# DESIGN MEMORANDUM

ON

# MATINICUS HARBOR, MAINE

(MINOR REHABILITATION BREAKWATER)

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND

CORPS OF ENGINEERS

WALTHAM 54, MASSACHUSETTS

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
424 Trapelo Road
Waltham 54, Mass.

Refer to File No. NEDGW 16 May 1961

SUBJECT: Design Memorandum on Matinicus Harbor, Maine - (Minor Rehabilitation of Breakwater)

TO: Chief of Engineers
Department of the Army
Washington 25, D. C.
ATTENTION: ENGCW-E

1. In accordance with EM 1110-2-1150. Engineering and Design, Definite Project Studies, and letter ENGCW-E, dated 24 August 1960, "Rehabilitation Projects - Definite Project Studies", there are inclosed four (4) copies of the design memorandum on the subject project. The work involved is the repair of the breakwater at Matinicus Harbor, the cost of which falls within the scope of projects defined as minor rehabilitation projects.

2. In accordance with the above-referenced authority, the design memorandum is approved. With funds in the amount of $60,000 to be allocated in Fiscal Year 1961, it is proposed to advertise the work in May 1961. Work is scheduled to be started before the end of the current fiscal year.

1 Inclosure -
Design Memo (in quad)

SEYMOUR A. POTTER, JR.
Brigadier General, USA
Division Engineer

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CORPS OF ENGINEERS
424 Trapelo Road
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NEDGW

16 May 1961

DESIGN MEMORANDUM ON MATINICUS HARBOR,
MAINE (MINOR REHABILITATION - BREAKWATER)

## PERTINENT DATA

1. A summary of physical features and costs of the repairs to the existing Federal breakwater at Matinicus Harbor, Maine is as follows:

| Features | Present Estimate (1961) |
|---|---|
| Repair to existing breakwater to restore structure for project purpose | $60,000 |

## PROJECT AUTHORIZATION

2. The existing project, authorized by the River and Harbor Act of 27 June 1910, provides for a rubblestone breakwater extending from Youngs Point on Matinicus Island to Indian Ledge, a distance of about 450 feet.

3. The breakwater was completed to project dimensions in 1911. Total Costs incurred under the existing project to 30 June 1960 amount to $22,413 of which $14,000 was expended for new work and $8,413 for maintenance work.

## INVESTIGATIONS

4. History of the Breakwater. - Basically, the existing breakwater resulted from a study made in 1875 at which time a system of 4 breakwaters was considered and various combinations of the 4 breakwaters were found to be practical. No improvement resulted from the study. A review of the 1875 study made in 1907 - 1908 and printed in House Document No. 653, 60th Congress, 1st Session found that Breakwater No. 1 described in the early report would provide refuge for the fishing interests centered in the locality from the destructive easterly storms, and that such a breakwater could be constructed at a cost of $13,000 or 60% of that estimated in the early report. In view of the small amount involved and the importance of the fishing fleet to the inhabitants of Matinicus Island, a breakwater

extending from Youngs Point to Indian Ledge was recommended and subsequently authorized by the River and Harbor Act of 1910. The breakwater was constructed and completed in 1911 at a cost of $14,000 to the following dimensions:

| | | |
|---|---|---|
| Length | - | 450 feet |
| Top width | - | 10 feet |
| Top elevation | - | 15 feet above mean low water |
| Side slope | - | 1 on 1.5 |
| Stone placed | - | 9,078 tons |

5. Maintenance work was first performed in 1934 when the top of the structure had reduced to an elevation of 12 feet above mean low water. At that time approximately 1,500 tons of stone, about 15-18 tons in size, were placed in the breakwater. In view of the size of the stone used an irregular surface resulted having an average top elevation 4 to 5 feet above project height. The cost of the maintenance work was about $8,000.

6. Surveys to determine the present condition of the breakwater were made in 1961. The cross sections and profile of the breakwater indicate a very irregular surface ranging from 13.5 feet to 20 feet above mean low water. There are two breaks in the breakwater, one at the outer end and one at the inner end where the breakwater ties to the natural ledge.

