DREDGING ON LONG ISLAND

Prepared by
The Center for the
Environment and Man, Inc.
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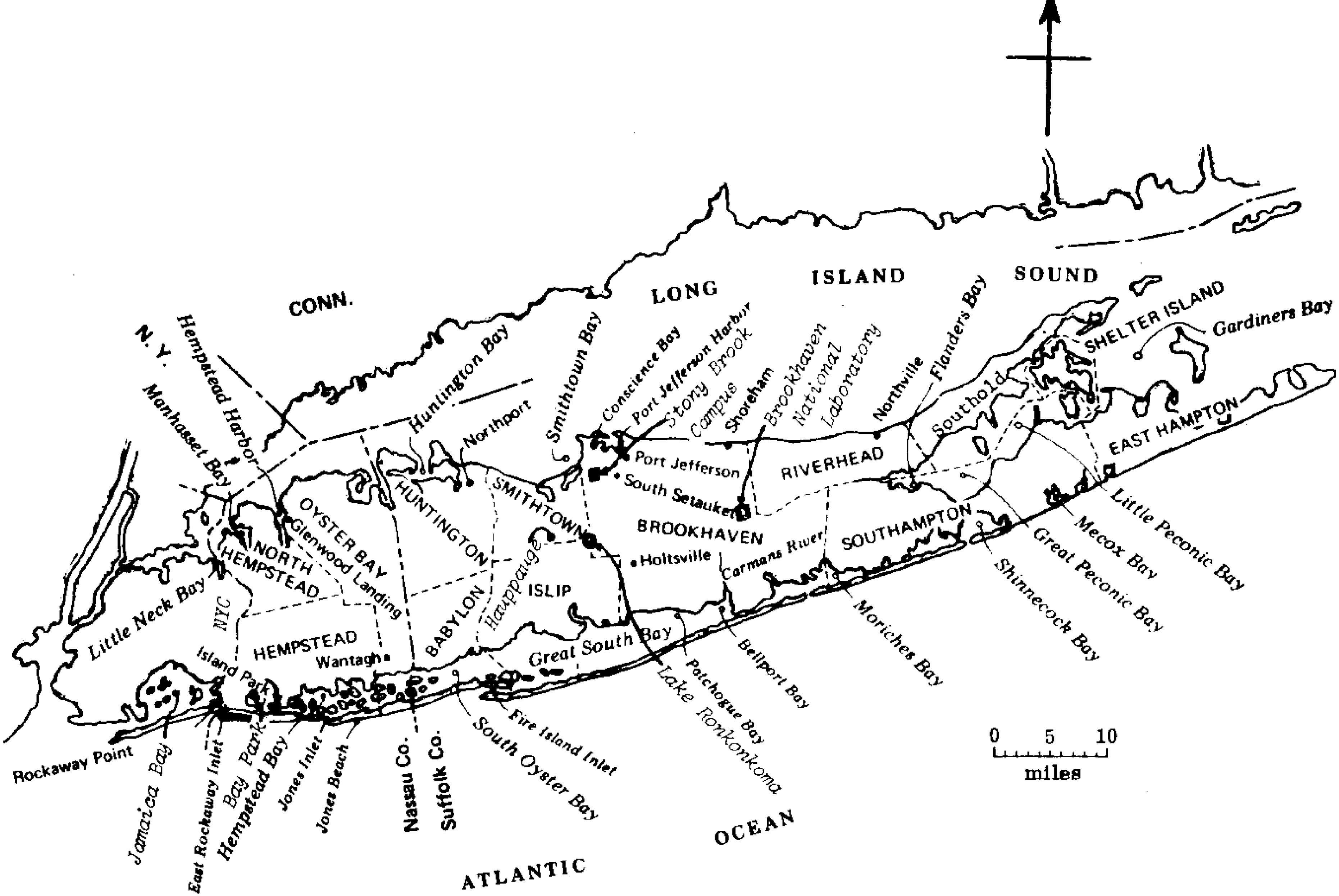
February 1972

R. M. Dowd

Regional Marine Resources Council

A COMMITTEE OF THE NASSAU-SUFFOLK REGIONAL PLANNING BOARD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Brookhaven National Laboratory
Northville
Flanders Bay
Southold
SHELTER ISLAND
Gardiners Bay
EAST HAMPTON
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RIVERHEAD
OYSTER BAY
Glenwood Landing
HUNTINGTON
SMITHTOWN
BROOKHAVEN
Holtsville
Carmans River
SOUTHAMPTON
NORTH HEMPSTEAD
Hauppauge
ISLIP
Little Neck Bay
NYC
HEMPSTEAD
BABYLON
Wantagh
Great South Bay
Island Park
Little Peconic Bay
Mecox Bay
Great Peconic Bay
Shinnecock Bay
Moriches Bay
Bellport Bay
Patchogue Bay
Lake Ronkonkoma
Fire Island Inlet
South Oyster Bay
Suffolk Co.
Nassau Co.
Jones Beach
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Hempstead Bay
Bay Park
East Rockaway Inlet
Jamaica Bay
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Principal Investigator

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FOREWORD

This report is part of a series prepared by The Center for the Environment and Man, Inc., for the Regional Marine Resources Council of the Nassau-Suffolk Regional Planning Board under the continuing program: The Development of Methodologies for Planning for the Optimum Use of the Marine Resources of the Coastal Zone. The program is being funded in part by the Sea Grant Program of the National Oceanic and Atmospheric Administration, U.S. Department of Commerce, and is structured into six functional steps:

Functional Step One (Problems). Identifies, classifies and briefly analyzes the problems that confront planners and decision makers with regard to the area's marine resources.

Functional Step Two (Knowledge Requirements). Categorizes the data and knowledge necessary for making sound decisions with regard to the use of the marine resources.

Functional Step Three (State of the Art). Assesses the availability and adequacy of the necessary data and knowledge.

Functional Step Four (Knowledge Gaps). Determines necessary data collection and research activity.

Functional Step Five (Data Collection and Research Program). Formulates a priority-oriented, marine-related data collection and research program and monitors its implementation.

Functional Step Six (Management Information System). Develops a system for organizing the data and knowledge and provides analyzed information to marine resource planners.

Functional Steps One and Two were completed in previous reports of this series [1a, 1b and 1c][1/].

The current report on dredging is one of seven which together constitute Functional Step Three. Two of these seven reports were completed previously for coastal water quality standards [1d] and for estuarine models [1e]. Four reports addressing selected priority problems are currently being prepared simultaneously for integrated

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1/ Citations in brackets are listed in Appendix A.

water supply and waste disposal [1g], coastal stabilization and protection [1h], dredging [1i], and wetlands [1j].

The current report and all previous reports will contribute to future reports in this series on the state of the art [1k] (Functional Step Three), a proposed research program [1ℓ] (Functional Steps Four and Five), guidelines for planning and policy formulation [1m], and a marine management information system [1n] (Functional Step Six).

In the preparation of this report, we are indebted to many individuals within and outside government. The staff of the New York District, U.S. Army Corps of Engineers, freely furnished information, comment, and access to permits. In addition, information provided by the Suffolk County Department of Public Works, the Nassau-Suffolk Regional Planning Board, university staffs, files from the Long Island Press and various private individuals on Long Island were very important in providing background for this study.

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SECTION 1 - INTRODUCTION

1.1 PROBLEM DESCRIPTION

The problem considered in this report is how to satisfy essential dredging requirements of Nassau and Suffolk Counties and do this in a socially acceptable, environmentally safe way that will not destroy existing marine resources in the area.

This analysis is an overview. The problem is introduced and analyzed in light of the social framework in which a dredging project takes place. The environmental impact of dredging is seen in terms of social motivation and affected social activities as well as its impact upon living and non-living resources.

It is suggested here that decisions made about dredging must include these social factors when evaluating and judging the benefits and costs. Issues of policy and decision frameworks are offered, rather than a series of suggestions about each individual decision. As a result, this analysis focuses upon the major types of effects and tries to avoid the smaller details.

Dredging has become a problem on Long Island because of two competing facts. First, Long Island is adjacent to the country's largest concentration of people. This generates large and growing pressures for the use of natural resources in many differing ways—housing, beach use, and recreational boating. Second, the Long Island marine environment is a highly productive, important natural resource which has been increasingly changed, enhanced, and destroyed. These two facets in one area bring about conflicting pressures for preservation and use. This conflict is visible in dredging activities.

1.2 POTENTIAL USERS OF THIS REPORT

This report is prepared primarily for the use of the Regional Marine Resources Council and its parent body, the Nassau-Suffolk Regional Planning Board. As such, it is an overview and seeks to provide a perspective useful for formulating broad public policy. In developing this overview, considerable information is provided that should be useful to other bodies such as the departments of public works of each county and the U.S. Army Corps of Engineers. The report is developed in such a way as to maximize its contribution to later reports in this series. Although the data and some of the effects are specific to the study area, the methodology used and some of the conclusions reached should be applicable to dredging operations elsewhere.

