BASS RIVER HARBOR

DENNIS and YARMOUTH

MASSACHUSETTS

SURVEY

(REVIEW OF REPORTS)

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

APRIL 1972

41

SYLLABUS

The Division Engineer has studied the requests of local interests for navigation channel improvements at Bass River Harbor, in the towns of Yarmouth and Dennis, Massachusetts. He finds that benefits to be expected from extending the existing jetties to prevent build-up of a sand bar across the channel are insufficient to justify the cost of construction.

An alternate plan of improvement was found to be economically justified. It would require dredging a channel 6 feet deep and 100 feet wide from deep water 0.8 miles out in Nantucket Sound, 2.0 miles upstream to 1,000 feet beyond the Route 28 highway bridge, a total distance of 2.8 miles. In addition, 28 acres of anchorage, 6 feet deep would be provided just inside the river mouth. Due to the vast amount of sand movement in the area, an integral part of the project would be frequent maintenance dredging to restore the authorized project dimensions, particularly about 1,000 feet offshore where a sand bar forms across the navigation channel.

The estimated first cost of the project is $480,000 for construction and $17,000 for navigation aids. The construction costs are to be shared equally by the Federal government and local interests. Annual charges amount to $118,000, of which $88,000 is for project maintenance, a local responsibility. The estimated annual benefits are $260,800 resulting in a benefit-cost ratio of 2.2 to 1.0.

By letter to the Division Engineer, the towns of Dennis and Yarmouth have both indicated that they cannot meet the required local cost contribution at this time.

Accordingly, the Division Engineer recommends that no Federal improvement in the interest of navigation at Bass River Harbor be undertaken at this time.

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd)

APPENDICES

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

IN REPLY REFER TO
NEDED-R

April 1972

SUBJECT: Survey (Review of Reports) on Bass River Harbor, Massachusetts

HQDA (DAEN-CWP-D)
WASH DC 20314

AUTHORITY

1. This report is submitted in compliance with a resolution adopted 24 June 1965 by the United States House of Representatives, Committee on Public Works. The resolution reads as follows:

> "RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE HOUSE OF REPRESENTATIVES, UNITED STATES, That the Board of Engineers for Rivers and Harbors is hereby requested to review the report on Bass River Harbor, Massachusetts, printed in House Document Numbered 142, 56th Congress, First Session, and other reports, with a view to determining if improvements in the interest of navigation are warranted at this time".

The Chief of Engineers assigned preparation of the report to the New England Division Engineer by letter dated 23 July 1965.

PURPOSE AND EXTENT OF STUDY

2. The study was made for the purpose of determining the need and justification for constructing navigation and allied improvements in the Bass River, in the towns of Dennis and Yarmouth, Massachusetts.

3. A public hearing was held on 26 June 1968 in Yarmouth, Massachusetts, to obtain information concerning the needs and desires of the local interests and to permit everyone an opportunity to present his views. The information obtained is described under "IMPROVEMENTS DESIRED". All Federal, State and local agencies that have an interest in the area have been consulted during the course of the study. Their views are included in the text and in Appendix D.

4. Available charts, maps, hydrographic surveys and other related reports of the area were utilized. Aerial photographs were taken specifically for this study. Field work consisted of hydrographic and topographic surveys. Studies of recreational boating in the Bass River area were made. There is presently very little commercial fishing but possible development as a result of the proposed improvements was also investigated.

DESCRIPTION

5. Bass River forms the southerly 4 miles of the border between the towns of Yarmouth and Dennis, Barnstable County, Massachusetts. It is a small estuary which runs from several inland ponds to Nantucket Sound on the south shore of Cape Cod, 5 miles east of Hyannis and 12 miles west of Chatham. It is about 65 miles southeast of Boston, at the mid-point of the east-west arm of Cape Cod.

6. The river entrance is flanked by two jetties. There are shoals outside the river mouth and some shoaling along the entire length of the river, particularly from several thousand feet north of the Route 28 highway bridge to the river mouth. There is a large marshy island just upstream of the mouth. To the east of this island is a narrow cove about 3/4 mile long which is separated from Nantucket Sound by Davis Beach. Navigation on the river is limited by the fixed Route 28 highway bridge with a vertical clearance of 15 feet. Only boats with low mast heights can proceed beyond that point. There are, however, numerous medium size and small craft located north of the bridge.

7. Both banks of the river are fully developed with residential housing, a few public landings, a marina and a private yacht club. The cove behind Davis Beach is also fully developed with residences and a yacht club.

8. The drainage area for Bass River contains 10 square miles of generally flat, sandy or marshy terrain. The mean tide range is 3.1 feet at the river mouth. Controlling depth in the river south of Route 28 is 6 feet at mean low water. North of the highway, it gradually reduces to 1 or 2 feet in Kellys Bay. In the channel leading to Nantucket Sound, a sand bar reduces the depth to 2.5 feet at mean low water.

9. Traffic consists almost entirely of recreational craft. A few fishing boats anchor in Bass River but normally land their catch elsewhere. Anchorage areas are within the mouth of the river and are well protected from storms. Tidal currents are small.

10. The area is shown on U. S. Coast and Geodetic Chart 258; U. S. Geological Survey, Yarmouth Quadrangle; and the maps accompanying this report.

TRIBUTARY AREA

11. The area economically tributary to Bass River includes the towns of Yarmouth and Dennis. Both towns have grown significantly during the past 20 years and are expected to continue growing at a rapid pace. Table 1 shows population statistics for these towns.

TABLE 1

POPULATION OF TRIBUTARY AREA

	1970	1965	1960	1955	1950
Dennis	5,792	4,240	3,727	3,322	2,499
Yarmouth	9,475	6,260	5,504	4,156	3,297

12. Like most Cape Cod communities, the economy of both towns is almost entirely dependent upon its attraction as a summer resort. The wholesale and retail trade industry is the largest employer in the area with the construction industry second in importance. Cranberries are extensively cultivated, but the bogs are individually owned and operated so that data concerning the relative economic importance is not readily available. The major business and commercial center in the central portion of Cape Cod is at Hyannis, 5 miles west of Bass River. Table 2 shows distribution of employment among different categories as of 1963.

TABLE 2 (1)

TYPES OF EMPLOYMENT

	Percent of Labor Force	
Industry	Yarmouth	Dennis
Wholesale, Retail Trade	32.5	41.6
Construction	25.9	30.8
Service Industry	19.4	12.4
Finance, Insurance and Real Estate	14.7	7.3
Manufacturing	4.9	2.1
Transportation, Communications and Utilities	1.4	4.9
Agriculture and Mining	1.2	0.9
	100.0	100.0

(1) Source - "Cape Cod 1980", Blair Associates Incorporated.

13. The public roads and highways throughout Cape Cod are in good condition meeting the requirements of modern transportation. Three major east-west highways service the area, providing excellent road transportation to all points off the Cape. Bus service to and within the towns is adequate. The Hyannis Municipal Airport, just west of Yarmouth, provides regularly scheduled flights to Boston, New York, and other points. Established trucking firms provide service to local and long distance points.

BRIDGES

14. There are four bridges spanning Bass River, one of which affects the study. It is a fixed highway bridge at State Route 28, 1.8 miles upstream from the river mouth. It has a vertical clearance of 15 feet at mean high water and a horizontal clearance of 30 feet. This limits the size of the recrational craft which can use the upstream reaches of the river.

15. Another highway bridge is located another 1.8 miles farther upstream at Highbank Road. It also limits the size of boats which can pass. But because of the limited dimensions and many bends in the navigation channel in that vicinity, only small boats can safely navigate there and are not restricted by the bridge.

16. The third bridge, 0.85 mile farther upstream, is a Penn Central Railroad bridge which indirectly affects the project in that the horizontal clearance is so small that the strong currents caused by the restricted flow at flood and ebb tides make it very hazardous to navigation. This bridge has the effect of a separator between navigation on Bass River and navigation in the ponds north of the bridge. Very few boats try to pass from one area to the other and then only at slack tide.

17. The fourth bridge is the U. S. Route 6 highway bridge, 350 feet north of the railroad bridge. It does not affect navigation.

PRIOR REPORTS

18. There have been several prior reports concerning Bass River. The first study was authorized by the River and Harbor Act of

2 March 1829. It recommended a 250-foot long breakwater to provide a protected anchorage southeast of the river mouth. Construction resulted from funds authorized on 4 July 1836 and 7 July 1838. The project was abandoned later when it was found to be unsuccessful in that the anchorage area so rapidly filled with sand that a reasonably safe depth could not be maintained.

19. Other reports concerning the need and justification for improvements in the form of a dredged entrance channel with protecting jetties were authorized by the River and Harbor Acts of 18 August 1894 and 3 March 1899 and by a resolution of the Committee on Rivers and Harbors of the U. S. House of Representatives on 18 August 1938. All studies recommended that such improvements not be undertaken at that time.

EXISTING CORPS OF ENGINEERS' PROJECTS

20. There are no existing Corps of Engineers' projects in Bass River. A Federal breakwater was constructed in 1838 but has subsequently been abandoned due to rapid shoaling of the anchorage behind the breakwater. There are several navigation projects in the vicinity, at Andrews River just east of Dennis, and at Hyannis Harbor just west of Yarmouth. Both provide recreational boating anchorages, navigation channel and jetties.

LOCAL COOPERATION ON EXISTING AND PRIOR REPORTS

21. There was no local contribution required in the breakwater project of 1838. In the survey study of 1938, there was noticeable reluctance at the public hearing toward contributing to any project unless assurances could be made that the improvement would be permanent and not require frequent future maintenance. There was a willingness to participate in a permanent improvement.

OTHER IMPROVEMENTS

22. The Commonwealth of Massachusetts has made numerous navigation improvements to Bass River.

23. In about 1935, the State constructed an offshore jetty 2,500 feet long east of the inlet. Several years later, they built a 400-foot jetty west of the inlet. The westerly jetty was extended about 300 feet in the mid 1950's. In 1956, the State built a series of groins along the Yarmouth town beach, west of the river mouth, to stablize that beach.

24. A channel 7 feet deep from the river mouth to Nantucket Sound was dredged in 1953 and maintained in 1958 and 1966. A 6-foot anchorage area containing 25 acres inside the river mouth was dredged in 1953 and redredged in 1966. The 7-foot channel was extended north to the Route 28 highway bridge in 1966. All the spoil from the dredging was good, clean beach fill and was used to build up Yarmouth and Dennis town beaches adjacent to the river.

TERMINAL AND TRANSFER FACILITIES

25. The only terminal facilities on Bass River are docks for recreational boating. Municipal facilities in Yarmough include a boat launching ramp just inside the river mouth and Packet Landing, a timber wharf immediately south of the Route 28 bridge. The landing is largely unused now, but at one time was used for landing fish and for party boats. The town of Dennis operates several boat launching ramps on its shore of the river. There are two marinas with repair facilities and two yacht clubs with berths for some of the member boats. There are many privately-owned wooden piers for docking some of the locally-based fleet.

IMPROVEMENT DESIRED

26. At the public hearing held at Yarmouth,, Massachusetts, on 28 June 1968, the towns of Yarmouth and Dennis requested the following improvements be made:

a. Extension of the existing State jetties;

b. A dredged channel from deep water in Nantucket Sound to the northerly boundary of the Bass River Golf Course;

c. Dredge a mooring basin in the cove known as Georgetown Flats;

d. Dredge a mooring area east of Marsh Island on land owned by the town of Dennis, and allow for future expansion.

Many people spoke in favor of the improvements. No one spoke in opposition. The major emphasis was placed on having a navigation channel which would remain navigable at all tide stages. Improvement was desired for the pleasure craft which now use the river and for commercial fishing boats which would use it as home port if a channel could be maintained. In conjunction with improved navigation, additional mooring areas would also be required.

27. Subsequent to the public hearing, one letter was received opposing the project on the grounds that boat traffic is already too great for the waterway.

EXISTING AND PROSPECTIVE COMMERCE

28. Boating on Bass River is limited to recreational craft. Several fishing boats anchor off Packet Landing but normally land their catch elsewhere, usually at Chatham. There are no facilities for handling commercial traffic and no indications of any likely change in the future. The number of boats operating there is too small and the lack of entrance depth precludes fleet expansion.

DIFFICULTIES ATTENDING NAVIGATION

29. Bass River, along with most harbors on Cape Cod, has become crowded with recreational craft. The boating boom has nearly exhausted available mooring facilities and anchorages. There are some unused areas in Bass River with water depths adequate for mooring recreational boats but they are remote from land access and not particularly desireable. The resultant crowded conditions in the waterway restrict maneuvering space, particularly on weekends in July and August. Local interests report a bar has formed across the

navigation channel about 1,000 feet offshore in Nantucket Sound. The depth at mean low water is 2 to 3 feet. This causes tidal delays in getting in or out of the river for most of the craft which use Bass River. The bar has been dredged to 7 feet several times in the past 15 years, but has reformed within a few years. Some of the local people feel that the existing channel is too narrow for sailboats to tack properly.

ENVIRONMENT, WATER POWER AND OTHER SPECIAL SUBJECTS

30. Bass River is a tidal waterway. There are no problems concerning water power or flood control.

31. There is little commercial fishing in Bass River but sport fishing is very popular. The proposed project is not expected to have any adverse effects on the sport fishing capabilities. In fact, the U. S. Fish and Wildlife Service reports that deep water near shore, such as in the navigation channel, is attractive to such sport fishing species as striped bass, bluefish and tautog.

32. Marshlands and mudflats inside the river mouth are important ecological areas and must be protected. The marshes provide excellent habitat for waterfowl during fall and spring with some species using the area during the winter, too.

33. Water pollution in Bass River is not a problem. The only source of pollution is gas and oil leakage and exhaust from the recreational craft using the waterway. The amounts are very small compared with the tidal prism and fresh water runoff. The flushing action of the tidal flow and fresh water flow keep the river free from pollution.

34. All spoil resulting from a project is expected to be good quality beach fill and would cause no problems in the disposal area along Davis Beach. Hence, a project in this river is expected to have no adverse effect on the ecology of the region or the environment in general as long as the marshlands and mudflats are kept intact.

PROJECT FORMULATION

35. An analysis of all factors affecting the project formulation was made. The analysis is summarized in this section and discussed in

detail in Appendix A.

36. The main navigation difficulty at Bass River is the sand bar which forms across the channel about 1,000 feet offshore, It severly reduces the depth of water and causes extreme tidal delays for recreational boats using the waterway. Local interests have requested an extension of the existing westerly jetty to protect the channel.

37. Due to large amounts of west to east littoral drift (sand movement along the shoreline) a jetty extension would trap sand and cause the shoreline west of the river mouth to advance to the end of the jetty. Sand would then move around the end of the jetty and the bar would form again. This has happened with each of the several jetty extensions constructed by the State. The jetty would have to be extended beyond the 6-foot contour in order to prevent the bar from interfering with navigation. Otherwise, frequent maintenance dredging of the sand bar would be required once the littoral drift has filled in the accretion area. Near the 6-foot contour, the bottom slope drops off rapidly so any sand forced beyond that contour would likely slough off into deeper water, or at worse, form a small bar below navigation depths.

38. The predominant direction of drift is from west to east so that the area west of the jetty would fill in. However, the drift occasionally goes east to west. In those instances, the area to the east of the jetty extension would experience some accretion. Any sand from the east which settled in the channel would remain there, out of reach of the littoral forces, causing the channel to shoal rapidly. To avoid this, the easterly jetty must also be extended the same distance as the westerly jetty.

39. Based on the local hydrography and an estimate of littoral drift quantities, it is estimated that the area west of a 500-foot and 2,500-foot jetty extension would be filled after three years and nine years, respectively.

