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ENGINEERING ANALYSIS OF TEN SIDE SCAN SONAR TARGETS
BETWEEN THE NORFOLK H. (U) WATERWAY SURVEYS AND
ENGINEERING LTD VIRGINIA BEACH VA J B WALSH ET AL

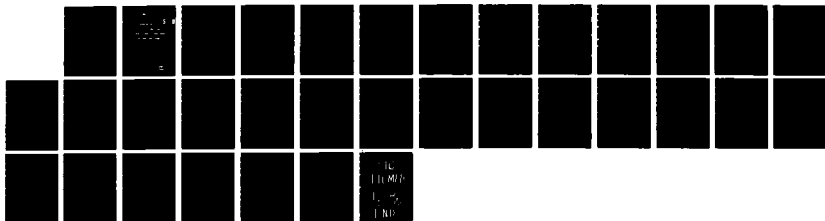
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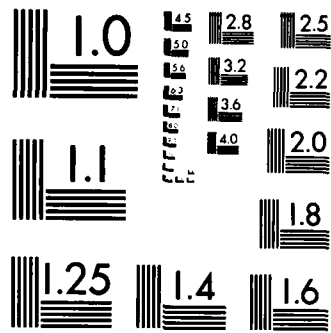
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**ENGINEERING ANALYSIS OF
TEN SIDE SCAN SONAR TARGETS
BETWEEN THE NORFOLK HARBOR CHANNEL
AND THIMBLE SHOAL CHANNEL
HAMPTON ROADS, VIRGINIA**

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December 1984

Final Report

This document has been approved
for public release and sale; its
distribution is unlimited.

Prepared for:

Dredging Management Branch
Norfolk District, Corps of Engineers
803 Front Street
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CONTENTS

	Page
List of Figures.....	i
Preface.....	ii
Introduction.....	1
Analysis of Targets:	
NH #1.....	4
NH #3.....	6
NH #4.....	8
NH #5.....	10
NH #6.....	12
NH #7.....	14
NH #10.....	17
NH #11.....	19
NH #12.....	21
NH #14.....	23
Summary.....	25
Appendix A - Configuration of Control Stations at Each Target.....	A-1
Appendix B - Daily Field Notes.....	B-1

LIST OF FIGURES

NO.	Page
1. Location Map.....	2
2. Distribution of Objects Found at NH #1.....	5
3. Distribution of Objects Found at NH #3.....	7
4. Distribution of Objects Found at NH #4.....	9
5. Distribution of Objects Found at NH #5.....	11
6. Location of Object Found at NH #6.....	13
7. Distribution of Objects Found at NH #7.....	15
8. Location of Object Found at NH #10.....	18
9. Location of Object Found at NH #11.....	20
10. Distribution of Objects Found at NH #12.....	22
11. Distribution of Objects Found at NH #14.....	24
12. Table: Summary of Results.....	25

PREFACE

This engineering analysis was conducted jointly by two firms for the Norfolk District, Corps of Engineers: Waterway Surveys & Engineering, Ltd. (WS&E) under Contract No. DACW65-82-D-0054 and Crofton Diving, Inc. under Contract No. DACW65-84-C-0054. The work was coordinated by Mr. Steve DeLoach, L.S., P.E., Project Manager, Dredging Management Branch. The field investigation was conducted under the supervision of Mr. Ken Crofton, Crofton Diving and Mr. Jeffrey W. Greene, Project Engineer (WS&E). This report was written by Mr. John B. Walsh, P.E. and Mr. Jeffrey W. Greene of WS&E.

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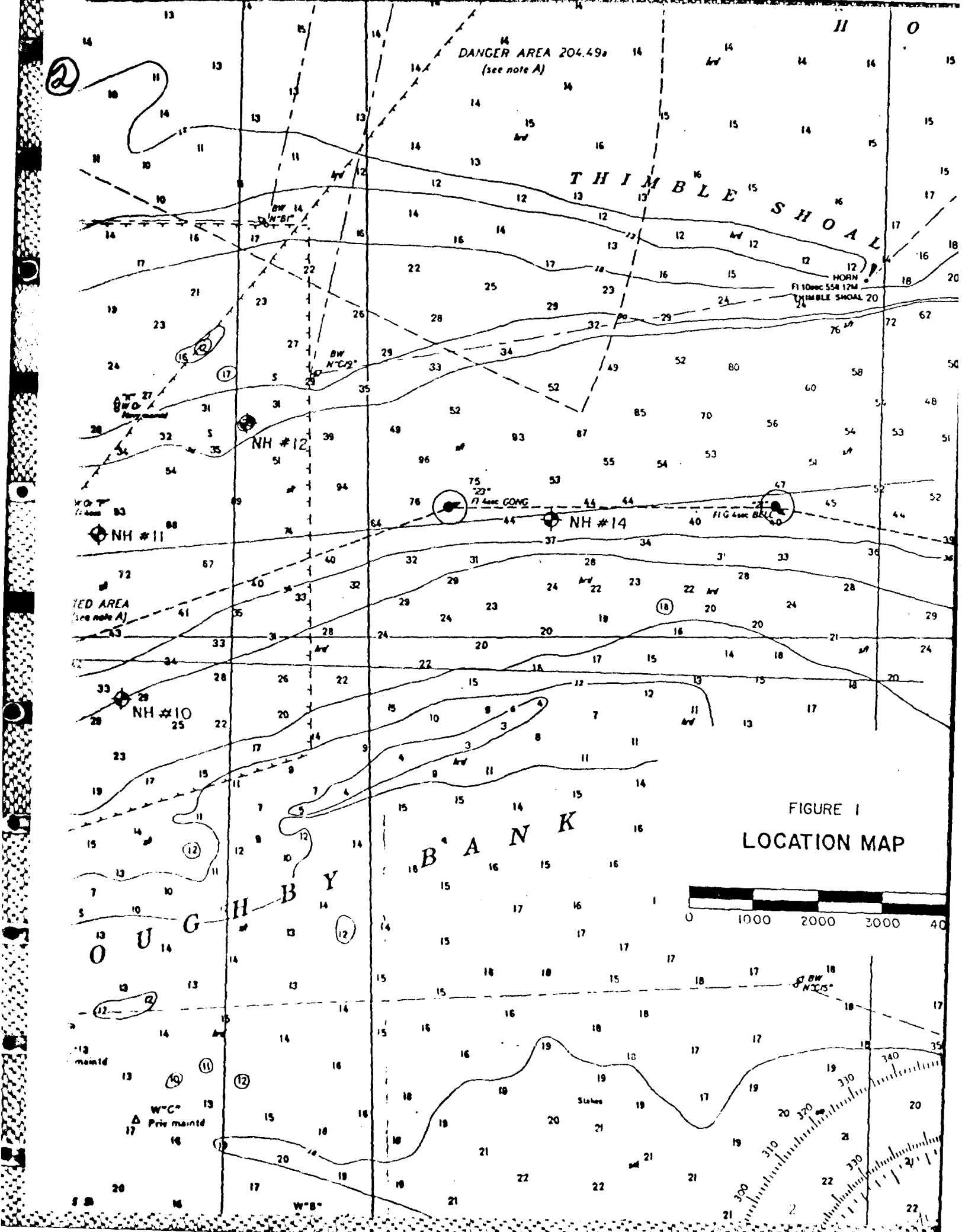


INTRODUCTION

The current proposal to deepen the port of Hampton Roads from an existing depth of 45 feet to a proposed depth of 55 feet will require additional dredging to deepen and widen the natural channel between the Norfolk Harbor and Thimble Shoal Channels. This area was swept with side scan sonar by the Corps of Engineers to determine if any obstructions exist that would effect future alignment and deepening of the channel. For purposes of this study, a design depth of 60 feet was established by combining the 55-foot project dredging depth with 3 feet advance maintenance dredging and 2 feet allowable overdepth. Side slopes were assumed at 3 horizontal to one vertical. Channel width is unknown at this time but is expected to be between 1000 feet and 1500 feet.

Ten side scan sonar targets were selected by the Corps from previous work for detailed investigation (see Figure 1) under this contract. The Corps used the Klein 500 KHZ Side Scan Sonar along with the Tellurometer MRD-1 for positioning from NGS and Corps Third-Order Control. Each target was located by WS&E using a Del Norte Model 540 Electronic Positioning System using 3 ranges from third-order control stations (See appendix A). All depths included in this report have been reduced to NOS Mean Low Water from a tide staff set at Fort Wool.

