Submerged Cultural Resources Inventory

PORTIONS OF POINT REYES NATIONAL SEASHORE and POINT REYES-FARALLON ISLANDS NATIONAL MARINE SANCTUARY

Field Research Results

Session 1
1983

By TONI CARRELL
SUBMERGED CULTURAL RESOURCES UNIT
NATIONAL PARK SERVICE

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by
Toni Carrell

With contributions by
Larry Murphy

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Submerged Cultural Resources Unit
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SUBMERGED CULTURAL RESOURCES UNIT
REPORT AND PUBLICATION SERIES

The Submerged Cultural Resources Unit is a part of the Southwest Cultural Resources Center, Southwest Regional Office in Santa Fe, New Mexico. It was established as a unit in 1980 to conduct research on submerged cultural resources throughout the National Park System with an emphasis on historic shipwrecks. One of the unit's primary responsibilities is to disseminate the results of research to National Park Service managers as well as the professional community in a form that meets resource management needs and adds to our understanding of the resource base. The following publication and report series has been initiated in order to fulfill this responsibility. The report "types" listed below represent the sequential stages of research activity that the unit is conducting or initiating in each park with a submerged cultural resources base. The reports are designed to be cumulative so that, in the ideal case, each marine or freshwater park would eventually have a "maritime archeology" publication which would have been preceded in most cases by an assessment, survey and inventory. This would put the parks in compliance with any reasonable professional and legal requirement to protect and interpret the underwater cultural resources under their custodianship.

Submerged Cultural Resources Assessment

First line document that consists of a brief literature search, an overview of the maritime history and the known or potential underwater sites in the park, and preliminary recommendations for long-term management. Designed to have application to GMP/DCP's and to become a source document for a park's Submerged Cultural Resources Management Plan.

Submerged Cultural Resources Survey

Comprehensive examination of blocks of park lands for the purpose of locating and identifying as much of the submerged cultural resources base as possible. A comprehensive literature search would most likely be a part of the Phase I report but, in some cases, may be postponed until Phase II.

Phase I - Reconnaissance of target areas with remote sensing and visual survey techniques to establish location of any archeological sites or anomalous features that may suggest the presence of archeological sites.

Phase II - Evaluation of archeological sites or anomalous features derived from remote sensing instruments to confirm their nature, and if possible, their significance. This may involve exploratory removal of overburden.

Submerged Cultural Resources Inventory

A document that discusses, in detail, all known underwater archeological sites in a given park. This may involve test excavations. The intended audience is managerial and professional, not the general public.

Site Report

Exhaustive documentation of one archeological site which may involve a partial or complete site excavation. The intended audience is primarily professional and incidentally managerial. Although the document may be useful to a park's interpretive specialists because of its information content, it would probably not be suitable for general distribution to park visitors.

Maritime Archeology Series

This is a series of publications on specific parks designed for appeal to a general audience including subject matter specialists, managers and the public at large, e.g., The Maritime Archeology of Isle Royale National Park. It fulfills an educational and interpretive function but meets professional standards in accuracy and substance.

Special Report Series

These may be in published or photocopy format. Included are special commentaries, papers on methodological or technical issues pertinent to underwater archeology, or any miscellaneous report that does not appropriately fit into one of the other categories.

Daniel J. Lenihan

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ACKNOWLEDGMENTS

No field research project is successfully accomplished without the cooperation and support of each individual associated with the effort, from initial planning through typing the final report. Western Regional Archeologist Roger Kelly contributed to all aspects of the project including coordination between the two Regional Offices and the park, transferring funds to the unit and reviewing the final draft of this report. Superintendent John Sansing and the staff at Point Reyes National Seashore gave the project 100% support, however, special thanks go to Rangers Bryan Sutton and Russ Lesko; without their extra efforts we would not have been able to complete the work. Don Morris, from the Western Archeological and Conservation Center, spent many long hours helping to convert the raw field data from MUNLEON into a preliminary base map. Larry Murphy, Robert Bennett and the crew on board NICK accomplished placement of the buoys on the anomaly targets despite radio problems, high winds and rough seas. Bob Lundberg, Captain of a floating historic resource the 'R.V.' NICK, was not only a willing pilot but also provided information on local maritime history and helped to track down information on SHASTA, the mystery ship at the fish dock. Dan Lenihan, Chief of the Submerged Cultural Resources Unit, reviewed this manuscript in draft form and made several helpful suggestions while Mary Volkert tackled typing the draft from my handwritten notes and turned them into a well ordered final manuscript. Thanks also go to Jerry Livingston for technical advice on mapping and map preparation and for printing the photographs in this report.

Toni Carrell

EXECUTIVE SUMMARY

The overall management approach to the study of submerged cultural resources within the National Park System may be conceptualized as occuring in distinct steps; the course of research leading in a logical sequence through initial assessment, remote sensing survey of blocks of land to locate then evaluate potential resources, and then inventory of all the known submerged sites in an area. The first task of the Submerged Cultural Resources Unit at Point Reyes National Seashore was, therefore, to conduct an assessment and a Phase I reconnaissance survey; these were accomplished in 1982. The inventory process was begun in 1983 and is reported on here.

The targeted research objectives of this initial inventory session were evaluation and preliminary mapping of MUNLEON, a World War I laker class vessel lost at Point Reyes on November 8, 1931; relocation and evaluation of RICHFIELD, a bulk oil tanker lost off Chimney Rock on May 8, 1930; and documentation and mapping of a circa 1880 schooner wharf site in the upper reaches of Schooner Bay. In addition to the inventory activities above, onsite examination of six anomaly clusters, identified in the 1982 survey, was completed.

A preliminary base map of MUNLEON was completed that includes all of the major structural components of the site. However, it raised more questions about the site than answers. Displacement of the starboard boiler and a large section of missing stern suggest questions of wreck deposition and possible intervention through salvage activities which should be addressed in future work at the site.

The site of RICHFIELD is hazardous to dive due to the currents present, boat traffic and poor visibility. Park divers now have a much better understanding of this site as well as knowing the exact location of RICHFIELD's remains. Determination of the full extent of the wreckage scatter and completion of a base map of the site are future inventory tasks.

The Schooner Bay Wharf Site was documented and mapped; it is an example of the potential for preservation of this type of site within the park boundary. Not surprisingly, only 8 of the 38 pilings present at the site were visible above the surface of the water.

Onsite examination of the six anomaly clusters resulted in a negative finding; no remains of any type were located protruding above the sand bottom. This confirms the supposition that whatever is creating the anomalous readings is most probably deeply buried in the sand and silt bottom of Drakes's Bay.

I. INTRODUCTION

This study of the submerged cultural resources of portions of Point Reyes National Seashore and Point Reyes-Farallon Islands National Marine Sanctuary has been designed within a park management framework. The project is geared toward generating information that will be useful in submerged cultural resources site protection, visitor safety and interpretation, in meeting Federal compliance requirements, in contributing to the story of the park and the maritime history of the Pacific coast, and in answering questions of general archeological and historical importance.

Planning is an important consideration in projects which are anticipated to run over several years or field sessions or where funding and time constraints dictate an otherwise segmented approach. The results of each segment should meet specific management needs and be able to stand alone as individual management documents. The philosophical approach to phased ship survey has been discussed by others, while Murphy (1983) provides a recent discussion of its application by the National Park Service. Briefly restated, shipwreck surveys consists of Phase I remote sensing reconnaissance of blocks of land for the purpose of locating as much of the resource base as possible and Phase II evaluation of sites or anomalies to confirm their nature and possible significance.

The overall submerged cultural resources management approach, of which survey is only one aspect, may also be conceptualized as distinct phases or steps; the course of research leading in a logical sequence through initial assessment, survey of portions of a park and then inventory of all the known submerged resources in an area. Each of these activities is discussed in greater detail, as separate report formats of the unit, elsewhere in this report. This sequence of steps may be physically divided activities by time, space and reporting as is the case with the Point Reyes study, or conducted concurrently and reported on in one document when a project runs continuously.

The overall project sequence of the specific Point Reyes study is progressing as follows:

Step 1. Literature and background research (i.e., assessment) and controlled remote sensing survey (i.e., Phase I reconnaissance).

Step 2. Initial inventory of known submerged cultural resources and onsite examination of selected anomalies (i.e., Phase II evaluation).

Step 3. Testing of buried anomalies (Phase II evaluation) and full-scale inventory of visible resources.

Step 4. Excavation/conservation of selected or threatened sites if deemed necessary.

Assessment and Phase I reconnaissance survey, (step 1) was accomplished in two sessions - August 23 to September 5, 1982 and October 4 to 14, 1982. The results of the survey have been reported on elsewhere (Murphy 1983). The field research undertaken in 1983 and reported on here, initiates the inventory process (step 2) of the overall Point Reyes project.

