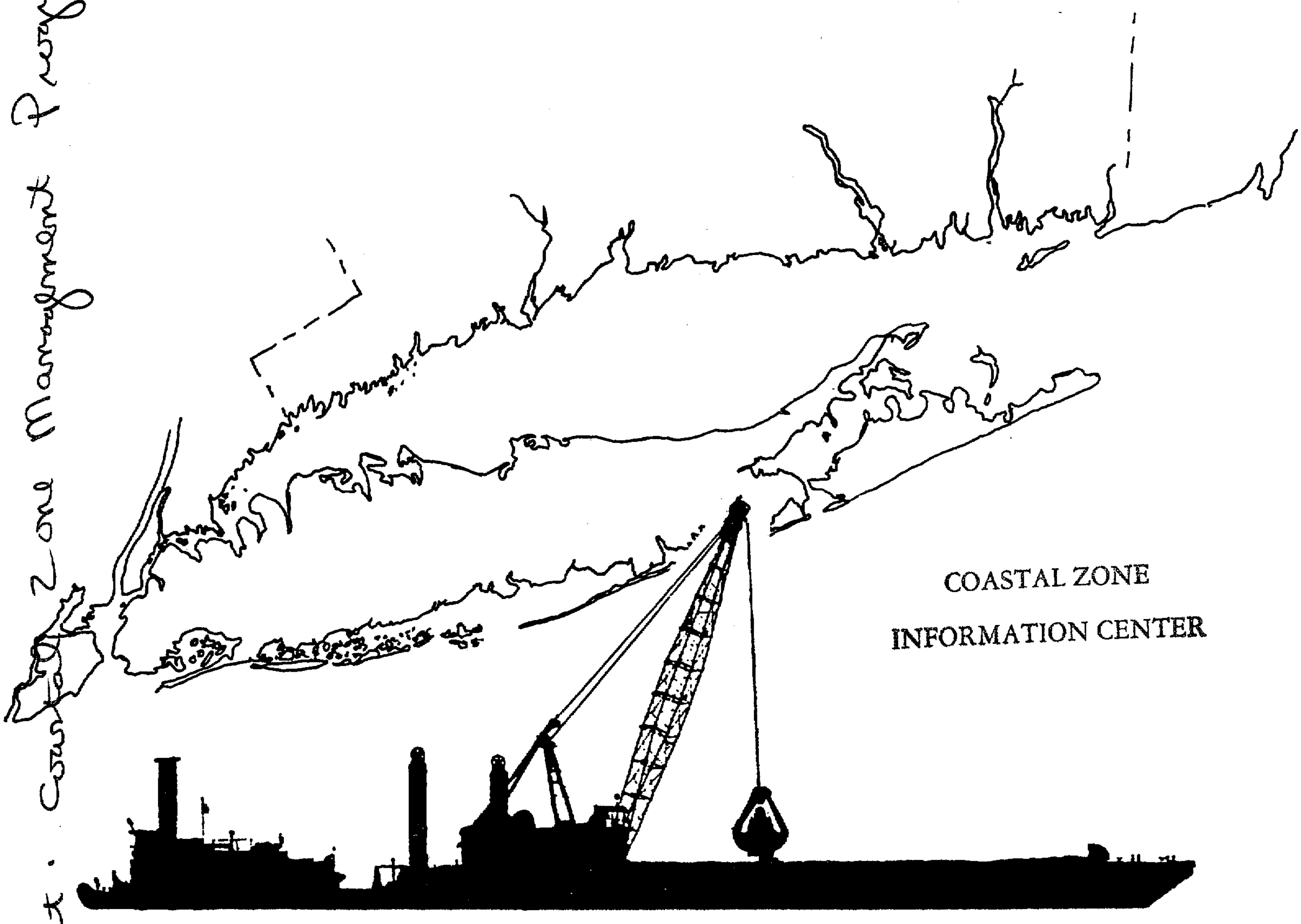
DREDGING AND DREDGED MATERIALS MANAGEMENT IN THE LONG ISLAND SOUND REGION



FINAL REPORT — AUGUST 1982

THE OCEANIC SOCIETY

EDUCATION • RESEARCH • CONSERVATION

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Submitted to the
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The views and statements contained in this report are solely those of the authors and do not represent the official views or policies of the New England Governors' Conference or its member states; other state agencies; the Water Resources Council or its member agencies; or any other federal agency.

The Authors

EXECUTIVE SUMMARY

Long Island Sound Dredging Study

This report to the New England Governors' Conference continues the New England River Basin Commission's work to develop a long range program for managing dredging and disposal of dredged materials in the Long Island Sound region.

The report includes:

* a comprehensive review of dredging, disposal and management in the Long Island Sound region (SECTION 1);

* a description of key findings for improving dredging and disposal management around the Sound (SECTION 2); and

* an analysis of the deep ocean alternative for disposal of materials dredged from the Sound (SECTION 3).

Key findings of the study include:

1. The Sound should be managed as a single, unified ecosystem in gauging the impact of human activities and natural systems.

2. A Soundwide management program is needed to base dredging and disposal policy on a sound scientific basis and increase public confidence in the regulatory process. The program should:

A. begin with identification and evaluation of alternatives for dredging and dredged material disposal;

B. detail a procedure for analyzing and classifying sediments in the Long Island Sound region; and

C. Link sediment classifications to specific management, dredging and disposal alternatives.

3. A Comprehensive Dredging Schedule or plan is needed to provide adequate time for managing dredging and disposal projects.

4. A Dredging Advisory Board, composed of Connecticut and New York officials; federal agency representatives; citizens and scientists should be formed to develop the Soundwide management program and schedule. The Board would be advised by:

A. a Scientific Advisory Committee composed of scientists from Connecticut and New York should advise the Board in development and revision of the program.

B. a Citizen Advisory Committee, composed of civic leaders, elected officials, conservationists and marine industry representatives should advise the Board on development of the program and schedule.

5. Deep ocean disposal is neither practical nor affordable at the current time for materials dredged from the Sound.

This report is based on consultation with a committee of scientists from around the Sound along with representatives of both state and federal officials, (see Section 2.3 for methodology). It was supported by funds from the U.S. Water Resources Council and the New England Governors' Conference with in-kind services contributed by state agencies as part of a study examining New England's regional dredge management needs.

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1.1 Introduction

Long Island Sound is an estuary stretching from the densely developed New York metropolitan area to the farm-lands of eastern Connecticut. In between, some 6 million people live on or near 577 miles of coastline in 40 munici-palities of two states.

The Sound has been called alternatively the "American Mediterranean" and an "urban sea." It serves as a major transportation route for marine transport of heating oil, gasoline, building products and exports. Commercial fisher-man harvest significant catches of oysters, clams, lobsters and finfish each year. Recreational boating and the tourist trade play an important role in the region's economy.

Many of the ways we use the Sound center on the use of ports and harbors. Access to these waterfronts is usually gained through channels, turning basins and berths dug out of the floor of the Sound. These "improvements" in the harbor bottom are continually being filled in with sediment from adjacent areas. Although this is as natural as the rise and fall of the tides, the rate of siltation can vary according to an area's geological and hydrological charac-teristics. The northern shore of the Sound, for example, suffers a higher rate of sedimentation in its harbors than found along the southern coast.

Geological Characteristics

Long Island Sound is an inland oceanic region fed by several estuarine systems. It extends east from the cut between Throgs Neck and Willets Point leading to the East River for some 113 miles to the "Race" and Fishers Island Sound between Watch Hill, RI and Orient Point, Long Island. In width, the Sound ranges from a scant 0.7 miles at Throgs

Neck to approximately 21 miles between New Haven and a point just east of Port Jefferson.

Geologically, the Sound can be divided into three distinct regions or basins:

* The eastern basin lies between Watch Hill and the Mattituck Sill, a submarine ridge extending from Hammonasset Point south to Duck Island Point. This is the deepest of the basins with depths reaching or exceeding 300 feet. Tidal currents and salinity are also greater due to the basin's shape and its proximity to the Race and Atlantic Ocean. Based on geological and political factors, Fishers Island Sound is included in this region.

* The central basin extends west from the Mattituck Sill to the Hempstead Sill which runs southwest from Greenwich Point toward Hempstead Harbor. This is the largest of the basins in area and averages 80 feet in depth. Here, slower tidal currents, lower salinities and warmer waters are found than in the eastern region.

* The western basin is found between the Hempstead Sill and Throgs Neck. It is the smallest of the regions and is included in the central basin in many descriptions of the Sound. The western basin, however, is distinguished by its proximity to the East River and the presence of the Hempstead Sill to the east.

Tidal currents in the Sound vary largely depending on the tidal cycle and location. The greatest velocities are seen at the Race where the ebb current may reach six knots; the ebb tide is stronger than the flood due in part to freshwater inflow. Surface currents in the middle of the Sound seldom exceed one knot. The tidal range varies through the Sound with the lowest ranges experienced in the eastern end (Stonington 2.8 feet), and the greatest ranges in the western end (Cold Spring Harbor 7.5 feet; Greenwich 7.4 feet). The times of low and high water also vary between the ends of the Sound. High water at Stonington on the eastern end of the Sound is experienced three hours later at Execution Rocks off Manhasset Neck.

As an estuary, Long Island Sound is a semi-enclosed coastal body of water freely connected to the ocean and within which seawater is measurably diluted with freshwater from runoff. The Sound has two connections with the ocean: the Race via Block Island Sound, and the East River via New York Harbor. In addition, more than 75 rivers and streams draining a watershed greater than 16,000 square miles flow into the Sound. The majority (80%) of freshwater inflow is from three rivers: the Thames, Connecticut and Housatonic. Total runoff into the Sound from upland sources is about 6,200 billion gallons per year (NERBC, 1975). Added to the net inflow from the East River, and factors such as precipitation directly on the Sound, there is a net movement of diluted waters eastward through the Sound and out the Race. These rivers also serve as a principal source of sediments suspended in the Sound. Shoreline erosion and primary productivity also contribute materials to the sediment system in LIS. Yet a substantial amount of sediment would remain suspended in the Sound even if these sources of additional materials disappeared.

As a result of the dynamic system described above, sediment transport and sediment resuspension are constant factors in Long Island Sound. Once in the Sound, the sediments, especially finegrained material, are transported throughout the Sound by tidal currents and littoral drift. In the central and western basins, a large amount of this sediment settles out onto the sea floor. According to Schubel _et al_ (1979), each tidal cycle resuspends a layer of sediment 1 to 2mm thick and redistributes it within the central basin. Throughout the Sound more than 7 million tons of sediment is resuspended each day. In the eastern basin, strong tidal currents work the sea floor into large underwater dunes or sand waves.

In the central and western basins, sediment accumulates at an average rate of one mm each year. Harbor improvements, such as channels, turning basins and berths, are depressions below the surrounding Sound floor and may act to trap silt. Schubel, et al (1979) found sedimentation rates approaching seven to eight cm annually. Dredging to create these features is referred to as "improvement" work while removal of silt from an established channel is called "maintenance" dredging.

When considering the above statistics, it is important to remember that the north and south shores of Long Island Sound were not created equally. The south shore, Long Island, is dominated by two terminal moraines deposited during the late Wisconsin glacier. These moraines were formed when the retreating glacier stalled, allowing material to mound up via the glacier's "conveyor belt" of glacial till.

In contrast, the north shore of the Sound is bedrock geology reshaped by the glacier. The actual shoreline is much more varied than the south shore with composition varying between rock, glacial drift, tidal marshes and artificial fill. Two of the most obvious effects of this glaciation on Long Island Sound are the distribution of rivers and harbors: all major river systems are located on the north shore along with 75% of the total number of harbors. These findings directly affect sediment size and distribution. In general all those harbors located at the mouth of a river system will have silt bottoms due to sediment load in the river along with the inflow of sediment from the Sound. The majority of harbors along the north shore have river systems draining into them. In contrast, the harbors along the south shore of Long Island Sound are larger in comparison to north shore harbors; lack major river systems transporting sediment from upland sources; and, as result of Long Island's geological make-up, contain largely sandy sediments. Sand is less easily resuspended than silt, and when dredged, offers greater alternatives for disposal.

The Dredging Dilemma

A look at a hypothetical harbor will illustrate the dredging dilemma which can arise as a result of sedimentation around the Sound.

Island-Port is a mythical town on the Sound's northern shore at the mouth of the Woebegawn River. It is an older urban community which served as an active harbor and manufacturing center during the 18th and 19th century. During that period, federal approval was given for dreding and maintenance of channels leading to Island-Port's waterfront.

Today, Island-Port has become a manufacturing center for computer chips and serves as the location for several corporate headquarters. The harbor is used principally for import of petroleum products and building materials. Much of the harbor's activity comes from recreational boating. Several marinas and three commercial fishing operations have dredged channels to the federal channel.

Since it was the first dredged in the early 1900s, the Corps of Engineers has returned to Island-Port roughly every 13 years for maintenance dredging. Their last operation was in 1966. By 1976 the channel needs to be dredged again. Sailboats with fixed keels and full oil barges cannot travel the channel at low tide without risk of running aground in some areas. The gradual sedimentation continues and, by 1979, full barges can travel only at high tide and rest on the bottom at their berths during low tide. Marina users are finding it difficult to move from their slips -- which are dredged by the marina owner and are "piggybacked" at the time of the federal project -- through the federal channel at low tide.

In 1978, municipal officials asked state and federal agencies for assistance in securing maintenance dredging of the channel. The Corps of Engineers (CE) surveyed the channel to establish the need to dredge. Scientific analysis of Island-Port sediments showed significant contamination of the materials to be dredged. After a public hearing, the CE and state granted approval for maintenance dredging which included special management steps to protect the marine environment. The CE sought bids for the project, hired a contractor and supervised both dredging and disposal of the dredged materials. A post-dredging survey conducted by the CE showed the federal channel had returned to its authorized depth. Time elapsed from recognition of problem to completion of dredging: three years.

While Island-Port is an imaginary harbor, this scenario is not. The Island-Port maintenance project moved ahead quickly (relatively speaking). In the past, maintenance proposals involving sediments contaminated with toxic chemicals, heavy metals or petroleum hydrocarbons have sparked regional environmental concern and repeated confrontations. Contaminated sediments are found in virtually every major urban center -- the same location as the most important federal channels.

Sediment Sources

Currently there are 41 Federal Navigation Projects in the Long Island Sound Region: 27 in Connecticut and 14 in New York. In addition, there are 5 federal projects in the East River west of the Throgs Neck Bridge whose proximity to Long Island Sound make them historical or future candidates for disposal in Long Island Sound.

The sediments come from three main sources:

1. material from upland areas suspended in the water column of river systems that settles out when the stream flow slows as it enters the Sound;

2. the Sound floor via the tidal currents that resuspend the sediments; and
3. longshore drift at mouths of harbors. Sediment accumulates throughout the harbor bottom. These sediments in the quiet harbor are easily stirred up by coastal storms, prop wash, and the change of tide. Much of this disturbed sediment finds its way into the deeper recesses of the dredged channel. The result is a gradual filling of the channel. Some channels may only need dredging every 15 years while others must anticipate maintenance dredging every 2 to 4 years. Severe storms and other major disturbances can shorten the projected interval.

Much of the material dredged from the Sound is clean and can be disposed of in open water without significant environmental damage. Pollutants are added to rivers, streams and the Sound from municipal sewer systems (sanitary and storm), industrial discharges, non-point sources, and accidental spills. The quality of water discharged from municipal sewage treatment plants and industrial outfalls is regulated by state officials through National Pollution Discharge Elimination System (NPDES) permits. These permits limit but do not necessarily eliminate discharge of contaminants such as heavy metals and chlorinated hydrocarbons into the water. Around the Sound, both sources of pollution and the need to dredge are often concentrated in the same urban port cities.

Schubel et al (1979) noted: "Since many contaminants are relatively insoluble in water and have a high affinity for fine-grained particles, they are rapidly scavanged by fine suspended particulate matter and end up on the bottom of the estuary in areas where fine-grained sediments are accumulating. One such locus of accumulations is the network of shipping channels."

1.2 Dredging the Sound: A Historical Perspective

On the Sound, dredging dates back to colonial times. During the 19th century, the first conflicts began to arise, often between dredging and the burgeoning oyster industry. At that time, dredged sediments were sidecast, or dumped alongside the channel, covering shellfish beds. This controversy led to the first state laws regulating dredging to protect oyster beds. The Rivers and Harbors Act of 1888 entrusted responsibility for regulation of dredged spoil disposal in Long Island Sound to the Superintendent of the Port of New York and marks the first regional attempt to control open water disposal.

Under this act, the Superintendent designated disposal areas with the goal of preventing obstruction of navigation and protecting shellfish beds. Eventually, some 19 disposal sites were designated in Connecticut, often in close proximity to a specific harbor or dredging project. Due to the higher demand for dredging along the northern coast, 13 of the 19 disposal sites were located in Connecticut waters. Four were set in New York waters while one was split between the two states and one was designated for Fishers Island Sound in the waters of Rhode Island (See Fig. 1.2-1). Demand for dredging in the Long Island Sound region was shaped by geological forces and urban growth.

Passage of the Rivers and Harbors Act of 1899 brought the first nationwide regulation of dredging and disposal operations. Section 10 of this act requires an Army Corps of Engineers permit for any construction or dredging within the navigable waters of the United States. This law focused on protection of navigation and was essentially designed to prevent obstruction of navigable waters by piers, docks and other structures or debris. Today, the CE continues to enforce this statute and all dredging proposals must receive approval under Section 10 in addition to other federal laws.

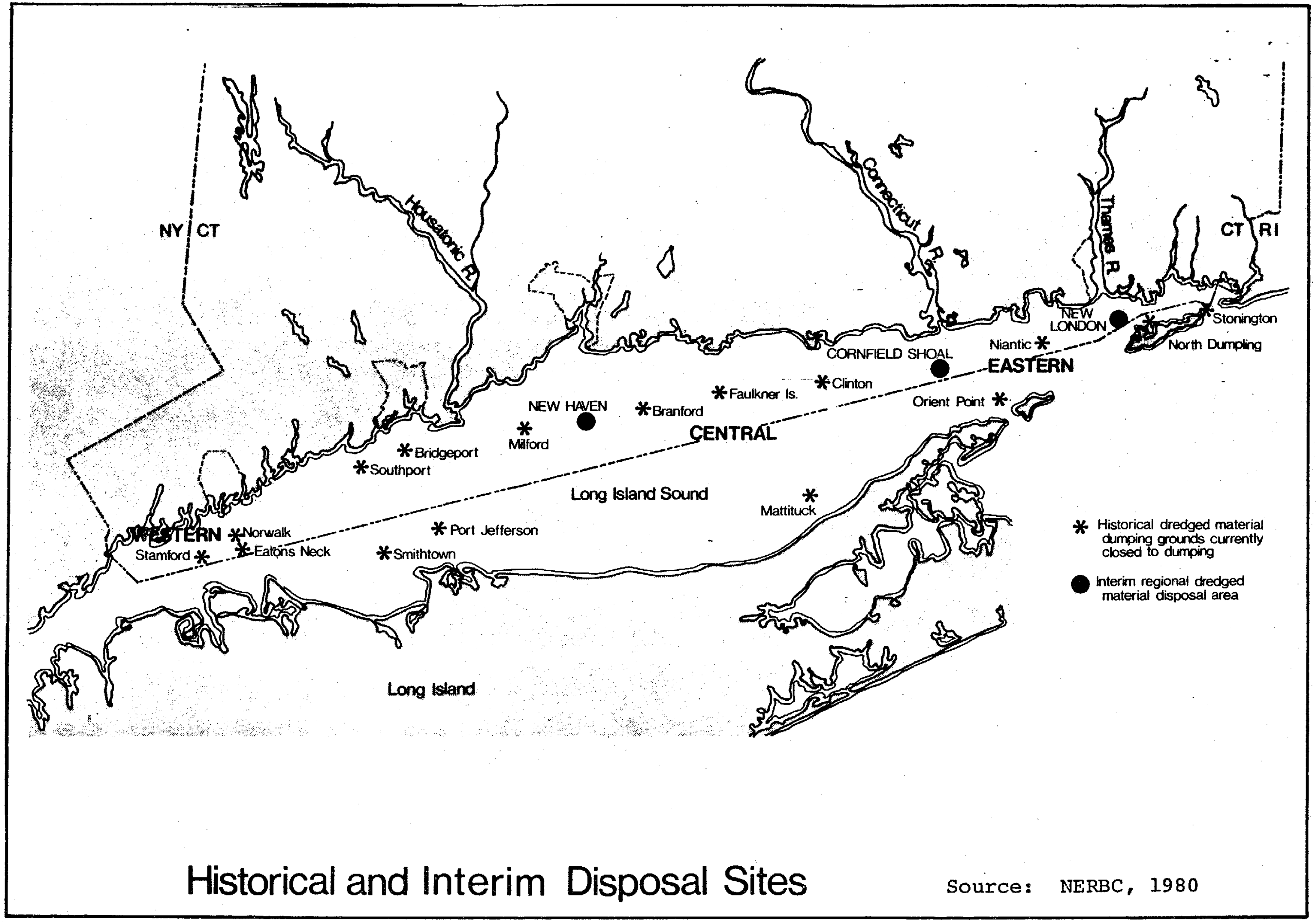


Figure 1.2-1, Historical and Interim Disposal Sites in Long Island Sound.

Although disposal of dredged materials in the Sound was supposed to be confined to the 19 designated sites, it is important to recognize that little or no effort was made to enforce this requirement. Observations by divers confirm the presence of dredged materials outside designated disposal sites, but the distribution and quantity of improperly dumped materials is not known. In part, this situation may have developed from imprecise navigation combined with little thought of the need to dump spoils at the designated site.

Not all the 19 dump sites were used equally, nor did they exhibit the same site characteristics, i.e. depth; containment or dispersal site; distance to shellfish grounds; etc. While site-specific disposal data does not date back accurately to 1890, volumes are available since the 1950's. It is estimated that during the period 1954-1977, four of the disposal sites -- Eaton's Neck, Bridgeport, New Haven, and New London -- received 77% of the total volume of dredged material. Table 1.2-1 outlines volume of dredged material deposits in open water disposal sites in Long Island Sound 1954-1976, the period for which quantitative data are available (CT DEP, NY DEC, 1977).

Regulated only by the Rivers and Harbors Act of 1899, Long Island Sound was the disposal option for any and all of the region's waste. Studies and reports conducted in the late 1960's and early 1970's document deteriorating water quality around the Sound. While disposal of dredged material is named as a contributor to the degraded quality (US EPA 1971), no report ever qualified or quantified dredged material's contribution. Instead, dredged material was thrown together with industrial, domestic, and marine vessel pollution.

An estimated 126 million cubic yards of material (the vast majority of which is dredged material) have been disposed of in the open waters of Long Island Sound in the period 1890-1977. (Schubel et al, 1979). Some 100 million

TABLE 1.2-1

OPEN WATER DISPOSAL SITES BY VOLUME
IN LONG ISLAND SOUND

Disposal area (listed in order of total volume dumped)	Total volume dumped between 1954 and 1972 (in cubic yards)	Years as active disposal site between 1954 and 1972	Disposal Activities in years	Average volume per year active use (in cubic yards	Volume dumped 1974-1976 (in cubic yards)
Eatons Neck	12,872,300	1955-1971	17	757,194	
Bridgeport	4,209,900	1954-1971	18	233,883	50,000+
New London	3,903,900	1955-1972	18	216,883	1,500,000+
New Haven	3,672,600	1955-1970	16	226,725	1,500,000+
Stamford	2,904,900	1954-1972	19	152,889	
Norwalk	1,338,400	1954-1972	18	74,356	
Cornfield Shoal	1,008,800	1960-1970	5	201,760	230,000+
Branford *	429,900	1956-1973	12	35,825	
Milford	399,000	1954-1971	16	24,938	
North Dumpling	348,200	1956-1971	4	87,050	
Southport	298,900	1952-1970	10	29,890	
Port Jefferson	228,600	1956-1969	9	25,400	
Niantic	176,000	1969-1972	3	58,667	
Stonington	73,200	1956-1957	2	36,600	
Clinton	26,900	1965	1	26,900	
Mattituck	10,600	1958-1966	4	2,650	
Falkner Island	3,000	1958-1968	2	1,500	
Smithtown	No data	-	-	-	
Orient Point	No data	-	-	-	
Total	32,005,000				

*No disposal activity in Long Island Sound reported for 1973 except at the Branford site--volume dumped in 1973 was 4,800 cubic yards.

(Source: CT DEP, NY DEC, 1977)

cubic yards was dredged from federal maintenance projects during the same period with the majority (80%) coming from Connecticut ports and harbors. The remainder of material came from private dredging for which records are incomplete.

Traditionally, dredged material was disposed of in one of three ways: 1) open water sites in Long Island Sound; 2) the open water site at Mud Dump, New York Bight; and 3) upland disposal at sites adjacent or close to dredge sites. The last category includes wetlands. The disposal option used varied, but historically, the upland option was the most attractive. As adjacent wetlands were filled and developed, other convenient upland sites became scarce and the open water option gained favor. This description is most accurate for the northern shore of Long Island Sound. Long Island has traditionally disposed of its sandy sediment upland, beach nourishment, or for construction purposes. Suffolk County, Long Island has used upland disposal since 1927 for all federal projects except one (Huntington Harbor in 1935 in open water). Beach nourishment accounted for approximately 50% of the upland disposal (ACE, 1979).

Open water disposal has been the preferred disposal method for federal projects in Westchester and Nassau Counties, New York. During the period 1961 to 1979, all material dredged from federal maintenance projects was disposed of in open water. Connecticut also preferred open water. Since 1948, upland disposal has been used in Connecticut infrequently. Except for the Housatonic and Connecticut River projects where upland disposal is still used, the vast majority of dredged material is disposed of in open water. For example, federal dredging projects in Connecticut during 1968-1977 utilized the open water option for 88% of the total volume dredged, not including the Housatonic and Connecticut River projects. (Table 1.2-2)

Today, dredging and disposal management occurs on several levels. First, a complex regulatory structure has evolved to process applications and review CE project pro-

TABLE 1.2-2

DISPOSAL METHODS FOR CORPS OF ENGINEERS DREDGING IN LONG ISLAND SOUND (1961-1979)

COASTAL AREA	TOTAL VOLUME[a]	DISPOSAL METHOD AND PERCENT OF TOTAL					
				OPEN WATER			
		LAND	%	LIS	%	MUD DUMP	%
WESTCHESTER CO	583	0	0	511	87.5	73	12.5
NASSAU CO.	7	0	0	7	100.0	0	0
SUFFOLK CO.	108	108	100.0	0	0	0	0
Subtotal	698	108	15.5	518	74.0	73	10.5
NEW YORK CITY	6,270	0	0	4,544	72.5	1,725	27.5
TOTAL NEW YORK	6,968	108	1.5	5,062	72.7	1,798	25.8
TOTAL CONNECTICUT[b]	3,024	1,171	39	1,821	60.0	0	0
COASTAL CONNECTICUT[c]	2,080	259	12	1,821	88.0	0	0

(Source, CE 1979a)

[a]Volumes are in thousands of cubic yards

[b]Data for Connecticut is for period 1968-1977

[c]Data for coastal area without the Connecticut and Housatonic River porjects

posals. Second, a procedure for designating sites within the open waters of the Sound for disposal activities has been established. Third, an effort towards development of a long term policy guiding dredging around the Sound began in the 1970's and continues today. After reviewing the history of dredging the Sound, we shall examine recent regulatory landmark decisions and the recurring dispute centered on designation of disposal sites and open water disposal of dredged materials.

After examining recent efforts toward developing long-term dredging management policy, this review will continue with a discussion of the legal framework for managing dredging and disposal around the Sound. Within this context, scientific and technical standards and concerns will be addressed. Throughout this report, dredging is taken to mean both the removal of materials from the bottom of the Sound and disposal of these spoils.

1.3 Recent Landmark Regulatory Decisions

Review of specific project proposals through the regulatory process has generated a series of decisions affecting dredging and disposal around the Sound and, in some cases, the nation. A brief chronology of dredging and dredged material disposal is outlined in Table 1.3-1. Select case histories are described here. Among these recent landmarks are:

* Sierra Club v. Mason, a 1972 court suit stemming from a federal plan for maintenance dredging of New Haven harbor. This action against the Corps of Engineers ended with a settlement establishing the applicability of National Environmental Policy Act (NEPA) requirements in federal consideration of maintenance dredging projects.

* NRDC et al v. Callaway, a 1975 suit arising from proposed dredging in New London challenging the CE's environmental impact statement as inadequate. The court ruled

in favor of the plaintiffs, resulting in revision of the dredging plan; initiation of increased disposal site monitoring of dumpsites; and the start of a seven year effort to draft a comprehensive assessment of the ecological effects of dredging and disposal activities on the Sound.

* New Haven-Stamford Capping, a 1978 experiment designed to determine if capping contaminated dredged materials from Stamford with cleaner spoils from New Haven would limit, or mitigate, environmental impacts.

* Norwalk Harbor "Hot Spot", a 1979 solution to a concentrated pocket of pollutants in the muds of Norwalk Harbor. Under this approach, highly volatile chemical contaminants were dredged and moved underwater to a nearby subaqueous pit where they were buried under cleaner materials. The location of this underwater capped pit will be noted on navigation charts to avoid disturbance of the site.

Sierra Club v. Mason

Indiscriminate and unregulated disposal of materials ended in early 1970 with the closure of all but three of the open water sites as a result of increased environmental concern and the passage of the Clean Water Act and National Environmental Policy Act (NEPA).

In late 1971, the Corps of Engineers announced plans for the maintenance dredging of New Haven harbor. The project entailed the open water disposal of approximately 800,000 cubic yards of material. The CE proceeded with this project without issuing an Environmental Impact Statement (EIS) as mandated by the newly enacted NEPA legislation. The Corps' action prompted a preliminary injunction in October 1972 by the Sierra Club against the Army Corps of Engineers (Sierra Club v. Mason, 351 F. Supp 419 CD. Conn. 1972). The CE defended its decision not to prepare an EIS on the grounds that maintenance projects were exempt from NEPA pending the preparation of an EIS within a three year period. The court did not agree and granted a permanent injunction in May 1973 following the issuance of a draft EIS deemed inadequate. Problems cited included the failure to discuss certain environment effects, alternatives to proposed action, and impacts as result of disposal action. This case marked the first NEPA suit against the New England Division, Corps of Engineers and tested the principals of NEPA and the EIS process. The injunction was lifted in October 1973 after the preparation of a satisfactory EIS and the establishment of a long-term monitoring program on dredging and disposal impacts. Field sampling was conducted by Yale and the University of Connecticut (Chase, 1976).

In response to the need to evaluate impacts and consider alternatives under the NEPA legislation, the Corps of Engineers in 1971 assigned the Waterways Experiment Station in Vicksburg, Mississippi to develop a comprehensive research program. WES developed the Dredged Material Research Program (DMRP) program in order to provide definitive information on the environmental impact of dredging and dredged material disposal operations and to develop alternatives to these operations. As of April 1980, more than 320 reports have been issued under the program. The New England Division sponsors DAMOS (Dredged Area Monitoring System) which conducted baseline studies on the four active disposal sites in the Sound and continues to conduct research on these sites to date.

NRDC _et al_ v. Callaway

In 1974, the Navy Submarine base in Groton, Connecticut requested a permit to dredge the Thames River in order to accomodate a new class of submarine. The project called for the removal of 2.8 million cubic yards of polluted sediment. The first phase of dredging commenced in August 1974 on the lower stretch of river. The second phase involving the more contaminated upper river portion was scheduled to commence in March 1976. Both phases of the project were to be disposed of at the New London dump site.

In 1975, a group of organizations including the Natural Resources Defense Council and the Long Island Sound Taskforce brought suit against the Corps and Navy (NRDC et al v. Callaway H-74-268) on the grounds that the action was in violation of NEPA; that the Environmental Impact Statement filed was insufficient and failed to adequately consider alternatives to the New London dump site. The court found in favor of the plaintiffs. The 1976 agreement between the parties provided that the Navy would complete the second phase of the project in a north-south direction (hence placing the less contaminated material on top of the more polluted material); the Navy would increase its monitoring of the disposal site; the Corps of Engineers was directed to prepare a Composite Environmental Impact Statement for Long Island Sound, including consideration of alternative disposal sites outside the Sound; and the Corps was to continue monitoring after the Navy exhausted its monitoring funds. The CE issued a final environmental impact statement in June, 1982 as the Programmatic Environmental Impact Statement for the Disposal of Dredged Material in the Long Island Sound Region. This step toward Soundwide dredging and disposal management is examined in Section 1.5.

Stamford-New Haven Capping

In July, 1978, the Corps announced its plans to maintenance dredge portions of the Stamford and New Haven projects. The two harbor projects were combined in order to "cap" the sediments in Stamford Harbor's East Branch with cleaner materials from the New Haven ship channel. Approximately 65,000 cubic yards of organically enriched silt from the East Branch was proposed for disposal at the New Haven site to be capped by 115,000 cubic yards of sediment from New

Haven harbor. The objectives of the capping procedure were to isolate the polluted material from the surrounding benthic community and water column. Monitoring of the site was undertaken by DAMOS and disposal operations begain in March, 1979. As the capping technique was new to the region, the New Haven-Stamford project was proposed as a "controlled" experiment. In order to evaluate the effectiveness of the procedure, two types of caps were used: clay and silt, and two disposal points were determined. The south site was capped with silt while the north site was capped with sand from the outer breakwater area of New Haven harbor. Utilizing precision disposal techniques, the project was successful in covering the Stamford spoils with up to 4 meters of silt and 3.5 meters of sand. Post-disposal examination suggests that the technique was successful in capping the Stamford material, but the cap's resistance to tidal currents, storm currents, and bioturbation is not fully known (Morton et al, 1980). One advantage of the capping and ongoing monitoring is the ability to add more capping material should the need arise. Hurricane David may have caused erosion of a meter of the silt cap.