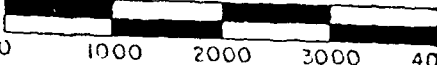
Each target was initially located using Virginia State Plane co-ordinates furnished by the Corps of Engineers and marked with an anchor and surface buoy. This enabled Crofton Diving, Inc. to position their boat over the target and perform a thorough search of the area within a 100-foot radius of the anchor buoy. Obstructions were either located by compass bearing and tagline distance from the anchor or a buoy line was attached to the object and positioned by plumbing this line from the surface. Least depths were obtained by pneumofathometer at all significant obstructions. Detailed descriptions of each dive were recorded daily by the Project Engineer in communication with the diver (see Appendix B).



DANGER AREA 204.49a
(see note A)

THIMBLE SHOAL

FIGURE 1
LOCATION MAP



DANGER AREA
(see note A)

NH #10

NH #12

NH #14

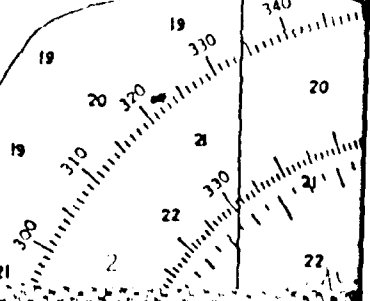
NH #11

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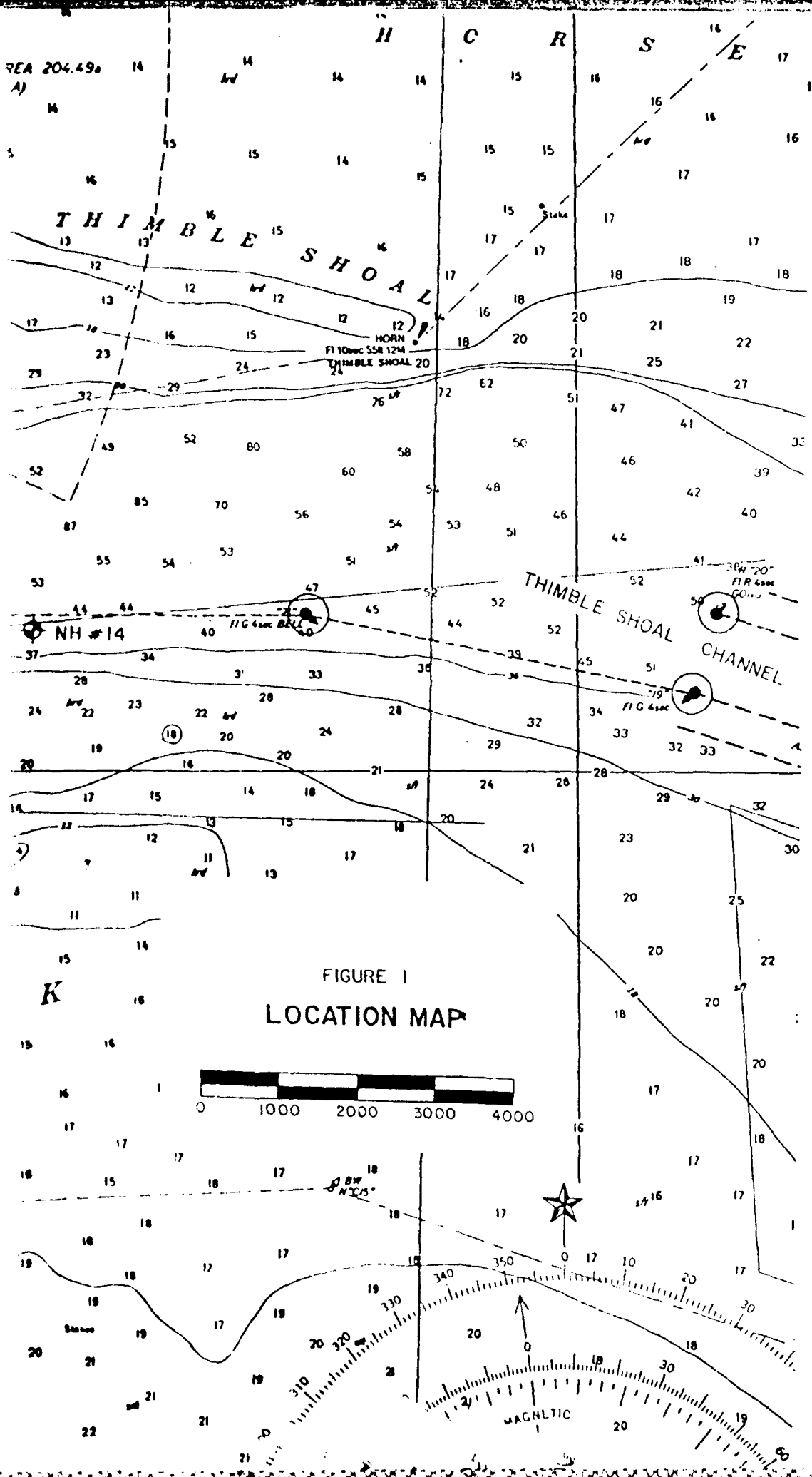
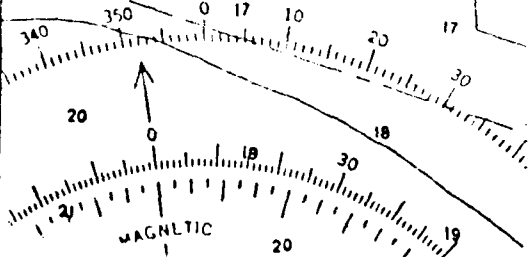
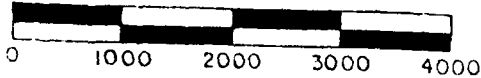
THIMBLE SHOAL

HORN
Fl 10sec SSR 12M
THIMBLE SHOAL 20

THIMBLE SHOAL CHANNEL

NH #14

FIGURE 1
LOCATION MAP



This report discusses each target individually, in detail, with a scale drawing showing the obstruction's relationship to the deepened channel (buoy line) and surrounding bottom bathymetry. Discussion includes the target's intimidation to shipping considering the deepened Port of Hampton Roads and recommendations for further investigation and/or removal.

TARGET: NH #1

Interpretation of side scan sonar records showed a large area of small scattered objects, extending 2 feet above bottom level (A.B.L.), in 36 feet of water. The Corps recommended searching a 400-foot diameter area, so a search pattern was set up using a 100-foot tag-line swinging around anchor buoys set in 4 locations (see Figure 2).

Most of the objects were within 100 feet of buoy 1 and range from small sections of 16-inch steel pipe to single pieces of 2-foot diameter rip-rap. As shown in Figure 2, the target area is well south of the southeast edge of the 1,500-foot wide Norfolk Harbor Entrance Reach; the closest object being more than 100 feet from any dredging activity. Even if dredging did take place in this area, none of these objects would be considered anything other than routine obstructions for a large hydraulic dredge.

These objects pose no threat to the shipping industry using Hampton Roads because of their small size and distance outside of the channel. The bottom depth in this area is more of a threat to ships than the objects investigated. No removal or further investigation will be necessary at this target.

