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MAIN REPORT

# NORFOLK HARBOR AND CHANNELS, VIRGINIA

# LONG-TERM DISPOSAL (INNER HARBOR)

US Army Corps
Of Engineers

Norfolk District
June 1990

Draft Information Report

# SYLLABUS

Federal legislation requires the Commonwealth of Virginia, as the local cost sharing sponsor, to provide the necessary disposal area for dredged material from Congressionally-authorized channels. Accordingly, this report is an information document to assist the Commonwealth in making a decision concerning the long-term disposal of dredged material from the inner harbor of Hampton Roads. It has been undertaken as a cooperative effort by the U.S. Army Corps of Engineers and the Commonwealth.

The Federally-authorized disposal area at Craney Island was completed in 1957. Since that time, it has received about 182 million cubic yards of material generated by new work dredging, maintenance, private, and permit dredging activities in Norfolk Harbor. Current estimates indicate that Craney Island will be filled to capacity by 1997. The necessity for maintaining a disposal area has been expressed by various public and private agencies, particularly those engaged in protection and enhancement of the port economy and the area's valuable marine environment.

The report discloses two plans that appear to be practical and feasible: an expansion of Craney Island, and ocean disposal. Whether these plans are ultimately determined to be environmentally acceptable and permittable will depend on the outcome of the procedural requirement of the National Environmental Policy Act (NEPA) and the Clean Water Act (in the case of an expansion of Craney Island). These two plans would each provide the storage necessary for dredged material for a period of about 50 years (ocean disposal would be available for a longer period).

The maximum expansion plan consists of a 2,500-acre extension of Craney Island to the west and north. It involves the construction of a levee and road around this extension, the provision of the necessary land, and measures to mitigate the environmental impacts. Lesser expansion plans are also considered practical and feasible, but would not provide the 50-year capacity. The second plan involves (a) barging of clean, suitable dredged material to the ocean and its placement in Dam Neck and/or Norfolk Disposal Sites; and (b) placement of material unsuitable for ocean disposal into the remaining storage in the existing Craney Island. This plan involves no construction. Expansion plans are less costly on a unit cost basis than ocean disposal.

NORFOLK HARBOR AND CHANNELS, VIRGINIA
LONG-TERM DISPOSAL (INNER HARBOR)

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# INTRODUCTION

## AUTHORITY FOR STUDY

This investigation of Norfolk Harbor and Channels, Virginia, long term disposal of dredged material was originally initiated in 1985 as a part of the advanced engineering and design studies for the 55-foot deepening project. Authority for these studies was the same as that for the feasibility study. Specifically, the studies were authorized by Congressional Resolutions adopted by the Senate Committee on Public Works on June 20, 1969 and June 24, 1974, and by the House Committee on Public Works on October 3, 1968 and October 10, 1974.

Authority for deepening various elements of the Norfolk Harbor and Channels, Virginia and the disposal of dredged material, was included in the Water Resources Development Act of 1986 (Public Law 99-662). Due to the importance of establishing a long-term disposal area for dredged material, the Norfolk District requested approval from higher authority for further investigation of this matter under authority contained in WRDA 86. In accordance with direction from the Chief of Engineers, under the provision of House Document 99-85 (Feasibility Report on Norfolk Harbor and Channels), the District obtained a Letter of Assurance (LOA) dated September 24, 1986 from the Virginia Port Authority (VPA) indicating the state's intent to pursue the 55-foot project, its support for the long-term disposal study, and its willingness to cost share in the study during construction of future elements of the deepening project. Permission and funds to continue the investigation under authority of WRDA 86 were received in March 1987.

Since the provision of a suitable disposal area is a non-Federal responsibility, in accordance with the Water Resources Development Act of 1986 and prior policies, this document will be an information report to assist the Commonwealth of Virginia, acting through the Virginia Port Authority, to make a decision concerning future disposal in the inner harbor port of Hampton Roads.

## PURPOSE AND SCOPE OF STUDY

The Norfolk Harbor and Channels as shown on plate 1, have been divided into two sections:

a. Inner Harbor. This refers to that portion of Norfolk Harbor west of the Hampton Roads Bridge Tunnel (plate 2).

b. Outer Harbor. This includes the Thimble Shoal Channel in Chesapeake Bay and the Atlantic Ocean Channel opposite Virginia Beach (required only for the 55-foot depth).

The Commonwealth of Virginia, as local cost-sharing sponsor for the Norfolk Harbor and Channels Deepening and responsible for dredged material disposal, is faced with the problem and need of developing a long-term disposal plan. In this regard, this study, which will be cost shared with the Commonwealth during dredging of the 55-foot outbound element of the Norfolk Harbor deepening project, will provide information to address the disposal problem and to assist the Commonwealth in making a decision on future disposal in Hampton Roads. Craney Island Disposal Area, which serves the inner harbor, is being rapidly filled to capacity. Therefore this report concentrates on the inner harbor dredged material disposal problem. It encompasses the disposal problems and needs and strives to provide the depth and detail necessary to adequately evaluate alternatives for resolving the long-term disposal problem facing the inner harbor portion of Hampton Roads. Although the report will not make a single recommendation, it will provide the state with the most viable options from which to select a long-term disposal plan taking the economic, environmental, and social aspects into account. With respect to the outer harbor, there is not a capacity problem with the availability of Dam Neck Ocean Disposal Area. However, there are opportunities for evaluating alternatives to lower dredging costs and enhance the lower Bay environment and to place suitable sand on area beaches. These studies are progressing as a separate element of the overall long term disposal investigation. Specifically with regard to dredged material on beaches in Virginia Beach, Norfolk, Hampton, etc., there are currently nine Section 933 studies underway. In addition, studies are planned to investigate disposal alternatives in the lower Chesapeake Bay Region.

## STUDY PARTICIPANTS AND COORDINATION

The Virginia Port Authority, the Virginia Institute of Marine Science, Virginia Marine Resources Commission, the Virginia Water Control Board, the

Historic Landmarks Commission, and the Council on the Environment participated in the study. The Federal agencies included the U.S. Fish and Wildlife Service, Environmental Protection Agency, and National Marine Fisheries Service.

This information report will include a draft environmental information report which the State could ultimately use to pursue a long term disposal plan. Such an effort will, of course, require coordination with all appropriate Federal, state, regional and local interests including private and conservation groups. Local entities include the cities of Norfolk, Portsmouth, Chesapeake, Hampton, Newport News, Suffolk, Virginia Beach and Isle of Wight County. Responses to comments received through this coordination effort will be carefully evaluated by the State and the Corps.

Five public meetings were held in connection with the preparation of the feasibility report on which Congress authorized deepening the channels in the harbor to as much as 55 feet. At that time the problems pertinent to dredged material disposal were discussed. A public scoping meeting was held by the district and the Virginia Port Authority for this current study in August 1987. All appropriate Federal, state, local, and private interests were invited to participate. In addition to those above, included in this group were the U.S. Navy, U.S. Coast Guard, Virginia Pilots Association, Hampton Roads Maritime Association, all cities including Norfolk, Portsmouth, Chesapeake, Virginia Beach, Suffolk, Hampton, Newport News, and Isle of Wight County. In addition, appropriate Congressional and State interests were invited. Private citizens and citizen groups were also invited. A more comprehensive listing and responses to the public hearing is included in appendix F. Coordination meetings were held on various aspects of this study. In addition, the Corps of Engineers Waterways Experiment Station (WES) has played an active role in the study. WES has specifically participated in several technical investigations in support of this study including numerical modeling of currents within Hampton Roads and evaluation of the useful life of the existing Craney Island as well as the design and useful life of disposal alternatives.

PRIOR STUDIES AND REPORTS

A number of studies have been or are currently being conducted which are related to the long-term disposal study. These include the following:

a. The feasibility report on Norfolk Harbor and Channels, Virginia, Deepening and Disposal was completed by the Norfolk District in July 1980. It was printed in House Document 99-85, in three volumes entitled "Norfolk Harbor and Channels, Virginia," dated July 18, 1985. It recommended deepening the major channels in Hampton Roads to a depth of 55 feet as well as lesser improvements on Elizabeth River and Southern Branch of Elizabeth River. The report also addressed the need for and feasibility of expanding or replacing the Craney Island Disposal Area. In that report, the district recommended construction of the 6,000-acre Suffolk Site to replace Craney Island. However, the Board of Engineers for Rivers and Harbors concluded that this site should not be recommended at that time because of the numerous unanswered environmental concerns and local opposition. Instead, the Board recommended ocean disposal for all suitable material from the deepening and Craney Island for all material unsuitable for ocean disposal. However, as indicated later in the section entitled "The Planning Process," all material dredged from the inner harbor for the 50 foot deepening project were placed in Craney Island Disposal Area in lieu of taking it to sea as recommended by the Board. In addition, the Board recommended that a post authorization planning investigation be conducted concurrently with the deepening project to develop an economical and environmentally acceptable long-term disposal plan.

A General Design Memorandum was prepared in June 1986. It is entitled "General Design Memorandum 1, Norfolk Harbor and Channels, Virginia." It affirmed and modified the recommended plan of improvement described in House Document 99-85. At that time, it was believed that Craney Island could accommodate the 55-foot project with some capacity for subsequent maintenance dredging. Therefore, in lieu of disposal at sea, as recommended by the Board of Engineers for Rivers and Harbors, the recommended plan provided for the disposal of all material from the deepened channels and anchorages in the inner harbor in the more economical Craney Island Disposal Area, and the disposal of all materials from the Chesapeake Bay and Atlantic Ocean channels in the Dam Neck Ocean Disposal Site, except

for material used for other beneficial purposes. The General Design Memorandum did not provide a long term disposal plan to accommodate future maintenance from the inner harbor. In June 1989, a Supplemental Engineering Report to the above General Design Memorandum relative to the 55-foot outbound channel recommended disposal of all new work from the inner harbor in the Dam Neck Ocean Disposal Site.

b. Section 148 of the Water Resources Development Act of 1976 directs the Secretary of the Army to utilize and encourage such management practices as he determines appropriate to extend the capacity and useful life of dredged material disposal areas such that the need for new disposal areas is kept to a minimum. Accordingly, the Norfolk District requested the Corps Waterways Experiment Station (WES) in Vicksburg, Mississippi to develop an appropriate management plan for extending the useful life of Craney Island. The results of this investigation are documented in "Technical Report EL-81-11, Development of a Management Plan for Craney Island Disposal," It was published by the U.S. Army Corps of Engineers Waterways Experiment Station (WES) in December 1981. The proposed management plan, which the Norfolk District implemented in 1984, consists of compartmentalization (3 subcontainments), dewatering, and raising the levees to +30 feet m.l.w. It was believed that implementation of the management plan would realize significant savings in available storage capacity without reducing effluent water quality. At the time of the study, it was estimated that existing project disposal operations (5 million cubic yards per year) of maintenance material could continue for approximately 36 years (until an average fill elevation of +30 feet m.l.w. is attained) using the recommended management approach, as compared to an estimated 19 years using the then present mode of operation. The performance experience vs the projections by WES including reasons for the differences are discussed in subsequent sections of the report.

c. The existing management plan, discussed in the previous paragraph, was designed without consideration of the proposed deepening of Hampton Roads channels. For this reason, at the further request of Norfolk District, WES prepared a draft report entitled "Effects of Norfolk Harbor Deepening on Management of Craney Island Disposal Area," dated April 1983. The final report was printed in 1987 recommending construction of a fourth

subcontainment (850 acres) adjacent to the west side of the existing area. The report concluded that by constructing a fourth subcontainment area, Craney Island could contain the deepening material and still provide storage capacity for 10 to 20 more years for maintenance. However, at that time there was no authority to pursue this action. Further details on Craney Island Disposal Area investigations are included in the chapter on Plan Formulation.

At the request of this district, WES prepared a draft report entitled "Site Operations and Monitoring Report 1980 - 1987", dated February 1989. The purpose of this report was to document site operations and monitoring data for the Craney Island disposal area from October 1980 to September 1987. Field sampling operations, laboratory testing, and monitoring and survey data are described and interpreted. Updated projections of filling rates are presented. Recommendations on management approaches and monitoring activities are given. This report also serves as a format for future monitoring reports as more data are generated. This report determined that Craney Island Management Plan (CIMP) as implemented to date will result in a gain in useful life of approximately three years or 25% of the remaining capacity. This benefit is less than the maximum possible benefit anticipated in the CIMP.

d. In order to attain a disposal area for the outer harbor (Thimble Shoal Channel in Chesapeake Bay and Atlantic Ocean Channel in the Atlantic Ocean), site evaluation studies with regard to the Dam Neck Ocean Disposal Site (DNODS), were initiated during 1984 for permanent designation of the Dam Neck Ocean Disposal Site (DNODS). It is located 37 miles from Craney Island. Its location is shown on plate 1. All of the general and specific criteria for site designation were fully investigated as required by the Environmental Protection Agency's ocean dumping criteria (40 CFR, Part 228), the Marine Protection, Research, and Sanctuaries Act (MPRSA) of 1972, as amended, and pertinent Corps/EPA regulations and guidance. Specific plans which were investigated during this process included reduction in size of the Dam Neck site, use of the existing 5,000-foot by 22,000-foot Dam Neck interim site, and expansion of the interim site to as much as two to three times its original area. Because significant advantages could be gained by expanding the site, a plan was selected which more than doubled the Dam Neck site from about 4 square miles to about 10 square miles. This plan has been indicated to be preferable

to other potential ocean sites because of historical use, logistics, sediment management aspects, and economics. The studies leading to selection and designation of this plan are fully described in the Final Supplement 1 to the Final Environmental Impact Statement for the Norfolk Harbor and Channels deepening project, dated May 1985. The expanded site, which is shown on plate 1, was designated in September 1985 under Section 103 of MPRSA. It was used in 1986 in connection with deepening the Thimble Shoal Channel in Chesapeake Bay to 50 feet. Subsequently, DNODS received final designation from EPA under authority of Section 102 of MPRSA on March 31, 1988.

e. In order to establish a permanent disposal area in the Atlantic Ocean for dredged material not only for the outer harbor (Thimble Shoal and Atlantic Ocean Channels), but also for the inner harbor, investigations were made of an area referred to as the Norfolk Disposal Site. The required studies were conducted in cooperation with the Environmental Protection Agency (EPA), the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Fish and Wildlife Service (FWS). Old Dominion University acted as the contractor for the majority of the investigations. The Final EIS was filed with EPA on July 23, 1982. NDS is located approximately 17 nautical miles east of the mouth of Chesapeake Bay (45 statute miles from Craney Island) and is delineated by a circle with a radius of 4 nautical miles as shown on plate 1. The site is approximately 50 square nautical miles and only 8 statute miles further from Craney Island than the Dam Neck Ocean Disposal Site. A portion of the site was previously used for the disposal of dredged material between about 1957 and 1971. Depths of the disposal area range from 43 to 85 feet with the center depths ranging from 65 to 80 feet. At the request of the Norfolk District, EPA is proceeding with the designation process. It anticipates final designation of this site in 1991. Due to the importance of this site as related to the long term disposal problem it is further discussed in subsequent sections of this report.

## DESCRIPTION OF HAMPTON ROADS

Hampton Roads is located approximately midway on the Atlantic Seaboard, 180 miles southeast of Washington D.C., at the southern end of Chesapeake Bay as shown on plate 1. It is a natural roadstead of 25 square miles formed by the confluence of the James, Nansemond, and Elizabeth Rivers. Comprising a total land area of 1,500 square miles, the study area

includes the cities of Norfolk, Portsmouth, Virginia Beach, Chesapeake, Suffolk, Newport News, Hampton, Poquoson, Williamsburg, and the counties of James City and York. The harbor in Hampton Roads is recognized as one of the largest and finest natural harbors in the world.

## EXISTING PROJECTS

The following table shows the navigation projects authorized by Congress in Hampton Roads prior to Public Law 99-662.

Table 1. HISTORICAL SUMMARY OF AUTHORIZATION OF PROJECTS WITHIN HAMPTON ROADS AREA

| Acts | Work authorized | Documents and reports |
|---|---|---|
| | **THIMBLE SHOAL CHANNEL** | |
| August 8, 1917 | A channel 40 feet deep, 750 feet wide. | H. Doc. 140, 65th Cong., 1st session |
| September 3, 1954 | A channel 40 feet deep, 1,000 feet wide. | S. Doc. 122, 83d Cong., 2d session |
| October 27, 1965 | A channel 40 feet deep, 1,000 feet wide. | H. Doc. 187, 89th Cong., 1st session |
| | **HAMPTON ROADS AND ELIZABETH RIVER** | |
| August 14, 1876 | A channel 25 feet deep to confluence of Southern and Eastern Branches. | Ex. Doc. 60, 45th Cong., 2d session |
| March 2, 1907 | A channel 30 feet deep to Navy Yard. | H. Doc 381, 59th Cong., 1st session |
| June 25, 1910 | A channel 35 feet deep to Navy Yard. | H. Doc. 551, 61st Cong., 2d session |
| August 8, 1917 | A channel 40 feet deep and 750 wide to mouth of Southern Branch. | H. Doc. 140, 65th Cong., 1st session |
| September 3, 1954 | A channel 40 feet deep and 1,500 feet wide from 40-foot contour in Hampton Roads to a point just south of Norfolk International Terminal. | S. Doc. 122, 83d Cong, 2d session |
| October 27, 1965 | A channel 45 feet deep and 800-1,500 feet wide from Ft. Wool to Lamberts Point. | H. Doc. 187, 89th Cong., 1st session |

Table 1. HISTORICAL SUMMARY OF AUTHORIZATION OF PROJECTS WITHIN HAMPTON ROADS AREA
(Cont'd)

| Acts | Work authorized | Documents and reports |
|---|---|---|
| | SOUTHERN BRANCH | |
| June 25, 1910 | A channel 22 and 25 feet deep. | H. Doc. 551, 61st Cong., 2d session |
| August 8, 1917 | A channel 40 feet deep and 450 feet wide from mouth to Belt Line Railroad bridge. | H. Doc. 140, 65th Cong., 1st session |
| March 3, 1925 | A channel 30 feet deep and 375 feet wide to Virginia Railway (now Norfolk and Western) bridge thence 25 feet deep and generally 200 feet wide to Norfolk & Western Railway bridge. | H. Doc. 226, 68th Cong., 1st session |
| August 30, 1935 | A channel 25 feet deep and 200 feet wide from Norfolk & Western Railway bridge to a point 2,500 feet above with a turning basin 500 feet square. | H. Doc. 182, 73d Cong., 2d session |
| June 30, 1948 | Approach and turning area 40 feet deep and a maximum of 830 feet wide opposite Norfolk Naval Shipyard, thence a channel 35-feet deep and 375 and 250 feet wide to a point 1,900 feet above Norfolk and Western Railway bridge and a turning basin 35 feet deep and 600 by 600 feet at upstream end. | H. Doc. 545, 80th Cong., 2d session |
| October 27, 1965 | A channel 40 feet deep from the Belt Line bridge to Old Virginia (now Norfolk and Western) bridge and a turning basin 35 feet deep opposite St. Julian Creek. | H. Doc. 187, 89th Cong., 1st session |

Table 1. HISTORICAL SUMMARY OF AUTHORIZATION OF PROJECTS WITHIN HAMPTON ROADS AREA
(Cont'd)

| Acts | Work authorized | Documents and reports |
|---|---|---|
| | SOUTHERN BRANCH (Cont'd) | |
| October 1, 1976 | A channel and turning basin 35 feet deep from the vicinity of Norfolk and Western Railway bridge crossing at Gilmerton upstream to the vicinity of the Norfolk and Portsmouth Belt Line Railroad crossing. | H. Doc. 355, 94th Cong., 2d session |
| | EASTERN BRANCH | |
| July 5, 1884 | Improvement of Eastern Branch. | Annual Report 1885, p. 1015 |
| March 2, 1907 | A channel 22-25 feet deep and 500 feet wide. | H. Doc. 373, 59th Cong., 1st session |
| March 2, 1907 | Removal of shoals at mouth. | Specified in act |
| March 3, 1925 | A channel 25 feet deep and 200 feet wide from Norfolk and Western Railway bridge to Virginia Railway (now Norfolk and Western) bridge. | H. Doc. 226, 68th Cong., 1st session |
| July 3, 1930 | A channel 30 feet deep to a point opposite terminal of Imperial Tobacco Co., in Berkley (inactive). | H. Doc. 37, 71st Cong., 1st session |
| March 2, 1945 | A channel 25 feet deep and 300 feet wide from Norfolk & Western Railway bridge to Campostella bridge. | H. Doc. 224, 76th Cong., 1st session |

Table 1. HISTORICAL SUMMARY OF AUTHORIZATION OF PROJECTS WITHIN HAMPTON ROADS AREA
(Cont'd)

| Acts | Work authorized | Documents and reports |
|---|---|---|
| | **WESTERN BRANCH** | |
| March 4, 1913 | A channel 24 feet deep and 300 to 200 feet wide to West Norfolk Bridge. | H. Doc. 566, 62d Cong., 2d session |
| July 3, 1930 | A channel 18 feet deep to a point about 3,000 feet above West Norfolk highway bridge. | H. Doc 265, 70th Cong., 1st session |
| | **ANCHORAGES** | |
| Jun 25, 1910 | An anchorage 30 feet deep at Lambert Point. | H. Doc. 551, 61st Cong., 2d session |
| August 8, 1917 | An anchorage 12 feet deep at Pinners Point. | H. Doc. 605, 63rd Cong., 2d session |
| September 3, 1954 | An anchorage 38 feet deep and 1,500 feet square; anchorage 35 feet deep and 1,500 feet square; and anchorage 20 feet deep, 1,000 feet wide, and 3,000 feet long. | S. Doc. 122, 83d Cong., 2d session |
| October 27, 1965 | Two anchorages opposite Sewells Point 45 feet deep with 1,200-foot swinging radius. | H. Docs., 187 & 143, 89th Cong., 1st session |
| October 27, 1965 | Two deep-draft anchorage berths opposite Newport News 45 feet deep over a 1,200-foot swinging radius. | H. Docs. 143 & 187, 89th Cong., 1st session |

Table 1. HISTORICAL SUMMARY OF AUTHORIZATION OF PROJECTS WITHIN HAMPTON ROADS AREA
(Cont'd)

| Acts | Work authorized | Documents and reports |
|---|---|---|
| | DISPOSAL AREA | |
| July 24, 1946 | A trapezoidal-shaped area of about 2,500 acres of flats adjacent to and north of Craney Island, including levees, sluiceways, rehandling basins, and approach and exit areas. | H. Doc. 563, 79th Cong., 2d session |
| | CHANNEL TO NEWPORT NEWS, VIRGINIA | |
| June 25, 1910 | A channel 35 feet deep and 400 feet wide. | H. Doc. 550, 61st Cong., 2d session |
| August 8, 1917 | A channel 35 feet deep and 600 feet wide. | H. Doc. 605, 63rd Cong., 2d session |
| January 21, 1927 | A channel 40 feet deep and 600 feet wide. | H. Doc. 486, 67th Cong., 4th session |
| October 27, 1965 | A channel 45 feet deep and 800 feet wide from that depth in Norfolk Harbor Channel about 4.5 miles long. | H. Docs. 143 & 187, 89th Cong., 1st session |

The Federal deep-draft navigation projects in Hampton Roads, including those authorized in the Water Resources Development Act of 1986 (P.L. 99-662), are described in the following paragraphs and are shown on plates 1, 3 and 4. Project depths are given with respect to mean low water (m.l.w.).

With regard to the authorized 55-foot improvement (consisting of the Atlantic Ocean, Thimble Shoal, Norfolk Harbor and Newport News Channels), it should be noted that this project is being constructed in stages or elements. The first element involves deepening the outbound lanes to a depth of 50 feet to accommodate loaded coal vessels leaving the port. The second element involves deepening the outbound lanes to a depth of 55 feet for additional benefits to the loaded coal vessels. The inbound elements to 50 and 55 feet, respectively, are not necessary at this time and have been classified under the deferred category It should be noted that the Channel to Newport News is being constructed to full width for both 50 and 55-foot elements.

a. Atlantic Ocean Channel. The authorized project provides for dredging a new channel in the Atlantic Ocean off Virginia Beach, referred to as the Atlantic Ocean Channel. It was originally planned to have a depth of 57 feet and a width of 1,000 feet. The 57-foot depth would allow for the additional wave action associated with the open ocean. Investigations conducted during the General Design Memorandum 1 on Norfolk Harbor Channels, Virginia indicate that this channel should actually be constructed to a depth of 60 feet. To date, the channel has not been dredged, but would be with the 55 foot project.

b. Thimble Shoal Channel. Thimble Shoal Channel is located between deep water in Hampton Roads and the Atlantic Ocean. It extends through Thimble Shoal in the open waters of lower Chesapeake Bay southeasterly from a point 4 miles east of Old Point Comfort, Virginia, toward the entrance to Chesapeake Bay at Cape Henry.

The authorized project provides for a main channel 55 feet deep and 1,000 feet wide for a distance of about 13.4 miles. To date, a 650-foot outbound lane has been dredged to a depth of 50 feet for its full length. This channel will serve all deep draft outbound traffic from Hampton Roads. The portions of

Thimble Shoal Channel that are not deepened to 50 feet will continue to be maintained at the previously authorized depth of 45 feet.

c. Norfolk Harbor Channel. The authorized project provides for a channel 55 feet deep and 1,500 feet wide from that depth in Hampton Roads near Fort Wool to a point just south of the Norfolk International Terminal Piers, thence at the same depth and 800-foot width to the Norfolk-Southern Coal Piers at Lamberts Point, a length of about 8.4 miles.

To date, the Norfolk Harbor Channel has been dredged to a depth of 50 feet. It was dredged over a width of 800 feet from the coal piers for the first 4,000 feet to allow adequate maneuvering area for vessels departing from the Lamberts Point facility and over a width of 650 feet for the remainder of the channel. The junctions of the Norfolk Harbor Channel and the Channel to Newport News were dredged over the full width of 1,500 feet to provide an adequate maneuvering area. The entrance reach and the Craney Island reach were dredged to a depth of 50 feet. The portions of the Norfolk Harbor Channel that were not deepened to 50 feet or more will continue to be maintained at the previously authorized depth of 45 feet to provide continued two-way channel service for deep draft vessels and an adequate maneuvering area for U.S. Navy vessels operating at the Norfolk Naval Station.

d. Channel to Newport News. The authorized project provides for a channel 55 feet deep and 6.2 miles long and over its existing 800-foot width to the coal terminals at Newport News. To date, the Channel to Newport News was dredged to a depth of 50 feet over its full width of 800 feet for its full length from A.T. Massey coal pier in Newport News to the junction with the Norfolk Harbor Channel, a length of about 5.4 miles.

e. Anchorages. There are four anchorages in Hampton Roads with authorized depths of 45 feet and radii of 1,200 feet with two anchorages located near Sewells Point and two anchorages located opposite Newport News. Only the Sewells Point east anchorage has been constructed and maintained to a depth of 45 feet , while the remaining three anchorages have been constructed and maintained to a depth of 40 feet. In addition, another anchorage area is located opposite Lamberts Point and consists of one space 38 feet deep and

1,500 feet square; one space 35 feet deep and 1,500 feet square; and one space 20 feet deep and 1,000 feet wide and 3,000 feet long.

As a result of the Water Resources Development Act of 1986 and the subsequent General Design Memorandum 1, the following anchorage modifications were authorized:

1. Construction of a new 55-foot anchorage with a 1,500-foot radius immediately inside the Hampton Roads Bridge Tunnel, north of Norfolk Harbor Channel, as shown on plate 3.

2. Modification of the Sewell's Point 45-foot anchorage from a radius of 1,200 feet to 1,500 feet, as shown on plate 3.

Since the anchorage improvements are considered to be part of the overall 55 foot outbound element, they will be constructed when this further deepening element is accomplished.

f. Elizabeth River and Its Southern Branch. The Elizabeth River between Lamberts Point and the mouth of its Southern Branch is currently maintained to its previously authorized depth of 40 feet over a width of 750 feet. Elizabeth River and its channel is 40 feet deep and 450 feet wide from the junction with the Eastern Branch (Mile 12) to the Norfolk and Portsmouth Belt Line Railroad Bridge (Mile 14), thence 40 feet deep and 375 feet wide to the Norfolk and Western Railway Bridge (Mile 15), thence 35 feet deep and 250 feet to 500 feet wide to a point 1.6 miles above the Interstate 64 high-level bridge (Mile 19.4). The channel includes an approach and turning area 40 feet deep opposite the Norfolk Naval Shipyard; a turning basin 35 feet deep, 400 to 600 feet long, and 800 feet wide at the mouth of St. Julian Creek (Mile 16.6); a turning basin at the mouth of Newton Creek (Mile 17.8) 35 feet deep and 600 feet square; and a turning basin at the mouth of Mains Creek (Mile 19.1), 35 feet deep and 800 feet square; 35 feet deep and 250 feet wide at the upstream end of the channel. The total length is 19.6 miles.

The authorized project in WRDA 86 provides for increasing the depth of the Elizabeth River and the Southern Branch of the Elizabeth River between

Lamberts Point (river mile 9) and the Norfolk and Western Railway Bridge (river mile 15) from 40 feet to 45 feet over its existing width ranging from 375 to 750 feet. It also provides for increasing the depth of the Southern Branch of Elizabeth River between the Norfolk and Western Railway Bridge (river mile 15) and the U.S. Route 13 and 460 highway crossing (river mile 17.5) from 35 feet to 40 feet over its existing widths ranging from 250 feet to 500 feet and providing a new 800-foot turning basin at the terminus of the channel improvement. To date, this work has not been accomplished. Preparation of a General Design Memorandum has been stopped pending resolution of the location of a disposal area for the dredged material both for new work and maintenance.

g. Eastern Branch of Elizabeth River. This channel is 25 feet deep and 500 feet wide from its junction with the Southern Branch to the Norfolk and Western Railway Bridge, including within its limits near the mouth a channel 30 feet deep, 300 feet wide , and 1,000 feet long; from the Norfolk and Western Railway Bridge, a channel 25 feet deep and 300 feet wide to the Campostella Bridge; thence a channel 25 feet deep and 200 feet wide to the Norfolk and Western Railway Bridge, including maintenance of an existing turning basin 25 feet deep and approximately 5.5 acres in an area located at the upper end of the project for a total length of 2.5 miles.

h. Western Branch of Elizabeth River. This channel is 24 feet deep, having a width of 300 feet from the 40-foot channel for a distance of 0.78 mile; thence 200 feet wide for 0.37 mile to the West Norfolk Bridge; thence 18 feet deep and 150 feet wide to a point 3,000 feet above the bridge for a total length of 1.78 miles.

i. Disposal Areas. A diked dredged material disposal area of about 2,500 acres and shown on plate 2, is located adjacent to and north of Craney Island in Portsmouth, Virginia. The disposal area is enclosed by a stone-faced levee of sand. The facility includes a rehandling basin, approach and exit channels connecting to the rehandling basin, and the Norfolk Harbor 45-foot inbound channel (50-foot outbound channel), and a hopper dredge unloading and/or pumpout facility located midway along the east levee.

The Dam Neck Ocean Disposal Site as shown on plate 1, has been developed for the deepening and future maintenance of Thimble Shoal Channel and Atlantic Ocean Channel. It has been utilized for dredging Thimble Shoal Channel to its existing depth.

Another ocean disposal site - the Norfolk Disposal Site, as shown on plate 1, has been under investigation. It is further out to sea and has a large capacity area. It is not as yet an authorized site.

The authorizing document (HD 99-85) provides for post-authorization planning studies to be conducted concurrently with the deepening project to identify an acceptable, economical and environmentally feasible solution for long-term disposal of dredged materials. This report presents the results of the planning studies to date with respect to the inner harbor.

THE REPORT

The findings of this study are documented by a main report and six appendices. The main report is a non-technical presentation with conclusions concerning the need and opportunities to provide a long-term solution to the disposal of dredged material from the inner harbor. The six appendices accompanying the main report include:

Appendix A - Engineering, Design and Cost Estimates
Appendix B - Geotechnical Investigations
Appendix C - Economic Studies
Appendix D - Real Estate Studies
Appendix E - Environmental Information Report
Appendix F - Public Involvement

The above appendices are more detailed technical presentations which supplement information presented in the main report. Appendix F, Public Involvement, contains pertinent correspondence, the Record of Public Meeting held in August 1987, and pertinent newspaper clippings.

## THE PLANNING PROCESS

The planning process for this study follows the procedures presented in "Economic and Environmental Principles for Water and Related Land Resources Implementation Studies" dated March 10, 1983. These Principles and Guidelines were established pursuant to the Water Resources Planning Act of 1965 (Public Law 89-90), as amended (42 U.S.C. 1962a-2 and d-1).

> "The planning process consists of a series of steps that identifies or responds to problems and opportunities associated with the Federal objective and specific State and local concerns, and culminates in the selection of a recommended plan. The process involves an orderly and systematic approach to making determinations and decisions at each step so that the interested public and decision makers in the planning organization can be fully aware of: the basic assumptions employed; the data and information analyzed; the areas of risk and uncertainty; the reasons and rationales used; and the significant implications of each alternative plan."

The following are the six major steps involved with the overall planning process:

(1) Specification of the water and related land resources problems and opportunities (relevant to the planning setting) associated with the Federal objective and specific State and local concerns.

(2) Inventory, forecast, and analysis of water and related land resource conditions within the planning area relevant to the identified problems and opportunities.

(3) Formulation of alternative plans.

(4) Evaluation of the effects of the alternative plans.

(5) Comparison of alternative plans.

(6) Selection of a recommended plan based upon the comparison of alternative plans.

It is important to understand that this is an advisory report to the State. There is no recommendation herein for a specific site to utilize for the future disposal of dredged material from the inner harbor. Public Law 99-662 (WRDA 86) states that in channel improvements in harbors, it is the responsibility of local interests to provide a disposal area to the Federal Government, since the Federal Government pays a substantial portion of the cost of required dredging. It has an interest in insuring that such a site is reasonable, economical, and environmentally acceptable. In this case, the State will be furnished an array of viable plans to assist in selecting a long term disposal plan for the inner harbor.

## BACKGROUND AND HISTORY OF EVENTS

It became apparent during the late 1960s that the Craney Island Disposal Area was rapidly becoming filled to its original design height of +18 feet, mean low water. This fact prompted local interests to request a survey study to address this potential problem. As a result, the Norfolk District, Corps of Engineers was authorized to conduct a study in accordance with a resolution adopted 3 October 1968 by the Committee on Public Works of the United States House of Representatives. The overall purpose of this study was to determine the feasibility of expanding or replacing the existing Craney Island Disposal Area. Since the issue of disposal was closely related to the concurrent feasibility study on deepening the major channels in Hampton Roads, the studies should be combined and results presented in one single report. The combined feasibility report on Norfolk Harbor and Channels, Virginia, Deepening and Disposal, was completed in 1980. With regard to disposal, the report recommended construction of a 6,000-acre upland site in Suffolk, Virginia. This plan was also the recommendation of the State Task Force on Disposal and was supported by the Commonwealth for dredged material requiring confinement.

During its review of the feasibility report, the Board of Engineers for Rivers and Harbors recognized two developments regarding the disposal of dredged material. First, the Norfolk District was studying and developing a management plan for Craney Island to extend its useful life. This work was being performed under authority of Section 148 of the 1976 Water Resources Development Act which directed the Secretary of the Army to minimize the need for new disposal sites by developing management plans to extend the lives of

existing sites. With assistance from the Corps' Waterways Experiment Station in Vicksburg, Mississippi, a management plan for Craney Island was recommended. The management plan, which became operational in 1984, involves compartmentalization, dewatering, and raising existing levees.

In addition, studies were being conducted to designate the Norfolk Disposal Site as an open ocean disposal area. These studies involved testing material throughout Hampton Roads to determine its suitability for ocean disposal. These studies revealed that the majority of the material west of the Hampton Roads Bridge Tunnel did not have to be confined, as previously believed, but was acceptable for ocean disposal under ocean disposal criteria.

The Board also recognized the fact that there were numerous unanswered environmental questions and considerable local opposition to the Suffolk site. Therefore, it concluded that the Suffolk site should not be recommended at this time. Instead, the Board recommended ocean disposal for all suitable material from the deepening and Craney Island for disposal of material not suitable for open water disposal. Furthermore, the Board recommended that a postauthorization planning study be conducted concurrently with the deepening to identify an economical and environmentally acceptable long-term disposal plan. However, all material dredged from the inner harbor for the 50-foot deepening project was placed in Craney Island in lieu of taking it to sea as recommended by the Board, in accordance with the recommendations of the General Design Memorandum 1, dated June 1986. As previously indicated, it was believed at that time that Craney Island could accommodate the 50-foot and 55-foot project elements.

In accordance with the Board's recommendation and pursuant to the authorization of the Norfolk Harbor and Channels Deepening Project by the Water Resources Development Act of 1986 (WRDA 86), a long-term disposal study for the inner harbor has been conducted and is documented by this report. As previously stated, additional studies relating to disposal in the outer harbor are underway and/or planned.

## RESOURCES AND ECONOMY OF THE STUDY AREA

The economic level and growth potential of a region are largely determined by the area's resources. A general understanding of these resources and the area's developmental trends is helpful in identifying regional problems and needs and selecting appropriate solutions. In this section of the report the development and economy of the Hampton Roads metropolitan area as well as its natural resources will be discussed.

### HUMAN RESOURCES

The Hampton Roads study area for this report is made up of the Norfolk-Virginia Beach-Newport News Metropolitan Statistical Area (MSA) with Gloucester County excluded and Isle of Wight County included. The MSA is made up of the old Norfolk-Virginia Beach-Portsmouth Standard Metropolitan Statistical Area (SMSA) and the Newport News-Hampton SMSA. The specific political jurisdictions encompassed in this area are listed in table 2 and shown in figure 1.

#### Population

The Hampton Roads area is the second most populous metropolitan complex in the state. The area's population grew from 1,062,990 in 1970 to 1,161,807 in 1980, an increase of about 9 percent. Provisional estimates published by the Tayloe Murphy Institute give the area a 1987 estimated population of 1,341,800, an increase of slightly over 15 percent in 7 years. This rate of growth is significantly higher than that of the state as a whole, which showed an increase of about 10 percent for the same time period, and indicates that the pace of growth is currently fairly high.

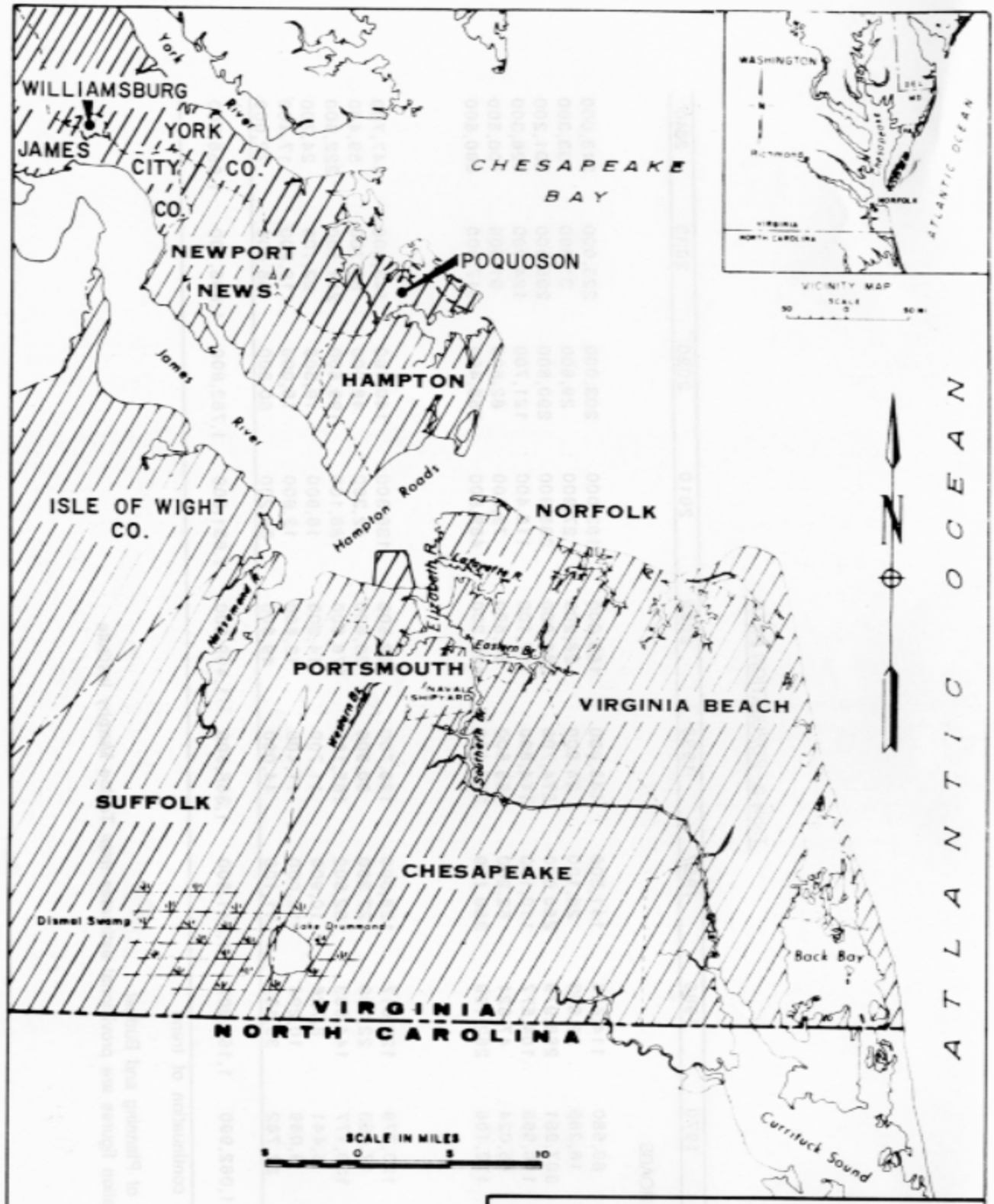
Within the the study area, growth rates vary considerably from place to place. An examination of table 2 , which shows past and projected population for the study area cities and counties, reveals that most of the growth is occurring in the jurisdictions that have large tracts of vacant land for expansion. On the southside most of the growth has been and will continue to be in Chesapeake and Virginia Beach, while on the Peninsula the growth centers are the counties and northern Newport News.

Table 2. POPULATION DATA

| | 1970 | 1980 | 1987 | 1990 | 2000 | 2010 | 2020 | 2030 | 2040* |
|---|---|---|---|---|---|---|---|---|---|
| SOUTHSIDE HAMPTON ROADS | | | | | | | | | |
| Chesapeake | 89,580 | 114,486 | 141,500 | 143,000 | 163,000 | 183,000 | 203,000 | 223,000 | 243,000 |
| Isle of Wight Coun | 18,285 | 21,603 | 25,100 | 24,500 | 26,200 | 27,900 | 29,600 | 31,300 | 33,300 |
| Norfolk | 307,951 | 266,979 | 280,800 | 274,700 | 280,000 | 285,300 | 290,600 | 295,900 | 301,200 |
| Portsmouth | 110,963 | 104,577 | 110,100 | 114,800 | 117,100 | 119,400 | 121,700 | 124,000 | 126,300 |
| Suffolk | 45,024 | 47,621 | 52,200 | 55,500 | 64,500 | 73,500 | 82,500 | 91,500 | 100,500 |
| Virginia Beach | 172,106 | 262,199 | 350,100 | 362,600 | 426,200 | 489,800 | 553,400 | 617,000 | 680,600 |
| PENINSULA | | | | | | | | | |
| Hampton | 120,779 | 122,617 | 128,000 | 128,700 | 132,500 | 136,300 | 140,100 | 143,900 | 147,700 |
| James City County | 17,853 | 22,339 | 27,200 | 30,900 | 36,600 | 42,300 | 48,000 | 53,700 | 59,400 |
| Newport News | 138,177 | 144,903 | 162,800 | 165,100 | 176,600 | 188,100 | 199,600 | 211,100 | 222,600 |
| Poquoson | 5,441 | 8,726 | 10,900 | 11,700 | 14,300 | 16,900 | 19,500 | 22,100 | 24,700 |
| Williamsburg | 9,069 | 10,294 | 12,000 | 11,400 | 12,600 | 13,800 | 15,000 | 16,200 | 17,400 |
| York County | 27,762 | 35,463 | 41,100 | 44,000 | 49,600 | 55,200 | 60,800 | 66,400 | 72,000 |
| TOTAL | 1,062,990 | 1,161,807 | 1,341,800 | 1,366,900 | 1,499,200 | 1,631,500 | 1,763,800 | 1,896,100 | 1,956,700 |

*Projections based on continuation of trend

Sources: Virginia Dept. of Planning and Budget
1987 population figures are provisional estimates from Tayloe Murphy Institute




NORFOLK HARBOR AND CHANNELS, VIRGINIA

LONG - TERM DISPOSAL (INNER HARBOR)

## HAMPTON ROADS STUDY AREA

NORFOLK DISTRICT, CORPS OF ENGINEERS

JULY 1989

Figure 1

Projections for population through the year 2040 show continued growth but at a decreasing rate. The more developed cities are projected to maintain roughly their existing population counts with very small increments of growth while the the more suburban cities and counties will expand as development spreads to the currently vacant areas.

One area of logical interest in this study is the northwestern section of Portsmouth and the northeastern portion of Suffolk because of its proximity to the existing Craney Island. Any changes in the use or operation of Craney Island could potentially affect this geographical area directly. This area has been growing at a much faster rate than either Portsmouth or Suffolk as a whole have been. The census tracts which encompass this section of these cities showed a 46 percent increase in population between 1970 and 1980, offsetting population losses in other parts of the cities. Growth has continued here since 1980 primarily because there is still vacant land which is conveniently located to employment and commercial centers in the region. Projections for the near future by regional planning officials show major growth in the Portsmouth portion of the area and even faster growth in the Suffolk portion, which would more than double its population by the year 2010.

## Education

Education levels in the study area vary considerably from jurisdiction to jurisdiction but overall are roughly comparable to levels for the state and nation as a whole as measured by the percentage of high school graduates. The most rural areas, Isle of Wight County and Suffolk, had the lowest percentages according to the 1980 census (48 and 47, respectively), while Virginia Beach and Williamsburg had the highest figures (80 percent and 78 percent). The census tracts in northwestern Portsmouth had figures that were almost as high as those of Williamsburg and Virginia Beach, reflecting the relatively high socio-economic level of this area. Although the figure for the Suffolk census tract near Craney Island was significantly lower than those for the two Portsmouth tracts, it was slightly higher than the state average and considerably higher than that for all of Suffolk.

Housing

The number of housing units has been increasing in every locality within the study area since 1970 in spite of population declines in some cities and relatively little change in other cities. Housing increases in slow or no growth areas can be attributed to the decline in the persons per housing unit, a figure which has been decreasing nationwide in recent years. In the cities and counties where growth is more rapid in-migration has fueled much of the new housing construction.

Housing patterns throughout the region vary from locality to locality with the faster growing areas having higher median home prices. The 1980 U.S. Census figures showed Portsmouth at $36,600 with the lowest value for owner-occupied housing units followed closely by Suffolk and Norfolk. The highest median values were found in Williamsburg, Poquoson, York County, and Virginia Beach, which averaged about $60,000. Since 1980, housing costs have escalated considerably, in some cases as much as doubling. However, the overall ranking of housing prices within the region has remained relatively constant during this same period.

Housing throughout the region is predominantly owner-occupied except in the cities of Williamsburg and Norfolk, where there is more rental housing. In Norfolk the presence of large numbers of military personnel has created a large market for rental housing, while in Williamsburg the high proportion of such housing is due, in large part, to the existence of a major college.

The housing in the area in Portsmouth adjacent to Craney Island, which is known as Churchland, is very heavily owner-occupied with values considerably above the median for the city as a whole. The area is one of the most stable sections of the city with less housing turnover than much of the rest of the city and the region as a whole. Housing in the section of Suffolk next to this area is almost totally owner-occupied and has values slightly less than those of the Churchland area, based on 1980 census data. More specific information on property values of this area can be found in the appendix on real estate.

The area along the water immediately west of Craney Island, known as River Shores, was originally farm land. In the early 1950s, it was divided into residential lots, with home construction beginning at that time and continuing through the early 1970s. The construction of the levees for Craney Island took place from August 1954 to January 1957, about the same time as the River Shores area began to be developed. After levee construction was completed, significant amounts of material began to be deposited in the containment area, a practice which still continues. Residential development in the area adjacent to and in the vicinity of Craney Island continues to flourish even with the presence of the disposal area.

## DEVELOPMENT AND ECONOMY

The economy of the Hampton Roads area is based on the military, port-related activity, and tourism. These are the basic industries that generate an inflow of income from outside the region, which then provides the impetus for the trade, services, and other sectors of the economy. Conditions in the basic industries play a large role in determining the health and growth patterns of the area's overall economy.

### Employment

The military establishment in the Hampton Roads area is the largest concentration of military activity in the country. Over 40 percent of the area's population is associated in some manner with the military. As of 1984 military earnings made up 20 percent of the area's total earnings and almost a fourth of the total earnings on the southside. The largest regional military facilities are the naval installations in the Norfolk-Portsmouth area and the Army and Air Force bases in the Newport News-Hampton area. A list of military installations in the study area is contained in table 3.

About 23 percent of the area's civilian employment in 1988 was in the government at all its levels, with the Federal Government responsible for slightly less than half of the governmental employment. When military personnel are included in the employment analysis, one-fourth of all employment is directly associated with the Federal Government. Additional employment in secondary industries results from the large presence of the military in the region. There are

also an estimated 38,500 retirees in the area receiving $454.2 million in retirement pay annually.

Table 3. LIST OF MAJOR MILITARY INSTALLATIONS IN THE STUDY AREA

| Installation | City/County |
|---|---|
| Langley Air Force Base (Tactical Air Command) | Hampton |
| Fort Eustis (Army) | Newport News |
| Fort Monroe (Army) | Hampton |
| Coast Guard Reserve Training Center | York County |
| Naval Weapons Center | Yorktown |
| Naval Base | Norfolk |
| Fifth Coast Guard District Headquarters | Portsmouth |
| Little Creek Naval Amphibious Base | Virginia Beach |
| Oceana Naval Air Station | Virginia Beach |
| Fleet Combat Training Center, Dam Neck | Virginia Beach |
| Fort Story (Army) | Virginia Beach |
| Norfolk Naval Shipyard | Portsmouth |
| Camp Pendleton State Military Reservation | Virginia Beach |

The port of Hampton Roads is the leader in export tonnage and second only to the port of New York in total export-import tonnage in the United States (see tables 4 and 5). The Hampton Roads port is oriented chiefly toward bulk cargo, with coal being the major export product. U.S. Department of Commerce figures quoted by the Hampton Roads Maritime Association show that the value of exports moving through Hampton Roads has fluctuated in the years between 1983 and 1987 and was valued at over $6.8 billion in 1987. Table 5 shows how the Hampton Roads port facilities compare with other Atlantic coast ports in terms of export tonnage and the dollar value of that tonnage.

Table 4 . FOREIGN WATERBORNE COMMERCE OF THE PRINCIPAL ATLANTIC COAST PORTS
(in thousands of short tons)

| Port | 1982 | 1985 | 1987 |
|---|---|---|---|
| Hampton Roads | 68,567.0 | 57,660.0 | 48,919.0 |
| New York | 47,616.5 | 54,786.0 | 57,475.0 |
| Philadelphia | 57,945.5 | 24,313.0 | 25,645.0 |
| Baltimore | 30,688.5 | 26,085.0 | 24,871.0 |
| Savannah | unavailable | 8,310.0 | 10,199.0 |
| Charleston | 4,812.0 | 6,797.0 | 7,526.0 |

Source: Hampton Roads Maritime Association

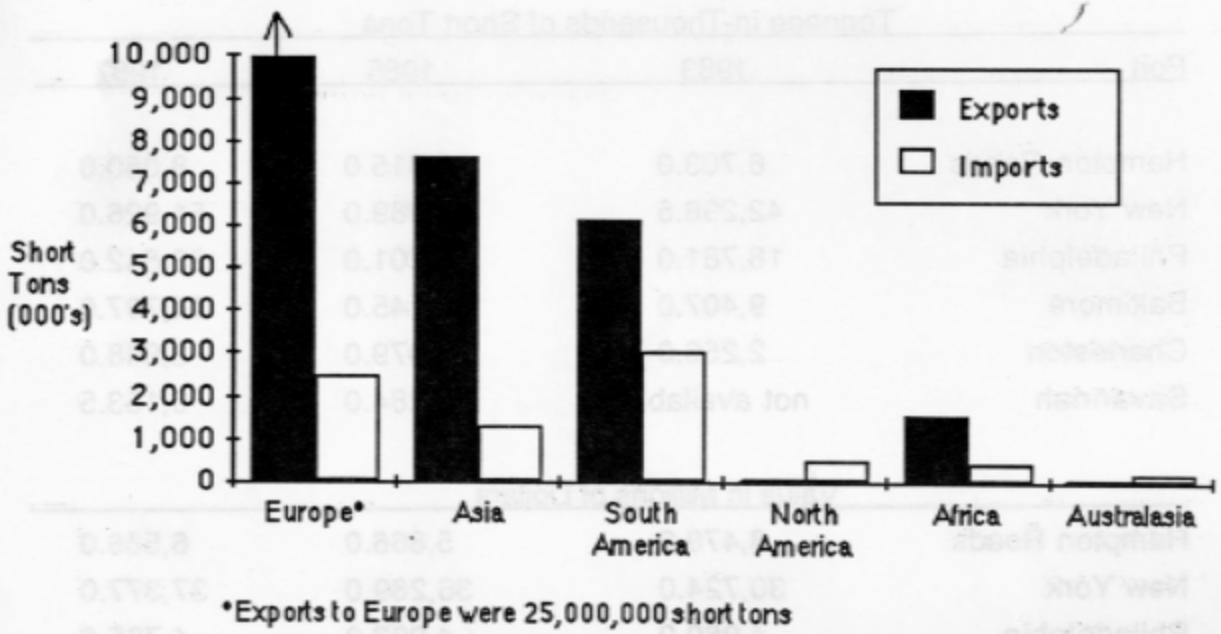
Table 5. EXPORTS THROUGH PRINCIPAL ATLANTIC COAST PORTS

| Port | 1983 | 1985 | 1987 |
|---|---|---|---|
| | Tonnage in Thousands of Short Tons | | |
| Hampton Roads | 41,058.0 | 49,345.0 | 40,869.5 |
| New York | 5,418.0 | 5,797.0 | 5,549.0 |
| Baltimore | 12,216.5 | 13,940.0 | 10,164.0 |
| Philadelphia | 4,269.5 | 5,612.0 | 2,103.0 |
| Charleston | 2,556.0 | 3,718.0 | 3,678.0 |
| Savannah | unavailable | 3,936.0 | 4,046.0 |
| | Value in Millions of Dollars | | |
| Hampton Roads | 6,743.0 | 4,887.0 | 6,812.0 |
| New York | 12,056.0 | 10,226.0 | 10,301.5 |
| Baltimore | 6,936.0 | 5,608.0 | 4,751.5 |
| Philadelphia | 1,223.0 | 1,010.0 | 700.0 |
| Charleston | 2,517.0 | 2,894.0 | 2,961.5 |
| Savannah | unavailable | 2,733.0 | 2,915.0 |

Source: Hampton Roads Maritime Association

Analysis of the type of commodities being exported shows the importance of coal to the Hampton Roads port. About 91 percent of the tonnage in 1987 was coal, while the next largest category, food products, had slightly less than 4 percent of the total volume. The other export commodities made up significantly smaller portions of the total volume. Figure 2 shows that in 1987 the bulk of the export tonnage went to Europe, with Asia, particularly Japan, the next most popular location.

Figure 2. 1987 FOREIGN WATERBORNE COMMERCE




Source: Hampton Roads Maritime Association

Imports play a much smaller role in the port in terms of volume although their dollar value at almost 6.6 billion was only slightly less than the value of exports for 1987. Table 6 shows how the Hampton Roads port compares to the other Atlantic ports in terms of imports. Petroleum and its products represent almost half the import tonnage for the port with various manufactured goods and crude materials the other major categories. South America is the source of the largest percentage of imports with Europe and Asia following.

Table 6. IMPORTS THROUGH PRINCIPAL ATLANTIC COAST PORTS

| Port | 1983 | 1985 | 1987 |
|---|---|---|---|
| | Tonnage in Thousands of Short Tons | | |
| Hampton Roads | 6,703.0 | 8,315.0 | 8,050.0 |
| New York | 42,296.5 | 48,989.0 | 51,926.0 |
| Philadelphia | 18,781.0 | 18,701.0 | 23,542.0 |
| Baltimore | 9,407.0 | 12,145.0 | 14,707.0 |
| Charleston | 2,256.0 | 3,079.0 | 3,848.0 |
| Savannah | not available | 5,284.0 | 6,153.5 |
| | Value in Millions of Dollars | | |
| Hampton Roads | 3,470.0 | 5,866.0 | 6,586.0 |
| New York | 30,724.0 | 36,289.0 | 37,377.0 |
| Philadelphia | 4,960.0 | 4,993.0 | 4,795.0 |
| Baltimore | 5,839.0 | 9,245.0 | 11,559.0 |
| Charleston | 2,257.0 | 3,505.0 | 6,673.0 |
| Savannah | not available | 4,374.0 | 4,844.0 |

Source: Hampton Roads Maritime Association

As table 7 shows, the majority of the deep water terminal facilities in the Hampton Roads area are located on the southside. Over 90 percent of the harbor's general cargo shipments passed through terminals on the southside in 1983 as well as about two-thirds of the coal. Local activities which are highly port dependent or related include railroads, ship chandlering, marine and industrial supply, stevedoring, passenger cruise services, and charter firms. An estimated 120,000 jobs in the state and beyond are in some way dependent in the port.

Table 7. MAJOR DEEP WATER COMMERCE TERMINALS

| Terminal | City | Waterway | Cargo Handled | No. of Piers | No. of Berths |
|---|---|---|---|---|---|
| Newport News Marine Termina | Newport News | James River | General Cargo | 2 | 5 |
| Pier IX | Newport News | James River | Coal | 1 | 2 |
| Dominion Terminal Facilities | Newport News | James River | Coal | 1 | 2 |
| Elizabeth River Terminal | Chesapeake | S. Branch, Eliz. R. | General Cargo | 2 | 2 |
| Lamberts Point Docks, Inc. | Norfolk | Elizabeth River | General Cargo | 5 | 19 |
| Norfolk International Terminal | Norfolk | Elizabeth River | General Cargo | 2 | 13 |
| Portsmouth Marine Terminal | Portsmouth | Elizabeth River | General Cargo | 1 | 3 |
| Sea-Land Service, Inc. | Portsmouth | Elizabeth River | General Cargo | 1 | 1 |
| Norfolk & Western Railway | Norfolk | Elizabeth River | Coal | 2 | 3 |
| CSX Transportation | Newport News | James River | Coal | 1 | 2 |
| Cargill Grain, Inc. | Chesapeake | S. Branch, Eliz. R. | Grain | 1 | 1 |
| Cargill Grain, Inc. | Norfolk | Elizabeth River | Grain | 0 | 1 |
| Amoco Oil Company | Chesapeake | S. Branch, Eliz. R. | Petroleum | 1 | 1 |
| Miller Oil Co. | Norfolk | E. Branch, Eliz. R. | Petroleum | 1 | 1 |
| BP Oil Inc. | Portsmouth | S. Branch, Eliz. R. | Petroleum | 1 | 2 |
| Crown Central Petroleum Corp. | Chesapeake | S. Branch, Eliz. R. | Petroleum | 1 | 1 |
| Koch Fuels, Inc. | Newport News | James River | Petroleum | 1 | 3 |
| Mobil Oil Corporation | Chesapeake | S. Branch, Eliz. R. | Petroleum | 1 | 1 |
| Swann Oil Co. | Chesapeake | S. Branch, Eliz. R. | Petroleum | 1 | 1 |
| Tenneco-Cities Service | Chesapeake | S. Branch, Eliz. R. | Petroleum | 0 | 1 |
| Texaco Refining & Marketing | Chesapeake | S. Branch, Eliz. R. | Petroleum | 1 | 1 |
| UNOCAL | Chesapeake | S. Branch, Eliz. R. | Petroleum | 1 | 1 |
| Atlantic Energy Inc. | Chesapeake | S. Branch, Eliz. R. | LPG | 1 | 1 |

Although the manufacturing sector of the area's economy is somewhat smaller proportionally compared to the state's economy, it is still a significant part of the regional employment picture. Much of the manufacturing that occurs is related to the military or to the commercial port facilities. The largest private employer in the area, Newport News Shipbuilding and Drydock Company, provides 70 percent of the the Peninsula's manufacturing employment and 17 percent of the Peninsula's total employment. Newport News Shipbuilding performs all the area's naval construction, which makes up almost all of the regional shipbuilding activity, and some repair work. However, the majority of the commercial and military ship repair work is done on the southside. As of July 1989, the total area employment in the shipbuilding and repair industry was approximately 33,700, 27,000 of which work at Newport News Shipbuilding and Drydock Company.

The third basic sector of the economy, tourism, employs roughly the same number of people on the southside as on the Peninsula. Jobs generated by tourism are a part of the services sector, which is the largest employment category for the region in the census classification system. On the southside the tourist industry is centered in Virginia Beach, which attracts a broad range of visitors primarily because of its beaches and the recreational facilities associated with them. By contrast, the Peninsula's attractions are more heavily historical and educational, which appeal to a more homogeneous upper-middle class type of visitor.

The remaining sectors of the economy provide significant employment for the area and goods and services to its residents. The services industry, which was mentioned earlier as the largest component of employment, and the wholesale and retail trade sector provide about half the area's employment with lesser numbers of jobs in the construction, transportation, and finance industries. Growth in employment in these areas is highly dependent on the health of the area's basic industries and the general economic climate of the nation.

Hampton Roads, including the ports of Norfolk, Portsmouth, Chesapeake, Newport News, and Hampton, comprises Virginia's greatest port complex. Deep-draft navigation has long been a key stimulus to its commercial,

agricultural, and industrial development. The movement of a large volume of waterborne commerce, together with the presence of major naval facilities, has made Hampton Roads one of the nation's leading ports. In fact, it is by far the largest port exporting bituminous coal from the United States. For a maritime economy to grow and accommodate the diversified needs of the area, adequate navigation channels must be maintained and even deepened.

