughly 25% - 30% should be townhouse units, 45% - 50% market-rate apartments, and 20% - 25% subsidized apartments for the elderly.

The housing development should take advantage of and orient to, as much as possible, the attractive views and desirable micro-climate toward the south, southwest and west. The buildings atop the hill should act as a buffer from the harsh winter winds from the north; they should capitalize on the attractive long distance vista of the hills to the north and northeast, while screening the views of the nearby industrial area.

The housing development should be designed to give a sense of neighborhoods within the overall development, through clustering of units and focal community spaces. The residents should be able to identify with a smaller neighborhood grouping, rather than only the overall 1200-unit development.

Certain existing structures on the site are to remain in the new development: those that are on the National Historic Register, including buildings one, fifty-nine, the Commandant's House and the Constitution Magazine; and some which are substantial residential structures that can be easily reused for residences and which add continuity to the historic character of parts of the site, including residence B, C, D, E, F, and G. These buildings should be actively reused and integrated into the overall development and use of the site. Others may desire to rehabilitate additional structures which is to be encouraged.

CHAPTER 5

COMMERCIAL-INDUSTRIAL DEVELOPMENT AREA

GENERAL DESCRIPTION

The redevelopment program of the Chelsea Naval Hospital site calls for one-fourth (1/4) or approximately 22 acres to be developed for commercial or industrial purposes. The area designated is the relatively flat section of the site adjacent to the Murray Industrial Park. The new access road will link this section directly to Spruce Street.

The major focus of this commercial-industrial development area will be a new marina for approximately 250 boats on the Island End River. In addition to the marina itself with ancillary commercial facilities such as a restaurant, the development program calls for marine related industrial uses such as boat repair and storage. Light industrial uses not marine related are also possible on the site.

A substantial need for pleasure boat docking facilities exists in Boston Harbor. With the increase in boating activities there are long waiting lists for docking space at protected marinas. The proposed marina area, though requiring substantial site improvements, is particularly well suited for this use. Removed from the main shipping channel the mooring area will be protected from the wave action of passing tugs and ships. The proposed marina will afford boat owners easy access to the open ocean and yet protection from storms.

The large marina as proposed will create a requirement for the ancillary boat repair and storage services. In addition, these services are not readily available in the inner harbor, so it is anticipated that boats moored elsewhere will be brought to the proposed facility for repair and storage. Eventually it is hoped that marine related manufacturing facilities might also be developed on the site. The land not used for marine facilities is available for general industrial development. Sweetheart Paper Company, an abutter to the site, is interested in acquiring a portion of the land for its expansion needs. It is also anticipted that when the Murray Renewal park is completely sold that there will be additional demand for industrial land. The physical improvements to the renewal area are now being completed so sales of the land should begin in the next six-months. One half of the site has been sold as a shopping center site which is now under construction. The industrial land in the Naval Hospital site will be ready for marketing in approximately two years when the access road is constructed. This time schedule will mesh with the completion of marketing activities in the renewal area.

SITE IMPROVEMENT COSTS

In addition to the new access road connecting the site to Spruce Street which is also required for the park and housing developments, substantial site improvements will be required to create a marina in the Island End River. Historically, marina development without some form of public subsidy has been difficult. It is especially so on this site where a harbor itself must be created. In general the public sector will create the waterfront facilities and piers and the operator of the facility will construct the buildings on the approximately eight acres of land. Some subsidy will also be required to offset the excessive costs of rehabilitating the Constitution Magazine. An estimate of the development costs prepared by Sasaki Associates based on similar marina design is set forth below for the marina facilities. The figures do not include the potential private development of the remaining 14 acres of industrial land. It is proposed that the facility would be constructed with public funds and leasedfor a long term to the private developer. The lease would guarantee the availability of berthing space on an equitable basis. Tax revenue from the commercial-industrial area should approximate $300,000 per year based on a 50% load coverage for industrial and 20% off gross marina revenues.

MARINA DEVELOPMENT

PRELIMINARY COST ESTIMATE

PUBLIC DEVELOPMENT COSTS

Dredging	$ 500,000
Floats	367,200
Piers	165,000
Bulkhead	550,000
Concrete Slap & Cap	63,000
Rip Rap	13,440
Extra Structural Repair of Bldg. 3	120,000
Sub Total	$1,779,140
Contingency, Engineering & Escalation 30%	533,742
Total Public Development Cost	$2,312,882

PRIVATE DEVELOPMENT COSTS

Plaza	562,000
Asphalt Paving	357,094
Structures	2,400,000
Renovation	372,750
Concrete Walk	9,300
Landscaping	18,450
Sub Total	$3,719,594
Contingency, Engineering & Escalation 30%	1,115,878
Total private Development Cost	$4,835,472

FUNDING PROGRAM
(000)

Total Cost	BOR	EDA	Corps Eng.	HUD UDAG	Comm. of Mass.	
PUBLIC COSTS						
PARK						
Demolition	$ 103.8		62.3		41.5	
Construction	2,255.9	1,128.0				1,127.9
Sub-Total	$2,359.7					
HOUSING & OTHER						
Demolition	924.2		554.5		369.7	
Roadways	1,070.0		128.4		941.6	
Sewer	365.0		54.8		310.2	
Storm Drains	564.8		84.7		480.1	
Water	796.5		119.5		677.0	
Electrical	410.0		61.5		348.5	
Restoration	360.0				360.0	
Land Purchase	746.0				746.0	
Contingencies/Engineering	826.1		123.9		702.2	
Sub-Total	6,062.6					
COMMERCIAL-INDUSTRIAL						
Dredging	500.0			250.0	250.0	
Piers & Bulkhead	1,159.1		695.5		463.6	
Restoration	120.0				120.0	
Contingencies/Engineering	533.7		320.2		213.5	
Land Purchase	622.6				622.6	
Sub-Total	2,935.4					
ADMINISTRATION & LEGAL	500.0				500.0	
ADJACENT ROAD IMPROVEMENTS	2,300.0					2,300.0
Sewer & Water	372.0		223.2		148.8	
Less Land Proceeds	(1,368.6)				(1,368.6)	
TOTAL PUBLIC COST	$13,161.1	1,128.0	2,428.5	250.0	$5,926.7	3,427.9
PRIVATE COSTS						
Housing	53,528.7					
Marina	4,835.5					
Industrial	10,323.7					
TOTAL PRIVATE COSTS	$67,687.9					
TOTAL INVESTMENT	$81,849.0					
RATIO PUBLIC TO PRIVATE	6.2:1					

ISLAND END RIVER
CHELSEA, MASSACHUSETTS

DETAILED PROJECT REPORT

FORMULATION, ASSESSMENT AND EVALUATION OF DETAILED PLANS
APPENDIX 2

PREPARED BY THE

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

FORMULATION, ASSESSMENT AND EVALUATION OF DETAILED PLANS

Table of Contents

FORMULATION, ASSESSMENT AND EVALUATION OF DETAILED PLANS

Table of Contents (Cont.)

List of Tables

List of Plates

SECTION A

FORMULATION, ASSESSMENT AND EVALUATION OF DETAILED PLANS

1. The formulation of a plan of improvements for the Island End River has followed the procedures of the Water Resources Council Principles and Standards. Local needs and objectives were identified and project-specific planning objectives and constraints were established. These planning objectives and constraints were considered in the formulation of detailed plans, as were the national objectives of National Economic Development (NED) and Environmental Quality (EQ).

FORMULATION AND EVALUATION CRITERIA

2. Detailed technical, economic and environmental criteria were applied in the formulation and evaluation of the alternative plans. These criteria reflect quantitative measures of the plan performance in relation to the national and local planning objectives and planning constraints. These criteria, which are described below, are utilized in the System of Accounts to evaluate the four alternative detailed plans.

TECHNICAL CRITERIA

3. The technical criteria are as follows:

- The selected plan should allow adequate space for a marina with a capacity of about two hundred fifty slips. The marina should be located such that the shore facilities can be provided at a reasonable cost and in a manner consistent with the overall redevelopment plans for the Naval Hospital property.

- Channel dimensions (length, width and depth) should be adequate for the types of craft expected to use the river.

- Provide adequate separation from the Everett shoreline such that dredging will not have an impact on the stability of the shore and no shore protection will be required.

ECONOMIC CRITERIA

4. The economic criteria are as follows:

- Maximize net benefits (project benefits minus project costs).
- Minimize local cost of the project.

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REPORT AND ENVIRONMENTAL ASSESSMENT REVISED(U) CORPS OF
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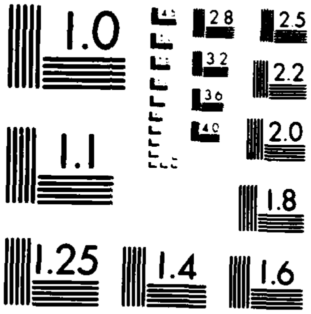
UNCLASSIFIED FEB 81 F/G 13/2 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

- Maximize net benefits to the City of Chelsea (sponsor of local share of project cost).
- Minimize potential development cost of locally funded harbor improvements, such as the boat launching ramp and marina.
- Minimize adverse impacts on operations of existing industries in Everett.

ENVIRONMENTAL, SOCIAL AND CULTURAL CRITERIA

5. The environmental, social and cultural criteria are as follows:

- Minimize volume of dredge material in order to reduce problems relating to the disposal of dredged materials.
- Minimize removal and alteration of intertidal areas to avoid impacts
- Provide aesthetic compatibility with MDC park and Naval Hospital housing redevelopment plans.
- Enhance and restore historic character of U.S.S. Constitution Magazine and pier.
- Maximize safety and ease of navigation to recreational craft.

SECTION B

POSSIBLE SOLUTIONS

6. Possible solutions to the problem of developing recreational boating facilities at the Chelsea Naval Hospital property include utilizing existing conditions (no improvement option) or developing new facilities.

NO IMPROVEMENT OPTION

7. The development of recreational boating at the Naval Hospital property without the federal project would be extremely unlikely. With no federal project there would be essentially two options that could be undertaken without dredging.

8. The first would be to make use of the Island End River in its present condition for the mooring of boats. Because of the tidal range and the present depths in the river, moored boats would have to be allowed to ground at low tide. The types of boats used would, therefore, be limited to small outboards or small centerboard sailboats. Use of the river would be limited by tide conditions.

9. The other possibility under the no improvement option would be to locate a marina along the Mystic River where adequate depths are already available.

10. Although the depth of the water at a Mystic River site would be adequate and would require little dredging, there are other disadvantages. A marina site on the Mystic River is not as sheltered as the Island End River. Boats would be exposed to waves in the river as well as wakes from passing ships. The number of berths in a marina would be constrained by the amount of space available between the shoreline and the pier/bulkhead line which is quite close to shore. Because of the heavy use of the Mystic River by commercial shipping, it is unlikely that a marina would be allowed to extend beyond the pier/bulkhead line. The pier/bulkhead line is also close to the shore along the Island End River; however, because there is currently no vessel traffic at the proposed marina site, it is anticipated that the restriction of the pier/bulkhead line can be relaxed. Even if the pier/bulkhead line restriction did not apply on the Mystic River, there would be sufficient space for marina development there than in the Island End River. There is a second primary factor, however, which precludes development of the marina on the Mystic River. It is the intended use of the shore as a park.

11. There would be a number of legal and jurisdictional problems involved with locating the marina off the shore of the proposed MDC park. The City of Chelsea would like the marina to be operated by private industry on a long-term lease and thus produce revenue for the City. Current MDC policies prohibit the providing of facilities for private use with public funds. Facilities in MDC parks are generally only provided for the users of the

park. In addition, the need to provide security for the marina is generally incompatible with the open access of the park. Substantial space would be needed on shore for parking and marina support facilities. Most of the land within the park has been allocated for various recreational uses. The marina is also intended to stimulate other tax-revenue producing private development on shore such as restaurants or marina-related enterprises. Neither marina support facilities nor related on shore private development is compatible with the aesthetic quality or function of a park. Therefore, location of a marina and related shore facilities within the limits of a publicly owned MDC park is incompatible with the plans for and the intended function of the area.

DEVELOP NEW FACILITIES

12. The development of new facilities in the Island End Rver is considered to be the most satisfactory means of meeting the needs of the City of Chelsea. In order to develop detailed improvement plans, the following four steps were undertaken:

PLAN FORMULATION RATIONALE

CHARACTERISTICS OF THE PROJECTED RECREATIONAL BOAT FLEET

13. The numbers, sizes and types of the boats expected to use the Island End River were estimated using the procedures set forth in Appendix 6.

ESTABLISH THE MARINA LOCATION, SIZE AND CONFIGURATION

14. Marina plans were shown in the Master Plan for the Naval Hospital in concept only. Although the Master Plan projected a capacity of two hundred fifty boats at the marina, there were no detailed drawings establishing the nature or location of piers, floating docks and boat launching ramp.

15. The Master Plan showed the use of the Constitution Magazine Buildings as marina-related commercial buldings. As illustrated in Exhibit 1-1, the existing stone pier behind these buildings was incorporated into the marina and additional piers were shown extending at right angles from the shore into the river.

16. In the Reconnaissance Report, the preliminary plan contained a two-acre turning basin approximately three hundred feet square immediately opposite the existing pier. The Reconnaissance Report made no assumptions about berthing configurations.

17. For the purposes of this study, marina concepts were evaluated in order to locate the channel and to establish the slip capacity.

18. Two alternative marina plans were developed and are illustrated in Figures 2-1 and 2-2. Marina "1" is based on the concept shown in the Master Plan, using the existing stone pier behind Building Two. A boat launching ramp is located at the far upstream end of the marina, while docks extend five hundred fifty feet downstream and seven hundred feet

upstream from the central pier. Marina "1" does not include a turning basin.

19. As shown in Figure 2-2, marina "2" is based on locating the marina facilities upstream of a two acre turning basin. A nonrectangular turning basin was used to correspond to the shape of the river.

20. An evaluation of the marina alternatives indicated that Marina "1" is preferable to Marina "2" for a number of reasons. In general, a turning basin requires an excessive amount of space within the tidal basin. Consequently, in order to accomodate the desired number of berthing slips at the marina, an extensive amount of dredging and bulkheading will probably be required with Marina "2".

21. The costs of development for Marina "2" are therefore higher, both because of more extensive shoreline protection and the larger amount of dredging needed for the marina basin. Assuming an upper limit on the per slip development cost of about $4,000 and further, assuming that no pier construction would occur along the Everett shoreline, the reasonable berthing capacity of Marina "2" is one hundred eighty boats.

22. Marina "1" provides a lower development cost per slip and also accommodates many more boats. There are two disadvantages to this marina configuration. First, the docks located on the downstream end are somewhat distant from the parking area. Secondly, no turning basin is provided.

23. Although Marina "1" does not include a turning basin, it does provide a one hundred foot wide channel adjacent to the berthing area. Most boats using the marina will be power boats less than forty feet in length. These vessels are highly maneuverable and will operate at low speeds in the marina area. In addition, many of the sailboats will probably have auxilary power. For these reasons, a turning basin is not considered a necessity. Elimination of a turning basin will improve the development advantages of the marina, reduce the amount of dredged material and reduce overall project costs. The marina concept shown in Figure 2-1 was, therefore, used as the basis of the development of detailed plans.

ESTABLISH REQUIRED CHANNEL DEPTHS AND WIDTHS

24. Alternative channel depths and widths were analyzed to determine the most cost effective dimensions based on the type of craft expected to use the Island End River. A channel depth of six feet MLW and a channel width of one hundred feet were found to be the most desirable channel dimensions. The determination of channel dimensions is explained in detail in Appendix 6.

DETERMINE ALTERNATIVE CHANNEL LOCATIONS

25. Four separate channel locations were developed for detailed study. These have been designated as Detailed Plans A, B, C and D. These four plans are analyzed in detail in the following section.

PLAN A

26. Plan A, which is indicated in Figure 2-3, requires the joint use of the existing commercial channel by recreational and commercial craft. The small craft channel would be dredged 1300 feet beyond the upstream end of the existing commercial channel. The channel would be one hundred feet wide by six feet deep at mean low water. It would be located roughly eighty to one hundred feet from, and parallel to, the Everett shoreline.

27. The area to be dredged for the channel generally follows the MLW stream bed. The present elevation of the river bottom ranges between one and one-half feet below to about 3 feet above mean low water.

28. Plan A necessitates the dredging of 52,000 cubic yards of material for the access channel. The marina basin and boat ramp would require the dredging of an additional 65,000 cubic yards, by local interests. This dredging would remove 2.0 acres of intertidal zone and alter an additional 0.5 acres. The dredging impacts of Plan A are summarized in Table 2-1.

29. Cost estimates for Plan A are summarized in Table 2-2. Plan A is estimated to have an initial cost of $519,000 and result in annual net benefits of $312,800.

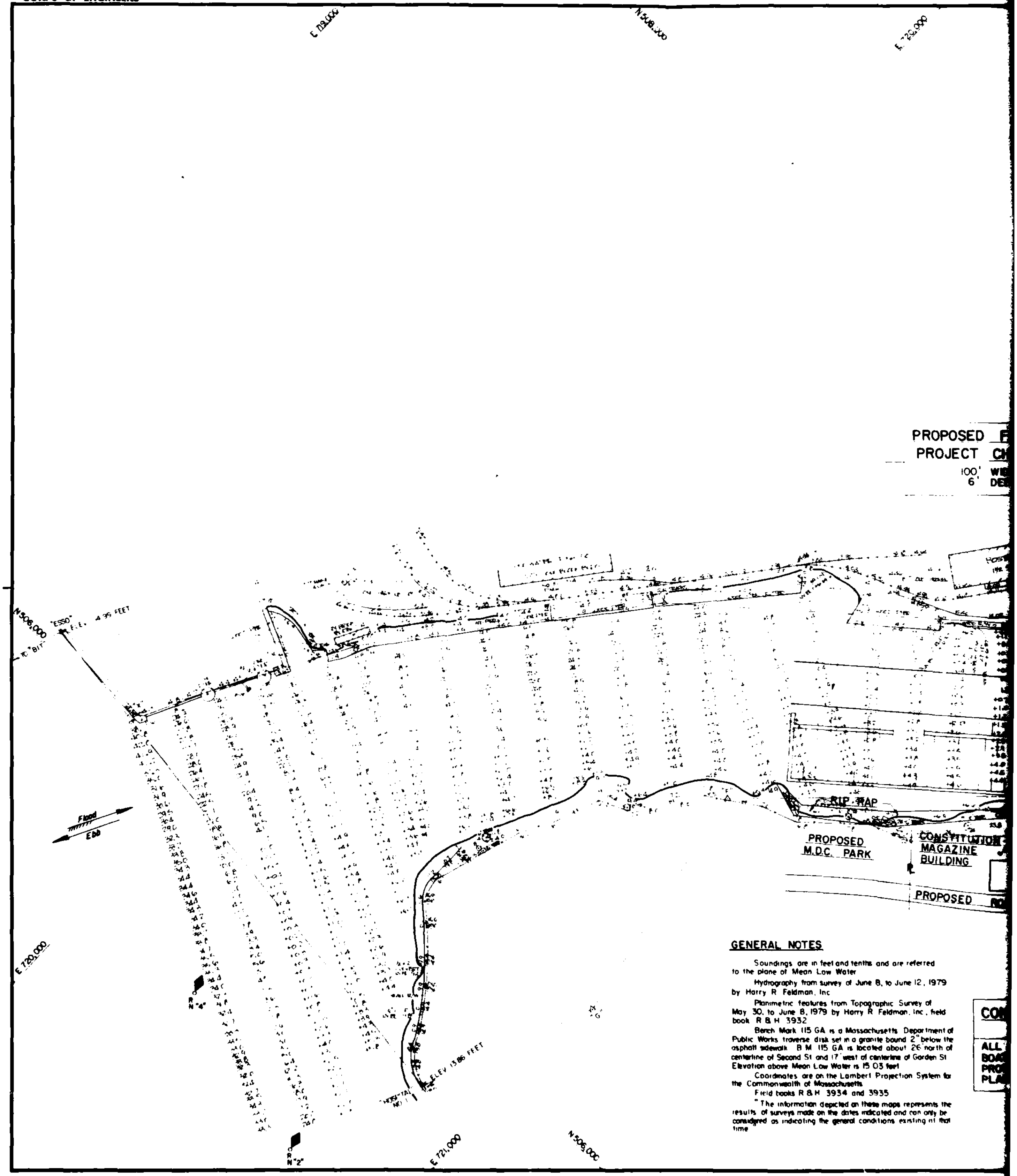
30. Since Plan A involves the joint use of the existing channel for both commercial and recreational craft, it may have some adverse impacts on existing shipping. There may be some minor delays to shipping, although, legally, the larger, less manuveurable ships have the right of way.

31. Delays to recreational craft are more likely, however, since they would be forced to wait for the barges and freighters to be maneuvered in the narrow channel. Delays are more likely to occur when there is heavy recreational boat traffic and when use of the river is restricted to the dredged channel limits at low tide. Based on the number of shipping operations, and the expected length of time for the barges or freighters to be berthed, it is estimated that the recreational benefits of Plan A would be reduced about seven percent due to delays.

32. Safety factors are more difficult to quantify. If all boaters used proper operating procedures and obeyed boating safety regulations, there should be no safety problems. However, there may be a number of inexperienced boaters who might be unaware of the potential safety problems. The primary dangers relate to the potential of collisions due to a small craft cutting across the path of a larger vessel and the potential of a small boat coming too close to the turbulent wash produced by the large commercial tugs.

33. It should be noted, however, that shared use of channels by commercial ships and recreational boats is common in harbor areas and presently occurs in the Mystic River.

CORPS OF ENGINEERS



GENERAL NOTES

Soundings are in feet and tenths and are referred to the plane of Mean Low Water

Hydrography from survey of June 8, to June 12, 1979 by Harry R Feldman, Inc

Planimetric features from Topographic Survey of May 30, to June 8, 1979 by Harry R Feldman, Inc, field book R B H 3932

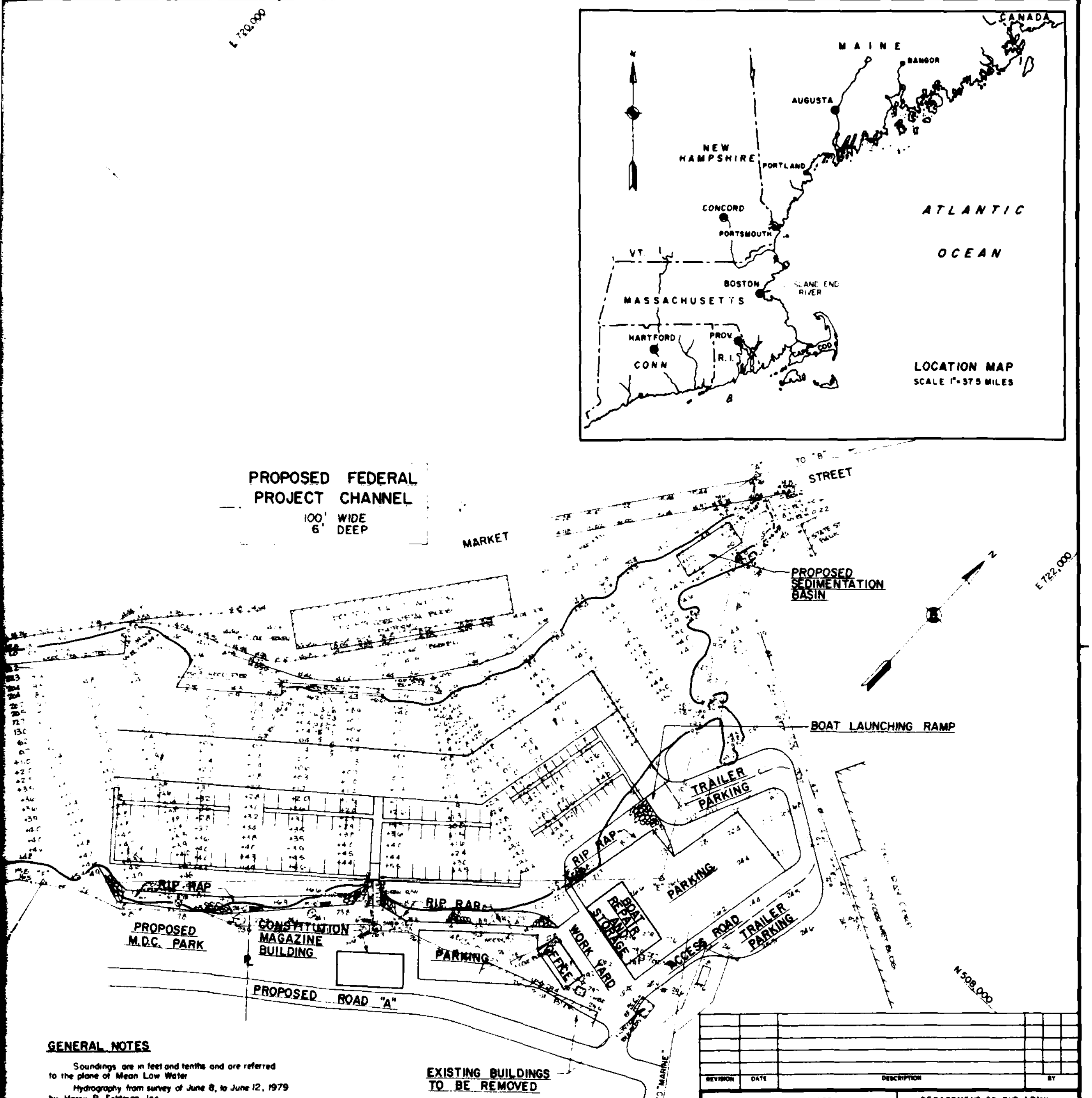
Bench Mark 115 GA is a Massachusetts Department of Public Works traverse disk set in a granite bound 2" below the asphalt sidewalk B M 115 GA is located about 26' north of centerline of Second St and 17' west of centerline of Garden St Elevation above Mean Low Water is 15 03 feet

Coordinates are on the Lambert Projection System for the Commonwealth of Massachusetts

Field books R & H 3934 and 3935

" The information depicted on these maps represents the results of surveys made on the dates indicated and can only be considered as indicating the general conditions existing at that time

U. S. ARMY



GENERAL NOTES

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Coordinates are on the Lambert Projection System for the Commonwealth of Massachusetts.

Field books R & H 3934 and 3935.

" The information depicted on these maps represents the results of surveys made on the dates indicated and can only be considered as indicating the general conditions existing at that time "

CONCEPTUAL MARINA PLAN I

ALL MARINA FACILITIES AND BOAT LAUNCHING RAMP TO BE PROVIDED BY LOCAL INTERESTS. PLAN SHOWN IS CONCEPTUAL.

GRAPHIC SCALE
100' 0 100' 200'

N 507,000

REVISION	DATE	DESCRIPTION	BY

STORCH ENGINEERS
2 CHARLESGATE WEST
BOSTON, MASS

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM MASS

DR. BY J D | TR. BY R P S | CK. BY A C B

SUBMITTED: STORCH ENGINEERS
ARCHITECT - ENGINEER
REVIEWED
CHIEF, [illegible]
APPROVAL RECOMMENDED
CHIEF, [illegible]
APPROVAL RECOMMENDED
CHIEF, PLANNING DIVISION

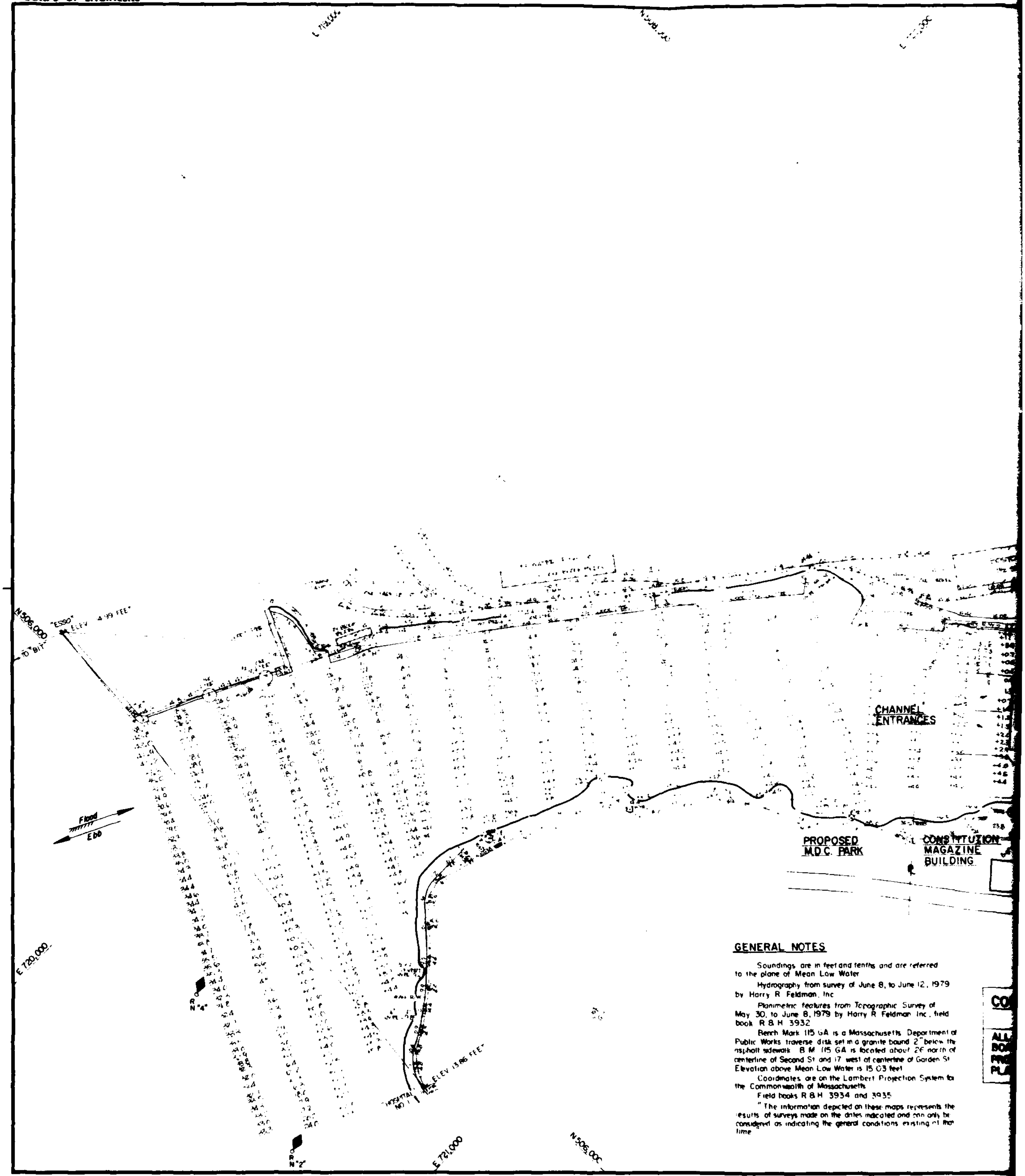
WATER RESOURCES IMPROVEMENT STUDY
ISLAND END RIVER - CHELSEA, MA.
MARINA I

APPROVED
CHIEF, ENGINEERING DIVISION
DATE JUNE 28, 1979

FIG. 2-1

SCALE 1"=100 | SPEC NO DACW 33-79-C 0076
DRAWING NUMBER
SHEET 1 OF 1

CORPS OF ENGINEERS



GENERAL NOTES

Soundings are in feet and tenths and are referred to the plane of Mean Low Water

Hydrography from survey of June 8, to June 12, 1979 by Harry R Feldman, Inc

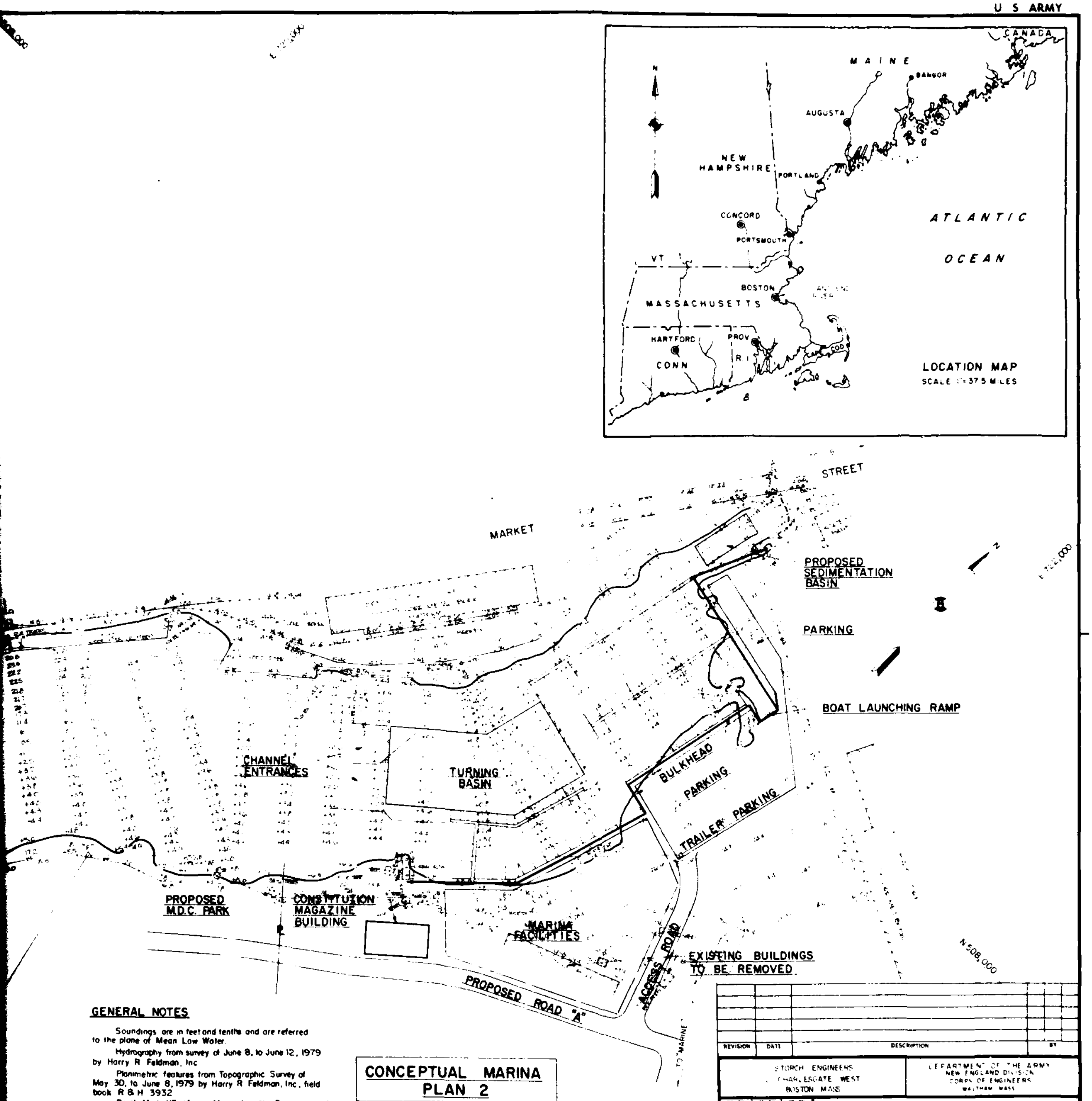
Planimetric features from Topographic Survey of May 30, to June 8, 1979 by Harry R Feldman Inc, field book R & H 3932

Bench Mark 115 GA is a Massachusetts Department of Public Works traverse disk set in a granite bound 2" below the asphalt sidewalk B M 115 GA is located about 26 north of centerline of Second St and 17 west of centerline of Garden St Elevation above Mean Low Water is 15 03 feet

Coordinates are on the Lambert Projection System for the Commonwealth of Massachusetts

Field books R & H 3934 and 3935

"The information depicted on these maps represents the results of surveys made on the dates indicated and can only be considered as indicating the general conditions existing at that time"



GENERAL NOTES

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CONCEPTUAL MARINA PLAN 2

ALL MARINA FACILITIES AND BOAT LAUNCHING RAMP TO BE PROVIDED BY LOCAL INTERESTS. PLAN SHOWN IS CONCEPTUAL.

GRAPHIC SCALE
100 0 100 200

REVISION	DATE	DESCRIPTION	BY

STORCH ENGINEERS
CHARLESGATE WEST
BOSTON MASS

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM MASS

DR BY J D | TR BY R P S | CK BY A C H

SUBMITTED STORCH ENGINEERS
ARCHITECT - ENGINEER

REVIEWED
CHIEF NAV & B E SECTION

APPROVAL RECOMMENDED
CHIEF TECH ENG BRANCH

APPROVAL RECOMMENDED
CHIEF PLANNING BRANCH

WATER RESOURCES IMPROVEMENT STUDY
ISLAND END RIVER-CHELSEA,MA.
MARINA 2

APPROVED
CHIEF ENGINEERING DIVISION

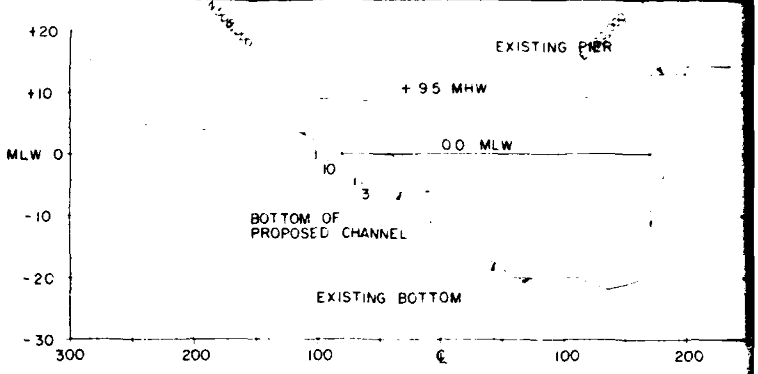
DATE JUNE 28, 1979

SCALE 1" 100
SPEC NO DACW 33 79 C 0016
DRAWING NUMBER
SHEET 1 OF 1

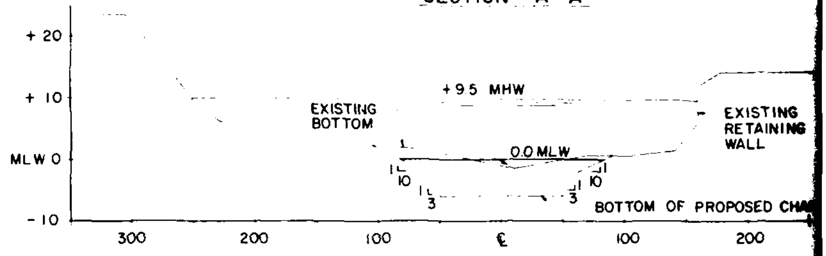
FIG. 2-2

12

CORPS OF ENGINEERS



SECTION A-A



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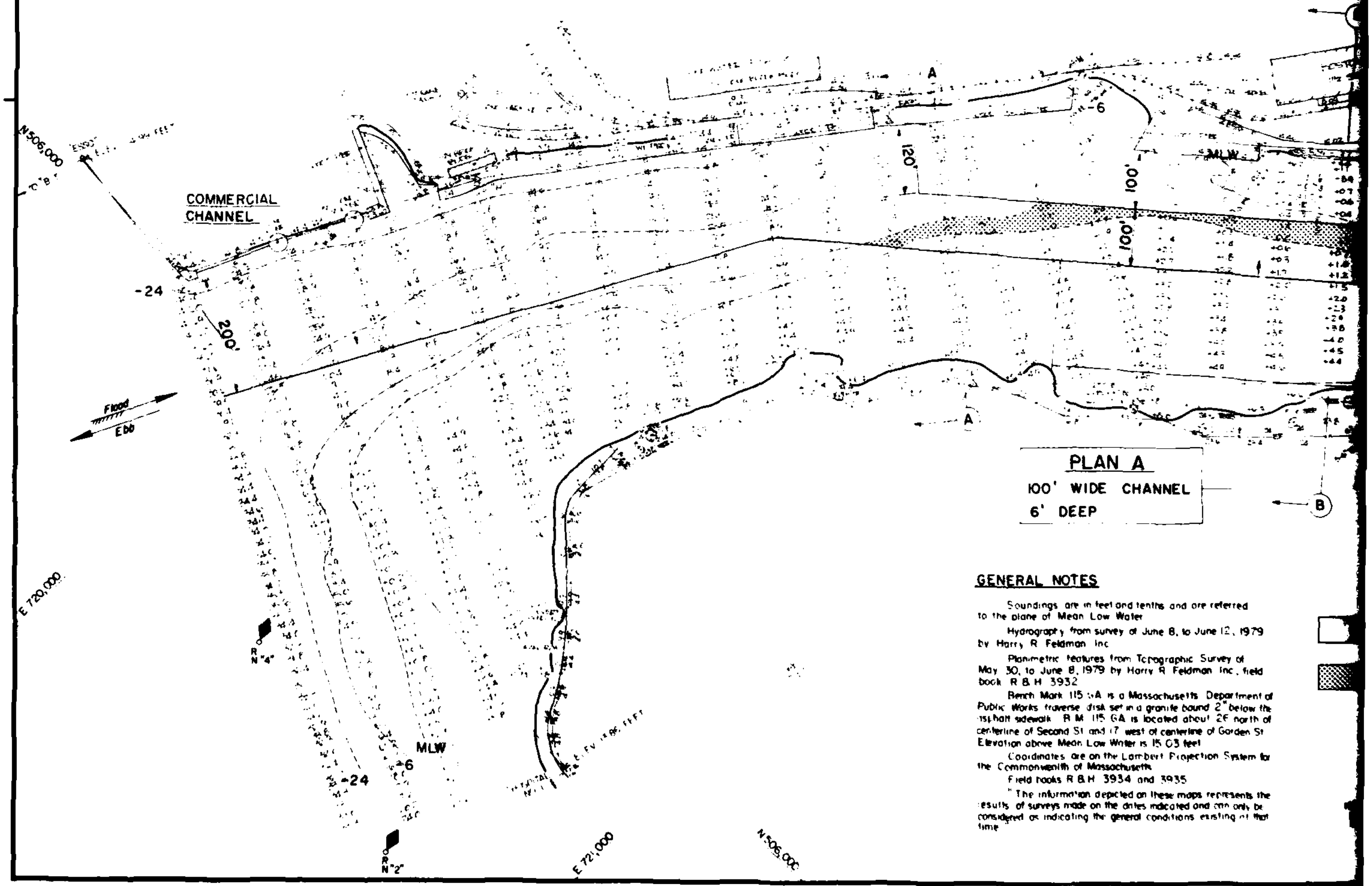

PLAN A

100' WIDE CHANNEL
6' DEEP

GENERAL NOTES

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Hydrography from survey of June 8, to June 12, 1979 by Harry R. Feldman Inc.

Planimetric features from Topographic Survey of May 30, to June 8, 1979 by Harry R. Feldman Inc., field book R.B.H. 3932.

Bench Mark 115 GA is a Massachusetts Department of Public Works traverse disk set in a granite bound 2" below the asphalt sidewalk. B.M. 115 GA is located about 26 north of centerline of Second St. and 17 west of centerline of Garden St. Elevation above Mean Low Water is 15.03 feet.

Coordinates are on the Lambert Projection System for the Commonwealth of Massachusetts.

Field books R.B.H. 3934 and 3935.

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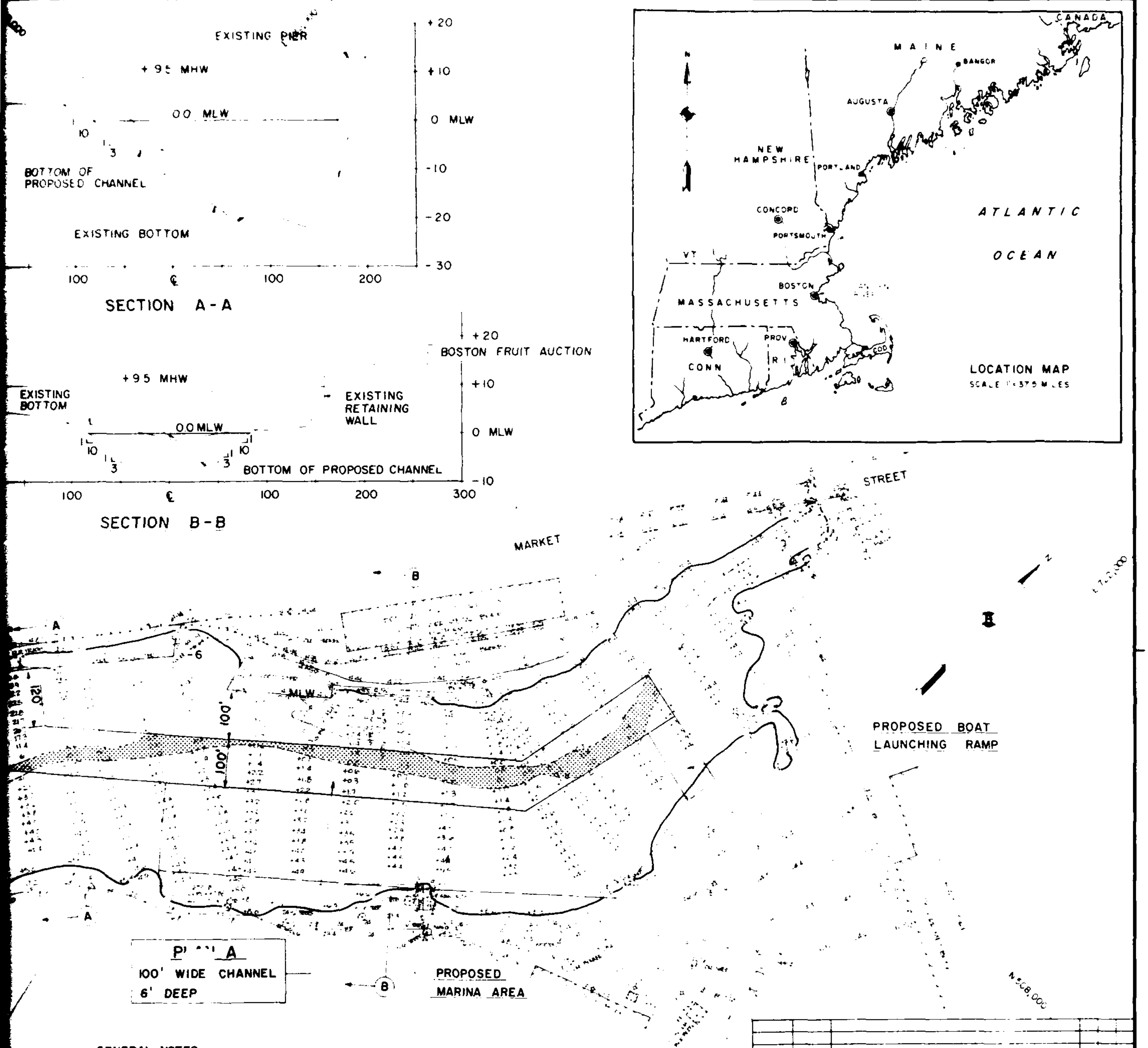
U S ARMY



GENERAL NOTES

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Hydrography from survey of June 8, to June 12, 1979 by Harry R Feldman, Inc

Planimetric features from Topographic Survey of May 30, to June 8, 1979 by Harry R Feldman, Inc, field book R & H 3932

Bench Mark 115 GA is a Massachusetts Department of Public Works traverse disk set in a granite bound 2" below the asphalt sidewalk R M 115 GA is located about 26' north of centerline of Second St and 17' west of centerline of Garden St Elevation above Mean Low Water is 15 03 feet

Coordinates are on the Lambert Projection System for the Commonwealth of Massachusetts

Field books R & H 3934 and 3935

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LEGEND

☐	DREDGING GREATER THAN 6 FEET
▨	DREDGING 0 TO 6 FEET

GRAPHIC SCALE

REVISION	DATE	DESCRIPTION	BY

STORCH ENGINEERS
CHARLESGATE WEST
BOSTON, MASS

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS

DR BY
TR BY
CK BY
R P S
SUBMITTED
STORCH ENGINEERS
ARCHITECT ENGINEER
REVIEWED
CHIEF NAV & S E SECTION
APPROVAL RECOMMENDED
CHIEF TECH ENG BRANCH
APPROVAL RECOMMENDED
CHIEF PLANNING BRANCH

WATER RESOURCES IMPROVEMENT STUDY
ISLAND END RIVER - CHELSEA, MA.
PLAN A

APPROVED
CHIEF ENGINEERING DIVISION
DATE JUNE 28, 1979

FIG. 2-3

SCALE
DRAWING NUMBER
SHEET OF

TABLE 2-1

Dredging Impacts of Plan A

A) Volume of Dredged Material (cubic yards)

Marina Basin and Ramp	64,900
Access Channel	51,800
TOTAL	116,700

B) Area Dredged (acres)

	Intertidal Area Removed	Intertidal Area Altered
Marina Basin	5.3	1.0
Channel	2.2	0.5
TOTAL	7.5	1.5

Total Intertidal Area in River 19.7 Acres

TABLE 2-2

Plan A Project Cost Estimates

Total First Cost

Dredging (52,000 c.y. @ $7.50/c.y.)	$390,000
Contingencies (15%)	58,500
SUBTOTAL	$448,500
Engineering (7%)	31,400
Supervision and Administration (8%)	35,900
SUBTOTAL	$515,800
Aids to Navigation	3,000
Total First Cost	$518,800

Annual Cost

Amortization (50 years at i = 7-1/8%)	$ 38,200
Annual Maintenance Dredging (4% @ $8.00/c.y.)	16,640
Maintenance of Aids to Navigation	1,500
Total Annual Costs	$ 56,340
SAY	$ 57,000

34. Although no adequate quantitative assessment of the safety impacts can be made, Plan A is considered to have a somewhat adverse impact in this regard. It also presents a second, and difficult to quantify, safety problem relating to the Exxon terminal. Plan A would require recreational craft to pass in close proximity to a facility where large volumes of volatile substances are handled and stored.

35. Another disadvantage of Plan A is that by designation of the existing commercial channel for recreational use, would require Federal acquisition of the channel. Future alteration of the channel or the Everett shoreline as required by the existing industries who paid for the original construction of the channel may be hampered. For example, future extension of piers into the channel or private maintenance dredging could be ruled out due to conflicts in use of the channel by recreational craft. This possible disadvantage to industries located in the City of Everett would occur as a result of a project partially funded by and intended to primarily benefit the City of Chelsea.

PLAN B

36. Plan B, shown in Figure 2-4, involves construction of a separate channel for recreational craft parallel to and contiguous with the existing commercial channel. Upstream of the commercial channel the alignment of the recreational channel would correspond to that in Plan A.

37. The dimensions of the existing channel are marked on Figure 2-4 by the -24 MLW contour. Since all three industries presently use craft with drafts of twentytwo feet, they are constrained to the area shown at mean low water. At present, the channel is somewhat restricted at low water, especially in the area of the Marquette Cement Company wharves.

38. In order to allow for future widening of the commercial channel and to provide an adequate separation between the small craft and the commercial ships, the channel was considered to be bounded as shown in Figure 2-4. For the purposes of delineating the small boat channel from the commercial channel, the latter was considered to be two hundred feet wide at the Exxon terminal at the mouth of the river, then tapering to one hundred twenty feet wide at the northern end of the Coldwater Seafood Corporation wharf. These dimensions will allow for some future widening of the commercial channel in order to permit more clearance past berthed barges at Exxon and Marquette Cement Corporation.

39. Plan B will require navigation aids to mark the eastern edge of the small boat channel and also possibly to mark the separation between the recreational and commercial channels.

40. The major advantage of Plan B over Plan A is the provision of separate channels in the lower portion of the river to eliminate potential navigation conflicts. The safety problems inherent in Plan A are greatly reduced but not eliminated. Even though a separate channel would be provided for small craft, it is likely that some would stray into the commercial channel. In addition, the wash generated by the large tug boats would have some effect in the small boat channel.

TABLE 2-3

Dredging Impacts of Plan B

A) Volume of Dredge Material (cubic yards)

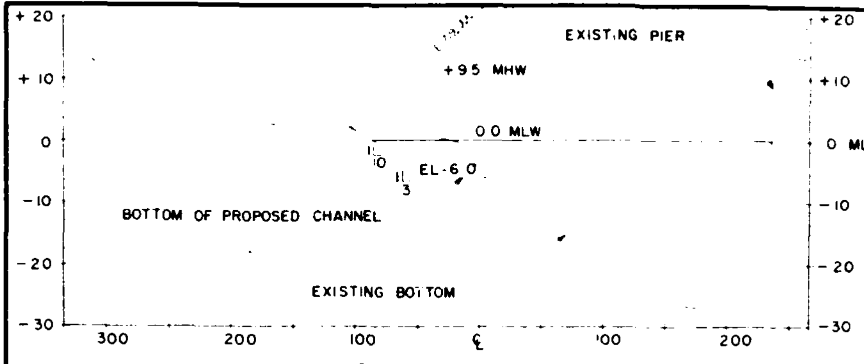
Marina Basin and Ramp	64,900
Access Channel	64,100
TOTAL	129,000

B) Area Dredged (acres)

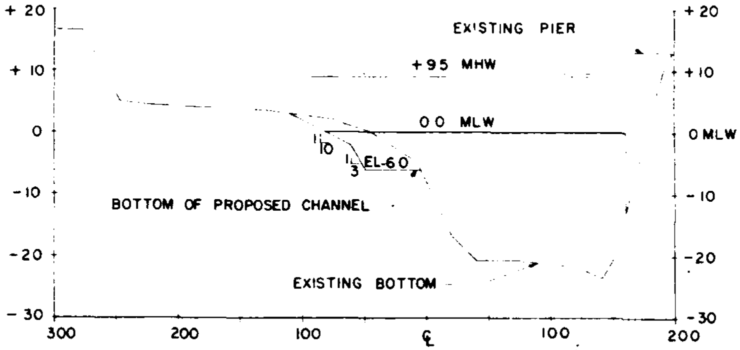
	Intertidal Area Removed	Intertidal Area Altered
Marina Basin	5.3	1.0
Channel	3.0	1.0
TOTAL	8.3	2.0

Total Intertidal Area in River 19.7 Acres

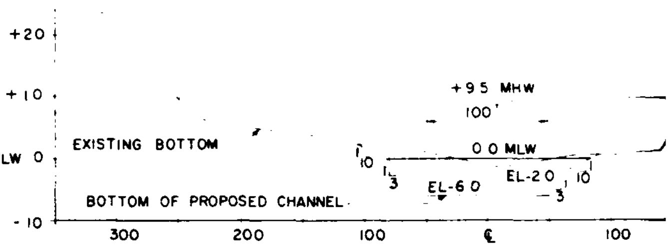
CORPS OF ENGINEERS



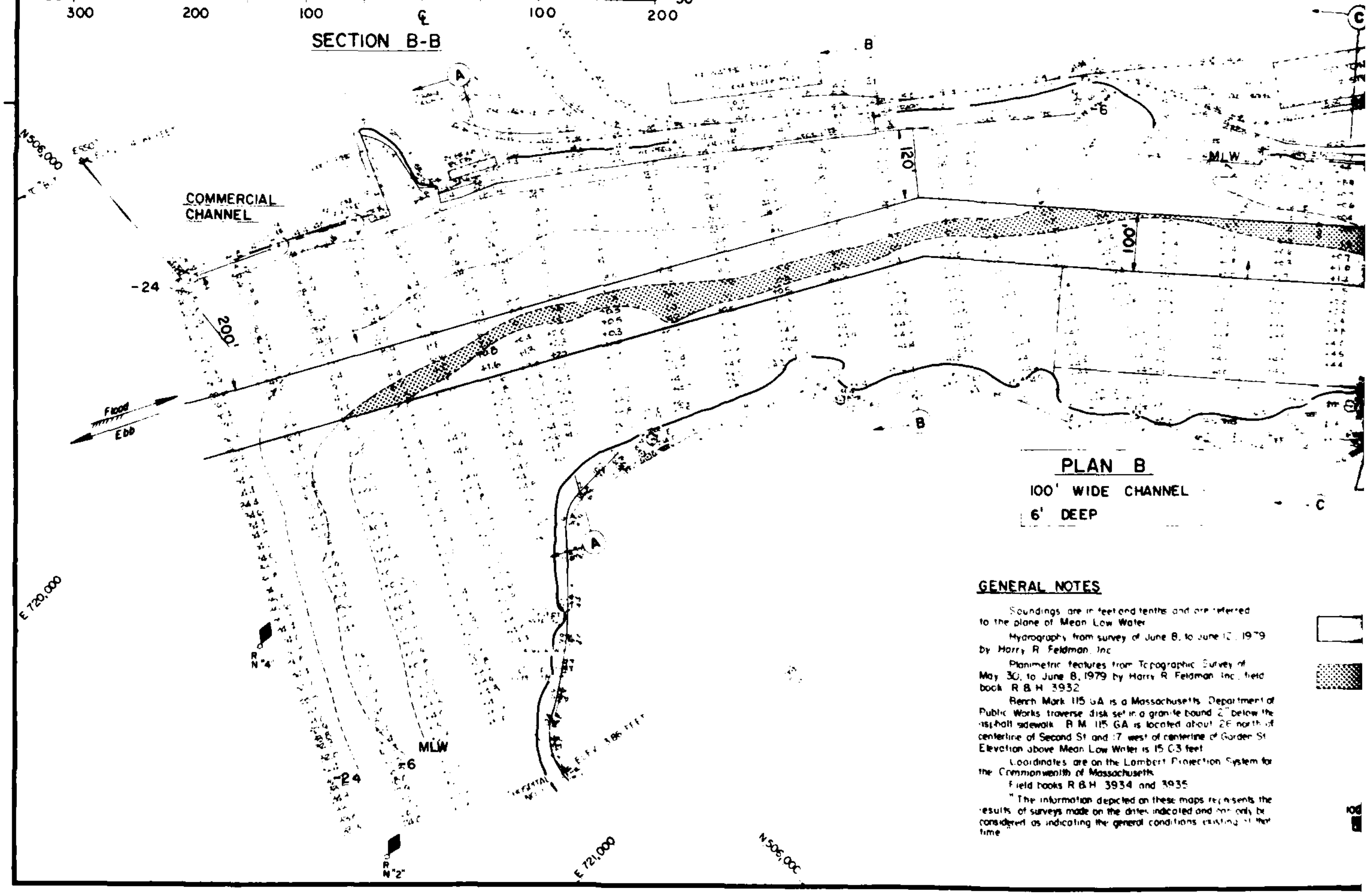
SECTION A-A



SECTION B-B



SECTION C-C



PLAN B

100' WIDE CHANNEL

6' DEEP

GENERAL NOTES

Soundings are in feet and tenths and are referred to the plane of Mean Low Water

Hydrography from survey of June 8, to June 12, 1979 by Harry R Feldman, Inc

Planimetric features from Topographic Survey of May 30, to June 8, 1979 by Harry R Feldman Inc, field book R & H 3932

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Coordinates are on the Lambert Projection System for the Commonwealth of Massachusetts

Field books R & H 3934 and 3935

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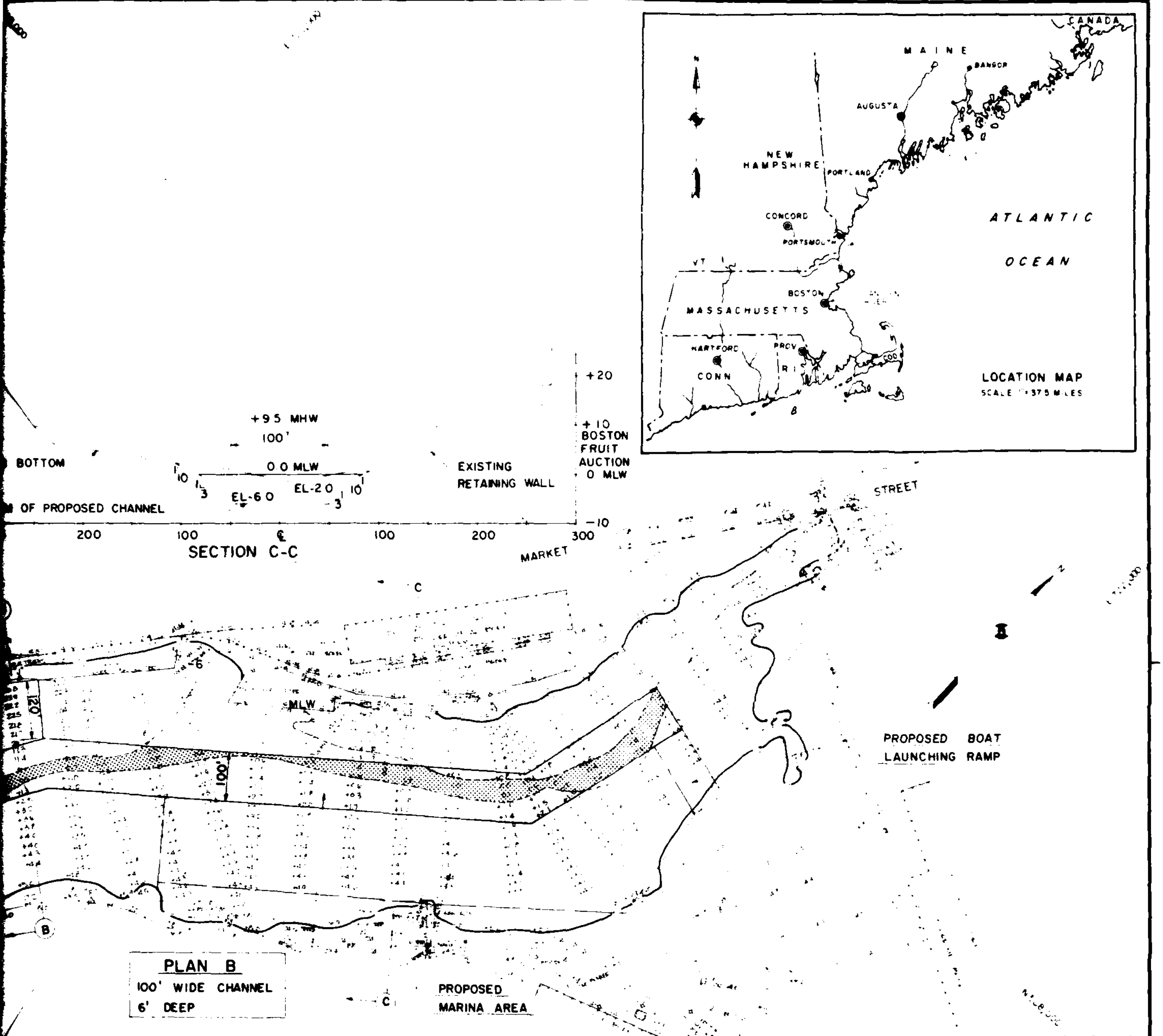

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Field books R B H 3934 and 3935

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LEGEND

☐ DREDGING GREATER THAN 6 FEET

▨ DREDGING 0 TO 6 FEET

GRAPHIC SCALE

REVISION	DATE	DESCRIPTION	BY

SUBMITTED
ARCHITECT ENGINEER
REVIEWED
APPROVED

WATER RESOURCES IMPROVEMENT STUDY
ISLAND END RIVER-CHELSEA, MA.
PLAN B

DATE JUNE 28, 1979
CHIEF ENGINEERING DIVISION

FIG. 2-4

SCALE
DRAWING NUMBER
SHEET

TABLE 2-4

Plan B Project Cost Estimates

Dredging (64,000 c.y. @ $7.40/c.y.	$473,600
Contingencies (15%)	71,000
SUBTOTAL	544,600
Engineering (7%)	38,100
Supervision and Adminsitration (8%)	43,600
SUBTOTAL	626,300
Aids to Navigation	3,000
TOTAL FIRST COST	$629,300
SAY	$629,000

Annual Costs

Amortization (50 years at i = 7.125%)	$ 46,300
Annual Maintenance Dredging (4% @ $8.00/c.y.)	20,500
Maintenance of Aids ot Navigation	1,500
TOTAL ANNUAL COSTS	$ 68,300
SAY	$ 68,000

41. Plan B requires the dredging of approximately 64,000 cubic yards for the access channel, the removal of 3.0 acres of intertidal zone and the alteration of 1.0 additional acres. The dredging impacts of the associated non-federal harbor improvements are the same as for Plan A, B, C and D. The dredging impacts of Plan B are summarized in Table 2-3.