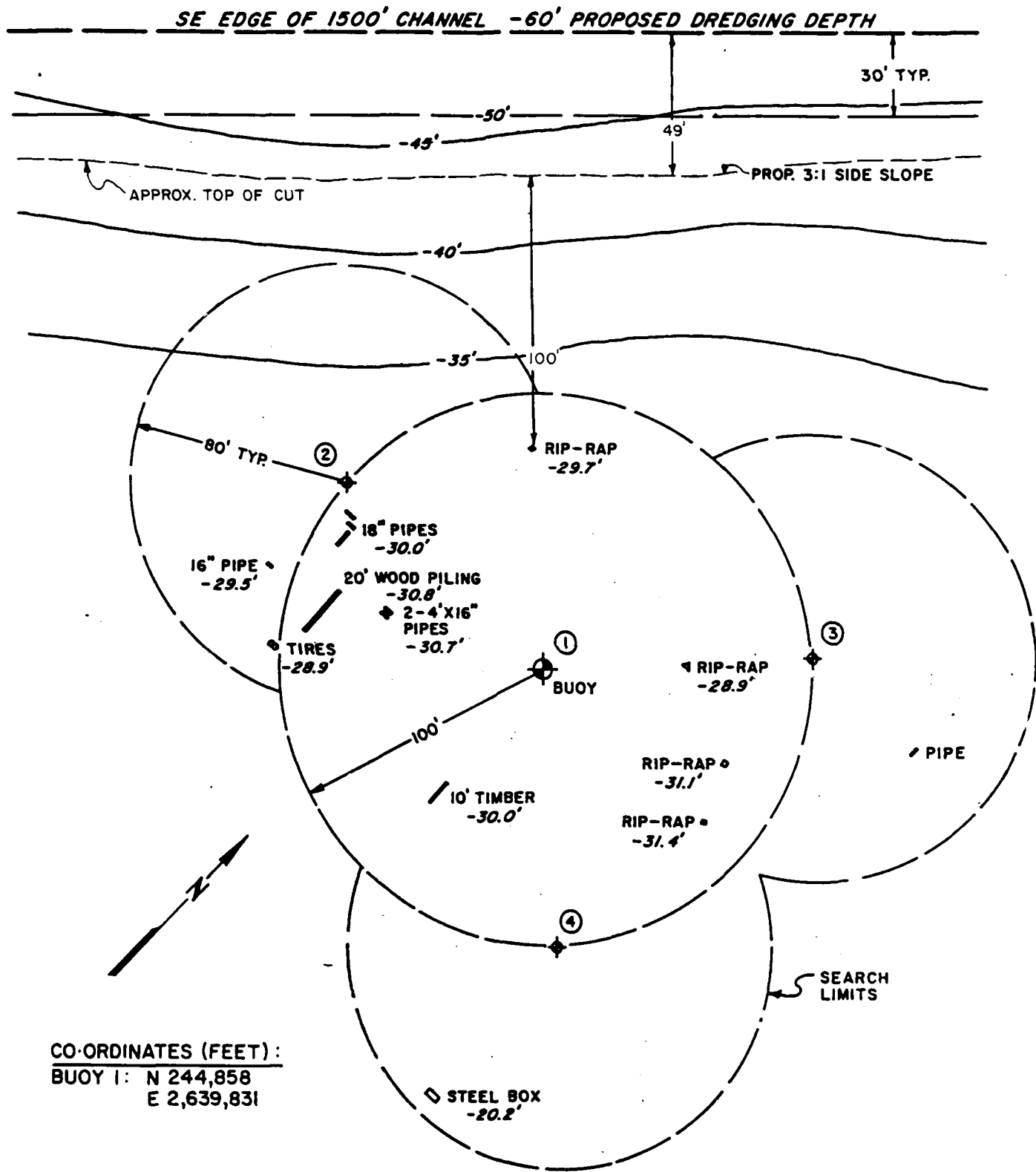


FIGURE 2
DISTRIBUTION OF OBJECTS FOUND AT NH # 1
 SCALE: 1"=50'

TARGET: NH #3

Interpretation of side scan records showed an area of small scattered objects, extending 3 feet A.B.L. in 56 feet of water. A tag-line search of the bottom was made out to a radius of 80 feet from buoy 1 (see Figure 3).

The target area is approximately 100 feet northwest of a straight line between channel buoys "1" and "25". These buoys currently mark the southern limit of the natural channel at approximately the 50-foot contour. With the proposed dredging depth at -60.0' MLW, all the objects found in this area will effect the dredging activity.

Two 4' x 4' concrete blocks were observed with 2.5' exposed above the bottom. These blocks are probably 4' tall, but there is no way of knowing without further investigation. Cables were found in the same situation with the ends disappearing into the mud. These cables could be connected to the concrete blocks, to another object underneath the existing bottom level, or could run an undetermined distance under the bottom. A piece of 1/2-inch thick steel plate 4 feet long and 1 foot A.B.L. was found encrusted with marine growth.

All these objects have the potential of having greater dimensions beneath the bottom. If dredging is necessary in this area, these objects should be described with co-ordinates in the plans and specifications for dredging and/or be investigated further for removal prior to dredging.

There is a natural channel 2,200 feet wide below -60.0' MLW beginning 200 feet to the northwest of this target area. If this channel is adequate for shipping and channel buoys "1" & "25" can be moved closer to the 60-foot contour, then these objects will not intimidate shipping and will not require any further investigation.