1.3 CHARACTERISTICS OF THE DECISIONS REQUIRED

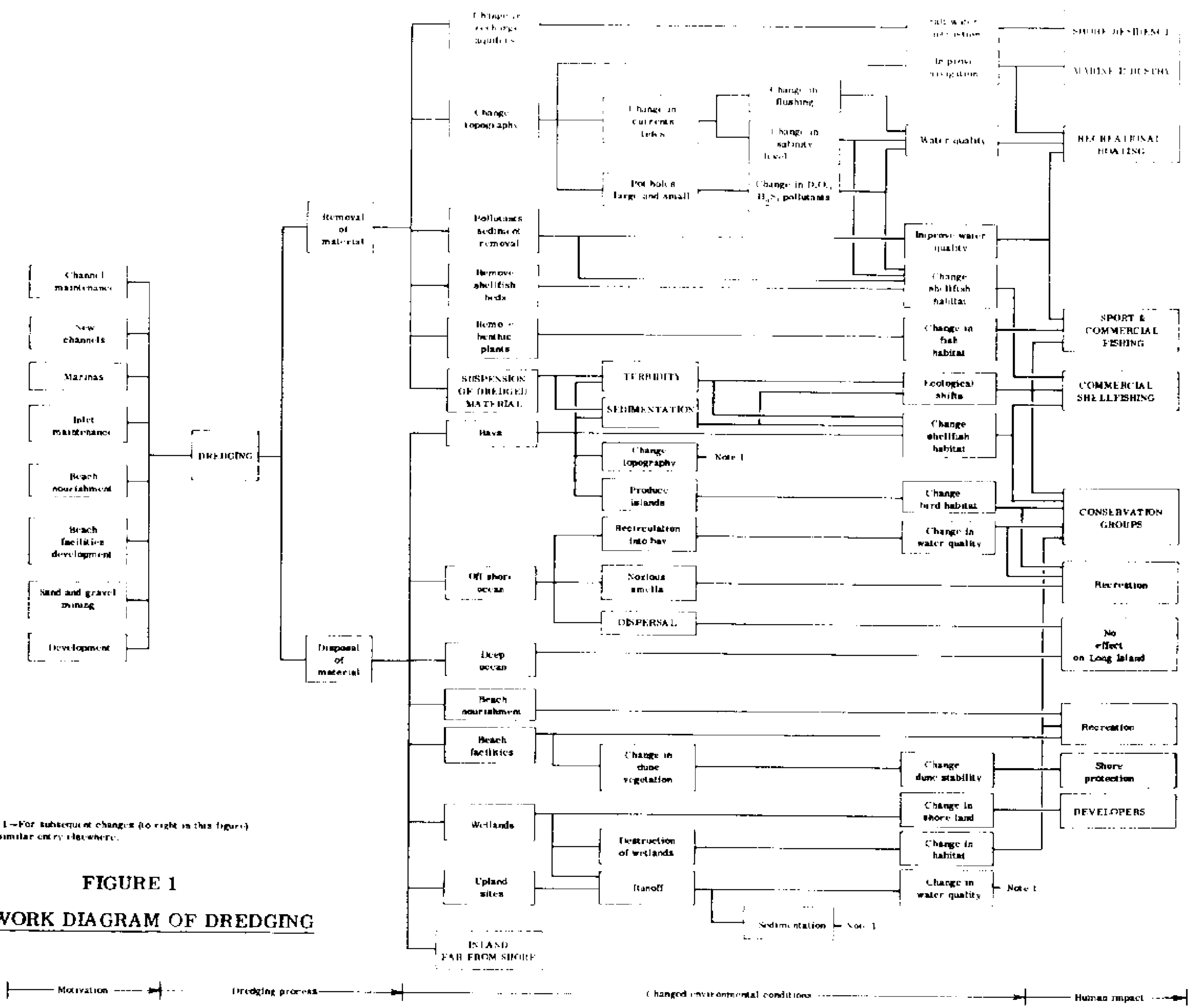
The basic decision is whether or not dredging ought to take place and under what conditions. The Corps has the ultimate responsibility to decide, but various other organizations have roles. Decisions are too often made on the basis of a very narrow conception of the impact of dredging. However, as this analysis attempts to show, dredging takes place in a social framework that significantly alters both the benefits and the costs of a project. Thus, the decisions made should take into account the demand for resources, economic value, impact on ecological systems, the effect on human activities and long-term plans for development of the area.

1.4 APPROACH TO THE PROBLEM

In Section 2, the problems involved in dredging will be analyzed in five sequential steps:

- Motivation - consideration of the variety of motives that lead to dredging;
- Process - examination of the technical process itself;
- Changes - ascertaining the changed environmental conditions which result from the dredging process;
- Impact - evaluation of the impact of those changed conditions on human activities and values; and
- Management - examination of the system presently employed in making dredging decisions and the implications of this system.

Figure 1 depicts some of the interrelationships involved in the first four steps. In Section 3, important data collection and research needs will be listed. In Section 4, broad guidelines to improve decision making will be presented.



Note 1—For subsequent changes (to right in this figure) see similar entry elsewhere.

FIGURE 1

NETWORK DIAGRAM OF DREDGING

SECTION 2 - ANALYSIS

2.1 DREDGING MOTIVATION

In any attempt to understand dredging as an activity that affects marine resources, it is important to understand the reasons why the dredging is proposed. This understanding will help to relate the benefits to be gained from the project to the less harmful side effects of the action.

We can divide the types of reasons into two broad classes—projects which have as a goal changing the shape of the bottom and projects which have as a goal obtaining material for use elsewhere. These classes may be further subdivided as follows.

- Changing the shape of the bottom
    1. Channel maintenance
    2. New channel dredging
    3. Construction of marinas and related facilities
    4. Sediment/pollutant removal
    5. Inlet maintenance
- Obtaining material for use elsewhere
    6. Beach nourishment
    7. Beach recreational facility construction
    8. Sand and gravel production
    9. Development of shore property

The approximate motivations and their relative importance can be gathered from applications made to the Corps of Engineers for permits to dredge. We have analyzed applications for Nassau-Suffolk Counties for the 38-month period, January 1, 1969, to March 1, 1971. This does not reflect the requests which were approved but only the applications made. Table 1 summarizes the applications in terms of the estimated volume of material to be dredged and to be placed in the proposed spoil areas. Since inlet maintenance is generally performed by the Corps as part of shore protection projects, it is not represented in the table. Table 5 in Section 2.4.2.1 presents the relative importance of different project sizes.

Major dredging applications are well scattered along the bays and inlets of the bi-county area (Figure 2).

2.1.1 Boating-Related Dredging

A very important motivation for dredging is associated with boating activities. In 1965 there were 175,000 boats on Long Island and the boating recreation industry

TABLE 1

DREDGING APPLICATIONS

Projects Greater than 9,999 Cubic Yards
Nassau-Suffolk January 1, 1968 - March 1, 1971

Dredging Motivation	Volume of Material		Spoil Disposal 1000's of Cubic Yards	
	1000's of Cubic Yards	% of Total		
Channel Maintenance	950	5.9	Upland	775
			Beach Nourishment	175
New Channels	930	5.8	Upland	690
			Beach Nourishment	205
			Other	35
Marinas	1,000	6.2	Upland	560
			Beach Nourishment	195
			Other	245
Sediment/Pollutant Removal	3,500	21.6	Upland	500
			Offshore	3,000
Beach Nourishment	700	4.3	Beach Nourishment	700
Beach Facility Development	2,965	18.3	Beach Facility	2,965
Sand and Gravel	5,000	30.9	Inland	5,000
Development			Upland	*
Miscellaneous	1,138	7.0	Upland	30
			Other	1,108
TOTALS	16,183	100.0	Inland (Sand & Gravel)	5,000
			Offshore	3,000
			Beach Facility	2,965
			Upland	2,555
			Beach Nourishment	1,275
			Other	1,388

*Up to 2,500, shown as "upland" in other entries in this table. See Section 2.1.7 of text.

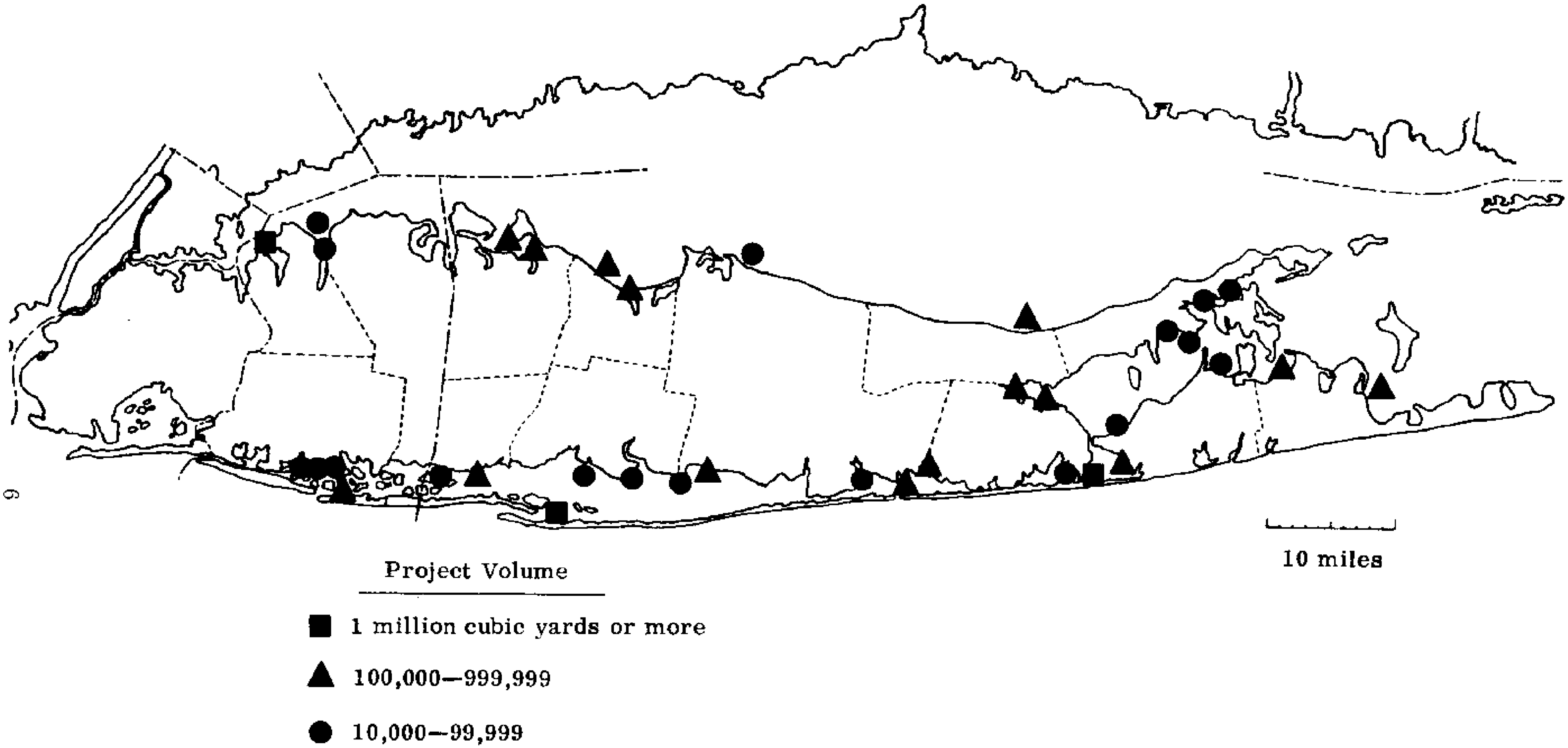


Figure 2

Locations of Major Dredging Applications was valued at $59 million [2]. Boating requires channels to be dredged and maintained and marinas and other facilities to be constructed. The construction of new channels and marinas will relate to the increase in the boating population while channel maintenance is a result of natural filling in of existing channels, as well as the boating use.