42. Plan B is estimated to have an initial construction cost of $629,000 with an equivalent net annual benefits of $329,800. Construction cost estimates are shown in Table 2-4.

PLAN C

43. Plan C is shown in Figure 2-5. It involves construction of a channel for recreational craft on an alignment that is completely separated from the existing commercial channel. At the mouth of the river the small boat channel would be located about 280 feet from the Exxon Corporation wharves. Upstream, the Plan C channel tapers towards the commercial channel. Two small bends are located in the channel, the second at the point where the proposed marina would begin.

44. Plan C corresponds closely to the channel alignment shown in the Reconnaissance Report. The channel alignment is generally as near as possible to the Chelsea shoreline without requiring extensive revetment to provide shore protection.

45. The western edge of the channel in Plan C generally follows the -6 MLW contour. Therefore, Plan C would result in moving the -6 contour one hundred feet to the east. This would provide a great deal of open water in the middle of the river and provide maximum maneuverability.

46. Plan C would require a minimal amount of revetment for a length of two hundred feet along the Chelsea shoreline.

47. As summarized in Table 2-5, Plan C requires the dredging of 89,700 cubic yards of material. Approximately 4.9 acres of intertidal zone area will be removed and an additional 1.9 acres will be altered.

48. The estimated construction cost of Plan C is $872,000 with an annual net benefit of $302,800. The cost estimates for Plan C are summarized in Table 2-6.

PLAN D

49. In Plan D, as shown on Figure 6, the small boat channel is aligned as closely as possible to the Chelsea shoreline. The western edge of the proposed channel is separated from the Exxon terminal docks by approximately three hundred eighty feet.

50. In order to retain the desired 3:1 slope, revetment would be required, extending from two feet below MLW to the top of the slope near the sixteen foot elevation. The area where the revetment is proposed for Plan D is along the shoreline of the MDC park. The provision of shore protection along this area is considered to be an aesthetic improvement due to the current poor condition of the area. The bank is presently suffering from

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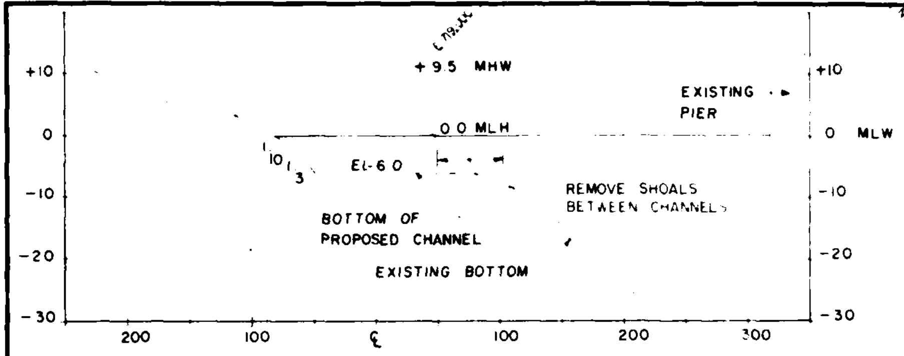

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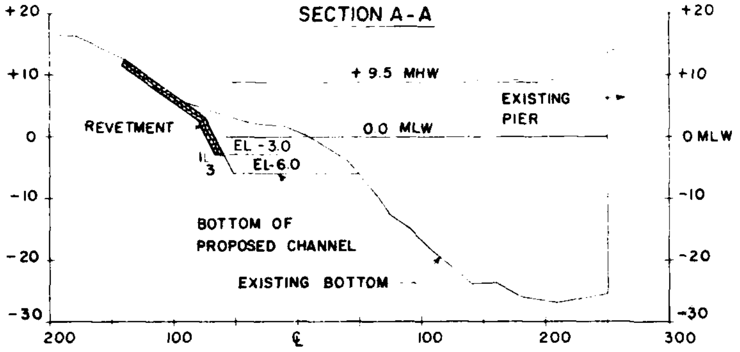

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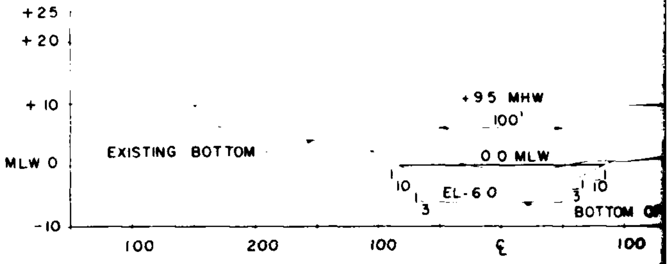

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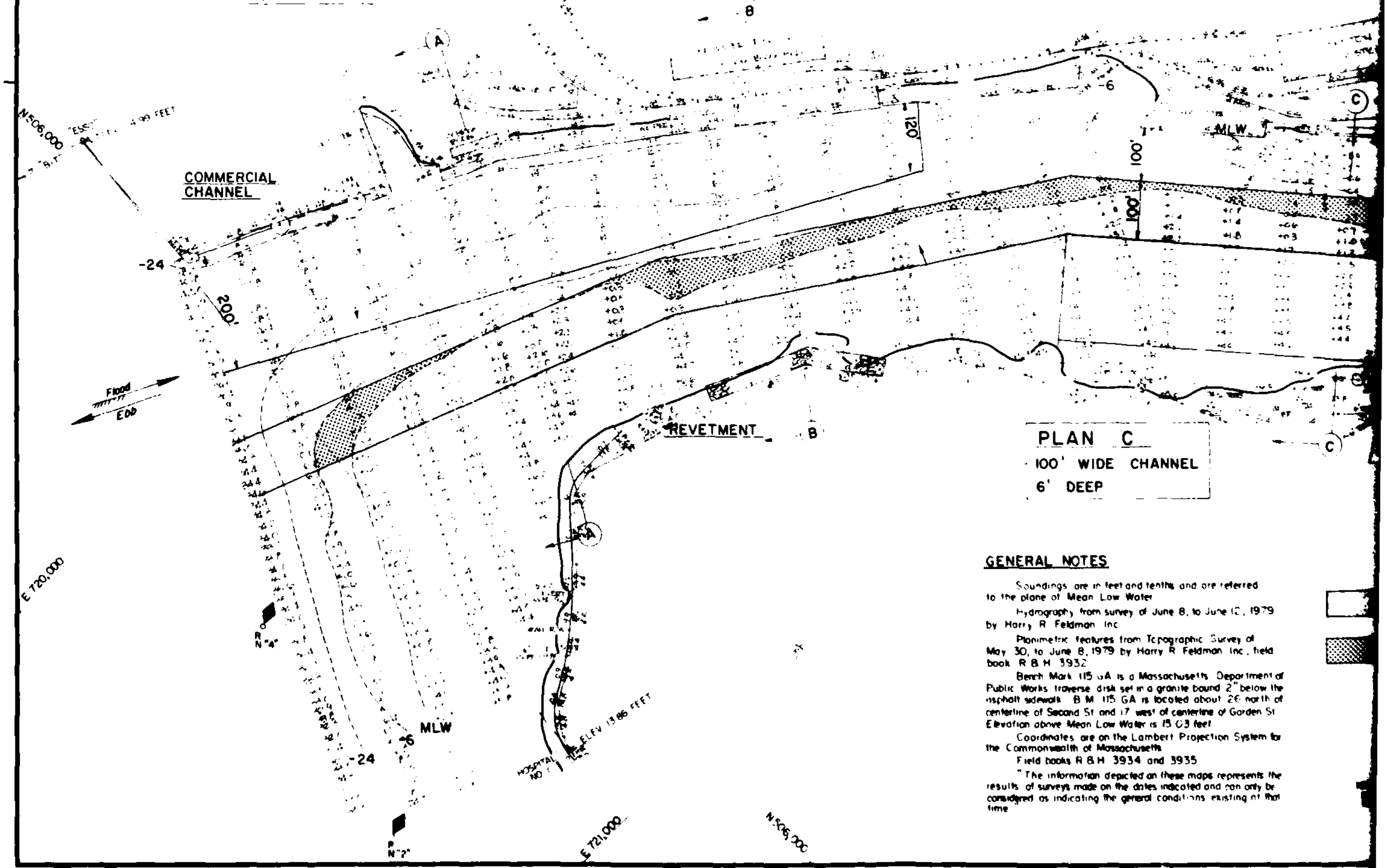

PLAN C

100' WIDE CHANNEL
6' DEEP

GENERAL NOTES

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Coordinates are on the Lambert Projection System for the Commonwealth of Massachusetts

Field books R & H 3934 and 3935

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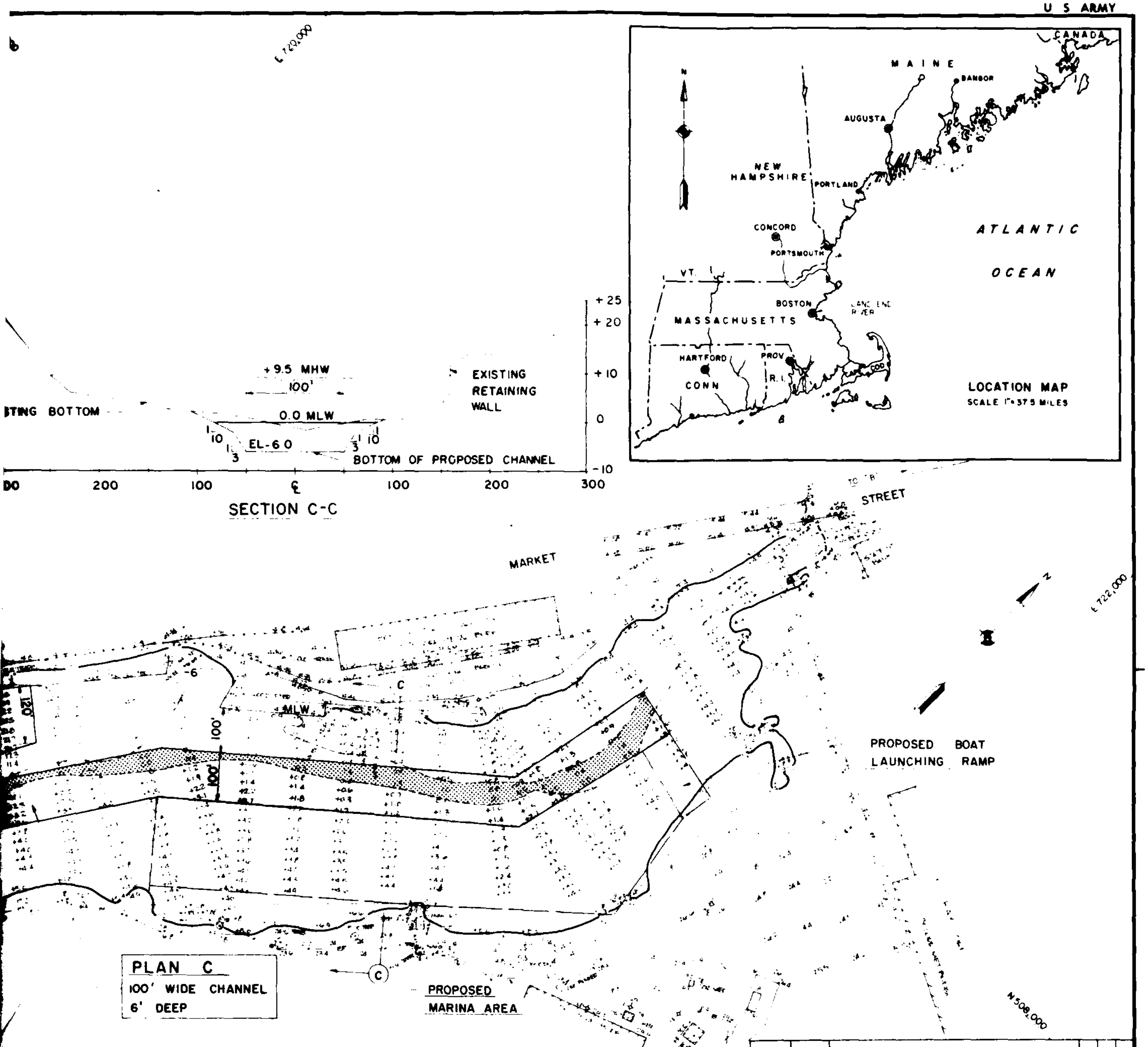
U S ARMY



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LEGEND

☐	DREDGING GREATER THAN 6 FEET
▨	DREDGING 0 TO 6 FEET

GRAPHIC SCALE
100' 0 100' 200'

REVISION	DATE	DESCRIPTION	BY

STORCH ENGINEERS
2 CHARLESGATE WEST
BOSTON, MASS

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM MASS

DR. BY J D
TR. BY R P S
CK. BY A C B

SUBMITTED STORCH ENGINEERS
ARCHITECT - ENGINEER
REVIEWED
CHIEF [illegible] SECTION
APPROVAL RECOMMENDED
CHIEF [illegible] BRANCH
APPROVAL RECOMMENDED
CHIEF PLANNING DIVISION

WATER RESOURCES IMPROVEMENT STUDY
ISLAND END RIVER-CHELSEA, MA.
PLAN C

APPROVED
CHIEF ENGINEERING DIVISION
DATE JUNE 28, 1979

FIG. 2-5

SCALE 1"=100'
SPEC NO DACW 33 79 C 0076
DRAWING NUMBER
SHEET 1 OF 1

TABLE 2-5

Dredging Impacts of Plan C

A) Volume of Dredged Material (cubic yards)

Marina Basin and Ramp	64,900
Access Channel	89,700
TOTAL	154,600

Intertidal Zone

B) Area Dredged (acres)

	Intertidal Area Removed	Intertidal Area Altered
Marina Basin	5.3	1.0
Channel	4.9	1.9
TOTAL	10.2	2.9

Total Intertidal Area in River 19.7 acres

TABLE 2-6

Plan C Project Cost Estimates

	Total First Cost
Dredging (90,000 c.y. @ $7.30/c.y.)	$657,000
Contingencies (15%)	98,600
SUBTOTAL	$755,600
Engineering (7%)	52,900
Supervision and Administration (8%)	60,400
SUBTOTAL	$868,900
Aids to Navigation	3,000
Total First Cost	$871,900
SAY	$872,000

	Annual Costs
Amortization (50 years at i = 7-1/8%)	$ 64,200
Annual Maintenance Dredging (4% @ $8.00/c.y.)	28,800
Maintenance of Aids to Navigation	1,500
Total Annual Costs	$ 94,500
SAY	$ 95,000

erosion near the high water line and of revetment or retaining walls may have to be constructed by the MDC. It should be noted that shoreline protection is not part of the federal project and would be funded completely by local interests.

51. With respect to navigation, Plan D provides for the maximum separation of small boats and the large ships, and therefore is the safest plan in that respect. However, Plan D would leave potentially hazardous shoals between the small boat channel and the commercial channel. Some of these points in the river bottom would be exposed surfaces two to four feet above MLW and covered at interim tides. Although they would be outside of the small boat channel they could represent a hazard to boaters.

52. Plan D provides a generally straight channel with the easiest navigation from the Mystic River to the proposed marina.

53. Although Plan D has the greatest impact on marine habitats, it is considered to be the most compatible alternative due to its aesthetic improvement of proposed adjacent land uses. The City of Chelsea representatives have expressed an interest in the location of the channel close to the Chelsea shoreline. This is provided by Plan D.

54. The dredging impacts of Plan D are summarized in Table 2-7. Plan D would require the dredging of 110,100 cubic yards of material. It would result in the removal of 6.2 acres and the alteration of 2.3 acres of intertidal zone.

55. Plan D has the maximum impact on intertidal zones near the mouth of the river where marine life is be found in highest concentration.

56. Cost estimates for Plan D are summarized in Table 2-8. Plan D has an estimated construction cost of $1,058,000. The annual net benefits of Plan D are estimated at $282,800.

TABLE 2-7

Dredging Impacts of Plan D

A) Volume of Dredged Material (cubic yards)

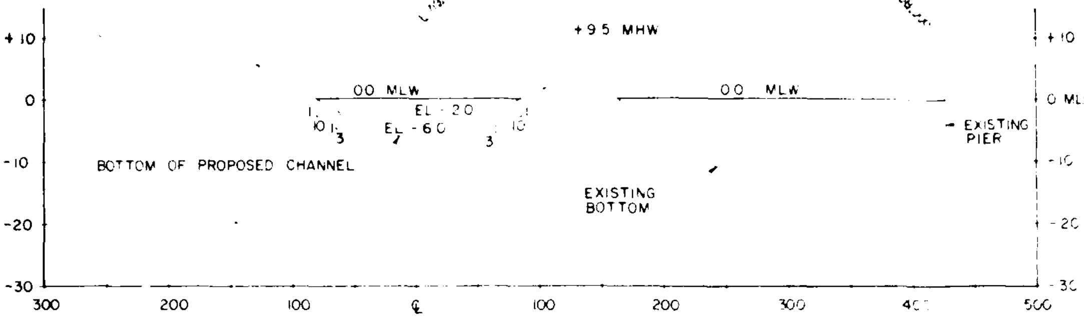
Marina Basin and Ramp	64,900
Access Channel	110,100
TOTAL	175,000

B) Area Dredged (acres)

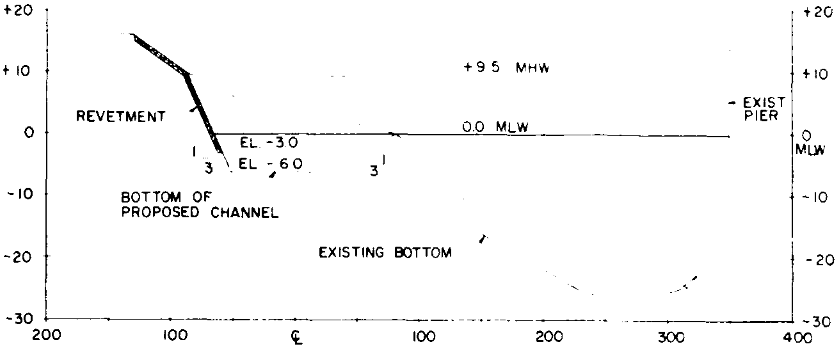
	Intertidal Area Removed	Intertidal Area Altered
Marina Basin	5.3	1.0
Channel	6.2	2.3
TOTAL	11.5	3.3

Total Intertidal Area in River 19.7 acres

CORPS OF ENGINEERS



SECTION A-A



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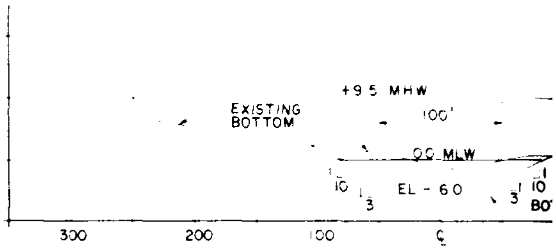

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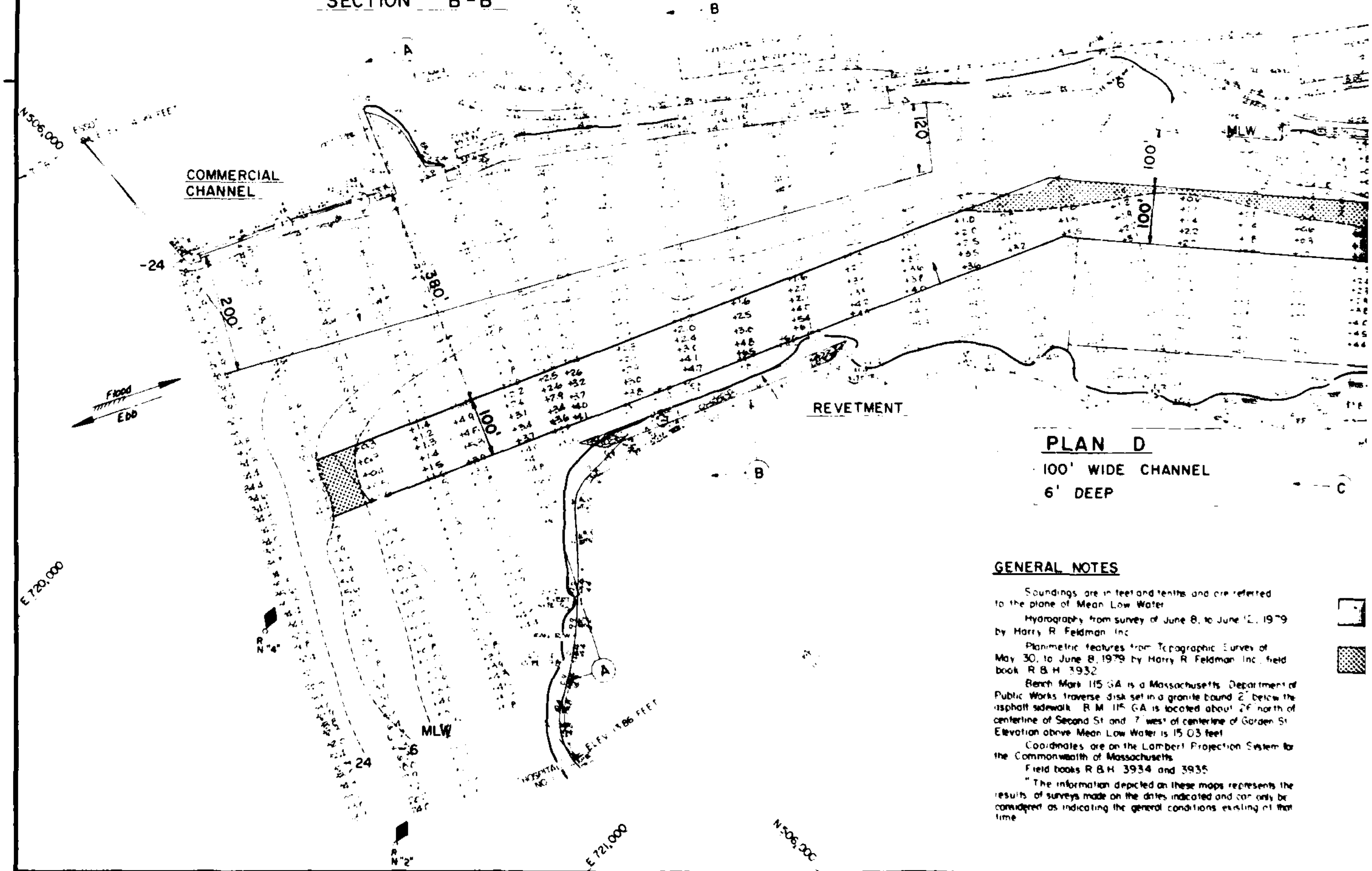

PLAN D

100' WIDE CHANNEL

6' DEEP

GENERAL NOTES

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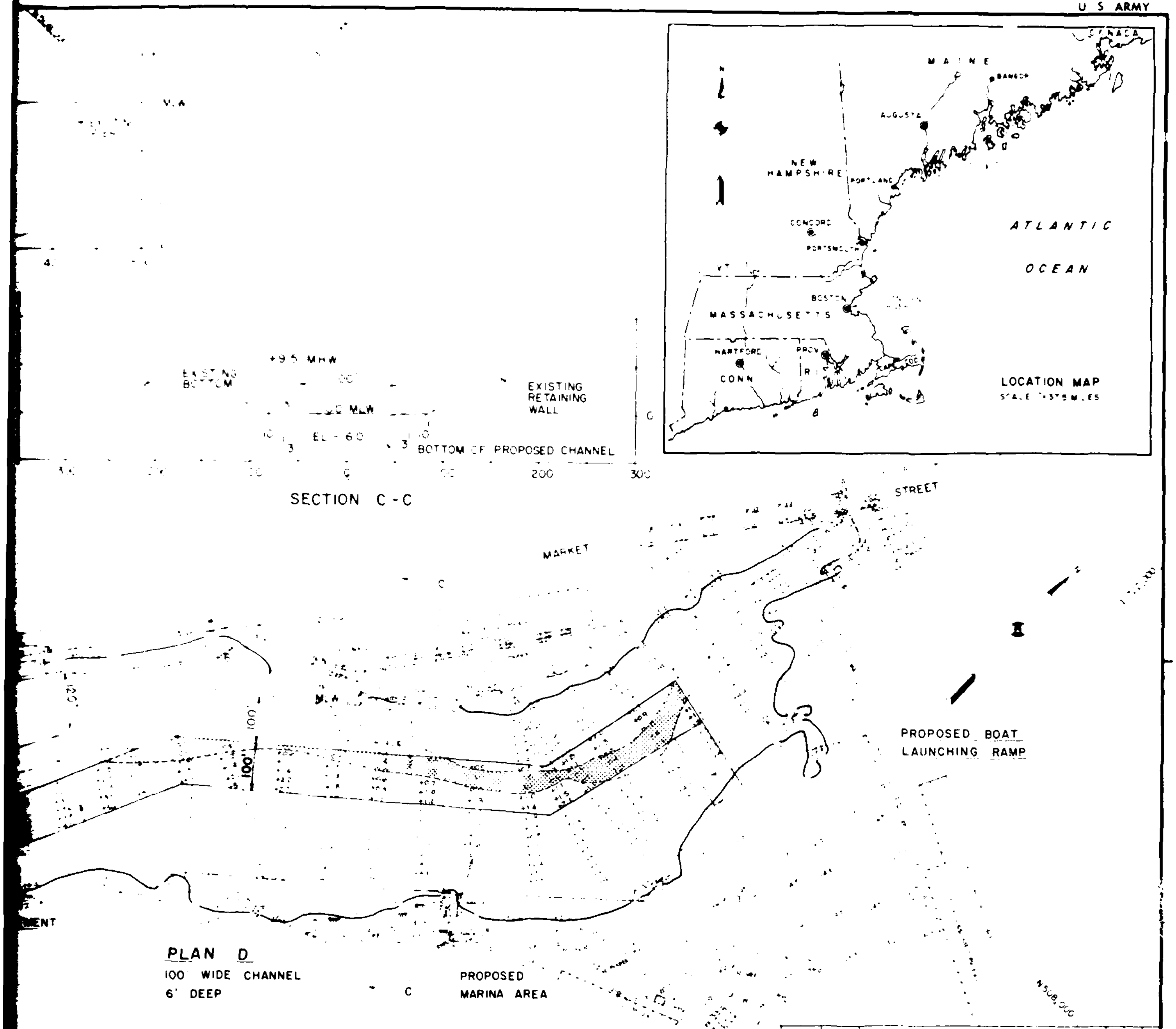
Field books R B H 3934 and 3935

" The information depicted on these maps represents the results of surveys made on the dates indicated and can only be considered as indicating the general conditions existing at that time"



PLAN D

100' WIDE CHANNEL
6' DEEP

GENERAL NOTES

Soundings are in feet and tenths and are referred to the plane of Mean Low Water.

Hydrography from survey of June 8 to June [illegible] 1979 by Harry R. Feldman, Inc.

Planimetric features from Topographic Survey of May [illegible] to June 8, 1979 by Harry R. Feldman, Inc. Field Book R.B.H. 393[illegible]

Bench Mark 15-A is a Massachusetts Department of Public Works traverse disk set in a granite bound 2' below the asphalt sidewalk. B.M. 15-A is located about 24' north of centerline of Second St. and [illegible] west of centerline of [illegible] St. Elevation above Mean Low Water is 15.[illegible]3 feet.

Coordinates are on the Lambert Projection System for the Commonwealth of Massachusetts.

Field books R.B.H. 3934 and 3935

The information depicted on these maps represents the results of surveys made on the dates indicated and can only be considered as indicating the general conditions existing at that time.

LEGEND

☐	DREDGING GREATER THAN 6 FEET
▨	DREDGING 0 TO 6 FEET

GRAPHIC SCALE
0 100 200

N 507,000

REVISION	DATE	DESCRIPTION	BY

STORCH ENGINEERS
CHARLESTATE WEST
BOSTON, MASS.

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DR BY J.D. TR BY R.P.S. CK BY A.C.R.

SUBMITTED STORCH ENGINEERS
ARCHITECT ENGINEER

REVIEWED
CHIEF [illegible]

APPROVAL RECOMMENDED
CHIEF [illegible] BRANCH

APPROVAL RECOMMENDED
CHIEF PLANNING DIVISION

WATER RESOURCES IMPROVEMENT STUDY

ISLAND END RIVER-CHELSEA, MA.

PLAN D

APPROVED
CHIEF ENGINEERING DIVISION

DATE JUNE 28, 1979

FIG. 2-6

SCALE [illegible]
SPEC. NO. [illegible]
DRAWING NUMBER
SHEET [illegible]

TABLE 2-8

Plan D Project Cost Estimates

Total First Cost

Dredging (110,000 c.y. @ $7.25)	$797,500
Contingencies (15%)	119,625
SUBTOTAL	$917,125
Engineering (7%)	64,200
Supervision and Administration (8%)	73,400
SUBTOTAL	$1,057,700
Aids to Navigation	3,000
Total First Cost	$1,057,700
SAY	$1,058,000

Annual Costs

Amortization (50 years at i = 7-1/8%)	$ 77,900
Annual Maintenance Dredging (4% @ $8.00/c.y.)	35,200
Maintenance of Aids to Navigation	1,500
Total Annual Costs	$114,600
SAY	$115,000

SECTION C

COMPARISON OF ALTERNATIVE PLANS

57. In general, there is a trade-off between minimizing delays and safety problems for small craft and minimizing the project costs and adverse environmental impacts.

58. By utilizing the existing commercial channel, Plan A minimizes dredging requirements. Therefore, this alternative has the lowest initial as well as annual maintenance cost. Since no dredging will take place in the lower section of the river, it also has the least impact on existing marine life.

59. Plan A, however, has a somewhat adverse impact on boating convenience and safety arising from shared use of the commercial channel by commercial and recreational craft.

60. Plan A would have virtually no impact on the existing environmental conditions downstream of the marina site. Although this would result in the maximum preservation of the intertidal lands, it would not have positive aesthetic impacts. Extensive mudflats would remain adjacent to the proposed waterfront park.

61. Plan B provides more safety and convenience to boaters than Plan A but necessitates expenditures for additional dredging. It also allows for the future expansion of the existing twenty-four foot deep industrial channel to accommodate larger vessels. Plan B requires the dredging of additional intertidal zones in the lower reaches of the river.

62. Plan C provides more separation from the commercial channel by approximately eighty feet at the mouth of the river, therefore, providing a greater margin of safety. Plan C would result in a significant increase in dredging in the lower part of the river.

63. Plan D has the maximum cost and requires the greatest amount of dredging and shoreline protection. However, it also provides the greatest separation between the two channels. This positive safety aspect of Plan D is somewhat reduced by the fact that shoals above the -6 MLW elevation would remain in the center of the river.

64. In general, environmental impacts increase from Plans A to D, since the greatest diversity of marine life is found in the region at the mouth of the river.

65. Aesthetic impacts are considered most positive for Plans C and D due to an increase in open water area at low tide. The City of Chelsea considers increasing the area of open water to be an important factor for enhancing the appearance of the Island End River when viewed from the proposed luxury housing.

66. Through consultation with state, local and federal government agencies and local industries, comments were obtained on the various alternatives. The Marine Division of the Everett Exxon Corporation terminal had objections about shared use of the channel, as proposed under Plan A, due to potential safety problems. The Marine Safety Office of the U. S. Coast Guard also cited potential boating safety problems with Plan A and recommended a widening of the existing channel as in Plan B.

67. Plan A was felt to be the most desirable plan by the Massachusetts Division of Marine Fisheries and the National Marine Fisheries Service, due to the fact that this plan required the least amount of dredging. Plan B was considered to be acceptable, however, if Plan A were shown to have adverse safety impacts. In general, these agencies had objections to Plans C and D.

68. The City of Chelsea is interested in providing the most compatible environment for the proposed waterfront park and housing redevelopment plans for the Naval Hospital property. From their point of view, this is best provided by Plans C and D which will bring the low water line closer to the Chelsea shoreline and remove some of the exposed mud flats.

SYSTEM OF ACCOUNTS

69. The System of Accounts is a summary evaluation required by the Principles and Standards. The System of Accounts provides in a concise format an evaluation of the alternative plans in terms of the national objectives of National Economic Development (NED), Environment Quality (EQ), national accounts of Social WellBeing (SWB) and Regional Development (RD). It also demonstrates plan performance in terms of the planning objectives and constraints; the technical, economic and other criteria, as well as other measures such as plan acceptability.

70. The System of Accounts is shown in Table 2-9. The summary assessments indicate that the plans have varying responses to the different national objectives and accounts. In evaluating all impacts considered, Plan B is shown to be the most favorable option considered. In addition, disposal of dredged material at the Boston Foul Area site was shown to be the most favorable disposal option available.

SELECTING A PLAN

71. Selection of a plan for navigation improvements to the Island End River has been based on considerations of economic efficiency, preservation of environmental quality, boating safety and the needs and objectives of local and state governments. Based on these criteria, Plan B is found to be overall the most favorable plan for meeting the project objectives.

NATIONAL ECONOMIC DEVELOPMENT PLAN

72. Of the four alternatives evaluated in this study, Plan B would provide the greatest net benefits. Appendix 6 of this report contains the detailed benefit/cost studies for the four alternatives, including the benefit/cost analysis of the proposed channel dimensions. The National Economic Development Plan is the selected plan.

ENVIRONMENTAL QUALITY PLAN

73. The Environmental Quality Plan is the alternative which makes the most significant contribution to the management, conservation, preservation, creation, restoration or improvement of the quality of certain natural and cultural resources and ecological systems. All four alternatives considered would have positive effects on enhancement, preservation and restoration of cultural resources. In terms of the proposed land uses of housing and recreation adjacent to the river, all of the plans would also have positive aesthetic impacts. However, each plan would have some adverse impact on natural resources. Consequently designation of an Environmental Quality plan has been replaced by designation of a Least Environmentally Damaging plan.

74. While Plan A would require the least amount of dredging, thereby minimizing the alteration of marine habitats and minimizing the material to be disposed of, Plan A is the Least Environmentally Damaging Plan. Plan A has not been selected, however, because Plan A has reduced recreational benefits due to interference with commercial shipping, as well as potential adverse safety problems.

TABLE 2-9
System of Accounts

	1	2	3	4	5	6	7
	IMPROVEMENT AT ISLAND END RIVER PLAN A	IMPROVEMENT AT ISLAND END RIVER PLAN B	IMPROVEMENT AT ISLAND END RIVER PLAN C	IMPROVEMENT AT ISLAND END RIVER PLAN D	DISPOSAL BOSTON FOUL AREA	DISPOSAL NAVAL HOSPITAL SITE	DISPOSAL SOUTH BOSTON CONTAINER TERMINAL
<u>PLAN DATA</u>							
Structures-Federal	Dredge Access Channel Utilizing Existing Commercial Channel	Dredge Access Channel Parallel to and Contiguous with Existing Commercial Channel	Dredge Access Channel Separate from Existing Commercial Channel	Same as 3	None	None	None
Structures-Local	Construct New Marina and On-Shore Support Facilities	Same as 1	Sames as 1 plus 200 Feet of Revetment	Same as 1 plus 600 Feet of Revetment	None	Construction of a Retaining Wall	Provided by Massport
Land Requirements							
Federal	None	None	None	None	None	None	None
Non-Federal	Approximately 8 Acres for Marina Site	Same as 1	Same as 1	Same as 1	None	Would Require Sufficient Acreage to Dispose of 130,000 c.y.	40-Acre Site Available
<u>NATIONAL ECONOMIC DEVELOPMENT</u>							
Implementation Costs							
Federal	$259,500	$314,500	$436,000	$529,000	None	None	None
Non-Federal	259,500 plus Marina with On-Shore Support Facilities	314,500 plus Marina with On-Shore Support Facilities	436,000 plus 200 Feet of Revetment and Marina with On-Shore Support Facilities	529,000 plus 600 Feet of Revetment and Marina with On-Shore Support Facilities	None	N.Q.	None
QUANTIFIABLE TOTAL	$519,000	$629,000	$872,000	$1,058,000	NA	NQ	NA
Average Annual Benefits							
Boats Added Immediately	$166,600	$179,200	Same as 2	Same as 2	NA	NA	NA
Immediate Transients	7,600	8,200	Same as 2	Same as 2	NA	NA	NA
Future Growth	184,400	198,300	Same as 2	Same as 2	NA	NA	NA
Future Transients	11,200	12,100	Same as 2	Same as 2	NA	NA	NA
TOTAL	$369,800	$397,800	Same as 2	Same as 2	NA	NA	NA
NQ - Not Quantified	NA - Non Applicable						

TABLE 2-9
System of Accounts (Cont.)

	1	2	3	4	5	6	7
	IMPROVEMENT AT ISLAND END RIVER PLAN A	IMPROVEMENT AT ISLAND END RIVER PLAN B	IMPROVEMENT AT ISLAND END RIVER PLAN C	IMPROVEMENT AT ISLAND END RIVER PLAN D	DISPOSAL BOSTON FOUL AREA	DISPOSAL NAVAL HOSPITAL SITE	DISPOSAL SOUTH BOSTON CONTAINER TERMINAL
Average Annual Costs							
Construction	$38,200	$46,300	$64,200	$77,900	NA	NQ	NQ
Maintenance	$18,800	$21,700	$30,800	$37,100	NA	NQ	NQ
TOTAL	$57,000	$68,000	$95,000	$115,000	NA	NQ	NQ
Benefit-Cost Ratio	6.4	5.8	4.2	3.4	NA	NA	NA
LEAST ENVIRONMENTALLY DAMAGING							
WATER QUALITY							
Turbidity at Dredge Site	Yes	Yes-Greater than 1	Yes-Greater than 1 or 2	Yes-Greater than 1,2 or 3	NA	NA	NA
Effluent Discharge at Dredge Site	NA	NA	NA	NA	No	Yes	No
Disposal Promotes Leaching of Effluent into Tidal Lands	NA	NA	NA	NA	No	Yes	No
AIR QUALITY							
Increased Fuel Emissions from Vessels and Vehicles	Yes	Yes	Yes	Yes	NA	NA	NA
Short Term Dust Conditions at Disposal Site	NA	NA	NA	NA	No	Yes	Yes
Dust and Noise at Dredging Area	Yes	Yes	Yes	Yes	NA	NA	NA
Dust and Noise at On-Shore Construction Sites	NA	NA	Yes	Yes	NA	Yes	Yes
Short Term Marine Odor During Dredging Operations	Yes	Yes	Yes	Yes	NA	NA	NA
LAND USE (Present)							
Wetlands Lost	No	No	No	No	No	No	Yes
Commercial Land Use Disrupted	Yes	Yes-Less than 1	Yes-Less than 1 or 2	Yes-Less than 1,2 or 3	No	Yes	No
Residential Land Lost	No	No	No	No	No	No	No
Sufficient Land for Land Disposal	Yes	Yes	Yes	Yes	NA	NA	NA
Recreational Land Lost	No	No	No	No	No	No	No
Wildlife Area Lost	Yes-Temporarily	Yes-Temporarily	Yes-Temporarily	Yes-Temporarily	Yes-Temp.	Yes-Temp.	No
NQ - Not Quantified	NA - Non Applicable						

Sheet 2 of

TABLE 2-9
System of Accounts (Cont.)

	1	2	3	4	5	6	7
	IMPROVEMENT AT ISLAND END RIVER PLAN A	IMPROVEMENT AT ISLAND END RIVER PLAN B	IMPROVEMENT AT ISLAND END RIVER PLAN C	IMPROVEMENT AT ISLAND END RIVER PLAN D	DISPOSAL BOSTON *FOUL AREA*	DISPOSAL NAVAL *HOSPITAL SITE*	DISPOSAL SOUTH BOSTON *CONTAINER TERMINAL*
PLANTS							
Terrestrial Vegetation Destroyed	No	No	NQ	NQ	No	Yes	NQ
Aquatic Vegetation Destroyed	NQ	NQ-Greater than 1	NQ-Greater than 1 or 2	NG-Greater than 1 or 2	No	NA	NQ
ANIMALS							
Wildlife Displaced	Yes-Temporarily	Yes-Temporarily	Yes-Temporarily	Yes-Temporarily	*Yes-Temp.*	*Yes-Temp.*	Yes
Wildlife Destroyed	Yes	Yes-Greater than 1	Yes-Greater than 2	Yes-Greater than 3	Yes		NQ
Benthic Fauna Destroyed	Yes	Yes	Yes	Yes	Yes	No	No
Temporary Disruption of Fish Habitat	Yes	Yes	Yes	Yes	Yes	No	No
Permanent Disruption of Fish Habitat	No	No	No	No	No	NA	NA
VISUAL APPEARANCE							
Temporary Loss of Aesthetics	Yes	Yes	Yes	Yes	Yes	Yes	NA
Support Construction Required	Yes	Yes	Yes	Yes	No	Yes	Yes
Industrial/Commercial Development Encouraged	Yes	Yes	Yes	Yes	NA	No	Yes
Land Filling Necessary	No	No	Yes	Yes	No	Yes	Yes
Increase Vehicle Activity In Existing Port Area	Yes	Yes	Yes	Yes	No	Yes	Yes
Increase Vehicle Activity in Other Areas	NA	NA	NA	NA	Yes	No	Yes
Archeological and Historical Value Lost	No	No	No	No	No	No	No
SOCIAL WELL BEING							
Encourages a Diversified Base through New Industrial Development	Yes	Yes	Yes	Yes	NA	No	NA
Decreases Risk of Vessel *Collision*	No	Yes	Yes	Yes	NA	NA	NA
NQ - Not Quantified	NA - Non Applicable						

TABLE 2-9
System of Accounts (Cont.)

	1	2	3	4	5	6	7
	IMPROVEMENT AT ISLAND END RIVER PLAN A	IMPROVEMENT AT ISLAND END RIVER PLAN B	IMPROVEMENT AT ISLAND END RIVER PLAN C	IMPROVEMENT AT ISLAND END RIVER PLAN D	DISPOSAL BOSTON FOUL AREA	DISPOSAL NAVAL HOSPITAL SITE	DISPOSAL SOUTH BOSTON CONTAINER TERMINAL
Short Term Disruption of Vehicular Traffic	No	No	No	No	No	Yes	No
Concentration of Heavy Equipment on Land Increases Potential Hazard To Health and Safety During Construction	No	No	No	No	No	No	No
Overall Navigation Project will Require Local Labor	No	No	No	No	No	No	No
Related Development of Facilities will Require Local Labor	Yes	Yes	Yes	Yes	No	Yes	No
Industrial, Commercial, and Residential Relocation Necessary	No	No	No	No	No	No	No
Disrupts Commercial Business Activities	Yes	No	No	No	No	Yes	No
Disrupts Recreational Activities	No	No	No	No	No	No	No
Related Commercial Development will Increase Tax Revenues	Yes	Yes	Yes	Yes	NA	NA	NA
Large Local Investment Required to Develop Related Commercial Facilities	Yes	Yes	Yes	Yes	NA	NA	NA
Project Makes Maximum Use of Existing Commercial Facilities	Yes	No	No	No	Yes	No	Yes
Disrupts or Overextends Police and Fire Protection	Yes	No	No	No	NA	NA	NA
<u>REGIONAL DEVELOPMENT</u>							
Supports Industrial and Commercial Growth	Yes	Yes	Yes	Yes	Yes	No	Yes
Provides Service and Maintenance Facilities	Yes	Yes	Yes	Yes	NA	NA	NA
Majority of Construction Labor for Basic Project Hired Locally	No	No	No	No	NA	NA	NA
NQ - Not Quantified	NA - Non Applicable						

TABLE 2-9
System of Accounts (Cont.)

	1	2	3	4	5	6	7
	IMPROVEMENT AT ISLAND END RIVER PLAN A	IMPROVEMENT AT ISLAND END RIVER PLAN B	IMPROVEMENT AT ISLAND END RIVER PLAN C	IMPROVEMENT AT ISLAND END RIVER PLAN D	DISPOSAL BOSTON FOUL AREA	DISPOSAL NAVAL HOSPITAL SITE	DISPOSAL SOUTH BOSTON CONTAINER TERMINAL
Construction Expenses Would Increase Local Income Through Secondary and Induced Economic Activity	Yes	Yes	Yes	Yes	NA	NA	NA
Non-Federal Government Funds Required for Implementation of Portion of Project	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Disrupts Commercial Production During Implementation	Yes	Yes	Yes	Yes	No	Yes	No
OTHER EVALUATED CRITERIA							
Minimizes Adverse Social Impacts	No	Yes	Yes	Yes	Yes	No	No
Navigation Benefits Exceed Costs	Yes	Yes	Yes	Yes	NA	NA	NA
Efficient Method for Meeting Needs of Island End River Recreational Boating	No	Yes	Yes	Yes	NA	NA	NA
Plan is Accetable to City Planners	No	Yes	Yes	Yes	Yes	No	No
Plan is Acceptable to State Agencies	Yes	Yes	No	No	Yes	Yes	Yes
Plan is Acceptable to Other Federal Agencies	Yes	Yes	No	No	Yes	Yes	Yes
Plan is Acceptable to Private Concerns	No	Yes	Yes	Yes	Yes	Yes	Yes
Plan Compliments Redevelopment Plans of the City	Yes	Yes	Yes	Yes	Yes	No	No
NQ - Not Quantified	NA - Non Applicable						

SECTION D
THE SELECTED PLAN

75. This section describes Plan B, the selected plan of improvement for the Island End River. The associated harbor improvements required by Plan B are described in more detail in this section, as are the construction and maintenance procedures. General environmental impacts of the Plan are outlined in this section.

PLAN DESCRIPTION

76. As is shown in Figure 2-4, Plan B will consist of widening the existing industrial channel for approximately 1150 feet upstream from the Mystic River, then dredging a new channel for 1350 feet. Table 2-10 summarizes the major features of Plan B.

Table 2-10
Pertinent Data - Selected Plan

Total length of channel (feet)	2500
Length adjacent to existing channel (feet)	1150
Length upstream of existing channel (feet)	1350
Width of dredging required adjacent to existing channel (feet) (varies)	0-80
Width of channel bottom - new section (feet)	100
Depth of channel MLW (feet)	6
Side slopes below -2 MLW	1 on 3
Side slopes above -2 MLW	1 on 10
Dredge quantity (cubic yards)	64,000
Maintenance, average annual (cubic yards)	2,560

HARBOR IMPROVEMENTS

77. No turning basin or anchorage basin areas have been proposed under the federal part of the selected plan. Instead, the access channel has been designed such that it will extend along the length of the proposed mooring area to be provided by local interests.

78. A conceptual plan for a marina has been developed in this study and is illustrated in Figure 2-1. Such a marina will provide a capacity for mooring approximately two hundred fifty boats, a boat launching ramp and all of the required shore facilities. The concepts shown here were based on information obtained from the Development Master Plan for the Chelsea Naval Hospital. It is estimated that such a plan would require the dredging of 65,000 cubic yards of material and the construction of 1250 feet of revetment along the Chelsea shoreline.

79. It should be noted that the planning, engineering and construction of the marina and related facilities will be the responsibility of the City of Chelsea. It is expected that the final design of the harbor facilities are likely to differ somewhat from the concepts illustrated in this study.

EVALUATED ACCOMPLISHMENTS

80. The evaluated accomplishments that would result from the selected plan of improvements are the recreational benefits that would accrue to boaters in the City of Chelsea and in the greater Boston area. The demand for mooring spaces in the Boston area is greater than the available supply; consequently, new marinas for small boats are required if full benefits are to be derived from recreational boating. The proposed plan would enable the City of Chelsea to develop a facility for small boats in accordance with its stated economic and land use development plans. The selected plan would result in estimated net annual benefits of $249,500.

81. Other accomplishments of the plan which have not been evaluated in economic terms are that it would (1) enhance the presentation and restoration of the historic cultural resources on the Chelsea Naval Hospital property and, (2) enhance the redevelopment of the Naval Hospital property for residential, commercial and industrial uses, thereby adding to the tax base and employment opportunities in the City of Chelsea.

CONSTRUCTION AND MAINTENANCE

82. The dredging contract will specify that the contractor form a channel with a minimum depth of 6 feet at MLW with a one foot allowable overdepth. Dredging of a channel in the Island End River will be affected by the need to schedule the work according to the height of the tide. The current shallow depths in the river will affect the types of equipment that can be used, the method of conducting the dredging and the project cost.

Typical equipment that could be used for this project includes:

- A six-yard clamshell bucket dredge on a small barge (up to one hundred forty feet by forty feet with a six foot draft).
- Two 2,000-yard scows drawing about two feet when empty and about sixteen feet when fully loaded.

83. The dredge, working upstream, would cut the channel to the desired depth from the mouth of the river to the point about eleven hundred feet upstream where the channel makes a bend and the adjacent deepwater channel ends. The scows would be floated alongside in the deeper water that would not have to be dredged. Provisions in the construction documents would require that these scows be moved as necessary to avoid interference with existing commercial shipping activities. In general, the scows could be fully loaded under all tide conditions. This part of the job consisting of approximately 12,000 cubic yards could be conducted fairly routinely.

84. Upstream of the end of the commercial channel, the 100 foot wide small boat channel would be dredged in two cuts, the first being 60 to 70 feet in width. The dredge, working upstream, would clear the first cut to a depth of 6 feet below MLW. Because the dredge barge would have a draft of only six feet, it would clear its own path as it advanced. The scows, however, would have to be loaded next to the dredge where insufficient depth is available. Current bottom elevations range from about -2 to +2 MLW. Since the scows would require two feet of water, even when empty, they could not be loaded at low tide. At high tide, there would be only about eight to

twelve feet of water where the scows would be loaded. Therefore, they could not be loaded to their maximum capacity, even at high tide. The most efficient way of loading the scow would appear to be to bring in an empty scow at low tide and fill it with the rising tide. It would then be floated out at high tide.

85. After the first cut has been made, the dredge would clear the other half of the channel while the scows are loaded in the prevously dredged half. While the scows would now have six feet of water at MLW, it would still be necessary to work around the tides to some extent.

86. Disposal of the dredged material will take place at sea Appendix 7 sets forth dredged material disposal options.

87. The nature of the dredged material is expected to be primarily mud. However, the test boring has indicated a layer of dense gravel till, in some areas, at five feet below MLW. If such material is encountered, it will tend to reduce the dredging rates.

88. A clamshell dredge could attain a theoretical production rate of 7200 cubic yards per 24 hours. However, substantial downtime is encountered in dredging operations. Daily maintenance requirements, weather delays, tidal variations and similar factors, limit productivity. Under normal conditions, a productivity of 5,000 cubic yards (70 percent efficiency) per 24 hours can be achieved with a 6 cubic yard clamshell mud bucket. However, based on the need to work the tide levels and the possibility of encountering gravel, this rate has been further reduced to a level of 2,000 yards per day for this project. Plan B would, therefore, require thirty two working days to dredge, or about six weeks.

89. Maintenance dredging is estimated to be required at five year intervals, based on a shoaling rate of four percent. Analysis of shoaling rates in the commercial channel indicates very little sedimentation occurring in that part of the river. More rapid sedimentation would occur in the upper part of the river. Sediments transported into the river from upland runoff would be deposited here due to the low velocities. Maintenance dredging is estimated at 2600 cubic yards annually, or about 13,000 yards at five-year intervals.

GENERAL IMPACTS OF CONSTRUCTION

90. The construction of the proposed plan will have both temporary and long-term effects on the environment. Short-term effects include air pollution, noise and water pollution due to the dredging equipment. Long-term effects relate primarily to the alteration of the river bottom.

WATER QUALITY

91. Short-term impacts on water quality will result from oil and grease discharges from dredging equipment, from increases in turbidity, and from the reintroduction of sediment trapped pollutants. Disposal of dredged material will also cause some temporary environmental effects. Appendix 7 contains

ner analysis of the impacts of ocean disposal. Of these short-term impacts, the increase in turbidity is probably the most serious. Suspended sediments in the water can have a detrimental effect on shellfish and [illegible]. For this reason dredging of the Island End River will be scheduled to take place in the fall in order to avoid adverse effects on the spring run of the anadromous alewives in the Mystic River.

Since there is presently limited use of the Island End River for recreational purposes, such as swimming, fishing or shellfishing, the temporary increase in turbidity will have no adverse effect on these activities.

IMPACTS ON MARINE LIFE

Long-term impacts of dredging include removal of existing benthic organisms from the river bottom, removal or alteration of marine habitats in the intertidal zone, and permanent changes to the shoreline and tidal currents in the river.

The most prominent marine species expected to be displaced by dredging in the Island End River is the clamworm which was found in fairly high populations near the stream below the low tide mark in the upper part of the river. It is expected that dreding will also result in the permanent removal of some soft shell clams which were found at the downstream end of the river. Long-term impacts will be mitigated by the eventual repopulation of these species in the dredged areas. If desired, shellfish could be reseeded in less polluted environs prior to dredging. No rare or endangered species will be affected by the proposed project.

The proposed plan will affect the *intertidal zone* of the river. The intertidal zone is the area of the river bottom between the low and high water [illegible]. This area is a valuable source of organisms at the lower end of the food chain and also a potential habitat for shellfish. At the present time, harvesting of shellfish in the Island End River is prohibited due to high levels of pollution. In time, the intertidal area of the Island End River [illegible] increase in value if water quality is significantly improved. The intertidal zone is eliminated if a section of river bottom is dredged to a depth [illegible] MLW. The intertidal zone may be effected by alterations of the river bottom above MLW in order to create the side slopes for the channel (see Appendix 4A).

AIR QUALITY

25. Temporary air pollution impacts will occur during construction due to engine exhaust from the dredge and the tending boats. This air pollution will not have a significant effect since the surrounding area is primarily industrial and the Naval Hospital is unoccupied. The primary air pollution impacts relating to the disposal of the dredge material at sea will be emissions from tow boats.

OTHER IMPACTS

97. By enhancing the plans for restoration of the U.S.S. Constitution Magazine, the proposed project would have a positive effect on historic and cultural resources.

98. The proposed project will have a beneficial impact on the City of Chelsea's plans for redevelopment of the Chelsea Naval Hospital property. It will enhance the ability of the City to provide better community services through added revenues by increasing the limited tax base of the City.

99. The project will also have the beneficial effect of increasing recreational opportunities for the residents of Chelsea and nearby communities.

100. The project may have minor adverse effects due to increased automobile traffic through an existing residential area to the north of the Naval Hospital. However, most of the area surrounding the project site, consists of heavily industrialized land uses which will not be significantly impacted.

101. No existing industrial, commercial or residential porperties will be physically affected by the proposed project. There will be no relocation of residents.

SECTION E

IMPLEMENTATION RESPONSIBILITIES

COST ALLOCATION

102. Allocation of costs of the project are one hundred percent to the channel. There are no other elements of the federal project.

COST APPORTIONMENT

103. Local governments would be responsible for fifty percent of the initial cost of the federal project, or $320,000. Local responsibilities also include a one hundred percent share of related improvements which are not part of the federal project.

FEDERAL RESPONSIBILITIES

104. The federal government will be responsible for contributing fifty percent of the cost of dredging the access channel only. The federal responsibility does not include any marina improvements, shoreline protection or site work at any land disposal area.

LOCAL RESPONSIBILITIES

105. Local responsibilities are as follows:

- Provide a cash contribution toward construction costs This is determined in accordance with existing policies for regularly authorized projects, considering recreational, land enhancement, and special or local benefits expected to accrue. The present basis for cost-sharing in recreational small-boat projects requires that the federal government provide not more than 50 percent of the first costs of general navigation facilities serving recreational traffic.

- Provide, maintain and operate without cost to the United States, an adequate public landing with provisions for the sale of motor fuel, lubricants and potable water open and available to the use of all on equal terms.

- Provide without cost to the United States all necessary lands, easements and rights-of-way required for construction and subsequent maintenance of the project including suitable dredged material disposal areas with necessary retaining dikes, bulkheads and embankments.

- Hold and save the United States free from damages that may result from construction and maintenance of the project.

- Accomplish without cost to the United States alterations and relocations as required in sewer, water supply, drainage and other utility facilities.

- Provide and maintain berths, floats, piers, and similar marina and mooring facilities as needed for transient and local vessels as well as necessary trailer facilities, access roads, parking areas and other needed public use shore facilities open and available to all on equal terms. Only minimum, base facilities and service are required as part of the project. The actual scope or extent of facilities and services provided over and above the required minimum is a matter of local decision. The manner of financing such facilities and services is a local responsibility.

- Assume full responsibility for all project costs in excess of the federal cost limitation of $2,000,000 under the 107 program.

- Establish regulations prohibiting the discharge of untreated sewage, garbage, and other pollutants in the waters of the harbor, said regulations being in accordance with applicable laws and regulations of federal, state and local authorities responsible for pollution prevention and control.