Unemployment

Unemployment rates for the Hampton Roads area tend to be slightly above state levels but below national levels. The figures for July 1988 show a 4.2 percent jobless rate for the Hampton Roads area compared to a rate of 3.7 percent for the state and 5.3 percent for the nation. A similar pattern was evident in 1987 with rates being about 0.5 percent higher in all three geographic categories. The higher unemployment rate in Hampton Roads compared to Virginia overall can be attributed to the continued turnover in the military. Within the region unemployment tends to be higher in the more rural areas of Suffolk and Isle of Wight County and the older cities of Norfolk, Portsmouth, and Hampton and lower in the more suburban cities and counties.

Commuter Patterns

As in many large, metropolitan areas, more people work in the traditional downtown cities of the Hampton Roads area than live in them. On the southside Norfolk is the location of the largest percentage of jobs and is the employment location for many of the residents of Chesapeake and Virginia Beach. Although Portsmouth has roughly the same number of residents in the work force as jobs in the city, many of those who work in Portsmouth live in surrounding cities and many Portsmouth residents work in Norfolk. On the Peninsula the numbers of residents in the work force and jobs located in Hampton and Newport News balance each other very closely, indicating a balance between in and out-commuters in these cities.

Income

Income levels for the Hampton Roads area are slightly below those for the state and the nation although there is quite a bit of variation among the cities and counties in the area. Census data for median family income in 1979 showed Norfolk with the lowest figure and Poquoson with the highest. For per

capita income Norfolk and Portsmouth had the lowest figure and Poquoson and Virginia Beach the highest, based on census data.

Projections by the Bureau of Economic Analysis of per capita income by city and county through 2035 are shown in the following table. These figures show that income will increase steadily through 2035, although in most jurisdictions it will not increase as fast as the national figure . By 2035 only Newport News and Williamsburg are projected to have per capita incomes greater than the national average.

Within the region, the northwest portion of Portsmouth and northeastern section of Suffolk are prosperous sections of their respective cities. Median family income levels in this area in 1979 were significantly higher than the state average and $7,000 to $9,000 higher than the medians for cities these areas are located in. Data on household income for 1987 for the zip code areas which encompass these tracts indicate that these characteristics have not changed significantly in the past decade.

## Land Use

Waterfront land use varies throughout the study area. Most of the industrial and commercial development is located in Norfolk, Chesapeake, Portsmouth, Hampton, Newport News, and one section of Virginia Beach's oceanfront. Waterfront land use in Suffolk and Isle of Wight County is predominantly undeveloped or residential with a small amount of agricultural. There are also substantial sections of residential development along the James River in Newport News, the Chesapeake Bay in Norfolk and Virginia Beach, the Atlantic Ocean in Virginia Beach, and tributaries to these waterways throughout the region. Portsmouth, Norfolk, Virginia Beach, and Newport News have significant portions of waterfront property owned by the Federal or state government, particularly for military uses.

Table 8. PER CAPITA INCOME (1984 Constant Dollars)

| Area | 1978 | % of U.S. | 1983 | % of U.S. | 1990 | % of U.S. | 2000 | % of U.S. | 2015 | % of U.S. | 2035 | % of U.S. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SOUTHSIDE HAMPTON ROADS | | | | | | | | | | | | |
| Chesapeake | 10,442 | 88 | 11,532 | 93 | 13,295 | 91 | 15,118 | 90 | 17,292 | 90 | 20,693 | 90 |
| Isle of Wight County | 9,799 | 83 | 11,125 | 90 | 13,146 | 90 | 15,270 | 91 | 17,638 | 92 | 21,218 | 92 |
| Norfolk | 9,988 | 84 | 11,207 | 90 | 13,005 | 89 | 14,880 | 89 | 17,007 | 88 | 20,259 | 88 |
| Portsmouth | 10,340 | 87 | 11,341 | 91 | 12,969 | 89 | 14,737 | 88 | 16,882 | 88 | 20,246 | 88 |
| Suffolk | 9,039 | 76 | 10,399 | 84 | 12,231 | 84 | 13,929 | 83 | 15,910 | 83 | 18,961 | 83 |
| Virginia Beach | 12,524 | 106 | 13,488 | 109 | 15,105 | 103 | 16,891 | 101 | 19,127 | 99 | 22,779 | 99 |
| PENINSULA | | | | | | | | | | | | |
| Hampton | 10,585 | 89 | 11,843 | 95 | 13,677 | 94 | 15,559 | 93 | 17,629 | 92 | 20,943 | 91 |
| James City County | 10,204 | 86 | 11,618 | 94 | 13,877 | 95 | 16,185 | 96 | 18,598 | 97 | 22,455 | 98 |
| Newport News | 10,596 | 90 | 12,301 | 99 | 14,462 | 99 | 16,680 | 100 | 19,381 | 101 | 23,365 | 102 |
| Poquoson | 12,188 | 103 | 12,621 | 102 | 14,596 | 100 | 16,691 | 100 | 19,048 | 99 | 22,698 | 99 |
| Williamsburg | 11,808 | 100 | 15,393 | 124 | 17,724 | 121 | 20,246 | 121 | 22,882 | 119 | 27,004 | 118 |
| York County | 10,996 | 93 | 11,457 | 92 | 13,100 | 90 | 14,884 | 89 | 16,932 | 88 | 20,201 | 88 |
| State of Virginia | 10,401 | 97 | 12,882 | 104 | 14,921 | 102 | 17,059 | 102 | 19,581 | 102 | 23,470 | 102 |

Source: Bureau of Economic Analysis, County-Level Projections of Economic Activity and Population, Virginia, 1990-2035

In general, the greatest concentrations of development occur in the older cities of Norfolk, Portsmouth, Hampton, and Newport News. Chesapeake, Virginia Beach, James City County, and York County have major residential sections with commercial centers to provide services to these areas. These localities also have some industrial development, but not the concentration of the older cities. The city of Suffolk and Isle of Wight County are primarily rural, with large tracts of agricultural and wooded land, although residential development is expanding into these areas from the more densely populated cities to the east.

Transportation Facilities

The Hampton Roads area is served by several major U.S. highways and many primary state highways. The interstate system, which is nearly complete, includes Route I-64 and inner city loops I-264, I-464, and I-664. The Hampton Roads Bridge-Tunnel and the Chesapeake Bridge-Tunnel provide highway access across Hampton Roads and the Chesapeake Bay. The I-664 bridge-tunnel crossing between the Newport News-Hampton and Portsmouth-Suffolk areas is currently under construction. In addition to the interstates, other major highways include U.S. Routes 460, 58, and 17.

More than 50 truck carriers currently operate in the study area. These include the common carriers, who provide service over regular and irregular routes, contract carriers handling freight transported under specific agreement, local cartage agents for short haul movements, refrigerated carriers, tank trucks, household goods carriers, and others.

Hampton Roads is served by five rail lines. Together, they provide accessibility to 27 states and an area encompassing two-thirds of the nation's population. Rail service is provided to such northern points as upstate New York; southward to Miami, Florida, and New Orleans, Louisiana; and westward to Omaha, Nebraska, and Kansas City, Kansas. The five railroad companies serving Hampton Roads are:

Norfolk and Southern Corporation
CSX Transportation
Norfolk, Franklin & Danville Railroad Company
Norfolk & Portsmouth Belt Line Railroad
Eastern Shore Railroad

The majority of the air service in the area is provided by Norfolk International Airport, which handled 3.5 million passengers in 1987. This airport is currently served by American, Delta, Eastern, Continental, TWA, United, and US Air. Three commuter lines, Henson, New York Air Connection, and Allegheny Commuter also serve the airport. Patrick Henry Airport in Newport News provides primarily commuter service for residents of the Peninsula. Several small airports in the area offer charter services and accommodate light plane traffic.

## ENVIRONMENTAL RESOURCES

The Hampton Roads area, although highly developed, still has many natural resources, which play an important part in this study.

### Climate

The following paragraphs discuss the climatic features of the area.

Temperature. The Hampton Roads study area is characterized by a generally moderate climate as a result of the area's proximity to the Atlantic Ocean. The average annual temperature is about 59 degrees with temperatures averaging 42 degrees in January and 78 degrees in July. Hot, humid weather is frequent in summer, but hot, dry weather may cause an occasional drought.

Rainfall and Storms. Precipitation, primarily rain, averages about 43 inches annually. Distribution is fairly even throughout the year. Average monthly amounts range from about 6 inches in August to about 3 inches in November. The average annual snowfall is less than 10 inches, occurring from December through March. The maximum snowfall recorded was about 38 inches in the winter of 1935-1936. Precipitation is fairly evenly distributed throughout the year, with average monthly amounts ranging from 5.74 inches in

July to 2.62 inches in November. Measurable amounts occur on an average of about 1 day out of 3. Two general types of major storms affect the Hampton Roads area in the form of northeasters and hurricanes.

"Northeaster" is the term given to a particular type of storm which occurs periodically throughout the fall, winter, and spring months along the Atlantic Coast. This region, for some reason, appears to be the focal point or spawning ground for a disproportionately large number of these storms. A northeaster is characterized by high winds circulating around an essentially stationary low pressure area and producing high tides, large waves, and heavy rainfall along the coast.

The most severe storms in the Hampton Roads area are the late summer hurricanes. A hurricane is characterized by low barometric pressure, high winds (over 74 mph), heavy rainfall, large waves, and tidal surges. Records indicate that about once a year, on an average, a tropical storm of hurricane force passes within 250 miles of Hampton Roads, thus posing threat to the area.

Tides and Currents. Tides and currents in the Hampton Roads area are semi-diurnal and generally complex. Table 9 summarizes the velocities and directions of currents and the spring ranges of tides at selected locations in the Hampton Roads area, as determined by NOAA (National Oceanic and Atmospheric Administration), National Ocean Survey.

## Table 9. TIDES AND CURRENTS - HAMPTON ROADS

| | | Tides (feet) | | Current Velocity (knots) | |
|---|---|---|---|---|---|
| | | Mean Range | Spring Range | Flood | Ebb |
| Waterway | Reference | | | | |
| Norfolk Harbor, VA Hampton Roads | Old Point Comfort | 2.5 | 3.0 | 1.3 | 1.2 |
| | Sewells Point | 2.5 | 3.0 | 0.9 | 1.2 |
| Elizabeth River | Craney Island | 2.6 | 3.1 | 0.7 | 1.2 |
| Southern Branch of Elizabeth River | Berkley | 2.8 | 3.4 | 0.3 | 0.3 |
| Channel to Newport News, VA | Newport News Channel, Middle | 2.6 | 3.1 | 1.1 | 1.2 |
| Nansemond River | Pig Point | 2.8 | 3.4 | 0.8 | 1.0 |
| James River | Newport News 0.1 mile off shipbuilding plant | 2.6 | 3.1 | 0.9 | 1.3 |

Astronomical ocean tides are caused by the gravitational pull of the sun and the moon. They are also affected by the shape of the coastline and the depth of the water along the land. These astronomical tides are usually called normal tides.

The normal tide height varies from tide to tide, depending primarily upon the phase of the moon, the distance of the moon from the earth, and the declination of the moon. Not only do the normal tides vary from tide to tide, but also from month to month and year to year. They make a complete cycle about every 19 years.

In the Hampton Roads area, the normal high tide varies from 1.7 feet to 3.5 feet above mean low water. Normal low tide in the Hampton Roads area

varies from about 0.4 feet below mean low water to 0.7 foot above mean low water.

As indicated in table 9, the mean tidal range at Sewells Point in Norfolk is 2.5 feet. The extremes of irregular fluctuations, due to the combined effects of tides and wind, are between -3.0 and +10 feet, referred to mean low water. Sea level rise in this area has been recorded to be about 1 foot per century.

Winds, Waves and Fog. The mean wind speed in the Hampton Roads area is 11 miles per hour with the prevailing direction being northeast and north in February, March, August, September, and October, and south or southwest for the remainder of the year. The highest wind speed occurring in every month of the year has been over 50 miles per hour, with the maximum speed of record at Norfolk Airport being 80 miles per hour. A speed of 134 miles per hour was recorded at Cape Henry in Virginia Beach. The stage of the tide in the Hampton Roads area is increased to damaging heights by strong northerly winds blowing down Chesapeake Bay and by strong easterly winds blowing into Hampton Roads from the Atlantic Ocean.

The largest waves develop in Hampton Roads, where the following fetch distances are available for wave generation: 8.3 miles in a north-south direction, 8.6 miles in an east-west direction, 11.7 miles in a northeast-southwest direction, and 19.2 miles in a northwest-southeast direction. At sustained wind velocities of 70 miles per hour, these fetch distances would permit the buildup of significant deep water waves of 9 to 13 feet in height. However, due to shallow depths throughout large portions of the various fetches, it is considered that a wave of 9 to 10 feet in height is the highest likely to be generated within the Hampton Roads area under the severest conditions experienced to date.

Fogs of varied density occur in the Hampton Roads area on an average of 25 days per year.

## Hydrology

The James River and its tributaries, Virginia's water drainage system, empties into Hampton Roads. The James River is under tidal influence from its

mouth for 105 river miles upstream to the fall line at Richmond, Virginia. The Elizabeth River and its main branches drain the northern portion of the city of Chesapeake and the cities of Norfolk and Portsmouth. The Nansemond River, which partially drains the city of Suffolk, empties into the mouth of the James River and Hampton Roads. The reaches of the Elizabeth and Nansemond Rivers are almost entirely tidal. Upper reaches of the Nansemond River in the vicinity of Suffolk, Virginia, are dammed, providing freshwater lakes used for recreation and municipal water supplies. Hampton Creek and its tidal tributaries drain the city of Hampton and empty into Hampton Roads near the Hampton Roads Bridge-Tunnel.

Water Quality

Water quality is a term used to describe the condition of water, whether it be river, bay, ocean, or groundwater. Water bodies may be used for many purposes, including water supply for cities, industry, and agriculture; wastewater disposal; cooling for power plants; navigation arteries; fish and shellfish propagation; and recreation. All these uses can be considered in the interests of man, but often they can cause degradation, either directly or indirectly, of the water quality. Several parameters are used as a measure of water quality degradation, including bacterial densities, dissolved oxygen, nutrient concentrations, heavy metals, and less frequently (but equally important) temperature, acidity, pesticides, and chlorine.

The Elizabeth River, a tributary of the James, is used extensively for waste disposal. Currently, forty-eight industrial and fifteen domestic discharges enter the Elizabeth River (VWCB, 1983). In addition, the river receives a wide variety of non-point source loadings from its 300 square mile drainage area, in which approximately one-half million people reside (Cerco and Kuo 1981). All totaled, such loadings represent a tremendous impact. To complicate matters, the Elizabeth River system has very poor flushing characteristics resulting from little freshwater input and a slight topographic relief. Any freshwater entering the system is a result of stormwater runoff and Dismal Swamp drainage. This poor flushing tends to increase the amount of sediment and associated pollutants that are trapped within the river system (Neilson and Kuo 1973-74).

Nutrient enrichment is also a factor influencing the water quality in the Elizabeth River. Algal blooms in the upper reaches of the Southern Branch result in high chlorophyll concentrations and low dissolved oxygen as plants decompose. Various dischargers contribute nutrients, sulfur-sulfites, and heavy metals. Previous discharges of zinc combined with spills and scrapings from ship refitting works have resulted in sediment deposits that are likely to be releasing these materials for some time.

The James River/Hampton Roads area receives substances such as heavy metals, chlorine, phenols, and oil residue which, when found in sufficient concentrations, can cause pathogenic conditions. The VWCB has historical data indicating that the Lower James River is contaminated with copper and zinc, possibly from the Newport News Shipbuilding and Drydock Company, the sewage outfall from Newport News at the Small Boat Harbor, or the Elizabeth River. High levels of copper and zinc have also been found in shellfish. Virginia Institute of Marine Science regards chlorine as the primary problem substance in the Hampton Roads area. In the past, the Lower James River has been closed to all fishing activity except the removal of seed oysters due to the concentrations of Kepone found in various organisms of the aquatic community. Some relaxations of the fishing ban in the James have occurred since the original restrictions were imposed in December 1975. As Kepone levels in sampled fish decreased, modifications were made to allow for some food fish to be taken.

Fecal coliform counts have been high from the mouth of the Nansemond River to the mouth of Hampton Roads and also in the Elizabeth River. This indicates the possibility of the presence of pathogenic microorganisms for infectious hepatitis, acute gastroenteritis, and other water-borne diseases. The Virginia Water Control Board data indicate that coliform counts are high especially during summer months when water temperatures and recreational use of the river is near its peak.

Recreational Resources

Hampton Roads Harbor offers several types of recreational resources. Pleasure boating encompasses activities ranging from sport fishing to transient boating on the harbor's waterways to recreational sites outside the harbor area.

Many marinas and boat ramps exist within the Hampton Roads Harbor area and these provide access and support facilities for recreational boating.

In the Newport News section of the harbor recreational boating occurs in the vicinity of access sites such as Deep Creek, Red's Pier, and the Small Boat Harbor. Typical activities include fishing, sailing and water skiing. On the western shore, the Nansemond River is a center for similar recreational activity. Sunset Creek and the Hampton River on the north side of the harbor are areas where recreational boating is also common.

Several yacht clubs and boating groups utilize the harbor for organized regattas, as well as casual boating. Small sailboat enthusiasts frequently use Willoughby Bay for activities because of its relatively sheltered location and easy public access. Powerboat regattas are occasionally held on the Elizabeth River.

Festival activities such as Norfolk's Harborfest and Hampton's Bay Days attract boaters to the Hampton Roads harbor annually. In recent years all cities bordering the harbor have increased waterfront activities and development in order to attract visitors and tourists. Many facilities for boater access are being created to take advantage of waterway access throughout Hampton Roads. Several cities offer harbor tours of Hampton Roads, generally during the tourist season when other recreational boating activity is at its peak.

On the south side of Hampton Roads the Elizabeth and Lafayette Rivers are the centers of recreational boating activities. The Lafayette River and the Eastern and Western branches of the Elizabeth River offer the surrounding residential areas access for sailing, fishing and water skiing, and the Southern Branch, while heavily industrialized, is a major segment of the Atlantic Intracoastal Waterway in Virginia and is therefore utilized by transient recreational boaters throughout the year.

Sport fishing in the harbor, especially near the Hampton Roads Bridge-Tunnel, has again become a significant recreational activity since the lifting of the Kepone ban on sportfishing in November, 1980.

## Geology and Topography

Hampton Roads, located in southeastern Virginia, lies on the Atlantic Coastal Plain which is composed primarily of unconsolidated marine and non-marine sediments which dip southeasterly, and rest upon a pre-Cambrian metamorphic rock base. These sedimentary layers ranging from clay, sand, and gravel to marine shells, vary in thickness from a few feet at the fall line in the vicinity of Richmond, Virginia, to approximately 12,000 feet on the Virginia continental shelf. In the Norfolk area, these sediments are approximately 2,800 feet thick and range in age from late Mesozoic to Recent.

The terrain of the Hampton Roads area is low-lying, relatively flat and featureless, with an average elevation of approximately 11 feet above mean sea level. The area is traversed by numerous bays and estuaries. Streams are shallow and their channels wide and meandering. Except for dredged channels, water depths in the inland bays and connecting waterways are generally less than 10 feet. Because of the low elevations, the area is quite often subject to tidal flooding caused by hurricanes and northeasters that frequent the area. Flooding of the low-lying land adjacent to the entrances has caused loss of life, damage to property, and blocking of land traffic arteries. Much of the land in downtown sections of the cities was formerly under water and has been reclaimed by use of fill material.

## Mineral Resources

A variety of minerals have been produced in the Hampton Roads area. Most of these resources consist of nonmetals found in sediments in the Coastal Plain. Sand, gravel, clay, and certain marls have been important in providing building material used for such things as brick, pipe, roadways, and fertilizers. The mining of minerals is of minor economic importance within the study area. With few exceptions, the resources mined are in small quantity and produced on a local level.

Some stones and clays are of sufficient quality, however, to be used both outside as well as within the study area. Clay deposits are numerous in Suffolk, where population is sufficient to create great demand for such clay products as brick, drain tile, hollow ware, sewer pipe, pottery, and flue linings. Marls, which

consist partially or wholly of calcareous shell material, are useful as a source of agricultural lime, and as an ingredient in Portland cement.

Aquatic Resources

The study area is an estuary and is of significant ecological and commercial importance. The Hampton Roads harbor is classed as a drowned river mouth type estuary. These estuaries are formed by the submergence of coastline with consequent flooding of river valleys. Complex physical, chemical, and biological factors interact to create the biotic communities characteristic of an estuary. Plant and animal species that inhabit these waters have adapted to wide fluctuations in salinity, temperature, turbidity, nutrients, and various other environmental factors.

Characteristically, estuaries tend to be more productive than either the sea on one side or the freshwater drainage on the other. This is largely due to the nutrient enrichment from salt marshes and subsequent detritus production that feeds the consumers, and is a major source of primary production. It has been estimated that 45% of the net primary production of a Spartina alterniflora marsh is flushed into the adjacent bay by tidal action. Coastal marshes and other shallow water areas export mineral and organic nutrients that support the marine life found in the estuary.

Estuarine phytoplankton populations are large and in turn support the primary consumers, including such local commercially important species as oysters, clams, blue crabs, menhaden, American shad, herring, and the remainder of the resident clupeid populations. Other primary consumers include zooplankton, other mollusks, bay anchovy, and silversides. Fish species that are common to the backwater marsh sections of the Hampton Roads harbor area include the bay anchovy, silversides, sheephead minnow, mummichog, striped killifish, and young of the year croaker and spot.

Tidal or mudflats are commonly built up in estuarine basins. They are composed of soft mud and sand and are usually barren of vegetation, but these flats provide a habitat for an abundant fauna (worms, mollusks and other invertebrates) which feed on the materials brought in by the tide. Estuaries are extremely important to the commercial fishing industry because most

commercial species of oysters, clams, and crabs thrive there. In addition, most coastal fishes of commercial importance utilize estuaries as nursery grounds where juveniles can take advantage of the protection and abundant food. The majority of the species important to the seafood industry are estuarine dependent during some stage of their life cycle.

Many of the shallow water coastal areas of the Chesapeake Bay and its tributaries are covered by dense beds of submerged aquatic vegetation (SAV). Eelgrass (Zostera marina) is one of the major types of SAV and is considered a highly productive ecosystem. Eelgrass beds nourish fishery resources through detrital food webs in much the same way that salt marshes do. They also furnish shelter for young fish and crabs and provide food for water fowl. Unfortunately, eelgrass beds have historically been beset with catastrophes including disease and overforaging by cow-nosed rays. The mainstem of the James River remained unvegetated when surveyed in 1986 (Orth, et al, 1986).

Historical and Archaeological Resources

Hampton Roads is an area endowed with many and varied points of historical and archaeological significance. The more notable of these include Yorktown of the Revolutionary War era (scene of British surrender), Jamestown Festival Park, Colonial Williamsburg, the College of William and Mary, the site of the Civil War battle between the Merrimack and the Monitor, Fort Monroe, Norfolk Naval Shipyard, and St. Paul's Church. There are numerous properties on the National Register in the study area, and the following list includes those which are closest to waterways of concern to this study:

City of Hampton

FORT MONROE, Old Point Comfort
FORT WOOL, Island between Willoughby Spit and Old Point Comfort
HAMPTON INSTITUTE, at the Hampton Roads Bridge-Tunnel
HERBERT HOUSE, on Hampton Creek
OLD POINT COMFORT LIGHTHOUSE
VICTORIA BOULEVARD HISTORIC DISTRICT, on Hampton Creek

City of Newport News

HILTON VILLAGE, on James River
SKIFFES CREEK SAND SPIT SITE, on James River
SOUTHERN TERMINAL REDOUBT, Oakland Farm Industrial Park
S.S. JOHN W. BROWN, Fort Eustis

City of Norfolk

FORT NORFOLK, on the harbor
JAMESTOWN EXPOSITION SITE BUILDINGS, on the harbor
WEST FREEMASON STREET AREA HISTORIC DISTRICT, on Elizabeth River

City of Portsmouth

CRADOCK HISTORIC DISTRICT, on Paradise Creek
DRYDOCK NO. 1, Norfolk Naval Shipyard
PORTSMOUTH NAVAL HOSPITAL, Hospital Point of Elizabeth River
PORTSMOUTH HISTORIC DISTRICT, on Elizabeth River
QUARTERS A, B, AND C, Norfolk Naval Shipyard

City of Virginia Beach

CAPE HENRY LIGHTHOUSE, mouth of the Chesapeake Bay

## PROBLEMS, NEEDS, AND OPPORTUNITIES

### INTRODUCTION

The natural benefits of size, location, ocean accessibility, and a system of deep-draft navigation facilities have all been responsible for the current substantial commerce enjoyed by the Port of Hampton Roads--one of the most important harbor complexes in the world. However, channels, anchorages, and pier facilities require continued maintenance to remain responsive to navigation needs. Therein lies the problem to which this study addresses itself. Required dredging creates the need to dispose of millions of cubic yards of material each year. With a rapidly diminishing capacity at the existing Craney Island Disposal Area, the problems and needs are obvious--where and how will future dredged material be disposed of?

## THE NEED FOR DREDGING

### History

Prior to any Federal improvement in Norfolk Harbor in 1876, there were shoals in the Elizabeth River opposite Sewells Point over which the controlling depth was 21 feet. A bar existed at the mouth of the Eastern Branch over which was a depth of 15 feet. The Southern Branch had a narrow channel with controlling depths of 18 feet, 1-1/2 miles above the Norfolk and Portsmouth Belt Line Railroad Bridge, and of 12 feet for an additional 3 miles upstream to the Norfolk and Western Railway Bridge. The Western Branch had a controlling depth of 12 feet up to one mile above its mouth. The channel to Newport News, in its unimproved state, had a controlling depth of 25 feet.

Like most coastal ports in the nation, increased vessel traffic generated by the growth of foreign and domestic commerce has created demands for improvement of the harbor's major navigable channels to support Naval, state, local, and private commercial needs. The earliest navigation improvements in Hampton Roads consisted of approach and egress channels to waterfront facilities. The work was undertaken by private interests. The first Federal project for systematic improvement of Norfolk Harbor was adopted by Congress in 1876. That project provided for a channel 10 miles long, 500 feet wide, and 25 feet deep (m.l.w.) from that depth in Hampton Roads to the junction of the Eastern and Southern Branches; dredging through the bar at the mouth of the Eastern Branch; deepening and widening of the channel at the mouth of the Southern Branch; and an additional anchorage in front of Berkley and Portsmouth. Between 1876 and 1907, this original project for Norfolk Harbor was modified eight times by various Federal River and Harbor Acts.

Since these early days of harbor improvement, local port interests (governmental and private) have frequently petitioned the Congress for assistance to keep improvement of the harbor abreast of economic development in the area. The Congress has favorably reacted to provide for the progressive deepening and widening of navigation channels within Hampton Roads.

The existing project, authorized by the Water Resources Development Act of 1986, provides for a main channel depth of 55 feet m.l.w. to the major port facilities and terminals of both Norfolk and Newport News.

## THE IMPORTANCE OF DREDGING

The Port of Hampton Roads consists of the commercial maritime facilities in the cities with access to the lower James River, lower Chesapeake Bay, and the Elizabeth River. Waterborne commerce is vital to not only the cities, but also to the Commonwealth of Virginia, to the East Coast, and to the nation as well. While Hampton Roads is and always has been a natural harbor of great importance, the depths of its many channels cannot accommodate deep draft vessels without periodic dredging. In order to retain the present shippers and to entice new business, channels must be maintained and even deepened. The three areas of commercial importance to Tidewater Virginia are non-military (coal, containers, fuels, bulk cargo, etc.), military (mostly the U.S. Navy), and the many area shipyards, civilian and military, for both repair and new construction. The harbor and channels also feature deep draft anchorages which are periodically maintained by dredging. In the Hampton Roads area, channel maintenance dredging is a way of life; a fact; indeed, a requirement. Without dredging, the area would fall far behind its competitors; the world's largest naval base would have to relocate.

As with most other ports in the nation, there is the continuing problem of what to do with material dredged from the channels. The Craney Island Disposal Area was one answer, but it has a capacity limitation. One approach is to raise and/or enlarge Craney Island or to create another confined disposal area. This approach is not well received by any of the local governments; they need and demand the commercial and military maritime business, but vociferously reject the placement of a "disposal area" because of potential adverse environmental, social, and economic impacts within their specific area of jurisdiction. While this sort of approach receives unilateral support from the local citizenry, it places a very difficult burden upon the governmental agencies and private associations pledged to provide for maritime commerce and even improve conditions so that additional business can be attracted and the area remain competitive. Other approaches for the disposal of suitable (clean) material include ocean disposal and beneficial uses such as beach

nourishment. The identification and evaluation of all practical alternatives for inner harbor disposal will be discussed in the subsequent section of this report.

Types of Dredging

All dredging considered in this report may be classified as either new work or maintenance dredging. "New work" is that dredging which will increase the official project depth and/or width of a navigation improvement. "Maintenance dredging" pertains to the removal of sediment and other products of accretion from these navigation improvements so as to maintain the project depth.

Types of Dredging Plant

A dredge may be defined as a machine which removes material from the bottom of waterways by means of scooping or suction devices. There are two primary dredging methods in use today--hydraulic and mechanical. The following paragraphs provide information concerning types of dredges that are available to work in the Hampton Roads area. Further information is contained in appendix A.

Dredges which operate hydraulically use water as a medium to convey the dredged material. The material to be excavated is mixed with water and pumped through the system by a pump as a slurry (generally 10 to 20 percent solids by weight). The cutterhead suction dredge and the hopper dredge operate hydraulically.

The cutterhead suction dredge cuts up the material and pumps it through a long attached pipeline to a confined area or to shore. The length of the discharge line depends on available power, but can be extended with booster pumping stations to a total length of several miles. It would not be practical to use this highly developed machine for discharging dredged material through a pipeline from Norfolk Harbor into the Atlantic Ocean, a distance of 37 to 45 miles from Craney Island Disposal Area.

The hopper dredge has two trailing drag arms extending from both sides of the ship to the waterway bottom. The material is removed from the bottom by suction and pumped into hopper bins aboard the ship. When the hoppers are

filled, the dredge proceeds either to a confined area, where the bins are pumped out, or to the Atlantic Ocean or deepwater dumping grounds where the bins are opened and the material discharged. Conversely, a substantial portion of the work time is spent travelling and pumping out and for discharging its hoppers even if the travel distance is short. This dredge is little affected by swells and waves.

Mechanical dredges remove the bottom material with excavation devices, but do not transport it to the disposal site. Barges, scows and tugs are used for this purpose. All mechanical dredge types resemble land equipment, including the clamshell and dipper dredges. In some cases surface equipment is floated on a barge and used for dredging. The dredge excavates the sediment and places it in an adjacent barge, which when filled, is towed by a tug to a confined disposal area or the Atlantic Ocean, the transfer from the barge to the disposal site may be performed either mechanically by clamshell buckets, or hydraulically by a pumpout system (barge rehandler), or bottom dumped in the Atlantic Ocean.

It is believed that studies should be initiated by the district to determine the practicality of reducing the amount of overdepth dredging. At present, dredging contractors are paid for material dredged below the depth required in the specifications. However, the contractor's equipment may permit more precision in dredging to the depth required which would reduce the amount of material to be disposed. This proposed procedure will challenge the contractor to reduce the dredging to only that required since he would not be paid for any additional dredging; knowing this in advance might produce better results between actual and allowable dredging depths. This would reduce, at least to some degree, the need for total storage in a disposal area which could slightly extend the life of that area.

## THE NEED FOR DREDGED MATERIAL DISPOSAL

### History of Disposal

In the 1870's the "Common Council" of Norfolk requested that material excavated from the harbor channels be used to fill up the low grounds within the city. Hampton Roads at that time was experiencing rapid post war growth; few,

if any, worried about possible environmental problems associated with disposal of dredged material. Actually, the quantities of material dredged from Hampton Road's ports and deposited on waterfront parcels in downtown Norfolk were relatively small. Open-water disposal was commonly practiced during those years when sites such as Craney Island Flats and Tanner's Creek (now the Lafayette River) were considered suitable for that purpose.

By the turn of the century, the Federal Government was dredging millions of cubic yards in Hampton Roads instead of thousands, using the "Ripraps" dumping ground, so called because of its proximity to Fort Wool. The dumping area extended between 1 and 3 miles east of Fort Wool, between the crest of Willoughby Shoal and the Willoughby shore as shown on plate 5. Although the alternate value of the disposal area was regarded as practically useless, complaints regarding its use did arise. Some people alleged that the dumped material was being washed into and shoaling some of the dredged channels in the vicinity, that it was interfering with fishing, and that it was injuring Willoughby Beach as a recreation area. Nonetheless, use of the Ripraps area as a dumping ground continued until about 1913, when the capacity of the area was approached. Consideration was then given to a new area. The site was the island originally called Craney Island, which although owned by the former War Department, was being used as a quarantine area by the cities of Norfolk and Portsmouth. The island was the point of disembarkation for immigrants arriving in Hampton Roads.

It was reasoned that by placing a bulkhead some distance from shore, but still not in water exceeding a depth of about 6 feet, a large repository for dredged material could be provided. Craney Island was in fact bulkheaded some years later by the Navy Department. Over the years, until about 1939, large quantities of dredged material were placed on and immediately around the island by pipeline dredge. Today, Craney Island no longer exists as an actual island. It has been joined to the mainland by filling in the dividing waters. The site comprises a portion of the southern boundary for the current Craney Island Disposal Area.

The Lynnhaven Dumping Ground (plate 5) was established in 1918 for the use of hopper dredges and scows. This disposal area was used regularly

until 1940 when amphibious training activities and emergency restriction forced curtailment of disposal there. At the time its use was discontinued, the Lynnhaven Dump had reached its capacity for hopper dredge dumping; then deposits were made for a time in deeper waters adjacent to the dumping ground as well as north and south of Thimble Shoal Channel.

During 1941-42, a disposal area was established in the lower James River (plate 5) just above Newport News. However, depositing of material was discontinued because of adverse effects on adjacent navigable waters.

During World War II, when entrance to Hampton Roads was restricted by submarine nets, a wartime disposal area was established within the harbor 1.5 miles west of Fort Wool (plate 5). This area of deep water had also been used prior to the establishment of the Lynnhaven dumping area. It was apparent in 1945, after a few years of dumping, that the capacity and retaining characteristics of the area would not permit continued use after the war's end. It was essential then that a solution be found to the problem of disposal of dredged material for the following reasons: (1) to properly plan for the considerable amount of material to be dredged by private and public interests from the Hampton Roads navigation complex; (2) to permit the area to continue to improve its navigation channels in the interest of worldwide shipping; and (3) to prevent the degrading effects of open-water disposal on the marine environment. The solution advocated at that time was an enclosed disposal basin located near the center of dredging activities. A recommendation to that effect was made as the result of a Congressionally authorized study on the matter of disposal. Following the recommendation, Congress passed the River and Harbor Act of 1946 which authorized the construction of the existing Craney Island Disposal Area. The project, as shown on plates 1 and 6, included an area 2 miles long and 2 miles wide, adjacent to the waters of Hampton Roads, entirely enclosed by stone-faced levees. Further discussion of this facility is included in subsequent paragraphs.

Within the Norfolk District, dredging records indicate no ocean disposal occurred prior to the 1950's. The earliest record of ocean disposal from Thimble Shoal and Cape Henry Channels was between 1957 and 1964, respectively. During this period and to about 1966, the material dredged from

these two channels were either used for tunnel cover and beach restoration or were dumped in undelineated ocean areas varying from about 10 to 20 nautical miles east or northeast of Cape Henry.

The Norfolk District began using the Dam Neck Ocean Disposal Site (DNODS) during 1967, shortly after work began on deepening Thimble Shoal Channel to a depth of 45 feet m.l.w. Dam Neck is located about 3.6 miles offshore of Virginia Beach and 37 miles from Craney Island as shown on plate 1. In 1988, EPA designated Dam Neck as an ocean disposal site for dredged material. With limited exceptions, all new work and maintenance dredged material from Cape Henry (leading to Baltimore) and Thimble Shoal Channels have been placed at Dam Neck since its initial usage in 1967.

Current Disposal Areas

Currently, dredged material within Norfolk Harbor is disposed in two major areas. Generally, dredging in the inner harbor (area west of the Hampton Roads Bridge-Tunnel) utilizes the Craney Island Disposal Area. Dredged material from the outer harbor, which includes only the Thimble Shoal Channel (but will eventually include another area in the Atlantic Ocean referred to as the Atlantic Ocean Channel required for the 55-foot channel project), as well as the Cape Henry Channel to Baltimore disposes of dredged material into the Dam Neck Ocean Disposal Site (DNODS), shown on plate 1. A second ocean disposal area, referred to as the Norfolk Disposal Site (NDS), is not in use since its approval is pending at the Environmental Protection Agency (EPA). This site is located about 45 miles from Craney Island and is also shown on plate 1. DNODS will be utilized to its full capacity prior to disposal of dredged material into NDS. With regard to NDS, EPA is initiating action to designate it as a permanent ocean site. Also, in the interest of utilizing dredged material as a beneficial resource, consideration is also given to placing suitable sand on area shorelines and beaches.

The following paragraphs describe the Craney Island Disposal Area in detail. Information pertinent to Dam Neck and the Norfolk Disposal Sites will be discussed in detail in the section on plan formulation since they could be considered for use in the disposal of material from the inner harbor.

Dredged Material Disposal into Craney Island

Craney Island. The Craney Island Disposal Area was authorized by the River and Harbor Act of 1946 and construction began in August 1954. The waters 4,000 feet west of the Norfolk Harbor Deepwater Channel, site of the planned fill area, varied in depth from the shoreline to a maximum of 12 feet m.l.w. The harbor bottom was composed of sand from the shore to a point some 3,000 feet north of the existing Craney Island. At this location, the bottom composition changed to marine clay with depths up to 100 feet thick.

The soft marine clay required the utilization of special construction techniques in the early phases of construction. The base of the levee was built up with sand pumped from a hydraulic dredge. The hydraulic sand fill was constructed up to a height of 3.5 feet m.s.l. (5 feet above mean low water) and had a slope of 1 on 15 down to 3.5 feet below m.s.l. Beyond this point, the slope was reduced to 1 on 30 all the way to the natural bottom. The flat slope was needed to spread the weight of the levee over a wide area of the very unstable harbor bottom. To successfully achieve the desired results, the contractor had to develop a floating swing-discharge line in order to spread the dredged material evenly over the wide area required to obtain a 1 on 30 slope. Plate 6 shows a plan and cross section of the levee as constructed.

The procedure which was utilized called for the construction of the west levee first, followed by construction of the north levee. With the west and north levees in place, a basin was created, protected from the James River currents, into which dredged material could be pumped while awaiting the completion of the east levee. The east levee was the last completed, and only after much difficulty with final closure, due to the action of the tide. Closure took place on 8 January 1957.

Meanwhile the main levees were constructed by a crane with a clamshell rig which followed behind the advancing swing-discharge pipeline cutting a trench on either side of the fill, depositing the material in the middle of the levee. Thus, the levee was built to its design height of 6.5 feet above m.s.l. (8 feet above mean low water). The two side trenches formed the toes for the protective stone riprap which was placed on the slopes. Stones used for the riprap ranged in size from 250 to 1,200 pounds. Finally, when the center

section of the levee was stabilized, a bituminous, 22-foot wide roadway was placed around the entire fill area.

As indicated earlier, some material was being deposited before the inclosure was completed; however, it was not until mid-1957 that substantial amounts of dredged material were being pumped behind the completed levees. The procedure for pumping dredged material called for operation to begin at the east and north sides and build westward. Besides being convenient to those utilizing the fill area, it also insured that any escaping silts would flow away from the deep water channels. Three sluiceways were constructed in the west levee to permit the water within the diked area to flow out as fill was pumped directly into the disposal area. Also, a rehandling basin was placed east of the east levee. Here, bucket and scow dredging operations deposited their material, which was then pumped behind the levees. This was first done by an old hopper dredge stripped of everything but its pumps and moored permanently in position to act as a depository for materials gathered by hopper dredges working in the harbor. In 1963, this procedure ceased and hopper dredges, with new and larger pumps, pumped directly into the disposal area through a special mooring barge which provides the transition connections to a submerged pipeline. In the case of the rehandling basin, when it fills, a contract is awarded for a cutterhead dredge to remove the dredged material and pump it into Craney Island.

Prior to construction, extensive tests were made of the harbor bottom. It was determined that there would be a consolidation of the marine clay bed under the weight of the levee and that settlement of up to 7.5 feet could be expected. To this date, the actual settlement which has taken place is not uniform. The most that has occurred in any 1 year and in any one place totaled 2.8 feet; at some specific places, total settlement did reach the projected 7.5 feet. Any changes which occurred in the design height of the main levee were corrected by project maintenance forces. Most of this consolidation took place during the first 7 years of the life of the main levee. Since 1964, the amount of compaction has ceased and the levees have remained practically stable.

As material is continually pumped behind the main levees, consolidation has been a factor in the inside portion of the fill area. At the time of original

design, it was estimated that ultimate capacity would be in the vicinity of 100,000,000 cubic yards. Due to compaction of the underlying marine clay bed, this figure has been periodically upgraded. As of September 1987, approximately 167,000,000 cubic yards had been deposited. The cost of operating and maintaining Craney Island for the past 3 years has averaged $1,296,000 per year.

The following summarizes the ultimate configuration of Craney Island as it was originally authorized:

| | |
|---|---|
| • Shape | Trapezoidal - offshore dimension east-west, 9,000 feet; inshore dimension east-west, 11,000 feet; north-south projection 11,000 feet. |
| • Area | 2,546 acres, more or less. |
| • Elevation | Main levee (8 feet above m.l.w). Step levee (18 feet above m.l.w.). (Step levee approximately 100 feet inside main levee). |
| • Material | Marine clay, shells, silt, fine sand. |

In accordance with Federal law, debris is now collected from the navigation channels and is disposed into Craney Island. Any further plan will have to provide space (albeit small) for disposal of the debris. This is further discussed in appendix A.

Craney Island Management Plan. As early as the late 1960's, the fact that the Craney Island Disposal Area (CIDA) had a finite life and was approaching the authorized fill height prompted the Norfolk District to consider extending its useful life. For this reason, the District Engineer in 1979 requested the U.S. Army Corps of Engineers' Waterways Experiment Station (WES) to develop a management plan for CIDA. Authority for development and

implementation of disposal area management plans is contained in Section 148 of the 1976 Water Resources Development Act (PL 94-587, 22 October 1976), which states:

> "The Secretary of the Army, acting through the Chief of Engineers, shall utilize and encourage the utilization of such management practices as he determines appropriate to extend the capacity and useful life of dredged material disposal areas such that the need for new dredged material disposal areas is kept to a minimum. Management practices authorized by this section shall include, but not be limited to, the construction of dikes, consolidation and dewatering of dredged material, and construction of drainage and outflow facilities."

Investigations pertinent to development of a management plan, including analysis of past performance and operations, field and laboratory investigations, water quality and storage capacity evaluations, were conducted during January - September 1980. The final Craney Island Management Plan report was published by WES in December 1981 (TR EL-81-11). The recommended plan for implementation, operation and management of CIDA was as follows:

- Subdivide the disposal area, forming three subcontainments, by completing the existing interior dikes.

- Construct new retaining dikes along alignments benched in 1000 feet from the main exterior levee to allow eventual dredged material placement to an average elevation of +30 feet m.l.w. Construct new weirs as required.

- Rotate future disposal annually among the three subcontainments, allowing 1 year active disposal cycle followed by a 2 year inactive cycle for each subcontainment.

- Limit inflow points to east side, and operate with adequate ponding depth.

- Drain and dewater the inactive subcontainment by providing interior and peripheral trenches.

• Continuously upgrade all dikes as conditions allow using on-site material.

• Monitor actual performance of the plan to assess its effectiveness.

A variety of investigations were required to enable rapid implementation of the management plan. Additional foundation investigations were performed to determine the best alignment for raising the perimeter dikes. Fabric-reinforced test dike sections were built on the alignments of the interior dikes. Evaluation of this method indicated the interior dikes could be completed expeditiously, even on the soft foundation. Piezometers were installed to monitor the fabric-reinforced dikes. Topographic and aerial survey investigations were performed to develop surface drainage systems. The types of equipment available for constructing trenches on dredged material were evaluated, and suitable trenching devices selected for procurement. During the period 1982 - 1984, the Craney Island Management Plan was implemented through a combination of construction contracts, procurement contracts, and Government personnel using project-owned equipment. Work included completing construction of the division dikes, using geotextile fabric reinforcement; raising the perimeter and division dikes; construction of five new weir structures; and acquisition of trenching equipment. The plan was fully implemented as of December 1984.

The Craney Island Management investigations and resulting 1981 report by WES was based on a projection of future filling rates of 5 million cubic yards per year. The report indicated that without the management plan, CIDA could contain the 5 million cubic yards per year of maintenance dredging only for an estimated remaining life of 19 years (from 1980). With the management plan operational, it was estimated that a maximum possible benefit of 17 additional years of useful life could be realized. This represents a maximum possible benefit of 89 percent,

$$\frac{36(2016-1980) - 19(1999 - 1980)}{19} \times 100\%.$$

These estimates do not take into account the short-term intensive use that would occur during the harbor deepening. However, it appeared at that time that implementation of the Craney Island Management Plan (CIMP) would likely gain sufficient capacity to consider CIDA as a short-term disposal alternative for the deepening.

In order to evaluate how the management plan has actually been functioning, a draft report dated February 1989, "Craney Island Disposal Area - Site Operations and Monitoring Report, 1980-1987" was submitted to this office. The report states:

> "The total time period for which the site has been operated with management is three years (FY 85 through FY 87). During this period each of the three subcontainments has been through only one total cycle of filling and dewatering. The site history with management is therefore insufficient to conclusively determine the associated benefits."

The letter dated February 23, 1989 forwarding this report stated that it was a summary of the results of recent Craney Island studies. It states:

> "Based on evaluations of the monitoring data and projections of future filling rates (5 m.c.y. per year of maintenance material), it is estimated that the site will be filled to elevation 30 during fiscal year 2000 if the present intensity of management is continued. . . If the site had not been subdivided and managed for increased dewatering, we estimate that the site would be filled during FY 1997. Therefore, the Craney Island Management Plan (CIMP) as implemented to date will result in a gain in useful life of approximately three years . . . . This benefit is less than the maximum possible benefit anticipated in the CIMP. The differences are due to a combination of factors which include limitations in technology/models for projecting long-term filling rates, limited implementation of the CIMP, natural variations in the desiccation processes, and unplanned variations of materials actually placed in the site."

The previously discussed management plans, which assumed an annual deposition rate of 5 m.c.y. maintenance material, did not take into account the intensive use of Craney Island in connection with the harbor deepening. The draft report of 1983 by WES, with final report of 1987, previously referred to, did recommend a fourth subcontainment, for the deepening project, to the west of and outside the boundaries of the existing Craney Island Disposal Area. At that time, there was no authority to adopt this course of action. However, General Design Memorandum 1 for Norfolk Harbor and Channels, Virginia, June 1986 states:

> "It is expected that all inner harbor new work materials from channel and anchorages deepening (50 and 55 feet) can be confined at CIDA. Thus, CIDA satisfies the short term disposal requirements for materials dredged inside Hampton Roads. Without significant expansion and modification, CIDA will not provide adequate capacity for long term maintenance disposal in addition to the deepening."

Accordingly, the 50-foot outbound channel for the inner harbor was completed in 1989 and all dredged material was disposed into Craney Island. Some of the dredged material from the channel to Newport News was utilized to stabilize the west levee.

With regard to the ongoing inner harbor long-term disposal study, WES was employed in 1988 to evaluate the useful life of the existing Craney Island Disposal Area as well as that of six expansion schemes being considered for long-term disposal under six different future dredging scenarios. The final report of the WES study is entitled "Technical Report EL-89 Storage Capacity Evaluation for Craney Island Expansion Alternatives," dated February 1989 and is included in appendix A. The study indicates that the existing Craney Island Disposal Area will be filled by 1997 based on a projected annual deposition rate of 4 m.c.y. based on updated data (see table 15) and no additional new work beyond the 50-foot outbound channel which has already been completed. Furthermore, if the 55-foot outbound project were initiated in 1993, the investigation indicated that Craney Island would be filled to elevation 30 m.l.w. before the end of 1994. By lengthening construction to either 48 or 60 months and optimizing placement of the material (on dike alignments and/or stabilizing

exterior to the containment area) deepening impacts on Craney Island could be reduced somewhat. Under any circumstances, Craney Island would be filled to capacity (elevation +30) within the next few years.

Basically, there have been a number of factors contributing to the difference of life estimates for CIDA between the Craney Island Management Plan and current estimates. These are (a) time elapsed between report (1980) and implementation (late 1984), (b) refinement in mathematical models used for predicting life expectancy, (c) exceptions made to plan operation, (d) more new work material deposited than CIMP anticipated, and (e) not being able to fully implement plan operations-wise.

The following table shows the principle sources of dredged material disposed into Craney Island periodically since its construction in 1957. It indicates the material dredged from the inner harbor by Federal, state, and private interests and deposited in Craney Island since 1957.

## Table 10. SOURCES FOR DREDGED MATERIAL PLACED IN CRANEY ISLAND DISPOSAL AREA

| Source | Description |
|---|---|
| Corps of Engineers: | |
| Norfolk Harbor | Includes material dredged from both the 40-, 45-, and 50-foot channels generally extending from Sewells Point anchorage upstream (south) to N&W railway bridge (Mile 15). |
| Sewells Point | Includes material dredged from Sewells Point Anchorages. |
| Newport News | Includes material dredged from Newport News Anchorage and Newport News Channel extending to Sewells Point Anchorage. |
| Rehandling Basin | Includes material dredged from Craney Island Rehandling Basin. |
| Southern Branch | Includes a portion of material dredged from 35-foot channel upstream (south) of the N&W railway bridge. |
| Miscellaneous | Includes material dredged from the Federal channels under small contracts i.e. Newport News Creek, Hampton Creek, Western and Eastern Branches. |
| Other: | |
| Navy Department | Includes material dredged from areas east of Norfolk Harbor 45-foot channel and slips located along the Naval Yard on Southern Branch. Also, includes material from the U.S. Naval Facilities in the York River. |
| Private Permit (state and private interests) | Includes material dredged from slips located south of Craney Island along eastern side of the channel and slips north of Newport News Anchorage as well as other areas in Norfolk Harbor. |

The following table indicates the material dredged from the inner harbor by Federal, state, and private interests and deposited in Craney Island from 1957 through fiscal year 1987.

Table 11. DREDGED MATERIAL DEPOSITED IN CRANEY ISLAND DISPOSAL AREA
(Cubic yards)

| Fiscal Year | Corps (000s) | Other Federal Interests (000s) | State and Commercial Interests (000s) | Total (000s) | Cumulative Total (000s) |
|---|---|---|---|---|---|
| 1957 | 2,717 | 0 | 983 | 3,700 | 3,700 |
| 1958 | 6,548 | 0 | 0 | 6,548 | 10,248 |
| 1959 | 6,099 | 1,965 | 0 | 8,064 | 18,312 |
| 1960 | 6,743 | 41 | 128 | 6,912 | 25,224 |
| 1961 | 1,717 | 818 | 687 | 3,222 | 28,446 |
| 1962 | 2,025 | 0 | 1,157 | 3,182 | 31,628 |
| 1963 | 2,706 | 548 | 94 | 3,348 | 34,976 |
| 1964 | 2,247 | 729 | 149 | 3,125 | 38,101 |
| 1965 | 3,222 | 710 | 71 | 4,003 | 42,104 |
| 1966 | 5,265 | 827 | 29 | 6,121 | 48,225 |
| 1967 | 10,719 | 0 | 1,708 | 12,427 | 60,652 |
| 1968 | 4,321 | 788 | 858 | 5,967 | 66,619 |
| 1969 | 4,204 | 1,122 | 0 | 5,326 | 71,945 |
| 1970 | 2,968 | 1,376 | 974 | 5,318 | 77,263 |
| 1971 | 15,982 | 1,156 | 182 | 17,320 | 94,583 |
| 1972 | 5,668 | 528 | 512 | 6,708 | 101,291 |
| 1973 | 1,101 | 58 | 2,011 | 3,170 | 104,461 |
| 1974 | 852 | 1,379 | 3,062 | 5,293 | 109,754 |
| 1975 | 2,393 | 568 | 604 | 3,565 | 113,319 |
| 1976 | 3,592 | 1,155 | 1,295 | 6,042 | 119,361 |
| 1977 | 789 | 698 | 513 | 2,000 | 121,361 |
| 1978 | 3,812 | 712 | 2,459 | 6,983 | 128,344 |
| 1979 | 0 | 1,214 | 187 | 1,401 | 129,745 |
| 1980 | 6,515 | 888 | 414 | 7,817 | 137,562 |
| 1981 | 0 | 935 | 0 | 935 | 138,497 |

Table 11. DREDGED MATERIAL DEPOSITED IN CRANEY ISLAND DISPOSAL AREA
(Cubic yards)
(Cont'd)

| Fiscal Year | Corps (000s) | Other Federal Interests (000s) | State and Commercial Interests (000s) | Total (000s) | Cumulative Total (000s) |
|---|---|---|---|---|---|
| 1982 | 4,292 | 891 | 426 | 5,609 | 144,106 |
| 1983 | 3,599 | 480 | 1,382 | 5,461 | 149,567 |
| 1984 | 5,073 | 833 | 0 | 5,906 | 155,473 |
| 1985 | 2,703 | 1,386 | 844 | 4,933 | 160,406 |
| 1986 | 872 | 185 | 2,616 | 3,673 | 164,079 |
| 1987 | 1,681 | 1,132 | 0 | 2,813 | 166,892 |
| Total | 120,425 | 23,122 | 23,345 | 166,892 | 166,892 |
| % Total | 72 | 14 | 14 | 100 | |

The above table indicates that from 1957 to August 1987, a total of about 167 million cubic yards have been deposited into Craney Island. Of this amount, about 20 million cubic yards were discharged by the Corps from the rehandling basin into Craney Island. Much of this material resulted from the discharge of dredged material by state and private interests and other Federal agencies into the rehandling basin. The following is a breakdown of the material deposited into the rehandling basin.

Table 12. MATERIAL DEPOSITED INTO REHANDLING BASIN
(In Cubic Yards)

| Year | Corps | Other Federal Agencies | State and Commercial | Total |
|---|---|---|---|---|
| 1957 | - | - | 340,000 | 340,000 |
| 1958 | 176,000 | 374,000 | 154,000 | 704,000 |
| 1959 | - | 231,000 | 372,000 | 603,000 |
| 1960 | - | 407,000 | 333,000 | 740,000 |
| 1961 | - | 157,000 | 333,000 | 490,000 |
| 1962 | - | 419,000 | 250,000 | 669,000 |
| 1963 | 258,000 | 61,000 | 364,000 | 683,000 |
| 1964 | 336,000 | 30,000 | 281,000 | 647,000 |
| 1965 | 43,000 | 127,000 | 260,000 | 430,000 |
| 1966 | 64,000 | 102,000 | 416,000 | 582,000 |
| 1967 | - | 298,000 | 73,000 | 371,000 |
| 1968 | 49,000 | 6,000 | 164,000 | 219,000 |
| 1969 | - | - | 267,000 | 267,000 |
| 1970 | - | - | 125,000 | 125,000 |
| 1971 | - | - | 397,000 | 397,000 |
| 1972 | - | 136,000 | 307,000 | 443,000 |
| 1973 | - | 6,000 | 35,000 | 41,000 |
| 1974 | - | 176,000 | 216,000 | 392,000 |
| 1975 | - | 142,000 | 201,000 | 343,000 |
| 1976 | - | 55,000 | 110,000 | 165,000 |
| 1977 | - | - | 689,000 | 689,000 |
| 1978 | 12,000 | 193,000 | 423,000 | 628,000 |
| 1979 | - | - | 1,073,000 | 1,073,000 |
| 1980 | 172,000 | 311000 | 604,000 | 1,087,000 |
| 1981 | - | 45,000 | 1,490,000 | 1,535,000 |
| 1982 | - | - | 1,122,000 | 1,122,000 |
| 1983 | - | 385,000 | 809,000 | 1,194,000 |
| 1984 | - | - | 588,000 | 588,000 |
| 1985 | - | - | 559,000 | 559,000 |
| 1986 | - | 231000 | 1,280,000 | 1,511,000 |
| 1987 | - | 151,000 | 227,000 | 378,000 |
| Totals | 1,110,000 | 4,043,000 | 13,862,000 | 19,015,000 |

The following table is a further breakdown of the dredged material deposited into Craney Island.

Table 13. SUMMARY OF FEDERAL VERSUS NON-FEDERAL USE OF CRANEY ISLAND
(in 1,000 cubic yards)

| Year | By Corps | By Other Federal Agencies | State & Private Interests | Total |
|---|---|---|---|---|
| 1957-87 | 120,425 | 23,122 | 23,345 | 166,892 |
| State & Private deposition (a) | - 13,862 | - | + 13,862 | - |
| Other Federal Agencies (a) | - 4,043 | + 4,043 | - | - |
| Total | 102,520 | 27,165 | 37,207 | 166,892 |

(a) Deposition by State/private interests and/or other Federal agencies into Craney Island rehandling basin and then pumped by the Corps into CIDA itself.

The above table indicates that 78 percent of the dredged material pumped into Craney Island between 1957 and 1987 was deposited by Federal agencies and 22 percent was deposited by State and commercial interests.

ORIGIN OF DREDGED MATERIAL

The following table summarizes the origin of the dredged material deposited into Craney Island during the 10-year period between 1978 and 1987. The volumes of material include not only dredging of the Federal channel itself, but also all adjacent Federal, State, and private dredging.

Table 14. LOCATION FROM WHICH MATERIAL WAS DREDGED AND DISPOSED INTO CRANEY ISLAND DURING THE PERIOD 1978 TO 1987

| Channel | Total $yd^3$ | % of total |
|---|---|---|
| Newport News Channel | 8,197,000 | 17.8 |
| Elizabeth River | | |
| Norfolk Harbor Channel (River mile 0 to 9) | 29,667,000 | 64.4 |
| Elizabeth River Channel (River mile 9 to 12) | 1,163,000 | 2.5 |
| Eastern Branch | 1,236,000 | 2.7 |
| Southern Branch | 3,733,000 | 8.1 |
| Western Branch | 820,000 | 1.8 |
| Other Locations | 1,258,000 | 2.7 |
| Total | 46,074,000 | 100% |

Future Disposal Requirements in Inner Harbor

The following table indicates the amount of new work to be accomplished in the inner harbor to obtain the stated depth of channel.

## Table 15. NEW WORK DREDGING TO BE ACCOMPLISHED IN INNER HARBOR

| Item of Work | Dredging Quantities in cubic yards | |
|---|---|---|
| | Incremental | Cumulative |
| **55-foot Outbound Channel** | | |
| Channel to Newport News (inbound/outbound) | 4,500,000 | |
| Norfolk Harbor | 4,300,000 | |
| 55' Anchorages | 800,000 | |
| 45' Anchorage at Sewells Pt. | 3,200,000 | |
| Access channels., berth. areas, etc. | 1,800,000 | |
| | 14,600,000 | 14,600,000 |
| **45-foot Channel** | | |
| Norfolk Harbor and Southern Branch | 3,900,000 | |
| Access channels & berthing areas | 300,000 | |
| | 4,200,000 | 18,800,000 |
| **40-foot Channel** | | |
| Southern Branch | 1,900,000 | |
| Access channels & berthing areas | 100,000 | |
| | 2,000,000 | 20,800,000 |
| **50-foot Inbound Channel** (a) | | |
| Norfolk Harbor | 1,200,000 | 22,000,000 |
| **55-foot Inbound Channel** (a) | | |
| Norfolk Harbor | 4,000,000 | 26,000,000 |

(a) Authorized by Congress, but deferred for construction until need develops.

The following table shows the average annual amount of dredged material deposited into Craney Island for various periods.

Table 16. DREDGED MATERIAL DEPOSITED INTO CRANEY ISLAND

| Period | Average Annual Rate of Deposition (c.y.) |
|---|---|
| 1957 thru 1979 | 5,534,000 (a) |
| 1980 thru 1987 | 4,352,000 (a) |
| 1957 thru 1987 | 5,229,000 (a) |
| 1980 thru 1987 | 708,000 (b) |

(a) Includes new work and maintenance.
(b) New work only.

The above table indicates that the new work and maintenance dredging for the period 1980 to 1987 were reduced significantly over that in the prior period. Subtracting the new work accomplished during this period (708,000 c.y.) and rounding the estimate to the nearest million cubic yards, a conservative average annual estimate of 4 million cubic yards per year is believed to be reasonable for maintenance work including public and private activity in the inner harbor in future years. This assumes no further deepening.

The following table summarizes the future disposal requirements for the inner harbor for the following 50 years.

Table 17. FUTURE DREDGE DISPOSAL REQUIREMENTS
FOR INNER HARBOR
(For Federal, state and private interests)

| Item | Amount (c.y.) |
|---|---|
| New work (see table 15) | 26,000,000 |
| Maintenance | |
| 1990-1994 = 5 years @ 4,000,000 | 20,000,000 |
| 1995-1996 = 2 years @ 4,200,000 (a) | 8,400,000 |
| 1997 (b) = 1 year @ 4,295,000 | 4,295,000 |
| 1998-1999 = 2 years @ 4,313,000 (c) | 8,626,000 |
| 2000 (d) = 1 year @ 4,474,000 | 4,474,000 |
| 2001-2039 = 39 years @ 4,474,000 | 174,486,000 |
| Total | 246,281,000 |
| Rounded | 250,000,000 |

(a) After completion of the 55-foot outbound channel.
(b) After completion of the Southern Branch 45-foot channel.
(c) After completion of the Southern Branch 40-foot channel and 50-foot inbound channel.
(d) After completion of the 55-foot inbound channel.

The above table indicates that in order to provide for the disposal of dredged material resulting from new work and/or maintenance of Federal and/or non-Federal improvements, a disposal area and/or areas with a capacity of about 250 million cubic yards will be required for the next 50 years. A subsequent section on project formulation will indicate the various alternatives considered to meet this objective. In addition, debris is currently collected from the navigation channels and disposed into Craney Island. Any future plan will have to provide space (albeit small) for disposal of the debris. This is further discussed in appendix A.