According to Table 1, applications for channel maintenance, new channels and marina-related projects amounted to a total of 18% of all applications by volume or a total of 2,880,000 cubic yards in the 38-month period examined. Not all of these applications were granted, but the requests indicate some of the pressure for this type of work.

The applications have been separated into different categories since there are intrinsic differences between the kind of environmental effects that can be expected from them. Channel maintenance projects, for example, will take place in areas previously dredged. Thus, the effects upon the bottom topography and biota will be different than for projects on previously untouched bottoms.

2.1.2 Sediment/Pollutant Removal

According to Table 1, the volume of dredged material in this category exceeds the volume in all other categories except sand and gravel, which represents a single project request that was later withdrawn. This category relates primarily to the attempt on Long Island to dredge up noxious silt from stream and bay bottoms. This is a problem in the bays on the South and East. The public benefit of this activity is fairly apparent; it is an attempt to rid the area of pollution. This pollution is a result in part of the presence of duck waste [1b]. In the long run, dredging does not provide a solution for the duck waste but rather a way of alleviating it, once it is there.

2.1.3 Inlet Maintenance

This type of project is not visible as part of Table 1, since most inlet maintenance is carried out by the Corps of Engineers, which would not make an application to itself. Such projects would, however, require the submission of an Environmental Impact Statement to the Council on Environmental Quality under the National Environmental Protection Act. This category also includes projects in which inlets are widened and deepened. Inlet maintenance is performed primarily to maintain navigability of the interior bays, but it is also accomplished as part of shore protection projects and efforts to improve the flushing characteristics of the bays. The latter two purposes are covered extensively in another report in this series [1h]. However, we shall evaluate the environmental effects of inlet maintenance changes along with other dredging projects.

2.1.4 Beach Nourishment

This type of project is related closely to shore protection projects because beach nourishment is frequently required to minimize beach erosion. In addition, this type of project is related to recreational uses of the beach. However, the dredging aspects are important in and of themselves. In Table 1, the 4% of proposed volume represents those projects for which beach nourishment was the only ostensible reason for the project. There are other projects for which another motivation is given but in which the dredge spoil is to be used for beach nourishment. We estimate, for example, that in boating-related projects, a total of 575,000 cubic yards is to be used for beach nourishment. This amounts to an additional 3.5% of total proposed dredging volume.

The social goal of stabilizing beach erosion for recreation and storm protection is evident in most cases and can be quite important insofar as the barrier beaches are concerned.

2.1.5 Beach Facility Development

Beach facility development relates primarily to the intensive use of shore line along the area's public beaches. There has been a substantial amount of dredging undertaken for the purpose of providing additional parking and related facilities adjacent to heavily used parks.

The problem of cars, congestion, and use of beaches is one which is clearly interrelated with many other sectors of society and is not a marine resource problem along. However, nearly 3 million cubic yards of material dredged is highly significant, especially since all of it has come from Great South Bay. In particular, the relation between additional parking and additional access roads is fairly obvious, with each increase bringing pressure for an additional increase. In this case, a long range plan which identified other solutions to beach access than purely private automobiles at the beach site could provide a powerful tool to understand and use this resource in the best possible way. A project of this type, proposed by a major public agency, is seen as an important public good and for this reason any major decision on this type of problem must be made in a wider social context.

2.1.6 Sand and Gravel Mining

The entry of 5,000,000 cubic yards under sand and gravel in Table 1 represents a single application that was later withdrawn. Currently, there are no large marine mining operations on Long Island. Some dredged material is being sold as sand and gravel, but the quantity appears to be small and occurs as a bi-product of dredging projects undertaken for other needs.

The long-range prognosis for the North Atlantic region is one of rapidly increasing demand coupled with a rapidly decreasing availability of environmentally acceptable inland sources within economical hauling range. In the next few decades, the regional pressure to use marine sources should increase greatly [3]. This pressure may not be so large on Long Island.

Demand for sand and gravel for construction purposes on Long Island is indeed great. In 1966, for example, 13.8 million short tons were produced on Long Island, about 83% of which was sand [4]. This quantity is equivalent to about 10 million cubic yards. Even a small percentage of this amount provided by dredging could have a major impact upon the island's marine resources.

Fortunately for Long Island marine resources, this demand is being met almost entirely by inland resources. In 1966, 2,173 acres in Nassau-Suffolk were used for sand and gravel mining. It would appear that, since inland sand is almost everywhere available on Long Island within economical hauling range, the formidable environmental impacts of inland acquisition can be resolved through careful planning and licensing. However, if these inland problems are not resolved or if demand cannot be satisfied in nearby areas, there will be increaseing pressures on the offshore resources. A case in point may be nearby Connecticut, where inland sand is not so plentiful as it is on Long Island. If available Connecticut resources run low, as many predict, increased demands will certainly be placed upon sand and gravel in Long Island Sound.

2.1.7 Development

Development as a motivation category of a dredging project is a very complex one. By development we mean that the purpose is to make shore land useful for industrial, commercial or residential construction. Development may require bulkheading and filling. In many cases, the area filled will be a wetland.

However, looking at Table 1, no large amount of development appears. Only if one looks at the applications for dredging permits for volumes less than 10,000 cubic yards, can one see a category of this type. And then there is a total of only 16,000 cubic yards for which applications have been made in the last three years, approximately 0.1% of the total volume.

It is clear that in an area undergoing the rapid expansion of Nassau-Suffolk Counties, this small amount vastly understates the total pressure for development, particularly since shore land is highly desirable. Thus, the reason for a dredging project may be masked. As a report of the Fish and Wildlife Service states, "In some cases the creation of building sites was the true (but unstated) motivating force behind the dredging operations." [5]

The potential magnitude of this force can be seen in Table 1 by noting that the total amount of dredging spoil proposed to be deposited on an upland site (exclusive of pollutant spoil) is about 2.5 million cubic yards, a more realistic 16% of the total applications by volume. This is enough to cover about 500 acres in the three-year period studied[1/]. Most of this dredge spoil is provided through public dredging projects as essentially no cost to the owner upon whose land the spoil is deposited.

Thus, in analyzing any project for its motivations, it must be kept in mind that hidden pressures may be pushing a project for other than the ostensible reason. Since this type of project is likely to affect wetland environments and the ecological and public values associated with them, issues of this sort must be dealt with carefully.

1/ At about 5,000 cubic yards per acre. (See Section 2.3.2.4). If placed on wetlands, the 500 acres would represent a major loss. Wetland destruction in Sassau-Suffolk was reported in an earlier report of this series [1b] at about 8,200 acres during the 10-year period, 1954—1964, some 23% of its 1954 total. Because of their significance, wetlands are being treated in greater depth in a separate report [1j].

Obviously, when considering projects in which development is a part of the rationale, hidden or otherwise, it is important in the analysis of costs and benefits to relate the development to the overall desire in the community for growth and the consistency of this aspect with long range planning.

2.1.8 Socio-Economic Relations

This section is meant to be a reminder that motivations are of necessity related to one another. Proposed dredging activities are buffeted by the political process. The physical act of dredging can affect interests other than those initiating a project. This may result in a reinforcement of the pressure for the project or the beginning of an opposition which will slow down or stop dredging. Thus, in looking at a dredging project, the benefits, the disadvantages, and the interested parties are important factors in making any decisions.

As an example, consider a simple model to illustrate the relationship between marina dredging and new channel dredging as in Figure 3. As the number of people who wish to have boats increases, the number of boats increases. The ratio of boats to channels and of boats to marinas increases. These ratios increase the desire for a new channel or a new marina. If the decision is made to dredge a new channel, this decision will have an environmental impact upon the area. The knowledge of that environmental impact will have an effect upon the decision through interest groups, such as shellfishermen or conservationists. The impact will also have some effect upon the desirability of having a boat which will, in turn, affect the number of boats. In addition, as the congestion is reduced, the desirability of boating will increase, and the cycle may repeat.

While this model is very simple, it illustrates the interrelatedness of different interests and the fact that dredging for one reason may affect other dredging motivation. The system is a closed loop with feedback in which one set of decisions affects others [16, 17]. Thus, an important factor is indeed the reason behind the dredging project.

In the real political and decision environment in which the decision is evaluated and made, these relations must be brought out by members of the concerned community—government officials, citizens, developers and conservationists alike.