ISLAND END RIVER
CHELSEA, MASSACHUSETTS

DETAILED PROJECT REPORT

PUBLIC VIEWS AND RESPONSES
APPENDIX 3

PREPARED BY THE

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

PUBLIC VIEWS AND RESPONSES

TABLE OF CONTENTS

PUBLIC VIEWS AND RESPONSES

TABLE OF CONTENTS
(cont.)

APPENDIX 3

PUBLIC VIEWS AND RESPONSES

SECTION A

PUBLIC INVOLVEMENT PROGRAM

1. Views of government agencies were obtained through initial contacts by telephone, written correspondence and meetings. A major reivew meeting was held at which the four detailed plans were reviewed and which was attended by representatives of the City of Chelsea, the Massachusetts Office of Coastal Zone Management, the Massachusetts Division of Marine Fisheries, and the National Marine Fisheries Service. The following is a summary of the major comments received during the coordination phase.

FEDERAL AGENCIES

U.S. COAST GUARD, AIDS TO NAVIGATION BRANCH

2. Existing navigation aids in the Island End River are being improved per request of Coldwater Seafood Corporation. Additional navigation aids would be required if a separate small boat channel is dredged. They did not forsee any significant navigation problems with any of the alternatives.

U.S. COAST GUARD, OFFICE OF MARINE SAFETY

3. Expressed concern over the safety aspects of Plan A, and recommended a separate channel as under Plans B, C and D in order to reduce the conflicts with industrial shipping and to avoid encouraging recreational boating close to the Exxon terminal.

U.S. FISH AND WILDLIFE SERVICE

4. Expressed opposition to the Reconnaissance Report plan. Recommended that Plan A be considered in order to minimize the impacts on marine life.

NATIONAL MARINE FISHERIES SERVICE

5. Felt that Plan A was most desirable because of minimal dredging impacts and effects on marine life, but also felt that Plan B was acceptable because of the safety aspects of Plan A. Objected to Plans C and D.

STATE AGENCIES

OFFICE OF COASTAL ZONE MANAGEMENT

They felt the project should consider the future industrial needs of Everett industries. Land disposal of dredge material should be given first priority over ocean dumping.

DIVISION OF MARINE FISHERIES

7. Felt that Plan A was the most desirable because of the minimum amount of dredging, but that Plan B was acceptable. They objected to Plans C and D.

DIVISION OF SOLID WASTE DISPOSAL

8. They indicated that disposal of dredged material on land is considered a severe problem. State review of land disposal plans would be required and special provisions would be needed, if land disposal is selected.

DIVISION OF WATER POLLUTION CONTROL

9. They believe that the dredged material will be highly contaminated and they thought a containment boom should be used to prevent the spread of oil. They also believe that disposal of dredged material would require water pollution abatement measures.

LOCAL GOVERNMENT AGENCIES

CITY OF CHELSEA

10. The City, through its spokesman, Urban Consulting Associates of Boston, expressed concern for the adverse odor and visual effects of the river's mud flats on the Naval Hospital redevelopment plans. The City would prefer to have the amount of open water in the river increased, particularly in proximity to the Chelsea shoreline. They feel the river has minimal ecological value in its present condition. Consequently, they prefer Plans C and D. Land disposal of dredge spoils on the Naval Hospital property is not desirable because it interferes with redevelopment plans.

OTHER GOVERNMENT AGENCIES

METROPOLITAN AREA PLANNING COUNCIL

11. Supported the project in general, citing the need for recreational opportunities and waterfront access for Mystic River communities.

MASSACHUSETTS PORT AUTHORITY

12. Although unable to make a committment to accept dredge material at the site of its proposed Container Port facility in South Boston, Massport indicated that the material might be accommodated if project schedules can be coordinated and if the dredged materials were similar in nature to other materials to be disposed of in the landfill site.

PRIVATE INDUSTRIES

EXXON CORPORATION

13. Exxon expressed concern about the accident potential inherent in Plan A, due to the large quantities of volatile chemicals handled at the terminal.

They are also concerned about collision potential and trespass. They felt that a small boat channel should be located as far as possible from their terminal.

COLDWATER SEAFOOD CORPORATON

14. They are more concerned about trespass than with collision possibilities.

MARQUETTE CEMENT CORPORATION

15. They stated that navigational improvements for small craft would have a minimal effect on their operations.

DISTRIGAS CORPORATION

16. They felt that navigational improvements for small craft would have a minimal effect on operations at their liquid natural gas facility on the Mystic River. There are already marina facilities along the Mystic River and numerous small craft presently use the river.

SECTION B

COPIES OF CORRESPONDENCE

17. Copies of correspondence received regarding this study are included on the following pages.

The Commonwealth of Massachusetts
Metropolitan District Commission
20 Somerset Street, Boston 02108

8 March 1978

Colonel John P. Chandler
Division Engineer
U.S. Army Corps of Engineers
424 Tropelo Road
Waltham, Massachusetts
02154

Dear Colonel Chandler:

Yesterday, Steve Andon, Project Manager for the Corps for your Island End River dredging project, Chelsea, Massachusetts, called to ask me if the Commission would allow the dredged material to be permanently placed on the proposed M.D.C. park construction land. While I cannot speak directly for the Commission, I can offer an opinion that it is doubtful that they would allow this salt and chemical ladden material to be placed within the proposed park.

We are aware of the difficult problems of disposing dredged materials and are finding problems with these materials in our own coastal projects where we are reconstructing parks or dredging for boat docking. The cost to reclaim this material to an agricultural state is costly and time consuming. The present grades at the proposed Mystic River Park Site at Chelsea appear to be what is desired in the park landscape, and the present soil conditions offer us an opportunity to provide a good and substantial turf for this site.

We are sorry to offer you this point of view regarding this matter.

Sincerely,

James W. Falck

James W. Falck
M.D.C. Landscape Section-Engineering

cc: Francis T. Bergin
M.D.C. Chief Construction Engineer

SSACHUSETTS
HISTORICAL
COMMISSION

COMMONWEALTH OF MASSACHUSET
Office of the Secretary of State
294 Washington Street
Boston, Massachusetts
02108
617-727-8470

MICHAEL JOSEPH CONNOLLY
Secretary of State

February 28, 1979

Joseph L. Ignazio
Chief, Planning Division
Department of the Army
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Re: Island End River dredging, Chelsea

Dear Chief Ignazio:

The Massachusetts Historical Commission has reviewed your letter of 21 February 19 in regards to the Island End River dredging in Chelsea. The Massachusetts Histori Commission concurs with your finding that significant historic and archaeological resources are not likely to exist in the project area. No further review in compliance with Section 106 of the National Historic Preservation Act of 1966 is necessary.

Sincerely,

Patricia L. Weslowski

Patricia L. Weslowski
State Historic Preservation Officer
Executive Director
Massachusetts Historical Commission

PLW/ej

RAYMOND H. HAMSON JR.

Customhouse Broker & Foreign Freight Forwarder

CABLE ADDRESS
HAMSON-BOSTON

99 STATE STREET
BOSTON, MASS. 02109

TEL. (617) 227-8996
TELEX 940717

May 17, 1979

Commander (oan)
First Coast Guard District
150 Causeway St.
Boston, Mass. 02114

Attention Lieutenant Commander J. F. Overath
Assistant Chief, Aids to Navigation

Dear Sir:

Thank you for your letter dated March 22, 1979 in reply to my telephone call to you in regard to establishment or relocation of a buoy to better mark the entrance of Island End River.

Kindly find attached correspondence I received from Coldwater Seafood Corp., 60 Commercial St., Everett, Mass. answering the excerpts from the Code of Federal Regulations which you requested.

The only addition I have to make is that the Office of the Boston Pilots have advised me that a "Dolphin" would be best suited in place of a new buoy as the "Dolphin" would not move at low tide whereas the buoy might.

Please be advised that I represent the following Steamship Lines that call at the dock of the Coldwater Seafood Corp. in the Island End River:

Iceland Steamship Co. Ltd.
Reykjavik, Iceland

Copenhagen Reefers
Copenhagen, Denmark

Thanking you for your attention in this matter, I remain

Very truly yours,

RAYMOND H. HAMSON JR.

R[illegible]
[illegible] 18 1979

RHH/jr
Enclosures Various

3-7

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
P.O. Box 1518
Concord, New Hampshire 03301

[illegible]

[illegible]

JUN 21 1979

Division Engineer
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Sir.

This planning aid letter is intended to aid in your planning efforts for a navigation project in Island End River, Chelsea, Massachusetts. Your study is authorized by Section 107 of the Rivers and Harbors Act of 1960, as amended. This report is submitted under authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

Island End River, about one-half mile long and 500 feet wide, is a tidal inlet located on the north side of the Mystic River and about one-half mile west of the confluence of the Mystic River and Boston Inner Harbor. The east side of the Island End River is relatively undeveloped and is the grounds of the former Chelsea Naval Hospital. The west shore is built up with commercial properties and the shoreline is lined with old wooden docks. The boundary between Chelsea and Everett runs along the approximate center of the river and the Chelsea (east) side is almost entirely a tidal flat.

An existing channel, 25 to 28 feet deep and about 100 feet wide, lies along the west side of the river. This channel is about 1,500 feet long. There is a small inflow to the river through a culvert at the upstream end.

The proposed work consists of a 2-acre turning basin to be dredged at the inland end of the channel and a 2,000 foot long channel 100 feet wide, to be dredged parallel to the east shore to the Mystic River. The turning basin and channel would be dredged to a depth of 7 feet at mean low water. The minimum area to be dredged would be about six and one-half acres not including allowances for side slope and depth of cut.

The Reconnaissance Report[1] predicts that 250 boats will eventually use marina facilities to be developed by the City of Chelsea along with development of the Chelsea Naval Hospital area for housing, recreation

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[1] Department of the Army, New England Division, Corps of Engineers, November 1978. Island End River, Chelsea, Mass.; Small Boat Navigation Project, Reconnaissance Report.

and industry. Dredging of the marina to accommodate the recreation boats used to justify the project is not described in the Reconnaissance Report. The details of this additional dredging should be included in the Detailed Project Report. The number of acres to be dredged, location of dredging, marina facilities to be constructed, depth of dredging, and amount and anticipated proposed spoil disposal procedures should be described.

The project site was visited on May 16, 1979, by biologists from this office and the Massachusetts Division of Marine Fisheries. It was found that the bottom materials on the intertidal area range from soft muds to rather firm gravel and sandy materials in the upper 6 to 12 inches. A clay base was found under the upper layers over much of the area. The upper 6 to 12 inches of substrate was found to be saturated with oil, and patches of tar several square feet in area were found at the upper tide levels. There were patches of oil sheen on the surface of the river.

In spite of the polluted condition of the flat, soft-shell clams were found at the confluence of the Mystic and Island End Rivers and for several hundred feet upstream along the Island End River. The clam population became sparse further upstream on the Island End River. The clams found ranged in size from 1/4 inch to 3 inches indicating that some reproduction was taking place. Barnacles were found on rocks along the Mystic River. Green crabs and a few blue mussels were found near the mouth of Island End River. Abundant populations of clam worms were found. They seemed to be generally located throughout much of the intertidal area near the mouth of Island End River but were confined to the channelward margins of the intertidal area in the upper sections of the river. A snowy egret was seen on the tidal flat.

The soft-shell clams cannot be harvested due to pollution; however, they probably provide a seed source for other areas of Boston Harbor. The clam worms could be taken as bait and a source for stocking other areas in the harbor. Conditions are expected to improve in the future as a result of pollution abatement activities. Tidal flats are now limited in the Boston Harbor area.

An alternate to dredging the 2,000 foot long channel through the tidal flat is to make use of the existing channel for recreational boats. This would reduce the proposed channel from 2,000 feet to about 700 feet and result in a significant reduction of spoil material for disposal and reduce disturbance of the substrate that could cause distribution of additional pollutants through the nearby waters. This alternate should be considered as an Environmental Quality Plan.

Potential problems of interference between ships and recreational craft could be minimized by marking the eastern edge of the existing channel for recreation boats. This edge of the channel slopes steeply to depths of 6 feet or more from mean low water. There should be no interference when the ships are tied up. Passage of recreation craft could be delayed, or restricted to the east side, when ships are turning or moving in the river. A traffic control system of warning signals might be necessary.

The Reconnaissance Report shows that the Marquette Cement Corporation receives one barge per month, the Coldwater Seafood Corporation handled 20 vessels during the first six months of 1978, and the Exxon Corporation handles about 500 vessels per year. The Exxon facilities are located at the mouth of the river and some of their vessels tie up along the Mystic River, not entering the Island End River.

Even though the tidal flat is polluted, we feel that it still has a sufficiently viable benthic population to warrant its preservation in view of the fact that an alternate exists which will reduce new dredging by about 70 percent and cause significant reduction in the amount of polluted spoil to be dredged.

Upland spoil sites should be utilized for disposal. Spoil should not be placed on intertidal areas or dumped at sea. The amount of sediments that will need to be dredged for future maintenance and the expected degree of pollution of the sediments should be predicted so that specific arrangements for upland disposal of maintenance dredging spoils can be incorporated into the project plan.

If the 2,000 foot channel is selected for dredging, biological studies will be necessary to determine the average annual loss in benthic organisms over the project life. There appears to be little possibility of constructing new tidal flats in the Boston Harbor area to mitigate the loss.

This Service will carefully review any future permits for dredging of a marina or for other developments to assure that destruction of intertidal habitat is minimized. We will probably object to dredging of a 2,000 foot channel through these tidal flats if that plan is selected.

We recommend that:

1. An alternate channel leading from the proposed turning basin to the existing channel be selected to avoid dredging the proposed 2,000 foot channel.

2. Upland sites be found for spoil disposal including any future spoil from maintenance dredging.

3. Details of the proposed or anticipated marina development be incorporated into the Detailed Project Report.

Sincerely yours,

Gordon E. Becket
Supervisor

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Federal Building, 14 Elm Street
Gloucester, Massachusetts 01930

June 6, 1979 FNE61:CLM

Col. John P. Chandler
Division Engineer
Department of the Army
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Colonel Chandler:

This is in reference to the Reconnaissance Report concerning Small Boat Navigation Improvements for the Island End River at Chelsea, Massachusetts.

We have reviewed the report and the U.S. Fish and Wildlife Service planning aid letter, dated June 1, 1979 (copy enclosed).

Due to manpower and time restraints, we have not been able to conduct our own investigation. However, because of the potential for adverse impacts to fishery resources in the Island End River, we concur and support the findings and recommendations of the referenced U.S. Fish and Wildlife Service planning aid letter. We also recommend that the existing channel be rehabilitated, as opposed to dredging a new one, and that spoil material not be placed on intertidal areas. Further, the proposed marina development should be described in more detail in future correspondence.

Please keep us informed of any action taken on this project.

Sincerely,

Robert W. Hanks
Acting Regional Director

Enclosure

RECEIVED
JUN 21 1979

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

MAILING ADDRESS:
Captain of the Port
U. S. Coast Guard
Marine Safety Office
447 Commercial Street
Boston, MA 02109

16611
16 July 1979

Mr. David A. Kinnecom
Storch Engineers
Two Charlesgate West
Boston, MA 02215

Dear Mr. Kinnecom:

This is in response to your letter of 20 June 1979 regarding the feasibility of alternate plans to improve channel access to a proposed recreational marina at the former Chelsea Naval Hospital.

Following are remarks concerning the three alternatives you listed:

(1) "Extending the present channel . . ." is the least desirable alternate due to the interface of commercial and recreational traffic that would result. The opposition expressed by Exxon is quite valid and should be seriously considered. They do handle a large amount of volatile material.

(2) "Constructing an entirely new channel . . ." would be an ideal solution but would likely prove cost prohibitive.

(3) "Widening the existing channel . . ." is the most practical of the three and the choice most favored by this office. We suggest that you consider the necessity of a buoyage system on the eastern side of Island End River.

[illegible]
JUL [illegible]

The Boating Safety Branch of the First District Office compiles data on recreational boating accidents. They have advised us that such data for a specific location is not readily available.

If we can be of any further assistance, please feel free to contact us.

Sincerely,

R Barry Eldridge

R. BARRY ELDRIDGE
Captain
U. S. Coast Guard
Captain of the Port
Boston, Massachusetts

[illegible] COMPANY, U.S.A.
30 BEACHAM STREET • EVERETT, MASSACHUSETTS 02149 STANSHIP BOSTON

MARINE DEPARTMENT
EAST COAST BRANCH

[illegible]

November 6, 1979

Mr. David A. Kinecom, P. E.
Storch Engineers
Two Charlesgate West
Boston, Massachusetts 02215

Proposed Small Boat Marina
Island End River
Chelsea-Everett, Massachusetts

Dear Mr. Kinnecom:

Complying with your request of October 23, 1979 we submit the following comments.

We have reviewed the existing conditions, e.g., the channel width, the small boat mooring area on the Chelsea shoreside between Buoy 2 and the Mystic River Bridge, current tug/barge and large vessel traffic including berthing restrictions and turning basin clearance, lateral visibility and maneuvering restrictions while executing the turn into said channel, intense background lighting and noise propagation from bridge, container terminal and bordering shoreside facilities affecting small vessel detection capability.

Taking these and future conditions into consideration, we believe that the use of the existing channel would definitely present a potential safety hazard. The obvious problems would be that of traffic congestion in the Island End River, directly affecting the terminal's tug/barge berths. Inexperienced small boat operators could present a dangerous situation for docking and undocking tugs and gasoline barges, not to mention the vulnerability of cargo handling operations. The exact effect on terminal security by this projected option is not known.

For the safety of the small boat operators and the better interest of this Company, we strongly oppose the use of the existing channel and advise the dredging of an entirely separate small boat channel.

Very truly yours,

J W Bennett

J. W. Bennett

JWB:kmcn

A DIVISION OF EXXON CORPORATION

SECTION C

PUBLIC REVIEW OF THE DRAFT DETAILED PROJECT REPORT

18. On 21 January 1980, the Draft Detailed Project Report was released for public review and comments. The review period allowed for 30 days, ending on 28 February 1980.

19. Concurrent with the review stage there was a transmittal letter announcing the final public meeting to permit full public involvement and input into the overall study process. The meeting announced on 22 January 1980 was held in Chelsea City Hall on 19 February 1980.

20. The plan of improvement, as outlined at the public meeting, met with favorable reaction from all concerned parties. However, three concerns were voiced during the course of the meeting.

21. The Community Development Director for the City of Chelsea indicated that the city preferred either Plan C or D, as it would allow for more water, but the city would accept Plan B as a second preferred alternative.

22. Members of the Chelsea Yacht Club, while not opposing the proposed development of the Island End River, voiced concern over the influx of high speed motor boats. It was indicated that vessels cruising past the clubs' moorings have caused damages in the past, and that 250 additional vessels would only compound the problem. It was indicated that this office would contact the U.S. Coast Guard and request a speed marker be positioned to help alleviate the the problem.

23. The final concern was over the possibility that more boaters than the facility could accommodate, would indicate a desire to utilize the marina and boat launching ramp. Should the design prove inadequate, this office has the authority, at a request from the city, to return and reevaluate the proposed plan. However, it was explained that the Island End River proposal was never meant to service the entire boating community of the Greater Boston area, only to assist in alleviating the present lack of recreational boat facilities throughout the area.

24. The remainder of this section contains correspondence released and received during the final public review stage.

DEPARTMENT OF DEFENSE

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:

NEDPL-C

21 January 1980

TO: Concerned Island End River Interests

This letter attaches a Draft Detailed Project Report and Draft Environmental Assessment concerning the advisability of providing navigational improvements in Island End River in the interests of recreational navigation and related purposes. These documents are forwarded to you for public review and comment at this time to obtain your views on the concept of dredging an access channel to the proposed marina to be built by the city of Chelsea.

Several alternatives were analyzed in an attempt to find the improvement plan which best fits the expected needs of the recreational boaters. The results of this analysis indicate that at this time the most feasible plan of improvement consists of a channel, 6 feet deep and 100 feet wide at MLW, from deep water in the Mystic River to a point off the proposed marina site for a total distance of 2,500 feet.

The report consists of a description and impact assessment for each alternative plan as well as a discussion of the rationale for selecting the final plan.

The attached report will undergo a 30-day period of public review, ending 28 February 1980. Please direct all comments, before this date, to the Division Engineer at the following address:

Division Engineer
U.S. Army, Corps of Engineers
New England Division
424 Trapelo Road
Waltham, MA 02154

Sincerely,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

1 Incl
As stated

DEPARTMENT OF DEFENSE

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:

NEDPL-C

ANNOUNCEMENT OF PUBLIC MEETING

ISLAND END RIVER, CHELSEA, MASSACHUSETTS

The New England Division, Corps of Engineers, is nearing completion of a study to determine the engineering feasibility, economic justification, and environmental acceptability for providing navigation improvements in Island End River, Chelsea, Massachusetts, in the interests of recreational navigation. The study is being conducted under the authority of Section 107 of the 1960 River and Harbor Act, as amended.

The study was originally initiated at the request of officials of the city of Chelsea dated 5 April 1977.

In order to allow for public review of, and input to, the project, there will be a public meeting held in Chelsea City Hall on Tuesday, 19 February 1980, at 7:00 p.m.

This meeting is being held in order that the public may be advised of the study findings. All interested parties are invited to be present or represented at the meeting, including representatives of federal, state, county, and local agencies; commercial, civic and conservation groups; property owners, private citizens, and other interests.

The study included the following work: analyses of the prospective recreational use of Island End River; detailed cost-benefit analyses; an investigation of all alternative navigation improvements; and detailed analyses of the impact of the proposed improvement including an environmental assessment. Plan formulation has been coordinated with all known affected and interested federal, state and local government agencies, private groups and individuals.

A plan of improvement, shown on Figure 1, has been developed that would provide the following:

- a 100-foot wide access channel extending from the Mystic River for a length of 2,500 feet to the site of the recreational boat marina.

- the selected plan would allow for an overall depth of 6 feet at mean low water.

The total cost of this improvement is presently estimated at $629,000. Since the benefits resulting from this improvement are entirely recreational in nature, the total construction costs will be apportioned 50 percent federal and 50 percent local.

In addition to their share of the initial construction costs, local interests would be responsible for bearing the costs of dredging and constructing the proposed marina and onshore support facilities. Local interests will also be responsible for provision of necessary lands, easements and rights-of-way; and holding the United States free from damages that may result from construction and subsequent maintenance of the project. Future project maintenance will be a responsibility of the federal government.

A detailed explanation of the plan of improvement, the attendant costs and benefits; the environmental impacts and all items of local cooperation will be presented at the public meeting. The intent of the meeting is to have a free and open exchange of views regarding the study findings.

Comments will be welcome from those who have new information not previously presented which may support justification for additional improvements. Likewise, those opposed to the improvements are invited to express any new information relating to their opposition and their reasons for it. All views, pro and con, will be included in the official written record of this study and will be available for public examination. Please be sure any information presented is new and not a repetition of data already presented and included in the study.

Any specific information and additional data on man's environment or the natural ecology that may be related to navigational improvements can be presented at this meeting.

Copies of the draft Detailed Project Report and Environmental Assessment are expected to be available to the public for review in Chelsea City Hall, Everett City Hall, and the Chelsea Public Library.

If you have any questions or comments regarding this project, please contact the project manager, Steven Andon, at:

NEDPL-C

Department of the Army
Corps of Engineers
New England Division
424 Trapelo Road
Waltham, MA 02154
Tel. (617) 894-2400, Ext. 550

All comments on any aspect associated with navigational improvements will receive full consideration before recommendations are made to the Chief of Engineers. Oral statements will be heard but,for accuracy of record, all important facts and statements should be submitted *in writing, in duplicate, to the presiding* officer at the meeting or may be mailed beforehand to the above address. Statements so mailed should indicate they are in response to this announcement.

Please bring this announcement to the attention of anyone you know to be interested in this study.

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

EDWARD J. MARKEY
7TH DISTRICT, MASSACHUSETTS

319 CANNON HOUSE OFFICE BUILDING
WASHINGTON, D.C. 20515
(202) 225-2836

COMMITTEES:
INTERSTATE AND FOREIGN COMMERCE

INTERIOR AND INSULAR AFFAIRS

Congreſs of the United States
House of Representatives
Washington, D.C. 20515

DISTRICT OFFICES
2100A JOHN F. KENNEDY BUILDING
BOSTON, MASSACHUSETTS 02203
(617) 223-2781

404B SALEM STREET
MEDFORD, MASSACHUSETTS 02155
(617) 396-4800

STATEMENT READ AT CHELSEA CITY HALL ON FEBRUARY 19, 1980 ON BEHALF OF CONG. EDWARD J. MARKEY REGARDING THE PLANNED IMPROVEMENT TO THE ISLAND END RIVER.

Congressman Ed Markey is in Washington this evening and unable to be here. But he has asked me to read his statement expressing support for the Army Corps of Engineers' proposal for improving the Island End River in Chelsea.

"I wholeheartedly support the plan recommended by the Army Corps of Engineers to improve the Island End River with a 100 foot wide, six foot deep access channel from the Mystic River to the Chelsea site. This will greatly enhance the navigation in the river opening another area for recreational craft of all sizes. It will also provide the necessary access to the waterfront park and 250 boat Marina at the Chelsea Naval Hospital site made possible by large federal and state funds. The proposed improvements would offer a recreational outlet and benefits for the citizens of Chelsea, Everett, and the entire Boston area.

But most importantly the Army Corps' commitment to this project would serve as another example of the federal governments determination to make the Chelsea Naval Hospital Project an unmitigated success.

I would like to offer the rest of my time to the real purpose of this evenings meeting, public input."

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

MAILING ADDRESS:
COMMANDER (dpl)
FIRST COAST GUARD DISTRICT
150 CAUSEWAY STREET
BOSTON, MA 02114
Phone: 617-223-6251

16475
11 February 1980

Division Engineer
U. S. Army, Corps of Engineers
New England Division
NEDPL-C
424 Trapelo Rd.
Waltham, MA 02154

Dear Sir:

The Review Draft of the Environmental Assessment and Detailed Project Report for the Small Navigation Project at Island End River, Chelsea, MA has been reviewed. Since the Coast Guard's concern for traffic safety and overall preference for alternative B is as already stated in the publication, no further comments are submitted.

Sincerely,

Richmond
S. L. RICHMOND
Commander, U. S. Coast Guard
Coastal Zone Management Officer
By direction of Commander,
First Coast Guard District

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

COASTAL ZONE
MANAGEMENT

February 20, 1980

Mr. Stephen Andon
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Mass. 02154

Dear Steve:

I am writing at this time to follow up some questions that I have regarding the proposed Island End River project. At the meeting held in Waltham on February 12 it was pointed out that one sediment sampling station was not in the area to be dredged (Plan B). This was to be corrected. In addition, a station is to be relocated into the marina basin. If available, could you please forward a map showing these realigned stations.

Some additional comments and questions I have are as follows:

- could you please outline the assumed maintenance dredging quantities and intervals
- is there sufficient area to increase the number of slips (double, triple, the number?)
- if there is sufficient area, what might be the required dredging amounts to double or triple the number of slips.
- because the sediments are so fine and the flushing rate of the river is so minimal what might be the chances and consquences of slumping.

We will continue to follow the progress of the project and will review for federal consistency when formally requested.

Sincerely,

Richard Tomczyk
Marine Biologist

RT:dc

cc: Michael Penney
Melvin P. Holmes (EPA)
Chris Mantzaris (NMFS)
Marita Yoder (Corps)

The Commonwealth of Massachusetts
Water Resources Commission
Division of Water Pollution Control
110 Tremont Street, Boston 02108

OFFICE OF THE DIRECTOR

March 3, 1980

Steven Andon
NED, Corps of Engineers
424 Trapelo Road
Waltham, MA 02154

Re: Water Quality Certification
Island End River
Chelsea
Improvement Dredging

Dear Mr. Andon:

In response to your request in your petition dated January, 1980, this Division has reviewed your application for a permit to conduct improvement dredging in the Island End River, Chelsea.

In accordance with the provisions of Section 401 of the Federal Water Pollution Control Act as amended (Public Law 95-217), this Division hereby issues the following <u>Water Quality Certification</u> relative to this project:

1. The dredging portion of the project could result in a violation of water quality standards adopted by this Division. Therefore, reasonable care and diligence shall be taken by the contractor to assure that the proposed activity will be conducted in a manner which will minimize violations of said standards.

2. The dredged material shall be disposed of in an area 1 nautical mile in diameter in Massachusetts Bay centered at 42°25'N latitude, 70° 35' longitude.

Should any violation of the water quality standards or the terms of this certification occur as a result of the proposed activity, the Division will direct that the condition be corrected. Non-compliance on the part of the permittee will be cause for this Division to recommend the revocation of the permit(s) issued therefor or to take such other action as is authorized by the General Laws of the Commonwealth.

Very truly yours,

Thomas C. McMahon
Director

TCM/RJI/amc

cc: Anthony D. Cortese, Sc.D., Commissioner, Dept. of Environmental Quality Engineering, 100 Cambridge Street, Boston 02202
Morgan Rees, Chief, Permits Branch, Corps of Engineers, 424 Trapelo Rd., Waltham 02154
John J. Hannon, Director, Division of Land & Water Use, Dept. of Environmental Quality Engineering, 100 Nashua Street, Boston 02114
Richard Cronin, Director, Division of Fisheries & Wildlife, 100 Cambridge Street, Boston 02202
Philip Coates, Director, Division of Marine Fisheries, 100 Cambridge St., Boston 02202
Samuel Mygatt, MEPA, 100 Cambridge St., Boston, MA 02202

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Environmental & Technical Services Division
Environmental Assessment Branch
7 Pleasant Street
Gloucester, Massachusetts 01930

March 7, 1980

Col. Max B. Scheider
Division Engineer
Department of the Army
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Colonel Scheider:

This is in reference to the Ecological Evaluation of Proposed Oceanic Discharge of Dredged Material from Island End River, Chelsea, Massachusetts. We have reviewed the above document and offer the following comments for your consideration.

Although mortalities in some test organisms were rather high in 100% liquid and suspended phases, we believe that no long-term adverse impacts will result from suspension of the proposed dredged material at the disposal site. However, we are concerned that the solid phase bioassays indicate that the potential exists for significant adverse impacts. In the initial solid phase bioassay mortality in the mysid shrimp, Neomysis americana, ranged from 73% to 88%, while in the second solid phase bioassay it averaged 25%. These data, especially the first set, strongly suggest that the sediments to be dredged are very toxic to at least some marine organisms. An additional point of concern is the difference between the results of the two solid phase bioassays. We would like some explanation for this difference. There is no way that we can tell which, if either, set of data demonstrate the actual potential for the sediments in question to cause impacts upon marine resources. If, in fact, the sediments in question contain a sufficient concentration of toxicants to result in the mortality of at least 73% of the mysid shrimp tested we would object to ocean disposal of such sediments without sufficient measures invoked to mitigate potential adverse impacts.

Bulk sediment analyses show high concentrations (Class III) of vanadium from all three stations, of lead from Station 2, and of arsenic, cadmium and chromium from Station 3. The sediments from all three stations also have high concentrations (Class III) of oil and grease.

It is our understanding that bioaccumulation data and perhaps additional bioassay data are being gathered. We shall defer our recommendations until receipt of this additional information.

If you have any questions, please contact Charles Karnella of my staff at FTS 837-9338.

Sincerely,

Ruth Rehfuss
Ruth Rehfuss
Acting Branch Chief

10 MAR 1980

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
P.O. Box 1518
Concord, New Hampshire 03301

MAR 12 1980

Colonel William E. Hodgson
Deputy Division Engineer
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Colonel Hodgson:

This is our report concerning your study of navigation improvement for the Island End River in Chelsea, Massachusetts, and our comment on your draft Detailed Project Report and Environmental Assessment. The study is being conducted under authority of Section 107 of Public Law 86-645 as amended. This report is prepared under authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and supplements a planning aid letter submitted to you on June 1, 1979.

The Island End River is polluted with obvious deposits of oil and grease and other urban debris and supports a benthic fauna consisting of pollution tolerant species. Conditions are less severe near the mouth of the river where a soft-shell clam population exists. There is a small area of phragmites in the northeast corner of the area and adjacent to the river. Clamworms, snails, and other benthic species are abundant. The area receives limited use by shorebirds, wading birds, and waterfowl. The river receives a small amount of inflow from a culvert at the upstream end. Little fishing, hunting, or other wildlife related activity occurs because of the commercialized nature of the site and pollution of the water. There is no harvest of the shellfish or clamworms but these populations probably benefit the entire estuary by producing young that are distributed to other areas.

The most important environmental problem associated with this project is the polluted nature of the materials to be removed by project and maintenance dredging, and the potential disturbance of bottom materials during each boating season. Further reduction of the intertidal zone also is a long-term adverse impact.

The high level of PCB's found in the substrate indicates both the existence of this material and its potential for redistribution from the spoil site whether it is offshore or at an upland site. A meeting of personnel from this Service, the National Marine Fisheries Service, Environmental Protection Agency, Corps of Engineers, and the Massachusetts Office of

Coastal Zone Management was held on February 12, 1980, to discuss this problem. It was agreed that two samples from sites in the proposed channel area and at least one at the future marina site be tested for bioaccumulation. We understand you will make no decision on the project until the test results are evaluated.

We are concerned that the PCB's and heavy metals will be redistributed into the environment if the project is implemented as planned. Ocean disposal of this material is not the way to eliminate these contaminants from the environment.

We believe that your report should be more detailed when describing the possible impacts of offshore disposal even though it is recognized that adverse impacts will occur as stated on pages 12, 1-13, and 1-16. The impacts of offshore disposal are either omitted or too briefly stated in the section on page 20, "General Assessment and Evaluation of Impacts" and on page 41, "Probable Environmental Impacts." We feel that the impacts of continued disposal of contaminated materials into the sea should be discussed more thoroughly. A recent article by Robert A. Murchelano of the National Marine Fisheries Service discusses possible, though poorly defined at this time, relationships between degraded habitat and diseases of fish and shellfish. He states that "There is increasing evidence that poor environmental quality causes disease and predisposes marine species to diseases to which they are normally susceptible."[1]

We note that the bulk sediment results show high levels of vanadium, arsenic, cadmium, chromium, lead, and zinc in the material to be dredged and that the first solid phase bioassay mortality of mysid shrimp was high. While mortality was much less in the second test it appears that the material has potential to be toxic to marine life.

Results of the second solid phase bioassay are confusing and possibly misleading. The survival of 75% of the mysid shrimp in the reference sediment was too low. According to the Implementation Manual the test should be repeated if survival in the reference sediment is 90% or less. Using the control (culture) sediment to justify the bioassay is not valid. You could be testing contaminated material against contaminated material. We cannot agree with your proposal (page 5-55) that solid phase tests be conducted with a "culture-sediment" control plus a "disposal-site-sediment" control.

Contamination of the material to be dredged at Island End is several times greater for mercury, lead, zinc, arsenic, and cadmium than found in sewage sludge placed in wetlands at the wastewater collection and treatment facilities at Cranston, Rhode Island. The Island End elutriate contains 12 to 26 ppm of PCB's compared to only 8.5 ppm at Cranston. In

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[1] Murchelano, Robert A. 1980. Environmental Quality and the Diseases of Fish and Shellfish, Maritimes, February 1980, Graduate School of Oceanography, University of Rhode Island, pp 7-10.

developing new facilities at Cranston the old sludge material will be removed and most of it will be placed in a landfill site approved for hazardous wastes. The material from Island End also should be placed in a site approved for hazardous waste or contained in a sealed container.

Because the material to be dredged is polluted it seems wise to move as little of it as possible. While the difference between the quantities of material to be dredged between Plan A and B is 12,300 cubic yards, Plan A would still require dredging of a total of 116,700 cubic yards. We appreciate that Plan B was chosen on the basis of the least amount of dredging consistent with safety and that Plan A was selected as the Environmental Quality Plan. However, we believe that an alternate, such as rack storage of boats, should be considered. It could reduce the amount of dredging needed for the marina.

We plan to await the results of bioaccumulation tests before making final recommendations. However, our most probable position will be to recommend that the material be deposited in a sealed containment site to prevent the contaminants from entering the environment even though construction of a containment site could delay this project for 10 years. Your report should include strong encouragement for development of a spoil management plan in the Boston area including sites for containment of polluted spoil. We also recommend that your report review the possibility of rack storage for recreational craft to reduce the dredging requirements.

Please forward the results of the further studies when they are completed.

Sincerely yours,

Gordon E. Beckett

Gordon E. Beckett
Supervisor

The City of Chelsea Massachusetts

City Hall
500 Broadway
Chelsea, MA 02150
884-0407

Office of the Mayor

Joel M. Pressman, Mayor

March 25, 1980

Col. Max B. Scheider
Division Engineer
U. S. Army Corps of Engineers
New England Division
424 Trapelo Road
Waltham, MA 02154

Dear Colonel Scheider:

The City of Chelsea supports the proposed dredging and marina project for the Island End River as outlined in the Draft Detailed Project Report and the Draft Environmental Impact Report.

The proposed dredging project is a critical catalyst to the $85,000,000 revitalization program for the former Chelsea Naval Hospital. In addition to providing sorely needed recreational boating facilities in Boston Harbor, the project is an important ingredient in our attempts to rebuild our hard pressed City.

Funds for the local share of the costs are available as part of our $6,749,000 Urban Development Action Grant received from the Department of Housing and Urban Development.

As we have stated the City of Chelsea would prefer Alternative C but would be satisfied with Alternative B.

I would like to take this opportunity once again to express the deep gratitude of the City of Chelsea to you and your staff, especially Mr. Andon, for the efficient and effective manner in which you have pursued this project so important to the rebirth of Chelsea.

Yours very truly,

Joel M. Pressman
Mayor

CITY OF EVERETT
MASSACHUSETTS 02149

Mayor's Office of
Planning and Community Development

EDWARD G. CONNOLLY
MAYOR

April 3, 1980

Col. Max B. Scheider
Division Engineer
U.S. Army Corps of Engineers
New England Division
424 Trapelo Road
Waltham, MA. 02154

Attn: Mr. Steven Andon, NEDPL-C

Dear Colonel Scheider:

The City of Everett supports the proposed dredging and marinar project for the Island End River as outlined in the Draft Detailed Project Report and the Draft Environmental Impact Report dated January 1980.

The project as outlined will not adversely impact the shipping activities on the Everett side of the river and will enhance the development potential of the Chelsea Naval Hospital.

As you may know, the City of Everett sought assistance from the Corps of Engineers last year concerning a flooding problem in the Spring Street area of the city, not far from the proposed dredging of the Island End River. The response of the Corps at that time was that the matter was beyond its jurisdiction and we were referred to the Metropolitan District Commission. Since we are looking into this matter further, please do not interpret our endorsement of the above dredging project as a relinquishing of our rights regarding the flooding problem which we believe are related in part to the Corps responsibilities concerning the Island End River.

Sincerely,

Edward G Connolly

Edward G. Connolly
Mayor

EGC:bf

cc: Representative George Keverian
Edward Bond, Bond Brothers

NEDPL-I

13 APR 1980

Mr. Gordon E. Beckett
Fish and Wildlife Service
P. O. Box 1518
Concord, NH 03301

Dear Mr. Beckett:

I am writing in response to your Supplemental Fish and Wildlife Coordination letter, dated 18 March 1980, on the proposed navigational improvements for the Island End River in Chelsea, Massachusetts. The letter raised certain issues that we are addressing in this letter to you. Your 18 March letter and this response will be included in the project Detailed Project Report.

Our recent conference on bioassay/bioaccumulation testing brought out some considerations which may have applications to this project. We will consult with you and the other agencies prior to undertaking further sampling and analysis.

On page 2, paragraph 1, you state your concern over the possibility of redistributing PCB's and heavy metals if the plan is implemented and further that ocean disposal is not a proper way to eliminate these contaminants from the environment.

We agree that disposal will not eliminate these contaminants, but the Corps is uncertain how these contaminants would be spread into the environment if the project is undertaken. There might even be a slight benefit from the proposal.

The Island End River sediments are contaminated with anthropogenic substances, and these substances are spread over a large surface area. As Bokuniewicz et al. 1976 points out, harbors are shallow water areas and polluted material can be suspended and resuspended in the environment. Sediments can also be swept from these areas, and thus a harbor can be a source of contamination for a large area of a coastal zone. Removing the objectionable material to deeper water would lessen the possibility of disturbance by storm waves or other events. And, disposal at a designated site is certainly perferable to disturbing a pristine area.

Further, we believe studies have demonstrated that there is little release or uptake of contaminants from sediments. Consequently, we expect only minor physical impacts at the disposal site itself and no impacts to any area outside the disposal site. Subsequent paragraphs will amplify this point.

On page 2, paragraph 2, you state that more information is needed on ocean disposal impacts and that environmental degradation could be causing diseases to those organisms present in the contaminated environment.

We believe that the research done to date by Waterways Experiment Station at Vicksburg, Mississippi, has shown that impacts from dredging and disposal are minimal. The Detailed Project Report succinctly points this out; and we see little advantage in expanding the discussion further.

As for the Murchelano article, a careful reading shows that the article is highly speculative, and as is pointed out on page 10: "To date, all of our evidence of environmentally induced marine disease is circumstantial." Further research may clarify the position being presented, however, the point that should be addressed by your agency is whether dredging and disposal produce environmental disease. The article only mentions dredged spoils once and never does demonstrate that these operations cause a significant problem.

Again on Page 2, paragraph 3, you point out that the bulk sediment results show high levels of heavy metals and that this may be the cause of mortalities in the bioassay test.

Bulk sediment characteristics do not give a good indication of the toxicity of contaminants found in sediments. At best, this test just shows that a certain element or chemical is present; the chemical state or the active portion of the chemical is a far better indicator of potential toxicity. However, there is not sufficient data on specific chemical state to use this method of testing. To overcome this lack of data, bioassay are conducted on potentially toxic sediments. As the Bioassay Manual points out on page 20, --- "EPA came to the conclusion that the basis for regulation (of trace contaminants) should be the probable impact of these constituents on the biota and that the measurement technique used should be bioassay on the waste itself." The bioassay test conducted by the Corps met the ocean disposal criteria -- there was toxicity but it was within acceptable limits.

Also, on page 2, paragraph 4, the procedures used in the bioassay test are questioned. A substantial amount of misunderstanding has arisen over the purpose of a control and reference sediment. This may be partly due to the bioassay manual itself for it does not explicitly explain the difference. The following explanation should clarify this situation.

A control sediment is used to determine if the laboratory is running the test properly. In this sense, the control is only a quality assurance mechanism. Consequently, a greater than 10% mortality in this test may indicate that the entire test is being run improperly, and should be conducted again. Greater than 10% mortality never occurred in the control test of Island End Bioassay tests.

On the other hand, the purpose of the reference sediment is to reflect the condition of the disposal site as if it had never been disposed on. (The Corps, for the Island End Bioassay, chose an area outside of the disposal site for a reference sediment.)

Since the bioassay is used to give an indication of possible impacts at the disposal site, it then follows that the comparison of mortalities should be between test and reference sediments, as the Corps did with Island End Bioassay testing. The test results met the criteria for ocean disposal.

The last concern expressed on Page 2 again relates to PCB's and heavy metals. We are uncertain as to the relationship of placing sewage sludge on wetland and placing dredged material in an ocean site -- the two instances are substantially different. However, the following response assumes that your agency's concern rests on bioavailability of contaminants in the sediments.

The presence of manmade contaminants in sediments does not necessarily mean that the contaminants are available to marine biota. The bioavailability of heavy metals has been studied by both the National Marine Fisheries Service (Cross and Sunda, 1978) and U.S. Army Corps of Engineers (Neff et al., 1978).

Cross and Sunda found that sediments were an insignificant source for the uptake of heavy metals. Neff et al. found in a laboratory test that:

> Of the resulting 136 metals-species-sediment combinations, only 49 (36%) demonstrated a statistically significant relationship between exposure to sediment and heavy metal concentrations in the tissues of the experimental animals. In 13 of these cases, the effect of the sediment was inverse. That is, control animals contained significantly higher metal concentrations than did the sediment-exposed animals. Thus, a significant accumulation of metal from sediment was demonstrated only 36 times (26.5%). In many cases where a statistically significant accumulation of a metal from a sediment occurred, the uptake was quantitatively marginal and of doubtful ecological significance.

This report also pointed out — "results indicated that bulk analysis of metals in sediments was useless in predicting availability and environmental effects of the sediment-associated metals on benthic organisms." This problem of bioavailability of sediment sorbed heavy metals has been addressed by many others (Bertine and Goldberg, 1972; Brannon et al. 1976; Luoma, 1977; Turekian, 1977 and Bryan, 1976); their conclusion is bulk sediment analysis has limited or no value for determining biological effects. From what has been presented here, it is obvious that the presence of metals in a sediment does not necessarily mean that a significant problem would arise if disposal takes place.

As for PCB's, Table 3 in the Detailed Project Report shows the concentrations in mg/l, but the true designation should have been in ug/l or one thousandth of what is shown. This is substantially below the Cranston sewage sludge figure. The Report will be corrected to show the true concentrations.

Finally, the successful bioassay tests run on the Island End sediments as well as the information presented here indicate that the sediments may not be as harmful as your report suggests. Therefore, we see little value in reducing the amount of dredging proposed or in sealing the sediments. The latter proposal would only impose an undue hardship upon the taxpayer.

While we hope this letter addresses and resolves concerns expressed in your letter, we realize further dialogue may be necessary. Please feel free to contact Mr. Andon, Ms. Yoder or Mr. Dupee on this letter or on other matters concerning this project.

Sincerely,

WILLIAM E. HODGSON
Colonel, Corps of Engineers
Deputy Division Engineer

<u>References:</u>

Bertine, K. K. and E. D. Goldbert. 1972. Trace Elements in Clams, Mussels and Shrimp. Limnolo Oceanogr. 17:877-834

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

COASTAL ZONE
MANAGEMENT

April 22, 1980

Colonel Max B. Scheider
New England Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Colonel Scheider:

The Massachusetts Coastal Zone Management Program has made a preliminary review of the Draft Detailed Project Report and Draft Environmental Assessment for navigational improvements in Island End River, Chelsea, Massachusetts. This review is not to be considered as a review for federal consistency with the Massachusetts Coastal Zone Management Plan.

A consultation meeting was held on February 12, 1980 attended by representatives from this office, the Environmental Protection Agency, the National Marine Fisheries Service, the Fish and Wildlife Service and the Army Corps of Engineers. Among the items discussed was the location of the sediment samples. Station 1 was not located within the boundary of dredging for Plan B, the selected plan. We reiterate our request that a new sample be located in the dredging boundaries of Plan B further upstream from the original location. Please provide us with a map describing the relocation of this Station and any other sampling stations.

By locating a new sample in the area to be dredged, as well as further upstream, a more accurate description of potential impacts will be provided through the bioassay and bioaccumulation procedure. In addition, a better representative sample will be provided with relocation upstream since this is the area of greatest dredging and more polluted sediments.

Alternative disposal methods, such as in-harbor bulkheading, have not been adequately addressed. By keeping the sediments in close proximity of their origin, which has been already impacted and acclimated to the sediments, cumulative affects of open ocean disposal would not occur. As stated in Policy 5 (3c) of the Massachusetts Coastal Zone Management Plan, in-harbor disposal sites should be favored over open ocean disposal of contaminated material. However, if alternatives as described by Policy 5 (3c) are not feasible, we recommend the use of the Boston Foul Site, located at 42° 25'42" N, 70° 34'00" W, providing the sediments have passed the agreed upon testing requirements.

We question why a second bioassay was performed. It is understood that justification for performing the second bioassay lies in the belief that mortality was a physical cause of suffocation, rather than a chemical one. However, as stated in the "Ecological Evaluation of Proposed Discharge of Dredged Material into Ocean Waters, Implementation Manual for Section 103 of Public Law 92-532", the total effect of the dredged material is assessed and "it matters little from a regulatory viewpoint whether that effect is due to the physical presence of the sediment or is due to some chemical constituent(s) associated with the sediment carried beyond the site." Therefore, since the critical solid phase bioassay revealed excessive mortality, this office recommends that an alternative disposal method be chosen.

Because of the assumed five year maintenance dredging scheme, the dredging and disposal of highly contaminated sediments will be a recurring and extremely costly problem. In light of the results of the initial solid phase bioassay, alternative disposal methods should be described and included in any economic justification for this project.

As stated in the draft assessment, dredging will remove contaminated sediment, possibly improving the local biota. However, this will exist only temporarily due to the poor flushing action of the river, industrial run-off from the surrounding area, influx of contaminated waters from Boston's Inner Harbor and the Mystic River and bed load motion. In addition, the mooring of 250 boats will be a source of pollution which poor flushing will contain in the marina basin. We feel that the location of public recreational facilities, such as marinas, along available urban waterfront areas is a sound concept. However, a marina located in the Island End River, with the problems associated with dredging and disposal of polluted sediments could be viable if the environmental concerns, as listed, are properly addressed.

Location of a marina in such close proximity to large commercial vessels will only serve to create a potentially dangerous problem. A description is needed of plans eliminating potential conflicts between recreational craft and commercial vessels.

Should you have any questions regarding our review, please contact Mr. Richard Tomczyk of my staff.

Sincerely,

Edward J. Reilly
Assistant Secretary

EJR/RT:kc

cc: Russell Wilder, EPA
Russell Iwanowitz, DMF
Chris Mantzaris, NMFS
Gordon E. Beckett, USFWS

NEDPL-C n 19 May 1980

Mr. Edward J. Reilly
Assistant Secretary
Massachusetts Coastal Zone Management
100 Cambridge Street
Boston, MA 02202

Dear Mr. Reilly:

Reference is made to your letter of 22 April 1980, concerning the Draft Detailed Project Report for Island End River, Chelsea, Massachusetts. The issues raised are addressed in the following paragraphs.

Our recent conference on bioassay/bioaccumulation testing brought out some considerations which may have application to this project. We will consult with you and the other agencies prior to undertaking further sampling and analyses.

On page 1, paragraph 4, you question the adequacy of the analysis of disposal alternatives. Disposal options have been addressed in the Environmental Assessment and Appendix 7 of the Draft Detailed Project Report titled, "Analysis of Disposal of Dredged Material." Although Appendix 7 describes the procedures and costs with disposal of the dredged material, a brief summary of the results of the analyses is provided below.

The project as proposed requires the removal of 64,100 cubic yards of material from the access channel and 64,900 bubic yards of material from the marina basin. The dredged material will be disposed of at the Boston Foul Area, located approximately 24 nautical miles from the project site. This method of disposal was chosen due to the physical nature of the sediments found in the Island End River. The silty-clay composition makes this material unsuitable for beach nourishment, and land disposal has been determined to be infeasible, as the following paragraphs illustrate.

Land disposal alternatives determined that the economic, environmental, and social impacts were not acceptable for implementation. Presented in detail in Appendix 7, the analyses revealed the following constraints to this method of disposal. A land site, removed from the Island End River, is not considered feasible as the material contains contaminants. The Massachusetts Department of Environmental Quality Engineering has indicated that there is no area in Eastern Massachusetts approved to receive material similar in nature to that found in the Island End River. In addition, the transport of large quantities of material to a distant site would cause significant adverse impacts and be economically prohibitive.

As a corollary to the data presented above, land disposal at the Chelsea Naval Hospital site would encompass identical negative impacts associated with toxic substances. However, even assuming the material could be treated to meet the Massachusetts Department of Environmental Quality Engineering disposal criteria, disposal of approximately 130,000 cubic yards of material would seriously disrupt the city's redevelopment plans. As the only site available is the proposed marina site, disposal at this location would severely impair the present construction plans and possibly negate the economic feasibility of constructing the marina and related onshore support facilities.

A final disposal option considered was to utilize the South Boston Container Terminal site being developed by the Massachusetts Port Authority. Communication with that agency revealed that the site would not be capable of receiving any material until 1983 and then could accommodate only 10,000 cubic yards out of a total of 130,000 cubic yards.

Based on the above data, it was therefore determined that ocean disposal was the only viable option for construction of the access channel and marina basin.

On page 2, paragraph 1, you question the rationale for performing a second bioassay. As was stated in the Environmental Assessment, it was felt the cause of mortality in mysid shrimp exposed to the solid phase test sediments was due to fouling or clogging of the animals' respiratory organs by fine sediment particles. This resulted in suffocation of the shrimp, a physical death. The EPA/Corps Implementation Manual, discussing the solid phase bioassay, states "...animals are used in a bioassay to provide a measurement of environmental activity of the chemicals found in the material," (page 16, paragraph 20) and, "The solid phase bioassay technique measures the effects of chemicals associated with this deposited sediment, rather than physical effects of the sediment." (page 20, paragraph 28). In outlining the procedures to be followed for solid phase bioassay (page F1, paragraph 1), the manual states, "Several benthic species are allowed to establish themselves in an appropriate reference sediment and are then covered with a layer of the dredged material being evaluated. Survival in the dredged material relative to that in the reference sediment control is used as the primary biotic response criterion." This paragraph states the rationale for repeating the solid phase bioassay. The first bioassay test results were not evaluated with respect to a reference sediment; the second test results were. As expected, the second solid phase bioassay showed no statistically significant difference in survival of organisms exposed to test sediments from Island End River when compared to organisms exposed to reference sediments collected outside the Boston Foul Area.

On page 2, paragraph 2, you raise the question of the assumed five year dredging scheme and recommend alternative disposal methods should be included in the economic justification of the project.

Maintenance evaluation and costs are located in Appendix 4 of the Draft Detailed Project Report. Economic justification for the project, as shown in Appendices 2 and 6, allowed for a higher per unit cost recognizing the smaller amounts of material to be removed. The report states, however, that maintenance of the project is dependent upon the availability of maintenance funds, the continuing justification of the project and the environmental acceptability of subsequent maintenance dredging. As this office is not in a position to determine what disposal methods will be deemed acceptable through the 50-year project life from initial construction of the project, any attempt to address such issues must rightly be deferred until such time as maintenance dredging is deemed necessary.

On page 2, paragraph 3, you indicate that the proposal to allow 250 recreational boats will be a source of pollution which poor flushing of the river will contain in the marina basin. The Island End River has a mean tide range of 9.5 feet and a spring range of approximately 11.0 feet. Based on the above tidal

Mr. Andon/mc/550

data, flushing action within the Island End River is considered more than adequate to contend with the influx of approximately 250 recreational craft. In addition, dredging of the material is not considered to be detrimental to the water quality of Island End River. As a corollary to the water quality concemn, the Division of Water Pollution Control issued a Water Quality Certificate relative to the project dated 3 March 1980.

In reference to page 2, paragraph 4, your concern about the aspects of safety and potential conflict is noted. On 9 August 1979, a meeting was held to discuss the issue of potential hazards to navigation. A member of your staff was present at the meeting, and all those in attendance agreed that the recommended plan of improvement was the plan which best satisfied all needs and requirements including safety. In addition, the Draft Detailed Project Report addressed the concerns about safety, as shown in Appendix 2, and Appendix 3 outlines the opinions of the U.S. Coast Guard and the preference that organization has for a separate channel. In a letter dated 20 February 1980, the U.S. Coast Guard states that their preference for the selected plan has been acknowledged in the report and that no further comments are required. A member of your staff was also in attendance during the public meeting held at Chelsea City Hall on 19 February 1980. At that time, the issue of safety was discussed, and it was stated that one of the criteria utilized in selecting the plan of improvement was the issue of safety.

Thank you for your continued interest in the project. Should you have any questions, please feel free to contact me at 894-2400, extension 220. Mr. Steven Andon of my staff is coordinating the investigation. He can be reached at extension 550.

Sincerely,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

cc: Executive Office
Coastal Dev. Br.
Reading File
Planning Div. File

NEDPL-I

Mr. Edward Reilly
Director, Massachusetts Office
of Coastal Zone Management
100 Cambridge Street
Boston, MA 02202

Dear Mr. Reilly

This letter is to request a Federal Consistency Determination from your office on the proposed navigation improvements to Island End River, Chelsea, Massachusetts. Included with this letter is a copy of the Detailed Project Report prepared by our office on this project. Review of this document will show the project, as described, is consistent with Massachusetts Coastal Zone Management Program Regulatory Policies 1, 2, 4, 5, 7, 10, 11, 12, 13, 17 and 19. Specifically,

Policy 1. Protect wetlands and buffers.

Proposed Project. No dredging will occur in any wetlands.

Policy 2. Areas for critical environmental concern.

Proposed Project. Island End River is considered to be a stressed habitat as illustrated by the predominance of polychaete worms and very few shellfish. Dredging this site will not constitute disruption of a healthy or commercially valuable environment.

Policy 4. Construction in water bodies, erosion control structures.

Proposed Project. Approximately 600 feet of shoreline stabilization will be required to develop onshore support facilities associated with the access channel and marina. This structure is not expected to alter tidal flushing patterns or water circulation patterns in the Island End Estuary.

Policy 5. Dredging and dredged material disposal.

Proposed Project. Dredging will not cause flooding nor adversely affect flood storage capacity flushing rates, ambient salinity or temperature. Turbidity levels will temporarily increase as a result of construction. No significant adverse effects on marine productivity are expected as a result of dredging. Significantly productive shellfish beds will not be disrupted. Water quality standards would be exceeded during dredging but should return to background levels shortly after dredging is completed.

Dredging will be scheduled to avoid conflicts with anadromous fish runs and will not significantly interfere with local recreational boating. Mechanical dredging is planned (as opposed to hydraulic) because open water disposal of dredged sediments is the preferred alternative.

Testing procedures to date have included elutriate test, bulk sediment analysis and bioassays tests. These sediments are not considered suitable for beach nourishment. The Corps of Engineers will comply with the five conditions specified for ocean disposal. Disposal is scheduled for the Boston Foul Area.

Policy 7. Licensing port and harbor development.

Proposed Project. This policy applies to commercial development and use of port areas and as such, is not applicable to the proposed recreational project at Island End River.

Policy 10. Conformance to existing air and water permit requirements.

Proposed Project. The Corps of Engineers has already been granted a Massachusetts Water Quality certificate for the proposed dredging. The proposed project is not expected to violate air pollution standards nor will it adversely impact any productive wetlands.

Policy 11. Scenic rivers, outdoor advertising.

Proposed Project. This policy is not applicable to the proposed dredging of Island End River.

Policy 12. Impacts on historic districts and sites.

Proposed Project. The project as proposed will not adversely impact any historic site. The Massachusetts Historical Commission, in a letter dated 26 February 1979 indicated that significant historical and archaeological resources are not likely to exist.

Policy 13. Impacts on public recreation beaches.

Proposed Project. Not applicable. The proposed project is designed to provide recreational boating in an area that currently does not offer public recreation.

Policy 17. Funding erosion control measures.

Proposed Project. Not applicable. The project will not require implementation of flood control measures.

Policy 19. Funding port and harbor dredging.

Proposed Project. The proposed project provides for recreational boating in an area that currently does not offer such opportunity and is considered ecologically unproductive.

Should you have any questions, please feel free to contact me at 894-2400, extension 220. Ms. Yoder, of my staff, coordinated the investigation. Should your staff desire more information, she can be reached at extension 255.

Sincerely,

CC: Mr. Andon
Ms. Yoder
Plng Div File
Reading Files

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I
J.F. KENNEDY FEDERAL BUILDING, BOSTON, MASSACHUSETTS 02203

September 29, 1980

Joseph L. Ignazio
Chief, Planning Division
U. S. Department of the Army
New England Corps of Engineers
424 Trapelo Road
Waltham, MA 02154

RE: EPA#8004

Dear Mr. Ignazio:

This letter concerns the proposed maintenance dredging of the Island End River in Chelsea, Massachusetts.

As you are aware, our agency has been working and coordinating with your office on this project. Presently, as part of the joint Corps of Engineers and EPA 1980 Boston Harbor study, a series of sediment samples (from the Island End River) have been taken and are receiving bioassay and bioaccumulation analyses for PCB's and DDT by our Lexington Laboratory. Your agency is performing the Bulk Chemical analyses. The current projected target date by our Lab for completion of the sediment samples is October 6, 1980. Upon review of those test results and your Labs test results, our agency will make its final determination of the acceptability of the material for ocean disposal.

If there are any further questions, do not hesitate to contact Mr. Melvin P. Holmes at 223-5061.

Sincerely yours,

Allen J. Ikalainen

Allen J. Ikalainen
Chief, Special Permits Development Section

URBAN CONSULTING ASSOCIATES OF BOSTON, INC.