Norwalk Harbor "Hot Spot"

The Corps of Engineers announced the maintenance dredging of the Norwalk Harbor federal project in April 1979. The project called for the restoration of authorized project dimensions by the removal of approximately 350,000 cubic yards of material. Of this material, some 2,000 cubic yards of material from the upper portion of the navigation project was determined to require special handling because of high concentrations of napthalene and nitrobenzene. The permit recommended that the material be buried underneath the federal channel at a point adjacent to the "hot spot" and covered with material of low permeability.

Conditions for the burial of the "hot spot" included conducting the work when water temperatures were at or below 42°F for protection of shellfish and benthic life; marking position of burial site on nautical charts in order that any activity in the area be cleared through the Corps; and monitoring by the EPA for air and water quality during the disposal operation. The New England Division undertook a similar project in Falmouth, MA in 1977 but failed to conduct follow-up testing to document the success of the operation. The "hot spot" disposal operation was carried out in early 1980 with the results judged successful.

In addition to the 2,000 cubic yards buried in-channel, some 11,000 cubic yards slated for open-water disposal were judged by the State of Connecticut to be "degrading" and were capped by cleaner material from Norwalk's outer harbor at the Central Long Island Sound disposal site. Work was scheduled to commence in December 1979 and was completed by November 1980. No work was authorized between June 1, 1980 and October 1, 1980 to prevent potential impact on spawning of shellfish.

TABLE 1.3-1
DREDGE DISPOSAL HISTORY IN LONG ISLAND SOUND
(A CHRONOLOGY)

Pre-1970	New England Division, CE (NED) conducts dump site studies in Rhode Island waters. Bulk inventory program established.
1970	National Environmental Policy Act (NEPA) established. Conference on "State of the Sound" conducted by the EPA and others concludes that all dumping in Long Island Sound should halt.
1971	Waterways Experiment Station (WES) initiates Dredged Material Research Program.
	NED sponsors first Ocean Disposal Conference at Woods Hole Oceanographic Institute to discuss management concepts.

1972	Second Ocean Disposal Conference held at Avery Point, Groton. Monitoring and research needs for Long Island Sound identified.
	Sierra Club files suit against CE for New Haven maintenance project (Sierra Club v. Mason).
	Draft EIS on New Haven project released.
1973	CE, NED, EPA, FWS, and CT DEP agree to establish mutual policy statement (project abandoned in 1975). Marks beginning of disposal site reduction and begins to lay basis for interim plan.
	Permanent injunction issued in New Haven case results in closure of entire Long Island Sound for dredged material disposal.
	"Interagency Policy Committee on Ocean Dumping and Spoiling" formed to discuss New London dredging project (spawned ISASODS).
	Injunction lifted -- monitoring program for New Haven disposal site established.
1974-5	WES Eatons Neck project terminated as result of political pressure (project failed to involve DEP or CE, NED in planning process: overall confusion over location and management of a "western" disposal site).
	Thames River law suit (NRDC et al v. Callaway) filed to stop Navy improvement project.
1976-77	NRDC et al suit settled. CE to issue PEIS, Navy and CE to monitor New London dump site.
1977	Hearings on NY/CT Interim Plan.
	Revisions to FWPCA (Clean Water Act), Section 404.
1979	New England River Basins Commission (NERBC) brought in to coordinate Interim Plan.
	Stamford/New Haven capping project.
	Norwalk Maintenance conducted with "hot spot" dredged.

1980	NERBC "Interim Plan" issued.
	Connecticut Coastal Area Management Act (CAM) adopted.
1981	"Ocean Dumping Act" revised to apply testing standards to LIS projects larger than 25,000 yd^3 (Ambros legislation).
	DEP regular participant in NED joint processing program along with EPA, FWS, NMFS.
1982	WLIS III site designated (Huntington <u>et al</u> suit pending). Final PEIS issued for Long Island Sound.
<u>NOTE</u>:	Chronology compiled through personal communications with DEP, Water Resources Unit and Coastal Area Management personnel.

1.4 Disposal Site Disputes

Much of the controversy surrounding dredging centers on alternatives for disposal of dredged materials and more specifically upon the use of designated dumping sites within the Sound for dredged material disposal. The process of selecting an open water site is a second element of the regulatory system which merits attention.

Eatons Neck Disposal Site

Historically, the Eatons Neck disposal site received the greatest proportion of dredged material of the 19 sites (approximately 40%). From 1954 until its closure in 1971, Eatons Neck received in excess of 12 million cubic yards of dredged material.

When Eatons Neck closed, it left the western Sound without a dump site. Dredging projects located in the western Sound could either haul to the Mud Dump Site or east to the New Haven site. However, strong political pressure, especially from Long Island, made disposal sites in the vicinity of Eatons Neck politically controversial.

In 1974, the Corps announced the development of the Environmental Impacts and Criteria Development Project under DMRP. A nationwide survey of open water sites was conducted to select four characteristic disposal areas: Eatons Neck was named as one of the sites. Eatons Neck was selected over New London, Cornfield Shoals and New Haven because New London and New Haven had an on-going monitoring program and Cornfield Shoals was not as accessible and appropriate for the research schedule.

The purpose of the project as originally conceived was a three phase project: Phase 1, to gather baseline data prior to disposal activities; Phase 2, monitor disposal operation; and Phase 3, follow-up with one year post-disposal monitoring program. However local political and public opposition to the "reopening" of the site caused the project to be cancelled between Phase 1 and Phase 2. As a result, baseline data was gathered on the site four years after disposal operations ceased but no further dumping has occurred.

As a footnote, the Eatons Neck site is currently considered one of the most productive lobster grounds in Long Island Sound. One important factor in the area's production is the dredged material which provides "reef" habitat for lobsters from a relatively featureless bottom habitat.

Mamaroneck's Dilemma

In conjunction with the federal maintenance dredging of Mamaroneck, New York, some two dozen riparian owners along with the Village of Mamaroneck requested a permit to dredge private channels within Mamaroneck Harbor with disposal at the Mud Dump Site off Sandy Hook (February 1981). Three months later, the applicants requested their permit be modified to permit disposal of the dredged material at the New Haven dump site. On October 2, 1981, the Corps of Engineers and the State of Connecticut released a joint public notice and public hearing on the designation of an open water disposal site in western Long Island Sound, and the application of Shore Acres Point et al (the Mamaroneck applicants) to use the site designated. Three public hearings were held in Norwalk, Mamaroneck, and Huntington to receive comments on five potential sites: Bridgeport, WLIS I, WLIS II, Eatons Neck, and a "Public Hearing Site" later to be designated as WLIS III. Considerations of distance to dredging projects, proximity to shellfish and lobster grounds, and underwater power cables were grounds for eliminating all but WLIS III from consideration. In a traditional western Long Island Sound standoff, the north shore of the Sound was basically in favor of the site, while the south shore along with many of the commercial shellfishermen and lobstermen were against it. On March 16, 1982, the Corps of Engineers approved the site naming WLIS as suitable for open water disposal. Certain conditions accompanied the decision: permits shall be issued on a case by case basis; Class III materials as determined under the Interim Plan are not to be considered for disposal at this site; only projects east of the Throgs Neck are eligible for consideration; and the best known mitigation measures such as taut line buoys, set transit lanes, and avoidance of shellfish spawning periods are to be implemented.

New Legal Challenge

The designation of WLIS III has brought legal action from Long Island. On March 24, 1982, the Towns of Huntington, North Hempstead, Oyster Bay, and the Counties of Nassau and Suffolk filed a Summons and Complaint against the U.S. Army Corps of Engineers and the EPA. This was followed by a motion to rescind all existing permits and restrain all future dumping at WLIS III which was filed on May 10, 1982. The Mamaroneck applicants began disposal operations in May and ceased operations because of the spawning season. Further disposal work is necessary in the fall pending the results of the federal suit. The plaintiffs in the case allege that the EIS issued for WLIS III was inadequate in that it failed to qualify and quantify the material to be disposed at the site and failed to properly delineate the site at the public hearing in Huntington. The suit declares the Corps decision premature, hasty, and untimely.

The search for a western Sound site has continued since Eatons Neck was closed in 1971. WLIS III is the same site named under the DEP/DEC Interim plan in 1977. It should also be noted that any site designated in western Long

Island Sound would possibly draw the dissent of some group or groups regardless of the location and safeguards.

Procedures for designation of open water disposal sites within the Sound are discussed in Section 1.7.

1.5 Long Range Policy Initiatives

Despite continuing refinement of the dredging management system, a long range, Soundwide policy for balancing competing interests and concerns remains an elusive goal. Although the Sound is a single, dynamic ecosystem, direction of dredging activities continues to be controlled by a fragmented, parochial system involving federal agencies, state authorities, regional planners and local officials. The demise of the New England River Basins Commission (NERBC) in 1981 left a vacuum for a regional coordinating mechanism to understand and manage the Sound which has yet to be filled.

Efforts to broaden the dredge management system can be traced through the Long Island Sound Study (NERBC, 1975) to the Interim Plan Disposal of Dredged Material from Long Island Sound (NERBC, 1980) and the Programmatic Environmental Impact Statement for the Disposal of Dredged Material in the Long Island Sound Region (CE, 1982). Development of a Long Range Dredging Management Study, started by NERBC and now being completed by the New England Governors' Conference (NEGCC), should provide a comprehensive overview of dredging around the Sound.

Combined with this, the review system described in Section 1.7 creates a system of consultation and communication between federal and state officials, the applicant and the public. The CE also convenes a monthly Joint Processing Meeting, bringing together the National Marine Fisheries Service, Fish and Wildlife Service, EPA, and CT DEP staff to discuss specific permit applications with the Corps. The Corps' Interagency Technical Advisory Committee began meeting in late July, 1982 to promote discussion of technical questions rising from the regulatory process among federal scientists. This panel, for example, may consider how many samples need to be taken to develop an accurate perspective on sediment characteristics in a given area.

Yet, despite current efforts, this system falls short of providing a comprehensive regional approach to LIS dredging. Citizens, scientists and agency officials have yet to join in a long-range planning effort for federal dredging projects on a Soundwide basis. Further, no publicity visible mechanism exists to revise CE dredging plans based on new scientific understandings or an improved view of dredging's cumulative impact on the Sound. Finally, these difficulties are exacerbated by the often conflicting parochial concerns of Connecticut and New York State.

Sound Study Sets Perspective

A Soundwide view of LIS dredging is reflected in the Long Island Sound Study (LISS), a major federal review of conditions around this "inland sea." The study suggests: "New York and Connecticut should assign permanent dredge spoil disposal sites, establish the quality of materials to be dumped there and, together with the EPA, CE and NOAA, set up dumping procedures to lessen the environmental harm and monitoring programs to determine the long-term effect of these activities." The LISS report also called for CE to study the use of dredged materials for construction of artificial islands or beach nourishment with the aim of increasing public recreational access to the Sound. The study also urged development of a coordinated and consistent coastal management program by the States of Connecticut and New York.

This study, however, did little to stem concern that contaminated sediments dredged from Connecticut's urban harbors could degrade water quality in the Sound. This concern may have led a Long Island Congressman to amend the Ocean Dumping Act in 1981 and require extensive biological testing of all dredging projects containing more than 25,000 cubic yards.

Interim Program Developed

The next landmark for dredging came with the issuance in the Spring of 1977 of the Interim Program for the Disposal of Dredged Material in Long Island Sound presented by the Connecticut Department of Environmental Protection (DEP) and the New York Department of Environmental Conservation (DEC). In this bi-state plan, the two agencies recognized the need for continued dredging and agreed additional information needed to be developed to adequately gauge the environmental impacts of dredged material disposal in the regulatory system. During a three year interim period, the bi-state plan called for the following steps:

1. formation of an independent Technical Advisory Committee;
2. designation of four open water sites in the Sound;
3. establishment of monitoring network for disposal areas;
4. guidelines for evaluating potential pollution characteristics of sediments to be dredged;
5. application of these guidelines on a case-by-case basis; and
6. development of a long-term dredged material disposal management program for Long Island Sound.

Though this interim plan contained the basic elements found in later mangement strategies, the bi-state nature of the plan made the implementation of this plan more difficult. Discussion between the DEC and DEP led to the decision to bring in an "independent broker," the New England River Basin Commission (NERBC).

Interim Plan Adopted

Three years later, in June, 1980, NERBC issued a final Interim Plan for Disposal of Dreged Material from Long Island Sound. A cumulation of discussion and cooperation between Connecticut, New York and federal agencies, the Interim Plan establishes policies and guidelines for classification of sediments to be dredged, management of designated open water disposal sites, and formulation of a long-range dredging and dredged material disposal plan. NERBC disbanded before the long-range plan could be completed and the effort moved to the New England Governors' Conference (NEGC). NEGC authorized this policy analysis project in mid-1982 to continue with the long-range planning process.

"The Interim Plan is a response to the public health concerns of several state, interstate and federal agencies regarding open water disposal," NERBC stated in this report. "The Plan represents a cooperative effort to define a consistent disposal management program and set forth the state policies of Connecticut and New York on open water disposal in Long Island Sound. The Plan will serve as a guide for dredged material disposal until completion of a long-range dredging and disposal plan for the Long Island Sound area."

The Interim Plan established the continuing role for NERBC in LIS dredging through creation of a Dredging Management Committee to "periodically review the effectiveness of the Interim Plan's Guidelines for open water disposal, make recommendations to the Commission for changes as they are needed, and amend those aspects of the guidelines as identified in the plan." NERBC was also to complete a long-range dredging mananagement study examining long-term impacts and a comprehensive evaluation of feasible disposal alternatives. With the demise of the Commission in 1981, the New England Governors' Conference took on the long-range dredging study. But no agency has accepted the responsibility of convening a regional Dredging Management Committee, and that panel has died with the NERBC.

The Interim Plan's policies and recommendations also call for:

* carefully controlled and monitored open water disposal designed to minimize open water impacts;

* incorporation of "all reasonable mitigating measures on a case-by-case basis;" and

* a "consistent, coordinated and timely" review of dredging applications. These standards are currently part of Connecticut's federally approved Coastal Area Management (CAM) Program and are utilized by the State Department of Environmental Protection in private and federal dredging proposals.

Interim Plan Guidelines

Guidelines for open water disposal in the Interim Plan include:

"1. Open water disposal of dredged material in Long Island Sound will be limited to three interim disposal sites. The use of these sites will be reviewed. Additional sites may be considered for designation based on the results of Corps of Engineers Composite Environmental Impact Statement on Dredged Material Disposal from Long Island Sound and other relevant studies. The Dredging Management Committee may change or add additional sites to the Interim Plan consistent with the policies and guidelines of the Plan and applicable state and federal laws.

"2. The sites selected for the disposal of contaminated materials should be those whose characteristics prevent any significant subsequent transport of those sediments or their chemical constituents. Contaminated sediments, when disposed of in these sites, should be placed on a small area of the bottom and in a manner which minimizes exposure of dredged sediments to the aquatic environment. Open water disposal sites should be sufficiently deep to reduce the probability of wave scouring of dumped sediment and where tidal and wind generated currents are too weak to disperse material out of the disposal area. In addition, disposal sites should be located away from critical breeding, feeding and nursery areas, and shellfish beds.

"3. The following three areas will be kept available for interim dredged material disposal activity:

"a. A two square mile area centered on 41°-08'-45"N, 72°-53'-15"W in the middle of the Sound south of New Haven, Connecticut, in the vicinity of the historical "New Haven" dumping grounds. This site is to be referred to as the "Central Long Island Sound Regional Dredged Material Disposal Area."

"b. A one mile square centered on 41°-12.6'N, 72°-21.6'W in the middle of the Sound south of the mouth of the Connecticut River, in the vicinity of historical "Cornfield Shoals" dumping grounds. This site is to be referred to as the "Connecticut River Regional Dredged Material Disposal Area."

"c. The historical New London dumping grounds is designated on an interim basis pending results and recommendations of ongoing disposal monitoring and research. This site is a one mile square area centered on 41°-16.3'N, 72°-04.6'W south of the mouth of the Thames River, New London and Groton.

"4. In view of the need to continue some level of open water disposal, while at the same time control the effect of disposal activities and protect the natural resources of Long Island Sound, disposal should continue to be restricted to a limited number of sites selected on the basis of their biological and physical characteristics, and distance from ecologically sensitive areas. The designation of additional disposal areas will be limited to a number of sites necessary to meet regional needs for disposal in order to maintain a program of carefully controlled and monitored open water disposal."

Initially, the Interim Plan restricted open water disposal to the historical New London, Cornfield Shoals and Central Long Island Sound regional dumpsites. The plan also stated new sites for open water disposal should be containment sites, or locations which prevent "any significant subsequent transport" of dredged materials. Project review guidelines along with a sediment classification system are enumerated in the Interim Plan and discussed in Section 1.8 of this report.

Unacceptable Impacts

After discussing disposal site management practices (see Section 1.12 of this report), the Interim Plan turns to a discussion of unacceptable and acceptable impact of open water disposal. The text states:

"Unacceptable impacts of open water disposal in Long Island Sound include:

"a. Persistent floating residues of any sort;

"b. Release of any material, substance, biological or chemical constituent, which is likely to result in long-term or permanent degradation of the water column fauna overlying the dumping ground;

"c. Dispersal or spreading of demonstrably toxic sediments outside of the designated disposal area; and

"d. Biological mobilization and subsequent transport of demonstrably toxic mutagenic or teratogenic substances quantitatively."

Acceptable effects include temporary and short-lived impacts, burial of disposal site benthic communities, and long-term changes in the spoil mound. The plan concludes with a review of minimum monitoring requirements and the Dredging Management Committee.

NERBC's initial design for the long-range management study included development of a basis for assessing alternatives to open water disposal; confirming the roles and responsibilities of specific government agencies in the management system; development of a "planning basis for public agencies to carry out their responsibilities;" and development of "substantive data that will improve the dredged material disposal regulation process." Legally, the CE and EPA are required to generate information improving dredging and disposal management.

Products of NERBC's New England Dredging Management Plan were, initially, to include for federal dredging projects:

1. a projected schedule for major federal efforts; and

2. a disposal plan including open water, containment and upland sites along with management practices for each site in terms of quantity, types and disposal conditions.

For all dredging activity, the plan was to propose:

1. alternative disposal sites for all practical methods of disposal;

2. specifications for the kinds of material that may be deposited in each site, developed along the lines of the Interim Plan; and

3. recommended dredging and disposal methods.

While NEGC is working to complete the NERBC long-range study, it is unclear how well any planning program can work without the degree of continuity and opportunity for modification provided by the now defunct Dredging Management Committee. Further, the absence of any mechanism for incorporating new scientific understandings into a regional dredge management plan is a significant concern. The effort to develop Soundwide dredge management through long-term planning will fall short of its goal unless the planning process is perceived as a dynamic, continuing program of communication and modification.

PEIS: A Regional Overview

In May, 1982, the Corps issued its final Programmatic Environmental Impact Statement (PEIS) on dredging in the Sound. Growing out of the 1976 court agreement for NRDC et al v. Callaway, this composite environmental impact statement assesses generic environmental impacts associated with a range of disposal alternatives. The PEIS is also designed to serve as the basis for supplemental environmental impacts assessments and statements for LIS dredging projects.

Significantly, the Corps characterizes the PEIS as a "living document" in that the text will be updated as new information is developed through scientific studies. The document also identifies specific areas where further research is needed. A review of the PEIS assessment of disposal alternatives is included in Section 1.13 of this report.

Three areas of controversy and concern were identified in the PEIS:

1. What is the most suitable alternative for dredged material disposal in this region?

2. Should disposal operations continue before long term cumulative impacts are identified and assessed?

3. Who regulates the various disposal alternatives?

The first two questions remain unanswered while the third is discussed in Section 1.6 of this report.

1.6 Legal Framework for Dredging and Disposal Decisions

Primary Statutes

A series of federal laws, regulations and interpretative guidelines provide the framework for managing dredging and disposal across the country. This element of the management system focuses on review of dredging proposals within an administrative process based on the requirements of law. Designation of open water disposal sites and evaluation of specific projects occurs through this process. Four major federal statutes serve as the foundation for dredging management. They are:

* Section 103 - Marine Protection Research and Sanctuaries Act of 1972 ("Ocean Dumping Act," 33 USC 1413), as amended. Nationally, the Ocean Dumping Act contains regulations covering transportation of dredged material beyond the territorial waters of a state ("the baseline") for the purposes of disposal. This element of the Act would affect dredged materials from the Sound destined for open ocean disposal. The Act was amended in 1981 to bring all LIS dredging projects of more than 25,000 cubic yards under the mandatory laboratory tests of Section 103. Section 103 also promulgates criteria for establishing open water disposal sites in open ocean and LIS. This section is similar to Section 404 of the Clean Water Act in that it creates a permit program administered by the CE and implements technical criteria which are quite similar to those detailed in Section 404(b).

* Section 404 - Federal Water Pollution Control Act as Amended in 1977 ("Clean Water Act," 33 USC 466 et seq.). Governs disposal of dredged materials and other pollutants into U.S. waters within the baseline, tidal marshes, inland wetlands and many interior waterways. The CE issues a permit for discharges of dredged material totaling less than 25,000 cubic yards in the LIS region under this act. Permits issued must comply with environmental guidelines under Section 404(b).

* Section 401 - Federal Water Pollution Control Act as Amended in 1977 ("Clean Water Act," 33 USC 466 et seq.). Section 401 requires state certification that a project will not unacceptably degrade water quality at the dredging or disposal site. In this region, 401 permits are issued by the Department of Environmental Protection for Connecticut waters and Department of Environmental Conservation for New

York waters. Certification entails evaluation of physical and chemical changes affecting water quality and the resulting environmental effects (particularly upon habitat and biological productivity) at the dredging and disposal site. Section 401 permits are only issued for projects within a state's territorial waters. Outside the baseline, Section 103 criteria of the Ocean Dumping Act apply.

* Section 10 - Rivers and Harbor Act of 1899 (33 USC 403). This act protects navigation and the navigable capacity of U.S. waters through a permit program administered by the CE. Section 10 prohibits obstruction or alteration of any navigable waterway without a permit from the Corps. All dredging activities are reviewed and issued permits within this section. "Navigable waters of the U.S." are defined as any waters subject to the ebb and flow of the tide which have been in the past, currently are, or may in the future be suitable for the purpose of interstate or foreign commerce.

Secondary Statutes

Although not directly involved in the LIS permit process, these additional federal acts influence dredging decisions within the region:

* Fish and Wildlife Coordination Act. Prior to permit issuance, consultation and coordination with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service are required for any activity which may affect fish and wildlife resources.

* National Environmental Protection Act (NEPA). The CE may determine that certain major or controversial non-CE dredging projects will be required to follow NEPA guidelines for preparing an environmental impact statement (EIS) to assess potential environmental effects.

* Resources Conservation and Recovery Act (RCRA). Currently applies to upland disposal of dredged materials containing hazardous wastes.

* Safe Drinking Water Act. Under Section 1424(e), EPA may identify certain drinking water aquifers which, if polluted, would pose a significant hazard to public health. This could affect selection and use of upland sites for disposal.

* Coastal Zone Management Act of 1972. All activities directly affecting a state's coastal zone must comply wth that state's approved coastal zone management program.

* Endangered Species Act of 1973. Protects critically endangered species from government actions, provides framework for resolution of interagency disputes concerning projects which could affect these species.

* National Historic Preservation Act of 1962. Protects cultural features of national significance.

Key Administrative Agencies

The requirements of these statutes which affect dredging and disposal around the Sound are administered by the following key agencies:

* The CE: Section 10 (River and Harbor Act) permit to dredge and dispose of sediment within the baseline in waters of the U.S.; Section 404 (Clean Water Act) permit to discharge material within the baseline; and Section 103 (Ocean Dumping Act) permit to transport material for disposal beyond the baseline and dumping site approval.

* The EPA: Section 404 (Clean Water Act) guidelines for evaluating dredged material for disposal within the baseline; and Section 103; (Ocean Dumping Act) designation of disposal sites beyond the baseline.

* DEP/DEC: Section 401 (Clean Water Act) water quality certification for dredging and disposal of material within the baseline; consultation on other apsects of dredging management.

It is important to note dredging projects in Connecticut ports are evaluated by the CE's New England Division, EPA Region 1, and other federal officials in regional offices covering New England. Connecticut DEP officials issue permits for dreding projects in the state under the structures and dredging program and must also issue a water quality certification for New York materials to be dumped in Connecticut waters.

Projects in New York waters must received 401 certification for the dredging from the state through the Department of Environmental Conservation (DEC) and from federal officials at the CE's New York District. Since all designated disposal sites in the Sound are in Connecticut waters, permission for open water disposal must come from Connecticut's Department of Environmental Protection (DEP) and the CE's New England Division. To avoid regulatory duplication, a process for coordinating administration between these four agencies has been established.

Through the regulatory process, other state and federal agencies are able to comment on specific project proposals and designation of open water disposal sites. In the past, all dredging projects were discussed at a Joint Processing Session coordinated by the CE. This monthly meeting brought federal and Connecticut officials together to discuss specific applications and proposed federal projects.

The Joint Processing Session has recently been reduced in scope. Now, maintenance dredging proposals will come before the Joint Processing Session if -- and only if -- an agency requests a project undergo joint processing. Improvement proposals would continue to undergo Joint Processing Session review. Agencies participating in these meetings range from the CT DEP to U.S. Fish and Wildlife Service, EPA and the National Marine Fisheries Service.

1.7 Administrative Review Process

This legal framework guides administrative review of both specific dredging projects as well as proposals to designate areas for open water disposal of dredged materials.

Dredging proposals are advanced either by the CE as a maintenance or improvement project or by a private applicant such as a marina, dock owner, or water dependent business. Projects proposed by the CE do not require CE issued permits but many elements of the review process -- including close communication and coordination with other agencies -- occurs with these proposals.

Dredging projects are either advanced by private interests such as marina owners or water dependent businesses or by the CE to maintain or improve channels and harbors. Private dredging applications require a Section 401 water quality certificate from the state in which the dredging will occur; a Section 10 CE permit to dredge and a CE 103 or 104 permit to dispose of dredged materials. The CE will not issue any permit unless the state grants 401 certification or a waiver. Then a single CE permit will be considered under Sections 10 and 103 or 104.

Proposals for dredging developed by the Corps of Engineers undergo much of the same interagency review as private applications. But Corps of Engineers permits, as such, are not issued for this work. Section 401 certification from the state is required for a Corps of Engineers project and each proposal must follow a process of project authorization and appropriation prior to the consideration of the dredging iteself. Both private and Corps of Engineers proposals are evaluated in light of Section 404 and 103 request.

Project Review Considerations

The 404 regulations prohibit specification and/or use of any disposal site in Long Island Sound when its use would result in unacceptable adverse effects of water quality, shellfish beds and fishery areas (including spawning, feeding, and breeding areas), wildlife or recreational areas. Under Section 404(c) of the Clean Water Act, the Regional Administrator of EPA can deny or restrict the use of the disposal site if, after notice and opportunity for public hearing, he determines that disposal will significantly degrade municipal water supplies or cause significant damage to fisheries, shellfishing, wildlife habitat or recreation areas.

In addition to the advance identification of a disposal site, the Clean Water Act requires an assessment of the environmental impacts of the proposed discharge prior to approval of the 404 permit. All plausible disposal alternatives must be considered. These options include no dredging, upland disposal, containment, beach nourishment, and open water disposal. Disposal of dredged materals in the deep ocean is also considered plausible by some.

Guidance for the assessment of disposal projects is found in the implementation manual for Section 103 of the Ocean Dumping Act (PL 92-532) entitled "Ecological Evaluation of Proposed Discharge of Dredged Material into Ocean Water." The application of ocean dumping guidelines to state territorial waters stems from a conscious EPA policy to provide an equal level of protection to both types of waters.

When considering a private proposal, within 15 days of receipt of a completed application, the CE issues a public notice describing the proposed work. Comments on an application may be filed from a variety of sources, including groups and the public state agencies, federal agencies, special interest groups, and the public.

The EPA reviews all proposed disposal actions, whether they be Corps of Engineers projects or applications for disposal permits issued by the Corps.

Sections 103 and 404

Section 103 standards apply only to dredging projects of more than 25,000 cubic yards in Long Island Sound and to any Sound sediments to be dumped in open ocean waters outside the baseline. Projects of 25,000 cubic yards or less are subject to CE review under technical standards specified in Section 404(b). Federal and state officials concur there is little substantive difference in the regulatory content and approach of 103 and 404 evaluations. The sole significant difference, they say, is the requirement of biological testing under Section 103. These tests are an option which may be required under Section 404 standards.

In considering a 404 dredging application, officials draw on data developed during 103 testing of sediments and often extrapolate this data to gauge potential environmental impact. Both state and federal officials will also look at historic sources of pollution in the area to be dredged and other factors to determine if biological tests are needed. To date, the State of Connecticut has yet to request bioassays of a 404 applicant. This stems from the availability of 103 data; staff knowledge of conditions in harbors around the Sound; and the small size of projects governed by 404 in this region.

Connecticut DEP officials also use 103 data and staff expertise in evaluating applications for 401 Water Quality Certification for dredging projects. State officials say bioassays and related data developed under 404 applications using 103 testing, provide a basis for the 401 evaluation.

State and federal officials say there is little difference between the level of protection afforded the marine environment under Section 103 in comparison to Section 404.

They suggest the principal difference is the mandatory requirement of laboratory analysis of sediments found under Section 103. Since these tests can be required under Section 404, these officials see little benefit from Section 103.

CE officials concerned with the effect of a dredging project on navigation under Section 10 review. Unless the project would create navigation hazards, the CE grants permit approval under this section.

The 1958 Fish and Wildlife Coordination Act provides for comments on the permit application by the U.S. Fish and Wildlife Service and the National Marine Fisheries Service. Objections to permit decisions at the regional level may be referred to the national level for resolution. Objections may result in modifications of the application to address the objections, a public hearing or denial of the disposal permit if adverse environmental impacts outweight public benefits.

Each project proposal is reviewed in the context of the National Environmental Policy Act (NEPA), which became effective January 1, 1970. NEPA requires that reasonable alternatives to proposed disposal actions be evaluated and that the cumulative effects of similar activities be considered in decision making. Pursuant to NEPA, the Corps prepares findings of no significant impact, environmental assessments, or, on significant or controversial projects, environmental impact statements, for both permit actions and their own projects.

In addition to the requirements for federal agency review of disposal actions, Section 401 of the Clean Water Act requires a state water quality certificate for disposal within state territorial waters such as Long Island Sound. Water quality certification is the confirming statement of a state's water pollution control agency that the proposed action will not permanently violate state Water Quality Standards. Current regulatory procedure requires a dredger to make application to both the state in whose waters the disposal will occur and the Corps of Engineers for approval of disposal in Long Island Sound. Finally, any federal action must be consistent with an approved state Coastal Zone Management Plan.

Federal Project Authorization

All federal or CE projects -- whether for maintenance dredging or new dredging to improve a specific harbor -- require authorization from Congress. Preliminary studies of a potential project (including an EIS) are undertaken at the request of state or local officials and must receive authorization by a Congressional act or resolution. Results and recommendations from these studies are sent to the appropriate House Public Works and Transportation Committee and Senate Environment and Public Works Committee. Both committees must approve the project. Post-authorization planning and feasibility studies for advanced design and engineering of the particular project are then undertaken and design memoranda produced. Maintenance of the improvement project is generally included in the authorization.

Authorization for constructing small navigation projects is delegated to the Chief of Engineers under Section 107 of the Rivers and Habors Act. At the request of a local sponsor, the feasibility of a small project is determined by the regional CE Division. Based on the results, a detailed project report and environmental assessment is to be prepared. The results of the assessment are then used to evaluate the poject by detailing its compliance with 404 guidelines. If it is determined that the project will not produce significant impacts, a finding of no significant impact (FONSI) is made. If potential impacts are significant and results form a major federal action, then an EIS must be prepared. The results and recommendations of these studies are sent to the Chief of Engineers, who is reponsible for project authorization, as well as the maintenance of small navigational projects.

Upon authorization of an individual CE project, financing must be appropriated by Congress. Depending on the type of dredging project, funding may be directly allocated to a specific project or made available through general improvement or maintenance funds. Improvement project costs may also be borne in part by the state of by a local sponsor, depending on project use.

Upon receipt of authorization and appropriation, the CE consults with appropriate federal, state and local interests on the specifics of the dredging and disposal. For maintenance dredging, an environmental assessment and 404 evaluation are prepared to examine project alternatives and potential impacts. When agreement is reached and a state water quality certificate obtained, the project may be undertaken. For recurring maintenance work involving clean materials -- such as removal of clean sand from the mouth of the Connecticut River -- general permits may be issued for the work. The New England Division instituted a limited program of general permits in 1982. Under this program, small projects utilizing upland disposal may be approved under the general permit with minimal review. An application describing the proposed project is required to determine whether the work qualifies for quick approval under the general permit program.

Site Designation Procedures

Criteria for determination of open water disposal sites in Long Island Sound are promulgated under Section 103 of the Ocean Dumping Act. These standards were recently utilized by the Corps of Engineers in designation of a disposal area in western Long Island sound, (see: Final Environmental Impact Statement, WLIS III). Generally, these rules require a site:

* minimize the interference of disposal activities with other activities in the marine environment, expressing specific concern for protection of fisheries or shellfisheries and regions of heavy commercial or recreational navigation; and

* serve as a natural containtment site.