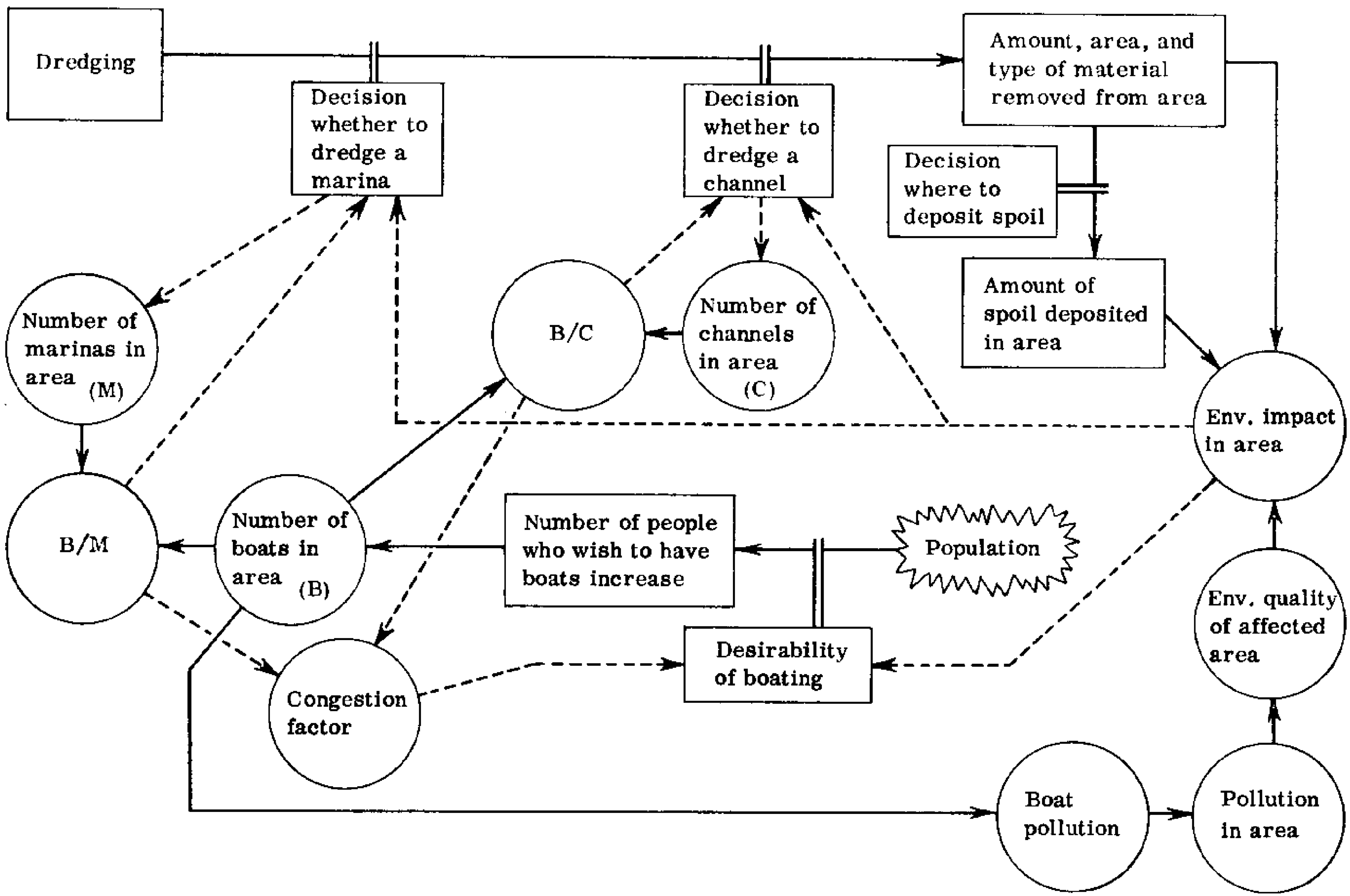


FIGURE 3

SOME RELATIONSHIPS BETWEEN DREDGING FOR MARINAS AND DREDGING FOR NEW CHANNELS

2.2 THE DREDGING PROCESS

Dredging processes have been studied in great detail [6]. Here we will very briefly outline the process in terms of transport and disposal.

2.2.1 Removal

Bottom material is removed either by suction or scooping. Suction dredges are usually called hydraulic dredges. Often a cutterhead, consisting of revolving steel blades, is attached to the inlet end of the suction pipe to loosen the bottom material so that it can be more easily sucked up. Scoop-type dredges are represented by the dragline, clamshell and dipper. Each is attached to a crane or power shovel and uses physical force to break up the bottom material and lift it out of the water. The dragline usually operates from the shore. The clamshell and dipper usually operate from floating platforms. The dipper dredge works well in hard material like rock, but in the soft bottoms typical of Long Island, all three types can be used. In contrast to the scoop dredges, the suction dredges, which operate like a vacuum cleaner, cause little turbidity in the removal area, a characteristic which may be significant in minimizing environmental impacts there.

2.2.2 Transport

Where material is to be removed from a location very close to a stable shore and deposited directly along the adjacent shoreline, draglines are usually employed. If the material is to be deposited in large quantity on a shoal or shoreline within 1/2 to 3 miles from the removal site, an hydraulic dredge and discharge pipeline are usually employed. If the material is to be moved further to a deep disposal site, a hopper dredge is usually chosen. In this type of dredge, the dredged material is stored temporarily in a hopper aboard the dredge that transports it to the disposal site for dumping.

2.2.3 Disposal

Dredging spoil may be deposited either on land or in water. Land disposal implies that the land be relatively close to the shore; therefore, the land is often a wetland-related upland. Barges and hoppers will deposit on the land only inconveniently. For an hydraulic dredge to use land disposal, a near-shore location is required; provision must be made for the spoil to settle with the excess water running out to some water body. The [illegible] area must therefore be bulkheaded high enough to contain the mixture, which consists of about 80% water. The area requirements for the material are generally one acre per 5,000 cubic yards of dredged material. A given spoil area may obviously be used again, if it compacts between uses.

Water disposal for hydraulic dredges is possible, keeping in mind that substantial dispersion of the spoil in bay will take place unless the area is bulkheaded. In the ocean, the dispersal will be affected by currents. A hopper or barge are both capable of unloading easily at a water site, and there are a number of approved federal dumping grounds for this purpose in the Atlantic and in Long Island Sound.

2.2.4 Usage on Long Island

Most major dredging off Long Island is performed with hydraulic dredges with pipelines depositing on a nearby shore or by hopper dredges that deposit the spoil at designated offshore sites. The Suffolk County Department of Public Works operates a hydraulic dredge that is capable of dredging nearly a million cubic yards annually, when fully operational.

2.3 CHANGED ENVIRONMENTAL CONDITIONS

Significant environmental changes of various kinds can occur due both to the removal of material and to the deposition of the material. Of these two kinds of changes, the more environmentally significant on Long Island are usually those due to deposition, as will be seen.

When dealing with a complex physical ecosystem, all changes will have some impact. However, rather than attempt to catalogue all of the possible environmental effects, this analysis will focus on those types of effects that are likely to be most significant on Long Island.

2.3.1 Material Removal

2.3.1.1 Physical and Chemical Changes

The most obvious change due to removal is the physical change in the shape of the bottom. The physical and chemical implications of these topographic changes depend upon the location of the dredging site.

The most significant case is the dredging of a new or substantially enlarged channel at inlets. A new or widened cross-section can trigger far-reaching effects on the entire regime of the backbay which is flushed by the inlet. Thus, dredging at inlets requires extensive and sophisticated analysis of the possible induced changes in important areas such as tidal range, currents, shoaling and scouring patterns, and salinity concentrations in the backbay. For major projects of this type, an analysis will be required employing a model of the relevant system. Maintenance of an inlet channel to a previously existing depth would not, of course, be as significant as the dredging of a new or enlarged channel.

The dredging of a new channel within a backbay also must be investigated in terms of possible changes in local currents, shoaling and scouring, although its environmental implications are likely to be less widespread than changes at the inlet.

Other projects are likely to be less significant than the above types. Maintenance dredging, as long as it only returns the channel or area to the original depth and width, should have very slight effects. However, it should be noted that maintenance dredging may increase the width or depth of a channel and effects will be similar to a new channel project.

Potholes occur when the bottom is dredged substantially below the surrounding area. They are more likely to occur when the principal purpose is to acquire fill. Potholes may trap sediments, organic material and pollutants. This material may decay, generating a high oxygen demand and resulting in an oxygen depletion of the area with anerobic conditions. The smaller and deeper the area, the more likely this is to result. In a study done in New Jersey estuarine areas [7], when excavation sites were not connected to a channel, about 80% of those with depths greater than 21 feet had dissolved oxygen concentrations less than 1 ppm. When the site was connected to a channel, only about 20% of those 21 feet or deeper had D.O. less than 1 ppm. Under these circumstances, there is likely to be a substantial production of H_2S which may be absorbed into the bottom material. Thus, the depth of the dredging project relative to the surrounding area is an important characteristic. In addition, small potholes may be created occasionally within a project and the same considerations apply. The small potholes are usually a result of the dredging operation, which is subject to monitoring. All types of dredging projects have the potential of creating small potholes. For the larger type, channel dredging will have the least effect and all other types of projects can have significant local effects depending upon the relative depth of the resulting bottoms.

Pollutants and nutrients are of significance primarily because dredging is performed to remove them. For example, duck waste sediment is prevelant in a number of bays and rivers on Long Island. The problem, in this case, is the possibility that the material will be stirred up and will drift to other locations to act as sediment and a nutrient source, causing eutrophication. This depends upon the type of dredge used, the efficiency of the dredge and the currents, winds, type of bottom sediment, and carrying capacity of the water. Sedimentation and turbidity may occur in any dredging project, although a study of the Suffolk County hydraulic dredge [8] indicated, "that the dredging operation was not seriously affecting the cove in the area immediately adjacent to the dredge" and concluded, "apparently the dredge was working efficiently, much like a vacuum cleaner, and was discharging all materials picked up to the spoil area." It is important to note that the discharge of spoil was a long distance away, and absence of immediate effect is not always the case. A careful study of dredging in the Chesapeake Bay area [9, 10], showed that increased turbidity and sedimentation were observed as far, but no further than, one-half mile from the dredging operation. In addition, it has been observed that in some cases as much as one percent of the dredged material can be put into suspension. All projects have a potential for this type of environmental change; but the larger projects over a longer period of time are especially significant. The turbidity associated with dredging projects will be present in the same local region over which sedimentation will occur. The essential difference between sedimentation and turbidity is temporal; the effects of sedimentation are present for some time, while increased turbidity will usually disappear soon after dredging ends.

A final physical result of topographic changes will be possible changes in the recharge aquifer. This effect will occur primarily in estuaries near the bay when a narrow wedge of fresh groundwater is close to the surface. Sometimes, the salt water is kept from percolating into the fresh water by estuarine river sediments. By dredging and removing a deep river bottom sediment in such an area, the fresh well water may become brackish. This can be particularly acute when the dredging attempts to remove most of the bottom sediment as in pollutant removal.