October 28, 1980

Mr. Steve Andon
New England Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Mr. Andon:

As you requested in our telephone conversation of this date, I am writing you this letter which will outline the various facets to the Chelsea Naval Hospital Project and summarize the activities to date.

The most complete description of the residential, commercial, industrial and recreational activities underway at the Naval Hospital is contained in "The Development Master Plan and Feasibility Analysis" which is attached for your review.

The site has been acquired by the Massachusetts Government Land Bank (MGLB) from the General Services Administration. While the Naval Hospital was owned by the MGLB, non-historical buildings within the residential, commercial and industrial areas were demolished, a water supply line was constructed and certain necessary infrastructure improvements on adjacent streets were completed. This program amounted to slightly over $1 million dollars.

In early October, the MGLB transferred ownership of the above-mentioned portions of the Naval Hospital to the City of Chelsea. The mortgage obligation of the City includes approximately $1.8 million dollars for the purchase price and $1 million dollars in preliminary site improvements.

The Metropolitan District Commission (MDC) acquired

150 Causeway Street/Boston Massachusetts 02114/Telephone 617-742-6640

title to the recreational portion of the Naval Hospital, from GSA in early October of this year. The master plan, engineering and construction documents for the Park development are in the final stages and are expected to be completed by the end of the year.

The demolition bid package for the waterfront park has been approved by the MDC and will be advertised within two weeks.

The City has advertised for, and selected a contractor who will undertake earth-work improvements, which will commence in mid November. Final design for the utilities and roadwork will be complete in mid January of 1981, with construction starting in mid March.

In support of this project the Economic Development Administration has awarded the City of Chelsea a $1,440,000 Public Works grant (June 13, 1979).

Also, the Department of Housing and Urban Development has awarded the City a $6.7 million UDAG grant (August 2, 1978).

The designated developer, Peabody Construction Company, has a funding commitment from the Massachusetts Housing Finance Agency for the construction of a 160 unit elderly building. The rehabilitation of the historic buildings for residential use and the new construction will begin in April of 1981.

As you can see, the project is coming together with quite a bit of construction scheduled for the spring of 1981.

The dredging of the Island End River and the subsequent creation of a marina is an essential recreational/ commercial component of the Master Plan. It will be an invaluable tool in marketing the housing units, will complete the river edge improvements initiated by the MDC and will provide a sorely needed public marina facility to an older urban city with few recreational amenities.

Should you require an additional information, do not hesitate to call.

Yours very truly,

Terry
Terrence Geoghegan
Vice President

TG:efl
cc: Michael Glavin

NEDPL-I 5 December 1980

Mr. Edward Reilly
Director, Massachusetts Office of
  Coastal Zone Management
100 Cambridge Street
Boston, MA 02202

Dear Mr. Reilly:

This letter is to request a Federal Consistency Determination from your office on the proposed navigation improvements to Island End River, Chelsea, Massachusetts. A similar request for Federal Consistency Determination was submitted to your office in a letter dated 6 June 1980. At the time of the initial request your office stated there was insufficient information available to determine whether or not the Island End River project, as proposed, was consistent with MCZM policies. While the information you have requested, specifically bioassay and bioaccumulation test results, are not yet available, we request you initiate your agency's 45-day review period now. In recent conversations between members of our staffs it was determined that state policies allow for information pertinent to the consistency determination to be submitted during that 45-day period. The bioassay and bioaccumulation test results will be forwarded as soon as they are received by this office. Should this information become available late in the review period, this office acknowledges that a two-week extension is reasonable and will be granted.

Copies of the Detailed Project Report prepared by our office on this project were sent to your office in June of this year. Review of this document will show the project as described is consistent with Massachusetts Coastal Zone Management Program Regulatory Policies 1, 2, 4, 5, 7, 10, 11, 12, 13, 17, and 19. Specifically:

Policy 1. Protect wetlands and buffers.

Proposed Project. No dredging will occur in any wetlands.

Policy 2. Areas for critical environmental concern.

Proposed Project. Island End River is considered to be a stressed habitat as illustrated by the predominance of polychaete worms and very few shellfish. Dredging this site will not constitute disruption of a healthy or commercially valuable environment.

Policy 4. Construction in water bodies, erosion control structures.

Proposed Project. Approximately 600 feet of shoreline stabilization will be required to develop onshore support facilities associated with the access channel and marina. This structure is not expected to alter tidal flushing patterns or water circulation patterns in the Island End Estuary.

Policy 5. Dredging and dredged material disposal.

Proposed Project. Dredging will not cause flooding nor adversely affect flood storage capacity flushing rates, ambient salinity or temperature. Turbidity levels will temporarily increase as a result of construction. No significant adverse effects on marine productivity are expected as a result of dredging. Significantly productive shellfish beds will not be disrupted. Water quality standards would be exceeded during dredging but should return to background levels shortly after dredging is completed.

Dredging will be scheduled to avoid conflicts with anadromous fish runs and will not significantly interfere with local recreational boating. Mechanical dredging is planned (as opposed to hydraulic) because open water disposal of dredged sediments is the preferred alternative.

Testing procedures to date have included elutriate test, bulk sediment analysis bioassay and bioaccumulation tests. These sediments are not considered suitable for beach nourishment. The Corps of Engineers will comply with the five conditions specified for ocean disposal. Disposal is scheduled for the Boston Foul Area.

Policy 7. Licensing port and harbor development.

Proposed Project. This policy applies to commercial development and use of port areas and as such, is not applicable to the proposed recreational project at Island End River.

Policy 10. Conformance to existing air and water permit requirements.

Proposed Project. The Corps of Engineers has already been granted a Massachusetts Water Quality Certificate for the proposed dredging. The proposed project is not expected to violate air pollution standards nor will it adversely impact any productive wetlands.

Policy 11. Scenic rivers, outdoor advertising.

Proposed Project. This policy is not applicable to the proposed dredging of Island End River.

Policy 12. Impacts on historic districts and sites.

Proposed Project. The project as proposed will not adversely impact any historic site. The Massachusetts Historical Commission, in a letter dated 28 February 1979, indicated that significant historical and archeological resources are not likely to exist.

Policy 13. Impacts on public recreation beaches.

Proposed Project. Not applicable. The proposed project is designed to provide recreational boating in an area that currently does not offer public recreation.

Policy 17. Funding erosion control measures.

Proposed Project. Not applicable. The project will not require implementation of flood control measures.

Policy 19. Funding port and harbor dredging.

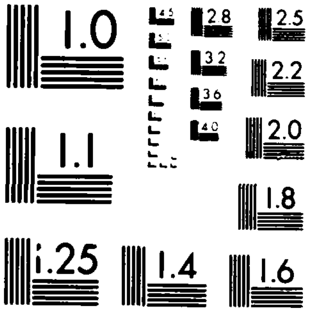
Proposed Project. The proposed project provides for recreational boating in an area that currently does not offer such opportunity and which is considered ecologically unproductive.

Should you have any questions, please feel free to contact me at 894-2400, extension 222. Ms. Yoder of my staff coordinated the investigation. Should your staff desire more information, she can be reached at extension 235.

Sincerely,

WILLIAM E. HODGSON, JR.
Colonel, Corps of Engineers
Acting Division Engineer

AD-A122 621 ISLAND END RIVER CHELSEA MASSACHUSETTS DETAILED PROJECT 3/4
REPORT AND ENVIRONMENTAL ASSESSMENT REVISED(U) CORPS OF
ENGINEERS WALTHAM MA NEW ENGLAND DIV S ANDON ET AL.
UNCLASSIFIED FEB 81 F/G 13/2 NL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COASTAL ZONE
MANAGEMENT

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

December 30, 1980

William E. Hodgson, Jr.
Colonel, Corps of Engineers
Acting Division Engineer
424 Trapelo Road
Waltham, Massachusetts 02154

Re: NEDPL-I Chelsea, Island End River Navigation Improvements

Dear Colonel Hodgson:

Thank you for submitting the detailed federal consistency determination for the referenced project. As you can see from the attached schedule we have published notice of our review in the Environmental Monitor. We will commit ourselves to reaching a decision as promptly as we can. However, I note with some concern that you are experiencing delays in obtaining bioassay/bioacumulation test results. We would appreciate being kept informed on your progress in obtaining these results as we will require from one to two weeks to adequately review them.

Please feel free to contact Mr. Michael Penney, of my staff, should you have any questions about our review.

Sincerely,

Edward J. Reilly
Director

EJR:MEP:bam
cc: Marita Yoder, Corps
Marjorie O'Malley, CZM

Consistency Review Schedule for a Federal Activity*

Review Step	Date
1. Received the consistency determination from agency on	December 11, 1980
2. Submitted for publication in earliest possible Environmental Monitor (either 31st or 15th of month)	December 15, 1980
3. Notice inviting comments and opening 21 day comment period will appear in Monitor on (either 8th or 22nd of month)	December 22, 1980
4. Comment period closes	January 12, 1981
5. Last day to inform agency of review status or request extension (45 days from Step 1)	February 15, 1981
6. Last day of extension review period closes	March 2, 1981

Corps of Engineers - Chelsea Island End River Dredging

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* Section 7.13 MCZM Regulations

ISLAND END RIVER
CHELSEA, MASSACHUSETTS

DETAILED PROJECT REPORT

ENGINEERING INVESTIGATIONS, DESIGN AND COST ESTIMATES
APPENDIX 4

PREPARED BY THE

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

ENGINEERING INVESTIGATIONS, DESIGN AND COST ESTIMATES

Table of Contents

List of Tables

List of Plates

APPENDIX 4

ENGINEERING INVESTIGATIONS, DESIGN AND COST ESTIMATES

SECTION A

SELECTION OF CHANNEL CROSS SECTION ELEMENTS

CHANNEL CROSS SECTION

1. Side slope design criteria were as follows:
Ratio of horizontal to vertical below 2 feet below MLW: 3/1
Ratio of horizontal to vertical above 2 feet below MLW: 10/1

2. In developing these criteria consideration was given to existing slopes in the bottom of the Island End River. In the portions of the river bottom above MLW with muddy surfaces, the existing slopes generally do not exceed 10:1. Below the low water line, slopes of the existing dredged channel appear to have stabilized at a 3:1 slope.

3. During the dredging process, no attempt would be made to grade the side slopes to these design criteria. Rather, the slopes would be created as shown in Figure 4-1. The channel would be dredged to an extra width as indicated in Figure 4-1 (b), such that Area "A" would be equal to Area "B". The slopes would then eventually stabilize themselves while preserving the desired 100 foot channel width.

4. Figure 4-1 (d) illustrates the impacts of the dredging on the intertidal zones in the river bottom. Estimates of intertidal area removed and altered were used as one measure of environmental impact of the dredging. It should be noted that in many cases, "alterations" of intertidal zones will actually have very minimal impacts. Any discussion of long-term slope stabilization and construction cut/slope assumptions is almost completely subjective and entirely academic in nature. The discussion presented in the report presents one possible scenario of long-term slope development and actually goes into the level of detail much too exacting in consideration of the minimal data available and the obvious uncertainty in the relative amount of disturbances that will occur in in situ soils during dredging, bulking factors that may be realized, and overall soil behavior. For a dredging project of this magnitude, the cost of obtaining sufficient data to evaluate slope development would be excessive. During construction, the specifications will simply call for a final channel dimension regardless of the construction behavior of disturbed soils. The discussion of channel cross-sections included in the report will be revised to indicate this uncertainty and outline the "end product" type specifications that will be used for the project.

SHORELINE PROTECTION

Plans C and D would require the use of shoreline protection along a portion of the eastern bank of the river. Revetment and bulkheads were analyzed to determine the most effective form of slope protection.

Both revetment and bulkhead walls are commonly encountered in harbors. They can, however, present some safety hazards to small boats. The hidden underwater portions of a revetted slope can damage a boat's hull if it runs aground. This could happen due to a loss of power or if the boat is operated improperly or carelessly. Provided the collision happened at a low speed, damage would be minimal. All vessels in harbor areas should operate at low speed. Therefore, for properly operated small craft or for small craft that have suffered a loss of power, the dangers incurred by collision with the hidden underwater portion of a revetted slope would be minimized.

The use of bulkheads would minimize the potential for underwater damage as the bottom adjacent to it could be of existing material. It would, however, present another potential safety problem. If a boat were to sink near the bulkhead, the occupants would not be able to safely scramble ashore, as they could not climb up the vertical bulkhead wall. Inexperienced operators might also mistake the bulkhead for a docking facility resulting in possible groundings.

Bulkheads would be considerably more expensive than revetment. The use of bulkhead rather than revetment would add approximately $100,000 to the cost of Plan D. This additional cost does not appear to be warranted based upon safety considerations.

CHANNEL SIDE SLOPES

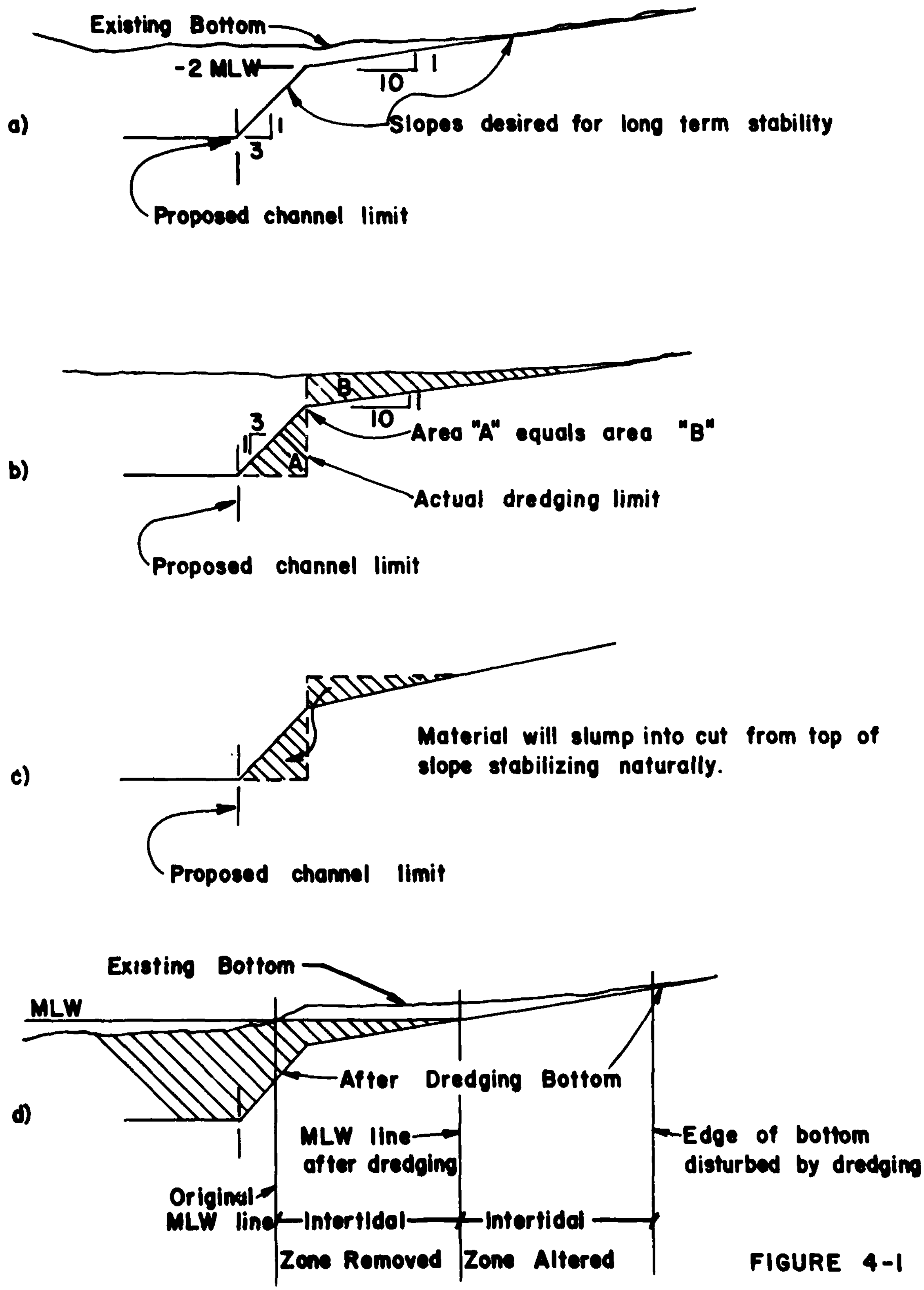


FIGURE 4-1

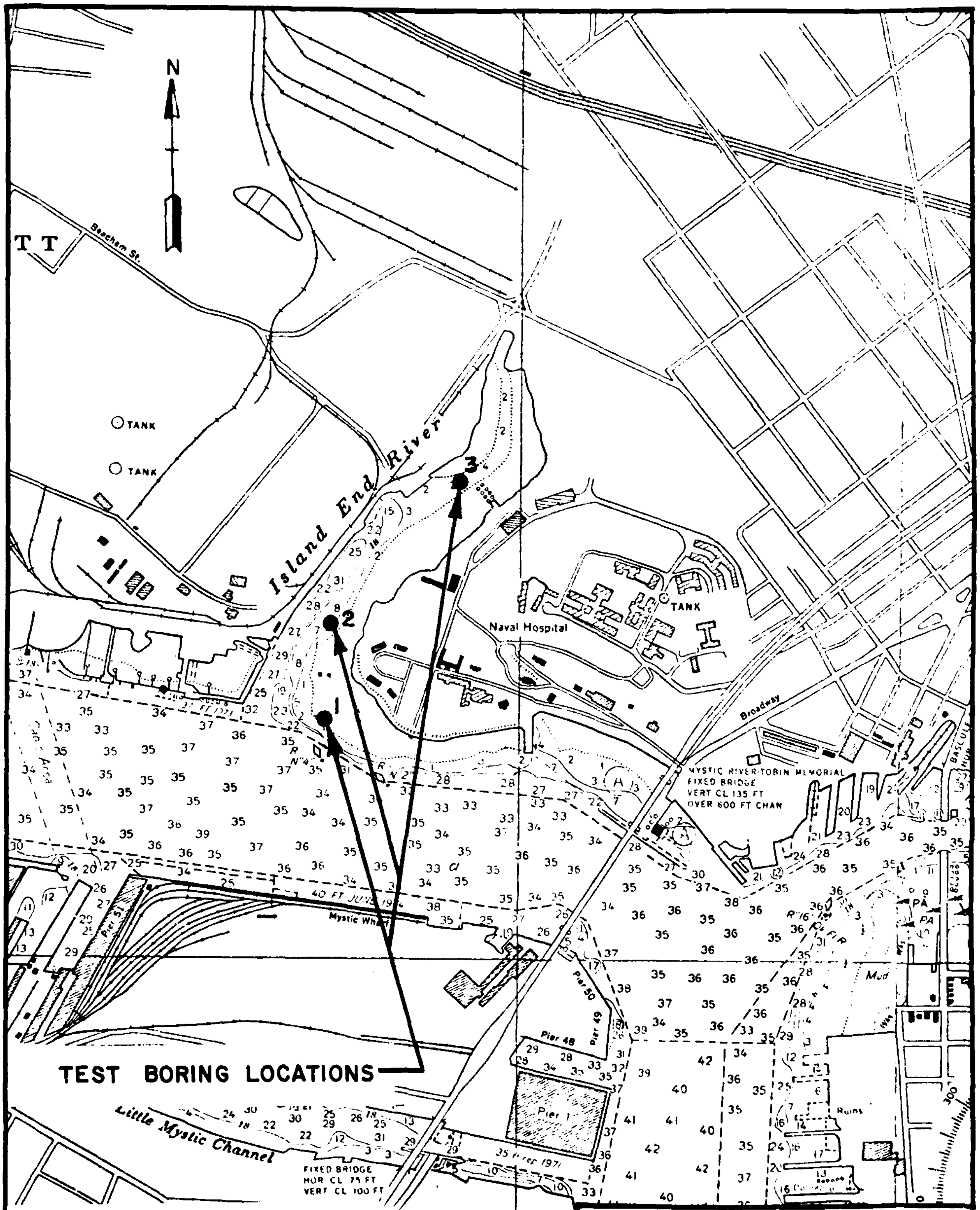
SECTION B

SUBSURFACE TEST BORINGS

5. Test borings were taken at the locations shown in Figures 4-2, to obtain an indication of subsurface conditions in the Island End River.

6. As Figures 4-3, 4-4, and 4-5 indicate, the dredged material is likely to be sand and silt that can be easily removed with a clamshell bucket dredge.

7. It should be noted that boring FD-1 indicated the presence of hard clay and gravel, which would require significantly more effort to remove. However, as the selected channel alignment does not impinge on this area, the assumption of easy removal is based on the data presented in borings FD-2 and FD-3.



TEST BORING LOCATIONS

FIGURE 4-2

SUMMARY OF TEST BORING* FD 1

Elevation of Top of Boring MLW — Hammer Weight 350

Elevation of Bottom of Boring -10 — Hammer Drop 18"

DEPTH	BLOWS PER FT.	CLASSIFICATION OF MATERIAL
0	PUSHED WITH EASE BY HAND	Black organic sandy clay with shell fragments with petroleum odor.
-1.0	PUSHED WITH DIFFICULTY BY HAND	
	8	Brown with grey gravelly sandy clay.
-2.0	10	
-3.0	16	
-4.0	73	
-5.0	59	Grey and brown stratified clayey sandy gravel till.
-6.0	57	
-7.0	64	
-8.0	110	
-9.0	155	
10		

* Boring conducted by U.S Army Corps of Engineers, April 24, 1979. Classification of materials by U.S.A.C.O.E.

FIGURE 4-3

SUMMARY OF TEST BORING* FU2

Elevation of Top of Boring ____ Hammer Weight 350

Elevation of Bottom of Boring - -4 Hammer Drop ____

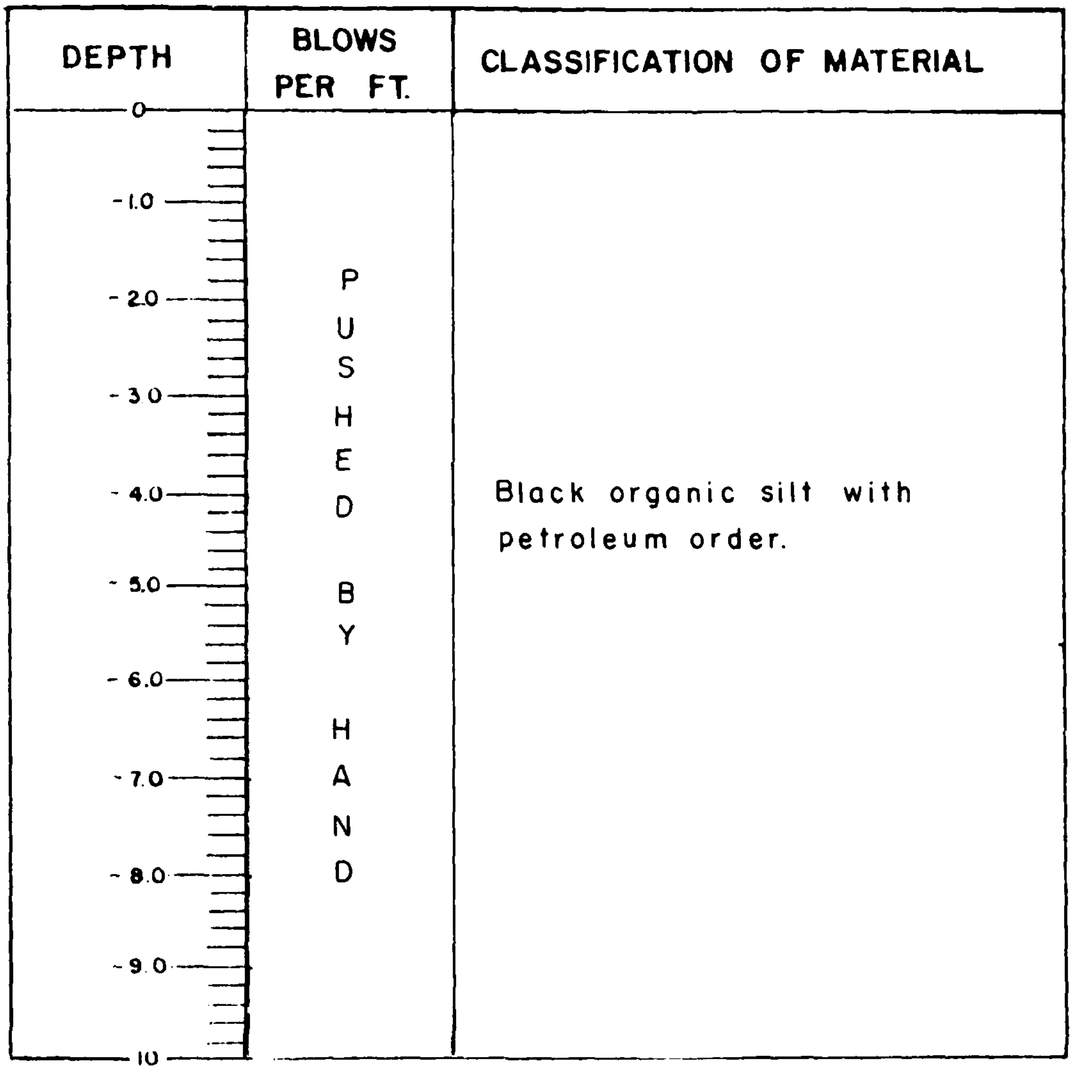
DEPTH	BLOWS PER FT.	CLASSIFICATION OF MATERIAL
0	6	Black fine sandy organic silt shell fragments and fiberous texture.
-1.0		
-2.0		Grey fine sandy organic silt with shell fragments.
-3.0		
-4.0		
-5.0	7	Grey fine organic silt.
-6.0	3	
-7.0	5	
-8.0	4	
-9.0	9	
10		

* Boring conducted by U.S. Army Corps of Engineers, April 24, 1979. Classification of materials by U.S.A.C.O.E.

FIGURE 4-4

SUMMARY OF TEST BORING* FD 3

Elevation of Top of Boring MSL
Hammer Weight 350
Elevation of Bottom of Boring - 11
Hammer Drop 30"



Black organic silt with petroleum order.

* Boring conducted by U.S. Army Corps of Engineers, April 24, 1979. Classification of materials by U.S.A.C.O.E.

FIGURE 4-5

SECTION C

GEOLOGIC ANALYSIS

8. In October 1979, efforts were made to obtain subbottom information in Island End River employing marine seismic reflection techniques.

9. Prior to mobilization, the reported presence of organics in the bottom sediments at the site raised doubt if seismic relection methods would acquire the desired subbottom information. The decay of these organic materials in a low flow environment such as Island End River can introduce gas into the pore spaces of the sediment. The resulting large acoustic impedence contrast between the water and the gas-rich sediment causes most of the energy in an incident seismic pulse to be reflected at the bottom allowing little or no subbottom penetration. The series of test runs conducted from inside Island End River out into the Mystic River with each of two seismic systems, a 3.5 kHz pinger and a high resolution boomer, indicate that this phenomena does, in fact, occur at the Island End River site.

10. During the afternoon of 22 October 1979 and the morning of 23 October 1979, a number of runs were made with each system through the survey area and out into the Mystic River. Records obtained with both systems were consistent. Little or no subbottom penetration was observed in Island End River until past the river's mouth adjacent to the Exxon terminal. Once into the Mystic River, a number of subbottom reflectors were observed including an apparent bedrock reflector. On reciprocal tracklines, essentially all these reflectors could be traced across the Mystic River to the mouth of Island End River where the record quality sharply deteriorated.

11. At the entrance to Island End River where the last high confidence detection of subbottom reflectors can be made, the apparent bedrock reflector can be traced to within approximately five feet below the bottom. As it was not possible to develop subbottom penetration within Island End River, no further information regarding the elevation of the bedrock could be obtained.

12. As an alternate approach to obtain subbottom information at this site, jet probing was conducted at two locations within the survey area. The first location was approximately 182 feet from survey station "K" and 900 feet from Station "J". The second was approximately 315 feet from station "J" and 510 feet from station "H".

13. Probe No. 1 was conducted in approximately 11 feet of water and penetrated 9 feet below the bottom without resistance. The material probed was a thick black petroleum ooze. The second probe was conducted in 8 feet of water and also penetrated 9 feet below the bottom at which depth refusal was encountered. The probed material at the second location was a black organic silt and although no sample of the resistant material was recovered, it is believed from the "feel" of the probe that the material was not bedrock but a coarse gravel or till. As an added note, noticeable "gas" discharge was observed at each

of the probe locations substantiating the original hypothesis that gas was present within these sediments and was the probable cause for the lack of subbottom penetration.

14. Based upon the conditions observed on site, it has been determined that the physical sampling techniques, described in Section B of this appendix, represented a viable alternative in developing the subbottom information required.

SECTION D

DREDGING COST ESTIMATES

15. Dredging of a channel in the Island End River will be affected by the need to schedule the work according to the height of the tide. The present shallow depths in the river will affect the types of dredging equipment, the methods of dredging and the project cost.

16. Typical equipment that could be used for this project include:

- A sixyard clamshell bucket dredge on a small barge (up to one hundred forty feet by forty feet with a six foot draft).
- Two 2,000 yard scows drawing about two feet when empty and about sixteen feet when fully loaded.

17. Different procedures would be required to dredge various portions of the channel.

18. The dredge, working upstream, could cut the channel to the desired depth from the mouth of the river to the point about eleven hundred feet upstream where the channel makes a bend and the adjacent deepwater channel ends. The scows would be floated alongside the deeper water that would not have to be dredged. In general, the scows could be fully loaded under all tide conditions. This part of the job consisting of approximately 12,000 cubic yards would be conducted fairly routinely.

19. Upstream of the end of the commercial channel, the small boat channel would be dredged in two cuts. The dredge, working upstream, would clear the channel to a portion of its width to its full depth. Because the dredge barge would have a draft of only six feet, it would clear its own path as it advanced. The scows, however, would have to be loaded next to the dredge where insufficient depth is available. Current bottom elevations range from about 2 to +2 MLW. Since the scows would require two feet of water, even when empty, they could not be loaded at low tide. At high tide, there would be only about eight to twelve feet of water where the scows would be loaded. Therefore, they could not be loaded to their maximum capacity, even at high tide. The most efficient way of loading the scow would appear to be to bring in an empty scow at low tide and fill it with the rising tide. It would then be floated out at high tide.

20. After the first fifty foot wide cut has been made, the dredge would clear the other half of the channel while the scows are loaded in the previously dredged half. While the scows would now have six feet of water at MLW, it would still be necessary to work around the tides to some extent.

21. Disposal of the dredged material will take place at sea. Appendix 7 contains a detailed analysis of dredged material disposal options.

22. The nature of the dredged material is expected to be primarily mud. However, one of the test borings indicated a layer of dense gravel till at five feet below MLW. If such material is encountered, it will tend to reduce the dredging rates.

23. Under normal conditions, a productivity of 5,000 (30% downtime) cubic yards can be achieved be a dredge with a 6 cubic yard clamshell bucket. This 5,000 cubic yard valve assumes a 60 second cycle time and accounts for 30 percent downtime for maintenance, moving from the channel to allow ships to pass, and other standard interruptions of normal operations. Based on the need to work the tide levels and the possibility of encountering gravel, a productivity of 2,000 yards per day has been estimated for this project. Tables D 1 and D-2 show the estimated cost per cubic yard for dredging in the Island End River.

TABLE 4-1
DREDGING COSTS
(Based on 6 days/week - 3 shifts per day)

WAGES:

Dredge		8500
Tending Boat		4300
Welder		100
3 Rodmen		1700
Boat 1		7500
2 Scowmen		1600
Subtotal	$	23,700
(Insurance and Benefits) X 1.5		
Subtotal	$	35,550

EQUIPMENT:

Dredge		8600
Tending Boat		4000
Boat 1		6800
2 Scows		10000
Miscellaneous		300
Outboard		200
Office		3000
Subtotal	$	32,900

SUBSISTENCE:	$	1300
Subtotal	$	69,750
(Profit & Overhead)	X	1.2
TOTAL	$	83,700 (Per Week)

COST PER CUBIC YARD

$$\frac{\$83,700}{\text{week}} \qquad 6 \text{ days/week} \qquad = \qquad \$13,950/\text{day}$$

Assuming 2,000 cubic yards/day

$$\frac{\$13,950/\text{day}}{2,000 \text{ cubic yards/day}} \qquad = \qquad \$6.98/\text{yard}$$

or SAY $7.00/yard

NOTE: Mobilization/Demobilization costs are not included in the above estimate. These costs are estimated at $25,000 (Lump Sum). Additional per yard costs for Mobilization/Demobilization are equal to $25,000/total yards.

TABLE 4-2

ESTIMATED DREDGING COSTS PER CUBIC YARD INCLUDING COSTS OF MOBILIZATION/DEMOBILIZATION

TOTAL MOBILIZATON/DEMOBILIZATION COST = $25,000

	Amount of Dredging Cu. Yds.	Additional Mob/Demob. Cost Per Yd.	Estimated Total Cost Per Yd.
Plan A	52,000	$0.48	$7.50
Plan B	64,000	$0.39	$7.40
Plan C	90,000	$0.28	$7.30
Plan D	110,000	$0.23	$7.25

SECTION E
MAINTENANCE DREDGING

24. Following initial dredging, the channel will tend to shoal or fill in, over time. Thus, periodic maintenance dredging will be required to preserve the desired channel depth. Shoaling of the channel will occur for two reasons:

- Settlement of side slopes
- Deposition of sediments from upland runoff

25. Although channel side slopes will be designed in such a way to enhance long term stability, changes in the bottom contours will occur over time resulting in gradually flattening of the slopes. Strong wave or current action occurring during storms may result in the movement of bottom sediments of a silty nature. The propeller wash produced by tugs and wakes of passing boats will also tend to disturb the river bottom, resulting in redistribution of material.

26. The river will also tend to shoal due to settling of solids carried into the river by storm drainage. The culverts which empty into the upstream end of the Island End River carry drainage from an area of approximately 2 square miles.

27. Portions of this drainage area consist of unpaved streets and parking areas, railroad yards, industrial sites and undeveloped areas. Those sites which are not paved or protected by vegetation, could contribute sediments to the stormwater runoff, despite the fact that the area is generally flat.

28. Erosion of the banks of the river will also tend to contribute to sedimentation of the river. At the present time, portions of the Chelsea shoreline exhibit erosion problems. Because both the tidal and downstream flow currents in the river are quite slack, sediments washing into the river will tend to settle on the bottom rather than being carried out of the river basin.

29. In order to estimate the rate of shoaling in the river, hydrographic surveys taken in 1979 were compared to surveys taken in 1975. Cross-sections from each survey were plotted and estimates were made of the net quantity of material that had settled in the river bottom. This analysis indicated that over a four year period 79,000 cubic feet of material was deposited over an area of 255,000 square feet. This indicates a shoaling rate of approximately 1" per year.

30. This shoaling rate, however, underestimates the rate at which shoaling will occur in a newly dredged channel. In addition, the 1975 hydrographic survey covered only the lower part of the river. The comparison of the two surveys and the calculated shoaling rate is therefore based only on that part of the river. More rapid shoaling is likely to take place in the upper part of the river where sediments from runoff will be deposited.

31. For the purposes of the cost estimates, an annual shoaling rate equal

to 4% of the initial dredged volume has been used. Based on a 6 foot channel depth, this rate would mean a decreace in channel depth by approximately 2-1/2 inches per year. Based on this rate, the one foot overdredge would be eliminated in about 5 years. Therefore, maintenance dredging would be required at 5 year intervals to maintain the desired channel depth.

TABLE 4-3

MAINTENANCE DREDGING COSTS

Plan B

Annual Amount = 2600 c.y.
Amount in 5 years = 13,000 c.y.

ASSUMING AN EFFICIENCY OF 80%

5,000 c.y./day X .80 = 4,000 c.y./day
12,000 c.y./4,000c.y./day = 3.2 days

4 days X $14,000/day = $56,000
+ Mob/Demob. 25,000
$81,000

$81,000 - 13,000 c.y. = $6.23/c.y.
6.23 X 1.3 = 8.10
SAY $8.00/c.y.

ISLAND END RIVER
CHELSEA, MASSACHUSETTS

DETAILED PROJECT REPORT

CULTURAL AND NATURAL RESOURCES
APPENDIX 5

PREPARED BY THE

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

APPENDIX 5

CULTURAL AND NATURAL RESOURCES

1. This appendix contains information pertaining to the natural and cultural conditions existing within the Island End River and within the general vicinity of the project area.

CULTURAL RESOURCES

2. The Chelsea Naval Hospital property constitutes a significant cultural resource , demonstrated by its nomination to the National Register of Historic Places. The land on which the hospital was constructed was the site of early settlement. Records show that the Samuel Maverick Palisades House was fortified against Indian attack in 1625. The hospital site was the terminus of Bay Colony Road (now Broadway), the first county road in Massachusetts. The Hospital property was the landing site of the first ferry service between Chelsea, Charlestown, and Boston.

3. The original main hospital building was completed in 1835 at the base of the hill facing the Mystic River. In 1836, land was turned over to the Bureau of Ordnance for construction of an ammunitions magazine. Buildings two and three were constructed as magazines at a location on the western side of the property near the Island End River. Behind these two buildings, a pier was constructed in the Island End River. It is thought that the USS Constitution was among the ships that were stocked from these magazines; hence, buildings two and three have been termined the USS Constitution Magazine. These buildings, along with the original hospital building, the Commandant's House, and the 1859 Marine Hospital constitute the five buildings on the site that are considered to be of special historic significance. Exhibit 5-1 is a copy of the nomination papers to the National Register and contains detailed background information on the historical importance of the Naval Hospital Area.

Form 10-300
(Rev. 6-72)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES INVENTORY - NOMINATION FORM

(Type all entries complete applicable sections)

STATE: Massachusetts
COUNTY: Suffolk
FOR NPS USE ONLY
ENTRY DATE

SEE INSTRUCTIONS

1. NAME

COMMON: Naval Hospital Boston

AND OR HISTORIC: Naval Hospital

2. LOCATION

STREET AND NUMBER: 1 Broadway

CITY OR TOWN: Chelsea
CONGRESSIONAL DISTRICT: 1st Suffolk, 7th Congressional

STATE: Massachusetts
CODE: 25
COUNTY: Suffolk
CODE: 025

3. CLASSIFICATION

CATEGORY (Check One)	OWNERSHIP		STATUS	ACCESSIBLE TO THE PUBLIC
☒ District ☐ Building ☐ Site ☐ Structure ☐ Object	☒ Public ☐ Private ☐ Both	Public Acquisition: ☐ In Process ☐ Being Considered	☒ Occupied ☐ Unoccupied ☐ Preservation work in progress	Yes: ☐ Restricted ☒ Unrestricted ☐ No

PRESENT USE *(Check One or More as Appropriate)*

☐ Agricultural	☐ Government	☐ Park	☐ Transportation	☐ Comments
☐ Commercial	☐ Industrial	☐ Private Residence	☐ Other *(Specify)*	
☐ Educational	☒ Military	☐ Religious		
☐ Entertainment	☐ Museum	☒ Scientific (Medical)		

4. OWNER OF PROPERTY

OWNER'S NAME: Department of the Navy

STREET AND NUMBER:

CITY OR TOWN: Washington
STATE: District of Columbia
CODE:

STATE: Massachusetts

5. LOCATION OF LEGAL DESCRIPTION

COURTHOUSE, REGISTRY OF DEEDS, ETC: Suffolk County Court House

STREET AND NUMBER: Pemberton Square

CITY OR TOWN: Boston
STATE: Massachusetts
CODE: 025

COUNTY: Suffolk

6. REPRESENTATION IN EXISTING SURVEYS

TITLE OF SURVEY: General Development Map

DATE OF SURVEY: 4/3/69 ☒ Federal ☐ State ☐ County ☐ Local

DEPOSITORY FOR SURVEY RECORDS: Naval Facilities Engineering Command

STREET AND NUMBER: Philadelphia Naval Base

CITY OR TOWN: Philadelphia
STATE: Pennsylvania
CODE:

FOR NPS USE ONLY
ENTRY NUMBER
DATE

Exibit 5-1

Form 10-300a
(July 1969)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES
INVENTORY - NOMINATION FORM

(Continuation Sheet)

STATE
Massachusetts

COUNTY
Suffolk

FOR NPS USE ONLY

ENTRY NUMBER	DATE

(Number all entries)

Naval Hospital Boston

7. DESCRIPTION (cont.)

the roof. The roof is pyramidal with 5 dormers in front, apparently added after 1836, the center one being three narrow windows wide; the others being standard width windows. There is a skylight on the Eastern roof, reputed to be over the old surgical ward. There are ventilation flues on western end of main building, 2 closely spaced dormer windows on west end. The 1903 attachment to the north has a pitched roof with no dormer.

Facade: gable end on West
relatively flat facade with center double-window bay on three floors as shallow octagonal inset.
Windows: on Western half of main building, 2 bays across
Northern addition has pitched roof, interior chimney, 3 narrow bays wide, 4 bays deep
Coursing: granite
Fronts on river and is on southern exposure of the hill. Built to accommodate 100 patients.
Since 1915 has housed personnel assigned to the hospital; now serves officially as Bachelor Officer Quarters.
See Attached Picture

Buildings 2 and 3 of Naval Hospital Boston date back to about 1836; in 1835 a Naval Appropriation Act had transferred to the Bureau of Ordnance an area of land for a Magazine Site. Building 2 of huge granite, rough ashlars, was divided by two longitudinal brick walls and the original roof, still intact, is of brick, in long arches toward the center, except the central area which is of brick, but of the "dome" type, numerous small domes of about 1 foot in diameter. A slate roof of the 2-way slope supported by structural steel has evidently been added in comparatively recent times and the building is now so designed that explosion will be directed upward through the roof, rather than outward through the walls.

Building 3 was of same construction and was used during the period the Radio Station was used at this site; it was converted and used as quarters for Chief Radio Operator.

These were transferred back to the Naval Hospital in February 1931 and are now used as storerooms.

Building 59 of Naval Hospital Boston, now in use as Bachelor Enlisted Quarters and undergoing interior modernization, was completed in December 1857 as a Marine Hospital, for which Congress sold 10 acres of the Naval Hospital site to the Treasury Department for $50,000. The brick building cost was $393,452.48. There were originally three stories above a basement, but after 1866, a fourth story was added by the adoption of a "French" or mansard roof, allowing the use of the attic. In 1939, a severe hurricane tore the slate roof off and uprooted 69 trees. The dormers have subsequently been altered to shed-type.

The original design provided for a central building 80' long, 50' wide with wings on each end 100' long and 30' wide. On both the facade and the rear

(cont.)

Exibit 5-1
(cont'd)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES
INVENTORY - NOMINATION FORM

(Continuation Sheet)

STATE
Massachusetts

COUNTY
Suffolk

FOR NPS USE ONLY

ENTRY NUMBER	DATE

(Number all entries)

Naval Hospital Boston

7. DESCRIPTION (cont.)

elevation the first, second and third floors with 8 rounded arches in each had arcades extending between the two protruding wings. The facade arches are now glassed in. There appears to be a single exterior chimney extending through the roof on the left wing. Although much of the original iron work is still in evidence, around the entries, it was discovered at an early date that flaws in the windows and cast iron roof permitted seepage and a new roof was proposed. The storeroom and laundry to the rear are brick; the stable, isolation ward and gate house were frame. Subsequently, the stable and storeoom have been converted to other uses. The building even as it now stands reflects the 19th Century's experimentation with iron columns; and the arcades and curved dormer windows of the mansard roof reflected the French influence of that period.

In June 1940, the building was released to the Navy Department once more. There are a number of other buildings in the Naval Hospital Boston Historic District over 50 years of age but it is believed that the five discussed above are of primary historical importance. As a matter of general interest, however, some of the other buildings and their dates are:

The Red Cross Building	1918
The Enlisted Men's Club	1920
The Maintenance Garage	1900
The Paint Shop	1918
The Waves Quarters	1900
Quarters B & C	1907
Quarters O & P	1900
Quarters T & U	1900
Quarters H	1910
Quarters D & E	1927

Exibit-5-1
(cont'd)

SIGNIFICANCE

PERIOD *(Check One or More as Appropriate)*

☐ Pre-Columbian
☐ 15th Century
☐ 16th Century
☐ 17th Century
☐ 18th Century
☒ 19th Century
☒ 20th Century

SPECIFIC DATE(S) *(If Applicable and Known)*

AREAS OF SIGNIFICANCE *(Check One or More as Appropriate)*

Aboriginal
☐ Prehistoric
☐ Historic
☐ Agriculture
☐ Architecture
☐ Art
☐ Commerce
☐ Communications
☐ Conservation
☐ Education
☐ Engineering
☐ Industry
☐ Invention
☐ Landscape Architecture
☐ Literature
☒ Military
☐ Music
☐ ~~Political~~
☐ Religion/Philosophy
☐ Science
☐ Sculpture
☐ Social/Humanitarian
☐ Theater
☐ Transportation
☐ Urban Planning
☐ Other *(Specify)*
Medical

STATEMENT OF SIGNIFICANCE

Naval Hospital Boston is the oldest Naval Hospital in continuous active service in the United States. Historically, apparently referred to as "Naval Hospital at Charlestown (Chelsea site)," then as Naval Hospital, Chelsea, and currently as Naval Hospital Boston, Chelsea. The current designation was effected in order to indicate the proximity of the Naval Hospital facilities and training programs to the acknowledged outstanding medical environment of Boston and thus attract potential Navy doctors to the Chelsea duty station.

Currently, Naval Hospital Boston comprises numerous buildings. Building 1 is known to have been commissioned and opened January 7, 1836, one of the first three hospitals authorized specifically to accommodate Naval personnel, who until that time had been treated at Marine hospitals, supported in large part by personal taxes levied on Naval personnel (twenty cents a month from pay of every officer, seaman and marine in the naval service). Naval personnel were dissatisfied with what they considered meager facilities of the Marine Hospital and often deserted rather than use the facilities.

The acreage of the district is directly traceable to Samuel Maverick and was the site of the first permanent settlement in the Massachusetts Bay Colony in Boston Harbor; i.e., Samuel Maverick's Palisades House, which records show he fortified in 1625 against the Indian attacks. The hospital site was the terminus of the first county road in the Colony - the Salem Turnpike, now Broadway in Chelsea; also, it was the site of the landing of the first ferry between Winnisimmet (now Chelsea), Charlestown and Boston, May 8, 1631. The toll gate was at the entrance to the hospital grounds and records indicate some disagreement as to the right of way. It is believed that the site was occupied in 1775 by the left wing of Washington's army; likewise, the people of Chelsea are reputed to have gathered on the site to watch the Battle of Bunker Hill in progress across the Mystic River on June 17, 1775; many of the wounded were brought back to the hillside by boat.

In 1811, Congress authorized withdrawal of the Naval Portion of the tax monies collected from sea-going personnel ($50,000) and transferred it to a Naval Hospital Fund. The Secretary of War, the Secretary of the Navy and the Secretary of the Treasury were directed to administer the fund as a Board of Commissioners. On July 10, 1832, Congress made the Secretary of the Navy the sole trustee and also provided for the construction of Naval Hospitals at Charlestown, Mass. (Chelsea site), Brooklyn, N.Y., and Pensacola, Florida.

On September 23, 1823, Dr. Aaron Dexter, a Boston physician, sold approximately 115 acres for $18,000 to the Commissioners of Naval Hospitals; because of uncertainty as to the legality of the transaction, on 4

(cont.)

SEE INSTRUCTIONS

Exibit 5-1
(cont'd)

10-300a
(July 1969)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES
INVENTORY - NOMINATION FORM

(Continuation Sheet)

STATE Massachusetts	
COUNTY Suffolk	
FOR NPS USE ONLY	
ENTRY NUMBER	DATE

(Number all entries)

Naval Hospital Boston

8. SIGNIFICANCE (cont.)

December 1826, Dr. Dexter again deeded the same site to "The United States of America." The Massachusetts Legislature ceded to the United States jurisdiction over the site on 20 February 1828, reserving the right to serve its civil and criminal processes.

In 1832, $26,000 was appropriated out of U. S. Treasury for construction at Charlestown, Mass. (Chelsea site) because in the War of 1812 money of the Naval Hospital Fund had been used for other purposes; and the Treasury appropriation was a form of retribution with no exact accounting. Other sums were appropriated in 1835 and 1836 and 1837, at which time $2750 was included for the Magazine.

The physical features of Dr. Dexter's land were of great value in establishing the hospital there. It was high (112' above sea level) and accessible to good water transportation, being right on the Mystic River and one terminus of a ferry, and to good land transportation, being at the end of the Salem Turnpike. The site was ideal and in selection of the appropriate site for the Marine Hospital to be built, the Collector and Hospital Agent of the Marine Hospital wrote to the Secretary of Treasury in December 1854, "As regards accessibility, airiness, salubrity, and isolation, they (the grounds owned by Naval Hospital in Chelsea) are all that could be wished." Westerly breezes from the river and the hospital is protected by the hill from the NE storms which prevail for six months of the year. Water is supplied from the Mystic reservoir and is abundant in quantity and very good in quality. The atmosphere was thus considered clean and healthy, and the institution later proved to be the only naval hospital on the entire Atlantic coast absolutely free from malarial poison.

In 1836 ground was turned over to the Bureau of Ordnance for a Magazine. The Buildings 2 and 3 were built as magazines and also subsequently used in connection with a radio station established on the hospital site and subsequently discontinued and now used as storerooms. It is believed that the Constitution was loaded with ammunition directly from these magazines. The Bureau of Ordnance returned the property to hospital cognizance in 1911.

In the middle of the 19th Century, 10 acres were sold to the Treasury Department as the site of a new Marine Hospital Building (the forerunner of the Public Health Hospital) which was completed in December 1857. The building has had some alterations through the years, e.g., a fourth story added in 1866 and a new roof after the 1938 hurricane, but the basic design is reasonably intact. The building, which in time of need also served the overload from the Navy Hospital, was returned officially to the Navy Department and has since been used as Bachelor Enlisted Quarters.

Many other buildings (both temporary and permanent in structure) have been erected on the site; the current main hospital building - Building #22 - was completed in 1915, just in time to struggle with the very severe flu epidemic of 1917.

Exibit 5-1
(cont'd)

OR BIBLIOGRAPHICAL REFERENCES

For the Relief of the Sick and Disabled, A History of the First U. S. Public Health Service Hospital, Richard H. Thurm, 1970

Official records, correspondence and documents on file at Naval Hospital Boston.

10. GEOGRAPHICAL DATA

LATITUDE AND LONGITUDE COORDINATES DEFINING A RECTANGLE LOCATING THE PROPERTY

CORNER	LATITUDE Degrees	LATITUDE Minutes	LATITUDE Seconds	LONGITUDE Degrees	LONGITUDE Minutes	LONGITUDE Seconds
NW	42 °	23 '	38 "	71 °	02'	58 "
NE	42 °	23 '	25 "	71 °	02'	31 "
SE	42 °	23 '	04 "	71 °	02'	48 "
SW	42 °	23 '	17 "	71 °	03'	16 "

OR

LATITUDE AND LONGITUDE COORDINATES DEFINING THE CENTER POINT OF A PROPERTY OF LESS THAN TEN ACRES

LATITUDE Degrees	LATITUDE Minutes	LATITUDE Seconds	LONGITUDE Degrees	LONGITUDE Minutes	LONGITUDE Seconds
°	'	"	°	'	"

APPROXIMATE ACREAGE OF NOMINATED PROPERTY: 87.85 acres

LIST ALL STATES AND COUNTIES FOR PROPERTIES OVERLAPPING STATE OR COUNTY BOUNDARIES

STATE:	CODE	COUNTY	CODE
STATE:	CODE	COUNTY:	CODE
STATE:	CODE	COUNTY:	CODE
STATE:	CODE	COUNTY:	CODE

11. FORM PREPARED BY

NAME AND TITLE: Captain James M. Sanders, Jr., MSC, USN, Administrative Officer

ORGANIZATION: Naval Hospital Boston

DATE: March 1, 1973

STREET AND NUMBER: 1 Broadway

CITY OR TOWN: Chelsea, Massachusetts

STATE: Massachusetts

CODE:

12. STATE LIAISON OFFICER CERTIFICATION

As the designated State Liaison Officer for the National Historic Preservation Act of 1966 (Public Law 89-665). I hereby nominate this property for inclusion in the National Register and certify that it has been evaluated according to the criteria and procedures set forth by the National Park Service. The recommended level of significance of this nomination is:

National ☒ State ☐ Local ☐

Name

JOHN F.X. DAVOREN, Secretary of the Commonwealth; Chairman of the

Title Mass. Historical Commission

Date

NATIONAL REGISTER VERIFICATION

I hereby certify that this property is included in the National Register

Director, Office of Archeology and Historic Preservation

Date

ATTEST:

Keeper of The National Register

Date

SEE INSTRUCTIONS

GPO 931-894

Exibit 5-1
(cont'd)

NATURAL RESOURCES

TOPOGRAPHY AND GEOLOGY

At one time the Island End River drained an extensive salt marsh which occupied presently developed areas of Everett and Chelsea. The river formerly followed a course which curved to the west from its present terminus and then in a semicircle back again to the east to an area of the Naval Hospital. Figure 5-1 shows the former course of the river as it appeared in 1884. Over the years, the marsh was filled in to provide land for urban development, reducing the river to its present size. Most of the land to the north and the west of the river is therefore reclaimed land. The land is relatively flat and lies at an elevation of fifteen to twenty feet above MLW. The fill consists of miscellaneous material such as sand, gravel, cinders and rubble in a layer up to fifteen feet thick.

5. Beneath the fill there is apparently a layer of soft highly organic silt and peat which formed by natural surficial deposition of alluvium in the saltwater marshes. These strata generally vary from two to twenty feet in thickness. Beneath the surface strata of silt and peat there is reportedly a layer of Boston Blue clay, ranging from fifteen to one hundred ten feet in thickness. Strata thickness increase to the west. The clay was deposited by the Wisconsin Glacier in adjacent morainal pools. Figure 5-2 illustrates the surficial geological features of the project area.

6. Dense glacial till consisting of sand and gravel with cobbles and bolders is found beneath the Boston Blue clay layer. To the west and north of the river the till is generally located at depths of sixty to one hundred feet.

7. To the east of the Island End River, at the location of the Chelsea Naval Hospital grounds, the topography and subsurface conditions change radically. The Naval Hospital site occupies a glacial drumlin rising about one hundred twenty feet above MLW. From the highest point of the site the ground slopes regularly to a flat area along the southwestern and western part of the property bordering the Island End and Mystic Rivers. The flat area extends inland from the shoreline at an elevation of twenty feet above MLW. A steep bank drops from this flat area to the edge of the river.

8. Subsurface conditions in the Island End River are likely to vary from east to west. To the east the glacial till is found close to the surface of the ground, and some boulders are visible in the river bottom and along the bank at the eastern edge of the river. The layer of till slopes downward to the west and is found at significant depths to the west of the river.

9. CLIMATE, WAVES, CURRENTS AND TIDES

The climate of the project is affected by its proximity to the Atlantic Ocean. Temperature ranges are moderated somewhat by the ocean and average from twenty-eight degrees Farenheit in January to seventy-one degrees Farenheit in July. The prevailing wind direction is northwest while predominant summer winds are southwest. Occasionally, hurricanes and other severe storms have entered the area.

10. Icing of the Mystic River and Boston Harbor occurs during the colder winters with ice occasionally remaining for a period of one or two months. The Harbor is often ice-free during milder winters.

11. Mean tidal range in the Island End River is 9.5 feet with a spring range of approximately 11.0 feet. Storm water levels of up to 3 feet above mean high water (MHW) are are likely to occur during winter northeast storms. Low tides of 2.0 feet below MLW occur regularly with the average yearly lowest tide of 3 feet below MLW. Extreme low tides are likely to occur in winter months when strong northwest winds drive the water offshore.

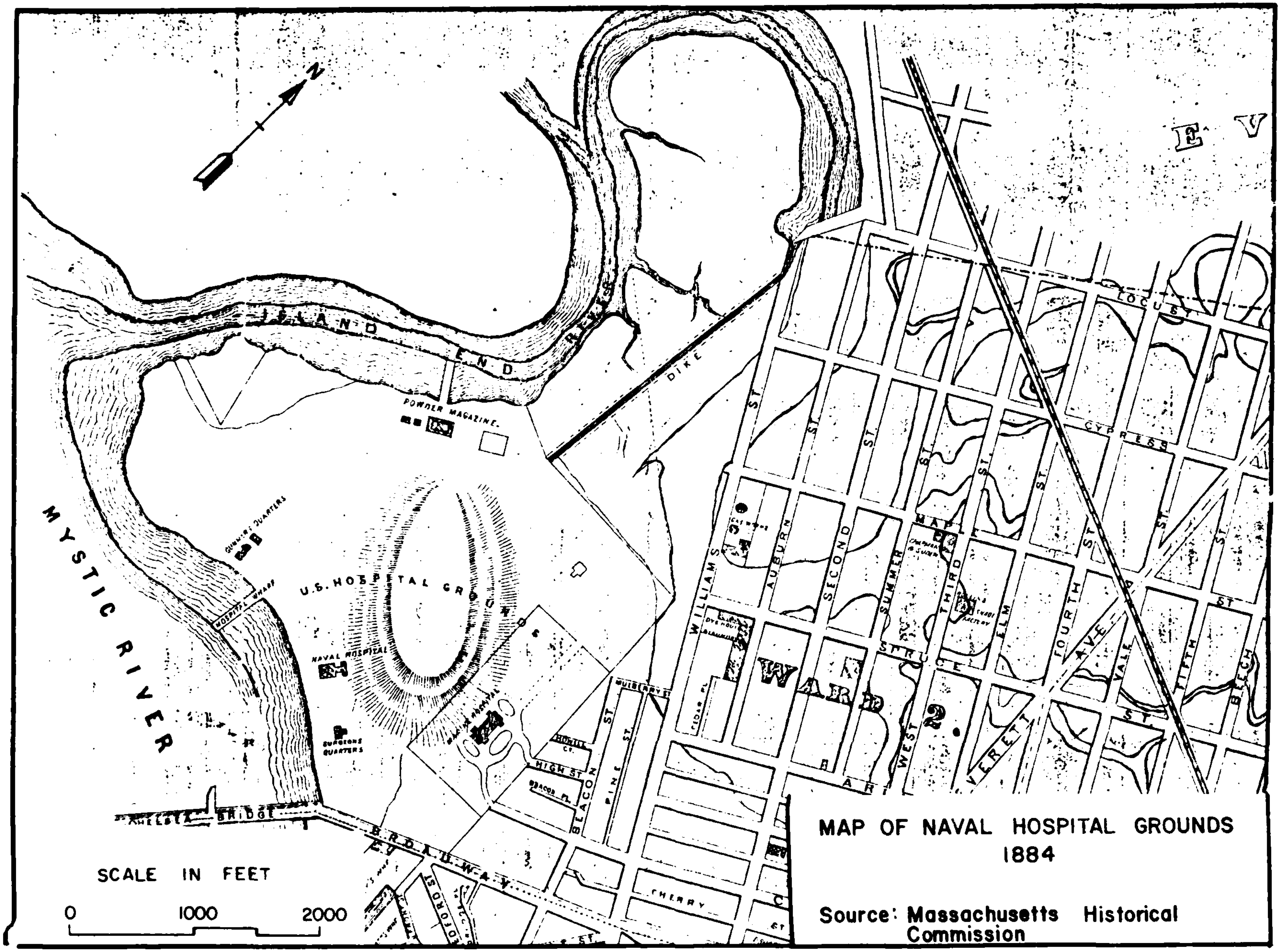
12. Current velocities in the Island End River and the Mystic River are low. Maximum tidal currents are about 1.5 knots. Due to short fetch length, wind wave heights are generally limited to less than two feet on the Mystic River and substantially less on the more sheltered Island End River. The most common wave action results from the wakes of passing vessels.

13. ENVIRONMENTAL SETTING

The Island End River is a tidal estuary approximately three thousand feet long and about four to five hundred feet wide at MHW. At the northern end of the river, the inlet narrows to about one hundred feet in width. Two large corrugated steel arch culverts outfall into the river at the upstream end.

14. The river is generally shallow and the bottom slopes gently to the commercial channel. Dredging has created steep side slopes and an average water depth of twenty-four feet below MLW in the shipping channel along the Everett shoreline. The channel is approximately 1400 feet in length and varies in width from about two hundred fifty feet at its entrance at the Mystic River to about one hundred feet at the northern end. This channel was dredged in the early 1900's to provide access to wharves of the Eastern Gas and Fuel Company in Everett. Maximum surveyed depth in the channel is twenty-nine feet with a controlling depth of twenty-four feet at mean low water. The channel serves barges and freighters frequenting the industries along the Everett shoreline.