7. Suitability of Design as Constructed. - The breakwater was originally authorized and constructed to provide a secure inner harbor in which the fishing fleet could take refuge during easterly storms. These storms are destructive, causing much damage, and causing waves to surge into the harbor with tremendous force, oftentimes driving the fishing craft ashore and even endangering wharves and building. Since the entire island economy and existence of the community is dependent upon the harbor, the necessity for the breakwater to provide a protected harbor is paramount. Although the breakwater as constructed served the purpose of providing protection to the harbor, it is considered that sufficient protection has not been provided, especially during severe storms. It is to be noted that the structure considered in the 1875 study was much more substantial than the breakwater actually constructed. The lesser breakwater was selected on the basis of a lesser cost. In view of present criteria for breakwater design, it is determined that the height to which the breakwater was constructed is not sufficient to provide adequate protection during severe easterly storm, at times when protection is greatly and most urgently needed.

8. Data and Criteria Used in the Design Developed for Repair of the Structure. - Wave refraction studies were not made to select a design wave. It was considered that a design wave could be reasonably established from hindcast

statistics in Technical Memorandum #55 for Station A off Penobscot Bay, Maine. Analysis of the tables for easterly storms indicate that wave heights up to 12 feet can be expected a significant number of times but for waves higher than 12 feet the percentage of time during which these larger waves would occur dropped sharply. The depths of water to the east of the breakwater range from 0 to 6 feet for a distance of about 250 feet, and generally averages 5 feet deep. The mean range of tide is 9.0 feet and the spring range is 10.4 feet. It is considered that existing conditions to the east of the breakwater would support waves up to a maximum of (5 + 10.4 x .78) or 12.0 feet. A design wave of 12.0 feet is, therefore, selected.

9. In order to maintain the repaired breakwater as near to the original design section as possible, the size of the cover stone is computed on basis of slopes of 1.0 to 1.5. Using the Wes-Hudson formula

$$Wr = \frac{Wsr\ H^3}{K_{\Delta}(Sr - 1)^3 \cot a}$$

for stone weighing 165 lbs. per cu. ft. with a K of 2.5 the cover stone is determined to be 5 feet thick weighing 10 tons. The required crest width, 2 stones wide, would be 10 feet. Riprap stone up to 15 tons is available within reasonable distance of the site. Contractors skilled in constructing riprap breakwaters and equipment capable of handling the proposed size of stone are available so that this type of structure is economical for this area.

10. The existing height is generally about 18 feet above mean low water as obtained through repair work in 1934. Based on the design wave of 12 feet, the height of the structure should be 27 feet (9 ft. tide plus 1.5 wave height) to provide for maximum protection under all tidal condition. Consideration of the project height of 15 feet, indicates that the maximum protection is attained for waves 4 feet or less. Construction of the breakwater to the previously attained elevation of 18 feet will provide complete protection against waves up to 6 feet. In view of the frequency of wave heights up to 6 feet, as compared to those 4 feet high and those in excess of 6 feet it is considered that the height of 18 feet should be restored throughout the length of the breakwater to provide protection against the larger waves and for longer periods of time. This height will reduce wave overtopping and reduce wave action in the anchorage. In addition, the height of 18 feet will provide for sufficient advance maintenance that will reduce the amount and frequency of overtopping by waves with a resultant decrease in the amount and frequency of maintenance work than would be required for the original project design of 15-foot height.

11. Proposed Design for Rehabilitation of the Breakwater. - The selected design for rehabilitation is a riprap mound with a crest width of 10 feet at elevation 18 feet above mean low water and side slopes of 1.0 to 1.5 constructed with stones up to 10 tons placed on top and on the harbor side of the existing structure. The largest stone will be used to fill in the breaks in the existing structures and for armor with smaller stone ranging down to a minimum of 3 tons being used to fill the larger voids in the existing slopes and to provide proper interlocking of the Armor stone. This design is considered to be a practical way to provide protection originally intended by the original structure at a minimum of cost.

12. Necessity for Repairs. - There is no indication that the need for a breakwater in this location will change. Since the existence of the community on the island is dependent upon its harbor for communication, and supplies to and from the mainland and since its primary industry and economy is dependent upon an adequately protected harbor, continued effective protection by the breakwater is necessary and essential.