A summary of the likely significant impacts of major dredging projects (removal phase) on physical and chemical conditions in the aquatic environment is presented in Table 2.

2.3.1.2 Aquatic Biota

The physical and chemical changes brought about by the dredging removal operation can impact directly and indirectly upon aquatic biota. The most significant impacts are felt by benthic life, especially by shellfish.

The primary direct effects stem from the removal of the bottom material, the creation of potholes, and sedimentation and turbidity induced in the removal area. During dredging, the shellfish and other benthic life are physically removed. The significance depends upon the size of the area involved and the probability that the benthic life will recolonize the area. Generally, if the new substrate is environmentally desirable, recolonization can occur in a year or two, although perhaps with reduced diversity. It is sometimes held that the permanent loss of a productive bottom is unimportant in areas closed to shellfish harvesting. However, this proposition ignores the possibility of eventual water quality improvements and, more importantly, the role these areas play in providing a significant reproductive population for the rest of the bay. The removal of duck wastes may provide more desirable bottom conditions and thus ultimately benefit shellfish and other benthic life. In the case of benthic plants, colonization of the new substrate depends primarily upon the depth to which the area is dredged. Benthic plant life has generally adapted to the shallow bays prevelant on Long Island.

Potholes will usually adversely affect aquatic life, because of the concentration of pollutants, H_2S and oxygen-deficient conditions there. In two-thirds of the potholes examined in the New Jersey study [7], no bottom invertebrates were observed. Of particular significance, in the 20 cases where the D.O. was less than 5 ppm, only 3 contained bottom invertebrates. On the beneficial side, there is some evidence that the warmer temperatures found in potholes attract fish during the colder winter months and provide good fishing areas. The fish population is apparently not increased in those areas, but rather concentrated in them [7].

In some coastal locations, such as in the silt-laden bottoms of upper Chesapeake Bay and along the Gulf Coast, dredging removal operations can stir up a large quantity

TABLE 2

LIKELY SIGNIFICANCE OF REMOVAL PHASE ON PHYSICAL-CHEMICAL CONDITIONS

Project Motivation	Changed Topography	Currents, Salinity, Tidal Excursion	Potholes	Changed Aquifer	Sediment, Turbidity
Channel Maintenance	0	0	+ → 0	+	0
New Channels	+	+	+ → 0	+	+
Marinas	+	+ → 0	+ → 0	0	+
Inlet Maintenance	++	++	+ → 0		
Sediment/Pollutant Removal	+	+	++ +	++	++
Beach Nourishment	+	+ → 0	++ If If +	0	+
Beach Facility Development	+	+ → 0	++ ← over less → +	0	+
Sand and Gravel	+	+ → 0	++ 30' 30' +	0	++
Development	+	+ → 0	++ +	0	+

++ = Significant over a large region of the entire water body
+ = Significant over a local region
0 = Little likely significance

of bottom sediments. These sediments can cause prolonged turbidity and can smother adjacent areas when they fall to the bottom. If the sediment contains a high proportion of nutrients, oxygen deficiency can result. In general, Long Island does not feel these effects as significantly as the other areas cited because of the prevalent sand-size soil particles which settle rapidly nearby and the prevailing use of suction-type dredges that tend to suck in the suspended material. Thus, little turbidity was observed in a Suffolk study [8], but in Chesapeake Bay temporarily increased turbidity was noted in a five square-kilometer area around the site [9, 10]. While the dredging was in progress, D.O. in the same area was lowered 15—80%. High turbidities associated with operations such as the one in Chesapeake Bay can effect phytoplankton by reducing the light penetration into the water and thus reducing primary productivity, should the condition be maintained for a long period of time. However, only sand and gravel operations are designed to be continuous over a long time period. Thus, only with sand and gravel projects would this type of change be likely to take place.

Sherk, in his report on the effects of sediments on estuarine organisms [11], notes particularly: "Two important concepts which are implicit in many discussions of the biological effects of suspended loads and deposited sediments are:

(1) that each estuarine, nearshore, or offshore site selected for engineering change has inherent physical, chemical, and biological limits beyond which significant effects will occur, and

(2) that sediment loads and deposited sediments may be expected to affect living systems in a number of different ways."

Sedimentation occurs at a distance from the dredging site that varies greatly with the local conditions. In upper Chesapeake Bay—an area characterized by deep deposits of very fine riverborne-silt—substantial deposits of sediment up to a few centimeters thick have been observed as far as a half-mile from the site of major dredging operations. In Long Island's sandy bays, sedimentation effects should be substantially less.

Whatever its range may be, thick deposits of sediment can smother and kill shellfish. Effects of sedimentation will differ for various stages of the benthic life cycle. The most serious effects are likely to be on the earliest life stages, although information is scarce. If this is so, the timing of dredging could have a significant effect.

All projects potentially can produce this effect, with the larger ones producing the most. Projects for pollutant removal, however, are least likely to have major effects, since the area is least productive in terms of shellfish.

In summary, insofar as Long Island is concerned, relatively little sedimentation damage is likely to occur beyond the boundary of the project, and turbidity is not likely to affect the primary productivity of the shallow bays that characterize most of the island's coastal areas.

Secondary effects, important to aquatic biota, stem from possible changes in currents resulting from the dredge removal operations. When the dredging occurs at an inlet or along channels, the water quality of the bays can be affected. Pollutants (and nutrients) are likely to be reduced or be concentrated in undesirable areas. Pollutant/sediment removal projects should be closely watched because of the high concentrations of organic wastes in these bottoms. It is possible that during the process of removal these fine-grain pollutants could be suspended and dispersed throughout the bay. The possibility can be minimized by carefully monitoring the dredging operation and giving careful attention to the timing of the operation. For example, the effects of such dispersion would probably be worse during the summer months.

If the dredging is done near inlets, it is possible for the resulting increased flushing to produce salinity changes in the bays. These changes may affect finfish and shellfish populations and their predators.

A summary of likely significant impacts of major dredging projects (removal phase) on aquatic biota is presented in Table 3 by project type.

2.3.2 Spoil Disposal

We have dealt with environmental changes as a result of removing material from a water bottom. There are similar effects in the process of disposing of the material collected. The only type of dredging project that will not concern us here is sand and gravel projects, as the sand dredged in Long Island waters probably would be used for construction at inland sites. However, all of the other projects dispose of material in some fashion either in the water or on the adjacent land.

2.3.2.1 Water Disposal in Bays

The disposal of spoil in the bays of Long Island can produce very significant effects upon a bay environment. This disposal would produce the same type of effect

TABLE 3

LIKELY SIGNIFICANCE OF REMOVAL PHASE ON AQUATIC BIOTA

Project Motivation	Removal of Substrate	Sedimentation	Physical/Chemical Changes on Biota
Channel Maintenance	0	+	+
New Channels	++	+	++
Marinas	+ → ++	+	+
Inlet Maintenance	0	0	++
Sediment/Pollutant Removal	0	++	++
Beach Nourishment			
From backbay	++	+	+
From offshore	+	+ → 0	0
Beach Facility Development	++	+	+
Sand and Gravel	++	+ → ++	+
Development	++	+	+

++ = Significant over a large region of the entire water body
+ = Significant over a local region
0 = Little likely significance

as the increased turbidity and sedimentation associated with removal, only magnified manyfold.

When spoil is dumped in the water, much of it will be in suspension and will drift away, covering a substantial area as it settles. The effects will depend upon site-specific information. The turbidity associated with spoil disposal is unlikely to to produce short-term shifts; however, if a spoil island is produced without any retaining structure, later erosion may cause a long-term rise in turbidity and consequent subtle ecological shifts. Obviously, the sedimentary effects will be most severe on the disposal site itself, with some area of shellfish smothered. Additional sedimentation beyond the immediate area will have the possibility of destroying more shellfish habitat.

Very few direct harmful effects due to in-water disposal of spoil have been observed on finfish at any stage of their life cycle. It has been suggested that the minimal damage to adult fish would take place December through February, with perhaps the most danger to juveniles and larval stages occurring April through August [11].

In the Chesepeake Bay study, benthic population and species diversity had recovered in 1.5 years in the in-bay disposal areas, while at that time the dredged channel area still seemed to be low in both factors. This would indicate that, to produce least damage to the benthic community, dredging operations: "should be undertaken in late winter or early spring when these populations tended to be lowest." [9]

In addition to the biological effects, the deposition of spoil may cause physical effects since the bottom is made shallower causing shoals, changing currents, and a possible rise in the temperature. In summary, the deposition of spoil in bay or shallow waters may cause very significant effects of the same order as the effects of the dredging itself.

2.3.2.2 Water Disposal Offshore

The type of disposal considered here is the disposal off the barrier beaches. The class where spoil is towed to an approved government dumping ground either in the Atlantic or in Long Island Sound will not be considered as it is outside of the direct Long Island area. In general, the physical changes will not be great in their impact upon Long Island resources, because the material will be dispersed in the ocean. It is possible, of course, that the movement of the material by littoral drift might cause somewhat faster shoaling of inlets; however, placement of the spoil far enough offshore to be beyond the range of littoral drift should cure this.

Insofar as the biota are concerned, offshore disposal presents few problems as long as the material is dispersed far into the ocean and remains there. However, if the disposal is placed close to shore, it is possible for the material to be swept along the shore and through an inlet back into the bay where it originated. In the study of dredging by Bennet and Foehrenback [8], this is exactly the condition observed. Since the material dredged was duck wastes, it proved to have a very significant effect: the highly polluted character and the high nutrient value of the waste could result in serious problems for the bay. Thus ocean disposal can produce detrimental effects, if care is not taken to avoid return to the bay areas.

The offshore disposal also produced substantial noxious smells due to the large amounts of H_2S present, which could have a detrimental effect upon recreational water activities. This objection can be minimized by performing the dredging operation in offseason when the beach is not used extensively.