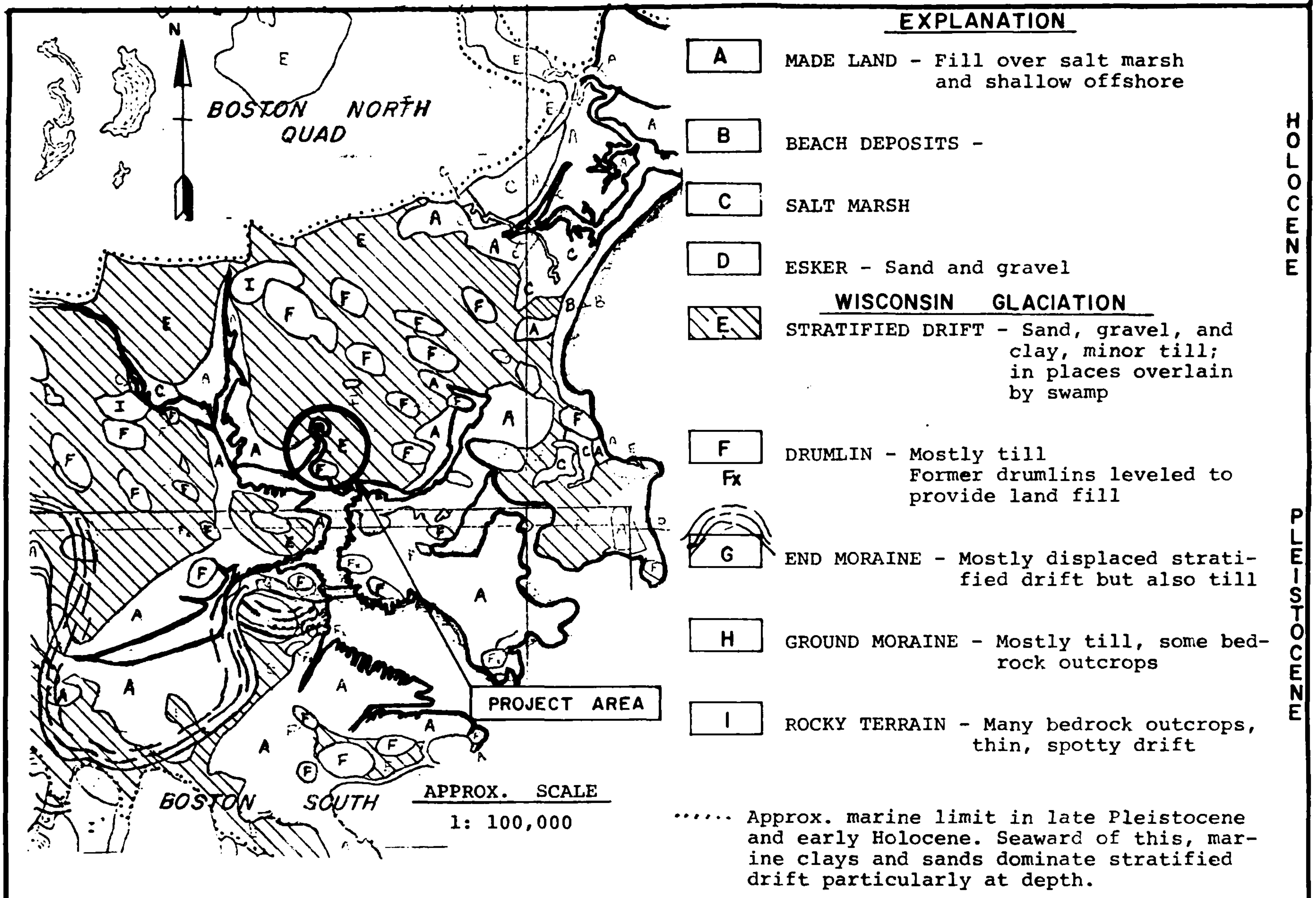
15. To the east and north of the channel, the river bottom ranges from



MAP OF NAVAL HOSPITAL GROUNDS
1884

Source: Massachusetts Historical Commission

FIGURE 5-1



SURFICIAL GEOLOGIC MAP OF THE BOSTON AREA, MASSACHUSETTS

FIGURE 5-2

two to four feet above MLW. At low water the river bottom forms an exposed mud flat. To the north, the mud flat averages 400 feet in width and is divided by a meandering stream about twenty to thirty feet in width and two feet deep. To the east, the bottom rises gently for two hundred feet across the river to the Chelsea shoreline where a steep bank climbs to an elevation of fifteen to twenty feet.

16. The present shoreline of the river generally borders landfill areas. Little marine growth was observed in the intertidal zone. North of the Coldwater Seafood wharves the shoreline consists of deteriorated cargo wharves, timber retaining walls, and banks of fill consisting of rocks and rubble such as broken concrete and bricks.

17. The largely undeveloped eastern shoreline bordering the Naval Hospital site generally consists of a steep bank extending from a mud flat at an elevation of approximately four feet above MLW to a level grassy area at an elevation of fifteen to twenty feet MLW. This bank is retained by a seawall along the first several hundred feet of the Naval Hospital shoreline near the river's mouth. North of the seawall the unprotected bank is eroding and localized areas are undercut between the high water line and the top of the bank. Rocks and large granite blocks have been dumped in the past along the bank in an apparent attempt to stabilize the shoreline in certain places. Refuse such as old tires, paint cans and rotting planks are visible along the shoreline.

18. At about 1500 feet from the mouth of the river, a pier constructed of granite blocks extends about fifty feet into the river. The pier is adjacent to a former magazine building on the Naval Hospital grounds which was used to transfer cargo to ships in the 1800's. At one time, a timber finger pier extended beyond the granite blocks to the middle of the river. Presently, there remains no evidence of the timber pier.

19. The steep bank continues along the eastern shoreline for another five hundred feet. Beyond that is a level marshy area at an elevation just above high water level. This area extends about one hundred feet back from the edge of the river and is thickly covered with saltwater marsh grasses. Other vegetation found along the eastern shoreline includes a number of large willows, sumacs, locusts, poplars and wild cherries.

20. MARINE LIFE

Because the Island End River is polluted, the species found there tend to be pollution tolerant. Near the mouth at the Mystic River, greater volumes of water in the tidal flows provide a cleansing effect. A greater diversity of species is found there.

21. The bottom sediments in the intertidal zone consist of an upper layer of soft mud up to one and one-half feet in thickness. The mud has a high content of organics and is polluted with high concentrations of heavy metals and petroleum residues. Clamworms, which are pollution tolerant, were found in higher concentrations near the channel in the upper part of the river. Clamworms were also found throughout the intertidal zone in the lower part of the river. Toward the mouth of the river, less tolerant organisms, such as soft-shell clams, blue mussels and barnicles were found in the intertidal zone. These species were not in evidence further upstream.

22. As stated in the Environmental Assessment and supplemented by data located in Appendix 7, it has been determined that ocean disposal is the most viable disposal alternative available.

23. To dispose of dredged material in an open marine environment, specific tests and analyses were required. The tests were conducted to determine if the material located within the Island End River would severely impact or disrupt those organisms located within the proposed disposal site. As the following sections indicate, disposal of dredged material within the Boston "Foul" Area is environmentally acceptable.

24. The following data are presented in three sections. Section A, performed in July 1979, analyzed the Benthic Macroinvertebrate Samples taken in the Island End River and Sources of Water Quality Data in Boston Harbor. Section B, performed in May 1979, is the "Ecological Evaluation of Proposed Oceanic Discharge of Dredged Material from Island End River." Section C, performed in October 1979, is a supplemental report to Section B. The solid phase testing was determined to be inconclusive and under the recommendations of the Environmental Protection Agency, this aspect of the test was repeated.

SECTION A

DATA AND INTERPRETATION OF
BENTHIC MACROINVERTEBRATE SAMPLES
ISLAND END RIVER
CHELSEA, MASSACHUSETTS
AND
SOURCES OF WATER QUALITY DATA
BOSTON HARBOR

JULY 24, 1979

TABLE OF CONTENTS

1. BENTHIC MACROINVERTEBRATE SAMPLES

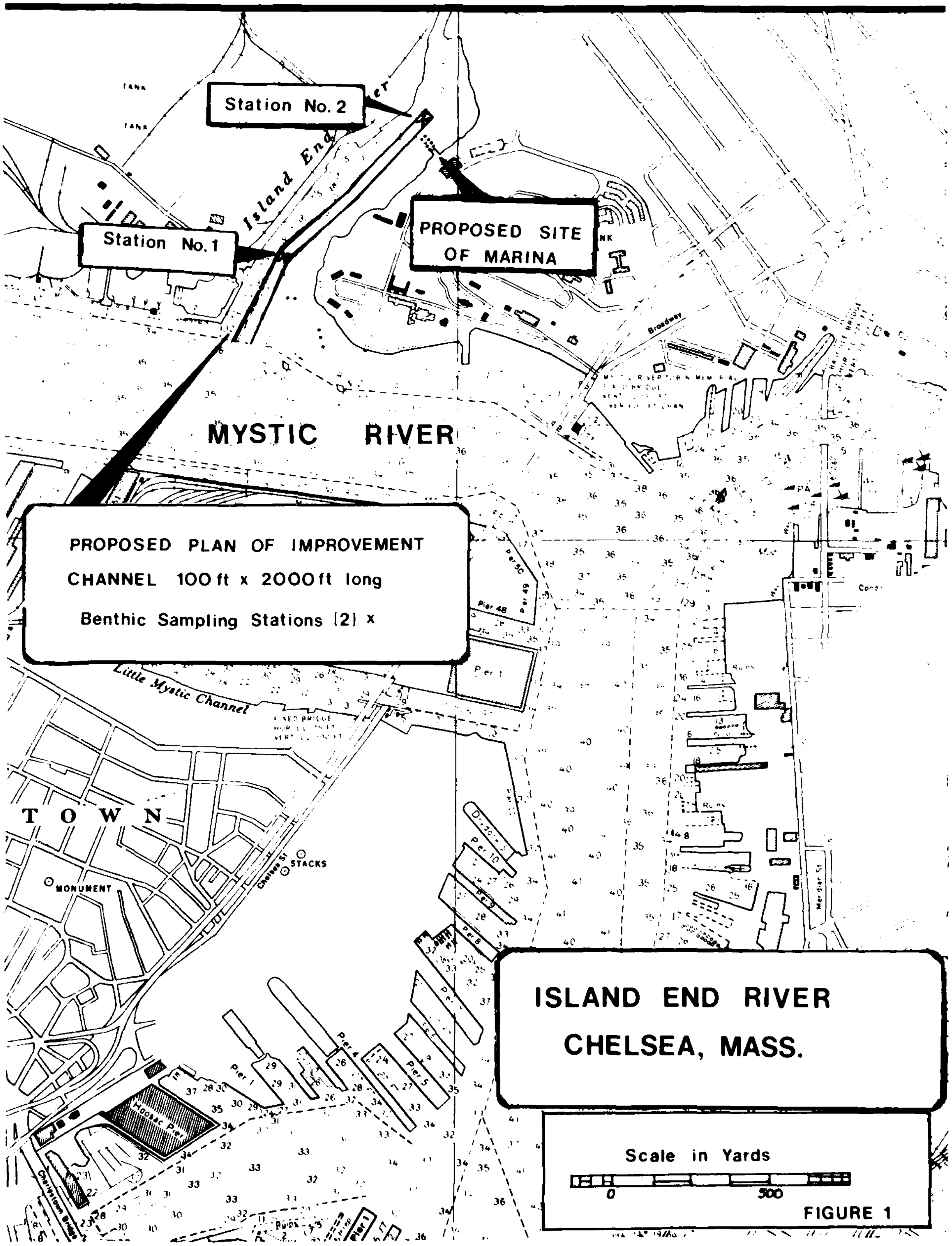
A. Methods

Ten samples of the bottom sediments of the Island End River were collected with an Ekman dredge on May 30, 1979. Samples numbered 01 through 05 were collected at Station 1 in the proposed channel while samples numbered 06 through 10 were collected at Station 2 in the proposed turning basin. At each Station, the 5 samples were collected within a 20 foot diameter circle. Station locations are indicated in Figure 1, Map of Island End River.

Samples were returned to the laboratory for the separation, identification and counting of benthic macroinvertebrates. Methods used are detailed in APHA *et al.*, 1976, *Standard Methods for the Examination of Water and Wastewater* and in Weber, I.C., 1973, *Biological Field and Laboratory Methods for Measuring the Quality of Surface Waters and Effluents*.

B. Data

The identification and population density (number per square foot) of the benthic macroinvertebrates found in each sample are given in the following data sheets.



PROPOSED PLAN OF IMPROVEMENT

CHANNEL 100 ft x 2000 ft long

Benthic Sampling Stations (2) x

ISLAND END RIVER

CHELSEA, MASS.

FIGURE 1

BENTHIC ORGANISMS	NUMBER/SQUARE FOOT
Polychaeta Nereidae	2320
Capitellidae	1872
Spionidae (Polydora)	496
Phyllodocidae	4
Sabellidae	16
Oweniidae	0
Other	4
Nematoda	8
Turbellaria	36
Hydrozoa	0
Crustacea Amphipoda	8
Mollusca Bivalvia	0
TOTAL BENTHIC ORGANISMS	4764

STATION NO. 1 , SAMPLE NO. 01

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BENTHIC ORGANISMS	NUMBER/SQUARE FOOT
Polychaeta Nereidae	3152
Capitellidae	1752
Spionidae (Polydora)	760
Phyllodocidae	0
Sabellidae	16
Oweniidae	0
Other	16
Nematoda	256
Turbellaria	16
Hydrozoa	0
Crustacea Amphipoda	0
Mollusca Bivalvia	0
TOTAL BENTHIC ORGANISMS	5968

STATION NO. 1 , SAMPLE NO. 02

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BENTHIC ORGANISMS	NUMBER/SQUARE FOOT
Polychaeta Nereidae	2648
Capitellidae	1024
Spionidae (Polydora)	320
Phyllodocidae	8
Sabellidae	0
Oweniidae	24
Other	0
Nematoda	40
Turbellaria	0
Hydrozoa	0
Crustacea Amphipoda	0
Mollusca Bivalvia	8
TOTAL BENTHIC ORGANISMS	4072

STATION NO. 1 , SAMPLE NO. 03

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BENTHIC ORGANISMS	NUMBER/SQUARE FOOT
Polychaeta Nereidae	2688
Capitellidae	2272
Spionidae (Polydora)	544
Phyllodocidae	16
Sabellidae	0
Oweniidae	0
Other	0
Nematoda	80
Turbellaria	16
Hydrozoa	0
Crustacea Amphipoda	0
Mollusca Bivalvia	0
TOTAL BENTHIC ORGANISMS	5616

STATION NO. 1 , SAMPLE NO. 04

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BENTHIC ORGANISMS	NUMBER/SQUARE FOOT
Polychaeta Nereidae	2016
Capitellidae	2768
Spionidae (Polydora)	752
Phyllodocidae	32
Sabellidae	0
Oweniidae	0
Other	0
Nematoda	368
Turbellaria	0
Hydrozoa	0
Crustacea Amphipoda	0
Mollusca Bivalvia	0
TOTAL BENTHIC ORGANISMS	5936

STATION NO. 1 , SAMPLE NO. 05

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BENTHIC ORGANISMS	NUMBER/SQUARE FOOT
Polychaeta Nereidae	2800
Capitellidae	5152
Spionidae (Polydora)	352
Phyllodocidae	48
Sabellidae	272
Oweniidae	0
Other	0
Nematoda	16
Turbellaria	16
Hydrozoa	48
Crustacea Amphipoda	0
Mollusca Bivalvia	0
TOTAL BENTHIC ORGANISMS	8704

STATION NO. 2 , SAMPLE NO. 06

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BENTHIC ORGANISMS	NUMBER/SQUARE FOOT
Polychaeta Nereidae	1984
Capitellidae	12320
Spionidae (Polydora)	80
Phyllodocidae	0
Sabellidae	208
Oweniidae	0
Other	1
Nematoda	0
Turbellaria	16
Hydrozoa	240
Crustacea Amphipoda	0
Mollusca Bivalvia	0
TOTAL BENTHIC ORGANISMS	14849

STATION NO. 2 , SAMPLE NO. 07

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BENTHIC ORGANISMS	NUMBER/SQUARE FOOT
Polychaeta Nereidae	800
Capitellidae	11296
Spionidae (Polydora)	48
Phyllodocidae	0
Sabellidae	0
Oweniidae	0
Other egg case	(16)
Nematoda	64
Turbellaria	16
Hydrozoa	48
Crustacea Amphipoda	0
Mollusca Bivalvia	0
TOTAL BENTHIC ORGANISMS	12272

STATION NO. 2 , SAMPLE NO. 08

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BENTHIC ORGANISMS	NUMBER/SQUARE FOOT
Polychaeta Nereidae	2240
Capitellidae	8640
Spionidae (Polydora)	64
Phyllodocidae	0
Sabellidae	32
Oweniidae	0
Other	0
Nematoda	0
Turbellaria	0
Hydrozoa	80
Crustacea Amphipoda	0
Mollusca Bivalvia	0
TOTAL BENTHIC ORGANISMS	11056

STATION NO. 2 , SAMPLE NO. 09

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BENTHIC ORGANISMS	NUMBER/SQUARE FOOT
Polychaeta Nereidae	928
Capitellidae	13216
Spionidae (Polydora)	32
Phyllodocidae	0
Sabellidae	16
Oweniidae	0
Other (egg cases)	(64)
Nematoda	32
Turbellaria	0
Hydrozoa	32
Crustacea Amphipoda	0
Mollusca Bivalvia	0
TOTAL BENTHIC ORGANISMS	14256

STATION NO. 2 , SAMPLE NO. 10	**NEW ENGLAND RESEARCH, INC.** **WORCESTER, MASSACHUSETTS** Project 126

C. Interpretation

The populations of organisms found in the ten samples are typical of those found in polluted marine ecosystems. Noteable characteristics of these populations are the relatively high density of polychaete worms and the absence or low density of many other forms including molluscs and crustaceans.

A comparison of samples from Station 1 (Samples 01-05) with samples from Station 2 (Samples 06-10) indicates a much higher density of Capitellidae at Station 2. The Capitellidae are polychaete worms which tend to be pollution tolerant, indicating that a somewhat more polluted situation, exists at the upstream station.

The close agreement between samples at a given station indicates that fairly uniform habitat conditions exist in the bottom sediments. At Station 1, the total number of organisms ranged from about 4000 to 6000 per square foot. At Station 2 the total number of organisms ranged from about 9000 to 15,000 per square foot, indicating more variation in these samples.

Visual examination of the sediments in the laboratory indicated that all samples were composed predominantly of a very fine-textured (probably silt to clay size), black, oily sediment. Samples 01 through 05 contained some small rocks. Samples 06 through 10 contained few or no rocks, but did contain parts of leaves, twigs and other fiberous organic matter. No chemical or physical analyses were performed on any of these samples.

2. LIST OF SOURCES OF WATER QUALITY DATA FOR BOSTON HARBOR

This list consists of two parts. The first part is a bibliographic list of reports and other documents along with a parenthetical note on the agency or company where they may be obtained or reviewed. The second part is a list of addresses of these agencies or companies.

A. Bibliographic List

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Boston Harbor Coordinating Group (BHCG). October 1974. Debris and Refuse in Boston Harbor: The Problem and Solution. Boston, Massachusetts. (Available from BRA)

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Verter Corporation. July 1976. *Phase I Final Report on Greater Boston: Water-Quality Issues in Planning for Pollution Control*. McLean, Virginia.

B. Address List

Boston Edison Company
800 Boylston Street
Boston, Massachusetts 02113

Boston Harbor Associates
70 Long Wharf
Boston, Massachusetts 02110

(BRA) Boston Redevelopment Authority
City Hall
1 City Hall Square
Boston, Massachusetts 02201

(EPA Region 1) United States Environmental Protection Agency
John F. Kennedy Federal Building, Government Center
Boston, Massachusetts 02203

(MAPC) Metropolitan Area Planning Council
44 School Street
Boston, Massachusetts 02108

(MDC) Metropolitan District Commission
20 Somerset Street
Boston, Massachusetts 02108

(MDWPC) Massachusetts Division of Water Pollution Control
Laverett Saltonstall Building
100 Cambridge Street
Boston, Massachusetts 02202

MIT Press
28 Carleton
Cambridge, Massachusetts 02138

(NEA) New England Aquarium
Central Wharf
Boston, Massachusetts 02110

(NTIS) National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA. 22151

Woods Hole Oceanographic Institution Library
Woods Hole,
Massachusetts 02543

SECTION B

ECOLOGICAL EVALUATION OF PROPOSED OCEANIC DISCHARGE OF DREDGED MATERIAL FROM ISLAND END RIVER, CHELSEA, MASSACHUSETTS

MAY 1, 1979

ACKNOWLEDGEMENTS

This report was written by Dr. Curt D. Rose, Principal Aquatic Ecologist, Energy Resources Company Inc. (ERCO). Mr. Timothy J. Ward, Aquatic Toxicologist, ERCO, observed collection of dredged material, prepared material and water for bioassays (toxicity tests), and conducted bioassays.

SUMMARY

The proposed oceanic discharge of dredged material from Island End River, Chelsea, Massachusetts is ecologically unacceptable as judged by several bioassay-related criteria employed in this investigation. Survival of the copepod (Acartia tonsa), mysid shrimp (Mysidopsis bahia), and Atlantic silverside (Menidia menidia) exposed for 96 hr to culture water control and 100% liquid phase of three samples of dredged material is not, with one exception, significantly different (P = 0.05). Mysid shrimp exposed to 100% liquid phase of Dredged Material - Sample C did exhibit significantly lower (P = 0.01) survival than control animals, but exposure-time-dependent limiting permissible concentrations (LPC's) for the liquid phase of that sample are greater than the environmental concentration of the phase after initial mixing. Survival of the above-identified species exposed for 96 hr to culture water control and 100% suspended particulate phase of the three samples of dredged material is not significantly different. However, total (combined) survival of the mysid shrimp (Neomysis americana), hard clam (Mercenaria mercenaria), and sandworm (Nereis virens) exposed for 10 days to control (reference) sediment and the solid phase of the three samples of dredged material is significantly different (P = 0.01). Moreover, this difference in survival is, at least in part, attributable to differences between the control sediment and all samples of dredged material. In addition, the mean magnitude of each of these differences is greater than 10%.

The conclusion that dredged material from Island End River is ecologically unacceptable for oceanic disposal is based solely on the low survival that characterized mysid shrimp exposed to the solid phase of the material. Similarly low survival may be experienced by shrimp exposed to sediment

from the vicinity of the proposed disposal site. In this eventuality, oceanic disposal of the dredged material would be judged to be ecologically acceptable. Therefore, we recommend that solid phase bioassays of the dredged material be conducted with a disposal-site-sediment control as well as a "culture-sediment" control.

TABLE OF CONTENTS

1. INTRODUCTION

The major objective of the investigation described in this report is to evaluate the ecological acceptability of the proposed oceanic discharge of dredged material from Island End River, Chelsea, Massachusetts (Figure 1). If the proposed discharge is judged to be ecologically acceptable according to the bioassay-related criteria employed in the investigation, the disposal practice is considered to be in partial compliance with Subpart B (Environmental Impact) of the ocean dumping regulations (Fed. Reg., 1977).

Subpart B (Environment Impact) of the ocean dumping regulations consists of the following basic sections: §227.5 (Prohibited Materials); §227.6 (Constituents Prohibited as Other than Trace Contaminants); §227.7 (Limits Established for Specific Wastes or Waste Constituents); §227.8 (Limitations on the Disposal Rates of Toxic Wastes); §227.9 (Limitations on Quantities of Waste Materials); §227.10 (Hazards to Fishing, Navigation, Shorelines or Beaches); §227.11 (Containerized Wastes); and §227.13 (Dredged Materials). Disposal of dredged material must comply with restrictions and limitations imposed by §227.5, §227.6, §227.9, §227.10, and §227.13 of the regulations (Fed. Reg., 1977).

This investigation addresses only §227.6 (Constituents Prohibited as Other than Trace Contaminants) and §227.13 (Dredged Materials) of the ocean dumping regulations. However, it is important to note that full compliance with even these sections is not evaluated in the study. Section 227.13, by its reference in ¶(c)(3) to ¶(b) of §227.27, requires that the potential for bioaccumulation, as well as the toxicity, of the suspended particulate and solid phases of dredged

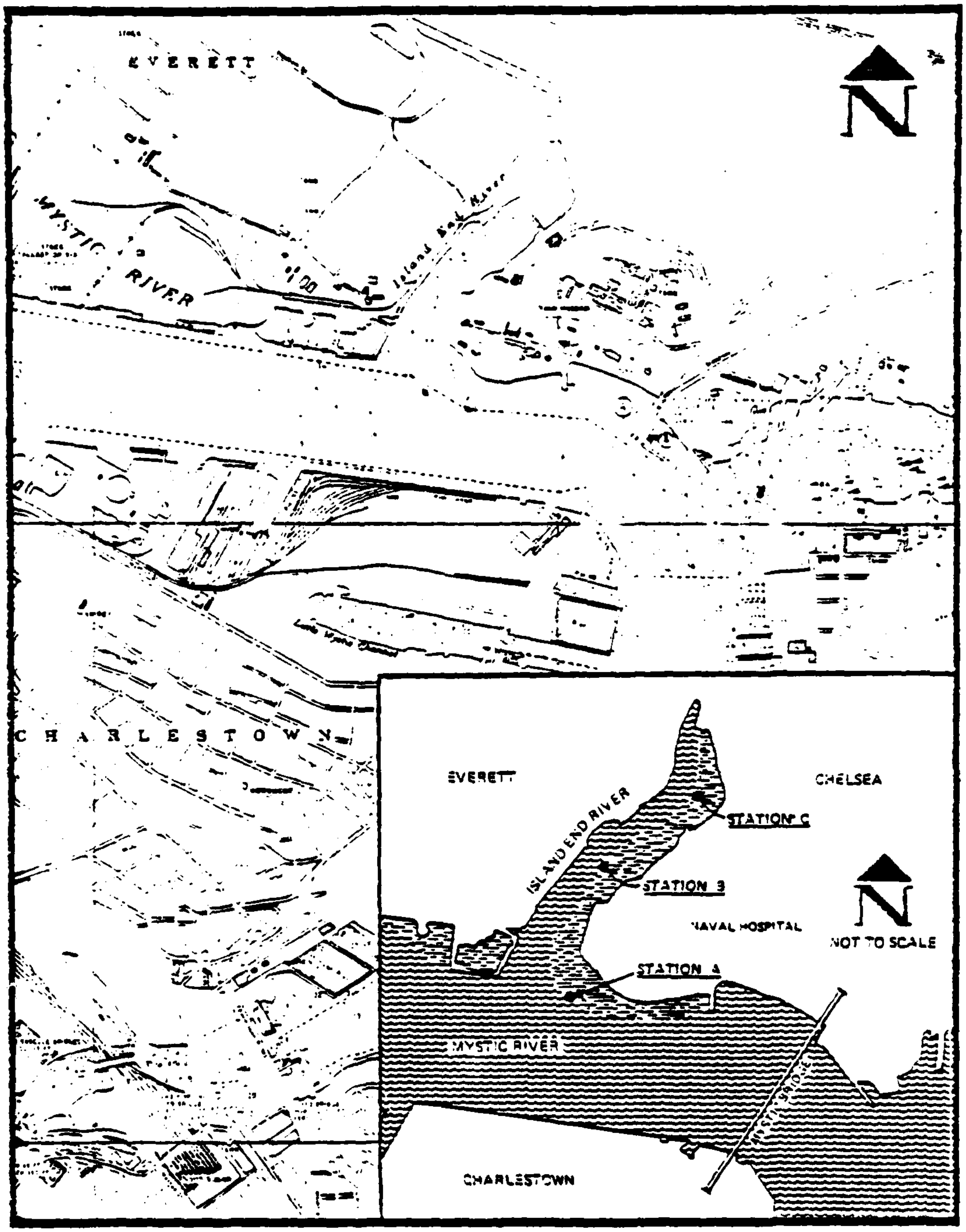

Figure 1. Location of dredging site. Sampling stations for dredged material are schematically depicted in inset.

material be considered. §227.6 also requires a consideration of the potential of the suspended particulate and solid phases of wastes to bioaccumulate (in §227.6, emphasis is placed on the use of bioassay organisms to assess the potential for bioaccumulation). In addition, §227.6 mandates a bioassay-based evaluation of the bioaccumulation potential of the liquid phase of a waste if the waste contains persistent organohalogens that are not included in marine water quality criteria (¶[c][4] of §227.6). Also, §227.6 contains a provision (¶[c][1]) that requires constituents of the liquid phase to be compared to applicable marine water quality criteria. Bioaccumulation and "water-quality-criteria" studies were not conducted as part of the investigation.

This report consists of five principal sections in addition to the Introduction. The first section, which precedes the Introduction, summarizes the ecological acceptability of the proposed discharge operation. The second section reviews the methods and materials employed in the investigation. The third section presents important results of the investigation. The fourth section is a discussion of the scientific credibility of several protocols utilized in the investigation. The last section lists references cited in the report.

The report contains two appendices. Appendix A details laboratory procedures employed for preparing dredged material and conducting bioassays. The appendix also serves as a quality-control document. Appendix B contains all raw bioassay-related data. Only data directly relevant to the ecological evaluation of the potential discharge operation are presented in the main body of the report.

2. METHODS AND MATERIALS[1]

Dredged material was collected from three stations in Island End River (Figure 1) during 0900-1100 on March 29, 1979. Material was collected from a commercial fishing vessel by representatives of the New England Division of the Corps of Engineers (supervisor was Mr. Roy S. Clark). Mr. Timothy J. Ward, Aquatic Toxicologist at Energy Resources Company Inc. (ERCO), observed the collection efforts.

Station A was located near the mouth of the river at approximately 1,000 m from the river's eastern shore. Depth of water at the station was about 2-3 m. Station B was situated upriver from Station A and approximately 500 m from the eastern shore of the river (depth of water was about 1-2 m). Station C was located upriver from Station B and approximately 500 m from the eastern shore (water depth was about 1-2 m). At each station, approximately 8-12 samples of dredged material were collected with a Van Veen grab after the fishing vessel had been anchored. Each set of samples was distributed into five 15-l bags, which were assigned identification numbers (Station A: GEB-1-79; Station B: GEB-2-79; Station C: GEB-3-79). The bags were transported immediately to ERCO's Bioassay Laboratory in Cambridge, Massachusetts. Bags were put into cold storage (2-4° C) at the laboratory at 1300 on March 29, 1979.

Dredged material was prepared for biological testing according to procedures described in Appendix B of the manual entitled Ecological Evaluation of Proposed Discharge of Dredged Material into Ocean Waters (U.S. EPA/U.S. COE, 1977).

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[1] Laboratory procedures used to prepare dredged material and conduct bioassays are described in detail in Appendix A of this report.

Artificial seawater (30 ppt salinity) was employed to formulate liquid and suspended particulate phases of the dredged material (disposal-site water was not used because a proposed disposal site for the material had not been identified). During preparation of the liquid and suspended particulate phases, dredged material and artificial seawater were mixed by mechanical methods (as opposed to mixing by compressed air) since anoxic conditions did not occur in the sediment-seawater mixtures. In preparation of the liquid phase, centrifugation was not required to reduce concentrations of suspended solids prior to filtration.

Bioassays with dredged material were, with one exception, conducted according to guidelines presented in Appendices D and F of the EPA/COE manual for dredged material (U.S. EPA/ U.S. COE, 1977). The one exception is that 19-l aquaria, rather than 38-l aquaria, were used to conduct liquid and suspended particulate phase bioassays with fishes. The use of the smaller aquaria is sanctioned by the EPA in its contemporary procedures for performing bioassays for the Ocean Dumping Permit Program (U.S. EPA, 1978).

Species employed in the liquid and suspended particulate phase bioassays were the copepod (Acartia tonsa), mysid shrimp (Mysidopsis bahia), and Atlantic silverside (Menidia menidia). The animals were purchased from Sea Plantations, Inc., Salem, Massachusetts. Bioassays were conducted at 2C ± 1° C, the recommended summer testing temperature for the New England region (U.S. EPA/U.S. COE, 1977). Since a proposed disposal site was not identified, artificial seawater was used to dilute liquid and suspended particulate phases to appropriate test concentrations and as the single control (culture water control).

Species tested in the solid phase bioassays were the mysid shrimp (Neomysis americana), hard clam (Mercenaria mercenaria, and sandworm (Nereis virens). All species were tested in the same aquaria. Source of animals and test temperature were the same as in the liquid and suspended particulate phase bioassays. Reference sediment was obtained from the intertidal zone of southern Massachusetts Bay and consisted primarily of sand. Water exchange (artifical seawater) during the bioassays was by the replacement, as compared to the flow-through, method.

During all bioassays, mysid shrimp were fed live 48-hr-old Artemia (brine shrimp) nauplii at a rate of approximately 1 ml of culture/200-ml crystallizing dish/day (liquid and suspended particulate phase tests) or 10 ml of culture/38-l aquarium/day (solid phase tests).

The environmental concentration of the liquid phase of Dredged Material - Sample C after the 4-hr period of initial mixing was estimated by the release-zone method (U.S. EPA/ U.S. COE, 1977; Appendix H). Volume of the initial mixing zone (V_m) was determined by the equation for instantaneous discharge of dredged material or discharge from a stationary vessel:

$$V_{m_{(m^3)}} = \pi(100)^2 d + 200wd + (200 + w)\ell d, \qquad \text{(Equation 1)}$$

with d (depth of mixing zone), w (width of disposal vessel), and ℓ (length of disposal vessel) assumed to be 20 m, 18 m, and 60 m, respectively. Thus, $V_m = 961{,}920\ m^3$. Volume of the discharged liquid phase (V_w) was determined by the equation:

$$V_{w_{(m^3)}} = \frac{P_b - P_d}{P_w - P_d} (V_T), \qquad \text{(Equation 2)}$$

with P_b (bulk density), P_d (particle density), P_w (liquid phase density), and V_T (volume of disposal vessel) assumed to be 1.5, 2.6, 1.0, and 3,058 m^3, respectively. Therefore, V_w = 2,102 m^3. Environmental concentration of the liquid phase after initial mixing (C_w) was calculated by the equation:

$$C_{w(\%)} = \frac{V_w}{V_m} (100) = \frac{2,102 \text{ m}^3}{961,920 \text{ m}^3} (100) = 0.22\% \qquad \text{(Equation 3)}$$

3. RESULTS

The three samples of dredged material employed in the investigation were characterized by physical differences. Sample A consisted primarily of sand, gravel, large rocks, and pieces of shells. The sample was black and contained traces of oil. Sample B was similar in characteristics to Sample A except that it contained more mud and less coarse material. Sample C consisted of black mud and large amounts of oil. No living organisms were observed in any of the samples.

3.1 Liquid and Suspended Particulate Phase Bioassays

Results of liquid and suspended particulate phase bioassays are presented according to the same format since analyses of both types of tests are based on identical components (U.S. EPA/U.S. COE, 1977): (1) selection of an appropriate control for comparison to test results (when disposal-site water as well as culture water is used for control purposes), (2) preliminary comparison of survival of animals exposed for 96 hr to the appropriate control and 100% liquid/suspended particulate phase, (3) calculation or estimation of exposure-time-dependent LC50's (median lethal concentrations) and associated 0.95 confidence intervals for the liquid/suspended particulate phase (if survival in 100% liquid/suspended particulate phase is significantly less [in a statistical sense] than survival in the appropriate control), (4) derivation of exposure-time-dependent limiting permissible concentrations (LPC's) for the liquid/suspended particulate phase by multiplying lower limits of the 0.95 confidence intervals of the LC50's for the phase by 0.01 or a pragmatically determined application factor, and (5) graphical comparison of the LPC's for the liquid/suspended particulate phase to estimated environmental concentrations ("dilution curve") of the phase as determined, in all probability, by the "release zone method."

3.1.1 Liquid Phase Bioassays

Data generated by liquid phase bioassays with the copepod, mysid shrimp, and Atlantic silverside are presented in, respectively, Tables B1, B2, and B3 (Appendix B). The silverside was the most resistant of all species to the liquid phase (all but one fish survived the bioassays). Mean survival rates for copepods and mysid shrimp exposed for 96 hr to 100% liquid phase were 53.3-60.0% and 63.3-96.7%, respectively. In most bioassays with copepods and shrimp, the liquid phase appeared to exert a noncumulative effect, i.e., mortality pattern of organisms had stabilized by the end of the 96-hr testing period.

Analyses of survival data for the copepod, mysid shrimp, and Atlantic silverside exposed for 96 hr to culture water control and 100% liquid phase of dredged material are presented in Tables 1-3, respectively. In the case of all species, survival in the control test was equal to or greater than 90%, thus permitting further analyses of data. Survival data for the copepod (Table 1) exhibited homogeneity of variances, as judged by Cochran's test. Thus, a one-way parametric analysis of variance (ANOVA) with nontransformed data was employed to determine if data are characterized by significant differences (the "t" test described in ¶25, Appendix D of the EPA/COE manual for dredged material [U.S. EPA/U.S. COE, 1977] is not appropriate for use with more than one sample of dredged material and a control). Results of

Table 1. Analysis of survival data for the copepod, <u>Acartia tonsa</u>, exposed for 96 hr to culture water control and 100% liquid phase of dredged material

Step 1. <u>Survival Data (From Table B1)</u>

		Number of Survivors			
Replicate (r)	Treatment (t):	Culture Water Control	Dredged Material - Sample A	Dredged Material - Sample B	Dredged Material - Sample C
1		9	4	5	3
2		8	8	5	9
3		10	4	8	6
	Mean ($\bar{x}$):	9.00 (90.0%)	5.33 (53.3%)	6.00 (60.0%)	6.00 (60.0%)

Step 2. <u>Cochran's Test for Homogeneity of Variances of Survival Data</u>

	Number of Survivors	
Treatment (t)	Mean ($\bar{x}$)	Variance(s^2)
Culture Water Control	9.00	1.00
Dredged Material - Sample A	5.33	5.34
Dredged Material - Sample B	6.00	2.99
Dredged Material - Sample C	6.00	9.00

$$C_{(cal.)} = \frac{s^2(max.)}{\Sigma s^2} = \frac{9.00}{18.33} = 0.49 \text{ ns,}$$

as compared to: $C_{(tab.)} = 0.77$ for $P = 0.05$, $k = 4$, and $v = 2$

Step 3. <u>One-Way Parametric Analysis of Variance (ANOVA) of Survival Data</u>

Source of Variation	df	Sum of Squares	Mean Square	$F_{(cal.)}$	
Treatment (Culture Water Control, Dredged Material - Sample A, Dredged Material - Sample B, Dredged Material - Sample C)	t-1=3	24.25	8.08	1.76 ns,	as compared to $F_{(tab.)}$ = 4.07 for P = 0.05, numerator df = 3, and denominator df = 8
Error	t(r-1)=8	36.67	4.58		
Total	tr-1=11	60.92			

Table 2. Analysis of survival data for the mysid shrimp, *Mysidopsis bahia*, exposed for 96 hr to culture water control and 100% liquid phase of dredged material

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Step 1. Survival Data (From Table B2)

	Number of Survivors			
Treatment (t): Replicate (r)	Culture Water Control	Dredged Material - Sample A	Dredged Material - Sample B	Dredged Material - Sample C
1	10	10	9	5
2	10	9	9	8
3	9	10	10	6
Mean ($\bar{x}$):	9.67 (96.7%)	9.67 (96.7%)	9.33 (93.3%)	6.33 (63.3%)

Step 2. Cochran's Test for Homogeneity of Variances of Survival Data

	Number of Survivors	
Treatment (t)	Mean ($\bar{x}$)	Variance(s^2)
Culture Water Control	9.67	0.33
Dredged Material - Sample A	9.67	0.33
Dredged Material - Sample B	9.33	0.33
Dredged Material - Sample C	6.33	2.34

$$C_{(cal.)} = \frac{s^2(max.)}{\Sigma s^2} = \frac{2.34}{3.33} = 0.70 \text{ ns,}$$

as compared to: $C_{(tab.)} = 0.77$ for $P = 0.05$, $k = 4$, and $v = 2$

Step 3. One-Way Parametric Analysis of Variance (ANOVA) of Survival Data

Source of Variation	df	Sum of Squares	Mean Square	$F_{(cal.)}$	
Treatment (Culture Water Control, Dredged Material - Sample A, Dredged Material - Sample B, Dredged Material - Sample C)	t-1=3	23.58	7.86	9.47**,	as compared to $F_{(tab.)}$ = 7.59 for P = 0.01, numerator df = 3, and denominator df = 8
Error	t(r-1)=8	6.67	0.83		
Total	tr-1=11	30.25			

Step 4. It is apparent without further statistical analysis that the source of the significant difference in survival data is Dredged Material - Sample C (see survival data presented in Step 1).

Table 3. Analysis of survival data for the Atlantic silverside, *Menidia menidia*, exposed for 96 hr to culture water control and 100% liquid phase of dredged material

Step 1. Survival Data (From Table B3)

		Number of Survivors			
	Treatment (t):	Culture Water Control	Dredged Material - Sample A	Dredged Material - Sample B	Dredged Material - Sample C
Replicate (r)					
1		10	10	10	10
2		10	10	10	10
3		10	10	10	10
	Mean ($\bar{x}$):	10.00 (100.0%)	10.00 (100.0%)	10.00 (100.0%)	10.00 (100.0%)

Step 2. There are no differences in survival of animals exposed to culture water control and 100% liquid phase of dredged material. Therefore, further statistical analysis is unnecessary.

the ANOVA indicate no statistically significant differences (P = 0.05) in survival of animals exposed to culture water control and 100% liquid phase of dredged material. Therefore, it is concluded that, in terms of its effect on the copepod, the liquid phase is ecologically acceptable for oceanic discharge.[1]

Survival data for the mysid shrimp (Table 2) also exhibit homogeneity of variances, thereby allowing the use of a one-way parametric ANOVA with nontransformed data for further analysis. The ANOVA identifies a real difference (P = 0.01) in survival of animals exposed to culture water control and 100% liquid phase of dredged material, and perusal of the survival data indicates that the source of this difference is the relatively low survival experienced by animals exposed to 100% liquid phase of Dredged Material - Sample C. However, exposure-time-dependent LPC's for the liquid phase of Dredged Material - Sample C are greater than the environmental concentration of the liquid phase of the sample after initial mixing (Figure 2). (Each LPC is the product of a 0.01 application factor [Fed. Reg., 1977] and a minimum estimate of the LC50 since the relatively high survival (>50%) of animals exposed for 96 hr to 100% liquid phase of the sample precludes the calculation of "real" LC50's and associated 0.95 confidence intervals.) Thus, it is concluded that, with regard to its effect on the mysid shrimp, the liquid phase is ecologically acceptable for oceanic discharge.

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[1] Paragraph 28, page D13, Appendix D of the EPA/COE manual for dredged material (U.S. EPA/U.S. COE, 1977) specifies that "when no differences are detected between control and test survival after 96 hr, the analysis may be considered complete at this point with no indication of potential impact of the liquid (or suspended particulate) phase if the proposed disposal operation occurs." Thus, further analyses relating to LC50's and associated confidence intervals, LPC's, and environmental concentrations of the phase are not warranted.

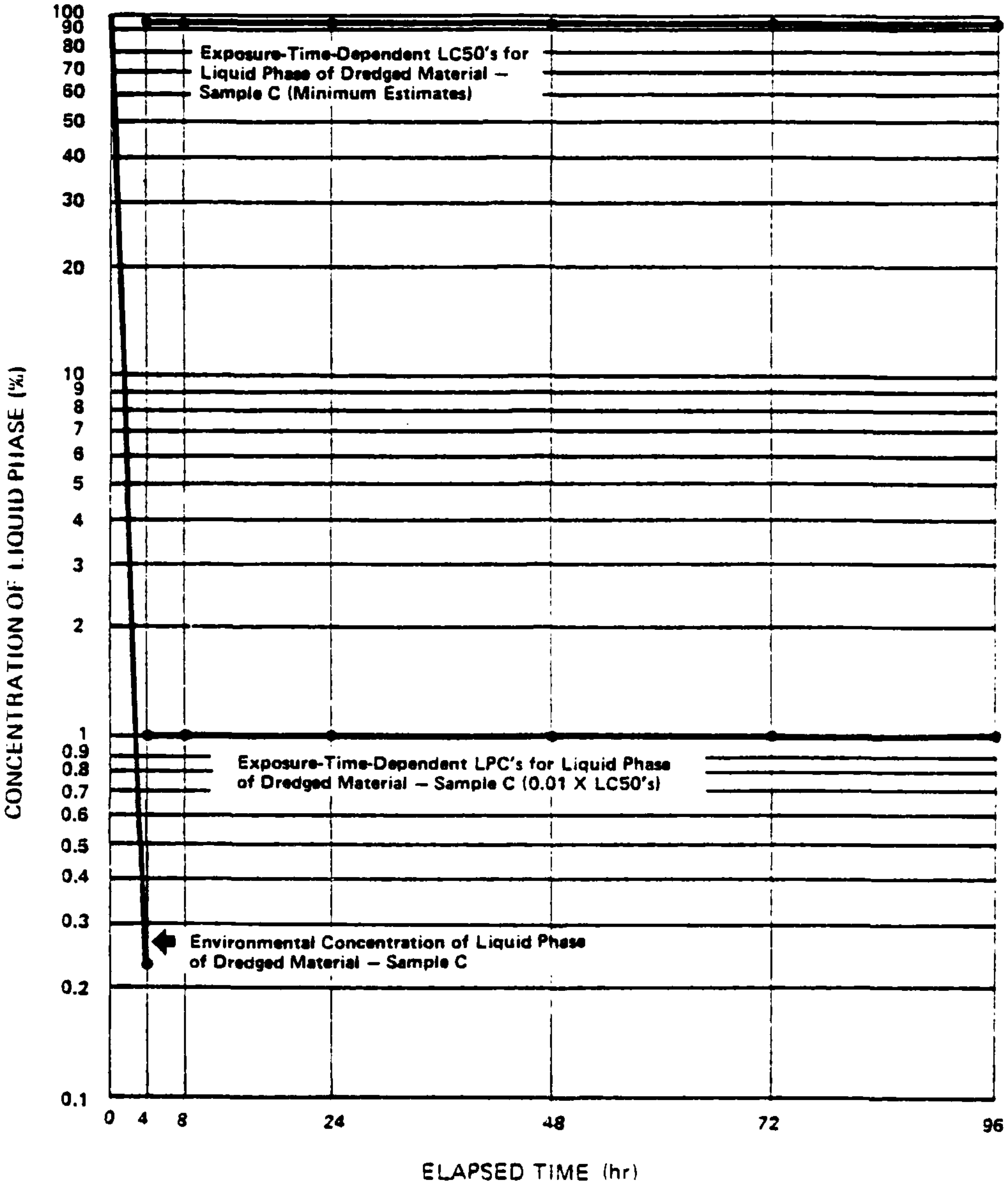

Figure 2. Comparison of exposure-time-dependent limiting permissible concentrations (LPC's) for liquid phase of Dredged Material – Sample C (tested with the mysid shrimp, *Mysidopsis bahia*) and environmental concentration of the liquid phase after initial mixing. Environmental concentration of the liquid phase after initial mixing (the 4-hr period immediately following discharge of dredged material) was estimated by the release-zone method (U.S. EPA/U.S. COE, 1977).

Survival data for the Atlantic silverside (Table 3) exhibit no variation (survival was 100% in all cases). Consequently, it can be concluded without further statistical analyses that, in terms of its effect on the silverside, the liquid phase is environmentally acceptable for oceanic disposal.

3.1.2 Suspended Particulate Phase Bioassays

Data produced by suspended particulate phase bioassays with the copepod, mysid shrimp, and Atlantic silverside are presented in, respectively, Tables B4, B5, and B6 (Appendix B). As in the case of the liquid phase, the silverside was the most resistant of all species to the test material (all fish survived the bioassays). Mean survival rates of copepods and mysid shrimp exposed for 96 hr to 100% suspended particulate phase were 50.0-56.7% and 50.0-76.7%, respectively. Mortality patterns of copepods and shrimp usually had not stabilized by the end of the testing period.

Analyses of survival data for the copepod and mysid shrimp exposed for 96 hr to culture water control and 100% suspended particulate phase of dredged material are presented in Tables 4 and 5, respectively. For both species, survival of animals exposed to culture water control was greater than 90%, thereby allowing further analyses of data. These analyses indicate that both sets of data exhibit homogeneous variances (Cochran's test) and that survival of animals exposed to culture water control and 100% suspended particulate phase of dredged material is not significantly different at P = 0.05 (one-way parametric ANOVA). Thus, it is concluded that the suspended particulate phase is ecologically acceptable for discharge to the ocean.

Table 4. Analysis of survival data for the copepod, *Acartia tonsa*, exposed for 96 hr to culture water control and 100% suspended particulate phase of dredged material

Step 1. Survival Data (From Table B4)

	Number of Survivors			
Replicate (r) / Treatment (t):	Culture Water Control	Dredged Material - Sample A	Dredged Material - Sample B	Dredged Material - Sample C
1	10	5	5	3
2	8	7	4	5
3	10	4	8	7
Mean ($\bar{x}$):	9.33 (93.3%)	5.33 (53.3%)	5.67 (56.7%)	5.00 (50.0%)

Step 2. Cochran's Test for Homogeneity of Variances of Survival Data

	Number of Survivors	
Treatment (t)	Mean ($\bar{x}$)	Variance(s^2)
Culture Water Control	9.33	1.32
Dredged Material - Sample A	5.33	2.34
Dredged Material - Sample B	5.67	4.33
Dredged Material - Sample C	5.00	4.00

$$C_{(cal.)} = \frac{s^2(max.)}{\Sigma s^2} = \frac{4.33}{11.99} = 0.36 \text{ ns,}$$

as compared to: $C_{(tab.)} = 0.77$ for $P = 0.05$, $k = 4$, and $v = 2$

Step 3. One-Way Parametric Analysis of Variance (ANOVA) of Survival Data

Source of Variation	df	Sum of Squares	Mean Square	$F_{(cal.)}$	
Treatment (Culture Water Control, Dredged Material - Sample A, Dredged Material - Sample B, Dredged Material - Sample C)	t-1=3	36.67	12.22	4.07 ns,	as compared to $F_{(tab.)}$ = 4.07 for P = 0.05, numerator df = 3, and denominator df = 8
Error	t(r-1)=8	24.00	3.00		
Total	tr-1=11	60.67			

Table 5. Analysis of survival data for the mysid shrimp, *Mysidopsis bahia*, exposed for 96 hr to culture water control and 100% suspended particulate phase of dredged material

Step 1. Survival Data (From Table B5)

		Number of Survivors			
Replicate (r)	Treatment (t):	Culture Water Control	Dredged Material - Sample A	Dredged Material - Sample B	Dredged Material - Sample C
1		9	7	9	8
2		10	5	8	2
3		9	8	6	5
	Mean ($\bar{x}$):	9.33 (93.3%)	6.67 (66.7%)	7.67 (76.7%)	5.00 (50.0%)

Step 2. Cochran's Test for Homogeneity of Variances of Survival Data

	Number of Survivors	
Treatment (t)	Mean ($\bar{x}$)	Variance(s^2)
Culture Water Control	9.33	0.34
Dredged Material - Sample A	6.67	2.34
Dredged Material - Sample B	7.67	2.34
Dredged Material - Sample C	5.00	9.00

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$$C_{(cal.)} = \frac{s^2(max.)}{\Sigma s^2} = \frac{9.00}{14.02} = 0.64 \text{ ns,}$$

as compared to: $C_{(tab.)} = 0.77$ for $P = 0.05$, $k = 4$, and $v = 2$

Step 3. One-Way Parametric Analysis of Variance (ANOVA) of Survival Data

Source of Variation	df	Sum of Squares	Mean Square	$F_{(cal.)}$	
Treatment (Culture Water Control, Dredged Material - Sample A, Dredged Material - Sample B, Dredged Material - Sample C)	t-1=3	29.67	9.89	2.83 ns,	as compared to $F_{(tab.)}$ = 4.07 for P = 0.05, numerator df = 3, and denominator df = 8
Error	t(r-1)=8	28.00	3.50		
Total	tr-1=11	57.57			

Survival data for the Atlantic silverside (Table 6) again exhibit no variation (survival was always 100%). Therefore, it can be immediately concluded that the suspended particulate phase is environmentally acceptable for oceanic disposal.

3.2 Solid Phase Bioassays

Solid phase bioassays, unlike liquid and suspended particulate phase tests, are analyzed almost exclusively according to statistical techniques. The concepts of preliminary comparisons of survival of control and test animals, LC50's and related confidence intervals, quantitative LPC's, and models of environmental fate of discharged material are not applicable.

Data generated by solid phase bioassays with the mysid shrimp, hard clam, and sandworm are presented in Table B7 (Appendix B). Mean survival rates of hard clams and sandworms exposed to dredged material were relatively high, i.e., 91.0-94.0% for the clam and 93.0-96.0% for the worm. However, mean survial rate of mysid shrimp exposed to the material was low - 12.0-27.0%. Mortality of shrimp appeared to be at least partly associated with fouling of animals by fine particulate matter.

Analysis of total (combined) survival data for the three species exposed for 10 days to control (reference) sediment and solid phase of dredged material is presented in Table 7. Survival of control animals was greater than 90%, thus allowing further evaluation of data. Data exhibited homogeneous variances (Cochran's test), thereby permitting a one-way parametric ANOVA to be performed with nontransformed

Table 6. Analysis of survival data for the Atlantic silverside, Menidia menidia, exposed for 96 hr to culture water control and 100% suspended particulate phase of dredged material

Step 1. Survival Data (From Table B6)

	Number of Survivors			
Treatment (t): Replicate (r)	Culture Water Control	Dredged Material - Sample A	Dredged Material - Sample B	Dredged Material - Sample C
1	10	10	10	10
2	10	10	10	10
3	10	10	10	10
Mean ($\bar{x}$):	10.00 (100.0%)	10.00 (100.0%)	10.00 (100.0%)	10.00 (100.0%)

Step 2. There are no differences in survival of animals exposed to culture water control and 100% suspended particulate phase of dredged material. Therefore, further statistical analysis is unnecessary.

Table 7. Analysis of total survival data for the mysid shrimp (*Neomysis americana*), hard clam (*Mercenaria mercenaria*), and sandworm (*Nereis virens*) exposed for 10 days to control (reference) sediment and solid phase of dredged material

Step 1. Total Survival Data (From Table 37)

		Total Number of Survivors			
Replicate (r)	Treatment (t):	Control (Reference) Sediment	Dredged Material - Sample A	Dredged Material - Sample B	Dredged Material - Sample C
1		54	44	46	40
2		56	42	38	36
3		55	41	40	45
4		57	45	43	38
5		56	44	36	4[illegible]
	Mean ($\bar{x}$):	55.6 (92.7%)	43.2 (72.0%)	41.0 (68.3%)	40.4 (67.3%)

Step 2. Cochran's Test for Homogeneity of Variances of Total Survival Data

	Number of Survivors	
Treatment (t)	Mean ($\bar{x}$)	Variance(s^2)
Control (Reference) Sediment	55.6	1.30
Dredged Material - Sample A	43.2	2.69
Dredged Material - Sample B	41.0	12.00
Dredged Material - Sample C	40.4	8.29

$$C_{(cal.)} = \frac{s^2(max.)}{\Sigma s^2} = \frac{12.00}{24.28} = 0.49 \text{ ns},$$

as compared to: $C_{(tab.)} = 0.63$ for $P = 0.05$, $k = 4$, and $v = 4$

Step 3. One-Way Parametric Analysis of Variance (ANOVA) of Total Survival Data

Source of Variation	df	Sum of Squares	Mean Square	$F_{(cal.)}$	
Treatment (Control sediment, Dredged Material - Sample A, Dredged Material - Sample B, Dredged Material - Sample C)	t-1=3	763.75	254.58	41.87**,	as compared to $F_{(tab.)}$ = 5.29 for P = 0.01, numerator df = 3, and denominator df = 16
Error	t(r-1)=16	97.20	6.08		
Total	tr-1=19	860.95			

Table 7. (Continued)

Step. 4 Student-Newman-Keuls' Multiple-Range Test for Identifying Source(s) of Significant Difference(s) in Total Survival Data

A. Ranking of Treatment Means ($\bar{x}$) From Lowest to Highest

(1)	(2)	(3)	(4)
Dredged Material, Sample C - 40.4	Dredged Material, Sample B - 41.0	Dredged Material, Sample A - 43.2	Control (Reference) Sediment - 55.6

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B. Comparison of Mean for Control (Reference) Sediment with Means for Dredged Material

Comparison of Means	Difference Between Means	
(4) versus (1)	55.6 - 40.4 = 15.2**,	as compared to LSD (least significant difference) = 5.71 for P = 0.01, $s_{\bar{x}}$ = 1.10, and K =4
(4) versus (2)	55.6 - 41.0 = 14.6**,	as compared to LSD = 5.26 for P = 0.01, $s_{\bar{x}}$ = 1.10, and K =3
(4) versus (3)	55.6 - 43.2 = 12.4**,	as compared to LSD = 4.54 for P = 0.01, $s_{\bar{x}}$ = 1.10, and K =2

data. The ANOVA indicates that survival of animals exposed to control sediment and dredged material is significantly different at P = 0.01. A subsequent test (Student-Newman-Keuls' multiple-range test) demonstrates that a source of this significant difference in survival is differences between animals exposed to control sediment and all samples of dredged material. In addition, the mean magnitude of each of these differences is greater than 10%. Therefore, it is concluded that the solid phase is ecologically unacceptable for discharge to oceanic waters.[1]

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[1] Paragraph 37, page F17, Appendix F of the EPA/COE manual for dredged material (U.S. EPA/U.S. COE, 1977) states that a solid phase has "real potential for causing environmentally unacceptable impacts on benthic organisms [only if] difference in mean survival between animals in the control and test sediments is statistically significant <u>and</u> [emphasis added] greater than 10 percent."

4. DISCUSSION

Results of the liquid phase bioassays with the copepod and the suspended particulate phase bioassays with the copepod and mysid shrimp demonstrate that a one-way parametric ANOVA sometimes does not indicate statistically significant differences (P = 0.05) in survival of animals exposed to culture water control and 100% liquid/suspended particulate phase of dredged material even when the differences appear to be substantial (in the case of the suspended particulate phase tests, survival of animals in 100% phase was almost low enough to allow calculation of LC50's). Several statistical techniques can be employed to increase the power (ability) of the ANOVA to detect real differences in survival between control and test animals, e.g., more than three replicates (samples) can be employed per treatment, criterion for declaring a difference to be significant can be changed from P = 0.05 to P = 0.10, and/or multiple-range or other appropriate tests can be used to compare control versus test survival even if the ANOVA does not signal the presence of such differences. Such statistical refinements, while desirable, would not alter the conclusions reached in this investigation concerning the ecological acceptability of the liquid and suspended particulate phases for oceanic disposal since, in all cases, the minimum LPC's for a phase are 1% (0.01 X 100% phase [the minimum estimate of the LC50's]) and the environmental concentration of a phase after intitial mixing is substantially less than the 1% value.

The most critical result of the solid phase bioassays is the low survival rate experienced by mysid shrimp exposed to dredged material. It is this low survival rate that, even when masked by the relatively high survival rate exhibited by the hard clam and sandworm, is the basis of the significant

(P = 0.01) and large (>10%) differences in survival between control and test animals and, consequently, the conclusion that the dredged material is ecologically unacceptable for discharge to oceanic waters. It is likely that the poor survival of mysid shrimp is, in great part, attributable to fine particulate matter in the dredged material. For similar reasons, poor survival may be experienced by shrimp exposed to sediment from the vicinity of the proposed disposal site. In this eventuality, oceanic disposal of the dredged material would be judged to be ecologically acceptable. Therefore, we recommend that solid phase tests of the dredged material be conducted with a disposal-site-sediment control as well as a "culture-sediment" control.