Research Objectives

Three research priorities were established for the 1983 field session: (1) ground truthing and onsite evaluation of several high priority anomaly clusters within Drakes Bay; (2) location and preliminary evaluation of two known shipwreck resources within the seashore; and (3) initial location and evaluation of other i.e., non-shipwreck, submerged resources.

Funding

This project was funded from the Point Reyes National Seashore ONPS (Operation of the National Park Service) account, and by the Submerged Cultural Resources Unit augmented by transfers of funds arranged by the Division of Park Historic Preservation, Western Regional Office.

Project Rationale

Although the Point Reyes enabling legislation (Public Law 87-657) does not specifically address preservation of cultural resources as a primary objective, the park's Statement for Management (approved in June, 1981) does discuss the necessity to "identify features and events that have played a vital part in the recorded history of Point Reyes, such as...shipwrecks" (page 23). These inventory activities conform to the Point Reyes cultural resource management plan, project PORE-C2. The field work undertaken in this initial effort to document the resources at Point Reyes was designed to maximize data returns from a very limited time, funding and personnel base in order to begin "filling in the blanks" for a total submerged cultural resources inventory of the park.

Project Dates and Participants

Field work began on September 7 and concluded on September 14, 1983. All activities took place within the Seashore localities of Drakes Bay, Drakes Estero and the Point Reyes headlands. Fifteen National Park Service employees, representing five Western or Southwest Region units, one Volunteer-in-Parks, and two contracted individuals participated in the 8-day project. A total of 33 persondays (diving) and an additional 30 persondays of work were completed. The session involved approximately 20 individuals, excluding numerous hours of preparation and planning between key personnel in the two Regional Offices, two parks and one cultural resources center.

The following people contributed to the success of the 1983 field session at Point Reyes National Seashore:

John L. Sansing - Superintendent, Point Reyes National Seashore
Roger Kelly - Western Regional Archeologist; Project Coordinator
Daniel J. Lenihan - Chief, Submerged Cultural Resources Unit
David Pugh - Chief, Division of Interpretation; Seashore Coordinator

Point Reyes National Seashore
LeeRoy Brock - Chief Ranger; diving assistance
Bryan Sutton - Park Dive Officer; diving assistance
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James Delgado - Park Historian; diving assistance
Martin Meyer - Cultural Resource Specialist; diving assistance

Western Archeological and Conservation Center
Don Morris - Archeologist; diving assistance

Western Regional Office
James Huddleston - Environmental Specialist; NPS video documentation

Submerged Cultural Resources Unit
Larry Murphy - Archeologist; instrument operation and anomalie relocation
Toni Carrell - Archeologist; field work supervisor

Other Participants
Bob Lundberg - Captain of NICK; research boat operation
David Buller - Volunteer-in-Parks; diving assistance
Robert Bennett - Civil Surveyor; instrument operation
Peter Gogan - Manager, Point Reyes-Farallon Islands National Marine Sanctuary; sanctuary clearance and coordination

II. FIELD RESEARCH RESULTS

The major research priorities established for the 1983 field session at Point Reyes National Seashore were: (1) evaluation of six anomaly clusters; (2) location and evaluation of selected known shipwreck resources, specifically MUNLEON and RICHFIELD; and (3) location and evaluation of other (non-shipwreck) submerged cultural resources.

Anomalies

Objectives

One of the objectives of this session of the field work at Point Reyes National Seashore included the relocation of specific magnetic anomalies and a natural feature discovered during the 1982 Phase I reconnaissance survey. Although it was strongly suspected that any cultural materials which may have caused the anomalies would be covered by sediment, it was necessary to confirm that supposition before programming and funding a Phase II survey. Relocation involved optical repositioning of electronically generated coordinates. This exercise also served to check optical relocation accuracy capabilities and to train Seashore and Western Regional personnel in these procedures for future test excavation and monitoring efforts within Drakes Bay.

Relocation of specific points within the magnetometer survey zone completed in 1982 relied on a shore-based system of accurately surveyed horizontal control stations. These control stations were planned and positioned so that a combination of two or more would provide geometrically acceptable locations (those giving an angle of intersection in the survey zone between 30-150 degrees and 60-120 degrees preferred) for installation of either electronic or optical survey stations.

Eight points were located or surveyed to provide control stations (Appendix I). Stations 1 and 6 are U.S. Geological Survey monuments, and the remainder were surveyed either by traditional methods (points 3, 4, 5) or by Mini-Ranger Satellite Positioning System provided by Motorola, Inc. Points 3-7 were closely spaced in the vicinity of Limantour Spit and the mouth of Drakes Estero to provide convenient optical stations in the area determined to be a zone of high probability for shipwreck occurrence. Universal Transverse Mercator (UTM) grid coordinates were computed for each control point.

During Phase I reconnaissance survey, electronic positioning was done from horizontal control stations (Murphy 1983). An x-y UTM grid coordinate was produced for each of the 684 anomalous magnetic readings. These included multiple readings resulting from broad anomalies, as well as single points.

Anomaly readings were stratified into ±1 to 4, ±5 to 9, ±10 to 14, ±15 to 19 and ±20 gamma intensity groups, then clustered if they were closer than 15 linear meters or if they appeared on two consecutive survey vessel transects. Some linear clusters can, of course, represent a single object. All anomalies were labeled with a discrete 5-digit number that indicates the survey block, survey lane and anomaly number of the lane.

Six target areas were selected for optical relocation and diver examination. Five of these represent magnetometer anomalies, and one represents the site of a deep, inundated channel located by the sub-bottom profiler survey. These target areas were relocated on the surface by boat and a buoy was dropped to mark the location for further examination. Buoys 1, 2 and 3 were in survey area 1 and the remainder in survey area 4. Buoys 1 and 2 represented, respectively, the offshore and nearshore anomalies of the largest cluster in this area. Survey area 1 was selected as the probable location of SAN AGUSTIN. The dive objective was to determine if any cultural material was visible.

The buoy 3 location was the site of the inundated channel delineated by the sub-bottom profiler. Here the dive objective was to determine if there were visible environmental attributes that would influence future test excavation in the area. The channel area will probably be the most difficult place to excavate in the study area. The sub-bottom profiler indicated that depths of sediment in front of the estero opening are in excess of 20 feet.

Study area 4 contains buoys 4, 5 and 6. Buoy number 4 was placed on a ±20 gamma anomaly in a three-lane cluster. Buoy 5 was placed on a cluster containing a +28 gamma anomaly; buoy 6 was set on a 7-count (7-second) anomaly cluster of +9 to 11 gammas. These anomalies may be the remains of the steam schooner POMO (1903-14). The purpose of the dive was to determine whether the winter storms of 1982-83 that uncovered structural remains of POMO on Limantour Spit had exposed structure offshore as well.

Figure 1. Identification of Anomaly Targets for Relocation and Onsite Examination

Buoy Number	Anomaly Number	Anomaly Intensity
1	119B3	+20 gammas
2	10604	+145 gammas
3	inundated channel	N/A
4	41605	±20 gamma three-lane cluster (90 meters; 17-anomaly cluster)

5	41205	+28 gamma four-anomaly, two-lane cluster (60 meters width)
6	42503	+9 to 11 gamma, 21-meter linear cluster

Methodology

Optical positioning, when used to relocate a specific point in the water, usually requires two instruments and operators in communication with each other and with the vessel pilot. Put simply, the procedure is to set each instrument up on a stable point (usually on land) and turn angles so that their intersection is the desired position on the surface of the water. The boat pilot is directed along one angle, with the course maintained by instructions from one instrument operator. When the vessel comes into view in the second instrument, a prepratory signal is given, and the buoy drop command is given when the buoy handler is aligned in the crosshairs. As soon as the buoy is dropped, both instruments are realigned on the floating buoy and the angles recorded. This final procedure allows an accurate plot of the buoy's real position relative to the desired location, so that the divers can be directed to concentrate their search in the appropriate direction away from the marker buoy.

In order to successfully execute this procedure, a number of factors must be present. The instruments must be set up on known locations so that they can be accurately plotted on a chart. The desired position in the water must be plotted in order to allow accurate angles to be measured or computed and turned. Angles can be turned from a baseline which must be plotted on the base map or azimuths from magnetic or grid north to generate correct instrument readings. The level of accuracy of each step in the relocation procedure significantly affects the precision of the desired in-water position.

Optical repositioning for Drakes Bay relies on accurate shore-based horizontal control positions and accurate anomaly locations ($\pm$1 to 3 meters). An x-y geographic coordinate (UTM) was developed for all positions. By maintaining consistent grid coordinates, grid north can be used to set up both instruments giving a higher accuracy than relying on magnetic north. The grid azimuth between stations can be trigonometrically computed and the appropriate reading can be loaded on the field instrument before it is aligned with the proper station. The lower plate on the transit is thus aligned to grid north and the upper plate can be loosened to set the aizmuth to the in-water position. UTM grid azimuths have been computed between all eight stations (Appendix I). A computer program was developed to generate for every anomaly, the azimuth between it and each shore-control point (these have been transmitted to the Western Region Archeologist and the park). This system provides an easy relocation capability for future test excavation and monitoring.