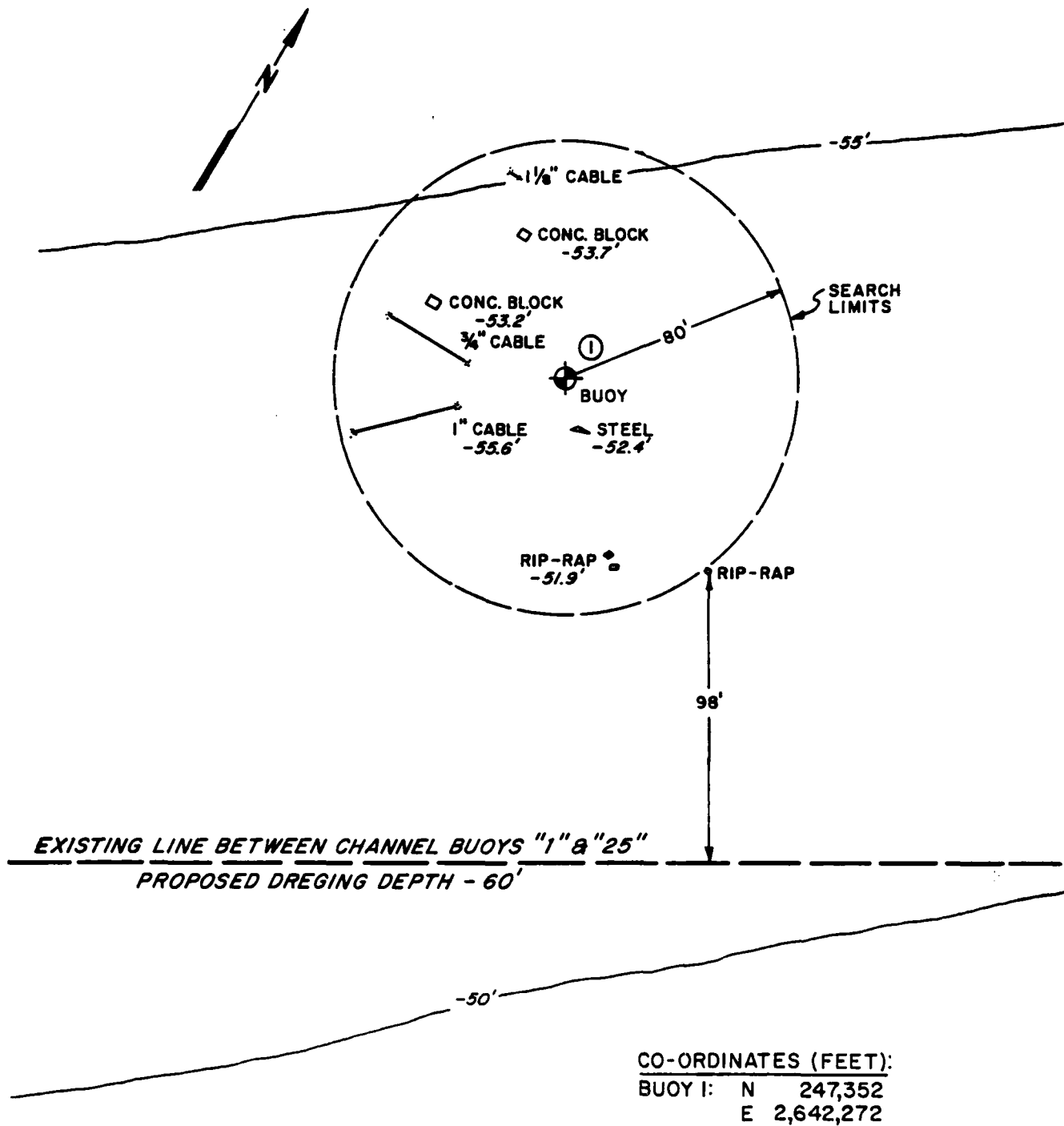


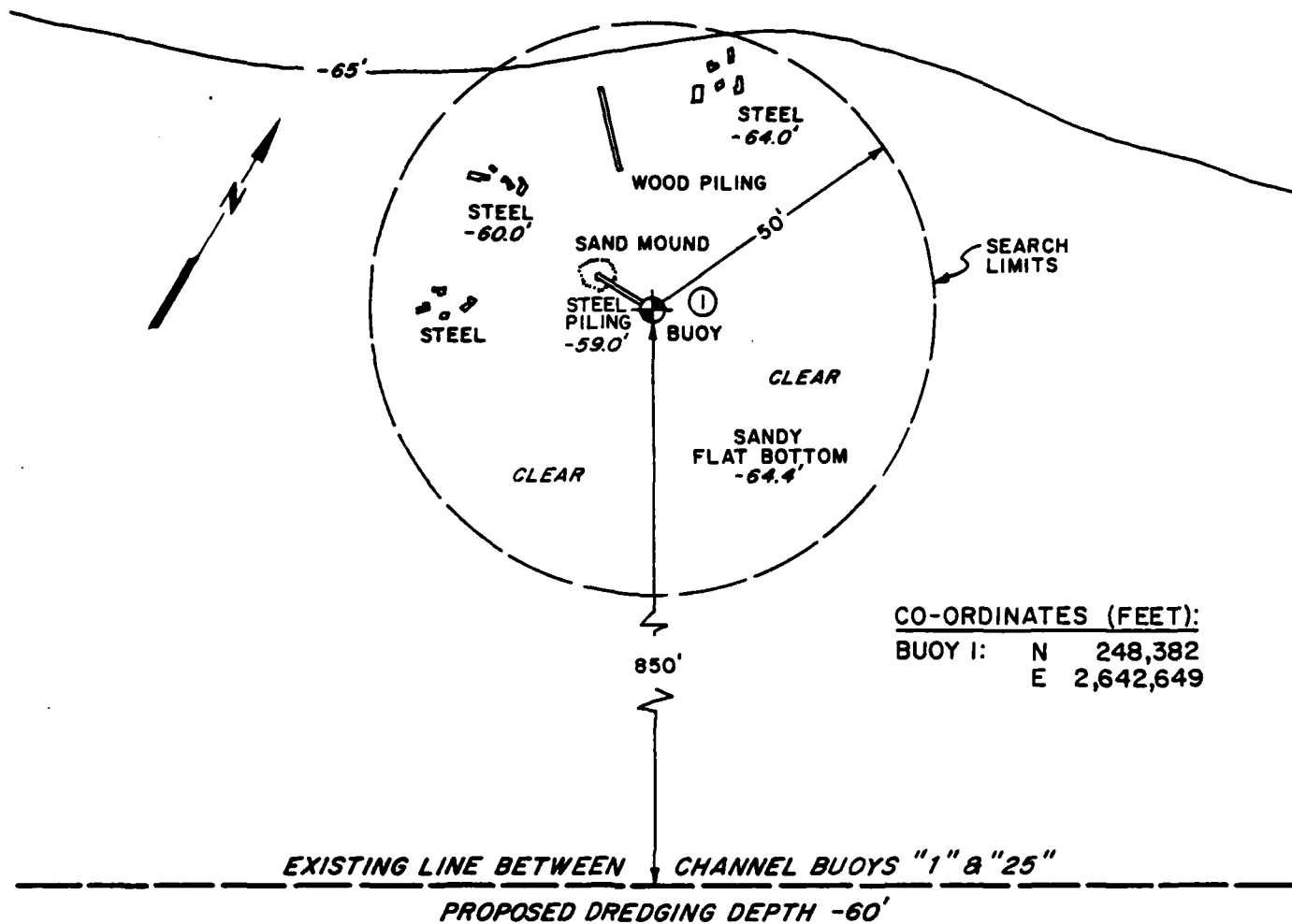
FIGURE 3
 DISTRIBUTION OF OBJECTS FOUND AT NH # 3
 SCALE: 1"=50'

TARGET NH #4

Interpretation of this side scan sonar record showed an area 30 feet wide by 60 feet long in 65 feet of water with objects extending up to 3 feet A.B.L. A 50-foot radial sweep of the bottom was made pivoting around the east end of a steel pile located at buoy 1 (Figure 4).

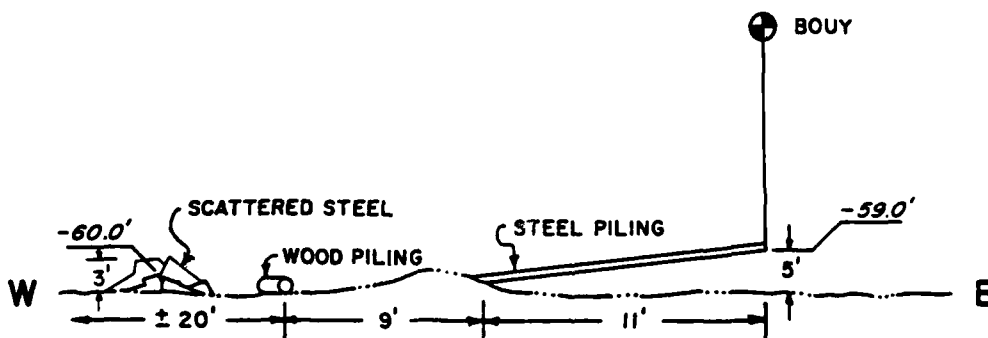
The average depth at this target area is 64 feet below MLW. The most significant object found is a 12-inch wide, 3/8 inch thick steel sheet pile with 11 feet exposed above the sand. The buoy was tied to the east end of the pile having a least depth of -59.0 feet MLW which is cantilevered 5 feet above the bottom. (See Profile View, Figure 4). Several small groups of scattered irregular-shaped steel plates were found to the west of the buoy. This thin steel is heavy with marine growth on exposed surfaces. It extends from 0 - 3 feet above the bottom with a least depth of -60.0 feet MLW.

The target area is well into the existing natural channel, being 850 feet northwest of the line between channel buoys "1" & "25". The total width of the natural channel at this point, below -60 feet MLW, is approximately 2,500 feet. Since the average depth at this target is 64 feet below MLW, dredging will not be necessary. The steel sheet pile, having a least depth of 59.0 feet below MLW, should be removed because it is in direct line with any outgoing ship traffic. It is recommended that the area to the west with the scattered steel plates be investigated further if, in fact, the channels are dredged to a depth of -60 feet MLW.



DISTRIBUTION OF OBJECTS FOUND AT NH # 4

SCALE: 1" = 30'



**FIGURE 4
PROFILE VIEW**

(NOT TO SCALE)

TARGET: NH #5

Interpretation of side scan sonar records showed a 15-foot by 20-foot object in 46 feet of water extending 10 feet above the bottom. The Corps of Engineers recommended a 400-foot diameter search area to be covered at this target. A search pattern, similar to that used at NH #1, was set up with buoy 1 dropped at the given co-ordinates and 3 additional buoys set at 100 feet in radials from buoy 1 in order to achieve maximum coverage (see Figure 5).

The average depth at this target is -45 feet below MLW. Most of the objects found are timbers, 2 x 10's and 2 x 12's of various lengths, scattered about the bottom, partially to totally exposed. The largest concentration occurs between buoy 1 and buoy 2. This large pile of timbers, 70 feet long and 15 feet wide, runs east-west with a large sand mound, 15 feet in diameter and 6 feet high, at its western-most end. The least depth occurs on this mound at -38.8 feet MLW. Most of these timbers are rotten and deteriorated.

The target area falls right on the line between channel buoys "1" and "25" marking the south side of the natural channel. The existing channel width is already adequate northwest of this point, with over 2,000 feet deeper than -60 feet MLW, therefore dredging will not be necessary at the target site. If additional widening was found to be necessary along the south side, these rotten timbers should not create a problem for a large hydraulic dredge, but a description of this area with co-ordinates should be included in the plans and specifications for dredging. No further investigation will be required at this target.