Specific factors which must be considered include:

(1) Geographical position, depth of water, bottom topography and distance from the coast.

(2) Location in relation to breeding and spawning; or passage of young or adult species.

(3) Location in relation to beaches and other amenity area.

(4) Types and quantities of wastes to be disposed of and methods of packing the waste, if any.

(5) Feasibility of surveillance and monitoring.

(6) Dispersal, horizontal transport, and vertical mixing characteristics of the area.

(7) Existence and effects of current and previous discharges and dumping in the area.

(8) Interference with shipping, fishing, recreation, mineral extraction, desalinization, fish and shellfish culture, research and other legitimate uses of the ocean.

(9) Existing water quality and ecology of the site.

(10) Potential for development or recruitment of nuisance species at the site.

(11) Existence at or near the site of any significant natural or cultural features of historical importance.

Procedurally, designation of an open water disposal site in Long Island Sound typically begins in consultations with state officials which result in a shared recognition of the need for an additional disposal area. Based on this need, the CE develops an Environmental Impact Statement (EIS) which is circulated in draft form to agencies and the public. Typically, in the LIS region, a public hearing would be held to take testimony on the proposal. Based on comments received, the CE would review the draft EIS and make appropriate revisions. A final EIS would then be issued along with a decision on designation of the disposal area.

1.8 Technical Review Standards

A gap exists between the broad language of the statutes related to dredging and the detailed technical standards needed to administer a regulatory program. Regulations, promulgated by the Corps of Engineers (CE) and U.S. Environmental Protection Agency (EPA) fill this gap. These regulations translate statutory requirement and intent into technical standards which scientists and regulators can use in implementing the law. These regulations can also bring the best available scientific knowledge to bear on management decisions.

The technical -- or scientific -- standards utilized in dredging management around the Sound are based on Section 103 and Section 404. Regulations based on these statutes address the center of controversy in most dredging debates: disposal of dredged materials contaminated with pollutants without unacceptable harm to the environment. These safeguards reflect the presence, at least in low levels, of potentially hazardous substances in some sediments which raise concerns regarding the effect dredging and disposal may have on marine environmental quality and public health.

Under some circumstances, contaminants found in Long Island Sound sediments are firmly bonded to individual sediment particles. This bond may be stronger for some contaminants, such as heavy metals, than for other pollutants, such as chlorinated hydrocarbons. The strength of this bond may also vary depending whether sediments are dumped in disposal sites of a similar milieu as the dredging site as well as the amount of disturbance which occurs. Mobility of these contaminants, then, can vary significantly depending on the disposal technique, characteristics of the dredged materials, disposal management practices, and milieu of the disposal site.

Issues involving sediment contamination are complex and difficult to resolve. These concerns entail comparisons between impacts on land with those on marine resources. More important, these issues involve significant scientific uncertainty within a regulatory and political context which prefers clearcut, definitive standards.

Compared to the levels of contaminants in other wastes, some officials say dredged materials can generally be regarded as relatively low-level wastes. Some industrial wastes discharged to waterways and harbors contain substantially higher concentrations of metals, organic chemical residues and hydrocarbons. Municipal sewage sludges from large industrial cities often contain several times the contaminants which are found in dredged materals. These comparisions serve only to put dredged materials in perspective, for the total amount of contamination present in a discharge may not be related to the amount of this substance which is actually available for release to the environment. Knowing the total amount of contaminant does not always permit a valid prediction of the potential for contaminant release.

Generally, bottoms of urban harbors around Long Island Sound, particularly on the north shore, tend to be lined with fine-grained and organically rich sediments. Especially along the upper reaches of these ports, sediments are often found to contain elevated levels of oil, grease, heavy metals, and organic chemicals. These contaminants tend to strongly bond to dredged materials so long as in a similar milieu. In some experiments, contaminants in disposal site water have been removed from the water by dredged material settling out during laboratory tests. Certain contaminants -- particularly chlorinated hydrocarbons -- may be remobilized by reprocessing from dredging or natural disturbances.

Tests and Standards

Several tests and standards have been developed to characterize dredged material and provide a basis for predicting the impact of alternative disposal plans.

Physical and colligative properties refer to the characteristics of whole samples taken from the bottom or areas to be dredged. They refer to such characteristics as grain size, distribution, cohesion, plasticity (resistance to deformation), solids content and density. Other whole sample properties such as percent organic matter (volatile solids) and percent of oil and grease are often included in this category.

Bulk chemical analysis refers to the total amount of a substance in a sediment sample. Bulk chemical analysis is often said to include assessment of physical properties and is usually expressed in parts per million (ppm), which means the number of milligrams of the substance found per kilogram of sample.

A key disadvantage of this laboratory test is the absence of any indication of a substance's availability to the marine environment. Thus, a potential pollutant may be found in a sample but this contaminant may be tightly bound to the sediment, limiting the potential ecological impact. Based on this, some scientists argue bulk chemical analyses cannot be used to predict the environmental effect of a dredged material's disposal since concentrations reported in the tests do not necessarily bear any relationship to the availability of the substance. This availability might change in a different chemical environment, such as upland or an alternative disposal technique.

The elutriate test has been developed to help assess the availability of potential pollutants in sediments to be dredged from harbors and channels. In this procedure, a sediment sample is mixed with water taken from the disposal site and through vigorous shaking resuspended. The sample is allowed to settle and then filtered. The concentration of contaminant released to the water can then be measured.

Elutriate tests are gauged by comparing the concentration of a contaminant in the disposal site water to that in the test sample after mixing. If the test level exceeds 1.5 times background data, then the contaminant level is said to be "elevated." During elutriate tests for the CE, "elevated" levels of the following substances have been found in LIS harbors (Connecticut only): oil and grease (O & G), mercury (Hg), cadmium (Cd), and other substances, ortho-phosphate (Ø-T), total-phosphate (+-P), nitrate phosphate (NO_3-N), arsenic (As), copper (Cu), nickel (Ni), vanadium (Vn), lead (Pb) and zinc (Zn) (see Table 1.8A).

For disposal on land, another test -- the hazardous waste or EP toxicity test -- is used to gauge the potential effect of rain leaching through a disposal site.

Neither the elutriate nor EP test address long term release of substances to the environment. Further, these procedures do not predict the effect release of contaminants may have on organisms in the dredging or disposal site.

Biological Testing

Bioassessment tests are used to evaluate the impact of dredged materials on marine life at open water disposal sites. A bioassessment procedure has yet to be developed for predicting upland disposal effects. Bioassessment tests expose test animals to dredged materials for specific periods of time under controlled laboratory conditions. Bioassays are typically divided into liquid, suspended particulate, and solid phases. Animals surviving the solid phase experiment are utilized for bioaccumulation tests to determine the degree to which test organisms take up contaminants from the sediments on the aquarium floor.

EPA interpretative guidelines issued under Section 103 require bioassays be performed with "appropriate sensitive marine organisms." Liquid phase bioassays are to include at least three species consisting of one phytoplankton or zooplankton species; one crustacean or mollusc; and one fish. Suspended particulate bioassays should include zooplankton; a crustacean or mollusc; and a fish. Test results on Connecticut sediments submitted to the CE by consulting laboratories have utilized the copepods Acartia tonsa (AT) and Acartia clausi (AC); the hard clam Mercenaria mercenaria (MM); mysid shrimp Neomysis americana (NA); the sand shrimp Crangon septemspinosa (CS); and the mysid shrimp Mysidopsis Bihia (MB). Table 1.8B reflects these data.

For solid phase bioassays, EPA guidelines suggest at least three species including filter feeders, deposit feeders, and burrowing species should be included in these tests. It is further recommended the species be selected to include one crustacean, an infaunal bivalve and an infaunal polychaete. Consulting laboratories submitting data on Connecticut harbor sediments to the CE have used the bivalve Astarte sp. (A); sand shrimp (Crangon septemspinosa (CS); hard clam Mercenaria mercenaria (HC); mysid shrimp Mes idopsis bihia (MB); bivalve Nucula sp. (N); mysid shrimp Neomysis americana (NA); sand worm Nereis virens (NV); polychaete Nepthys sp. (S); and bivalve Yoldia sp. (Y). These data are summarized in Table 1.8C. Table 1.8D reflects bioaccumulation data showing the presence of polychlorinated biphenyls (PCBs); DDT; mercury (Hg); petroleum hydrocarbon (PHC) and cadmium (Cd) in some tests.

KEY TO TABLE 1.8-A

CE ELUTRIATE TEST RESULTS

NOTE: THESE TABLES ARE MEANT TO SUMMARIZE THE TEST RESULTS FOR PURPOSES OF COMPARISON. FOR MORE DETAILED ANALYSES, THE ACTUAL DATA SHOULD BE CONSULTED. REPORTS CONTAINING THE DETAILED RESULTS ARE ON FILE AT THE CORPS OF ENGINEERS, NEW ENGLAND DIVISION, ENGINEERING DIVISION: MARINE SCIENCES UNIT, AND OPERATIONS DIVISION: REGULATORY BRANCH.

Any substances GT 1.5X: Was any substance present in the elutriate at a level exceeding 1.5 times its level in the test water before exposure to the sediment sample.

Major substances GT 1.5X: Was any major substance present in the elutriate at a level exceeding 1.5 times its level in the test water before exposure to the sediment sample.

Elevated Major substances: List of major substances found in the elutriate at a level exceeding 1.5 times the test water levels.

Elevated Other Substances: List of other substances found in the elutriate at a level exceeding 1.5 times the test water levels.

Reference Water Site: The area from which the water used in the test was obtained.

<u>Key to Constitutents</u>

Major Substances:

O+G - oil and grease
DDT - dichloro-diphenyl-trichloroethane family
PCB - polychlorinated biphenyls
Hg - mercury
Cd - cadmium

Other Substances:

o-P - ortho phosphate
t-P - total phosphate
NO_3-N - nitrate nitrogen
NO_2-N - nitrite nitrogen
As - arsenic
Cu - copper
Ni - nickel
Vn - vanadium
Cr - chromium
Pb - lead
Zn - zinc

(Source: NERBC, 1981a)

TABLE 1.8-A

SUMMARY OF ELUTRIATE TEST RESULTS- CONNECTICUT

Project		Major Substance Greater Than 1.5 X ?	Other Substance Greater Than 1.5 X ?	Elevated Major Substances	Elevated Other Substances	Reference Water Site
Black Rock Harbor		no	no			Dredge Site
Branford Harbor		no	no			New Haven Dump Site
Bridgeport Harbor		yes	yes	Cd	NO_3-N	Dredge Site
Clinton Harbor		no	yes		t-P,o-P, As, Vn	Dredge Site
CT River North Cove		yes	no	O+G		Cornfield Shoals Site
CT River Saybrook Shoals		yes	yes	O+G, Cd	NO_3-N, SO_3	Dredge Site
Mianus River		no	yes		o-P, NO_3-N	Eaton's Neck Disposal Site
New Haven Harbor	1973	no	yes		t-P, NO_3-N, As	Dredge Site
New Haven Harbor	1977	no	yes		t-P, o-P, NO_3-N,	New Haven Disposal Site
New Haven Harbor	1978	no	no			New Haven Disposal Site
New London Shaw's Cove		no	yes		t-P	Dredge Site
Norwalk Harbor	1978	no	yes		t-P, o-P, As	Dredge Site
Norwalk Harbor	1979	no	yes		t-P, o-P, As	Dredge Site
Stamford Harbor	1975	yes	yes	O+G, Hg	t-P, o-P, As	Eaton's Neck Disposal Site
Stamford Harbor	1977	yes	yes	Hg	o-P, t-P, As, Ni	New Haven Dump Site
Stamford Harbor	1978	yes	yes	O+G	t-P, o-P, As, Ni, Zn, Pb	Dredge Site
West River		no	yes		o-P, As	New Haven Dump Site

(Source: NERBC, 1981a)

KEY TO TABLE 1.8-B

BIOASSAY RESULTS SUMMARY CHART
(LIQUID AND SUSPENDED PARTICULATE PHASES)

NOTE: THESE TABLES ARE MEANT TO SUMMARIZE THE TEST RESULTS FOR PURPOSES OF COMPARISON. FOR MORE DETAILED ANALYSES, THE ACTUAL DATA SHOULD BE CONSULTED. BIOASSAY REPORTS CONTAINING THE DETAILED RESULTS ARE ON FILE AT THE CORPS OF ENGINEERS, NEW ENGLAND DIVISION, ENGINEERING DIVISION: MARINE SCIENCES UNIT, AND OPERATIONS DIVISION: REGULATORY BRANCH.

Species Used: List of species used in test. (see key to species below)

Liquid Phase sp. with significant mortality: species if any that were found to have statistically significant mortality difference between the sediment test and the control in the liquid phase bioassay.

Liquid LPC exceeded?: Was the mortality in the liquid phase high enough so that the Limiting Permissible Concentration would be exceeded?

S. P. phase spp. with significant mortality: species if any that were found to have statistically significant mortality difference between the sediment test and the control in the suspended particulate phase bioassay.

S.P. LPC exceeded?: Was the mortality in the suspended particulate phase high enough so that the Limiting Permissible Concentration would be exceeded?

Performed by: Laboratory performing the tests: (ERCO-Energy Resources Corporation, Raytheon-Raytheon Inc., Batelle-Batelle Duxbury Laboratories, NEA- New England Aquarium, Essex Mar. Lab.- Essex Marine Laboratories Inc., Normandeau Associates Inc., JBF-JBF Scientific Inc.)

Species Key

A - *Astarte sp.*, bivalve
AT - *Acartia tonsa*, copepod
AC - *Acartia clausii*, copepod
CL - *Cancer sp.*, crab larvae
CS - *Crangon septemspinosa*
HC - *Mercenaria mercenaria,* hard clam
MB - *Mysidopsis bihia*
MM - *Menidia menidia*, Atlantic Silversides
MY - *Menidia beryllina*, silversides
NA - *Neomysis americana*, mysid shrimp
NS - *Nereis succinea*, sandworm
NV - *Nereis virens*, sandworm
PP - *Palaemonetes pugio*, grass shrimp

(Source: NERBC, 1981a)

TABLE 1.8-B

BIOASSAY RESULTS SUMMARY CHART
(LIQUID AND SUSPENDED PARTICULATE PHASES)

Summary of Bioassay Test Results (Liquid and Suspended Particulate Phases)

CE Project	Date	Species Used	liquid phase:[1] ssp with Sig. mortality	LPC exceeded?	S.P. phase[1] ssp. with Sig. mortality	LPC exceeded?	performed by
Pawtuxet Cove, RI	11/78	MB, MY, CL	MY, CL	no	MB, MY, CL	no	Raytheon
Bridgeport, CT	1/80	AT, NA, MM	AT	no	none	no	ERCO
Black Rock Harbor, CT	1/80	AT, NA, MM	MM	no	MM	no	ERCO
New Haven, CT	6/78	CS, MB, MM	CS, MB	no	C, MB,	no	Batelle
Norwalk, CT	8/78	NA, MB, c[2]	MB, c	no	MM, MB, c	no	JBF
Norwalk, CT	2/79	AT, AC, MM	AT	no	none	no	NEA
Norwalk, CT	8/79	AT, NA, MM	MM	no	MM	no	ERCO
Quinnipiac R., CT	11/80	AT, NA, MM	AT	no	AT,NA,MM	no	ERCO
Stamford, CT	12/78	HC, MB, MM, PP	3	no	3	no	Essex Mar. Lab
Stamford, CT	5/80	AT, NA, MM, AC					NEA
Shaw Cove, CT	11/78	AT, NA, MM	none		none		ERCO

1. In most cases, significant mortality did not occur at all stations tested.
2. Specified only as calanoid.
3. Results not analyzed by individual species.

(Source: NERBC, 1981a)

KEY TO TABLE 1.8-C

BIOASSAY RESULTS SUMMARY CHART
(SOLID PHASE)

NOTE: THESE TABLES ARE MEANT TO SUMMARIZE THE TEST RESULTS FOR PURPOSES OF COMPARISON. FOR MORE DETAILED ANALYSES, THE ACTUAL DATA SHOULD BE CONSULTED. BIOASSAY REPORTS CONTAINING THE DETAILED RESULTS ARE ON FILE AT THE CORPS OF ENGINEERS, NEW ENGLAND DIVISION, ENGINEERING DIVISION: MARINE SCIENCES UNIT, AND OPERATIONS DIVISION: REGULATORY BRANCH.

Species Used: List of species used in test. (see key to species below)

reference sediment used: Area where control or reference sediment was obtained. (c) Indicates that sediment was used as a control. (r) Indicates sediment used as reference. Intertidal means that sediment was obtained from presumably uncontaminated intertidal area.

Difference in mortality: The difference in (species combined) mortality between reference sediment and test sediment (NSD-no statistically significant difference; LT 10% - significant difference less than 10% was found; GT 10%-mortality in test greater than 10% more than reference)

Performed by: Laboratory performing the tests: (ERCO-Energy Resources Corporation, Raytheon-Raytheon Inc., Batelle-Batelle Duxbury Laboratories, NEA- New England Aquarium, Essex Mar. Lab.- Essex Marine Laboratories Inc., Normandeau Associates Inc., JBF-JBF Scientific Inc.)

Species Key

AT - *Acartia tonsa*, copepod
AC - *Acartia clausii*, copepod
CL - *Cancer sp.*, crab larvae
A - *Astarte sp.*, bivalve
CS - *Crangon septemspinosa*, sand shrimp
HC - *Mercenaria mercenaria*, hard clam
MB - *Mysidopsis bahia*, mysid shrimp
MM - *Menidia menidia*, Atlantic Silversides
MY - *Menidia beryllina*, silversides
N - *Nucula sp.*, bivalve
NA - *Neomysis americana*, mysid shrimp
NS - *Nereis succinea*, sandworm
NV - *Nereis viriens*, sandworm
PP - *Palaemonetes pugio*, grass shrimp
S - *Nephtys sp.*, polychaete
Y - *Yolida sp.*, bivalve
NI - *Nephtys incisa*
T - *Tellina agilis*

(Source: NERBC, 1981a)

TABLE 1.8-C

BIOASSAY RESULTS SUMMARY CHART
(SOLID PHASE)

CE Project	Date	Species Used	control or reference: sediment from	difference[1] in mortality	performed by
Pawtuxet Cove, RI	11/78	NV, HC, MB	intertidal(c)	GT 10%	Raytheon
Black Rock Harbor, CT	1/80	HC, PP, NV	New Haven D.S.(r)	NSD	ERCO
New Haven, CT	6/78		intertidal(c)	NSD	Batelle
Norwalk, CT	8/78	N, Y, A, S	New Haven D.S.(r)	GT 10%	JBF
Norwalk, CT	2/79	HC, NV, MB	Buzzards Bay(c)	NSD	NEA
Quinnipiac R., CT	11/80	HC, NV, PP	New Haven D.S.	NSD	ERCO
Stamford, CT	12/78	NA, HC, PP, C, S		GT 10%	Essex Mar. Lab
Stamford, CT	5/80		Buzzard's Bay(c)		NEA
Shaw Cove, CT	11/78			GT 10%	ERCO

(Source: NERBC, 1981a)

KEY TO TABLE 1.8-D

BIOACCUMULATION TEST SUMMARY

sig. accum. cases/total: Number of replicates in which significant accumulation was found/total number of replicates.

Species Listed: constitutents found to have statistically significant accumulation comparing test sediment to reference sediment organism (none-none, nt-species not tested).

Performed by: Laboratory performing the tests: (ERCO-Energy Resources Corporation, Raytheon-Raytheon Inc., Batelle-Batelle Duxbury Laboratories, NEA- New England Aquarium, Essex Mar. Lab.- Essex Marine Laboratories Inc., Normandeau Associates Inc., JBF-JBF Scientific Inc.)

Constituent Key

PCB - polychlorinate biphenyls
DDT - dichloro-diphenyl-trichloroethane family
Hg - mercury
Cd - cadmium
PHC - petroleum hydrocarbons

(Source: NERBC, 1981a)

TABLE 1.8-D

BIOACCUMULATION TEST SUMMARY

			substances found to significantly accumulate					
Project	date	sig. accum. cases/total	Mercenaria mercenaria	Nereis virens	Palaemonetes pugio	Crangon septemspinosa	Nereis succinea	performed by
(CE projects)[1]								
Black Rock Harbor, CT	1/81	5/45	PCB, DDT	PCB, PHC, DDT	none	nt	nt	ERCO
Bridgeport, CT	1/80	5/45	PCB, DDT, Hg	none	none	nt	nt	
President Roads, MA	4/81	6/45	Hg, PHC	none	none	nt	nt	ERCO
Chelsea River, MA	3/81	8/45	Hg, PHC	Cd	none	nt	nt	ERCO
Fall RIver, MA	5/81	3/105	PHC	PHC	none	nt	nt	ERCO
Lynn Harbor, MA	11/80	0/45	none	none	none	nt	nt	ERCO
Mystic River, MA	3/81	4/45	HG, PHC	none	none	nt	nt	ERCO
Salem Harbor, MA	11/80	2/36	none	none	CD	nt	nt	ERCO
Stonington, ME	1/81	1/15	Cd	none	none	nt	nt	ERCO
Weymouth Fore R. MA	1/81	0/45	none	none	none	nt	nt	ERCO
(non CE projects)								
Mystic River, MA Schiavone and Son, Inc.		6/15	PCB, PHC	nt	nt	PCB, PHC DDT	PCB	Normandeau
Neponset River, MA MA DEQE		2/9	none	nt	PCB	PCB	nt	Normandeau
Allerton Harbor, MA MA DEQE		3/15	PHC, PCB	none	nt	PCB	nt	ERCO

1. Data from Boston Harbor 7/80 and Island End River 10/79 tests not included.

(Source: NERBC, 1981a)

1.9 Limitations on Data Interpretation

We find interpretation of biological tests to be the subject of considerable controversy. Bioassays were developed to simulate the effects of dredged material disposal on marine life at open water sites. Bioaccumulation tests are designed to estimate the extent to which test organisms take up certain substances from dredged materials. Yet there is little scientific certainty that these tests bear a significant relationship with what actually happens in the marine environment due to dredging and dredged material disposal. These evaluatory laboratory procedures are simply the best at hand when EPA drafted regulations implementing the Ocean Dumping Act. As such, the regulations undergo periodic review and revision.

New England River Basin Commission (NERBC) dredging policy analyses (Dredging Management: Data and Analysis for the New England/Long Island Sound Region and Narragansett Bay Case Study: Technical and Institutional Constraints to Land and Nearshore Disposal of Dredged Material from Narragansett Bay), advance several concerns regarding bioassessment tests. First, NERBC notes, these lab tests cannot reflect long term effects since they last for a relatively short period of reference. Further, it is impossible to determine which substance in the dredged sediment is responsible for mortality in bioassays.

Sources of variability in these procedures are not well defined, NERBC continued. Finally, the relationship between the results of laboratory tests and ecological effects in the marine environment are, according to some, difficult to establish.

In light of this, no single test is accepted by federal agencies as the best basis for disposal management decisions. Uncertainties in the tests create an element of future risk and move dredging questions beyond the realm of scientific evaluation and into the arena of public policy and societal values. Yet the scientific complexity of interpreting data developed in evaluation of dredging projects often tends to exceed the grasp of many who make public policy and of the public itself. The Section 103 interpretative guidelines, issued in 1977 as the "Ecological Evaluation of Proposed Discharge of Dredged Material into Ocean Waters," reflects this difficulty.

Section 103 Interpretation

"This manual provides technical guidance to the fullest extent practical on implementation of the [Section 103] criteria," the EPA states in this text. "Yet technical evaluations can provide only part of the input to the decision making process. Many of the criteria do not concern subjects amenable to qualitative evaluation. In such cases, objective, qualitative decisions must be made. Indeed, the decision of granting a permit is ultimately subjective. The criteria do not prohibit environmental change, but rather 'unacceptable environmental impact.' Consequently, for each permit application, the Regional [EPA] Administrator and [CE] District Engineer must decide how much potential impact is acceptable under the environmental, economic, social and political conditions related to the operation in question. Technical and scientific evaluations provide an important but incomplete input to such decisions."

The 103 evaluative process, EPA continues, emphasizes biological effects and not chemical analysis. Chemical evaluation is meaningful only when dealing with contaminants for which specific water-quality criteria have been estabished. In considering bioevaluation laboratory experiments, EPA states:

"It should be recognized that dredged material bioassays cannot be considered precise predictors of environmental effects. They must be regarded as quantitative estimators of those effects, making interpretation somewhat subjective. In order to avoid adding more uncertainty to their interpretation, the animal bioassays given in this manual all utilize mortality as an end point. The significance of this response to the individual [animals] involved is clear, but the state of ecological understanding is such that it remains impossible to predict the ecological consequences of the death of a given percent of the local population of a particular species. For example, there is no basis for estimating whether the loss at the disposal site of 10 percent of a particular crustacean species would have inconsequential or major ecological effects. This interpretative uncertainty becomes overpowering when a perameter whose ecological meaning is not as clear as mortality is used as the bioassay end point...Interpretative guidance does not attempt to consider the ecological meaning of the mortality observed, but takes the ecologically protective approach prescribed in the Federal Register that any statistically significant increase in mortality compared to the controls is potentially undesirable. It is important to realize, however, that a statistically significant effect in a laboratory bioassay cannot be taken as a prediction that an ecologically important impact would occur in the field..."

"Potentially Undesirable" Effects

Interpretation of bioaccumulation studies is, EPA states, even more difficult due to the lack of research linking tissue concentrations with environmental impact. "Almost without exception in the marine environment," EPA continued, "there is no technical basis for establishing, for example, the tissue concentration of copper in a species of polychaete that would be detrimental to that organism, not to mention the impossibility of estimating the effect of that organism's body on a predator."

Faced with this dilemma, EPA assumed "any statistically significant bioaccumulation relative to animals not in dredged material, but living in material of similar sedimentological character, is potentially undesirable."

Section 103 also requires evaluation of all three phases of the dredging process (liquified, suspended particles and solid) for specific contaminants. If greater than trace amounts of organohalogen compounds; mercury and mercury compounds; cadmium and cadmium compounds; oil and known carcinogens, mutagins or teratogens, are found, the sediments may not be dumped in the open waters of Long Island Sound or in the open ocean on other than an emergency basis. Once again, through bioassays, marine organism are used as "analytical instruments for determining the environmentally active portions of any contaminants present" by EPA. Statistically significant mortality is taken within the limits of current science to reflect the presence of prohibited materials, since "it cannot be established this was not the case."

"In practice, the exact identity of the contaminant(s) causing the effect is of little concern from a regulatory viewpoint, since any dredged material that might cause an environmental effect for any reason should not be ocean dumped except perhaps under special circumstances," EPA continued. Generally a 10 percent increase in mortality between the sediment sample and laboratory control is taken to be significant.

Once the biological assessments have been satisfactorily completed, EPA requires consideration of whether the dredged materials will be generally compatible with the proposed disposal site. The EPA also requires under Section 103:

* the need to ocean dump material is demonstrated through evaluation of alternative disposal options;
* probable impacts on esthetics, recreational and economic values must be considered;
* impacts on other uses of the ocean; and
* site management considerations.

Based on this data and evaluation, a decision to issue or deny the permit is made by the CE.

1.10 Sediment Classification Systems

One option for sorting out some of the confusion surrounding bioevaluation techniques and their role in the regulatory process involves development of classification systems. These schemes order sediments based on an assessment of the contamination or potential environmental impact of materials in sediments to be dredged. Several classification systems for dredged materials have been advanced. The most recent and widely used in the LIS region was proposed in the New England River Basin Commission's 1980 Interim Plan for Disposal of Dredged Material from Long Island Sound.

Before delving into this and other attempts to classify dredged materials, a serious difficulty with any classification system should be recognized. Dredging management classification schemes are designed to reflect a wide range of geochemical and ecological information in a broad category which implies a specific degree of risk to the marine environment. Some scientists argue classifications provide inadequate information to assess the potential risk and develop sound dredging decisions. Further, they feel these classifications may lead to unwarranted or counterproductive misunderstandings.

Dredged materials can be classified by physical properties, chemical characterists or biological assessments. Two approaches are commonly taken for evaluation of a sediment's physical properties:

* Classification by texture and one or more additional properties such as plasticity, mineralogy, and structure are used to infer engineering properties.
* Direct measurement of engineering properties.

Several systems are presently in use that are based on physical properties such as texture. The U.S. Department of Agriculture textural classification is widely used for soils. For dredged material, the Permanent International Association of Navigable Congresses (PIANC) system has been used, but is applicable only to materials before dredging occurs. The United Soil Classification System (USCS), used by the Corps of Engineers, is the most frequently used physical classification scheme for dredged material. It is based on sediment texture and plasticity, and defines 15 different physical sediment types.

Interim Plan Classifications

Physical and chemical characteristics are utilized in the Plan's classification system. This approach is utilized on both the state and federal level as an element of dredging management around the Sound. This classification approach is described in the text from the Interim Plan:

> "In the absence of more definitive knowledge on the pollution effects of dredged material or the effects of specific pollutants found in dredged sediments at the disposal sites, the following physical and chemical parameters will be used to determine whether biological testing of sediments will be called for in the review of a disposal action or what conditions will be placed on the disposal of the dredged material. Dredged material sediment is classified as follows:

	Class I	Class II	Class III
Percent Oil and Grease (Hexane Extract)	0.2	0.2 - .75	.75
Percent Volatile Solids (NED Method)	5	5 - 10	10
Percent Water	40	40 - 60	60
Percent Silt-Clay	60	60 - 90	90

"Relative to the subjective probability for adverse environmental impact these parameters rank in descending order of significance: oil and grease volatile solids percent water percent silt-clay. For example, sediment analyses may yield Class III percent silt-clay, Class II percent water, and Class I percent volatile solids and oil and grease, or any other combination. This sediment would be judged as Class II material; similarly, Class I silt-clay, Class I water, Class II volatile solids, and Class III oil and grease would probably be judged Class III material.

"Class I sediments are often relatively coarse-grained with high solids content; volatile solids, oil and grease, heavy metals, and potential pollutant concentrations are low [sic]. Class I sediment based on a case-by-case subjective evaluation of the dredge site and/or metals concentration. Class I materials include non-recent and recent sediments which are suitable for capping materials at open water dump sites, for habitat creation projects, or rehandling for productive uses including beach nourishment and land fill cover based on the evaluation.

"Class II sediments are often relatively fine-grained with moderate solids content. Class II materials may contain a moderate amount of potential pollutants, volatile solids, oil and grease, and metals, at levels often sufficient to be a cause for concern. A subjective evaluation of the dredge site and metals is needed to designate this material as either "non-degrading" or "potentially degrading." Potentially degrading Class II material will be treated as Class III material. On the other hand, this evaluation may show that some Class II material is suitable for habitat creation projects, capping Class III material, and landfill cover.

"Class III sediments are usually fine-grained with low solids content. These materials often contain high levels of potential pollutants, volatile solids, oil and grease, and metals. Class III sediments may be judged "potentially degrading" or "potentially hazardous" based on the relative concentrations of pollutant constituents. The probability for Class III sediments being "toxic" to marine bottom fauna may be high. Subjective evaluation of metals and other pollutants, and objective review of bioassay and/or bioaccumulation test results, may be required to determine the suitability of Class III material for open water disposal at Long Island Sound regional disposal areas.

"As a general policy, Class III material will not be dumped at regional disposal sites unless it is capped with suitable Class I or Class II material. Therefore, the conditions under which Class III material may be dumped may include both temporal and seasonal restrictions relating to the availability of suitable material for capping or alternative management techniques directed towards the goal of maximum environmental protection. In addition, there may be certain circumstances under which open water disposal may be prohibited. Statistical analysis of metals data on sediments developed by the Corps of Engineers from numerous New England ports and harbors, as well as non-spoil sediments from the vicinity of open water disposal areas, suggest the following operational limits are appropriate to enable confirmation of the sediment class designations described above. Average and range values for metals in Central Long Island Sound sediments are included for comparative purposes. In general, the Corps of Engineers data shows that high concentration of metals appear in the sediments of highly industrialized ports and harbors.

	Central Sound Sediment Average (ppm dry basis)	Range	Level of Contamination Low	Moderate	High
Hg	.05	.05	0.5	0.5-1.5	1.5
Pb	27.8	6-63	100	100-200	200
Zn	87.8	2.3-214	200	200-400	400
As	--	--	10	10-20	20
Cd	1.3	1-2.9	3	3-7	7
Cr	28.8	2-108	100	100-300	300
Cu	69.6	2-269	200	200-400	400
Ni	11.2	2-40.6	50	50-100	100
V	--	--	75	75-125	125

"Concentrations of PCB's of 1.0 parts per million (ppm) will be considered as confirmation of high contamination, DDT 0.5 ppm and Dieldrin 0.1 ppm (dry basis).

"Class I material is considered clean material acceptable for beach nourishment or open water disposal at regional disposal sites or at a site of similar lithologic background. Class II material may be discharged at one of the three identified disposal sites. Class III material is considered to be contaminated and may only be considered for open water disposal if there is a compelling necessity to accomplish the dredging and special mitigating measures such as capping and seasonal constraints are employed to prevent adverse environmental impacts. The availability of suitable material for capping Class III sediments will be a criteria for the issuance of state Water Quality Certification."

Other Classification Systems

Massachusetts has devised a more complicated classification system in which sediments are given both a physical classification and a metals classification (the classification levels are similar to those in the Interim Plan system). Together these classifications are used in a table that determines the suitability of sediments with a given pair of physical and chemical classifications for various disposal options.