## LOCAL COOPERATION

13. No requirements of local cooperation were prescribed when the breakwater was authorized in 1910.

## LOCATION AND TRIBUTARY AREA

14. Matinicus Harbor is located on Matinicus Island, part of a group of islands in the Atlantic Ocean about 17 miles southerly of the mouth of Penobscot Bay, Maine. The nearest mainland port is Rockland Harbor, 20 miles to the northwest. Matinicus Isle Plantation comprises the entire area of Matinicus Island and five small adjacent islands. In 1960, it has a population of 100. The community's principal source of income is derived from lobstering. For communication with the mainland, the communities depend principally on a diesel powered 60-foot vessel which runs from Rockland to Criehaven, via Matinicus. Lobster smacks having a cargo capacity of about 20,000 pounds also operate between the islands and the mainland ports of Port Clyde, Tenants Harbor and Rockland. The communities depend on oil for heat, light and cooking, and on gasoline for the chief motor fuel for the lobster fishing fleet. Small coastal tankers deliver oil and gasoline from Rockland.

## PROJECT PLAN

15. The project plan consists of rehabilitation of the existing breakwater to an elevation of 18 feet at mean low water by placing stone riprap on

the harbor side of the existing structure and filling in the gaps at the inner and outer end. Top width of 10 feet at elevation 18, and side slopes of 1 on 1.5 will be provided. Stone to be used will range from 3 tons to 10 tons with 75% of the stone in excess of 8 tons. The larger stones will be used to fill the gaps at the inner end between stations 0 + 60 and 1 + 35 and at the outer end between Station 4 + 70 and 5 + 65 and also as cover stone for remainder of the breakwater. The small stone will be used to fill the voids between the existing irregular harbor side of the breakwater and the cover stone to achieve as much interlocking as possible. The project plan is shown on the attached plan and cross sections of the existing and proposed breakwater repairs.

## COST ESTIMATES

16. The estimate of cost of repairing the breakwater is based on the volume of materials required to achieve design dimensions as determined from a cross-section survey made in April 1961 and unit prices obtained during 1960-61 for similar work. The amount of stone to be placed to design dimension is 4,100 tons.

Contract

| | |
|---|---|
| 4,100 tons @ 12.00/Ton = | 49,000 |
| Contingencies | 5,000 |
| | 54,000 |
| Engineering & Design | 1,000 |
| Supervision and Administration | 5,000 |
| Total | $60,000 |

## SCHEDULE FOR DESIGN AND CONSTRUCTION

17. Field investigation consisting of profiles and cross sections were completed in April 1961. Design studies are complete and preparation of standard plans and specifications are about 80% complete. Invitation for bids will be issued 19 May 1961 with construction scheduled to begin by 1 July 1961. Construction of the breakwater repair is proposed to be completed within 60 days.

18. Funds in the amount of $60,000 required to repair the breakwater to design dimensions are to be allocated in FY 1961.