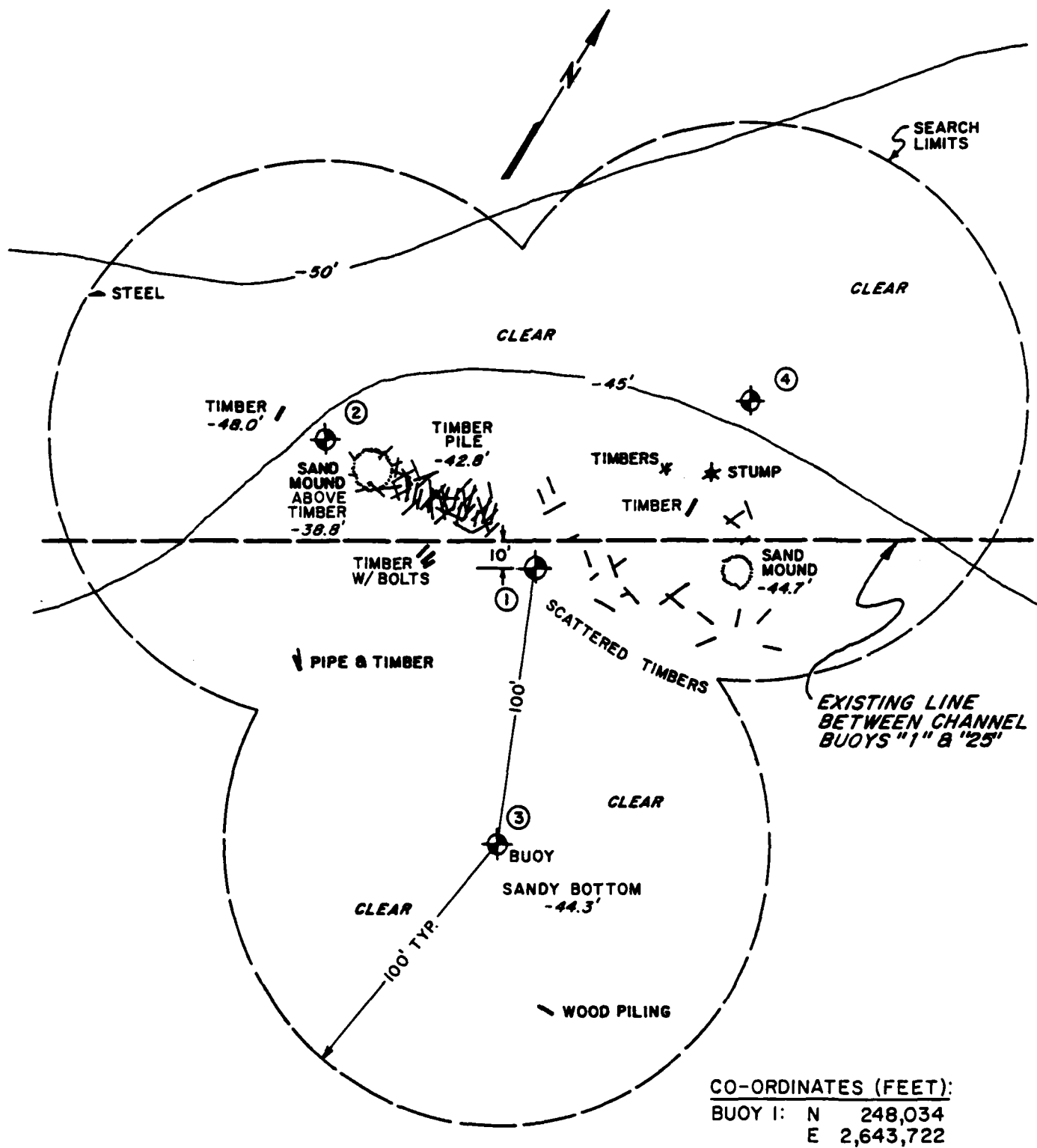


FIGURE 5
 DISTRIBUTION OF OBJECTS FOUND AT NH # 5

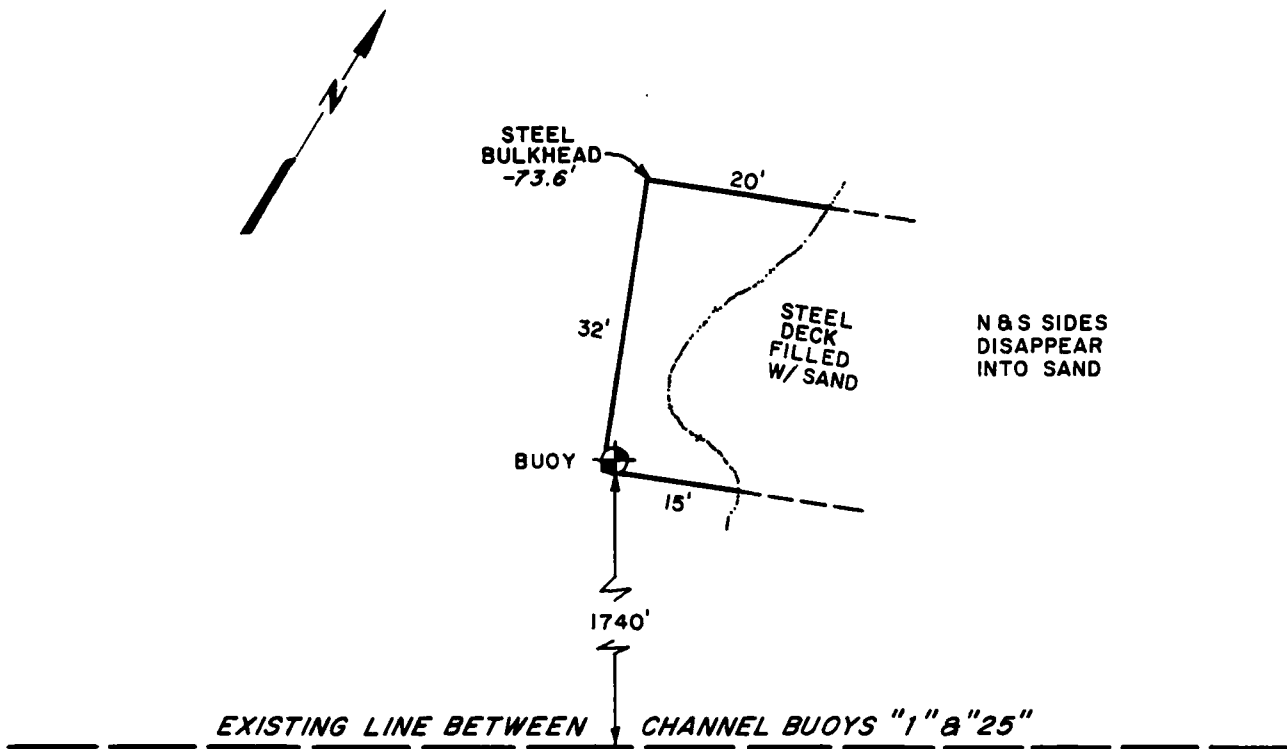
SCALE: 1"=50'

TARGET: NH #6

Interpretation of side scan sonar records showed a target 60 feet by 100 feet in 75 feet of water rising 5.5 feet above the bottom. The buoy anchor was dropped directly onto the object, therefore, a sweep of this area was not necessary.

The object can be described as a large steel box 32 feet across (north-south) with 15-20 feet exposed above the sand on the west end (see Figure 6). The box has a steel deck with a steel bulkhead approximately 3 feet high around the perimeter. The west end of the box is cantilevered out of the sand with sand filling the inside of the box from the east. The northwest corner is highest, with a least depth of -73.6 feet MLW.

The object is located in deep water in the center of the natural channel. This object is much too deep to intimidate ships navigating a 55-foot project channel. The side scan sonar records show more than one of these objects, but because of the bottom depth throughout this area, the object would have to be over 20 feet above the bottom to intimidate shipping. Since the records indicate a maximum height of 5.5 feet, no further investigation or removal of this target is necessary.



LOCATION OF OBJECT FOUND AT NH # 6

SCALE: 1"=20'

CO-ORDINATES (FEET):