2.3.2.3 Land Disposal on Beaches and Beach-Related Areas

This type of disposal is related to either beach nourishment or recreational facilities development. In either case, the type of dredged material is deposited on or near beaches of the same composition, the change is only one of quantity rather than type.

As discussed in more depth in another report of the series [1h], beach nourishment projects can be initiated either for shore protection purposes or for recreation-related reasons. In either event, the spoil is generally devoid of nutrients and is deposited on an area that will be benefited.

The recreation-related projects on Long Island primarily concern fill needed to make parking facilities back of the beach. This can have the effect of destroying some eixisting dune grass, which is needed for dune stabilization, and replacing it with macadam or concrete parking areas. The environmental effect will then be that of replacing sand with an impervious cover. In addition, if the excess water from fill material runs off into the bay, the turbidity and sediment would increase in the immediate vicinity of the water discharge. However, to the extent that the material is largely sand, it will settle rapidly and will not be a serious problem. Finally, the operation of such parking areas will introduce oil and gas to the runoff.

2.3.2.4 Land Disposal on Wetlands

The disposal of spoil on wetlands and their consequent destruction is a serious problem on Long Island. As seen above in Section 2.1.7, in about 16% by volume of all proposed dredging in the last three years it was planned to use upland sites for dredge spoil. Since the requirements of the disposal system require an upland site to be close to a water body, and since the economic value of land is least for wetland, wetlands tend to be used as the upland sites. The usual environmental effects of placing dredging spoil on wetlands are the irreversible loss of the wetlands, and the sedimentation and turbidity produced in the adjacent waters.

The significance attached to the loss of wetlands depends upon their value for a variety of biological, physical and aesthetic purposes. Because of the potentially high ecological value of Long Island's wetlands and their rapid rate of destruction in recent decades, another report in this series [1j] has been devoted entirely to this subject. In brief, that report advocates the development of a wetlands classification and management system to guide planners and decision makers. Conceptually, the environmental effects of spoil disposal on Long Island's wetlands system need not necessarily be negative in all cases. At some locations throughout the United States [3], spoil disposal sites are being selected to create new wetlands or enhance the biological value of existing wetlands. The feasibility of adopting such a strategy at selected sites on Long Island warrants further research. Thus far however, the normal result is the loss of the wetland from the ecological system.

When fill is placed on wetlands, sedimentation and turbidity usually increase in the adjacent waters during the filling process [8]. In upland disposal from an hydraulic dredge, sediment must settle out and excess water run off. A high retaining earth dam is built around the site with wooden baffles above. The amount of water contained in the spoil effluent limits the spoil capacity of an area. The approximate relationship is 5,000 cubic yards of spoil per acre of disposal site [12].

When water drains from a spoil site, it may contain many nutrients that are present in an organic bottom dediment. This is particularly significant in the case of pollutant spoil which has been seen to contain a high density of coliform bacteria. The sludges and spoils themselves, "can be extremely detrimental to shellfish, finfish, and other animal life in small, shallow bays with limited circulation." And the runoff from these wastes may produce pollutant levels that could necessitate closing shellfishing and swimming areas [8].

Other wastes may produce nutrient enriched situations from the runoff, resulting in algae blooms. This can be particularly true if spoil disposal is carried out in the summer when growth is greater. Thus, the results of spoil runoff can be significant.

In addition to the effect of the environmental change upon dependent species of life which either live and feed in or adjacent to wetlands, the change has bearing upon human resources. Simply put, land unsuitable for development is now made suitable. The industrial, residential or commercial development that will follow the rise in the developmental value of the land may itself have important environmental impacts upon the marine resources of Long Island.

Although not specifically a topic of this report, it should be noted that the resulting development, particularly where cesspools are employed in home sewage systems, may have as large or larger impact on the bay as the original dredging and filling operation.

A summary of likely significant impacts of major spoil disposal operations upon the marine environment is presented in Table 4.

TABLE 4

LIKELY SIGNIFICANCE OF DREDGE SPOIL DISPOSAL ON THE MARINE ENVIRONMENT

Project Motivation	Water Disposal		Land Disposal		
	Bay Sedimentation	Ocean	Beach	Wetland	
				Runoff	Destruction
Channel Maintenance	+	0	0	+	++
New Channels	+	0	0	+	++
Marinas	+	0	0	+	++
Inlet Maintenance	+	0	0	+	++
Sediment/Pollutant Removal	++	0 → ++		++	++
Beach Nourishment	0	0	0		
Beach Facility Development	0	0	0 → +		
Sand and Gravel		0			
Development	0	0		+	++

++ = High significance
\+ = Moderate significance
0 = Little significance

2.4 IMPLICATIONS OF CHANGED ENVIRONMENTAL CONDITIONS

Given the list of possible environmental changes, we now need to know whether or not significant uses or activities are affected, and if so how important the changes can be. This will be discussed in terms of the affected interest groups and the relations between them, and between the groups and the decision makers. This also will bring out some general principles which will flag the importance of the effect.

2.4.1 Affected Uses

It is important to understand the environmental effects of dredging in a social setting. It is, of course, closing the circle for dredging activities since we started with motivation embedded in the social fabric and now it is proper to see the consequent changes in that same fabric.

The environmental changes that can occur will affect human activities, and will result in interest groups placing value judgments on the changes. These judgments will be based on past experience with dredging and on a perception of how activities will be affected. Value judgments will be different for different groups. Beach nourishment is beneficial and even critical for residents of the barrier beaches, but if the sand is taken from the bay in large quantities very detrimental consequences may be felt by commercial shellfishermen.

Around any one dredging project, there may be arrayed a multitude of interest groups supporting and opposing it. Arguments will be marshalled about the possible effects, which in most cases will be local and site specific.

As seen in Figure 1, the affected interest groups primarily involved will be commercial shellfishermen; various recreation interests such as boating, swimming, hunting, and their associated support interests such as marine suppliers; shoreline residents (especially owners of beach front property); developers; and, finally, a loosely-defined but growing group of conservationists.

One of the most important affected groups is commercial shellfishermen. This group provides a 10—15 million dollar annual contribution to the Long Island economy and the attraction of the area for tourism is based in part upon the presence of an available, high-quality shellfish resource [2]. The various baymen's associations can speak strongly as a group of motivated citizens. This becomes important, since many dredging projects potentially may have an adverse effect upon the shellfish habitat. Thus, having an element of the local economy tied to the existence of a high quality resource is a protective feature for the environment.

Recreation interests depend not only on a high quality natural resource but also upon availability of resources such as channels and beach parking. These facilities are, however, closely related to the natural resource changes as the model in Figure 3 illustrated.

The main impact of dredging upon beach residents will be through the shore protection features of beach nourishment projects, because storms may destroy substantial property without proper shore protection. In general, inhabitants of the protected bays do not have this problem and thus tend to be more affected by the general water quality.

Real estate developers are benefited by the changing of shoreline wetland into land on which construction can proceed. This interest would tend to place developers in general opposition to those who wish to preserve open wetlands and avoid dredging projects.

However, as was noted in Section 2.1.7, rarely does a project have as its stated primary goal the production of developable land. Since much of the upland spoil disposal is associated with projects related to boating interests, channel maintenance, new channels, and marinas, controversy about a proposed project may be seen to be between conservationists and boaters: that is, wetlands vs. channels, rather than wetlands vs. development.

These factors would make it difficult to assess the strength of the perceived effect without some information from interests in the immediate area.

2.4.2 Significance of Effects

Thus far this report has brought out the multiple nature of possible environmental effects and has emphasized some of these effects that appear to be especially important. For management purposes, it is not feasible to conduct a full-fledged environmental evaluation of every possible effect for every dredging application. A method is needed to distinguish between the applications that have the greatest potential environmental consequences and the applications that may be relatively less significant. Unless such a method is developed for weighting the depth of environmental review, the limited environmental review capabilities of important governmental and non-governmental interest groups can be sqandered on areas of little probable significance. Considerations are suggested below that will help focus attention on the most environmentally significant applications.

2.4.2.1 Size

It has been suggested throughout the analysis in Section 2.3 that to a large extent the magnitude of the effect is related to the size of the project. It is useful at this point to use the applications to the Corps of Engineers for dredging permits to evaluate the sizes of proposed projects. Table 5 shows this relationship. Note that 95%

TABLE 5

DREDGING APPLICATIONS BY NUMBER AND VOLUME OF REQUEST

Size of Dredging Project in Cubic Yards	Number of Applicants	% of Applications	Total of Dredged Material in Category	% of Total Dredged Material
Less than 1,000	15	20	6,000	.04
1,000— 9,999	20	27	91,000	.6
10,000— 99,999	21	28	645,000	4.0
100,000—999,999	14	19	4,240,000	26.0
1,000,000 or more	4	5	11,300,000	69.4
Total	74		16,282,000	100

of the volume of dredged material is concentrated in only a quarter of the applications above 100,000 cubic yards. If the bottom were to be uniformly deepened by 10 feet, a project that size would encompass a dredged area of about six acres. If the spoil were to be deposited on a wetland to a depth of about four feet, about 15 acres of wetlands would be covered.

2.4.2.2 Quality

In addition to the size of the proposed dredging project, qualitative factors must be considered. These factors vary greatly with location.

Dredging in the following sensitive locations deserves special evaluation.

- At inlets.
- Along channels that can effect backbay current regimes.
- In important shellfish areas.
- Where induced sedimentation and turbidity can be widespread, e.g., in removal of highly polluted sediments such as duck wastes and in long-term sand and gravel mining projects.

Also for reasons brought out earlier, spoil deposition in the following areas deserves special evaluation.

- On wetlands. The significance varies with the value of the affected wetland from biological, physical and aesthetic points of view. At present, an appreciation of wetland values often requires long, complex and expensive research. However, if the recommendations of another report [1g] in this series are accepted, a wetland's classification and management system will be developed. Such a system can guide planners, applicants, review agencies, and other interested parties in judging the possible order-of-magnitude implications of the proposed filling.