Turning to biological tests, a simple classification scheme based on the results of the elutriate test was developed by the Environmental Protection Agency (EPA). If any constituent was found in the water after having been shaken with the sediment which was 1.5 times the level found in the disposal site water before shaking, then the material was considered "polluted" for EPA's regulatory purposes. This classification scheme is no longer used, and a replacement has not been adopted.

A similar scheme has been developed for the EP test. If the leachate from the dredged material contains more than 100 times the interim primary drinking water standards, then the sediment must be treated as a hazardous waste and suitably contained.

EPA's interpretation rule for bioassay results can also be considered a classification scheme. If statistically significant (i.e., 10 percent or higher) numbers of organisms die in dredged material tests when compared to control tests during the same experiment, then the sediment undergoing testing is generally considered unsuitable for open water disposal under Section 103 standards.

The New York District of the CE has adopted a sophisticated classification system for reflecting the nature of sewage sludge to be dumped in the open ocean. The New England Division of the CE is evaluating this approach and has not reached a decision on adopting a similar structure for classifying dredged materials in their region.

1.11 Dredging Related Research Around the Sound

Research related to dredging in the Long Island Sound region can be described through a review of government supported monitoring programs along with a compilation of recent research on this topic.

At the national level, the Corps of Engineers' Dredged Material Research Program (DMRP) examines many aspects of dredging and disposal from both an environmental and engineering viewpoint. Regionally, the CE's New England Division sponsors the Disposal Area Monitoring System (DAMOS) which has completed baseline characterizations of ten disposal area in New England, including four disposal sites in Long Island Sound.

As a result of these and other studies, the short-term impacts of sediment disposal are now better understood. According to the Interim Plan, by looking at old disposal areas in Long Island Sound, NERBC gained a limited understanding of the potential long-range cumulative effect of open water disposal but could not assess adequately the chronic consequences of this practice. Of particular concern, but as yet not clearly understood, is the potential for mobilization of constituents from sediment into food chains.

Results of the DAMOS program, and the U.S. Navy's monitoring of the New London disposal site which has been assumed by DAMOS, have been used to develop disposal practices designed to limit the spread of contaminants from dumpsites and their absorption by marine organisms, the Interim Plan continued. Recent disposal projects have utilized point dumping of highly contaminated materials and "capping" such material with cleaner sediments, as well as continued monitoring under DAMOS to determine the effectiveness of these mitigative practices.

"Generally, the results of monitoring programs in Long Island Sound to date have shown that once material has been deposited it tends to remain stable at sites chosen for their high containment ability, such as New London and New Haven. Resuspension during storms appears to be no higher than in surrounding areas. This characteristic of disposed sediments argues well for a program of point dumping and capping. The existing monitoring program has shown that certain disposal practices need to be improved for these measures to be fully successful. However, both federal and state agencies are making use of the DAMOS program to improve disposal practices," the Interim Plan stated.

DAMOS

DAMOS grew out of requirements in the New London dredging case settlement requiring the U.S. Navy to monitor ecological effects of spoil disposal at the open water disposal site. In describing the program in the PEIS, the CE stated:

"The Disposal Area Monitoring System (DAMOS) provides a long term monitoring program to evaluate disposal activities at specific open water sites. On-going sampling and evaluation of environmental data of past and present dump sites (including four in Long Island Sound) is providing insight into the following areas of concern: bathymetric changes, turbulence and erosion relationships, suspended sediments, sediment chemistry, bioaccumulation of contaminants, benthic ecology and fisheries. The specific programs designed to study these concerns are provided by the Naval Underwater Systems Center (NUSC, 1979) and Science Applications, Incorporated, (SAI, 1980a) and are briefly described below.

"Under the bathymetric study, the physical dimensions of the sediment mounds are defined using high precision bathymetric and navigational instruments linked to a computer. Changes in the bottom profile are monitored before and after disposal as well as over the long term. This method has been used to assess the effectiveness of capping at the Central Long Island Sound dump site (NUSC, 1979; Morton and Miller, 1980; Morton, 1980a; Morton, 1980b).

"The benthic ecology program of DAMOS is compiling species and community data on the various dump sites to study long term changes in community structure, and recolonization processes (SAI, 1980a). This study is also augmented by diver observations (SAI, 1980a).

"The DAMOS chemistry program is currently studying changes in disposal site sediment chemistry. Present studies show potential for evaluating the effectiveness of capping for the sequestering of contaminants. Recent expansion of this program to include water column chemistry will aid in assessing potential water quality impacts associated with disposal of dredged material.

"DAMOS is a participant in the International Mussel Watch program and has been testing mussels in the vicinity of disposal sites for potential accumulation of sediment contaminants and abnormal growth (SAI, 1980a,b). Mussels are filter-feeders which are particularly sensitive to water quality deterioration.

"The DAMOS fisheries program is designed to maintain an awareness of the commercial fisheries existing in the near shore waters of New England (NUSC, 1979). Conferences are held with fishing interests in order to minimize any adverse effects and maximize the advantages of disposal relative to the fishing industry.

"Information gathered under DAMOS forms the data base on which seasonal changes are assessed and compared with nearby virgin areas and will ultimately lead to a more complete understanding of long term impacts."

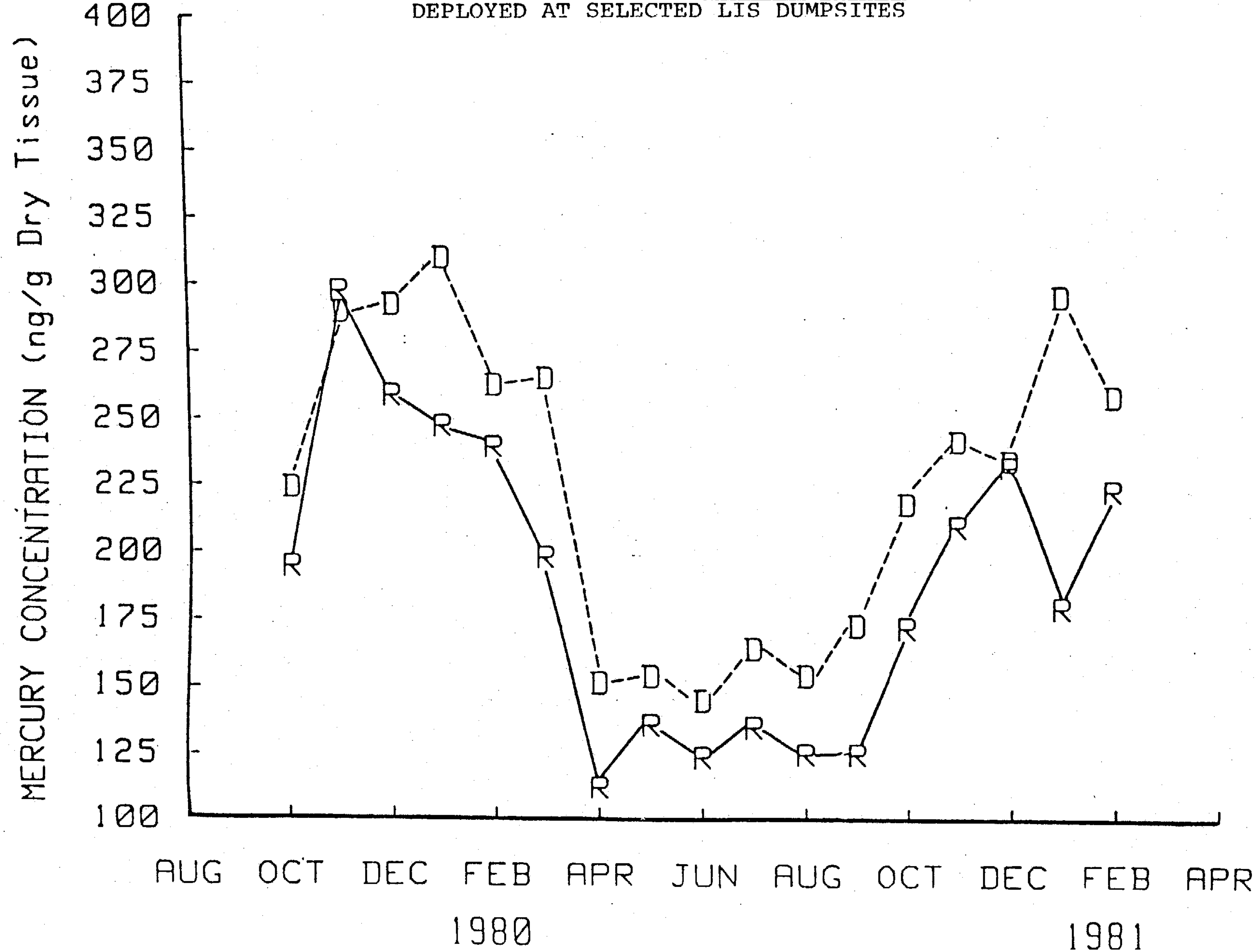
Mussell Watch Program

DAMOS, in an effort to gauge bioaccumulation of contaminants found in dredged materials, uses a biological indicator. The "Mussel Watch Program" was described recently by Dr. S. Y. Feng:

"Long term monitoring of two dredge material disposal sites in eastern LIS and central LIS was initiated in March 1977 and April 1980 respectively and is continuing. During this period, we have learned a great deal on the uptake of trace metals and PCBs by the blue mussel, *Mytilus edulis*, experimentally introduced into the disposal site. This approach, in essence, can be considered as a field bioassay procedure equivalent to the mortality and bioaccumulation tests of the bioassay procedures outlined in the EPA-CE manual, and more realistic. Mussels from a single population suspended one meter off the bottom from a PVC platform were deployed in or near the disposal and reference sites. The uptakes of trace metals and PCBs (at the New London Disposal Site) were monitored by sampling the mussels from each station on a monthly or bimonthly basis. Analysis of PCBs in tissues were limited to six stations in the New London Site and continued for 15 months. Tissue concentrations of PCBs increased during the disposal operations (700 ng/g), but decreased after their cessation (500 ng/g). Also, temporal change in PCB levels were correlated with the seasonal runoff from the Thames River. Seasonal variations in the tissue concentrations of Cd, Cu, Hg, Ni and Zn were clearly evident. During the winter and spring of 1977-1978, elevated levels of these trace metals coincided with a period of heightened disposal activity, river runoff, and the physiological state of the mussel. Similar peaks were observed during 1979 to 1980 when there was little or no dumping at the site. Such cyclic changes in trace metal concentrations were seen again in 1980-1981. Figure 1.11-1 shows the typical seasonal variation of mercury concentrations at the disposal site and reference site. Although the concentrations of mercury at the disposal site are higher than that of the reference, the difference is not statistically significant (Figure 1.11-2). However, in general, the cumulative mortality of the mussels was higher at the dump site than at the reference site.

FIGURE 1.11-1

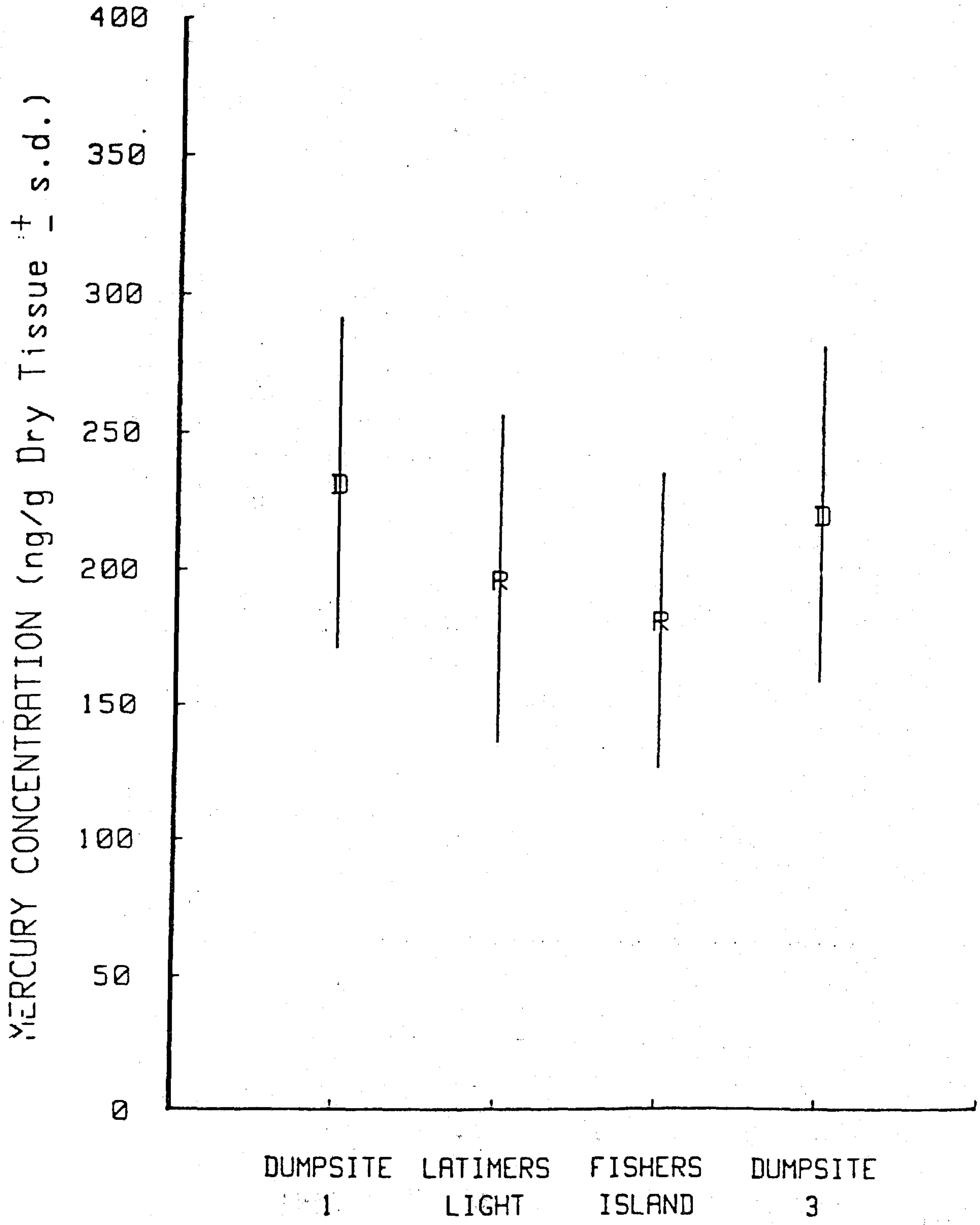
SEASONAL CYCLE OF MERCURY
OBSERVED IN MUSSELS (*Mytilus edulis*)
DEPLOYED AT SELECTED LIS DUMPSITES



(Source: S. Feng, pers. comm.)

FIGURE 1.11-2

MEAN CONCENTRATIONS OF MERCURY
FOUND IN MUSSELS (*Mytilus edulis*)
DEPLOYED AT SELECTED LIS DUMPSITES



(Source: S. Feng, pers. comm.)

"These observations suggest that the elevation of PCBs and certain trace metals during the disposal phase is a transient event due to increased pollutants in the environment and that the seasonal pattern of trace metals in the mussels is a normal phenomenon reflecting the physiological state of the individuals. The results also argue strongly for the long-term monitoring in order to properly assess the effect of dredging and dumping on marine and estuarine organisms. Such observations also lead us to ask whether the peak tissue concentration of a given metal represents the limit of metal binding capacity of the organism in question. If so, the laboratory assessment of bioaccumulation potential of the organism could be grossly distorted, depending on when the organism was collected for the assay.

"In the interpretation of results derived from field experiments, one must try to segregate, though often with difficulty, the effect of intrinsic factors (normal physiological activities) from that of the extrinsic factors (dredge material disposal) on the uptake of trace metals in mussels. Implicit also in the field experiment is the fact that the data set is correlational and causation cannot be assumed; it is unlike laboratory experimentation where independent variables can be elicited, e.g., uptake of metals, accurately measured. We are able to account for the variance observed in the trace metal data. At the New London dumpsite, in most cases, the variance can be explained by three major factors: the physiological state of the mussel, river runoff and dredge material disposal in descending order of importance. This type of information is not unexpected because the influence of the Thames River on the dumpsite is more pervasive than that of dumping which is episodic. Furthermore, natural perturbations, such as storm-induced resuspension of sediments, according to Dr. Frank Bohlen, are several orders of magnitude greater, both temporally and spatially, than those induced by dumping of dredge materials. Our results are thus also reassuring to the public that the environment is not irreparably damaged by dredged material disposal."

DAMOS Field Findings

In describing the DAMOS program, Shonting and Morton (1982) wrote:

"A principal aim of the DAMOS program is to gain understanding of how a disposal site containing "foreign" material interacts with its surroundings. In order to define the approaches to the study of a spoil site, it is helpful to consider it as a physical and geological entity within the ocean environment. A typical modern dredge disposal area in the New England region (usually labeled "dumping ground" or "dump site" on navigation charts) is a rectangle measuring 1-10 kilometers on a side and having water depths ranging from 20-50 meters. Until recently the delineation of dumping grounds by marks or buoys was inconsistent, sometimes two or more buoys were used and in other areas none. This resulted in dump materials being spread over areas with a minimal control of the site location. In recent years, as a result of DAMOS operations, dredged material is more often released by use of modern navigation systems in close proximity to specially constructed dump site buoys.

"Assuming that dumping is conducted with consistent navigation fixing at the marker buoy, a typical disposal site may be a circular or eliptical shaped mound of material 300-800 meters across and may reach 3-8 meters above the mean local depth. The volume of the mound may range from 50,000 to 500,000 m^3 (500,000 m^3 is roughly the volume of a right parallelepiped with a football field as a base and a height of 400 feet). Probably the single most important characteristic of a spoil site is its ability to hold or contain deposited material, i.e., its degree of "containment", other related terms being its stability or erodibility. It is upon the parameters that affect the sites' containment that we concentrate our study.

"Dredge disposal sites are usually located in relatively shallow coastal waters. The oceanographic implications are that the overlaying water column is very dynamic and that perturbations on the spoil mound are imposed by strong tides and meterological events. Since the amount by which the spoil mound is disturbed or eroded governs its interaction with the local environment, the effects of these geophysical phenomena must be measured.

"Another important factor governing the degree of containment and the "erodibility" of a dredge material is its physical-geological character at the time it is deposited from a dumping barge and after the physical changes which it may endure after deposition on the sea floor. The physical character of dredge material is determined by its composition, grain size distribution, degree of compaction, porosity, and water content. Furthermore, spoils contain varying amount of organic material that can significantly affect cohesive properties.

"The greatest potential for interaction of dredge material with the water column occurs at the time of release as the sediment cascades downward through the water column. However, studies have shown that the material falls as a density current and a large percentage of the material impacts the bottom within one to two minutes after disposal. A small plume of fine material is often generated which disperses and is advected from the disposal site in several minutes.

"Once the spoil material impacts the bottom, the ambient water motions may affect the deposit to an extent depending upon the character of the resident material, how it is physically distributed on the bottom, and on the motions of the water. Erosion of the bottom material can only occur if the kinetic energy and Reynolds stresses of the motions at the bottom can overcome the threshold of cohesive forces and inertia of the material.

"Turbulent or oscillatory motions sufficient to cause erosion may be associated with strong tidal currents which produce a shear zone (boundary layer) near the bottom and with large surface waves whose orbital motions extend clear to the sea bottom. Abnormally strong tidal currents and large surface waves are associated with storms and hurricanes and it appears that most of the signficant sediment motion on New England disposal sites may be caused by these spurious events. When the bottom material is brought into suspension, it is then moved horizontally by the ambient currents. The material will begin to resettle to the bottom when the turbulent mixing forces become less than those of gravity. Since the energy required to erode material is signficantly greater than that required for transport, any material eroded is carried well beyond the disposal site, dispersed, and mixed with natural suspended sediment before it is redeposited. Consequently, the possibility of tracing such a material is nil since it is rapidly lost in the background levels.

"During the period of active dumping, the topography of the site is continuously changing, possibly altering its surfacial character. Further, new dredged material may be added from different source areas, thus the site may contain several strata of varied composition and cohesive character.

"Another effect on the spoil pile which can promote erosion are biological processes caused by the macrobenthic animals which burrow in and out of the spoil material. This "bioturbation" changes the pile surface, in some cases reducing the size of microtopography and homogenizing the upper layers.

"The portrayal of the spoil site as a dynamic system emphasizes the need for hydrodynamical studies. Chemical and biological programs which traditionally dominate all pollution studies can only register the net results of material transfer, whereas prediction of the occurrence and magnitude of such material transfer into the environment lies in the understanding of the dynamics of the spoil site."

According to Shonting and Morton, DAMOS data shows the Stamford-New Haven capping experiment succeeded in isolating contaminated spoils from the marine environment. "The precision disposal of Stamford spoils resulted in a small compact mound that was readily covered with the New Haven material, "the authors concluded.

Surveys completed in August, 1979 showed little change in the disposal piles on the bottom of the Sound. However, a survey two months later showed a change equivalent to the loss of some 100,000 cubic meters of material from one pile. Although this loss did not expose any Stamford spoils, additional surveys were made on the site and found that through 1980 "no additional changes" have occurred. Shonting and Morton suggest topographical factors or the character of the capping material could have played a role in the shift on spoils three years ago.

1.12 Dredging Methods and Generic Effects

Dredging and disposal can be managed to minimize marine environmental effects. Understanding the range of dredging and disposal options open to dredging managers is an essential element in developing proposals to develop long range dredging policy for the Sound. Steps to mitigate environmental impact can range from the simple -- such as prohibiting dredging during the oyster's spawning season -- to complex, such as the underwater capping procedure used for recent dredging of a "hot spot" in Norwalk Harbor.

Historically, two general methods of dredging have been employed in Long Island Sound: mechanical and hydraulic.

In terms of volume, the most common dredging method used around the Sound is the mechanical bucket and scow. Sediment is scooped from the bottom by a jaw-shaped apparatus called a clamshell which is mounted on a barge and then deposited into a scow for transport to the disposal site. The material is discharged via bottom-opening doors which allow the entire load to be dropped essentially as one mass. This provides for minimal dispersion of the sediments into the surrounding environment at both the dredge and disposal site because the material remains cohesive and is mixed with little water. It also allows relatively accurate placement of the load. Its mobility and comparatively low cost makes this method highly suited to the small-scale operations most prevalent in the Sound.

A hydraulic dredge operates similar to a vacuum cleaner. A suction tube equipped with rotating cutter heads dislodges the sediments and travels along the bottom at the desired depth. The suction provided by large pumps on the dredge remove the dislodged sediments, along with about 4 to 5 times as much water, and deposits the slurry onto a disposal site via pipelines. Usually this system uses a land disposal site.

Hopper dredges are another form of hydraulic dredge. A suction plate is extended from the barge to the bottom of the channel and suction is provided by large pumps aboard the vessel. The dredged material is brought aboard in a slurry, placed in hoppers within the vessel, and dewatered at the dredge site. The dredge then takes the material to the disposal site and releases it through the bottom opening doors. Hopper dredges also may have the capability to pump the dredged material to disposal sites via pipelines.

Hopper dredges have been used occasionally for larger projects such as the Connecticut River dredging in 1970. The pipeline dredge has been used more frequently than the hopper dredge in LIS but considerably less than bucket and scow.

Another method of hydraulic dredging available is the side cast dredge. In this instance the vessel is self propelled. Suction plates extract the material in a slurry which is pumped via a long discharge pipe to the side of the channel. The side cast dredge operates by making as many passes along the area of the channel being dredged as needed.

Each dredging method has its own advantages and disadvantages. Hydraulic dredging is generally considered to have a greater potential for environmental impact since it resuspends sediment in removing it from the bottom. A combination of factors, including scarcity of land and economic as well as environmental concerns, precludes hydraulic dredging in most Connecticut harbors. Hydraulic dredges work in areas like the Connecticut River where sediments are relatively clean and disposal can occur nearby. Urban harbors, as a rule, are dredged by clamshell and sediments carried to an open water site by barge for disposal.

Past Disposal Practices

In the past, dredged material from Long Island Sound has been placed in at least five kinds of disposal areas:

1. upland or marsh sites most often adjacent to the dredging area;
2. the Mud Dump Site in the New York Bight;
3. in open-water sites in Long Island Sound proper;
4. beach extension; and
5. beach nourishment.

Historical data on the partitioning of the total volume of dredged material among these five disposal alternatives are incomplete. Upland disposal was used extensively in the early decades of this century as an inexpensive disposal strategy prior to the development of many areas bordering the Sound and before the ecological value of near-shore areas and marshes was recognized.

The viability of upland disposal has decreased in recent years primarily due to a lack of suitable sites. At present this alternative is used infrequently for larger projects in the Sound and is primarily restricted to maintenance dredging of several Connecticut rivers and small recreational harbors. The Mud Dump Site in New York Bight is occasionally used for the disposal of material dredged from a number of ports in the western Sound region, particularly Flushing Bay, Bronx River, East Chester and West Chester Creeks. A recent agreement between the States of Connecticut and New York has stipulated that dredged materials from harbors west of Throgs Neck Bridge will continue to use the Mud Dump or other alternative.

When a nearby upland disposal site is available, land disposal is usually the least expensive disposal strategy. In terms of the number of permits issued by Connecticut's DEP, upland disposal is a major dredged material disposal method. But, upland sites are feasible usually only for small projects. Larger projects -- such as those of the Corps of Engineers -- cannot economically use the land disposal option in much of Connecticut. Measured in volume, then, open water disposal is the prevalent disposal method for dredged materials.

Mitigation Measures

Capping, as demonstrated in the New-Haven-Stamford and refined in the Norwalk Harbor dredging projects, appears to be a major tool for protecting the marine environment from contaminated sediments. Capping simply places a covering layer of clean dredged materials atop polluted sediments removed from a harbor. While questions remain to be answered about some aspects of capping, the procedure is generally seen in this region as acceptable mitigation for disposal of most Class III materials in the Sound. The exception arose in Norwalk where additional precautions were required and taken to prevent highly volatile contaminated sediments from damaging the environment.

There are a number of management measures that can be established which will have a direct effect on the extent of adverse impacts from open water disposal. These measures range from planning decisions to techniques used during the actual dredging and disposal operations.

The two most obvious methods to mitigate impact from dredged materials are:

1. the reduction of dredged materials to be disposed of; and

2. the reduction of contaminants in the dredged sediments.

As already mentioned, the curtailment of maintenance dredging in the Sound would lead to extreme economical and social impacts. However, the initiation of improvement projects with their large disposal needs and the redefinition of federal and private maintenance projects to reduce project dimensions and subsequently disposal needs are two possible planning methods to reduce overall disposal volumes.

The contamination of sediments is a direct result of historical and current water quality in urban harbors and watercourses. Future reductions in contaminants will result from the dredging and disposal of already contaminated material and the elimination of point and non-point pollution sources. The continuation and improvement of NPDES and 208 non-point programs would result in the gradual improvement of the sediments dredged.

A number of mitigation measures can be implemented at the dredging site, during transit, and during disposal operations. A partial listing follows:

* Silt Curtain: as the name imples, the method entails the use of a curtain or skirt around the dredging operation in order to contain the silt plume from dispersing throughout the embayment or harbor. This measure is considered when the dredging is to occur in close proximity to shellfish beds or other sensitive marine areas.

* Inspector: it is now required that an inspector from the Army Corps of Engineers be present on board all disposal barges en route to open water disposal sites. The expense is borne by the applicant, and the purpose of the inspector is to verify proper placement of the dredged material at the designated disposal site, hence the prevention of "short dumping."

* Taut Line Buoy: Once at the disposal site, the barge is to be placed in close proximity to a taut buoy affixed at the location within the designation site deemed to be best suited for receiving the dredged material. This prevents random dumping throughout the site and allows the creation of disposal mounds which aid in the monitoring of the site.

* Lanes of Transit: In the effort to limit loss of fishing gear sustained during transportation to and from the disposal site, current mitigation measures include the

determination of set transit lanes to be followed by the tug and barge in travelling between the dredging site and disposal site. These lanes are established in consultation with Coast Guard officials and local fishermen. Examples of typical gear loss include oyster stakes and lobster buoys.

* Oyster Spawning: As a result of the potential impact of increased turbidity on oyster spawning success, the State of Connecticut as a matter of policy prohibits the disposal of dredged materials during the summer months from May 15 to September 15. All dredging must be completed before the date or suspended until after September 15.

* Dissolved Oxygen: New York State does not have a summer closure. However, they do require the monitoring of dissolved oxygen levels during the operation. If levels drop below 4.0 ppm, dredging is to cease. To date, according to the New York DEC officials, no dreding has been curtailed due to low D.O. The meters are owned and operated by the dredging contractors.

During the disposal of dredged material, dumped sediment settles out rapidly therefore limiting the impact on dissolved oxygen to the brief time the sediment is passing through the water column and the demand placed through the interstitial water during compaction of the sediment mound. Significant oxygen depletion is limited primarily to the western Sound especially during the summer months when large inputs of sewage combined with thermal stratification of the Sound's waters combine to lower D.O. Sewage derived nutrients feed phytoplankton resulting in mid-summer blooms. When these organisms die, they settle to the bottom and consume oxygen. The thermal stratification cuts off the supply of new oxygen from the surface waters (Schubel et al, 1979).

Generic Environmental Impacts

According to the CE's Programmatic Environmental Impact Statement;

"The generic environmental impacts of open water disposal are summarized with regard to the physical and chemical alterations to the environment and associated biological ramifications. These are interrelated and produce combined short-term (<2 years) and long term (>2 years) impacts to the aquatic environment.

"The disposal of dredged material causes two major physical impacts: increased turbidity in the water column and burial of benthic organisms. These impacts are generally short term and are local to the disposal site area.

"Disposal of sediment in open water will temporarily increase the amount of suspended solids in the water column. Although most of the large sized particles will fall immediately, silt-clay size particles as well as particulate organic material will remain suspended for longer periods of time. Turbidity studies have shown that a large percentage of the fine-grained sediments placed in suspension settle within a few hours after disposal thereby reducing the duration of adversity. Increased suspended solids can impact resident aquatic organisms. The cloudiness can cause a temporary reduction in light penetration through the water column. This would temporarily reduce photosynthetic activity of phytoplankton as well as shallow water benthic algae. Such reduced activity, if occurred, would return to normal as the water cleared through settling or mixing by currents. Increased suspended solids may interfere with feeding patterns of marine organisms by either reducing visibility for predator species, such as fish or crabs, or clogging filter-feeding apparatus of more sessile forms. It may also affect respiratory functions by clogging gill filaments. Fish and certain crustacea are mobile and therefore can avoid the area if irritation occurs. Studies by Peddicord et al. (1978) for the Corps of Engineers DMRP have shown that fish, crabs and juvenile lobsters are generally tolerant of increases in turbidity and will move if irritated.

"Benthic organisms at the disposal site would be buried once the dredged material hits on the bottom. The extent of burial will depend on the amount and type of sediment, the rate of disposal and settling, and whether the sediment is point dumped or dispersed around the site. Burrowing sediment-feeding organisms, especially the deep burrowing forms have a better chance of survival than the non-motile forms living on the surface (Maurer et al., 1978). Burial of the weaker juvenile forms or eggs of demersal fish will probably result in death. Therefore, known spawning areas should be avoided whenever possible during the spawning period.

"The action of open water disposal would introduce the natural and man-made constituents of the dredged sediment into the water column and onto the bottom sediments. The constituents may include nutrients, organic compounds, heavy metals, and coliform bacteria which may be injurious to the health of plant, animal and human populations. This is especially true for organic compounds such as polychlorinated biphenyls (PCB), DDT and heavy metals such as mercury and cadmium.

"Hydraulic dredging mixes the sediment with large amounts of water during its operation and could result in release of contaminants which could degrade the quality of water. For example, high quantities of nutrients such as phosphates, nitrates, or toxic ammonium-nitrogen could cause increases in the biochemical oxygen demand (BOD) which, in turn, could cause localized reductions in dissolved oxygen or localized plankton blooms which could have the same resulting effect. Increases in dissolved organic compounds or heavy metals might become toxic to marine organisms.

"Release of contaminants may cause lethal or sublethal effects on organisms exposed to the contaminated water. The potential for short-term lethal effects may be determined by the bioassay test.

Guidelines for this test are included also in the EPA/CE 1977 manual. Such tests may be required for all projects in Long Island Sound larger than 25,000 cy. The contaminants released in the liquid or suspended solids phases could be toxic to water column exposed organisms, especially to gill breathers or filter-feeders which pass water through their systems to breath and eat. The acceptability of ocean disposal includes a consideration of significance of mortalities of the test organisms exposed to liquid, suspended solid or solid phases of dredged material mixed with seawater collected at the disposal site. However, the concentration of the contaminants are diluted during disposal operations so that organisms at the site are not exposed to the same concentrations as those in the laboratory tanks. Thus, significant mortality in the liquid and suspended solid phases may not indicate true impact on the in-situ organisms. Dilution of the phases which exhibited significant mortality are calculated to determine the "limiting permissible concentration" of that phase. To date no Long Island Sound liquid and suspended phase bioassays have exceeded the "limiting permissible concentration" (CE, 1980b). To exceed the "limiting permissible concentration" would give the Regional Administrator of EPA cause to recommend against ocean disposal.