BUOY: N 250,003
E 2,643,623

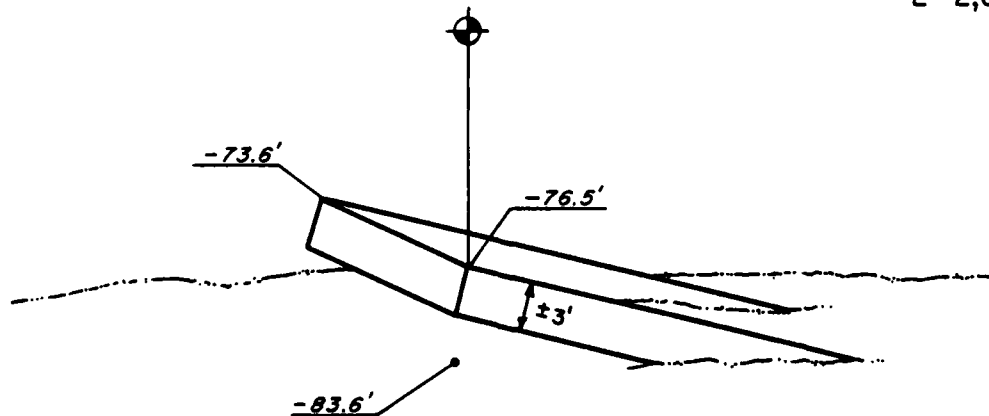


FIGURE 6
PROFILE VIEW

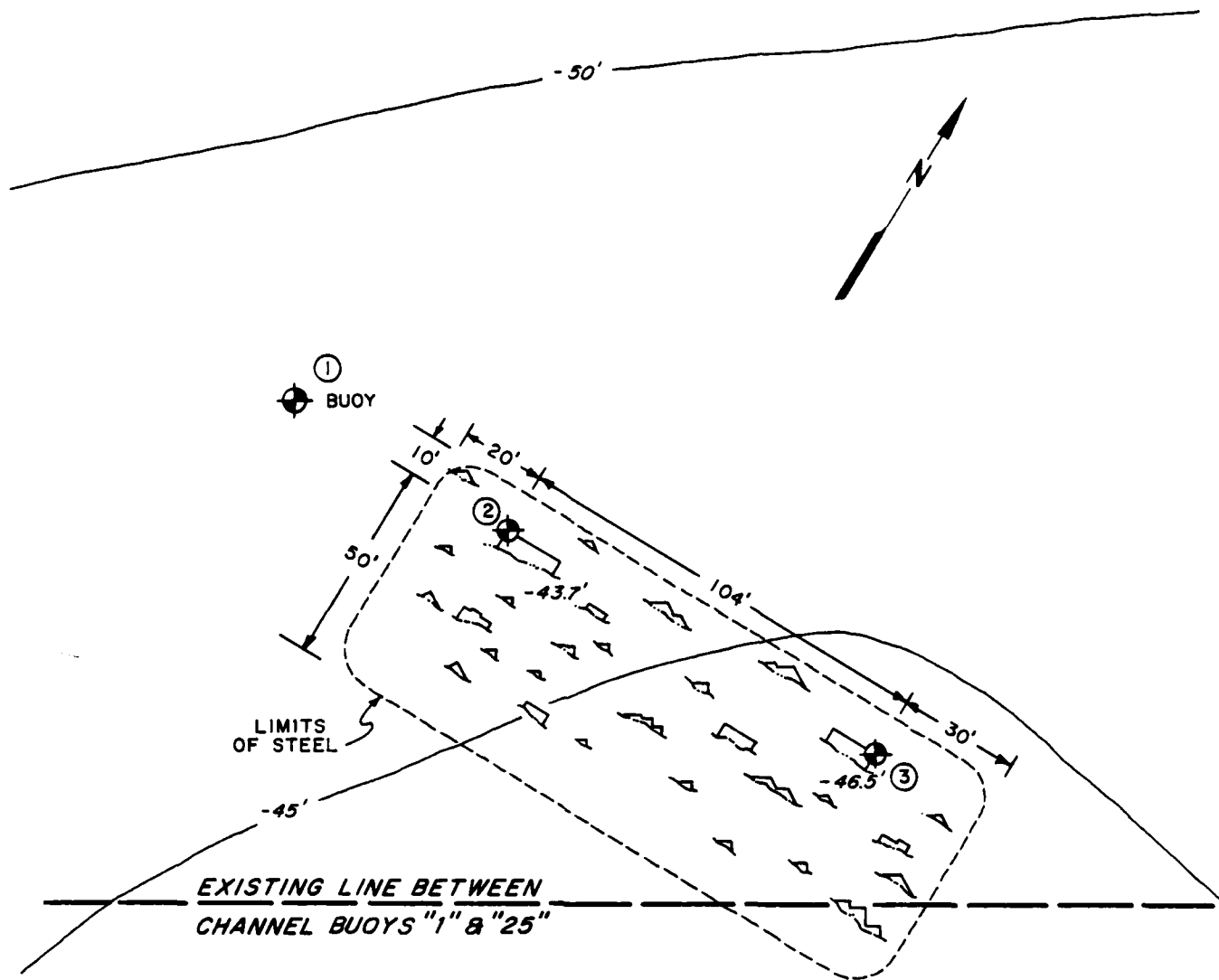
(NOT TO SCALE)

TARGET: NH #7

Interpretation of side scan sonar records showed that this target would cover an area 225 feet by 55 feet in 44 feet of water and extend 4 feet above the bottom. Buoy 1 was dropped using the given co-ordinates. A radial sweep revealed the west edge of the target, 60 feet east of buoy 1. A second buoy was then set and the investigation continued to the east where a third buoy was placed near the eastern limit. Buoy 2 and buoy 3 were positioned and the entire target area was then related to these two buoys (see Figure 7).

Buoy 2 was tied to the NW corner of a large piece of 1/2 inch thick steel plate covered with marine growth. It is 15 feet long running east-west and 5 feet wide, with the north side elevated, sloping down to the south and disappearing into the sand. The least depth is at the northeast corner, -46.1 feet MLW. Buoy 3 was tied to a 4-foot wide piece of 1/2 inch thick steel, again sloping out of the sand to the north. Sand was built up at the south side and scouring occurred to the north - this being typical around all the steel. The least depth was -46.5 feet MLW. These were the largest pieces of steel, but the shallowest object was a piece of steel plate, 10 feet east-southeast of buoy 2 with a least depth of -43.7 feet MLW. The entire target area, approximately 154 feet long by 60 feet wide, is made up of irregular, scattered pieces of partially exposed steel plate with extensive mounding, which suggests additional steel beneath the bottom.

The target area extends from the line between channel buoys "1" & "25" to 100 feet northwest, with an average bottom depth of -48 feet MLW. A cross-section of the natural channel at this point would show 2,000 feet of width below -60 feet MLW. Therefore, if the channel buoys are moved northwest to the 60-foot contour, this area would pose no threat to ships and no further investigation would be required.



CO-ORDINATES (FEET):
 BUOY 2: N 248,658
 E 2,644,539
 BUOY 3: N 248,717
 E 2,644,624

FIGURE 7
 DISTRIBUTION OF OBJECTS FOUND AT NH # 7
 SCALE: 1" = 50'

If dredging is determined necessary to deepen the area northwest of the existing channel buoys to -60 feet MLW, then this area of steel will be a problem for the dredge. Further investigation will be necessary prior to removal of the steel. A suggestion would be to move buoy "25" to the northwest to avoid this obstructed area.

TARGET: NH #10

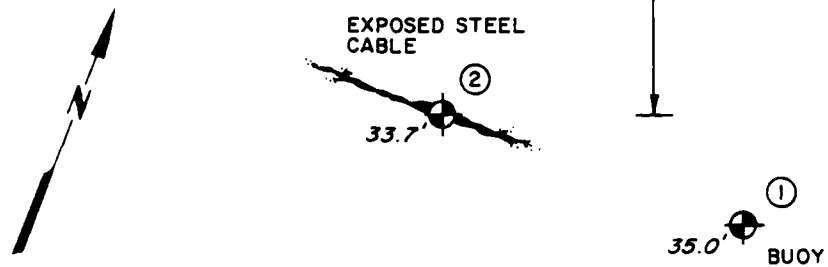
Interpretation of side scan sonar records showed this target to be 5 feet by 30 feet in 26 feet of water and extending 1 foot above the bottom. Buoy 1 was dropped in 35 feet of water at the given co-ordinates and a 50-foot radial sweep was performed (see Figure 8).

The bottom was consistently flat and sandy. At 35 feet west of the pivot point, a bundle of steel cable was found. The cable is approximately 1/2-inch to 3/4-inch in diameter, with up to 12 lays bundled together, shaped like a coil lying on its side. Only the top of this coil is exposed, being 18 inches above the bottom with a least depth of -33.7 feet MLW. Buoy 2 was tied off to this point and co-ordinates were obtained from the surface. The exposed cable extends 10 feet to the east and 15 feet to the west of this high point before disappearing into the sand.

The steel cable is located 970 feet south of the line between channel buoys "25" and "23" (see Figure 1). This area is too far outside the existing channel to intimidate the ships using the channels. No dredging will occur in this area, therefore, no further investigation of this target will be necessary.

EXISTING LINE BETWEEN CHANNEL BUOYS "25" & "23"
 PROPOSED DREDGING DEPTH -60'

CO-ORDINATES (FEET):
 BUOY 2: N 249,540
 E 2,648,292



LOCATION OF OBJECT FOUND AT NH #10

SCALE: 1"=20'

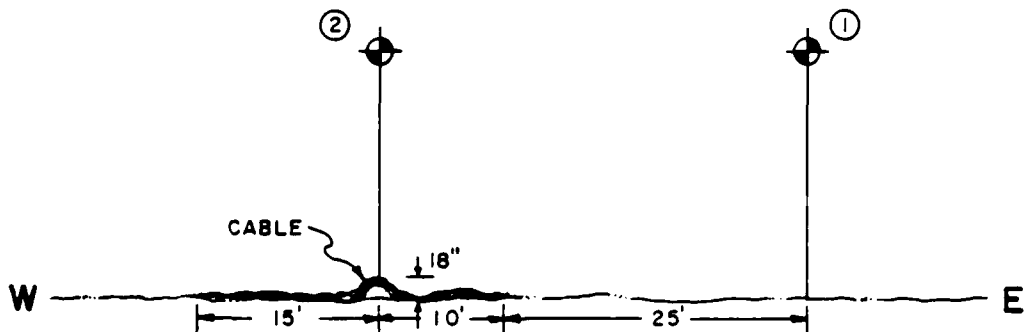


FIGURE 8
 PROFILE VIEW

(NOT TO SCALE)

TARGET: NH #11

Interpretation of side scan sonar records showed this target to be 70 feet by 70 feet in 65 feet of water rising 6 feet above the bottom. The actual depth of the bottom by fathometer at the given co-ordinates is -92 feet MLW. This agrees with the depths shown on the nautical chart in this area (see Figure 1).