40. Four possible channel improvement plans were considered. They are:

PLAN A: no jetty extensions, but a program of regular maintenance dredging to remove the sand bar.

PLAN B: 500-foot jetty extensions with regular maintenance dredging after three years.

PLAN C: 2,500-foot jetty extensions with regular maintenance dredging after nine years.

PLAN D: 4,000-foot jetty extensions to 6-foot depth with no sand bar maintenance dredging required.

The costs and benefits of each plan were studied. The cost of jetty construction is so great when compared to average annual maintenance dredging costs that no jetty construction could be justified. Accordingly, a program of regular maintenance is the most economical plan of improvement. Details of jetty costs are shown in Appendix A.

41. As maintenance dredging would comprise the major portion of project costs, shoaling in Bass River was studied in great detail. Pre-dredge and after-dredge surveys of the channel and surrounding area were obtained for State dredging projects in 1953, 1958 and 1966, and supplemented with a Corps of Engineers report survey in 1969. From these surveys, shoaling rates were calculated for various portions of the channel and anchorages and annual maintenance dredging requirements were estimated. Based on the experience with State dredging at Bass River, it was estimated that the offshore sand bar would shoal to its original 2-foot depth by three years after construction of the project.

42. Starting in the summer of 1972, a new type of dredge, a side-caster, will be available for use in New England. This dredge provides a quick, inexpensive method of clearing an offshore channel. It acts much like a snow blower in that it digs up the sand and throws it off to the side. Its range is about 100 feet. However, it cannot be used inside the jetties because it would discharge sand onto adjacent river banks, anchorages, moorings, and marsh areas. Accordingly, the optimum plan of maintenance dredging for Bass River would be annual use of the side-caster dredge outside the jetties to remove the sand bar and hydraulic dredging of the channel and anchorage inside the jetties every three to five years depending on shoaling problems encountered.

43. Various channel and anchorage plans to provide for the existing and prospective fleet were considered. All channels are 6 feet deep and 100 feet wide. Anchorages are 6 feet deep.

PLAN NO. 1: Channel to 1,000 feet north of the Route 28 highway bridge; 13-acre anchorage near Marsh Island.

PLAN NO. 2: Channel to Georgetown Flats; 13-acre anchorage near Marsh Island; 12- acre anchorage at Georgetown Flats.

PLAN NO. 3: Channel to 1,000 feet north of the Route 28 highway bridge; 44-acre anchorage near Marsh Island.

PLAN NO. 4: Channel to Georgetown Flats; 44-acre anchorage near Marsh Island; 12-acre anchorage at Georgetown Flats.

PLAN NO. 5: Channel to 1,000 feet north of the Route 28 highway bridge; 28-acre anchorage near Marsh Island.

Results of calculations of costs and benefits for each plan are shown on Table 3.

TABLE 3

COMPARISON OF VARIOUS IMPROVEMENT PLANS

Plan	Annual Charges	Annual Benefits	Benefit-Cost Ratio	Net Benefits
1	$ 70,700	$182,400	2.58	$111,700
2	$139,400	$260,800	1.87	$121,400
3	$194,000	$323,900	1.67	$129,900
4	$261,700	$363,300	1.39	$101,600
5	$118,000	$260,800	2.21	$142,800

Plans 2 and 4 include anchorage areas in Georgetown Flats. It can be seen from the benefit-cost ratios and from net benefits, that providing anchorage in the vicinity of Marsh Island is more desireable. When Plans 1 and 3, which include 13 acres and 44 acres of anchorage, respectively, near Marsh Island were investigated, it was apparent that perhaps some other anchorage size provided the optimum improvement. The anchorage size which provided the maximum net benefits was 28 acres. Based on this principle of maximization of net benefits, PLAN NO. 5 showing net benefits of $142,800 was selected as the proposed plan of improvement.

PLAN OF IMPROVEMENT

44. Based on the discussion in the previous section, the proposed plan of improvement would consist of a channel 6 feet deep and 100 feet wide from the 6-foot contour in Nantucket Sound, 0.8 miles into Bass River and extending 2.0 miles upstream to 1,000 feet north of the Route 28 highway bridge, a total of 2.8 miles. It also provides for an anchorage totaling 28 acres, 6 feet deep inside the river mouth.

SHORELINE CHANGES

45. The shoreline and seabed along the Nantucket Sound coast of Cape Cod is generally comprised of sand of medium texture. It is continually moving and changing.

46. The Commonwealth of Massachusetts has dredged and maintained a navigation channel in Bass River since 1953. It has placed the spoil, which is excellent beach fill, on beaches adjacent to Bass River. It has also built a series of groins along the beach west of Bass River to prevent beach erosion.

47. The jetties, constructed by the State on either side of the river mouth, have had a significant effect on the shoreline. Littoral drift has accreted on the west (updrift) side of the westerly jetty. Between natural accretion and spoil disposal by the State, the shoreline west of the river mouth has advanced about 1,000 feet in the

past 25 years. The shoreline east of the river mouth has been developed by spoil disposal into the very long Davis Beach owned by the town of Dennis. It has experienced some erosion in the past because the westerly jetty has impounded some drift, thereby starving the downdrift beach of its sand supply. But the accretion area west of the jetty is now filled so that the normal littoral processes are no longer interrupted. Hence, Davis Beach is relatively stable as Cape Cod shoreline goes.

48. The proposed plan of improvement would require initial dredging of 125,000 cubic yards of good beach fill material, annual side-caster maintenance dredging of 8,000 cubic yards and maintenance dredging of about 135,000 cubic yards every five years from inside the river mouth. Disposal of all this material except for side-caster dredging would take place on Davis Beach, building it up appreciably during the project life. Yarmouth also indicated a need for good beach material for its town beaches.

49. When the sand bar is dredged and the spoil placed on Davis Beach, some sand placed near the easterly jetty, which would normally nourish the downdrift beaches through normal littoral processes, would be out of the path of littoral forces. However, due to additional sand from anchorage and channel maintenance dredging, the amount of sand in the littoral process would be the same or greater than if no dredging were done with no net effect on the downdrift beaches.

REQUIRED AIDS TO NAVIGATION

50. The U. S. Coast Guard has not been contacted concerning required aids to navigation because local authorities have established channel marker buoys along the existing channel which adequately delineate the channel. Based on similar nearby channels and anchorages, it is estimated that it would be necessary to replace the existing 13 buoys in the proposed Federal channel area with Coast Guard approved buoys, and add one channel buoy at the Route 28 highway bridge and six buoys to mark anchorage limits. Based on previous cost estimates for similar buoys furnished by the U. S.

Coast Guard, the total of 20 buoys is expected to cost $17,000 and require $1,000 annual maintenance.

ESTIMATE OF FIRST COSTS

51. Federal construction under the proposed plan of improvement would consist of dredging 125,000 cubic yards of loose, clean sand; 25,000 yards from the channel and 100,000 yards for the anchorage. The cost estimate is based on March 1972 price levels and includes an allowance for contingencies, engineering, design, supervision and administration. Initial dredging would be performed by hydraulic plant with disposal of materials on Davis Beach.

Project Cost Estimate:

Channel dredging	25,000 cu. yds.	
Anchorage dredging	100,000 cu. yds.	
	125,000 cu. yds. @$2.90	$362,000
Contingencies		$ 55,000
Total Dredging Costs		$417,000
Engineering & Design		$ 33,000
Supervision & Administration		$ 30,000
Total First Cost of Construction		$480,000
Navigation Aids (U. S. Coast Guard)		$ 17,000
		$497,000 *

* Exclusive of study costs.

ESTIMATE OF ANNUAL CHARGES

52. The estimated annual charges for the proposed plan of improvment are based on a project life of 50 years and an interest rate of

5.375% for both Federal and local cost shares. Annual maintenance charges are based on an investigation of the historic shoaling rate in Bass River and the existing State navigation channel as previously explained in Paragraph 41. See Paragraph 61 for breakdown of Federal and local cost shares.

Annual Charges:

Interest & Amortization $497,000 x .0580	$ 29,000
Annual Maintenance Inside the jetties: 27,000 yds. @ $2.90	$ 78,000
Outside the jetties: 8,000 yds. @ $1.25	$ 10,000
Aids to Navigation	$ 1,000
Total Annual Charges	$118,000

ESTIMATES OF BENEFITS

53. By providing a Federal channel with frequent maintenance to the authorized depth, boatowners at Bass River would enjoy full use of their boats. The increased boat usage and fleet expansion resulting from the proposed channel and anchorage are considered to be project benefits. The dollar value is expressed in terms of an increase in annual net return on the value of the boat which might be expected if the boat were for hire.

54. Because of the availability of side-caster dredging, the channel could be maintained to its authorized depth every year and provide maximum use of the boating fleet throughout the project life.

55. Boats using Bass River now and those expected to use it in the future were classified into five categories:

A. Existing permanently based fleet

B. Existing transient fleet

C. New boats purchased immediately as a result of the project.

D. Long term fleet growth (50 years)

E. Transient fleet growth (50 years)

Each category and type of craft within each category was analyzed in terms of the current net annual return if it were for hire and the net annual return which could reasonably be expected after construction of the project. The findings are summarized in Table 4 and discussed in detail in Appendix B.

TABLE 4

SUMMARY OF BENEFITS

Category	Number of Boats	Annual Benefits
A	550	$ 51,300
B	23*	$ 3,800
C	40	$ 25,700
D	410	$163,800
E	25*	$ 16,200
TOTAL	948	$260,800

* Number of transient boats is stated in terms of equivalent permanently based boats, i.e., the number of boat-days transient boats use the waterway, divided by the number of days in the boating season.

56. Categories C, D, and E show benefits proportionately greater than categories A and B because they reflect new boats resulting from construction of the improvement. All the return on these boats is considered a benefit. Boats in categories A and B are existing and realize benefits only to the extent of increased usage.

57. Possible land enhancement benefits from creating beach area by spoil deposition were also considered. The dry beach, i.e., that portion of the beach above mean high water, contains about 700,000 square feet. Local officials report that weekly usage of the beach amounts to about 30,000 people per week, with a peak of about 8,000 people, per day. Based on 75 square feet per person, and a turnover factor of two, i.e., only 4,000 people would be there at any one given time, a beach area of 300,000 square feet would be required on the busiest days. Future increases in the use of the beach would result in more crowded conditions, but additional beach area would not be necessary until near the end of the 50-year project life. When any benefits resulting therefrom are discounted to their present worth, they become insignificant. Accordingly, no benefits would result from beach buildup resulting from spoil disposal.

58. Therefore, net benefits resulting from proposed project construction all result from recreational boating and are estimated to be $260,800.

COMPARISON OF BENEFITS & COSTS

59. Annual benefits amount to $260,800 and annual charges are estimated to be $118,000. This results in a favorable benefit-cost ratio of 2.2 and net benefits of $142,800.

PROPOSED LOCAL COOPERATION

60. In conjunction with the proposed plan of improvement, local interests would be required to comply with the following items of local cooperation:

a. Contribute 50 percent of the first cost of construction of the Federal project, currently estimated to be $240,000;

b. Perform or contribute the cost of performance of the operation and maintenance of the project in accordance with regulations prescribed by the Chief of Engineers. Local interests may request the Corps of Engineers to accomplish the maintenance work with funds provided by local interests.

c. Provide, without cost to the United States, all lands, easements and rights-of-way required for construction of the project and for construction and maintenance of aids to navigation, upon request of the Chief of Engineers;

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

e. Provide and maintain without cost to the United States, necessary mooring facilities and utilities including a public landing with suitable supply facilities open to all on equal terms;

f. Establish a competent and properly constituted public body empowered to regulate the use, growth and free development of the river facilities with the understanding that said facilities will be open to all on equal terms.

APPORTIONMENT OF COSTS AMONG INTERESTS

61. Benefits that would result from improvement of Bass River are considered to be 50 percent general and 50 percent local in nature since only the recreational fleet would benefit. The first cost of dredging the channel and anchorage areas would be divided equally between the Federal government and local interests. Subsequent operation and maintenance charges would be borne by local interests.

Federal Investment

Corps of Engineers - 50% of $480,000	$240,000
U. S. Coast Guard - Aids to Navigation	$ 17,000
Total Federal Cost	$257,000

Non-Federal Investment

Cash Contribution - 50% of $480,000	$240,000

COORDINATION WITH OTHER AGENCIES

62. All Federal, State, and local agencies considered to have an interest in the Bass River study were notified of the public hearing held at Yarmouth on 26 June 1968. Some of these agencies have been consulted during the study concerning the effects of the proposed improvement on their activities. Any statements received are shown in Appendix D.

63. Interested agencies were also furnished copies of the environmental impact statement associated with this study. Pertinent comments have been considered in the study.

DISCUSSION

63. Recreational boating on Cape Cod, including Bass River, has increased so greatly in recent years that facilities have lagged far behind demand. The offshore sand bar which forms across the navigation channel at Bass River restricts full use of that waterway for recreational boating. There is also a definite lack of anchorage areas in Bass River to provide for any expansion of the fleet.

65. Jetty extensions to prevent the offshore bar from forming were found to be too costly in comparison with anticipated benefits. However, a program of annual dredging to maintain adequate channel depths and dredging every five years to maintain adequate anchorage areas was found to be economically justified.

66. There are various items of local cooperation required which include local interests contributing half the initial cost of construction and all the maintenance costs. The Boards of Selectmen of the towns of Dennis and Yarmouth have indicated by letter to the Division Engineer that they cannot at this time undertake such expenditures. These letters are included in Appendix D.

CONCLUSIONS

67. The Division Engineer finds that there is need and economic justification for dredging and maintaining a navigation channel and

anchorage at Bass River. However, local interests have indicated that they cannot fulfill the requirements of local cooperation and therefore, no Federal project is recommended at this time.

RECOMMENDATIONS

68. The Division Engineer recommends no Federal project be constructed at Bass River Harbor, Massachusetts at this time.

FRANK P. BANE
Colonel, Corps of Engineers
Division Engineer

CORPS OF ENGINEERS

U. S. ARMY

DESIRED IMPROVEMENTS
NOT RECOMMENDED

CHANNEL – 6 FT DEEP AND 100 FT. WIDE
12 ACRE ANCHORAGE – 6 FT DEEP

N

TURTLE POND

BASS RIVER GOLF COURSE

GEORGETOWN FLATS

LONG POND

RTE. 28

PACKET LANDING

SOUTH YARMOUTH

BASS RIVER MARINA

RTE. 28

FIXED BRIDGE
HOR. CL. 30 FT.
VERT. CL. 15 FT.

WEST DENNIS

SHIP SHOPS MARINA

BASS RIVER YACHT CLUB

KELLEYS POND

SEINE POND

WRINKLE POINT

BASS RIVER

MARSH ISLAND

WEST DENNIS YACHT CLUB

MARSH

MARSH

DAVIS BEACH

M.L.W.

PARKERS RIVER

PARKER NECK

M.L.W.

EXISTING STATE JETTIES

M.L.W.

STATE GROINS

M.L.W.