We additionally recommend that future dredged-material evaluations be conducted with a large species, e.g., the grass shrimp, Palaemonetes sp., being substituted for the mysid shrimp in solid phase bioassays. Such a substitution would minimize the impact of particle size of sediments on test results and would allow an efficient assessment of the potential for bioaccumulation of constitutents of dredged material. Also, it is more scientifically correct to analyze all results of solid phase bioassays according to species than to perform the analyses for "grouped" species.

5. REFERENCES

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U.S. Environmental Protection Agency/U.S. Corps of Engineers. 1977. Ecological evaluation of proposed discharge of dredged material into ocean waters. Implementation Manual for Section 103 of PL-92-532. Environmental Effects Laboratory, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. Second printing, April 1978.

APPENDIX A

LABORATORY PROCEDURES FOR PREPARING DREDGED MATERIAL AND CONDUCTING BIOASSAYS[1]

Procedure	Date/Time of Implementation of Procedure	Certifications of Performance of Procedure		
		Technician	Laboratory Director	Group Director
1. Store 3 samples of dredged sediment (DS) and 1 sample of reference sediment (RS) at 2-4° C in four separate containers. Mix sediment in each container as thoroughly as possible.	DS 3/29/79 1:00pm RS 4/2/79 3:00pm	 "	 "	 "

Solid-phase Bioassays

Bioassays must be initiated by April 12, 1979 (2 weeks after March 29, 1979, date of dredged sediment collection).
Maintain dissolved oxygen in aquaria at >4 ppm.
Cover aquaria to prevent salinity changes.

2. Remove RS from storage and wet sieve through 1-mm mesh into single container (Use minimum volume of artificial sea water [ASW] of salinity of 30 ppt for seiving purposes.) Place nonliving material remaining on sieve in container.	4/9 9:00am	"	"	"
3. Mix RS in container and allow to settle for 6 hr.	4/9 9:30am	"	"	"
4. Decant ASW and mix RS as thoroughly as possible.	4/9 3:30pm	"	"	"
5. Assign treatments (3 DS samples), control (1 RS sample), and replicates (5 r per treatment and control) to aquaria.	4/9 10:30am	"	"	"
6. Randomly position aquaria (20) in environmental chamber maintained at 20±1°C.	4/9 10:30am	"	"	"

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[1] This document is a copy of the work sheet that was used during the investigation. The document differs from the work sheet in that dates/times appear in typed form and certifications were added at a single time after the dates/times were typed.

Procedure	Date/Time of Implementation of Procedure	Certifications of Performance of Procedure		
		Technician	Laboratory Director	Group Director
7. Partially fill aquaria with ASW.	4/9 3:00pm	"	"	"
8. Place 30 mm of RS in each aquaria. Fill 1st aquarium to ∿10 mm, then 2nd aquarium to ∿10 mm, ..., and finally 20th aquarium to ∿10 mm. Repeat sequence until aquaria are filled to ∿20 mm. Repeat sequence again until aquaria are filled to ∿30 mm. This procedure will help to ensure that RS in all aquaria is homogeneous. Store remaining RS at 2-4°C for later use.	4/9 3:30-5:30pm	"	"	"
9. Replace ASW 1 hr after RS has been added to aquaria. Do not disturb sediment during replacement.	4/9 6:30-7:00pm	"	"	"
10. Select 400 hard clams from holding tanks and randomly distribute into 20 finger bowls. Follow same procedure for sandworms.	4/9 7:30pm	"	"	"
11. Randomly distribute contents of each set of 20 finger bowls into 20 aquaria.	4/9 8:00pm	"	"	"
12. If necessary, replace 75% of ASW 24 hr after animals are introduced into aquaria.	Not necessary	"	"	"
13. Acclimate animals for 48 hr. At end of this time period, remove dead animals and replace with live animals.	4/9 - 4/11	"	"	"

Laboratory Procedures (Continued)

Procedure	Date/Time of Implementation of Procedure	Certifications of Performance of Procedure		
		Technician	Laboratory Director	Group Director
14. During acclimation period, remove appropriate volumes of 3 samples of DS from storage and wet-sieve each sample through 1-mm mesh into 3 separate containers. Use minimum volume of ASW for seiving purposes. Place nonliving material remaining on sieves in containers.	4/11	*	*	*
15. Mix material in containers and allow to settle for 6 hr.	4/11	*	*	*
16. Decant ASW and mix DS as thoroughly as possible.	4/11 2:30-5:00pm	*	*	*
17. Place 15 mm of appropriate sample of DS in each treatment aquarium. Employ basic strategy identified in Step 8.	4/11 4:30-6:30pm	*	*	*
18. Remove remaining RS from storage. Warm to test temperature (20+1°C). Add 15 mm to each reference aquarium. Employ basic strategy identified in Step 8.	4/11 12:00pm	*	*	*
19. Replace 75% of ASW 1 hr after addition of DS and final addition of RS.	4/11 7:30-8:30pm	*	*	*
20. Select 400 mysid shrimp from holding tank and randomly distribute into 20 finger bowls.	4/11 8:30pm	*	*	*
21. Randomly distribute contents of finger bowls into 20 aquaria.	4/11 9:00pm	*	*	*

Laboratory Procedures (Continued)

Procedure	Date/Time of Implementation of Procedure	Certifications of Performance of Procedure		
		Technician	Laboratory Director	Group Director
22. Perform the following activities:				
<u>Every day after introduction of mysid shrimp into aquaria</u>				
● Record salinity, temperature, dissolved oxygen and pH in each aquarium (record in log book)	<u>Day 0 4/11 9:00pm</u>			
	<u>Day 1 4/12 6:00pm</u>	*	*	*
	<u>Day 2 4/13 4:00pm</u>	*	*	*
	<u>Day 3 4/14 2:00pm</u>	*	*	*
● Record obvious mortality, formation of tubes or burrows, and unusual behavior patterns of animals (record in log book)	<u>Day 4 4/15 1:00pm</u>	*	*	*
	<u>Day 5 4/16 2:00pm</u>	*	*	*
	<u>Day 6 4/17 3:00pm</u>	*	*	*
	<u>Day 7 4/18 2:00pm</u>	*	*	*
	<u>Day 8 4/19 3:00pm</u>	*	*	*
	<u>Day 9 4/20 3:00pm</u>	*	*	*
	<u>Day 10 4/21 10:00am</u>	*	*	*
<u>Every 2 days after addition of DS and final addition of RS into aquaria</u>				
● Replace 75% of ASW	<u>Day 2 4/13</u>	*	*	*
	<u>Day 4 4/15</u>	*	*	*
	<u>Day 6 4/17</u>	*	*	*
	<u>Day 8 4/19</u>	*	*	*
23. At end of 10-day testing period, sieve sediment in each aquarium through 0.5-mm screen. Count live animals. Note sublethal responses.	<u>4/21 10:00am-4:00pm</u>	*	*	*

Laboratory Procedures (Continued)

Procedure	Date/Time of Implementation of Procedure	Certifications of Performance of Procedure		
		Technician	Laboratory Director	Group Director
	Suspended-Particulate-Phase Bioassays			
	Bioassays must be initiated by April 12, 1979 (2 weeks after March 29, 1979, date of dredged-sediment collection). Maintain 14-hr light photoperiod with cool-white fluorescent bulbs mounted approximately 0.5-1 m above tops of aquaria. Maintain dissolved oxygen in aquaria at >4 ppm. Cover aquaria to prevent salinity changes.			
24. Prepare 3 suspended-particulate-phase samples. Follow procedures in Appendix B of EPA/COE Implementation Manual. In particular:				
● Clean laboratory glassware thoroughly	3/29	"	"	"
● Remove from storage appropriate volume of each sample of DS. Mix as thoroughly as possible. Combine with ASW in 1:4 ratio by volume. Shake on automatic shaker for 30 min at 100 oscillations/min. Do not allow dissolved oxygen to reach zero. Settle for 1 hr. Collect supernatant. Store initial volumes of suspended particulate phase at 2-4°C. Begin suspended-particulate-phase bioassays for each tested species (copepod, mysid shrimp, and silverside) as soon as sufficient suspended particulate phase is prepared. Combine all volumes prior to use in bioassays.	4/3 - 4/10	"	"	"
25. For each species tested assign treatments (10%, 50%, 100% suspended-particulate phase), control (100% ASW), and replicates (3 r per treatment and control) to aquaria/crystallizing dishes.	Copepod 4/10 Silverside 4/6,4/10 Mysid shrimp 4/10	"	"	"

Laboratory Procedures (Continued)

Procedure	Date/Time of Implementation of Procedure	Certifications of Performance of Procedure		
		Technician	Laboratory Director	Group Director
26. For each species tested, randomly position aquaria/crystallizing dishes (30) in environmental chamber maintained at 20±1°C.	Copepod 4/10 Silverside 4/6,4/10 Mysid shrimp 4/10	"	"	"
27. Establish appropriate concentrations of suspended particulate phase and control water in aquaria/crystallizing dishes.	Copepod 4/10 Silverside 4/6,4/10 Mysid shrimp 4/10	"	"	"
28. Randomly distribute 10 individuals of each species into each aquarium/crystallizing dish. Cover aquaria/dishes.	Copepod 4/10 Silverside 4/6,4/10 Mysid shrimp 4/10	"	"	"
29. Monitor the following variables:				
<u>At start and end of 96-hr testing period</u>				
● Salinity, temperature, dissolved oxygen, and pH in each aquarium/crystallizing dish (record in log book) — Start of test	Copepod 4/10 Silverside 4/6,4/10 Mysid shrimp 4/10	"	"	"
End of test	Copepod 4/14 Silverside 4/10,4/14 Mysid shrimp 4/14	"	"	"
<u>During 96-hr testing period</u>				
● Survival (record in log book) — Start of test (0 hr)	X	"	"	"
4 hr	X	"	"	"
8 hr	X	"	"	"
24 hr	X	"	"	"
48 hr	X	"	"	"
72 hr	X	"	"	"
End of test (96 hr)	X	"	"	

Laboratory Procedures (Continued)

Procedure	Date/Time of Implementation of Procedure	Certifications of Performance of Procedure		
		Technician	Laboratory Director	Group Director
	Liquid-Phase Bioassays			
	Bioassays must be initiated by April 12, 1979 (2 weeks after March 29, 1979, date of dredged-sediment collection). Maintain 14-hr light photoperiod with cool-white fluorescent bulbs mounted approximately 0.5-1 m above tops of aquaria. Maintain dissolved oxygen in aquaria at >4 ppm. Cover aquaria to prevent salinity changes.			
30. Prepare 3 liquid-phase samples. Follow procedures in Appendix B of EPA/COE Implementation Manual. In particular:				
• Clean laboratory glassware, filtration equipment, and filters (0.45 μ)	4/2	"	"	"
• Remove from storage appropriate volume of each sample of DS. Mix as thoroughly as possible. Combine with ASW in 1:4 ratio by volume. Shake on automatic shaker for 30 min at 100 oscillations/min. Do not allow dissolved oxygen to reach zero. Settle for 1 hr. Collect supernatant and filter (centrifugation may be employed if needed to expedite filtration process). Discard first 50 ml of filtrate passed through each filter. Collect remainder of filtrate. Store initial volumes of liquid phase at 2-4°C. Begin liquid phase bioassays for each tested species (copepod, mysid shrimp, and silverside) as soon as sufficient liquid phase is prepared. Combine all volumes prior to use in bioassays.	4/3 - 4/10	"	"	"
31. For each species tested, assign treatments (10%, 50%, 100% liquid phase), control (100% ASW), and replicates (3 r per treatment and control) to aquaria/crystallizing dishes.	Copepod 4/10 Silverside 4/6,4/10 Mysid shrimp 4/10	"	"	"

Laboratory Procedures (Continued)

Procedure		Date/Time of Implementation of Procedure	Certifications of Performance of Procedure		
			Technician	Laboratory Director	Group Director
32. For each species tested, randomly position aquaria/crystallizing dishes (30) in environmental chamber maintained at 20±1°C.		Copepod 4/10 Silverside 4/6,4/10 Mysid shrimp 4/10	"	"	"
33. Establish appropriate concentrations of liquid phase and control water in aquari/crystallizing dishes.		Copepod 4/10 Silverside 4/6,4/10 Mysid shrimp 4/10	"	"	"
34. Randomly distribute 10 individuals of each species into each aquarium/crystallizing dish. Cover aquaria/dishes.		Copepod 4/10 Silverside 4/6,4/10 Mysid shrimp 4/10	"	"	"
35. Monitor the following variables:					
<u>At start and end of 96-hr testing period</u>					
● Salinity, temperature, dissolved oxygen, and pH in each aquarium/crystallizing dish (record in log book).	Start of test	Copepod 4/10 Silverside 4/6,4/10 Mysid shrimp 4/10	"	"	"
	End of test	Copepod 4/14 Silverside 4/10,4/14 Mysid shrimp 4/14	"	"	"
<u>During 96-hr testing period</u>					
● Survival (record in log book)	Start of test (0 hr)	X	"	"	"
	4 hr	X	"	"	"
	8 hr	X	"	"	"
	24 hr	X	"	"	"
	48 hr	X	"	"	"
	72 hr	X	"	"	"
	End of test (96 hr)	X	"	"	"

APPENDIX B

Raw bioassay-related data are presented according to the following sequence - liquid phase bioassays, suspended particulate phase bioassays, and solid phase bioassays.

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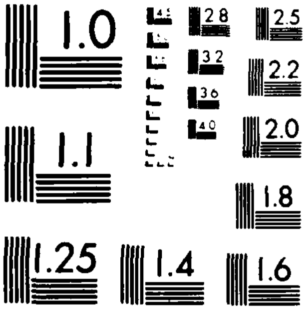

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

B.1 Liquid Phase Bioassays

Table B1. Results of liquid phase bioassays with the copepod, *Acartia tonsa*[a]

Treatment (Exposure Condition)	Replicate (r)	Number of Survivors						
		0 hr	4 hr	8 hr	24 hr	48 hr	72 hr	96 hr
Culture water control	1	10	10	10	10	9	9	9
	2	10	10	10	9	8	8	8
	3	10	10	10	10	10	10	10
	Mean ($\bar{x}$):							9.00 (90.0%)
10% liquid phase								
Dredged material - Sample A	1	10	10	10	10	9	9	9
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	9	8
Dredged material - Sample B	1	10	10	10	10	10	10	9
	2	10	10	10	9	9	9	9
	3	10	10	10	9	9	8	8
Dredged material - Sample C	1	10	10	10	10	10	10	10
	2	10	10	10	10	8	8	7
	3	10	10	10	10	10	10	9
50% liquid phase								
Dredged material - Sample A	1	10	10	10	9	9	9	8
	2	10	10	10	10	10	10	10
	3	10	10	9	9	8	8	8
Dredged material - Sample B	1	10	10	10	10	9	9	9
	2	10	10	10	9	8	8	7
	3	10	10	10	9	9	9	9
Dredged material - Sample C	1	10	10	10	10	10	10	10
	2	10	10	10	9	9	9	9
	3	10	10	10	10	9	8	8

Table B1. (Continued)

Treatment (Exposure Condition)	Replicate (r)	Number of Survivors						
		0 hr	4 hr	8 hr	24 hr	48 hr	72 hr	96 hr
100% liquid phase								
Dredged	1	10	10	10	10	5	5	4
material -	2	10	10	9	9	8	8	8
Sample A	3	10	10	10	8	6	6	4
	Mean ($\bar{x}$):							5.33 (53.3%)
Dredged	1	10	10	10	9	7	7	5
material -	2	10	10	10	8	6	5	5
Sample B	3	10	10	9	9	9	8	8
	Mean ($\bar{x}$):							6.00 (60.0%)
Dredged	1	10	10	9	5	3	3	3
material -	2	10	10	10	10	10	9	9
Sample C	3	10	10	10	9	7	6	6
	Mean ($\bar{x}$):							6.00 (60.0%)

---

[a] Bioassays were conducted at 20±1°C in 200-ml crystallizing dishes. A 14-hr light (~1200 μw/cm^2 at surface of dishes) and 10-hr dark photoperiod was maintained with cool-white fluorescent bulbs. Test media were not aerated. Dissolved oxygen concentrations in the media ranged from 6.0-6.7 ml/l at the start of the bioassays to 5.9-6.6 ml/l at the end of the tests. pH varied from 7.6-7.9 (start of bioassays) to 7.4-7.9 (end of bioassays). Salinity was maintained at 30-31 ppt.

Table B2. Results of liquid phase bioassays with the mysid shrimp, *Mysidopsis bahia*[a]

Treatment (Exposure Condition)	Replicate (r)	Number of Survivors						
		0 hr	4 hr	8 hr	24 hr	48 hr	72 hr	96 hr
Culture water control	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	9
	Mean ($\bar{x}$):							9.67 (96.7%)
10% liquid phase								
Dredged material - Sample A	1	10	10	10	9	9	9	9
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
Dredged material - Sample B	1	10	10	10	10	10	9	9
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
Dredged material - Sample C	1	10	10	9	9	9	9	9
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	9	9
50% liquid phase								
Dredged material - Sample A	1	10	10	10	10	10	10	9
	2	10	10	10	10	10	10	10
	3	10	10	10	9	9	9	9
Dredged material - Sample B	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
Dredged material - Sample C	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10

Table B2. (Continued)

Treatment (Exposure Condition)	Replicate (r)	Number of Survivors						
		0 hr	4 hr	8 hr	24 hr	48 hr	72 hr	96 hr
<u>100% liquid phase</u>								
Dredged material - Sample A	1	10	10	10	10	10	10	10
	2	10	10	10	10	9	9	9
	3	10	10	10	10	10	10	10
	Mean ($\bar{x}$):							9.67 (96.7%)
Dredged material - Sample B	1	10	10	10	10	10	9	9
	2	10	10	10	9	9	9	9
	3	10	10	10	10	10	10	10
	Mean ($\bar{x}$):							9.33 (93.3%)
Dredged material - Sample C	1	10	10	10	10	9	8	5
	2	10	10	10	9	9	8	8
	3	10	10	10	10	8	6	6
	Mean ($\bar{x}$):							6.33 (63.3%)

---

[a] Bioassays were conducted at 20±1°C in 200-ml crystallizing dishes. Animals were fed live 48-hr-old *Artemia* (brine shrimp) nauplii at a rate of ~1 ml of culture/dish/day. A 14-hr light (~1200 μw/cm^2 at surface of dishes) and 10-hr dark photoperiod was maintained with cool-white fluorescent bulbs. Test media were not aerated. Dissolved oxygen concentrations in the media ranged from 6.2-6.9 ml/l at the start of the bioassays to 6.0-6.6 ml/l at the end of the tests. pH varied from 7.7-7.9 (start of bioassays) to 7.4-7.8 (end of bioassays). Salinity was maintained at 30-31 ppt.

Table B3. Results of liquid phase bioassays with the Atlantic silverside, *Menidia menidia*[a]

Treatment (Exposure Condition)	Replicate (r)	Number of Survivors							
		0 hr	4 hr	8 hr	24 hr	48 hr	72 hr	96 hr	
Culture water control	1	10	10	10	10	10	10	10	
	2	10	10	10	10	10	10	10	
	3	10	10	10	10	10	10	10	
	Mean ($\bar{x}$):							10.0	(100.0%)
10% liquid phase									
Dredged material - Sample A	1	10	10	10	10	10	10	10	
	2	10	10	10	10	10	10	10	
	3	10	10	10	10	10	10	10	
Dredged material - Sample B	1	10	10	10	10	10	10	10	
	2	10	10	10	10	10	10	10	
	3	10	10	10	10	10	10	10	
Dredged material - Sample C	1	10	10	10	10	10	10	10	
	2	10	10	10	10	10	10	10	
	3	10	10	10	10	10	10	10	
50% liquid phase									
Dredged material - Sample A	1	10	10	10	10	10	10	10	
	2	10	10	10	10	10	10	10	
	3	10	10	10	10	10	10	10	
Dredged material - Sample B	1	10	10	10	10	10	10	10	
	2	10	10	10	10	10	10	10	
	3	10	10	10	10	10	10	10	
Dredged material - Sample C	1	10	10	10	10	10	10	10	
	2	10	10	10	10	9	9	9	
	3	10	10	10	10	10	10	10	

Table B3. (Continued)

Treatment (Exposure Condition)	Replicate (r)	Number of Survivors						
		0 hr	4 hr	8 hr	24 hr	48 hr	72 hr	96 hr
<u>100% liquid phase</u>								
Dredged material - Sample A	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
	Mean ($\bar{x}$):							10.0 (100.0%)
Dredged material - Sample B	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
	Mean ($\bar{x}$):							10.0 (100.0%)
Dredged material - Sample C	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
	Mean ($\bar{x}$):							10.0 (100.0%)

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[a] Bioassays were conducted at 20±1°C in 19-l aquaria. A 14-hr light ($\sim$1200 μw/cm^2 at surface of aquaria) and 10-hr dark photoperiod was maintained with cool-white fluorescent bulbs. Test media were not aerated. Dissolved oxygen concentrations in the media ranged from 6.0-6.9 ml/l at the start of the bioassays to 5.0-6.0 ml/l at the end of the tests. pH varied from 7.6-8.0 (start of bioassays) to 7.4-7.9 (end of bioassays). Salinity was maintained at 30-31 ppt.

B.2 Suspended Particulate Phase Bioassays

Table B4. Results of suspended particulate phase bioassays with the copepod, *Arcartia tonsa*[a]

Treatment (Exposure Condition)	Replicate (r)	Number of Survivors						
		0 hr	4 hr	8 hr	24 hr	48 hr	72 hr	96 hr
Culture water control	1	10	10	10	10	10	10	10
	2	10	10	9	9	9	8	8
	3	10	10	10	10	10	10	10
	Mean $(\bar{x})$:							9.33 (93.3%)
10% suspended particulate phase								
Dredged material - Sample A	1	10	10	9	9	8	8	8
	2	10	10	10	10	10	10	10
	3	10	10	9	9	8	7	7
Dredged material - Sample B	1	10	10	10	10	10	9	9
	2	10	10	10	10	10	10	9
	3	10	10	10	9	8	8	7
Dredged material - Sample C	1	10	10	10	9	9	8	8
	2	10	10	10	10	9	9	9
	3	10	10	10	10	10	10	10
50% suspended particulate phase								
Dredged material - Sample A	1	10	10	10	10	10	9	9
	2	10	10	10	10	10	10	10
	3	10	10	10	9	9	9	9
Dredged material - Sample B	1	10	10	10	10	9	8	8
	2	10	10	10	10	10	9	9
	3	10	10	10	8	8	8	8
Dredged material - Sample C	1	10	10	10	10	10	10	10
	2	10	10	9	9	9	8	8
	3	10	10	10	10	9	9	9

Table B4. (Continued)

Treatment (Exposure Condition)	Replicate (r)	Number of Survivors						
		0 hr	4 hr	8 hr	24 hr	48 hr	72 hr	96 hr
100% suspended particulate phase								
Dredged material - Sample A	1	10	10	10	9	7	5	5
	2	10	10	9	8	8	8	7
	3	10	10	10	10	8	6	4
	Mean ($\bar{x}$):							5.33 (53.3%)
Dredged material - Sample B	1	10	10	10	10	9	8	5
	2	10	10	10	9	6	4	4
	3	10	10	10	10	9	8	8
	Mean ($\bar{x}$):							5.67 (56.7%)
Dredged material - Sample C	1	10	10	9	8	5	3	3
	2	10	10	10	10	9	5	5
	3	10	10	9	7	7	7	7
	Mean ($\bar{x}$):							5.00 (50.0%)

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[a] Bioassays were conducted at 20 ± 1°C in 200-ml crystallizing dishes. A 14-hr light ($\sim$1200 μw/cm^2 at surface of dishes) and 10-hr dark photoperiod was maintained with cool-white fluorescent bulbs. Test media were not aerated. Dissolved oxygen concentrations in the media ranged from 6.1-6.9 ml/l at the start of the bioassays to 5.8-6.6 ml/l at the end of the tests. pH varied from 7.7-7.9 (start of bioassays) to 7.4-7.9 (end of bioassays). Salinity was maintained at 30-31 ppt.

Table B5. Results of suspended particulate phase bioassays with the mysid shrimp, *Mysidopsis bahia*[a]

Treatment (Exposure Condition)	Replicate (r)	Number of Survivors						
		0 hr	4 hr	8 hr	24 hr	48 hr	72 hr	96 hr
Culture water control	1	10	10	10	10	9	9	9
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	9
	Mean ($\bar{x}$):							9.33 (93.3%)
10% suspended particulate phase								
Dredged material - Sample A	1	10	10	10	10	10	9	9
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
Dredged material - Sample B	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
Dredged material - Sample C	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
50% suspended particulate phase								
Dredged material - Sample A	1	10	10	10	9	9	9	9
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
Dredged material - Sample B	1	10	10	10	10	10	9	7
	2	10	10	10	10	10	10	10
	3	10	10	10	10	9	9	9
Dredged material - Sample C	1	10	10	10	10	9	9	9
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	9

Table B5. (Continued)

Treatment (Exposure Condition)	Replicate (r)	Number of Survivors						
		0 hr	4 hr	8 hr	24 hr	48 hr	72 hr	96 hr
<u>100% suspended particulate phase</u>								
Dredged material - Sample A	1	10	10	10	10	9	7	7
	2	10	10	10	8	6	6	5
	3	10	10	10	10	10	9	8
	Mean ($\bar{x}$):							6.67 (66.7%)
Dredged material - Sample B	1	10	10	10	10	10	9	9
	2	10	10	10	9	9	9	8
	3	10	10	10	10	8	6	6
	Mean ($\bar{x}$):							7.67 (76.7%)
Dredged material - Sample C	1	10	10	10	9	9	8	8
	2	10	10	10	6	4	4	2
	3	10	10	10	8	5	5	5
	Mean ($\bar{x}$):							5.00 (50.0%)

---

[a] Bioassays were conducted at 20±1°C in 200-ml crystallizing dishes. Animals were fed live 48-hr-old <u>Artemia</u> (brine shrimp) nauplii at a rate of ~1 ml of culture/dish/day. A 14-hr light (~1200 µm/cm^2 at surface of dishes) and 10-hr dark photoperiod was maintained with cool-white fluorescent bulbs. Test media were not aerated. Dissolved oxygen concentrations in the media ranged from 6.5-6.9 ml/l at the start of the bioassays to 6.0-6.8 ml/l at the end of the tests. pH varied from 7.7-7.9 (start of bioassays) to 7.4-7.9 (end of bioassays). Salinity was maintained at 30-31 ppt.

Table B6. Results of suspended particulate phase bioassays with the Atlantic silverside, *Menidia menidia*[a]

Treatment (Exposure Condition)	Replicate (r)	Number of Survivors						
		0 hr	4 hr	8 hr	24 hr	48 hr	72 hr	96 hr
Culture water control	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
	Mean ($\bar{x}$):							10.0 (100.0%)
10% suspended particulate phase								
Dredged material - Sample A	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
Dredged material - Sample B	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
Dredged material - Sample C	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
50% suspended particulate phase								
Dredged material - Sample A	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
Dredged material - Sample B	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
Dredged material - Sample C	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10

Table B6. (Continued)

Treatment (Exposure Condition)	Replicate (r)	Number of Survivors						
		0 hr	4 hr	8 hr	24 hr	48 hr	72 hr	96 hr
100% suspended particulate phase								
Dredged material - Sample A	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
	Mean ($\bar{x}$):							10.0 (100.0%)
Dredged material - Sample B	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
	Mean ($\bar{x}$):							10.0 (100.0%)
Dredged material - Sample C	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
	Mean ($\bar{x}$):							10.0 (100.0%)

[a] Bioassays were conducted at 20±1°C in 19-l aquaria. A 14-hr light (~1200 μw/cm^2 at surface of aquaria) and 10-hr dark photoperiod was maintained with cool-white fluorescent bulbs. Test media were not aerated. Dissolved oxygen concentrations in the media ranged from 6.0-7.1 ml/l at the start of the bioassays to 5.0-5.9 ml/l at the end of the tests. pH varied from 7.7-8.0 (start of bioassays) to 7.3-7.9 (end of bioassays). Salinity was maintained at 30-32 ppt.

B.3 Solid Phase Bioassays

Table B7. Results of solid phase bioassays with the mysid shrimp (Neomysis americana), hard clam (Mercenaria mercenaria), and sandworm (Nereis virens)[a]

Replicate (r)	Control (Reference) Sediment				Dredged Material - Sample A				Dredged Material - Sample B				Dredged Material - Sample C			
Treatment (t):	Mysid Shrimp[d]	Hard Clam	Sandworm	Total	Mysid Shrimp[d]	Hard Clam	Sandworm	Total	Mysid Shrimp[d]	Hard Clam	Sandworm	Total	Mysid Shrimp[d]	Hard Clam	Sandworm	Total
1	18	17	19	54	5	19	20	44	8	18	20	46	1	20	19	40
2	20	18	18	56	7	16	19	42	4	16	18	38	0	19	19	38
3	16	19	20	55	2	20	19	41	3	18	19	40	5	20	20	45
4	19	20	18	57	7	20	18	45	6	20	17	43	2	17	19	38
5	18	19	19	56	6	19	19	44	0	19	19	38	4	18	19	41
Mean ($\bar{x}$)	18.2	18.6	18.8	55.6	5.4	18.8	19.0	43.2	4.2	18.2	18.6	41.0	2.4	18.8	19.2	40.4
(%)	(91.0)	(93.0)	(94.0)	(92.7)	(27.0)	(94.0)	(95.0)	(72.0)	(21.0)	(91.0)	(93.0)	(68.3)	(12.0)	(94.0)	(96.0)	(67.3)

Number of Survivors[b,c]

[a] Bioassays were conducted at 20±1° C in 38-l aquaria. Animals were exposed to each replication of a treatment in a single aquarium. Water in aquaria was exchanged by the replacement, as compared to the flow through method. Mysid shrimp were fed live 48-hr-old Artemia (brine shrimp) nauplii at a rate of approximately 10 ml of culture/aquarium/day. A 14-hour light and 10-hr dark photoperiod was maintained with cool-white fluorescent bulbs. Water in aquaria was aerated. Minimum recorded values of dissolved oxygen and pH during the bioassays were 5.7 ml/l and 7.3, respectively. Salinity was maintained at 30 ppt.

[b] Twenty (20) individuals of each species were initially exposed to each replication of a treatment. Thus, a total of 60 animals were employed in each aquarium.

[c] In addition to monitoring survival of all species, burrowing behavior of sandworms was noted at [illegible] day intervals. No differences were observed among aquaria.

[d] Mortality of mysid shrimp was qualitatively monitored during the bioassays by noting dead organisms on the surface of the sediment. Most mortality occurred during the first 5 days of the bioassays. Mortality of shrimp exposed to dredged material appeared to be at least partly associated with fouling of animals by fine particulate matter.

SECTION C

ECOLOGICAL EVALUATION OF PROPOSED OCEANIC DISCHARGE OF DREDGED MATERIAL FROM ISLAND END RIVER, CHELSEA, MASSACHUSETTS

-- Supplemental Report --

OCTOBER 1979

ACKNOWLEDGEMENTS

This evaluation was written by Dr. Curt D. Rose, Director, Aquatic Hazard Evaluation Division, Energy Resources Company Inc. (ERCO). Mr. Robert L. Boeri, Aquatic Toxicologist, ERCO, and Mr. Timothy J. Ward, Director, Toxicology Laboratory, ERCO, observed collection of dredged sediment, control sediment, and reference sediment. Mr. Boeri, with the supervision of Mr. Ward, prepared sediments and water for bioassays (toxicity tests) and conducted bioassays.

SUMMARY

The proposed oceanic discharge of dredged material from Island End River, Chelsea, Massachusetts, to the Boston "Foul Area" is ecologically acceptable as judged by the bioassay-related criterion employed in this evaluation. Total (combined) survival of mysid shrimp (Neomysis americana), the hard clam (Mercenaria mercenaria), and sandworm (Nereis virens) exposed for 10 days to reference (disposal-site) sediment and the solid phase of a composite sample of dredged material collected from three sampling stations was not significantly different ($\alpha = 0.05$).

TABLE OF CONTENTS

1. INTRODUCTION

The major objective of this evaluation is to assess the ecological acceptability of the proposed oceanic discharge of dredged material from Island End River, Chelsea, Massachusetts (Figure 1), to the Boston "Foul Area." The evaluation addresses only the solid phase of the dredged material. An earlier investigation (Contract No. DACW33-79-M-0778) was conducted with liquid, suspended particulate, and solid phases of the material. The previous investigation indicated no unacceptable ecological hazard associated with the two aqueous phases and an unacceptable danger related to the solid phase. However, previous solid-phase testing was not performed with reference sediment collected from the proposed disposal site. Therefore, a definitive conclusion regarding the ecological acceptability of the solid phase could not be reached.

This evaluation consists of four principal sections in addition to the Introduction. The first section, which precedes the Introduction, summarizes the ecological acceptability of the proposed discharge operation. The second section reviews the methods and materials employed in the evaluation. The third section presents important results of the evaluation. The last section lists references cited in the evaluation.

The evaluation contains two appendices. Appendix A details laboratory procedures employed for preparing dredged material and conducting bioassays. The appendix also serves as a quality-control document. Appendix B contains all unanalyzed bioassay-related data. Only data directly relevant to the ecological evaluation of the proposed discharge operation are presented in the main body of the evaluation.

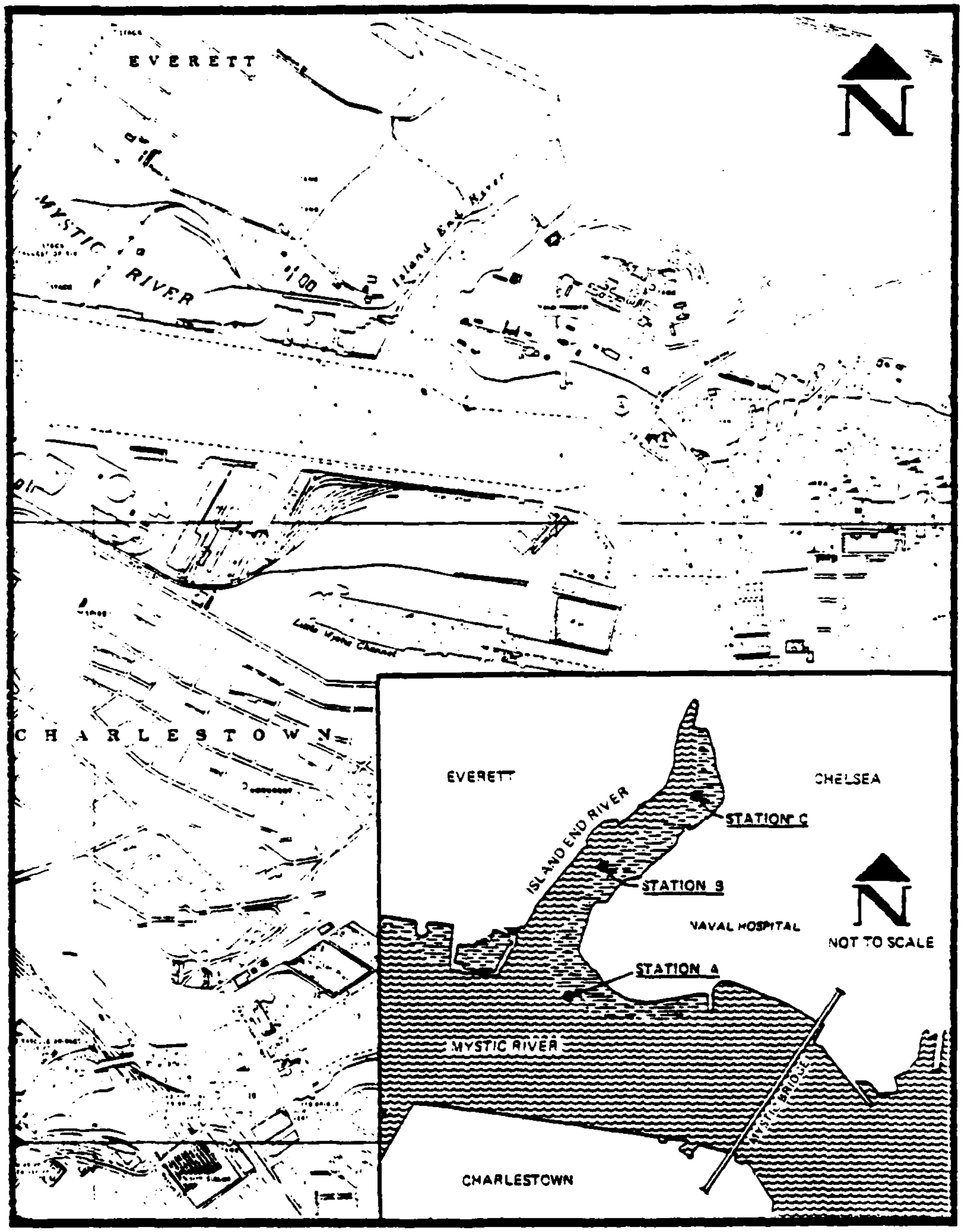

Figure 1. Location of dredging site. Sampling stations for dredged material are schematically depicted in inset.

2. METHODS AND MATERIALS[1]

Dredged material was collected from three sampling stations in Island End River (Figure 1) during 1000-1200 on September 19, 1979. Material was collected from the vessel Bobby L III by representatives of the New England Division of the Corps of Engineers (supervisor was Mr. Roy S. Clark). Mr. Timothy J. Ward and Mr. Robert L. Boeri, Energy Resources Company Inc. (ERCO), observed the collection efforts.

Station A was located near the mouth of the river at approximately 1,000 m from the river's eastern shore. Depth of water at the station was about 2-3 m. Station B was situated upriver from Station A and approximately 500 m from the eastern shore of the river (depth of water was about 2 m). Station C was located upriver from Station B and approximately 500 m from the eastern shore (water depth was about 2 m). At each station, two samples of dredged material were collected with a Van Veen grab. Each set of samples was placed in a 15-l bag, which was assigned an identification number (Station A: GEB-4-79; Station B: GEB-5-79; Station C: GEB-6-79). The bags were transported immediately to ERCO's Bioassay Laboratory in Cambridge, Massachusetts. Bags were put into cold storage (2-4° C) at the laboratory at 1400 on September 19, 1979. Material in the bags was composited just prior to initiating solid-phase bioassays.

Solid-phase bioassays were conducted according to procedures described in Appendix F of the manual entitled Ecological Evaluation of Proposed Discharge of Dredged Material into Ocean Waters (U.S. EPA and COE, 1977).

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[1] Laboratory procedures used to prepare dredged material and conduct bioassays are described in detail in Appendix A of this evaluation.

Species employed in bioassays were mysid shrimp (Neomysis americana), the hard clam (Mercenaria mercenaria), and sandworm (Nereis virens). Mysid shrimp and hard clams were obtained from, respectively, Sea Plantations, Inc., Salem, Massachusetts, and Long Island Shellfish, Inc., West Sayville, New York. Sandworms were acquired from a commercial supplier in Boston. Animals were acclimated in artificial seawater for at least 5 days prior to initiation of testing. All species were tested in the same aquaria (38-l capacity) at 20±1°C. Water exchange (artifical seawater) in aquaria was by the replacement, as compared to the flow-through, method. During testing, mysid shrimp were fed live 48-hr-old Artemia (brine shrimp) nauplii at a rate of approximately 10 ml of culture/aquarium/day.

Control (culture) sediment employed in the tests was collected on September 19, 1979, from the intertidal zone of Nahant Beach. The sediment, which was collected by Mr. Ward and Mr. Boeri, consisted primarily of sand. Reference (disposal-site) sediment used in the tests was collected at approximately 1100 on September 25, 1979, from a single sampling station located about 1 nautical mile west of the "A" buoy at the center of the Foul Area. The sediment was collected with a Van Veen grab operated from the vessel Bobby L III by representatives of the Corps (Mr. Ward and Mr. Boeri were observers). Depth of water at the sampling station was approximately 80 m. The sediment was put in plastic bags and placed in cold storage (2-4°C) at ERCO's Toxicology Laboratory at 1700 on September 25, 1979.

3. RESULTS

The three samples of dredged material employed in the evaluation consisted primarily of gray to black clay and silt (visual determinations). Mya shells were observed in Sample A and live Nereis were noted in Samples B and C. The reference (disposal-site) sediment was similar in texture to the samples of dredged material and contained starfish and sea cucumbers.

Data generated by solid phase bioassays with mysid shrimp, the hard clam, and sandworm are presented in Table B1 (Appendix B). Mean survival of hard clams and sandworms exposed for 10 days to dredged material was relatively high, i.e., 92-100%. Mean survial of mysid shrimp exposed to the material was only 75%. However, shrimp exposed to reference sediment exhibited the same average survival.

Analysis of total (combined) survival data for the three test species is presented in Table 1. Survival of control animals was greater than 90%, thus allowing a comparison of total survival of organisms exposed to reference sediment and dredged material. These survival data exhibited homogeneous variances (Cochran's test), thereby permitting a parametric one-way analysis of variance (ANOVA) to be performed with nontransformed data. The ANOVA indicates no statistically significant difference ($\alpha = 0.05$) in survival of animals exposed to the reference sediment and dredged material. Therefore, it is concluded that the dredged material (solid

Table 1. Analysis of total survival data for mysid shrimp (*Neomysis americana*), the hard clam (*Mercenaria mercenaria*), and sandworm (*Nereis virens*) exposed for 10 days to control (culture) sediment, reference (disposal-site) sediment, and solid phase of dredged material

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Step 1. Total Survival Data (From Table B1)

Treatment (t): Replicate	Total Number of Survivors Control (Culture) Sediment	Reference (Disposal-Site) Sediment	Dredged Material (Composite of Three Samples)
1	60	57	52
2	52	49	52
3	58	56	56
4	57	54	54
5	55	54	53
Mean ($\bar{x}$):	56.4 (94.0%)	54.0 (90.0%)	53.4 (89.0%)

Step 2. Cochran's Test for Homogeneity of Variances of Total Survival Data

Treatment (t)	Number of Survivors Mean ($\bar{x}$)	Variance(s^2)
Reference (Disposal-Site) Sediment	54.0	9.50
Dredged Material (Composite of Three Samples)	53.4	2.80

- -

$$C_{(cal.)} = \frac{s^2(max.)}{\Sigma s^2} = \frac{9.50}{12.30} = 0.77 \text{ ns},$$

as compared to: $C_{(tab.)} = 0.91$ for $\alpha = 0.05$, $k = 2$, and $v = 4$

Step 3. Parametric One-Way Analysis of Variance (ANOVA) of Total Survival Data

Source of Variation	df	Sum of Squares	Mean Square	$F_{(cal.)}$	
Treatment (Reference Sediment, Dredged Material)	t-1=1	0.90	0.90	0.15 ns,	as compared to $F_{(tab.)} = 5.32$ for $\alpha = 0.05$, numerator df = 1, and denominator df = 8
Error	t(r-1)=8	49.20	6.15		
Total	tr-1=9	50.10			

phase) is ecologically acceptable for discharge to oceanic waters.[1]

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[1] Paragraph 37, page F17, Appendix F of the EPA and COE manual for dredged material (U.S. EPA and COE, 1977) states that a solid phase has "real potential for causing environmentally unacceptable impacts on benthic organisms [only if] difference in mean survival between animals in the control and test sediments is statistically significant <u>and</u> [emphasis added] greater than 10 percent."

4. REFERENCES

U.S. Environmental Protection Agency and Corps of Engineers. 1977. Ecological evaluation of proposed discharge of dredged material into ocean waters. Implementation Manual for Section 103 of PL-92-532. Environmental Effects Laboratory, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. Second printing, April 1978.

APPENDIX A

LABORATORY PROCEDURES FOR PREPARING DREDGED MATERIAL AND CONDUCTING BIOASSAYS[1]

Procedure	Date/Time of Implementation of Procedure	Certifications of Performance of Procedure		
		Aquatic Toxicologist	Laboratory Director	Division Director
1. Store control sediment (CS), reference sediment (RS) and dredged sediment (DS) at 2-4° C in separate containers. Mix sediment in each container as thoroughly as possible.	CS 9/19/79	RB		CDRose
	RS 9/25/79	"	"	"
	DS 9/19/79	"	"	"

Solid-phase Bioassays

Bioassays must be initiated by October 3, 1979 (2 weeks after September 19, 1979, date of dredged sediment collection).
Maintain dissolved oxygen in aquaria at >4 ppm.
Cover aquaria to prevent salinity changes.

2. Remove CS and RS from storage and wet sieve through 1-mm mesh into separate containers. (Use minimum volume of artificial sea water [ASW] of salinity of 30 ppt for sieving purposes.) Place nonliving material remaining on sieve in appropriate containers.	9/26 1000	"	"	"
3. Mix CS and RS in respective containers and allow to settle for 6 hr.	9/26 1000	"	"	"
4. Decant ASW and mix CS and RS as thoroughly as possible.	9/26 1600	"	"	"
5. Assign treatments (CS, RS, DS) and replicates (5 r) to aquaria.	9/26 1615	"	"	"
6. Randomly position aquaria (15) in environmental chamber maintained at 20±1°C.	9/26 1630	"	"	"

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[1] This document is a copy of the work sheet that was used during the evaluation. The document differs from the work sheet in that dates/times appear in typed form and certifications were added at a single time after the dates/times were typed.

Laboratory Procedures (Continued)

Procedure	Date/Time of Implementation of Procedure	Certifications of Performance of Procedure		
		Aquatic Toxicologist	Laboratory Director	Division Director
7. Partially fill aquaria with ASW.	9/26 1630	*	*	*
8. Place 30 mm of CS in 5 control aquaria. Place 30 mm of RS in each remaining aquarium. Fill 1st aquarium to ~10 mm, then 2nd aquarium to ~10 mm, ..., and finally 15th aquarium to ~10 mm. Repeat sequence until aquaria are filled to ~20 mm. Repeat sequence again until aquaria are filled to ~30 mm. This procedure will help to ensure that CS and RS in all aquaria are homogeneous. Store remaining CS and RS at 2-4°C for later use.	9/26 1645	*	*	*
9. Replace ASW 1 hr after CS and RS have been added to aquaria. Do not disturb sediment during replacement.	9/26 1745	*	*	*
10. Select 300 hard clams from holding tanks and randomly distribute into 15 finger bowls. Follow same procedure for sandworms.	9/26 1300	*	*	*
11. Randomly distribute contents of each set of 15 finger bowls into 15 aquaria.	9/26 1745	*	*	*
12. If necessary, replace 75% of ASW 24 hr after animals are introduced into aquaria.	(Not necessary)			
13. Acclimate animals for 48 hr. At end of this time period, remove dead animals and replace with live animals.	9/26-9/28	*	*	*

Laboratory Procedures (Continued)

Procedure	Date/Time of Implementation of Procedure	Certifications of Performance of Procedure		
		Aquatic Toxicologist	Laboratory Director	Division Director
14. During acclimation period, remove appropriate volume of DS from storage and wet-sieve through 1-mm mesh into 1 container. Use minimum volume of ASW for sieving purposes. Place nonliving material remaining on sieve in container.	9/27 0830	*	*	*
15. Mix material in container and allow to settle for 6 hr.	9/27 0900-1500	*	*	*
16. Decant ASW and mix DS as thoroughly as possible.	9/27 1500	*	*	*
17. Place 15 mm of DS in 5 dredged-material aquaria. Employ basic strategy identified in Step 8.	9/28 0830	*	*	*
18. Remove remaining CS and RS from storage. Warm to test temperature (20±1°C). Add 15 mm of CS to each control aquarium and 15 mm of RS to each reference aquarium. Employ basic strategy identified in Step 8.	9/28 0900	*	*	*
19. Replace 75% of ASW 1 hr after addition of DS and final addition of CS and RS.	9/28 1000	*	*	*
20. Select 300 mysid shrimp from holding tank and randomly distribute into 15 finger bowls.	9/28 0930	*	*	*
21. Randomly distribute contents of finger bowls into 15 aquaria.	9/28 1015	*	*	*

Laboratory Procedures (Continued)

Procedure	Date/Time of Implementation of Procedure	Certifications of Performance of Procedure		
		Aquatic Toxicologist	Laboratory Director	Division Director
22. Perform the following activities:				
Every day after introduction of mysid shrimp into aquaria				
● Record salinity, temperature, dissolved oxygen and pH in each aquarium (record in log book)	Day 1 9/29	"	"	"
	Day 2 9/30	"	"	"
	Day 3 10/1	"	"	"
● Record obvious mortality, formation of tubes or burrows, and unusual behavior patterns of animals (record in log book)	Day 4 10/2	"	"	"
	Day 5 10/3	"	"	"
	Day 6 10/4	"	"	"
	Day 7 10/5	"	"	"
	Day 8 10/6	"	"	"
	Day 9 10/7	"	"	"
	Day 10 10/8	"	"	"
Every 2 days after addition of DS and final addition of CS and RS into aquaria				
● Replace 75% of ASW	Day 2 9/30	"	"	"
	Day 4 10/2	"	"	"
	Day 6 10/4	"	"	"
	Day 8 10/6	"	"	"
23. At end of 10-day testing period, sieve sediment in each aquarium through 0.5-mm screen. Count live animals. Note sublethal responses.	10/8/9	"	"	"

Table B1. Results of solid phase bioassays with mysid shrimp (Neomysis americana), the hard clam (Mercenaria mercenaria), and sandworm (Nereis virens)[a]

Treatment (t):	Number of Survivors[b,c]											
	Control (Culture) Sediment				Reference (Disposal-Site) Sediment				Dredged Material (Composite of Three Samples)			
Replicate (r)	Mysid Shrimp	Hard Clam	Sand-worm	Total	Mysid Shrimp	Hard Clam	Sand-worm	Total	Mysid Shrimp	Hard Clam	Sand-worm	Total
1	20	20	20	60	19	20	18	57	14	20	18	52
2	18	20	14	52	11	20	18	49	12	20	20	52
3	20	20	18	58	16	20	20	56	18	20	18	56
4	19	20	18	57	15	20	19	54	15	20	19	54
5	15	20	20	55	14	20	20	54	16	20	17	53
Mean ($\bar{x}$)	18.4	20.0	18.0	56.4	15.0	20.0	19.0	54.0	15.0	20.0	18.4	53.4
(%)	(92.0)	(100.0)	(90.0)	(94.0)	(75.0)	(100.0)	(95.0)	(90.0)	(75.0)	(100.0)	(92.0)	(89.0)

[a] Bioassays were conducted at 20±1°C in 38-l aquaria. Animals were exposed to each replication of a treatment in a single aquarium. Water in aquaria was exchanged by the replacement, as compared to the flow-through, method and was aerated. A 14-hour light and 10-hr dark photoperiod was maintained with cool-white fluorescent bulbs *during testing*. Mysid shrimp were fed live 48-hr-old Artemia (brine shrimp) nauplii at a rate of approximately 10 ml of culture/aquarium/day. Minimum values of dissolved oxygen and pH recorded during the bioassays were 4.6 ml/l and 7.3, respectively. Salinity was maintained at 30 ppt.

[b] Twenty (20) individuals of each species were initially exposed to each replication of a treatment. Thus, a total of 60 animals were employed in each aquarium.

[c] In addition to monitoring survival of all species, burrowing behavior of sandworms was noted at 2-day intervals. No differences were observed among aquaria.

ISLAND END RIVER
CHELSEA, MASSACHUSETTS

DETAILED PROJECT REPORT

ECONOMICS
APPENDIX 6

PREPARED BY THE

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

ECONOMICS

Table of Contents

List of Tables

ECONOMICS

Table of Contents

Item Page No.

List of Tables (cont.)

List of Plates

APPENDIX 6

ECONOMIC ANALYSIS

SECTION A

ANALYSIS OF PROJECT COSTS AND BENEFITS

1. This appendix contains the detailed analyses of the benefits and costs of the alternative plans. Benefits and costs are calculated and compared for each alternative to determine each plan's economic feasibility. Section B of this appendix contains a detailed economic analysis of the proposed channel depth and width.

METHODOLOGY

2. Benefits attributable to the federal project are derived from increased use of the Island End River for recreational boating. At the present time, recreational use of the Island End River is nonexistent. By dredging a channel to the site of the proposed marina, the federal project would permit the City of Chelsea to feasibly develop the marina in accordance with its development plans for the Chelsea Naval Hosptial site. This would also expand the supply of safe and convenient mooring spaces. Given the present backlog of applications for mooring spaces in the Boston area, and the expected continued growth of recreational boating, the benefits resulting from this project are expected to be net benefits to the national economy. That is, the opportunities for recreational boating will be new opportunities that would not be available otherwise, and are not due merely to the transference of boating benefits from other areas.

3. Benefits are calculated in economic terms by estimating the annual return to boat owners as if the boats were "for hire." This is a measure of the boat owners "willingness to pay" for recreational benefits. The ideal percentage of return is considered the maximum return that could be expected with full unrestricted use of the harbor. At the present time, the actual return is 0% of the ideal. With the proposed improvements, actual return would range up to 100% of the ideal return depending upon the type of boat.

PROJECTIONS OF THE RECREATIONAL BOAT FLEET

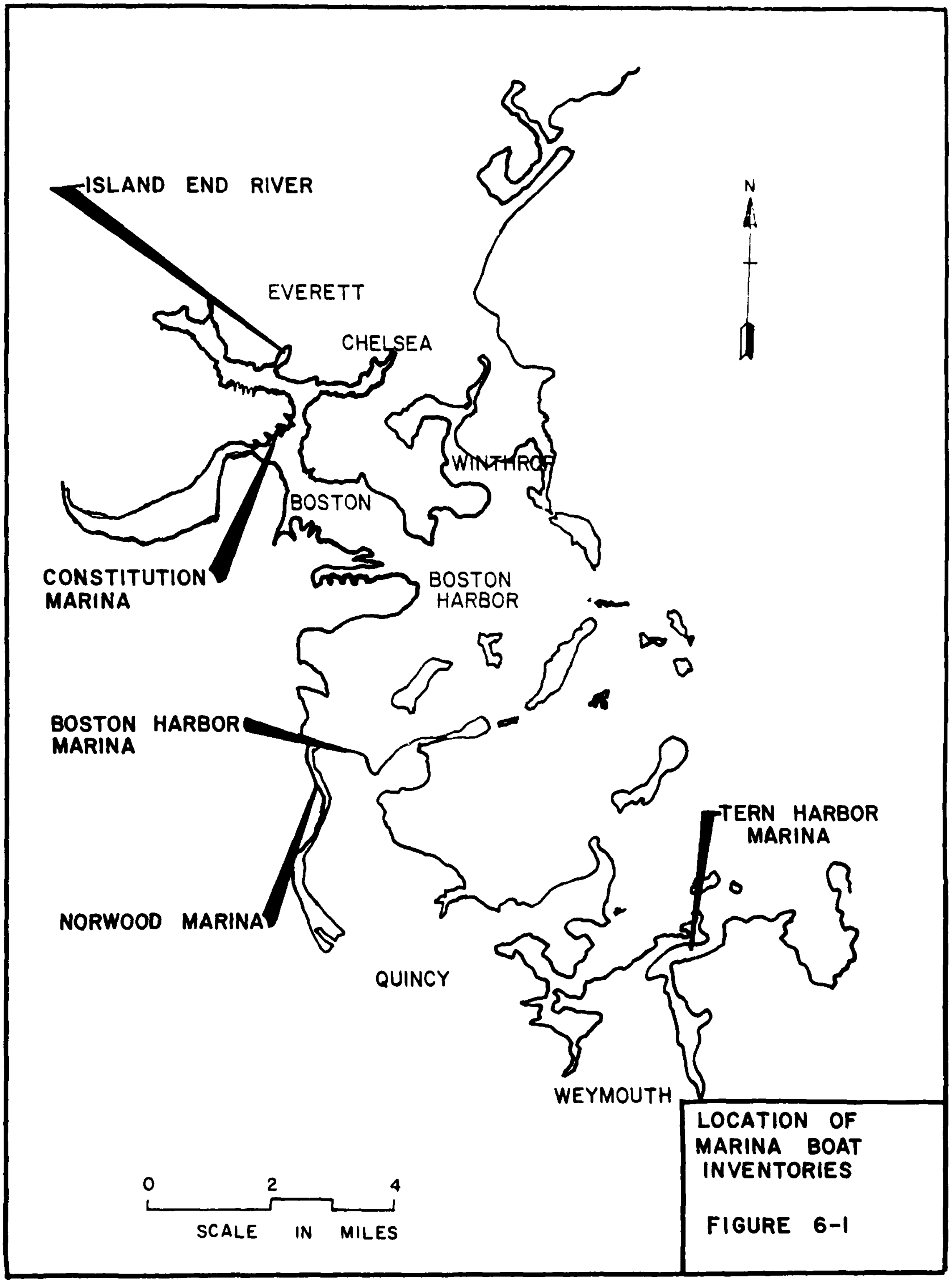
4. Projections of recreational boat use in the Island End River were required to establish the economic benefits of the project as well as to determine the required mooring area and channel dimensions.

5. Because there is currently no recreational boating in the Island End River projections of future use were made based on the types of boats observed at four nearby marinas. Four marinas in the greater Boston area

that were considered to be representative of the Island End River site were examined. The locations of the marinas are shown in Figure 6-1. The marinas selected were fairly large and privately owned and operated. The Boston Harbor Marina, Norwood Marina and the Tern Harbor Marina were considered representative due to their locations on rivers with fairly shallow depths, and the availability of shore facilities similar to those proposed for the Island End River Marina. The Constitution Marina was selected due to its comparable size and its nearby location.

6. Inventories were taken by visually classifying moored boats by size and type. The observations were made on a weekday morning during the summer. The results of the surveys are shown in Tables 6-1 through 6-5. Table 6-5 shows the average mix of boats for the four marinas surveyed.

7. Table 6-6 shows the mix of boats projected for the Island End River. The percentages shown in this table reflect a slightly higher percentage of sailboats than observed at the four marinas. The number of sailboats is anticipated to be higher in the future due to increases in the price of fuel. Within the categories of power boats and sailboats, the breakdown by percent is the same as observed in the survey.