A sweep was made of the bottom even though the depth of the water exceeded 90 feet. The north end of a large mound of sand was found 22 feet south of the buoy anchor (see Figure 9). The bottom depth at this point is -92.4 feet MLW. The sand mound rises gradually to 5 feet above the average bottom depth and levels off 40 feet south of the buoy. At this point the mound is approximately 15 feet wide. Small pieces of jagged steel plate were found extending 6 inches out of the mounded sand. The search was stopped at this point because of strong currents and lack of bottom time.

The target area is located in very deep water on the north side of the natural channel. Soundings in the vicinity of the target verified the depths. These depths were consistent and showed no local shoaling. No further investigation of this target will be necessary because of its extreme depth.

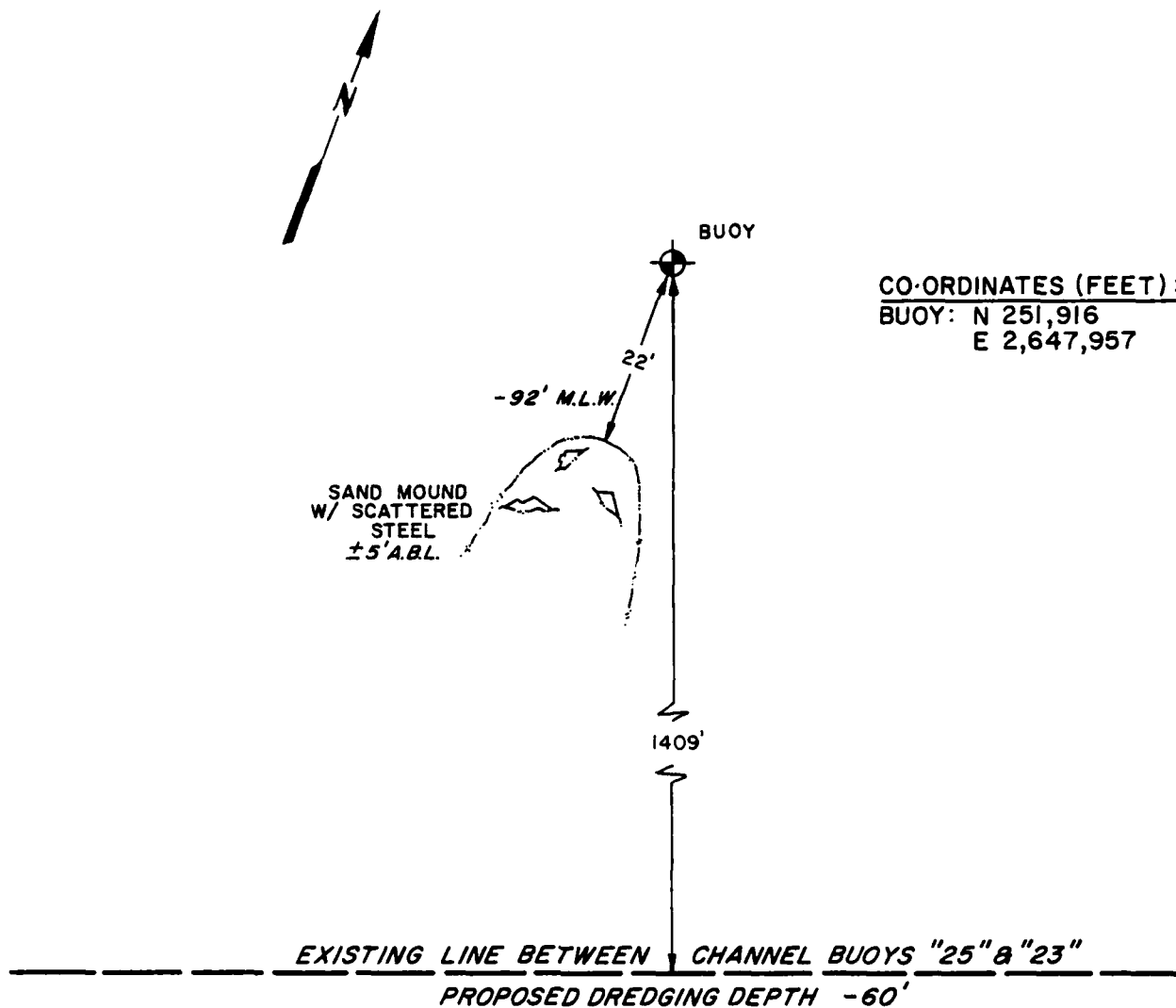


FIGURE 9
 LOCATION OF OBJECT FOUND AT NH # 11
 SCALE: 1" = 20'

TARGET: NH #12

Interpretation of side scan sonar records showed an area 50 feet by 60 feet in 30 feet of water extending 2 feet above the bottom. Buoy 1 was set at the given co-ordinates and a radial search of the bottom was performed about this point. (See Figure 10).

The average bottom depth at this target is -30 feet MLW. A small group of 1 foot diameter rip-rap with sponges growing on top was found 40 feet southwest of buoy 1. The maximum height of the sponges is 2 feet above the bottom. This area was marked with buoy 2. The most significant object found was a 40-foot long, 6-inch by 12-inch timber, oriented northeast-southwest, with its southwest end disappearing into the sand. Buoy 3 was tied to the northeast end, and positioned. A least depth of -26.5 feet MLW was recorded.

This target area is located on the north side of the natural navigation channel, 510 feet north of the existing 60-foot contour. It is 2,100 feet north of the line between channel buoys "25" and "23". The total width on the natural channel at this point, with depths greater than 60 feet, is 1,350 feet. This target is already shown on the nautical chart as a 29 foot obstruction between the 30-foot and 36-foot contours (see Figure 1).

The target does not intimidate ships using the channel to Hampton Roads because the shoal water surrounding it to the south is a threat in itself. It is unlikely that dredging will occur this far north of the channel because shoal waters extending east and west would have to be removed on the outside of the turn. Therefore, no further investigation of this target will be necessary.