## BENEFITS

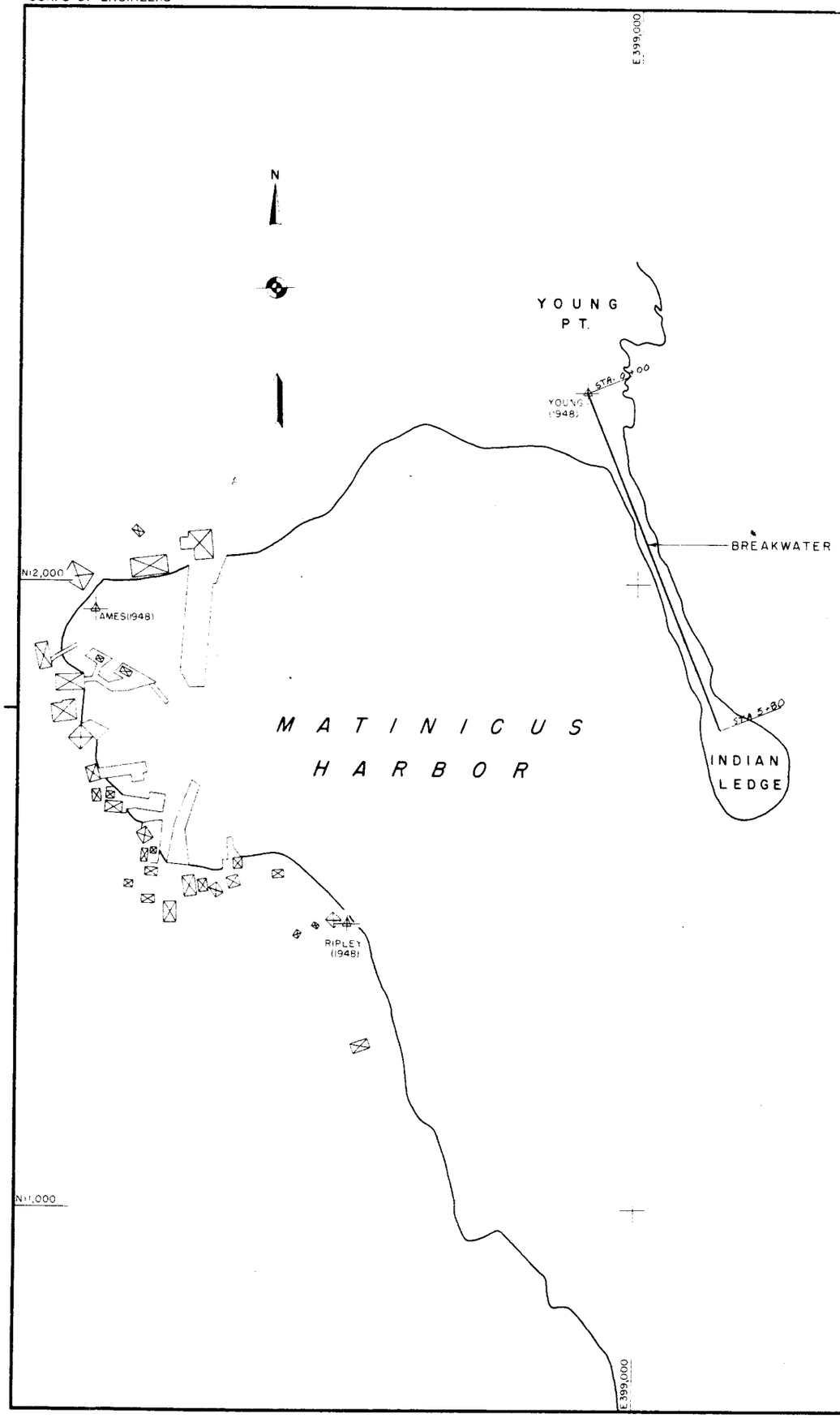
19. The economy of Matinicus Island is entirely dependent upon fishing which in turn depends upon protection offered by the harbor and breakwater. The physical and geographical location of the island is such that a sound structure is required to provide necessary shelter from easterly and northeasterly storms. More than 30 commercial lobstermen base their operations at Matinicus. In addition the harbor is regularly visited by seining boats and draggers as well as transient pleasure craft. Commerce in the harbor amounts to about 800 tons annually consisting principally of fish and lobsters. Vessel trips in 1958 amounted to nearly 13,000. A protected harbor is as urgently needed now as it was in 1907 when the study was made. At that time elimination of annual losses and damages to vessels were estimated at $10,000. It is considered that benefits at least to that extent would be realized by the present fishing boats based in the harbor and to the many fishing vessels which fish off the Coast of Maine. In sudden easterly storms, Matinicus Harbor is ideally situated as a harbor of refuge for the transient fishing and recreational crafts; the alternative nearest port being at Rockland Harbor, 23 miles distant. The breakwater has served a useful life of 50 years since its completion in 1911. The average annual charges of $2,100 due to rehabilitation which will provide a project life of an additional 50 years plus the nominal average annual maintenance of $500 are considered well justified in view of the benefits to be returned in the form of elimination of vessel damages to the fleet based in the harbor and as a harbor of refuge to the many small fishing and recreational craft cruising along the coast.