Nature of Dredged Material

Material within the Norfolk Harbor of the Elizabeth River and the Newport News Channels are considered to be clean and suitable for ocean disposal. Material within the piers and docks have not been tested and therefore there is no assurance that they are sufficiently clean for ocean disposal. For the

purpose of this report, the material in the piers and docks have been assumed clean - the same as the adjoining navigation channels. Detailed tests would have to be made according to EPA guidelines to determine their suitability for ocean disposal. If they prove to be not suitable, they would impinge on the available storage capacity at Craney Island.

Material not suitable for ocean disposal exists in several channel sections of the Elizabeth River and its Southern and Eastern Branches and represent about 16 percent of the 26 m.c.y. of new work which are summarized in table 15.

Sediments of the Elizabeth River are enriched with potentially toxic trace metals and polynuclear aromatic hydrocarbons (PAHs). The PAHs exceed thousands of ppm. The potential sources of these compounds are numerous: petroleum products, coal, creosote, and the incomplete combustion of fossil fuels (e.g. automobile exhausts, industrial smoke stacks, home heating, incinerators, etc.), among others (EPA , 1979). Currently, forty-eight industrial and fifteen domestic discharges enter the Elizabeth River (VWCB, 1983). In addition, the river receives a wide variety of non-point source loadings from its 300 square mile drainage area, in which approximately one-half million people reside (Cerco and Kuo, 1981). All totaled, such loadings represent a tremendous impact. To complicate matters, the Elizabeth River system has very poor flushing characteristics resulting from little freshwater input and a slight topographic relief. Any freshwater entering the system is a result of stormwater runoff and Dismal Swamp drainage. This poor flushing tends to increase the amount of sediment and associated pollutants that are trapped within the river system (Neilson and Kuo, 1973-74).

Toxicity which is measured by observing lethal and sublethal effects on test organisms exposed to potentially toxic sediments (bioassays) was evaluated in Norfolk Harbor and the Southern Branch of the Elizabeth River by Alden and Hall (1984) of Old Dominion University. The toxicity data were analyzed statistically to indicate station locations containing sediment producing significant biological response in test populations. They observed a change in sediment quality associated with maintenance dredging which occurred in the Southern Branch between the summer of 1981 and the spring of

1982. Toxicity of the sediments diminished during this period and PAHs appeared to have decreased in concentration by nearly two orders of magnitude. However, upon subsequent analysis in 1983, levels of toxicity and concentration of PAHs appeared to have increased once again to significant levels. This indicated a "re-invasion" of contamination into the area. The post-dredging return of contamination tends to suggest that the source(s) of contamination (i.e. creosote-saturated river and upland soils, industrial discharges, other non-point sources, etc.) are still prevalent and will be for some time to come.

There are at least two abandoned creosote plants on the Elizabeth River. The Atlantic Wood Industries continues to operate a creosote plant on the river and is on EPA's National Priority List (Superfund). The Virginia Water Control Board indicates that while EPA has designated this area as a high priority for clean-up, there are presently no funds available for clean-up of this site.

The following paragraphs summarize the extent of contaminated material in the inner harbor and Southern Branch, Elizabeth River as observed by Alden and Hall (1984). Based upon these and other investigations, the sediments in the Channel to Newport News and the Norfolk Harbor Channel from Sewells Point to Lamberts Point are suitable for ocean disposal. In the Norfolk Harbor 40-foot channel reach between Lamberts Point and Town Point (see plate 7), the sediments were sampled at four stations. The lower third of this reach should be reserved as a transitional or buffer area between acceptable material and the more unsuitable material immediately upstream which does not meet ocean disposal criteria. Material from this third of the channel should be disposed in Craney Island Disposal Area (CIDA) or another enclosed containment area. For the purposes of this evaluation, it has been assumed that the estimated volumes of new work and/or maintenance material are equally distributed over each mile of the reach under consideration. Table 15 indicates that 3,900,000 cubic yards of material will be dredged in the Elizabeth River and its Southern Branch to attain a depth of 45 feet. Of this amount, 2,300,000 cubic yards are located in the reach of river from Lamberts Point to Town Point. One-third of this amount or 767,000 cubic yards should be disposed in CIDA or another enclosed containment area. The same is true for the maintenance material of about 20,000 cubic yards annually. Based on the

findings, the entire Norfolk Harbor Channel, Southern Branch portion (Town Point to Mile 15) should be placed in an enclosed containment area (1,600,000 cubic yards of new work and 100,000 cubic yards of maintenance annually).

The final section, the Southern Branch 35-foot Channel, was sampled over five stations by Alden and Hall (1984). Bioassays performed using sediments taken from this reach of river produced both lethal and sublethal effects in bioassays. Based on these findings, 100 percent of the total length of this reach, representing 1,900,000 cubic yards of new work and 90,000 cubic yards of average annual maintenance should be placed in CIDA, rehandling basin, or another enclosed containment area.

Table 18 summarizes the unsuitable material in the Elizabeth River and Southern Branch Channels. The estimates of suitable and/or unsuitable material, shown in table 19 are based on the results of studies made in the adjoining navigable channels dredged by the Corps.

The following data applies to channels maintained by the Corps of Engineers. Permit activities in the above river reaches and other dredging activities performed by the Navy and other state and private interests would be in addition to the above mentioned volumes.

A study was made of the dredged material disposed into Craney Island for the 10-year period from January 1978 to August 1987. Table 19 indicated the breakdown between material suitable/unsuitable according to EPA criteria for ocean disposal.

The Corps of Engineers, assisted by the Virginia Institute of Marine Science (VIMS), conducted a study in February 1984 to look at the question of whether Craney Island Rehandling Basin (CIRB) is an environmentally secure means of dredged material containment (Bender, et al., 1984). The Norfolk District participated in the planning and execution phases of the project. Dredged material was obtained from an area near the confluence of the Eastern and Southern Branches of the Elizabeth River (1800 cubic yards) and was discharged into CIRB. The site and adjoining river were monitored for plume dispersion, suspended sediments, and dissolved polynuclear aromatic

hydrocarbons (PAH's). The results of this study in a report prepared by VIMS indicated that the CIRB is an effective trap for the sediments and sediment sorbed PAH's discharged into the Basin. It was noted that liquid inclusions of creosote contained in some dredged materials in the Southern Branch may behave differently than particulate sediments examined in this study.

Based on the 10-year period, the unsuitable material entering the rehandling basin is equal to about 33.3 percent (3,244,786/9,733,739) of the total material disposed of therein. The contaminated material discharged directly into Craney Island is about 1.3 percent (472,401/35,622,448) of the total material pumped therein. Of the total material discharged into Craney Island for the period indicated in the above table, 8.2 percent (3,717,187/45,262,993) was unsuitable.

Table 18. MATERIAL IN ELIZABETH RIVER AND SOUTHERN BRANCH CHANNELS UNSUITABLE FOR OCEAN DISPOSAL

| From | To | Depth | | New Work, CY | | Annual maintenance, CY | |
|---|---|---|---|---|---|---|---|
| | | Existing | Proposed | To be dredged | Into CIDA (a) | To be dredged | Into CIDA |
| Lamberts Pt | Town Pt | 40 | 45 | 2,300,000 | 767,000 | 60,000 | 20,000 |
| Town Pt | Mile 15 | 40 | 45 | 1,600,000 | 1,600,000 | 100,000 | 100,000 |
| Mile 15 | Mile 18 | 35 | 40 | 1,900,000 | 1,900,000 | 90,000 | 90,000 |
| | | | TOTALS | 5,800,000 | 4,267,000 | 250,000 | 210,000 |

(a) Includes rehandling basin.

## Table 19. DREDGED MATERIAL DISPOSED INTO CRANEY ISLAND

| Material disposed into rehandling basin | | | | Material pumped from rehandling basin into Craney Island | Material pumped directly into Craney Island | | |
|---|---|---|---|---|---|---|---|
| Year | Unsuitable | Clean | Total | | Unsuitable | Clean | Total |
| 1978 | 53,370 | 344,845 | 398,215 | 1,231,637 | 222,230 | 5,298,563 | 5,674,936 |
| | | | | | 151,893 | | |
| | | | | | 2,250 | | |
| 1979 | 313,989 | 987,821 | 1,301,810 | | | 3,108,360 | 3,108,360 |
| 1980 | 162,538 | 924,077 | 1,086,615 | 1,637,381 | | 4,396,468 | 4,396,468 |
| 1981 | 515,498 | 1,019,950 | 1,535,448 | | | 3,259,134 | 3,259,134 |
| 1982 | 627,966 | 551,458 | 1,179,424 | 1,414,988 | | 1,870,351 | 1,870,351 |
| 1983 | 490,243 | 704,521 | 1,194,764 | 1,414,988 | | 4,409,347 | 4,409,347 |
| 1984 | 223,256 | 364,695 | 587,951 | 869,433 | | 6,446,432 | 6,446,432 |
| 1985 | 65,642 | 493,213 | 558,855 | 1,391,094 | | 1,748,564 | 1,748,564 |
| 1986 | 555,173 | 956,799 | 1,511,972 | | 96,028 | 3,481,104 | 3,577,132 |
| 1987 | 237,111 | 141,574 | 378,685 | 1,681,024 | | 1,131,724 | 1,131,724 |
| TOTAL | 3,244,786 | 6,488,953 | 9,733,739 | 9,640,545 | 472,401 | 35,150,047 | 35,622,448 |

The following table summarizes the estimated future amount of unsuitable dredged material from the inner harbor. It indicates that of the 250 million cubic yards of dredged material to be disposed of over a 50-year period, about 22 million or about 9 percent will be unsuitable and cannot be disposed of in the Atlantic Ocean, but must be placed in a confined area. Plate 7 shows the location of the material unsuitable for ocean disposal.

Table 20. ESTIMATED FUTURE AMOUNT OF UNSUITABLE DREDGED MATERIAL IN INNER HARBOR

| Item | Total Yardage | Unsuitable Material C.Y. | Unsuitable Material % Total |
|---|---|---|---|
| New Work to be Accomplished | 26,000,000 | 4,667,000 (c) | 18 |
| 50-year Maintenance (a) | 221,703,000 (b) | 17,736,000 | 8.2 |
| Total | 247,703,000 | 22,403,000 | |
| Rounded | 250,000,000 | 22,400,000 | 9 |

(a) By Corps, other Federal agencies and state and private interests over a 50-year period.
(b) This reflects increased maintenance associated with new work projects.
(c) All in Elizabeth River and/or Southern Branch 45/40 foot channels. None are in proposed 55-foot outbound channels.

Although table 18 indicates that about 210,000 cubic yards per year of unsuitable material can be expected from future dredging of the Elizabeth River and Southern Branch channels (and would thereby increase the amount of unsuitable material in table 20 to 30 million cubic yards for the 50-year period), the entire 10 year record from 1978 to 1987 shows that only about 50,000 cubic yards per year were dredged from these channels during this entire period. This may be due in part to the fact that in earlier years, channel dredging with the Federal hopper dredges was done more frequently resulting in the

equivalent of advanced maintenance. The following are factors to be considered:

a. The 210,000 cubic yards per year includes buffer areas that are specifically reserved and considered as unsuitable for ocean disposal.

b. It is conjectural whether the Virginia Department of Highways will, in the future, dredge the substantial quantities of unsuitable material it has in the past from this area to place future tunnels.

c. Although not specifically investigated, dredging of the Eastern Branch of the Elizabeth River has been conservatively included in table 20 as unsuitable material.

d. Retention and desiccation would further reduce the amount of material stored.

e. As previously stated, EPA has designated this area as a high priority for cleanup. The Virginia Water Control Board (VWCB) has an ongoing program for the management of toxics in discharges from point sources such as those located in the Southern Branch. The Toxics Management Regulation was adopted by the VWCB and became effective in 1988. This regulation is designed to provide standards and procedures to minimize, correct or prevent discharge of toxic pollutants. The regulation is already being vigorously enforced with industrial dischargers on the Southern Branch. In addition, the VWCB is developing a sediment quality management plan in concert with Virginia Institute of Marine Science, Old Dominion University, and the Norfolk District Corps. This endeavor will involve mapping the areal and vertical distribution of toxic sediments in the Elizabeth River and developing a long-term strategy for management and cleanup. As part of the 1987 Chesapeake Bay Agreement, an implementation plan for the reduction and control of toxics entering the Chesapeake Bay ecosystem from point and nonpoint sources and from bottom sediments was developed and adopted by Federal and state participants in December 1988. These developments indicate a concern for reducing and controlling pollution in the Elizabeth River which, if realized, will

result in smaller proportions of unsuitable sediments to suitable sediments being dredged from the Southern Branch in the future.

Based on the above factors it is believed reasonable to assume that the channels in this area will be cleaned up before the future 50-year period under consideration in this study for disposal of dredged material is over. For the above reasons, the data for the 10-year historical period from 1978-1987 was considered reasonable for establishing the amount of unsuitable material to be disposed.

LONG-TERM DISPOSAL PROBLEM

The disposal of dredged material is always a major concern in connection with large harbor projects. The Port of Hampton Roads is no exception. With the prospects of a major deepening and continued maintenance of existing and/or improved channels and anchorages, it is essential that the problem of long-term disposal be addressed at this time. This position is in accordance with the conclusion of the Board of Engineers for Rivers and Harbors that post-authorization studies should be conducted to develop economical long-term disposal solutions.

As a part of this long-term disposal investigation, the Waterways Experiment Station (WES) was requested to evaluate the filling rate of Craney Island. In order to determine the remaining disposal life, the following dredging scenarios were considered by WES:

a. Maintaining existing inner harbor project (including 50-foot deepening)

b. Dredging of 55-foot outbound channel.

c. Dredging entire 55-foot channel (full width).

d. Disposal of Southern Branch new work deepening only.

e. Dredging 55-foot outbound and deepening Southern Branch.

f. Dredging entire 55-foot deepening (full width) and deepening Southern Branch.

A total of 4 million cubic yards annually of maintenance dredged material was used for disposal from 1987 through 1994. This was gradually increased to 4,474,000 cubic yards in year 2000 as shown in table 17.

At present Craney Island consists of three cells, each of which has a surface area of approximately 750 acres. For the filling simulations to which Craney Island was considered, the existing interior elevations of each of the three cells were assumed to be elevation +19 m.l.w. Furthermore, it was assumed that the interior of each of these cells is level, i.e., all of the interior is at elevation +19 m.l.w.

The following assumptions were made relative to site conditions and/or operations. All material for dike raising will come from inside the site. Only one dewatering scenario was considered; it was assumed that an active dewatering program would be followed, thereby resulting in maximum dewatering of the site. Placement of the average annual quantity of dredged material was simulated by semi-annual disposal of one half the quantity each in January and July. The disposal cells were assumed to be filled when the dredged material surface reaches elevation +30 m.l.w.

The following table indicates the results of the WES evaluation.

Table 21. ESTIMATED REMAINING LIFE OF CRANEY ISLAND

| Dredging Scenario (see items a thru f above) | Year filled | Remaining life in years after 1989 |
|---|---|---|
| a | 1997 | 8 |
| b | 1994 (a) | 4 |
| c | 1994 (a) | 4 |
| d | 1994 (a) | 4 |
| e | 1994 (a) | 4 |
| f | 1994 (a) | 4 |

(a) Predicted to fill before end of fiscal year.

The above table indicates that Craney Island will be full to capacity (elevation +30 m.l.w.) in less than 10 years under existing maintenance conditions and will be full in about five years if the dredged material from the 55-foot channel is placed therein. Recently, a decision was made to take this dredged material from the 55-foot channel to sea. However, depending on (a) the state's decision relative to a future disposal area, (b) construction thereof if it be a confined site, and (c) the timing of Federal and state appropriations, it is possible that this material may be placed in a confined site.

RELATED PROBLEMS, NEEDS AND OPPORTUNITIES

There are several other important factors that must be considered in evaluating future opportunities for disposal of dredged material in Chesapeake Bay and its tributaries. They include the following:

a. Chesapeake Bay Agreement,

b. Action by the Virginia General Assembly,

c. Wetlands agreement between EPA and the Department of the Army,

d. Newspaper statement on Chesapeake Bay cleanup by EPA and Defense Department,

e. Agreement between the U.S. Department of Interior and Defense regarding waterfowl habitat conservation, and

f. Economic impacts on the economy of Virginia and Hampton Roads of increases in the unit cost of dredging.

Chesapeake Bay Agreement. In 1987, an agreement was reached on restoring and protecting Chesapeake Bay. The following is an excerpt:

1987 CHESAPEAKE BAY AGREEMENT

"The Chesapeake Bay is a national treasure and a resource of worldwide significance. Its ecological, economic, and cultural importance are felt far beyond its waters and the communities that line its shores. Man's use and abuse of its bounty, however, together with the continued growth and development of population in its watershed, have taken a toll on the Bay system. In recent decades, the Bay has suffered serious declines in quality and productivity. Representing the Federal government and the states which surround the Chesapeake Bay, we acknowledge our stake in the resources of the Bay and accept our share of responsibility for its current condition. We are determined that this decline will be reversed. In response, all of our jurisdictions have embarked on ambitious programs to protect our shared resource and restore it to a more productive state. In 1980, the legislatures of Virginia and Maryland established the Chesapeake Bay Commission to coordinate interstate planning and programs from a legislative perspective. In 1985, Pennsylvania joined the Commission. And, in 1983, Virginia, Maryland, Pennsylvania, the District of Columbia, the U.S. Environmental Protection Agency and the Chesapeake Bay Commission formally agreed to a cooperative approach to this undertaking and established specific mechanisms for its coordination. Since 1983, our joint commitment has carried us to new levels of governmental cooperation

and scientific understanding. It has formed a firm base for the future success of this long-term program. The extent and complexity of our task now call for an expanded and refined agreement to guide our efforts toward the twenty-first century. Recognizing that the Chesapeake Bay's importance transcends regional boundaries, we commit to managing the Chesapeake Bay as an integrated ecosystem and pledge our best efforts to achieve the goals in this Agreement. We propose a series of objectives that will establish a policy and institutional framework for continued cooperative efforts to restore and protect Chesapeake Bay. We further commit to specific actions to achieve those objectives. The implementation of these commitments will be reviewed annually and additional commitments developed as needed.

## GOALS AND PRIORITY COMMITMENTS

This new agreement contains Goals and Priority Commitments for Living Resources. Water Quality; Population Growth and Development; Public Information, Education and Participation; Public Access; and Governance. The parties to this 1987 Agreement are the U.S. Environmental Protection Agency representing the Federal Government, the District of Columbia, the State of Maryland and the Commonwealths of Pennsylvania and Virginia (hereinafter the "States") and the Chesapeake Bay Commission. This Agreement may be amended and attachments added in the future by unanimous action of the Chesapeake Bay Commission.

## WATER QUALITY

Goal: Reduce and control point and non-point sources of pollution to attain the water quality condition necessary to support the living resources of the Bay. The improvement and maintenance of water quality are the single most critical elements in the overall restoration and protection of the Chesapeake Bay. Water is the medium in which all living resources of the Bay live, and their ability to survive and flourish is directly dependent on it. To ensure the productivity of the living resources of the Bay, we must clearly establish the water quality conditions they require and must then attain and maintain those conditions. Foremost, we must

improve or maintain dissolved oxygen concentrations in the Bay and its tributaries through a continued and expanded commitment to the reduction of nutrients from both point and non-point sources. We must do the same for toxics and conventional pollutants. To be effective, we will develop basin-wide implementation plans for the control and reduction of pollutants which are based on our best understanding (including that derived from modeling) of the Bay and its tributaries as an integrated system.

OBJECTIVES

- Provide timely construction and maintenance of public and private sewerage facilities to assure control of pollutant discharges.

- Reduce the discharge of untreated or inadequately treated sewage into Bay waters from such sources as combined sewer overflows, leaking sewage systems, and failing septic systems.

- Evaluate and institute, where appropriate, alternative technologies for point source pollution control, such as biological nutrient removal and land application of effluent to reduce pollution loads in a cost-effective manner.

- Establish and enforce pollutant limitations to ensure compliance with water quality laws.

- Reduce the levels of non-point sources of pollution.

- Reduce sedimentation by strengthening enforcement of existing control regulations.

- Eliminate pollutant discharges from recreational boats.

- Identify and control toxic discharges to the Bay system, including metals and toxic organics, to protect water quality, aquatic resources and human health through implementation and enforcement of the states National Pollutant Discharge Elimination System permit programs and other programs.

- Reduce chlorine discharges in critical finfish and shellfish areas. Minimize water pollution incidents and provide adequate response to pollutant spills.

- Manage sewage sludge, dredged spoil and hazardous wastes to protect the Bay system.

- Manage groundwater to protect the water quality of the Bay.

- Quantify the impacts and identify the sources of atmospheric inputs on the Bay system."

It is noted that the management of dredged material and hazardous wastes are one of the objectives of the Chesapeake Bay agreement. The agreement, signed by Federal and state representatives in 1987 is committed to "restoration and protection of living resources, their habitats and ecological relationships." The Commonwealth of Virginia is considering adopting regulations to insure the compliance with the objectives of the Chesapeake Bay Agreement.

Action by the Virginia General Assembly

On February 12, 1988 the Virginia General Assembly declared the lower James River a state historic river with noteworthy scenic and ecological qualities. The enabling act was within the framework of the Virginia Scenic Rivers Act of 1970. The James River segment so named runs generally from the Charles City/Henrico County line south and eastward to the mouth of the Chickahominy River, which empties into the James River about 40 miles upstream of Hampton Roads.

The following House Joint Resolution No. 163 was agreed to by the House of Delegates and Senate during the 1988 Session of the General Assembly of Virginia. Undoubtedly, the state will consider this joint resolution in its effort to resolve the long-term dredged disposal needs for the Port of Hampton Roads.

GENERAL ASSEMBLY OF VIRGINIA - 1988 SESSION
HOUSE JOINT RESOLUTION NO. 163

Requesting the United States Army Corps of Engineers, the Virginia Marine Resources Commission, the Virginia Institute of Marine Science and other appropriate federal and state agencies to consider and make recommendations with respect to the Craney Island landfill.

Agreed to by the House of Delegates, March 11, 1988
Agreed to by the Senate, March 9, 1988

WHEREAS, in 1946, the Governor of Virginia conveyed certain submerged lands containing 2,500 acres, more or less, known as Craney Island, lying and being in Hampton Roads, to the United States of America to be used as a disposal site for material dredged from Hampton Roads Harbor; and

WHEREAS, the United States Army Corps of Engineers has announced proposals for the expansion of the Craney Island landfill area and continued use thereof beyond the originally projected termination date; and

WHEREAS, Craney Island is within the boundaries of the City of Portsmouth and its ultimate development is vital to the economic vitality of the City of Portsmouth and the Commonwealth of Virginia; and

WHEREAS, Craney Island represents a site of substantial size which the City of Portsmouth can offer for expansion of its tax base to the relief of its private homeowners and residents; and

WHEREAS, in excess of sixty percent of the land of the City of Portsmouth is nontaxable either as real estate or personal property primarily by reason of ownership thereof by federal or state governmental agencies; and

WHEREAS, the Virginia Port Authority has expressed an interest in acquiring a certain portion of the Craney Island property for port development and expansion; and

WHEREAS, an assessment of the environmental impact on the seed oyster beds, other shellfish and crabs, which might be affected by alternatives to the Craney Island landfill should be considered prior to any expansion; and

WHEREAS, the Council of the City of Portsmouth has steadfastly expressed this intention to assure that Craney Island is developed in a manner which will guarantee maximum benefits for the city and the Commonwealth; and

WHEREAS, the Council of the City of Portsmouth is further committed to assure that Craney Island is developed in a manner compatible with the continued residential expansion occurring on the property in close proximity thereto; now, therefore, be it

RESOLVED by the House of Delegates, the Senate concurring, That the United States Army Corps of Engineers, the Virginia Marine Resources Commission, the Virginia Institute of Marine Science and other appropriate federal and state agencies consider and make recommendations with respect to (i) all alternatives to the expansion of Craney Island landfill for disposal of material dredged from Hampton Roads and (ii) plans which would make Craney Island available for development at the earliest possible date; and, be it

RESOLVED FURTHER, That the Clerk of the House of Delegates transmit copies of this resolution to the Speaker of the United States House of Representatives, the President of the United States Senate, the United States Army Corps of Engineers, and to all members of the Virginia Delegation to the United States Congress in order that they may be apprised of the sense of the Virginia General Assembly.

## MEMORANDUM OF AGREEMENT BETWEEN ENVIRONMENTAL PROTECTION AGENCY AND ASSISTANT SECRETARY OF THE ARMY

On 15 November 1989, Mr. Robert W. Page, Assistant Secretary of the Army for Civil Works, and Ms. LaJuana S. Wilcher, Assistant Administrator for Water, U.S. Environmental Protection Agency, signed a Memorandum of Agreement (MOA) providing guidance on the type and level of mitigation of wetlands impacts required to implement Section 404 of the Clean Water Act (Federal Water Pollution Control Act, Public Law 92-500). This MOA became effective in February 1990 and is intended to clarify the Corps mitigation practices in applying guidelines. The MOA also clarifies and establishes a consistent Corps-wide practice for considering mitigation. Mitigation should occur in the following sequences:

1. Avoidance of wetlands impacts through a determination of the least environmentally damaging practicable alternative.

2. Appropriate and practicable steps to minimize the adverse impacts through project modifications, and

3. Appropriate and practicable compensatory mitigation for unavoidable adverse impacts which remain after all appropriate and practicable minimization has been required.

The term "practicable" means available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes.

While the MOA focuses on the Section 404 regulatory program, the Corps plans to integrate the mitigation framework provided in the MOA into all Corps activities.

The MOA is consistent with the President's goal of no overall net loss of wetlands. However, the MOA expressly recognizes that achieving no net loss of wetlands values and functions is not possible for every permit action. The President's Domestic Policy Council Interagency Working Group on Wetlands is currently developing policy on no overall net loss of wetlands.

## CHESAPEAKE BAY CLEANUP BY EPA AND DEFENSE DEPARTMENT

An article in the Virginian-Pilot/Ledger-Star newspaper dated 21 April 1990, stated:

> "Declaring their agencies the 'guardians of America's future', Defense Secretary Dick Cheney and Environmental Protection Agency Administrator William K. Reilly signed a cooperative effort Friday to help restore the Chesapeake Bay.
> 'As a user of the Chesapeake's many resources, the Defense Department has a shared responsibility to restore and protect this natural treasure,' Cheney said 'I want our environmental policies in the Chesapeake Bay to stand as a model for Federal environmental activities everywhere.' New development and construction will be consistent with President Bush's goal of 'no net loss' of wetlands."

## AGREEMENT BETWEEN THE U.S. DEPARTMENTS OF INTERIOR AND DEFENSE REGARDING WATERFOWL HABITAT CONSERVATION

On 23 January 1990, the Department of the Interior and Army entered into a cooperative agreement regarding waterfowl habitat conservation, in particular, the opportunities associated with Corps of Engineers projects and activities consistent with the North American Waterfowl Management Plan. This

plan focuses on the value of maintaining an adequate habitat base to ensure perpetuation of North American waterfowl populations. In principle, waterfowl management is dependent on protection, restoration, and management of habitat, the persistent loss of which must be reversed.

Economic Impact of Increases in the Unit Cost of Dredging

In the evaluation of future disposal plans for the Port of Hampton Roads, it will be important to consider the impact of increases in dredging and disposal costs associated with the various plans. Of major concern is the fact that once dredging and disposal costs are increased to a certain point, there can be severe financial impacts on the private maritime companies whose berths are located along the channels serving Hampton Roads. This can mean that some companies may go out of business or have to relocate to other ports. These occurrences would in turn have an effect on the overall economic welfare of the Hampton Roads area. Consideration will be given to these impacts in the formulation and evaluation of long-term disposal plans.

## BENEFICIAL USES OF DREDGED MATERIAL

The beneficial usage of dredged material has been limited to sediments composed predominantly of sand. These suitable materials may contain smaller amounts of clay and silt but still maintain sufficient shear strength for construction purposes or fill materials. Cleaner sands are used for shoreline stabilization and beach nourishment. Unsuitable sediments composed of loose silts and soft clays have shear strengths that are too low for construction purposes and are too fine to be used for shoreline stabilization.

Considerable quantities of suitable materials dredged from navigable channels have been used for beneficial purposes in the past. In October and November 1975, maintenance dredging was accomplished in Thimble Shoal Channel in Chesapeake Bay. It resulted in the accumulation of over 450,000 cubic yards of sand which were retained within a storage area at Fort Story. The Virginia Beach Erosion Commission conducted a truck haul from this stockpile to nourish the beach for each successive year from 1975 through 1979. Excellent quality, beach grade sand is also obtained on a two to three year cycle from the maintenance dredging in Lynnhaven Inlet. This on-going project results in 150,000 to 200,000 cubic yards of material that is stockpiled at

an adjacent storage area. This sand is truck hauled to the resort strip at Virginia Beach for beach nourishment. In 1988 approximately 3 million cubic yards of suitable material was dredged from the Newport News channel to stabilize the west dike of the CIDA. Other projects have included tunnel cover and/or beach restoration from Thimble Shoal and Cape Henry Channels. The Virginia Department of Transportation obtained dredged material from Thimble Shoal Channel for construction of islands in the James River Estuary for Interstate 664. Approximately 3 million cubic yards of suitable material was dredged by the Navy for harbor expansion in 1985. 528,000 cubic yards of these sediments were used for shoreline stabilization at Willoughby Spit while 1,514,000 cubic yards were used as fill material at an adjacent site.

Consideration was given toward the potential for utilizing suitable dredged material from the inner harbor. This would serve a two-fold purpose of beneficially using the dredged deposits and reducing the needed storage in CIDA for these sediments. At present, approximately 4 million cubic yards of sediments are disposed into the CIDA each year (see table 17). The majority of these sediments are soft, low-strength clays which comprise most of the sediments in CIDA. However, on an average 15 to 20 percent of these dredged materials are predominantly sand with varying amounts of clay and silt intermixed. These sandy materials, though not meeting most construction specifications have historically been excellent for the construction and maintenance of exterior and subcontainment dikes in CIDA and will continue to be used for this purpose in the future.

Deposition of clean dredged material over a shallow area for the purpose of marsh creation would be one method of using the material for a beneficial purpose. However, there are several drawbacks to this idea. These include:

(1) Dredged material capacity would be severely limited compared to a diked containment area,

(2) There would still be a loss of shallow water habitat,

(3) Stability of the created marsh may be in question due to wave action and/or erosion.

## MAINTENANCE AND IMPROVEMENT OF DIKES

Generally, the suitable material in CIDA is located in the eastern portion of the disposal area adjacent to the rehandling basin. The heavier material, pumped into Craney Island, either directly or from the rehandling basin, settles here. Coarse grained materials have been rehandled and trucked to various locations within the disposal area by the Norfolk District for use in maintenance and upgrading of the main retaining dike, especially the western dike and interior division dikes. This is partly due to erosion of the dikes caused by heavy rains and the need to raise them as the disposal area fills and to allow for freeboard. Large volumes of normally unacceptable silts and clays have been utilized in constructing the benched dike section used in upgrading the overall dike elevations. The material is brought up the dike crest from inside the containment area in short lifts (several feet) and allowed to dry. This method has been successfully used along the northern and eastern retaining dikes. As mentioned previously, 3 million cubic yards of acceptable sediments were used to strengthen the western dike. This material was pumped directly to the dike with no intermediate rehandling, creating a sandy beach several hundred feet to the west of the dike. Acceptable sediments are also used to create and maintain a six mile long, 22 foot wide roadway around the perimeter of the disposal area. The use of acceptable coarse grained sediments and normally unacceptable silts and clays for strengthening and raising dike sections will continue into the future. The areas over which acceptable materials are located are relatively small in comparison with the overall size of the disposal area. However, maximum benefit from the usage of suitable coarse grained sediments should be an integral part of a long term management plan.

### Construction and Industrial Use

The following table indicates the volumes of coarse grained material sold mostly to local sand and gravel companies between 1970 and 1985. These data indicate a magnitude of material moved off site in the order of only tens of thousands of cubic yards versus the average annual deposition of millions of cubic yards.

The Norfolk District indirectly markets dredged material from Craney Island. If excess suitable material is available, the district will sell it on request. However, as indicated in table 22, there has not been much material sold in

recent years because of the increased levee requirements at Craney Island in connection with the Craney Island Management Plan.

A study was made by Lone Star Industries, Inc. in 1980 wherein it examined market requirements for Craney Island material. The study identified possible offsite productive uses of the material and associated constraints. A primary market for material removed from Craney Island (assuming truck transport) was considered to encompass an area within approximately a 10-mile radius. Within the vicinity of the primary market, there were 24 authorized borrow pits, 20 of which were commercially operated. The volume of material produced from these existing sources will likely decrease in future years.

## Table 22. COARSE-GRAINED MATERIAL SOLD OR DONATED FROM CRANEY ISLAND DISPOSAL AREA

| Date | Volume cu. yds. | | Date | Volume cu. yds |
|---|---|---|---|---|
| May 1970 | 15,000 | (a) | Nov 1981 | 10,000 |
| Oct 1970 | 4,500 | (a) | Nov 1981 | 40,000 |
| Apr 1975 | 7,000 | (b) | Dec 1981 | 1,500 |
| Feb 1976 | 21,736 | (c) | Dec 1981 | 10,000 |
| Sep 1976 | 13,400 | (c) | Dec 1981 | 1,500 |
| Oct 1976 | 300 | (a) | Mar 1983 | 40,000 |
| Oct 1977 | 2,840 | (d) | Mar 1983 | 40,000 |
| May 1978 | 5,811 | | Feb 1985 | 8,000 |
| Sep 1978 | 1,015 | | | |
| Nov 1978 | 34,030 | | | |
| Dec 1978 | 479 | | 1986 | None |
| Mar 1979 | 25,260 | | | |
| Sep 1979 | 18,534 | | | |
| Dec 1979 | 3,020 | | | |
| Dec 1979 | 2,980 | | 1987 | None |
| Nov 1979 | 5,000 | | | |
| Dec 1979 | 20,000 | | | |
| Dec 1979 | 1,000 | | | |
| Jul 1980 | 3,000 | | | |
| Nov 1980 | 15,000 | | 1988 | None |

(a) Lump sum price
(b) Donation to U.S. Navy
(c) $0.30/c.y.
(d) $0.50/c.y. since 1977

The estimated market requirements for coarse-grained material for various uses within the general vicinity of South Hampton Roads and within the primary market area are shown in the following table. In general, demand for fill material in the area will decrease in the mid-1990's.

Table 23. ESTIMATED MARKET REQUIREMENTS FOR COARSE-GRAINED FILL MATERIAL IN SOUTH HAMPTON ROADS (SHR) AND CRANEY ISLAND'S PRIMARY MARKET (PM)[a]
(thousands of cubic yards)

| | Highway and Road Construction | | Cover for Sanitary Landfill | | Other General Uses | | Total | |
|---|---|---|---|---|---|---|---|---|
| Year | SHR | PM | SHR | PM | SHR | PM | SHR | PM |
| 1979 | 2600 | 1600 | 475 | - | 425 | 150 | 3500 | 1750 |
| 1980 | 2300 | 1300 | 500 | - | 350 | 125 | 3150 | 1425 |
| 1981 | 3800 (b) | 2700 (b) | 510 | - | 375 | 135 | 4685 (b) | 2835 (b) |
| 1982 | 3700 (b) | 2700 (b) | 520 | - | 475 | 160 | 4695 (b) | 2860 (b) |
| 1983 | 2100 | 1100 | 530 | - | 500 | 170 | 3130 | 1270 |
| 1984 | 1900 | 1000 | 540 | - | 510 | 170 | 2950 | 1170 |
| 1985 | 1800 | 900 | 550 | - | 520 | 175 | 2870 | 1075 |
| 1986 | 1600 | 800 | 560 | - | 530 | 175 | 2690 | 975 |
| 1987 | 1600 | 750 | 570 | - | 540 | 180 | 2710 | 930 |
| 1988 | 1500 | 700 | 580 | - | 550 | 180 | 2630 | 880 |
| 1989 | 1500 | 675 | 590 | - | 560 | 185 | 2650 | 860 |
| 1990 | 1400 | 650 | 600 | - | 570 | 185 | 2570 | 835 |
| 1991 | 1400 | 650 | 610 | - | 580 | 190 | 2590 | 840 |
| 1992 | 1400 | 650 | 620 | - | 590 | 190 | 2610 | 840 |
| 1993 | 1400 | 650 | 630 | - | 600 | 195 | 2630 | 845 |
| 1994 | 1400 | 650 | 640 | - | 610 | 195 | 2650 | 845 |
| 1995 | 1400 | 650 | 650 | - | 620 | 200 | 2670 | 850 |

(a) Taken from report by Lone Star Industries (1980).
(b) Includes 1500 cu. yds. in 1981 and 1982 for I-664 bridge-tunnel islands.

The above table indicates that the principal use of fill material in the market area is for highway and road construction, comprising approximately 70 percent of total fill usage in South Hampton Roads. The coarse-grained material available for use at Craney Island generally conforms to lower grade specifications for select fill as set by the Virginia Department of Highways and Transportation. This material should be acceptable for use as fill in both public and private applications. Dewatered fine-grained material does not meet specifications for select fill. The demand for such usage in the Craney Island

primary market area may decrease slightly in the future due to completion of major road construction projects.

Only four large sanitary landfill cover operations were identified in the market area in 1980. Closing of two of these was planned, and the remaining sites either operate onsite borrow pits or use trenching techniques for covering the waste. Therefore, the potential use of material from Craney Island for this purpose will probably not occur.

Dewatered fine-grained silts and clays available at Craney Island could conceivably be used for some random landfill purposes. However, in general, the dewatered fine-grained material is not suitable for most landfill purposes, and would only have limited marketability as low-grade fill material.

Analysis of a sample of silts and clays by the Virginia Truck and Ornamental Research Station indicated a salt concentration greater than 4,000 ppm (parts per million). This renders the material unsuitable for use in agricultural land enhancement activities.

A preliminary assessment (Palermo, 1978) of the potential for large-scale removal of fine-grained silts and clays from Craney Island, which is contained in most of the disposal area, identified significant technical constraints. The fine-grained material extends over the major portion of the disposal area, and water content of the dredged material deposits remain near the liquid limit. Significant dewatering of these deposits would be required before any removal could be seriously considered (except removal adjacent to dikes for upgrading purposes). Removal of fine-grained material offsite for any known productive use has not been recorded.

Joint Use of Craney Island

There is an opportunity for joint use of a portion of Craney Island. The primary area of interest is located on the eastern leg of the project disposal area adjacent to the Norfolk Harbor Channel. The ground therein has been created by the deposition of the coarse-grained material deposited by pipeline from dredges discharging into Craney Island. The Norfolk District has indicated that a small portion of the easternmost section of Craney Island could possibly be

made available to the Virginia Port Authority for study and determination whether it can be used for commercial and/or industrial purposes including port development without interfering with the operation of the project for dredged material disposal. The Virginia Port Authority is considering the matter. Prior to approval of joint use, it is essential that the state provide specific information concerning its proposed development in order for the Corps to ensure that this development will not interfere with dredging and disposal activities. The exact location and size would be the subject of further studies identifying the specific use and taking into account (a) the existing dredge disposal operations including the rehandling basin and direct pumpout areas. It would also require appropriate design of any proposed bulkhead to insure that the existing levee cross section is maintained and that the weak clay foundation does not cause failure of the dike system.

The city of Portsmouth has expressed an interest in taking over the Craney Island Disposal Area. It has stated that its tax base has been materially affected by the considerable land area acquired by the Federal Government. However, the acquisition of the entire disposal area by anyone is not practical until the present area has been filled to its maximum capacity, can no longer receive any further dredged material, and a Federal interest in the site is determined not to exist. In this regard, the Navy has indicated a possible interest in the site.

Possible Future Use of Craney Island Disposal Area

In the 1950s when the Craney Island Disposal Area (CIDA) was being formed, it was taken for granted that one day it would become entirely filled and no longer available as a disposal site for dredged material. Since then, attempts have been made to extend the useful life of the site. Once its useful life as a disposal area is up, the Commonwealth of Virginia could assume ownership and perhaps turn the site into some port or maritime related facility. The city of Portsmouth has expressed keen interest in the site contending that it could be used as a regional airport or for expansion of its tax base for relief of private homeowners. The disposal area is a haven year-round for many species of birds; therefore, environmental interests have suggested that perhaps a bird sanctuary or refuge would be a suitable use.

Thinking of useful purposes for a future Craney Island may be somewhat premature until the makeup of the "island" is understood. The eastern section, where material is first discharged into the basin, receives most of the solid matter resulting from settlement. This is a rather firm area which can be utilized for an "industrial" purpose such as port development. The remainder of the area receives the real fine, silty material that is sectioned off into areas for dewatering which requires two to three years. The subsurface structure of these areas would be highly questionable for industrial development.

The importance of Craney Island as a receiver of dredged material from Hampton Roads as well as the recipient of drift material picked up in the harbors cannot be overemphasized, especially where unsuitable sediments are concerned. Probably the best use for Craney Island, at least in the near future, is for it to continue just as it is. The project benefits all of Hampton Roads, not just one community.

Habitat Development

While Craney Island Disposal Area was not created as a wildlife area, it nonetheless has served this function well. Professionals and amateur bird lovers often visit the site. The following was taken from an October 1975 environmental impact statement concerning a replacement study for Craney Island Disposal Area.

The life existing on Craney Island is limited to those forms that can adapt quickly to the drastic changes that are imposed on the environment. In order to be successful, these species must be able to establish themselves quickly and tolerate a wide range of physical conditions. Of the 47 species of birds on Craney Island during different seasons of the year, they included an occasional flock of Canada geese as well as cormorants, snowy egrets, American avocet, black-bellied plovers, sandpipers, gulls, terns, and black skimmers. Only two species are known to actually nest on the ground and within the step levees. The District has entered into an agreement with the College of William and Mary and the Virginia Department of Game and Inland Fisheries on the operation of Craney Island during the breeding and nesting season of the least tern.

On infrequent occasions, trouble does occur in areas of CIDA when stagnant pools of water warm in the sun creating a climate for the production of botulism. This disease can be fatal to wildlife, especially waterfowl which tend to frequent such areas. When this happens, there is an attempt to frighten the birds away from the site followed by flushing the affected site with salt water. All in all, however, Craney Island area is highly valuable for a multitude of species both seabirds and typical inland varieties. It also provides an overwintering habitat for several species of waterfowl.

Offshore Bar

In 1982, the Norfolk District began investigating the construction of an offshore bar as a new concept for the disposal of dredged material. The plan involved the controlled placement of dredged material within a narrow area just offshore from Virginia Beach in the Atlantic Ocean between Cape Henry and Rudee Inlet. The offshore bar concept was judged to have the potential for dissipating the wave energy on the beach, thereby contributing to a reduction in shoreline erosion rates.

In connection with maintenance dredging of Cape Henry and Thimble Shoal Channels during August to November 1982, the Norfolk District determined that a mound or bar could be built in the offshore zone with conventional equipment. Hopper dredges deposited the dredged material at a point within the Dam Neck Ocean Disposal Site, resulting in a mound about 11 feet high, 1,600 feet wide, and 2,800 feet long below 35 feet of water.

During 1983, Norfolk District and the U.S. Army Corps of Engineers Coastal Engineering Research Center (CERC) began an investigation into the physical processes within the offshore region between Cape Henry and Rudee Inlet. The investigation was planned to identify the dominant physical processes and predict the effects of constructing an offshore bar. Field data collection, including wave, current and tide level data, began during August 1983. Due to the complexity of the physical and environmental aspects of the investigation, the study could not be completed in time for the Norfolk Harbor and Channels deepening project (50 feet). Consequently, the data collection effort was terminated in December 1983.

The offshore berm is in an experimental and testing stage and has not been proven as yet. There are two types of berms. They include:

a. A feeder berm that is located in fairly shallow water; it requires a high quality beach sand. This sand is not available within the inner harbor.

b. A stable berm which is further offshore and in at least 30 to 35 feet of water so that a hopper dredge can operate in the vicinity. It does not require the above quality of beach sand, and it can incorporate material similar to that used for maintenance of the levees at Craney Island. The hydrodynamic impacts associated with a stable berm are unknown, but there is potential for a permanent feature such as this to influence the Chesapeake Bay plume. The plume is thought to influence the recruitment of finfish, plankton, and other important bay species. Because of these, and other unanswered questions raised by state and Federal resource agencies concerning the environmental impacts associated with construction of a major feature offshore of Virginia Beach, it was determined that investigation of this concept would be too costly and time-consuming and that it was not environmentally feasible at this time.

Thus, an offshore berm is not deemed to be feasible for the disposal of dredged material from the inner harbor.

Beach Nourishment and Shoreline Stabilization

Beach nourishment and shoreline stabilization involve the deposition of suitable dredged material onto beaches, and should be considered where economically feasible. The major source of available (sandy) material would be from the dredging operations performed in the proposed Newport News and Norfolk 55-foot channels.

Anticipated future dredging in the inner harbor is expected to exceed 4 million cubic yards annually. The majority of this dredging will consist of maintaining depths of navigation channels and entrances to docks and piers by Federal, state, and private interests. This dredged material is primarily composed of clay and silt and is unsuitable for beach nourishment or construction purposes. The only possibility of obtaining some suitable material from the inner harbor is from new work dredging in areas previously undredged

or locations being dredged to greater depths. With regard to the inner harbor, when channels were deepened to 50 feet, a portion of the material within the Newport News Channel was used for dike stabilization at Craney Island. The 50-foot Norfolk Harbor Channel Deepening consisted primarily of clay and silt and was therefore disposed inside Craney Island.

Borings in the Newport News Channel indicate that some usable sediments, consisting mainly of silty fine to medium sands may be obtained in deepening the channel from 50 to 57 feet. This material is concentrated mostly in the central portion of the channel. It is best suited for dike construction or foundation fills and has been so used at Craney Island. The sand present in the channel is mostly fine grained. Patches of medium to coarse sands do exist in the channel. Because of the fine nature of the sand and the appreciable amount of silt and clay (fines) present, this material would be expected to be unstable on beaches under wave attack. Overfill ratios are estimated to be 5 or greater for beaches within the Chesapeake Bay area. The term "overfill ratios" is used to express the stability of borrow material with that of native beach sand. It is estimated that 5 units or greater of borrow sediments are needed to behave hydraulically similar to 1 unit of native material for beaches within the Chesapeake Bay area. In the case of the Norfolk Harbor Channel, little suitable material is available in deepening the channel from 50 to 57 feet. The material consists of appreciable amounts of fines for beach restoration projects and this would result in excess overfill ratios. Dredged material from the proposed 40- and 45-foot projects in the Southern Branch of the Elizabeth River are composed primarily of unsuitable clays, clayey sands, and silty sands.

SUMMARY OF BENEFICIAL USES OF DREDGED MATERIAL

There are sources of suitable dredged material from small dredging projects which occur throughout the inner harbor area. These projects are usually associated with creating new docking facilities or the deepening of existing facilities. Each of these projects must be dealt with independently based on the quality of material and dredge location to determine the maximum benefit. A management plan should be prepared by the district so that the issuance of a dredging permit would require permittees to (a) take advantage for the beneficial use of dredged sediments and (b) seek to dispose the material upland and thereby reduce to a degree the need for storage of those sediments

similar to that being accomplished in other districts in an attempt to reduce the need for dredged material disposal requirements. This, however, should not alter the need for a long-range disposal plan due to the small quantity of suitable sediments and the future uncertainty of available suitable material. Future details are included in appendix B.

## PLAN FORMULATION

### INTRODUCTION

This section of the report presents the rationale for the development and refinement of alternative plans for fulfilling the inner harbor long-term disposal needs. The formulation and evaluation of possible alternatives were conducted in accordance with the U. S. Water Resources Council's Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, dated March 10, 1983. In accordance with these Principles and Guidelines, alternatives were screened to arrive at plans most responsive to the problems and needs of the particular areas, giving consideration to their contribution towards the enhancement of the four accounts of National Economic Development (NED), Environmental Quality (EQ), Regional Economic Development (RED), and Other Social Effects (OSE).

These four accounts were established to facilitate evaluation and display of the effects of alternative plans. They encompass all significant effects of a plan on the human environment as required by the National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. 4321 et seq.). They also encompass social well-being as required by Section 122 of the Flood Control Act of 1970 (Public Law 91-611, 84 Stat. 1823). The EQ account shows the significant effects on ecological resources that cannot be measured in monetary terms. The OSE account shows urban and community impacts and effects on life, health and safety. The NED account, which is the only required account under Principles and Guidelines, shows effects on the national economy and, as such, establishes Federal interest. The RED account shows the regional incidence of NED effects, income transfers, and employment effects.

The above accounts are important from a national standpoint and would be desirable from a state standpoint. For example, if a disposal plan that encompasses a greater cost to the Federal Government for dredging a Federal channel (such as an ocean disposal area versus a less expensive area adjacent to a channel that is environmentally acceptable) is recommended for use, it would behoove the state to pay the increased cost of dredging unless Congress authorizes otherwise. This is discussed later in the report. Other economic factors, strictly from a state perspective are discussed in the main report and in appendix C.

PLAN FORMULATION PROCESS

In general, the plan formulation process follows five major steps, as listed and summarized below. Again, this procedure is in accordance with the Principles and Guidelines and related regulations.

a. Step 1 is the identification of all possible measures, Corps or non-Corps, that have the potential to solve, either partially or totally, the problems of the study area. All measures identified are also screened for the purpose of determining their ability to address study objectives. Measures found to be highly impractical are eliminated at this stage.

b. Step 2 consists of the development of preliminary plans from those measures which passed the Step 1 screening. A description of environmental, social, and cultural concerns is presented. Preliminary or initial screening continues to be accomplished during this stage.

c. Step 3 consists of the evaluation of each remaining plan including least cost comparisons, environmental assessment, and social and cultural concerns. Also accomplished during this step is the further reformulation of plans, as deemed necessary.

d. Normally, step 4 consists of the selection by the Corps of Engineers of the plan that best addresses the planning objectives and conforms with established planning criteria. In this instance the State is responsible for disposal of dredged material. Therefore, this report will present the plans that

appear to be the most practical and logical for a decision by the State in this matter.

## STUDY OBJECTIVE

Plate 1 shows the relation of the inner and outer portion of the harbor. The overall objective of this investigation is to address the long-term disposal problem facing the inner harbor portion of the Port of Hampton Roads and to develop environmentally and socially acceptable, technically feasible, and economical long-term disposal plans for dredged material.

## PLANNING CONSTRAINTS AND PROBLEMS

Planning constraints are any policies, technicalities, or other considerations that have the capacity to restrict or otherwise impact on the planning process. For this reason, the identification and appraisal of alternative plans is accomplished with consideration for potential constraints to their implementation. There are several significant constraints which must be considered in this investigation. A summary of the formulation and evaluation criteria for disposal areas utilized in this study is presented in subsequent paragraphs. These criteria involve physical, economic, environmental, and social factors which tend, in varying degrees, to constrain the options and/or ultimate selection of a replacement for the existing Craney Island Disposal Area. Although all of the formulation and evaluation criteria were considered for the various alternatives, key factors or constraints can be further summarized as follows.

- A disposal area should have a useful lifespan of about 50 years.

- The costs associated with a disposal area should be minimized.

- The destruction of bottom lands, wetlands, coastal zones, and wildlife resources in the Hampton Roads area should be minimized.

- The adverse social impacts associated with providing a disposal area should be minimized.

Due to its very nature, the disposal of dredged material on a large scale and in a highly developed area such as Hampton Roads is always a sensitive and controversial issue. The environmental, social, and political aspects of implementing a disposal plan can become exceedingly complex and must also be recognized as likely planning constraints.

The importance of the Port of Hampton Roads and its related activities, and the need to provide for economical disposal is a definite constraint to consider when developing a long-term disposal plan because the economy of the area/State is so heavily dependent on a vibrant port activity.

It is also important to note that disposal of dredged material is traditionally a non-Federal responsibility, and the Commonwealth of Virginia, acting through the Virginia Port Authority, is the local sponsor for the Hampton Roads deepening project. Therefore, the Commonwealth has a vital interest in this study on disposal. In fact, the Virginia Port Authority is an actual partner in this effort and has agreed to cost share in this study during future elements of the deepening project requiring a new disposal area. Therefore, the study must also be responsive to the needs and desires of the Commonwealth.

FORMULATION AND EVALUATION CRITERIA

Technical, economic, and environmental criteria, in addition to intangible considerations, permit the development and selection of a plan which best responds to problems and needs of an area. Criteria developed for the purpose of this investigation on inner harbor disposal are discussed in the following paragraphs.

Technical Criteria. The following technical criteria, within a planning framework, were adopted for use in plan formulation. It corresponds to Federal guidelines which are comprehensive.

a. The plan should be consistent with local, regional, and state goals for water resources development. For example, it should not deter development of a marina or a waterfront area for maritime purposes, or airplane ingress and/or egress via water, or affect the stormwater drainage of an urban area.

b. The plan should be technically feasible to implement.

c. The plan should be complete within itself for fulfilling projected long-term disposal requirements.

d. The plan should be capable of handling all types of material normally dredged in Hampton Roads, e.g., silt, sand, shell, and mixtures of these as well as suitable and unsuitable material.

e. The plan should be capable of accommodating all disposal requirements including Federally authorized new work and maintenance and routine public and private permit activities for about 50 years. The state has been so advised and concurs that the study should be so accomplished, recognizing that it might choose a lesser time interval.

f. The plan should accommodate large and small input loads without undue sacrifice of effectiveness. It should be capable of accommodating unanticipated new work without appreciable disruption.

g. With the possible exception of extreme storms, the plan should function regardless of weather conditions.

h. The entire plan should withstand disruption as a result of damage to part of the system. It should be a product of proven elements and practices and be resilient under emergency or catastrophic conditions such as storms, floods, waves, and so on.

i. The plan should be capable of serving or utilizing all types of dredging equipment, including hopper dredges, hydraulic pipeline dredges, and mechanical (bucket) dredges. It should permit simultaneous operation of several types of dredges.

j. If onshore or offshore levees are considered, they must be sized sufficiently to withstand storm tides and wave action.

k. The size and shape of any disposal area should optimize the relationships between capacity (useful life), economy, and future use of the area.

l. The plan should exhibit potential side benefits such as salvage or land reclamation and/or beneficial use of dredged material whenever possible.

m. The plan should include management schemes for operating the facility with a view to maximizing its useful life as a disposal area.

Economic Criteria. The economic criteria which were applied in the formulation of the alternatives plans are essentially as follows.

a. In accordance with the overall objectives of the study, the plan should:

...minimize the total cost including investment, operations, maintenance, and replacement.

...enable a rapid cutback in costs if the load is reduced, whether temporarily or permanently.

...minimize the overall economic impact on the surrounding area.

b. Alternative plans will be compared on the basis of a least cost analysis. Cost to be considered in the analysis should include but not be limited to the following:

(1) Construction cost, if any, of disposal area;

(2) Interest during construction;

(3) Lands and damages, easements, and rights-of-way;

(4) Salvage value of disposal area;

(5) Environmental and mitigation costs;

(6) Average cost of operation and maintenance and/or monitoring of facility; and

(7) Average cost of dredging.

c. To be consistent with planning horizons on Federal navigation projects, alternatives will be compared using an economic life approaching 50 years.

d. Alternatives will be compared using October 1988 price levels and a discount rate of 8-7/8 percent.

e. Appropriate risk and uncertainty analyses will be required to determine the economic sensitivity of the various economic variables. These could include such items as (a) increases in cost of construction material required, (b) increases in cost of fuel associated with dredging disposal operations, and (c) reduction in estimated lives of alternatives.

f. An approximate cost recovery analysis for the state will be presented.

g. The plan or system should be consistent with present and future local, regional, state, and national needs for port and industrial growth.

h. The plan should reduce the dredging cost whenever possible.

i. The plan and/or plans should be responsive to the State's financial and economic perspective.

Environmental and Social Criteria. Environmental and social criteria considered throughout the study include the following:

a. The plan should minimize the commitment of natural resources, whether they be marine bottom lands, wetlands, other coastal zones, inland environments, or wildlife in these areas.

b. The available sources of expertise should be used to identify environmental resources which might be endangered, damaged, or destroyed by plan implementation. These would include the Fish and Wildlife Service, the Environmental Protection Agency, National Marine Fisheries Service and appropriate state agencies such as Virginia Institute of Marine Science and the Virginia Marine Resources Commission.

c. The plan should be capable of being integrated into local or regional plans for solid waste management, water and air pollution abatement, transportation, recreation, and land use. For example, it should not deter development of a marina, airplane ingress or egress by water, affect outflow of stormwater drainage or a development for maritime purposes.

d. The plan should meet existing public health and environmental control standards.

e. As nearly as possible, the plan should minimize noise, dust, odor, and unsightliness, and potential health risks.

f. As nearly as possible, the plan should be aesthetically pleasing to the public which has to support and live with it.

g. The plan should not displace, devaluate, or destroy important historical and cultural landmarks or sites.

h. Measures should be incorporated into the selected plan which protect, preserve, replace (through mitigation), or enhance environmental quality in the project area.

i. The adverse impacts on area recreation resources should be minimized.

j. The plan should be publicly acceptable.

The degree to which a long-term plan for disposal of dredged material for the Hampton Roads inner harbor area met the foregoing criteria was taken as a

measure of its relative merit. Clearly, no system of disposal could have met all these criteria fully. However, the evaluation, selection, and development of alternatives emphasized optimization in terms of the respective cost-performance and environmental parameters and consideration of social and regional impacts.

POSSIBLE SOLUTIONS

There are a number of solutions to the problem of dredged material disposal. These include:

a. Reducing, by various means, the amount of material actually dredged. This could include a reduction, if possible, of (1) sediments deposited into streams and rivers from upland sources and (2) overdepth dredging of channels;

b. Dredging and disposing of the material by conventional methods such as open-water disposal or confinement within diked disposal areas similar to the existing Craney Island Disposal Area;

c. Dredging and disposing of the materials by nonconventional methods such as recycling the dredged material back to the land (where it came from originally);

d. Using dredged material to fill and reclaim marginally useful land; and

e. Treating the dredged material as a resource and using it for beneficial purposes.

Under existing and projected future circumstances, it is not feasible to stop dredging in the Port of Hampton Roads. As has been previously documented, Hampton Roads is a rapidly growing area whose economy has in the past and is still dependent on port and related activities. Furthermore, continued maintenance of navigation channels is required for the operation of large naval vessels. There is little doubt as to the need for and importance of improving and maintaining the navigation system in the Port of Hampton Roads.

It might be possible to reduce the required dredging by effecting some reduction in the rate at which these channels shoal. By preventing sediment from entering the estuary through upstream riverbank stabilization and erosion control measures, the sediment load of the estuaries joining in Hampton Roads might be reduced, thereby affecting the dredging requirement as well. Sediment causing shoals in Hampton Roads originates partially from upstream sources. Some observations indicate that sizeable portions of the sediment dredged from Norfolk Harbor Channel originate as urban runoff from the surrounding cities. However, there is little confirmed information concerning the source of the shoal material or the mechanism of its transport and deposit, and many unknowns exist regarding physical and economic features of this solution.

Regardless of implications in the above discussion, the authorized channel dimensions in Hampton Roads and the channels to private docks must be maintained to serve the continuing needs of commerce and defense in Hampton Roads; consequently, the current maintenance dredging program must be continued. The dredging itself, to be efficient, must not be of a type that will permit eventual return of the dredged material to the channel. With regard to the inner harbor, neither agitation dredging (where material is stirred up, resuspended, and hopefully carried away by stream or tidal currents) nor side-cast dredging provides for positive and permanent removal of sediment. These two types of dredging are not considered to be effective methods of removal. In addition, they cause previously precipitated pollutants to be resuspended and reintroduced into the marine environment.

Conventional types of sediment removal considered appropriate for use inside Hampton Roads are hopper dredging, hydraulic pipeline dredging, and mechanical dredging, e.g. bucket and scow. Open-water disposal, in conjunction with these dredging methods and in approved locations, has been practiced for many years and was recently carried out for the disposal of material dredged from the 50-foot outbound deepening of Thimble Shoal Channel in the outer harbor. Specifically, material from Thimble Shoal Channel was transported to the Dam Neck Ocean Disposal Site shown on plate 1. Dam Neck has been permanently designated for ocean disposal of dredged material under Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972.

In summary, open water disposal for acceptable material has been practiced many times in the past and should be considered as an alternative for long-term disposal from the inner harbor area of Hampton Roads.

Another solution to the dredged material disposal problem is an inclosed disposal site such as the existing Craney Island Disposal Area as shown on plate 1. Craney Island has served as a valuable and economical disposal area since its construction during the mid-1950s.

Such a disposal area with spillways or sluices to control effluent density provides for a more positive retention of material. For convenience, inclosed disposal areas may be classified as harborside areas, inland areas, and offshore areas. A harborside area would include any shoreline site similar to the existing Craney Island Disposal Area, whether fast land, water, or both to begin with. A harbor location offers both protection from storms and high seas as well as economy in construction and operation.

Offshore disposal areas may be more vulnerable to storm and hurricane damage. They are very expensive to build because of the transportation costs of men and material to the site, the adverse working conditions at the site, and the high cost of deep-water construction.

With present technology, it is both feasible and practical to move large quantities of dredged material great distances by pipeline. Such an operation, in effect, would allow removal of the main disposal area from a highly developed port area to a more remote inland area or even to sea. To explore this method further, it would be possible to empty existing disposal areas by transferring the material elsewhere, thus recreating the disposal capacity of existing sites for future use. But, the problem remains one of locating a suitable depository for the transferred material.

There has always been a challenge for the proper disposal of dredged material. There have been many instances of creating or reclaiming island or shoreline land by using dredged material. In some instances, material from disposal areas has been used for construction fill. Wherever feasible and

practical, dredged material should be viewed as a resource, not as a waste product.

## BENEFICIAL USES OF DREDGED MATERIAL

The idea of treating dredged material as a resource and using it for beneficial purposes is not new but is currently being emphasized by Federal, state, regional and local agencies. In fact, the Corps of Engineers has published an Engineer Manual (EM 1110-2-5026, June 30, 1987) entitled Beneficial Uses of Dredged Material. This manual provides guidance for planning, designing, developing, and managing dredged material for beneficial uses, incorporating ecological concepts and engineering designs with biological, economical, and social feasibility.