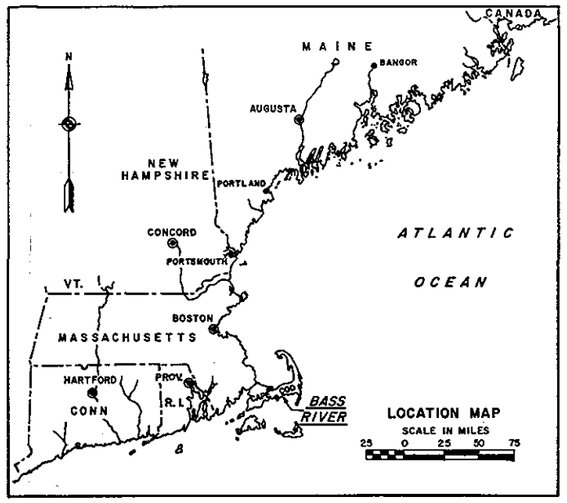
DESIRED IMPROVEMENT
NOT RECOMMENDED
28 ACRE ANCHORAGE – 6 FT. DEEP

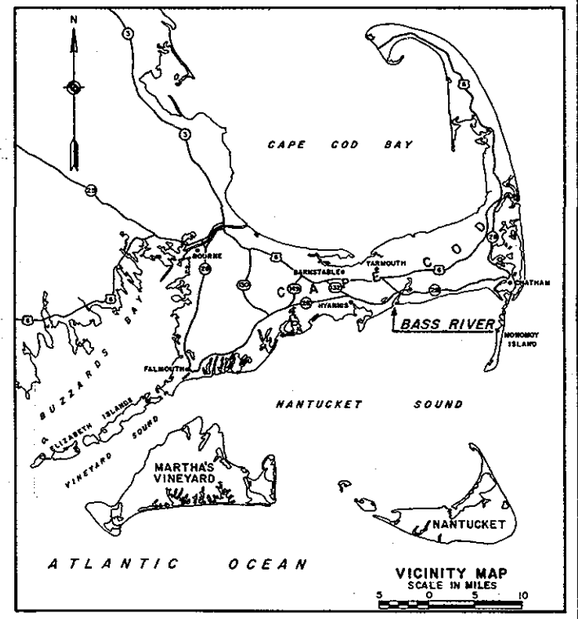
DESIRED IMPROVEMENT
NOT RECOMMENDED
CHANNEL – 6 FT. DEEP AND 100 FT. WIDE

BREAKWATER

NOTE:
For general notes see sheet 2.

DESIRED IMPROVEMENT
NOT RECOMMENDED
JETTY EXTENSIONS UP TO 4000 FT.





REVISION	DATE	DESCRIPTION	BY

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

DR. BY C.T.G. | TR. BY C.T.G. | CK. BY S.P.B. | S.T.B.

SUBMITTED:
PROJECT ENGINEER

CHIEF, COASTAL DEVEL. SECT.

APPROVAL RECOMMENDED:
CHIEF, PLANNING DIVISION

BASS RIVER HARBOR MASSACHUSETTS

GENERAL MAP

SCALE IN FEET
500 0 500 1000 1500

APPROVED
CHIEF, ENGINEERING DIVISION

DATE MARCH 1972

SCALE AS SHOWN

TO ACCOMPANY SURVEY REPORT
DATED: 28, APRIL 1972

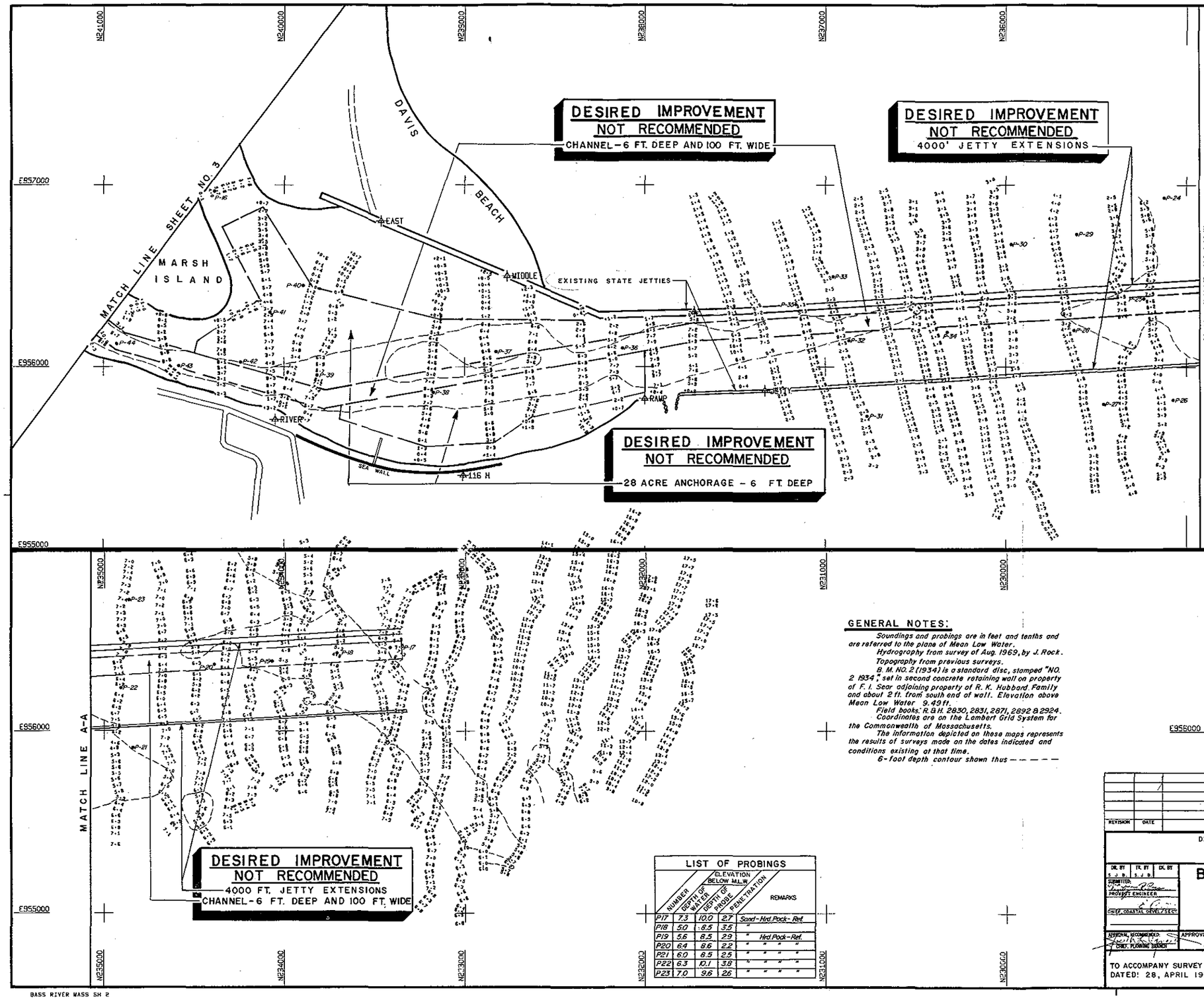
DRAWING NUMBER
B.R. 1

SHEET 1 OF 4

PLATE NO.1

CORPS OF ENGINEERS

U. S. ARMY



LIST OF PROBINGS

NUMBER	DEPTH OF WATER	ELEVATION BELOW M.L.W. DEPTH OF PROBE	PENETRATION	REMARKS
P16	6.1	8.5	2.4	Sand - Hrd. Pock - Ref.
P24	7.2	9.4	2.2	" " " "
P25	8.6	12.0	3.4	"
P26	5.2	8.4	3.2	" Hrd. Pock - Ref.
P27	3.3	5.5	2.2	" " " "
P28	3.2	5.6	2.4	" " " "
P29	2.9	5.4	2.5	" " " "
P30	3.5	6.7	6.7	" " " "
P31	2.4	5.0	2.6	" " " "
P32	5.3	10.3	5.0	" " " "
P33	2.7	5.1	2.4	" " " "
P34	1.9	8.0	6.1	" " " "
P35	3.1	5.3	2.2	" " " "
P36	6.9	10.4	3.5	" to Ref.
P37	6.7	12.1	5.4	"
P38	8.2	13.7	5.5	"
P39	8.2	11.4	3.2	"
P40	1.1	4.4	3.3	" Hrd. Pock - Ref.
P41	3.6	9.7	6.1	" " " "
P42	7.5	11.5	4.0	" " " "
P43	9.9	12.7	2.8	" Mud - Soft
P44	9.0	13.1	4.1	" " "

LIST OF PROBINGS

NUMBER	DEPTH OF WATER	ELEVATION BELOW M.L.W. DEPTH OF PROBE	PENETRATION	REMARKS
P17	7.3	10.0	2.7	Sand - Hrd. Pock - Ref.
P18	5.0	8.5	3.5	"
P19	5.6	8.5	2.9	" Hrd. Pock - Ref.
P20	6.4	8.6	2.2	" " " "
P21	6.0	8.5	2.5	" " " "
P22	6.3	10.1	3.8	" " " "
P23	7.0	9.6	2.6	" " " "

GENERAL NOTES:

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

Hydrography from survey of Aug. 1969, by J. Rock.

Topography from previous surveys.

B. M. NO. 2 (1934) is a standard disc, stamped "NO. 2 1934", set in second concrete retaining wall on property of F. I. Sear adjoining property of R. K. Hubbard Family and about 2 ft. from south end of wall. Elevation above Mean Low Water 9.49 ft.

Field books: R.B.H. 2830, 2831, 2871, 2892 & 2924.

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

The information depicted on these maps represents the results of surveys made on the dates indicated and conditions existing at that time.

6-foot depth contour shown thus - - - - -

REVISION	DATE	DESCRIPTION	BY

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

DR. BY	TR. BY	CK. BY
S J B	S J B	

SUBMITTED:
PROJECT ENGINEER
CHIEF, COASTAL DEVEL. SECT.

BASS RIVER HARBOR MASSACHUSETTS

SURVEY MAP

SCALE IN FEET

200 0 200 400

APPROVED:
CHIEF, PLANNING BRANCH
CHIEF, ENGINEERING DIVISION

DATE MARCH 1972

TO ACCOMPANY SURVEY REPORT DATED: 28, APRIL 1972

SCALE

DRAWING NUMBER
B. R. 1

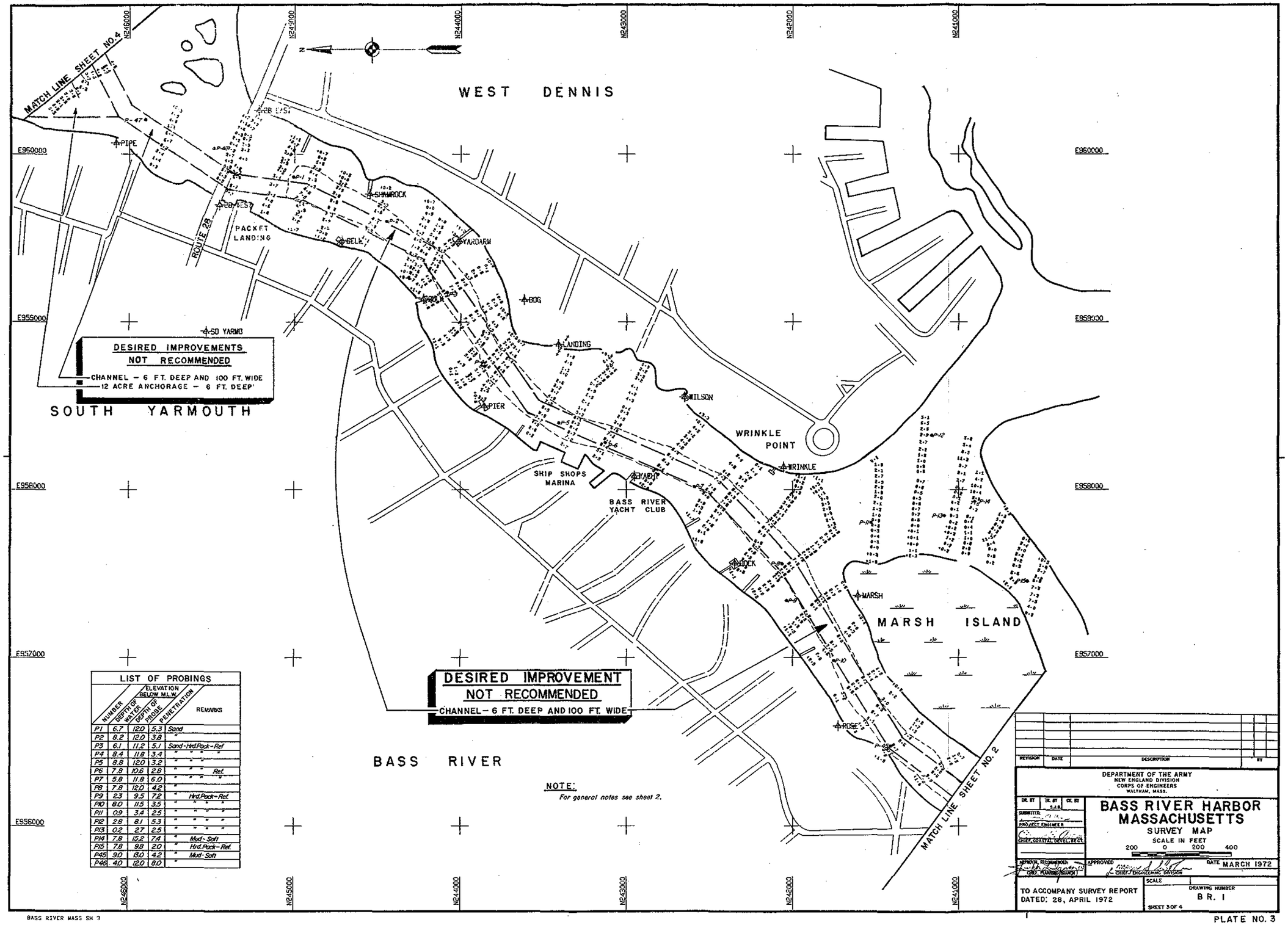
SHEET 2 OF 4

BASS RIVER MASS SH 2

PLATE NO. 2

CORPS OF ENGINEERS

U. S. ARMY



LIST OF PROBINGS

NUMBER	DEPTH OF WATER	ELEVATION BELOW M.L.W. DEPTH OF PROBE	PENETRATION	REMARKS
P1	6.7	12.0	5.3	Sand
P2	8.2	12.0	3.8	"
P3	6.1	11.2	5.1	Sand-Hrd.Pack-Ref.
P4	8.4	11.8	3.4	" " " "
P5	8.8	12.0	3.2	" " "
P6	7.8	10.6	2.8	" " " Ref.
P7	5.8	11.8	6.0	" " " "
P8	7.8	12.0	4.2	"
P9	2.3	9.5	7.2	" Hrd.Pack-Ref.
P10	8.0	11.5	3.5	" " " "
P11	0.9	3.4	2.5	" " " "
P12	2.8	8.1	5.3	" " " "
P13	0.2	2.7	2.5	" " " "
P14	7.8	15.2	7.4	" Mud-Soft
P15	7.8	9.8	2.0	" Hrd.Pack-Ref.
P45	9.0	13.0	4.2	" Mud-Soft
P46	4.0	12.0	8.0	"

NOTE:
For general notes see sheet 2.