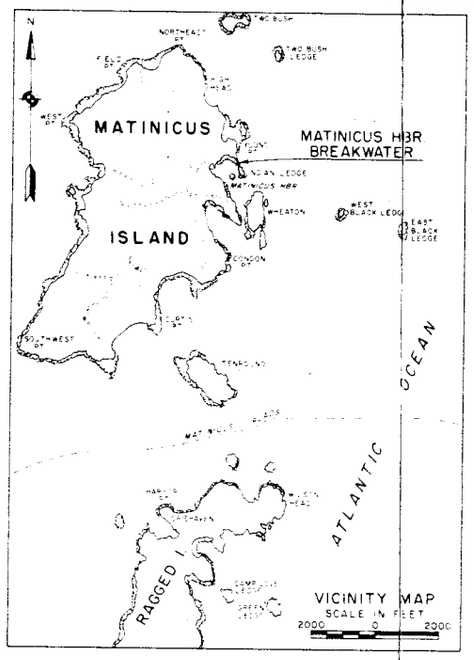
## RECOMMENDATION

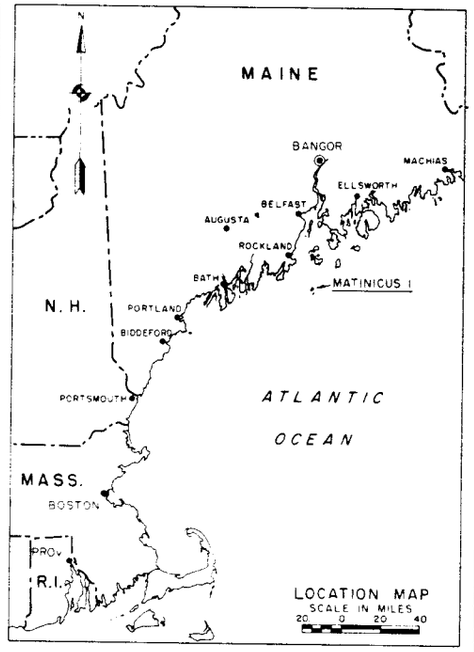
20. It is recommended that the breakwater at Matinicus Harbor be rehabilitated to the extent provided in the project plans to provide for continuous protection of the harbor.

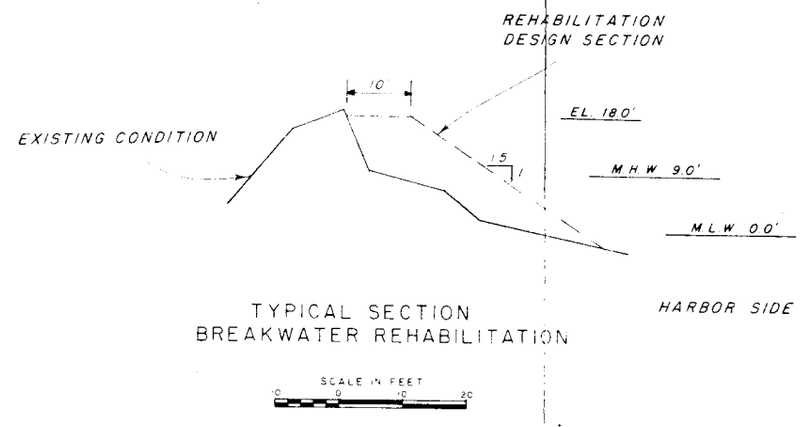
2 Incl
1. Map - Project Plan
2. Survey Drawing - Profile and Cross Sections