Ten broad categories of beneficial uses of dredged material have been identified. They are:

a. Habitat development (wetland, upland, island, aquatic, including migratory and nesting use by waterbirds, shorebirds, waterfowl, and other groups).

b. Beach nourishment

c. Aquaculture

d. Parks and recreation (commercial and noncommercial)

e. Agriculture, forestry, and horticulture

f. Strip mine reclamation and solid waste management.

g. Shoreline stabilization and erosion control.

h. Construction and industrial use (including port development, airports, urban, and residential).

i. Material transfer (fill, dikes, levees, parking lots, roads).

j. Multiple purposes.

Recognition of the ecological value of many habitats that have been historically used as dredged material disposal sites has resulted in severe environmental constraints on location and placement of disposal sites, especially those in open water and wetlands. These constraints have increased the values placed on coastal and riparian wetlands and aquatic areas, and have increasingly accented the need for alternate methods of dredged material disposal. As land uses have changed and areas once available for dredged material disposal have become scarce, the concept of beneficial use of dredged material disposal sites, such as land improvement and habitat development, have become more attractive economically and environmentally.

The known and potential effects of dredging and dredged material disposal on the environment in and around U.S. waterways has led to considerable research efforts and interagency and intraagency coordination. Waterway projects involving dredging require consideration of ecological effects. While maintenance of navigable channels is the prime objective, the development and application of beneficial alternatives for dredged material disposal must receive appropriate consideration.

## FACTORS ASSOCIATED WITH PLAN SELECTION

### Rate of Filling

Previous sections of this report have presented information relative to projected dredging and disposal requirements for the inner harbor. These projections include (a) existing annual maintenance involving both public and private permit activity; (b) new work dredging of Federal channels; and (c) increased maintenance associated with channel improvements. Table 17 summarizes the total future 50-year disposal requirements. For purposes of initial screening of alternatives, the 50-year disposal requirement (Federal, state, and private) was estimated at 250,000,000 cubic yards or an average of 5 million cubic yards per year. This figure reflects existing maintenance and authorized channel improvements and associated increases in maintenance.

After detailed plans are developed, different future dredging scenarios will be used in the analyses included in this report.

Useful Life

Without doubt, the question of how long a plan will last is of the utmost importance. Normally, navigation projects have a planning horizon (useful life) of 50 years. This fact would logically indicate that a plan for disposal be structured likewise. The need for a 50-year plan is further emphasized by the fact that the Commonwealth of Virginia expects that the Port of Hampton Roads will have a long-term role in the state's economy. Although a useful life of 50 years was chosen, in the final analysis, it will be up to the Commonwealth to decide whether it deems a shorter or longer life than 50 years for a disposal area for Federal, state, and private interests is appropriate. This study has investigated disposal areas having lives shorter than 50 years and the results thereof.

In this connection, the development of a 50-year plan may necessitate the combining of other plans in order to satisfy the minimum useful life objective. This would preclude the elimination of an attractive site which might not have a full 50-year useful life. In addition, in order to satisfy the requirements of the Principles and Guidelines referred to in the introductory paragraph, it is essential that alternative plans are compared on the basis of equal useful lives, i.e., 50 years or closely approaching thereto, plus the same scenarios encompassing new work.

With respect to combining plans, it should be recognized that there may be negative consequences associated with combining short-lived plans on the order of 10 to 15 years. For example, possible options may be foreclosed or made more costly by delay and piece-meal implementation. For example, piece-meal construction of a large site or multiple sites would preclude the benefit resulting from compartmentalization allowing effective dewatering. This scheme would not result in accelerated settlement of dredged material and, therefore, a longer life for a given disposal area. Other disadvantages might include multiple start-up costs, possible discontinuity of service for users of the disposal site(s), additional costs to users if the series of sites are widely dispersed and/or require different methods of deposition, and need for more

intensive administration/management of a plan with many separate elements phased in over 30 to 50 years.

In view of the difficulties associated with the implementation of several short-lived structural plans, emphasis will be given to including ocean disposal as a plan element for the remaining years required to even out useful lives of the alternative plans. It should also be noted that in estimating useful lives of the various alternatives, consideration and allowances were made for settlement and the implementation of management practices such as active dewatering. Thus the size of a plan is not the only variable toward attaining maximum life. The useful life was also based on 100 percent efficiency in dewatering.

Economics

Traditionally, disposal plans are compared economically by utilizing a least cost approach. For this reason, alternatives in this study will be compared from a cost standpoint with the least cost alternative being identified as the National Economic Development Plan (NED Plan). In this connection, Corps policy has always been to use the least costly, acceptable disposal alternative for Federal projects.

The costs for comparing disposal alternatives consist of two elements. These are: (a) initial construction where applicable, and (b) unit operating cost. Initial construction costs include the costs of rights-of-way and site acquisition, levees, drainage facilities, spillways, access roads, rehandling facilities, aids to navigation, and appurtenant equipment at the disposal site. Unit operating costs include the costs of dredging, transportation, pumpout, and maintenance converted to a "per cubic yard" basis. Project construction costs including interest during construction are amortized for the expected useful life of the project, thence converted to a per unit basis. Thus, the two unit costs can be combined to arrive at an equitable, economic basis to compare plans. All cost computations are based on October 1988 price levels and an interest rate of 8-7/8 percent.

Environmental Impact

All dredging projects involve the artificial removal of a resource (bottom sediments), artificial transportation of this resource, and the placement of the resource in an area whose composition will most likely be unlike that from which the sediment was removed. The cycle is one of man-imposed environmental changes. It is certain that environmental impacts are associated with the action of dredging. In this study, however, the method of dredging (and associated environmental impacts) would not noticeably vary with the selected plan of disposal. Consequently, such impacts were not used to compare alternatives.

The environmental variables which are pertinent elements of plan comparison are those relating to the area receiving the material and the impact that deposition would have. If a diversion of environmental values and potential impacts were sought, there would likely be two considerations. These are (a) environmental resources which would be immediately destroyed or damaged by actual construction, and (b) environmental resources which would be damaged, destroyed, or replaced as a result of gradual dredged material deposition.

Public Sentiment and Social Impacts

In the search for a necessary means of disposing of dredged material from the channels in Hampton Roads, the pertinent questions are not "if", but "how" and "where." Compounding the usual problems in a study of this type is the fact that there are various public agencies and citizens who oppose, for one reason or another, the selection of each specific location or plan. At the same time, these citizens and agencies are demanding that an acceptable plan of disposal be located to maintain project channel depth, to continue the area's vital defense and commerce activities, and to stimulate a healthy economy. Maintaining the search until a plan acceptable to all interests is located could be futile. Since every alternative involves impacts on the social environment, objections from the parties affected are a real certainty.

WITHOUT PROJECT ALTERNATIVE (NO ACTION ALTERNATIVE)

The existing project depth for the major channels in Hampton Roads is 50 feet. The present trend is the utilization of larger vessels to more

economically carry larger cargoes. This trend has been realized in Hampton Roads by vessels taking advantage of the entire 50-foot depth which was completed in January 1989. Therefore, any decrease in project depths in the area would curtail the present transportation patterns. The average shoaling rate in major channels serving Hampton Roads has been estimated at about 0.8 feet per year. Should this shoaling continue without maintenance, vessels leaving the harbor would in time be severely hampered by diminished channel depths and vessel transportation costs would increase. In the eyes of shippers, manufacturers, and all who are concerned with maintaining a healthy economic climate in Hampton Roads, such an occurrence would be of very serious concern.

It is difficult to establish with certainty what would happen in the inner harbor of Hampton Roads when Craney Island is filled and there is no provision for an alternate disposal area for future dredging work. Studies by the Waterways Experiment Station indicate that Craney Island will be filled to capacity in the 1990s.

The following are possibilities for future disposal without a specific project alternative.

a. The Corps has sought declaration, with approval of EPA, either the Dam Neck Ocean Disposal Site or the proposed Norfolk Disposal Site as available not only for dredged material from channels in Chesapeake Bay and Atlantic Ocean but for clean dredged material from the inner harbor of Hampton Roads. EPA has indicated that DNODS can be used for inner harbor material. It is now proceeding with designation of NDS as an additional site.

b. The U.S. Navy may continue to improve its dockage facilities by placing good dredged sand on nearby beaches or adjacent areas as it has done in the past. The remaining material suitable for ocean disposal would probably be disposed in the Atlantic Ocean.

c. Private firms such as Newport News Shipyard and others with clean dredged material would seek permits from the Corps to discharge dredged material into the Atlantic Ocean (see a. above). Private companies may also

find some onshore locations for small amounts of the dredged material. They may also make arrangements with a contractor, dredging a Federal channel, to remove material from their entrance channels to docks and/or piers.

d. Dredging of the material not suitable for ocean disposal from the Elizabeth River and its Southern Branch by the U.S. Navy and numerous private firms would have to cease unless they could locate confined estuarine or upland locations for the dredged material. Maintenance of the channels in these rivers by the Corps would also have to cease unless the state could provide an appropriate confined containment area similar to Craney Island.

ALTERNATIVE PLANS CONSIDERED

The study has considered numerous alternatives for the disposal of dredged material from the inner harbor, including the following:

a. Within the Inner Harbor

Raising Craney Island;

Removing dredged material from Craney Island;

Expanding Craney Island;

Willoughby Bay, Hampton Flats, and Ragged Island; and

Dredging alongside of channels.

b. In Chesapeake Bay

Horseshoe Area off Buckroe Beach;

Ocean View; and

Chesapeake Bay Bridge-Tunnel.

c. Inland

Suffolk;

Abandoned borrow pits; and

Abandoned mining sites.

d. Ocean Sites (plus the existing Craney Island for unsuitable material)

Dam Neck Ocean Disposal Site (DNODS);

Norfolk Disposal Site (NDS);

Pipeline to Sea; and

Capping unsuitable material at sea.

Each of these plans is discussed in subsequent sections of this report. In all cases, the beneficial uses of dredged material are being considered as a part of any plan. Also, all disposal strategies should include methods to reduce the amount of dredge material such as by reducing, whenever practicable, the amount of overdepth dredging required on Federal projects.

INITIAL SCREENING

The following paragraphs describe the alternative plans considered as a part of the initial screening process for the disposal of inner harbor dredged material. Most of these alternatives are shown on plate 8 (not to scale). None of the alternatives meet all stated selection criteria. No plan can reasonably be expected to do so. It should be noted that most of these alternatives have been previously considered during the feasibility study on Norfolk Harbor and Channels, Virginia, Deepening and Disposal. However, because a number of years has elapsed since these studies and because of the limited number of options available for inner harbor disposal, it was deemed necessary to reconsider these plans to take into account current conditions.

Existing Disposal Area at Craney Island

The feasibility of alternatives described in succeeding paragraphs relies on the use that is made of the existing disposal facilities. In order that these alternatives may be better understood and related to the present disposal method, a detailed discussion on Craney Island is included in a previous section of this report entitled "Dredged Material Disposal into Craney Island." The existing Craney Island Disposal Area is shown on plate 6.

Raising Craney Island

The question arises as to whether the useful life of CIDA can be extended by raising the elevation of the containment area. The Waterways Experiment Station, Corps of Engineers, Miscellaneous Paper GL-87-4, dated May 1987 and entitled "Perimeter Dike Stability Analysis, Craney Island, Norfolk, Virginia," (included in appendix B) concluded that it was technically feasible to raise the east and north perimeter dikes to elevation +40 feet m.l.w., with safety factors of 1.4 and 1.28, respectively. This paper further concluded that with remedial site work (i.e., construction of waterside and road berms) the west perimeter dike could be raised to elevation +34 feet m.l.w., with a resulting safety factor of 1.3.

The Norfolk District evaluated the feasibility of raising the dikes to elevations higher than those determined in the miscellaneous paper mentioned above and concluded that the dikes are at or near their design height. In accordance with Corps of Engineers Engineering Manual (EM 1110-5027), Confined Disposal of Dredged Material, the minimum safety factor recommended is 1.3. Therefore, the dikes studied in the miscellaneous paper marginally meet the minimum criteria and are at or near maximum elevations. The limiting factor is a very soft clay foundation that extends to a considerable depth (90 feet). If further dike raising can be accomplished, it will require specialized construction techniques to improve the strength of the soft underlying clays.

The foundation soils are underconsolidated with respect to the weight of the overlying dikes. A comparison of undrained shear strength values since initial construction show no appreciable increase in strength has occurred. This is probably due to the extensive thickness and low permeability of the

foundation clay. The excessive pore pressures have not readily dissipated and subsequent strength gain has not yet appreciably occurred. Therefore, the surcharging load is not effectively improving the site conditions. An alternate means is needed to improve the foundation shear strength before further raising of the dikes is feasible.

One method to speed up the consolidation process is the use of vertical wick drains. The wick drains are composed of band-shaped plastic surrounded by filter fabric. The drains are installed on a grid pattern over the site and are designed to accelerate the consolidation process by shortening the seepage path that pore water must take to exit the clay layer. As the pore water exits the clay, its shear strength increases. Depending on the degree of increased strength, the elevation of the containment area could be raised using a combination of berms and dike set backs.

There are many uncertainties with such new technologies. In addition, they are very expensive and currently not economical. But with further evaluations and improved costs, they may provide a means to improve the dike stability and allow further raising of the containment area. The Norfolk District will continue to evaluate methods to improve dike stability. However, it is doubtful that such improvements will significantly increase the capacity of the containment area to fully support the long-term disposal needs of Norfolk Harbor.

At present, the Craney Island dikes are at or near their maximum design height. Capacity calculations for the island and any proposed lateral extension should be based on a dredge material elevation of +30 m.l.w. This is a safe, conservative elevation controlled by the stability of the west dike. New technologies will provide opportunities to improve its capacity, but such improvements will be insufficient for a 50-year disposal plan. However, its limitations should not preclude it as an option. Craney Island could serve as supplemental disposal capacity, easing the demand on other selected alternatives.

Removal of Material from Craney Island

Consideration was given to emptying Craney Island. One plan would be to place dredged material onto scows and transport them with tugs to DNODS or NDS. This would be accomplished by excavating and transporting the material with mechanical equipment to a constructed scow mooring facility, thence loading the scows and transporting them to the ocean sites. Such an operation requires that the dredged material be sufficiently dried so that heavy land equipment (trucks, scraper, bulldozers, conveyers, etc.) could operate. Unfortunately, only about 20 percent of the material in Craney Island is sufficient for this purpose. Furthermore, only about 1.3 million cubic yards per year could be removed with one daily operating shift and only about 2.7 million cubic yards per year with a two shift operation. Therefore, such an operation is not practical for a four to four and one-half million cubic yards per year deposited in Craney Island.

An alternate plan would be to breach the Craney Island dike, float a bucket dredge into the area and load scows thereby. Since the material in Craney Island is highly unstable to depths of more than 100 feet, a thorough design and construction of bulkheads would be required to insure stability of the remaining material adjacent to the breached dikes. It is estimated that only about four million cubic yards per year could be dredged under this method. This would not result in emptying Craney Island since the amount entering is equal to or greater than four million cubic yards annually. It would merely mean a continuous deposition of material into Craney Island (and the cost thereof), thence its transfer to the ocean with an overall greater average cost than its movement direct to sea following the dredging from channels or piers. Also, such an operation could limit the use of Craney Island for other purposes.

Further details including cost data are included in appendix A.

Expansion of Craney Island

One obvious plan for inner harbor disposal is the expansion of the existing Craney Island Disposal Area. A western extension was initially given consideration during the feasibility study on Norfolk Harbor and Channels, Virginia, Deepening and Disposal which was completed in 1980. Also, plans for the I-664 crossing were being formulated in the area which would likely

impact the proposed westward extension. The State Task Force on disposal also ruled out further extension of Craney Island because it would provide a useful life of less than 50 years based on the assumptions and studies at the time. The Task Force preferred the Suffolk Disposal Site which is discussed in subsequent sections of the report. Although the plan was not recommended in that feasibility study, current conditions warrant reconsideration of this alternative.

During 1982-1983, the Norfolk District requested WES to review the management plan and investigate the effects of the Norfolk Harbor and Channels deepening project on the management of CIDA. For the purposes of this investigation, it was assumed that all inner harbor and new work dredged material from the 55-foot project (full width) features would be deposited at CIDA. This amount was then estimated to be about 29 million cubic yards, during a 4 to 8 year construction period, depending on the actual schedule and progress of work. WES investigated three alternative plans for use of CIDA during the deepening:

a. Use CIDA as one containment area.

b. Subdivide the disposal area as recommended by the management plan and rotate active dredged disposal material among the three subcontainments.

c. Expand CIDA to add a fourth subcontainment to hold the deepening material.

The investigations included field and laboratory investigations to characterize and compare the new work deepening material and maintenance dredging materials, water quality, and storage capacity evaluations.

WES made the following conclusions in its draft report dated 1983 (final report printed in 1987):

• Effluent water quality (suspended solids) considerations through the weirs would limit the rate of dredge inflow to 245 c.f.s.

• The large volumes of new work material will quickly exhaust the remaining storage capacity of CIDA in its single-containment configuration.

• Close coordination between dredging and dike construction is required.

With filling of the disposal area to an average design elevation of +30 feet m.l.w., WES made the following specific conclusions:

• As a single subcontainment, all available storage capacity at CIDA would be exhausted with the deepening project about 75 percent complete.

• With implementation of the management plan (3 subcontainments) the entire deepening volume can be placed into CIDA. Virtually no additional storage capacity will remain after the deepening is completed.

• An 850-acre expansion capable of being filled to +30 feet m.l.w. will hold the deepening and maintenance material during the deepening project. This would leave the remaining volume of CIDA for future maintenance dredging.

As previously stated, in 1987, as part of this long range disposal study, WES was requested to determine the remaining useful life of Craney Island. Also it was deemed desirable to take advantage of the existing sides of Craney Island and to expand on them as appropriate. Accordingly, it was also requested to evaluate six expansion plans shown on the following page based on completion of construction of each plan in 1993 and on the following scenarios:

Scenario 1. Maintenance dredging of the inner harbor channels to their existing depths plus other Federal, state, and private dredging (refer to section of report on Problems, Needs, and Opportunities).

Scenario 4. Scenario 1 plus dredging of Elizabeth River and its Southern Branch to depths of 40 and 45 feet.

Scenario 5. Scenarios 1 and 4 plus new work dredging of outbound channels to a depth of 55 feet (plans are now to take suitable material to sea.)

Additional evaluations were made based on additional scenarios including dredging the inbound 55-foot channels (whose construction has been deferred until found to be economically feasible).

The following table indicates the results of the WES investigations for scenarios 1, 4, and 5. Further details are included in appendix A.

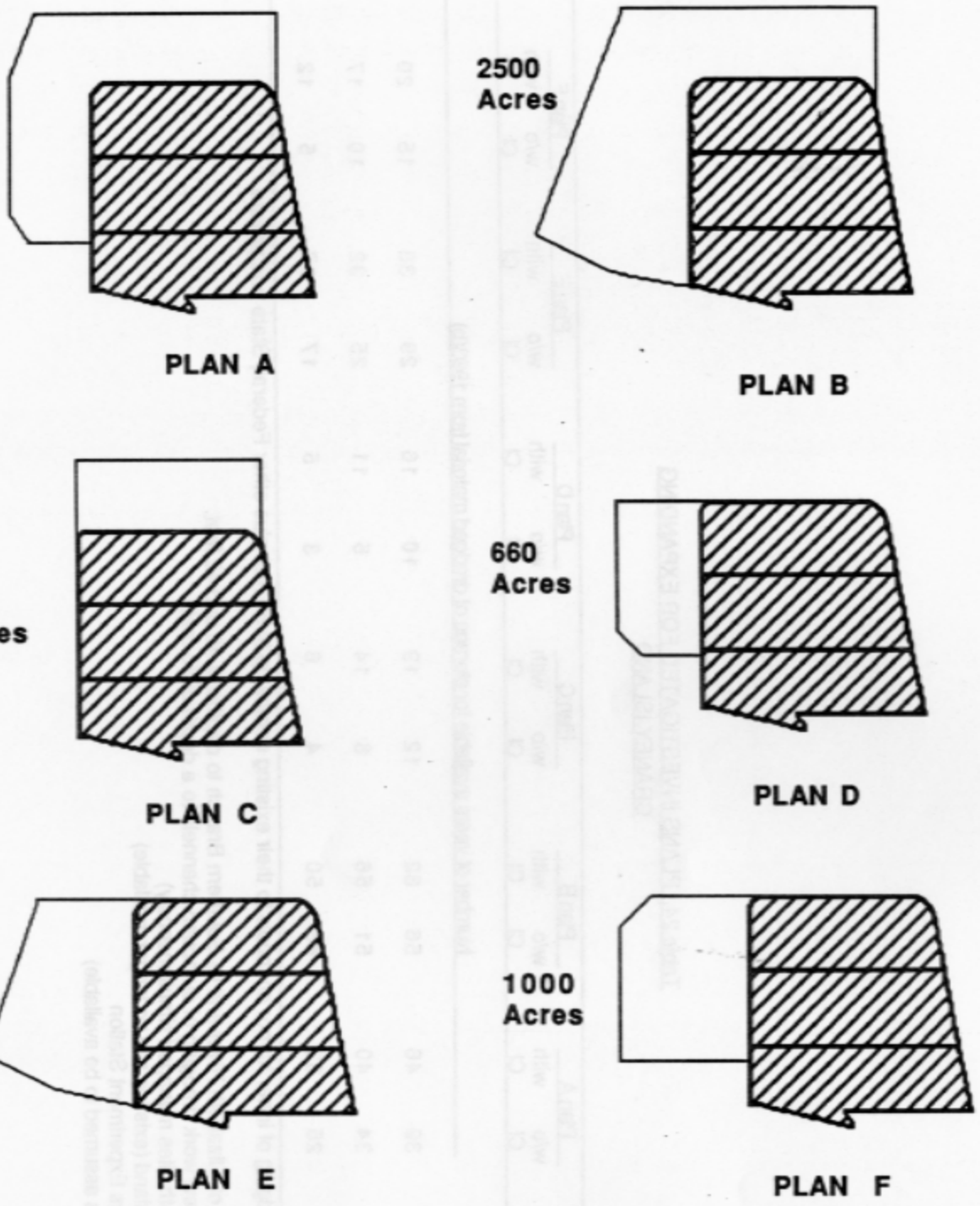



Figure 3. ALTERNATIVE CONFIGURATIONS FOR EXPANSION OF CRANEY ISLAND

## Table 24. PLANS INVESTIGATED FOR EXPANDING CRANEY ISLAND

| Scenario (a) | Existing CI | Plan A w/o CI | Plan A with CI | Plan B w/o CI | Plan B with CI | Plan C w/o CI | Plan C with CI | Plan D w/o CI | Plan D with CI | Plan E w/o CI | Plan E with CI | Plan F w/o CI | Plan F with CI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Number of years available for storage of dredged material from 1993(b) | | | | | | | | | | | |
| S1 | 1997 | 39 | 46 | 56 | 62 | 12 | 19 | 10 | 16 | 29 | 36 | 15 | 20 |
| S4 | 1994 | 34 | 40 | 51 | 56 | 8 | 14 | 5 | 11 | 25 | 32 | 10 | 17 |
| S5 | 1994 | 25 | 33 | 43 | 50 | 4 | 6 | 3 | 5 | 17 | 27 | 5 | 12 |

S1 = Maintenance dredging of inner harbor channels to their existing depths up to 50 feet plus other Federal, State and private dredging.
S4 = S1 plus dredging of Elizabeth River and its Southern Branch to depths of 40 and 45 feet.
S5 = S1 and S4 plus new work dredging of outbound channels to a depth of 55 feet.
CI = Craney Island (both sites managed simultaneously)
w/o CI = Without Craney Island (existing site no longer available)
(a) As referred to by Waterways Experiment Station
(b) Base year 1993 (year site is assumed to be available)

The area is conveniently located with respect to dredging and disposal activities. Its protected and centralized location would permit the continuance of the economical dredging and disposal methods now employed. By extending shore pipe to the new area, the existing rehandling facilities could be used.

Expansion of Craney Island would accomplish maintenance and improvement of the navigational features as follows: (1) initial removal of in situ (in-place) shoal material by current methods--hopper, hydraulic pipeline, and bucket-scow dredges; and (2) transfer of the material using the existing rehandling facilities to the diked area for final disposal. The hydraulic pipeline dredges discharge directly into the diked area. The existing rehandling facilities were described previously. Essentially, the rehandling operation would be the same as at present, with the qualification that additional shore pipe would be used from the rehandling area to the new disposal area. In hydraulic pipeline dredging, the outfall end of the pipe would be inside the new disposal area.

As indicated by table 24, Plan B essentially meets the 50-year useful life objective for long-term disposal. Plans A and E alone provide storage for dredged material for a period estimated at 31 and 22 years, respectively (assuming dredging scenario indicated as S4) and after an allowance of three years storage to accommodate unsuitable material.

Expansion of Craney Island would mean the permanent loss of between 660 to 2,500 acres of estuarine bottom. The following paragraphs summarize the potential environmental and social impacts which would be associated with the implementation of an expansion plan:

a. Water Quality/Hydrology - The effect of a westward extension on the tides, currents, and salinities of Hampton Roads was studied on a fixed-bed model by the U.S. Army Corps of Engineers Waterways Experiment Station in 1974. The test results indicated that using either one of two suggested levee configurations (expansions to the west) would have no significant effects on the local current velocities, salinities, or tidal heights. The water quality effects produced in the Hampton Roads Harbor during construction of an expansion to Craney Island with either a hydraulic pipeline dredge, bucket dredge, or hopper dredge will be short term and are not expected to have significant adverse

impacts on estuarine or marine nekton. Also, disposal of dredged material within the constructed dikes is not expected to have significant adverse impacts on estuarine or marine nekton as all impacts will be confined within the diked area(s). Fish and shellfish species inhabiting the Hampton Roads Harbor project vicinity are adapted to, and highly tolerant of, naturally elevated suspended sediment concentrations.

In 1987 and 1988, the Corps Waterways Experiment Station (WES) investigated the impacts to sedimentation and circulation associated with six expansion alternatives. A 2-dimensional (2-D) model has been run and a high-resolution 2-D model was performed to focus on specific areas of interest associated with the expansion alternatives. It was found that, for both sedimentation and circulation, there were no significant differences between the proposed plans and the existing condition at any of the critical areas of interest.

b. Aquatic Environment - Numerous benthic surveys have been conducted in the Hampton Roads area (Boesch, 1971; Boesch, 1974; Dauer and Ewing, 1986; Diaz, 1988). The muck-type substrate which predominates is high in numbers of individual organisms but low in community diversity. Oyster distribution in Hampton Roads Harbor is severely limited by the presence of its major predator, the oyster drill and the disease organism MSX (Haplosporidium nelsoni) and "dermo" (Perkinsus marinus), which are typically found in salinities of about 15 ppt and greater. Another commercially valuable species is the hard clam, Mercenaria mercenaria, which has a patchy distribution in the Hampton Roads Harbor area. Haven, et al. (1981) researched its abundance and distribution in Hampton Roads Harbor. Due to fecal coliform contamination in shellfish areas in Hampton Roads, the shellfish have been condemned by the State Health Department but may be used as seed sources by those willing to transfer the mollusks to clearer water for harvesting later. The hard clams in the project area have been condemned for harvesting by the Virginia Shellfish Sanitation Commission but may be used after depuration. The Nansemond River (situated west of and adjacent to a westward expansion) is the site of both public and private grounds which would not be impacted by the proposed expansion.

The development of a westward-northward expansion of Craney Island Disposal Area could result in the loss of as much as 2,500 acres of shallow water habitat, and would impact, in varying degrees, the faunal communities that use it. The loss of benthic macroinvertebrates would be through direct smothering; the impact to fish would be indirect resulting primarily in the displacement of organisms from the affected area with some attendant reduction in total aquatic productivity in the region. Hampton Roads Harbor is not unique or critical to the aquatic species occurring there. Areal measurements indicate that the proposed site comprises approximately 5 percent of the benthic habitat within the Hampton Roads Harbor (assuming a 75-square-mile harbor). The loss of this aquatic habitat, while not critical, is considered significant and its compensation is a primary aim of the mitigation plan (see Environmental Information Report). Construction impacts are expected to be minor but contingency actions that will minimize unexpected impacts will be included in the construction plans.

If a westward expansion of Craney Island is determined to be the least environmentally damaging practicable alternative, compensatory mitigation will be required to offset these losses.

c. Wetlands - There would be some minor impact to wetlands caused by the proposed expansion of CIDA. A 1-acre salt marsh is located in the southwest corner of the proposed expansion area. This marsh would be eliminated with expansion plan B. There are a few scattered salt marsh sites along the Portsmouth shoreline. These are not extensive, totaling about 0.3 square mile and should not be affected by the project. An impact of siltation effects from placing the southernmost levee may occur; however, this should be of short duration followed by recovery. Of importance is the maintenance of the proper tidal exchange along the Portsmouth border; unless channel depths are maintained to assure proper tidal flushing, increased siltation and ultimate loss of the marsh areas could result. The project will be designed to prevent this from occurring.

d. Navigation - From a navigation standpoint, there is no problem anticipated with a westward expansion. There would, however, be a loss of total area available for both commercial and recreational boating, although the

area is not presently of a depth adequate for deep draft navigation. A northward expansion could infringe on the Channel to Newport News or the anchorages which lie to the north depending on the size of the extension proposed. However, the northward plans, as currently proposed, would not affect these deep draft navigation features. Open water occupied by any northward extension would be lost to shallow draft commercial and recreational vessel use.

e. Aesthetics - The shorelines of Portsmouth (Churchland) and Suffolk which would overlook a westward expansion have residential developments whose occupants favor an unrestricted view of the harbor. An expansion to the west would be undesirable aesthetically from the perspective of these communities. The community of River Shores is situated between Hoffler Creek to the west and Craney Island to the east and would be one of those most directly influenced.

A northward expansion would not be visible to most people, except those using the water in the vicinity of the area. Aesthetically, there are detrimental effects (i.e., open water would be transformed into a disposal site) but they are not as great as those associated with the westward expansion where people would be viewing the effects continuously from land-based development.

f. Archaeological Resources - Investigations have been carried out to determine the probable existence of archaeological resources in the proposed expansion areas. In July 1986 a strip of bottom 1,500 feet wide around the perimeter of Craney Island was surveyed with a side-scan sonar as part of the Craney Island Disposal Area Perimeter Dike Stabilization Study. As a result of this survey, three targets were selected for further investigation by diving, which revealed their non-historic value.

In January 1989, a side-scan sonar survey of the area that would be covered by the largest expansion scheme was carried out. Analysis of the results did not reveal any targets which might represent historical remains.

Both studies have been coordinated with the Virginia Historic Landmarks Commission (VHLC). In addition, personnel from the VHLC personally assisted in the review of the side-scan records from the first survey.

g. Social Impacts - The potential impacts of this plan are closely related to those of continued use of Craney Island without expansion, although expansion would logically create more local opposition than continued use would. Even though the extent of local opposition to all six expansion plans appears uniformly strong, these plans would have slightly different effects in certain areas.

One of the chief areas of concern is property values, which would very likely decrease for waterfront property owners with construction of several of these plans (see appendix D). Plans B and E would have the greatest effect on property values with Plan C having very little, if any, impact in this area. Closely related to property values is the change in the appearance of the area, which would be significantly affected with construction of these plans. As with property values, Plans B and E would have the greatest effect in this area with Plans A and F next in severity. The waterfront view of Hampton Roads, for residents in this area, would be either eliminated or limited by these plans.

Other areas of concern for residents here include decreased access to the harbor and loss of a portion of the open-water area of Hampton Roads. Because there is a highly unified group of citizens supported by civic leaders and local governmental officials strongly opposing this plan, proposing its implementation could lead to litigation which could delay implementation.

At the meeting of the City Council held on August 9, 1988, the following resolution was adopted:

A RESOLUTION EXPRESSING THE OPPOSITION OF THE COUNCIL OF THE CITY OF PORTSMOUTH TO THE FURTHER EXPANSION OR PROLONGATION OF CRANEY ISLAND AS A DISPOSAL AREA; ENDORSING THE CONCEPT OF HOUSE JOINT RESOLUTION 163.

WHEREAS, the 1988 session of the Virginia General Assembly adopted House Joint Resolution 163 memorializing the Congress of the United States

and the United States Army Corps of Engineers to develop recommendations regarding alternatives to the expansion of Craney Island as a disposal area and to expedite the availability of this land for development purposes; and

WHEREAS, the Council of the City of Portsmouth has steadfastly expressed its opposition to the expansion or unnecessary prolongation of the Craney Island disposal area; and

WHEREAS, the Council of the City of Portsmouth is further committed to assure that Craney Island is developed in a manner compatible with existing residential property in close proximity thereto; and

WHEREAS, appropriate development of the Craney Island area would enhance and strengthen the State and local economy and expand the tax base of the City of Portsmouth.

NOW, THEREFORE, BE IT RESOLVED by the Council of the City of Portsmouth, Virginia, that it hereby expresses its opposition to the further expansion or prolongation of Craney Island as a disposal area.

BE IT FURTHER RESOLVED that the Council of the City of Portsmouth hereby endorses the concept of House Joint Resolution 163 that alternatives to the use of Craney Island as a disposal area be developed and that its availability for development purposes be expedited.

BE IT FURTHER RESOLVED that the City Clerk be, and she hereby is, directed to forward copies of this resolution to the Virginia Delegation to the United States Congress, the Governor of Virginia, the Portsmouth Delegation to the General Assembly of Virginia, and the United States Army Corps of Engineers.

Willoughby Bay

Another alternative is Willoughby Bay which is located at the northwest tip of the city of Norfolk, adjacent to the Norfolk Naval Base, as shown on plate 8. The bay is approximately 1.5 by 1 miles, the average depth being about 9 feet below m.l.w. The entire southern shoreline of Willoughby Bay is on the Norfolk Naval Station property while the opposite shoreline is almost entirely residential property. Interstate 64 crosses about 4,000 feet off the northern edge of Willoughby Bay.

The bay is conveniently located with respect to dredging and disposal activities, by virtue of being adjacent to the entrance reach of the Norfolk Harbor Channel. The Navy has filled portions of the bay, including the mouth of Mason Creek and the east end of the bay.

A channel would be provided on the south side of Willoughby Spit to assure continued access to the water from the Willoughby Beach area. Otherwise, the bay would be filled to an elevation of about 18.0 feet above m.l.w. The ultimate fill height was limited to this elevation due to the relative proximity of the Naval airfield and heliport activities. Approximately 15,000 feet of levee would be required for this plan. The levee would inclose about 1,280 acres. With the water depth averaging about 9 feet, a levee with an ultimate height of 18.0 feet above m.l.w. would provide a storage capacity of about 60,000,000 cubic yards. The design capacity corresponds to an effective life of only about 12 years. This plan would not interfere with harbor traffic other than local recreational craft. The convenient location with respect to dredging and disposal activities would permit the continuance of the economical dredging and disposal methods now employed.

The plan would accomplish maintenance and improvement of the navigational features as follows: (1) removal of shoal material by current methods--namely, hopper, hydraulic pipeline, and bucket-scow dredges, and (2) transfer of the material through rehandling facilities to the diked area for final disposal. The rehandling facilities would be similar to those at the Craney Island Disposal Area, consisting of a rehandling basin for dumping scows and a pipeline for hopper dredge unloading.

Implementation of this plan would mean the permanent loss of approximately 1,280 acres of natural harbor area. The intangible effects include damage to marine life, loss of the bay view, possible air pollution, and the loss of water-oriented recreation within the project area. The following paragraphs summarize the potential environmental and social impacts which would result from implementation of this plan.

a. Water Quality - Willoughby Bay water quality and drainage into the bay would be effected by this proposal. Drainage of the surrounding area, notably the aqueduct outfall from Mason Creek, would be affected with this plan. Heavy population density, heavy boat traffic, numerous marinas, and sewage treatment plant effluents have already degraded the water quality in Willoughby Bay to some degree. The total mixing zone within the bay would be reduced in size and water quality would further suffer as a result.

b. Fish - Willoughby Bay supports some recreational fishing but probably is more important as a protected area for juvenile fish. The extent to which this area acts in this capacity is not known and would have to be investigated further by field investigations. Shellfish growing areas within Willoughby Bay have been condemned for direct commercial harvesting by the State Department of Health. Despite the condemnation, private catches continue in the Willoughby Bay area, especially of the blue crab.

c. Benthos - Willoughby Bay consists of a variety of marine habitats including sand flats, mudflats, small marshes, and rocky sections. Commercial benthos such as oysters and clams are seriously limited by disease organisms and poor water quality.

d. Hydrodynamics - There is a significant probability that this proposal would severely alter circulation in Willoughby Bay.

e. Wetlands - Where wetlands are present bordering Willoughby Bay (approximately 7.64 acres according to VIMS Tidal Marsh Inventory), there would be a loss or change of wetlands in those areas adjacent to the proposed disposal site. Mitigation for lost or altered wetlands would undoubtedly be required.

f. Navigation - An extensive area of open water occupied by this proposal would be lost to shallow draft commercial and recreational vessel use (approximately 1,280 acres). Elimination of recreational boating within the protected waters of the bay constitute a major impact of this alternative. A public boat ramp at Willoughby Bay is heavily used throughout the year. A channel would be provided on the south side of Willoughby Spit to assure continued access to the water from the Willoughby Beach area. The Navy's small boat basin may also be adversely affected.

g. Archaeological resources - A cultural resources survey might be required in order to assess the archaeological potential of the area which would be impacted by this proposal.

i. Social Impacts - The chief objections to this site center on aesthetics, anticipated decreases in property values, and loss of a resource for water-oriented recreation. The residents of the area, especially those whose property fronts Willoughby Bay, would lose their view of the water, which would be substituted by a view of a disposal area and ultimately whatever development was allowed there. Such a view would be seen as far less desirable than the existing one of the bay. The elimination of a relatively secluded area for water-based recreation would reduce an already limited resource, intensifying the use of other bodies of water nearby, most of which are already heavily used. All of these negative effects would undoubtedly lead to some decrease in property values for those structures located adjacent to Willoughby Bay.

The chief positive effect of this plan as well as all others that involve creation of new land is that after the site is filled, there would be additional land for development in an urban area that is almost totally developed now. This would be an asset to a city such as Norfolk, which has almost no large tracts of vacant land left.

Opposition to the use of Willoughby Bay as a new disposal area logically stems from individuals living in that area, including the Willoughby Civic League. The objections are based on risk of air pollution, aesthetic and recreational losses, and lowered area property values impacted by the use of the bay for disposal activities. A similar view was expressed by the city of Norfolk in a letter dated August 3, 1987 which stated:

> "1. Willoughby Bay - The City would not support any filling of Willoughby Bay. The City's concerns are the negative impact on adjacent property values and on recreational use of the Bay as well as the negative environmental impacts associated with this option."

The latest formal position of the Navy was presented at a 1 June 1972 public meeting, which read in part as follows:

> "Inasmuch as Willoughby Bay is used extensively by Navy personnel and dependents, as well as the general public, we would not, at this time, want to be a party to the elimination of such an irreplaceable recreational facility."

During the feasibility study on Norfolk Harbor and Channels, Virginia, Deepening and Disposal, the Willoughby Bay alternative was eliminated because of short useful life. The reevaluation of this plan has indicated that a short useful life is still a major disadvantage. For this reason coupled with the adverse environmental and social effects discussed previously, Willoughby Bay is being eliminated from further consideration as a long term plan for inner harbor disposal.

Ocean View Area

An area north of Willoughby Spit and Ocean View in Chesapeake Bay was considered. The site location is in open, deep water which gives rise to comparatively high construction costs.

The location of the disposal area is shown on plate 8. The facility would be located offshore in order to prevent disruption of existing shoreline use. It would be filled to an elevation of 30 feet above m.l.w. Approximately 37,300 feet of levee would be required. The levee would inclose about 2,000 acres. With the water depth averaging close to 24 feet, a levee with an ultimate height of 30 feet above m.l.w. would provide a storage capacity of 250,000,000 cubic yards. This capacity corresponds to a useful life of about 50 years.

Maintenance and improvement of the navigational features would be accomplished as follows: (1) initial removal of in situ shoal material by current methods--namely, hopper, hydraulic pipeline, and bucket-scow dredges, and (2) transfer of the material through rehandling facilities to the diked area for final disposal. The rehandling facilities would be similar to those at the Craney Island Disposal Area.

Implementation of this plan would result in the permanent loss of approximately 2,000 acres of marine bottom land in Chesapeake Bay. The following paragraphs summarize the environmental and social impacts which would result from implementation of this plan:

a. Water Quality - Water quality would be impacted by the construction and operation of a confined disposal site at this location. The total mixing zone

within the bay would be reduced in size and water quality may further suffer as a result.

b. Fish/Shellfish/Benthos - There would be a permanent loss of 2,000 acres of marine bottom land and associated benthos. The Crumps Bank area which lies just north of Ocean View was found by Diaz (1983) to have the greatest density and number of clams of six different areas in the lower bay which were being considered for sand mining. Impacts on clam resources would be direct and indirect. There would be the direct loss of bottom habitat and the clams which inhabit this bottom and the hydrodynamic changes caused by the presence of the disposal facility could substantially change current patterns on Crumps Bank, thereby altering potential recruitment of clam larvae. Fish migrations into and out of the Chesapeake Bay and its tributaries could be affected by this proposal.

c. Hydrodynamics - Changes in circulation and sedimentation could impact living resources and their recruitment and also could change erosion rates at area beaches. Also, depending on wind direction during severe storms, a disposal area off Ocean View may have beneficial effects along the shoreline.

d. Aesthetics - There would be a drastic change in the appearance of this open water area. From the vantage point of either land or water, this proposal would cause a negative impact aesthetically.

e. Archaeological resources - A cultural resource survey would assess the archaeological potential of the area which would be impacted by this proposal.

f. Social Impacts - Although this plan would have fewer effects than the Willoughby Bay plan, it would still be objectionable to the residents of Ocean View. It would present a visual intrusion for those residents of Central Ocean View whose property fronts the Chesapeake Bay and for any users of the beach in this vicinity. For these people the view of an open expanse of water would be changed eventually to one of a large land mass offshore in the bay. The possibility exists that turbidity would increase in the area as a result of the disposal operation, adversely affecting the recreational use of the beach and

the area immediately offshore. Any increase in erosion along this section of the beach could reduce further the area's recreational potential and hinder the ongoing efforts at redevelopment. Although this plan would not interfere with the navigation of large vessels, it would inconvenience fishermen and pleasure boaters by obstructing their access to the Chesapeake Bay. It would also remove a section of the bay from use for fishing or other water sports.

All of the above reasons make this site unacceptable to local residents and to city officials as well. The Ocean View Coordinating Committee has requested that additional problems not be created in an effort to solve the dredging disposal problems. The city of Norfolk, via letter dated August 3,1987, stated:

> "2. Ocean View. The City would not support the Ocean View disposal area option. The City's concerns are the negative impact on adjacent property values and on boating and fishing in the Chesapeake Bay as well as the negative environmental impacts associated with this option."

Hampton Flats

Another possibility for a new disposal site is the area called Hampton Flats, located in Hampton Roads just southeast of the cities of Hampton and Newport News. This area is conveniently located with respect to dredging and disposal activities in that it is adjacent to the Channel to Newport News and the entrance reach of the Norfolk Harbor Channel as shown on plate 8.

Two areas for a harbor development project in this vicinity were investigated by the city of Newport News. In 1967, the firm of Uhl, Hall and Rich made an engineering study of a proposed development of land reclamation with port facilities for general cargo at Newport News. The development plan was based on reclaiming an area of submerged land by diking, bulkheading, and hydraulic filling with material dredged from the Newport News Channel and from approach channels. The project site comprised about 225 acres as shown in figure 4.

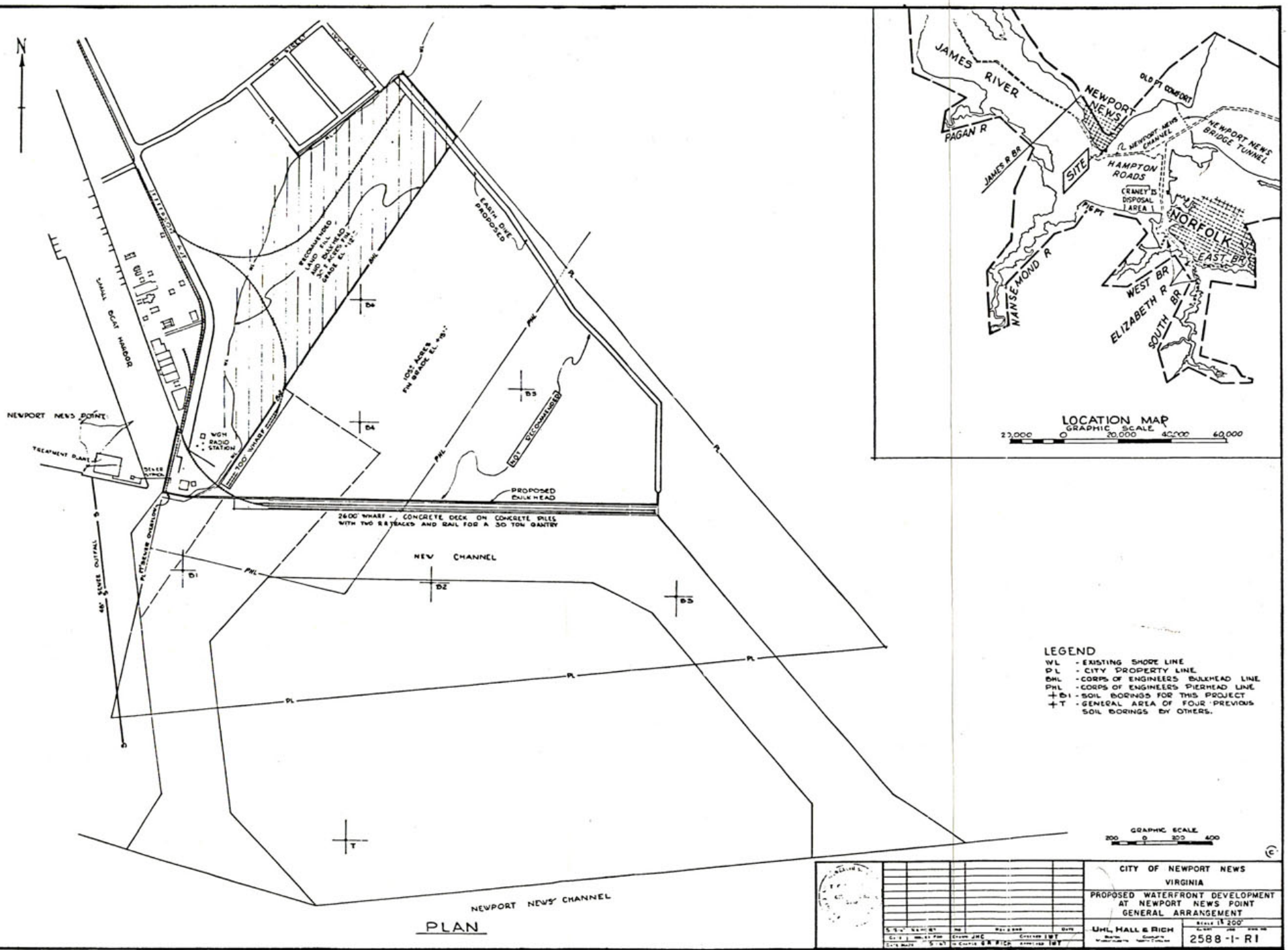

N
JAMES RIVER
NEWPORT NEWS
OLD PT COMFORT
PAGAN R
NEWPORT NEWS CHANNEL
NEWPORT NEWS BRIDGE TUNNEL
JAMES R BR
SITE
HAMPTON ROADS
CRANEY IS DISPOSAL AREA
NORFOLK
EAST BR
WEST BR
ELIZABETH R
SOUTH BR
NANSEMOND R
LOCATION MAP
GRAPHIC SCALE
20,000 0 20,000 40,000 60,000
SMALL BOAT HARBOR
NEWPORT NEWS POINT
TREATMENT PLANT
WGH RADIO STATION
RECOMMENDED LAND FILL/BULKHEAD LINE & PIERHEAD GRADE EL +12'
EARTH DIKE PROPOSED
105± ACRES FIN GRADE EL +8'
NOT RECOMMENDED
PROPOSED BULKHEAD
2600' WHARF - CONCRETE DECK ON CONCRETE PILES WITH TWO RR TRACKS AND RAIL FOR A 30 TON GANTRY
NEW CHANNEL
48" SEWER OUTFALL
B1
B2
B3
B4
T
BHL
PHL
PL
NEWPORT NEWS CHANNEL
PLAN
LEGEND
WL - EXISTING SHORE LINE
PL - CITY PROPERTY LINE
BHL - CORPS OF ENGINEERS BULKHEAD LINE
PHL - CORPS OF ENGINEERS PIERHEAD LINE
+B1 - SOIL BORINGS FOR THIS PROJECT
+T - GENERAL AREA OF FOUR PREVIOUS SOIL BORINGS BY OTHERS.
GRAPHIC SCALE
200 0 200 400
CITY OF NEWPORT NEWS
VIRGINIA
PROPOSED WATERFRONT DEVELOPMENT
AT NEWPORT NEWS POINT
GENERAL ARRANGEMENT
UHL, HALL & RICH
SCALE 1" 200'
2588-1-R1



Figure 4

The following recommendations were included in the report:

> "Because of generally poor soils in the project area we recommend that only a comparatively small portion [30 acres] of the project area be developed. This would be the area behind the established bulkhead line in soils thought to be better suited to support the intended loads of about 2,000 pounds per square foot. Additional soil borings in this area would be necessary to determine more realistic cost estimates.
>
> The development of the area could be aimed towards attracting port-oriented commercial interests. Actual port terminal activities probably can be handled better over existing facilities in Newport News.
>
> Although containerized general cargo movements are increasing rapidly, the cost of providing this type of terminal facility in this project area does not seem feasible at this time."

In January 1980, a report was prepared by Dravo Van Houten, Inc. of New York for the Newport News Department of Development. The report presented the results of a study to determine the feasibility of constructing and developing a dredge spoil island of about 300 acres to a height of about 12 feet above water adjoining the Newport News Channel and opposite the city of Newport News. About 15 million cubic yards of dredged material would have been required. As stated in the report:

> "The impetus for this study comes from proposals to deepen Norfolk Harbor and its major shipping channels. The dredging associated with this deepening project is expected to generate large quantities of spoil material. The construction of an artificial island from some of these materials is viewed as a possible means of economically disposing of these materials and at the same time creating potentially valuable waterfront acreage.
>
> "There would be access to the island both from the mainland and the 50-foot Newport News channel. The island would be a site for shipping cargo and

public recreational facilities. The cost was of the order of $34 millions."

A detailed study of the environmental factors involved was conducted by the Virginia Institute of Marine Science. The following are conclusions reached by this agency. Sketches of the four options considered are shown in figures 5, 6, 7, and 8.

"1. Impacts on the Larval Transport System

a. Due to proposed island locations A and B - application of frontal theory and 2-D hydrodynamic model combined with inferences from oyster larvae studies indicate that transport effectiveness would be markedly reduced by island construction in either location (i.e., reduction in total transport of 14.5 and 12% for Options A and B respectively). No quantitative assessment can be made as to the extent of impact to recruitment to seed oyster beds, however, there is a material probability of adverse impact on this resource.

b. Estimated Impacts of Island Locations C and D - island location shifted to a more easterly location suggests that the effectiveness of the frontal system could be virtually maintained (i.e., reduction in total transport of approximately 2% - within error limitations of the analysis).

2. Impacts on the Hampton Flats Hard Clam Habitat

Results do not permit a strictly quantitative assessment due to modifications of sedimentation patterns. Of four island locations tested, the proposed locations A and B are projected to induce more severe impacts. Configuration A is projected to cause formation of blanket mud deposits in area between island and mainland. Preliminary tests indicate that position C would have the least likelihood to cause deposition of fine grained sediments over a large area.

3. Combined Impact

Island construction at either of locations A or B as proposed would present a material probability of adverse impact on seed oyster beds in James River and hard clam habitat on Hampton Flats. Of four island locations considered in the VIMS study the 370 acre island at location C is projected to have the minimum combined impact."

Further information on the effect of these islands are discussed in the following paragraphs.

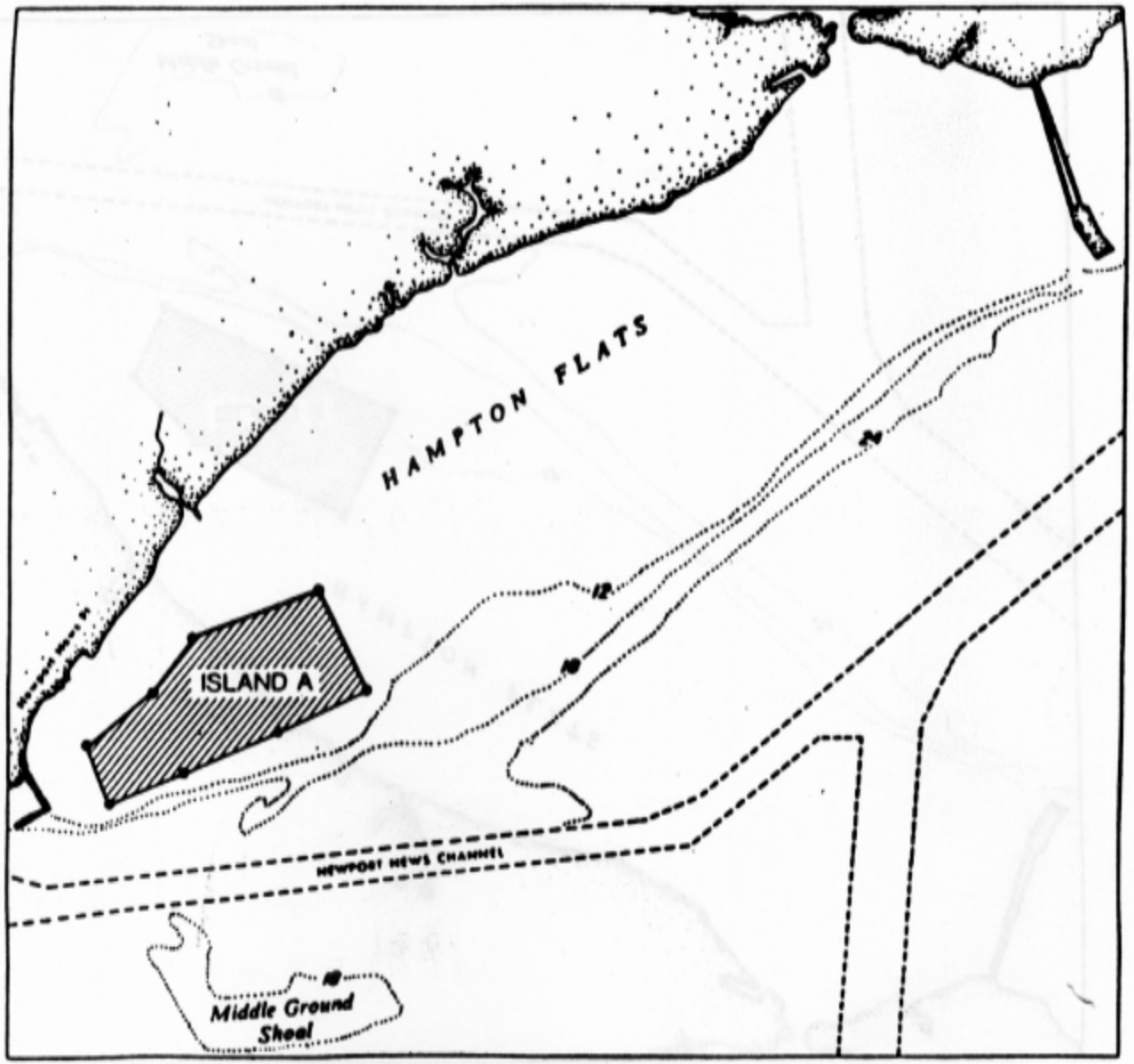



**Figure 5 Location of proposed New Port Island, Option A.**

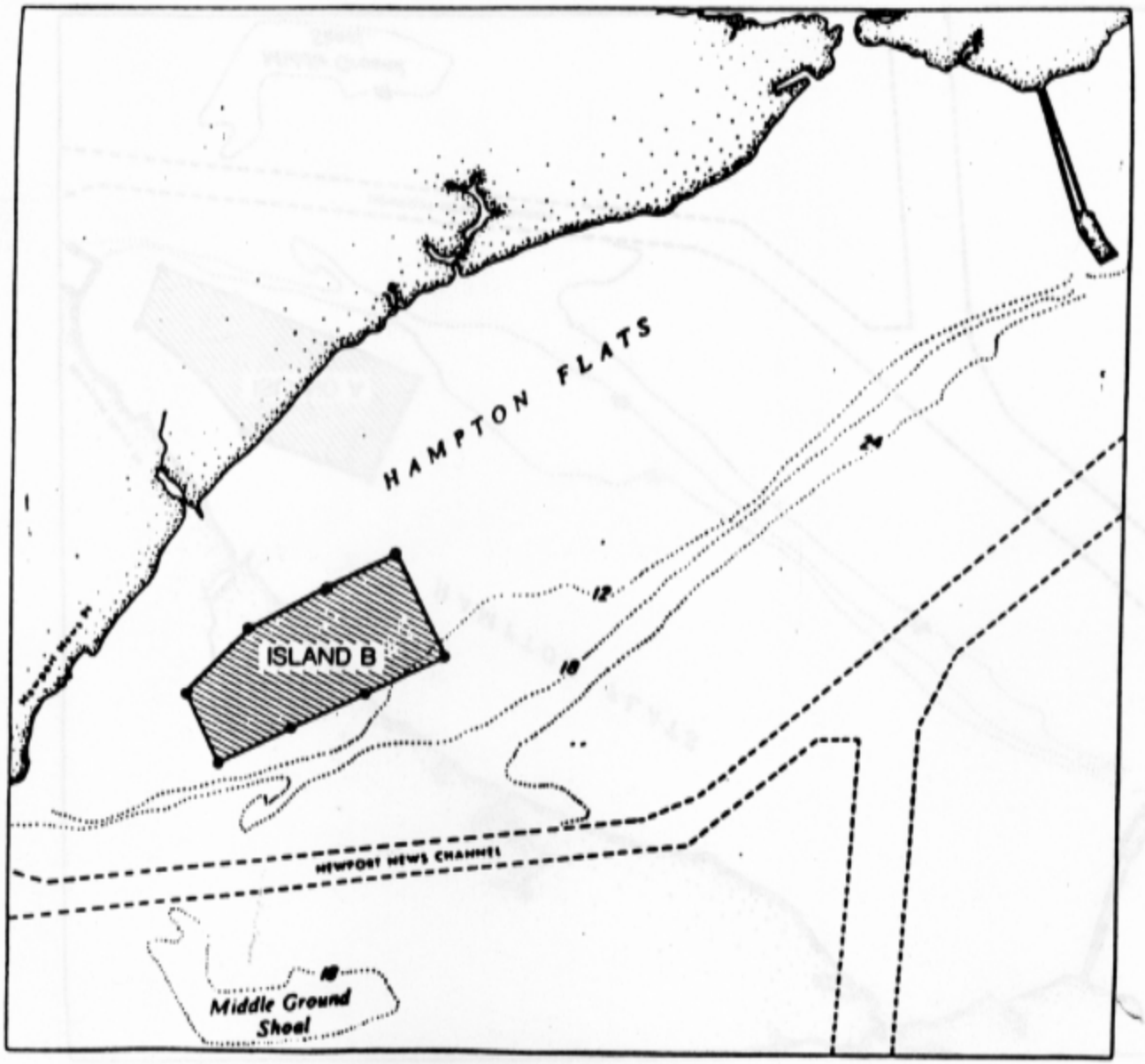



**Figure 6 Location of proposed New Port Island, Option B.**

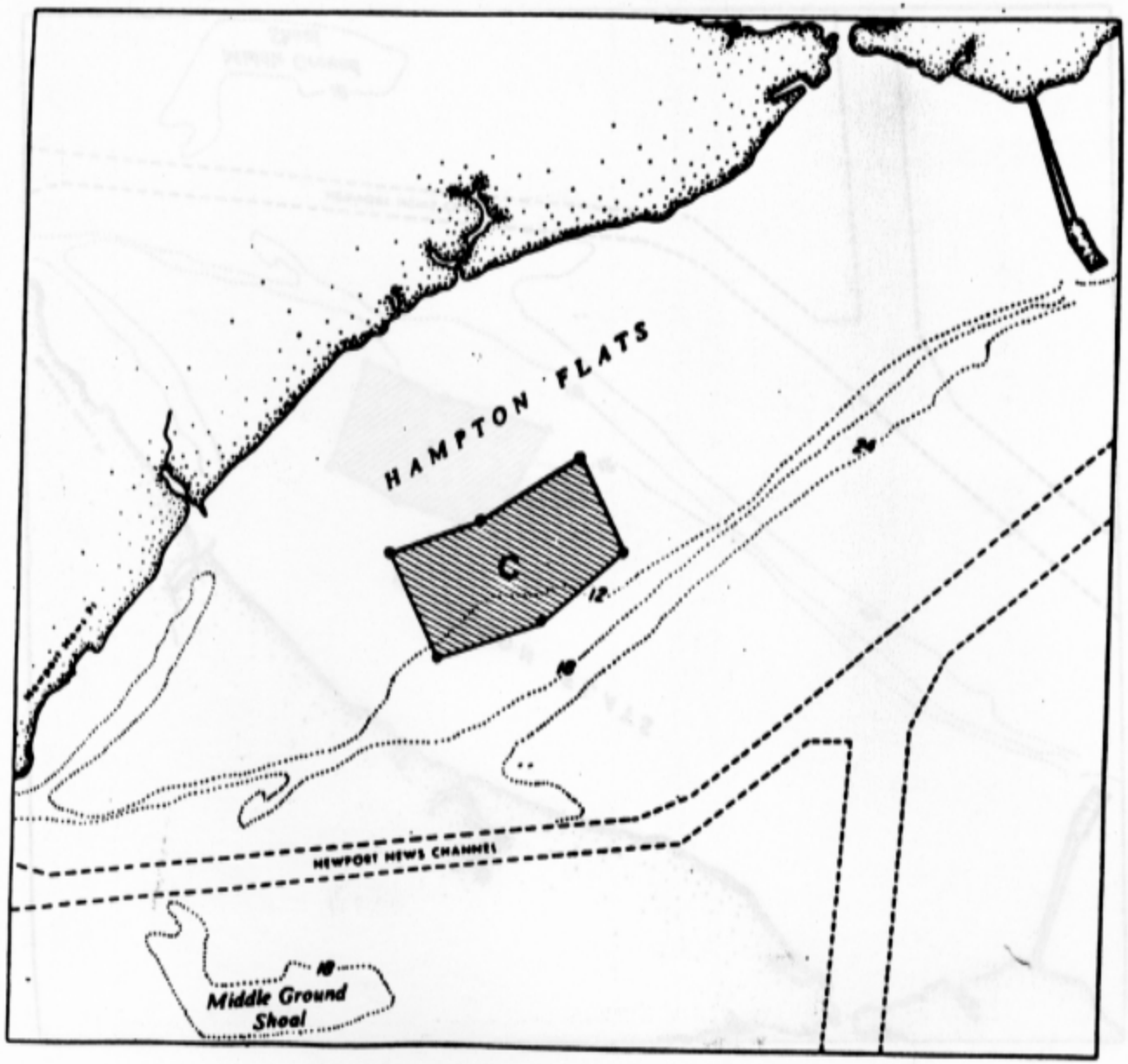



**Figure 7 Location of Test Island C.**

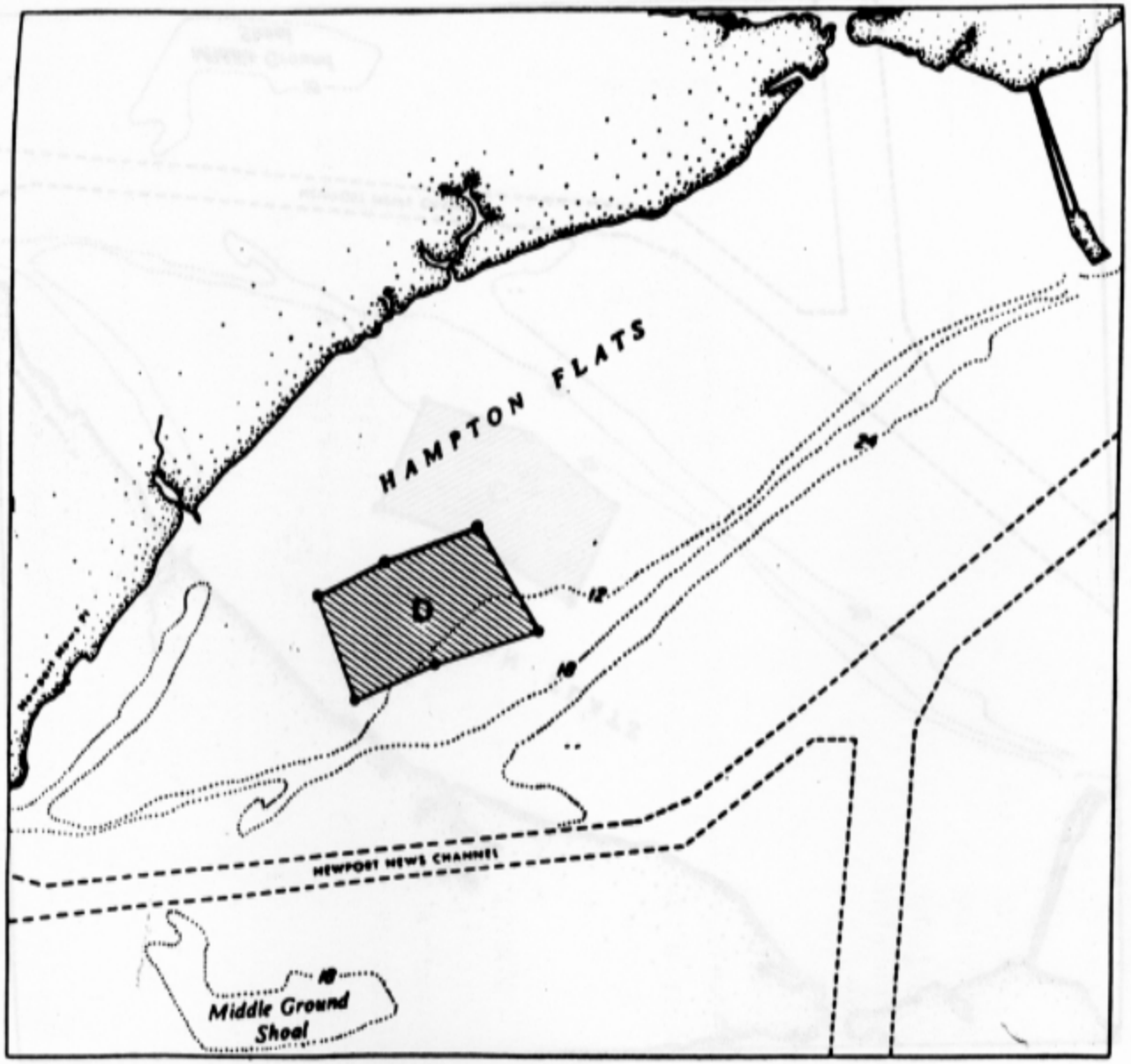



**Figure 8 Location of Test Island D.**

Although the city of Newport News requested a Corps of Engineers' permit for development of the island, it is now in an inactive category.