The first task of the relocation field work was to find the shore controls. The stations were marked with an iron pipe and witness post driven into the ground. Station 3 could not be visually located. Search with a metal detector was also negative. This point may have been lost through cliff erosion or vandalism and should be re-established. If the loss was due to cliff erosion another should be surveyed in this key area. Grid azimuths between stations and anomalies would then have to be recalculated. All other shore stations were relocated and permanent monuments are being established on each of these control stations.

Shore stations 4, 5 and 7 were used for positioning the buoys on the target areas. A 12-foot pole and flag were placed on station 5 so that both transits could be aligned to grid north. The proper azimuths were put on the transits. Both instrument operators were in radio communication with the boat. The boat was directed toward one transit following port and starboard steering directions given by the instrument operator while the second operator gave the buoy drop signal. Buoys 1, 2, 3 and 4 were dropped precisely on-line, and buoys 5 and 6 were 3-6 meters off the desired position.

Results

Anomaly buoy number 1 was placed in an area where a large cluster of anomalies were recorded and where other evidence (Lenihan 1983) suggested remains of SAN AGUSTIN might be found. On September 9, 1983, this anomaly was field checked through an onsite examination of the bottom. Water depth over the site was 30 feet, with a flat, silty/sand bottom; visibility was limited to 24 inches. A 40-foot radius circle search, consisting of eight measured 5-foot transects, was undertaken. Divers positioned themselves on the search line so that each transect overlapped the previous by an arms reach of the diver positioned nearest the buoy (i.e., circle center point). In this manner, both a visual and tactile search of the 5,027 square foot area was completed. Results of the search were negative; no remains were found protruding above the sand bottom. A few starfish and only limited growth of a small variety of brown algae were noted.

Anomaly buoy number 2 was also placed in a high probability wreck location. This site was examined on September 9, 1983, using the circle search technique described above. Water depth over the site was 15 feet; visibility was limited to 24 inches on a flat, silty/sand bottom. Results of the search were negative; no remains were found protruding above the bottom.

Anomaly buoy number 3 was placed in an area targeted by the sub-bottom profiler as an ancient inundated channel (McCulloch 1983). An attempt to dive this anomaly on September 13, 1983, was cancelled due to heavy surf over the site.

Anomaly buoy number 4 was placed in an area of suspected additional POMO remains. The site was examined on September 13, 1983, using the search technique described above. Water depth over the site was 15 feet on a flat, silty/sand bottom; visibility remained 24 inches. A 60-foot radius circle search revealed no remains protruding above the bottom.

Anomaly buoy number 5 was also placed in an area of suspected POMO remains. A 60-foot radius circle search was completed on September 12, 1983. Water depth over the site was 15 feet while visibility was 8 to 10 feet on a flat, silty/sand bottom. Results of the search were negative, no remains were noted.

On September 13, 1983, an attempt was made to locate anomaly buoy number 6. A visual scan of the surface area, where the buoy had been placed earlier in the week, was negative; the buoy appears to have either filled with water and sunk or worked its way loose and floated from the target area.

Shipwreck Resources

The variety of shipwreck resources which lay within Point Reyes National Seashore mirrors the maritime history of the Pacific coast. Small craft used by native populations for subsistance, trade and coastal travel, were followed by square-rigged ships designed by their European owners for long voyages of exploration and conquest. Later, similar vessels were active in the early hide and tallow trade. A flood of sailing ships appeared during the California gold rush, transporting passengers and general cargo. Steam schooners, paddle wheelers then eventually steel freighters each plied the coastline as passenger and package freight commerce increased. Whaling, sealing and fishing vessels were active in the region; sleek, maneuverable schooners and later steam-powered ships were used in the quest for whale oil and fur. An increased demand for raw materials, in quantities sufficient to support the rapid industrial and population growth of the region, resulted in the development of specialized vessels to carry bulk lumber and heralded the appearance of the oil tanker along the coastline.

The known shipwreck population at Point Reyes includes a cross section of vessel types representative of the diversity of Pacific coastal maritime activities and commerce.

Figure 2. Summary of Vessel Types
in Drakes Bay, Point Reyes National Seashore
and Point Reyes-Farallon Islands National Marine Sanctuary

Activity	Type	Construction/ Propulsion	Name
Exploration	Brig	Wood/Sail	SAN AGUSTIN
Hide & Tallow	Brig	Wood/Sail	AUYACHUCHO

Sealing	Schooner	Wood/Sail	LIZZIE DERBIE
Passenger/General Cargo (package freight)	Bark	Wood/Sail	NAHUMAKEAG
	Schooner	Wood/Sail	ANNE
	Schooner	Wood/Sail	FRANCIS
	Schooner	Wood/Sail	VALENTINE ALVISO
	Schooner	Wood/Sail	COLONEL BAKER
	Schooner	Wood/Sail	ANNE E. SMALE
	Freighter	Steel/Steam	MUNLEON
Bulk Cargo	Lumber Schooner	Wood/Steam	WILLIAM ACKMANN
	Lumber Schooner	Wood/Steam	POMO
	Lumber Schooner	Wood/Steam	HARTWOOD
	Oil Tanker	Steel/Steam	RICHFIELD

Vessels engaged in exploration, hide and tallow trade, sealing, passenger and general cargo and bulk cargo movement evolved to meet specific economic and transportation needs. The two vessels selected for examination in the initial inventory session at Point Reyes were MUNLEON, a steel package freighter and RICHFIELD, a steel bulk freighter. Both of these vessels were built on the Great Lakes; MUNLEON came out of the Detroit Shipbuilding Company's Wayandott, Michigan yards and RICHFIELD from Lorain, Ohio shipyards of the American Shipbuilding Company. MUNLEON, although known as a vessel in the "Laker" class, has its design origins in the North and Baltic Seas. The term Laker coming from both the area where the majority of these vessels were built and the prefix LAKE assigned to the name of these vessels. RICHFIELD evolved from a shipbuilding tradition developed among Great Lakes builders who were addressing the specific environmental demands of the Lakes and the desire for maximum bulk cargo capacity.

Vessel Context

<u>Package Freight Lakers - The Place of MUNLEON in American Shipping Development</u>: After the outbreak of World War I in Europe there was an urgent need for ocean freighters that were well adapted for coastal use. Yards in Europe could not keep up with the demand so European shipowners turned to Great Lakes builders, among others, to fill the void. The vessels they ordered had to be suitable for use on the Baltic and North Seas and be able to pass through the Lakes canals; a standard design that had been developed in Norway was chosen. Known as the "Frederickstad" type, these vessels were compact general cargo steamers with raised forecastle and poop decks and machinery, bridge and boat decks amidships, generally referred to as a three-island one-decked vessel.

The first orders for Frederickstad vessels came from Scandanavia and France in 1917. A total of 25 hulls, 253'6"x43'6"x22'6", were contracted for with six Great Lakes builders. By March 1917, the British Shipping Controller had placed orders in Canada and the United States for nearly 700,000 gross tons of shipping to be built using a "modified" Frederickstad design (Wilterding 1981a:1). These vessels were known as "war ships" because each vessel's name began with the word WAR (Barry 1973:193).

During this period, the United States was suffering due to a lack of vessels for its own coastal trade. In late 1916, the U.S. Congress finally agreed on a shipping policy and the result was the passage of the Shipping Act of 1916 which was:

> for the purpose of encouraging, developing, and creating a naval auxiliary and naval reserve and a Merchant Marine to meet the requirements of the commerce of the United States...[and] to regulate carriers by water engaged in the foreign and interstate commerce of the United States... (Hurley 1927:22).

The act also established the U.S. Shipping Board which was given the power to form a corporation in order to implement the provisions of the act. The first action to be taken by the U.S. Shipping Board, in January 1917, was to place an embargo on the transfer of vessels from American to foreign owners. The pressures of the war and the need for vessels was rapidly depleting an already small American fleet. On April 6, 1917, the United States entered World War I and 10 days later, on April 16, the Emergency Fleet Corporation (EFC) was created. It was this corporation that coordinated the procurement of materials, negotiation of contracts and construction of vessels for the war effort (Hurley 1927:22-24). Very shortly thereafter, the EFC requisitioned all ships being built in U.S. yards, predominantly in the Great Lakes, including more than 90 "warships" intended for the British Shipping Controller. All of these vessels were renamed, with few exceptions, and given the U.S. Shipping Board prefix LAKE (Barry 1973:194; Wilterding 1981a:2; Hurley 1927:25).