File 14810-5-4




TO ACCOMPANY
DESIGN MEMORANDUM
DATED MAY 16, 1961

| REVISION | DATE | DESCRIPTION | BY |
|---|---|---|---|

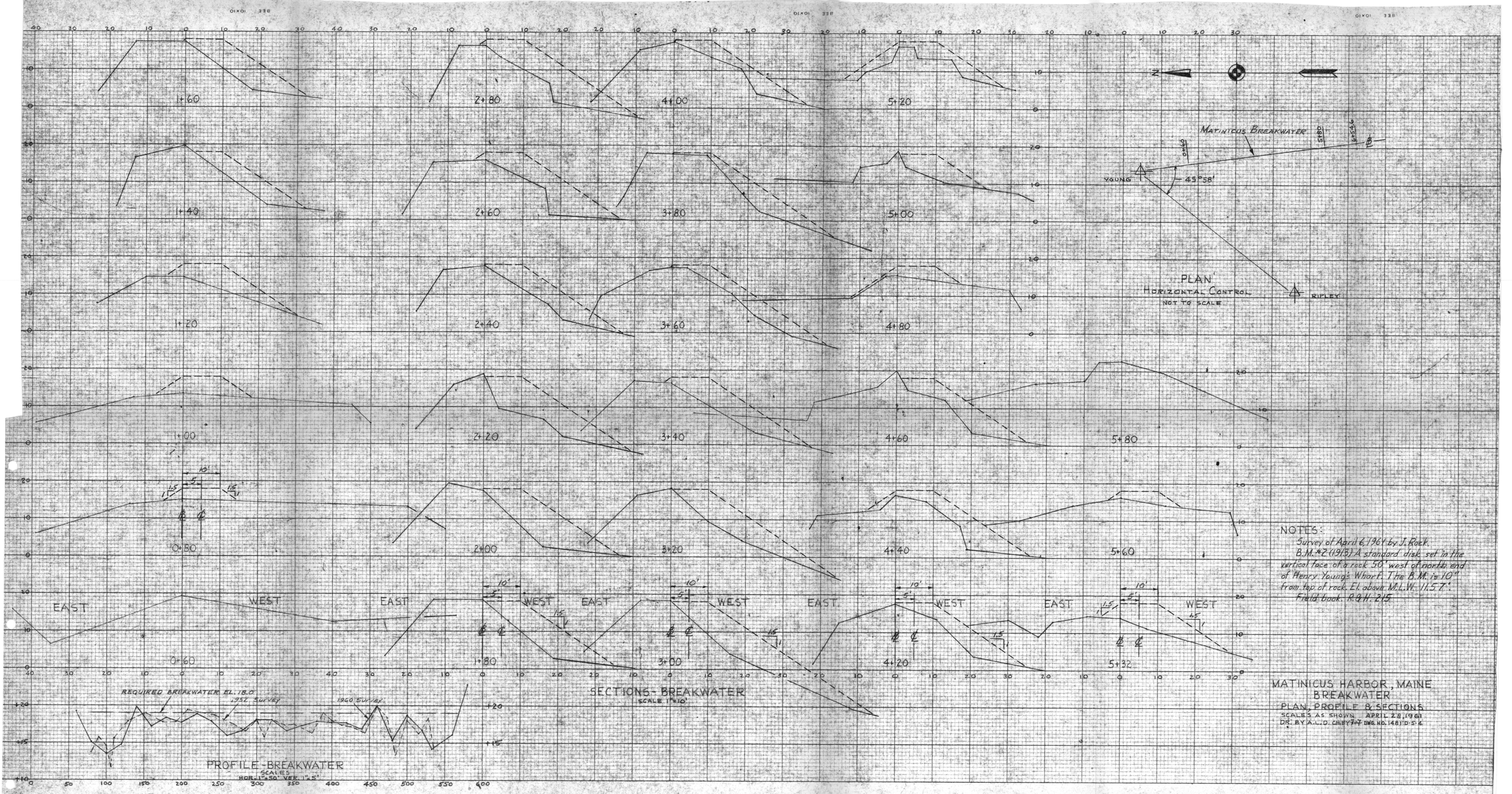
# MATINICUS HARBOR, MAINE

## PROJECT PLAN

SCALE IN FEET
100 0 100 200 300

U.S. Army Engineer Division, New England

Corps of Engineers Waltham, Mass



MATINICUS BREAKWATER
YOUNG
45°58'
RIPLEY
PLAN
HORIZONTAL CONTROL
NOT TO SCALE
1+60
2+80
4+00
5+20
1+40
2+60
3+80
5+00
1+20
2+40
3+60
4+80
1+00
2+20
3+40
4+60
5+80
0+80
2+00
3+20
4+40
5+60
0+60
1+80
3+00
4+20
5+32
EAST
WEST
SECTIONS - BREAKWATER
SCALE 1"=10'
REQUIRED BREAKWATER EL. 18.0
1952 Survey
1960 Survey
PROFILE - BREAKWATER
SCALES
HOR. 1"=50' VER. 1"=5'
NOTES:
Survey of April 6, 1961 by J. Rock.
B.M. #2 (1913) A standard disk set in the vertical face of a rock 50' west of north end of Henry Young's Wharf. The B.M. is 10" from top of rock. El. above M.L.W. 11.57'.
Field book. R.9.H. 215
MATINICUS HARBOR, MAINE
BREAKWATER
PLAN, PROFILE & SECTIONS
SCALES AS SHOWN APRIL 28, 1961
DR. BY A.L.D. CH. BY 7-7 DWG. NO. 148) D-5-4