"The disposal of contaminated dredged material would introduce contaminants into the bottom sediments. Benthic organisms intimately associated with these sediments potentially can have the same impacts as those organisms exposed to the water column. The solid phase bioassay is intended to indicate the potential for lethal effects of contaminated sediments. Mortalities that are statistically significant and 10% greater than that of the "reference" sediments is a basis for consideration of rejection of open water disposal. Contaminants in fine-grained dredged sediment are generally stable in an oxygen-deficient environment at a near-neutral pH. The initial settling of the sediment, and/or resuspension by currents or invading organisms can expose the sediment to higher levels of oxygen so that the generally stable contaminants may be mobilized into the pore water or water column. The mobilized contaminants are then potentially available to exposed organisms. Recent studies by Neff et al (1978) for the Corps of Engineers have questioned the ecological significance of direct uptake of sediment contaminants by burrowing benthic organisms.

"The 1977 EPA/CE guidelines manual also described the bioaccumulation test. This test measures the short-term uptake of potential sediment contaminants of test organisms in the solid phase bioassay. Statistically higher concentration of contaminants in test animal tissues in comparison with those exposed to a reference sediment indicates a positive bioaccumulation. Such results could again indicate chemical impact on aquatic organisms and could lead to rejection of ocean disposal. Short-term sublethal effects such as impairment of reproduction and growth behavioral deviations are more difficult to detect and are not as clearly defined. Such effects are usually observed during the bioassay/bioaccumulation tests (behaviorial) or during long-term laboratory studies (reproduction and growth)."

Generic Long-Term Cumulative Impacts

"Although there is no evidence to show unacceptable detrimental impacts at open water dredged material disposal sites, the pervasive argument exists that unacceptable effects may yet accrue with continued disposal. As this study [PEIS] concludes, identification of such impacts is difficult due to complex and interrelated environmental factors. The following discussion is provided as a generic overview of potential long term effects due to long term open water disposal of dredged material in Long Island Sound.

"The increased sedimentation associated with open water disposal may have two direct long-term physical effects. Mounding of the disposed sediment would permanently alter the bottom topography and could alter the local habitat.

"Mounding would cause secondary impacts such as changes in water circulation patterns, temperatures and salinities if disposal occurred in a shallow water area. Such impacts would not be signficant for deep ocean disposal or the proposed candidate sites and the interim sites. Such impacts could become a problem in a River/Harbor disposal site.

"Disposal could permanently alter the benthic habitat within the affected discharge area. If the dredged sediment is markedly different from the disposal site sediment, the benthic habitat will be altered. Bottom communities are closely associated with sediment type (McNulty et al., 1962); therefore, the resulting community at a disposal site may be different from the original or surrounding community. Sediment feeders, for example, are more common in muddy sediments whereas filter-feeders are more common to sandy substrates. Dumping mud on a sand bottom would change the community type inhabiting the dump site and reduce the species diversity because the source of recolonizing animals, i.e., the areas adjacent to the dump site, are a different substrate, and therefore, of different species composition. Dumping on a past disposal site or matching dredge and disposal site sediments could mitigate this impact.

"Recolonization by small, short-lived pioneering species will occur soon after disposal. Studies of disposal sites have shown that successions of benthic colonies occur until a climax community of long lived larger species become established. The time required for achievement of such a climax community depends on the sediment quality and the availabilty of organisms in the immediate area. Continuous long-term disposal may temporarily enhance productivity by keeping the pioneer recolonizing species in dominance but it may impact on community stability. The long-term effects of this instability on the ecosystem are not predictable and of a localized nature (less than 1% of Long Island Sound). Benthic impacts would be monitored by the DAMOS.

"Alteration of sediment type and bottom topography may enhance the potential for resuspension of the deposited sediment. If not properly confined, resuspension can further destabilize colonizing benthic organisms and/or surrounding populations.

"Displacement of sediments by dredging and disposal may introduce persistent foreign substances (heavy metals, petroleum hydrocarbon residues, chlorinated hydrocarbons) into the disposal site environment. However, such substances could remain unavailable over the long term if the disposal mound remains undisturbed. In general, most heavy metals in a reducing environment at a near-neutral pH are sequestered in insoluble geochemical forms. Petroleum and chlorinated hydrocarbons are mostly insoluble in water and are generally tightly bound to organic pariculates and clay. The surface sediments of the mound are adjacent to the water column so that sporadic disturbances by short term, localized currents or biological activity (microorganisms, burrowing, sediment feeding, etc.) could cause minor releases into the pore water and water column. Any such releases would be quickly diluted by the water column and therefore rendered harmless. Eventually the sediment contaminant levels down to the depth limit of biological activity (10-25 cm) would reach an equilibrium with the water column. The contaminants below this depth would remain sequestered.

"The long term exposure or accumulation of contaminants by organisms may cause reproductive, developmental and growth impairment, deviations in behavior, or cause mutagenic or carcinogenic abnormalities. Synergistic effects of contaminants can cause death to an individual or whole local populations. At least one persistent contaminant (DDT) has been shown to be magnified through an aquatic food chain (Jarvenin et al., 1977) such that sublethal and lethal effects have been spread throughout the ecosystem via the food web. However, such impacts, although theoretically possible, have not been related to the disposal of dredged material.

"Impacts to organisms have been suggested to be related with solid waste disposal in the New York Bight (Pearce, 1970). Contaminated dredged sediments are only one element in the existing myriad of contaminants entering the Bight. Scientific studies to date have not demonstrated that dredged material alone is the causative agent for these impacts. The East River as well as industrial and sewage discharge, and runoff contribute to the contaminant loading of the Sound (Fitzgerald, et al., 1974). Studies by Valenti and Peters (1977) have indicated that the finfish and lobster populations at the Eatons Neck disposal area were viable in spite of the years of disposal activities that occurred at the site. In fact Cobb et al (1077) concluded that the abundance of suitable sediments (mainly dredged material), building rubble, and other materials for burrow construction is probably responsible for the abundance of lobsters. The benthic forage must also be considered adequate and healthy to support these populations."

1.13 Disposal Alternatives and Impacts

Today, alternatives for dredged materal disposal include: open water, upland, containment, beach restoration, incineration, resource reclamation, and the option of not proceeding with the project. Open water disposal is the most common method of disposal in this region due principally to its relatively low comparative cost.

Open Water Disposal

The open water disposal alternative can be split into three categories:

1. Near Shore Disposal, or disposal within the Sound at a site designated by the CE under criteria described in Section 1.7 of this report;
2. Deep Ocean Disposal, involving transportation of dredged material out of the Sound through the Race or East River and then to a designated offshore location; and
3. River/Harbor Disposal, placing sediments dredged from the channel within the river or harbor where the dredging occurs. The feasibility; general environmental impact, social and economic effect, and historical as well as archaeological impacts entailed in each of these disposal alternatives was reviewed in the CE's Programmatic Environmental Impact Statement for Disposal of Dredged Material in the Long Island Sound Region (PEIS).

Near Shore Disposal

This open water disposal option involves transport of dredged material to designated open water disposal sites within the Sound. Historically, according to the PEIS, some

60 percent -- or at least 35 million cubic yards -- of dredged materials has been dumped in open water sites within this estuary. Current CE projections call for an equal volume to be disposed in the Sound during the next 50 years.

* Feasibility: The most widely used dredging system used in LIS is the bucket and scow. This methodology is well suited to working in large and small areas such as harbors and slips. Transport to disposal areas may be limited if the scow must travel through exposed areas where large waves develop. Hydraulically dredged material can be transported in seagoing vessels with interior hoppers and bottom opening doors. This method has, according to the PEIS, been used occasionally for LIS projects involving large amounts of spoils, including the 1979 New Haven dredging. The nearest CE hopper dredge is based in Philadelphia. The hopper dredge, according to the CE, is capable of operating in "moderately rough water" and provides a minimum of interference to passing vessels operating in the channel being dredged. In the PEIS, the CE estimates transportation costs for both methods at some $0.062/c.y./mile. Near shore disposal sites are, the CE states, most cost effective due to the proximity of LIS dredging projects to designated open water disposal sites.

* Environmental impact: "The potential for environmental impacts associated with disposal in nearshore sites from man's perspective is generally greater than for deep ocean disposal," the CE states in the PEIS. "The affected biological resources important to man are in greater numbers and overall productivity is generally higher near shore." The CE notes specific effects depend on the characteristics of sediments to be disposed. "In general, no significant adverse water quality effects, including turbidity, are expected during disposal of materals which have passed the appropriate testing procedures," the CE continues. Summer dredging and disposal could create dissolved oxygen concerns in some areas of the western Sound. Disposal activities

create a localized loss of benthic life buried by the sediments.

* <u>Socioeconomic impacts</u>: In the PEIS, the CE predicts minimal social effects from use of designated open water sites and notes this option is economically advantageous when compared to other alternatives. Near shore disposal could, in theory, obstruct some recreational uses of the Sound, but since most LIS dredging occurs in cool weather, this is not a significant issue. Public concern may focus on plans to dispose significantly contaminated sediments at open water sites unless appropriate mitigation measures are employed in the project.

* <u>Historical/archaeological impacts</u>: During designation of areas for use as open water disposal sites, consideration should be given to the possibility of covering an historic shipwreck or prehistoric site which has been covered by the rise in sea level.

Deep Ocean Disposal

In the PEIS, the CE characterizes deep ocean disposal as involving an offshore location "beyond the limits of the continental shelf with depths ranging from one to two miles. For material dredged in Long Island Sound, this would involve the transport of material approximately 100 miles beyond the limits of the Sound."

* <u>Feasibility</u>: Engineering considerations, according to the CE, are likely to limit use of this alternative. Additional and larger barges would be needed to maintain the present rate of dredging in the Sound since each trip to the disposal area would take additional time. Larger, ocean-going barges would be needed, and this would require the acquisition of new equipment by private dredging companies. This capital cost would be indirectly borne through higher dredging project costs. Further, the CE notes, open ocean dumping would require additional consultation with federal

agencies not now involved in the LIS dredging management system. In the PEIS, the CE estimates deep ocean disposal would increase project cost by $6.00/c.y. based on a transportation cost of $0.06/mile (Conner et al, 1976).

* Environmental impacts: Pequegnat et al (1978) suggested potential impact from deep ocean disposal may be less significant than near shore disposal based on the sparseness of the biota as well as the larger dilution factor. "However," the CE notes, "little is known of the ecology of deep ocean communities and therefore the nature and ecological significance of potential impacts from disposal remain ill-defined. If a deep ocean site is to be chosen, careful monitoring would be necessary to insure the integrity of the environment. Such monitoring would be more difficult and expensive than at a near shore disposal site." Further, open water disposal in depths of one to two miles would probably not be contained in sediment mounds on the bottom, the CE notes. Instead, these dredged materials would probably be dispersed on the abyssal plain.

* Socioeconomic impacts: Aside from a substantial increase in dredging project cost, the distance of deep ocean sites from human activities would appear to minimize impact on the regional or national economy. For the same reason, the CE considers social effects stemming from this alternative would be minimal.

* Historical/Archaeological impacts: "Disposal of dredged material on prehistoric or archaeological sites could have either adverse or positive effects," the CE states in the PEIS. Disposal operations would cover artifacts, preventing discovery and possibly speeding decomposition through chemical reaction between the item and chemicals in the disposed sediment. Alternatively, the sediments might prevent erosion or later accidental destruction from human activity. The difficulty -- if not impossibility -- of retrieving artifacts combined with the absence of data on location of significant areas makes this a difficult factor to consider.

Further discussion of the deep ocean alternative is given in Section 3.0 of this report.

River and Harbor Disposal

This alternative calls for the placement of dredged materials in the river or harbor where the dredging project takes place. Concern centered on the impact of contaminants in dredged materials renders this approach unsuitable for many urban harbors. Current regulations, difficulty in finding suitable sites, public opposition, and economic factors have prompted a decline in the use of this option according to the CE. "River/harbor disposal is applicable in limited situations -- but cannot be considered a significant large scale disposal alternative to most other methods of disposal," the CE states in the PEIS. "This alternative must be considered as applicable only on projects with relatively clean material." Assuming a transportation cost of $0.06/c.y./mile, this is a low-cost alternative. Hydraulic dredging could further reduce the expense of removing clean sediments from the bottom.

* Environmental impact: Disposal of dredged materials in rivers and harbors may cause navigation hazards and speed deposition of these sediments in the maintained channels. The potential for disruption of circulation and salinity patterns by dredged material disposal is greater in these areas than the first two open water options. Critical habitats for fish and shellfish can be adversely affected through this alternative.

* Socioeconomic impact: This option could, according to the CE, depress waterfront real estate values near the disposal site. This effect could be significant if the area is even partially related to water dependent recreational activities. Further, economic effects could come from disruption of fishing or shellfish catches following

destruction of critical habitat. Social acceptability of this alternative would probably be lower than either of the preceeding open water options.

* Historical/Archaeological impacts: Of the three open water disposal alternatives, this option holds the highest probability of entailing significant impact on archaeological or historic sites. These effects, according to the CE, should be evaluated on a site by site basis in consultation with the appropriate state historical preservation officials.

Upland Disposal

Upland disposal involves transport of dredged materials to a site on land. Utilization of the upland option often requires that local interests be responsible for the site once disposal is completed. This can create an economic constraint to implementation of this alternative. However, the CE states, significant public benefits can arise from this effort.

Feasibility: The feasibility of upland disposal is highly dependent upon the availability of a site, the nature of the site, characteristics of the sediments to be removed from the marine environment, and post-disposal management of the site.

In Connecticut, the Department of Environmental Protection's Natural Resources Center has completed a coastal survey of potential upland disposal sites for dredged materials. This project is designed to provide the regulator and/or the project sponsor with information on the upland disposal alternative through a two-step process. The first step is to identify the areas nearby a particular dredging project with the physical potential for receiving dredged material. This preliminary screening is accomplished with the aid of overlay maps. The overlay maps identify potentially feasible areas by land use. Therefore they exclude residential areas, building and structures in manufacturing areas, commercial areas, communication and utility transmission lines, cultural areas (e.g., golf course, fairgrounds, cemeteries) and water/wet areas. The overlays also include the 20-foot contour line because that is the elevation restriction of a single pump and a potential limiting factor to engineering an upland disposal project. It must be stressed that these overlays are simply a planning tool and aid in identifying potentially feasible upland disposal areas.

The second step is the site specific evaluation in the context of a particular dredging operation. In this step the regulator and the sponsor could examine the nearby potential sites shown on the overlays and based on criteria such as compatible land use, water quality standards and dredged material quality, determine the feasibility of upland disposal for the particular dredging project.

Previous dredge management studies have noted much of the materials removed through small projects are usually disposed through upland disposal. Connecticut officials have expressed concern about the ultimate destination of these sediments, noting it is difficult to track the materials once they are removed from the marine environment. This disparity in management control is amplified when the controls for small land disposal projects are contrasted with those for open water disposal. While specific projects approved for local land disposal may be small, the cumulative total of materials earmarked for this disposal option may be signficant.

The feasibility of using sediments taken from large dredging projects in Connecticut is questionable. Major projects tend to involve dredging in urban ports where contaminated spoils are found. There is some question whether upland disposal of Class III materials is environmentally acceptable from either an agency or public perspective in Connecticut. Further, large upland sites are difficult to find along the state's heavily developed coastline.

On the north shore of Long Island, the upland option is used frequently for sandy sediments dredged from area harbors. For example, during the period 1961-1979, upland disposal was used in Suffolk County for 90-100% of the disposal. Beach nourishment is the most common use of these dredged sediments.

Upland disposal was the focus of a major study conducted by the Mitre Corporation (1979) under contract with the New York Division, Corps of Engineers. Disposal of Dredged Material Within the New York District Volume II, Preliminary Evaluation of Upland Disposal identifies potential upland sites within a 100 mile radius of the Statue of Liberty and selected 15 candidate disposal sites for evaluation of their general suitability for use as upland sites. The Mitre report concluded that upland disposal is feasible for large volumes of material providing mitigation measures are undertaken; such mitigation measures would include protection of groundwater and surface waters. However, the main problem facing this alternative is the availability of an appropriate site for the New York Harbor region. The fifteen sites reviewed by Mitre all had serious limitations and currently there are no upland sites used for dredged material disposal in the New York Harbor region (ACE, NYD, 1982)

Containment Facilities

Dredged materials can be placed behind dikes to create artificial islands or extend existing shorelands. Island construction is most feasible in shallow waters, and at least 70 such facilities have been built or are being planned by government agencies around the country. The New England Division is currently in the midst of a study examining the potential of this alternative for the Sound.

* Feasibility: Clinton Harbor and Black Ledge off Groton sites may be selected for review. Within the Northeast, containment sites have been used for port facilities, warehouse sites, and housing developments. In the PEIS, the CE suggests a containment island could also serve as an "industrial island: handling deep draft tankers carrying oil or liquified natural gas."

CE presentations around the Sound at workshops and conferences have focused on the more likely development of these areas for marsh habitat or recreational uses, reflecting the recommendations of the Long Island Sound Study as well as the intent of Congress in authorizing CE study of this option.

Offshore islands would, the CE stated in the PEIS, be particularly valuable for wildlife refuges and habitat. Section 150 of the Public Law 940587 provides up to $400,000 in federal funds for wetlands creation with dredged materials. "Utilization of dredged materials for other uses may be undertaken provided extra cost to the United States is not incurred," the CE continued.

Under present authorities, the cost of retaining structures (dikes) must be borne by a local interest. However, the CE stated, when the present feasibility study is completed in 1984, and if a regional facility is recommended, authority could be provided by Congress for federal funding of containment facilities in the Sound.

*Environmental impact: Development of a site for habitat use may create new marshland or upland. Creation of new land for construction purposes would not create new habitat. Either development of artificial islands or extension of existing shorelands entails the loss of some shallow water marine habitat. Since these areas can be highly productive and may contain shellfish resources, it appears any containment project in the Sound will require a trade off between existing resouces and potential benefits from the project. Contaminated sediments can be isolated and contained from the marine environment through these structures. Water quality may also be affected by the dewatering process at the containment facility.

* Socioeconomic impacts: Based on CE public workshops discussing the containment option, the major area of concern centers on the fate of contaminants found in dredged materials. Containment facilities using clean materials would, workshop participants said, pose little problem so long as the project created new habitat and did not destroy significant marine habitat. Use of containment to dispose of Class III materials could engender public opposition. "Overall, social acceptability could be high for the creation of usable waterfront land," the CE continues.

* Historical/archaeological impacts: Impacts will depend on the specific site selected and would be reviewed in coordination with appropriate state historical preservation officials.

Beach Restoration

This alternative entails disposition of dredged sands onto existing beaches and is a common practice wherever clean dredged sands are available in close proximity to beaches requiring nourishment. The acceptability of sand for use in beach restoration depends, according to Conner et al (1979), upon its similarity in grain size composition to that of the receiving beaches.

* Feasibility: Beach restoration is feasible only for clean sands. Disposal of contaminated materials on beaches would, in moderate or high energy intertidal areas, result in release of contaminants in particulate or soluable form to the environment (Gambrell et al., 1978). Silty sediments would quickly erode away in this area. However, the CE states clean silts -- where they exist -- may be suitable for disposal in low energy intertidal areas to enhance or replenish mudflats. If a suitable area is nearby, this disposal option competes favorably with open water disposal.

* Environmental Impacts: "The impacts associated with nourishment of beaches with dredged materials are generally short-term and physical in nature and limited to the beach area," the CE states in the PEIS. Chemical contaminants are not a problem so long as the sediment is clean. Beach nourishment can lead to burial of some intertidal animals and lead to a shift in the forms of life found at the beach by shifting the tidal range.

* Socioeconomic Impacts: "The economic and social impacts of beach nourishment could generally be characterized as favorable in the Long Island Sound area," the CE continues. Restoration of beaches improves public recreational facilities; can boost private property values and tax revenues collected on those properties; and improve tourism.

Beach nourishment, however, can also be a stop gap measure for dealing with coastal erosion sparked by rising sea levels. Beach erosion is a natural and continuous process which can be complicated by human interference in natural coastal processes. Seawalls constructed to protect homes, for example, can block the natural mechanism for nourishment of a beach, creating a need for the artificial nourishment of the area with dredged materials. While fulfilling the laudable goal of protecting private homes, these artificial structures can place the shoreline out of balance with other elements of the coastal environment. When this happens, the potential for significant damage to coastal dwellings can develop if a storm breaches the artificial structure and abruptly reestablishes a natural equilibrium between coastline and erosion (Pilkey and Evans, 1981). Beach nourishment cannot be seen as a permanent solution for this problem around the Sound.

* Historical/archaeological Impacts: Once again, the effect of this alternative on historical and archaeological sites must be reviewed in coordination with state historical preservation officers on a site by site basis.

Incineration

EPA proposed incineration, either combustion (burning under atmospheric conditions) or pyrolysis (heat treatment without an atmosphere), as a method for detoxication of contaminated dredged sediments last year. These processes would reduce the volume of organic substances such as PCBs and DDT as well as petroleum hydrocarbons found in dredged sediments. Inorganic contaminants, the CE stated in the PEIS, would not be eliminated by incineration but would be transformed into a nontoxic solid phase by pyrolysis.

* <u>Feasibility</u>: The absence of a facility to perform these processes on dredged materials in the LIS region means this option is not currently feasible. The estimated $100/c.y. cost would also be prohibitive for most large projects, the CE states in the PEIS. Future advances, however, may make incineration feasible in the future.

* <u>Environmental Impact</u>: Incineration would leave an inorganic residue which would still have to be disposed of in an appropriate manner. Some sediments may be too contaminated to be incinerated under current EPA regulations.

* <u>Socioeconomic Impacts</u>: Social impacts, the CE states, would be minimal, although public concern could center on possible degradation of air quality and disposal plans for the residue from this process.

* <u>Historical/archaelogical Impacts</u>: For this alternative, the effect on historical and archaelogical resources would depend upon the ultimate disposal plan for incinerator residue.

Resource Reclamation

Reclamation of dredged materials could involve use of these sediments for sanitary landfill cover, agricultural land enhancement, and soil enhancement for general landscaping purposes.

* <u>Feasibility</u>: The high cost of drying and transporting sediments for these purposes -- plus the unquantified impact of high salt content which might accompany these sediments -- makes this option currently unfeasible.

No Action

The "no action" alternative entails a cessation of dredging and disposal activities in the Long Island Sound region. An end to dredging would leave harbors and ports to slowly choke with sediment. As channels became shallow, smaller vessels would have to be used and more trips made to maintain the current level of waterborne commerce. "No action" would also have a severe impact on the region's recreational boating and fishing industry.

<u>Environmental impacts</u>: As harbors shoal, navigation becomes increasingly dangerous with a greater chance of vessels running aground. In the case of oil barges and the like, such an accident might cause a major spill. As a Coast Guard official put it, "dredging <u>may</u> cause environmental harm, while an oil spill will <u>definitely</u> cause impact." In addition, certain impacts may result from change in circulation and flushing patterns within the individual harbors. The nature and extent of this impact can only be supposed without further knowledge.

This alternative, according to the CE, could have initial beneficial effects by reducing the rate of sediment and contaminant loading of Long Island Sound. While it is not known to what extent dredging and disposal affect these environmental factors, it is likely this activity represents only a small portion of the total sediment and contaminant loading in LIS.

<u>Socioeconomic impacts</u>: A "no dredging" policy would have significant and severe economic effects on the economy of LIS regions. Such actions would affect petroleum suppliers; likely increase consumer prices for petroleum prod-

ucts; and utilities burning oil or coal could face higher transportation costs for transporting these fuels to electrical generating stations. Recreational use of the Sound by boaters, sailors and fishermen, ferry service between Connecticut and Long Island -- as well as the commercial and shellfishing industry -- would be seriously affected.

Historical/Archaelogical impacts: none.

2.0 Findings on Improving the Technical Selection Process

A major element of this policy analysis project entails evaluation of potential improvements in the process for forming dredging decisions around the Sound. In this report, "dredging management" refers to state and federal procedures used to regulate, and set policy for, removal of harbor sediments as well as disposal of these dredged materials. "Dredging" is taken to involve the process of both removing and disposing of these sediments. The "technical selection process" is one part of the dredging management system and involves use of scientific standards and data in governmental decision making. Economic, environmental and political considerations are reflected in dredging decisions. These factors are interrelated within the dredging management system and must be addressed in any meaningful review of the technical selection process. Findings in this report are focused on Long Island Sound but may also be of interest to citizens and officials in other New England or coastal states.

Dredging managment operates on two principal planes. First, through the regulatory process, state and federal officials review and act upon proposals advanced by the Corps of Engineers (CE) or other interests. The regulatory review process reacts to specific projects within a framework of statutory requirements, government regulations, and interpretative guidelines. Designation of specific areas of the Sound to serve as open water, or nearshore, disposal sites also occurs within this framework.

Second, through a policy formation process, state, regional and federal agencies work to develop overall mechanisms for managing dredging around the Sound. The "Interim Plan" drafted by the New England River Basin Commission (NERBC) represents this aspect of dredging management. Now part of Connecticut's federally approved Coastal Area Management Program, the NERBC Interim Plan provides a broad context for managing dredging decisions in this region. Findings in this report will enable the New England Governors' Conference or some other entity to move on from the 1980 Interim Plan and establish a long-term Sound-wide dredging management program.

During development of this report, five major findings emerged:

1. the Sound should be managed as a single, unified ecosystem which may be significantly affected by a wide range of apparently unrelated human activities;

2. a Soundwide management program should be designed to base public policy governing dredging management on a comprehensive identification and objective assessment of alternatives;

3. a comprehensive scheduling plan and mechanism should be developed as an integral element of the management program;

4. a mechanism for regular (perhaps annual) review and revision of the Soundwide dredging management program is essential; and

5. scientists, citizens and government officials should be involved in the process of developing this program.

These points are addressed more completely in Section 2.1. A series of specific findings for improving technical aspects of the dredging management system is advanced in Section 2.2 while Section 2.3 reviews the process used in developing these points.

2.1 General Findings for Improving Dredging Management

An understanding of dredging management around the Sound can begin with review of state and federal statutes, regulations and guidelines before moving on to encompass government planning studies, papers describing scientific research, New England River Basin Commission (NERBC) reports, the Long Island Sound Study, the Corps of Engineers' Final Programmatic Environmental Impact Statement, and NERBC's Interim Plan. Supplemented by interviews with state and federal officials, this information reflects the regulatory sturcture used on a day to day basis to manage dredging in this region. Yet none of these sources provide a clear, comprehensive picture of long -term management policy or how this kind of Soundwide policy is to be formulated.

The regulatory structure which has developed to manage dredging around the Sound has become almost as complex as the marine environment it affects. In reviewing dredging proposals and applications, state and federal agencies are required by law to consider a wide range of alternatives and competing interests. An evaluation of risks and benefits is based on interpretation of data and scientific tests, interagency communications, citizen comments, and other factors. This assessment is used in the decision to approve or deny permits for dredging and disposal of dredged materials.

Few outside the regulatory process understand the interrelated set of standards and rules which apply to complex dredging decisions. Even a smaller number are able to comprehend the mechanisms and long-range objectives which currently shape dredging policy around the Sound.

In part, this lack of widespread understanding stems from limitations inherent in the regulatory process. Regulatory systems focus on processing project proposals from federal agencies and applications from other parties. As such, the system is essentially a reactive process, responding to initiatives from outside the regulatory process. A planning process, in contrast, responds to broader concerns and considerations in forming long-range policies. Federal officials, working within a national legal framework, may lack the authority to initiate a planning effort to establish a Soundwide dredging management program. We do not find the same impediments confronting regional agencies such as the New England Governors' Conference or the states of Connecticut and New York.

Citizen Confusion Created

Confronted with a complex regulatory process, government officials must often rely on a reference to statutes, regulations and interpretative guidelines when questioned on dredging policy. While this is legally correct, and while these standards play an important part in the dredging process, these resources are difficult for those outside the regulatory process to understand. And a majority of persons concerned with the Sound, as well as the political leaders who influence dredging decisions, are outside the regulatory process. At best, they become involved in this process on a case by case basis, often to oppose specific projects or disposal alternatives advanced in individual dredging proposals.

We find citizens and political leaders frequently face a complex regulatory system which lacks a mechanism for broad based formulation of long-range dredging management policies. Further, we find a clear and present danger of becoming lost in the intricacies of the regulatory process and missing the key dredging policy questions altogether.

The technical selection process for using science in regulatory and policy decisions further complicates matters. In part, this stems from the difficulty of trying to manage a complex ecosystem with the imperfect tool of current knowledge. Limits to scientific understanding make it difficult for researchers to confidently predict specific environmental impacts or evaluate specific sediment samples. This inprecision, reflected in federal interpretative guidelines, increases the subjective nature of interpreting scientific data for dredging decisions.

Within this context, it is easy to understand why individual citizens and some political leaders criticize the current dredging management system. Unfortunately, these critiques too often take the form of court suits and political confrontations. This addresses only the symptoms of the so-called "dredging dilemma" and leaves unresolved the broader policy questions. We find a clear need for a process which involves scientists, citizens, users, political leaders and agency representatives in a Soundwide planning process to resolve this problem.

To some, the current dredging management system seems designed to dump as much sediment in the Sound with as little regulatory interference as possible. A few individuals may subscribe to this view as a matter of personal conviction. But, based on our experience in coordinating workshops and conferences around the Sound, we have found most citizens take a more reasonable view of dredging. Legitimate public concerns merit a more thoughtful response than possible with currently available information. Formulation of the NERBC Interim Plan and Corps of Engineers Final Programmatic Environmental Impact Statement have moved in the right direction. We find it is now possible to initiate another step toward long-range, Soundwide management of dredging.

Developing a Soundwide Management Program

To succeed in this region, a long-range dredging management effort must go beyond the classfication systems and disposal site management procedures contained in the Interim Plan. This process must be built upon a rigorous, scientific evaluation which objectively identifies and assesses alternatives to dredging and dredged material disposal. This project should:

1. establish an agreed upon range of current scientific conclusions gauging the impacts of dredging and dredged material disposal;

2. create a continuing mechanism to advise regulatory agencies of planning and management implications arising from scientific research;

3. entail a broad research effort to establish a reliable site specific classification system encompassing sediments from all historically dredged Long Island Sound harbors;

4. select specific disposal areas for certain classes of dredged materials;

5. require, based on sediment classification, specific management steps to minimize environmental effects from dredged material disposal; and

6. develop a centralized scheduling and planning mechanism for predicting and managing all dredging projects in the Long Island Sound region.

A public involvement program should then be developed to disseminate information and to establish citizen and community concerns as well as policy preferences. The product of this process should then move on to the Dredging Advisory Board for incorporation into a long-range policy proposal for state and federal consideration.

Based on the discussions of our project's Scientific Committee and interviews with government officials, we find interest for a bi-state planning process spanning 18 to 24 months. An agency such as the New England Governors' Conference (NEGC) could serve as an impartial third party, coordinating the planning process and managing services of consultants in this effort. An "independent broker" like NEGC might also serve as a mechanism for mediating, or finding a mediation service to resolve, dredging management disputes around the Sound.

This planning process should be designed to develop:

* a Soundwide Dredging Management Program which makes clear the steps to be taken in review of individual projects and specifies measures to be taken to minimize environmental effects. This program should begin with evaluation and testing of sediments and continue with classification of these materials; identification of alternative disposal strategies and sites open to this class of dredged sediments; and appropriate steps for protecting the marine environment.

* a Comprehensive Dredging Schedule or plan which projects future dredging needs on a site specific basis for maintenance and improvement work; identifies sediment characteristics based on past sampling programs as well as expertise of state officials; and forecasts potential problem projects. This would substantially extend the lead time agencies and citizens have to identify acceptable disposal strategies for contaminated sediments. To the extent possible, this effort should include projections for major private maintenance dredging. The comprehensive dredging schedule would be based on historical records and current sedimentation rates. Unlike the dredging program, the schedule could be developed by an interagency taskforce or advisory committee.

Connecticut and New York officials could clear the way for federal agency participation in the planning process by requiring involvement in the program as a condition for approval of federal projects. To meet this requirement, federal funds might be made available to support the planning process through a state agency or an entity such as the New England Governors' Conference.

We find it is important to recognize a Soundwide dredging management program and schedule entail a dynamic process of review and revisions which continues on a regular basis once the initial drafting process has been completed. Like the Corps' Final Environmental Impact Statement, these must be "living documents" which are subject to improvement based on practical experience, public concerns and scientific discoveries. The process described in this report provides a mechanism to meet this need.

We find the Soundwide Dredging Management Program and comprehensive dredging schedule should be compiled through a process involving:

* a Dredging Advisory Board, composed of Connecticut and New York officials as well as federal agency representatives plus two members each from the scientific and citizen advisory committees. An "honest broker" from outside the dredging process might serve as the coordinator of the Dredging Advisory Committee.

The Board would establish two committees:

1. a Scientific Advisory Committee, composed of marine and terrestrial scientists from the Long Island Sound region, to develop an objective analysis of dredge management alternatives and, on a continuing basis, propose alternative advance improvements to the plan based on new scientific findings.

2. a Citizen Advisory Committee, patterned after that of the Connecticut Coastal Area Management Program, composed of civic leaders, elected officials, conservationists, marine transportation and trades representatives, commercial fishermen, and recreational interests, this panel would examine the alternatives analyzed by scientists and make recommendations on public policies for Soundwide dredging management based on their area of expertise or interest.

Role of Dredging Advisory Board

The Dredging Advisory Board would advise on and coordinate the development of a proposed Soundwide management program and comprehensive schedule. This board would be charged with drafting a management program based on the Scientific Advisory Committee's findings and recommendations of the Citizen Advisory Committee. Public comment on the proposal should be developed through the Citizen Advisory Committee and a series of hearings on the management program by the Dredging Advisory Board.