The EFC contracted for some 1,400 ships nationwide. On the Great Lakes, 346 ships were contracted which were predominantly Laker class vessels. All of the Lakers were built using a variety of modified Frederickstad designs. There were seven different basic designs adopted by the EFC, one of which was not a Frederickstad design at all.

Design 1020	Laker Type A	3500 dwt	Coal
Design 1042	Laker Type B	3350 dwt	Coal
Design 1044	Manitowoc Ship Building Co.	3400 dwt	Coal
Design 1060	Stemwinders	4200 dwt	Oil/Coal
Design 1074	Great Lakes Engineering Works	4050 dwt	Oil
Design 1093		4200 dwt	Coal
Design 1099	American Shipbuilding Co.	4050 dwt	Coal/Oil

(after McKellar 1962:272)

Of the 346 vessels contracted with Great Lakes builders, 336 were actually built. Three hundred eleven of these were ocean freighters of the Laker type. All totaled, there were 430 ships built or requisitioned by the EFC of the Laker class in the United States (Wilterding 1981b:1).

Laker Type A, design 1020, saw the most use; a total of 92 hulls were laid nationwide, 21 of which were constructed on the Great Lakes. Design 1099 was not far behind with 91 vessels launched on the Great Lakes (Wilterding 1981b:1-4). It was under this second design that MUNLEON, the Laker eventually stranded at Point Reyes in 1926, was built.

Design 1099 was further divided into two subcategories: design 1099-A oil burners and design 1099-B coal burners. MUNLEON is a 1099-A vessel. A total of 68 vessels were built with the "A" design. They were all 251 feet long, 43 feet 6 inches midline breadth, 28 feet 2 inches midline depth on a draft of 24 feet 1-1/4 to 4-1/4 inches; their deadweight tonnages varied from 4,000 to 4,155 dwt. They were equipped with twin Scotch boilers with a rated pressure of 180-185 psi and triple-expansion steam engines with 21-inch, 36-inch, 59-inch or 22-inch, 35-inch, 59-inch diameter cylinders by 42-inch stroke. Two hatches, four holds, eight booms, eight winches and two masts were standard on these vessels. All were constructed of steel, transversely framed, and with few exceptions, the 'tween deck beams were in place but decking never laid. The American Shipbuilding Company built 50 vessels of this type during 1918-1919 (U.S. Shipping Board 1925:32). One of these 50 was MUNLEON, built by the Detroit Shipbuilding Company which was one of several companies amalgamated into the American Shipbuilding Company in 1898 (Ken Hall, personal communication 1984).

<u>Bulk Freighters - The Place of RICHFIELD in American Shipping Development</u>: The first special purpose bulk freighter was built in Cleveland in 1869. R.J. HACKETT represented an innovation in design and construction and was specifically designed by her builder, Eli Peck, to carry bulk cargos.

The design of HACKETT, based on the sailing schooner and first called a steam barge, incorporated many basic features from earlier vessels that became standard in subsequent bulk carrier construction. She had her engine in the stern as did the 1843 HERCULES, and her boilers on the main deck similar to the 1840 MISSOURI. HACKETT's cabins were above the deck, resembling the 1839 GREAT WESTERN, with her pilothouse forward and her crew quarters aft. The vessel had three masts comparable to the 1830 SHELDON THOMPSON, the first steamboat to carry that rig on the Great Lakes (Mansfield 1899:610), and a single stack like the 1840 CHESAPEAKE. The vessel's most innovative feature was her unbroken deck between the fore and aft cabins to allow easy access to the hatches which were set 12 feet apart (Barry 1973:109). This deck arrangement was unique to Great

Lakes ships and met the need for extensive cargo space. At 211 feet in length, R.J. HACKETT could carry about 1200 tons of bulk freight (Ericson 1968:5).

Arches or hogging trusses, which usually rose above the hull in other classes of steamers, were reduced to rise no higher than the top of the deck in order to leave open access to the hatches. A photograph of FOREST CITY, HACKETT's sister ship (Barry 1973:108), suggests that the hull actually had two arches for support, with steel sheeting on the outside of the hull planks.

ONOKO, the first iron-hulled steam barge, was launched in 1882. Over 280 feet long and capable of carrying 216 net tons, this vessel was the next step in bulk freighter evolution, further refining the basic characteristics of these special purpose vessels. ONOKO was propeller-driven with engine aft, bridge and forecastle forward, and an open cargo hold amidships. This vessel is considered the first of the modern iron-hulled freighters (Mansfield 1899:413).

Insurance underwriters did not entirely trust iron ships; this mistrust was reflected in the granting of lower premium rates to wood sheathed vessels. Composite vessels of iron and wood were built primarily to take advantage of this situation. These vessels had iron frames, oak planking and iron plates sheathing the wood from the water line up to the main deck (Barry 1973:136). The first composite hull freighter, FAYETTE BROWN, launched in 1887 was followed by five more composite vessles by 1890; all were built at the Detroit Dry Dock Company.

SPOKANE, the first steel-hulled freighter, was launched in 1886 from the Cleveland Yards of Globe Iron Works, four years after ONOKO. Capable of carrying over 3,000 long tons and 310 feet long, steel-hulled steamers like SPOKANE quickly replaced iron and composite vessels. The size and length of bulk freighters increased very quickly after the introduction of steel hulls in 1886.

The year 1886 also represented a turning point in the development of bulk freighters specifically constructed to carry petroleum and other oil products with the launch of the prototype of the modern oil tanker.

Oil consumption in Europe by the early 1860's had increased to such a degree that it was necessary to find a more economical and efficient method of transport. Traditionally, oil had been carried in barrels stacked in the hold often as auxillary cargos. The sailing vessel RAMSEY (1863) was the first ship to have tanks actually constructed into her hold to carry oil in bulk in addition to barrels of oil stowed in her 'tween deck space (Frear 1945:135).

CHARLES, a sailing vessel of 794 tons, was converted to the bulk oil trade in 1869 when 59 iron tanks were built into her hold. Between 1869 and 1872, several additional sailing vessels had iron tanks installed, however, they were failures "because the required strength of the tanks and their oil-tightness were insufficiently understood" (Frear 1945:135). In 1872, VADERLAND, a three-decked passenger steamer built in England, had tanks fitted into the lower hold with essentially a double hull up the side and under the lower deck; two additional vessels were built in the same manner in 1873 and 1874. These vessels failed for economic reasons as they were never permitted to carry oil and passengers on the same voyage. Wooden sailing vessels were considered safer for oil transport than steamers and many were altered to carry oil in their holds. The holds in these vessels were divided by a centerline (i.e., longitudinal) bulkhead and transverse bulkheads of wood (Frear 1945:134). ANDROMEDA, a sailing vessel built in 1884, had 72 metal tanks integrated into her hull structure. CRUSADER followed in 1886 with 12 cylindrical tanks, laid horizontally 3 deep in her hold (Frear 1945:136).

The first steamer to be constructed to carry oil directly against the ships plating was ZOROASTER, launched in 1878, in the Baku district of Russia. Many similar ships followed, but resistance to carrying oil against the ships plating remained strong. Leaky rivets, butts and plate seams as well as undue tension on the rivets were all cited as contraindicators to carrying oil in bulk against the plates (Frear 1945:136). Evidence of this resistance continued even up to the launching GLUCKAUF in June 1886, considered to be the prototype of the modern tanker (Frear 1945:136; Haviland 1978:175). GLUCKAUF'S design was that of:

> ...a single-screw steamer with poop, forecastle, machinery aft and pump room forward of the boiler space in which there were two Scotch boilers. Her rig was that of a three-masted barkentine. The length was 3090 feet, breadth 37 feet, depth molded 24 feet, gross tonnage about 2,300, deadweight about 3,020 tons, capacity about 18,000 barrels...she had...a double bottom [in the machinery space only] with the tank top sloping up steeply to the center. The hold was subdivided by a centerline bulkhead and transverse bulk heads...and the cargo was carried against the ships plating (Frear 1945:136).

When she arrived in New York to pick up her first petroleum cargo in July 1886, longshoremen and oil workers conspired to prevent her loading and refueling (Frear 1945:136).

A number of tanker designs followed one another in rapid succession during this period. SVIET was built in 1885 at Gothenberg. She was a single-decked vessel with one tank, her double-bottom plating forming the tank bottom; the tank sides and top were well in from the ships plating. The tank was divided by a longitudinal centerline bulkhead and three transverse bulkheads. CHIGWELL

(1885) had her machinery amidships, double bottom throughout, tanks forward and aft extending from side to side and up to the deck in small trunks. Void spaces between the tanks and hull, however, presented explosion hazards. CHARLOIS, ERA and OKA (ca. 1887) carried their cargos against the hull plating with cofferdams placed at each end of the tank and machinery aft (Frear 1945:137).