- In locations where the spoil is subject to subsequent widespread dispersion causing shoaling and deteriorated water quality. Locations adjacent to main channels, for example, would require special provisions to contain the spoil.
- In important shellfish areas.

2.4.2.3 Timing

This factor is important as a result of the dependence of aquatic life cycles and human activities upon the season. Thus, a given dredging project may have substantially different effects and hence a different quality if performed in the summer rather than the winter. It would seem that danger of eutrophication is least in the colder months and damage to some species of fish least in late winter or early spring.

If a project is one of a long and recurrent series, ecological shifts could take place as a result of the recurrent dredging. This is related to the past history of the area. If an area has been previously dredged and has not yet recovered, the incremental effect might be small but the cumulative effect could be serious. Finally, a series of projects each judged insignificant either because of size or quality may have a total effect that would be highly significant to the marine resources in the area. In this sense, individual projects may not be independent.

2.4.2.4 Reversibility

Since knowledge of the environmental effects of dredging projects is not currently well developed, potential reversibility considerations are especially important. Reversibility as used here implies the use of reasonable resources the community may wish to employ, not the application of an unlimited supply of energy or money.

Dredging may be considered to produce irreversible biological effects, if the recolonization of the new substrate is considered unlikely. Spoil deposition is generally irreversible because it is unlikely that the spoil will be removed. The significance of this observation is judged under the other criteria suggested herein, especially those of size and quality.

2.4.2.5 Compatibility with Master Plan

Where a master plan exists, the implications of the proposed project upon that plan should be considered. For example, even if the project is acceptable under every other suggested criteria, it may call for the creation of a marina, port facility or housing area along a shoreline that is planned to be utilized in a different way.

2.5 MANAGEMENT IMPLICATIONS

In trying to use the information and analysis just developed in the management of dredging projects, it is worthwhile to summarize some of the points made earlier.

First, it has become abundantly clear that different dredging projects have quite different impacts upon the environment, both in character and in significance. Second, the human values associated with these effects are necessarily related to various interest groups.

Given these statements, the present management structure will be discussed and the implications for changes in the management structure will be made.

All dredging in the navigable[1/] waters around Long Island require a permit from the District Engineer, New York District, U.S. Army Corps of Engineers, 26 Federal Plaza, New York, New York 10007. This basic and preeminent authority stems from the navigation servitude provision of the U.S. Constitution. The authority has been broadened considerably by legislation, administrative interpretation, and judicial review. In the words of the public notices on dredging applications:

> "The decision as to whether approval of plans will be granted will be based on an evaluation of the impact of the work on the public interest. Factors affecting the public interest include, but are not limited to, navigation, fish and wildlife, water quality, economics, conservation, aesthetics, recreation, water supply, flood damage prevention, ecosystems, and, in general, the needs and welfare of the people."

Figure 4 outlines the general procedure. An applicant sends a request for a permit to the Corps. The Corps then prepares public notices which include a copy ot the application. These public notices are sent to a list of interested parties, including the Fish and Wildlife Service (F & WLS) of the U.S. Department of the

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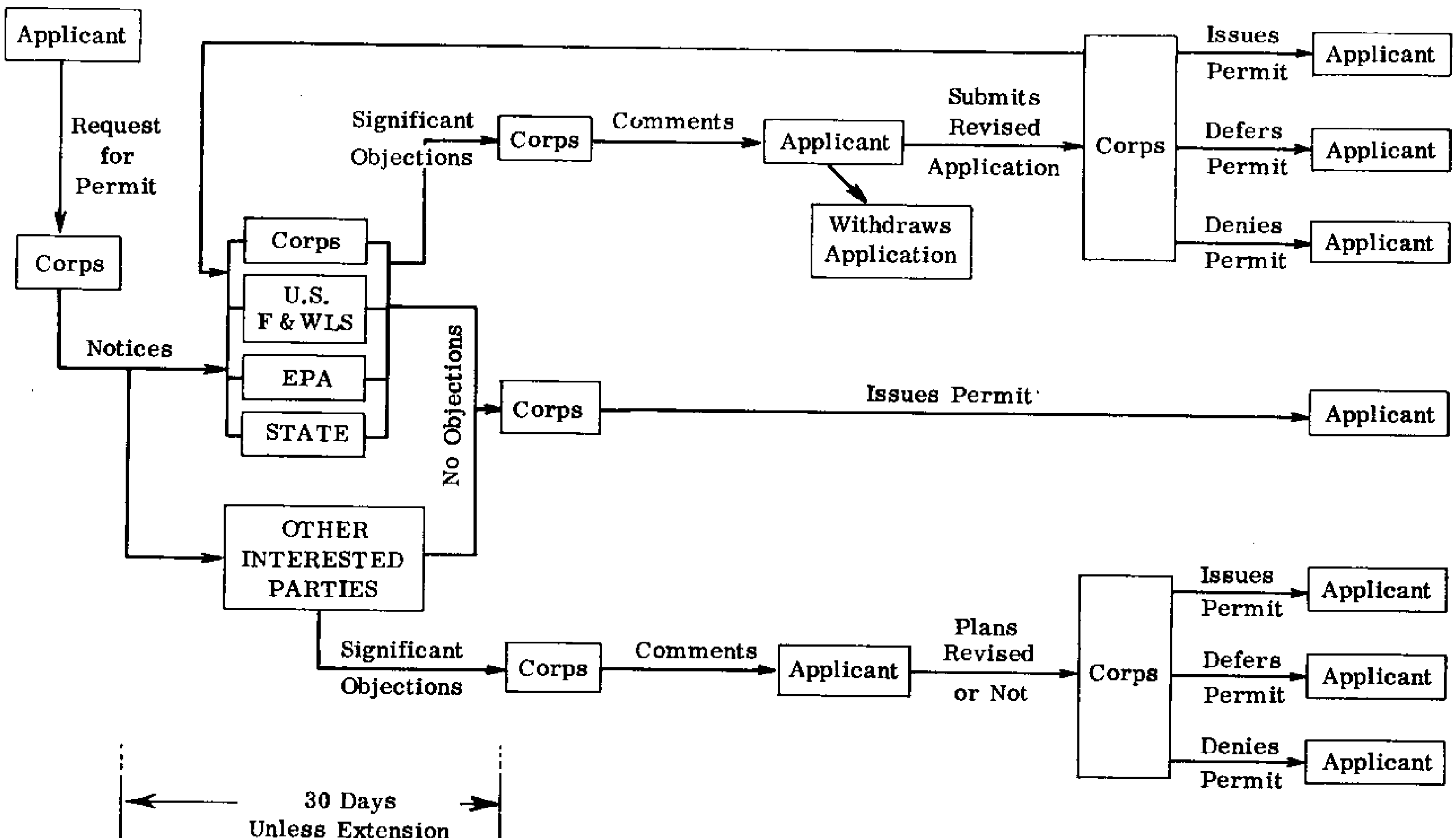
[1/] Corps permit authority is limited to "navigable waters." This term has been interpreted very broadly by the Corps and by the courts. For all practical purposes, it may be considered to include all coastal waters and wetlands. For example, in a letter citing San Francisco Bay, but equally applicable to Long Island, the Under Secretary of the Army has stated, "...the 'navigable waters' of San Francisco Bay include areas laid bare at low tide, as well as areas presently occupied by marsh grasses but never-the less subject to normal tide inundation." [13]



Note—For unusually controversial applications, the Corps holds a public hearing and/or refers the case to higher authority for resolution.

Fig. 4. Structure of Corps approval.

Interior, the U.S. Environmental Protection Agency (E.P.A), the New York State Department of Environmental Conservation and other interested parties[2/]. All parties have 30 days to send comments and/or objections to the Corps unless an extension is requested and granted. Objections to the project are sent by the Corps to the applicant who may revise his plans and return them to the Corps for a decision. This decision may be to issue the permit, to disapprove the application, or to defer decision to allow the applicant and the objecting parties to discuss revisions. In many cases, a deferral of decision is tantamount to a denial.

There are some important points to be noted in this process. The U.S. Fish and Wildlife Service may object strongly to an application and recommend that a permit not be granted. When the objections cannot be satisfied by modifying the application, under a memorandum of understanding between the Corps and the U.S. Department of the Interior, the District Engineer will either deny the application or forward it to Washington for interdepartmental consideration at that level. In addition, the Corps has a long-standing policy of withholding approval whenever the appropriate state agency, as designated by the Governor, objects.

These policies may conflict, and in cases of substantial controversy the District Engineer may hold a public hearing. If it is a particularly difficult decision, it may be referred to higher authority at the regional or national level, especially as a result of the policies above. For example, assume the state strongly supports an application; the Fish and Wildlife Service strongly opposes the application; and field attempts to reach an acceptable solution have failed. For such areas, the Army and the Department of the Interior have worked out a procedure to resolve the issues at successively higher

[2/] An individual or group interested in receiving the public notices can do so merely by writing to the District Engineer at the above address and stating the locality or localities of his interest. The Marine Resources Council of the Nassau-Suffolk Regional Planning Board, for example, routinely receives a copy of every dredging application in Nassau-Suffolk Counties.

levels of review. Nationally, the "Corps gets about 7,000 permit applications annually, of these, 300 come to Washington because of dispute and only about 30 become serious issues." [18]. A particularly complex and important application may take years to resolve and may involve congressional hearings.

Thus great weight is given to the comments and objections of state and federal agencies. This same policy is not generally followed for other interested parties, whether members of the public or local units of government. Their comments may be very persuasive and as a matter of practical administration, if unsupported by either state or federal agencies, they are rarely decisive.

Finally, the Corps analyzes each project primarily for navigation (which is its special charge); it relies mainly upon other agencies for other analyses. The Corps subjects each application to the administrative procedure outlined above.

Given widespread public notice, coordination and higher level review when necessary, one should not expect that decisions can be made without controversy. It is unlikely that for significant projects any decision will satisfy all interests within the community. However, the procedure can be altered and some observations are made on this procedure with special reference to Long Island in the following sections.

2.5.1 Reviewers

As has been pointed out, the permit procedure provides opportunities for review and comment by almost everyone, in and out of government, but special weight is given to comments of several governmental agencies judged to have special cognizance. The principal question here is an important one—how viable is the public input?