REVISION	DATE	DESCRIPTION	BY

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

BASS RIVER HARBOR MASSACHUSETTS

SURVEY MAP

SCALE IN FEET
200 0 200 400

APPROVED
CHIEF, ENGINEERING DIVISION

DATE MARCH 1972

TO ACCOMPANY SURVEY REPORT
DATED: 28, APRIL 1972

SCALE

DRAWING NUMBER
B R. 1

SHEET 3 OF 4

BASS RIVER MASS SH 3

PLATE NO. 3

CORPS OF ENGINEERS

U. S. ARMY

N251000 N250000 N249000 N248000 N247000 N246000

E965000

E964000

E963000

E962000

E961000

GRAND COVE

PUINT

AIRWAY

SAND

PINE

STUMP

PORE

TOWN

GOLF

BASS RIVER GOLF COURSE

GEORGETOWN FLATS

CULVERT

HILLY

WEST DEN

P-47 P-48 P-49 P-50 P-51 P-52 P-53 P-54 P-55 P-56 P-57 P-58 P-59 P-60 P-61 P-62

MATCH LINE SHEET NO. 3

LIST OF PROBINGS

NUMBER	DEPTH OF WATER	ELEVATION BELOW M.L.W. DEPTH OF PROBE	PENETRATION	REMARKS
P47	6.1	11.3	5.2	Sand
P48	5.4	9.0	3.6	Sand to Ref.
P49	5.0	9.0	4.0	" " "
P50	6.5	10.5	4.0	" " "
P51	7.6	12.1	4.5	"
P52	6.8	10.7	3.9	" to Ref.
P53	4.8	12.0	7.2	"
P54	3.8	12.0	8.2	" to Mud
P55	4.3	12.7	7.8	" " "
P56	5.9	12.7	6.8	Mud
P57	3.6	13.7	10.1	"
P58	+0.3	2.7	3.0	Sand to Ref.
P59	0.6	4.8	4.2	" " "
P60	0.6	7.6	7.0	" Mud to Ref.
P61	0.1	5.8	5.7	" " " "
P62	0.4	5.5	5.1	" " " "

NOTE:

For general notes see sheet 2.

DESIRED IMPROVEMENTS NOT RECOMMENDED

CHANNEL — 6 FT. DEEP AND 100 FT. WIDE

12 ACRE ANCHORAGE — 6 FT. DEEP

REVISION	DATE	DESCRIPTION	BY

461300

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

DR. BY J. J. B. | TR. BY J. J. B. | CK. BY

SUBMITTED:

PROJECT ENGINEER

CHIEF, COASTAL DESIGN SECT.

BASS RIVER HARBOR MASSACHUSETTS

SURVEY MAP

SCALE IN FEET

200 0 200 400

APPROVAL RECOMMENDED: CHIEF, PLANNING BRANCH

APPROVED: CHIEF, ENGINEERING DIVISION

DATE MARCH 1972

TO ACCOMPANY SURVEY REPORT DATED. 28, APRIL 1972

SCALE AS SHOWN

DRAWING NUMBER B. R. 1

SHEET 4 OF 4

BASS RIVER MASS SH 4

PLATE NO. 4

APPENDIX A

PROJECT FORMULATION

1. The existing channel established by the State, 7 feet deep and 100 feet wide, is more than adequate for current and prospective navigation requirements in Bass River. A 6-foot depth is considered deep enough for boating needs in that area.

2. The major navigation problem in Bass River results from the bar which forms across the channel about 1,000 feet offshore. This severely restricts the drafts of boats which may be used and the stages of the tide during which they can be used.

3. There appear to be two possible remedies, either extend the existing jetties a sufficient length to prevent the sand bar from forming or conduct a program of regularly scheduled maintenance dredging at intervals frequent enough to allow optimum use of the channel by the recreational boating fleet.

4. The littoral drift, i. e., sand movement along the shoreline, in the area of Bass River is predominantly from west to east. The wave and current forces which transport the sand change as the water depth changes. This causes some sand particles to settle out as they pass over the channel. As the tide ebbs, the current picks up these particles and transports them seaward. Once outside the jetties, the current is dissipated and the sand settles out. At this point, some 1,000 to 1,500 feet off the channel entrance, the bar forms. The ensuing flood tide does not carry the sand back toward shore because the flow is not restricted and velocities are not great enough to transport the sand. Because of the large amounts of medium grain, loose sand on the seabed in this vicinity, vast quantities of sand are continually being moved back and forth by wind and wave action. Only a small portion of the total sand movement manifests itself in the formation of the offshore sand bar.

5. To find the approximate amount of littoral drift, complete long term wind data for Memorial Airport, Nantucket, Massachusetts, was

analyzed and the number and size of waves occurring from all directions were estimated. Knowing the wave height, length and period, the amount of energy in the wave can be calculated and the amount of sand transport estimated. It was estimated that the total west to east movement is 450, 000 cubic yards per year and the total east to west movement is 150, 000 cubic yards per year. The net annual movement is 300, 000 cubic yards toward the east. Details of this estimate are shown in Appendix C.

6. If the existing jetties are extended as the local interests requested, some sand now involved in the littoral process would be impounded on the seabed west (updrift) of the westerly jetty. The amount of sand impounded is a function of the total sand movement, the jetty length, and the bottom hydrography.

7. Most of the littoral drift takes place between the breaker line and the shoreline where most of the wave energy is expended. Accordingly, most of the sand transported alongshore between the shoreline and the end of the jetty extension would be impounded. Although there are many short-term variations in the drift movement due to changes in direction and intensity of wind and wave action, the net long-term effect will be an accretion to the west of the westerly jetty. Because some material will be removed from the littoral process by the accretion, the equilibrium of the beaches east of the jetties will be disturbed. The result there would be erosion equal in volume to the accretion.

8. As accretion continues, the accretion area would become shoaler and the shoreline would advance, eventually to near the end of the westerly jetty. As the shoreline advances, a smaller precentage of the drift would be impounded and more and more sand would move around the end of the jetty. Then, the conditions which currently exist would again be present, causing the bar to reform. Hence, a jetty extension would not solve the problem. At best, it would delay reforming of the bar for a period of time which it takes to fill the accretion area. Further, it would cause a problem of downdrift erosion. The shoreline has already advanced to the end of the westerly jetty and no sand is now being impounded. Hence, downdrift erosion due to the existing jetties is not now a problem.

9. It is important to note that if one jetty is extended, the other must also be extended. If a jetty were built on the west (updrift) side of the river mouth, it would impound not only west to east drift, but east to west drift as well. East to west drift would settle in the dredged channel out of reach of the littoral forces. This would cause the channel to shoal rapidly and require a great deal of maintenance dredging.

10. The effective life of the jetty extensions, i. e., the length of time during which the bar would not form, was a critical determination. Factors affecting this are the net littoral drift, jetty extension length and the bottom hydrography. The net littoral drift rate was estimated to be 300, 000 cubic yards per year towards the east. Storage lives for jetty extensions of 500 feet; 1, 000 feet; 1, 500 feet; 2, 000 feet; 2, 500 feet; and 4, 000 feet were estimated. The storage volumes were estimated for each jetty extension length from the hydrography shown on U. S. Coast and Geodetic Survey Chart No. 258.

11. The 4, 000-foot jetty extension would reach the 6-foot bottom contour. There the bottom slope increases sharply. Any sand which would get around the jetty end would therefore be in relatively deep water. Because of this, the sand bar would probably not reform. But even if it did, the depth of water over it would be great enough to provide for safe navigation at all tide stages, Hence, it was not necessary to calculate a storage volume for the 4, 000-foot extension.

12. The effective life of each jetty extension was based on the net annual drift rate of 300, 000 cubic yards and a surf zone extending to 4, 500 feet offshore within which virtually all of the drift takes place. The jetty extensions, storage volumes, and effective lives are shown in Table A-1. The storage life represents the period it takes to fill the respective storage capacity behind the jetty.

TABLE A-1

Jetty Extension (Ft.)	Drift Storage Volume (c. y.)	Effective Life (yrs)
500	85, 000	3

TABLE A-1 (Con't)

Jetty Extension (Ft.)	Drift Storage Volume (c. y.)	Effective Life (yrs)
1, 000	290, 000	5
1, 500	670, 000	7
2, 000	1, 025, 000	8
2, 500	1, 375, 000	9

At the end of the effective life, sand would again move around the jetty end to form the bar. From then on, regularly scheduled maintenance would be necessary. Without any jetty extension, maintenance dredging would have to be done throughout the entire 50-year project life.

13. To properly compare the economics of the alternatives, the average annual charges were developed. A summary of the plans is :

PLAN A - no jetty extensions, regular maintenance dredging for 50 years.

PLAN B - 500-foot jetty extensions, regular maintenance dredging after 3 years.

PLAN C - 2, 500-foot jetty extensions, regular maintenance dredging after 9 years.

PLAN D - 4, 000-foot jetty extensions, no maintenance dredging required.

Maintenance dredging in these plans refers only to removal of the sand bar. Other maintenance of the channel and anchorage areas has been excluded as it would be the same for all plans and does not affect this comparison. Cost comparisons are shown in Table A-2.

TABLE A-2

COMPARSION OF JETTY EXTENSION COSTS

PLAN	A	B	C	D
Jetty Extensions	None	500 ft.	2, 500 ft.	4, 000 ft.
First Costs:				
Jetty Stone	-	$343, 000	$1, 728, 000	$2, 820, 000
Contingencies	-	52, 000	259, 000	423, 000
E&D and S&A	-	59, 000	298, 000	487, 000
TOTAL		$454, 000	$2, 285, 000	$3, 730, 000
Annual Charges:				
Interest & Amort. (5-3/8%)	-	$ 26, 300	$ 132, 500	$ 216, 000
Jetty Maintenance	-	4, 300	21, 600	40, 000
Sand bar removal maintenance	$10, 000	$ 8, 400	5, 900	-
TOTAL ANNUAL CHARGES	$10, 000	$ 39, 000	$ 160, 000	$ 256, 000

The annual sand bar maintenance dredging charges were based on the average annual equivalent of all anticipated sand bar maintenance dredging costs during the project life. Plans B and C were less costly on an average annual basis than Plan A because they would need no maintenance until after their respective storage areas were filled. Plan D would need no sand bar maintenance dredging at all. Sand bar removal maintenance costs were calculated as follows:

PLAN B: $10,000 per year for 47 years (year 4 through 50 inclusive). Value at year 4 of $10,000 per year for 47 years at 5-3/8% interest.

$10,000 x 17.016 = $170,160

Present worth of $170,160 paid 3 years hence:

$170,160 x 0.855 = $145,487

Amortization of $145,487 over 50 year project life:

$145,487 x 0.058 = $8,438, Say $8,400

PLAN C: $10,000 per year for 41 years (year 10 through 50 inclusive). Value at year 10 of $10,000 per year for 41 years.

$10,000 x 16.430 = $164,300

Present worth of $164,300 paid 9 years hence:

$164,300 x .6242 = $102,556

Amortization of $102,556 over 50 year project life:

$102,556 x 0.058 = $5,948, Say $5,900

14. From Table A-2, it can be seen that all jetty extension plans would be more costly than a program of regular maintenance. Accordingly, the plan of improvement must be based on a program of regular maintenance dredging.

15. To estimate the annual maintenance dredging requirements, shoaling rates within various portions of the river and in the offshore channel were estimated. Comparative pre-dredge and after-dredge surveys made by the Commonwealth of Massachusetts in 1953, 1958 and 1966 were used and supplemented with a Corps of Engineers report survey made in 1969. The waterway was divided into four areas; the offshore bar, downstream anchorage area (near Marsh Island), the

anchorage area upstream (Georgetown Flats), and the navigation channel itself. The shoaling rate for each area was estimated to be:

offshore sand bar: 3.8 cu. yds. /lin. ft. /year for a 100-foot wide channel.

navigation channel: 0.8 cu. yds. /lin. ft. /year for a 100-foot wide channel

downstream anchorage: 550-750 cu. yds. /acre/year.

upstream anchorage: 800-850 cu. yds. /acre/year.

The anchorage shoaling rates vary depending on the original depth and the proximity to the shoreline and natural flow of the river.

16. It is essential to point out that annual side-caster maintenance dredging of the offshore sand bar is an integral part of the project. Otherwise, controlling depths would become too shallow to allow full use of the channel by the entire fleet. Consequently, full benefits of the project could not be realized.

17. Two other aspects to be considered were how far upstream to extend the navigation channel, and how much anchorage area should be provided for fleet expansion. Several alternate plans were investigated and costs and benefits of each were calculated. The plans are:

PLAN NO. 1 - Channel to 1,000 feet north of the Rte. 28 highway bridge; 13-acre anchorage near Marsh Island.

PLAN NO. 2 - Channel to Georgetown Flats; 13-acre anchorage near Marsh Island; 12-acre anchorage at Georgetown Flats.

PLAN NO. 3 - Channel to 1,000 feet north of the Rte. 28 highway bridge; 44-acre anchorage near Marsh Island.

PLAN NO. 4 - Channel to Georgetown Flats; 44-acre anchorage near Marsh Island; 12-acre anchorage at Georgetown Flats.

It was apparent from the benefit-cost ratios of each plan that the anchorage areas in the vicinity of Marsh Island were more economical than those in the vicinity of Georgetown Flats. Further study was made to determine the optimum size of an anchorage area near Marsh Island. The costs and benefits of each plan, plus a subsequently developed Plan No. 5 are shown in Table A-3.

18. Costs and benefits for the Plans 1 and 3 were plotted and curves drawn using cost and benefits of the channel with no anchorage as a third point on each curve. The resultant graph, shown in Figure A-1, indicated an anchorage area of about 30 to 35 acres as being the optimum size. Based on surveys of the area, a practical location and shape was established which resulted in a 28 acre anchorage. Such a plan was designated as Plan No. 5 and was compared in detail with the other plans. Table A-3 shows that net benefits of $142,800 resulting from that plan to be more than any of the other plans. Detailed analysis of benefits is shown in Appendix B.

19. Accordingly, the proposed plan of improvement consists of dredging a channel 6 feet deep and 100 feet wide from the 6-foot contour 0.8 miles out in Nantucket Sound into Bass River, extending 2.0 miles upstream to 1,000 feet north of the Route 28 highway bridge. It also provides for 28 acres of anchorage 6 feet deep in the vicinity of Marsh Island.