In 1886 there were only about a dozen vessels capable of carrying oil in bulk; by 1907 there were 137 steamers and 149 sailing vessels carrying oil in bulk on the Caspian Sea alone. In 1885, 99 percent of all oil cargos were carried in barrels, but by 1906, 99 percent were being moved in bulk (Frear 1945:135-137). The majority of the early tankers in the transatlantic oil trade were European owned and were not available nor suited to American coastal service (Haviland 1978:175). The development of an American tanker fleet was based upon both the conversion of vessels, built for other purposes, and bulk tanker construction.

The first tank steamer built in the United States was STANDARD (1888) by J. Roach and Son (Delaware River Iron Shipbuilding and Engine Works) of Chester, Pennsylvania. Constructed of iron for Standard Oil Company of New York, the vessel was 162 feet long, 30 feet in breadth and 14 feet 4 inches deep. Powered by a triple expansion engine (14 inch, 22 inch and 36 inch diameter cylinders by 24 inch stroke), she was capable of carrying 4,000 barrels.

Subsequent to STANDARD's launching, tanker construction and conversion moved rapidly in the United States.

Figure 3. Early Development of American Tanker Fleet
(after Haviland 1978:175-202)

1888 STANDARD (US 116,199) iron screw tank steamer. Built by Delaware River Iron Shipbuilding & Engine Works, Chester, Pennsylvania; 162'x30'x14.4'; 832 gross tons and 590 net; carrying capacity 4,000 barrels. The first American tanker.

1889 W.L. HARDISON (US 81,181) wooden screw tank steamer. Built by A. Hay, San Francisco; 160'x32.5'x14.5'; 453 gross tons and 352 net. The first wooden tank steamer to have iron tanks placed in her hold.

1890 MAVERICK (US 92,171) steel screw tank steamer. Built by Columbian Iron Works and Dry Dock Company, Baltimore; 239.9'x36'x17'; 1,722 gross tons and 1,118 net; carrying capacity 12,000 barrels.

1896 GEORGE LOOMIS (US 86,340) steel tank steamer. Built by Union Iron Works, San Francisco; 175'x27.4'x16.5'; 691 gross tons and 492 net. The first steel tank steamer built on the Pacific coast.

1898 ATLAS (US 107,430) steel screw tank steamer. Built by Delaware River Iron Shipbuilding & Engine Works, Chester; 248'x40'x22.5'; 1,942 gross tons and 1,243 net; carrying capacity 22,860 barrels.

ALLEGHENY (US 107,426) steel screw tank steamer. Built 1890 by Craig, Taylor and Company, Stocton, England; 320'x42.2'x19.2'; 2,914 gross tons and 1,914 net; sunk 1894. Rebuilt and registered in the United States in 1898; modified dimensions 310'x42.4'x27.1'; 3,009 gross tons and 1,889 net.

1901 PARAGUAY (US 150,880) steel screw steamer converted to tanker. Built by American Shipbuilding Company, Lorain, Ohio, as package freighter; 242'x42'x26.5'; 2,201 gross tons and 1,323 net. Lengthened 1909 by 50'; modified gross tonnage 2,672 and 1,583 net.

MAJOR BARRETT (US 93,061) wood screw steamer converted to tanker. Built 1900 by Jackson Sharp Company, Wilmington, Delaware; 175'x34'x13.5'; 738 gross tons and 517 net; carrying capacity 25,700 barrels. Rebuilt by an American company 1901.

1902 J.M. GUFFEY (US 77,519) steel screw tank steamer. Built by New York Shipbuilding Company, Camden, New Jersey; 292.2'x40.2'x23.5'; 2,520 gross tons and 1,593 net; converted to a tanker during construction.

TOLEDO (US 145,947) steel screw tank steamer. Built by Craig Shipbuilding Company, Toledo; 250.5'x42'x25.5'; 2,277 gross tons and 1,868 net. Converted to a tanker during construction.

ASUNCION (US 107,598) steel screw steamer converted to tanker. Built by American Shipbuilding Company, Lorain, as package freighter; 242'x42'x26.5'; 2,196 gross tons and 1,328 net; carrying capacity 21,000 barrels. Sister ship to PARAGUAY.

WINIFRED (US 81,626) steel screw steamer converted to tanker. Built 1898 by Bath Iron Works, Bath Main; 282.5'x42.5'x21.1'; 2,551 gross tons and 1,520 net. First American tramp steamer specifically built for that trade. Rebuilt by Morse Iron Works, Brooklyn.

CATANIA (US 127,251) steel screw steamer converted to tanker. Built 1881 by Alexander Stephen & Sons, Linthouse, as dry cargo steamer; 2,635 gross tons and 1,932 net. Registered the United States in 1898 and rebuilt by an American company; modified dimensions 307.4'x35.7'x22.6'; 3,269 gross tons and 2,535 net.

ROMA (US 111,417) steel screw steamer converted to tanker. Built 1889 by J.L. Thompson & Sons, Sunderland, England, as bulk carrier.

Rebuilt 1902 in Brooklyn; modified dimensions 316'x40.6'x20.8'; 2,939 gross tons and 2,164 net; carrying capacity 27,500 barrels.

WASHTENAW (US 81,499) steel screw steamer converted to tanker. Built 1887 by William Gray & Company, Hartlepool, England; 315.3'x42.6'x25'; 2,897 gross tons and 2,004 net; carrying capacity 28,500 barrels. Converted by an American company.

HARRY LUCKENBACH (US 93,008) steel screw steamer converted to tanker. Built 1881 by William Gray & Company, Hartlepool. Rebuilt by Newport News Shipbuilding & Drydock Company, Virginia; modified dimensions 300'x40.2'x24.5; 2,798 gross tons and 1,799 net.

JULIA LUCKENBACH (US 77,555) steel screw steamer converted to tanker. Built 1882 by Nederlandsche Stoomboot, Rotterdam, as dry cargo steamer. Rebuilt by Newport News Shipbuilding & Drydock Company; modified dimensions 313'x39.4'x29.9'; 3,100 gross tons and 1,977 net.

ROSECRANS (US 127,310) iron screw steamer converted to tanker. Built by Barclay, Curle & Company, Whiteinch, as passenger steamer. Rebuilt by Matson Navigation Company; modified dimensions 335'x38.2'x27.2'; 2,976 gross tons and 1,816 net; carrying capacity 23,000 barrels.

1903 COLONEL E.L. DRAKE (US 127,743) steel screw tank steamer. Built by William Cramp & Sons, Phildelphia; 360'x50'x21.5'; 4,205 gross tons and 3,307 net; carrying capacity 38,000 barrels. The first American tanker built from the keel up as such since ATLAS (others converted while under construction).

CAPTIAN A.F. LUCAS (US 201,645) steel screw tank steamer. Built by William R. Trigg Company, Richmond, Virginia; 360'x50'x28.5'; 4,188 gross tons and 3,252 net; sister ship to COLONEL E.L. DRAKE.

WHITTIER (US 81,862) steel screw tank steamer. Built by Union Iron Works, San Francisco; 240'x32'x17.5'; 1,296 gross tons and 798 net; carrying capacity 14,300 barrels.

LARIMER (US 141,870) and LIGONIER (US 141,861) steel screw tank steamers. Built by New York Shipbuilding Company, Camden, New Jersey; 352.5'x46.4'x19.2'; 3,738 and 3,737 gross tons, respectively and 2,397 net tons each; carrying capacity 50,160 barrels each.

CITY OF EVERETT (US 127,055) steel screw steamer converted to tanker. Fabrication done by American Steel Barge Company, West Superior, Wisconsin; assembly by American company in Everett, Washington, whaleback for package freight trade. Rebuilt dimensions 346'x42.1'x22.9'; 2,590 gross tons and 1,718 net.

NORTHWESTERN (US 130,908) 2,207 gross tons and 1,299 net; NORTHEASTERN (US 130,905) 2,157 gross tons and 1,496 net; NORTHMAN (US 130,906) 2,120 gross tons and 1,306 net; NORTHTOWN (US 130,907) 2,028 gross tons and 1,297 net; steel screw steamers converted to tankers. Built 1901 by Chicago Shipbuilding Company as package freighters; 242'x42.2'x23.2'; Great Lakes design with machinery aft, side loading hatches, double bottom full length of hull. Rebuilt by an American company; carrying capacity 22,000 barrels each.

FLORIDA (US 120,926) steel screw steamer converted to tanker. Built 1887 by R. Duncan & Company, Port Glasgow, as passenger steamer. Rebuilt by Dialogue Shipyard, Camden; modified dimensions 230'x35.5'x18.5'; 1,596 gross tons and 1,052 net; carrying capacity 12,000 barrels.