This management program should also clearly identify the process and factors to be considered in evaluating and directing specific dredging proposals. As part of this proposal, conditions which require special management action to protect the marine environment should be identified. Further, specific sediment characteristics should be linked to specific disposal sites and requirements for special mitigation strategies to minimizing adverse ecological impacts.

As part of this process, the board should also propose how the management program should be implemented, financed, reviewed and revised. Continuing roles for the board and the two committees discussed in this section may be suggested to oversee implementation, monitoring and revision of the program.

This board should also coordinate development of the comprehensive dredging schedule. This process may best be accomplished by an agency effort followed by review through the scientific and citizen advisory panels.

The Dredging Advisory Board should be composed of representatives from the States of Connecticut and New York along with those from the Corps of Engineers and Environmental Protection Agency. Equally important, a significant percentage of the panel should be drawn from the two advisory committees. Additional representatives of the public or political process may be included on the board.

Scientific Advisory Committee

Drawn from the Long Island Sound region, the Scientific Advisory Committee will provide the objective basis for formulation of the comprehensive management program. First, this committee will identify alternatives which arise for the process of dredging, transporting, and disposing of dredged materials. The committee will then evaluate these options based on the best available research. The panel's findings would provide a context for management decisions based on comparison of benefits and risks of specific actions.

Much of the committee's concerns will be focused on alternative strategies for disposal of dredged materials. But the committee may also examine based on scientific studies, new dredging techniques or other options which might improve the process of keeping ports and harbors around the Sound open. The committee's findings would go to both the citizen panel and Dredging Advisory Board.

Scientists at the State University of New York at Stony Brook's Marine Sciences Research Center (MSRC) have had considerable success in using a procedure to develop preliminary dredging and dredged material management plans for the Port of New York and New Jersey and for the Maryland portion of the Chesapeake Bay.

If adopted, this approach would lead to development of a comprehensive dredging and dredged material disposal management plan for the Long Island Sound region (see Table 2.1-1). This plan should be based upon a thorough documentation of the quantities and qualities of the materials that are likely to be dredged and the areas from which they will come; on identification of the full range of plausible dredging and disposal alternatives; and on a rigorous assessment of the short, intermediate and long-term environmental, public health, and economic effects of disposal of different kinds (qualities) and quantities of dredged material in each kind of alternative disposal site. Only after this analysis has been made can scientists match types (and amounts) of dredged matieral with kinds of disposal sites -- open water, confined, unconfined, fringing areas, upland, disposal island, etc. -- in such a way that decision makers will have the information needed for selecting the most appropriate strategies for dredging and dredged material disposal; selecting the kind of disposal site needed for different kinds of dredged materials; and ensuring predictable and acceptable effects -- environmental, public health and economic.

The steps needed for the development of such a dredging/ dredged material management plan are outlined below. The plan should be a dynamic, evolving plan; one that could be modified relatively quicky and easily as our knowledge and understanding increase, and as society's priorities change. The development of the intitial plan should be based entirely upon existing data and information. It will become apparent early on in this process which important questions can be answered adequately with existing data and information, and which cannot. The results of this process can be of enormous benefit in eliminating unnecessary, redundant and costly monitoring and research. These activities which no longer add to our understanding of the effects of dredging and dredged material disposal on the natural environment or to our ability to manage these activities, must be evaluated if we are to improve our understanding of the effects of dredging and dredged material disposal on the environment and its living resources. Such an evaluation will also improve our ability to manage these activities for maximum benefit to society.

Membership in the Scientific Advisory Committee should involve scientists from both states and include terrestrial as well as marine researchers. Disciplines which sould be represented on the panel include:

* organic geochemistry;
* inorganic geochemistry;
* benthic ecology;
* physical oceanography;
* hydrology;
* wetlands ecology;
* fisheries management; and
* economics.

Nominations to the committee could come from state agencies in Connecticut and New York; the Long Island Regional Planning Board, other regional planning agencies, and other sources. Appointments could be made through the Dredging Advisory Board discussed in this section.

The Scientific Advisory Committee would also gauge cumulative environmental impacts, alert policy makers to implications of new research findings, and produce an annual list of topics meriting study in the Long Island Sound region related to dredging. The Committee should convene or co-sponsor a yearly conference on dredging-related science around the Sound or throughout New England.

While the Scientific Advisory Committee would identify areas of research needed to resolve dredge management questions, the panel would neither propose specific projects nor endorse proposals from individuals or institutions. The research "need to know" list would be circulated to the public, within the scientific community, to government agencies and specifically to Sea Grant programs in Connecticut as well as New York.

The Scientific Advisory Committee's report would evaluate alternatives within the regulatory system currently guiding dredging in this region. Specifically, the committee would focus on options like upland disposal by evaluating, in a comprehensive and objective manner, prospects for utilizing this means of disposal. Likewise the committee would identify various disposal plans. The Scientific Advisory Committee, will not, however, form specific recommendations as to which option, mitigation measure, etc. constitutes the best public policy.

Recommendations from the Scientific Committee would go simultaneously to the Citizen Advisory Committee and the Dredging Advisory Board.

Citizen Advisory Committee

The Citizen Advisory Committee would develop recommendations for adoption of policies based on the options described by scientists. This process would be patterned after that used in developing legislation establishing Connecticut's Coastal Area Management Program. In that effort, technical reports were presented to an advisory panel composed of state, regional and local officials and citizens representing marine industry, conservation, community and recreational interests. Based on the panel's recommendations, the CAM program staff developed a specific proposal for review by the Governor and presentation to state lawmakers.

In this case, the citizen committee would respond to an objective analysis of alternative management actions as examined by the Scientific Advisory Commitee. The citizen panel would also play a prime role in developing public understanding of, and support for, Soundwide dredging management.

The Citizen Advisory Committee should develop a public education and involvement program designed to help people

Table 2.2-1

STEPS TO DEVELOP A DREDGING/DREDGED MATERIAL MANAGEMENT PLAN FOR LONG ISLAND SOUND

I. IDENTIFY THE MAINTENANCE DREDGING REQUIREMENTS AND PREDICT NEW WORK PROJECTS

* How much material is likely to be dredged in the future for maintenance? At what frequency? From which projects will material be dredged?

* How much material is likely to be dredged in the future for new work? Where? When? How will new work affect maintenance requirements?

II. CHARACTERIZE THE MATERIALS TO BE DREDGED

* What are the physical and chemical characteristics, and the engineering properties of the materials that will be dredged? What are the associated contaminant levels? How do these properties vary within a project and among dredging projects?

III. CLASSIFY THE MATERIALS TO BE DREDGED

* What is a diagnostic scheme to clarify the materials to be dredged on the basis of their physical properties and particularly on the basis of their contamination potential?

* Which projects fall in which classes?

* How is total volume of material to be dredged apportioned among the various classes?

IV. IDENTIFY AND CHARACTERIZE THE FULL RANGE OF PLAUSIBLE DISPOSAL ALTERNATIVES

* What is the full range of disposal alternatives? Where are the sites?

* What are the important and distinguising characteristics --environmental, socio-political, economic, and public health -- of each site?

* What is the capacity of each site?

V. ASSESS THE IMPACT OF DISPOSAL OF EACH CLASS OF DREDGED MATERIAL IN EACH DISPOSAL OPTION

* What are the environmental, public health, socio-political, and economic impacts of disposal of each of the different classes of dredged material associated with each disposal option?

VI. RANK THE DISPOSAL OPTIONS FOR EACH CLASS OF DREDGED MATERIAL USING DIFFERENT RANKING CRITERIA

* What is the ranking of disposal options for each class of material based on environmental, public health, socio-political and economic grounds?

* What is relative weighting of each disposal option within each ranking?

understand and comment upon the dredging management plan proposed for the Sound. This effort would entail a series of meetings, recommendations and conferences around the region.

Membership of the Citizen Advisory Committee should be drawn to represent as large a segment of the region's population as possible. Once again, nominations could be advanced to the Dredging Advisory Committee from a variety of sources.

Interim Management Proposal

While a comprehensive dredging management program and plan is being developed, state officials should consider requiring capping of all material judged to be Class III under the Interim Plan. If capping is required as a matter of policy for all Class III sediments, state and federal authorities should, based on evaluation of existing data, conclude additional bioassey and bioaccumulation tests are not needed.

During this period, the CE should expand its efforts in the Sound to characterize harbor sediments using available data. Combined with state expertise and existing research reports, this should provide an adequate basis for sediment disposal management so long as the policy to cap all Class III materials continues.

The exception to this exclusion from additional biological testing would arise when existing data or state information suggest additional mitigation measures -- such as used in Norwalk Harbor -- may be required.

2.2 Specific Points

A series of specific points and concerns arose during this study which merit further attention. In some cases, these issues can be addressed with minor modifications in the administrative system. In others, the questions could be reviewed through the planning process described in Section 2.1. The following points are included among these items:

1. Classification Systems

a. The classification system advanced in the Interim Plan is adequate as a preliminary indication of sediment quality and characteristics. It is not, however, sufficient to serve as the sole or long term basis for all dredging decisions.

b. Class III, the most contaminated category, can be disposed in the Sound under the Interim Plan. Class III materials do not, necessarily, need capping although that is generally accepted as the solution for nearshore disposal of these materials.

c. There is no scientific reason why Class III materials cannot be removed from a channel. Class III materials are acceptable for upland disposal in controlled circumstances.

d. The CE should refrain from issuing permits for projects involving Class III materials which require capping unless and until material is available.

e. It is unclear how long Class III materials should be left uncapped on the floor of the Sound before capping occurs.

2. Selection Process

a. Disposal site selection should be based on analysis of materials to be disposed and characteristics of the site. Geographical proximity should not be the controlling factor.

b. Dispersal sites like Cornfield Shoals should continue to be restricted to clean material disposal.

3. Capping

a. Capping can be acceptable for most Class III materials at nearshore disposal sites in the Sound.

b. Subaqueous barrow pits may offer an extra measure of protection when capping some materials. This question should be examined and benefits quantified.

4. Research

a. Additional work is needed to examine the long range effects of capping. Research focusing on historic capping projects, such as the 1979 New Haven Project, would be appropriate.

b. Additional work could be completed on the Stamford/ New Haven Project site to determine forces causing a shifting of the cap.

5. Public Involvement

a. The public must be clearly involved in the dredge management process from the earliest stages of the planning effort.

b. Specific attention must be given to citizen education to avoid situations such as arose in Morris Cove where a lack of understanding generated opposition to use of a barrow pit for disposal of materials.

6. CE Communications

a. Improved communications are needed between the CE's regulatory branch and state water quality offices on permit applications.

b. Clear guidelines are needed to show applicants what tests will be required for their projects.

2.3 Project Methodology

Recommendations for improvements in the dredging technical selection process were developed through a consultative process utilizing an eight member Scientific Committee augmented by representatives of the New England Governors' Conferece (NEGC); U.S. Army Corps of Engineers, New England Division; U.S. Environmental Protection Agency, Region 1; Connecticut Department of Environmental Protection; New York Department of Environmental Conservation and

Department of State, and dredging policy experts from the Oceanic Society as well as the Long Island Sound Taskforce.

The composition of the Scientific Committee was developed during preparation of a contract proposal to the New England Governors' Conference submitted June 17, 1982 (a complete roster is shown in Table 2.3-1). Initial federal and state agency contacts were suggested by the Conference although participation in the project usually extended beyond any single member of an agency's staff (list of key agency contacts is shown in Table 2.3-2). The project staff is listed in Table 2.3-3.

The project team's approach to this effort centered on circulation of drafts to members of the Scientific Committee and agency representatives. A preliminary text of a part of the Comprehensive Review Document required under Task 1 of this project, for example, was used as the basis for stimulating discussion of the technical selection process. Once the draft of that section had been circulated, project staff met with Connecticut, New York, and NEGC staff to review the document. The text also went to Scientific Committee members who then made editorial suggestions and commented on the technical selection process itself. These comments were then compiled and sent to all Committee members and Agency representatives in preparation for a July 22, 1982 meeting (see Appendix A of this report).

In preparation for the July 22 Scientific Committee meeting, a series of discussion questions based on comments from the scientists as well as agency representatives were complied by the project staff. These questions were organized into a series of topics of critical concern and incorporated into an agenda for the day's deliberations, (these documents along with a list of participants in the meeting are found in Appendix B).

As the Scientific Committee focused on Task 2, the project staff completed a first draft of the Comprehensive Review Document required under Task 1. This text has been circulated to Committee members and agency representatives for comments to be reflected in the final report to NEGC. The staff also met twice with Scientific Committee members on Task 3 to develop a draft report on the deep ocean alternative. This document was circulated to agency representatives for comments.

A draft report on all three project elements was submitted to NEGC on July 30, 1982. This text was reviewed in an August 9 meeting between NEGC, project staff, Connecticut officials and New York representatives. Prior to that session, the project staff reviewed and evaluated comments on the draft report from Committee members and agency representatives. The majority of these comments suggested editorial changes or provided additional information to be included in the final report. Based on these comments, and the August 9 meeting, the project staff revised the draft report and submitted a completed document to NEGC on August 13, 1982.

Throughout the project, the staff maintained contact with state and federal agencies through meetings, telephone conversations and written communications. In addition to the Scientific Committee meeting, the staff met with CE officials twice in Waltham, EPA officials once in Boston, and NEGC officials twice in Boston.

TABLE 2.3-1

SCIENTIFIC COMMITTEE

Dr. Walter F. Bohlen, Marine Sciences Institute, University of Connecticut, Avery Point

Dr. Henry J. Bokuniewicz, Marine Sciences Research Center, State University of New York, Stony Brook

Dr. Robert Michael Cerrato, Marine Sciences Research Center, State University of New York, Stony Brook

Dr. Sung Yen Feng, Marine Sciences Institute, University of Connecticut, Avery Point

Dr. Donald C. Rhoads, Committee Chairman, Yale University, New Haven

Dr. J. R. Schubel, Marine Sciences Research Center, State University of New York, Stony Brook

Dr. Lance L. Stewart, Marine Sciences Institute, University of Connecticut, Avery Point

Robert M. Summers, Marine Sciences Research Center, State University of New York, Stony Brook

TABLE 2.3-2

KEY AGENCY CONTACTS FOR PROJECT

Vyto Andreliunas, Chief of Operations, Army Corps of Engineers, New England Division, 424 Trapelo Road, Waltham, MA, 02254, (617) 647-8225

Kenneth Koetzner, Chief, Bureau of Tidal Wetlands, NYDEC, Building 40, SUNY, Stony Brook, NY, 11794, (516) 751-7900

Beth Powers, New England Governors' Conference, 156 State Street, Boston, MA 02109, (617) 720-4606

Arthur Rocque, Connecticut CAM, 71 Capitol Avenue, Hartford, CT 06115, (203) 566-7404

Doug Thompson, EPA Region 1, Water Quality Branch, Municipal Permit Section, JFK Building, Boston, MA, 02203, (617) 223-5061

TABLE 2.3-3
OCEANIC SOCIETY PROJECT STAFF

Christopher Roosevelt, Oceanic Society President

Thomas C. Jackson, Oceanic Society Vice President, and Project Manager

Barbara S. Devlin, Oceanic Society Administrative Assistant

Whitney C. Tilt, Long Island Sound Taskforce Executive Director

Megan Goodwin, Long Island Sound Taskforce Intern

The Oceanic Society
Stamford Marine Center
Magee Avenue
Stamford, Connecticut 06902
(203) 327-9786

3.0 Deep Ocean Disposal of Dredged Material from the Sound

Deep ocean disposal of dredged materials has been proposed as an alternative to dumping these sediments in the Sound. Deep ocean disposal represents a significant philosophical shift in managing dredged material disposal. Unlike other disposal alternatives, which aim at containing dredged materials within a specific site or structure, the deep ocean option involves dispersion of sediments. This is a clear change in the direction of policy for managing dredged material disposal.

"Deep ocean disposal" can loosely be defined as disposal of dredged materials in waters seaward of the continental shelf. The shelf marks the border between nearshore (neritic) and oceanic waters and lies between 80 to 125 miles from the Long Island Sound region. More specific definitions of the "deep ocean" involve boundaries based on depths and varies from source to source. The Corps of Engineers defined deep ocean disposal as taking place in waters one to two miles deep (ACE, 1982) while Shepard (1963) defines the continental shelf as "those platforms bordering a continent that terminate oceanward at depths of less than 300 fathoms." In terms of general oceanography, oceanic waters and the terminus of the continental shelf off Long Island occurs in approximately 200 fathoms of water (366 meters) where water depths rapidly fall off to more than 2,200 fathoms.

The deep ocean alternative is advanced for several reasons. First, the abyssal depths of the open ocean account for the 57% of the earth's "land" surface. Second, many believe that the assimilative capacity of these waters is boundless allowing the deep ocean to receive disposal materials without adverse effect to ocean life and nearshore environments. Finally, dredged material disposed of at a deep ocean site will have little or no impact because: 1) sediments will be dispersed and diluted in the long transit to the bottom spreading throughout the water column; 2) the dredged material that does reach the bottom will cause little impact since there is little or no marine life at these depths; or 3) sediments introduced into the deep ocean environment supply organic material to the seafloor enhancing the bottom environment (Peguenat, 1978). Proponents of deep ocean disposal also point out that compared to disposal in nearshore environments, deep ocean disposal offers much less potential for adverse impact because nearshore systems are much richer and more productive than deep ocean environments.

However, arguments against deep ocean disposal as an alternative for dredged material disposal point to several objections:

1. Lack of knowledge concerning the nature of deep ocean environments and hence an inability to clearly assess the impact of disposal operations;

2. Effect of long transit through water column on the dredged material making wide dispersal likely;

3. Potential for increased turbidity, toxicity, and overall adverse impact as result of the dredged materal dispersing through the water column; and

4. Increased costs associated with greater transportation distances, greater capital expenditure on ocean-going barges, increased wear and tear on equipment, etc.

While the economic factor can be quantified in general terms to compare the costs of deep ocean and nearshore disposal, the environmental impacts can not be readily compared. The use of deep ocean as "waste space" is currently, and will continue to be, a subject of much debate and disagreement within scientific and policy circles.

3.1 Economic Considerations for Unit Disposal Costs

In attempting to determine unit costs for dredging and dredged material disposal, a myriad of conditions and variables must be considered. Some of these factors are constant while others change continually or are project specific. Conner et al (1979) listed the following considerations:

* the type of plant and equipment employed -- the equipment used and the mode of operation of the Corps of Engineers is significantly different from that of the private dredging companies;

* the type of dredging performed -- new work dredging differs from maintenance dredging in terms of both the average quantity of material to be removed and transported and the quality of material, i.e., sand vs. rock;

* location and accessibility of the dredge site -- these factors determine the type of equipment that can be used; and

* location of the disposal site relative to the dredge site -- when the disposal site is at a greater dis tance, a significant proportion of the total unit cost results from hauling the material.

If disposal is done near the project, it may be possible for dredging and disposal to be performed at the same time. If not, additional costs will be incurred for transportation to the disposal site. The cost of the dredging operation and the cost of disposal are weighted against each other to determine to what extent the operation should be continuous, bearing in mind the specific characteristics of the work being performed. These characteristics include:

1. productive rate of dredging in cubic yards per hour, which is a function of the size of the equipment, the hardness or softness of material, and the characteristics of the face of the cut;

2. <u>the width and depth of the channel</u>, which may limit the size of the scows that can be used, thus reducing the productive rate of dredging; and

3. <u>the distance to the disposal site</u>, which along with the rate of production determines the number of scows required to maintain a continuous operation.

3.2 Economics - New York Harbor

In evaluating the unit cost of maintenance dredging in the New York District, Conner *et al* (1979) found that the unit cost varied considerably depending on the contractor, and that private contractors were more expensive than the Corps of Engineers: unit cost per cubic yard for CE operations varied between the extremes of \$0.75 and \$5.75, while private contractor operations ranged between \$0.75 and \$6.75.

Based on an average distance to the Mud Dump site of 20 miles from New York Harbor, the cubic yard transport cost for CE operations was estimated by Conner *et al* to average \$0.80 per cubic yard, exclusive of time spent at Mud Dump. When this is compared to the estimated cost of \$1.04 per cubic yard for dredging and disposal, disposal operations represent some 77 percent of the total cost (Conner *et al* suggests that this percentage is somewhat high as a result of the dredging site).

Data for private contractors estimate a cost of \$0.05 per cubic yard per mile. Using this estimate, a 20 mile trip to Mud Dump would average \$1.00 per cubic yard and represent 59% of the total dredging project cost of approximately \$1.69. These price estimates are in 1976 dollars.

The Draft Environmental Impact Statement (DEIS) for the Port of New York and New Jersey (COE, NYD, 1982) states that estimating disposal costs is tenuous but gives a cost estimate as \$0.80/yd^3 with transportation representing upwards of 75% of the total cost of the project.

Conner et al (1979) in the Mitre Technical Report on the Disposal of Dredged Material within the New York District also considered deep ocean disposal of dredged materials "not currently reasonable." Conner et al gave much the same rationale as the DEIS but give a different estimate.

> "Ignoring the initial investment, the disposal cost of dredged material would increase by \$6.00/cubic yard for transportation alone if it is assumed that transport would cost \$0.06/mile. Thus the minimum cost of dredging and deep ocean disposal would appear to be about \$6.46/yd^3."

In considering the deep ocean disposal option for the disposal of dredged material from the port of New York and New Jersey, the New York District CE concluded this option is not feasible (COE, NYD, 1982). Transportation of dredged material between the Port of New York and an open ocean dump site would entail a round trip of approximately 250 miles. There is little doubt that this disposal option would increase travel time, transportation expense and would require larger barges. The DEIS suggests that while the existing barge fleet might be capable of ocean disposal operations, it is doubtful that it could do so in an economically efficient manner. The report reiterates the intensive capital investment required to develop a fleet of ocean going barges of sufficient size to operate economically, and an operational estimate of more than \$7.50/yd^3 is given (Mitre, 1979 as quoted by NYD, COE 1982). Finally, the DEIS states that surveillance of the disposal operations at a site far offshore would be difficult and costly and concludes that economics represent a major constraint to the use of this alternative for the Port of New York and New Jersey.

3.3 Economics - Long Island Sound

Nearshore open water disposal in Long Island Sound is estimated at $0.062/ cubic yard/mile for transportation alone (Dames and Moore, 1980). The Final PEIS for the Disposal of Dredged Material in Long Island Sound states that this unit cost will be significantly higher in the case of smaller harbor or marina projects utilizing smaller pieces of equipment. The PEIS also states that unit transportation costs are constant up to approximately 19 miles after which the unit cost rises in response to overtime costs and the increased likelihood of offshore weather curtailing transport, increased hauling time, down time for the dredge, etc. The figure given above assumes the use of a 1,800 hp tug towing one 2,000 cubic yard scow at 6 miles-per-hour. The mileage refers to one way distance but allows for the round trip distance.

The size of the dredging project and the equipment used plays an important role in the cost per cubic yard. Generally speaking, the larger the project, the smaller the cost per cubic yard. This accounts for the difference in the unit costs between the Corps projects and the small private contractor. A large project in Long Island Sound can utilize a 2,000 yard bottom dumping barge drawing between 15 and 18 feet. However, the majority of small harbors cannot utilize this larger equipment, relying instead on a 500-1,000 cubic yard barge filled by a 3 cubic yard mechanical dredge. The use of less efficient equipment drives up the cost with unit transportation costs up to $0.14 per cubic yard per mile.

In considering the possible need to transport dredged materials offshore to a disposal site, the PEIS considers a site some 75 miles south from New London. In estimating the unit costs, the PEIS considered a round trip of some 150 miles and the commonly used combination of tug/scow would take a minimum of 21.5 hours to complete the round trip (an optimistic figure assuming good sea conditions). Overtime costs, for crew and federal inspector, higher fuel consumption, etc. make the $0.062/cubic yard per mile unlikely. Assuming that the unit transport cost would rise to 0.07/ c.y./mile after eight hours, such a trip would raise transportation costs to approximately $4.87/c.y. For comparison, nearshore disposal at a site 8 miles from the dredging site would entail transportation costs of $0.49/cubic yard, or 11% of the offshore site cost.

Even though the above site lies outside LIS some 65 to 70 miles, it falls short of the deep ocean. A trip beyond the shelf from New London would likely entail a round trip distance of 200 miles. Utilizing similar conditions to those outlined above, such a disposal run would entail a round trip of 28.5 hours minimum with unit costs reaching $6.62/cubic yard. Compared to this figure, the use of the New London disposal site would be 7% of the open ocean transportation cost.

As part of its effort to ascertain the feasibility of containment sites as alternatives for dredged material disposal in Long Island Sound, the Corps contracted the Center for Environment and Man to undertake a study of the Social and Economic Impacts of Selected Potential Containment Sites in Long Island Sound (CEM, 1982). As part of this study, CEM undertook a comparison of the cost per cubic yard of disposal in Long Island Sound (10 miles), and open ocean disposal (100 miles). It should be noted that these distances are conservative: nearshore disposal areas are often further away than 10 miles; and distance from the harbor site to deep ocean is more likely on the order of 100-150 miles. In estimating the nearshore cost units, CEM based their estimates on the use of a clamshell dredge and transport by barge with a unit cost of $1.50/ cubic yard for dredging and $2.70/c.y. for 10 miles transport. For deep ocean, CEM used a transportation cost of $5.10/c.y with a linear variation in between.

The difficulty of estimated unit costs for dredging on a general project basis is illustrated by the following example for Mamaroneck Harbor in Westchester County, New York. In attempting to dredge the private channels within the harbor, the City of Mamaroneck and others received estimates from a number of dredge contractors to dispose at three sites: Mud Dump disposal site, Central Long Island Sound disposal site, and WLIS III. The following figures were quoted to the City of Mamaroneck for a project of 21,000 cubic yards; prices quoted included mobilization and demobilization (D. Natchez, per. comm.):

DISPOSAL SITE	DISTANCE	QUOTED COST PER CUBIC YARD
Mud Dump	44+/-	$16.45
Central LIS	42+/-	$9.31 to $10.57
WLIS III	15+/-	$4.28 to $ 4.71

In attempting to correlate these figures, several factors must be considered. As mentioned, the equipment to be used and the size of the project are major factors in determining the unit cost of the dredging project. However, a look at the quotes for Mud Dump and the Central LIS site demonstrate several other factors not readily apparent at first glance. Though the distances to the disposal sites are similar, the travel conditions are not. For example, because of tides in the East River and Hells Gate, only one trip per day per tow vessel is possible to the Mud Dump while more than one is possible to CLIS; as a result of tides and traffic, the tug can tow only one barge to the Mud Dump while two or three can be towed at a time to CLIS under good conditions; and finally, while the barges to both areas must be "sealed", barges traveling to the Mud Dump must be further certified for ocean travel (D. Natchez, pers. comm.). The results are estimates for disposal operations of similar distances that are $6-7 per cubic yard apart.

3.4 Estimated Costs for Deep Ocean Disposal

As is apparent, estimating unit costs for dredging and dredged material disposal is a difficult task demanding the consideration of variables from fuel consumption to tidal currents and navigational constraints.

The task of estimating unit costs for deep ocean disposal is made even more difficult by the paucity of data on actual deep ocean disposal projects. One project involving a long disposal distance was recently completed in Providence, RI by the Great Lakes Dredge and Dock Company. The disposal site used for dredged material was the Foul Area in Massachusetts Bay off Marblehead, a distance of some 110 miles via the Cape Cod Canal. The distances involved were equivalent to deep ocean disposal but the disposal operation was undertaken in coastal waters. According to Brian Lindholm of Great Lakes Dredging (pers. comm., 1982), 50,000 cubic yards of material was dredged and disposed of at a cost of approximately $10.00 per cubic yard.

Dredging costs are best expressed as a ratio between the cost of dredging sediment and the expense of transporting these materals. One reason for this is the influence of transport distance on dredge stand-by time: as the distance to the disposal site increases so does stand-by time, prompting an increase in dredging unit costs. While the actual percentage between the dredge work and transportation varies, for the purposes of this study a dredge work to transportation ratio of 35:65 is used.

Assuming the above ratio, the $10.00 per cubic yard cost of the Providence project represents $3.50 for dredging and approximately $6.50 for the transportation. A distance of 110 nautical miles to the Foul Area disposal site breaks down to $0.06 per cubic yard per mile. This estimate is consistent with nearshore disposal costs for Long Island Sound and New York Harbor. Table 3.4-1 lists unit cost information for nearshore and deep ocean disposal from a number of different sources.

As illustrated in Table 3.4-1, unit cost estimates for transportation to deep ocean disposal sites range from $0.06 to $0.07 and represent up to 93% of the total cost of a dredge project.

In the attempt to distinguish between nearshore and deep ocean disposal cost, four harbors evenly spaced through the region were selected in Long Island Sound. For each of these sites, three open water disposal sites were selected:

1. the designated disposal site closest to the harbor;
2. the Central Long Island Sound disposal site; and
3. a deep ocean disposal site off the eastern end of the Sound.

In order to reflect rising transportation costs, a sliding scale was used depending on distance to the site. The results were found on Table 3.4-2.

TABLE 3.4-1

ESTIMATED UNIT COSTS

FOR NEARSHORE AND DEEP OCEAN DREDGED MATERIAL DISPOSAL

Location	Distance	Unit Cost/yd^3	Source
Nearshore Disposal			
New York Harbor to Mud Dump (Corps Projects)	20	\$1.04 total \$0.80 trans. (77%) \$0.04/mile/yd^3	Conner *et al* 1979
New York Harbor to Mud Dump (Private Projects)	20	\$1.69 total \$1.00 trans. (59%) \$0.05/mile/yd^3	Conner *et al* 1979
Long Island Sound Port to site 20 miles away (Corps Project)	20	\$1.61 total \$1.24 trans. (77%) \$0.062/yd^3/mile	ACE, 1982
LIS Port to site 20 miles away (Private Projects)	20	\$3.64 total \$2.80 trans. (77%) \$0.14/yd^3.mile	ACE, 1982

Range -- \$0.04 - 0.14 per cubic yard per mile
Mode -- \$0.05

Location	Distance	Unit Cost/yd^3	Source
Deep Ocean			
New York Harbor to site deep ocean	100	\$6.46 total \$6.00 trans. (93%) \$0.06/yd^3/mile	Conner *et al* 1979
New York Harbor 125 miles offshore	125	\$7.50 total \$6.98 trans. \$0.06/yd^3/mile	Mitre, 1979
LIS to offshore site, 75 miles	75	\$5.24 total \$4.86 trans (93%) \$0.07/yd^3/mile*	CE, 1982
LIS to deep ocean site 100 miles	100	\$7.12 total \$6.62 trans. \$0.07/yd^3/mile*	CE, 1982

Range -- \$0.06 - 0.07 per cubic yard per mile
Mean -- \$0.065

*rate determined by \$0.06 for first 8 hours, and \$0.07 for remaining time.

TABLE 3.4-2

DISTANCES (IN NAUTICAL MILES) AND ESTIMATES FOR TRANSPORTATION COSTS OF DREDGED MATERIALS DISPOSAL AT SELECTED NEARSHORE AND OFFSHORE SITES FROM FOUR LIS PORTS.

DREDGE SITE	LOCAL SITE miles (site name)	$\$/yd^3$	NEW HAVEN miles	$\$/yd^3$	OCEAN miles	$\$/yd^3$
Mamaroneck	12 (WLIS)	$0.72	40	$2.40	165	$11.55
Bridgeport	--	$0.72	13	$0.78	140	$ 9.80
New Haven	--	--	8	$.48	130	$ 9.10
New London	5 (N.L.)	$0.30	40	$2.40	95	$ 5.70

1. Distances for the above ports and disposal sites were taken from NOAA Chart #12300; the distances represent linear nautical miles and do not accurately depict mileage traveled by tug.

2. Rates are assigned on a sliding scale as follows: 0-101 miles @ $.0.06; 101+ @ $0.07;

3. Deep ocean site used for the purposes of this estimate was located approximately 80 miles south of the Race at the point where water depth is in excess of 200 fathoms.

The cost estimates given in Table 3.4-2 are for Corps projects. Due to the small volumes usually found in private dredging projects, private dredging is often more expensive than federal projects. If the dredging cost estimates from the Mamaroneck project are used for a similar purpose as outlined in Table 3.4-2 the unit costs for transportation increase dramatically.

DREDGE SITE	DISPOSAL SITE	DIST.	COST PER CUBIC YARD[1]
Mamaroneck	WLIS III	12	\$ 2.78 (\$0.23/yd^3/mile)
Mamaroneck	CLIS	40	\$ 6.50 (\$0.16/yd^3/mile)
Mamaroneck	Mud Dump	40	\$10.69 (0.27/yd^3/mile)
Mamaroneck	Ocean[2]	125	\$33.75 (0.27/yd^3/mile)

1. Figures used from D. Natchez, pers. comm. They are quotes for the 21,000 cubic yard project.

2. Figure used for ocean disposal unit cost estimated for travel to the Mud Dump disposal site and reflects travel through the East River.

Although the major portion of the expense of deep ocean disposal results from transport costs and cannot be easily reduced, some savings can be gained by reducing the dredge stand-by time. For example, in the case of the Providence, RI dredging project, involving a transport distance of 110 n.m. to the disposal site, a round-trip dump site visit would require approximately 37 hours at an average towing speed of 6 knots. Assuming it takes 8 hours to fill a 4,000 c.y. barge using a 15 cubic yard bucket, a minimum of 5 barges would be required to eliminate all dredge stand-by time. A major factor preventing this is a lack of suitable ocean going barges. According to Mr. Lindholm of Great Lakes Dredge and Dock Company (pers. comm. 1982) only 14 barges of the type required for efficient deep ocean disposal are available on the east coast of the United States.