LOCATION OF MARINA BOAT INVENTORIES

FIGURE 6-1

TABLE 6-1

RECREATIONAL FLEET OBSERVED AT NORWOOD MARINA, BOSTON

Type of Craft	Length	Number	Percent
Outboards	15-20	9	10.4
	20+	1	1.2
Sterndrive	15-20	5	5.8
	21-25	10	11.6
	26+	5	5.8
Inboards	15-20	2	2.3
	21-30	27	31.4
	31-40	13	15.1
	41-50	2	2.3
	51+	1	1.2
Cruising Sailboats	15-20	0	0
	21-30	6	7.0
	31-40	3	3.5
	41+	0	0
Daysailers	8-15	1	1.2
	16-20	5	5.0
	21-25	1	1.2
	26+	0	0
		86	100.0

TABLE 6-2
RECREATIONAL FLEET OBSERVED AT TERN HARBOR MARINA, WEYMOUTH

Type of Craft	Length	Number	Percent
Outboards	15-20	14	12.3
	20+	2	1.8
Sterndrive	15-20	2	1.8
	21-25	4	3.5
	26+	1	0.9
Inboards	15-20	1	0.9
	21-30	35	30.7
	31-40	15	13.1
	41-50	6	5.2
	51+	2	1.8
Cruising Sailboats	15-20	1	0.9
	21-30	16	14.0
	31-40	11	9.6
	41+	0	0
Daysailers	8-15	1	0.9
	16-20	1	0.9
	21-25	2	1.8
	26+	0	0
		114	100.0

TABLE 6-3
RECREATIONAL FLEET OBSERVED AT BOSTON HARBOR

Type of Craft	Length	Number	Percent
Outboards	15-20	37	10.9
	20+	7	2.1
Sterndrive	15-20	6	1.8
	21-25	35	10.3
	26+	9	2.7
Inboards	15-20	3	0.9
	21-30	107	31.6
	31-40	50	14.8
	41-50	3	0.9
	51+	1	0.3
Cruising Sailboats	15-20	0	0
	21-30	56	16.6
	31-40	15	4.4
	41+	0	0
Daysailers	8-15	1	0.3
	16-20	2	0.6
	21-25	5	1.5
	26+	1	0.3
		338	100.0

TABLE 6-4
RECREATIONAL FLEET OBSERVED AT CONSTITUTION MARINA, BOSTON

Type of Craft	Length	Number	Percent
Outboards	15-20	6	3.6
	20+	2	1.2
Sterndrive	15-20	4	2.4
	21-25	13	7.8
	26+	7	4.2
Inboards	15-20	3	1.8
	21-30	22	13.2
	31-40	22	13.2
	41-50	9	5.4
	51+	0	0
Cruising Sailboats	15-20	1	0.6
	21-30	43	25.7
	31-40	23	13.7
	41+	3	1.8
Daysailers	8-15	0	0
	16-20	7	4.2
	21-25	2	1.2
	26+	0	0
		167	100.0

TABLE 6-5
RECREATIONAL FLEET OBSERVED AT FOUR MARINAS

Type of Craft	Length	Number	Percent
Outboards	15-20	66	9.4
	20+	12	1.7
Sterndrive	15-20	17	2.4
	21-25	62	8.8
	26+	22	3.1
Inboards	15-20	9	1.3
	21-30	191	27.0
	31-40	100	14.2
	41-50	20	2.8
	51+	4	0.6
Cruising Sailboats	15-20	2	0.3
	21-30	121	17.2
	31-40	52	7.4
	41+	3	0.4
Daysailers	8-15	2	0.3
	16-20	11	1.6
	21-25	10	1.4
	26+	1	0.1
		705	100.0

TABLE 6-6
RECREATIONAL FLEET PROJECTED FOR ISLAND END RIVER

Type of Craft	Length	Percent
Outboards	15-20	9
	20+	2
Sterndrive	15-20	3
	21-25	12
	26+	2
Inboards	15-20	1
	21-30	22
	31-40	12
	41-50	2
	51+	0
Cruising Sailboats	15-20	0
	21-30	21
	31-40	10
	41+	0
Daysailers	8-15	0
	16-20	3
	21-25	1
	26+	0

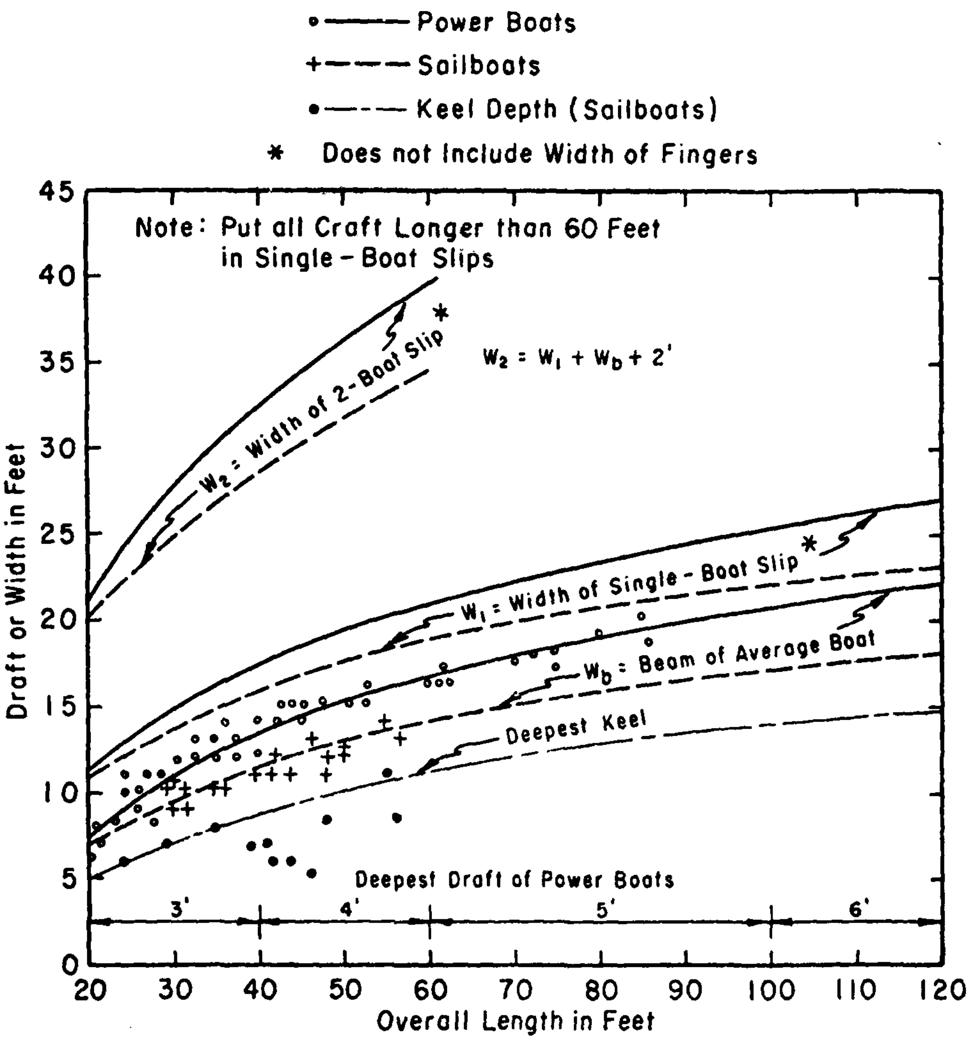
8. Actual return as a percentage of ideal return is dependent upon the type of boat. In general, the smaller, more maneuverable boats can utilize the harbor and river more effectively under all tide conditions. Boats with large drafts are more likely to be restricted to the channel and may be prevented from using the river at low tide conditions.

9. Figure 6-2 shows the criteria used to determine the required channel depth. Reductions in benefits are considered to occur if the draft exceeds the depth of water available at low tide. Table 6-7 shows the percent reductions in benefits estimated to occur with different channel depths.

10. Channel dimensions of 100 feet wide and 6 feet deep were selected as the most cost effective means of providing the desired boating. A "marginal" benefit/cost analysis of these design criteria is contained in Section B of this appendix. The following discussion of project benefits is based on this channel size.

11. Net benefits have been calculated by converting the future recreational benefits to an equivalent annual basis using an interest rate of 7-1/8 percent. This rate is currently applicable to all federal water resource projects.

12. Because of the conflict between recreational boats and large ships inherent in Plan A, recreational benefits are reduced for this plan. As shown in Table 6-8, the delay to recreational boats is estimated to reduce benefits by 7%, as compared to other alternatives.



SOURCE: <u>SMALL CRAFT HARBORS: DESIGN CONSTRUCTION AND OPERATION</u>
U.S. ARMY CORPS OF ENGINEERS, COASTAL ENGINEERING RESEARCH CENTER, 1974

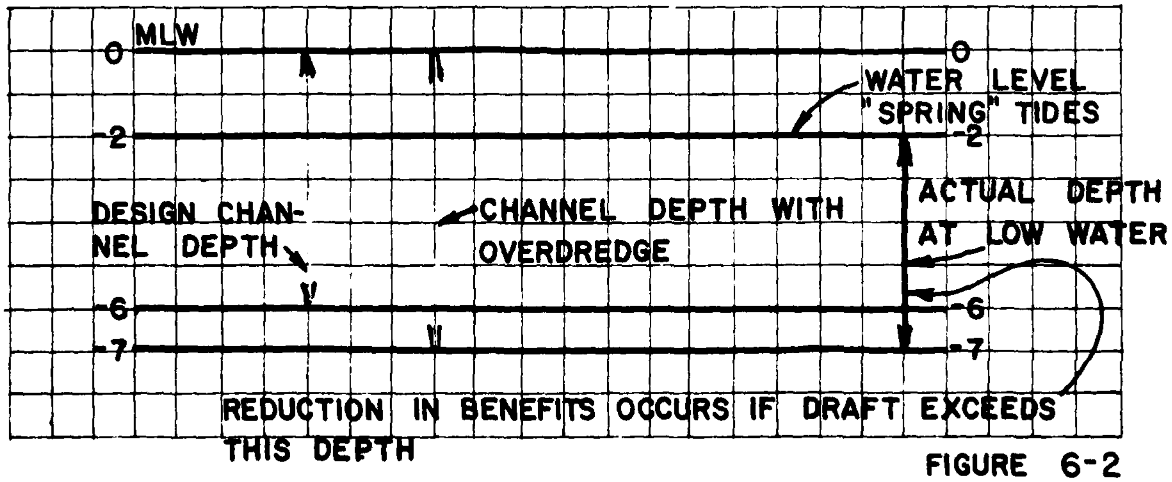


FIGURE 6-2

CHANNEL DEPTH CRITERIA

TABLE 6-7
ESTIMATED REDUCTIONS IN BENEFITS (% FROM IDEAL) BASED UPON DESIGN CHANNEL DEPTH (FEET)

Type of Craft	5'	6'	7'	8'
Outboards				
15-20	-	-	-	-
20+	-	-	-	-
Sterndrives				
15-20	-	-	-	-
21-25	-	-	-	-
26+	-	-	-	-
Inboards				
15-20	-	-	-	-
21-30	5	-	-	-
31-40	15	-	-	-
41-50	25	-	-	-
51+	35	15	-	-
Cruising Sailboats				
15-20	15	-	-	-
21-30	25	15	-	-
31-40	35	25	15	-
41+	45	35	25	
Daysailers				
8-15	-	-	-	-
16-20	15	-	-	-
21-25	25	15	-	-
26+	35	25	15	-

TABLE 6-8

REDUCTION IN BENEFITS DUE TO CONFLICT WITH INDUSTRIAL SHIPPING

COMPANY	SHIPS PER YEAR RECEIVED
1. Exxon Corp.	150
2. Coldwater Seafood	50
3. Marquette Cement	25
Total	225

1. 225 ships per year X 2 = 450 trips per year or 1.25 per day
2. Assuming 1 hour of delay for each industrial shipping movement: 1.25 hours of delay per 16 hour sailing day = 7%
3. Benefits of Plan A are reduced by 7%.

TABLE 6-9 RECREATIONAL BOATING BENEFITS
BOATS ADDED IMMEDIATELY

ISLAND END RIVER
6 ft. DEPTH, 100 ft. WIDTH

1979 BOATING VALUES

BOATING SEASON: 160 DAYS

TYPE OF CRAFT	LENGTH (Feet)	# OF BOATS	DEPRECIATED VALUES Average $	Totals $	PERCENT Ideal	RETURN % of Ideal Pres.	Fut.	Gain	VALUE $	ON CRUISE Avg. Days	% of Season	Value $
Outboards	10-14	0	2,950	-	14	0	-	-	-			
	15-20	9	3,900	35,100	13	0	100	13.0	4,563			
	21&Up	2	7,750	15,500	13	0	100	13.0	2,015			
Sterndrive	15-20	3	6,550	19,650	12	0	100	12.0	2,358			
	21-25	12	9,850	118,200	11	0	100	11.0	13,002			
	26&Up	2	22,600	45,200	10	0	100	10.0	4,520			
Inboards	15-20	1	7,350	7,350	12	0	100	12.0	882			
	21-30	22	16,680	366,960	12	0	100	12.0	44,035	14	9	3,963
	31-40	12	45,500	546,000	11	0	100	11.0	60,060	19	12	7,207
	41-50	2	103,600	207,200	10	0	100	10.0	20,720	32	20	4,144
	51&Up	0	240,800	-	9	0	-	-	-	-	30	-
Cruising Sailboats	15-20	0	4,850	-	8	0	-	-	-	-	-	-
	21-30	21	15,600	327,600	8	0	85	6.8	22.277	8	5	1,114
	31-40	10	43,200	432,000	7	0	75	5.3	22,896	26	16	3,663
	41&Up	0	85,500	-	6	0	-	-	-	-	25	-
Daysailers	8-15	0	1,400	-	12	0	-	-	-	-	-	-
	16-20	3	3,450	10,358	12	0	100	12.0	1,242	-	-	-
	21-25	1	6,350	6,350	11	0	100	11.0	699	8	5	35
	26&Up	0	12,050	-	10	0	-	-	-	-	25	-
TOTALS		100							$199,305			$20,126

Annual Net Benefits (Plans B, C, and D) = $199.305 - $20,126 = $179,179
say $179,200

Annual Net Benefits (Plan A) $179,179 x .93 = $166,636
say $166,600

TABLE 6-10 RECREATIONAL BOATING BENEFITS
BOATS ADDED IMMEDIATELY
TRANSIENT FLEET

ISLAND END RIVER
6 ft DEPTH, 100 ft. WIDTH

1979 BOATING VALUES

BOATING SEASON: 160 DAYS

TYPE OF CRAFT	LENGTH (Feet)	# OF BOATS	DEPRECIATED VALUES		PERCENT RETURN				VALUE $	ON CRUISE		
			Average $	Totals $	Ideal	% of Ideal Pres.	% of Ideal Fut.	Gain		Avg. Days	% of Season	Value $
Outboards	10-14											
	15-20	4	3,900	15,600	13	0	100	13.0	2,028			
	21&Up	1	7,750	7,750	13	0	100	13.0	1,008			
Sterndrive	15-20	1	6,550	6,550	12	0	100	12.0	786			
	21-25	4	9,850	39,400	11	0	100	11.0	4,334			
	26&Up											
Inboards	15-20											
	21-30											
	31-40											
	41-50											
	51&Up											
Cruising Sailboats	15-20											
	21-30											
	31-40											
	41&Up											
Daysailers	8-15											
	16-20											
	21-25											
	26&Up											
TOTALS		10							$8.156			

Annual Net Benefits (Plans B, C, and D) = $8,156
say $8,200

Annual Net Benefits (Plan A) =$8,156 x .93 = $7,585
say $7,600

TABLE 6-11 RECREATIONAL BOATING BENEFITS
BOATS ADDED WITHIN 10 YEARS

ISLAND END RIVER
6 ft. DEPTH, 100 ft. WIDTH

1979 BOATING VALUES

BOATING SEASON: 160 DAYS

TYPE OF CRAFT	LENGTH (Feet)	# OF BOATS	DEPRECIATED VALUES Average $	DEPRECIATED VALUES Totals $	PERCENT RETURN Ideal	PERCENT RETURN % of Ideal Pres.	PERCENT RETURN % of Ideal Fut.	PERCENT RETURN Gain	VALUE $	ON CRUISE Avg. Days	ON CRUISE % of Season	ON CRUISE Value $
Outboards	10-14	-	2,950	-	14	0	-	-	-			
	15-20	14	3,900	546,000	13	0	100	13.0	7,098			
	21&Up	2	7,750	15,500	13	0	100	13.0	7,015			
Sterndrive	15-20	4	6,550	26,200	12	0	100	12.0	3,144			
	21-25	18	9,850	177,300	11	0	100	11.0	19,503			
	26&Up	3	22,600	67,800	10	0	100	10.0	6,780			
Inboards	15-20	2	7,350	14,700	12	0	100	12.0	1,764			
	21-30	33	16,680	550,440	12	0	100	12.0	66,053	14	9	5,945
	31-40	18	45,500	819,000	11	0	100	11.0	90,090	19	12	10,810
	41-50	3	103,600	310,800	10	0	100	10.0	31,080	32	20	6,216
	51&Up	-	240,800	-	9	0	-	-	-	-	30	-
Cruising	15-20	-	4,850	-	8	9	-	-	-			
Sailboats	21-30	31	15,600	483,600	8	0	85	6.8	32.885	8	5	1,644
	31-40	15	43,200	648,000	7	0	75	5.3	54,344	26	16	5,495
	41&Up	-	85,550	-	6	0	-	-	-	-	25	-
Daysailers	8-15	-	1,400	-	12	0	-	-	-			
	16-20	5	3,450	17,250	12	0	100	12.0	2,076			
	21-25	2	6,350	12,700	11	0	100	11.0	1,397	8	5	70
	26&Up	-	12,050	-	10	0	-	-	-	-	25	-
TOTALS		150							$298,223			$30,180

Annual Net Benefits After Ten Years (Plans B, C, and D) = $298,223 - $30,180 = $268,043
Annual Net Benefits After Ten Years (Plan A) = $268,043 x .93 = $249,280
Annual Equivalent Benefits (Plans B, C, D) = $268,043 x .7397385 = $198,282 say $198,300
Annual Equivalent Benefits (Plan A) = $249,280 x .7397385 = $184,402 say $184,400

$$E_f = \frac{1}{(1 + i)^n - 1} \quad \frac{(1 + i)^{n+1}}{(1 + i)g} \quad \frac{(1 + i)^g - 1}{g \times i} - 1$$

Where: E_f = Average annual equivalent factor
i = Annual interest rate (7 1/8%)
n = Project life (50 years)
g = Growth period (10 years)

$$E_f = \frac{1}{(1.07125)^{50} - 1} \quad \frac{(1.07125)^{51}}{(1.07125)10} \quad \frac{(1.07125)^{10} - 1}{(10 \times .07125}$$

$$= \frac{1}{30.22783} \quad \frac{33.126755}{1.4180555} - 1$$

$$= .7397385$$

TABLE 6-12 RECREATIONAL BOATING BENEFITS
BOATS ADDED WITHIN 10 YEARS
TRANSIENT FLEET

ISLAND END RIVER
6 ft. DEPTH, 100 ft. WIDTH

1979 BOATING VALUES

BOATING SEASON: 160 DAYS

TYPE OF CRAFT	LENGTH (Feet)	# OF BOATS	DEPRECIATED VALUES		PERCENT RETURN				VALUE $	ON CRUISE		
			Average $	Totals $	Ideal	% of Ideal Pres.	Fut.	Gain		Avg. Days	% of Season	Value $
Outboards	10-14											
	15-20	8	3,900	31,200	13	0	100	13.0	4,056			
	21&Up	2	7,750	15,500	13	0	100	12.0	2,015			
Sterndrive	15-20	2	6,550	13,100	12	0	100	12.0	1,572			
	21-25	8	9,850	78,800	11	0	100	11.0	8,668			
	26&Up											
Inboards	15-20											
	21-30											
	31-40											
	41-50											
	51&Up											
Cruising Sailboats	15-20											
	21-30											
	31-40											
	41&Up											
Daysailers	8-15											
	16-20											
	21-25											
	26&Up											
TOTALS		20							16,311			

Annual Net Benefits After Ten Years (Plans B, C, and D) = $16,311
Annual Net Benefits After Ten Years (Plan A) = $16,311 x .93 = $15,169
Annual Equivalent Benefits (Plans B, C, and D) = $16,311 x .7397385 = $12,066 say $12,100
Annual Equivalent Benefits (Plan A) = $15,169 x .7397385 = $11,221 say $11,200

13. Construction of the proposed marina is anticipated to take place in stages, reflecting the construction of residential housing on the former Naval Hospital site. Within 2 years after completion of the federal project, it is estimated that marina facilities for 100 boats would be provided. The use of the Island End River by the 100 boats based at the marina would produce net recreational benefits of $166,600 for Plan A and $179,200 for Plans B, C and D (See Table 6-9).

14. In addition to the 100 boats berthed at the marina, an average of 10 boats per day are estimated to use the marina facilities as transient vessels, or to be launched for day use. These craft are anticipated to be outboards or stern drive boats. Annual net benefits of $7,600for Plan A and $8,200 for Plans B, C and D are estimated for these boats (See Table 6-10).

15. Based upon the increasing population at the Naval Hospital site and in general upon the continued growth in demand for mooring spaces in the greater Boston area, the marina facilities are projected to be expanded to provide a capacity of 250 mooring spaces within a ten year period. A marina with a capacity of 250 boats has been proposed in the City of Chelsea's Redevelopment Master Plan for the Naval Hospital. Benefits from the additional boats added within the ten year period are estimated at $184,400 for Plan A and $198,300 for Plans B, C and D (See Table 6-11).

16. Transient and launched boats are anticipated to increase from an average of 10 per day to an average of 20 per day with a ten year period. Annual net benefits of $11,200 and $12,100 are estimated for these crafts (See Table 6-12).

17. Project benefits are summarized in Table 6-13. Plan A results in total equivalent annual benefits of $369,800 Plans B, C and D have equivalent annual benefits of $397,800.

Table 6-13
PROJECT BENEFITS
(EQUIVALENT ANNUAL BENEFITS)

	PLANS			
	A	B	C	D
Boats Added immediately	$166,600	$179,200	$179,200	$179,200
Immediate Transients	7,600	8,200	8,200	8,200
Boats Added Within 10 Years	184,400	198,300	198,300	198,300
Future Transients	11,200	12,100	12,100	12,100
TOTAL	$369,800	$397,800	$397,800	$397,800

COST ESTIMATES

18. Detailed cost estimates for each alternative have been presented in Appendix 2, Tables 2-2, 2-4, 2-6, and 2-8. These cost estimates have been based on the following factors:

Price per cubic yard for dredging
Price per linear foot for revetment
Constructon contingencies (15%)
Engineering (7%)
Supervision and Administration (8%)

Appendix 4, Sections D and E contain an explanation of the method of determining dredging prices.

SUMMARY

19. Table 6-14 contains a summary of the project costs and benefits for each alternative. Each plan will result in benefit/cost ratios greater than 1.0 and will result in positive net benefits. Plan B, the selected plan, will result in the greatest net benefits.

Table 6-14
SUMMARY OF ECONOMIC ANALYSIS

	PLAN	A	B	C	D
1.	Annual Cost	$ 57,000	$68,000	$95,000	$115,000
2.	Annual Benefits	$ 369,800	$ 397,800	$ 397,800	$ 397,800
3.	BenefitCost Ratio	6.4	5.8	4.2	3.4
4.	Net Benefits	$ 312,800	$ 329,800	$ 302,800	$ 282,800

SECTION B

ANALYSIS OF ALTERNATIVE CHANNEL DIMENSIONS

20. Following the designation of the selected plan, further analysis of the proposed channel dimensions were undertaken in order to ensure that the proposed plan represented the plan producing the maximum net benefits. Therefore, "marginal" benefit/cost calculations were made to determine the changes in net benefits with changes in channel dimensions.

CHANNEL DEPTHS

21. Figure 6-2 illustrates the criteria used to evaluate channel depths. Table 6-7 shows the reductions in benefits assumed to occur with differing channel depths. Based on Table 6-7, benefits have been evaluated for channel depths of 5, 6, and 7 feet, shown in Tables 6-13, 6-15, and 6-16 respectively. The results are based on the fleet mix expected to occur in the Island End River and are shown in terms of the average benefit per boat.

22. Table 6-18 shows the differences in project benefits and costs associated with 5, 6 and 7 foot channel depths, with annual net benefits maximized at the six foot depth.

TABLE 6-15 RECREATIONAL BOATING BENEFITS
PLAN B, FIVE FOOT DEPTH

ISLAND END RIVER 1979 BOATING VALUES BOATING SEASON: 160 DAYS

TYPE OF CRAFT	LENGTH (Feet)	# OF BOATS	DEPRECIATED VALUES		PERCENT RETURN				VALUE	ON CRUISE		
			Average $	Totals $	Ideal	% of Ideal Pres.	% of Ideal Fut.	Gain	$	Avg. Days	% of Season	Value $
Outboards	10-14	0	2,950	-	14	0	100	-	-			
	15-20	9	3,900	35,100	13	0	100	13.0	4,563			
	21&Up	2	7,750	15,500	13	0	100	13.0	2,015			
Sterndrive	15-20	3	6,550	19,650	12	0	100	12.0	2,358			
	21-25	12	9,850	118,200	11	0	100	11.0	13,002			
	26&Up	2	22,600	45,200	10	0	100	10.0	4,520			
Inboards	15-20	1	7,350	7,350	12	0	100	12.0	882			
	21-30	22	16,680	366,960	12	0	95	11.4	41,884	14	9	3,770
	31-40	12	45,500	546,000	11	0	85	9.4	51,324	19	12	6,159
	41-50	2	103,600	207,200	10	0	75	7.5	45,540	32	20	3,108
	51&Up	0	240,800	-	9	0	65	-	-	-	30	-
Cruising	15-20	0	4,850	-	8	0	85	-	-	-	-	-
Sailboats	21-30	21	15,600	327,600	8	0	75	6.0	19,656	8	5	983
	31-40	10	43,200	432,000	7	0	65	4.6	19,872	26	16	3,180
	41&Up	0	85,550	-	6	0	55	-	-	-	25	-
Daysailers	8-15	0	1,400	-	12	0	100	-	-			
	16-20	3	3,450	10,350	12	0	85	10.2	1,056			
	21-25	1	6,350	6,350	11	0	75	8.3	527	8	5	26
	26&Up	0	12,050	-	10	0	65	-	-	-	25	-
TOTALS		100							177,199			17,226

Annual Net Benefits = $177,199 - $17,226 = $159,973 say $160,000

TABLE 6-16 RECREATIONAL BOATING BENEFITS
PLAN B, SEVEN FOOT DEPTH

ISLAND END RIVER 1979 BOATING VALUES BOATING SEASON: 160 DAYS

TYPE OF CRAFT	LENGTH (Feet)	# OF BOATS	DEPRECIATED VALUES		PERCENT RETURN				VALUE $	ON CRUISE		
			Average $	Totals $	Ideal	% of Ideal Pres.	Fut.	Gain		Avg. Days	% of Season	Value $
Outboards	10-14	0	2,950	-	14	0	100	14.0	-			
	15-20	9	3,900	35,100	13	0	100	13.0	4,563			
	21&Up	2	7,750	15,500	13	0	100	13.0	2,015			
Sterndrive	15-20	3	6,550	19,650	12	0	100	12.0	2,358			
	21-25	12	9,850	118,200	11	0	100	11.0	13,002			
	26&Up	2	22,600	45,200	10	0	100	10.0	4,520			
Inboards	15-20	1	7,350	7,350	12	0	100	12.0	882			
	21-30	22	16,680	366,960	12	0	100	12.0	44,035	14	9	2,963
	31-40	12	45,500	546,000	11	0	100	11.0	60,060	19	12	7,207
	41-50	2	103,600	207,200	10	0	85	8.5	17,612	32	20	3,522
	51&Up	0	240,800	-	9	0	-	-	-			
Cruising Sailboats	15-20	0	4,840	-	8	0	-	-	-			
	21-30	21	15,600	327,600	8	0	100	8.0	26,208	8	5	1,310
	31-40	10	43,200	432,000	7	0	85	6.0	25,920	26	16	4,147
	41&Up	0	85,500	-	6	0	-	-	-			
Daysailers	8-15	0	1,400	-	12	0	-	-	-			
	16-20	3	3,450	10,350	12	0	100	12.0	1,242			
	21-25	1	6,350	6,350	11	0	100	11.0	699	8	5	35
	26&Up	0	12,050		10	0	-					
TOTALS		100							203,116			20,184

Annual Net Benefits = $203,116 - $20,184 = $182,932 say $183,000

TABLE 6-17

ECONOMIC ANALYSIS OF CHANNEL DEPTHS

	Channel Depth		
	5	6	7
ANNUAL PROJECT BENEFITS			
A) Boats Added Immediately			
1. Moored Boats	$160,000	$179,200	$183,000
2. Transient Boats	8,200	8,200	8,200
B) Boats Added Within 10 Years			
1. Moored Boats *	177,500	198,300	203,100
2. Transient Boats	12,100	12,100	12,100
Total	$357,800	$397,800	$406,400
ANNUAL PROJECT COSTS			
A) Amortization	$ 37,600	$46,300	$ 53,200
B) Maintenance	15,300	22,000	23,700
Total Annual Cost	$ 52,900	$68,300	$ 76,900
ANNUAL NET BENEFITS	$304,900	$329,500	$329,500

*Computed by multiplying the total benefit for 100 boats added immediately by 1.5 to account for the additional 150 boat growth, and multiplying that product by the discount factor 0.739739 to express the benefit as an average annual equivalent.

CHANNEL WIDTH

23. A channel width of 100 feet has been selected based on a consideration of convenience and safety to boaters. At the upper end of the project, the channel serves to provide access to the marina as well as serving as a maneuvering and turning area. A width of the turning area equal to twice the length of the largest boat is considered to be the minimum allowable width for adequate maneuvering. Since boats up to 50 feet long are expected, a minimum width of 100 feet is required adjacent to the marina.

24. Downstream of the marina, the existing channel will be widened by dredging up to 80 feet of additional width. However, the channel will be clearly marked to designate a 100 foot wide small boat channel.

25. Reduction of the proposed channel width will result in additional congestion within the small boat channel as well as a smaller separation between the recreational boats and the large ships. This will lead to a reduction in the recreational benefits.

26. Elimination of the proposed widening of the commercial channel is the same as Plan A. This would result in a reduction in benefits of 7%. Therefore, narrowing of the proposed width of 100 feet would produce reductions in benefits ranging up to 7%.

27. On the average with a 100 foot wide channel the eastern edge of the small boat channel would be about 40 feet from the deeper water of the commercial channel. With an 80 foot wide channel, the eastern edge would be about 20 feet away. Therefore, a reduction of 3-1/2% was assumed to occur within an 80 foot wide channel. No additional benefits were assumed to occur with a 120 foot wide channel.

28. The following table shows the estimated costs and benefits for alternative channel width.

Table 6-18
ANALYSIS OF ALTERNATIVE CHANNEL
WIDTHS PLAN B

	Channel Widths		
	80	100	120
Annual Cost	$ 57,100	$68,300	$ 71,600
Annual Benefits	$383,900	$397,800	$397,800
Annual Net Benefits	$326,800	$329,500	$326,200

SECTION C

SENSITIVITY ANALYSIS

29. In order to satisfy questions concerning risk and uncertainty associated with projects of future fleet composition, benefits have been calculated to correspond with the two extreme ends of the reasonable range of fleet mixes. Benefits previously reported in this appendix were thought to reflect the most probable future fleet, depicting a slight increase in sailboats as a percentage of total fleet due to increased price and decreased availability of fuel. Tables 6-19 and 6-20 display the benefits which would be expected to accrue to a fleet composed on a percentage breakdown by size and vessel type to correspond exactly with the existing fleet in the Boston Harbor area. Benefits which would be anticipated if the proposed anchorage provided mooring space for sailboats exclusively, an extreme case which would realize the lowest possible return on investment of all fleet mixes, is shown in Tables 6-21 and 6-22. All annual benefits are summarized in Table 6-23, and are compared to annual costs which determine economic feasibility. In all cases, a return of greater than one dollar could be expected for every dollar spent, with return maximized for Plan B.

TABLE 6-19 RECREATIONAL BOATING BENEFITS
BOATS ADDED IMMEDIATELY
PROJECTED FLEET COMPOSITION CONSISTENT WITH EXISTING FLEET

ISLAND END RIVER
6 ft. DEPTH, 100 ft. WIDTH — 1979 BOATING VALUES — BOATING SEASON: 160 DAYS

TYPE OF CRAFT	LENGTH (Feet)	# OF BOATS	DEPRECIATED VALUES		PERCENT			RETURN	VALUE	ON CRUISE		
			Average $	Totals $	Ideal	% of Ideal Pres.	Fut.	Gain	$ Days	Avg. Season	% of $	Value
Outboards	10-14	0	2,950	0	14	0	100	-	-			
	15-20	10	3,900	39,000	13	0	100	13.0	5,070			
	21&Up	2	7,750	15,500	13	0	100	13.0	2,015			
Sterndrive	15-20	3	6,550	19,650	12	0	100	12.0	2,358			
	21-25	9	9,850	88,650	11	0	100	11.0	9,752			
	26&Up	3	22,600	67,800	10	0	100	10.0	6,780			
Inboards	15-20	1	7,350	7,350	12	0	100	12.0	882			
	21-30	27	16,680	450,360	12	0	100	12.0	54,043	14	9	4,864
	31-40	14	45,500	637,000	11	0	100	11.0	70,070	19	12	8,408
	41-50	3	103,600	310,800	10	0	100	10.0	31,080	32	20	6,216
	51&Up	1	240,800	240,800	9	0	85	7.7	18,542	48	30	5,562
Cruising Sailboats	15-20	0	4,850	0	8	0	100	8.0	-	-	-	-
	21-30	17	15,600	265,200	8	0	85	6.8	18,034	8	5	902
	31-40	7	43,200	302,400	7	0	75	5.3	16,027	26	16	2,564
	41&Up	1	85,550	85,500	6	0	65	3.9	3,335	40	25	834
Daysailers	8-15	0	1,400	0	12	0	100	-	-	-	-	-
	16-20	2	3,450	6,900	12	0	100	12.0	828	8	5	41
	21-25	1	6,350	6,350	11	0	85	9.4	597	40	25	149
	26&Up	0	12,050	0	10	0	75	-	-	-	-	-
TOTALS		100							$239,413			$29,540

Annual Net Benefits (Plans B, C, and D) = $239,413 - $29,540 = $209,873
Say $209,900
Annual Net Benefits (Plan A) = $209,900 x .93 = $195,207
Say $195,200

TABLE 6-20 RECREATIONAL BOATING BENEFITS
BOATS ADDED WITHIN 10 YEARS
PROJECTED FLEET COMPOSITION CONSISTENT WITH EXISTING FLEET

ISLAND END RIVER
6 ft. DEPTH, 100 ft. WIDTH — 1979 BOATING VALUES — BOATING SEASON: 160 DAYS

TYPE OF CRAFT	LENGTH (Feet)	# OF BOATS	DEPRECIATED VALUES Average $	Totals $	PERCENT Ideal	% of Ideal Pres.	Fut.	RETURN Gain	VALUE $ Days	ON CRUISE Avg. Season	% of $	Value
Outboards	10-14	0	2,950	0	14	0	100	-	-			
	15-20	15	3,900	58,500	13	0	100	13.0	7,605			
	21&Up	3	7,750	23,250	13	0	100	13.0	3,023			
Sterndrive	15-20	5	6,550	32,750	12	0	100	12.0	3,930			
	21-25	14	9,850	137,900	11	0	100	11.0	15,169			
	26&Up	4	22,600	90,400	10	0	100	10.0	9,040			
Inboards	15-20	2	7,350	14,700	12	0	100	12.0	1,760			
	21-30	40	16,680	667,200	12	0	100	12.0	80,064	14	9	7,206
	31-40	21	45,500	955,500	11	0	100	11.0	105,105	19	12	12,613
	41-50	5	103,600	518,000	10	0	100	10.0	51,800	32	20	10,360
	51&Up	1	240,800	240,800	9	0	85	7.7	18,542	48	30	5,562
Cruising	15-20	0	4,850	0	8	0	100	8.0	-	-	-	-
Sailboats	21-30	25	15,600	390,000	8	0	85	6.8	26,520	8	5	1,326
	31-40	10	43,200	432,000	7	0	75	5.3	22,896	26	16	3,663
	41&Up	1	85,500	85,500	6	0	65	3.9	3,335	40	25	834
Daysailers	8-15	0	1,400	0	12	0	100	-	-	-	-	-
	16-20	3	3,450	10,350	12	0	100	12.0	1,242	8	5	62
	21-25	1	6,350	6,350	11	0	85	9.4	597	40	25	149
	26&Up	0	12,050	0	10	0	75	-	-	-	-	-
TOTALS		150							$327,736			$41,775

Annual Net Benefits After 10 Years (Plans B, C, & D) = $327,736 - $41,775 = $285,961
Annual Net Benefits After 10 Years (Plan A) = $285,961 x .93 = $265,944
Annual Equivalent Benefits (Plans B, C, and D) = $285,961 x .7397385 = $211,536
Say $211,500
Annual Equivalent Benefits (Plan A) = $265,944 x .7397385 = $196,729
Say $196,700

TABLE 6-21 RECREATIONAL BOATING BENEFITS
BOATS ADDED IMMEDIATELY
ALL SAILBOATS

ISLAND END RIVER
6 ft. DEPTH, 100 ft. WIDTH

1979 BOATING VALUES

BOATING SEASON: 160 DAYS

TYPE OF CRAFT	LENGTH (Feet)	# OF BOATS	DEPRECIATED VALUES Average	DEPRECIATED VALUES Totals $	PERCENT Ideal $	PERCENT % of Ideal		RETURN Gain Pres. Fut.	VALUE $	ON CRUISE Avg.	ON CRUISE % of Days	ON CRUISE Value Season $
Outboards	10-14											
	15-20											
	21&Up											
Sterndrive	15-20											
	21-25											
	26&Up											
Inboards	15-20											
	21-30											
	31-40											
	41-50											
	51&Up											
Cruising	15-20	1	4,850	4,850	8	0	100	8.0	388	-		
Sailboats	21-30	54	15,600	842,400	8	0	85	6.8	57,283	8	5	2,864
	31-40	29	43,200	1,252,800	7	0	75	5.3	66,398	26	16	10,624
	41&Up	4	85,550	342,000	6	0	65	3.9	13,338	40	25	3,335
Daysailers	8-15	0	-	-	12	0	100	-	-	-	-	-
	16-20	9	3,450	31,050	12	0	100	12.0	3,726	8	5	186
	21-25	3	6,350	19,050	11	0	85	9.4	1,791	40	25	448
	26&Up	0	-	-	10	0	75	-	-	-	-	-
TOTALS		100							$142,915			$17,457

Annual Net Benefits (Plan B, C, & D) = $142,915 - $17,457 = $125,458
Say $125,500

Annual Net Benefits (Plan A) = $125,500 x .93 = $116,715
Say $116,700

TABLE 6-22 RECREATIONAL BOATING BENEFITS
BOATS ADDED WITHIN 10 YEARS
ALL SAILBOATS

ISLAND END RIVER
6 ft. DEPTH, 100 ft. WIDTH

1979 BOATING VALUES

BOATING SEASON: 160 DAYS

TYPE OF CRAFT	LENGTH (Feet)	# OF BOATS	DEPRECIATED VALUES		PERCENT			RETURN	VALUE	ON CRUISE		
			Average $	Totals $	Ideal	% of Ideal Pres.	Fut.	Gain	$ Days	Avg. Season	% of $	Value
Outboards	10-14											
	15-20											
	21&Up											
Sterndrive	15-20											
	21-25											
	26&Up											
Inboards	15-20											
	21-30											
	31-40											
	41-50											
	51&Up											
Cruising Sailboats	15-20	2	4,850	9,700	8	0	100	8.0	776	-		
	21-30	81	15,600	1,263,600	8	0	85	6.8	85,925	8	5	4,296
	31-40	43	43,200	1,857,600	7	0	75	5.3	98,453	26	16	15,752
	41&Up	6	85,500	513,000	6	0	65	3.9	20,007	40	25	5,002
Daysailers	8-15	0	-	-	12	0	100	-	-	-	-	-
	16-20	13	3,450	44,850	12	0	100	12.0	5,382	8	5	269
	21-25	5	6,350	31,750	11	0	85	9.4	2,985	40	25	746
	26&Up	0	-	-	10	0	75	-	-	-	-	-
TOTALS		150							$213,528			$26,065

Annual Net Benefits After 10 Years (Plans B, C, and D) = $213,528 - $26,065 = $187,463
Annual Net Benefits After 10 Years (Plan A) = $187,463 x .93 = $174,341
Annual Equivalent Benefits (Plans B, C, and D) = $187,463 x .7397385 = $138,674
Say $138,700
Annual Equivalent Benefits (Plan A) = $174,341 x .7397385 = $128,967
Say $129,000

TABLE 6-23

RISK AND UNCERTAINTY ANALYSIS

SUMMARY OF ECONOMIC ANALYSIS ASSUMING FUTURE FLEET CONFIGURATION SIMILAR TO EXISTING MIX

PLAN	A	B	C	D
1. Annual Cost	$57,000	$68,000	$95,000	$115,000
2. Annual Benefits	$313,400	$337,000	$337,000	$337,000
3. Benefit-Cost Ratio	5.5	5.0	3.5	2.9
4. Net Benefits	$256,400	$269,000	$242,000	$222,000

SUMMARY OF ECONOMIC ANALYSIS ASSUMING FUTURE FLEET COMPOSED EXCLUSIVELY OF SAILBOATS

PLAN	A	B	C	D
1. Annual Cost	$57,000	$68,000	$95,000	$115,000
2. Annual Benefits	$245,700	$264,200	$264,200	$264,200
3. Benefit-Cost Ratio	4.3	3.9	2.8	2.3
4. Net Benefits	$118,700	$196,200	$169,200	$149,200

1980 BOATING VALUES

TABLE 6-24 BENEFITS TO RECREATIONAL BOATING

HARBOR:

TYPE OF CRAFT	LENGTH (feet)	# of Boats	DEPRECIATED VALUE		PERCENT RETURN				VALUE $	ON CRUISE		
			Average $	Total $	Ideal	% of Ideal		Gain		Avg Days	% of Season	Value $
						Pres.	Fut.					
RECREATIONAL FLEET												
Outboards	15-20		4350									
	21 & Up		8850									
Sterndrive	15-20		6700									
	21-25		10850									
	26 & Up		24200									
Inboards	15-20		7250									
	21-30		17750									
	31-40		47650									
	41-50		98050									
	51-Up		255800									
Cruising Sailboats	15-20		6100									
	21-30		18450									
	31-40		47050									
	41&Up		93250									
Daysailers	8-15		2150									
	16-20		3800									
	21-25		6300									
	26&Up		11500									
Totals												

ISLAND END RIVER
CHELSEA, MASSACHUSETTS

DETAILED PROJECT REPORT

ANALYSIS OF DISPOSAL OF DREDGED MATERIAL
APPENDIX 7

PREPARED BY THE

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

ANALYSIS OF DISPOSAL OF DREDGED MATERIAL

Table of Contents

List of Tables

List of Plates

APPENDIX 7

ANALYSIS OF DISPOSAL OF DREDGED MATERIALS

1. This appendix identifies and evaluates various methods for disposal of dredged materials. Three options have been analyzed: the option of ocean disposal, the option of disposal on land at a site on the shores of the Chelsea Naval Hospital, and disposal in a landfill at the site of the proposed Container Port facility in South Boston.

2. The option of disposal at a land fill site in the City of Cheslea removed from the Island End River or elsewhere in eastern Massachusetts is not considered feasible. There is no landfill site in the City of Chelsea capable of receiving the material. In addition, beacuse the material contains high amounts of pollutants, it is regarded as a toxic substance. The Massachusetts Department of Environmental Quality Engineering has indicated that there is no landfill area in eastern Massachusetts currently approved to receive toxic materials. Even if a suitable landfill site could be found for disposal of dredged materials, it is anticipated that the transport of large quantities of dredged materials to a distant site would cause significant adverse impacts.

3. The option of selling or donating the dredged materials for use as structural fill for most types of construction projects is not considered feasible. The upper strata are generally believed to have poor structural properties. Lower strata particularly on the easterly shore of the river generally are of a granular nature, however, stratified dredging would add to removal costs. Additionally, disposal of lower strata for structural fill would not solve the problem of disposal of the structurally unsuitable upper strata.

4. Massport is currently proposing construction of a major container port facility at the site of the former South Boston Naval Annex. An approximately 40 acre site will be filled to accomodate the loading cranes and container storage facilities. While the dredged material from the Island End River is not ideal fill due to its poor structural properties, other poor quality fill will be placed in the area. Massport plans to dredge the bottom sediments adjacent to the site to create deepwater berths. Additionally, the existing bottom sediments in the container port will not be removed prior to filling. Although no information is available on subsurface conditions at the Massport site, it is probable that the structural properties of the material from the Island End River will be no worse than materials already slated for deposition in the landfill site. Massport plans to obtain fill from various construction projects in the Boston area including the M.B.T.A. red line tunnel excavations. However, there will be ample room to accomodate the volume of materials from the Island End River.

5. The Massport site would be suitable as a disposal site for dredged materials. It is close to the Island End River which would minimize transport costs. Access by water is available which would minimize transport impacts. The feasibility of using the site is based upon scheduling, the properties of the dredged materials, and the acquiescence of Massport.

[illegible] design development for the proposed container port is [illegible] schedule of implementation is similarly uncertain. It is currently [illegible] that fill will be accepted no earlier than 1982 or 1983. Thus, the Island End River improvements might have to be delayed if the Massport site is to be used.

Massport will design appropriate containment, sedimentation and leachate treatment facilities to accommodate proposed fill materials. If the dredged materials from the Island End River were different from the other fill then a pretreatment or modification of the above facilities might be required. The additional expense of facility modification might lead Massport to reject material from the Island End River.

8. At present, the Boston Foul Area is the only designated location off the Massachusetts coast where the ocean disposal of dredged materials is permitted. It is located approximately 24 nautical miles from the Island End River. The area is approxiamtely 1 nautical mile in diameter with a center point at 42° 25' N latitude, 70° 35' W longitude. Water depths at the site range from 270 feet to 300 feet. See Figure 7-1.

9. The currents at all depths in the Boston Foul Area fluctuate considerably in both direction and speed seasonally with the bottom currents being consistently weaker than those measured at mid-depth and near the surface. Along the sea floor the residual drift is southeasterly in January, consistently westerly during June, mostly easterly in September, and variable but somewhat northly in October. The character of the currents and sediments in this area show that discharge of silty/clay dredge material will tend to remain suspended in the water and cause little erosion over time.

10. Although the water quality of the Boston Harbor meets current state and federal standards, there is a measurable deposit of materials on the [illegible] of the Harbor from the effluent discharge of sewage treatment plants containing elevated levels of heavy metals, PCB's, and a complex mixture of hydrocarbons resembling heavy lubrication oil. The concentrations of heavy metals and hydrocarbons are relatively high in the Boston Foul Area in comparison to other areas in Boston Harbor. According to a 1976 study of the Distribution of Polluted Materials in Massachusetts Bay by the New England Aquarium, it would be tempting to assign the higher concentrations near the Foul Area to the dispersion of polluted dredge spoil dumped there in recent years, especially since the net residual drift of bottom currents is shoreward and toward the Foul Area. However, a second factor may contribute to the distribution patterns displayed here. The regions of highest metal and hydrocarbon content are also those with the deepest deposits of silt and clay. The sedimentation rates evidenced by the depth of existing deposits indicates that these areas may be natural sinks for both polluted

and unpolluted suspended solids entering Massachusetts Bay.

11. The offshore benthic population in the fine-grained substrates of Massachusetts Bay can best be characterized as a spio filicornis-thyosira (gouldi) community. In the Boston Foul Area, the number of species and individuals are relatively depressed as compared with the entire area. Since this is not biologically productive, the dumping of dredge materials here is considered to be less environmentally damaging than disposal elsewhere.

12. An analysis of bottom sediments from the Island End River classified the material as "black, oily, fine sandy clay with strong petroleum odor and fibrous organics." The sediments exhibit a high percentage of grain sizes classified as "fine" and also high water contents. This indicates that the material is likely to disperse somewhat when dumped at sea, rather than settling rapidly to the bottom.

13. The chemical analysis of the bottom sediments indicated that the solids are polluted with fairly high levels of heavy metals, such as zinc, lead and mercury. The elutriate tests, which determine the chemical concentrations in the liquid phase, generally are more significant in terms of indicating potential environmental impacts. The pollutants contained in the elutriate are more likely to be ingested by marine organisms and enter the food chains. An analysis of the chemical pollutants is found in the Environmental Assessment.

14. Specific standards must be attained before approval can be obtained for ocean disposal of dredge materials. Section 103 of the Marine Protection Reseach and Sanctuaries Act of 1972 (Public Law 92-532) requires that any proposed dumping of dredged material into ocean waters must be evaluated to determine its potential environmental effects on marine organisms. Appendix 5 contains the detailed bioassay report entitled Ecological Evaluation of Proposed Oceanic Discharge of Dredged Material from Island End River, Chelsea, Massachusetts.

15. The bioassay is conducted by determining the effects of a liquid phase, a suspended particulate phase and a solid phase from the dredged sediments on the mortality rates of marine animals. The mortality rates occurring in the dredge samples are compared to those occurring with control samples to determine if disposal of the dredge material will have adverse ecological effects.

The bioassay conducted for the Island End River indicated that the liquid phase and the suspended particulate phase samples from the dredge material were not significantly different from the control samples. The solid phase, however, in the first evaluation appeared to have a significantly different effect than the control sediments.

16. The solid phase dredge material sample had a significant effect on the mortality of mysid shrimp when compared to the control sample. It was believed that the high mortality of shrimp exposed to Island End River sediments was due to the effects of fine particles clogging their gills. The control sample consisted of clean sand, in comparison to the silty mud of the dredge sample, and therefore, did not have this clogging effect on the shrimp.

17. Consequently, the original solid phase bioassay results were considered inconclusive. The solid phase bioassay was repeated using reference samples from the disposal site. Sediments from the Boston Foul Area are similar to Island End River in that they are both silt-clay size particles. This test indicted that there was not a significant difference between Island End River dredged material and the disposal site and was therefore judged to be ecologically acceptable for ocean disposal.

18. Ocean disposal would have a lower economic cost than land disposal. Secondary impacts relating to transport would be minimal when compared to any alternative involving trucking dredged materials for substantial distances.

19. Discussions with Department of Environmental Quality Engineering indicate that there are no communities in the area of the project having sanitary landfills that meet the present criteria for disposal of polluted waste. No communities other than Chelsea are likely to be willing to designate a disposal are for the wastes from this project. Because Chelsea is urbanized, finding a suitable location for such a site would be difficult.

20. Land disposal would limit the development potential of the land disposal site due to the poor structural properties of the dredged material. Therefore, ocean disposal is considered preferable. Land disposal of dredged material is less desirable than ocean disposal for a number of economic and environmental reasons. In the case of the Island End River, the following factors must be considered:

- The upper layer of river bottom sediments consists of highly organic mud. When this is placed on land to dry, anaerobic decomposition of organic material is likely to give off objectionable odors. Thus, it is undesirable to dispose of the material near populated areas.

- Dredged materials would be characteristically clayey and silty, and would form poor quality landfill subject to substantial consolidation.

- It would have poor bearing capacities without substantial soil improvement efforts.

- High concentrations of heavy metals such as lead, zinc, and mercury in the upper layers, as well as high concentrations of oil residues would result in pollution of ground and surface water.

Massachusetts Department of Environmental Quality Engineering regulations require that dredged materials with physical and chemical properties comparable to those found in the Island End River be placed in sites contained by dikes or bulkheads. Weir effluent must also be controlled. The disposal site must be designated by the local Board of Health. Depending on the nature of the pollutants, Department of Environmental Quality Engineering may also place other conditions on the disposal method.

21. There is an available land disposal site contiguous to the marina site on the proposed Chelsea Naval Hospital Redevelopment site. The site has a surface area of 393,000 square feet, and is capable of handling the 130,000 cubic yards of dredged material. The primary planning effort was to determine the optimum elevation of the top of the dike, which would would provide the required volume. This was accomplished by computing the volume at selected elevations and performing a linear interpolation. The results indicate that the optimum elevation for the top of the dike would be 37 feet above mean low water. This would require a containment dike with an average height of 9.3 feet and a total volume of 28,000 cubic yards.

22. Disposal of dredge material adjacent to the Island End River presents a number of problems. Because of the proposed MDC park, the only possible land disposal site would be at the marina development site. Figures 7-2 and 7-3 show the existing and proposed land uses at this location. Disposal of dredged materials here would raise the elevation of the marina parking lot and work yard area, and would provide poor soil foundation conditions for roads, parking lots, and buildings. Although capacity and cost of constructing a land disposal area for dredged materials are dependent on existing subsurface characteristics of the site, no site specific soils information is available. While present soil conditions in the proposed disposal area are not known, the city of Chelsea feels that the eastern portion of the area designated for industrial and commercial development presently provides good foundation conditions for construction. However, the western part of the site in the area of the proposed marina parking lot was apparently used at one time as a dump. Therefore, in this area, subsurface conditions are likely to be poor and very little good borrow is likely to be available for construction of retaining dikes. The area would require earthen dikes to contain the dredged material. The dikes could be constructed of material which is locally available. The dikes must, however, be impervious in order to prevent leeching of the toxic dredged materials back into the river or the harbor. If the locally available borrow is not impervious, then the entire containment facility must be lined in such a way as to make it impervious. This can be accomplished in many ways, including a neoprene liner, or an impervous core.

23. The land disposal area must be capable of handling the spoils from the marina basin as well as from the channel. Volumes for the channel dredging range from 51,800 to 110,000 cubic yards while the marina basin and boat launching ramps would require dredging of approximately 64,900 cubic yards. For the selected Plan B, the channel proides 64,100 cubic yards, virtually the same as for the marina basin.

24. If dredging of the marina basin were to take place one or two years after the channel dredging, a staged disposal method could be used. After the channel dredging spoils have sufficiently dewatered, they may be excavated and the diked area used to dewater the marina basin dredged materials. Double use of the diked area would reduce the size and cost of construction of the area, offsetting the double mobilization cost involved in staged dredging.

25. Four alternative land disposal plans have been evaluated. These are described below. It should be noted that the costs are for the shore work only and do not include the costs of placing the dredged material into the diked basins.

26. Alternative 1 is illustrated in Figure 7-4. A triangular basin would be constructed in the area north of the proposed Road "A" which is to be constructed as part of the Chelsea Naval Hospital redevelopment. The top of the dike would have to be built up to about elevation 38, providing a capacity of 65,000 cubic yards in the basin. A total of 46,000 cubic yards of embankment fill would be required to construct the retaining dikes; of this amount, only about 10,000 cubic yards would be available from local borrow pits.

27. Dredged material could be disposed of in two stages. After the channel material has dewatered sufficiently, it could be excavated and placed in areas to the south and east of Road "A." The retention basin could then be used again to dewater the material dredged from the marina basin. The following is a preliminary cost estimate of this disposal option.

TABLE 7-1

Projected Land Disposal Costs
Alternative 1

Locally Available Borrow	10,000 cy @ $1/cy	$10,000
Additional Fill	35,000 cy @ $4/cy	140,000
Effluent Weir and Flume and Site Work		15,000
	Subtotal	$165,000
Rehandling of First State Dredgings	65,000 cy @ $1/cy	65,000
Capping Layer Over Second Stage	8,000 cy @ $4/cy	32,000
	TOTAL	$262,000

28. Alternative 2, shown in Figure 7-5, provides for the disposal of the total amount of dredged material from the Plan B channel and the marina basin in an area north of Road "A". This would require bulkheading a low marshy area to the north of the marina site, as well as the construction of retaining dikes as in Alternative 1. The tops of the dikes would have to be brought up to elevation 43.

29. For the purposes of this preliminary evaluation it has been assumed that subsurface conditions are such that such large dikes and bulkheads could feasibly be constructed in this area. It is possible that subsurface conditions could limit the size the location of the retaining dikes proposed in Alternative 1 and 2.

30. The following is a cost estimate for Alternative 2:

TABLE 7-2

Projected Land Disposal Costs
Alternative 2

Available Borrow	10,000 cy @ $1/cy	$10,000
Other Fill	60,200 cy @ $4/cy	240,000
Bulkheads	560 L.F.	140,000
Effluent Weir and Flume Site Work		15,000
Capping Layer	12,000 cy @ $4/cy	48,000
	TOTAL	$453,000

31. Alternative 3 is illustrated in Figure 7-6. This alternative would require the relocation of proposed Roads "A" and "B" as shown. The existing road would have to be temporarily deadened near Building 2. After the dredged material has consolidated, Roads "A" and "B" could be constructed as planned, although their construction costs would be considerably higher since preconsolidation may be required.

32. Alternative 3 spreads the dredged materials over a much larger area, consequently the necessary retaining dikes are much lower. Because the borrow area is extended into the hillside where gravel-like material is more likely to be found, it appears that retaining dikes could be constructed from locally available borrow. Costs of Alternative 3, not including additional road construction costs, are as follows:

TABLE 7-3

Projected Land Disposal Costs
Alternative 3

Stet Borrow	28,000 cy @ $1/cy	$28,000
Effluent Weir and Flume and Site Work		15,000
Capping Layer	27,000 cy @ $1/cy	27,000
	TOTAL	$70,000

33. All three alternatives would require placing dredged material of poor structural fill over an area where marina parking and service buildings are proposed. Although the existing subsurface conditions are not defined, a layer of loose organic fill would certainly add to subsequent development costs. Alternative 1, in particular, would greatly increase the cost of developing the proposed industrial site adjacent to the marina, and would make development of the marina site difficult. The marina parking lot area would be left at an elevation of more than 40 feet above mean low water, and the area of the proposed boat launching ramp would be more than 20 feet above mean low water. Development of the industrial site is somewhat more feasible with Alternative 2, although some regrading would be needed and building foundation costs would be increased. A final alternative, Alternative 4, shown in Figure 7-7, provides for the disposal of the dredged material from a uniform 1 foot cut through the channel and marina basin. This will allow for removal of the more toxic material from the river. The rest of the dredged material will be disposed of at sea in the Boston Foul Area (see Paragraph 8). This alternative would require the construction of containment dikes as in Alternatives 1 through 3. The tops of these dikes would have to be brought up to elevation 30. This would provide a capacity of about 27,500 cubic yards. The construction of the containment dikes would require approximately 8,500 cubic yards of material, which is available in local borrow pits.