ARGYLE (US 107,577) steel screw steamer converted to tanker. Built 1892 by William Gray & Company, Hartelpool, as dry cargo steamer. Rebuilt by Union Iron Works, San Francisco; modified dimensions 320.2'x40.7'x24.4'; 2,953 gross tons and 1,880 net; carrying capacity 30,000 barrels.

1904 LANSING (US 200,595) steel screw steamer converted to tanker. Built 1902 by Palmers' Shipbuilding & Iron Company, Ltd., Newcastle-on-Tyne, England, as dry cargo freighter. Rebuilt in the United States; modified dimensions 400'x47.2'x27.9'; 4,561 gross tons and 3,429 net; carrying capacity 47,000 barrels.

1906 W.S. PORTER (US 203,629) steel screw tank steamer. Built by Newport News Shipbuilding & Drydock Company; 385'x49.7'x28.7'; 4,902 gross tons and 3,525 net; carrying capacity 52,000 barrels.

MINNETONKA (US 93,224) and MINNEWASKA (US 93,255) steel screw steamers converted to tankers. Built 1902 by American Shipbuilding Company, Cleveland, as package freighters for ocean service; 430'x43.7'x29.4' each; 5,270 and 5,273 gross tons, respectively. Rebuilt by Newport News Shipbuilding & Drydock Company; modified tonnage 5,318 and 5,273 gross and 3,346 and 3,862 net.

1907 SUN (US 203,923) steel screw tank steamer. Built by Newport News Shipbuilding & Drydock Company; 382'x49.9'x29'; 4,837 gross tons and 3,501 net.

CONTRA COSTA (US 204,889) steel twin screw tanker. Built by Union Iron Works, San Francisco; 190.1'x37.2'x13.3'; 832 gross tons and 497 net; carrying capacity 9,524 barrels. First American tanker to be fitted with internal combustion engine.

1908 OKLAHOMA (US 205,040) steel screw tank steamer. Built by New York Shipbuilding Company; 419'x55.2'x28.8'; 5,853 gross tons and 3,795 net; carrying capacity 80,000 barrels. One of the largest tankers in the world when launched.

TEXAS (US 205,362) steel screw tank steamer. Built by Newport News Shipbuilding Company; 389.4'x52.1'x29.1'; 5,106 gross tons and 3,746 net; carrying capacity 56,000 barrels.

1910 CURRIER (US 208,114) steel screw tank steamer. Built by Fore River Shipbuilding Company, Quincy, Massachusetts; 370'x52.1'x27'; 4,711 gross tons and 2,869 net.

J.A. CHANSLOR (US 207,222) steel screw tank steamer. Built by Newport News Shipbuilding Company & Drydock Company; 378'x52.1'x29.5'; 4,938 gross tons and 3,121 net.

1911 THOMAS (US 145,862) steel screw steamer converted to tanker. Built 1900 by Maryland Steel Company as dredge. Rebuilt by William Camp & Sons, Philadelphia; modified dimensions 293'x52.5'x25'; 2,525 gross tons and 1,717 net; carrying capacity 35,000 barrels.

A closer look at the 41 vessels listed above reveals some trends. Twenty vessels, nearly one-half including two conversions during initial construction, were designed and built as tankers. All of these, with the exception of ATLAS, had their machinery aft (Haviland 1978:200) in the Great Lakes fashion, regardless of their builders. It appears that tanker design adopted this placement of machinery, open decks and unbroken holds from the Great Lakes builders in order to maximize cargo capacity and facilitate access to the tanks.

A total of six American-built tankers were launched between STANDARD in 1888 and ATLAS and ALLEGHENY in 1898, a 10-year period. Conversions of other vessels for the American tanker fleet did not begin until 1901 and the years 1901 and 1902 saw a flurry of activity in conversions; the ratio of conversions to new tanker construction was 10:2. Tanker construction was clearly on an upswing by 1903 with the ratio of conversions to construction at 7:5; conversions, however, still dominated. Looking at the period 1904 to 1911, the year that tanker construction became commonplace (Haviland 1978:175), the ratio changes dramatically with conversions to construction at 4:7; tanker construction in the United States had come into its own.

World-wide tanker tonnage also reflected rapid expansion in conversions and construction efforts in both the United States and Europe. In 1900 the tonnage, comprised of 193 vessels, was 637,014 deadweight tons; just 14 years later that had jumped to 441 vessels with 2,343,877 deadweight tons (Frear 1945:138).

Although the concept employed in CHARLOIS (ca. 1887), that is carrying the oil against the bottom, side and deck plating, machinery aft and cofferdams at the ends of the tanks, set a precedent for tanker design, the period from 1888 to about 1911 saw several improvements in structural design. Early failures from overall stress occurred most often in the decks; compressive stress is higher in the decks if the machinery is placed aft, while stress in the bottom may be greater with the machinery amidships (Frear 1945:137). A circular issued in 1891 by the Lloyd's Committee objected to the practice of filling alternate tanks with water ballast and recommended, instead, the use of the middle adjacent tanks. Kendall (1892) strongly reputiated this practice by showing that sagging stress would be nearly twice as great by placing ballast amidships rather than in alternate tanks (in Frear 1945:137). Kendall proved himself correct when a series of vessels, among them OKLAHOMA (1908-1914), broke in two and were lost after loading ballast amidships (Frear 1945:137).

The overall structural arrangement of iron- and steel-hulled bulk freighters, constructed on the Great Lakes between 1882 and 1904, is similar to oil tankers built during that period. Lake vessels were built on the channel-frame system; the floors were heavy channels over which were placed side keelsons, forming a double bottom (True 1956:32).

ATLAS, built in 1898, is an example of American tanker construction at the turn of the century. Unlike her peers, her machinery was amidships, but in other details is representative of the class. She was:

> ...fitted with a cellular double bottom extending from the forward bulkhead in the bunkers to the after bulkhead in the engine space, and this was piped so that it could be used for carrying fuel oil, though...she burned coal. Machinery was amidships and the ship fitted with a longitudinal bulkhead and ten transverse bulkheads forming (with the hull) twelve tanks...The frames were spaced 24 inches throughout. Pump rooms were located forward of the tanks and aft of the after tanks...The tanks were fitted with...expansion hatches, and the masts were equipped with cargo booms so that...[she] could carry package cargo (Haviland 1978:179).

Arch construction above the cargo space, introduced on the Great Lakes bulk carriers in 1905, eliminated the need for centerline stantions (U.S. Steel News

1937:4). The introduction in 1909 of a fourth side keelson in Great Lakes bulk carriers strengthened the bottom hull and made the vessel stiffer, and less prone to sagging (U.S. Steel News 1937:5).

Prior to 1908 tankers and bulk freighters were framed transversely, that is the strength members ran crosswise of the ship. In 1906 the Isherwood system of construction was patented. This construction technique consisted of:

> longitudinal and horizontal stiffeners worked continuously through widely spaced web frames and connected to bulkheads or to each other at the ends by brackets (Frear 1945:138).

Longitudinal framing alleviated problems of leakage at the bulkheads found in transversely framed tankers as well as strengthening the deck (Frear 1945:138). RICHFIELD, built in 1913 at the Lorain, Ohio yards of the American Shipbuilding Company, was constructed using longitudinal framing. The Isherwood (longitudinal) system of framing remained unchanged until 1925 when a modification, consisting of omitting the brackets and respacing the webs closer to the bulkheads, was introduced. Although, better designed brackets and the original spacing of webs were also favored and in fact Lloyd's classification rules of 1945 included this design (Frear 1945:138).

As problems of deck strength, leaking and sagging were resolved by shipbuilders, the overall length of tankers constructed steadily increased, as did length to breadth and breadth to depth ratios. The ratio of length to breadth influences draft and speed of the vessel. The reasoning behind lengthening the hull while keeping it proportionately narrow in beam was faster vessels because water (frictional) resistance is relatively less for a long vessel than for a short one, "...the essential condition of speed is length" (Russell in Hunter 1969:87). Similarly, the shallower the draft of a vessel the less resistance it affords to the water. The problem, of course, was to balance length to breadth and length to depth to create a fast, stable vessel with maximum cargo capacity.