A large disposal area, envisioned by the Norfolk District at Hampton Flats, is shown on plate 8. Access to the present shoreline would be assured by building the levees away from the shore as shown. Drainage from the nearby cities would not be affected.

Approximately 43,000 feet of levee would be required in this plan. The levee would enclose about 1,800 acres. With the water depth averaging about 11 feet, a levee with an ultimate height of 30 feet above m.l.w. would provide a storage capacity of about 128,000,000 cubic yards. The capacity corresponds to a life of about 26 years. Current dredging methods could be continued with this convenient and protected area as a disposal site. The Plan calls for construction of a rehandling basin and hopper dredge pumpout facility similar to those at the Craney Island Disposal Area.

This plan would accomplish maintenance and improvement of the navigational features as follows: (1) removal of shoal material by current methods--namely, hopper, hydraulic pipeline, and bucket-scow dredges, and (2) transfer of the material through rehandling facilities to the diked area for final disposal.

Approximately 1800 acres of marine bottomland would be lost in its conversion to a disposal site. This represents a disposal area many times larger than the Newport News proposal studied by VIMS. The following paragraphs summarize the environmental and social impacts which would result from implementation of this plan:

a. Water Quality - The Hampton Roads Harbor mixing zone would be reduced in size as a result of this proposal. There would be a greater volume of dredged material effluent draining into the harbor from the new disposal site. Depending on changes in circulation patterns, flushing of the harbor may be impeded.

b. Fish/Shellfish - Spawning adults (fish) pass through the harbor enroute to spawning grounds in tributaries. A disposal area located in Hampton Flats may impede this passage or affect circulation in such a way that larval recruitment (especially oysters) may be hindered. As referenced earlier, the study of the proposed Newport Island conducted by the Virginia Institute of Marine Science in November, 1986 concluded that an artificially created island off Newport News Point would present a high probability of adverse impact on seed oyster beds in the James River. It is probable that a similar consequence could be expected from the proposed alternative.

c. Benthos - Hampton flats is worked by oystermen, clammers, and other commercial fishermen. The total biomass lost would include a variety of polychaete worms, bryozoans, mussels, clams, and oysters. Recreational usage is also high, with much boating, sailing, and sport fishing in the area. Investigations concerning the benthic productivity of this area were conducted in connection with the Newport Island study. The study concluded that Newport Island construction, as proposed, would present a high probability of adverse impact on seed oyster beds in the James River and hard clam habitat on Hampton Flats (direct impact and formation of blanket mud deposits in the area between the island and the mainland). Since Hampton Flats is one of the most productive commercial clam beds in Hampton Roads, a significant impact to this industry would result from construction of a disposal area at this site.

d. Hydrodynamics - The circulation and sedimentation patterns in the Hampton Roads Harbor, which could potentially be changed by this proposal, have been investigated by Norfolk District, Waterways Experiment Station, and Virginia Institute of Marine Science (VIMS) in connection with the Newport Island proposal. VIMS' application of frontal theory and 2-D hydrodynamic model combined with inferences from oyster larvae studies indicate that larval oyster transport effectiveness would be markedly reduced or impacted by island construction in the locations investigated. There are strong indications that a similar hydrodynamic impact would result from construction of a disposal site on Hampton Flats.

e. Wetlands - Where wetlands are present, there would be a loss or change of wetlands in those areas adjacent to the proposed disposal site. Mitigation for lost or altered wetlands would be required.

f. Navigation - An extensive area of open water occupied by this proposal would be lost to shallow draft commercial and recreational vessel use (approximately 1800 acres). A change in circulation and sedimentation patterns may cause more rapid shoaling of nearby navigation channels.

g. Aesthetics - Waterfront property owners in Hampton would be affected by implementation of this alternative. The present unrestricted view of the harbor would be interrupted by the aesthetically less-desirable presence of the disposal site.

h. Archaeological resources - A cultural resources survey would be required in order to assess the archaeological potential of the area which will be impacted by this proposal.

i. Social Impacts - In many ways the adverse effects of this plan are similar to those of the Ocean View site. One of the chief negative effects would be the reduction in available area for boating, sailing, and sport fishing, all of which are popular in this area. Since Hampton Flats is also used by oystermen, crabbers, and fishermen, construction of a disposal site here would reduce the available area for watermen to work in and would remove some of the resources that provide their livelihood. The areas adjacent to the disposal area might be adversely affected by potential increases in turbidity and changes in patterns of currents, which could reduce the biological productivity there.

In spite of the many potential negative effects of this plan, there might be some support for this alternative because of the valuable land that would be created after the Hampton Flats area was filled. As previously stated, Newport News has been interested in building an offshore island as a means of creating developable land in the vicinity of the city's downtown section. However, various studies have pointed out many problems with such an island, and the probability of its construction currently appears remote.

The Virginia Council on the Environment, in a letter dated September 8, 1987, stated that the Hampton Flats is an area where water circulation patterns are critical to shellfish larvae in the James River. Due to the possibility of serious adverse environmental effects, no further consideration has been given to a plan of development at Hampton Flats.

Suffolk Site

It is technologically feasible to transport dredged material by pipeline over long distances. Such a transport capability allows the consideration of alternative disposal areas far removed from the harbor itself. The nearest onshore area feasible is located in the eastern sector of the city of Suffolk as shown on plate 8. The entire area is about 6,000 acres in size and is bounded by U.S. Route 460 on the southeast; a pipeline on the southwest; the Atlantic Coastline and Norfolk, Franklin, and Danville Railroads on the west and north; and by the Suffolk-Chesapeake boundary line on the east. The area is not accessible by navigable water routes; however, it is feasible to connect Craney Island to the Suffolk area by pipeline. The pipeline considered would be 20 inches in diameter and approximately 55,000 feet in length. It would utilize five successive booster stations. As envisioned, the line would run from a rehandling basin formed from part of the west side of Craney Island, alongside the existing rail line, to the northern tip of the Suffolk Disposal Site. Water would be returned to Craney Island by means of a separate 16-inch pipeline.

In this plan, approximately 70,000 feet of levee would be required. The levee would be a simple, non-riprapped, earth-raised type. In addition, it would include an impervious slurry cutoff trench in order to seal the area. It would inclose about 6,000 acres. The area elevation averages +20 feet m.s.l., which, with a levee of ultimate height +47 feet m.s.l., would provide a storage capacity of about 275,000,000 cubic yards. The capacity corresponds to an effective life of over 50 years.

This plan would permit continuance of the economical dredging and disposal methods now employed. The existing rehandling facilities at Craney Island would be used for hopper dredge pumpout and scow unloading. The dredged material would be pumped through pipelines across the filled portion of Craney Island Disposal Area to the confined rehandling basin on the west

side of the disposal area. The material would be injected into a long pipeline by a rehandling unit and pumped to the Suffolk area by successive booster stations. Several pipeline rights-of-way would be reserved in this plan; other than these and the rehandling area, the filled Craney Island Disposal Area would be available for development.

This plan would accomplish maintenance and improvement of navigational features as follows: (1) initial dredging, which consists of removing shoal material by hopper, pipeline, and bucket dredges; (2) rehandling through pipeline from hopper dredge pumpout facilities and scow dumping basin (hydraulic pipeline dredges discharge directly into the diked rehandling basin); (3) temporary storage in the diked harborside rehandling basin; and (4) removal from the rehandling basin by pipeline for final disposal in the diked remote land disposal area in Suffolk. Rehandling and final disposal of the dredged material would be accomplished by a rehandling unit and pipeline.

The Suffolk Disposal Site alternative encompasses approximately 6,000 acres of primarily wooded wetland just north of U.S. Route 460 between the Chesapeake city limits and Suffolk. The heavily timbered land is relatively flat with highest elevations ranging about 25 feet m.s.l. Numerous drainage canals have been cut through the area, primarily to regulate water levels and to afford fire prevention measures. The surface soils are primarily peat and are usually less than 5 feet thick. Subsurface mineral deposits of economic value, with the exception of a thin veneer of sand, are not known to exist.

A large variety of commercially valuable trees occur in this area. Among them are loblolly and pond pine, black and tupelo gum, cypress, white cedar, red maple, and several species of oak, together with numerous shrub species, such as holly, redbay, and wax myrtle. Most of these species are very sensitive to the amount of moisture contained in the soil and their areal distribution is controlled by the prevailing water level. Of particular commercial value is the white cedar, a species endemic to the Dismal Swamp and adjacent forest.

Animal forms found in the proposed disposal site are those which are adapted to both dense woods and standing water. Principal mammals found here include whitetail deer, black bear, marsh rabbit, and gray fox. This site and

adjacent land appear to support a larger concentration of black bear than is found in the Dismal Swamp south of U.S. Highway 460. This is probably the result of its isolation from the rest of the Dismal Swamp and the fact that bear are not hunted as much as in the Swamp.

There are perhaps 80 species of breeding birds in the Dismal Swamp proper and presumably the majority of these would also be found north of U.S. Highway 460. This number includes both transient and resident species.

Reptiles and amphibians also abound in the Dismal Swamp area. There are about 14 species of reptiles present, which include three poisonous species--the cottonmouth water moccasin, the copperhead, and the cane brake rattlesnake. Approximately 15 to 20 species of amphibians occur in the Swamp region.

The following summarizes the environmental and social effects of the Suffolk disposal alternative:

a. Water Quality - Major concerns with the Suffolk Site include the possibility of saltwater intrusion into freshwater aquifers and the possibility that the site may be a recharge area for the Dismal Swamp. Another concern is salt seepage from the disposal site into surrounding swamp forest and ditches.

b. Fish/Shellfish/Wildlife - Animal forms found in the Suffolk Site are those which are adapted to both dense woods and standing water. There are a variety of mammals, birds, reptiles and amphibians found here. The U.S. Fish and Wildlife Service has indicated the presence of two endangered species, the southern bald eagle and the red-cockaded woodpecker. Habitat of these species, especially the woodpecker would be jeopardized with the use of this site.

c. Wetlands - Approximately 6,000 acres of wooded wetland would be lost with this alternative.

d. Aesthetics - The loss of this natural area would have a pronounced aesthetic impact, especially for those residential areas which are situated in close proximity to the proposed site.

e. Archaeological resources - It is well known that the Dismal Swamp area, of which this site is a part, was heavily inhabited or frequented by prehistoric peoples, as well as by people in historic times. Numerous sites have been found in the Dismal Swamp area; however, most of them have been confined to relatively high ground. Since the area is low-lying it is unlikely that any major significant sites exist therein.

f. Social effects - The selection of this site would be disruptive in terms of social impacts. About 6,000 acres of property would be enclosed with levees that eventually would be 27 feet above the height of the surrounding terrain. There would be approximately 10 miles of pipeline from Craney Island through Portsmouth, to the site in Suffolk. The proposed site in Suffolk is currently used for raising timber and hunting by various hunt clubs. There is a small housing development adjacent to the northern edge of the area. The pipeline route would cross a variety of land types including commercial and residential.

In Suffolk, those individuals who would be most directly affected are the landowners of the proposed disposal site who would suffer the loss of their land and the income it could produce from current and future timber sales and the residents of the housing area known as Wonderland Forest, who would be adjacent to the proposed site. Other groups affected would be the hunters who use the area and the residents of the city as a whole. The city itself would lose the revenues produced from real estate taxes on the disposal site for the life of the site. Land values in the vicinity might also be adversely affected although this is more difficult to project and is highly dependent on development patterns in the areas adjacent to the proposed site. The appearance of the proposed site would be changed through disposal operations, affecting the neighboring residents most directly. This effect could be lessened by the use of a buffer zone of natural vegetation between the disposal operation and the surrounding areas.

Another area of concern is the potential effect of this alternative on the expansion plans and daily operation of the Hampton Roads Airport, a general aviation airport located directly east of the proposed disposal site. The airport has embarked upon an extensive expansion program which involves extending a runway into what would be part of the disposal site along the city boundary. Also, airport personnel are concerned about the potential impact of birds which would be attracted to the site and then pose a threat to the air traffic from the airport. Current Federal Aviation Administration regulations prohibit construction of an airport within 10,000 feet of a landfill, unless the landfill is used exclusively for the disposal of rocks and earth.

It should be noted that the Southeastern Public Service Authority of Virginia (SPSA) operates a landfill for disposal of solid wastes generated within its service area including the cities in the Hampton Roads area. This site is located about 3 miles west of the Hampton Roads Airport (formerly referred to as the Portsmouth-Chesapeake Airport). It lies within the considered 6000-acre Suffolk Disposal Site. SPSA is planning to expand this landfill site.

Because of the potential negative impacts discussed above and numerous environmental concerns, many residents of Suffolk and the local governmental officials are opposed to this disposal site.

The people most affected by the pipeline alignment would be the owners and residents of the businesses and homes that would be acquired for the pipeline easement area. Opposition from these property owners and occupants could be expected with selection of this plan.

In a letter dated July 17, 1987, the City Manager of Suffolk stated that the City Council unanimously reaffirms its position to adamantly oppose the disposal of dredged material at any location within the city of Suffolk and is prepared to take all possible legal action to prevent the use of the area for such disposal purposes.

The following summarizes a position report that the City Council has adopted:

"1. There exists a serious possibility that such disposal activities on the Suffolk Site may result in the contamination of potable water in the shallow groundwater aquifers by the intrusion of saltwater spoils material....

2. As pointed out by the Task Force's Environmental Measures Subcommittee and the Army Corps of Engineers' Draft Feasibility Report, sediments analyzed thus far from Hampton Roads contain the chemical kepone. This condition obviously increases the potential contaminating quality of the spoil effluent.

3. Extensive and conclusive testing has not provided the necessary assurances that saltwater dredged material and its contaminants can be permanently prevented from entering the fresh water aquifers at the site....

4. There exists the distinct possibility that the site may be a recharge area for the Great Dismal Swamp....

5. There exists a real danger of contamination to the surrounding area by drainage runoff from the deposited spoils material....

6. Conversion of the Suffolk Site from a low lying forest to a dredged spoil disposal area would result in the combined loss of approximately 6000+- acres of commercial timber producing wetland and high quality wildlife habitat....

7. A key recreation feature to the City of Suffolk is its clean water for fishing, as well as its forest and woodlands for wildlife habitat and subsequent game hunting.... This recreational aspect of the properties in question would be significantly affected and/or eliminated altogether....

8. There is apparently no economic incentive for conversion of the site from timber producing acreage to a dredged spoils receiving area....

9. Use of the site would result in the loss of 6000+- acres for an undeterminable period of time....

10. It is important to note that the Suffolk Site is immediately west of and adjacent to the Portsmouth-Chesapeake Airport and lies within that facility's air traffic 'approach zones'....

11. The proposed use of the Suffolk Site as a confined area for the disposal of dredged spoils material is not in conformance with the City's existing or proposed zoning regulations,...."

As previously stated, the Norfolk District and North Atlantic Division recommended the Suffolk Disposal Site in the !980 Feasibility Report on Norfolk and Channels, Virginia, Deepening and Disposal. However, the Board of Engineers for Rivers and Harbors recommended that the Suffolk Site should not be constructed at that time. This position was concurred in by the Chief of Engineers and the Assistant Secretary of the Army for Civil Works.

Due to the serious environmental effects, no further consideration will be given to a plan of development for the storage of dredge disposal at the Suffolk site.

Horseshoe Area off Buckroe Beach

The Hampton beach front is a mixture of private, municipal, and Federally-owned lands. The southern limit includes Fort Monroe where a major seawall exists with practically no beach. Adjoining this area is Buckroe Beach which is intensively used and includes a dense residential development. Adjoining Buckroe Beach are privately owned beaches with little public access, relatively few houses and cottages, and with adjoining salt ponds, marshes, and a nature preserve.

A disposal area could be built off the Buckroe Beach area in what is known as The Horseshoe. The area is somewhat removed from harbor facilities where the majority of dredging is required. A disposal area at Buckroe as shown on plate 8, would be one to two miles offshore in waters ranging from 9 to 20 feet deep. The site lies directly north of the Thimble Shoal Channel and about 3 miles beyond the entrance to Hampton Roads. The deeper waters of the lower Chesapeake Bay are directly east of this site.

Rehandling areas would be located on the south side of the area where they would be protected from northern exposure. The entire facility, located offshore, would avoid conflict with existing development and costly disruption of present use and would permit continued access to the present shoreline. Drainage of the adjacent land areas would not be affected.

In the above plan, approximately 42,000 feet of levee would be required. The levee would inclose about 2,500 acres. With the water depth averaging 14 feet, a disposal area with an ultimate fill height of 30.0 feet m.l.w. would provide a storage capacity of 250,000,000 cubic yards over an effective life of 50 years. Current dredging methods could be continued. The plan calls for the construction of a rehandling area similar to that at Craney Island Disposal Area.

The plan would accomplish maintenance and/or improvement of the navigational features as follows: (1) removal of shoal material by current methods--namely, hopper, hydraulic pipeline, and bucket-scow dredges, and (2) transfer of the material through rehandling facilities to the diked area for final disposal.

The following paragraphs summarize the environmental and social effects:

a. Water Quality - The total mixing zone within the harbor would be reduced in size and water quality would likely be impacted as a result of a confined disposal site at this location.

b. Fish/Shellfish - The area off Buckroe Beach is a known clamming area of moderate commercial value (Diaz, 1983). Fish migrate through this area on the way to spawning and nursery areas in the upper tributaries of the bay. Bottom feeding species such as spot, croaker, and crabs rely directly on the benthos for food. Pelagic predatory species such as bluefish, striped bass and trout rely directly on the benthos as juveniles or indirectly on benthic production passed through the food chain. Blue crabs are actively sought in this area from April through August.

c. Benthos - There would be a loss of about 2,500 acres of subaqueous bottom with this proposal. This constitutes a sizeable portion of the bottom near the mouth of the Chesapeake Bay. The Horseshoe Area off Buckroe Beach was recently investigated by Diaz (1983) for macrobenthos. Together with 5 other sites, it was found to be one of the most productive in the lower bay area.

d. Hydrodynamics - Placing a 2,500-acre site in the lower bay has the potential to significantly impact the hydrodynamics of this area. It is anticipated that this would impact larval recruitment, community biological make-up or erosion at nearby shorelines. The location of the beach to the lee side of the disposal site island (to the northeasterly and easterly winds) might have beneficial effects in reducing beach erosion.

e. Aesthetics - There would be a drastic change in the appearance of this open water area. However, from the vantage point of land, this would be a relatively minor one aesthetically.

Since a dredged material disposal site in this vicinity would be a substantial distance offshore, this should reduce any complaints about the appearance of the construction site and its visual intrusion to the users of the beach front.

f. Navigation - Construction of this alternative would not interfere with navigation of large vessels, although it would inconvenience pleasure boaters and fishermen.

g. Archaeological resources - A cultural resource survey would assess the archaeological potential of the area which will be impacted by this proposal.

h. Social - There would not be any conflict with existing or future development on shore and access to the shoreline would not be disrupted. Undoubtedly, numerous recreational boaters, sports fishermen who frequent this water section in favorable weather, and the watermen who use this site and the surrounding areas for generating their livelihood would object to this site as a dredged material disposal area. There would be some movement of trucks and manpower to and from the disposal area.

In a letter dated September 10, 1987, the City Manager of Hampton stated the following:

> ".... Under a comprehensive shoreline policy adopted by Hampton City Council in June 1986 much in the way of public improvement, parks and recreational development, beach access, and economic development is actively taking place. A significant investment is being made to upscale residential projects and water associated amenities. All of this raises concern from Hampton's viewpoint pertaining to an offshore disposal site and we are opposed to a disposal site at this location. Any change in this position would have to be based on overriding benefits that may provide additional economic development opportunity and shoreline protection."

Chesapeake Bay Bridge-Tunnel

One alternative considered was for the east side of the Chesapeake Bay Bridge-Tunnel complex as shown on plate 8. The facility would be located between the Thimble Shoal Channel Tunnel and the Chesapeake Channel Tunnel. This location would not interfere with harbor traffic. However, it is removed from the center of dredging activity within the inner harbor area.

In the above plan, approximately 37,000 feet of levee would be required. The levee would inclose about 2,000 acres. The water depth averages 28 feet in this area; therefore, a disposal area with an ultimate fill height of 30 feet above m.l.w. would provide a storage capacity of 250,000,000 cubic yards. This capacity corresponds to an effective life of 50 years. Present dredging methods could be continued as the plan calls for construction of a rehandling basin and hopper dredge pumpout facility similar to those at Craney Island Disposal Area. The rehandling facilities would be located on the south side of the facility so as to be protected from adverse weather factors of a northern exposure.

In evaluating this plan, consideration must be given to the fact that Chesapeake Bay is currently under study by a multiagency group including the EPA, Fish and Wildlife Service, National Marine Fisheries Service, Corps, and the states bordering the bay. This group was formed in 1983 to coordinate actions to enhance, restore and protect the resources of the Bay (see chapter on Problems, Needs, and Opportunities). The 1987 Chesapeake Bay

Agreement further outlines specific actions or initiatives to be taken in accomplishing this goal. The state and Federal Government has been tasked with developing and executing programs to reverse the environmental decline of the bay. This program also applies to all other areas in and adjacent to Chesapeake Bay.

The potential environmental and social impacts of constructing a disposal site in the Chesapeake Bay follow.

a. Water Quality - Water quality in the lower Chesapeake Bay could be impacted by this alternative. The disposal area would be located near the mouth of the Bay where there is strong tidal flushing; it is anticipated that the above proposal would adversely impact hydrodynamics, and to this extent water quality.

b. Fish/Shellfish - The lower Chesapeake Bay represents a very popular site used by local commercial and sport fishermen as well as commercial crabbers. Adult finfish pass through this area enroute to spawning grounds in tributaries and the upper bay. A disposal area located in lower Chesapeake Bay may impede this passage or effect circulation in such a way that larval recruitment may be adversely impacted. There would be a direct loss of habitat and feeding area associated with this proposal.

c. Benthos - The lower Chesapeake Bay is known as an overwintering area for adult blue crabs. Depending on the exact location of the disposal area, this resource could be adversely impacted. The total benthic biomass lost would include a variety of polychaete worms, bryozoans, mussels, clams, and oysters. The 2,000 acres of bottom that this proposal would eliminate would further affect the food resources of local and migrant fish which frequent this area of the Bay enroute to upstream tributaries or locations on the eastern seaboard. It is not known precisely to what extent these bottom areas at the mouth of the Chesapeake Bay contribute to the habitat needs and food requirements of local and migrant fish and other species.

d. Hydrodynamics - The circulation and sedimentation patterns in the lower Chesapeake Bay could potentially be changed by this proposal. Among

other detrimental effects, hydrodynamic changes could impact larval recruitment (finfish and shellfish) into the bay and its tributaries.

e. Wetlands - No wetlands would be directly impacted by the above proposal.

f. Navigation - An extensive area of open water occupied by this proposal would be lost to shallow draft commercial and recreational vessel use. A change in circulation and sedimentation patterns may cause more rapid shoaling of nearby navigation channels such as the very important Thimble Shoal Channel.

g. Aesthetics - The site would be visible from the Chesapeake Bay Bridge-Tunnel and to vessels using the area. The disposal site would be far less pleasing, aesthetically, than, say, the open waters of the bay itself.

h. Archaeological resources - A cultural resources survey might be required in order to assess the archaeological potential of the area which would be impacted by this proposal. The Virginia Historic Landmarks Commission has indicated that there is potential in the affected area.

i. Social Impacts - The major social effect of this plan would be the removal of a section of a popular area from recreational use. The Chesapeake Bay in the vicinity of the bridge-tunnel is a very popular area for local sports fishermen. Construction of a disposal area here would eliminate part of this area from use by pleasure boaters as well as fishermen. Since water areas available to small craft is limited, any reduction in this supply will intensify use of the remaining areas, which are all heavily used during the peak parts of the season.

In a letter dated August 3, 1987, the Executive Director of the Chesapeake Bay Bridge and Tunnel District stated:

> "...It is our understanding that the Chesapeake Bay disposal area would contain approximately 2500 acres and could be utilized as a disposal site for the next 30 to 40 years. The activity involving many tug

boats, barges, and other vessels in close proximity to the Bridge-Tunnel during the construction stage of the confinement area, and the subsequent years of utilizing the disposal area, is of great concern to us due to the potential of damage to our structure by a vessel.

"Since we opened to traffic in April of 1964, the Bridge-Tunnel has been struck on several occasions by vessels that experienced mechanical problems or vessels that were driven off course because of severe weather conditions. On three occasions, as a result of ship collisions, we were completely closed to traffic for periods ranging from 14 to 42 days. During the fiscal year July 1, 1986 through June 30, 1987, 2,240,450 vehicles crossed the Bridge-Tunnel. An accident causing the Bridge-Tunnel to be closed would be devastating to us financially and would also adversely impact the citizens and businesses of the cities of Southeastern Virginia, the two counties of the Eastern Shore of Virginia, and other surrounding areas.

"The Chesapeake Bay Bridge and Tunnel Commission, at its meeting on July 14, 1987, went on record expressing its concern and objection to the proposed Chesapeake Bay disposal site. Your consideration in eliminating the Chesapeake Bay site as a proposed area for the disposal of dredged material will be greatly appreciated."

Ragged Island

Ragged Island is a wetland marsh that projects into the James River near the south end of the James River Bridge. It is located about 9 miles from the center of the dredging activity and is shown on plate 8. This area is now a wildlife management area of the Commonwealth of Virginia.

In the Ragged Island proposal, approximately 64,000 feet of levee would be required which would inclose about 2,300 acres. Elevation of the area averages +4 feet m.l.w. A disposal area with an ultimate fill height of 18 feet m.l.w. would provide a storage capacity of about 64,000,000 cubic yards. This capacity corresponds to an effective life of 13 years. The ultimate fill height was limited to 18 feet m.l.w. due to its proximity to the James River Bridge crossing (U.S. Route 17).

Removal of shoal material would be accomplished by current methods--namely, hopper, hydraulic pipeline, and bucket-scow dredges; material would be transferred through rehandling facilities to the diked area for final disposal. The rehandling facilities would be similar to those at Craney Island.

The use of Ragged Island as a disposal site would result in the loss of 2300 acres of wetland salt marsh. The following paragraphs summarize the environmental and social effects.

a. Water Quality - The extensive wetlands at Ragged Island act as a buffer to trap sediments, stabilize the shoreline and trap nutrients coming from upland areas. Without this buffer, there would be a greater chance of adverse impact to water quality in the adjoining James River. Also, adjacent seed oyster beds in the James would be sensitive to any changes in the suspended sediment loads resulting from construction and operation of this site as a disposal area.

b. Fish/Shellfish and Wildlife - Ragged Island is a state wildlife management area operated so as to make the land produce a sustained crop of wildlife for recreational purposes. Wildlife management areas are managed primarily for the development of wildlife habitat with only minimal facilities necessary to carry out the program. The intent is to keep each area attractive to wildlife, hunters, fishermen, trappers, naturalists, hikers, and the thousands who enjoy being outdoors. The scarcity of this type of open and undeveloped land in the state is obviously one reason for its establishment. Striped bass fishing has long been good in this area and bluefish and trout are available in season in the adjacent James River.

c. Benthos - Depending on where dikes were constructed and how the effluent from the site was handled, there may be some impact on benthos in the adjoining James River. This area of the James is one of the most productive seed oyster areas in the state.

d. Hydrodynamics - Circulation patterns in this portion of the James River are critical to the recruitment of oyster larvae to the James River seed beds. By

changing shoreline configurations, there is the potential for changing the hydrodynamics of the area.

e. Wetlands - The use of Ragged Island as a disposal site would result in the loss of 2,300 acres of wetland saltmarsh. Managers consider this area to have had little, if any, use by man over the years and is generally an unspoiled section of river marsh. Much of the area is subjected to tidal flooding making it a contributor to the food chain in the form of detrital and organic matter. The loss of this wetland habitat may be in conflict with the Federal Executive Order 11990 (Protection of Wetlands) which advocates "...avoidance to the extent possible the long and short term adverse impacts associated with the destruction or modification of wetlands and avoidance of direct or indirect support of new construction in wetlands wherever there is a practicable alternative." Prior to issuance of E.O. 11990, the Corps of Engineers recognized that wetlands are productive and valuable public resources and through its regulatory program, as a matter of policy, gives special consideration to applications for activities in wetlands. This policy is contained in 33 CFR 320. All wetlands fall under jurisdiction of Section 404 of the Clean Water Act amendments of 1987 (Public Law 100-4).

f. Navigation - Changes in sedimentation or circulation patterns in the James River could affect shoaling of navigation channels.

g. Aesthetics - This area is especially visible from the James River Bridge which transects it. Obviously, much would be lost in the transition from a natural, unaltered wildlife and wetland area to a confined disposal site for dredged materials lacking vegetation and the same extent and variety of wildlife.

h. Archaeological resources - A cultural resources survey would be required in order to assess the archaeological potential of the area which would be impacted by this proposal.

i. Social Impacts - Due to the remoteness of the area, this plan would not impact on residential and/or commercial properties. Ragged Island is a state wildlife management area with hunting and fishing allowed in season. Game

available here include deer, rabbit, raccoon, fox, squirrel, and ducks; fish caught here include striped bass, catfish, and perch. Therefore, the most important social impact would be the removal of a recreation area for nature walks, hunting, and fishing.

In a letter dated September 8, 1987, the Governor's Council on the Environment (Virginia) stated the following:

> "Ragged Island is a Wildlife Management Area belonging to the Department of Game and Inland Fisheries. It is one of the wetland areas in the United States placed on the list of 'Wetlands of International Importance Especially as Waterfowl Habitat' in an international treaty, also known as the Ramsar Convention, to which the United States is party. Therefore, the Army Corps of Engineers should delete this site as a possible dredged material disposal site."

Due to the serious environmental effects, no further consideration will be given to a plan of development for the storage of dredged material at Ragged Island.

Disposal of Dredged Material Alongside Channel

Consideration was given to disposing of dredged material alongside the channels of the inner harbor. In the case of the Southern Branch of the Elizabeth River, the areas along both banks of the channel are highly industrialized and numerous piers extend across the floodplain toward the channel. Furthermore, the navigable channel itself takes up much of the cross sectional area of the river and its overflow area from bank to bank. In the case of the Elizabeth River, there is also continuous development along the stream. There are numerous long piers along the east side of the river. On the west side, the anchorages, Craney Island and Craney Island Disposal Area all tend to reduce the overflow area of the stream. Dredged material from the Channel to Newport News has been used to reinforce the diked area at Craney Island.

Shoaling of the Norfolk Harbor channels is from the west bank toward the east. Most of the material in the Elizabeth River and its Southern Branch

consists of fine sand, silt and clay. This material if placed alongside the small adjoining areas, would flow back into the channel and would have to be redredged, frequently. Accordingly, no further consideration has been given to such a plan.

Disposal at Sea

The dredging of new work and/or maintenance would be accomplished either by hopper dredge and/or bucket dredge with the material disposed of at sea. In the case of the hopper dredge, present dredging methods would be used to achieve maximum economic load, whereupon dredging would cease and the load would be carried to sea for dumping. In the case of the bucket dredge, the dredged material would be discharged into attendant barges. The barges, when loaded, would be towed to sea by tug, and the material dumped. The considered open sea disposal areas are: (a) Dam Neck Ocean Disposal Site, and (b) Norfolk Disposal Site. They are shown on plates 1 and 8 and discussed in the paragraphs that follow. Plans considered for disposal at sea are highlighted later in the paragraph entitled "Summary of Ocean Disposal Plans."

Disposal at Sea - Dam Neck Ocean Disposal Site (DNODS)

The ocean disposal site at Dam Neck (37 miles from Craney Island) has been in use since 1967 when the Corps dredged Thimble Shoal Channel in Chesapeake Bay to a depth of 45 feet. Since that time all new work and maintenance dredged material from Cape Henry Channel and Thimble Shoal Channel (with limited exceptions) has been deposited at DNODS. These deposits included a variety of naturally occurring marine sediments, ranging from silts and clays to fine, medium, and coarse sands. Some of the material has been deposited along the Virginia Beach shoreline and has also been used to build the islands for the I-664 bridge-tunnel crossing. As of May 1985, about 20.4 million cubic yards of dredged material have been placed at Dam Neck.

In 1977, the Environmental Protection Agency (EPA) designated Dam Neck as an interim ocean disposal site for dredged material. The EPA approval

of this site was for an interim period pending final designation for continuing use. The use specification (dredged material) and size were based on historical use.

An expanded DNODS was designated as an approved ocean disposal site under the Corps of Engineers authority contained in Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (MPRSA). The Final Supplement, containing evaluations with respect to the criteria included in Parts 228.5 and 228.6 of the Code of Federal Regulations, Title 40 (40 CFR 228), was filed with EPA and appeared in the Federal Register on June 14, 1985. The Record of Decision, giving DNODS final site designation, was signed by the Division Engineer, North Atlantic Division, U.S. Army Corps of Engineers, on September 23, 1985.

More recently, EPA gave DNODS final designation under authority in Section 102(c) of MPRSA. This final designation by EPA appeared in the Federal Register on March 31, 1988.

In accordance with the draft Memorandum of Agreement (MOA) between the Corps and EPA on management of DNODS (this has not as yet been executed).

> "...The DNODS, as designated, is the primary disposal site for three Federal navigation channels: the Atlantic Ocean Channel (proposed in connection with the 55-foot channel into Hampton Roads), the Cape Henry Channel, and the Thimble Shoal Channel. They are shown on plate 1. Approximately 70 million cubic yards of materials are predicted to be dredged from these 3 channels over the life of the site (50 years) based on a predicted 35-foot minimum clearance depth for any management area within the site.

Also in accordance with the draft MOA,

> "...Use of the DNODS for dredged materials, other than from the channels identified above, is not precluded. However, all dumping must be compatible and consistent with the long-term primary

need for the Federal navigation channels. Further, all dumping must conform to the ocean dumping criteria, to the site designation environmental assessment, and to the objectives of the site management. Last, an alternative review analysis must be performed."

During the process of coordinating the environmental documents which were required to designate DNODS, various concerns were expressed by the environmental resource agencies. These included:

a. Impacts of dredged material disposal on breeding, spawning, nursery, and passage activities of commercially important finfish and shellfish in and out of the Chesapeake Bay.

b. Sediment transport from the disposal site toward area beaches at Virginia Beach.

c. Impacts to sea turtle migration through the site during the spring migration.

d. The effects on area water quality (especially dissolved oxygen) of dredged material disposal at DNODS and the operation of the Hampton Roads Sanitation District outfall located off Virginia Beach.

e. Impacts of dredged material disposal on meroplankton including blue crab, bay anchovy, and sand shrimp larvae.

f. Impacts to commercially important benthos.

The National Marine Fisheries Service, U.S. Fish and Wildlife Service, and the Chesapeake Bay Foundation continue to express the above as unresolved concerns.

The most extensive breeding, spawning, and nursery activities occur either in offshore waters or in the adjacent Chesapeake Bay estuarine waters that are offshore or inshore of the dredged material disposal site. In addition,

the total area of the disposal site represents only a small portion of the total breeding, spawning, and nursery areas along the mid-Atlantic Coast for these species. Due to the mobility of finfish, it is unlikely that dumping will have a significant impact on either anadromous or pelagic species.

Sediment transport at the DNODS is minimal, with little adverse environmental impacts. The majority of sediments released would be expected, based on the historical use of the site, to sink to the bottom and remain in place. After 20 years of use, no apparent adverse impacts to beaches have been associated with the previous dredged material disposal at the site. Thus, use of the site should not adversely affect recreation, coastal development or other uses of the shoreline.

Dumping of dredged material over 20 years has not significantly affected water quality. Therefore, use of the site is not expected to have significant water quality or ecology impacts. Water quality monitoring will continue by both the EPA and Corps to assure no changes in water quality due to ocean disposal during the critical summer months.

Studies indicate the migration of thousands of the loggerhead and Ridley turtles into the Chesapeake Bay. However, there is little evidence that a significant number of turtles would in fact traverse the dump site during migration. During EPA's surveys over a four year period, no turtles were sighted nor were any recovered from extensive benthic trawls at the site.

Studies by EPA and the Corps showed that during development, a significant fraction of larval blue crabs reside in the Chesapeake Bay plume. However, DNODS represents only a small fraction of this total plume and a single dump an even smaller fraction of the total area. Therefore, the potential impacts to larval crabs would be very small, especially since the crab larvae are primarily in the surface waters and dredged material is deposited well below the surface.

The DNODS supports a productive benthic faunal population which is typical of the mid-Atlantic inner Continental Shelf. However, EPA found no commercial quantities of any shellfish in the DNODS. A small conch fishery

occurs inshore of the site and the surf clam and sea scallop are found offshore of the site.

The following table summarizes the capability of the existing DNODS to accept dredged material in accordance with its formal designation in 1985 and assuming only construction of the 55-foot outbound lane. (All amounts are in millions of cubic yards [m.c.y.]):

Table 25. CAPABILITY OF EXISTING DNODS

| Item | Deposition (mcy) | Capacity (mcy) |
|---|---|---|
| Total design capacity (to fill site to a maximum height of 35 feet below m.l.w.) (based on site designation document) | | 70 (a) |
| Material placed to date Thimble Shoal 50-foot outbound) | 4.7 | 65.3 |
| Outer harbor (Cape Henry Channel to Baltimore) | 2.1 | 63.2 |
| Remaining capability to accept dredged material | | 63.2 |

(a) Exclusive of 20.5 mcy which had been placed in site prior to 1985.

In a letter dated September 9, 1988, EPA stated that dredged material from the inner harbor which is suitable for ocean disposal can be deposited in DNODS. This is discussed further in subsequent portions of this report.

Disposal at Sea - Norfolk Disposal Site

The area described as the Norfolk Disposal Site (NDS) is a dredged material disposal site delineated by a circle with a radius of 4 nautical miles centered at 36°59' N latitude and 75°39' W longitude in the coastal waters off the mouth of the Chesapeake Bay. The site is shown on plate 1 and is located beyond the 10-fathom depth contour line, approximately 17 nautical miles due

east of the Chesapeake Bay mouth and about 45 miles from Craney Island. It is approximately 50 square nautical miles in area.

In May 1984, the U.S. Environmental Protection Agency and the U.S. Army Corps of Engineers jointly developed and published a general approach to designation studies for ocean dredged material disposal sites. The purpose of the document is to provide consistency in the evaluations by the two agencies leading to the selection of environmentally acceptable and operationally efficient dredged material disposal sites in the ocean. The environmental factors listed in Section 102(a) of the Marine Protection, Research and Sanctuaries Act of 1972 (MPRSA) on the effects of dumping are specifically oriented toward the avoidance of unreasonable degradation or endangerment of human health, welfare, or amenities on the marine environment, ecological systems, or economic potentialities. The purpose of the site-designation study process is to delineate economically feasible sites that are sufficiently far removed from ecologically sensitive or incompatible use areas to eliminate or minimize adverse impacts to these areas. The criteria for site selection are set forth in Codes of Federal Regulations (40 CFR, Part 228) and include evaluation of geographically limited breeding, spawning, nursery, feeding, or passage habitats; navigation lanes; beaches; hydrology; water quality and other critical areas that may be determined to be incompatible with dredged material disposal activities. Norfolk District's successful implementation of this guidance and EPA/COE site evaluation process led to the final designation, by the Corps, of the Dam Neck Ocean Disposal Site (DNODS) under Section 103 of MPRSA in September 1985.

Prior to development of the joint EPA/COE guidance in 1984, the same evaluation criteria, as mentioned above and specified in the MPRSA and in 40 CFR, Part 228, were used to select the Norfolk Disposal Site for more intensive evaluation. The decision to pursue NDS was a consensus arrived at by the Norfolk District in consultation with the F&WS, NMFS, NOAA, EPA, VMRC, VIMS, and ODU. After preliminary review and application of the 40 CFR, Part 228 criteria, the NDS was selected for further study as documented in the NDS Environmental Impact Statement. Following are several important selection criteria.

(1) NDS was located within a reasonable hauling distance.

(2) NDS was situated far enough offshore to be outside of the Chesapeake Bay plume and disposition therein would not impact circulation patterns in and around the bay mouth.

(3) NDS had been previously used as a disposal site for dredged material.

(4) NDS was situated outside of the area of offshore transport of blue crab larvae (a critical bay resource).

(5) NDS was situated so as to avoid impact on commercial fisheries: south of the surf clam fishery, north of commercial fish trawling, and inshore of scallop and lobster fisheries.

(6) The position of NDS would not interfere with shipping, fishing, recreation, or migration of fish into and out of the Chesapeake Bay.

(7) Sediment transport from NDS, if any, would be offshore rather than into the bay.

Following this preliminary selection of NDS, the site was intensively evaluated between 1978 and 1981. During the process of this evaluation (application of the "General and Specific Criteria for Selection of Sites" as specified in 40 CFR, Part 228), issues on site location, critical areas and resources, water quality, and other relevant issues were investigated and addressed. The findings were published in the NDS Environmental Impact Statement and Appendices and were filed with EPA on 23 July 1982. These studies confirmed the environmental and operational suitability of NDS for designation as an ocean dredged material disposal site.

There were no areas of controversy or unresolved issues in the EIS relating to the use of NDS as an ocean disposal site for dredged materials. There are no foreseeable impacts which would preclude the use of NDS for Norfolk Harbor and Channels materials.

By letter of 9 September 1988, EPA has requested that Norfolk District give it direction as to which way the district wants to proceed with NDS (to designate or not). EPA expressed that,

> "EPA favors the designation of the Norfolk Disposal Site as a second option for use with the long-range disposal plan for all suitable material from the Norfolk and Baltimore Channels."

EPA further stated that the designation of NDS would not preclude the continued use of DNODS. By letter of 1 August 1989, the Norfolk District requested EPA to designate NDS.

Disposal at Sea - Capping Unsuitable Dredged Material

As stated in the previous chapter on "Problems, Needs and Opportunities," portions of the dredged material from the Elizabeth River and its Southern and possibly Eastern Branches are not suitable for ocean disposal. Therefore, material dredged therein must be disposed in a containment area.

Accordingly, the majority of the material dredged from these channels cannot be disposed in the Dam Neck Ocean Disposal Site or the Norfolk Disposal Site. Some of this material may be deposited in the ocean if it is capped. Capping unsuitable dredged material with a clean sediment is a technique used to contain and isolate the unsuitable material placed in subaqueous disposal sites. Recent research has focused on stability of capped material and biological activity in the cap.

In recent years the search for alternatives to expensive and limited upland containment areas for unsuitable sediment has centered on in-water capped disposal. The London Dumping Convention (February 1983) accepted the capping concept, subject to monitoring, as an appropriate technology for disposal of contaminated dredged materials. Subsequent detailed investigations (e.g. Brannon et al., 1985) have confirmed that capping can be effective in chemically and biologically isolating unsuitable dredged material from the overlying aquatic environment.

Capping has been used by the New England Division and the New York District of the Corps of Engineers in their open-water disposal sites in the New York Bight and Long Island Sound. These efforts have shown that capping is technically feasible and that the caps are stable under normal tidal and wave conditions. Morton and Miller (1980), indicated that during storms, sand caps appear to be more stable than fine-grained caps. However, there are unsuitable materials in New York Harbor that are too toxic to permit them to be placed on the ocean floor and capped.

Field experience with subaqueous capping is limited, but eleven sites have been identified where the technique has been applied in one form or another as shown in the following table.

Capping studies conducted in 1980-81 and subsequent monitoring has shown that ocean disposal of dredged material in the New York Bight can be managed effectively by pinpoint dumping and capping when necessary to mitigate potential adverse environmental impacts. The physical, chemical, and biological monitoring performed concluded that (a) through pinpoint dumping, it was possible to place a 3-foot cap of uncontaminated dredged material over contaminated material in the New York Bight; (b) less than 4 percent by weight of the dredged material to be capped is dispersed during the dumping operation; (c) the sand cap is stable and should remain in place for 20 to 46 years under normal weather conditions; (d) the cap is an effective barrier to the migration of metals and organic compounds from the unsuitable dredged material into the water column; and (e) bioaccumulation of contaminants from the dredged material is not likely to occur.

Approximately 5 percent of the New York Harbor dredged material is unsuitable for unrestricted ocean disposal and requires capping as a mitigative measure. This material passes the EPA/Corps ocean disposal criteria, but is marginal (i.e., some effects are seen in bioassay testing, but not greater than 10% mortality in test organisms). Any material that does not pass the ocean disposal criteria does not go in the ocean, capped or not capped. A quadrant of the New York Mud Dump Site is reserved for the purpose of dumping marginal material which is then capped.

Table 26. DESCRIPTIONS OF CAPPED DISPOSAL PROJECTS FROM THE LITERATURE

| Project | | Contaminated Material | | | Capping Material | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Location (Date) | Site Characteristics | Volume of Material $yd^3$* | Dredging Method | Placement Method | Volume, $yd^3$* (Type) | Thickness of Cap, ft | Placement Method | Positioning Method | Data Source |
| Duwamish Waterway Seattle, WA (1984) | Existing subaqueous depression ~70 ft deep | 1,100 | Clamshell | Scow | 3600 | 1-3 (sand) | Sprinkling from scow | Surveying instruments | Truitt 1986, Sumeri 1984 |
| Rotterdam Harbor, The Netherlands (1981-1983) | Phase I: Botlek Harbor Excavated to ~98 ft deep | 1,200,000 | Trailing suction hopper | Pumpout-submerged diffuser | -- (clay) | 2-3 | Scow, then leveled over site | Surveying instruments | d'Angremond et al. 1986 |
| | Phase II: 1st Petroleum Harbor Excavated to ~80 ft deep | 620,000 | Matchbox suction | Pipeline submerged diffuser | -- (clay) | 2-3 | Scow, then leveled over site | Automated dredge and suction head positioning equipment | d'Angremond et al. 1986 |
| Hiroshima Bay, Japan (1979-80) | Contaminated bottom sediment overland in situ with capping material ~70 ft deep | N/A | N/A | N/A | -- (sand with shell) | 1.6 | Conveyor to gravity-fed submerged tremie | Surveyed grid and winch/anchor wires | Kikegawa 1983 |
| | | | | | | | Suction/ pumpout thru submerged spreader bar | | Togashi 1983 |

Table 26. DESCRIPTIONS OF CAPPED DISPOSAL PROJECTS FROM THE LITERATURE
(Cont'd)

| Project | | Contaminated Material | | | Capping Material | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Location (Date) | Site Characteristics | Volume of Material $yd^3$* | Dredging Method | Placement Method | Volume, $yd^3$* (Type) | Thickness of Cap, ft | Placement Method | Positioning Method | Data Source |
| New York Bight (1980) | Generally flat bottom ~80-90 ft deep | 860,000 (mounded to 6 ft thick) | Clamshell | Scows | 1,800,000 (majority fine sand) | Avg. 3-4 Max. 5-9 | Scow, hopper dredge | Buoy, real-time navigation electronics | Freeland 1983, Mansky 1984, O'Connor 1983, Suszkowski 1983 |
| Central Long Island Sound Disposal Area (1979) | Stamford-New Haven North Generally flat bottom ~65 ft deep | 34,000 (mounded 3-6 ft thick) | Clamshell | Scows | 65,400 (sand) | up to 7-10 | Hopper dredge | Buoy, Loran-C coupled positioning system | Morton et al. (eds.) 1984, O'Connor and O'Connor 1983 |
| (1979) | Stamford-New Haven, South Generally flat bottom ~70 ft deep | 50,000 (mounded 4-6 ft thick) | Clamshell | Scows | 100,000 (cohesive silt) | up to 13 | Scow | Buoy, Loran-C coupled positioning system | |
| Central Long Island Sound Disposal Area (1979) (Continued) | | | | | | | | | Morton et al. (eds.) 1984 O'Connor and O'Connor 1983 |
| (1981) | Norwalk Generally flat bottom ~65 ft deep | 92,000 (multiple mounds up 8-12 ft thick) | Clamshell | Scows | 370,000 (silt and sand) | up to 6-7 | Scow | Buoy | |

Table 26. DESCRIPTIONS OF CAPPED DISPOSAL PROJECTS FROM THE LITERATURE
(Cont'd)

| Project | | Contaminated Material | | | Capping Material | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Location (Date) | Site Characteristics | Volume of Material $yd^3$* | Dredging Method | Placement Method | Volume, $yd^3$* (Type) | Thickness of Cap, ft | Placement Method | Positioning Method | Data Source |
| (1982-83) | Mill-Quinnipiac Generally flat bottom ~65 ft deep | 40,000 | Clamshell | Scows | 1,300,000 (silt ) | Multiple broad area placement Estimated final avg 6-10 | Scow | Buoy | |
| (1983) | Cap Site No. 1 Generally flat ~60 ft deep | 33,000 (mounded 3 ft thick) | Clamshell | Scows | 78,000 (silt ) | Incomplete | Scow | Buoy, Loran C | |
| (1983) | Cap Site No. 2 Generally flat ~56 ft deep | 40,000 low mound, 2 ft thick) | Clamshell | Scows | 40,000 (sand ) | Irregular - maximum 4.5, areas as little as 0.6 | Scow | Buoy, Loran C | |

* All volumes are approximate, usually based on estimated in-scow measurements. Dash entries indicate volume of capping either unknown or not reported.

Since Japan, the Corps of Engineers, and others are utilizing capping procedures in the ocean, it may be desirable to determine whether it is a viable management technique in this area. The results of studies and monitoring by the New England Division of the Corps of Engineers indicated that (a) capping material could be effectively emplaced on contaminated dredged material at a taut-mooring buoy, (b) sand was less likely to erode under hurricane conditions than silt, and (c) benthic organisms populated the site within 1 year of emplacement of the cap. In the New York District, silt and clay-sized material are now used for capping at the disposal site for operation and maintenance dredging. The same is now true, to a degree, in the New England Division.

Capping of dredged material should be considered for materials which meet ocean dumping criteria for restricted ocean disposal. By capping the "buffer area" sediments taken from the Elizabeth River, the life of CIDA (when used exclusively for unsuitable materials) could be extended. New work buffer area sediments represent approximately 2,097,000 cubic yards of material. Use of the capping option would require an EPA designated ocean disposal site with an EPA/Corps management plan that would permit the deposit of "marginally suitable" dredged materials. The capping option would be more costly than routine ocean disposal of suitable material. Using CIDA exclusively for unsuitable sediments, i.e., not diluting incoming sediments with cleaner materials, may impact sediment quality and water quality effluent since there would be no mixing or dilution taking place within CIDA. This can probably be controlled through the implementation of a revised management strategy at CIDA. For the purpose of this report, only the existing Craney Island was considered as a suitable disposal area for restrictive dredged material.

Disposal Into Craney Island and Ocean

In its report dated January 21, 1981, relative to the deepening of the Norfolk Harbor channels to 55 feet, the Board of Engineers for Rivers and Harbors stated:

> "Based on current information and criteria, the Board believes that most of the material for new work and maintenance dredging can be placed in ocean disposal sites. The existing 2500-acre Craney Island diked disposal area would then have sufficient

capacity for dredged material that should be confined as a result of the recommended deepening project and annual maintenance. With the reduction of maintenance quantities needed to be confined, the useful life of Craney Island can be extended....However, the Board believes that studies should be conducted in the post authorization planning stage to better identify alternative disposal sites or methods to satisfy long-term Norfolk Harbor needs for disposal...."

It would be possible to utilize both the existing Craney Island Disposal Area (CIDA) and the ocean. Unsuitable dredged material could be disposed of into CIDA and the remaining material taken to either DNODS or NDS. The mechanics of this operation would be as follows:

a. The new work to create a 55-foot channel and associated anchorage improvements in the inner harbor, and portions of the 45-foot improvement in the Elizabeth River, would be disposed at sea. The unsuitable portion of the new work from the Elizabeth River and its Southern Branch would be placed in CIDA.

b. Thereafter, all clean dredged material resulting from the maintenance of the inner harbor channels and from other private and public facilities in the harbor would be disposed at sea.

c. All unsuitable material from portions of the Elizabeth River and its Southern Branch would continue to be placed in CIDA.

If only unsuitable material was deposited in Craney Island starting in about 1990, the 22.4 m.c.y. of such material shown in table 20 could be deposited in the remaining available space (32 m.c.y. between 1990-1997 per WES useful life study). Therefore, by placing the new work referred to in a. above at sea, the remaining life of CIDA to accept only the unsuitable material referred to in c. above, is estimated to be at least 50 years. This is based on depositing material to elevation +30 feet m.l.w. This should be monitored periodically to check the availability of space for unsuitable material and to ensure that it remains innocuous. It may be possible to remove the material

periodically as it becomes innocuous so that portions of CIDA will continue to remain available for unsuitable material well into the future.

If nothing but unsuitable materials were deposited in CIDA, it is not anticipated that there would be any greater concern over impacts associated with operation of the facility than that which is now realized. There would be no greater total volume of unsuitable materials placed in the facility, only a greater proportion in relation to suitable dredged materials.

While it is true that dilution of unsuitable sediments with suitable sediments within CIDA would be reduced with the proposed management strategy (reserving CIDA for unsuitable materials only), dilution within the site would still take place. As proposed, only 37% of new work and 50% of maintenance materials going into CIDA would be taken from the most unsuitable reaches of the Southern Branch (Town Point to Mile 15). The remainder of the new work and maintenance (2,097,000 cubic yards and 87,000 cubic yards, respectively) would be dredged from transitional or buffer areas to the north and south of the most contaminated reach of the Southern Branch. These buffer areas contain sediments which are "marginal", i.e., they are not suitable for ocean disposal but are marginally unacceptable by the EPA/Corps testing procedures. In this regard then, dilution of the most unsuitable materials coming from the Southern Branch would still be occurring by a factor of almost two to one with the transitional or buffer sediments coming from the reaches to the north and south. If, as mentioned previously, buffer sediments were placed in the ocean and capped, this dilution would not take place.

Scientifically, the dilution question may be a moot point since CIDA will receive the same total volume of unsuitable sediments whether it is managed to receive both types of material or only unsuitable material. The adage, "the solution to pollution is dilution," has long been dismissed as inadequate to answer the pollution question. In the case of CIDA, regardless of the management strategy employed, there is still the same total volume of unsuitable material that must be handled, stored, and carefully monitored and managed over time.

Studies by WES and others have demonstrated that the operation of CIDA is greater than 99.9% efficient when it comes to retaining the sediments placed therein (Palermo, et. al., 1981). Trace metals and most organic compounds of concern in the Southern Branch display a strong affinity to fine-grained (cohesive) sediment. The transport, deposition and resuspension of such sediment-bound chemicals determined the exposure to, and effects on, organisms in the water column as well as those on or in the sediment substrate. Since the toxics (heavy metals and organics) are tightly bound to the sediments, they too are being retained along with the sediments in the confined site. Because of this efficiency in retaining sediments, there is no apparent concern over the toxicity of the effluent coming from CIDA, and this should not change - even if only unsuitable materials are placed in the site.

The Virginia Water Control Board (VWCB) has an ongoing program for the management of toxics in discharges from point sources such as those located in the Southern Branch. The Toxics Management Regulation was adopted by the VWCB and became effective in 1988. This regulation is designed to provide standards and procedures to minimize, correct or prevent discharge of toxic pollutants. The regulation is already being vigorously enforced with industrial dischargers on the Southern Branch (personal communication, Roger Everton, VWCB). In addition, the VWCB is developing a sediment quality management plan in concert with VIMS, ODU, and the Norfolk District Corps. This endeavor will involve mapping the areal and vertical distribution of toxic sediments in the Elizabeth River and developing a long-term strategy for management and clean-up. As part of the 1987 Chesapeake Bay Agreement, an implementation plan for the reduction and control of toxics entering the Chesapeake Bay ecosystem from point and nonpoint sources and from bottom sediments was developed and adopted by Federal and state participants in December 1988. These developments indicate a concern for reducing and controlling pollution in the Elizabeth River which, if realized, will result in smaller proportions of unsuitable sediments to suitable sediments being dredged from the Southern Branch in the future.

There are several management strategies that could be employed at CIDA that would serve to alleviate concerns over using CIDA for unsuitable materials only. These include:

(1) "Clean" materials could be placed in the site periodically, if monitoring so warrants, to dilute the unsuitable sediments.

(2) If effluent suspended solids concentrations (and toxics) rise above acceptable limits, the ponding depth at the weirs could be increased to allow longer retention (settling) time.

(3) The inflow rates could be decreased by operating intermittently or temporarily diverting flow to an inactive subcontainment.

(4) During the final years of operation, CIDA could be capped with clean material to an acceptable depth so as to seal off any contaminants.

The thick deposits of marine clay which underlie CIDA effectively seal this area preventing seepage to adjoining ground or water environments. Limiting CIDA to unsuitable dredged material may eventually increase total contaminant levels in the facility but would not alter the effectiveness of CIDA to contain those contaminants.

As discovered by Alden, et. al. (1984), most of the sediments of CIDA have been rendered fairly innocuous by dilution and weathering processes. These include sediments placed in CIDA from the Southern Branch of the Elizabeth River. If CIDA were limited to unsuitable materials, it is expected that weathering processes would continue, and that sediments placed in CIDA would continue to become less contaminated over time.

The negative effects of this plan are those associated with the disposal operation; specifically, occasional odor and appearance. There have been complaints by residents of the area adjacent to Craney Island about these problems throughout much of the operation of the disposal area, and a continuation of this situation would be expected as long as Craney Island is used as a disposal area. The disposal site should be monitored periodically for sediment quality and effluent water quality in order to document any changes which may take place and to determine compliance with effluent standards. Certification must be obtained from or waived by the state under Section 401 of the Federal Water Pollution Control Act such that the effluent discharge will not

violate applicable water quality standards. Section 401 also requires the certification to set forth necessary effluent limitations and monitoring requirements.