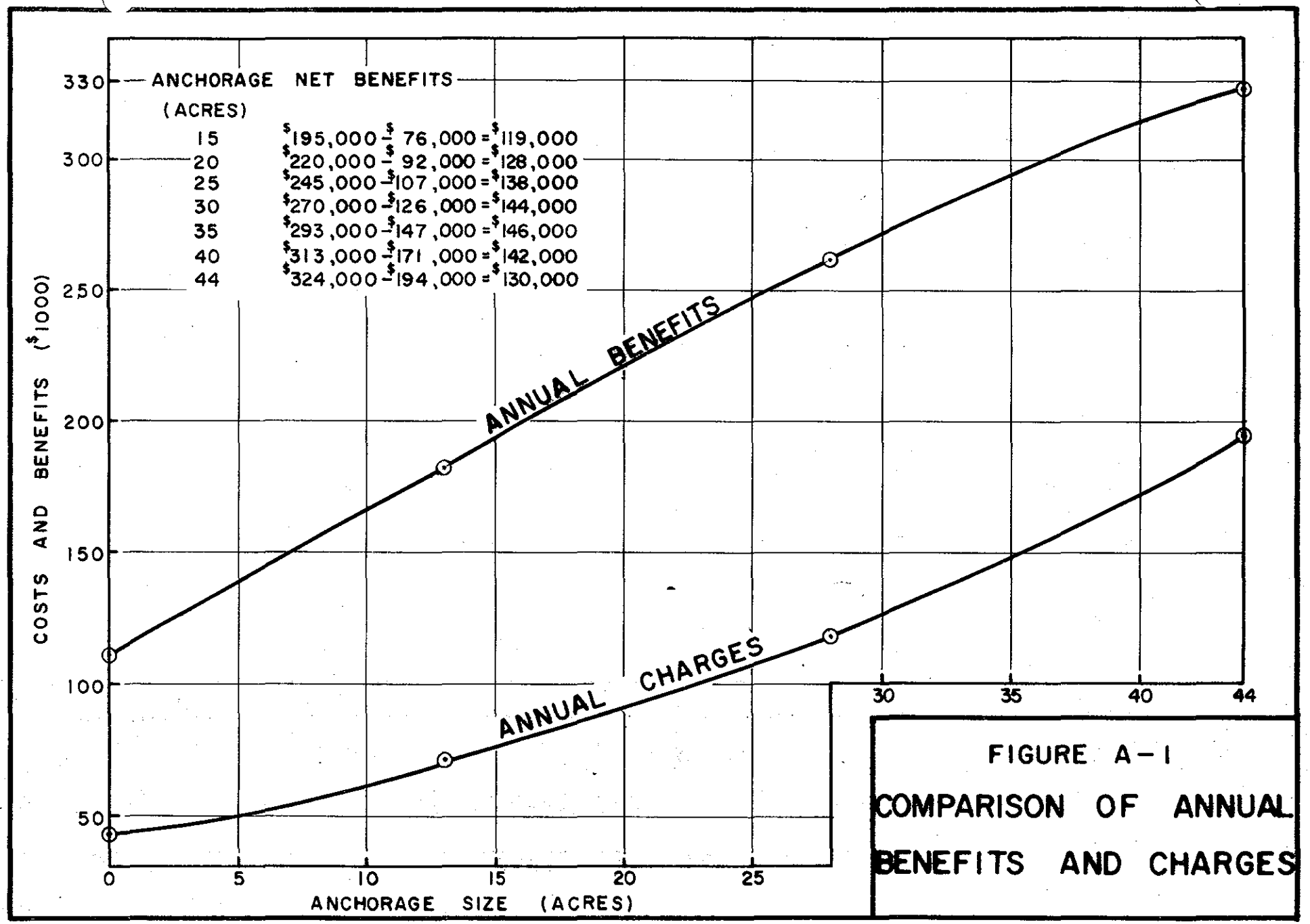


FIGURE A-1

COMPARISON OF ANNUAL BENEFITS AND CHARGES

TABLE A-3

OPTIMUM CHANNEL & ANCHORAGE PLAN

PLAN NO.	1	2	3	4	5
First Cost - Dredging	$ 174,000	$ 493,000	$ 725,000	$1,038,000	$ 363,000
Contingencies	26,000	74,000	109,000	156,000	54,000
Engineering and Design	19,000	39,000	51,000	70,000	33,000
Supervision and Administration	16,000	40,000	53,000	74,000	30,000
Aids to Navigation	14,000	20,000	25,000	30,000	17,000
TOTAL	$ 249,000	$ 666,000	$ 963,000	$1,368,000	$ 497,000
Annual Charges					
Interest & Amortization	$ 14,400	$ 38,600	$ 55,900	$ 79,300	$ 29,000
Maintenance - dredging	55,500	99,600	136,700	180,800	88,000
Navigation Aids	800	1,200	1,400	1,600	1,000
TOTAL	$ 70,700	$ 139,400	$ 194,000	$ 261,700	$ 118,000

TABLE A-3 (Con't)

OPTIMUM CHANNEL & ANCHORAGE PLAN

PLAN NO.	1	2	3	4	5
Benefits					
Existing Local Fleet	$ 51,300	$ 51,300	$ 51,300	$ 51,300	$ 51,300
Existing Transient Fleet	3,800	3,800	3,800	3,800	3,800
Immediate Fleet Additions	6,600	25,700	25,700	25,700	25,700
Long-Term Fleet Growth	109,100	163,800	215,900	250,700	163,800
Transient Fleet Growth	11,600	16,200	27,200	31,800	16,200
TOTAL	$ 182,400	$ 260,800	$ 323,900	$ 363,300	$ 260,800
Benefit-Cost Ratio	2.58	1.87	1.67	1.39	2.21
Net Benefits	$ 111,700	$ 121,400	$ 129,900	$ 101,600	$ 142,800

APPENDIX B

BENEFITS

1. Recreational boating benefits are based on the average annual net return boatowners might expect if their boats were for hire. This, of course, varies with the size and type of boat and is expressed as a percent of the boat's average depreciated value. The ideal percent return is the maximum return that could be realized with full and unrestricted use of the harbor. For Bass River, the ideal net return varies from 14% for the smaller boats to 7% for the larger boats. The percent return estimate is based on the length of season, population concentration, costs of alternate types of outdoor recreation, and income range of the using public.

2. Because the offshore sand bar restricts full use of the boats, ideal return on the boat investment cannot be realized. By providing the proposed improvement, use of the boats would be increased to a more nearly ideal situation. This increase in usage, expressed as an increase in the net return on the boat, is considered to be the benefit.

3. The existing locally based fleet comprises 550 boats. Benefits to these boats would result from the increased usage that the proposed improvement would permit. This increase varies with the size and type of boat, use of smaller boats increasing less and larger boats increasing more. For example, a 35-foot cruiser drawing 3 feet has an ideal net return of 8%. Presently, with a controlling depth of 2 feet and a tide range of 3 feet, it realizes about 75% of ideal usage. After improvement, it would realize 100% of ideal return. This results in an increase of 25%. Twenty-five percent of 8% net annual return results in a 2% increase in the net annual return. This type of boat is valued at $17,700 so that the annual benefits to each boat of that type and size is $354. The item "On Cruise" means the amount of time a locally based boat is away from the subject waterway. During those times, it is neither affected by local navigational restrictions nor contributing fully to the local recreational boating activity. Hence, a deduction must be made from the local recreational boating benefits derived from that boat. The entire fleet underwent a similar analysis which resulted in

estimated benefits to the existing permanently based fleet of $51,300. These benefits are detailed in Table B-2.

4. There are many transient boats which use the harbor and realize benefits similar to those of the permanently based local fleet. It is estimated that a total of 3,000 visits are made by transient craft each year. This is equivalent to 23 boats based locally for the entire 130 day boating season. Benefits are somewhat less than for the permanent fleet because transient craft would visit the area only when conditions for boating are favorable. Accordingly, the current percent of ideal return would be greater than for locally-based boats and the increase in return as a result of the proposed improvements would be correspondingly less. Benefits to the transient boats are estimated to be $3,800 as shown in Table B-3.

5. If anchorage is provided, the fleet would be able to expand, providing additional benefits. There is a general overcrowded boating situation on Cape Cod such that some people have deferred boat purchases pending availability of good anchorage. Should anchorage become available, some new boats would be purchased immediately. Benefits from these boats would equal their full annual net return. It is estimated that 40 boats would be added immediately resulting in benefits of $25,700 annually. See Table B-4 for details.

6. Based on an average boat length of 23 feet, a 3-foot tide range, only minor wave action, and assuming boats are moored in overlapping circles, it is estimated that an anchorage in Bass River could accommodate 13 to 14 boats per acre. For 28 acres of anchorage, this amounts to 375 boats in the proposed anchorage.

7. With current rates of increase of boating activity, the expansion of the fleet would be limited only by the anchorage area available. The proposed anchorage contains 28 acres and can accommodate 375 boats. In addition, there are some naturally deep areas along the river which are not now used for anchorage. This is due to inconvenient access to shore facilities. However, the boating demand on Cape Cod is so great that undoubtedly, these areas would eventually be used even though they are of marginal desireability. An inspection of the area indicated that about 100 additional boats could be accommodated in these marginal areas.

8. Accordingly, the fleet could be expanded by 475 boats as follows:

New boats immediately purchased	40
New boats, gradual growth	410
* New equivalent transient boats	25
TOTAL	475

* See Paragraph B-11.

9. To estimate the average annual increase in the number of boats, trends of population growth and boat registrations were studied and compared. Table B-1 shows the magnitude and percent increase of these factors. Boating registrations in Massachusetts have increased at an average annual rate of about 5% over the past eight years. Statistics prior to that are not available. The population of Massachusetts has increased at an average annual rate of slightly under one percent since 1929. U. S. Department of Commerce, Office of Business Economics, projects that the rate of growth will increase to 1.5% average annual growth during the 50-year project life. The population growth rate of Barnstable County and the towns of Yarmouth and Dennis have increased at average annual rates of 5%, 10%, and 6% respectively, much greater than the rest of the State. This is due in a large part to new vacation homes and retirement homes which result in a proportionately larger number of recreational boats than do other types of housing. It is probable that the growth of boating on Cape Cod would exceed the 5% rate for the entire State. Therefore, it is projected that the average annual growth rate for boating at Bass River would be 6%. It is assumed to be straight line growth.

10. The existing fleet of 550 boats would grow by 33 boats per year and at 13 to 14 boats per acre would fill available and proposed anchorages of 28 acres plus 100 additional boats in 12 years. The benefits from this type of growth are shown in Table B-5 and amount to $163,800 annually. It should be noted that at the bottom of Table B-5, a deduction of $23,300 from the benefits was made to reflect the net return on

TABLE B-1

POPULATION AND BOAT REGISTRATION DATA

POPULATION

Year	Population	Column 1/ 1	2	3
Barnstable County				
1940	37,295	-	-	-
1950	46,805	25.5	25.5	2.55
1960	70,286	50.2	88.5	4.42
1970	88,639	26.1	137.7	4.59
Yarmouth Town				
1940	2,286	-	-	-
1950	3,297	44.2	44.2	4.42
1960	5,504	66.9	140.8	7.04
1970	9,475	72.1	314.5	10.48
Dennis Town				
1940	2,015	-	-	-
1950	2,499	24.0	24.0	2.40
1960	3,727	49.1	85.0	4.25
1970	5,792	55.4	187.4	6.25

Massachusetts Boating Registrations

Year	Registered Boats	Column 1/ 1	2	3
1961	72,596	-	-	
1962	83,000	14.3	14.3	14.3
1963	79,846	-3.8	9.99	5.0
1964	84,680	6.05	16.6	5.5
1965	88,430	4.43	21.8	5.4
1966	88,049	-0.43	21.3	4.3
1967	88,049	0	21.3	3.6
1968	99,630	13.2	37.2	5.3
1969	103,326	3.71	42.3	5.3

1/ Column 1 indicates % increase over previous year in table

Column 2 indicates % increase over first year shown

Column 3 indicates average annual % increase over first year shown

additional boats which would locate at Bass River even if the project were not constructed. As previously mentioned, there is marginal mooring area for about 100 additional boats not now being used, but which would come into use due to the critical shortage of good mooring areas elsewhere. As this increase is not dependent upon project construction, it cannot be counted as a project benefit. Computations of this net return without the project is shown in Table B-7. A similar deduction was made from the growth of equivalent transient vessels. It is shown in Table B-8.

11. Because of the improved facilities resulting from the proposed project, additional transient boats are expected to call at Bass River. The visits are estimated to amount to 3,300 boat days, or the equivalent of 25 permanently based boats. Benefits from this source are estimated to be $16,200 annually. See Table B-6 for details.

12. Summarizing the benefits:

Existing permanently based fleet	$ 51,300
Existing equivalent transient boats	3,800
New boats immediately purchased	25,700
New boats - gradual growth	163,800
New boats - equivalent transient fleet	16,200
TOTAL BENEFITS	$ 260,800

TABLE B-2 BENEFITS TO RECREATIONAL BOATING

EXISTING PERMANENTLY BASED FLEET

TYPE OF CRAFT	LENGTH (ft.)	No. of Boats	DEPRECIATED VALUE Average $	DEPRECIATED VALUE Total $	PRECENT RETURN Ideal	% of Ideal Pres./Fut.		Gain	VALUE $	ON CRUISE %	ON CRUISE Value $
Outboards	15-20	250	1,800	450,000	14	80	100	2.8	12,600		
	20&up	95	2,800	266,000	14	60	100	5.6	14,900		
Inboards	15-20	40	3,200	128,000	12	90	100	1.2	1,500		
	21-30	15	6,000	90,000	11	85	100	1.65	1,500		
	31&up	3	23,000	69,000	10	75	100	2.5	1,700		
Sterndrives	15-20	-	2,800	-	12	-	-	-	-		
	21-25	-	5,000	-	11	-	-	-	-		
	26&up	-	10,000	-	10	-	-	-	-		
Cruisers	21-30	27	7,600	205,200	9	85	100	1.35	2,800	9	250
	31-40	7	17,700	123,900	8	75	100	2.0	2,500	12	300
	41-50	4	43,200	172,800	8	45	100	4.4	7,600	20	1,500
	51&up	-	91,600		7	-	-	-	-	28	-
Aux. Sail	15-20	6	2,500	15,000	9	80	100	1.8	300	-	-
	21-30	4	6,000	24,000	8	60	100	3.2	800	5	40
	31-40	3	18,000	54,000	8	25	100	6.0	3,200	12	380
	41&up	-	37,000	-	7	-	-	-	-	15	-
Sailboats	8-15	32	900	28,800	12	90	100	1.2	300	-	-
	16-20	42	1,800	75,600	12	80	100	2.4	1,800	-	-
	21-25	16	2,400	38,400	11	75	100	2.75	1,100	5	60
	26&up	6	4,300	25,800	10	45	100	5.5	1,400	12	170
TOTALS		550		$1,766,500					$54,000		$2,700

Type of Growth: N/A Ef = N/A Benefits: $54,000 - $2,700 = $51,300

Growth Period: N/A

TABLE B-3 BENEFITS TO RECREATIONAL BOATING

EXISTING EQUIVALENT TRANSIENT FLEET

TYPE OF CRAFT	LENGTH (ft.)	No. of Boats	DEPRECIATED VALUE Average $	DEPRECIATED VALUE Total $	PRECENT RETURN Ideal	% of Ideal Pres./Fut.		Gain	VALUE $
Cruisers	21-30	4	7,600	30,400	9	95	100	0.45	140
	31-40	4	17,700	70,800	8	90	100	0.8	570
	41-50	4	43,200	172,800	8	85	100	1.2	2,070
Aux. Sail	21-30	4	6,000	24,000	8	90	100	0.8	190
	31-40	3	18,000	54,000	8	85	100	1.2	650
Sailboats	21-25	3	2,400	7,200	11	85	100	1.65	120
	26&up	1	4,300	4,300	10	80	100	2.0	90
TOTALS		23		$357,500					$3,830

Type of Growth: N/A

Growth Period: N/A

Ef = N/A

Benefits: Say $3,800

TABLE B-4 BENEFITS TO RECREATIONAL BOATING

NEW BOATS - IMMEDIATELY ADDED

TYPE OF CRAFT	LENGTH	No. of Boats	DEPRECIATED VALUE Average $	DEPRECIATED VALUE Total $	PRECENT RETURN Ideal	% of Ideal Pres./Fut.		Gain	VALUE $	ON CRUISE %	ON CRUISE Value $
Outboards	15-20	18	1,800	32,400	14	0	100	14	4,540		
	20&up	4	2,800	11,200	14	0	100	14	1,570		
Inboards	15-20	1	3,200	3,200	12	0	100	12	380		
	21-30	1	6,000	6,000	11	0	100	11	660		
	31&up	1	23,000	23,000	10	0	100	10	2,300		
Sterndrives	15-20	1	2,800	2,800	12	0	100	12	340		
	21-25	1	5,000	5,000	11	0	100	11	550		
	26&up	1	10,000	10,000	10	0	100	10	1,000		
Cruisers	21-30	1	7,600	7,600	9	0	100	9	680	9	60
	31-40	1	17,700	17,700	8	0	100	8	1,420	12	170
	41-50	1	43,200	43,200	8	0	100	8	3,460	20	690
	51&up	1	91,600	91,600	7	0	100	7	6,410	28	1,790
Aux. Sail	15-20	1	2,500	2,500	9	0	100	9	220	-	-
	21-30	1	6,000	6,000	8	0	100	8	480	5	20
	31-40	1	18,000	18,000	8	0	100	8	1,440	12	170
	41&up	1	37,000	37,000	7	0	100	7	2,590	15	390
Sailboats	8-15	1	900	900	12	0	100	12	110	-	-
	16-20	1	1,800	1,800	12	0	100	12	220	-	-
	21-25	1	2,400	2,400	11	0	100	11	260	5	10
	26&up	1	4,300	4,300	10	0	100	10	430	12	50
TOTALS		40		$326,600					$29,060		$3,350