The desirability of having such viable input is implied in the existing system and emphatically reinforced by the National Environmental Protection Act (NEPA) of 1969. This act strengthens the citizen's responsibility to play an important role in presenting relevant environmental information to the Corps. As a recent report by the Council on Environmental Quality (CEQ) states, "Traditionally, citizens have had particularly little voice in the innumerable decisions made by agencies without public hearings........... ...NEPA's requirements are particularly important in informal agency decisions ... the environmental impact statement is the only way the public can learn of an impending action—or of the environmental issues raised. Even more important, NEPA and the Council's revised guidelines require agencies, when appropriate, to consider the comments of citizens as well as those of government agencies." [14]

The decisions of the Corps would seem to be included under NEPA by the CEQ guidelines for statements on proposed federal action. Section 5.aii of these guidelines states, "Projects and continuing activities, involving a federal leasé, permit, license, certificate or other entitlements for use" are included under the provisions of the Act [14]. Thus the intent of the Act seems to be for some form of environmental impact statement as well as an increased role for citizens in the decision-making procedure.

However, it is easy to see that, considering the great number of permit applications, it is not at all feasible to develop in-depth environmental impact statements, conduct public hearings and include viable public representation in all of the coordination steps for each and every application. For all of its difficulties, some achievable method of focusing informed, viable, public attention on the most "significant" applications is a practical necessity. Some thoughts on how this might be done are presented in the following paragraphs.

2.5.2 Relative Significance

The current system treats all applications alike unless and until some special problems are perceived during the review process. To make public review viable, it appears that government in some way should flag the more significant cases for special public consideration. Some principles and administrative guidelines for doing this were suggested earlier in Section 2.4.2.

If permit applications were to be initially screened by the Corps on the basis of these or similar yardsticks, a general preliminary significance rating could be assigned, e.g., Class A, B and C. The extent of the review would be weighted according to the probable order of likely significance. It is stressed that the preliminary rating should be objective, based on criteria that could be applied rather simply. That is, a simple screening mechanism is envisioned, not a complex, controversial evaluation. Class C permits involving, for example, only a few yards of non-polluted material disposed in an ecologically unimportant area could be decided promptly in a routine manner. Class A permits, at the other extreme, would be given the widest dissemination, would be highlighted in the news media, would require the applicant to submit his own environmental impact evaluation, would receive an extended time period for review (well above the 30 day now given to all permits regardless of their character) and, in general, would receive the deliberate consideration they warrant.

The feasibility of developing such a management pattern nationally to handle its 7,000 permit applications a year should be considered by the Corps. The system could be tested on Long Island. The Corps could continue to operate as it now does—sending out its public notices as it is currently required to do. To each notice it could append a simplified rating sheet classifying the application in terms of criteria similar to that suggested in Section 2.4.2. The feasibility of the proposed management system could be reviewed following an adequate trial period (1—2 years). Comments and objectives received could be analyzed and correlated with the initially-estimated significance classification. The criteria, with possible adjustments, could then be used with reasonable confidence in determining the depth of review required for future applications.

2.5.3 Local Leverage

A system such as the one discussed above, could increase the significance of local review. State and federal agencies would expect and receive informed, viable comment from the local interests and the governments most likely to be affected by the decision.

The importance of the local perspective is further highlighted in Table 6. Applica-

TABLE 6

TYPE OF APPLICATION AND PERCENT APPROVAL

Type	1,000's of C.Y.	% of Total Volume	% Volume Approved
Suffolk County D.P.W.	7,650	47% (67.5%)*	73%
Other Public	3,258	20% (29.0%)*	93%
Total Public	10,883	67% (96.5%)*	79%
Private*	5,374	33% (3.5%)*	(94%)*

*Note: A large application for a 5,000,000 cubic yard sand and gravel project was withdrawn after submission. Numbers in parentheses apply if this project is not included.

tions of the Suffolk County Department of Public Works constituted two-thirds of the applications by dredging volume[1/] Privately-sponsored applications represented a meager 3%[1/]. It would thus appear that one good, practical method of exerting local control over dredging is to insure full coordination and consideration within the county and township structure before the local government processes its applications through the federal permit system. Of all levels of government, local government should be the one most intimately responsive to the views of the people most directly affected by the decision.

2.5.4 Monitoring

Related to the dredging decision is the monitoring carried out during and after the dredging to see that the conditions of the permit are met. Monitoring is especially important on projects where deviation from the permit conditions can trigger major undesirable side effects. When work is to be performed for a public agency, the Corps normally holds that agency responsible for providing the monitoring [15]. However, some overview must be retained to assure that the monitoring program is indeed being conducted in a way that is responsive to the magnitude of the potential adverse side effects. To be effective, the monitoring program should have some objective means of determining that the actual dredging and spoil disposal locations are identical with approved locations and that the dredging is no deeper than was approved. This could be done either by the Corps or by a local agency such as the Marine Resource Council of the Bi-County Regional Planning Board. This role could be an informal one. Some better method of maintaining control over dredging practives is needed.

[1/] Based upon elimination of one subsequently-withdrawn major private dreding application.

SECTION 3 - DATA COLLECTION AND RESEARCH NEEDS

During the analysis in Section 2, data collection and research needs were identified in five areas:

- Information on the intended future use of major dredged spoil areas;
- A systematic wetlands inventory and classification system;
- Greater understanding of the likely impacts upon marine life of changes in salinity conditions that can occur as a result of major dredging around inlets;
- Models that will predict the consequences of major dredging projects around inlets, and chemical conditions in the affected waters; and
- Simplified management tools to facilitate dredging decisions. Methods to distinguish readily among the multitude of dredging applications, on the basis of most likely levels of environmental significance, are particularly needed.

In a later report in this series (16), these needs will be developed in greater detail, assigned relative priorities in relation to needs developed in other reports, and will be incorporated into a proposed problem-oriented marine research program for Long Island.

SECTION 4 - GUIDELINES

4.1 SOME BASIC CONSIDERATIONS

A set of guidelines relating to dredging must ultimately rest on the question of whether a project should be permitted or not. While guidelines such as these may be descriptive, they cannot be prescriptive in making each individual decision. Instead, the guideline must lay out suggested ground rules for a decision.

The decision makers must recognize some of the important factors identified previously:

- Motivation for dredging is founded on a variety of purposes. The most significant in order of volume dredged are:

—Sedimentation/pollutant removal	(22%)
—Beach facility development	(18%)
—Boating-related	(18%)
—Development (land-fill)	(16%)
—Sand and gravel mining	(nil now, but potentially large)

- Dredging processes can effect environmental conditions. Hydraulic suction type dredges tend to have the least harmful effects in the removal area. Hopper dredges tend to have the least harmful environmental effects in the disposal area since they dump offshore at designated sites.
- Changed environmental conditions must be considered at both the removal and the disposal areas. The most significant effects in the removal area are apt to stem from inlet dredging, sedimentation/pollution removal and all dredging in shellfish areas, particularly if the recovery of benthic life is determined to be slow. Of all environmental effects, wetland destruction is the most significant.
- The significance of the environmental impacts is most clearly related to five characteristics of dredging projects—size, environmental quality of the removal and disposal location, timing, reversibility, and compatibility with the master plan.
- Management implications are of special concern to the Marine Recources Council. The principal management tool is the permit system administered by the U.S. Army Corps of Engineers. The basis for evaluation

is extremely comprehensive; as a result, the system is very complex and prone to controversy. The element of controversy can never be eliminated from any comprehensive public permit system, but complexity can be reduced and the public role and the quality of decision making can be improved by focusing attention on the most environmentally significant applications. Local viewpoints can be decisive if they are informed and organized. Almost all (about 97% by volume) applications, for example, are by local public agencies. Careful monitoring of major dredging projects is a must.

4.2 GUIDELINES

Policy and Planning Guidelines

- The MRC should recommend that the Corps of Engineers develop, on a trial basis, a preliminary classification system for dredging applications based upon: 1) size (volume), 2) environmental quality at the removal and disposal location, 3) timing, 4) reversability and 5) compatability with Comprehensive Development Plan; and that this preliminary classification be distributed along with the public notices.
- The MRC should recommend that the Corps of Engineers adopt an interim classification whereby all dredging projects at inlets and all projects of 100,000 cubic yards or more in volume be classified or defined as "major projects."
- For "major" applications, the MRC should recommend establishment of a policy that environmental impact statements be prepared and disseminated along with the Corps of Engineers' public notices; and that as an interim measure, reveiw comments by agencies such as the Fish and Wildlife Service be distributed as proxy environmental impact statements.
- The MRC should recommend that a report of the physical, chemical and biological character and composition of the areas to be dredged and disposed upon be included as a required part of "major" applications.

- The MRC should recommend that monitoring provisions be included in the permit for "major" applications.
- The MRC should adopt a policy that no dredging spoil from any public dredging project be deposited on any wetland in Nassau and Suffolk Counties, until such time as a wetland management program or plan is available; and that the MRC recommend this policy to the Regional Planning Board.
- Since most dredging applications are submitted by county governments, the MRC should adopt a policy that there be thorough in-house review of county dredging projects at the county level, based on the criteria cited above, before applying for a federal permit; and that the MRC recommend this policy to the Regional Planning Board.

Council Responsibility and Activity Guidelines

- The MRC should include "major" applications on the Council agenda for review and approval, encourage widespread public awareness, and submit the Council views to both the Corps of Engineers and the New York State Department of Environmental Conservation.
- The MRC should invite periodic progress reports on "major" dredging projects at council meetings, and inform the Corps of Engineers when monitoring inadequacies are observed or reported, or when a dredging activity is apparently not being carried out as approved.

Research and Analysis Guidelines

- The MRC should initiate and support a research program to identify and evaluate spoil disposal alternatives, especially including wetlands as spoil disposal areas.
- The MRC should encourage research for the development of tools (models) used in predicting environmental changes due to inlet and bay dredging.

APPENDIX A

REFERENCES

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