The other negative aspect of this plan is that it would delay to some degree the development of Craney Island for as many years as the site is used for disposal operations. However, further studies would be required to optimize use of the site for long-term disposal of unsuitable material. For example, if properly managed for the smaller amount of material, it may be possible to free up additional areas for other uses. Both the state and the city of Portsmouth have expressed interest in the potential development of the area, which is in a prime waterfront location. Portsmouth is extremely interested because most of the city is already developed and there is a shortage of vacant land, particularly for industry. In addition, a high proportion of the land in the city is owned by the Federal government and thus cannot be taxed. During the past 20 years, Portsmouth has made numerous requests for acquisition of the property and studies on options for its use. Continued use of Craney Island for an indefinite period of time would preclude these options for any time in the foreseeable future. There is, however, the possibility of joint use of Craney Island.

Disposal at Sea by Pipeline

Maintenance dredging in this plan would be accomplished in three steps: (1) initial dredging, which consists of removing the shoal material by current methods--namely, hopper, hydraulic pipeline, and bucket-scow dredges; (2) temporary storage in a diked harborside rehandling basin (a portion of Craney Island Disposal Area); and (3) rehandling, which consists of removing the material from the temporary disposal area with transport to sea by permanent pipeline for final disposal. The rehandling phase would be accomplished by a rehandling unit which would inject the material into a long pipeline to be pumped to sea by successive booster stations. At least 12 booster stations would be required for the 190,000 feet of pipeline between Craney Island and Dam Neck Ocean Disposal Area. For the Norfolk Disposal Site, additional booster stations and a longer pipeline would be required. The booster stations would be unmanned and remotely operated and controlled from the rehandling unit.

A portion of Craney Island Disposal Area was considered for the temporary disposal area because of its proximity to dredging areas, its protected location, and, in general, the lower cost from both an environmental and economic point of view. Various state, local, and private interests have proposed development of Craney Island Disposal Area when completely filled for recreational, industrial, commercial, and/or residential use. Use of a portion of the area as a temporary disposal area may conflict with some proposed plans for Craney Island's development, but any such conflict is surmountable through coordinated land-use planning.

The rehandling unit would consist of a modified barge, endless chain bucket pickup, hopper, and first booster unit. An endless chain bucket could deliver the material at close to in-situ density. Also, such a system would deliver a constant supply of material to the pump, preventing fluctuations of the hydrodynamic forces throughout the pipeline which would cause variations in the slurry velocity and density. A segregating device, such as a rotating screen above the hopper, is envisioned as a means of preventing clogging of the long pipeline by oyster shells or foreign objects. Electric power would be used to operate the booster stations and would be obtained from a commercial source.

According to a report by the Great Lakes Dredge and Dock Company for the Virginia Port Authority, the installation of a permanent pipeline and booster stations, if feasible, is estimated to cost about $88.5 million. The daily operating cost for this equipment could be over $100,000, producing possibly 10,000 cubic yards per day. In addition, there would be a mobilization cost of $2.75 per cubic yard, resulting in an overall cost of $12.75 per cubic yard. This is far greater than other plans considered in this report.

Summary of Ocean Disposal Plans

The following table summarizes the plans considered for ocean disposal of dredged material:

## Table 27. DISPOSAL OF DREDGED MATERIAL FROM INNER HARBOR INTO OCEAN

| Plan | Comment |
|---|---|
| A. Method of disposal to ocean | By hopper dredge whose hoppers open and material is dumped on the ocean floor.<br><br>By bucket dredge that places material on scows or barges. A tug then pulls barge to deposit area where barges are emptied. |
| B. Disposal into DNODS, 37 miles from Craney Island | DNODS was planned to accommodate clean dredged material from outer harbor (Thimble Shoal, Cape Henry, Atlantic Ocean Channels) for 50 years. Since inbound (45-foot) channels in the outer harbor are not being dredged to 55 or 60 feet (or have been deferred), there is space in DNODS for clean new work from the proposed inner harbor 55-foot channel (about 14.6 m.c.y.) plus inner harbor maintenance for only about 2 years for Federal, state and private dredged material (assuming 50-year capacity for the outer harbor is reserved in DNODS). |
| C. Disposal into NDS, 45 miles from Craney Island | NDS has unlimited space for clean inner harbor dredged material. |
| D. Disposal into Craney Island and ocean | A contained area such as Craney Island is required for dredged material unsuitable for ocean disposal such as that existing in the Southern Branch. The available remaining storage in Craney Island could be utilized for this purpose for the next 50 years. Clean dredged material could then be placed in DNODS for the available space therein (see item B) and/or NDS (see item C). |

Table 27. DISPOSAL OF DREDGED MATERIAL FROM INNER HARBOR INTO OCEAN
(Cont'd)

| Plan | Comment |
|---|---|
| E. Capping unsuitable material on ocean floor | In lieu of placing unsuitable material in a confined area, this involves its placement with accuracy in a specific area on the ocean floor. Capping sediment (clean sand, silt, etc.) must then be transported to the area to cover the unsuitable material. The area must be.maintained carefully and monitored periodically to insure that none of the unsuitable material leaches through the sand covering. Capping of "buffer area" sediments from Elizabeth River may be feasible. Capping would require an EPA-designated ocean disposal site with an EPA/Corps management plan that would permit deposit of "marginally suitable" dredged material. |
| F. Removal of dredged material from Craney Island | Consideration was given to emptying Craney Island to make it available for future use. Material could be excavated by bulldozers, scraper, etc., and conveyed to a mooring facility constructed adjacent to Craney Island. Thence, it would be placed on scow barges and towed by tug to either DNODS or NDS. However, only 20% of the entire Craney Island area is sufficiently dry to accommodate heavy mechanical equipment. Also, only 1.3 to 2.6 m.c.y./year can be removed with one and/or two daily shifts respectively. This would not empty Craney Island since it receives 4.0 to 4.5 m.c.y. annually.<br><br>An alternate plan would breach the dike surrounding Craney Island, float a bucket dredge into the area, and load scows within the area. The softness of the material to |

Table 27. DISPOSAL OF DREDGED MATERIAL FROM INNER HARBOR INTO OCEAN
(Cont'd)

| Plan | Comment |
|---|---|
| | depths of more than 100 feet makes this a serious undertaking requiring careful analysis. A dredge may remove about 4 m.c.y./year which would not result in emptying Craney Island. There would be a continuous deposit of material into Craney Island, thence its transfer to sea at greater average cost than its movement direct to the ocean following dredging from channels and piers. |
| G. Disposal at Sea by pipeline | This plan would require initial dredging of shoal material, temporary storage in a portion of Craney Island or similar confined area, and rehandling and pumping through a 190,000-foot pipeline and at least 12 booster stations to the sea. Even if feasible, the cost would be excessive. |

Disposal by Truck Haul to Abandoned Borrow Pits

This plan involves consideration of reclaiming abandoned borrow pits by using them for disposal areas. Initial planning, depended upon several basic assumptions. These included that (a) the dredged material would be hauled by trucks, (b) the material would be loaded on trucks from the existing Craney Island, and (c) borrow pits would be available within a reasonable (0 to 25-mile radius) driving distance from the point of loading to provide capacity for a 50-year project life.

By this plan, maintenance of the navigational features would be accomplished as follows: (1) initial removal by current methods--namely, hopper, hydraulic pipeline, and bucket-scow dredges; (2) temporary storage in a diked harborside rehandling area ( a portion of CIDA); (3) rehandling which

consists of removal from the temporary disposal area to inland disposal areas by truck.

The plan has several difficulties of an environmental and operational nature that weigh heavily upon its overall feasibility. First, the possibility of saltwater damage to ground water supplies is much the same as with the Suffolk site. Thus, each borrow pit would have to be sealed. In this connection, it should be noted that many of the borrow sites in southeastern Virginia are now used as components of the region's storm drainage system and most are linked to shallow aquifers and serve as aquifer recharge areas. In addition, many borrow areas have been the center of new residential developments, providing waterfront property. Second, a survey of the area revealed that the capacity of available borrow pits is significantly less than the desired 50-year life. Third, the plan would present serious difficulties from an operational point of view because of the large number of trucks that would be required. Thousands of truck loads per day would be required to move 5.0 million cubic yards of material annually. Impacts of this substantial volume of traffic on the condition of existing highway systems and safety of everyday highway users must be considered detrimental. Based on the problems with this alternative, it is not considered viable and worthy of additional study.

Inland Disposal by Rail

One method of dredged material disposal that was considered and discussed in the 1980 feasibility report on Norfolk Harbor and Channels, Virginia, Deepening and Disposal was by rail haul to a suitable fill site. The following discussion summarizes the possibility of rail haul as presented in that study.

The idea of solid waste disposal by rail haul has captured the attention of many in recent years. Some promising results from studies have been reported, although the studies have dealt with solid waste in general, which has characteristics substantially different from dredged material. Single point pickup, large quantities, and the fact that no processing is required, all suggest potential economy in an operation of material disposal by rail. However, the fluid nature of the material when dredged requires a settling and drying basin.

Also to be confronted are (1) location of disposal areas, (2) loading, (3) unloading, and (4) the environmental impacts.

Location of Disposal Areas. Primary areas being considered for dredged material disposal utilizing rail haul are the open pit and strip mining areas of western Virginia and West Virginia. Although there are other type mining operations in the area, the open pit, the area strip, and the contour strip mining areas appear to be the most conducive to disposal of dredged material. The extent of area available and the exact locations have not been determined, but for the purpose of this study it is assumed that the area is available in sufficient "fillable" capacity. The open pit type areas appear to offer the greatest potential for disposal. This type of operation is exemplified by quarries producing limestone, sandstone, marble, and granite. The resulting pits are usually very deep, confined, and free from ground water infiltration.

Loading. Due to the fluid nature of the dredged material, loading presents a major problem. Rail cars can be obtained to move the material in a fluid nature, but the efficiency of the operation is greatly reduced if the material is not allowed to settle and drain so that it is in at least a semi-dry state. The drying process would possibly be carried out at the present CIDA site but would require most of the 2,500 acres. After discussion with officials of the Norfolk and Western Railway, the most feasible means of loading appears to be by a conveyor system. Trains entering Craney Island would be loaded directly, versus double handling. The conveyor system would have to be constructed so as to be readily relocated after the material in a dry area was removed.

Transportation. There are at least four basic alternatives for a rail haul dredged material disposal system. They are (1) regular freight train service, (2) dedicated freight train service, (3) rent-a-train, and (4) return haul by unit train. The last appears to be the most suitable to solve the problem at hand. However, utilization of trains returning to West Virginia and western Virginia requires washing of cars after unloading to avoid contamination of products, largely coal, being transported to the Hampton Roads area. This washing, with attendant disposal of residue, may result in an economic situation which would demonstrate that dedicated freight train service would be more feasible. Officials of Norfolk and Western Railway have suggested, for estimating

purposes, that a 70-ton car be used, with a maximum of 55 cars per train. Since one cubic yard of material weighs approximately one ton, one unit train will transport about 3,850 cubic yards of dredged material. To move the estimated 5.0 million cubic yards annually, over 200 rail cars would have to be loaded and unloaded daily with at least 4 trains per day leaving the loading area.

Unloading. The major elements of the unloading process can be grouped as follows:

- Unloading of rail cars.
- Conveyance to pit and/or strip mine areas.
- Final deposition of dredged material.

Implementation of the unloading process depends, of course, upon the state in which the material arrives. Operation for a relatively dry material will differ greatly from that in a slurry form. In order to facilitate the unloading process, it is assumed that a railroad trestle will be constructed at the unloading point. Utilization of the trestle will permit bottom dumping of the rail cars either manually or automatically depending upon which method proves to be the most economical. After unloading, the material will then be transported to the designated mining area. This operation could be carried out by using existing mine trucks if the mine is in operation or by using a special fleet of trucks if an abandoned mining area is used. The final step of the unloading operation would be the deposition of the dredged material at the site.

Environmental Factors. Regardless of the location of the fill site, there are several environmental factors associated with rail haul disposal which must be reconciled prior to its implementation. Some of the more pertinent environmental factors are discussed in the following paragraphs.

The placement of dried dredged materials in mined areas would involve the loss of some scrub vegetation and the fauna that have entered these areas from adjacent regions. The loss of these resources is slight when compared with the impact on the prevailing life forms which resulted in the original strip

mining operations. Filling the excavation would provide the first step in returning the devastated areas to their original state.

Ground water resources and the local watershed at the dredged material fill sites can easily be jeopardized by the percolation of dissolved salts from the material into the underlying strata. In addition to dissolved salts, other pollutants such as heavy metals may also become part of the leachate which in turn could contribute to the contamination of local water resources. The rate and direction which the leachate will flow through the underlying strata are questions which must be answered before the total environmental impact of such an operation can be determined. Similarly, the quality of the dredged materials must be carefully analyzed prior to determining their impact on the environment at the fill site. Similar to the Suffolk Site, each mine area would have to be sealed. The exact methods for sealing these mines have not been determined. However, it is believed that sealing these mines could be much more complex than sealing the Suffolk Site with the slurry cutoff trench.

An additional consideration associated with the placement of dredged material in a surface-mined area is the freshwater runoff and its impact on the surrounding surface water resources. Sediment-laden runoff will invariably increase the sediment load in nearby rivers, ultimately affecting the biological productivity and carrying capacity of these rivers. Turbidity increases will also indirectly cost the taxpayers more to arrest erosion and to remove sediments from the rivers for both flood protection and navigation purposes. In summary, any attempt to reclaim strip mines will cause short-term increase in stream sediment loads. However, the trade-off between this short-term sediment increase and continued erosion of existing strip mine lands would have to be considered.

In summary, aside from the substantial cost, there are several environmental impacts associated with rail haul disposal extending from Hampton Roads to western Virginia and West Virginia, which make its viability as an alternative method of disposal highly questionable. Consequently, no further consideration will be given to this alternative.

Summary of Initial Screening

The preceding paragraphs have provided a discussion of various alternatives for long-term disposal of dredged material from the inner harbor area. The following table highlights the environmental, social, and other factors involved with each alternative. The table excludes the further raising of Craney Island (above elevation 30 m.l.w.), transfer of dredged material from Craney Island to either the DNODS or the NDS, disposal of material alongside channels, and/or disposal by pipeline to the ocean. None of these plans were deemed to be viable at this time. Similarly, the truck haul and rail haul alternatives will be eliminated from further consideration. Both of these plans possess complex physical implementation and operational problems and constraints. Furthermore, the fact that there would be a high potential for saltwater contamination of freshwater supplies make these plans unacceptable.

## Table 28. ENVIRONMENTAL IMPACT MATRIX FOR DISPOSAL ALTERNATIVES

| Environmental Category | *Craney Island Expansion* | *Willoughby Bay* | *Ocean View* | *Hampton Flats* | *Suffolk Site* |
|---|---|---|---|---|---|
| **Water Quality** | No additional impact | Mixing zone decreased in size; effluent may impact w.quality | Mixing zone decreased in size; effluent may impact w.quality | Mixing zone decreased in size; effluent may impact w.quality | Saltwater intrusion to aquifers |
| **Fish/Shellfish/Wildlife** | Loss of feeding area & habitat/Baylor Grounds | Loss of protected habitat for juvenile fish | Loss of prime clamming area | Adverse to larval oyster transport; loss of comm. clamming area | Two endangered species threatened |
| **Benthos** | Smothering & loss of all benthos max. 2500 acres | Smothering & loss of all benthos - 1280 acres | Smothering & loss of all benthos - 2000 acres | Smothering & loss of all benthos - 1800 acres | No impact |
| **Hydrodynamics** | WES study indicates no significant change | Severe changes in circulation expected | Changes could impact erosion rates @ area beaches | Oyster larval transport to James River may be impeded | No impact |
| **Wetlands** | 1 acre loss | Loss of fringe marsh | No impact | No impact | 6000 acres wooded wetlands lost |
| **Navigation** | Loss of comm. & rec. boating areas | Loss of comm. & rec. boating areas | Loss of comm. & rec. boating areas | Loss of comm. & rec. boating areas | No impact |
| **Cultural/Historical Resources** | Survey performed - no impact | Possible impact - survey required | Possible impact - survey required | Possible impact - survey required | Possible impact - survey required |
| **Social Impact** | Loss of view and associated reduced waterfront property values | Loss of view and associated reduced waterfront property values | Loss of income - comm. clammers | Loss of view and associated reduced waterfront property values; Loss of income-comm. clammers | Property values near site may decline; Lost income - timber product. |
| **Aesthetics** | Disposal site would replace open water | Disposal site would replace open water | Disposal site would replace open water | Disposal site would replace open water | Disposal site would replace natural area |

**Table 28. ENVIRONMENTAL IMPACT MATRIX FOR DISPOSAL ALTERNATIVES (Cont'd)**

| Environmental Category | *Horseshoe Area/Buckroe* | *Chesapeake Bay Bridge-Tunnel* | *Ragged Island* | *Disposal @ Sea (a)* |
|---|---|---|---|---|
| **Water Quality** | Mixing zone decreased in size; effluent may impact w.quality | Mixing zone decreased in size; effluent may impact w.quality | Mixing zone decreased in size; effluent may impact w.quality | Short-term impacts; return to ambient rapidly |
| **Fish/Shellfish/Wildlife** | Loss of habitat & feeding areas for fish & benthos; loss of clamming area | Loss of habitat & feeding areas for fish & benthos | Wildlife Management Area severely impacted | Minor & short term impact |
| **Benthos** | Smothering & loss of all benthos - 2500 acres | Smothering & loss of all benthos - 2000 acres | Smothering & loss in James R. | Temporary loss |
| **Hydrodynamics** | Changes could impact erosion rates @ beaches | Could adversely impact larval transport assoc. with Ches Bay plume | Could change circulation /sedimentation near seed oyster beds in James R. | No impact |
| **Wetlands** | No impact | No impact | Loss of 2320 acres of saltmarsh | No impact |
| **Navigation** | Loss of comm. & rec. boating areas | Loss of comm. & rec. boating areas | Loss of comm. & rec. boating areas | Minor impact (increased barge traffic) |
| **Cultural/Historical Resources** | Possible impact - survey required | Possible impact - survey required | Possible impact - survey required | No impact |
| **Social Impact** | Minor impacts | Minor impacts | Minor impacts | No impact |
| **Aesthetics** | Disposal site would replace open water | Disposal site would replace open water | Disposal site would replace natural area | No impact |

(a) Material which meets ocean disposal criteria. Unsuitable material must be disposed in a contained area

Based on initial screening (table 28), several of the plans can be eliminated from further consideration. Key criteria in this screening process included extreme environmental consequences and useful life limitations.

From an environmental point of view, it is apparent that disposal plans at Ragged Island, Hampton Flats, and Suffolk should not be pursued further. Ragged Island is an important wildlife management area and has been placed on the list of "Wetlands of International Importance Especially as Waterfowl Habitat" as a part of an international treaty. Based on studies performed by the Virginia Institute of Marine Science in connection with the proposed Newport Island, construction of a disposal area along Hampton Flats would present a high probability of adverse impact on seed oyster beds in the James River and hard clam habitat on Hampton Flats. Major concerns with the Suffolk Site are the possibility of saltwater intrusion into freshwater aquifers, the possibility that the site may be a recharge area for the Dismal Swamp, and salt seepage from the disposal site into surrounding forest and ditches.

Of the remaining alternatives considered in the initial screening process (with the exception of the no action plan), only the Willoughby Bay alternative failed to provide for a future life approaching 50 years. Specifically, the Willoughby Bay alternative would only last about 12 years. In order to meet the 50-year useful life objective, consideration must, therefore, be given to the possibility of combining Willoughby Bay with other short-lived plans. In previous portions of this report, the negative consequences associated with combining short-lived plans were discussed. There would be multiple startup costs, possible discontinuity of service for users of the disposal site(s), additional costs to users if the series of sites are widely dispersed and/or require different methods of deposition, and the need for more intensive administration/management of a plan with many separate elements phased in over time. In addition, combining plans would greatly magnify the total adverse environmental and social impacts since completely separate areas would be disturbed. For this reason, no further consideration will be given to developing a series of small short-lived confined plans in order to obtain a 50-year capacity.

In view of the difficulties associated with the implementation of several short-lived structural plans, consideration should be given to including ocean

disposal as a plan element for the remaining years required to provide a 50-year useful life. For plans with useful lives approaching 50 years, the addition of ocean disposal as an element of a plan to provide a 50-year life (for purposes of comparison with other plans) is both a logical and reasonable strategy. However, with a short-lived plan such as Willoughby Bay (12 years), it would not be reasonable or advantageous to disrupt such an area as Willoughby Bay when the major portion of the 50-year plan would involve ocean disposal. Therefore, Willoughby Bay in combination with ocean disposal will not be given further consideration. Willoughby could serve as a "long-term" plan if it were restricted to only unsuitable material or small volumes of material uneconomical for ocean disposal. However, the remaining capacity in the existing Craney Island Disposal Area could serve this purpose without further construction.

ALTERNATIVE PLANS CONSIDERED - INTERMEDIATE SCREENING

The following alternatives do possess a 50-year life and will be given further consideration in this intermediate screening process:

- Expansion of Craney Island (Plan B)
- Buckroe Beach
- Ocean View
- Chesapeake Bay
- Ocean Disposal
- Beneficial Uses of Dredged Material

With regard to beneficial uses of dredged material, detailed discussions have been presented in the previous section on Problems, Needs and Opportunities. The opportunities for the use of dredged material, whether it be for construction purposes or disposal of appropriate material on beaches, or for other uses should continue indefinitely into the future as a part of any strategy developed for the disposition of dredged material. Hopefully, the amount used beneficially will increase. At this time, however, the amount used for beneficial

purposes is relatively small and cannot be considered as a complete solution to the dredged material disposal problem for the inner harbor.

Each of the above alternatives, with the exception of beneficial uses, possess various environmental and social impacts which have been discussed in previous sections of this report and shown on table 28. In further consideration of these plans, an important evaluation criteria becomes economics. In this connection, table 29 provides a summary of cost data associated with each alternative. It is based on disposal of dredged material for (a) the 40- and 45-foot improvements in the Elizabeth River and its Southern Branch, and (b) future maintenance of inner harbor channels, both Federal, state and private. The following table indicates that CIDA Expansion B has a capacity of 219 million cubic yards and a life expectancy of 51 years, according to modelling studied by WES. This is exclusive of the storage yet available in the existing CIDA. In order to properly compare the economics of ocean disposal, which also has additional available storage (similar to that at the existing CIDA) as well as the smaller expansions, these were each based on 219 million cubic yards of storage. Thus, for example, table 29 indicates that expansion E can only store 100 million cubic yards and that, when full, 119 million cubic yards (219 mcy - 100 mcy) would be disposed in an ocean disposal site.

As indicated previously, the cost for comparing disposal alternatives consists of two elements. These are: (a) initial construction, and (b) unit operating cost. Initial construction costs include the costs of rights-of-way and site acquisition, levees, drainage facilities, spillways, access roads, rehandling facilities, aids to navigation, and appurtenant equipment at the disposal site. Unit operating costs include the costs of dredging, transportation, pumpout, and maintenance converted to a "per cubic yard" basis. Project construction costs, including interest during construction, are amortized for the expected useful life of the project, thence converted to a per unit basis. Thus, the two unit costs can be combined to arrive at an equitable, economic basis to compare plans. All cost computations are based on October 1988 price levels and an interest rate of 8-7/8 percent.

In the case of an expansion to Craney Island, the useful life of each of the projects considered was made equal to the longest life of any of the alternatives within a specific dredging scenario. For example, in the following table, the dredging scenario included the following:

a. Dredging and disposal for deepening the Southern Branch Channels to 40 and 45 feet.

b. Maintenance of existing and proposed 40- and 45-foot channels including public and private channels to docks, piers, etc.

Under this scenario, expansion plan B lasts for 51 years. Expansion plans A and E last for 31 and 22 years, respectively. In order to compare them to plan B, it would be necessary to take the dredged material to the ocean for 20 and 29 years, respectively. These plans do not take into account any remaining life in the existing Craney Island.

Other dredging scenarios are discussed in the following pages.

Table 29. ECONOMIC SUMMARY OF DISPOSAL PLANS

(Dredging Scenario S4)

| Plan | Capacity (1000 CY) (a) | Plan life (yrs) | Size (acres) | Cost to construct (b) | Mitigation costs (c) | 1993 Base year APW all costs (d) | Average annual equivalent cost per cu yard |
|---|---|---|---|---|---|---|---|
| Horseshoe area/ Buckroe Beach | 219,000 | 51 | 2500 | $106,883,000 | $14,586,000 | 422,866,000 | 8.86 |
| Ocean View | 219,000 | 51 | 2000 | 128,666,000 | 11,669,000 | 443,837,000 | 9.29 |
| Chesapeake Bay Bridge-Tunnel | 219,000 | 51 | 2000 | 210,562,000 | 11,669,000 | 545,432,000 | 11.42 |
| CIDA Expansion B | 219,000 | 51 | 2500 | 63,401,000 | 14,586,000 | 255,813,000 | 5.36 |
| Ocean Disposal plus Existing Craney Island | 219,000 | 51 | - | - | | 336,266,000 | 7.04 |
| Smaller Expansion A plus Ocean | 137,000 (82,000) | 31 (20) | 1700 | 61,079,000 | 9,919,000 | 253,694,000 | 5.31 |
| Smaller Expansion E plus Ocean | 100,000 (119,000) | 22 (29) | 1500 | 29,081,000 | 8,752,000 | 232,511,000 | 4.87 |

(a) Includes new work (40 and 45 feet in Southern Branch.)
(b) Includes interest during construction.
(c) Details regarding the development of these mitigation costs are presented in Appendix E, Environmental Information Report.
(d) APW or the Accumulated Present Worth of the stream of costs associated with each alternative brought back to the base year 1993 using a discount rate of .08875.

Note: All alternatives assume average annual maintenance of 4.3 m.c.y. commencing after end of 1998; average yardage deposited yearly is 4.294 m.c.y. over 51-year period. This includes new work referred to in (a).

The previous table indicates that construction of an island off Buckroe Beach, Ocean View, or the Chesapeake Bay Bridge-Tunnel would be considerably more costly than expansion of Craney Island. For example, the accumulated present worth of the stream of costs over their project lives for each of these plans would exceed that of the expansion of Craney Island and ocean disposal by about $167 million and $86.6 million or more respectively. Furthermore, there would be time involved in transporting labor, material, and/or equipment to an offshore island and their return to the mainland.

The following summarizes the information in the previous table for Expansion Plans A, B and E. It expands on the statements in the previous paragraphs. Further details are presented on the costs in a later table.

a. Plan A would fill in 31 years, then the clean material would have to be taken to sea for 20 years (to make its life comparable to Plan B) the unsuitable would have to continue to be placed in Plan A. The overall annual equivalent cost is $5.31 per cubic yard.

b. Plan B would fill in 51 years with an overall annual equivalent cost of $5.36 per cubic yard.

c. Plan E would fill in 22 years, thence the suitable material would have to be taken to sea for 29 years. Space would have to be vacant in Plan E for unsuitable material for 29 years. The overall annual equivalent cost would be $4.87 per cubic yard.

Plans A and E would allow filling (at the rate of over 4 m.c.y. per year) for 31 and 22 years, respectively. This reserves 3 years to insure that sufficient empty space would be available for unsuitable material from the Southern Branch of the Elizabeth River which has to be placed in a confined area. Another important factor is that the tests made by the Waterways Experiment Station were based on the assumption that maximum dewatering of each expansion site would be accomplished, thereby resulting in a maximization of storage capacity. This is further discussed in the report in the paragraph entitled "Risk and Uncertainty."

Although ocean disposal costs are $7.04 per cubic yard, the advantages from an environmental, social, as well as useful life (assuming Norfolk Disposal Site) standpoint necessitate further consideration of ocean disposal.

The following table highlights the major advantages and disadvantages associated with the various remaining alternatives. In addition, it shows what plans have been eliminated from further consideration. Since all disposal plans, with the exception of ocean disposal, have somewhat similar environmental and social impacts, the key screening criteria, as previously discussed, becomes economics. In this regard, economics was the basis for no further consideration of Buckroe Beach, Ocean View, and Chesapeake Bay.

Table 30. SUMMARY OF INTERMEDIATE SCREENING

| Plan | Advantages | Disadvantages | Action |
|---|---|---|---|
| Expansion of Craney Island | Costs, accessibility, useful life | Adverse social impacts, destruction of estuarine bottom and related environmental impacts. | Retain for Further Consideration (a) |
| Horseshoe Area Off Buckroe Beach | Useful life | Destruction of bay bottom and related environmental impacts, potential adverse social impacts, costs, accessibility. | No Further Consideration (b) |
| Ocean View | Useful life | Destruction of bay bottom and related environmental impacts, adverse social impacts, costs, accessibility. | No Further Consideration (b) |
| Chesapeake Bay Bridge-Tunnel | Useful life | Destruction of bay bottom and related environmental impacts, proximity to Chesapeake Bay Bridge-Tunnel, costs, accessibility | No Further Consideration (b) |
| Ocean Disposal at Dam Neck | Already designated, favorable environmental features, little social impact | Useful life, costs, accessibility | Retain for Further Consideration |
| Ocean Disposal at Norfolk | Unlimited useful life, favorable environmental features, little social impact | Costs, accessibility | Retain for Further Consideration |

(a) Providing mitigation is a proper course of action.
(b) High cost was the basis for "No Further Consideration."

In summary, the formulation process for inner harbor disposal has surfaced two basic options for further consideration and refinement. They include:

- Expansion of Craney Island; and
- Ocean Disposal for suitable material plus the existing CIDA for unsuitable material.

Maximum use of the existing Craney Island Disposal Area will be considered in the overall evaluation of the above options. In addition, opportunities for the beneficial use of dredged material will always be incorporated as a part of any long-term disposal plan.

NATIONAL ECONOMIC DEVELOPMENT PLAN

It is necessary to establish the National Economic Development (NED) Plan. This plan represents the least cost to the nation for the disposal of material dredged from Federally authorized channels. In essence, the NED plan seeks to achieve the greatest national economic benefits for the money spent.

Table 29 indicates the cost of various expansion plans for CIDA. This comparison was based on the assumption that the Southern Branch 40 and 45-foot dredging would be accomplished and the material placed therein. However, it should be noted the least costly expansion plan can vary depending on the predicted future dredging requirement. In this connection, the following table presents a list of possible future dredging scenarios. The scenario numbers correspond to those in reports on the matter by the Waterways Experiment Station. Scenario S4 is listed ahead of S2 since plans are now underway to take the dredged material to create the 55-foot outbound channel to the ocean.

Table 31. DREDGING SCENARIOS

| Scenario | Description of Scenario |
|---|---|
| S1 | Maintenance of existing channels (including existing 50-foot channel, public and private access channels to docks, piers, etc.) |
| S4 | Same as S1 plus dredging and disposal for deepening the Southern Branch Channels to 40 and 45 feet. |
| S2 | Same as S1 plus dredging and disposal for the 55-foot channel for the inner harbor. |
| S5 | Same as S1 plus dredging and disposal for the 55-foot channel plus the 40 and 45 foot channels in Southern Branch. |

Table 32 provides a comparison of the unit cost of dredging and disposal for the three expansion sites listed in table 29 under the above dredging scenarios. The derivation of these costs is shown in tables 35 through 38. Further details are provided in appendix C.

Table 32. COMPARISON OF AVERAGE UNIT DREDGING AND DISPOSAL COSTS FOR THREE CIDA EXPANSION SITES AND OCEAN DISPOSAL UNDER FOUR SCENARIOS

| Dredging scenario | Life of 2500-acre site (Site B) | Average annual yardage | Cost per cubic yard for dredging and disposal into | | | | Life of site in years with lowest unit cost |
|---|---|---|---|---|---|---|---|
| | | | Site A 1,700 acres | Site B 2,500 acres | Site E 1,500 acres | DNODS & NDS | |
| S1 | 56 | 4,000,000 | $4.96 | $5.08 | $4.41 | $6.53 | 26 |
| S4 | 51 | 4,294,235 | 5.31 | 5.36 | 4.87 | 7.04 | 22 |
| S2 | 49 | 4,488,714 | 5.42 | 5.37 | 4.97 | 7.20 | 20 |
| S5 | 43 | 4,856,953 | 5.74 | 5.53 | 5.60 | 7.58 | 43 |

The previous table shows that CIDA Expansion Plan B is the least costly plan under scenario S5. It is somewhat more costly than plan E varying from 15 percent for scenario 1 (the existing condition) down to 10 percent for scenario 4. (See figure 3 for sketches of plans.) The latter appears to be the more probable scenario for the future since it has been decided to take the dredged material from the proposed 55-foot channel to sea. Furthermore, Plan B lasts for 51 years or over 2.3 times longer than Plan E, with the latter requiring vacant space therein (prior to filling) for unsuitable material, and requiring a considerable number of years for ocean disposal. In the case of Plan A, its cost is practically comparable to Plan B. However, Plan A would last for only 36 to 31 years for scenarios 1 and 4, respectively, after which material would have to be taken to the ocean.

The three plans (A, B, or E), providing for 21 to 51 years of disposal area, are considered to be viable and/or cost effective alternatives. Plan B may be considered to be the most viable since it would provide a disposal area for about 51 years. It would also represent practically the least cost to the nation for the disposal of material dredged from the Federally authorized channels.

It is therefore considered to be the National Economic Development (or NED) Plan. However, implementation of plan B would require the state to meet the economic, social, environmental and political aspects required in connection with its construction. Although plan B may be considered the NED plan, plans A and/or E are sufficiently comparable, if not lower in some instances to unit cost of dredging, that the state may wish to consider one of these alternatives even though their life is much less than plan B.

SUMMARY OF PROJECT FORMULATION ANALYSIS

The following table summarizes the initial and intermediate screening of alternatives and the final array of plans considered for disposal of dredged material by Federal, state, and private interests within the inner harbor of Hampton Roads.

Table 33. SUMMARY OF PROJECT FORMULATION SCREENING PROCESS
(Costs and Useful Lives are for Dredging Scenario 4)

| Plan | Initial Screening | Intermediate screening (a) Cost per c.y. | Intermediate screening (a) Comments | Final array of plans |
|---|---|---|---|---|
| | A. PLANS CONSIDERED WITHIN INNER HARBOR | | | |
| 1. Further raising of Craney Island | Not now technologically feasible to raise level above elevation 30 m.l.w.<br><br>Eliminated from further screening. | | | |
| 2. Removing dredged material from Craney Island | Continuous disposition into Craney Island, thence transfer to ocean, more costly than transport direct to sea.<br><br>Eliminated from further screening. | | | |
| 3. Expanding Craney Island | Six expansion plans of various sizes considered. Adverse social and environmental effects.<br><br>Retain to evaluate economics. | 4.97-5.42 | Least costly. Retain Plans A, B and E since others have lives of 5 to 10 years | Retain A, B, and E |
| 4. Willoughby Bay | Short useful life (12 years) for disposal of dredged material. Adverse social and environmental effects.<br><br>Eliminated from further screening. | | | |
| 5. Hampton Flats | Worked by oystermen, clammers, and other commercial fishermen. A disposal area would present a high probability of | | | |

Table 33. SUMMARY OF PROJECT FORMULATION
SCREENING PROCESS
(Cont'd)

| Plan | Initial Screening | Intermediate screening (a) Cost per c.y. | Intermediate screening (a) Comments | Final array of plans |
|---|---|---|---|---|
| | adverse impact on seed oyster beds in James River and hard clam habitat. Serious environmental effects.<br><br>Eliminated from further consideration. | | | |
| 6. Ragged Island | Wildlife management area. On list of international importance.<br><br>Eliminated from further consideration. | | | |
| 7. Disposal of material alongside channels | Maritime developments close to channels. If dredged material were placed along small adjoining areas, possibility of returning to channels requiring redredging frequently.<br><br>Eliminated from further consideration. | | | |
| | B. PLANS CONSIDERED IN CHESAPEAKE BAY | | | |
| 8. Ocean View (offshore) | Loss of clamming areas, benthos, and commercial and recreational boating area. Access to shoreline not disrupted.<br><br>Retain due to long useful life. | 9.29 | Eliminated due to high cost plus environmental factors | |

## Table 33. SUMMARY OF PROJECT FORMULATION SCREENING PROCESS (Cont'd)

| Plan | Initial Screening | Intermediate screening (a) Cost per c.y. | Intermediate screening (a) Comments | Final array of plans |
|---|---|---|---|---|
| 9. Horseshoe Area off Buckroe Beach (offshore) | Loss of habitat and feeding areas for fish and benthos. Loss of commercial and recreational boating area.<br><br>Retain due to long useful life. | 8.86 | Eliminated due to high cost plus environmental factors | |
| 10. Chesapeake Bay-Bridge Tunnel (offshore) | Loss of habitat and feeding areas for fish and benthos. May adversely impact on larval transport associated with Chesapeake Bay plume. Loss of commercial and recreational boating.<br><br>Retain due to long useful life. | 11.42 | Eliminated due to high cost plus environmental factors | |
| | C. PLANS CONSIDERED IN INLAND AREAS | | | |
| 11. Suffolk site | Saltwater intrusion into aquifer. 6,000 acres of woodland area lost. Two endangered animal species threatened. Possible effect on Hampton Roads airport.<br><br>Eliminated from further consideration. | | | |
| 12. Truck haul to abandoned borrow pits | Possible saltwater intrusion in ground water supplies. Capacity of available borrow pits small. Difficulties from an operational standpoint due to required movement of thousands of truck loads daily.<br><br>Eliminated from further consideration. | | | |

## Table 33. SUMMARY OF PROJECT FORMULATION SCREENING PROCESS (Cont'd)

| Plan | Initial Screening | Intermediate screening (a) Cost per c.y. | Intermediate screening (a) Comments | Final array of plans |
|---|---|---|---|---|
| 13. Rail Haul to abandoned mining pits | Groundwater resources at dredged material fill site can be jeopardized by percolation of dissolved salts from material into underlying strada. Fluid nature of material when dredged, requires settling and drying basin. Pollutants such as heavy metals may become part of the leachate which could contribute to contamination of local water resources. Sediment-laden runoff would increase sediment load in nearby rivers, affecting productivity and carrying capacity of rivers.<br><br>Eliminated from further consideration. | | | |
| | D. OCEAN PLANS CONSIDERED | | | |
| 14. Dam Neck Disposal Site plus existing Craney Island for unsuitable material | 37 miles from Craney Island. Existing disposal site for navigation channels in Chesapeake Bay and Atlantic Ocean. Available for clean material from inner harbor per EPA.<br><br>Retain for further screening. | 7.04 | Environmentally acceptable. Retain | Retain (b) |
| 15. Norfolk Disposal Site plus existing Craney Island for unsuitable material | 45 miles from Craney Island. District has requested EPA to designate site as a disposal area.<br><br>Retain for further screening. | | | |

Table 33. SUMMARY OF PROJECT FORMULATION
SCREENING PROCESS
(Cont'd)

| Plan | Initial Screening | Intermediate screening (a) Cost per c.y. | Intermediate screening (a) Comments | Final array of plans |
|---|---|---|---|---|
| 16. Discharge of dredged material via pipeline to the sea | Require a 45-mile pipeline to sea with at least 12 booster stations. Portion of Craney Island required as a temporary disposal area. Cost excessive.<br><br>Eliminated from further consideration. | | | |
| 17. Capping unsuitable material at sea | Capping of "buffer area" sediments from Elizabeth River may be feasible. Capping would require an EPA-designated ocean disposal site with an EPA/Corps management plan that would permit the deposit of "marginally suitable" dredged materials. | | | |

(a) Including plans having life approaching 50 years.
(b) Ocean plan calls for initial disposal in Dam Neck until site is filled to capacity; thereafter, disposal would be at Norfolk Disposal Site.

As previously stated, all plans must include the opportunity for beneficial uses of dredged material, thereby reducing the amount of dredged material to be stored and/or disposed. In addition, as a part of any long-term disposal strategy, it is believed that studies should be initiated by the district to determine the practicality of reducing the amount of overdepth dredging. At present, dredging contractors are paid for material dredged below the depth required in the specifications. However, the contractor's equipment may permit more precision in dredging to the depth required which would reduce the amount of material to be disposed. Perhaps penalizing the contractor could be considered if he should exceed the allowable depth; knowing this in advance might produce better results between actual and allowable dredging depths. This would reduce, at least to some degree, the need for total storage in a disposal area which could slightly extend the life of that area.

FINAL ARRAY OF PLANS

The final array of plans for the disposal of dredged material from the inner harbor would include the following:

a. Expansion of Craney Island

b. Disposal into Dam Neck Ocean Disposal Site (DNODS) and/or Norfolk Disposal Site (NDS) plus Craney Island

As previously stated, each of the above two plans provides for a life approaching 50 years for dredged material disposal. In the case of Craney Island expansion, a smaller area can be developed at first, if desirable, and later expanded to Plan B, although this would prove to be more costly. Costs of the smaller areas are included in appendix A.

In the case of DNODS, if the new work dredging in the inner harbor required for the 55-foot channel and anchorages, access channels, etc. (14.6 m.c.y.) plus suitable material from the proposed 45-foot channel in the Elizabeth River (1.5 m.c.y.) were disposed therein, this would limit use of the area for maintenance dredging from the inner harbor to only about 7 years (table 34). Furthermore, space would be required in the existing Craney Island to insure that unsuitable material dredged from the Southern Branch of the Elizabeth

River and possibly the Eastern Branch could be placed therein for many years and perhaps a period approaching 50 years.

In the case of the Norfolk Disposal Site, dredged material from the inner harbor could be placed therein not only for 50 years, but indefinitely. Again, unsuitable dredged material would have to be placed into the existing Craney Island Disposal Area.

COMPARISON OF FINAL PLANS

The final plans must include a confined area for the material dredged from the Southern Branch and its tributaries since the material therein is not suitable for ocean disposal. Accordingly, the following paragraphs compare plans based on a life approaching 50 years.

a. The existing Craney Island plus ocean disposal.

b. Expansion plan B only (NED Plan).

c. Expansion plans A and/or E plus DNODS plus NDS.

Existing Craney Island Plus Ocean Disposal

The following is an excerpt from a letter dated September 9,1988, from the Environmental Protection Agency:

> "The Dam Neck Site was specifically designated based upon the needs of the Norfolk and Baltimore projects. However, the designation does not preclude the disposal from other projects. Any material from outside the identified project areas must be 'clean' as provided in 40 CFR Part 227 and preferably of a fine grain sand or coarser nature. Further, all disposal at the Dam Neck Site must be prioritized to assure adequate volumes as necessary to handle the Norfolk and Baltimore projects.
>
> "...EPA would not recommend the expansion of the Dam Neck Site. Based on coordination of the existing site, we would expect other resource agencies to raise environmental concerns."

Based on the recent position from EPA as well as the agency concerns raised during the site designation process for the existing (expanded) DNODS, no consideration has been given to further expansion of this site.

As previously stated, DNODS was designed to store all dredged material from the following channels:

a. Thimble Shoal Channel in Chesapeake Bay. This includes the material from the authorized inbound and outbound 50 and 55-foot depths and the maintenance of this channel for 50 years.

b. Cape Henry Channel in Chesapeake Bay to Baltimore. This includes the material from the authorized 50 foot depth and the maintenance of this channel for 50 years.

c. Atlantic Ocean Channel. This includes the material from the authorized inbound and outbound 60-foot depth and the maintenance of the channel for 50 years. The natural depths exceed 50 feet, and a 60-foot depth is required for the heavily laden ships traversing the proposed 55-foot channel in Chesapeake Bay and the effect of waves in the Atlantic Ocean.

Based on the above dredging requirements, DNODS was designed to store 70 million cubic yards of material. The inbound 50- and 55-foot depths in Thimble Shoal and Atlantic Ocean (60-foot depth) Channels have been deferred.

The following table shows the effect on the storage available at DNODS based on the stated assumptions and the amount of clean material suitable for ocean disposal that can be placed therein from the inner and outer harbors, assuming maintenance from both are placed in DNODS.

Table 34. REMAINING LIFE OF DAM NECK OCEAN DISPOSAL SITE

| Item | Quantity m.c.y. | Remaining Capacity in DNODS/m.c.y. |
|---|---|---|
| Assumption A | | |
| 1. Construction of outbound 55' depth in Thimble Shoal and 60' depth in Atlantic Ocean Channels and 50' improvement in Cape Henry Channel. | | |
| 2. Construction of outbound 55' depth in Norfolk Harbor, outbound and inbound Newport News Channels, anchorages, etc., suitable material in construction of 45' depth in Elizabeth River and Southern Branch. | | |
| 3. Maintenance of all suitable material including public and private permit activity. | | |
| a. Capacity of DNODS | 70.0 | 70.0 |
| b. Material placed to date | 4.7 | 65.3 |
| c. Outer Harbor (see 1 above) | 18.2 | 47.1 |
| d. Inner Harbor (see 2 above) | 16.1 | 31 |
| e. Maintenance of Outer and Inner Harbors including public and private permit activity @ 4.4 m.c.y./yr - remaining life of Dam Neck = $\frac{31 \text{ mcy}}{4.4 \text{ mcy/yr}}$ = 7 years | | |
| Assumption B | | |
| 1. Construction of outbound 55' depth in Thimble Shoal and 60' depth in Atlantic Ocean Channels and 50' improvement in Cape Henry Channel. | | |
| 2. Construction of outbound 55' depth in Norfolk Harbor, outbound and inbound Newport News Channels, anchorages, etc. | | |

Table 34. REMAINING LIFE OF DAM NECK OCEAN DISPOSAL SITE
(Cont'd)

| Item | Quantity m.c.y. | Remaining Capacity in DNODS/m.c.y. |
|---|---|---|
| 3. Maintenance of Federal channels only. | | |
| a. Capacity of DNODS | 70.0 | 70.0 |
| b. Material placed to date | 4.7 | 65.3 |
| c. Outer Harbor (see 1 above) | 18.2 | 47.1 |
| d. Inner Harbor (see 2 above) | 14.6 | 32.5 |
| e. Maintenance of Outer and Inner Harbor Channels @ 0.5 + 2.3 = 2.8 m.c.y./year - remaining life of DNODS = 32.5/2.8 = 12 years | | |
| Assumption C | | |
| 1. No further new work accomplished in Hampton Roads. Cape Henry Channel dredged to a 50' depth. | | |
| 2. Maintenance of all suitable material including public and private permit activity. | | |
| a. Capacity of DNODS | 70.0 | 70.0 |
| b. Material placed to date | 4.7 | 65.3 |
| c. Outer Harbor (Cape Henry) | 2.1 | 63.2 |
| d. Maintenance of Outer and Inner Harbors including public and private permit activity @ 4.1 m.c.y./yr - Remaining life of DNODS = $\frac{63.2 \text{ mcy}}{4.1 \text{ mcy/yr}}$ = 15 years | | |

The previous table indicates the following:

Under assumption A, DNODS could contain all clean outer and inner harbor new work material suitable for ocean disposal plus about 7 years of maintenance from both harbors including public and private permit activity. Unsuitable material from the Southern Branch would have to be contained in the existing Craney Island. The available space therein is sufficient to store both the unsuitable new work material and unsuitable maintenance material for about 50 years.

Under assumption B, DNODS could contain all clean inner and outer harbor new work material suitable for ocean disposal plus about 12 years of maintenance dredging from the inner and outer harbor channels. However, other Federal, state and private interests would have to take their clean dredged material to the Norfolk Disposal Site.

Under assumption C, wherein no new work is accomplished in Hampton Roads, all maintenance of clean material from the inner and outer harbors could be disposed in DNODS for only about 15 years.

In summary, DNODS cannot provide storage capacity for both new work and maintenance for 50 years for inner harbor Federal, state, and private dredging. If it is planned to take clean material from the inner harbor to sea for this period, it is essential that the NDS be utilized as well as DNODS.

Expansion of Craney Island

Table 24 shows that the remaining storage in CIDA will be filled by about 1997 based on existing dredging operations by Federal, state, and private interests, or even earlier if any new work is disposed therein. Furthermore, there is no assurance when an expansion will occur and Craney Island may be full at that time. Expansion Plan B provides storage capacity for about 50 years. Plan B is about equal in area and storage to the existing project. The two, Craney Island plus Expansion Plan B, would double the size of the existing project, providing for an enclosed area of about 5,000 acres in the immediate vicinity of practically all the harbor activity in Hampton Roads.

Table 24 also shows that Craney Island Expansion Plan A or E would provide for 34 or 25 years, respectively (under dredging scenario S4), for the storage of the proposed new work on the Southern Branch plus the maintenance of the channels and other Federal, state, and local dredging activities in the inner harbor.

After expansion plans A or E were almost filled, it would be necessary to utilize DNODS and NDS to attain a life approaching 50 years for the disposal of dredged material from the inner harbor. Under such a plan, it would be essential to insure that expansion Plan A or E were not filled to capacity so that unsuitable material from the Southern Branch, Eastern Branch, and other areas could continue to be disposed therein (if necessary at that time) while clean material was taken to sea.

Summary

The following table presents a summary of the final array of plans. Information is also shown for two of the smaller alternative expansion plans for Craney Island.

The table is based on investigations by the Waterways Experiment Station and the following for the CIDA expansion plans:

a. An initial point in time was needed for this study. This was taken as the beginning of 1987.

b. The elevations of each of the existing three cells at that time into which CIDA were divided were: north cell, 20 ft. m.l.w.; center cell, 15.4 ft. m.l.w.; and south cell, 20.2 ft. m.l.w. The final elevation was assumed to be 30 ft. m.l.w. This requires all perimeter and interior dikes to have a minimum final elevation of 34 ft. m.l.w. with 2 feet of freeboard and 2 feet of ponding depth.

c. According to investigations by WES that included consolidation and settlement, CIDA will be the only site until 1993; therefore, it will receive all material dredged in the Hampton Roads area from 1987 through 1992. An expansion of CIDA was assumed to be available for use in 1993.

d. The dredging scenario includes disposal of dredged material for the dredging of the 40- and 45-foot channels in the Elizabeth River and its Southern Branch plus the disposal of all maintenance dredging from all Federal, state, and private interests.

e. Estimates in the following table are for disposal of dredged material prior to dewatering and consolidation through management practices.

Although the decision has now been made to take dredged material from the inner harbor to sea to create the authorized Federal 55-foot outbound channel, a table is also presented for disposing the material in an expanded Craney Island in the event that an inclosed area is created prior to receipt of funds to dredge the channel.

Table 35: COST FOR DISPOSAL OF DREDGED MATERIAL INTO CIDA EXPANSION AND/OR OCEAN

Scenario S1: Maintenance of existing channels (including 50-foot channel, public and private access channels to docks, piers, etc.)

| Item | Expansion Plan A | Expansion Plan B | Expansion Plan E | Ocean Disposal plus CIDA |
|---|---|---|---|---|
| Cost | | | | |
| Construction | $53,504,000 | $55,538,000 | $24,688,000 | |
| Interest during construction | 7,575,249 | 7,863,229 | 4,392,579 | |
| Real estate economic loss | 579,000 | 2,637,000 | 2,637,000 | |
| Mitigation costs | 9,919,000 | 14,586,000 | 8,752,000 | |
| Subtotal | 71,577,249 | 80,624,229 | 40,469,579 | |
| Salvage value of disposal area (e) | -281,020 | -374,693 | -234,183 | |
| Costs remaining to amortize | 71,296,229 | 80,249,536 | 40,235,396 | |
| Acreage | 1,700 | 2,500 | 1,500 | |
| Average annual O&M | 1,000,000 | 1,200,000 | 700,000 | |
| Number years site can receive dredged material from 1993 | 36(a) | 56(b) | 26(a) | 56(b) |
| Cost summary (present value) | | | | |
| Construction | 71,296,229 | 80,249,536 | 40,235,396 | |
| Operation & Maintenance for site life | 10,693,032 | 13,395,245 | 6,946,030 | |
| Approximate dredging cost | 139,485,508 | 133,505,939 | 149,711,835 | 291,607,440 |
| Total | 221,474,770 | 227,150,720 | 196,893,260 | 291,607,440 |
| Interest and amort. 56 yrs | 0.08952 | 0.08952 | 0.08952 | 0.08952 |
| Average annual amount of all costs | 19,825,415 | 20,333,500 | 17,624,990 | 26,103,373 |
| Yardage dredged | | | | |
| Total deposited at site | 144,000,000 | 224,000,000 | 104,000,000 | - |
| Total under ocean plan (c) | 80,000,000 | 0 | 120,000,000 | 224,000,000 |
| Approximate per year | 4,000,000 | 4,000,000 | 4,000,000 | 4,000,000 |
| Average annual cost per cubic yard | $4.96 | $5.08 | $4.41 | $6.53 |

(a) Years derived by WES are reduced by 3 years to reserve capacity for unsuitable material during period clean material must be transported to sea. (See discussion on equivalent lives, Risk and Uncertainty Section).
(b) Full life expectancy.
(c) Unsuitable material confined in existing Craney Island or reserved capacity in another site.
(d) Includes APW of dredging costs, $100,000 per year to monitor ocean site and cost to maintain site for material which must be confined. See Economic Appendix for further detail.
(e) Discounted to base year.

Table 36: COST FOR DISPOSAL OF DREDGED MATERIAL INTO CIDA EXPANSION AND/OR OCEAN

Scenario S4: Same as S1 plus dredging and disposal for deepening the Southern Branch Channels to 40 and 45 feet.

| Item | Expansion Plan A | Expansion Plan B | Expansion Plan E | Ocean Disposal Plus CIDA |
|---|---|---|---|---|
| Cost | | | | |
| Construction | $53,504,000 | $55,538,000 | $24,688,000 | |
| Interest during construction | 7,575,249 | 7,863,229 | 4,392,579 | |
| Real estate economic loss | 579,000 | 2,637,000 | 2,637,000 | |
| Mitigation costs | 9,919,000 | 14,586,000 | 8,752,000 | |
| Subtotal | 71,577,249 | 80,624,229 | 40,469,579 | |
| Salvage value of disposal area (e) | -429,910 | -573,214 | -358,259 | |
| Costs remaining to amortize | 71,147,339 | 80,051,015 | 40,111,320 | |
| Acreage | 1,700 | 2,500 | 1,500 | |
| Average annual O&M | 1,000,000 | 1,200,000 | 700,000 | |
| Number years site can receive dredged material from 1993 | 31(a) | 51(b) | 22(a) | 51(b) |
| Cost summary (present value) | | | | |
| Construction | 71,147,339 | 80,051,015 | 40,111,320 | |
| Operation & Maintenance for site life | 10,388,610 | 13,328,550 | 6,564,695 | |
| Approximate dredging cost | 172,158,442 | 162,433,513 | 185,834,989 | 336,265,599 |
| Total | 253,694,391 | 255,813,078 | 232,511,004 | 336,265,599 (d) |
| Interest & amort. over 51 yrs | 0.08993 | 0.08993 | 0.08993 | 0.08993 |
| Average annual amount of all costs | 22,813,820 | 23,004,346 | 20,908,875 | 30,239,151 |
| Yardage dredged | | | | |
| Total deposited at site | 136,746,000 | 219,006,000 | 99,729,000 | - |
| Total under ocean plan (c) | 82,260,000 | 0 | 119,277,000 | 219,947,000 |
| Approximate per year | 4,294,235 | 4,294,235 | 4,294,235 | 4,312,686 |
| Average annual cost per cubic yard | $5.31 | $5.36 | $4.87 | $7.04 |

(a) Years derived by WES are reduced by 3 years to reserve capacity for unsuitable material during period clean material must be transported to sea. (See discussion on equivalent lives, Risk and Uncertainty Section).
(b) Full life expectancy.
(c) Unsuitable material confined in existing Craney Island or reserved capacity in another site.
(d) Includes APW of dredging costs, $100,000 per year to monitor ocean site and cost to maintain site for material which must be confined. See Economic Appendix for further detail.
(e) Discounted to base year.

Table 37: COST FOR DISPOSAL OF DREDGED MATERIAL INTO CIDA EXPANSION AND/OR OCEAN

Scenario S2: Same as S1 plus dredging and disposal for the 55-foot channel for the inner harbor.

| Item | Expansion Plan A | Expansion Plan B | Expansion Plan E | Ocean Disposal Plus CIDA |
|---|---|---|---|---|
| Cost | | | | |
| Construction | $53,504,000 | $55,538,000 | $24,688,000 | |
| Interest during construction | 7,575,249 | 7,863,229 | 4,392,579 | |
| Real estate economic loss | 579,000 | 2,637,000 | 2,637,000 | |
| Mitigation costs | 9,919,000 | 14,586,000 | 8,752,000 | |
| Subtotal | 71,577,249 | 80,624,229 | 40,469,579 | |
| Salvage value of disposal area (e) | -554,833 | -104,653 | -770,106 | |
| Costs remaining to amortize | 71,022,416 | 80,519,576 | 39,699,473 | |
| Acreage | 1,700 | 2,500 | 1,500 | |
| Average annual O&M | 1,000,000 | 1,200,000 | 700,000 | |
| Number years site can receive dredged material from 1993 | 26(a) | 49(b) | 20(a) | 49(b) |
| Cost summary (present value) | | | | |
| Construction | 71,022,416 | 80,519,576 | 39,699,473 | |
| Operation & Maintenance for site life | 9,922,899 | 13,292,850 | 6,319,510 | |
| Approximate dredging cost | 189,085,655 | 173,382,024 | 201,260,169 | 358,321,905 |
| Total | 270,030,970 | 267,194,450 | 247,279,152 | 358,321,905 (d) |
| Interest & amort. over 49 yrs | 0.09015 | 0.09015 | 0.09015 | 0.09015 |
| Average annual amount of all costs | 24,342,724 | 24,087,018 | 22,291,696 | 31,090,945 |
| Yardage dredged | | | | |
| Total deposited at site | 123,347,000 | 219,947,000 | 98,147,000 | - |
| Total deposited at sea (c) | 96,600,000 | 0 | 121,800,000 | 219,947,000 |
| Approximate per year | 4,488,714 | 4,488,714 | 4,488,714 | 4,488,714 |
| Average annual cost per cubic yard | $5.42 | $5.37 | $4.97 | $7.20 |

(a) Years derived by WES are reduced by 3 years to reserve capacity for unsuitable material during period clean material must be transported to sea. (See discussion on equivalent lives, Risk and Uncertainty Section).
(b) Full life expectancy.
(c) Unsuitable material confined in existing Craney Island or reserved capacity in another site.
(d) Includes APW of dredging costs, $100,000 per year to monitor ocean site and cost to maintain site for material which must be confined. See Economic Appendix for further detail.
(e) Discounted to base year.

Table 38: COST FOR DISPOSAL OF DREDGED MATERIAL INTO CIDA EXPANSION AND/OR OCEAN

Scenario S5: Same as S1 plus dredging and disposal for the 55-foot channel plus the 40 and 45 foot channels in Southern Branch.

| Item | Expansion Plan A | Expansion Plan B | Expansion Plan E | Ocean Disposal Plus CIDA |
|---|---|---|---|---|
| Cost | | | | |
| Construction | $53,504,000 | $55,538,000 | $24,688,000 | |
| Interest during construction | 7,575,249 | 7,863,229 | 4,392,579 | |
| Real estate economic loss | 579,000 | 2,637,000 | 2,637,000 | |
| Mitigation costs | 9,919,000 | 14,586,000 | 8,752,000 | |
| Subtotal | 71,577,249 | 80,624,229 | 40,469,579 | |
| Salvage value of disposal area (e) | -779,606 | -174,310 | -1,282,683 | |
| Costs remaining to amortize | 70,797,643 | 80,449,919 | 39,186,896 | |
| Average annual O&M | 1,000,000 | 1,200,000 | 700,000 | |
| Number years site can receive dredged material from 1993 | 22(a) | 43(b) | 14(a) | 43(b) |
| Cost summary (present value) | | | | |
| Construction | 70,797,643 | 80,449,919 | 39,186,896 | |
| Operation & Maintenance for site life | 9,378,135 | 13,140,911 | 5,275,984 | |
| Approximate dredging cost | 225,931,437 | 201,308,912 | 254,290,408 | 404,058,722 |
| Total | 306,107,215 | 294,899,743 | 298,753,288 | 404,058,722 (d) |
| Interest & amort. over 43 yrs | 0.0911 | 0.0911 | 0.0911 | 0.0911 |
| Average annual amount of all costs | 27,887,285 | 26,866,250 | 27,217,320 | 36,810,961 |
| Yardage dredged | | | | |
| Total deposited at site | 113,963,000 | 208,849,000 | 79,459,000 | N/A |
| Total deposited at sea (c) | 94,886,000 | 0 | 129,390,000 | 208,849,000 |
| Approximate per year | 4,856,953 | 4,856,953 | 4,856,953 | 4,856,953 |
| Average annual cost per cubic yard | $5.74 | $5.53 | $5.60 | $7.58 |

(a) Years derived by WES are reduced by 3 years to reserve capacity for unsuitable material during period clean material must be transported to sea. (See discussion on equivalent lives, Risk and Uncertainty Section).
(b) Full life expectancy.
(c) Unsuitable material confined in existing Craney Island or reserved capacity in another site.
(d) Includes APW of dredging costs, $100,000 per year to monitor ocean site and cost to maintain site for material which must be confined. See Economic Appendix for further detail.
(e) Discounted to base year.

TRADE-OFF ANALYSIS

Craney Island will be filled with dredged material in only a few years. It is neither practical nor justified at this time to raise this project in order to provide additional storage or to remove the material therein and transport it to sea. It is imperative that an alternate site be established soon so that main channels and entrance channels to docks and piers can be properly maintained in order for commercial activity in Hampton Roads to continue as it does at present.

Whatever plan is finally selected for disposal of dredged material will have a decided effect on Hampton Roads shipping. The Craney Island Expansion Plan B would be in the center of Hampton Roads commercial and navigational activity. It represents the NED plan. On the other hand, DNODS and NDS are located about 37 and 45 miles, respectively, from the harbor. Thus, a 75 to almost 100-mile round trip would be required in order to discharge dredged material at sea.

For example, if ocean disposal for clean dredged material is utilized, the four or more million cubic yards of dredged material annually less the 9 percent of unsuitable material which must be placed in Craney Island, would cost an additional present value of $7.2 million per year (Expansion B/dredging scenario S4) to most Federal, state, and commercial interests in the harbor compared to disposal costs for an expanded Craney Island. On the other hand, in order to obtain the benefit of placing material into a 2,500-acre expansion of Craney Island, it would be necessary to incur an expenditure of over $78 million to construct the expansion. Individuals may face different costs.