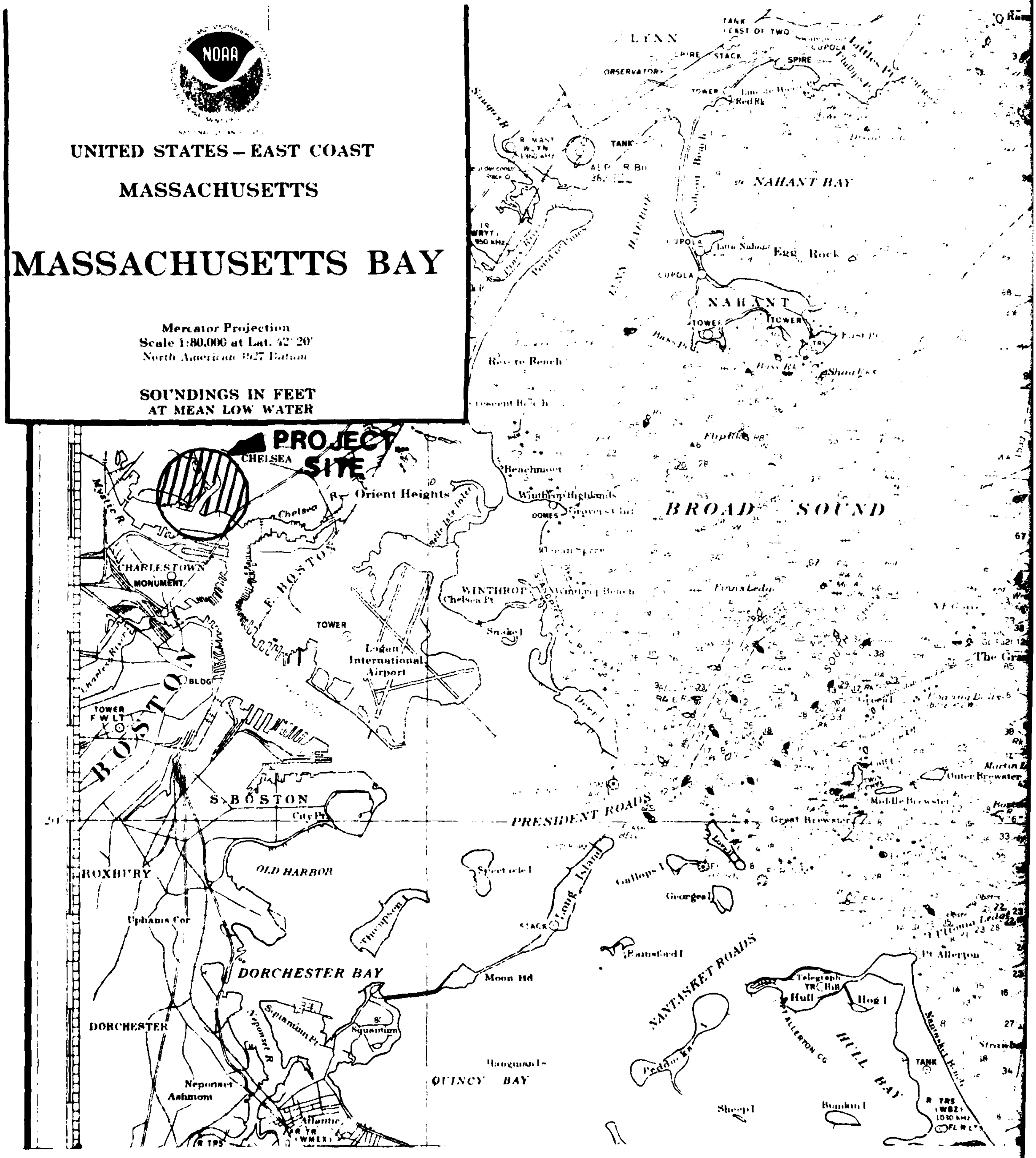
TABLE 7-4

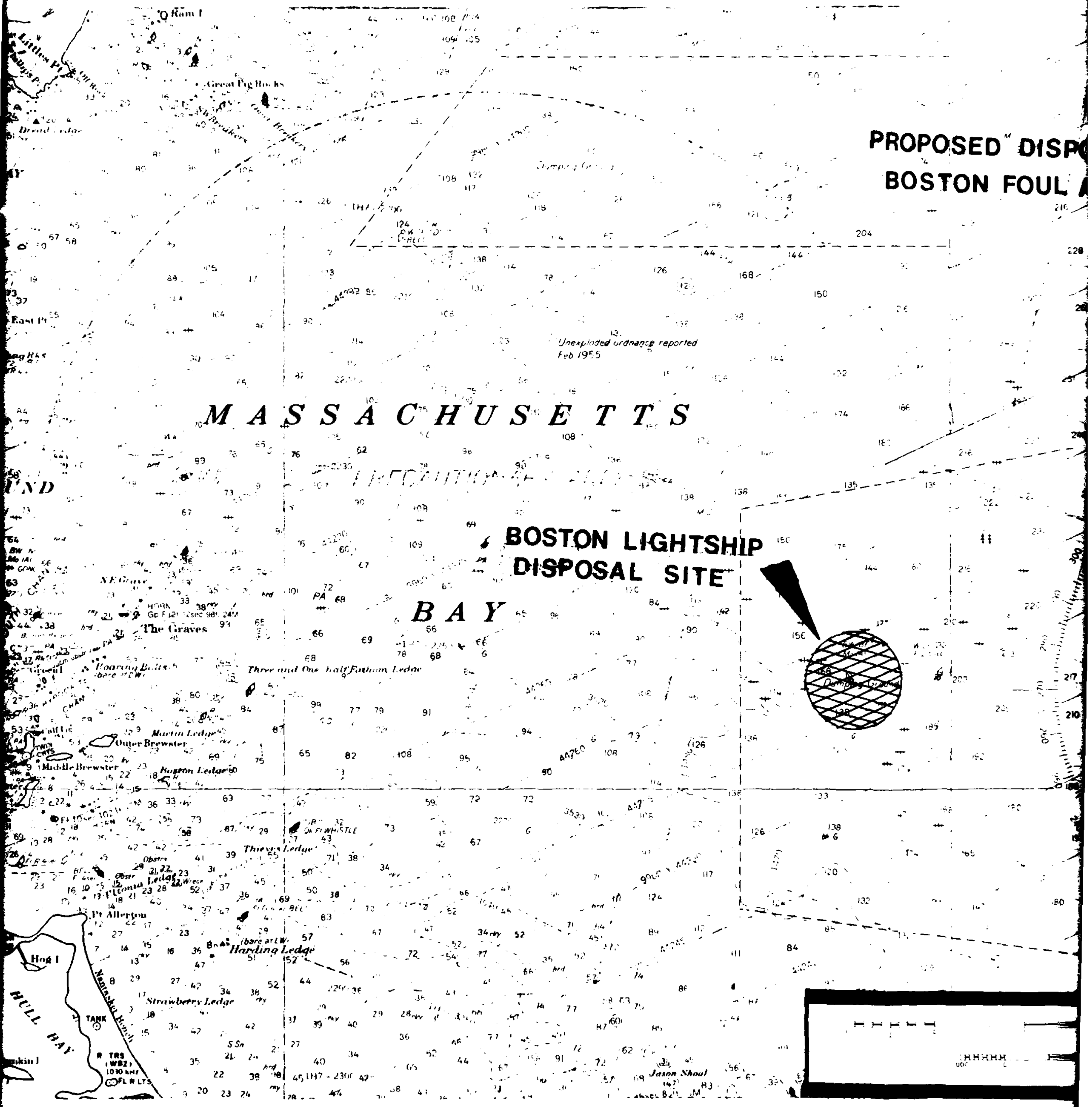
Projected Land Disposal Costs
Alternative 4

Locally Available Borrow	8,500 cy @ $1/cy	$8,500
Effluent Weir and Flume and Site Work		15,000
Capping Layers	13,000 cy @ $1/cy	13,000
	TOTAL	$36,500

34. In summary, disposal of dredged materials at the Chelsea Naval Hospital site would be incompatible with the city of Chelsea development plans. Disposal at the proposed containment facility in

South Boston, would necessitate a significant delay in the construction of the proposed project. As ocean disposal is economically feasible and would cause no delays in construction of the project, it was deemed the most feasible of the disposal options. To ascertain the environmental acceptability and impacts of ocean disposal, a number of tests and analyses was required. The data is located in Appendix 5. Evaluation of the test results and the anticipated impacts are discussed in the Environmental Assessment.


NOAA
UNITED STATES – EAST COAST
MASSACHUSETTS
MASSACHUSETTS BAY
Mercator Projection
Scale 1:80,000 at Lat. 42°20'
North American 1927 Datum
SOUNDINGS IN FEET
AT MEAN LOW WATER
PROJECT SITE
CHELSEA
Mystic R
CHARLESTOWN
MONUMENT
Chelsea
Orient Heights
E. BOSTON
TOWER
Logan International Airport
BOSTON
BLDG
TOWER F W L T
S. BOSTON
City Pt
ROXBURY
OLD HARBOR
Uphams Cor
DORCHESTER BAY
DORCHESTER
Neponset R
Squantum Pt
Squantum
Neponset
Ashmont
Atlantic
R TR (WMEX)
R TRS
Thompson I
Moon Hd
Hangman I
QUINCY BAY
Spectacle I
Long Island
STACK
Gallops I
Georges I
Rainsford I
NANTASKET ROADS
Peddocks I
Sheep I
Bumkin I
Telegraph
Hull
Hog I
ALLERTON CG
HULL BAY
TANK
Nantasket Beach
Pt Allerton
PRESIDENT ROADS
Lovell I
Great Brewster
Middle Brewster
Outer Brewster
BROAD SOUND
Deer I
Snake I
WINTHROP
Chelsea Pt
Winthrop Beach
Winthrop Highlands
Beachmont
Revere Beach
Crescent Beach
DOMES
Ocean Spray
Belle Isle Inlet
Flip Rk
Finns Ledge
Nix Mate
Egg Rock
NAHANT
NAHANT BAY
Little Nahant
East Pt
Bass Pt
Shag Rks
CUPOLA
TOWER
LYNN
LYNN HARBOR
Lynn Beach
TANK
OBSERVATORY
SPIRE
STACK
Saugus R
Pines R
Point of Pines
Red Rk
The Graves
Martin Ledge
Strawberry


PROPOSED DISP
BOSTON FOUL
BOSTON LIGHTSHIP
DISPOSAL SITE
Dumping Ground
MASSACHUSETTS
BAY
Unexploded ordnance reported
Feb 1955
Great Pig Rocks
The Graves
N E Grave
Three and One half Fathom Ledge
Roaring Bulls
Outer Brewster
Martin Ledge
Middle Brewster
Boston Ledge
Thieves Ledge
Harding Ledge
Strawberry Ledge
Pt Allerton
Hog I
HULL BAY
Nantasket Beach
TANK
Jason Shoal
East Pt
Dread Ledge
Ram I
Littles Pt

2

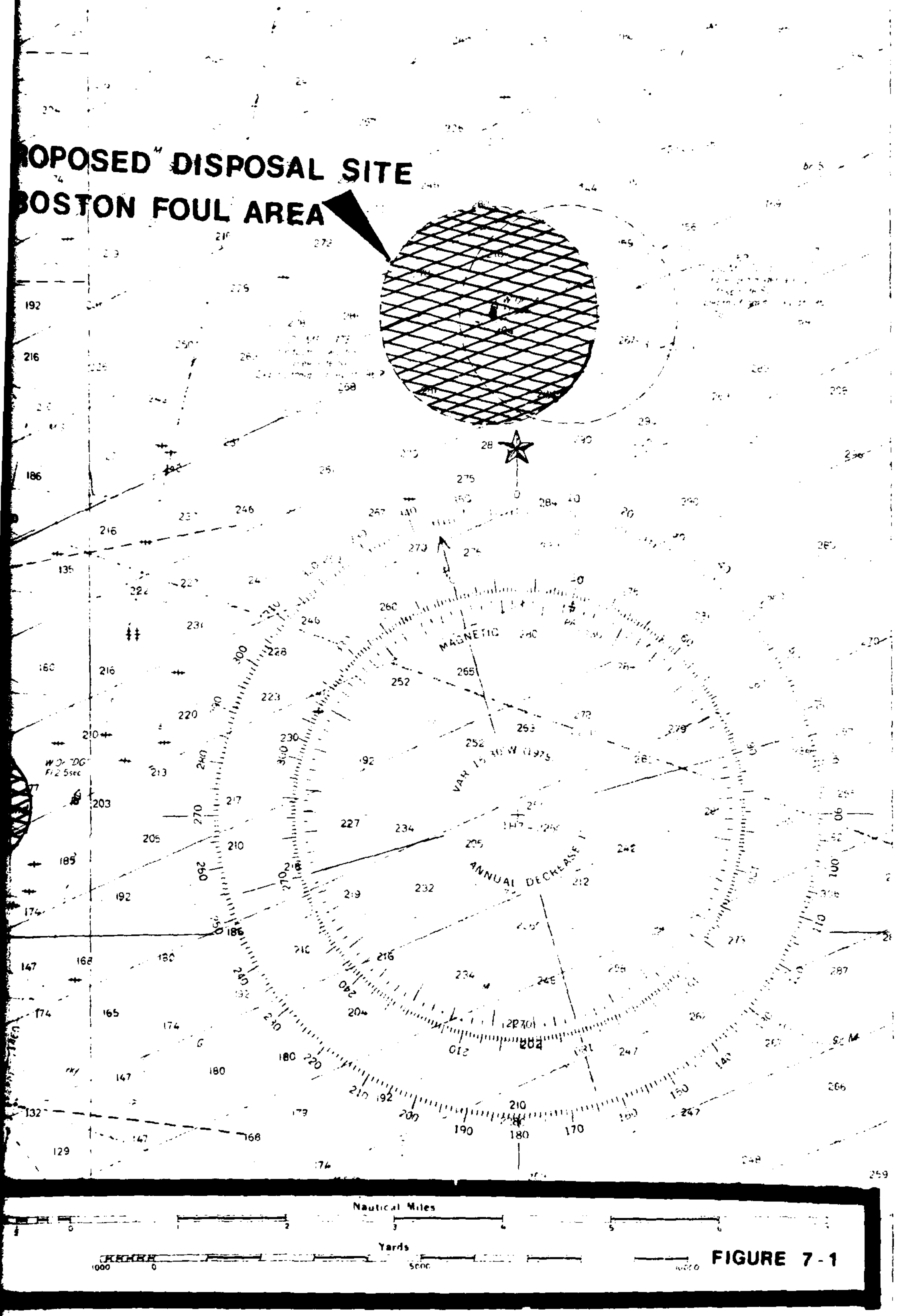
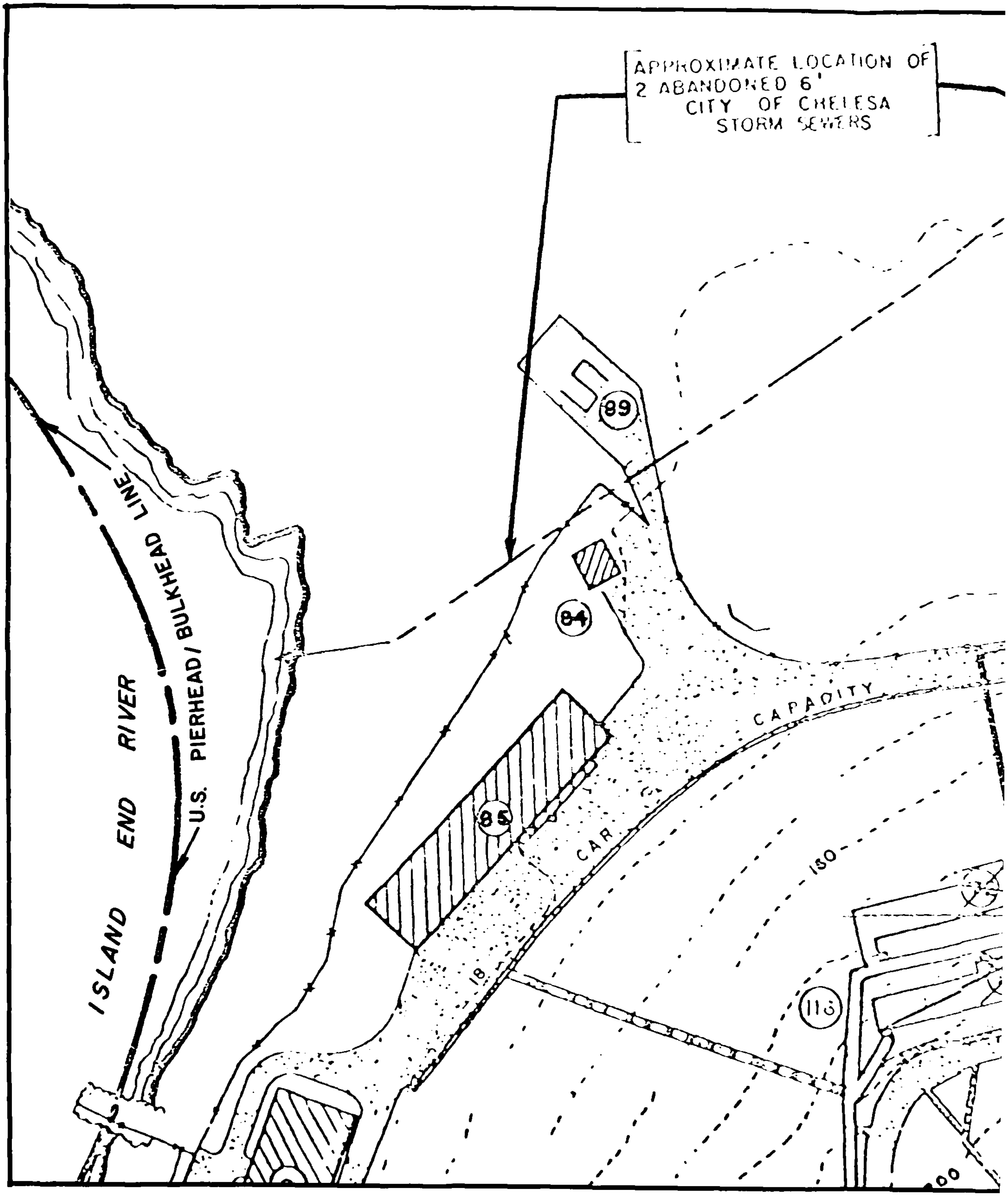
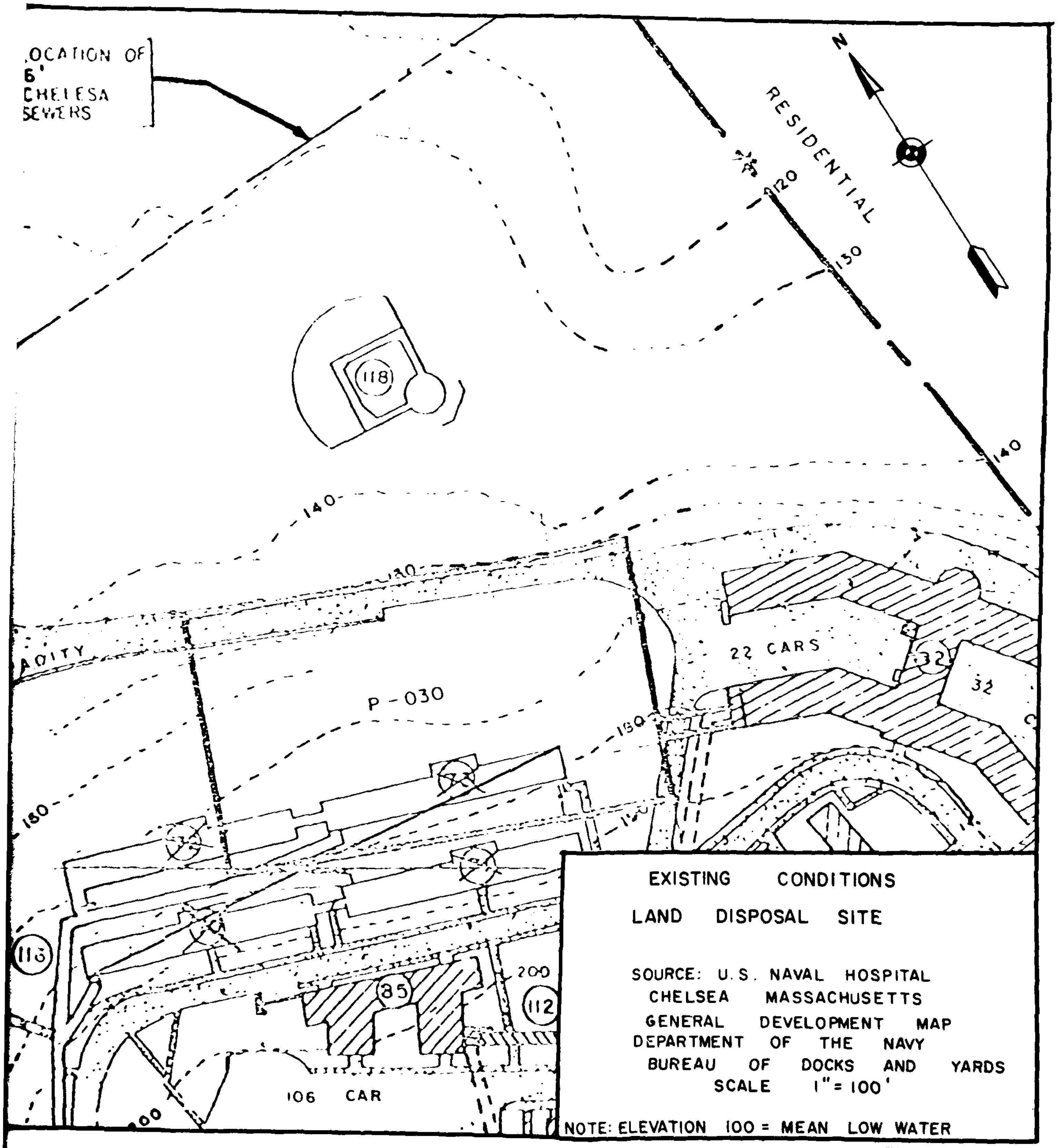

OPOSED" DISPOSAL SITE
OSTON FOUL AREA
MAGNETIC
VAR 15°30'W (1975)
ANNUAL DECREASE 1'
Nautical Miles
0
1
2
3
4
5
6
Yards
1000
0
5000
10000

FIGURE 7-1


APPROXIMATE LOCATION OF
2 ABANDONED 6'
CITY OF CHELESA
STORM SEWERS
ISLAND END RIVER
U.S. PIERHEAD/ BULKHEAD LINE
89
84
85
113
CAPACITY
CAR
18
130
00



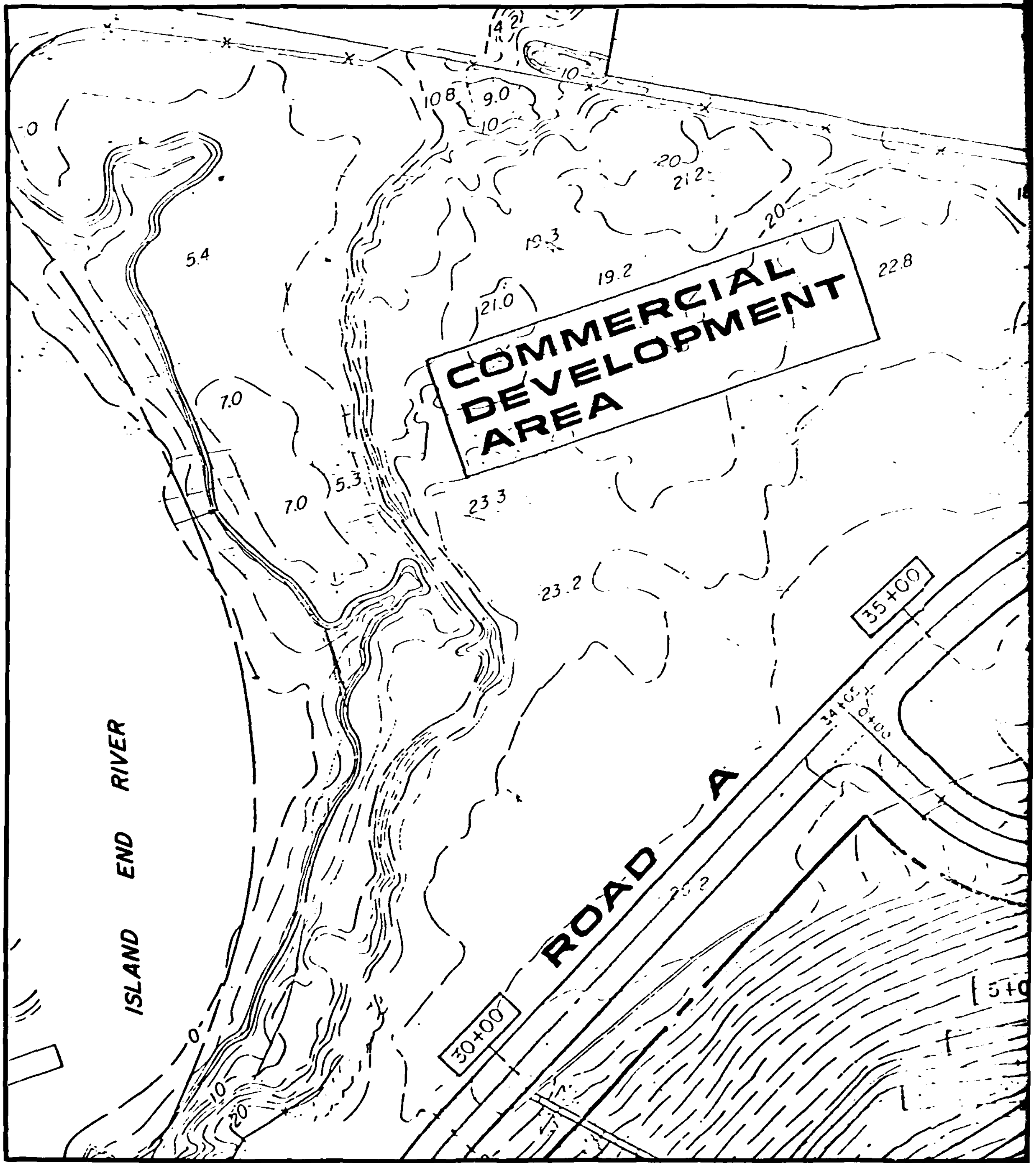
EXISTING CONDITIONS

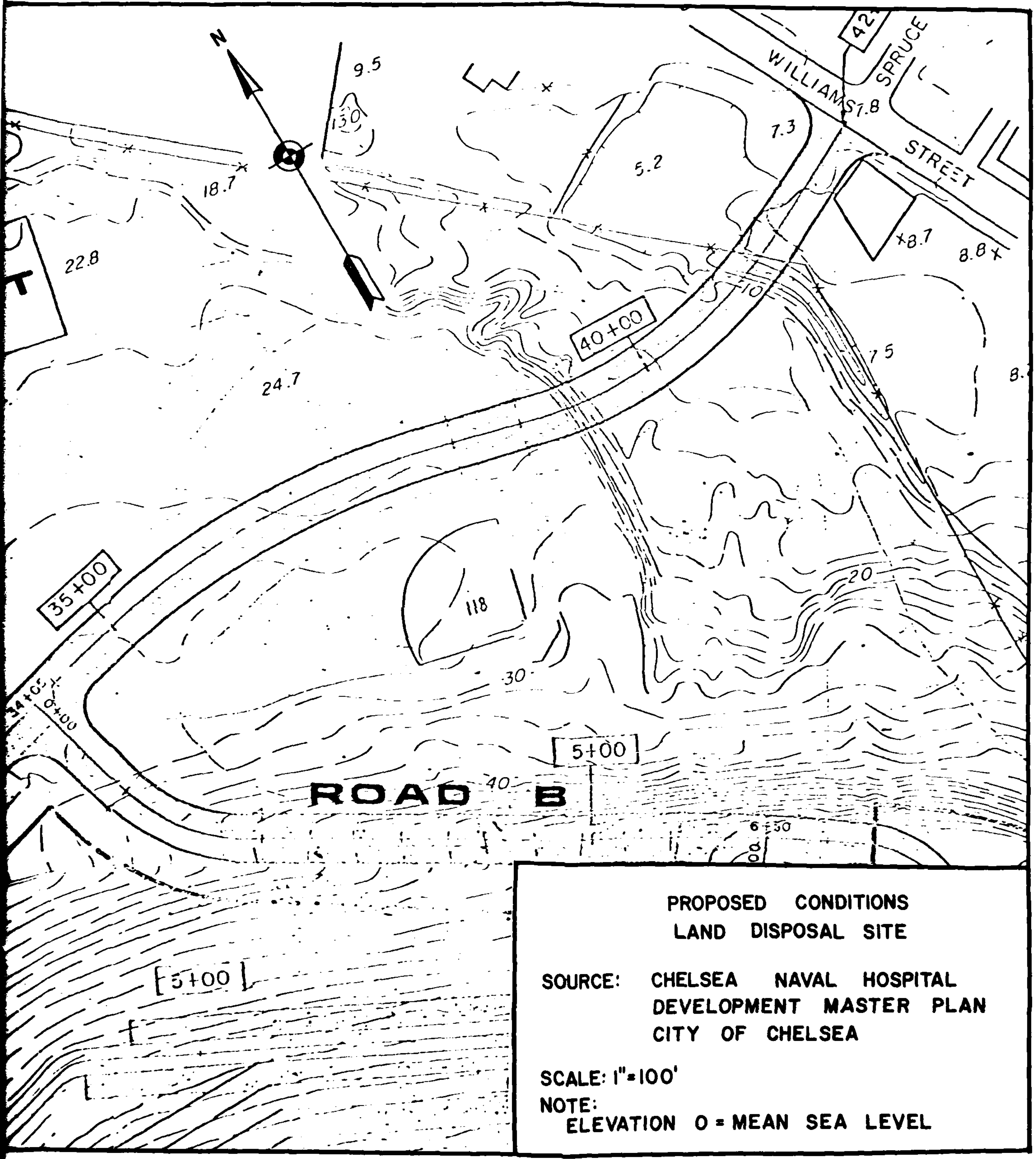
LAND DISPOSAL SITE

SOURCE: U.S. NAVAL HOSPITAL
CHELSEA MASSACHUSETTS
GENERAL DEVELOPMENT MAP
DEPARTMENT OF THE NAVY
BUREAU OF DOCKS AND YARDS
SCALE 1" = 100'

NOTE: ELEVATION 100 = MEAN LOW WATER

FIGURE 7-2


COMMERCIAL DEVELOPMENT AREA
ISLAND END RIVER
ROAD A
35+00
30+00
34+05
0+00
5.4
7.0
7.0
5.3
10.8
9.0
10
20
21.2
19.3
19.2
21.0
22.8
23.3
23.2
0
10
20



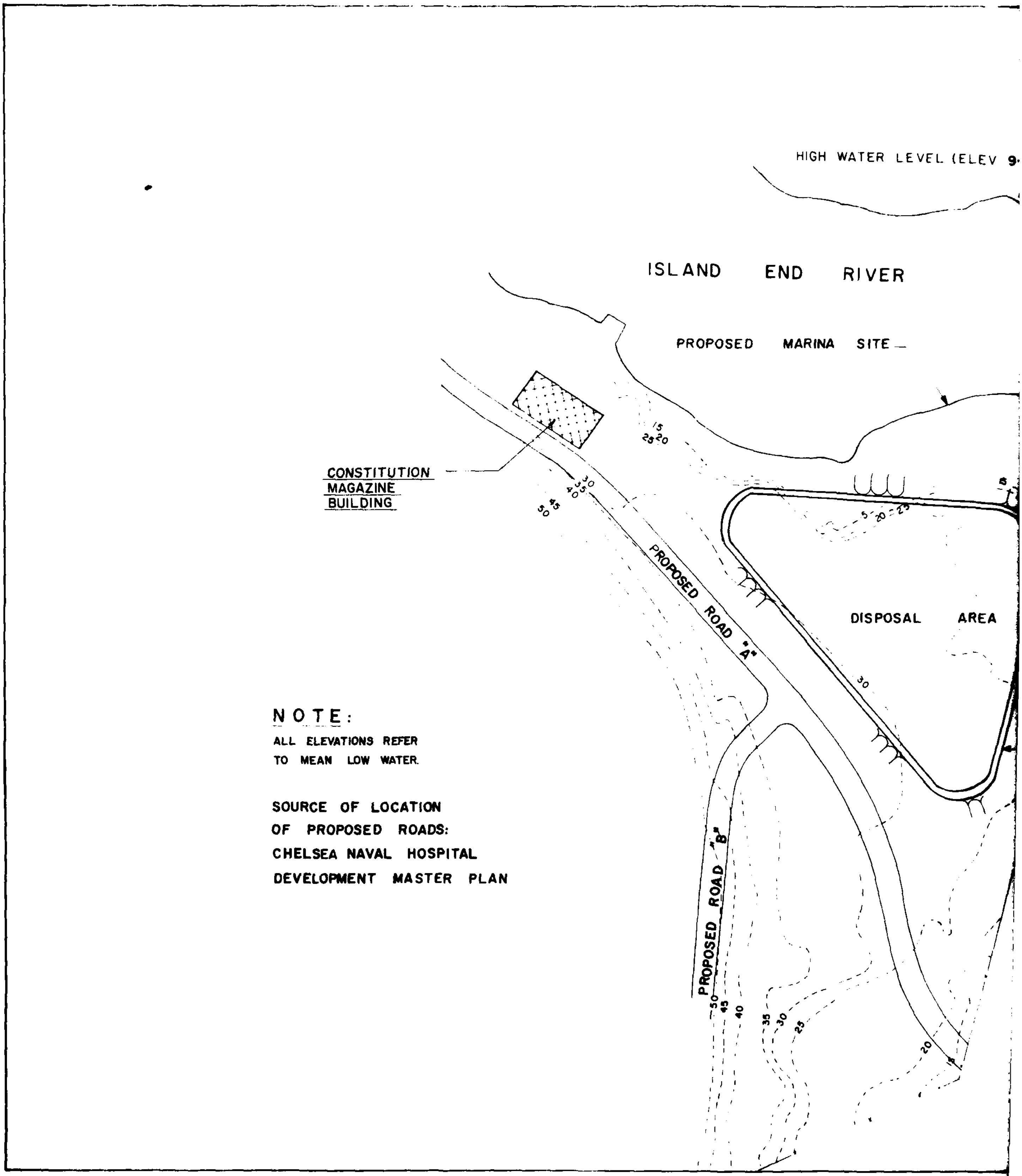
PROPOSED CONDITIONS
LAND DISPOSAL SITE

SOURCE: CHELSEA NAVAL HOSPITAL
DEVELOPMENT MASTER PLAN
CITY OF CHELSEA

SCALE: 1"=100'

NOTE:
ELEVATION 0 = MEAN SEA LEVEL

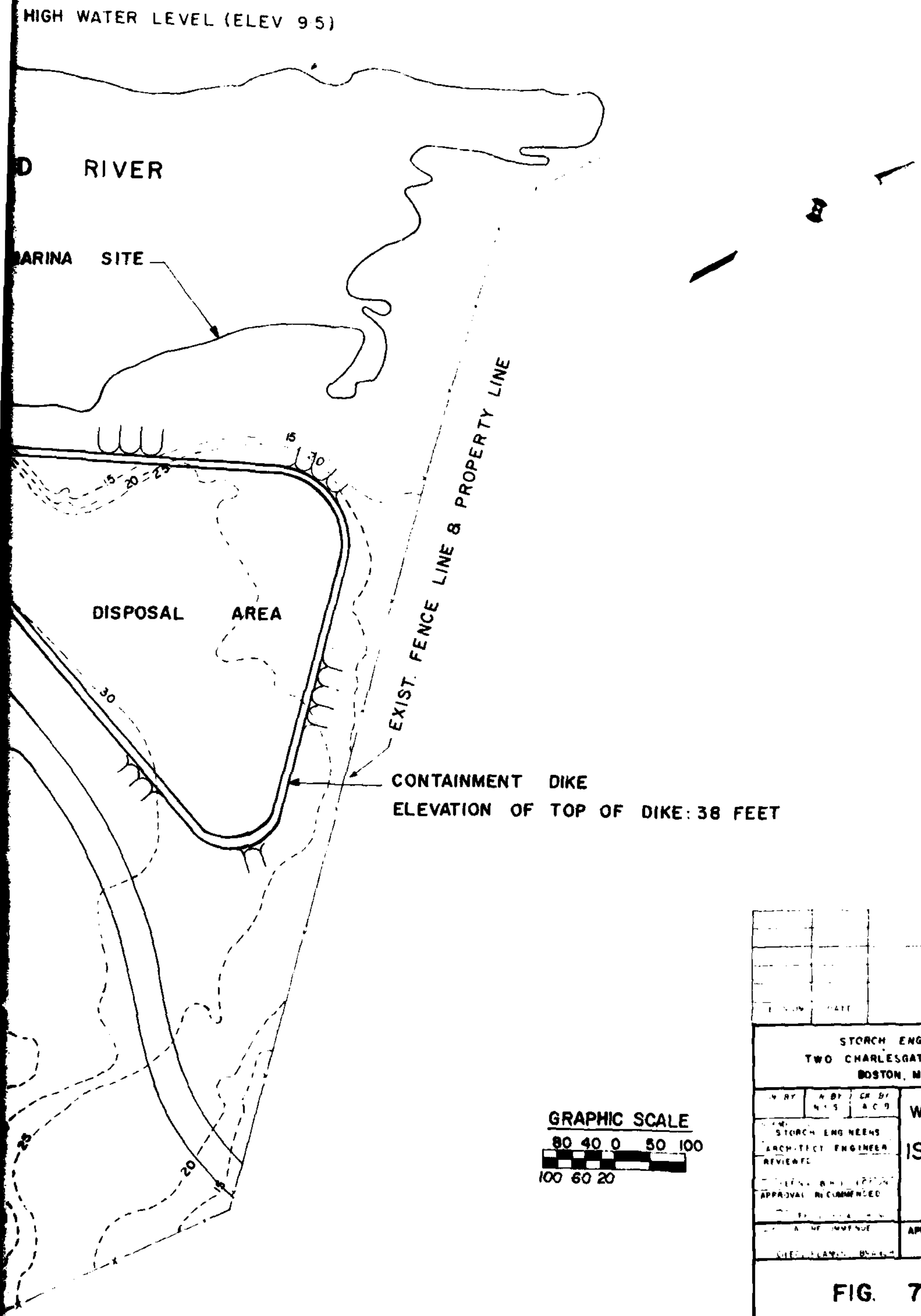
FIGURE 7-3



NOTE:

ALL ELEVATIONS REFER
TO MEAN LOW WATER.

SOURCE OF LOCATION
OF PROPOSED ROADS:
CHELSEA NAVAL HOSPITAL
DEVELOPMENT MASTER PLAN



STORCH ENGINEERS
TWO CHARLESGATE WEST
BOSTON, MASS

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

STORCH ENGINEERS
ARCHITECT ENGINEER
REVIEWED
APPROVAL RECOMMENDED

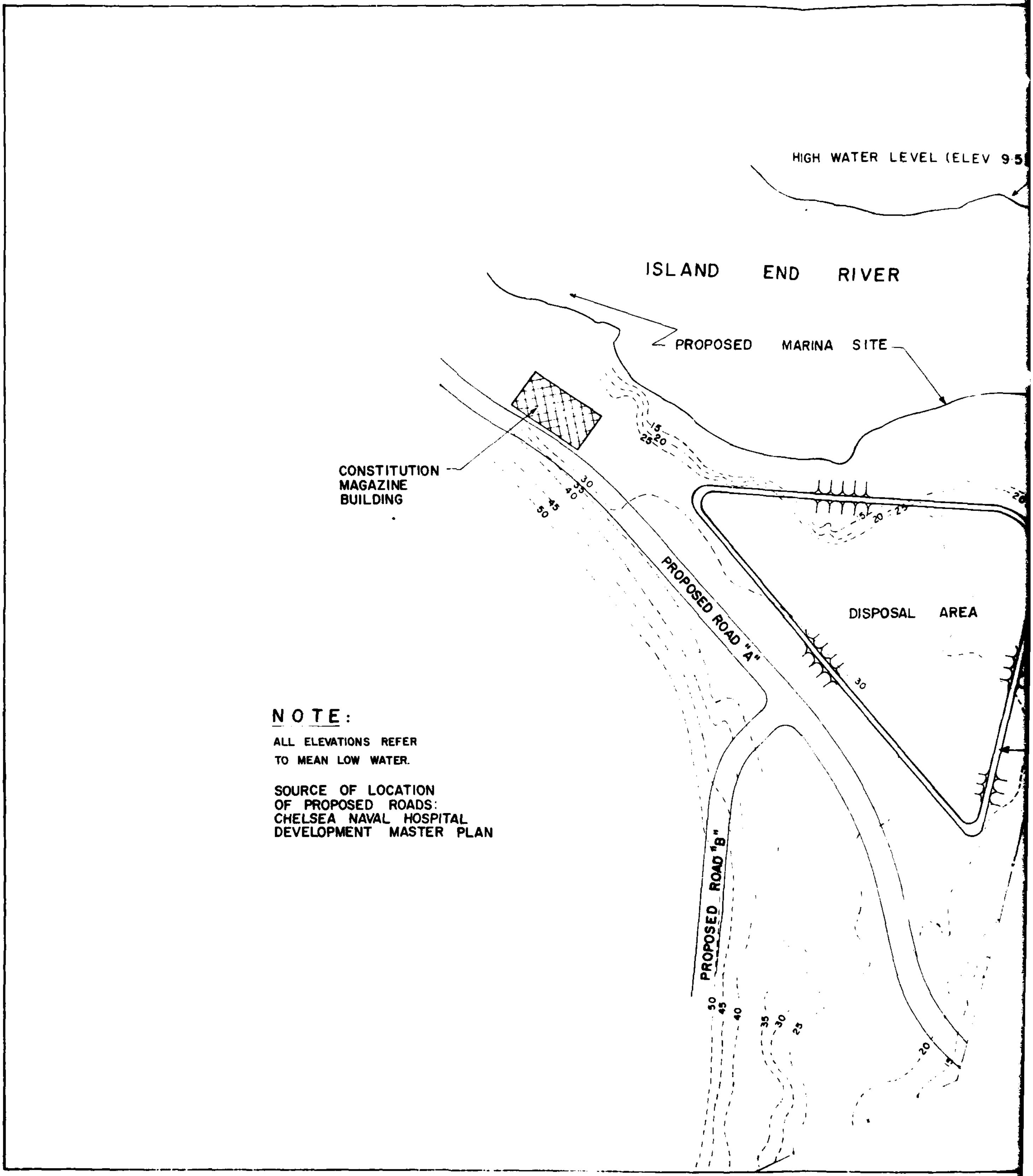
WATER RESOURCES IMPROVEMENT STUDY
ISLAND END RIVER- CHELSEA, MA.
ALTERNATIVE PLAN I

APPROVED
DATE

SCALE
SPEC NO DACW 33-79-C 0076
DRAWING NUMBER

FIG. 7-4

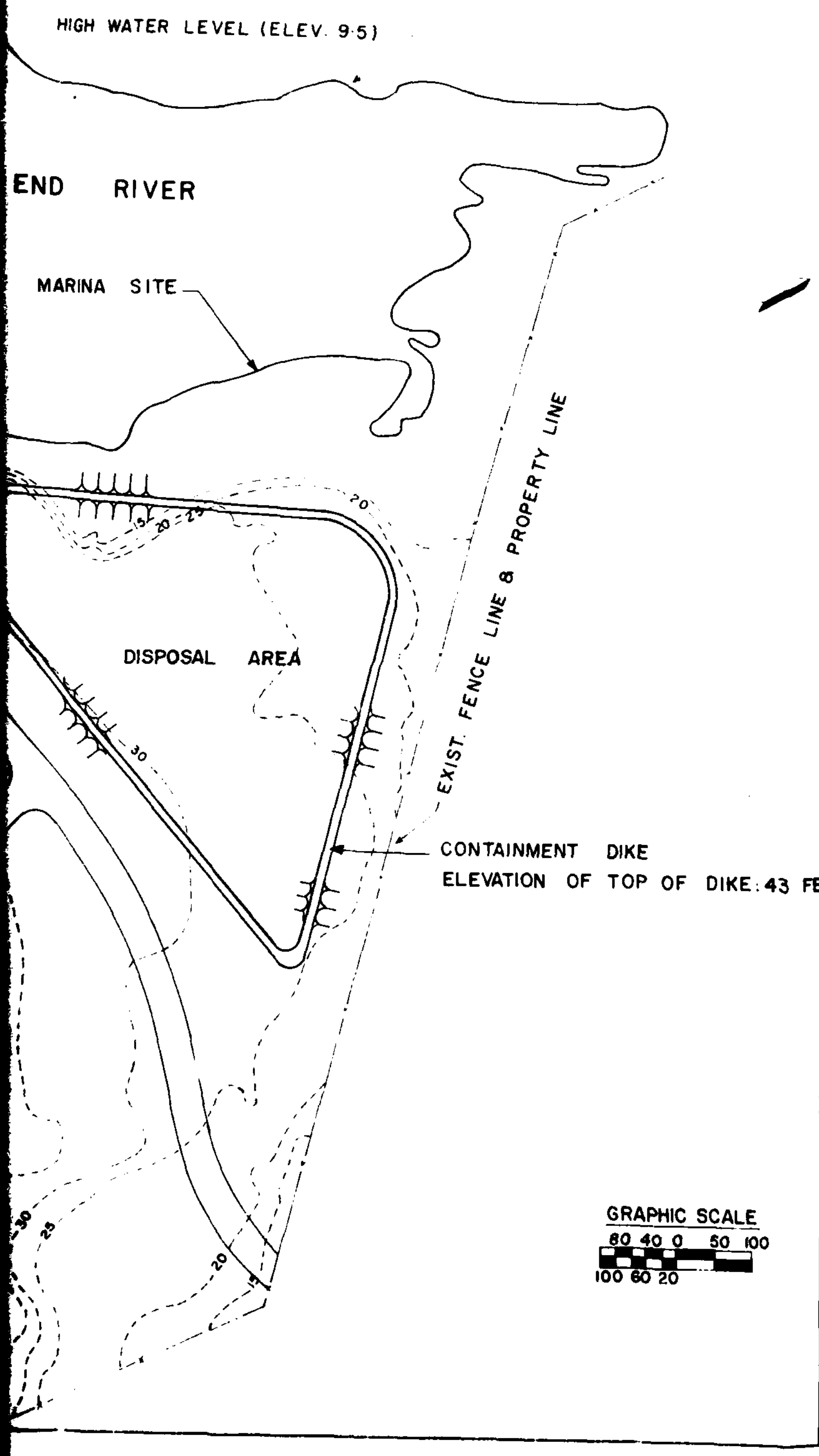
12



NOTE:

ALL ELEVATIONS REFER TO MEAN LOW WATER.

SOURCE OF LOCATION OF PROPOSED ROADS:
CHELSEA NAVAL HOSPITAL DEVELOPMENT MASTER PLAN



STORCH ENGINEERS
TWO CHARLESGATE WEST
BOSTON, MASS

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DN. BY
N. BY
N. S.
CK. BY
A. C. H.
STORCH ENGINEERS
ARCHITECT ENGINEER
REVIEWED
APPROVAL RECOMMENDED

WATER RESOURCES IMPROVEMENT STUDY

ISLAND END RIVER - CHELSA, MA.

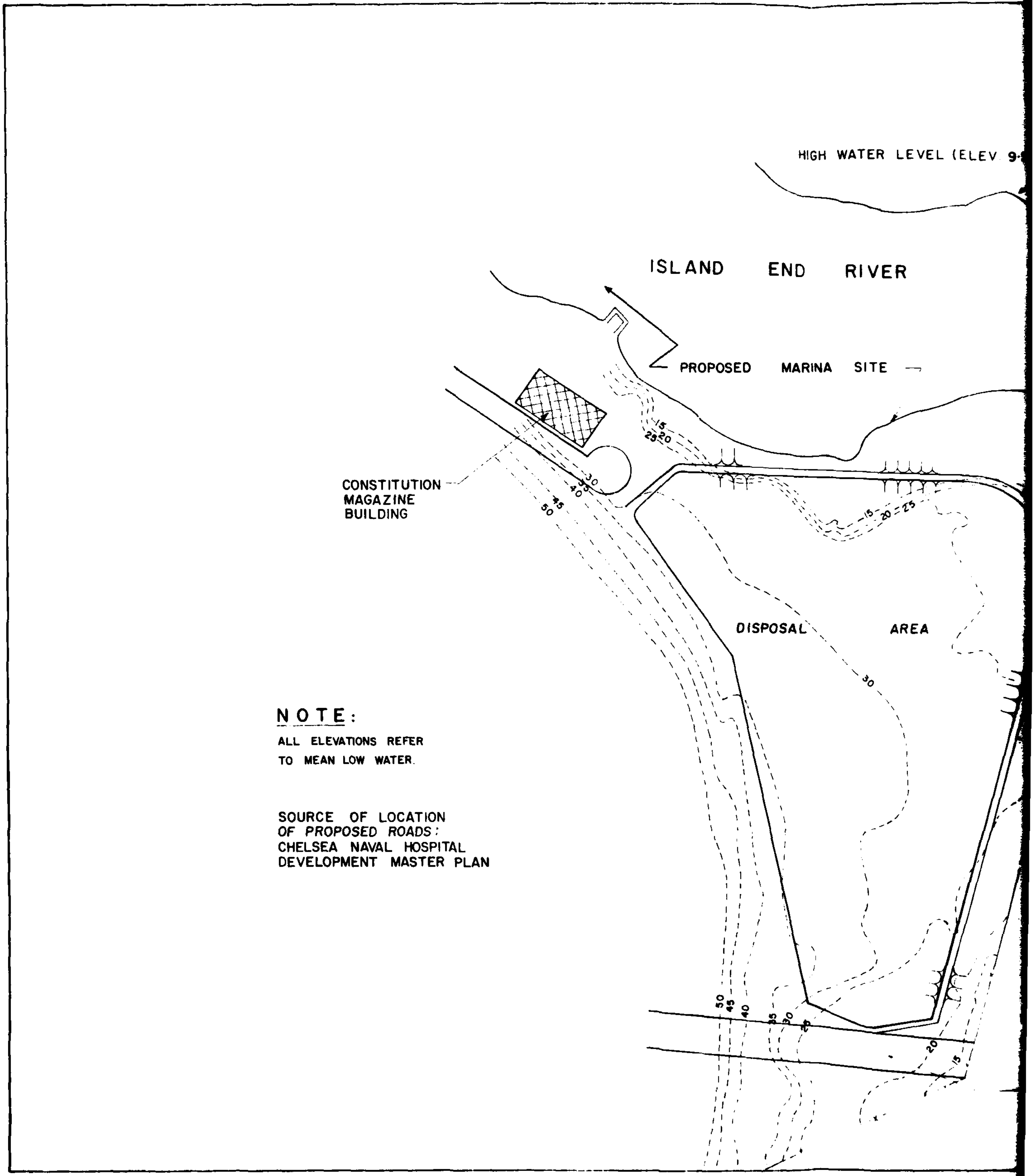
ALTERNATIVE PLAN 2

APPROVED
DATE
CHIEF, ENGINEERING DIVISION

FIG. 7-5

SCALE

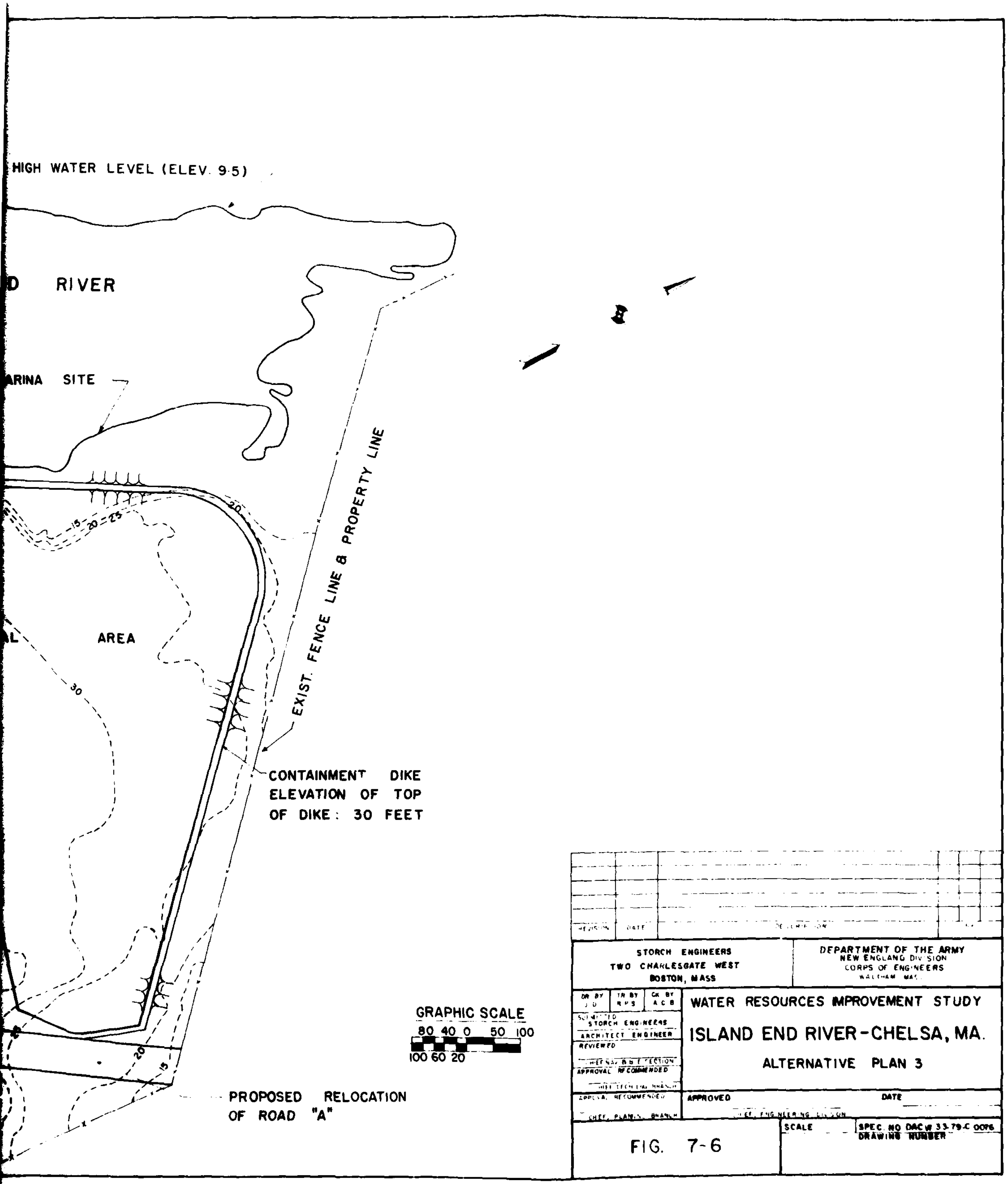
SPEC NO DACW 33-79-C 0076
DRAWING NUMBER



NOTE:

ALL ELEVATIONS REFER TO MEAN LOW WATER.

SOURCE OF LOCATION OF PROPOSED ROADS:
CHELSEA NAVAL HOSPITAL DEVELOPMENT MASTER PLAN



STORCH ENGINEERS
TWO CHARLESGATE WEST
BOSTON, MASS

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM MASS

DR BY	TR BY	CK BY
J D	R P S	A C B

SUBMITTED
STORCH ENGINEERS
ARCHITECT ENGINEER

REVIEWED
CHIEF NAV. B & E SECTION

APPROVAL RECOMMENDED
CHIEF TECHNICAL BRANCH

APPROVAL RECOMMENDED
CHIEF, PLANNING BRANCH

WATER RESOURCES IMPROVEMENT STUDY

ISLAND END RIVER-CHELSA, MA.

ALTERNATIVE PLAN 3

APPROVED
CHIEF, ENGINEERING DIVISION

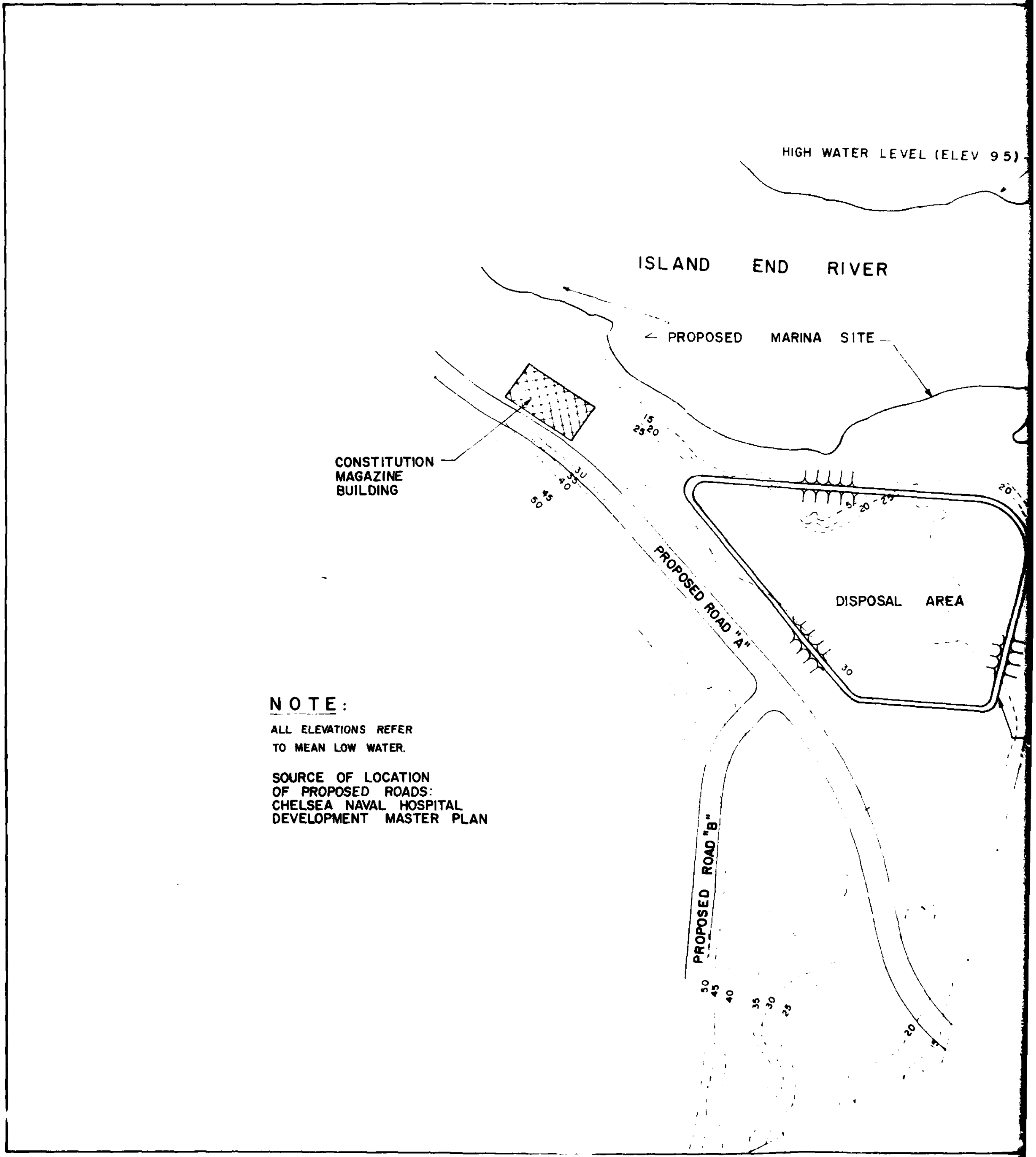
DATE

FIG. 7-6

SCALE

SPEC. NO DACW 33-79-C 0076
DRAWING NUMBER

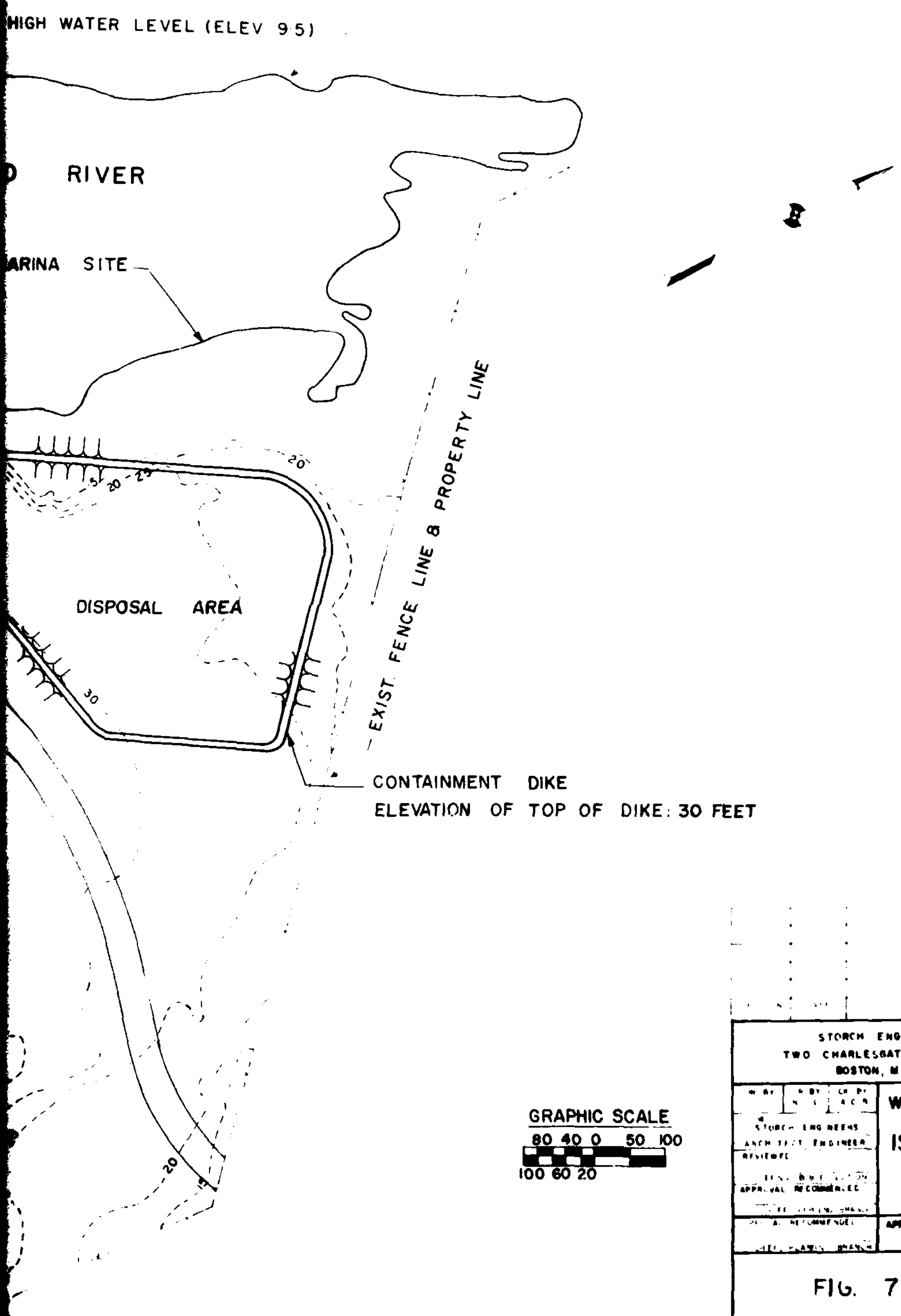
2



NOTE:

ALL ELEVATIONS REFER TO MEAN LOW WATER.

SOURCE OF LOCATION OF PROPOSED ROADS: CHELSEA NAVAL HOSPITAL DEVELOPMENT MASTER PLAN



STORCH ENGINEERS
TWO CHARLESGATE WEST
BOSTON, MASS

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS

WATER RESOURCES IMPROVEMENT STUDY

ISLAND END RIVER - CHELSEA, MA.

ALTERNATIVE PLAN 4

STORCH ENGINEERS
ARCHITECT ENGINEER
REVIEWED
APPROVAL RECOMMENDED
APPROVAL RECOMMENDED
APPROVED
DATE
CHIEF, ENGINEERING DIVISION
SCALE
SPEC NO DACW 33-79-C-0076
DRAWING NUMBER

FIG. 7-7

7

ME

83