At an approximate cost of 2 million each (B. Lindholm, per. comm. 1982), the necessary barges represent a substantial investment. Before such an investment is considered an accurate assessment of demand for ocean disposal and potential costs savings due to more available barges must be made. To date this analysis has not been done in view of the extremely high cost of deep ocean disposal and the uncertainty in its implementation because of questions about the environmental desirability of large scale deep ocean disposal.

3.5 Ocean Disposal: A Long Island Sound Perspective

In order that ocean disposal approach economic feasibility, large ocean going barges and minimum dredge stand-by time must be achieved. However, dozens of ports and harbors in Long Island Sound may be incompatible with such equipment demands. The 4,000 cubic yard barge mentioned in the previous section draws some 18 feet when loaded. Contractors can lower this controlling depth to 15 feet through the use of the tides. In addition, a minimum width of 70 feet is necessary to allow manuevering. A look at Long Island Sound ports shows that only 4 harbors have sufficient depth and width to permit use of these large barges (New London, New Haven, Bridgeport, Port Jefferson). This does not include the Connecticut and Housatonic River projects which generally dispose of material near the dredging site. The remaining projects must use smaller barges and dredge equipment.

A 2,000 cubic yard barge draws 11 feet when fully loaded, thus increasing its use in the Sound. But more commonly it is the smaller barges (500 - 1,500 yd^3) that transport dredged material. These smaller barges are not certified for ocean disposal and are not of sufficient size to haul large distances economically. To consider ocean disposal for approximately 70 to 80 percent of harbors on Long Island Sound would require the use of a rehandling facility to offload the dredged material from the smaller barges and load the sediment onto the larger 4,000 cubic yard barges. While good data is not available for assessing the additional cost of rehandling, it is realistic to consider it as a second dredging, or an additional 35%, added to the cost of the dredging project. For example, if the estimated cost of open water disposal is $7.50/cubic yard (Mitre, 1979), rehandling the material might raise the cost per cubic yard by $2.63 to $10.13/cubic yard. The quote for a project in Long Island Sound that called for rehandling the material from smaller barges into larger barges for transport to Mud Dump estimated the cost at $12.00 per cubic yard (B. Lindholm, pers. comm.).

3.6 Environmental Impact of Deep Ocean Disposal

In arguing in favor of deep ocean disposal Pequegnat (in press) reports that while the continental shelf accounts for less than 8% of the ocean floor and underlies only 0.1% of the ocean's waters, it accounts for over 90% of our seafood, is a source of oil, gas and mineral resources and provides a disposal site for large quantities of wastes. On the other hand, according to Pequegnat (in press), the deep ocean environment serves us in few ways. In apparent contradiction to this are figures in a report on fisheries of the New York Bight (McHugh and Ginter 1978) which show foreign fishing fleets to be concentrated around the edges of the continental shelf at and beyond the 200 fathom contour. Because of our dependence on nearshore resources and the large capacity of the deep ocean for dilution and assimilation of wastes, deep ocean disposal is an attractive option for dealing with dredged material. Before we conclude that deep ocean disposal is acceptable, however, we must examine the option in more detail to ascertain the true impact of dredged material disposal on deep ocean environments.

The deep ocean environment is generally believed to be sparsely populated and relatively unproductive in comparison to shelf and nearshore waters. Nevertheless, highly complex ecological systems have evolved in the deep ocean and for the most part these systems are poorly understood. While high species diversity and low population densities are generally observed, Grassle and Sanders (1973) believe the ecosystem is maintained by the extremely stable deep sea environment; Dayton and Hessler (1972) propose that diversity is maintained by continued biological disturbance. In the case of the former hypothesis, any disturbance, including dredged material disposal would be devastating to the existing ecological structure.

An alternate possibility was suggested by Rhoads et al (1978), when they observed enhanced biological production caused by dredged material disposal in Long Island Sound. It may in fact be possible to cause beneficial impacts to the ecosystem through proper management of dredged material disposal. In any event, disposal of contaminated dredged material into this environment would result in some sort of impact and should be considered carefully.

In order to evaluate the impact of dredged material disposal on the deep ocean environment it is first necessary to determine the fate of dredged material dumped in over 200 miles of water. Pequegnat (in press) describes the disposal process in detail. The fate of the dredged material is largely determined by its physical properties, water content and particle size. More fluid, fine grained materials will be more widely dispersed than cohesive, low water content or coarse grained material. Fine silts and clays with settling rates less than 0.001 cm/sec can be transported greater distances and many particles may remain in suspension indefinitely. Pequegnat concludes, however, that it is improbable that any significant build up of turbidity would occur because of the vast volume of water involved at deep ocean sites. In general, based on this information it appears that deep ocean disposal results in much more dispersion of dredged material than shallow water sites where 95 to 99% of the dredged material settles on the bottom in a fairly small area.

The increased dispersion of dredged material at deep ocean disposal sites increases the risk of contaminant release from sediment particles. Drastic chemical changes in the dredged material may occur during dumping due to the introduction of oxygen, change in pH, and change in salinity. While many contaminants remain tightly bound to sediment particles in quiescent, reducing conditions, changes in these conditions, such as encountered in deep ocean disposal may result in the release of some contaminants. In any event these factors deserve further attention prior to the widespread dispersion of dredged material through deep ocean disposal. Because of the extent of dilution expected at deep ocean sites it is doubtful that contaminant levels will increase to observable levels. Even so, as the extent of DDT contamination has so dramatically illustrated, many organisms have the ability to concentrate contaminants to unacceptable levels. Given the uncertainties involved, it is difficult to advocate the dispersal of contaminated dredged material at deep ocean sites.

3.7 Comparing the Deep Ocean Alternative

To date, most research has been directed at evaluating the economics and environment impacts of near shore disposal of dredged material in the Sound. Under most circumstances, this alternative has been judged the most acceptable based on an evaluation of costs and ecological effects of alternative disposal options. In cases involving contaminated sediments, capping dredged materials with cleaner material has been scientifically shown to be an effective means of isolating contaminants from the marine environment.

In comparison, the deep ocean option carries higher costs and entails a strategy of dispersing pollutants. The dispersion approach represents a significant shift from the current philosophy of containing contaminated sediments either under caps of cleaner materials, in upland sites or as part of containment projects which involve island construction or shoreline extension. Before any attempt is made to implement the pollution dispersion strategy as exemplified by deep ocean disposal this change in management strategy must be studied in more detail.

At this point, deep ocean disposal carries higher costs and poses a possible risk of environmental damage. While the reality of the ecological risk is the subject of scientific debate, it is clear the deep ocean alternative would significantly increase the cost for dredged material disposal around the Sound.

Within the current Administration's current fiscal and harbor management policy, higher dredging costs could be expected to:

(1) lead to lower dredging volume unless additional funds are authorized for continuing the current rate of federal dredging projects; and/or

(2) add pressure for sharing the cost of federal dredging projects through user fees or contributions from local and perhaps state sources.

Either of these impacts could be expected to restrict dredging around the Sound and lead to difficult dredging management decisions. Some smaller harbors, which principally serve recreational interests, might be, to all intents and purposes, abandoned as federal projects. Improvement projects aimed at expanding major ports such as New Haven and Bridgeport might become too expensive to justify under current cost-benefit requirements.

The economic impact, especially when combined with uncertain environment effects, significantly reduces the acceptability of the deep ocean alternative. While this option should be addressed in shaping a Soundwide dredging management program and plan, it must be recognized as an alternative where the risks currently outweigh any benefits.

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APPENDIX A

SCIENTIFIC COMMITTEE AND AGENCY COMMENTS ON DRAFT COMPREHENSIVE REVIEW DOCUMENT

The University of Connecticut

AVERY POINT
GROTON, CONNECTICUT 06340
COLLEGE OF
LIBERAL ARTS AND SCIENCES
Department of Marine Sciences

RECEIVED
9/1982

July 12,1982

Mr. Thomas C. Jackson
Vice President
The Oceanic Society
Magee Avenue
Stamford,Connecticut 06902

Dear Tom:

As requested,I have reviewed your draft chapter describing the technical screening process used in the management of dredging and dredge spoils disposal in Long Island Sound. This chapter forms a portion of the report on long range dredging management being prepared for the New England Governors' Council. The following represents a summary of my review notes.

Overall this chapter presents a reasonable and reasoned discussion of the technicalities associated with dredging and dredge spoils disposal. It is dry but readable. It should be recognized that review of style and substance is rendered difficult due to the lack of context. i.e. to some extent it is necessary to review this section in combination with other sections of the report. This factor should be taken into consideration during the final editing of the report. Specifically be sure that all statements are adequately referenced. It is not sufficient to say that " some scientists think..." without an attendant reference. Some examples are given below.

The listing of the pertinant regulations governing dredging is good and impresses the reader with the complexity of the permit process. Is this a subject that will be addressed in the report? Are we asked to recommend ways to eliminate un-necessary complexity? In practice the Corps is the lead agency with the EPA and the States next in line. Possibly the present multiplicity of regulations and associated permits could be replced by a single governing ordinance and permit initiated by the Corps or rather through the Corps and passed to the States etc. for comment and subsequent signature. This effectively takes place now. Why not simply codify it ?

Both the section describing permit requirements and the next dealing with designation of spoils disposal areas would benefit by some additional historical perspective. In particular it is important for the reader to realize that whereas in 1970 many of the laws may have been initiated through good intentions by 1980 they were being modified and/or replaced because of experience and data obtained within a variety of carefully documented field and laboratory studies. I expect that this point will be clearly made within the summary of research to date but it should be worthwhile to reinforce the point within the description of operational requirements. I must say that I consider this lack of awareness by the public of the amount of work that has been done over the past ten years on dredging and dredging impacts one of the major reasons (if not the major reason) for many of the project difficulties, lawsuits etc.. Promulgation of the results of studies through the normal means of journal publication, seminars etc. is plainly inadequate. More general dissemination of study results and implications is necessary. If the report served to document the progressive increase in our understanding of dredging related impacts and the use of this information within the decision making process it should prove extremely valuable. You might also consider adding a few comments concerning this lack of communication. Some of the responsible agencies might be moved to action.

1.4-1 pp 4 ... Statement that "Generally these rules require a site:..." leads one to wonder just when the rules are not applied. The use of the qualifier may be misleading. An explanatory sentence may be in order.

pp 5 first paragraph-- some mention should be made of the use of previous information within the evaluation of the probable environmental impacts. Also at what point will the political and economic considerations be discussed ? In most cases these are the over-riding consideration.

pp 6 .. 2nd paragraph.. point out that the qualitative term "unacceptable" will be discussed in more detail later.

1.4-4 pp 10 2nd paragraph ... Statement that scientists say that contaminants found in LIS sediments are firmly bonded should be supported by a reference. The degree of mobility and ultimate availability of sediment associated contaminants is dependent on many more things than simply operational procedures. It might be best to simply point to the complexity of the subject, provide some references and leave it at that.

-- It is not clear what is included under disposal management procedures. Spell it out. Capping,precision navigation, close supervision, etc.

-- 3rd paragraph last line need some editing.. wordy.

-- 4th paragraph Are the industrial discharges referred to permitted discharges ? It might be well to point it out if they are. Is sewage sludge presently being dumped in LIS ? Not to my knowledge. If not why mention it unless you wish to refer to past dumping practises . Next to last line discussing the amount of a contaminant available versus the amount present is not clear.

pp 11 ... 1st paragraph Harbor sediments are organic rich . Last sentence in paragraph needs some expansion or clarification. As written it is misleading.

-- 3rd paragraph First line need a word before substance. Bulk chemical analyses... prece-ding spelling errors in 2nd line.

--4th paragraph.. Scientists argue that bulk chemical analyses should not be used because of the difficulty in interpretation. The availability of contaminants associated with sediments will change in different chemical environments. Provide references.

pp 12 2nd paragraph could use some references.

--3rd paragraph -- I'm not sure that either of the referenced tests were intended to provide indication of the long term impacts associated with a dredging operation. EPA or the Corps should be able to provide some guidance on the subject.

pp 13 ... with reference to the bioassay technique..... you might consider adding a few comments on the fact that following the solid phase tests the animals being used in the remainder of the tests have been severely stressed. This adds an additional uncertainty to the tests. Also the bioassay technique fails to adequately account for the mobility of the animals and their ability to adapt to persistent low levels of contamination. It is at best a worst case assessment.

pp 22 Continuing comments on the bioassay technique... The relationships between the results of laboratory tests and ecological effects in the marine environment (bottom line 2nd paragraph) will be the subject of a joint EPA -Corps of Engineers study. I expect this work will be outlined in the summary of research to date. Information on project details schedules, etc. can be obtained from EPA Narragansett (Dr. Alan Beck).

--4th paragraph-... the fact that ultimately decisions concerning dredging are political/economic cannot be sufficiently stressed. It is my impression that the public perceives the dredging decision(s) to be primarily scientific/ quantitative. In fact the scientific input is often no more than an additional element of protocol required within the permit process. The decision is generally qualitative and based primarily on political considerations. This point should be clearly and forcefully made in the report. It will not be easy to impress the reader with this point given the shear volume and space dedicated to largely scientific aspects of dredging decisions within the report.

--- Is there a way to improve citizen participation in the final decision making process ? Add some recommendations along this line..

pp 25 ... with regard to alternative means of disposal.. within the Long Island Sound area this aspect of project evaluation is seldom taken seriously and the subject is treated briefly at best. The primary reason appears to be associated with the probability of ground water contamination due to leachate derived from the spoils. This is a subject that has been treated in some detail by DEP as part of their solid waste management program. Much of the data developed for this program should be applicable within considerations of upland disposal of dredge spoils. The Natural Resources Data Center (Dr. Hugo Thomas) DEP has used these data to develop maps of areas that could be used as new dumps. On review there appears to be very little area available within Connecticut for this purpose. This being the case it could be said that there is similarly no space available for upland disposal of spoils and that consideration of this factor within each permit request is a waste of time. Such a line of reasoning would argue for the removal of this consideration from the permit process and simply limit dredge spoils disposal to open water areas. However, such an approach would be appropriate only if upland disposal required use of areas not previously used for waste/spoils disposal. The use of dredge spoils as cover within existing dumps appears to be feasible depending on the physical characteristics of the spoil. The utility of this approach , given relatively "clean" spoils, again depends on the economics of the situation, handling costs etc.. I suspect that it is this latter factor that generally dominates the decision making process and not the probability of ground water contamination. Briefly.. I think that the statement of alternative means of disposal pp 25 needs to be expanded !

... Same thing goes for the statement on site management considerations... it is not clear what you mean by this-spell it out. At what point does dredging site considerations enter? All of the comments appear to be primarily related to the disposal area. When discussing the dredging site some few words should be said about the variety of dredging techniques available to reduce and/or eliminate the possibility of contamination due to turbidity or sediment related contaminants. Possibly a page or two summarizing engineering details of some of the more modern hydraulic dredging techniques might be useful. Also some words on siltation curtains, settling basins, etc. There are ways available to essentially eliminate significant resuspension outside of the immediate project area.

pp 27.. I think I'm beginning to dislike the use of the phrase "some scientists argue".Is this being used to add some credence to the statement? I think its use could be discontinued without damaging the credability of the discussion.

.. Classification schemes represent the simplest form of a management tool. There are not being used in an effort to "sort out some of the confusion surrounding the bioassay technique". This statement is misleading. If anything they replace the bioassay technique on those projects involving less than 25,000 yds^3 of spoil.

With reference to recommendations concerning ways to improve the technical screening process :

1. Simplify it. Establish a single permit system with one agency (the Corps?) as lead with the remaining State and Federal groups involved on a review with veto basis.

2. Initiate an active and effective public information program to communicate the results of ongoing research. EPA seems like the logical agency to handle this assignment.

3. Make a clear delineation of the economics of individual projects a prominent part of the permitting process. Now although cost-benefit analyses are required as part of all Federal projects this aspect is often obscured by the more "scientific-ecological" concerns. Despite this appearance most projects stand or fall on their economics. The public should be made more aware

of this component of the decision making process.

4. The alternative means of disposal question should be strengthened or eliminated. If upland disposal in Connecticut is feasible then DEP should take a more active role in seeing to it that an applicant has indeed explored all of the possibilities. The present "lip-service" appears to be little more than a waste of everybody's time.

5. The use of innovative dredging and disposal techniques should be encouraged. This requires monies to be successful. The support can be either real in terms of the State or other public agency purchasing modern machinery or less tangible in the form of tax relief or some form of investment credit. At present there is little reason for private dredgers to use anything but the existing machinery. A look to the trends in northern Europe can give some indication of the range and capabilities of the available systems.

6. Finally, develop a more comprehensive view of the dredging process beginning with an understanding of what causes sedimentation in harbors and waterways. In many areas this could be reduced or at least controlled by sedimentation barriers along bordering construction sites, catchbasin maintenance on roadways, and a general program of sedimentation control along tributary streams. The State of Connecticut discussed such controls a number of years ago but to my knowledge nothing effective has been implemented.

Next, plan waterway usage. Not every waterway in the State needs to provide a controlling depth of 4ft +MLW. The people very often expect this, however. This is because of a range of expectations that includes navigable waters adjacent to 'my' property. A reasonable adjustment in these expectations could reduce pressures for dredging and associated disposal.

Consolidate the permitting process as discussed above incorporating modern methods and alternative means of disposal as much as possible.

Include within the permitting process the function of an overseer. The Corps (as at present) during the conduct of the project and EPA (or some similar relatively disinterested agency) following project completion to assess both short and long term impacts at the dredge and disposal sites. The long term aspects of this monitoring could be coordinated to provide more essential information within the regulatory process than is presently available. Such data input provided in a timely manner could serve to permit the development of more dynamic (i.e. subject to change) regulations and procedures that are more nearly in step with current-up-to-date understanding of dredging impacts.

Trust that some of this material will assist in your compilation of the final report. Excuse my lack of editing and somewhat rambling comments. Your time schedule simply does not permit a more detailed and carefully edited review.

If there are any questions don't hesitate to call. As you know I will be unable to make the meeting on the 22nd but if you have any points that require clarification I should be in the office most of Friday afternoon.

I look forward to receiving a copy of the final report.

My best regards

Sincerely,

Frank

W.Frank Bohlen
Associate Professor

WFB:ep

marine sciences research center

STATE UNIVERSITY OF NEW YORK AT STONY BROOK
LONG ISLAND, NY 11794
516-246-7710

13 July 1982

Mr. Thomas Jackson, Vice President
The Oceanic Society
Magee Avenue
Stamford, CT 06902

Dear Tom:

I have reviewed the preliminary draft manuscript on the review of the technical selection process involved in dredge management. Most of the document seems to be fairly straightforward. The discussion of the regulations and definitions seems to be all right but I am not the one to verify that the description is without error. I am concerned, however, that the treatment of scientific opinion does not help the reader. On page 10, line 18, p. 11, lines 26 and 29, and p. 22, lines 5 and 9, you say that "some" or "many" experts hold certain opinions. The issues addressed by this opinion are vital to the resolution of the management dilemma and your statements do not give the reader any evidence to judge the value of these opinions or to assess them. To do this the document must at least say who holds the opinion and who believes the contrary position so that the informed reader can judge the merit of either opinion by the qualifications of its proponents and opponents either in scientific stature or in numbers. It would be even better to give the data upon which the opinions are based. As they are given, the statements tend to obfuscate the issue rather than to clarify it. I am fairly familiar with the scientific aspects of these problems but I would not know who would claim that a significant substance, like lead, may not be tightly bound to the sediment in the marine environment. The need for producing a comprehensive document for the informed lay audience probably precludes the expectation that any significant improvement can be made in the complex management process simply because most of the effort will be spent in educating the audience in generalities and not enough effort devoted to the details of the technical questions that really underlie the conventional wisdom.

I was surprised to see that most of the document deals with the classification schemes. I was under the impression that it was to deal with disposal site selection. I have been involved in many discussions of the possibilities of improving the classification techniques but I do not have any details of an improved technique to recommend. In general, the specific analyses to which dredged material is subjected depend upon the specific hypotheses that are formulated concerning its behavior at a particular type of disposal site. For example, I believe it would be useless to characterize the long-term release of lead from the sediment under oxygenated conditions if the disposal site was chosen to keep the sediment reduced; on the other

Mr. Thomas Jackson
13 July 1982
Page 2

hand, if the disposal site was sub-aerial, such a test may be extremely useful, if the sediment contains a significant fraction of lead. As a result, a general test for all sites probably is not possible or, if possible, would likely be very expensive. Instead, a battery of tests should probably be specified where the results of one test determines the next test to be done. The limiting step in formulating such a scheme is to decide upon specific, quantifiable effects upon which a dredging operation can be judged to be environmentally acceptable. Easier said than done, but I am looking forward to discussing the problem.

Regards,

Henry Bokuniewicz

Henry Bokuniewicz

marine sciences research center

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July 13, 1982

Thomas C. Jackson
The Oceanic Society
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Dear Tom:

I have reviewed your draft description of the technical selection process, and I would like to submit the following comments.

1)Page 3 - Re The Coastal Zone Management Act of 1972: It is stated that activities affecting a state's coastal zone must comply with that state's approved CZM plan. You do not, however, mention whether the states involved have approved CZM plans. I do not believe that New York has one. It would be helpful to know which states in the region have approved CZM plans, as well as, what benefits, restrictions, etc. are carried with an approved plan.

2)A diagram or flow chart showing the permit process would be a useful addition.

3)Throughout the text some important statements are made rather imprecisely. For example,

Page 10, paragraph 2: "Under most circumstances, scientists say..." What circumstances? Which scientists?
Page 10, paragraph 4: "...some officials say..."
Page 10, paragraph 4: "Some industrial wastes..."
Page 11, paragraph 5: "Thus, some scientists say..."
Page 22, paragraph 1: "First, some scientists are concerned..."
Page 27, paragraph 2: "Some scientists argue..."

I would like to see these statements more explicitly written.

4)Page 22, paragraph 1: It is stated that some scientists are concerned that bioassessment tests do not measure long term effects since they last for a relatively short period of time. I think that it would be helpful to the reader to know how long these tests last.

5)Section 1.4-5: This section discusses the difficulty in interpreting bioassay tests. Some discussion of the ecological effects of increased mortality is given here. I think that it would be appropriate to point out that nonlethal pollution effects may occur and may also have significant ecological consequences. In addition, a list of some of the possible nonlethal effects might be included.

6)Page 24, paragraph 3: "Section 103 also requires evaluation of all three phases of the dredging process..." This probably should be "all three phases of the bioassay..."

7)Page 29, paragraph 1: The first two sentences of this paragraph need rewriting.

8)Page 30-31: Several references are made to "temporal and seasonal restrictions" on dumping. The relevance of timing to disposal problems should be explained to the reader.

9)Page 31, paragraph 3: The simple classification scheme for the elutriate test is discussed. You state that "This classification scheme is no longer used." What replaces it?

Sincerely yours,

Bob Cerrato

Robert M. Cerrato

Dr. Sung Y. Feng
University of Connecticut
Avery Point

Comments:

1.4 p.1-3. This section details the federal statutes under which the decisions of dredging are implemented and summarizes the authorities and roles of federal and state agencies involved in issuing disposal permits. It seems appropriate to include a section here stating the need of dredging ship channels and harbors around the Sound, particularly in Connecticut, the estimated amount of material to be dredged in the next 10 to 20 years, and what management schemes, if any, have been developed to deal with the problem. Since the issue involved is clearly bistate and the potential impacts of dredge material disposal do not stop at the state line, it seems reasonable to create an interstate-interagency organization to coordinate the activities of state and federal regulatory agencies as well as to facilitate the permit application procedures.

In Section 103 the mandatory laboratory tests of section 103 are required for dredging projects of more than 25,000 cubic yards. What is the rationale for establishing this criterion? Should it not be based on the quality (or classification) of the dredge material rather than the volume of the material?

p.3. Last paragraph "CE's New York Division" should be "CE's New York District".

1.4-2 p.5. Second paragraph, line 8 - Insert "or a waiver" after "has granted 401 certification".

1.4-4 p.10. Second paragraph, 1st sentence ".....contaminants found.....are firmly bonded to individual sediment particles." I suggest the following for your consideration:

".....contaminants found in LIS sediments are bound to sediment". "firmly bonded" conveys to the layman the notion that contaminants, once bound to the sediment, are difficult to dissociate. In fact, the binding of contaminants to sediments is complex and depends on a number of physical and chemical properties of the sediments, e.g., the particle size, organic and calcium carbonate content of the sediment. Also, the tendency of contaminants to adhere to or form complexes with organic and inorganic particles is an important consideration.

p.11-12 Bulk chemical analysis vs Elutriate test. I do not see the point in making a judgement of which test is superior. The tests simply provide us with an upper and lower limit estimate of a given contaminant in the sediment, and neither reflects the real state of pollutant uptake by organisms living in and on the sediment.

p. 12 Second paragraph, line 9 "nitrate phosphate (NO_3-N)" should be "nitrate nitrogen".

Last paragraph - this paragraph saying that the elutriate test and EP test neither "address the long-term impact of disposal" nor "predict the effect of disposed sediments on organisms in the environment" seems to contradict the second paragraph on p. 11.

p. 13 Last paragraph, lines 9 and 11, typo errors: "Nucla" should be "Nucula"; "Yolida" should be "Yoldia".

1-4-5 Interpretative Limitations of Bioassessment

While I agree with your assertion that there are limitations in interpreting the impact of disposal activities on organisms with bioassay data, the dredge and disposal projects carried out to date under the Section 103 criteria have caused no disastrous and irreparable damage to the environment. However, this does not mean that the present scheme of bioassay is satisfactory. In fact, there have already been discussions between the CE and EPA on the needs of developing a new field verification test.

We feel that our team experiences in monitoring the physical and biological parameters of the two active LIS disposal sites are extremely relevant to the issues being discussed in this section. I would, therefore, suggest that a Section on monitoring of the disposal site be added to this Review. I believe the public,as well as the governors,have the right to be informed of the latest state-of-the-art technology related to the investigation of dredge material disposal sites. Long term monitoring of two dredge material disposal sites in eastern LIS and central LIS was initiated in March 1977 and April 1980 respectively and is continuing. During this period, we have learned a great deal on the uptake of trace metals and PCBs by the blue mussel, *Mytilus edulis* experimentally introduced into the disposal site. This approach, in essence, can be considered as a field bioassay procedure equivalent to the mortality and bioaccumulation tests of the bioassay procedures outlined in the EPA-CE manual, and more realistic. Mussels from a single population suspended one meter off the bottom from a PVC platform were deployed in or near the disposal and reference sites. The uptakes of trace metals and PCBs (at the New London Disposal Site) were monitored by sampling the mussels from each station on a monthly or bimonthly basis. Analyses of PCBs in tissues were limited to six stations in the New London Site and continued for 15 months. Tissue concentrations of PCBs increased during the disposal operations (700 ng/g), but decreased after their cessation (500 ng/g). Also, temporal change in PCB levels were correlated with the seasonal runoff from the Thames River. Seasonal variations in the tissue concentrations of Cd, Cu, Hg, Ni and Zn were clearly evident. During the winter and spring of 1977-1978, elevated levels of these trace metals coincided with a period of heightened disposal activity, river runoff, and the physiological state of the mussel. Similar peaks were observed during 1979 to 1980 when there was little or no dumping at the site. Such cyclic changes in trace metal concentrations were seen again in 1980-1981. Figure 1 shows the typical seasonal variation of mercury concentrations at the disposal site and reference site. Although the concentrations of mercury at the disposal site are higher than that of the dumpsite, the difference is not statistically significant (Figure 2). However, in general, the cumulative mortality of the mussels was higher at the dump site than at the reference site.

These observations strongly suggest that the elevation of PCBs and certain trace metals during the disposal phase is a transient event due to increased pollutants in the environment and that the seasonal pattern of trace metals in the mussels is a normal phenomenon reflecting the physiological state of the individuals. The results also argue strongly for long-term monitoring in order to properly assess the effect of dredging and dumping on marine and estuarine organisms. Such observations also lead us to ask whether the peak tissue concentration of a given metal represents the limit of metal binding capacity of the organism in question. If so, the laboratory assessment of bioaccumulation potential of the organism could be grossly distorted, depending on when the organism was collected for the assay.

In the interpretation of results derived from field experiments, one must try to segregate, though often with difficulty, the effects of intrinsic factors (normal physiological activities) from that of the extrinsic factors (dredge material disposal) on the uptake of trace metals in mussels. Implicit also in the field experiment is the fact that the data set is correlational and causation cannot be assumed; it is unlike laboratory experimentation where independent variables can be carefully controlled and altered one at a time, and the response of the organism elicited, e.g., uptake of metals, accurately measured. We are able to account for the variance observed in the trace metal data. At the New London dumpsite, in most cases, the variance can be explained by three major factors: the physiological state of the mussel, river runoff and dredge material disposal in descending order of importance. This type of information is not unexpected because the influence of the Thames River on the dumpsite is more pervasive than that of dumping which is episodic. Furthermore, natural perturbations, such as storm-induced resuspension of sediments, according to Bohlen, are several orders of magnitude greater, both temporally and spatially, than those induced by dumping of dredge materials. Our results are thus also reassuring to the public that the environment is not irreparably damaged by dredged material disposal.

S.Y. Feng

Figure 1. Seasonal cycle of mercury observed in mussels (*Mytilus edulis*) deployed at the Eastern Long Island Sound disposal site (D) and Fishers Island Sound and Latimers Light, the reference sites (R).

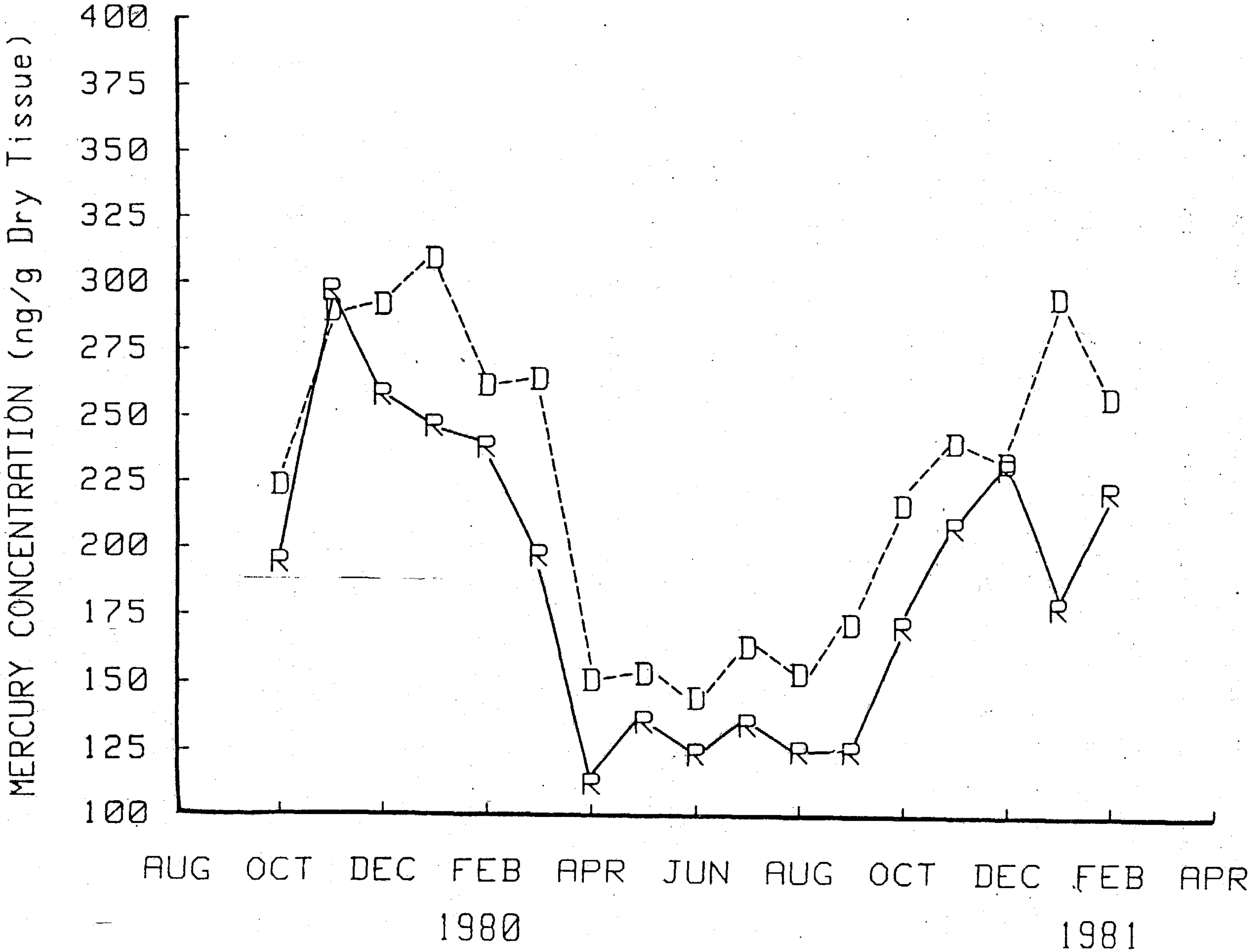
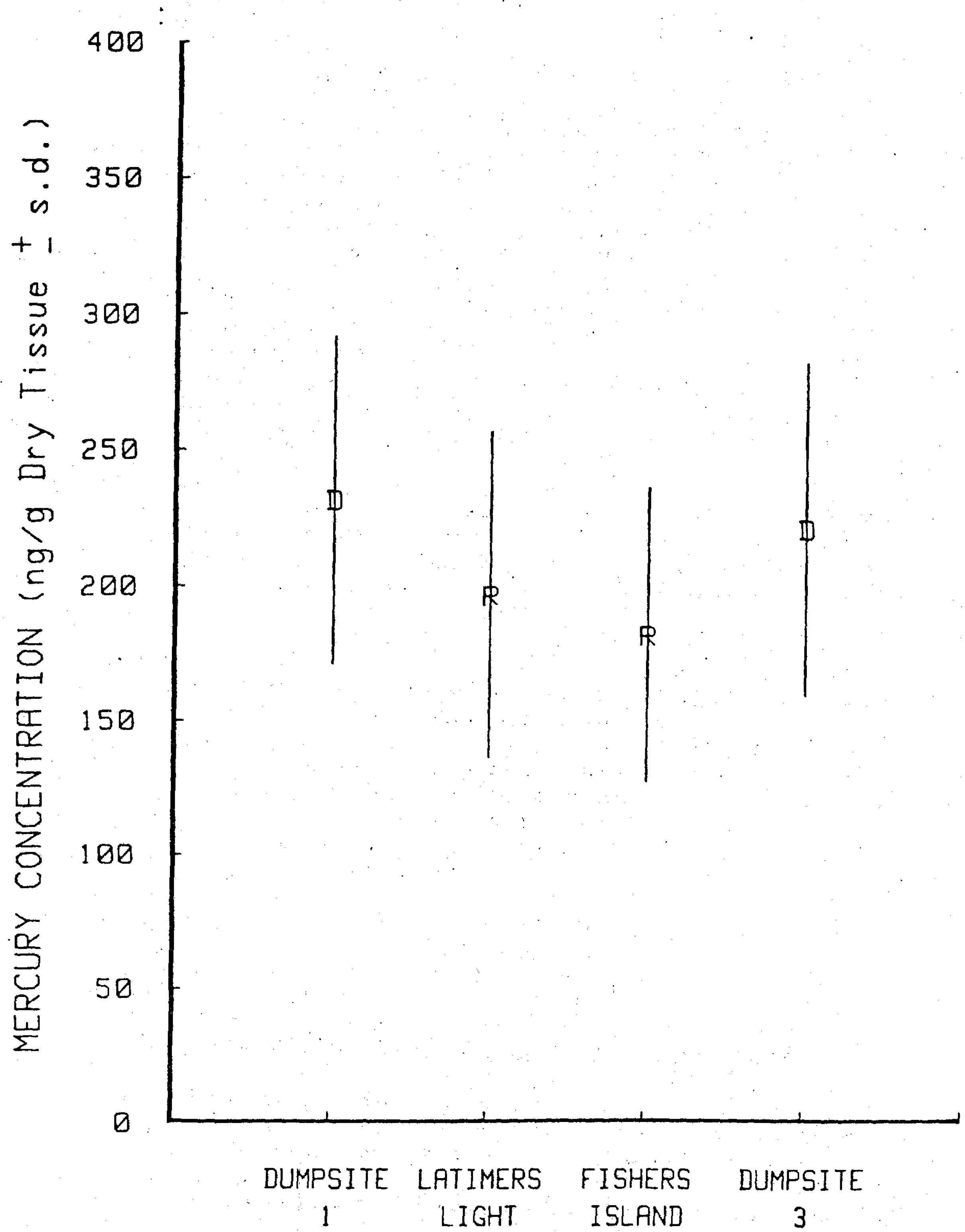


Figure 2. Mean concentrations of mercury found in mussels deployed at Dumpsite 1, Dump 3, Latimers Light and Fishers Island Sound.