Environmentally, expansion of Craney Island would render 2,500 acres of shallow water habitat in the James River and Hampton Roads estuary unusable for benthic populations and fishery habitation. The Chesapeake Bay Agreement, signed by Federal and state representatives in 1987, is committed to " . . . restoration and protection of living resources, their habitats and ecological relationships." The same would apply to the Memorandum of Agreement signed recently by the Assistant Secretary of the Army and EPA and to the cooperative effort by the Department of Defense and EPA to help restore Chesapeake Bay. With this consideration in mind, mitigation of the lost habitat and its cost has been included in the overall estimate of cost for expansion. The

aquatic habitat cannot be replaced in-kind unless wetlands and/or fast land were dredged along Chesapeake Bay or its environs to create new subaqueous bottom and this is not practical. Further details on out-of-kind mitigation plans and their costs are presented in the Environmental Information Report (Appendix E).

In the case of DNODS, a previous chapter indicates the concerns expressed during the process of coordinating the environmental document. The concerns included a number of items such as the effects of dredged disposal material on breeding, spawning, nursery, and passage activities of commercially important finfish and shellfish in and out of the Chesapeake Bay, the impact to commercially important benthos, blue crab, bay anchovy, and sand shrimp larvae, and other effects. The National Marine Fisheries Service, U.S. Fish and Wildlife Service, and Chesapeake Bay Foundation continue to list these as unresolved. However, the DNODS Site Evaluation Study (May, 1985) indicates little, if any, ecological or other impact expected. EPA concurs and has approved the site for dredged material disposal (March, 1988). Thus, there are no unresolved environmental concerns as long as material meeting ocean disposal criteria under authority of Section 102 of MPRSA is placed therein. EPA has signed and submitted a Memorandum of Agreement on site management of DNODS for approval of the District Engineer.

In the case of the Norfolk Disposal Site (NDS) there are no areas of controversy or unresolved issues in the environmental information report relating to its use as an ocean disposal site for dredged material. Thus, there are no foreseeable impacts which would preclude the use of NDS for Norfolk Harbor and Channels materials. EPA favors its use for this purpose. Site designation by EPA is still required. By letter of 1 August 1989, the District has requested EPA to designate NDS. This is being done under Section 102 of the Marine Protection, Research and Sanctuaries Act, which will take from 1 to 2 years to complete.

In the case of DNODS or NDS, there are no unresolved environmental concerns as long as suitable dredged material is placed therein. Of course, the areas would have to be monitored closely to insure that there is little movement of the placed material; that, within DNODS, it is located 35 feet below mean low

water; and that dredged material mounds do not intrude on the movement of ocean-going vessels. Unsuitable material, such as that which exists in portions of the Southern Branch of the Elizabeth River, would still have to be placed in the existing Craney Island. If all suitable material is placed in ocean disposal sites, space would be available in CIDA for unsuitable materials for about 50 years. Unsuitable materials would be more concentrated in Craney Island than exists at present since they would not be mixing with as much clean dredged material as at present. However, as stated in a previous chapter, if a plan to limit CIDA to only unsuitable material were implemented, the overall reduction in volumes should, in fact, serve to increase retention time of dredged material placed in the facility, and improve effluent water quality. If CIDA were limited to unsuitable materials, it is expected that weathering processes which break down unsuitable materials would continue, and that even this more concentrated sediment would also become innocuous over time.

There are social and regional impacts to consider in connection with these plans. In the case of Craney Island expansion, the Portsmouth shoreline which would be affected includes 39 homes where residents have an unrestricted view of the harbor. If expansion plan B is accomplished their view of the harbor would be eliminated by its construction and access to the harbor would decrease, both of which would cause property values to decline. Furthermore, there would be a loss of 2,500 acres of water area available for shallow draft recreational and/or commercial boating. The city of Portsmouth is presently finding it difficult to balance its budget due partially to the considerable amount of Federal property within the city. Expansion of CIDA would result in a further loss of taxes due to the reduced values of shoreline property in the vicinity of the CIDA expansion. Significant opposition to this plan can be expected from Portsmouth and Suffolk residents and governmental officials, especially those whose property would be directly affected.

On the other hand, the 2,500 acres in the existing Craney Island, when filled in the next 50 years under this plan, could be developed for industry, commerce, recreation, wildlife, or a combination of these and other uses. It could, thereby, create a substantial benefit to the community and the entire Hampton Roads area.

As previously stated, Corps of Engineers projects and activities are to be consistent with a waterfowl management plan. The Departments of the Interior and Army entered into a cooperative agreement regarding waterfowl habitat conservation, in particular, the opportunities associated with Corps of Engineers projects and activities consistent with the North American Waterfowl Management Plan. This plan focuses on the value of maintaining an adequate habitat base to ensure perpetuation of North American waterfowl populations. In principle, waterfowl management is dependent on protection, restoration, and management of habitat, the persistent loss of which must be reversed. Concerning habitats along the Atlantic Coast of the United States, priority is currently with black duck populations where areas such as the present Craney Island can provide for migration and wintering needs to some extent. It would seem reasonable to assume that an extension of Craney Island could do the same on an expanded basis. The argument is made, however, that while the above may be a reality, the entire existing area plus the expansion will be lost to future development and that the small overall gain for waterfowl populations will ultimately result in a total loss of habitat.

The potential for much of the area of both the present Craney Island as well as any extension would be as wildlife habitat. Due to the nature of the sediments and material placed therein there would be an insufficient base for development along the major portion of its west side such as required for port activities. The best and highest use category for such land having little or no development potential is wildlife habitat to benefit not only waterfowl, but also other species as well. The long-term management of major portions of the existing and proposed extension to Craney Island for this purpose is included as a recommendation at the end of this report.

The alternative disposal of dredged material in DNODS and NDS would create no social impacts in either the city of Portsmouth or the Hampton Roads area of that type created by CIDA expansion. As previously stated, these sites would have to be monitored closely to insure that the fishery resources of Chesapeake Bay are not impaired. Again, as previously indicated, there would be an increased cost for existing commercial and industrial companies as well as Federal and state interests in Hampton Roads to take material dredged from their piers, channels, etc., about 37 to 45 miles out to sea. Whether this would

affect their existence in Hampton Roads or possibly reduce employment by their removal from the area is conjectural. Possibly some may find areas onshore for discharging small amounts of clean dredged material. Others may possibly deposit the small amounts of material in the CI rehandling basin eventually to be taken to sea in larger quantities by either the Federal or state entities and at less cost -- whichever accepts the responsibility for Craney Island. Others may make arrangements with the contractor, who is dredging the channels in the harbor, to dredge the piers and take the material to sea simultaneously at a reduced unit cost.

In any case, only clean material could be deposited in DNODS or NDS. The existing CIDA would have to continue to accept material unsuitable for ocean disposal.

As previously stated, the state may consider the utilization of CIDA for the discharge of all unsuitable material plus suitable material only from private entities. All clean dredged material from Federal and state entities would be transported to DNODS or NDS. Under these circumstances, one of the smaller expansions to CIDA (plans A or E) could be constructed when the need therefor becomes evident.

Whichever plan is adopted, opportunities for the beneficial use of dredged material should always be incorporated as a part of any long-term disposal plan. This shall include the use of satisfactory material for beach nourishment, for the strengthening of existing levees around Craney Island or any expansion thereto, for landfill, for highway construction where appropriate, or for any other beneficial use.

## RATIONALE FOR PLAN SELECTION

It is necessary for the Commonwealth of Virginia to select that dredge disposal plan it deems appropriate. In this connection, consideration should be given to all the factors previously discussed in this report. This will include the economic, environmental, social, and regional conditions that pertain to each proposed plan. The Commonwealth would have to weigh the alternatives,

including the beneficial and/or detrimental effects, and then adopt the plan that it deems appropriate for the foreseeable future.

## RISK AND UNCERTAINTY

In order to evaluate risks associated with disposal plan cost and performance, there must be some knowledge of the range and probability distribution of critical cost elements and performance characteristics (e.g., useful life). Evaluating uncertainty is more difficult since it involves a condition for which there is no basis for estimating the probability of occurrence. This section discusses the uncertainties associated with several of the assumptions or variables which affect the cost of disposal alternatives. Since there are no objective probabilities, it is useful to examine the extent to which a variable or an assumption would have to change before the cost of one of the Craney Island expansion plans would equal the cost of ocean disposal, which is more expensive than any of the alternatives examined except for disposal islands in the Chesapeake Bay, i.e., Ocean View, Buckroe Beach and Chesapeake Bay.

Three major factors influencing the cost of disposing of a cubic yard of material in a confined site are: (1) cost of constructing and operating the confined site, including any mitigation; (2) cost of dredging material and transporting it to the site; and, (3) capacity (or life) of the site, as determined by the rate and amount of deposition, and desiccation/consolidation of material which can be realized.

The major cost element for constructing the site is obtaining and placing material for dikes, which represents 52% of the total cost of CIDA Expansion Plan B. Over 18 million cubic yards of sand are required to construct the levee for that plan. It is possible that up to 25% of the sand may have to be obtained from a source outside the 3-mile radius assumed in the cost estimate presented here. The estimated cost of alternative sources for approximately 4.5 m.c.y. of material is $3.50 per yard compared with $1.62 per yard. If the material had to be obtained at the higher unit cost, Expansion B would still be less expensive than ocean disposal.

Another large item of expenditure is mitigation measures, estimated at $14.6 million or 23% of project first costs for Expansion B. A number of

mitigation options with a considerable range of values were examined, but for this exercise, mid-range costs proportionate to the bottom acreage affected are being used for economic comparison of all confined disposal alternatives.

Since the accumulated present worth of all Plan B costs are $78 to $127 million less than for the ocean plan, the potential increases in the cost categories described above would not cause Site B to become as expensive as ocean disposal. For Site E, it would take $107 to $125 million in additional first costs before that site was equal in cost to the ocean plan.

All construction or first costs are fixed once the site is built, and only the recurring expenditures (dredging and disposal site operation) are subject to inflation or other cost increases. Ocean disposal expenditures, however, are predominantly recurring costs for dredging, with only a small percentage of the total charges required to protect or renew space in a portion of the existing Craney Island site for material which is unsuitable for ocean disposal. Thus, almost all costs associated with ocean disposal are vulnerable to future price increases in dredging plant (dredges, tugs and barges) and operation. Fuel is the largest component of dredging cost after plant, especially when all material must be hauled 40 miles by barge to an ocean site. At the fuel price used in this analysis ($0.90 per gallon), disposal at Norfolk Disposal Site cost $1.75 to $2.38 more per yard than disposal at Site B, when the full range of dredging scenarios was considered. If the price of fuel increases in the future, the absolute increase in total dredging costs will be higher for ocean disposal than for alternatives A through F.

The applicable dredging scenario describes the amount of material deposited each year and influences the useful life of a site. Sites A, B, and E have the longest lives and the greatest storage capacity under all dredging scenarios. Under Dredging Scenario S1, which assumes maintenance of the 50-foot Federal channel, and dredging deposits from State/local organizations, private interests, and other Federal agencies, Site B is estimated to last up to 56 years and would have a unit cost of $5.35. There would be no further deepening of the Southern Branch under this scenario. Under S5, which includes deepening the Southern Branch and the 55-foot outbound Norfolk

Harbor Channels, Site B may only last 43 years and average unit costs would be $5.87.

The useful life estimates were developed by the Waterways Experiment Station (WES) under an assumption of 100% efficiency in site management practices to dewater and consolidate the material, thus obtaining the maximum life possible from the site under a given dredging scenario. Based on the results of WES's modeling, the potential for consolidation is greater when the site is large enough to create separate cells for rotating the placement of material, allowing each cell to stop receiving material for a time so that dewatering and consolidation of the material already there is optimized. Expansion B is the only site with 3 cells available for rotation. Expansions A and E are configured with 2 cells, while all other options have only 1 compartment. The smaller, single compartment sites hold less material than their physical storage capacity would allow, because material is continually being pumped into the site, limiting the dewatering which can occur.

Since the 100% efficiency assumption used in this analysis is the most optimistic possible, a sensitivity analysis looked at the effect on cost of very large reductions in the useful lives of the confined sites. Under S5, the accumulated present worth of all costs associated with Site B was calculated for lives of 5 to 11 years (versus 43 to 56 years) and compared with the present worth of all ocean disposal plan costs. Ocean disposal was still the more expensive option even with this extreme case.

Because Site B has the longest life of the 6 confined sites, comparison of unit costs for all plans is based on the life of Site B under a given dredging scenario. To obtain equivalent costs for ocean disposal, which has a longer potential life than Site B, costs for the ocean plan are accumulated as present worth amounts for the same number of years which Site B is expected to last. In order for unit costs of shorter-lived CIDA expansion sites to be correctly compared, they must be supplemented by ocean disposal for the number of years required to make their lives equal to that of Site B. Since all material cannot be deposited in the ocean, a confined area would still be needed for 355,000 to 468,000 cubic yards of unsuitable material per year, just as it would under the pure ocean disposal plan. For alternatives A and E, which are among

the 3 least costly alternatives, the lives of the sites which WES estimated for each dredging scenario were shortened by 3 years to reserve capacity for the deposition of ocean unsuitable material. This increased the unit costs of A and E slightly. However, the actual number of years required to reserve the space necessary can only be determined through further modeling and analysis. This test was not applied to alternatives C, D and F, because their lives became unacceptably short in most cases. Appendix C presents the supporting documentation for the least cost analysis of alternatives.

## FINAL ARRAY OF MOST VIABLE PLANS

The preceding sections discussed in detail the process of plan formulation, screening of alternative plans, and the final array of viable plans. It terminated with identification of the two plans that have significant merit. This section presents a description of components of the two plans, their construction and maintenance considerations, their costs and accomplishments, and a summary of environmental and other social effects. Furthermore, if the state chooses a smaller extension plan to Craney Island, the problems to be resolved would be similar to those for extension plan B.

### PLAN COMPONENTS

As previously stated the components of the two plans are as follows:

a. Craney Island Expansion Plan B. This includes 2,500 acres of shallow Hampton Roads bottomland to the west and north of the existing Craney Island. It would contain sufficient space therein, up to elevation 30 m.l.w. to accept over 200 million cubic yards of dredged material from Federal, state, and private interests operating along the channels and waterfront of the inner harbor of Hampton Roads. It would thus provide sufficient storage for the deposition of dredged material for about 50 years. However, it would be necessary to actively manage and dewater the dredged material to allow this alternative to last for approximately 50 years. Any available space, up to elevation 30 m.l.w., remaining in the existing Craney Island after Expansion Plan B has been constructed would add storage thereto. Further information on small expansions to CIDA is discussed in detail in appendix A.

b. DNODS and/or NDS plus existing Craney Island. As previously stated, under this plan clean dredged material from the proposed deepening of (1) the inner harbor (Norfolk and Newport News 55-foot channels and Elizabeth River 45-foot channel, and (2) the outer harbor (Thimble Shoal 55-foot channel and Atlantic Ocean 60-foot channel) would be placed in DNODS. Thereafter, maintenance required in these "clean" channels and clean material from all other Federal, state, and private interests could be placed in DNODS for about 7 years. All further suitable maintenance material from the inner and outer harbor would be disposed in NDS where space is available indefinitely.Craney Island would be used only for the disposal of dredged material unsuitable for ocean disposal. Sufficient storage would be available for about 50 years for material from the Southern and Eastern Branches of the Elizabeth River.

Thus, either of these two plans would satisfy the requirement in the inner harbor for the future disposal of dredged material obtained from Federal, state, and private interests in the Hampton Roads area well into the future.

There is one important factor that should be considered prior to the disposition of dredged material under either plan. This is whether any of the material can be used to arrest or diminish erosion along beaches and/or shorelines, to reinforce existing levees, for borrow material in highway or building construction, or any other beneficial use. Also, consideration should be given to placing small amounts of dredged material in upland areas.

## DESIGN AND CONSTRUCTION CONSIDERATIONS - CRANEY ISLAND EXPANSION PLAN B (NED PLAN)

This plan, as shown on plate 6, requires considerable design and construction. It would include over 7 miles of levee, including over 18 million cubic yards of sand initially and about 180,000 square yards of rock revetment to protect the levee from erosion. Initially, the levee would be constructed to elevation 8 m.l.w. Eventually, as material is placed behind the levee, it would be gradually raised and stepped back, if necessary, to its final elevation of 30 m.l.w. Since the Hampton Roads bottom in this vicinity consists of fine soft saturated clay, about 100 feet thick, construction and raising of the levee would have to be carefully accomplished to insure against its failure. Spillways would be constructed comparable to those that now exist in Craney Island. They would be located along the west levee, and discharge would be designed to empty the area of standing water. Since the proposed levee would abut the west levee of CIDA, pipelines would have to be constructed from the existing spillways in order for them to discharge their waters into Hampton Roads. The quality of the effluent would have to be satisfactory for its return to the waters of Hampton Roads as designated by the Virginia Water Control Board. The proposed southern levee would be aligned away from the shoreline to insure proper drainage and tidal exchange of water from Hoffler and Streeter Creeks with the harbor area. A hopper dredge pumpout facility and pipeline would be constructed on the north side of the expansion area to minimize the pumping distance for emptying dredged material from hopper dredges. The existing rehandling basin on the east side of Craney Island could still serve for unloading bucket and scows into the expanded area. The material from the hydraulic dredge would continue to enter the expanded area at the most convenient and feasible entry point similar to the current operation.

A road would be designed and constructed around the periphery of the levee. This would permit traversal of the area for inspection and maintenance. The area would be gradually compartmentalized by inner levees into about three zones. Two zones could be drying and settling for a year or two as another zone received dredged material from active dredging projects. Further details on the design and construction of expansion Plan B and the other smaller expansions discussed in this report are included in appendix A.

Once expansion Plan B is constructed, all material dredged from the inner harbor, whether it be to attain depths of 55 feet in Norfolk Harbor or 45 and 40 feet in the Elizabeth River and Southern Branch, respectively, could be immediately placed therein. The same would be true for the maintenance of Federal, state, and private channels in the inner harbor for the future. Phased construction would allow rapid implementation of a portion of the plan, thereby providing earlier beneficial use.

In the Water Resources Development Act of 1986, Congress approved a project for the placement, in CIDA, of floating debris from within the inner harbor. The debris includes that from dilapidated piers, wharves, bulkheads, abandoned vessels, etc. Although the amount of debris is small, some space and a dock must be available for this purpose in CIDA or other contained area.

If expansion plan B or one of the smaller expansions encompassed some of the existing levee area, it may be possible to reduce its cost by utilizing the riprap around the existing levee. Also, if the existing facility were filled before the expansion plan reached above water, there would be no need to provide for spillway flow from the existing levee.

An important item is the provision and design of a proper mitigation plan for the bottomland acreage taken for the disposal area.

DESIGN AND CONSTRUCTION CONSIDERATIONS - DNODS AND/OR NDS PLUS EXISTING CRANEY ISLAND SITE

This plan would require practically no design and/or construction features. The following would be adopted:

a. For new work requiring dredging to obtain a 55-foot depth in the inner harbor (see plates 3 and 4). It includes the Newport News and Norfolk Harbor Channels, one 55-foot depth anchorage with a 1,500-foot radius, and one 45-foot depth anchorage with a 1,200-foot radius (this would be dredged at the same time). The new work includes 14.6 m.c.y. of dredging (see table 15), is suitable for ocean disposal, and can be emptied into DNODS (see table 34) and/or NDS.

b. For new work requiring dredging to obtain a 45-foot and 40-foot depth in portions of the inner harbor (see plate 3). It includes a portion of the Elizabeth River and its Southern Branch. This new work includes 6.2 m.c.y. of dredging (see table 15). Clean material from the Elizabeth River can be disposed in DNODS (see table 34) and/or NDS. Material unsuitable for ocean disposal (see plate 7) would be placed into the existing Craney Island.

If new work dredging from the inner harbor were placed in DNODS, maintenance dredged material from the inner and outer harbor channels, access channels, and berthing areas would eventually have to be placed in NDS where practically unlimited space is available for more than 50 years.

In the case of the existing Craney Island, capacity up to elevation 30 m.l.w. would be available for unsuitable material, either for new work or maintenance from portions of the Elizabeth River and its tributaries for about 50 years. This would include all unsuitable material dredged by other Federal, state, and private interests. No construction would be necessary for this purpose.

OPERATIONS AND MAINTENANCE CONSIDERATIONS - CRANEY ISLAND EXPANSION PLAN B

Following completion of Expansion Plan B, the operation and maintenance requirements would be similar to those now existing in Craney Island. They would include the following:

a. Upgrading and maintaining outer dikes.

b. Upgrading and maintaining spillway weirs.

c. Maintaining adequate access.

d. Maintaining heavy equipment.

e. Maintaining perimeter roads.

f. Both existing and new confined facilities should be operated to maximize their useful life. Procedures should include timely initiation of surface trenching following cessation of disposal operations in a particular cell.

g. Maintaining effluent water quality from spillway weirs.

h. Surveying expanded area to determine rate of filling.

If Craney Island is expanded and there are no more restrictions as to what may be placed in it than there are now, there would be no change to the way permits are presently handled. Any chemical or physical sampling which may be required in the future to more efficiently utilize space in the disposal area would be made a condition of the permits and the costs would be borne by the permittees. This has been done on occasion in the past for kepone and PAH's.

OPERATION AND MAINTENANCE CONSIDERATIONS - DNODS AND/OR NDS PLUS EXISTING CRANEY ISLAND SITE

This plan would require operation and maintenance activities similar to that at Craney Island (see above paragraph). There have been several times when purely unsuitable material has been pumped into Craney Island in the past. The effluent has been monitored, groundwater checked, and the mixing zone calculated. The retention is on the order of 99.99%. Polluted (not in toxic quantities) material in CIDA undergoes mixing as well as chemical, biological, and physical "weathering," which all serve to break organic pollutants down to benign forms. The factor which would change if CIDA is reserved for unsuitable materials would be the mixing with suitable materials. Proportionately, mixing with suitable material volumes would decrease. Mixing would continue to occur to some extent, though, because most dredging projects pick up at least some suitable material regardless of location. Also, for smaller projects, there are many situations where the first 2-4 feet would be unsuitable but the next 3-6 feet are suitable. In these cases, the quantities of suitable materials are too small to separate out, and mixing of sediment types would continue.

In the case of DNODS and/or NDS, the following operation and maintenance would apply:

a. Monitoring the DNODS and NDS with the cooperation of EPA to insure that no adverse environmental impacts result from suitable materials placed in these areas.

b. Sampling and testing dredged material in channels, access channels, and docks and piers to determine suitability for ocean disposal. Testing of dredged material for ocean disposal must be accomplished in accordance with EPA/Corps criteria as presented in the "Green Book" (Ecological Evaluation of Proposed Discharge of Dredged Material into Ocean Waters, January 1990).

Private interests with relatively small amounts of clean dredged material could dispose it (a) upland if practical, (b) by arrangement with contractor dredging a Federal channel, (c) into the existing rehandling basin at Craney Island where it would remain until a substantial quantity is accumulated therein (1 to 1.5 million cubic yards) when it would be taken to sea, or (d) by contract to have the material transported to Dam Neck or Norfolk Disposal Area and disposed therein. If a contractor disposes the material at sea, it would be desirable to have an inspector accompany the tug and barge to insure that the dredged material is placed in the proper disposal area. An alternate method is for the contractor to have radio communications along the route to the disposal area with the U.S. Coast Guard and/or the Corps. Electronic technology has advanced such that radio communication should be feasible for this purpose.

Operation of tugs and barges and/or hydraulic dredges carrying the dredged material from the inner harbor to sea should not present a safety hazard. It is necessary to coordinate such activities with the Marine Safety Division of the U.S. Coast Guard as in other districts.

PLAN ACCOMPLISHMENTS

As previously stated, either plan will provide for the storage of dredged material well into the future. The primary accomplishment of Craney Island Expansion Plan B is providing about 50 years of storage for dredged material from the inner harbor, permitting the Federal, state and commercial entities depending on Hampton Roads shipping to continue to operate but at greater

cost now existing for the maintenance of Federal channels, as well as access channels and berthing areas to state and private interests.

The existing Craney Island could be considered for transfer to state and/or municipal interests for maritime development vital to the Port of Hampton Roads, or for a possible airport, public park, wildlife development, and/or other industrial and/or commercial use. The U.S. Navy has also indicated an interest. Time would be required to develop the entire existing 2,500 acres of Craney Island due to the watery softness of much of the area and the need for it to dry out. However, the eastern section where much of the sand and other similar material collects, could be immediately considered for development provided that there would be no conflict with dredge disposal operations.

Some of the Craney Island expansion alternatives would create a sheltered bay between the Portsmouth shoreline and the disposal area. It is possible that limited private development could occur within this area, so long as it did not interfere with operation of the expanded disposal facility. One potential use could be a marina with associated recreational facilities. This would involve a great deal of additional investigation beyond the scope of this study to investigate feasible road access, parking, and utilities. Permits would be needed from the Corps, the Virginia Marine Resources Commission, and the Virginia Water Control Board in order to construct such a marina. Whether or not these permits would or could be issued is uncertain. An extended landfill area offers considerable potential for decorative and screening types of landscaping (as was envisioned by WES in the 1981 management report for the existing project and as shown in the following figures). This method of land treatment offers pleasantries for the close-up visitor and a more comfortable visage for the nearby residential developments.

It would be important to insure that such development will not lead to a decline in the availability of foraging and resting habitat for waterfowl and shore bird species. Craney Island is recognized for its high use by avifauna.

In the case of DNODS and/or NDS plus the existing Craney Island, this plan would also provide storage for dredged material from the inner harbor well into the future. However, the cost over a period of about 50 years, as indicated

in table 29 and tables 35 through 38, would be greater than that indicated for Expansion Plan B. Furthermore, Craney Island, as it exists, would be required for the next 50 years to provide storage for dredged material unsuitable for ocean disposal.

It would be desirable to expedite restriction of Craney Island to unsuitable material. This action could take 1 or 2 years during which period Craney Island would continue to fill with an average of 4 million cubic yards per year. Based on the projected 50-year requirement for unsuitable material, practically all the remaining capacity may be required. If the state or city desires a portion of Craney Island, a small acreage could undoubtedly be considered as previously discussed in the section on Joint Use of Craney Island.

It may be possible for Federal, state, and/or private interests to individually or collectively clean up the Southern Branch and its tributaries in the foreseeable future. If such is the case, there would be no need to preserve Craney Island for unsuitable material. It could be filled quickly to capacity (elevation 30 m.l.w.) in a relatively short period of time with over 4,000,000 c.y. per year of dredged maintenance material. It could then be transferred to the state and/or a local entity or to a Federal agency. All clean material emanating from the inner harbor could then be carried to sea.

## PLAN COSTS

The first cost of construction and annual costs of the two plans are summarized in the following table. Both costs would be incurred by the state. Details relative to these costs, as well as costs for expansion plans A and E, are shown in appendix A.

The cost of dredging about 4 m.c.y. or more per year of material from inner harbor channels, access channels thereto, berthing areas, etc., by Federal, State, and private interests (dredging scenario S4) is estimated to average $5.36 per year to deposit all material in CI Expansion Plan B and $7.04 to deposit suitable material in DNODS and/or NDS and unsuitable material in the existing CI.

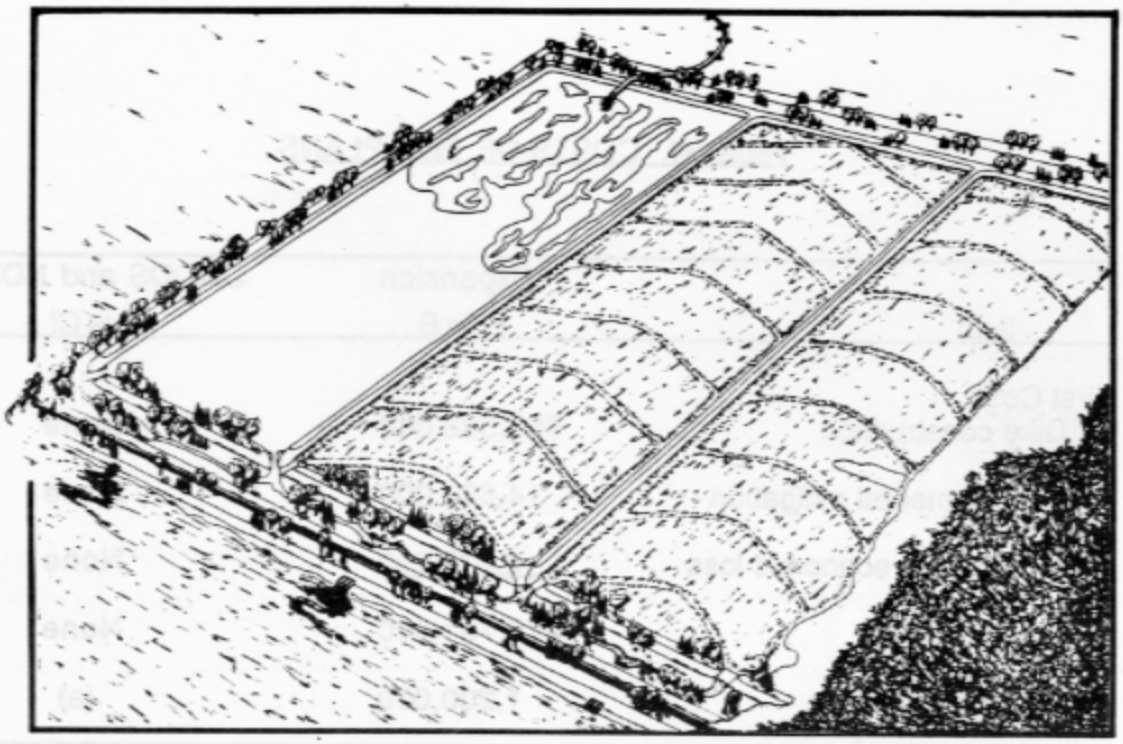


**Figure 9 Artist's conception of overall appearance of Craney Island disposal area, showing alteration of disposal operations, interior trenching, and landscaped dikes**

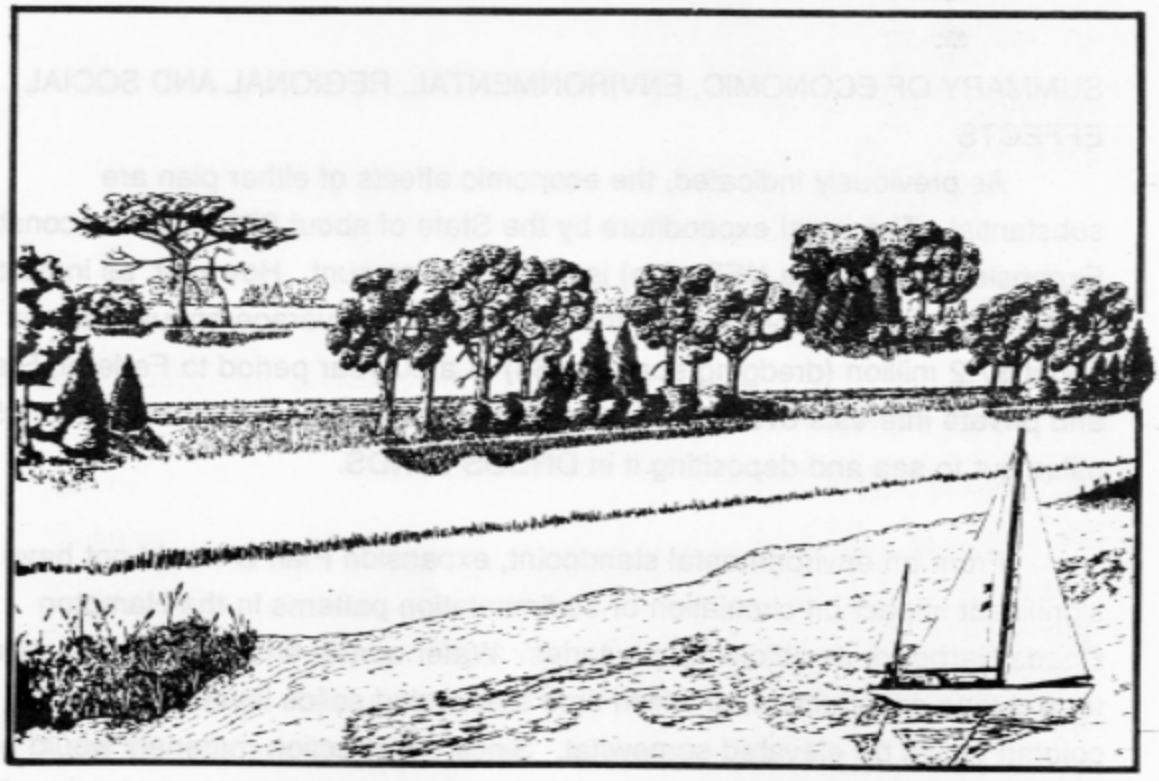


**Figure 10 Artist's conception of landscaped dikes from the water level**

Table 39. COSTS OF TWO PLANS

| Item | Expansion Plan B | DNODS and NDS Plus CI |
|---|---|---|
| First Cost | | |
| Dike construction | $55,538,000 | None |
| Environmental mitigation | 14,586,000 | None |
| Real Estate economic loss | 2,637,000 | None |
| TOTAL | $72,761,000 | None |
| Annual maintenance | 1,200,000 | (a) |

(a) Annual costs aside from dredging and transportation of material to site include $100,000 to monitor the ocean site and charges associated with the continued operation of CIDA for unsuitable material. (see Appendix C)

SUMMARY OF ECONOMIC, ENVIRONMENTAL, REGIONAL AND SOCIAL EFFECTS

As previously indicated, the economic effects of either plan are substantial. The initial expenditure by the State of about $73 million to construct Expansion Plan B (the NED plan) is a sizeable amount. However, as indicated in table 29, when accomplished, there would be an average annual savings of about $7.2 million (dredging scenario S4) in a 50-year period to Federal, State, and private interests over taking the dredged material approximately 37 to 45 miles out to sea and depositing it in DNODS or NDS.

From an environmental standpoint, expansion Plan B would not have significant impact on circulation or sedimentation patterns in the Hampton Roads Harbor or its adjoining tributaries. Water quality effects would be short-term during construction, at which time suspended solids levels in the water column would be elevated somewhat. Since construction materials would be almost exclusively coarse-grained (sand), turbidity is not anticipated to be either a major short-term or long-term problem at the site. However, dissolved oxygen

and suspended solids may have to be monitored during construction. The Virginia Water Control Board will determine the need for other measures to maintain acceptable water quality. The estuarine and marine organisms which inhabit or transit the harbor area are adapted to and tolerant of periodically elevated sediment concentrations characteristic of semi-enclosed estuaries. There would be only minor impact on wetlands with the proposed expansion (less than 1 acre). The most significant major impact of this proposal is the loss of 2,500 acres of shallow water habitat and those organisms living on and in the sediment bottom. While this particular parcel does not appear to be overly productive from a biological standpoint, once covered and coverted to terrestrial habitat, all possibility for recovery would be lost permanently.

This proposal may appear to run counter to the basic tenet of the 1987 Chesapeake Bay Agreement to enhance, protect, and restore the resources of the Bay. The proposal must also take into account the Memorandum of Agreement between EPA and the Assistant Secretary of the Army relative to wetlands impacts and to the agreement between EPA and the Department of the Army to preserve the environment of the Chesapeake Bay. This Long-Term Disposal Study evaluated several different alternatives which would meet the dredged material disposal needs of the Port of Hampton Roads. Several of these alternatives were found to be practicable in terms of cost, existing technology, and logistics, and all were evaluated in relation to Section 404 Guidelines. The environmental costs associated with the expansion alternative, while significant, were not considered great enough to offset its practicality in terms of cost and, therefore, the proposed expansion is presented in the report as a practicable alternative. Mitigation, as presented for the expansion alternative, includes avoidance, minimization and compensation. After all efforts were made to avoid and minimize to the greatest extent possible, compensation was pursued and compensation alternatives and costs were thoroughly investigated with the assistance of the U.S. Fish and Wildlife Service (FWS). The value of the parcel is recognized and its compensation is the primary aim of the mitigation plan and is presented in Appendix E, Environmental Information Report.

Deposition of dredged material in DNODS and NDS should have no adverse environmental effect. DNODS is an approved ocean disposal site both

by the Corps and by EPA. Use of the site is not expected to have significant water quality or ecological impacts. Due to the mobility of finfish, it is unlikely that dumping will have a significant impact on either estuarine or marine finfish. The same conclusions are true for NDS as are true for DNODS. EPA's formal designation of NDS which was requested by the Corps in a letter dated 1 August 1989 will further confirm this conclusion. Based on the historical use of DNODS, sediments generally sink to the bottom and remain in place. Thus, use of either or both sites should not adversely affect environmental resources, recreation, coastal development, or other uses of the ocean and shoreline.

In conjunction with the use of DNODS and NDS, the existing Craney Island must be preserved promptly for containment of dredged material not suitable for ocean disposal. This may require Federal legislation. Contrary to existing conditions, where unsuitable material has represented about 9 percent of the material deposited in CIDA, under the new situation, practically all the material placed into CIDA would be unsuitable.

If only unsuitable materials were deposited in CIDA, it is not anticipated that there would be any greater concern over impacts associated with operation of the facility than that which is now realized. There would be no greater total volume of unsuitable materials placed in the facility, only a greater proportion in relation to suitable dredged materials. Since the heavy metals and organics are tightly bound to the sediments, and the operation of CIDA is greater than 99.9% efficient when it comes to retaining the sediments, effluent water quality would be essentially unchanged. Also, unsuitable sediments placed within CIDA would still be diluted by cleaner materials which occur along the Southern Branch. Because of the physical limitations of the dredge equipment in segregating clean materials, and the difficulty involved in defining the exact boundaries of the unsuitable sediments, there is no practical way to completely isolate clean material from the unsuitable sediments. This is especially true in the buffer areas to the north and south of the most contaminated reaches of the Southern Branch. If monitoring so warrants, several management strategies could be employed to further alleviate concerns over using CIDA for unsuitable materials only. These include:

(1) If monitoring indicated any problems, "clean" materials could be placed in the site periodically to dilute the unsuitable sediments.

(2) If effluent suspended solids concentrations (and toxics) rise above acceptable limits, the ponding depth at the weirs could be increased to allow longer retention (settling) time.

(3) The inflow rates could be decreased by operating intermittently or temporarily diverting flow to an inactive subcontainment.

(4) During the final years of operation, CIDA could be capped with clean material to an acceptable depth so as to seal off any contaminants.

The city of Portsmouth, in 1987, formed a Craney Island Study Commission which has involved representatives from the Virginia Institute of Marine Science, Old Dominion University, the Virginia Water Control Board and the Army Corps of Engineers (Washington, D.C.). The city of Portsmouth presented its recommendations based upon the Commission findings in a letter to the Norfolk District dated November 13, 1987. The recommendations of the Commission Chairman included: (1) placing all suitable dredged material from the inner harbor in the Norfolk Disposal Site; (2) placing all unsuitable dredged material from the Southern Branch in the CIDA until the Southern Branch is cleaned up; and (3) the placement, after the Southern Branch is cleaned up, of all suitable material in the ocean disposal site. Based upon these recommendations, it appears that there may be local and agency support for the concept of placing all suitable materials in the ocean and reserving CIDA for unsuitable materials only.

There would be both social and regional effects as a result of the construction of expansion Plan B. Plate 6 indicates how the appearance of the area would be affected. There would be decreased access to the water in this vicinity. Regionally, there would be a loss of taxes to the Cities of Portsmouth and Suffolk due to the reduction in the values of property. There would also be strong opposition to this plan by residents and local governmental officials of Portsmouth and Suffolk. Balanced against these undesirable factors is the fact that the existing Craney Island could possibly be transferred to Federal and

state agencies and/or the city of Portsmouth for whatever development they would deem appropriate.

In the case of the plan involving the existing Craney Island and DNODS and/or NDS, it is anticipated that there would be no significant social effects from implementation. Although the unsuitable material entering Craney Island would be more concentrated, it is not anticipated that a significant impact would result.

From a regional standpoint, the cost to the maritime industry (Federal, state, and private) for the disposal of dredged material will increase in the future. This increase will result whether the material will be disposed in a constructed confined area such as Craney Island or taken to sea. The cost to private interests was estimated based on the 10-year record from 1978 to 1987. During this period about 10 million of the 45 million cubic yards deposited into Craney Island was disposed by 47 private maritime companies operating in Hampton Roads. The amount deposited varied from 100 to over 100,000 cubic yards as follows:

Table 40. COMPANIES THAT DEPOSITED INTO CRANEY ISLAND FROM 1978 TO 1987

| Total amount deposited by each company in 10-yr. period, c.y. | Number of companies that deposited dredged material into Craney Island in 10-yr. period | | | | |
|---|---|---|---|---|---|
| | 1 time | 2 to 4 times | 5 to 9 times | over 9 times | Total |
| 100 to 39,999 | 22 | 6 | 0 | 0 | 28 |
| 40,000 to 99,999 | 2 | 2 | 2 | 0 | 6 |
| over 100,000 | 2 | 1 | 5 | 5 | 13 |
| Total | 26 | 9 | 7 | 5 | 47 |

Based on the quantities and frequencies of dredging jobs for private companies shown in table 40, several generalizations are possible about the economic impact of future disposal options on this group. The companies, whose total cumulative yards were under 40,000 over this 10-year period, did not dredge often. In 22 out of 28 cases, they had only one dredging job in 10 years. In contrast, 10 out of 13 companies which generated over 100,000 cubic yards in this period dredged 5 times or more.

To estimate the monetary differences in the two types of disposal options for the three categories of companies, the following methods were assumed in order to construct comparative costs for actual volumes of material from jobs dredged between 1978 and 1987.

(a) Disposal into rehandling basin at Craney Island with periodic dredging and transfer of material either to expansion plan B or Norfolk Disposal Site.

(b) Disposal by barge directly to Norfolk Disposal Site.

(c) Hydraulic dredging for large jobs close enough to a Craney Island extension for material to be pumped direct.

For the small jobs (less than 40,000 cubic yards) accomplished by bucket and scow, the cost for utilizing the rehandling basin plus the charge necessary for amortization (and operation) of a Craney Island expansion is less than transporting the material the extra distance direct to an ocean site. However the 2-year cost difference for all jobs of this size was small because the total yardage was small.

For the intermediate class of companies, those with 40,000 to 99,000 cubic yards in a 10-year period, cost differences between these two least expensive options are not significant. It is the companies which generate large volumes of material, of the order of 100,000 cubic yards and which presently use or could use hydraulic dredging, which will incur the greatest additional costs if they must use ocean disposal. Companies which barge their dredged material to Craney Island because they are too far away to pump it will pay approximately the same under either plan.

Of the total amount of material disposed into Craney Island during this 10-year period by all users (Federal, state and/or local), almost 78%, or 35 million cubic yards, was dredged hydraulically and pumped directly into Craney Island. Therefore, it is organizations with large jobs that have used or can use hydraulic dredges which will experience the greatest impact of higher costs if future disposal is at DNODS or NDS rather than a confined site adjacent to Craney Island.

Further analysis of the differential impacts to the various maritime interests may be desirable and should involve interviews with the organizations or companies affected. Since costs developed to make this initial examination of impacts can only approximate dredging costs, the conclusions presented are intended for comparing impacts on groups of users rather than individual jobs. Actual charges depend on the availability of dredging companies at the time the work is accomplished and other market considerations.

DREDGE DISPOSAL OPERATIONS BY OTHER DISTRICTS

The following paragraphs provide information on some recent dredging activities by Corps Districts along the Atlantic coast.

a. Wilmington District. The Wilmington District is currently working on a 50-year maintenance plan for Wilmington Harbor. The plan calls for ocean disposal in the Wilmington Harbor Ocean Disposal Site and use of an 880-acre upland site located within the harbor. Approximately 1 million cubic yards are taken annually to the ocean site (silt and clay).

Currently, Wilmington District has a contract for maintenance dredging of Wilmington Harbor. About 600,000 cubic yards of material are being placed in an ocean disposal site. Dredging is being accomplished by bucket and scow. The round trip distances to the ocean site vary from 24 to 48 miles depending on the dredging location. Dredging and disposal costs for this project range from $2.30 to $3.00 per cubic yard.

b. Charleston District. The Charleston Harbor Deepening Phase I General Design Memorandum (a 40-foot project) recommends that all harbor material go to open ocean disposal which amounts to a 30- to 40-mile round

trip. The estimated cost in the General Design Memorandum was $2.50 per cubic yard. Since this document was prepared, the district has come up with a management strategy for inland disposal sites to increase their life to 50 years. Thus, the ocean disposal site will be used only for the district's entrance channel work. The distance to the ocean site from the entrance channel varies from 4 to 6 miles round trip. The government estimate for the entrance channel work was $2.00 per cubic yard; contractor bids ranged form 83¢ to $3.00 per cubic yard.

c. Mobile District. Approximately 20,000 acres of open water bottom in Mobile Bay were previously committed for disposal of maintenance material from the Mobile Ship Channel. Adverse environmental impacts from the disposal in Mobile Bay included intermittent disruption of bottom dwelling organisms, temporary increases in turbidity, and minor releases of heavy metals and nutrients into the water column. Dredged material buildup in the upper bay was thought to be interfering with normal circulation patterns. Implementation of offshore disposal (about 35 miles to the Gulf of Mexico) represented a shift in the long-term commitment of open water bottom for dredged material disposal from Mobile Bay to the Gulf area. This represents an improvement in the long-term productivity of the more limited estuarine resource area. The district has an investigation underway to establish an environmentally satisfactory and more cost efficient disposal area.

The Mobile Harbor deepening project will result in the dredging and subsequent offshore disposal of as much as 154 million cubic yards (m.c.y.) of material if upper and lower bay material is disposed in this manner. The lower bay portion of the channel would result in 130 m.c.y. of material for offshore disposal. Quantities of maintenance material to be disposed offshore would be approximately 4.1 m.c.y. annually.

Great Lakes Dredging Company is performing the work using a 50 cubic yard clam dredge and a 6,000 cubic yard bottom dump scow (the largest in the nation). The Great Lakes contract was for $35 million for dredging a total of 29 m.c.y. over the next three years, the breakdown of which was to be 13 m.c.y. of new work in Mobile Bay; 10 m.c.y. of maintenance, and 6 m.c.y. of new work on Bar Channel. Maintenance material will be placed overboard in Mobile Bay;

the remainder (new work) will be placed in the offshore site. The cost per cubic yard for materials going to the offshore site was approximately $2.20. A check (by Mobile District) on dredging work being accomplished by districts along the Atlantic Coast indicated that using typical machinery available (a 26-yard bucket and 4,000 yard scow) dredging and disposal costs have ranged from $3.50 to $4.50 per cubic yard.

d. Jacksonville District. Collectively, the Ports of Tampa, Old Tampa, and Hillsborough Bays are among the leading ports in the United States ranking seventh in total tonnage and third in export tonnage. Approximately 8 to 10 m.c.y. of sediments were dredged during improvements of the Tampa Bay main channel and in the maintenance of St. Petersburg Harbor and Port Tampa Channel. Dredged material disposal was scheduled for the ocean including 3.6 m.c.y. remaining from the Tampa Harbor project. Estimates of future channel maintenance dredging volumes are expected to be about 1.1 m.c.y. annually.

Upland disposal areas are not available within any reasonable price constraints, and the method of disposing of the materials containing rock and other hard material in Tampa Bay appeared to have environmental consequences which were unacceptable.

The Tampa Bay Harbor Dredged Material Disposal Site is located 18 nautical miles southwest of the mouth of Tampa Bay, Florida. Costs associated with dredging and disposal at the ocean site are estimated at $5.73 per cubic yard using a 2,000-yard hopper dredge. Tampa Harbor sediments are primarily fine sand with silt and clay and limestone, whereas channel sediments are medium to coarse sand overlain with fine sand and silt. Increased dredging and disposal costs are associated with the hard limestone bottom which requires some blasting which makes dredging difficult.

Two alternative ocean disposal sites were evaluated which were located 9 and 13 nautical miles away from Tampa Bay. However, environmental considerations precluded use of these sites.

e. New York District. More than 90 percent of the 6 million cubic yards of material dredged annually from the New York/New Jersey Harbor is slated for

ocean disposal. The Mud Dump Site (New York Bight Dredged Material Disposal Site) is 1 by 2 nautical miles in size and is located about 12 miles southeast of Rockaway, New York and 6 miles east of Sandy Hook, New Jersey. Disposal has occurred in this vicinity since 1914. In 1984, the present site was designated by the EPA for a maximum capacity of 100 m.c.y. which should last approximately 10 years. New York District is studying an ocean disposal site which will replace the Mud Dump Site when that site reaches capacity.

About 5 percent of the harbor dredged material is unsuitable for unrestricted ocean disposal and requires capping as a mitigative measure. This material passes the EPA/Corps ocean disposal criteria, but is marginal (some effects are seen in bioassay testing, but not greater than 10 percent mortality in test organisms). Any material that does not pass the ocean disposal criteria does not go in the ocean, capped or not capped. A quadrant of the Mud Dump Site is reserved for the purpose of dumping marginal material which is subsequently capped. The approximate average costs associated with dredged material disposal at the Mud Dump Site ranges from $5.00 to $6.00 per cubic yard.

f. Baltimore District. The 50-foot harbor project in Maryland includes the dredging of 30 million cubic yards. About 50 percent of this amount is already completed. The other 15 million cubic yards will probably more than fill the Hart-Miller Island confined disposal site. In accordance with the applicable Master Plan, the state of Maryland started to raise the dikes in Hart Miller Island from 18 to 28 feet. The dikes were completed to 28 feet in 1988. It is questionable whether they will raise dikes more. By placing the 15 m.c.y. therein, little, if any, spare room will be left by 1991.

Maintenance of the harbor requires the dredging of one and one-quarter million cubic yards per year. Of this amount, about 500,000 cubic yards are dredged from the Patapsco River. In 1975-76, the state of Maryland declared the entire Patapsco River contaminated. Thus, the dredged material from within this river could not be placed in the Chesapeake Bay, but had to be placed in a confined area.

The state of Maryland is presently developing a Master Plan for disposal area alternatives for Baltimore Harbor. It is considering the existing confined sites. However, these are small with storage for only 10,000 to 20,000 cubic yards. There is, of course, the open water option for clean materials. The state hopes to finalize their plan shortly.

## PLAN IMPLEMENTATION

### INSTITUTIONAL REQUIREMENTS

In order to accomplish either of the two plans developed, it will be necessary to implement certain institutional requirements. The Corps and the Commonwealth of Virginia will undoubtedly have to share in the responsibility for implementation. For example:

a. In the case of a major expansion, particularly Expansion Plan B, it would be necessary to establish the mechanism for releasing the existing Craney Island, when filled to elevation 30 m.l.w. (which would be soon) from Corps of Engineers control.

b. In the case of the plan consisting of Craney Island plus DNODS and NDS, it would be necessary to insure that the Corps has the authority to (a) allow only unsuitable dredged material from Federal, state and private interests placed in Craney Island and (b) have all suitable material placed in DNODS and NDS. As previously indicated, restricting the use of Craney Island for only unsuitable material would most likely require Federal legislation.

### CRANEY ISLAND DISPOSAL AREA

Craney Island, the present disposal site for dredging activities in the inner harbor, was authorized by the River and Harbor Act of 1946. The following excerpt is from House Document 563, 79th Congress, 2d Session.

> "The District Engineer recommends: (1) That the existing project for Norfolk Harbor, VA., be modified to provide for the construction of a toll disposal area of approximately 2,500 acres in Hampton Roads adjacent to and north of Craney Island, VA., including

> necessary appurtenances and rehandling facilities at a total estimated first cost of $6,343,600, with an estimated cost of $608,900 per year for operation and maintenance of this part of the Norfolk Harbor project; (2) that cooperation in this part of the Norfolk Harbor project shall be contributed by the users of the recommended disposal facilities, who shall pay to the United States a fixed unit toll for rehandling dredged material into the disposal area, the amount of which shall be established upon completion of construction of the disposal facilities and the procurement of a rehandling dredge and attendant plant; and (3) that before actual construction is begun, the United States shall obtain from the State of Virginia, by appropriate legislation or other procedure, all right, title, and interest in submerged lands to be permanently occupied by the disposal area, and nullification, for the operational or useful life of the disposal facilities, of all rights of oyster cultivation in the submerged lands adjacent to the disposal area that may be adversely affected by its operation."

This action is uniquely different from existing policies of local cooperation in navigation improvement projects. At present, local interests must provide all lands, easements, rights-of-way, dikes, and other retaining works required for containment of spoil, etc. -- but are <u>not</u> required to deliver title of lands involved to the United States.

The Commonwealth of Virginia was required to convey to the United States title to the submerged lands which underlie the disposal site. In the past, Virginia has asserted that the title will automatically revert to it when the disposal site is filled. However, it has been determined that there is no reverter clause in the deed to the United States and therefore the United States will retain ownership. In this regard, the following was excerpted from a letter dated October 25, 1977, from Mr. William J. Kollins, Acting Chief, Land Acquisition Section, Land and Natural Resources Division, Department of Justice to Mr. E.L. Ingram, Jr., Chief, Acquisition Division, Directorate of Real Estate, Office of the Chief of Engineers, concerning the title to Craney Island.

> ". . . In the instant case, the Governor of the Commonwealth did by deed dated June 11, 1948,

recorded December 2, 1948, among the land records of Norfolk County, Virginia in Book 932, Page 283, convey to the United States all the Commonwealth's rights, title and interest in and to the lands therein particularly described containing thirty-four hundred acres, more or less. As recited in the deed, the authority for the conveyance was Chapter 266 of the Acts of Assembly of the General Assembly of the Commonwealth of Virginia, approved March 25, 1946, as amended by Chapter 472 of the Acts of 1948, approved April 2, 1948. By the terms of Section 1 of the Act and amendment thereto, the Governor was 'authorized and empowered to execute in the name of the Commonwealth of Virginia a deed conveying, subject to such jurisdictional limitations and reservations as are contained in sections eighteen, nineteen, and nineteen-a and nineteen-b of the Code of Virginia, or as the Governor and the Attorney General may enlarge or modify same in the manner provided in section nineteen-c of the Code of Virginia' (underscoring supplied). In a subsequent portion of Section 1, the Governor was authorized and empowered in his discretion to also include in any such deed 'such rights of reversion of the title and ownership of said land to the Commonwealth' as he deemed proper. It, therefore appears that the Governor, in his discretion, had the authority to convey a defeasible or indefeasible title to the United States, but had to convey either ownership subject to the provisions of Sections eighteen, nineteen, and nineteen-a and nineteen-b.

"Sections eighteen, nineteen, nineteen-a, nineteen-b and nineteen-c of the Code of Virginia, deal mainly with the cessation of jurisdiction over lands acquired by the United States but do include certain provisions relating to the reversion of certain lands to the Commonwealth under certain circumstances. Since the Governor had to convey subject to these sections, no intent to create a reverter can be implied from their inclusion in the deed. By the terms of Chapter 266 of the Acts of the General Assembly of the Commonwealth of Virginia, the Governor was authorized to convey a defeasible title 'in his discretion' by including additional language to this effect to the deed. Since the deed itself does not include additional language or a defeasance clause,

it can be assumed that the Governor did not intend to so limit the estate conveyed.

"This conclusion is supported by the Attorney General of the Commonwealth of Virginia as indicated by his letter of August 28, 1953 and by the Director, Virginia State Planning Board, by his letter of January 30, 1946. In both instances, the indicated officials of the Commonwealth indicate that in their opinion the title vested in the United States is indefeasible . . . "

The original report for Craney Island Disposal Area directed that dikes and other necessary facilities be built with Federal funds. However, this Federal investment, including interest and amortization, was to be "recovered" through the imposition of a user's toll. In determining the toll, the estimated value of the completed site ($2.5 million) was subtracted from the amount of investment, interest, and amortization to be recouped. Thus, the original intention of the authorizing document was that at least $2.5 million should be realized upon the disposition of Craney Island.

It should be noted that the Craney Island operation is "self-liquidating" only in the sense that the Corps, as a major user of Craney Island, has been conducting a paper transaction by charging the user toll for its portion of the deposits against dredging maintenance costs and project costs, while crediting the Craney Island revolving account. In other words, there is no actual cash income to the Federal Government for that portion of Craney Island's capacity being used by the Corps. In any event, the Federal Government has paid for a major portion of the cost for levees and spillways at the existing project.

DIVISION OF PLAN RESPONSIBILITIES - CRANEY ISLAND EXPANSION PLAN B

There are three facets to this plan:

a. The need to construct a levee to inclose 2,500 acres of subaqueous land to the west and north of Craney Island, including the provision and design of a proper mitigation plan. Plate 6 shows the extent of this enclosure.

b. During the interim period while Craney Island is still being used for disposal of dredged material, the state has asked the Corps to consider turnover of a portion of the site along the east levee for use and/or development.

c. The eventual disposition of Craney Island.

It must be recognized that under present Congressional authorization, Federal practice differs from the arrangements under which Craney Island was authorized. Accordingly, it is believed that:

(1) Local interests should furnish all lands, easements, and rights-of-way necessary for the construction and subsequent maintenance of the new disposal area for a period of about 50 years.

(2) Local interests should be required to provide the costs of dikes, spillways, etc., associated with the new disposal area in accordance with current policy for general navigation projects.

(3) Local interests should maintain and operate all the works including rehandling facilities, pipeline, etc. after completion of the new disposal area in accordance with regulations prescribed by the Secretary of the Army.

It is anticipated that Craney Island will fill in the 1990s depending on the amount of new work and maintenance deposited therein. If the state completes construction of the extension prior to the filling of Craney Island, the state may wish the Corps to operate both projects during the few years remaining for Craney Island to fill to the 30 m.l.w. level. A written agreement would be required for the two entities to accomplish this.

If the state decides to pursue an expansion of Craney Island, a Federal permit would be required under certain circumstances. The following summarizes the conditions that would or would not require a permit.

a. If the Corps completes the National Environmental Policy Act (NEPA) process addressing disposal requirements relative to the Federal navigation project (i.e., supplement to the Federal project EA or EIS) and the local sponsor (state) elects to construct the facility, a permit would be issued administratively without permit processing.

b. If the Corps completes the NEPA process addressing disposal requirements relative to the Federal navigation project (i.e., supplement to the Federal project EA or EIS) and the local sponsor (state) asks the Corps to construct, no permit is required, regardless of the source of funding.

c. If the area is authorized by Congress, subsequent to the Corps preparing a NEPA document, no permit would be required whether the Corps or state constructs the site.

d. If the Corps prepares an information report and does not complete the NEPA process, a permit must be processed and undergo a full public interest review if the local sponsor proposes to construct the facility.

It would be desirable for any toll charges that the state sets for disposal of dredged material into CIDA extension to be the same for all users - Federal (e.g., Navy, Coast Guard), state, and private interests.

The state and city of Portsmouth have advised that they want eventual ownership of CIDA. If the Corps determines that a portion of CIDA is available for use by either of the referenced political entities, there are several avenues which would allow the transfer/role of CIDA or a portion thereof to the Commonwealth of Virginia. One of the following avenues could be available.

Approval by the Secretary of the Army under his Excess Property Authority. If the property is determined to be excess to Department of Defense requirements, including the Army, Navy and Air Force, it would be turned over to the General Services Administration (GSA). GSA would screen other Federal agencies prior to making Government property available for acquisition by the state or locality. The disposal thru GSA would be negotiated at Fair Market Value (40 U.S.C. 471, et seq).

If for port/industrial development, approval would be required by the Secretary of the Army at Fair Market Value under the Development of Public Port or Industrial Facilities Authority (Sec. 108 of P.L. 86-645, approved 14 July 1960) (33 U.S.C. 578). This authority is limited to lands within a navigation project and CIDA would qualify.

Approval by the U.S. Congress to transfer ownership of CIDA or a portion thereof to the Commonwealth of Virginia by special legislation. The consideration and conditions of such a transfer would depend on the provisions of the legislation.

Several other miscellaneous authorities are possible (Example: for Airport Development, Wildlife Refuge, etc.) for which there are special provisions and authorities but may not fit into the states present proposal.

The disposal of Government land is a time consuming process. If the State decided to develop Craney Island or a portion thereof as a public port or industrial facility, the amount of time required for disposal would be less than through a normal disposal process. CIDA is a Water Resource Development Project and would qualify for disposal under this Act subject to approval by the Secretary of the Army, and the sale would be for the Fair Market Value of the parcel. Under any circumstances, a minimum of $2.5 million, as suggested in House Document 563, should be realized upon the disposition of CIDA according to the original intent of the authorizing document.

Congressional action initiated by the state to acquire any portion of Craney Island could bypass the normal requirements of a disposal process, i.e., screening with other Federal agencies, payment of Fair Market Value.

The Navy has also expressed a desire to acquire all or a portion of Craney Island as it needs additional acreage in the Hampton Roads area. Its needs could affect any disposition to the state.

The following restrictions/easements should be placed by the Corps on the area if transferred to the state.

a. Prevent interference with the operation of CIDA. This would include such items as pipelines, road access, use of rehandling basin and the bulkhead used for unloading debris accumulated in the harbor.

b. Land would be conveyed subject to easements of record including those to the city of Portsmouth, C&P Telephone, The Virginia Marine Resources Commission, Virginia Power, etc. In addition, the Federal Government would want to maintain any easements, rights of entries, etc., necessary for operation of the Navy's Refueling Depot or any Corps of Engineers monitoring, research activities, inspections, etc. that may be necessary once the project is completed and sold.

In the interim period while CIDA is still being used, Virginia has asked the Corps to consider turnover of a portion of the site along the east levee to the state for use/development. In this connection, such joint use depends on the compatibility of the two operations. For example, the Corps needs to maintain control of the southeastern end of the site for several reasons. That is where the material is pumped into the disposal area and pipelines are installed and removed at various locations on a continuing basis. The rehandling basin is on the east side of Craney Island. The bulkhead for handling harbor debris is on the east side. Access is needed to both these areas. Also careful consideration should be given not to disturb the existing levee whose slope extends for a considerable distance under water.

DIVISION OF PLAN RESPONSIBILITIES - CRANEY ISLAND DISPOSAL AREA PLUS DNODS AND NDS

There are four facets to this plan:

a. The Corps must obtain final designation from the Environmental Protection Agency to utilize the Norfolk Disposal Site.

b. The Corps must promptly limit use of CIDA so that it will be available for unsuitable material only.

c. Use by the state of a portion of CIDA along the east levee.

d. Cost Sharing

e. Disposition of CIDA 50 years hence.