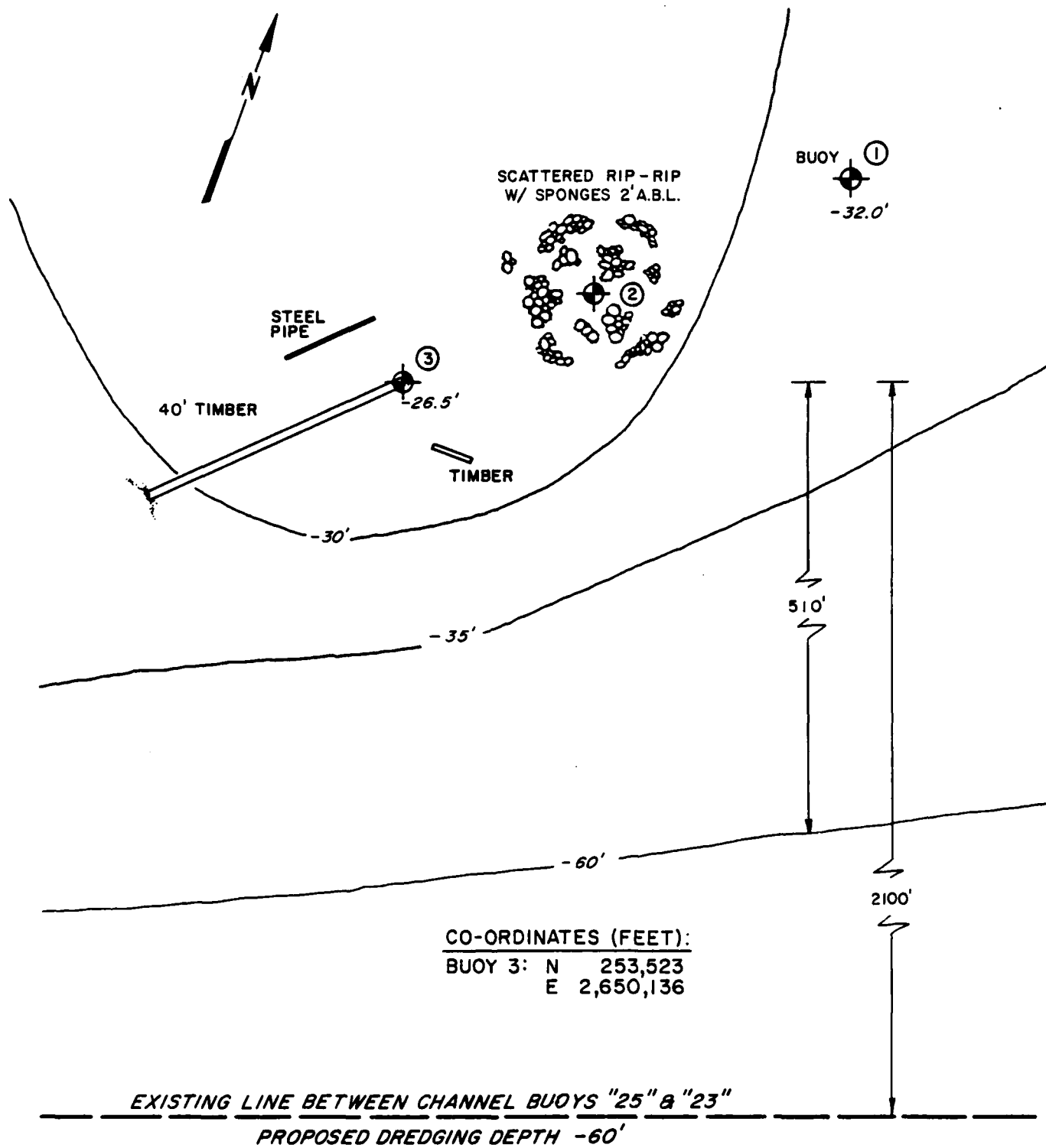


FIGURE 10
 DISTRIBUTION OF OBJECTS FOUND AT NH # 12
 SCALE: 1" = 20'

TARGET: NH #14

Interpretation of side scan sonar records showed an area 30 feet by 50 feet in 36 feet of water, with a maximum height of 3 feet above the bottom. A 100-foot radial sweep of the bottom around buoy 1 revealed a consistent, soft, muddy bottom, with the only objects found being 50 feet to the southwest (see Figure 11).

Further investigation found 3/8-inch to 1/2-inch thick steel plates varying in size, extending out of the bottom up to 3 feet. This steel is scattered about with no uniformity, covering an area of 30 feet east-west by 10 feet north-south. Buoy 2 was attached to the largest piece of steel at the eastern edge and its least-depth was determined to be -39.3 feet MLW.

This target lies 265 feet to the south of the line between channel buoys "23" and "21", with an average bottom depth of 42 feet. A cross-section of the natural channel at this point shows only 1,000 feet of width below -60 feet MLW. It is very likely that the Thimble Shoal Channel will be extended to the west to channel buoy "23". Assuming it is dredged to -60 feet along the line between buoys "23" and "21", the top of the side-slope will be over 200 feet to the north of any steel. Therefore, this target will not intimidate any ships using the deepened port of Hampton Roads and will not require any further investigation.

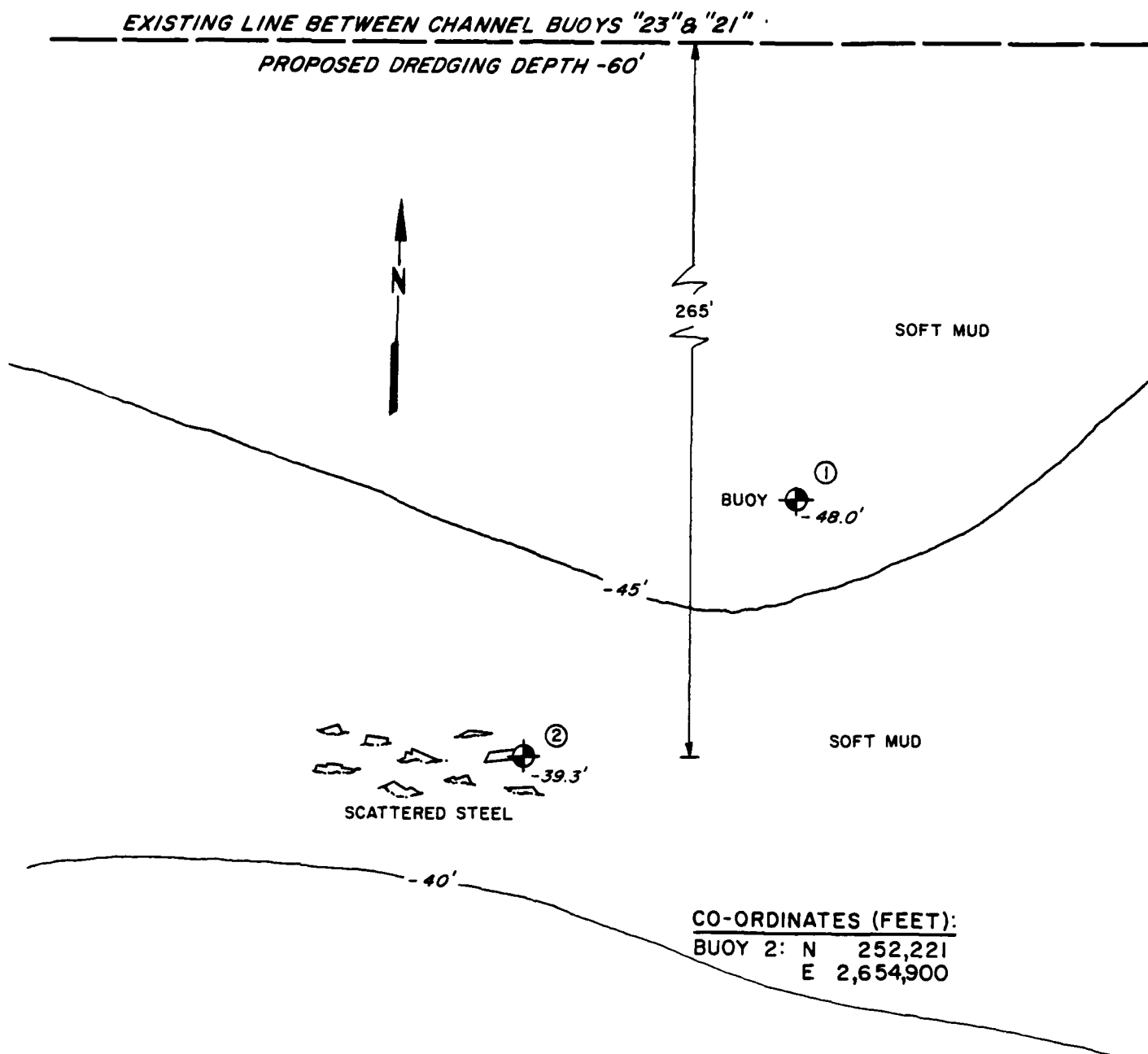


FIGURE II
 DISTRIBUTION OF OBJECTS FOUND AT NH # 14
 SCALE: 1" = 20'

SUMMARY

Target areas NH #3, NH #4, NH #5 and NH #7 will require removal or further investigation if the channel is dredged to a project depth of -55 feet MLW along the existing southern channel buoy line. All of these targets except NH #4, fall along this line between channel buoys "1" and "25". If these two channel buoys can be moved to the north and set on the 55-foot contour line without restricting the ships maneuverability, then targets NH #3, NH #5 and NH #7 should not intimidate shipping and will require no further investigation. Target NH #4 is in direct line with any outgoing ships and cannot be avoided by any reasonable channel realignment.

SUMMARY OF RESULTS

<u>TARGET</u>	<u>BRIEF DESCRIPTION</u>	<u>RECOMMENDATIONS</u>
NH#1	Small scattered objects	No further investigation
NH#3	4'x4'x4' conc. blocks, cable, steel	Move channel buoys "1" & "25" to north.
NH#4	Large steel pile, steel plates	Remove steel
NH#5	70'x15' pile of timber	Move channel buoys "1" & "25" to north
NH#6	32'x20'x3' steel box	No further investigation
NH#7	154'x60' area of steel plates	Move channel buoys "1" & "25" to north
NH#10	Steel cable	No further investigation
NH#11	Sand mound w/scattered steel	No further investigation
NH#12	40' timber pile, rip-rap	No further investigation
NH#14	30'x10' area of steel plates	No further investigation

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