Type of Growth: N/A Ef = N/A Benefits: $29,060 - $3,350 = $25,710 Say $25,700

Growth Period: N/A

TABLE B-5 BENEFITS TO RECREATIONAL BOATING

NEW BOATS - GRADUAL GROWTH

TYPE OF CRAFT	LENGTH (ft.)	No. of Boats	DEPRECIATED VALUE Average $	DEPRECIATED VALUE Total $	PRECENT RETURN Ideal	% of Ideal Pres.	% of Ideal Fut.	Gain	VALUE $	ON CRUISE %	ON CRUISE Value $
Outboards	15-20	194	1,800	349,200	14	0	100	14	48,900		
	20&up	19	2,800	53,200	14	0	100	14	7,400		
Inboards	15-20	13	3,200	41,600	12	0	100	12	5,000		
	21-30	8	6,000	48,000	11	0	100	11	5,300		
	31&up	8	23,000	184,000	10	0	100	10	18,400		
Sterndrives	15-20	26	2,800	72,800	12	0	100	12	8,700		
	21-25	21	5,000	105,000	11	0	100	11	11,600		
	26&up	3	10,000	30,000	10	0	100	10	3,000		
Cruisers	21-30	17	7,600	129,200	9	0	100	9	11,600	9	1,040
	31-40	22	17,700	389,400	8	0	100	8	31,200	12	3,740
	41-50	22	43,200	950,400	8	0	100	8	76,000	20	15,200
	51&up	3	91,600	274,800	7	0	100	7	19,200	28	5,380
Aux. Sail	15-20	3	2,500	7,500	9	0	100	9	700	-	-
	21-30	13	6,000	78,000	8	0	100	8	6,200	5	310
	31-40	8	18,000	144,000	8	0	100	8	11,500	12	1,380
	41&up	3	37,000	111,000	7	0	100	7	7,800	15	-
Sailboats	8-15	3	900	2,700	12	0	100	12	300	-	-
	16-20	8	1,800	14,400	12	0	100	12	1,700	-	-
	21-25	13	2,400	31,200	11	0	100	11	3,400	5	170
	26&up	3	4,300	12,900	10	0	100	10	1,300	12	160
TOTALS		410		$3,029,300					$279,200		$27,380

Type of Growth: Straight Line Ef = 0.743

Growth Period: 12 years

Benefits: ($279,200 - $27,380) x .743 = $187,100

Less Increase Without Project 23,300

Say $163,800

TABLE B-6 BENEFITS TO RECREATIONAL BOATING

EQUIVALENT TRANSIENT FLEET - GROWTH

TYPE OF CRAFT	LENGTH (ft.)	No. of Boats	DEPRECIATED VALUE Average $	DEPRECIATED VALUE Total $	PRECENT RETURN Ideal	% of Ideal Pres./Fut.		Gain	VALUE $
Cruisers	21-30	4	7,600	30,400	9	0	100	9	2,740
	31-40	4	17,700	70,800	8	0	100	8	5,660
	41-50	2	43,200	86,400	8	0	100	8	6,910
Aux. Sail	21-30	4	6,000	24,000	8	0	100	8	1,920
	31-40	4	18,000	72,000	8	0	100	8	5,760
Sailboats	21-25	4	2,400	9,600	11	0	100	11	1,060
	26&up	3	4,300	12,900	10	0	100	10	1,290
TOTALS		25		$325,100					$25,340

Type of Growth: Straight Line

Growth Period: 10 years

Ef = 0.783

Benefits: Say $25,300 x 0.783 = $19,800

Less increase without project (Table B-8) 3,600

BENEFITS - $16,200

TABLE B-7 BENEFITS TO RECREATIONAL BOATING

NEW BOATS - GRADUAL GROWTH WITHOUT PROJECT

TYPE OF CRAFT	LENGTH (ft.)	No. of Boats	DEPRECIATED VALUE Average $	DEPRECIATED VALUE Total $	PRECENT RETURN Ideal	% of Ideal Pres.	% of Ideal Fut.	Gain	VALUE $	ON CRUISE %	ON CRUISE Value $
Outboards	15-20	45	1,800	81,000	14	0	80	11.2	9,070		
	20&up	5	2,800	14,000	14	0	60	8.4	1,180		
Inboards	15-20	5	3,200	16,000	12	0	90	10.8	1,730		
	21-30	2	6,000	12,000	11	0	85	9.35	1,120		
	31&up	-	23,000	-	10	-	-	-	-		
Sterndrives	15-20	7	2,800	19,600	12	0	85	10.2	2,000		
	21-25	4	5,000	20,000	11	0	80	8.8	1,760		
	26&up	-	10,000	-	10	-	-	-	-		
Cruisers	21-30	7	7,600	53,200	9	0	85	7.65	4,070	9	370
	31-40	4	17,700	70,800	8	0	75	6.0	4,250	12	510
	41-50	-	43,200	-	8	-	-	-	-	20	-
	51&up		91,600	-	7	-	-		-	28	-
Aux. Sail	15-20	5	2,500	12,500	9	0	80	7.2	900	-	-
	21-30	2	6,000	12,000	8	0	60	4.8	580	5	30
	31-40	-	18,000	-	8	-	-	-	-	12	-
	41&up	-	37,000	-	7	-	-	-	-	15	-
Sailboats	8-15	5	900	4,500	12	0	90	10.8	490	-	-
	16-20	2	1,800	3,600	12	0	80	9.6	350	-	-
	21-25	1	2,400	2,400	11	0	75	8.25	200	5	10
	26&up	-	4,300	-	10	-	-	-	-	12	-
TOTALS		94		$321,600					$27,700		920

Type of Growth: Straight Line Ef = 0.871 Benefits: ($27,700 - $900) x .871 = $23,300

Growth Period: 6 years

TABLE B-8 BENEFITS TO RECREATIONAL BOATING

EQUIVALENT TRANSIENT FLEET - GROWTH WITHOUT FEDERAL PROJECT

TYPE OF CRAFT	LENGTH (ft.)	No. of Boats	DEPRECIATED VALUE Average $	DEPRECIATED VALUE Total $	PRECENT RETURN Ideal	% of Ideal Pres./Fut.		Gain	VALUE $
Cruisers	21-30	1	7,600	7,600	9	0	95	8.55	650
	31-40	1	17,700	17,700	8	0	90	7.2	1,270
	41-50	-	43,200	-	-	-	-	-	-
Aux. Sail	21-30	1	6,000	6,000	8	0	90	7.2	430
	31-40	1	18,000	18,000	8	0	85	6.8	1,220
Sailboats	21-25	1	2,400	2,400	11	0	85	9.35	220
	26&up	1	4,300	4,300	10	0	80	8.0	340
TOTALS		6		$56,000					$4,130

Type of Growth: Straight Line

Growth Period: 6 years

Ef = 0.871

Benefits: $4,130 x 0.871 = $3,597
Say $3,600

APPENDIX C

LITTORAL DRIFT ESTIMATE

1. In order to determine the amount of drift in the vicinity of Bass River, the method described in Chapter 2, Technical Report No. 4 (TR-4), third edition, published by the U. S. Army Coastal Engineering Research Center, was applied.

2. Variables necessary to compute the drift rate are the average longshore wave energy component, the average number of waves per day, and the angle between the wave crest and the beach. The data shown in Table C-1 adjusted to delete calm and light wind periods was used to determine the average wave from each guadrant. Wave height and length calculations were as indicated in Chapter 1 of the above noted report. Table C-2 summarizes the computations. From the average wave estimates, the wave energy and its longshore component were computed for each quadrant. The occurrence of waves from each quadrant was taken from the wind rose. The wave period was used to determine the annual number of waves from each quadrant. Annual values were converted to an average daily basis in order to use the graph in Figure C-1 which gives longshore littoral transport in cubic yards per day as a function of longshore energy in millions of foot-pounds per day per foot of beach. Table C-3 summarizes the computations of longshore energy per day from each quadrant. Positive energy values indicate west to east energy and negative values indicate east to west energy.

3. The sum of west to east energy values is 8,541,000 foot-pounds per day per foot of beach and east to west energy is 2,497,000 foot-pounds per day per foot of beach. The graph in Figure C-1 indicates drift rates of 11,500 cubic yards per day west to east and 350 cubic yards per day east to west. Converted to annual values, west to east drift is 430,000 cubic yards per year and east to west drift is 130,000 cubic yards per year. This results in a net drift rate of 300,000 cubic yards per year from west to east.

TABLE C-1

WIND SPEEDS AND DIRECTIONS-NANTUCKET, MASSACHUSETTS

AUGUST 1952 - JULY 1957, AUGUST 1958 - JULY 1960, AUGUST 1961 - JULY 1962, INCLUSIVE

Wind Speed M. P. H.	DURATION IN HOURS 0-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	>47	Total Duration Hrs.	Ave. Speed MPH	Wind Movement Miles	% Total Duration	% Total Movement	% Duration Per Degree
DIRECTION															
N	77	513	1,263	1,324	602	226	47	9	3	4,064	14.1	57,419.7	5.8	6.1	0.26
NNE	78	347	852	1,200	643	295	76	17	1	3,509	15.7	55,238.8	5.0	5.9	0.22
NE	103	534	1,073	956	441	167	25	5	1	3,305	12.7	41,825.9	4.7	4.4	0.21
ENE	74	426	937	839	473	145	55	14		2,963	14.1	41,864.1	4.2	4.4	0.19
E	83	391	773	730	328	114	26	8	1	2,454	13.4	32,982.6	3.5	3.5	0.16
ESE	71	351	922	789	380	163	42	6	2	2,726	13.7	37,448.9	3.9	4.0	0.17
SE	60	329	904	657	211	49	16	5	1	2,232	12.4	27,735.8	3.2	2.9	0.14
SSE	54	417	1,520	1,174	309	79	17	1	3	3,574	12.6	44,933.2	5.1	4.8	0.23
S	78	552	1,674	1,242	433	101	19	3	2	4,104	12.8	52,695.2	5.9	5.6	0.26
SSW	56	442	1,862	1,917	623	114	16	4	1	5,035	13.5	68,113.6	7.2	7.2	0.32
SW	87	505	2,683	2,773	583	102	15	4		6,752	13.1	88,199.0	9.6	9.3	0.43
WSW	68	649	2,573	2,985	893	214	43	1		7,426	13.7	101,812.1	10.6	10.8	0.47
W	78	617	1,626	1,540	558	173	54	4		4,650	13.5	62,814.6	6.6	6.6	0.29
WNW	113	820	2,306	2,235	951	306	44	6		6,781	13.7	92,983.9	9.7	9.8	0.43
NW	101	771	1,553	1,664	687	260	37	5	1	5,079	13.3	67,603.4	7.2	7.2	0.32
NNW	62	508	1,530	1,926	759	195	34	1		5,015	14.2	70,977.4	7.2	7.5	0.32
CALMS										414			0.6		
TOTALS	1,243	8,172	24,051	23,951	8,874	2,703	566	93	16	70,083	13.5	944,648.2	100.0	100.0	

TABLE C-2

SUMMARY OF AVERAGE WAVES FROM EACH QUADRANT

Quadrant	Fetch (ft) F	Mean Depth (ft) d	Wind (ft/sec.) U	$\frac{g}{U^2}$	$\frac{gF}{U^2}$	$\frac{gd}{U^2}$	From TR-4 Charts $\frac{gH}{U^2}$	From TR-4 Charts $\frac{gL}{2\pi U^2}$	Wave Height (ft.) H	Wave Length (ft.) L
S	120,000	32	22	.0666	8,000	2.20	0.14	0.32	2.10	30.2
SSW	120,000	32	23	.0609	7,310	1.95	0.14	0.30	2.30	30.9
SW	120,000	28	22	.0666	8,000	1.87	0.14	0.32	2.10	30.2
WSW	78,000	24	24	.0569	4,440	1.37	0.14	0.27	2.46	29.8
W	12,000	2	23	.0609	731	0.122	0.039	0.070	0.64	7.22
WNW	6,000	5	23	.0609	366	0.304	0.052	0.095	0.85	9.79
NW	6,000	5	22	.0666	400	0.333	0.053	0.095	0.80	8.96
NNW	6,000	5	24	.0569	341	0.284	0.051	0.090	0.90	9.96
N	6,000	5	24	.0569	341	0.284	0.051	0.090	0.90	9.96
NNE	6,000	5	26	.0476	286	0.238	0.050	0.088	1.05	11.6
NE	12,000	10	21	.0730	870	0.730	0.090	0.14	1.23	12.1
ENE	30,000	10	20	.0805	2,420	0.805	0.13	0.20	1.62	15.6
E	60,000	18	23	.0609	3,660	1.10	0.135	0.23	2.21	23.7
ESE	54,000	28	23	.0609	3,290	1.71	0.135	0.23	2.21	23.7
SE	54,000	28	20	.0805	4,350	2.26	0.14	0.27	1.74	21.1
SSE	120,000	32	21	.0730	8,760	2.34	0.14	0.33	1.92	28.4