The length to breadth ratio of STANDARD (1888), the first tanker constructed in the United States, was 5.4 to 1 while the average ratios of the seven vessels launched in 1902-3, a period of rapid construction for the developing American tanker fleet, was 7.2 to 1. A steady, general increase in length to depth ratios is also evident in these vessels. STANDARD's ratio was 11.2 to 1; during the period 1902-3 the average ratio was 14.5 to 1 and 13.3 to 1 in 1910. The capabilities of Great Lakes shipbuilders to exceed the peak of 14.5 to 1 was clearly demonstrated by construction of much larger vessels during RICHFIELD's era. Why then was RICHFIELD constructed with less than the peak ratios of her predecessors? Hunter (1969:86) suggests that a reduction in length-to-breadth and length-to-depth ratios of western river steamboats reflected a shift in emphasis from speed to cargo capacity and economy of operation. Although a

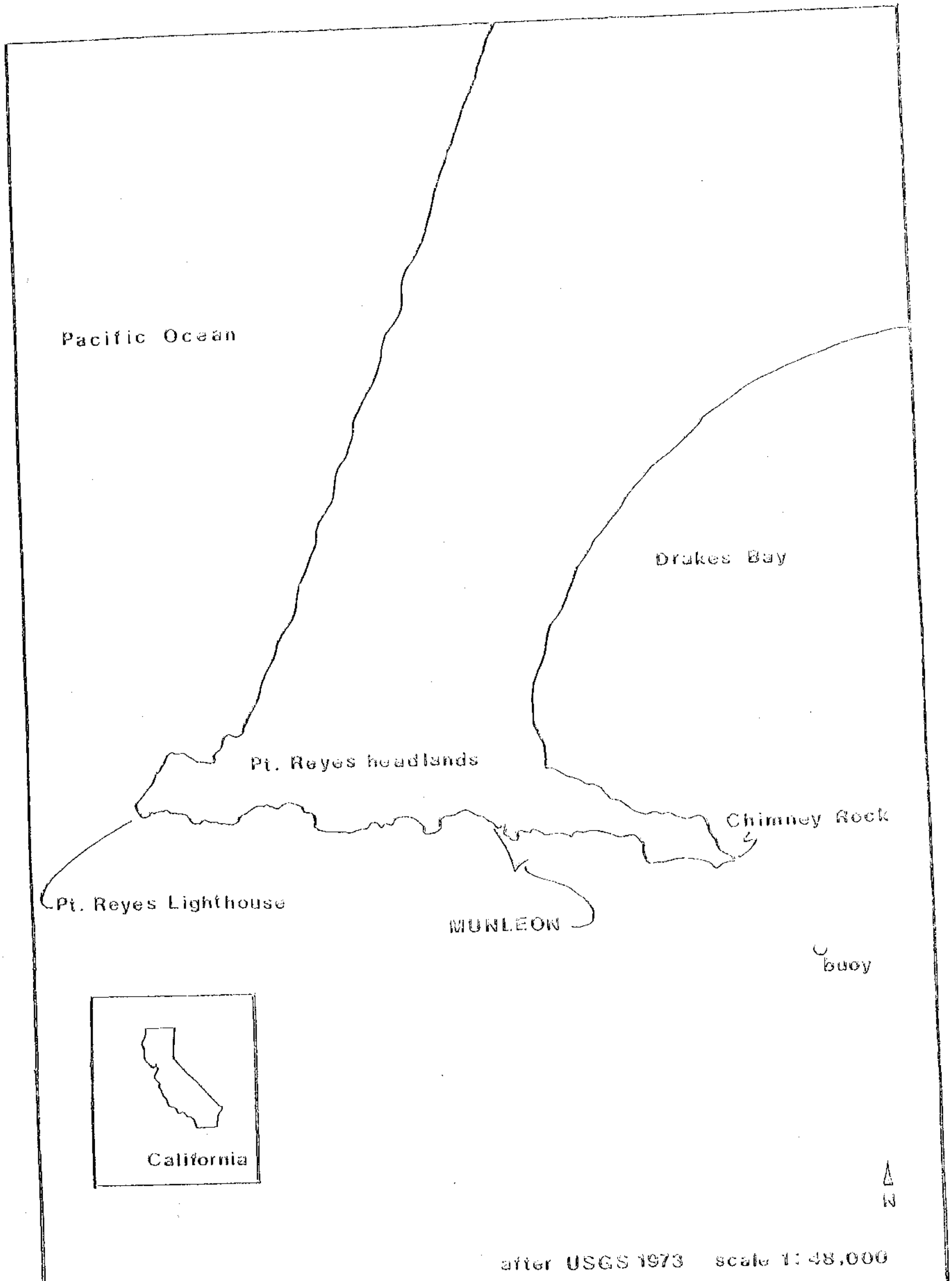


Figure 4. LOCATION OF MUNLEON

different set of environmental circumstances exist, possibly a similar desire for economy and greater capacity prompted RICHFIELD's builders to construct her with a length to breadth of 5.8 to 1 and length to depth of 9.6 to 1.

MUNLEON

MUNLEON was selected as one of two vessels targeted for preliminary documentation in the 1983 field season. The loss of this vessel off Point Reyes headlands is well known and sport scuba diving has occurred on the site. The park staff did not have available to them detailed information on the nature and extent of this resource upon which they could base long-term management decisions. Therefore, preliminary documentation of this site was determined to be an important focus of the Submerged Cultural Resources Unit's efforts within allocated time and funding constraints for the 1983 field session.

Objectives: Five research objectives were outlined for MUNLEON, they were: (1) obtain a verbal description and photograph of the site location; (2) determine the nature and extent of wreckage present; (3) begin the process of documenting the site through mapping and photography; (4) train the park diving team in underwater mapping techniques; and (5) familiarize the park diving team with the resource.

Site Location: MUNLEON lies in a small cove along the Point Reyes headlands approximately 1-3/10 miles west of Chimney Rock and 1-9/10 miles east of the Point Reyes Lighthouse (Figure 4). The site is located within the overlapping boundaries of the Point Reyes National Seashore and Point Reyes-Farallon Islands National Marine Sanctuary. A large bedrock outcropping which looks like a razorback, locally known as "Sail Rock" in the area of the "abalone cabin", marks the wreck site (Figure 5). A National Park Service trail and designated overlook is on the cliffs above the site and is clearly visible from the water. The vessel lies at the base of the bedrock outcropping in a gully formed by Sail Rock and another large outcropping (Figure 6). Its unprotected location is subject to heavy surge, tidal change and breaking waves. The water depth over the site ranges from 15 to 35 feet and visibility averages 4 feet. Due to its location against the rocks and shallow water depth, diving the site is difficult and possible only during brief periods in the early morning. Later in the day, wind chop normally increases and heavy swells are common across the site. Reduced visibility and inability to maintain position while mapping can make work on the site impossible.

Prior Research: The site of MUNLEON is known to sport divers and diving is known to have occurred at the wreck. There are no records of a systematic survey ever having been conducted at the site although references to the wreck have appeared in Gibbs (1962:299), Becker (1961:47), U.S. Department of Commerce, Bureau of Navigation (1932:964), Evans (1969:106-109), Marshall (1978:122) and in San Francisco Chronicle (November 8-9, 1931). A brief