July 10, 1982

Dear Tom,

I have read your preliminary draft of the technical selection process for dredged materials. For a first draft I think you have done quite well. I offer the following comments on its organization. The existing document lays out the pertinent laws and organizations which deal with this problem. However, I kept wondering as I read the paper how the sequence of decisions are made. Who contacts who and at what point? How are impasses gotten around? How much of this involves formal communication and how much is "worked out" informally? Could these questions be answered in the form of organizational or decision-making flow diagrams? This could be important for our subsequent discussions as we may decide that 'improved techniques' for the technical selection process are involved with the communication and decision-making process itself.

The decision and selection process appears to include only state and federal entities. No provisions (other than public meetings) are given for having structured input from independent researchers that are out on the sound collecting data on a day-by-day basis.

On a technical level I offer the following points of weaknesses in existing approaches. The several tests applied to the properties (both physical and chemical) of dredge site sediments assume that these properties have some predictive value as to how these sediments, once dredged and dumped, will behave at the dump site. This will depend on the post-depositional dispersion of the spoil on both the short and long term and how this material is physically or biologically mixed with the ambient sediment. These relationships are poorly known. (1)

The bioassessment work is a mess. Its intent is noble---to be able to predict the effects of the dumped material on marine organisms. However, the tests are not run on the most sensative life stages nor are the test organisms often the ones most frequently encountered at the dump site. A review of the commonly used test organisms shows most of them to come from shallow, if not intertidal habitats. Marine metazoans from these habitats are typically physiologically robust and do not reflect the physiological tolerances of deeper water species typically found at deeper dump sites. Also the tests emphasize percentage death upon exposure. One should be more interested in sublethal concentrations and bioamplification within the food chain.

The prediction game is in poor shape largely because of our ignorance of how the system works and how to design more sophisticated and meaningful tests. Test costs are also a big factor here. My own thoughts are that the best one can do with our present state of knowledge is to try to predict but, at the same time.measure effects as they take place in the field. None of the legal acts appear to encompass this management idea. No mention is made of measuring structural or production changes in the benthos. I could elaborate on this alot more at the meeting.

The acts are five to ten years old and could use some updating. Our technical understanding of the problem of dredging and dumping has grown over this time span and these acts should be periodically revised to encorporate these ideas and technologies.

I have no comments about defining the types of potential spoil. I think this is the best one can do at the present time and it is a reasonable approach until we learn more.

I hope this is the kind of first-cut critique you were looking for. In any event these points may seed some discussions when we meet.

Sincerely,

Donald C. Rhoads

STATE OF CONNECTICUT

DEPARTMENT OF ENVIRONMENTAL PROTECTION

COASTAL AREA MANAGEMENT PROGRAM

July 14, 1982

Mr. Thomas Jackson
Oceanic Society
Magee Avenue
Stamford, Connecticut 06902

Dear Mr. Jackson:

As a result of our meeting yesterday, I pass along these comments on your draft site selection process. I have attempted to arrange them in a logical fashion, but given the urgency of the task, I hope you will bear with me if at times the comments appear to be random.

Of primary interest to the fisheries and shellfisheries representatives was that the biological aspects (biota, community, habitat, breeding or nursery grounds, etc.) be examined first and last. In other words not only should these aspects be examined early in disposal site selection, but the biologists and fisheries experts should be consulted again for advice when the process has narrowed to selection of a specific site.

Another comment on the selection process relates to the recommendation for an advisory committee from the scientific community. It was noted that the membership of any technical advisory committee should be flexible enough to include scientists who have not been active with the DAMOS program or previous Corps projects.

If anything, two general comments arose from yesterday's discussion. First, there appears to be a general interest in instituting an ad hoc scientific advisory committee to assist in dredging—related decision-making. Secondly, there is an interest in making decision-making more visible and public. Whether public participation should go beyond comment or hearing on a public notice is worth discussion. The scale of the dredging project may influence the need for, degree of and timing of public involvement.

Before moving on to comments on the text, allow me a quick reiteration of highlights from my notes of the meeting:

- is there an objective mechanism to determine whether or not Class III dredged material from a particular project needs capping? or to determine at which site it should be disposed? or to determine how soon it should be capped?

- should private projects be assigned disposal sites?

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- is there a mechanism to link or order projects (both private and federal) so that capping, when necessary, is facilitated?

All of these comments suggest processes which need to be developed. Admittedly, the first two are further from resolution than the third.

There are two general comments on the text. First, it is important to separate regional disposal site designation from individual project decision-making. As one reads through the document, the differentiation of dredging management into three aspects becomes diffuse. Perhaps a simple reorganization of Sections would clarify your points and emphasize each aspect. Section 1.4-3 may fit better under Section 1.1. Sections 1.4-4 through 1.4-7 generally refer to the second aspect, individual dredging project evaluation. The third aspect, project-specific disposal options, could be introduced with the discussion of the subjective interpretation of the technical data which leads to the choice-of-disposal-alternative decision.

It should be emphasized that despite rigorous testing procedures, the results are open to some degree to subjective analysis at the time the regulator makes the decision on the disposal site for a particular project. This leads to the second comment. There is no discussion of the site selection process for upland or containment facilities. Although openwater disposal is the most abundantly utilized method of disposal, containment is an option under study and DEP's Natural Resources Center has devised a process to identify potential upland disposal opportunities for Connecticut. Opportunities to actually dispose on land are not abundant and, for class III materials, perhaps not practical given the potential for groundwater contamination.

The purpose of developing a procedure to investigate upland disposal was to respond to the federal regulatory need to examine all disposal alternatives before turning to open water disposal. It is different from designating upland disposal sites per se. Cindy Rummel in DEP's Natural Resources Center is most knowledgeable about the process. It is included here as a "detailed improved technique" for site selection.

To provide the regulator and/or the project sponsor with information on the upland disposal alternative a two-step methodology has been proposed. The first step is to identify the areas nearby a particular dredging project with the physical potential for receiving dredged material. This preliminary screening is accomplished with the aid of overlay maps. The overlay maps identify potentially feasible areas by land use. Therefore they exclude residential areas, buildings and structures in manufacturing areas, commercial areas, communication and utility transmission lines, cultural areas (e.g. golf courses, fairgrounds, cemeteries) and water/wet areas. The overlays also include the 20-foot contour line because that is the elevation restriction of a single pump and a potential limiting factor to engineering an upland disposal project. It must be stressed that these overlays are simply a planning tool, an aid to identifying potentially feasible upland disposal areas.

The second step is the site specific evaluation in the context of a particular dredging operation. In this step the regulator and the sponsor could examine the nearby potential sites shown on the overlays and based on criteria such as compatible land use, water quality standards and dredged material quality, determine the feasibility of upland dispoal for the particular dredging project.

Also under discussion is the reinstatement of the Dredging Management Committee and all its functions as described on p. 27 of the Interim Plan. As for other ideas you should include our discussion on Monday of a mechanism to link up projects for disposal, particularly for the purpose of impact mitigation (e.g., capping) for Class III materials.

Finally, I have included specific comments, page by page, on the extra copy of your draft, attached to this letter. As you can see, the comments are merely editing notes or clarifications of state review processes.

You're undertaking an ambitious task, and we wish you success. Please call if you have any questions.

Sincerely,

Tina Suarez-Murias

Tina Suarez-Murias
Environmental Analyst

TSM/mic

Enclosures

cc Arthur Rocque, DEP
Hugo Thomas, DEP
Cindy Rummel, DEP
Carolyn Gimbrone, DEP
Denis Cunningham, DEP
Eric Smith, DEP
Fred Banach, DEP
John Volk, Department of Agriculture

The University of Connecticut

AVERY POINT
GROTON, CONNECTICUT 06340

MARINE SCIENCES INSTITUTE

July 25, 1982

Mr. Thomas C. Jackson
Oceanic Society
Magee Avenue
Stamford, CT 06902

Tom:

My comments, as member of the Scientific Committee on the technical selection processes in dredge management decisions (LIS), are enclosed. You will note much of my review emphasizes the practical operational considerations of disposal site selection, surveillance and monitoring, and negotiations on dredge site procedures. Certainly you must agree that despite a vast effort over the last decade, in bioassay/bioaccumulations analysis, we do not have predictive capabilities for pollutant/organism/sediment ecological effects.

Much of this draft text addresses past laboratory results and classification schemes that are not conclusive means to gauge impacts. A more intensive field verification program and attention to design of in-situ experiments seems justified. Therefore my comments reflect measures identified from the DAMOS program that have proven to be affective site selection strategies and methods to minimize environmental impact.

Included also are copies Chapter 9 and 10 from Impact of Marine Pollution on Society, Tippie and Kester, 1982. The context of these chapters deals directly with your proposal tasks 1 and 2. I am sure you are familiar with the content of Chapter 11.

I will look forward to receiving the compiled critiques and will provide my responses before your 22 July working meeting.

Sincerely,

Lance L. Stewart

Lance L. Stewart
Sea Grant Program

LLS/cnf
Enc.

Dr. Lance Stewart
University of Connecticut
Marine Sciences Institute
Sea Grant Advisory
Groton, Connecticut

Preliminary Draft: comments (14 July 82)

Pg. 4 2nd Paragraph: "minimize the interference of disposal activities with other activities".... Considering the disqualification of WLIS II site selection, after a long deliberation process and special compromise meetings (fishermen, NOAA, DEP, Connecticut M.A.S.), because of a "cable interference zone", possibly priority weighting should shift definitely to fisheries resources and public health safety, as stated, but not practiced as in the case of WLIS II decisions.

Pg. 4: "specific factors".....

All those listed (#1-11) in the text give no indication of relative rank. Also the entire emphasis of the following text deals with only #4 and #9.

Before comment on the remainder of the text, I strongly feel definition needs to be added to each:

#1 "Geographic position,....bottom topography"....

Since it is inferred, yet not specifically stated "unique benthic habitat" should be clearly identified as prime biotypes to protect (i.e. bedrock outcrop, glacial till reefs, exposed clay banks, irregular rough cobble-boulder terraine) in the sense all these regions tend to concentrate important economics species and serve critical roles in feeding, shelter and reproductive life functions. More exact terminology for the lay audience would directly state "containment sites" as verified by oceanographic parameters (tidal currents, wave forces, depth, #6) are characteristically deeper basin regions, with soft homogenous fine grained sediments of uniform flat featureless topography. Of concern would be avoidance of habitat smothering, and preference at sacrificing the most common flat-soft mud silt clay bottom.

Also, of note here is the misconception that the deeper, the further offshore, the more oceanic the location, the less liklihood of significant fisheries/ecological impact. It may be that mere sediment load additions in further offshore pristine water sites, where sediment resuspension is rare and negligible, may severely effect the resident fauna and disrupt normal benthic conditions to a far greater degree than at selected inshore sites (LIS) where storm disturbance and/or river discharge sediment loads are high (mg/l) and frequent. Coastal organisms sensitivities and assimilative capacities may be far greater in the shallow ($<$100 m) zone, than those in deep-water quiesent,yet "well qualified" containment sites.

#2) From observational records throughout the 5 year period of DAMOS monitoring (in-situ visual assessment), a major consideration should be behavioral modifications of megabenthic organisms due to disposal pile location and sediment type. Of main concern are schooling and migration orientation effects on benthic fish (scup, winter flounder, fluke, hake, dog fish), mollusks (conch, squid), and crustacea (lobster, cancer and hermit crabs). Recognizing the thigmotactic responses, as "artifical reef attractants" with the full scope of potential concerns: bioaccumulation caused by species concentrations; "chum grazing" feeding habits; extreme bioturbation at periodic and unpredictable locations.

#4) (for later comment)

#5) "Feasibility of surveillance and monitoring"....

During the era of the grand experiment, in detection of dredge disposal impacts, the consequences and magnitude of suspected effects were not known, and it was scientifically essential for sites to be within multidisciplinary investigation range. Presently, although somewhat tempered, many unanswered contaminant/fisheries/sediment dynamics processes remain to be described more precisely. Also, present disposal site designation relies on "search and selection" procedures. Detailed bathymetric and side scan sonar charts are obtained for a candidate region. In addition, SCUBA reconnaissance or remote camera systems provide transect photographic evidence of benthic/faunal baseline conditions. Together with the oceanographic parameters, these surveys provide a basis for pre-site area survey, specific target site selection, and repeated-periodic monitoring of disposal phases as they procede spatially and temporarily within a designated region (DAMOS). The long term monitoring capability provides a chronological record of: recolonization sequences, "naturalization" process on spoil surfaces, frontal boundary stability, and compaction events.

#6) to be combined with #1.

#7) An often suggested approach by DAMOS investigators has been to address present conditions at historical disposal site mounds, for purposes of long-term end point estimates of benthic conditions.

The consolidation of (22) Connecticut LIS disposal sites (previous to 1972), into the (4) existing to date, implies a strategy to limit and regionalize disposal operations. The management procedure also allows an invesigation focus to a relatively small 1 mile square area of the sea bed, at four points within LIS waters. Within these specific sites, once active receiving locations exist as historical (10 year+) spoil mounds (with the exception of WLIS III). New disposal target points have been designated not to coincide with historic mounds so that: additional topographic relief will not occur at the location, and newly designed monitoring techniques will not be influenced by relict spoil proximity.

#8) "Interference....fishing....shellfish culture"...

A major interagency negotiation, representing direct attention to the fishing sector, involved timing of dredge and disposal activities to minimize possibility of interference with New Haven harbor oyster larval and spat fall production. During the summer (June-September) period dredging was prohibited to prevent sediment water-column interference with oyster larval development and drift and also prevent increased siltation that could result in inhibition of spat set and cause suffocation mortality.

#9) (to review later with #4).

#10) "Development or recruitment of nuisance species at the site"....

A newly posed issue involved spread of endemic disease (i.e. shellfish *Vibrio* (sp.) strains). Microbial and parasites infestations have not been addressed. One major consequence resulting from DAMOS monitoring, was the apparent mass transport of live estuarine species, (oyster, quohogs, soft clam, scallop, ribbed mussel, polycheat (sps.)) to the deeper water disposal site. Several dive observations indicated repositioning and survival within spoil sectors; quohog, oyster etc. represent food source species to be regulated by Public Health Services depuration standards (2 weeks > 50°F) until harvest is permissible; but also may represent significant population relay or introduction potential of previously absent species due to the disposal operations. Another biological event, mass set (100 m square areas) and growth of blue mussel, Mytilus edulus, on phase III New London spoil indicated large scale, single species predominance in the recolonization process.

#11) "historical importance"...

One overlooked aspect of LIS history is marine archeology. Relatively little academic/research attention, to my knowledge, has sought to identify, partially explore, and/or begin to preserve potential nautical shipwrecks - a far out consideration however....

Pg. 5. In contrast to criteria and procedures for designation of disposal sites, is the consideration of estuarine ecological changes that are produced at the dredging site. Often these may be many times more significant (subjective) than at the disposal site, for the coastal topography (channel depth, hydrographic patterns, salinity profiles, flux rates, etc.) are more greatly pronounced in the shallow, confined estuarine basins.

A contradictory case in point, is dredge/disposal strategy for the State of Maine (vs. New Haven Harbor oyster priority). Most harbor/ estuaries were considered to have most fisheries vulnerability during winter, when lobsters migrated inshore to overwinter within the clay burrows of harbor channel banks and scallops were abundant and harvested from river channels. This point emphasizes again, the significance of merely seasonal physical location of commercially important species and not the apparently unresolvable question of pollutant toxicity and pathways relative to sediment classification and testing schemes.

Pg. 6 2nd Parag. Clearly 404 regulations site fishery resources and the public health/safety implication of quality seafood as prime issues. We must approach the questions directly, choose and experiment with food species known to exist at dredge and disposal sites.

Pg. 7 1st Parag. In the interest of closing the gap in lag time between what appears to be a normal agency reviewer knowledge of dredge environmental consequences, a timely technical seminar convening management officials, review teams, and research/monitoring expertise seems prudent.

Pg. 8 A (FONSI) -

Pg. 9. At this point a flow diagram or matric would be extremely useful (if possible) to illustrate the relative project scale (small private → 25K cu yd → major maintenance), the overlay of regulation (103, 404, 401) jurisdiction, and the water boundaries (baseline, U.S.) these apply to. In reference to the 25K volume criteria: what were the qualifying conditions

a) of what sediment contaminant condition
b) at what site destined for disposal
c) by which dredge method and barge transport (clam shell, hydraulic, hopper, skow)

Pg. 10
2nd Paragraph

The nature of bonding to sediment particles varies greatly. First sentence is a sweeping overstated generalization. A clarification of the second sentence-disposal techniques, sediment characteristics and disposal management practices would appear necessary.

The relation of dredge spoil contaminant load/volume should be verified as it contrasts to the composed waste substances, since most public opinion would reason much of the material you site as higher contaminant loads. Would ultimately come to rest within harbor bottoms.

Pg. 11
1st Paragraph

An unintentional reversal in logic from the previous paragraph? In particular, last two sentence contradictions.

Pg. 11
Last Paragraph

The issue should be clearly stated. This availability might change (increase in range and pollutent component concentrations) if subjected to a different chemical environment (i.e. acid rain, atmospheric oxygenation environment, different submarine salinity regimes, below or above benthic Eh levels, and/or sediment/water PH values).

Pg. 13
1st Paragraph

Bioassessment/ "specific periods of time"....
Give some frame of reference (90 hr - 7 day - 2 mo?)

2nd Paragraph

also subjecting "appropriate sensitive marine organisms"... is not defined under what T° sea water (season) are tests required?

2nd Paragraph

species utilized ...
Recommendations to require an apex predator, or juvenile fish species added to the list - this trend is shaping for future "select species" testing.

Pg 13 Last Paragraph	Species selection should be based on known faunal dominants at the dredge site or more importantly at the disposal site. Each site specific location differs as to faunal assemblage composition. Ecological sensitivity further varies through seasons of the year as water temperatures influences behavioral, physiological or geo-chemical availability to unnatural elements.
Pg. 15 Table A	To be explicit, some explanation is deserving of whether the results represent composite samples, upper strate, or specific individual site samples. For over the entire area to be excavated, the nature of test sediments varies greatly in concentration and pollutant scope, the seaward to upper harbor extremes should be submitted. This one classification index for harbors in Connecticut is disputable. The key "caution level" elevation points (Cr, Pb, Hg, PCB) should be distinguished from phosphate, nitrate levels, for public education of dangerous indicators.
Pg. 21 Table D	A statement of "analytic standards" should enter the text in reference to this table. Inter-laboratory calibration requirements, technician reliability, and similar instrumentation/ result units should be cited as mandatory measures to make data significant and comparable between sites and consultant laboratories.
Pg. 22 1st Paragraph	S pecific organs or tissue types effected (i.e. gonads vs gill), histological deterioration, caustic tissue damage visible by anatomical lesions, fin rot.

Pg. 22
2nd Paragraph

Trend toward selected species placement (platform or cages) to monitor long-term expsoure effects and field verification is essential.

Pg. 24
1st Paragraph

It would seem rational to proceed with the next scientific test series: feed quantified "dosed" prey to confined apex predator(s) to determine accumulation tendencies.

Also the fact that dredge/disposal processes represent "pulsed availability" of compounds raises the condition of spiked short-term uptake, followed by natural depuration either due to environmental return to background or natural phsiological balancing.

Pg. 25
1st Paragraph

site management considerations....

. point target
. cap sequences
. timing
. visual inspection
. bathymetric charts.

Pg. 28
3rd Paragraph

Class I, II, III....

Relative to the major sediment types dredged from Connecticut harbors: To add to descriptive term "plasticity" the phase, "cohesiveness" of substrate might be included. This would imply the high silt-clay fraction of the material, tends to remain in large "cohesive clumps" if dredged by the clam shell method.

Concluding Comments:

a) Assumption of homogeneity - what are real values of Class I-III sediment in terms of exposure area, interstitial leaching volume; and dilution-dispersion.

b) weigh existing environmental conditions (pre-dredge) of harbor sediments:

   a) in shallow estuarine region

   b) prone to storm disturbance, prop wash and coastal transport/mixing of contaminants to food species (shellfish), and greatest access to man, overall prudent ecological strategy - transport to deeper water, containment site, long-term monitoring.

A complete set of field evaluation-site selection procedures seem to be omitted:

1. extensive bathymetric charting, side range sonar transects of the entire prospective areas to characterize the bottom terraine via shipboard instrumentation.
2. As collaborative survey methods, either SCUBA baseline description dives and/or remote system photography are conducted across horizontal transect to further confirm or negate areas of prime species concentration, optimum benthic topographic habitats, and low species diversity-flat containment type regions.
3. An exact site location is determined with consideration of the expected dredge volume discharge and consequent radius of impact. Based on the physical oceanographic and visual assessment standards, a tight tether buoy location is implaced to mark the disposal point.

An important operational point re: disposal site management would relate to the sediment mechanics of gradual compaction and consolidation from the immediate post disposal to 6 month term.

. An off-limits "notice to mariners" (commercial fishermen) should forewarn potential trawlers or dredgers from opezating within certain radius limits. This practice would advise fisheries operators on the probability of gear fouling and/or loss and also minimize any possibility of added spoil resuspension due to mobil gear passage over or about the perimeter of the pile. The situation of Class III placements followed by capping procedures would merit critical attention, to prevent the remote possibility that reexpsoure of buried contaminant fields might occur during the short-time period when the Class III was not capped and before the final cap had stabilized. A fishing closure zone is not however recommended in that no health hazard has been shown to exist under these conditions and static gear would have no substrate interface effect.

In addition, apparent problems of "cleanliness" in the dredge/disposal management process involve operational transport and inspection systems:

a) water tight barge requirements should be insisted in the contract let to bid.

b) a black box (Loran C "flight" records) system would log all disposal routes and traffic to and from the designated sites; and would aid in circumstances of temporary buoy loss, instrument failure or severe weather.

APPENDIX B

SCIENTIFIC COMMITTEE MEETING

THURSDAY, JULY 22, 1982

Scientific Committee Meeting

July 22, 1982

Attendees

Christopher Roosevelt	Oceanic Society	(203) 327-9786
Thomas C. Jackson	Oceanic Society	(203) 327-9786
Edward Reiner	US EPA Region 1	223-5061
Jim Bajek	Corps of Engineers New England Division	(617) 894-2400 x 213
Michael Goetz	New England Governor's Conference	(617) 720-4605
Henry Bokuniewicz	Marine Sciences Research Center, SUNY	(516) 246-8306
Jerry Schubel	Marine Sciences Research Center, SUNY	(516) 246-6543
Donald C. Rhoads	Yale University	(203) 436-3129 (203) 436-8080
Steven Colman	New England Governor's Conference	(617) 720-4605
Ken Koetzner	NYS DEC	(516) 751-7900
Jim Morton	NYS DOS - Coastal Management	(518) 474-1847
Tina Suarez-Murias	CT DEP	(203) 566-7404
Denis Cunningham	CT DEP	(203) 566-7220
R. M. Summers	Marine Sciences Research Center	(516) 246-6730
Katherine Minsch	Marine Sciences Research Center	(516) 246-8306
Meg Goodwin	Oceanic Society	(203) 327-9786
Robert M. Cerrato	Marine Sciences Research Center, SUNY	(516) 246-7160

A G E N D A

Scientific Committee Meeting

July 22, 1982

9:00 a.m. Registration

9:15 a.m. Welcome, Review of Purpose and Agenda

9:30 a.m. <u>First Discussion Topic</u>

* Review of Current Technical Selection Process Definition
* Review of General and Specific Critique of the Technical Selection Process
* Review of Tentative Discussion Questions
  - Classification Systems
  - Selection of Sites for Designation
  - Selection Among Designated Sites
  - Bioassessment Tests & Interpretation

10:45 a.m. <u>Break</u>

11:00 a.m. <u>Second Discussion Topic</u>

* Review of Mitigation Methods and Management Mechanisms
  - Mitigation Methods
  - Management Mechanisms
  - Monitoring Program

Noon Lunch

12:45 <u>Third Discussion Topic</u>

* Specific Scientific and Technical Proposals
  - Management Improvements
  - Areas for Further Research; Field Verification of Tests

2:00 p.m. Break

2.15 p.m. <u>Fourth Discussion Session</u>

* Discussion of General Recommendations Developed During Discussion
* Discussion of Priorities Among Recommendations

3:45 p.m. Break

4:00 p.m. <u>Comments on Draft Comprehensive Review Document</u>

5:00 p.m. Adjournment

A draft summary of today's meeting will be circulated to the Committee and Agency representatives by Wednesday, July 28, 1982

TENTATIVE DISCUSSION QUESTIONS
Scientific Committee Meeting

July 22, 1982

Classification Systems

1. The Interim Plan (IP) establishes a system for classifying sediments to be dredged based on straightforward and inexpensive chemical tests and analysis of physical properties. The plan also states: "As a general policy, Class III materials will not be dumped at regional disposal sites unless it is capped with suitable Class I or II material." The plan qualifies this policy by noting open water disposal of these materials may be permitted under certain circumstances. yet some officials believe the Interim Plan prohibits any disposal of Class III material without capping in the Sound. How should this confusion be addressed?
2. Should specific situations where Class III materials can be disposed of without capping be stated in a long term dredge management plan?
3. Is the IP classification system adequate? Should it be expanded to differentiate between Class III materials which need only to be capped and those which, as in the case of Norwalk Harbor, require even more stringent safeguards?
4. Are there circumstances where Class III material should not be dredged from LIS Harbor?
5. Should Class III materials be considered acceptable for upland disposal? If so, under what conditions?
6. Does the IP system adequately reflect the actual character of sediments in a project area?

Selection Among Designated Sites

7. Selection of an open water disposal site for a specific project is currently based on geographical proximity combined with a policy of placing only clean materials at the Cornfield Shoals site. Is this appropriate?

8. Should both private and CE projects be assigned specific disposal sites? If so, on what basis?
9. Should the CE refrain from issuing a permit for a project involving Class III sediments if clean capping material is not readily available? What would be the basis for this decision?
10. Is a regional planning and coordination effort needed to develop long and mid range plans for large government projects with the goal of scheduling projects involving Class III materials so that clean capping materials would be readily available. Should this be expanded to cover private work? Is this practical or enforceable?
11. Should Class III materials be capped (either on the bottom or in subaqueous borrow pits) as a matter of public policy?
12. If, as a matter of policy, Class III materials are to be capped, is there a purpose to conducting bioassessment tests?
13. One panelist suggests bioassessment work is not performed "on the most sensitive life stages nor are the test organisms often the ones most frequently encountered at the dump site." What implications does this have for past and future tests?
14. Is there a way to guage sublethal concentrations and bioamplification within the food chain for contaminants in dredged sediments?
15. Even in New England's most polluted harbors, sediments rarely fail the EPA's statistical standards for interpreting bioassessment tests. What does this suggest regarding the EPA's interpretative guidelines? Are these "failsafe" and therefore meaningless tests or do managers receive valuable information from the lab?
16. Can data from bioassessment in harbors be "piggybacked" and used to evaluate the potential impact of nearby dredging projects?

Mitigation Methods

1. Capping, either on the Sound's bottom or in subaqueous burrow pits, has become the most stringent mitigation method employed in dredge management. Is this adequate treatment of all Class III spoils?

2. When should subaqueous burrow pits be used? Does use of these pits provide any extra measure of protection to the marine environment?

3. In his comments, Lance Stewart writes: "The situation of Class III placements followed by capping procedures would merit critical attention, to prevent the remote possibility that reexposure of buried contaminant fields might occur during the short time period when the Class III was not capped and before the final cap has stabilized" (page 11). How long should Class III materials be left before a cap is in place?

4. Can it now be concluded that "capping" is a successful mitigation measure and if so with what kind of specified materials as the cap?

5. Are additional studies of the capping process needed? If so, what aspects merit attention?

Management Mechanisms

6. Should the current management system (designation of sites, processing of permits, monitoring and research) be simplified or modified?

7. Is it possible to simplify the permit process by, as a matter of policy based on a generic review of disposal alternatives, declaring certain options are not practical and therefore need not be considered?

8. Is there a need to further clarify the interrelationship and jurisdictional boundaries of government agencies in the dredge management process around LIS?

9. In his comments, Frank Bohlen emphasized his belief that political and not scientific concerns are the driving force behind dredging decisions. He urged addition of language to the Comprehensive Review Document reflecting this concern and avoiding a report which could mislead people into believing dredging decisions are primarily based on scientific considerations. To the extent to which this concern is valid, what can be done to make clear competing scientific and political concerns?

And what can be done to reduce the impact of political considerations on what should be a scientific, technical and economic decision-making process?

10. Is there a way to reintroduce scientific or biological impact concerns in the final stage of a management review to insure these issues have been addressed?

11. Should additional scientific tests be included in management analysis? Or should a series of tests be outlined with specific findings at each stage of the process triggering additional tests when needed to evaluate potential environmental impact?

12. Does the management system protect the Sound's ecology?

13. Frank Bohlen sees a need for improved public participation in the dredge management system. What objectives should this effort entail?

Scientific/Technical Proposals

1. The demise of NERBC's Dredging Management Committee appears to have left a void in regional planning and coordination of this activity. Should some form of interagency panel be formed to fulfill this role? If so, how?

2. Regulatory programs often lag behind advances in scientific understanding of dredging impacts. Is there a need to form a Soundwide Scientific Advisory Committee to translate research findings into information which can be used by managers and understood by concerned citizens?

3. Should this Committee also play a review role in evaluating and offering comments on government research in the Sound related to dredging?

4. What disciplines should be represented on this Committee?

5. Should dumpsite management methodology be improved? If so, how and why?

6. Should transportation methodology be improved? Specifically, through use of watertight barges? Should black box "flight recorders" be included to document travel time and dumping location?

7. What areas of scientific research are needed to better manage dredging in the LIS region?

8. Is a regional plan for dredging which schedules major projects needed? If so, how should this plan be developed and modified? Should this plan include provision for capping all Class III materials?

9. Are the environmental effects of "deep ocean" disposal less significant thatn those of near-shore disposal? Should "deep ocean" disposal be considered at all, why and for what projects?