Final Designation of NDS. EPA has stated that it would designate the Norfolk Disposal Site upon request by the Norfolk District. This request has been forwarded to EPA by letter dated 1 August 1989. Following designation it would be necessary to insure that all permittees who have clean dredged material, take it to DNODS and ultimately to NDS and not dispose the material overboard elsewhere.

If the state decides on the deposition of clean material into the ocean:

a. No Federal permit would be required for material dredged by the Corps of Engineers from authorized channel projects.

b. A Federal permit would be required by all other Federal, state or local agencies and by maritime interests or other general public.

The Corps and EPA will develop a monitoring plan for the NDS Site similar to that for DNODS to ensure that acceptable conditions at the site are not exceeded and to provide a basis for any necessary plan adjustments.

Limiting Use of CIDA. HD 99-85 (Feasibility Report) recommended deepening the project with disposal of suitable material into the ocean and unsuitable material into CIDA with a view toward conserving the remaining life of CIDA. In addition, Section 148 of WRDA of 1976 reads as follows:

> "The Secretary of the Army, acting through the Chief of Engineers, shall utilize and encourage the utilization of such management practices as he determines appropriate to extend the capacity and useful life of dredged material disposal areas such that the need for new dredged material disposal areas is kept to a minimum. Management practices authorized by this section shall include, but not be limited to, the construction of dikes, consolidation and dewatering of dredged material, and construction of drainage and outflow facilities."

Consideration of the provisions of HD 99-85 (authorized by WRDA 86/P.L. 99-662) and Section 148 of WRDA 1976 do not clearly provide the necessary authorization to restrict use of CIDA for only unsuitable material. Therefore, additional Federal and/or state legislation may be required in order to implement this plan.

Any chemical or physical sampling which may be required in the future to more efficiently utilize space in the disposal area would be made a condition of the permits and the costs would be borne by the permittees. This has been done on occasion in the past for kepone and PAH's.

There have been several times when purely unsuitable material has been pumped into Craney Island. The effluent has been monitored, groundwater checked, and the mixing zone calculated. Retention of sediments is on the order of 99.99%. Polluted (not in toxic quantities) material in CIDA undergoes mixing as well as chemical, biological, and physical "weathering", which all serve to break organic pollutants down to benign forms. The factor which would change if CIDA is reserved for unsuitable materials would be the mixing with suitable materials. Mixing will continue to occur to some extent, though, because all dredging projects pick up at least some suitable material. Also, for smaller projects, there are many situations where the first 2-4 feet would be unsuitable but the next 3-6 feet are suitable. In these cases, the quantities of suitable materials are too small to separate out and mixing of sediment types would continue. There is no designation process under current law which CIDA would have to go through if it were reserved for unsuitable material.

If Craney Island is reserved for unsuitable material only, the permittees would be required, in most cases, to have samples of the material analyzed prior to dredging. An exception to this would be where adequate data is already available to characterize sediments. Just as the district now has generalized zones within Norfolk Harbor project channels where it knows that material is either suitable or unsuitable, it is expected that general conclusions could eventually be drawn regarding sites for private dredging. There would inevitably be more exceptions for private sector dredging (owing to process-related contaminants at specific sites) but a generalized map of suitable and

unsuitable zones throughout the harbor would eliminate the need to sample each and every site. The sampling results would have to be reviewed by district staff since the District Engineer (through a designate) would be responsible for determining suitability for ocean disposal.

It is believed that one toll charge should be charged for both direct pump into Craney Island and use of rehandling basin for subsequent ocean disposal. It would be calculated by adding all the cost of Craney Island, the rehandling basin, and ocean dumping of the rehandling basin and dividing by the total number of cubic yards deposited. It can be assumed that since disposal costs will rise, some portion of those needing to dredge will find it more economical to make arrangements to dispose of their dredged material in privately owned sites.

- Use by state of a portion of CIDA

This has been discussed in the previous chapter on expansion of CIDA and would also apply here.

- Cost-sharing

Section 101 of WRDA 1986 provides cost-sharing formulas for improvements and maintenance of general navigation features. The Federal/non-Federal percentage varies with the depth of the improvement. For example, channel improvements greater than 45 feet are cost-shared on a 50/50 basis. In addition, WRDA 1986 requires the local cost-sharing sponsor to provide the necessary disposal areas. With regard to maintenance, the Federal share for channels 45 feet deep or less is 100 percent. The Federal share of channels deeper than 45 feet is 100 percent of that required to maintain a 45-foot channel and 50 percent of the additional amount required as a result of the channel depth in excess of 45 feet.

Cost-sharing on Federal projects is normally based on the least costly, environmentally acceptable disposal plan (the National Economic Development or NED plan). This report has identified the expansion of Craney Island as the NED plan. Whether it is ultimately determined to be environmentally acceptable

and permittable will be dependent on the outcome of the NEPA process and the 404 (b)(1) analysis (Clean Water Act). Therefore, cost sharing for the maintenance would be in accordance with WRDA 1986 assuming the expansion of Craney Island as the NED disposal plan. If the Commonwealth elects to go with ocean disposal in lieu of the NED plan (expansion of Craney Island), then the Commonwealth would be responsible for any increase in cost associated with ocean disposal of all Federal channel dredging within the inner harbor of Hampton Roads. An exception would be the 55-foot project (new work) wherein Congress authorized its construction (WRDA 86) using the more costly ocean disposal option.

• Economic versus financial costs from the perspectives of the Commonwealth of Virginia and the Corps of Engineers

When looking at the financial cost of alternatives from the viewpoint of the local sponsor, the following factors are important:

(1) Confined sites have significant start-up costs which may have to be financed through debt. Since there are limits on total debt of state agencies, other capital investments may have to be deferred if a dredged material disposal site is built.

(2) The ability to recover investment costs through user tolls is limited by cost of alternative dredging methods available, i.e., ocean disposal. Rates must be competitive, otherwise revenue will be lost.

(3) The financial commitment is the annual debt service for the disposal facility and any operations and maintenance charges. These are relatively fixed regardless of the volume of material the Port Authority or the Corps generates. Within a nonstructural alternative such as ocean disposal, under either cost-sharing scenario, there are no costs unless dredging is performed. In order to compare costs of ocean disposal with a confined site from the perspective of the Commonwealth of Virginia, Site A (under Dredging Scenario 1) was evaluated for the purpose of illustration only. A number of assumptions were made in order to produce these estimates, including an average yearly dredging workload for the Corps, VPA and other interests. Actual cost-sharing amounts

would be determined during the process of forging a Local Cost-Sharing Agreement between the Corps and VPA. The assumptions used were as follows:

(a) VPA would finance the cost of site construction. The bond rate would be 8-7/8 percent, which is the same as the current Federal discount rate.

(b) Tolls would be used to generate some of the revenue for debt repayment. In order to satisfy investor requirements, the tolls would be set high enough that the revenues, net of operating expenses, would be 1.2 times the annual debt service. In estimating potential revenue from tolls, each yard of material would be assessed the same rate, whether or not the organization responsible actually pays. In the case of Corps of Engineers material from authorized channels, the Commonwealth would be responsible for those tolls.

(c) Bond term is limited to 30 years, although without new work, Site A might last 39 years under the most optimistic circumstances.

If the Commonwealth were to construct site A, the annual debt service plus operations and maintenance costs would be $7.9 million. They would also pay approximately $2.2 million in dredging costs (primarily for VPA and Department of Transportation work). Tolls from private commercial firms and other non-state government agencies (especially the Navy) might be expected to contribute $2.4 million (with a toll rate set at $1.98 per cubic yard), making the net cost of this option to Virginia $7.8 million (rounded to the nearest hundred thousand). No tolls would be collected from the Corps of Engineers; the Commonwealth would in effect be paying the tolls attributable to this work ($4.1 million).

Under the assumptions stated, and assuming that expansion of Craney Island is ultimately determined to be environmentally acceptable, if ocean disposal were elected by VPA as the option for Hampton Roads' dredged material disposal, the state would pick up all Federal costs in excess of what expansion alternative (a) would have cost the Corps, or $7.6 million of the $13.7 million total related to Federal channel maintenance. In addition to $7.6 million for the Corps work, the state would pay approximately $4.6 million for its own

work. Thus, the Commonwealth would have to assume annual costs of $12.2 million for choosing ocean disposal under the conditions described above.

If the Secretary of the Army's office were to grant an exception (i.e., when there is some overriding reason for selecting another plan, based upon other Federal, state, local, and international concerns) to the cost sharing provision for ocean disposal, this non-NED plan would have a lower financial cost to Virginia than a number of confined sites, (at the fuel prices evaluated, i.e., $.90 to $4.00 per gallon). Under this plan, dredging and ocean disposal of maintenance material from Federal authorized channels deeper than 45 feet would be cost shared 50-50 between the Commonwealth and the Federal Government, and the Corps would pick up the cost of maintaining channels down to 45 feet. Thus, most of the additional cost for ocean disposal would be shifted from Virginia to the Federal Government and the commercial sector.

A detailed analysis of the distribution of financial costs to all parties under the two cost sharing scenarios described is presented in Appendix C.

- Disposition of CIDA 50 years hence

This has been discussed in the previous chapter on expansion of CIDA and would apply here. Also, a value should be realized upon disposition of Craney Island Disposal Area equivalent to that claimed as a revenue credit in fixing tolls for the use of CIDA. The authorizing document (HD 563) had used a salvage value of $2.5 million. Appendix C presents a current estimate of real property value.

## VIEWS OF NON-FEDERAL SPONSOR AND OTHER AGENCIES

This report for the Virginia Port Authority contains an Environmental Information Report which could be used in connection with preparation and processing of appropriate NEPA documentation for a particular plan. Appropriate coordination would include but not be limited to the following Federal, state and other interests:

U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service

National Marine Fisheries Service
National Park Service
Department of the Navy
Virginia Historic Landmarks Commission
Virginia Research Center for Archaeology
Virginia Water Control Board
Virginia Council on the Environment (A-95 Clearinghouse)
Virginia Department of Game and Inland Fisheries
Virginia Department of Conservation and Economic Development
Virginia State Department of Health
Virginia Institute of Marine Science
Virginia Marine Resources Commission
Virginia Soil and Water Conservation Commission
City of Chesapeake
City of Hampton
City of Newport News
City of Norfolk
City of Portsmouth
City of Suffolk
City of Virginia Beach

Continued dialogue has been maintained with various Federal, state, and local agencies. During preparation of the Environmental Information Report, the U.S. Fish and Wildlife Service (USFWS) has participated in the evaluation of alternatives, project impacts, and mitigation proposals. The following is an excerpt from its report which is included in Appendix E:

> "The Fish and Wildlife Service does not support the expansion of Craney Island. Further studies are needed to quantify the likely hydrodynamic impacts of an expansion of Craney Island on circulation, current velocities, water quality, and the James River seed oyster beds. Until such studies have been conducted, the potential risks to the aquatic resources of the Hampton Roads area from the expansion of Craney Island are too significant to undertake such a project."

The U.S. Fish and Wildlife Report also indicates the alternatives to be considered in connection with mitigating the effect of constructing a westward extension to Craney Island. They include the following:

a. Creation of intertidal flats around the perimeter of the expanded disposal area.

b. Stabilization of the face of the perimeter dikes with riprap.

c. Marsh stabilization at the Ragged Island Wildlife Management Area.

d. Oyster reef construction and/or enhancement in the James River.

e. Acquisition and restoration of wooded wetlands in the Great Dismal Swamp.

f. Construction of artificial finfish reefs.

g. Protection of riparian buffers within the anadromous fish spawning ground of the James River.

h. Construction of anadromous fish passage facilities on the James River.

i. Creation of submerged aquatic vegetation beds.

j. Removal of contaminated sediments from the Southern Branch of the Elizabeth River.

It is important to note that further investigation of the mitigative measures in accordance with NEPA will have to be made before a firm plan is finalized by the state and Federal regulatory agencies.

A scoping meeting which included Federal and state environmental agencies was held at the Norfolk District on 23 July 1987. A later meeting of these agencies on 16 November 1988 served as an arena to discuss mitigation

proposals developed by the Corps and the USFWS. The Virginia Port Authority (VPA), a partner in this investigation, participated in a meeting with the USFWS at the Norfolk District on 9 January 1989, at which time various mitigation proposals were discussed on a preliminary basis.

The following are excerpts from a letter, dated September 9, 1988, from EPA on the matter of dredged material disposal from the Port of Hampton Roads.

> " . . . The Dam Neck Site has been designated by EPA as part of the long-term disposal solution for the Baltimore and Norfolk deepening projects. This project includes the deepening and maintenance materials from Thimble Shoal, Atlantic Ocean, and Cape Henry Channels. Designation of the Norfolk Site would provide the Corps with an alternate disposal option. It would not preclude the use of one site over another except as provided in the original site designation of the Dam Neck Site. Specifically, should dumping at the Dam Neck Site cause significant environmental impacts outside the site or should the elevation of the site limit its useful life, then dumping may be limited or stopped at the Dam Neck Site.
>
> " . . . The Dam Neck Site was specifically designated based upon the needs of the Norfolk and Baltimore projects. However, the designation does not preclude the disposal from other projects. Any material from outside the identified project areas must be "clean" as provided in 40 CFR Part 227 and preferably of a fine grain sand or coarser nature. Further, all disposal at the Dam Neck Site must be prioritized to assure adequate volumes as necessary to handle the Norfolk and Baltimore projects.
>
> " . . . EPA would not recommend the expansion of the Dam Neck Site. Based on coordination of the existing site, we would expect other resource agencies to raise environmental concerns.
>
> " . . . EPA favors the designation of the Norfolk Disposal Site as a second option for use with the long range disposal plan for all suitable material from the Norfolk and Baltimore Channels. Further, we believe the Norfolk Site should play a significant role in the maximization of the Craney Island Disposal area for material suitable for overboard disposal."

## PUBLIC VIEWS AND COMMENTS

The formulation section of this report included the views of city officials of Hampton Roads on the disposal of dredged material within the confines of the city involved. As stated at the beginning of this report, five public meetings were held in connection with the preparation of the feasibility report on which authorization for deepening the channels in the harbor to as much as 55 feet. At that time, the problems pertinent to dredged material disposal were discussed. A public scoping meeting was held for this study in August 1987. A transcript and summary thereof are included in appendix E. Basically, those present at the hearing were very much opposed to the construction of additional disposal facilities adjacent to Craney Island Disposal Area or within other areas in the inner harbor. Many of the letters received from interested citizens confirmed this opinion. This is particularly true for those received from residents along River Shore Road and vicinity who were adamant in their opposition to an extension of the Craney Island Disposal Area.

The Virginia Department of Highways, in a letter dated July 29, 1987 (exhibit 43 in appendix E) requested that adequate protection be provided to highway bridges in the vicinity of proposed disposal areas. The Izaak Walton League was opposed to any dumping of dredged material in the city of Suffolk and was not in favor of expanding Craney Island. The Norfolk Shipbuilding and Drydock Corporation, in a letter dated August 6, 1987 (exhibit 77) stated:

> "On behalf of 3,400 employees, I would like to stress the necessity for developing a long-term plan for disposal of dredged material from the inner harbor of Hampton Roads. As a shipyard, it is essential that by dredging we maintain adequate water depths alongside our piers and under our floating drydocks.
>
> "Due to the national and international depressed conditions of the maritime industries, one very important part of the deliberations should be the accessibility of a long-term disposal site for economic reasons. Shipyards and shipping today are fragile industries and added unnecessary expenses can do us in ... it is essential to develop a long-term disposal site ... the economic well-being of the entire area dictates no less."

The Hampton Roads Maritime Association, in a letter dated September 3, 1987 (exhibit 115), stated in part:

> "Our past experience has been that a disposal site or sites in the inner harbor area of Hampton Roads is essential for dredge materials for the future operations of the Port of Hampton Roads. Such a disposal site should be in close proximity to dredging requirements.
>
> Our major concerns focus on whether the port would have to rely solely on ocean dumping in the future for dredged materials.
>
> Our following comments should be addressed by the Corps of Engineers before any determination is made.
>
> The adverse consequences of using ocean dumping for dredged material must be fully addressed by the Corps of Engineers, according to our Ad Hoc Committee on Coal and Dredging. Permits for using such open waters for dumping dredged materials would be required for all users, from the small projects involving maintenance dredging at a pier, to the large construction projects of deepening channels or construction of a new super aircraft carrier berth.
>
> Ocean dumping should also be analyzed for reliability as a disposal site on an ongoing basis similar to the Craney Island Disposal Area (CIDA) concept. Your study should address the question if the ocean site had been designated, permitted and used for materials dredged from the Port of Hampton Roads, what would be the impact on commercial and military maritime interests if the dumping permits to use it would be revoked pending an environmental study of an ocean disaster such as the recent dolphin deaths as noted in the news media. As an example, dredging of the James River was suspended for six years due to the kepone incident.
>
> Alternatives to ocean dumping must be also fully studied by the Corps of Engineers to determine where "not suitable materials" for ocean dumping could be deposited. Today, the mixture of "suitable" and "not suitable" dredged materials contained in the CIDA is totally acceptable since the "not suitable materials" have been substantially diluted. However, an assessment by the Corps of Engineers should be made in terms of probable environmental impact, social

well-being and economic factors should only "not suitable materials" be deposited in the future at CIDA.

While the Hampton Roads Maritime Association would not oppose any expansion of the CIDA, we believe the Corps of Engineers should consider several smaller disposal sites in the inner harbor area of Hampton Roads to eventually succeed CIDA. As an example, the Newport News Bar reportedly has been determined to be environmentally feasible to accommodate a fill site."

The Newport News Shipbuilding and Drydock Company, in a letter dated September 3, 1987 (exhibit 117) stated in part:

"... We employ approximately 27,000 ... personnel for the design, planning and scheduling, construction ... of the most complicated vessels in the world today. Despite all of our skills, technology, know how, equipment and facilities, our ability to receive or deliver a given vessel on time, or at all, can be beyond our control without operable facilities within a reasonable proximity that are capable of accepting dredge-spoil on very short notice.

As a major user of the existing Craney Island Disposal Facilities, we have come to depend upon it and have developed a keen sense of appreciation for the initiative and foresight of those responsible for building it. That appreciation is heightened by the memory of our experiences in 1976 when we needed to move some 10,000 cubic yards of material, in order to launch the first of the large LNG vessels we built, during a moratorium on dredging declared because of kepone concerns. Any major storm over the upper James River water shed can, without notice, create a situation nearly as critical as far as the capability to move vessels is concerned. Accordingly, we applaud your efforts to bring before the public the matter of planning for long-term disposal of dredge spoil in the Hampton Roads Port area as expressed by the notice referenced above.

We acknowledge that our interests in having a disposal site for dredge spoil are somewhat self-serving. However, our interests go far beyond our own fences because we are aware of the benefits of such a disposal facility on our country's national defense efforts as they pertain to this port area. We are also aware of the positive impact of shipping activities of this port area as they affect the economy, growth, and employment of all of Virginia and the

surrounding states, as shown by the Tayloe Murphy studies a few years ago. In the best interests of ourselves, the Commonwealth of Virginia, and the nation, we urge you to continue with the studies and planning to ensure that the disposal of dredge spoil for the inner harbor area of Hampton Roads will be done in an acceptable and economical manner far into the future. Dredge spoil disposal is important to all shipping interests in this area, and it must not be allowed to cease for any reason."

The following are excerpts from a letter by the Virginia Port Authority dated July 31, 1987 (exhibit 47):

"The Virginia Port Authority is charged by statute with promoting the flow of oceanborne commerce through the ports of Virginia. VPA also has statutory authority to act as local sponsor for major Federal dredging projects. VPA comes here tonight as a partner in this endeavor that can impact the flow of cargo and civilian and military vessels through this port.

It is difficult and troublesome to comprehend the operation of this port without the Craney Island Disposal Area. Craney Island is an asset to the Commonwealth - practically every marine terminal and shipyard in the Inner-Harbor of this port benefits from the close proximity of Craney Island when terminal berths must be deepened and/or maintained. State, Federal, and private facilities alike owe the low costs of disposal of dredge material to the public officials with great foresight who years ago saw the need to develop Craney Island. Not only are costs kept to a minimum, but environmental impact is low. One only need look at the problems surrounding the Port of Baltimore and its Hart-Miller Island Disposal Area to appreciate the asset we have in the Craney Island Disposal Area.

It is definitely to the benefit of this Port to keep Craney Island viable as long as possible.

At the same time, we recognize two other factors: first, Craney Island will be full in the foreseeable future, especially upon completion of the 55-foot channel, and second, Craney Island, a 2,000 acre site on deep water represents, if usable, one of the largest most promising untapped, undeveloped land areas on the East Coast.

With all these thoughts in mind, we respectfully request of the Corps the following:

1. Any successor site to the present Craney Island Disposal Area must reflect the economics of dredged material disposal that are already part of the cost/time infrastructure of the Port of Hampton Roads. A successor to the present Craney Island Disposal Area must be chosen that preserves the economics of Craney Island, based on distance and cost, that are already built into the infrastructure of the operation of this port.

2. The present Craney Island Disposal Area must be regarded as a benefit to the Commonwealth and utilized to the fullest extent."

Dominion Terminal Associates, in a letter dated September 3, 1987 (exhibit 116) stated:

"At the public hearing in Portsmouth on August 6, 1987 ocean dumping of dredging spoils was discussed. We would like to express our concern that open ocean dumping would sharply increase the cost of our maintenance dredging program.

We would like to urge the Corps of Engineering to look for an ecologically suitable disposal site in the Hampton Roads Harbor area."

Excerpts from a letter dated September 8, 1987 (exhibit 118) from the Virginia Council on the Environment follow:

"The Commonwealth of Virginia has completed its review of the scoping notice concerning the study to be conducted on the long-term disposal of dredged material from Norfolk Harbor and the Inner Harbor Channels. The Council on the Environment is responsible for coordinating Virginia's review of federal environmental documents and responding to appropriate federal officials on behalf of the Commonwealth. The following agencies joined in this review:

Virginia Marine Resources Commission
Virginia Water Control Board
Department of Conservation and Historic Resources
Virginia Institute of Marine Sciences
Department of Health
Department of Game and Inland Fisheries
Department of Waste Management
Virginia Port Authority

The Port of Hampton Roads is the largest coal handling port in the United States and is also vital to national defense. The study underway will investigate dredged material disposal ... Use of dredged material for beach nourishment is a priority of the Commonwealth ... all dredged material that would be suitable for highway fill or other construction purposes should be used accordingly. Agencies of the Commonwealth which can use dredged material for the aforementioned purposes should be involved as early as possible in the planning process.

A number of the disposal site alternatives presented in the public notice for this scoping effort present environmental issues which go beyond the consideration of storage capacity of a given potential disposal site ... Examples of the resource values at issue in these sites include the following:

- Ragged Island is a Wildlife Management Area belonging to the Department of Game and Inland Fisheries. It is one of the wetland areas in the United States placed on the list of "Wetlands of International Importance Especially as Waterfowl Habitat" in an international treaty, also known as the Ramsar Convention, to which the United States is party. Therefore, the Army Corps of Engineers should delete this site as a possible dredged material disposal site.

- The Ocean View site is an area which contains productive clam beds. The Horseshoe area also contains clam beds.

- Hampton Flats is an area where water circulation patterns are critical to shellfish larvae in the James River.

The Draft EIS should carefully analyze the habitats associated with all potential disposal sites to ensure degradation of unique environmental areas does not occur.

The Corps of Engineers should define the boundaries of disposal sites in upland areas to reduce impacts to wetlands as a result of dredged material disposal. The productivity of wetlands and subaqueous bottoms of tributaries of the Chesapeake Bay must be protected to prevent further loss of these habitats. Some alternative disposal sites are close to significant wildlife habitat areas or are themselves significant wildlife and wetland habitat; such areas must be carefully evaluated before they are used for dredged material disposal. Disposal alternatives

must also minimize impacts to public beaches, other recreational areas, and historic sites.

This study should thoroughly explore the cost and feasibility of all non-structural means of dredged material disposal including the use of open-ocean disposal for material that meets open-ocean disposal criteria. Costs of particular disposal alternatives should include the cost of development and implementation of long-term mitigation plans needed if wetland or subaqueous habitats are threatened or lost. The Corps should explore the cost and feasibility of removing clean material now in Craney Island and transporting it to ocean disposal sites to maximize the useful life of Craney Island for the containment of dredged material not suitable for ocean disposal."

## STUDY FINDINGS

The Hampton Roads Area is a rapidly expanding metropolitan area whose economy has long been anchored in port and related activities. Through the years, the number and size of ships using the harbor for defense and commerce have gradually increased. Natural water depths in the harbor became inadequate. As channels in the harbor were deepened, then redredged periodically to maintain desired depths, the problem of what to do with material removed during the dredging process became more acute.

A number of different disposal areas had been used when, in 1945, the Congress authorized construction of the Craney Island Disposal Area. Construction of the area was completed in 1957. Today, the ultimate capacity of Craney Island is within a few years of being reached (1997). Realization of the impending need prompted the Congress to authorize this study for determining a replacement for the Craney Island Disposal Area. This is a coordinated effort with the Commonwealth of Virginia since under Congressional authority, the state must, in the final analysis, provide the lands and facilities required therefore.

This report has attempted to be responsive to the Commonwealth of Virginia's need to develop a future disposal plan for the inner harbor area in Hampton Roads. Its purpose was to address the disposal problem and provide

information to assist the Commonwealth in making a decision regarding disposal. Although the ultimate decision on disposal lies with the Commonwealth, the following paragraphs summarize the conclusions of this information report.

Various methods and locations for disposing of dredged material have been explored. Many of these were discarded because of severe environmental impacts, high costs, or difficulties of construction. In the formulation portion of this study, some possible plans were developed. Each of these plans has the common denominator of about a 50-year life. These plans were further evaluated in terms of their responsiveness to stated problems and needs, conformity to formulation criteria, and comparison with other possible solutions. As a result the following schemes were further considered:

a. Buckroe Beach

b. Chesapeake Bay

c. Ocean View

d. Expansion of Craney Island (Expansion Plan B)

e. Ocean disposal plus existing Craney Island

f. Smaller Expansion of Craney Island plus ocean

Of the above, plans d and e are believed to be the most responsive plans toward resolving the problem of providing a 50-year disposal area for material dredged by Federal, state, and private interests from the inner harbor of Hampton Roads. The expansion of Craney Island has been identified as the National Economic Development Plan (least cost to the Nation). The proposal involves construction of a levee to the west and north of Craney Island. It would encompass an area of 2,500 acres of subaqueous lands in the James River estuary. Following completion, its operation would be similar to that existing in the present Craney Island project. Its life expectancy would be approximately 50 years. Its location would be in the heart of Hampton Roads port activities.

Since the Congress mandates that local interests provide disposal areas for material dredged from Federal channels, it would be the state's responsibility to provide the land, build the encompassing dikes and operate the expanded disposal area. Currently the cost of a 2,500 acre expansion plan to the west and north of Craney Island is about $73 million. This includes the cost of substantial measures to mitigate the environmental losses associated with such construction.

Alternate e involves the barging of clean dredged material to the Atlantic Ocean and placement in DNODS initially and ultimately in the Norfolk Disposal Site, 45 miles east of Craney Island. Unsuitable material, primarily from the Southern Branch and possibly the Eastern Branch of the Elizabeth River, would be placed in the existing Craney Island Disposal Area. There would be no initial construction required under this plan. Also the social and environmental impacts would be less under this plan. However, the cost of dredged material disposal over a period approaching 50 years is anticipated to be higher than that under the previous stated expansion plan for Craney Island. The average annual cost of dredging by Federal, state, and private interests would be about $5.36 per cubic yard (dredging scenario S4) if an expansion of CIDA is developed. As explained in the document, costs for using CIDA expansion would vary greatly depending on the size of the job and whether or not bucket dredging must be used. This average cost reflects the predominance of material which would continue to be pumped into the expansion area hydraulically, mainly by the Federal Government. Actual costs would vary from as low as $3 per yard up to $21 per yard. The average cost would be $7.04 per cubic yard if clean dredged material were deposited in the Atlantic Ocean and unsuitable material deposited in the existing CIDA.

The smaller expansion plans A and/or E would provide a confined capacity less than 50 years depending on the scenario considered. Expansion plan E provides a capacity ranging from 14 to 26 years (see tables 35 through 38). Expansion plan A provides a capacity of from 22 to 36 years. After filling, the cost of dredged disposal at that time would equal that required to place the material at sea. Furthermore, it may be necessary to insure that space remains in the inclosed area for unsuitable material, while the clean material is being placed in Norfolk Disposal Site.

A new landfill may offer opportunities for recreational development concurrent with disposal operations. This may include marinas, fishing, swimming, touring vessels, and supporting landside facilities. There would also be an opportunity for landscaping the landfill. These opportunities have been discussed in the previous section on Plan Accomplishments.

It is important that port activities in Hampton Roads continue. In order to do so, navigable channels must be maintained, and dredging of access channels, berthing areas, etc. by Federal, state, local and private entities must continue. The Craney Island Disposal Area is being filled and in the near future will no longer be available to accept over 4 million cubic yards of dredged material annually from these activities. Accordingly it would be desirable for the State to adopt a long-term disposal plan for dredged material from the inner harbor soon. Any plan should incorporate the beneficial uses of dredged material whenever the opportunities present themselves.

Based on the findings of this study, the following actions are deemed desirable:

a. Since Craney Island is rapidly being filled to capacity, the Commonwealth of Virginia should expeditiously implement a long-term plan for the disposal of dredged material from the inner harbor of the port of Hampton Roads. This should include the required Federal and/or state legislation for implementation of a given plan. For example, if a plan involving ocean disposal plus the existing CIDA for unsuitable material is adopted, action should be taken promptly to stop placing clean material into CIDA. This will insure the availability of CIDA for unsuitable material far into the future.

b. Studies and investigations should be conducted with a view toward determining the sources of material deposited into the channels of the inner harbor and methods for reducing this amount.

c. Cleanup of the Southern Branch of the Elizabeth River should continue to be accelerated. This would involve further effort toward the location,

identification, and reduction of unsuitable dredged material through regulatory, physical removal, containment and/or treatment in place.

d. Opportunities for beneficial use of dredged material should continue to be explored and plans implemented when determined feasible. Particular emphasis should be given to methods of reducing dredging costs and enhancing the environment. Prior to issuance of a permit for dredged material disposal, permittees should arrange for either its beneficial use or upland disposal if practicable. The same is true for any channel dredged by the Corps. This will reduce to a degree the deposition into Craney Island. The district should also insure that suitable and unsuitable materials are properly separated in Craney Island for future use.

e. Management of existing disposal sites should continue to be investigated so that the life thereof can be extended. This would include studies to extend the life of the existing Craney Island Disposal Area by means of raising levees and/or emptying the area, when future technologies indicate that such plans are economically feasible.

f. Technological methods for ocean disposal be evaluated with a view toward reducing dredging costs.

g. If a contained area is developed, consideration should be given to proper landscaping thereof, a public beach, parking facilities and boat harbor.

h. It would be important to consider the preservation of foraging and resting habitat for waterfowl and shore bird species in connection with any plan for future development of Craney Island.

i. If an extension of Craney Island is developed, the plan should investigate whether some of the riprap now protecting Craney Island from wave action, etc., could be removed and salvaged for use in the new levee construction. Also, if an extension is developed and Craney Island has been filled to capacity, the cost of the extension could be reduced by deleting the construction of pipelines from the existing spillways since there would be no discharge from the existing project.

j. If Dam Neck and Norfolk Disposal Sites are selected as a long-term disposal area, further studies should be conducted at that time to determine whether the entire existing 2,500-acre Craney Island Site will be required for the disposal of unsuitable material for the future.

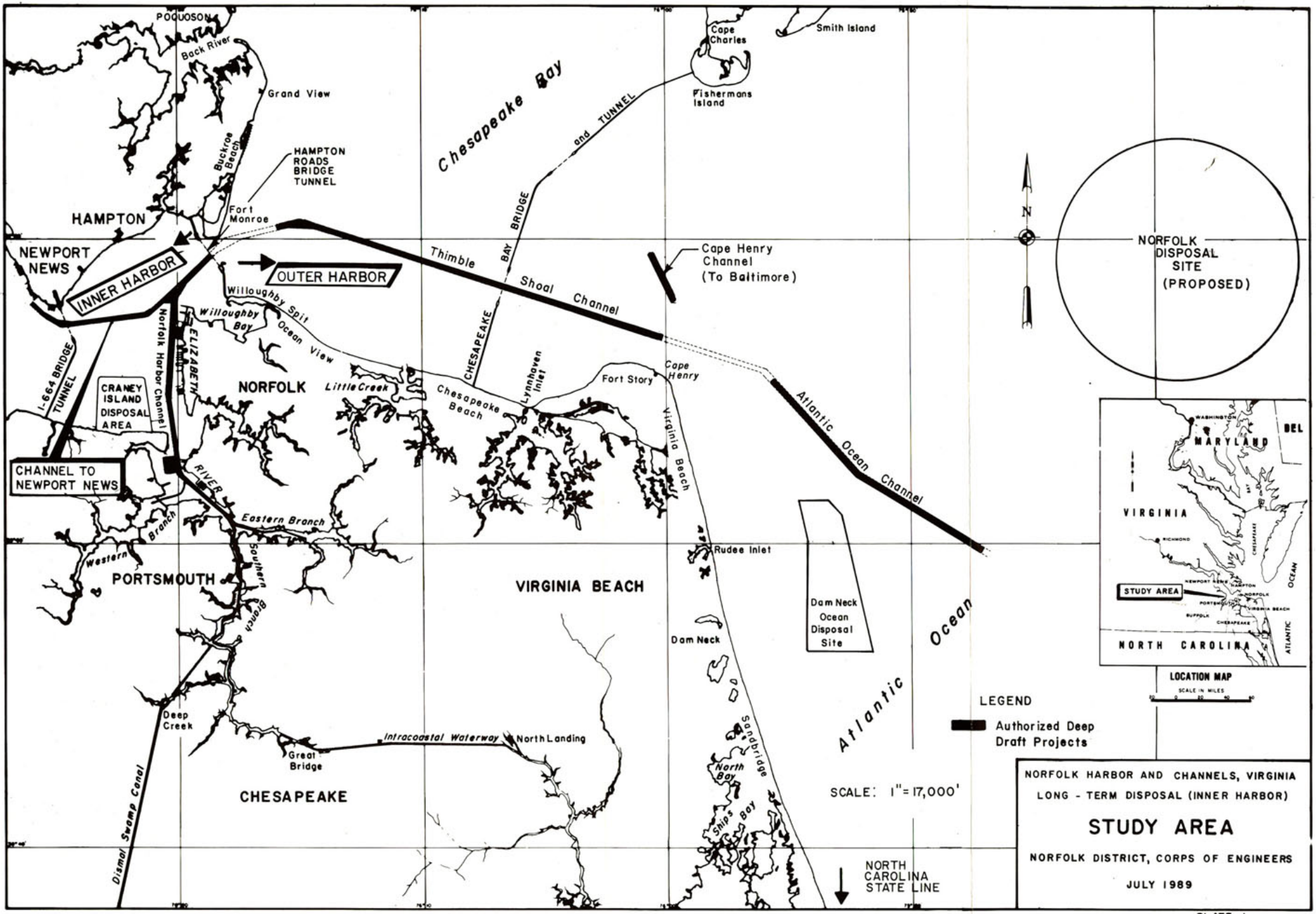
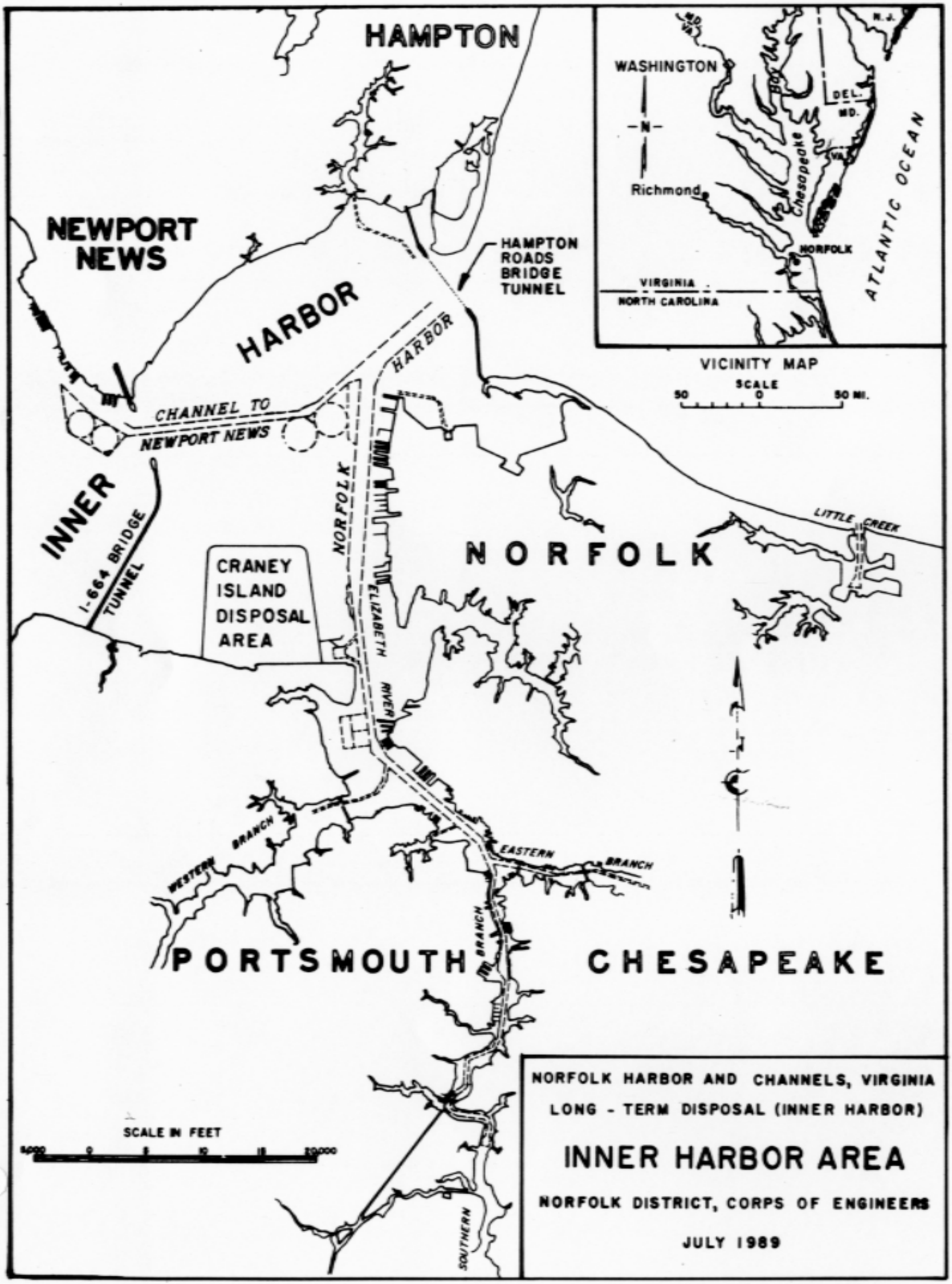

POQUOSON
Back River
Grand View
Buckroe Beach
HAMPTON ROADS BRIDGE TUNNEL
HAMPTON
Fort Monroe
NEWPORT NEWS
INNER HARBOR
OUTER HARBOR
Willoughby Spit
Willoughby Bay
Ocean View
Norfolk Harbor Channel
ELIZABETH
I-664 BRIDGE TUNNEL
CRANEY ISLAND DISPOSAL AREA
NORFOLK
Little Creek
CHANNEL TO NEWPORT NEWS
RIVER
Eastern Branch
Western Branch
Southern Branch
PORTSMOUTH
Deep Creek
Dismal Swamp Canal
Intracoastal Waterway
North Landing
Great Bridge
CHESAPEAKE
Chesapeake Bay
and TUNNEL
BAY BRIDGE
Thimble Shoal Channel
CHESAPEAKE
Lynnhaven Inlet
Chesapeake Beach
Fort Story
Cape Henry
Virginia Beach
Rudee Inlet
VIRGINIA BEACH
Dam Neck
Dam Neck Ocean Disposal Site
Atlantic Ocean
Sandbridge
North Bay
Ships Bay
Atlantic Ocean Channel
Cape Charles
Smith Island
Fishermans Island
Cape Henry Channel (To Baltimore)
NORFOLK DISPOSAL SITE (PROPOSED)
N
NORTH CAROLINA STATE LINE
SCALE: 1"= 17,000'
LEGEND
Authorized Deep Draft Projects
MARYLAND
VIRGINIA
NORTH CAROLINA
STUDY AREA
LOCATION MAP
NORFOLK HARBOR AND CHANNELS, VIRGINIA
LONG - TERM DISPOSAL (INNER HARBOR)
STUDY AREA
NORFOLK DISTRICT, CORPS OF ENGINEERS
JULY 1989

PLATE 1




NORFOLK HARBOR AND CHANNELS, VIRGINIA

LONG - TERM DISPOSAL (INNER HARBOR)

# INNER HARBOR AREA

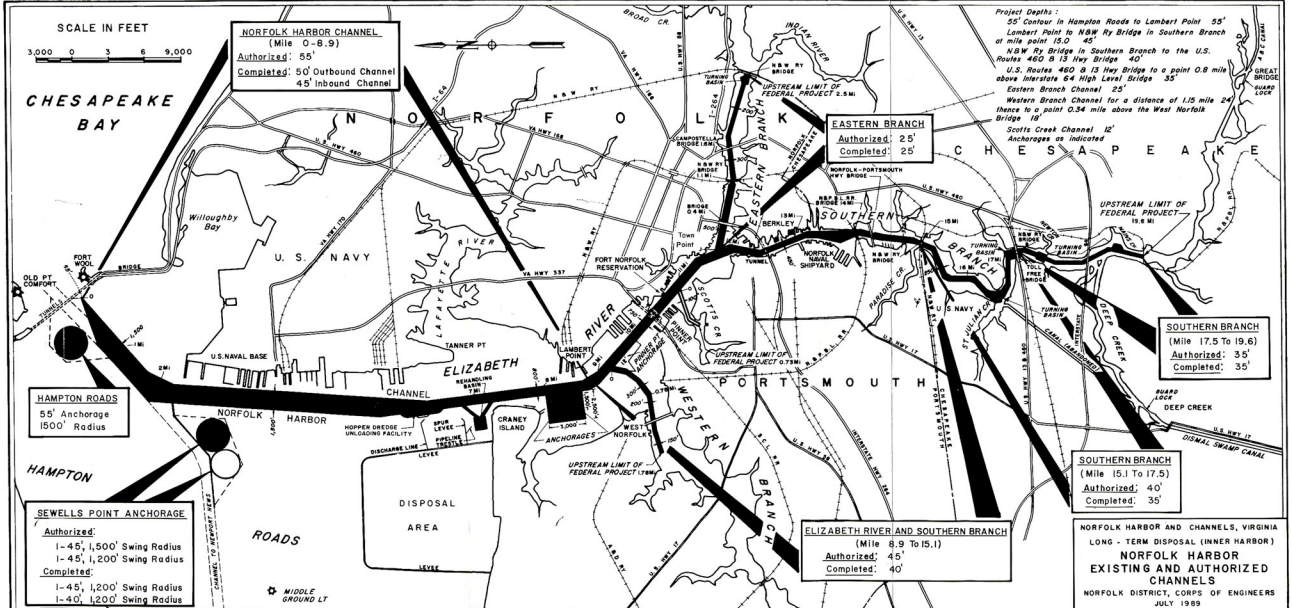
NORFOLK DISTRICT, CORPS OF ENGINEERS

JULY 1989

PLATE 2

CORPS OF ENGINEERS

U.S. ARMY




NORFOLK HARBOR AND CHANNELS, VIRGINIA
LONG - TERM DISPOSAL (INNER HARBOR)

# NORFOLK HARBOR EXISTING AND AUTHORIZED CHANNELS

NORFOLK DISTRICT, CORPS OF ENGINEERS
JULY 1989

PLATE 3

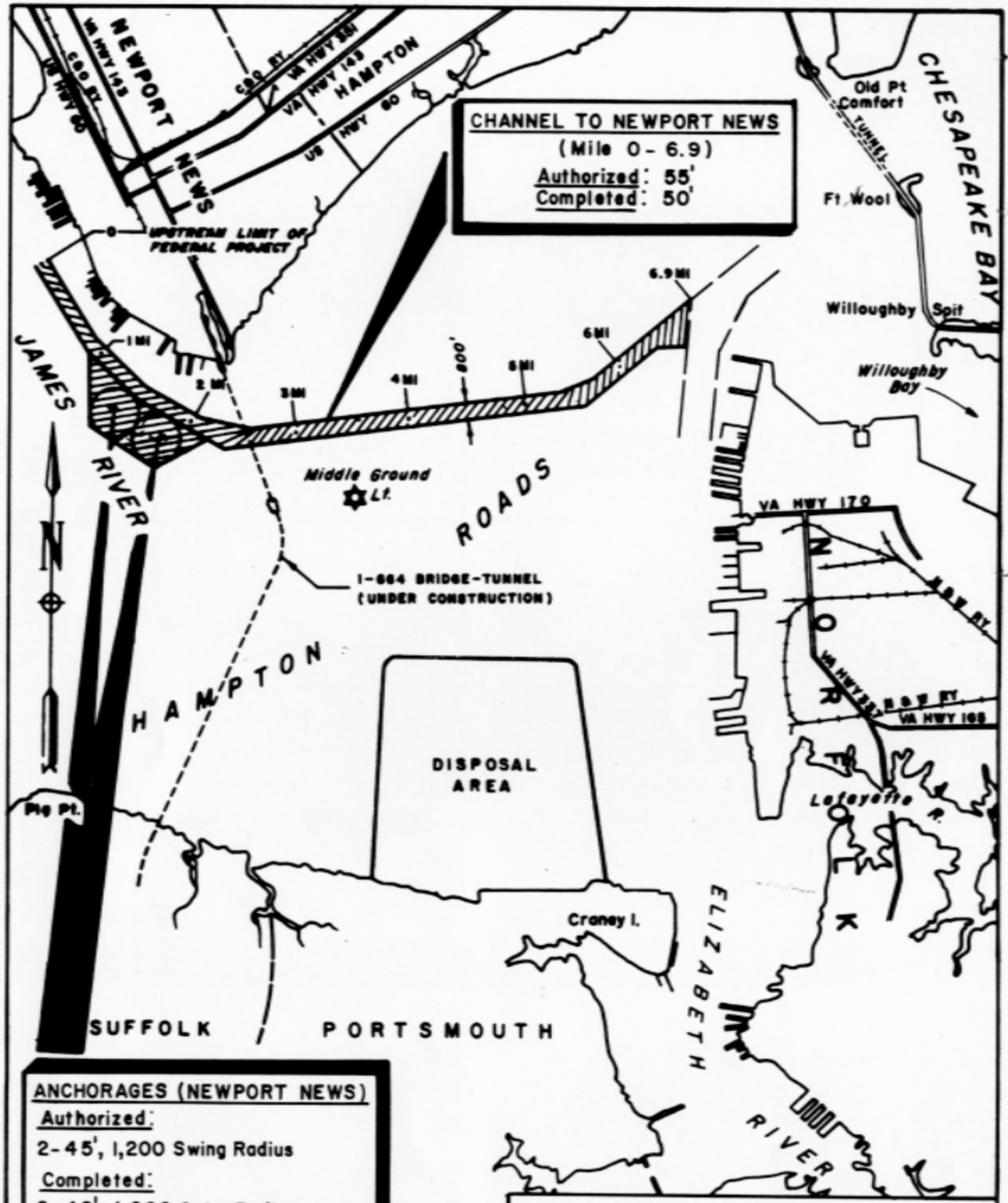
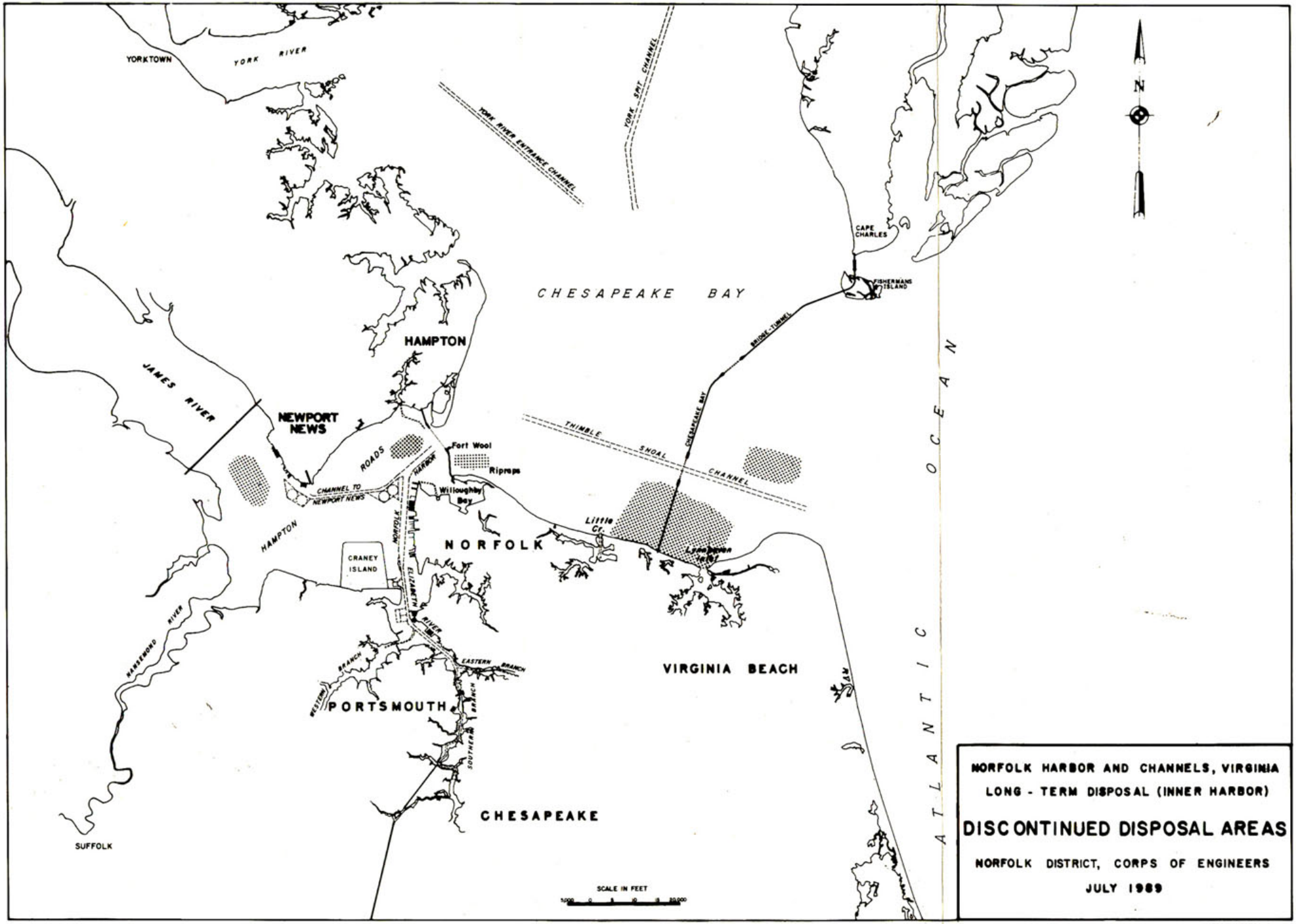

CHANNEL TO NEWPORT NEWS
(Mile 0 - 6.9)
Authorized: 55'
Completed: 50'
NEWPORT NEWS
HAMPTON
CHESAPEAKE BAY
Old Pt Comfort
Tunnel
Ft Wool
Willoughby Spit
Willoughby Bay
UPSTREAM LIMIT OF FEDERAL PROJECT
0
1 MI
2 MI
3 MI
4 MI
5 MI
6 MI
6.9 MI
600'
JAMES RIVER
Middle Ground Lt.
HAMPTON ROADS
I-664 BRIDGE-TUNNEL (UNDER CONSTRUCTION)
VA HWY 170
VA HWY 337
VA HWY 168
NORFOLK
DISPOSAL AREA
Lafayette R.
Pig Pt.
Craney I.
ELIZABETH RIVER
SUFFOLK
PORTSMOUTH
ANCHORAGES (NEWPORT NEWS)
Authorized:
2-45', 1,200 Swing Radius
Completed:
2-40', 1,200 Swing Radius
SCALE IN FEET
4,000 0 4 8 12,000
NORFOLK HARBOR AND CHANNELS, VIRGINIA
LONG - TERM DISPOSAL (INNER HARBOR)
CHANNEL TO NEWPORT NEWS
NORFOLK DISTRICT, CORPS OF ENGINEERS
JULY 1989

PLATE 4

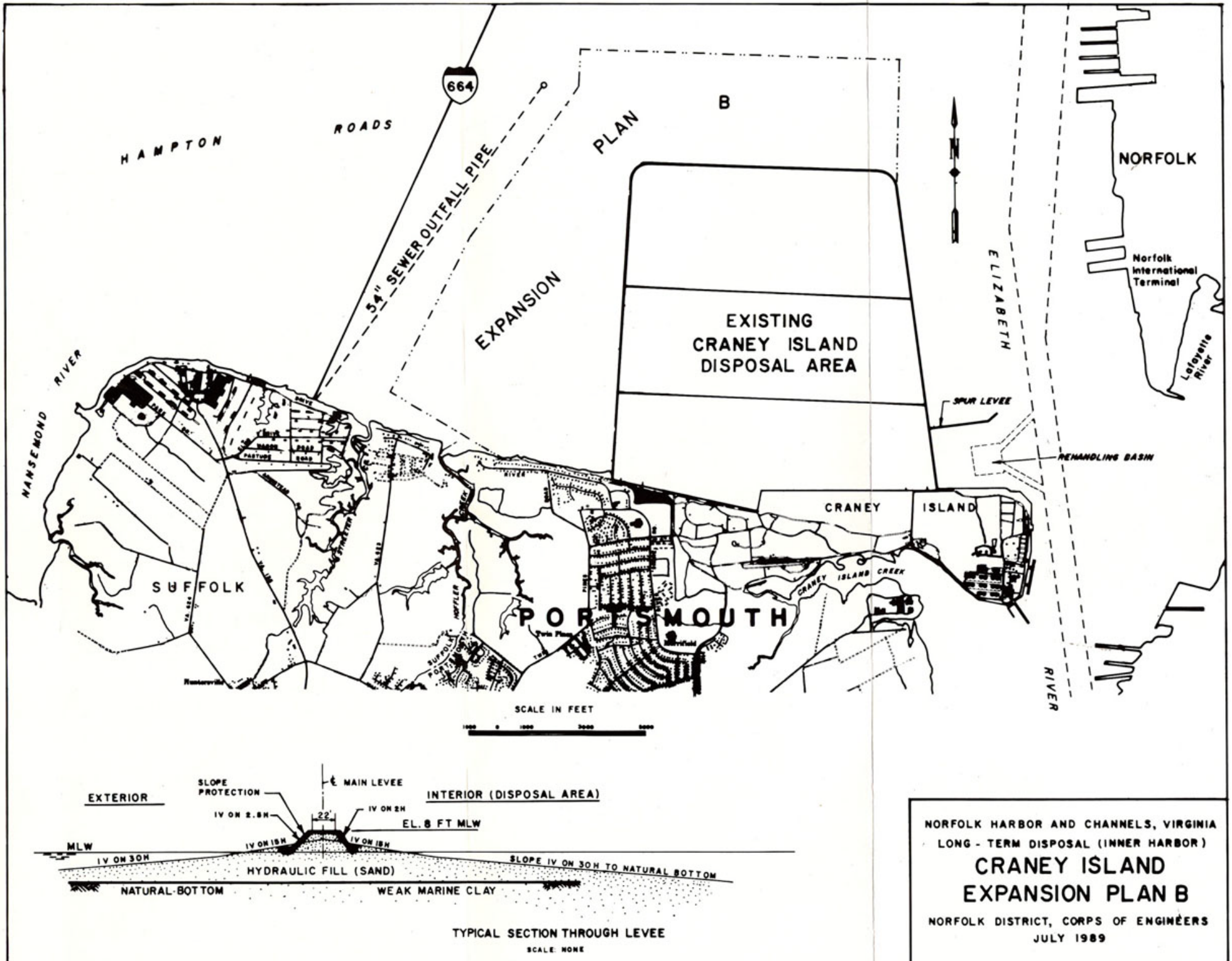



NORFOLK HARBOR AND CHANNELS, VIRGINIA
LONG - TERM DISPOSAL (INNER HARBOR)

# DISCONTINUED DISPOSAL AREAS

NORFOLK DISTRICT, CORPS OF ENGINEERS
JULY 1989

PLATE 5

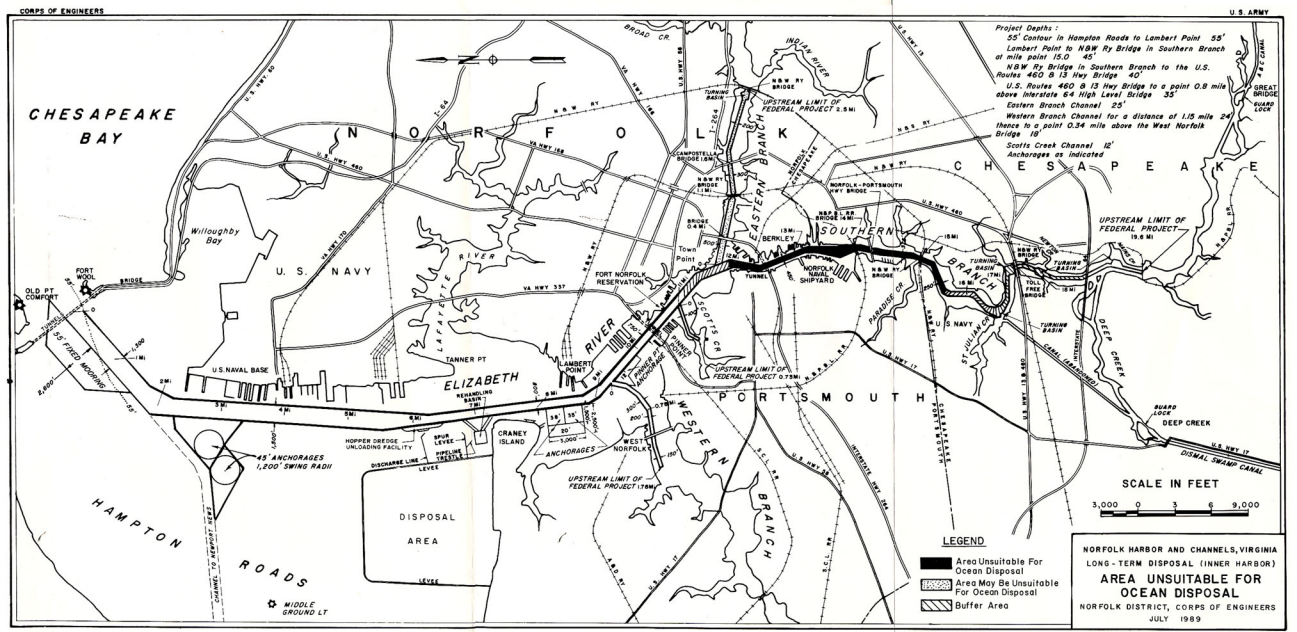



NORFOLK HARBOR AND CHANNELS, VIRGINIA
LONG - TERM DISPOSAL (INNER HARBOR)

# CRANEY ISLAND EXPANSION PLAN B

NORFOLK DISTRICT, CORPS OF ENGINEERS
JULY 1989

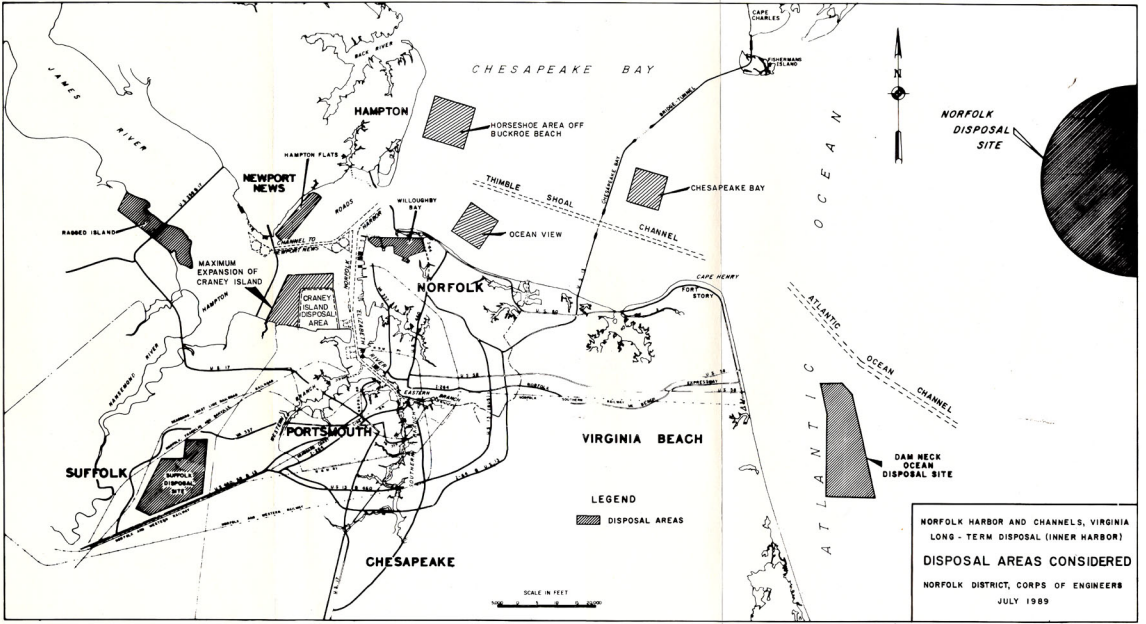
PLATE 6




NORFOLK HARBOR AND CHANNELS, VIRGINIA
LONG-TERM DISPOSAL (INNER HARBOR)

# AREA UNSUITABLE FOR OCEAN DISPOSAL

NORFOLK DISTRICT, CORPS OF ENGINEERS
JULY 1989




NORFOLK HARBOR AND CHANNELS, VIRGINIA
LONG - TERM DISPOSAL (INNER HARBOR)

## DISPOSAL AREAS CONSIDERED

NORFOLK DISTRICT, CORPS OF ENGINEERS
JULY 1989

PLATE 8