TABLE C-3

LONGSHORE WAVE ENERGY COMPUTATIONS

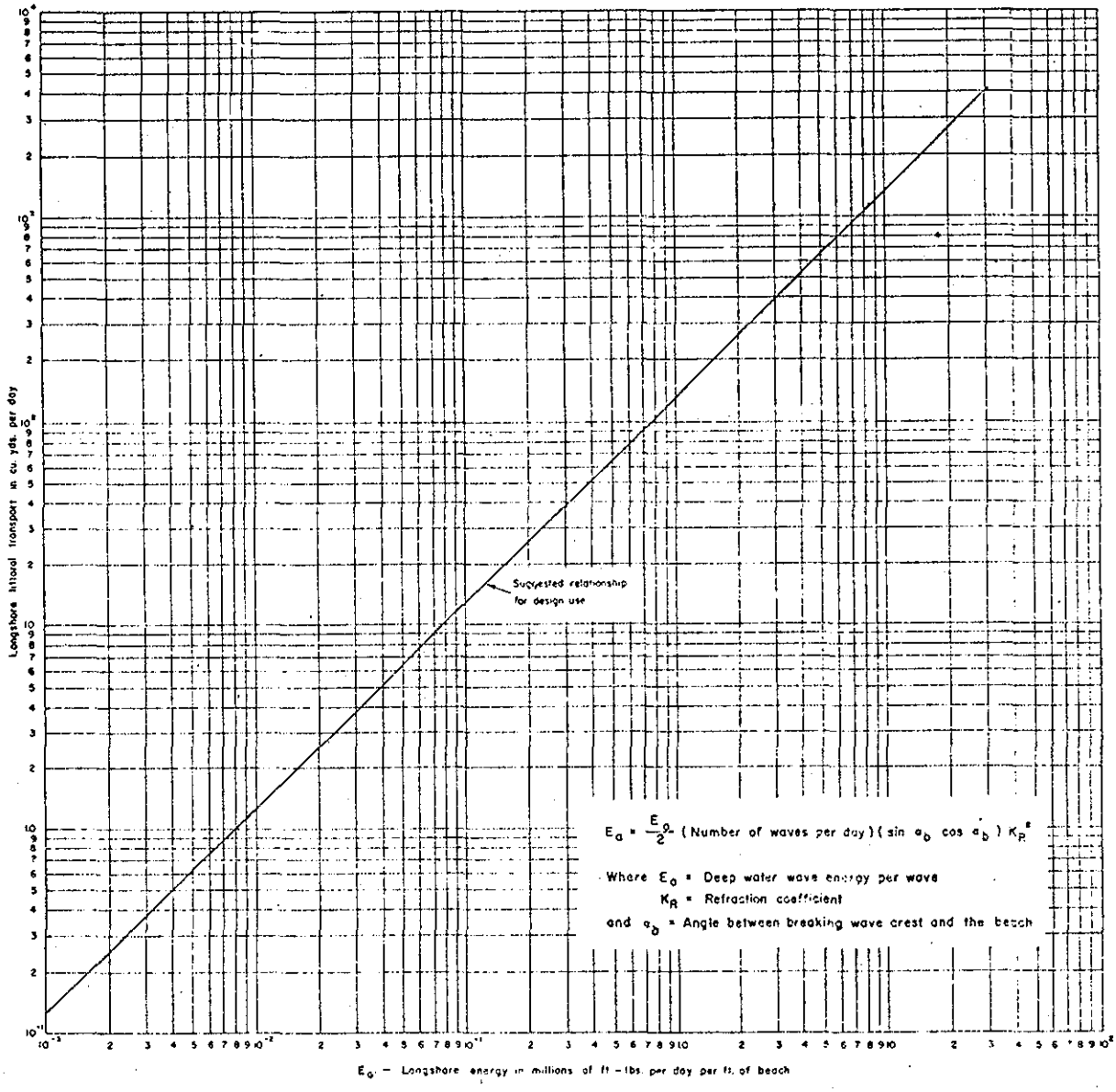
Quadrant	Average Energy per wave (ft. lbs. per ft.)	Longshore Component (ft. lbs. per ft.)	Occurrence per day (Sec.)	Wave Period (Sec.)	Number of waves per day	Longshore Energy per day (ft. lbs./ft. of beach)
S	1,065	408	5,260	3.7	1,422	580,000
SSW	1,308	925	6,220	3.8	1,637	1,514,000
SW	1,065	984	8,570	3.7	2,316	2,279,000
WSW	1,443	1,443	9,330	3.5	2,666	3,847,000
W	24	22	5,840	2.1	2,781	61,000
WNW	57	40	8,570	1.8	4,761	190,000
NW	46	18	6,220	1.6	3,888	70,000
NNW	65	0	6,220	1.8	3,456	0 *
N	-65	-25	5,260	1.8	2,922	-73,000
NNE	-102	-72	4,290	1.9	2,258	-163,000
NE	-146	-135	3,890	2.1	1,852	-250,000
ENE	-328	-328	3,500	2.8	1,250	-410,000
E	-926	-856	2,920	3.2	912	-781,000
ESE	-926	-655	3,300	3.3	1,000	-655,000
SE	-511	-196	2,530	3.0	843	-165,000
SSE	-838	0	4,480	3.7	1,211	0 **

* Sum of positive values 8,541,000 ft.-lbs./ft.

** Sum of negative values -2,497,000 ft.-lbs./ft.

Positive is west to east
Negative is east to west

FIGURE C-1



RELATION BETWEEN LONGSHORE COMPONENT OF WAVE ENERGY AND LITTORAL TRANSPORT RATE

(After Savage, R. P. - "Laboratory Study of the Effect of Groins on the Rate of Littoral Transport," U. S. Army Corps of Engineers, Beach Erosion Board, Tech. Memo No. 114, June 1959).

APPENDIX D

KIRKWOOD B. BROWN, Chairman
DAVID B. LANE, JR.
SARAH A. CAVERLY

Town of Dennis

South Dennis, Mass. 02660

February 11, 1972

Office of
SELECTMEN
ASSESSORS
BOARD OF HEALTH
398-3141
398-6700

Colonel Frank P. Bane, Division Engineer
Department of the Army
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Re: Navigational Improvements to Bass River

Dear Colonel Bane:

The Selectmen of the Town of Dennis have concluded that the Town cannot at this time provide contributions toward the first cost of construction, or the annual maintenance as required in your survey report of navigation improvements to Bass River, Mass. With an increase in budgetary requirements, the Board of Selectmen feel that there are too many other pressing demands on the town's resources to be faced at the coming town meeting, and therefore we do not feel that the town would be able to meet our share of the required contribution at this time.

We understand the recommended improvements to be a channel 6 ft. deep and 100 ft. wide from the 6 ft. contour on Nantucket Sound, 2.8 miles to 1000 ft. above the Route 28 highway bridge, and an anchorage of 28 acres, 6 ft. deep just inside the mouth of the River - the first cost of construction being estimated at $480,000, of which $240,000 would be the federal share, and $240,000 would be provided in combination by the Commonwealth of Massachusetts and the towns of Dennis and Yarmouth. In addition, annual maintenance charges of $88,000 would be borne entirely by state and local governments. Depending upon the State's contribution, the share for each town involved would be between 1/4 and 1/2 of the amount stated for non-federal contributions.

If at some future time the towns of Dennis and Yarmouth feel they can support such improvements, we understand it will be possible to restudy the project in terms of costs and benefits existing at that future date.

With many thanks for your kind services and cooperation, we are

Very truly yours,

Kirkwood B. Brown Chairman
David B. Lane
Sarah A. Caverly
Dennis Board of Selectmen

DBL/dc

TOWN OF YARMOUTH

SOUTH YARMOUTH MASSACHUSETTS

BOARDS OF
SELECTMEN
ASSESSORS
-HEALTH-

February 11, 1972

Colonel Frank P. Bane
Division Engineer
U. S. Army Engineer Division,
New England
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Col. Bane:

The Selectmen of the Town of Yarmouth have concluded that the town cannot at this time provide contributions toward the first cost of construction of the annual maintenance as required in your survey report of navigation improvements to Bass River, Massachusetts.

We understand the recommended improvements to be a channel six feet deep and 100 feet wide from the six foot contour in Nantucket Sound, 2.8 miles to 1000 feet above the Route 28 highway bridge and an anchorage of 28 acres, six feet deep just inside the mouth of the river.

We understand, further, that the first cost of construction is estimated to be $480,000, of which $240,000 is the Federal share and $240,000 would be provided in combination by the state and the towns of Dennis and Yarmouth. In addition, annual maintenance charges of $88,000 would be borne entirely by state and local governments. Depending upon the state's contribution, the share for each town involved would be between ¼ and ½ of the amounts stated for non-Federal contributions.

The Board of Selectmen has decided there are too many other pressing demands on the town's resources to be able to meet our share of the required contribution at this time.

Sincerely yours,

Henry P Darling

Charles W Rogers

Yarmouth Board of Selectmen

26 June 1968

THE TOWNS OF YARMOUTH AND DENNIS DO HEREBY REQUEST THAT THE UNITED STATES OF AMERICA, DEPARTMENT OF THE ARMY, NEW ENGLAND DIVISION, CORPS OF ENGINEERS, MAKE CERTAIN IMPROVEMENTS TO NAVIGATION, INSIDE AND OUTSIDE OF BASS RIVER, CAPE COD, MASSACHUSETTS.

GENERAL DESCRIPTION OF THE IMPROVEMENTS DESIRED ARE:

1. POSSIBLE JETTY WORK EXTENDED BEYOND EXISTING JETTIES, CONTINUING IN A SOUTHERLY DIRECTION INTO NANTUCKET SOUND AS WILL BE ENGINEERED BY THE CORPS OF ENGINEERS.

2. DREDGE AREAS OUTSIDE AND INSIDE TO A DEPTH THAT WILL HANDLE TRAFFIC OF AREA FISHING BOATS AND SIZEABLE PLEASURE CRAFT. THIS DREDGING TO BE AS FAR UP RIVER AS THE NORTHERLY BOUNDARY OF THE BASS RIVER GOLF COURSE.

3. MAKE AVAILABLE FOR PUBLIC FACILITIES THE AREA KNOWN AS "GEORGETOWN FLATS". THIS COVE LIES DIRECTLY IN FRONT OF THE YARMOUTH TOWN OWNED GOLF COURSE, WHICH HAS APPROXIMATELY 1/2 MILE FRONTAGE.

4. DREDGE A MOORING AREA EAST OF STAGE ISLAND ON TOWN OF DENNIS OWNED LAND WITH PLANS FOR FUTURE EXPANSION.

LARGER VESSELS ARE FORCED TO FOLLOW A VERY NARROW CHANNEL FROM ABOUT 1/2 MILE OUTSIDE THE MOUTH ALL THE WAY TO THE BRIDGE, AS THE RECENT DREDGING BY THE STATE WAS DONE ONLY TO A DEPTH OF SIX FEET AND 100 FT. IN WIDTH.

OUTSIDE THE MOUTH, CROSS CURRENTS CONTINUALLY FILL IN THE CHANNEL AND BEFORE NEW DREDGING PROJECTS CAN BE IN OPERATION, BOATS LAY ON THEIR SIDES WHILE WAITING FOR THE TIDE TO RISE.

SAND BARS HAVE FORMED IN MANY AREAS INSIDE THE RIVER, MAKING A LARGE PERCENTAGE OF THE RIVER NOT NAVIGABLE TO MANY VESSELS AND THEREBY CURTAILING THE ACTIVITIES OF AN OTHERWISE NATURAL HARBOR.

BASS RIVER, WITH ITS UPPER PONDS, NEARLY CUTS THE CAPE IN HALF AT THIS POINT MAKING A WATERWAY IN EXCESS OF 6 MILES. RECENTLY, THE TOWN OF YARMOUTH MADE APPLICATION TO THE FEDERAL GOVERNMENT, DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT FOR A STUDY AS TO THE POSSIBILITY OF MAKING BASS RIVER, ITS UPPER PONDS, STREAMS, ETC., A CANAL. THE CANAL STUDY WAS APPROVED BY YARMOUTH TOWN MEETING, THE YARMOUTH BOARD OF SELECTMEN, THE MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS, AND THE CAPE COD PLANNING AND ECONOMIC DEVELOPMENT COMMISSION AND WAS TO HAVE BEEN A $56,000 STUDY PROJECT. DUE TO PRESIDENT JOHNSON'S CUT BACK ON CERTAIN PROJECTS, WE RECEIVED NOTICE OF REFUSAL OF THE STUDY, BUT WERE INVITED TO REAPPLY AT A LATER DATE. THE CANAL JOB WAS TO HAVE BEEN AN ESTIMATED $6,000,000 PROJECT. WE FEEL THAT THE RIVER IS NOT USED TO ITS FULLEST AND BEST USE.

THE BRIDGE AT ROUTE 28 LIMITS THE SIZE OF VESSELS THAT NORMALLY COULD CONTINUE IF IT DIDN'T EXIST. THE COVE (GEARGETOWN FLATS) CREATES A NATURAL AREA FOR A MUNICIPAL MARINA SERVING BOATS UP TO APPROXIMATELY 25 FEET. THIS WOULD SERVE MANY, MANY BOATS AND WOULD MAKE USE OF A PRESENTLY STAGNANT AREA.

THE RIVER HAS THREE PRIVATE MARINAS - ONE BELOW THE BRIDGE AND TWO ABOVE. THEY ARE PRIVATELY OPERATED, AND SERVICE BOATS WITH FUEL AND MAINTAIN MECHANICS FOR REPAIRS. THESE YARDS MAKE STORAGE AVAILABLE FOR BOATS DURING THE WINTER SEASON AND HAVE EITHER RAILWAYS OR TRAVEL-LIFT

INSTALLATIONS FOR HAULING. THEY HAVE GRADUALLY EXPANDED THEIR FACILITIES AND ARE VERY ACTIVE FROM APRIL 1ST TO NOVEMBER 1ST EACH YEAR.

BOTH DENNIS AND YARMOUTH HAVE PUBLIC PIERS WHICH ARE AVAILABLE TO ANYONE AND BOTH TOWNS HAVE IN EXCESS OF TWENTY WAYS TO THE WATER WHICH ARE OPEN TO THE PUBLIC.

THE AREA EAST OF STAGE ISLAND IS PARALLELED BY A ROAD WHICH SERVICES THE OUTER BEACH, WHICH IS ABOUT ONE MILE LONG.

THE MASSACHUSETTS DEPARTMENT OF NATURAL RESOURCES, PUBLIC ACCESS BOARD, IS NOW PREPARING PLANS FOR A BOAT RAMP AT BASS RIVER BEACH, SOUTH YARMOUTH, WITH PARKING FOR 100 CARS AND TRAILERS. THE CONSTRUCTION OF THIS INSTALLATION HAS BEEN PROMISED IN 1968 AND WILL TREMENDOUSLY INCREASE THE BOATING ACTIVITY ON BASS RIVER. THE TOWN OF DENNIS ALREADY HAS BOAT RAMPS AVAILABLE TO THE PUBLIC.

COMMERCIAL FISHERMEN AND PARTY-BOATS HAVE BEEN HELD TO A MINIMUM BECAUSE OF LACK OF WATER, UNTIL THE RECENT DREDGING, AND SINCE THIS WAS DONE THERE HAS BEEN AN INCREASE IN THE TYPE OF BOATING. IF THE RIVER WAS ACCESSABLE AT ALL TIDES, IT IS OUR OPINION THAT MORE AND LARGER FISHING BOATS WOULD USE THE RIVER AS THEIR HOME PORT. COMMERCIAL CRAFT USING THE RIVER AT PRESENT ARE IN THE 30 TO 40 FOOT CLASS AND ARE EITHER MOORED SOUTH OF THE BRIDGE OR AT PUBLIC AND PRIVATE DOCKS. THEIR SEASON IS FROM EARLY SPRING UNTIL FREEZE-UP IN THE WINTER. IF COMMERCIAL FISHERMAN COULD USE THE RIVER AT ALL TIDES, IT WOULD NOT BE NECESSARY TO SEEK OTHER HOME PORTS. THIS WOULD AUTOMATICALLY INVITE OTHER FISHERMEN AND PLEASURE CRAFT VISITING ALONG THE COAST AND WOULD CONTRIBUTE TO THE ECONOMY OF THE LOCAL MERCHANTS.

PLEASURE CRAFT OWNERS FROM ALL OVER THE COMMONWEALTH, PLUS OUT OF STATE OWNERS, STORE THEIR BOAT EACH WINTER AND ADDITIONAL BOATS WOULD BE STORED, REFURBISHED AND REPAIRED IF THE RIVER WAS IMPROVED, THUS ADDING TO THE GENERAL ECONOMY OF THE IMMEDIATE TOWNS.

THE TOWNS OF YARMOUTH AND DENNIS TOTAL ASSETS ARE ABOUT $200,000,000 AND THE ESTIMATED VALUE OF BOATS USING THE RIVER WOULD BE AT A MINIMUM IN EXCESS OF $2,000,000.

TO SUM UP OUR REMARKS, WE FEEL THAT BASS RIVER IS A NATURAL HARBOR. WE CANNOT, AS TOWNS, PROPERLY DEVELOP THE RIVER, BUT WE ARE WILLING TO DO OUR PART. IF PROPERLY DEVELOPED, THE RIVER WOULD BE A TREMENDOUS HARBOR, A REFUGE FOR VESSELS, A NAVIGABLE, USEABLE AND PROTECTIVE HARBOR. WE EARNESTLY REQUEST THAT THE FEDERAL GOVERNMENT WILL AGREE WITH US AND IMPROVE IT FOR THOSE WHO ARE NOW USING IT, AND FOR THOSE WHO WOULD SEE FIT TO, IF IT WAS MADE USEABLE.

John G. Sears	Kirkwood B. Brown
Howard W. Marchant	Nathaniel H. Wixon
Henry R. Darling	Elias C. Terpos
Yarmouth Selectmen	Dennis Selectmen

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
U. S. POST OFFICE AND COURTHOUSE
BOSTON, MASSACHUSETTS 02109

January 28, 1969

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

Dear Sir:

This is our preliminary report on your plan for navigation improvements in Bass River, Dennis-Yarmouth (Barnstable County), Massachusetts. The study is being made under authority of a Resolution adopted 24 June 1965 by the U. S. House of Representatives Committee on Public Works. This report was prepared under the authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661-666 inc.), in cooperation with the Massachusetts Division of Marine Fisheries and Division of Fisheries and Game and has their concurrence as indicated by letters dated January 2 and 6, 1969 respectively, The report has also been coordinated with and represents the views of the Bureau of Commercial Fisheries.

We understand that consideration will be given to the following improvements:

1. Dredging an entrance channel 100 feet wide and six feet deep from that depth in Nantucket Sound to the Highway 28 bridge in South Yarmouth.

2. Extending the existing jetty on both the north and south ends an undetermined length.

3. Dredging a relatively long, narrow mooring basin perpendicular to and east of the navigation channel between Davis Beach and Wrinkle Point.

Bass River is currently navigable and utilized almost exclusively by recreational boats.

Summer flounder and scup occupy the existing channel within the project area and striped bass, bluefish and tautog frequent the channel's mouth in Nantucket Sound. It is not uncommon for fishermen to catch striped bass during the day and flounder at night in the same location.

Marshland on the east side of the channel provides excellent habitat for waterfowl, primary black ducks, during spring and fall months. Other migratory species use these wetland areas during spring and fall, and some birds remain in the area throughout the winter months.

Dredging of the channel and adjacent narrow mooring area near the mouth is not expected to adversely affect fish and wildlife so long as there is no infringement upon the marsh area and mud flats on the east side of the river in the vicinity of Wrinkle Point. There is a possibility that channel dredging will create more favorable habitat for striped bass, bluefish and tautog by creating a deep channel close to shore. As these predator species feed on the abundance of food fishes near the river's mouth, shore-based fishermen will have greater opportunity to catch them.

Extending the jetty seaward on the east side of the channel is also expected to improve sport fishing provided such features as a smooth walking surface, safety handrail and adequate access are included as part of the project.

Based on our preliminary findings we recommend:

1. That valuable marshland on the east side of the river not be dredged or used for spoiling.

2. That spoil undesirable for beach fill be either dumped on an approved off-shore dumping area or placed above mean high water and suitably diked to prevent re-entry into the water.

We will undertake further studies to determine whether significant fishery benefits will accrue to the project and whether modifications in project plans will be necessary to preserve existing resources. Our studies will be coordinated with yours and the findings reported in a conservation and development report.

Sincerely yours,

Richard E. Griffith

Regional Director

Edward A. Loomer

REALTOR

ROUTE 28, WEST DENNIS, MASS. 02670

Telephone 398-8261

June 25, 1968

The Division Engineer
U. S. Army Engineer Division, New England
Corps of Engineers
424 Trapelo Road
Waltham, 54, Massachusetts

Dear Sir:

I wish to go on record as being in favor of having improvements made to the boating facilities in Bass River.

For one thing, the chanel leading in to the mouth of the river has consistently needed widening and deepening. Whether that means that more jetty construction is necessary is an engineering problem beyond my ken, but I do know, from using the river and from conversation with fishermen and others, that boats of much over 30 feet are apt to have difficulty entering the river at other than high tide. Bass River, being the only navigable river on Cape Cod for any distance, should be able to accommodate vessels in the 50-70 foot range. In other words, many commercial fishermen and others have to use other ports. They would use Bass River if it were possible.

For another thing, because of the rapid increase in boating activity in the area, additional mooring and docking facilities are becoming necessary. The Town of Dennis has provided seven public landings below High Bank Bridge. However, because of increased boating traffic, these landings are becoming inadequate. I would be in favor of the Town contributing its share to their improvement.

I cannot stress enough the fact that the present facilities for boating, both commercial and recreational, in Bass River are inadequate and are becoming more serious each year.

Very truly yours,

Edward A. Loomer

Edward A. Loomer, Realtor
and Assistant Harbormaster
TOWN OF DENNIS

EAL/mbp

June 3, 1968

The Division Engineer
U.S. Army Engineer Div.
New England Corps of Engineers
424 Trapelo Road
Waltham 54, Mass. 02154

Dear Sir;

It has come to my attention that you are considering dredging the Bass River and converting it into a usable all weather harbor.

I am in favor of this project for the following detailed reasons.

For the Bass River the most important part of this project would be the establishment of a permanent channel of 8-10 feet in depth and at least 30 to 40 feet in width. Our channel was dredged in the fall of 1966. We had one year (1967) when we could come and go as we wished at any time regardless of the tide. This year (1968) bars are building so that we will have to limit our arrivals and departures to half tide or better. Dredging without the necessary jetties to make the channel permanent has been a very expensive venture for the taxpayers. It would also be useful if we had 8 - 10 foot deep mooring areas and would relieve the present crowded conditions in our existing mooring areas.

I own and operate for my own pleasure and charter fishing parties a 38' X 4' draft power boat. At present I will go aground at half to low tide. A channel of 2 - 3 feet depth is also very dangerous to run in rough weather. Over the years I have gone aground many times and could have damaged my boat.

My boat represents an investment of $20,000 and if we had an adequate channel I could use it at least twice as much as I do now since I can only go into the sound when the tide is favorable.

Anything that improves the boating in Bass River improves the vacation recreation business on Cape Cod. Even people who don't actively participate like to watch.

Finally I think that Bass River could be one of the best Harbors of Refuge on Cape Cod. In a bad blow it would provide good moorings for hundreds of boats. The banks are high enough in most parts of the river to provide lees protected from the wind. I know of no other harbor that will provide this kind of refuge on the Cape.

Very truly yours,

Carl Buck

Carl Buck
112 Old Main St.
Bass River, Mass.

Davenport Realty Trust

SOUTH YARMOUTH · CAPE COD · MASS.

TRUSTEES
JOHN K. DAVENPORT
PALMER DAVENPORT

PHONE
398-2293
20 NORTH MAIN STREET

May 31, 1968

Department of the Army
New England Division, Corps of Engineers
424 Trapelo Road
Waltham,
Massachusetts 02154

Re:NEDED-R

Gentlemen:

Thank you for the opportunity to go on record of Navigation Improvements for Bass River contained in your notice reference NEDED-R.

There is a positive need of improvement in this river as it helps support the number one industry on Cape Cod, namely tourists, recreation and vacation requirements, plus some commercial fishing and charter boat work.

My knowledge of boating on Bass River covers some 55 years. At present I am a member of the U.S.C.G. Auxiliary with the facility of a well founded 38 foot sport fisherman.

As to the improvement in the river, at present it seems adequate for the uses it now serves. A maintenance program to keep the channel at six to seven feet in the river plus a channel through the east west fingers bars up to a quarter of a mile off shore from the jetties is needed.

An accrual budget for Federal, State, County and Villages could be set up to carry out a maintenance program. Accurate figures can be obtained from the dredging company that did this job two years ago. The difficulties are a build up of occasional bars in the river and most of all two finger bars just outside the river that need cleaning out every four to five years.

The alternate of groins and jetties at millions of dollars does not seem feasible as long as the South Yarmouth and Highbank bridges are fixed and not draw bridges.

The commercial fishing is important and others can supply figures. The sport fishing from the boats docked in the

river is from swordfishing and white marlin to stripers, blues, cod, haddock, pollack, flounders and many other smaller fish enjoyed by the old and especially the young.

As the river is a safe harbor for small boats in bad weather, it is used frequently for temporary shelter - this river could be a harbor of refuge.

We own a 38 foot sport fisherman, with tuna tower, well equipped with electronic and fishing equipment. It is moored at a dock and float at my residence, Davenport Road and Bass River in West Dennis.

Our business is Real Estate and developers and we have two Inns, Golf Course and other interests. The boat is used in business for promotion, prospects, etc.

It is trite to repeat that the last few years boating has grown by leaps and bounds but this factor points to the growing needs for Cape Cod's number one industry - namely tourisim.

We feel it is imperative that Federal, State, County and Village monies be allocated to a budget for continual maintenance.

Yours very truly,
DAVENPORT REALTY TRUST

John K. Davenport
Treasurer-Trustee

JKD/eh

B A S S R I V E R Y A C H T C L U B

July 28, 1969

U.S. Army Engineer Div., New England
Corps of Engineers
424 Trapelo Road
Waltham 54
Massachusetts

Gentlemen:

Enclosed is the completed Yacht Club Information sheet you requested with respect to the survey you propose for Bass River in South Yarmouth, Mass.

I have not filled in the other forms as I am not familiar with the Fishing, Boat Yard, etc., data. This would be better left to someone more qualified.

I did not receive the Navigation Questionnaire, Form 1, referred to in your notice, but would be pleased to file one if you will forward it.

I would like to go on record with respect to two key issues relating to the use of Bass River for boating purposes:

1. The main channel from the Lighthouse jetty to the Route #28 bridge is reasonably adequate (with one or two exceptions) for sailing and power boats drawing up to 5'-6'. However, from the Lighthouse jetty seaward to channel marker #4, the channel continues to fill in rapidly even after having been recently dredged. At low tide it is not uncommon for boats drawing $3\frac{1}{2}$'-4' to bottom midway between channel marker #4 and the Lighthouse. This precludes boats of this size from using the channel for two hours either side of low tide.

2. Recreational boating has grown to such an extent on Bass River that it is now becoming very crowded and, at times, dangerous for the small boats, particularly on weekends.

   There are two Yacht Clubs using the river for racing and sailing, with a total fleet numbering 60. It has become almost impossible to safely conduct a race inside the river with the many outboards converging from all points. When the racing fleets are attempting to enter the river mouth from the saound at the same time the power boats are converging on the entrance, a very dangerous situation develops.

The launching ramp, recently constructed adjacent to the lighthouse, has added to the congestion. In my opinion very poor judgement was exercised in placing this ramp in this particular location. The ramp leads immediately into the main channel, at the river's narrowest point, where the tide runs strongest and at the point where all boats must converge to enter or leave the river.

3. The dredging done in the last 15 years has created an erosion of the river banks in some areas which has created a problem for some property owners, as well as accelerating the filling in of the channel. In one area, due north of the lighthouse jetty, an old wood and concrete bulkhead has deteriorated and the banking behind it has been eroded to a depth of 20'-30'. This area was just recently refilled with sand pumped out of the launching ramp previously mentioned. Perhaps this erosion is due to some other phenomenon, but it has become noticeably worse since the river was dredged in recent years.

In conclusion, the river does need dredging and some protection to maintain a deep channel. At the same time, I feel that as a waterway for boating, it is becoming saturated and nothing should be done to promote any sizeable increase in the number of boats using the river.

Sincerely yours

Henry C. Gill, Jr.
Commodore

Bass River Yacht Club
Pleasant Street
South Yarmouth
Massachusetts

HCG:jms

BASS RIVER HARBOR, MASSACHUSETTS

Information Required by Senate Resolution 148, 85th Congress, Adopted 28 January 1958

1. Navigation Problems. The Commonwealth of Massachusetts has dredged a channel 7 feet deep and 100 feet wide from deep water in Nantucket Sound into Bass River, 1.8 miles upstream to the Route 28 highway bridge. Due to littoral drift and tidal action, a sand bar forms across the channel about 1,000 feet offshore in Nantucket Sound. The controlling depth at mean low water is reduced to about 2 feet. This restricts many of the locally-based boats from crossing the bar until the tide is high enough for them to clear the bar. The State has re-dredged the channel several times during the past 20 years, but the bar has always reformed within a few years.

2. Improvements Considered. All considered plans of improvement included the existing channel to a depth of 6 feet from Nantucket Sound to 1,000 feet north of the Route 28 highway bridge. Several alternate methods of dealing with the offshore sand bar were considered. First, as requested by local interests, channel stabilization by extending the existing jetties was investigated. Costs and benefits for extensions from 500 feet to 4,000 feet were estimated in increments of 500 feet. All were found to be economically infeasible due to the high cost of jetty construction. In addition, the longer jetty extensions would cause serious beach erosion to the east of Bass River. The only apparent alternative was a program of regular maintenance to keep the channel open. This proved to be economically justified. In addition, to provide for anticipated increases in the fleet size resulting from normal fleet expansion and from an improved navigation channel, additional anchorage areas were considered. These ranged in size from 12 acres to 56 acres. An anchorage of 28 acres in the deepest existing areas resulted in the optimum plan. Dredging depths and costs in other areas become too great to justify providing for the related additional fleet expansion. Improvements beyond 1,000 feet north of Route 28 were considered, but existing depths are very shallow and the extensive dredging and high cost involved in providing adequate anchorage precluded any work in that area.

3. Improvement Recommended. The proposed improvement provides for a channel 6 feet deep and 100 feet wide from deep water 0.8 miles out in Nantucket Sound into Bass River, 2.0 miles upstream to 1,000 feet north of the Route 28 highway bridge. Total channel length is 2.8 miles. It also provides for 28 acres of anchorage, 6 feet deep inside the river mouth, in the vicinity of Marsh Island. An integral part of the project is provision for frequent maintenance dredging, especially for the sand bar which forms across the channel about 1,000 feet offshore in Nantucket Sound.

4. First Cost of Improvement. The estimated first cost of construction is based on prices for similar work in the area as of April 1971. Detailed costs are:

Corps of Engineers:

Dredging	$ 362,000
Contingencies	55,000
	$ 417,000
Engineering & Design	33,000
Supervision & Administration	30,000
Total First Cost of Construction	$ 480,000

U. S. Coast Guard:

Navigation Aids	17,000
Total Project Costs	$ 497,000

5. Annual Costs. Annual charges are based on an anticipated 50-year project life and an interest rate of 5.375 percent. Detailed annual charges are:

Corps of Engineers: - Dredging

Interest & Amortization	$ 28,000
Annual Maintenance	88,000
Total	$ 116,000

U. S. Coast Guard: - Aids to Navigation

Interest & Amortization	$ 1,000
Annual Maintenance	1,000
Total	$ 2,000
Total Annual Charges	$ 118,000

6. Annual Benefits. Benefits resulting from the project stem from increased usage of the existing recreational fleet and from providing anchorage for fleet expansion in an otherwise crowded waterway. Annual benefits are estimated to be $260,800.

7. Benefit to Cost Ratio. Annual benefits of $260,800 and annual charges of $118,000 result in a benefit-cost ratio of 2.2 to 1.0.

8. Apportionment of Costs and Local Cooperation. The benefits resulting from the project are recreational in nature and are considered to be local benefits. Accordingly, local interests are required to contribute 50% of the first costs and provide for all maintenance charges. These are currently estimated to be $240,000 for first costs and $88,000 annually for maintenance. Local interests must meet the following requirements:

a. Contribute 50 percent of the first cost of construction of the Federal project, currently estimated to be $240,000;

b. Provide, without cost to the United States, all lands, easements and rights-of-way required for construction of the project and for construction and maintenance of aids to navigation, upon request of the Chief of Engineers;

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

d. Provide and maintain without cost to the United States, necessary mooring facilities and utilities including a public landing with suitable supply facilities open to all on equal terms;

e. Establish a competent and properly constituted public body empowered to regulate the use, growth and free development of the river facilities with the understanding that said facilities will be open to all on equal terms;

f. Perform or contribute the cost of performance of the operation and maintenance of the project in accordance with regulations prescribed by the Chief of Engineers. Local interests may request the Corps of Engineers to accomplish the maintenance work with funds provided by local interests.

9. Discussion. The project is economically justified based on data in the report and criteria for similar projects. However, local interests have been consulted and have indicated that they are not able to comply with the required items of local cooperation. Accordingly, no Federal project can be recommended for Bass River Harbor at this time.