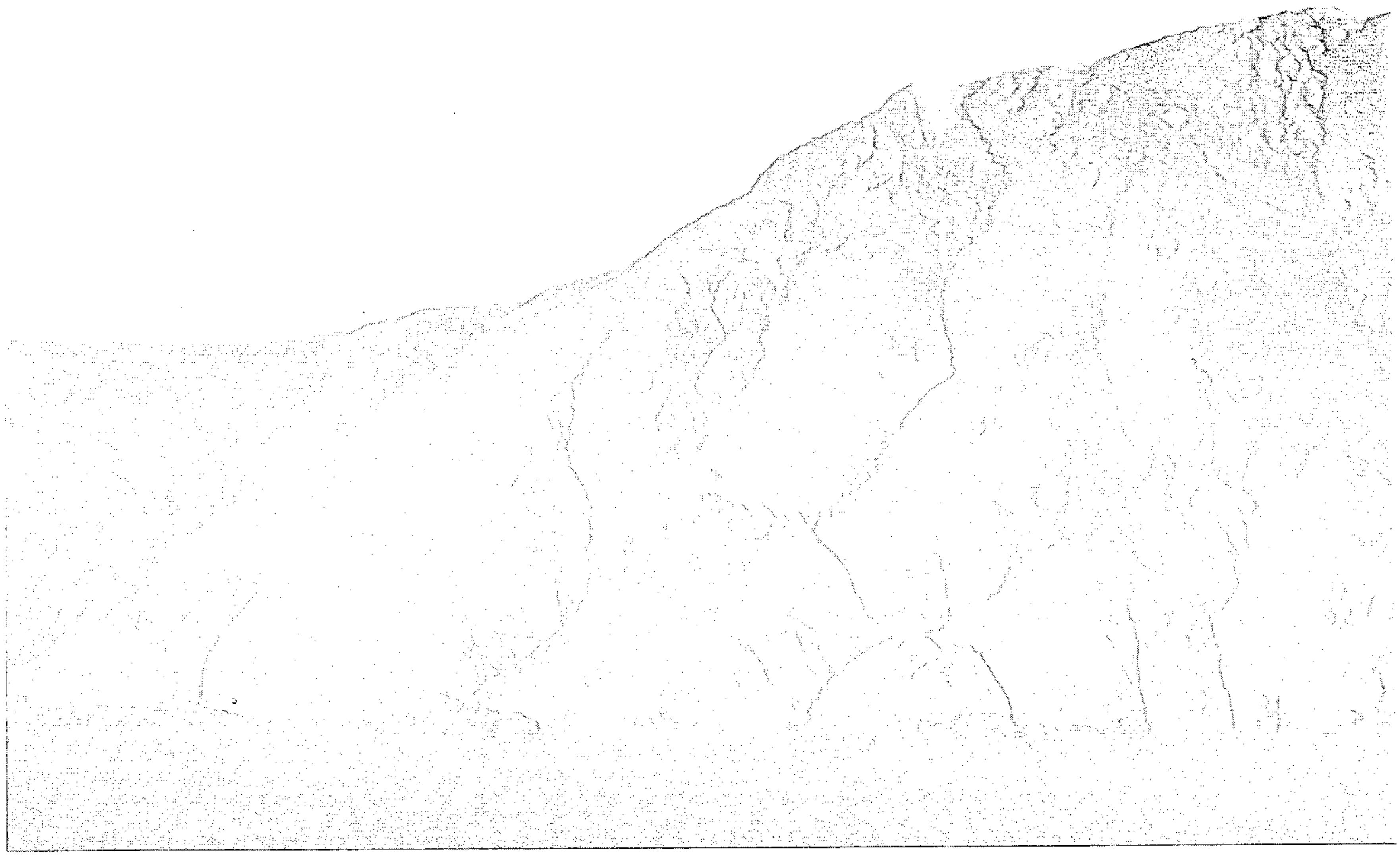


Figure 5. A large bedrock outcropping (center) resembling a razor back, locally known as "Sail Rock," is the most prominent landform at the site of MUNLEON's loss. Buoys mark the engine and aft flange on the main shaft.

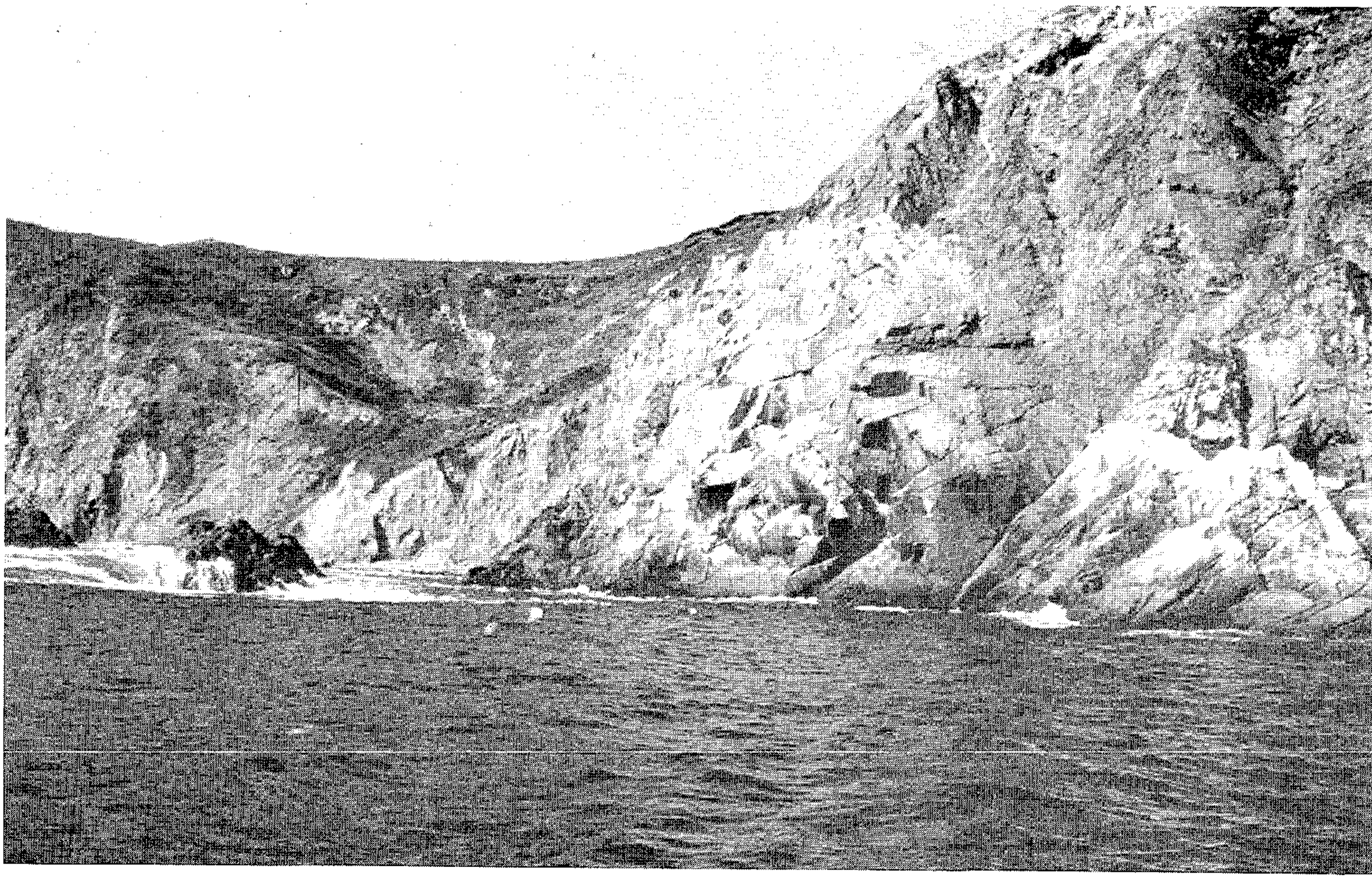


Figure 6. Sail Rock (right) and another smaller outcropping (left) mark the boundaries of the shallow gully where MUNLEON rests. The three buoys (center) indicate the locations of the engine, port and starboard boilers.

discussion of MUNLEON's background up to and including her loss at Point Reyes was presented by Butler and Delgado (1983). The vessel was visited briefly in October 1982, by members of the Submerged Cultural Resources Unit in a cursory examination and evaluation for later research.

Historic Description: MUNLEON was built in 1919 by the Detroit Shipbuilding Company at their Wayandott, Michigan yards for the U.S. Shipping Board's Emergency Fleet Corporation. Hull number 264 was originally named LAKE FABYAN and was registered as US 218,439 on October 17, 1919. The vessel was built as a package freighter for the war effort using a standardized design that was based upon Frederiksstad vessels. U.S. Shipping Board design number 1099-A was used in LAKE FABYAN's construction (Figure 7).

From keel to rail, the vessel was constructed of steel. LAKE FABYAN was 251 feet long, 43 feet 6 inches wide, 26 feet 1 inch deep, on a draft of 24 feet 4-1/4 inches. Her gross tonnage was 2,606, net tonnage 1,612 and 4,155 deadweight tons. She was of three-island design, with small raised forecastle and poop decks and her boat and bridge decks sitting amidships. The vessel was equipped with twin Scotch boilers and a triple-expansion engine of 1,500 IHP placed amidships. Fuel oil rather than coal powered her single screw at an average speed of 9.5 knots (U.S. Shipping Board 1920:56).

The standard 1099-A vessel had only one deck, although 'tween deck beams were in place, but decking was never laid on most of these vessels. According to U.S. Shipping Board information, however, LAKE FABYAN was an exception with temporary wood decking placed in her at the time of construction (U.S. Shipping Board 1925:32). The vessel had two holds and four hatches which were served by a total of eight booms on two sampson posts centered between hatches 1 and 2 and 3 and 4, respectively. Each boom was powered by a separate deck winch and could lift up to 4 tons. The vessel was capable of carrying 166,806 cubic feet of package freight and 180,033 cubic feet of grain (U.S. Shipping Board 1920:56).

LAKE FABYAN remained under the ownership of the U.S. Shipping Board until December 12, 1925 when she was sold to Munson Steamship Line of New York. Rechristened MUNLEON, she was used in the Atlantic package freight trade until sold to the Charles McCormick Lumber Company of Delaware on January 31, 1928 and transferred to their San Francisco headquarters. MUNLEON continued in the Pacific package freight trade for McCormick until her loss at Point Reyes on November 7, 1931. Stranded on the rocks and battered by the waves (Figure 8), the vessel was declared a total loss on November 19, 1931. The vessel and her cargo were valued at 3.5 million dollars at the time of loss (Documents of Registry and License 1919-1928, U.S. Department of Commerce, Bureau of Navigation).

Field Work Results: A total of 15 dives over a 5-day period were made on MUNLEON. A verbal description of the site location (see above) and photographs

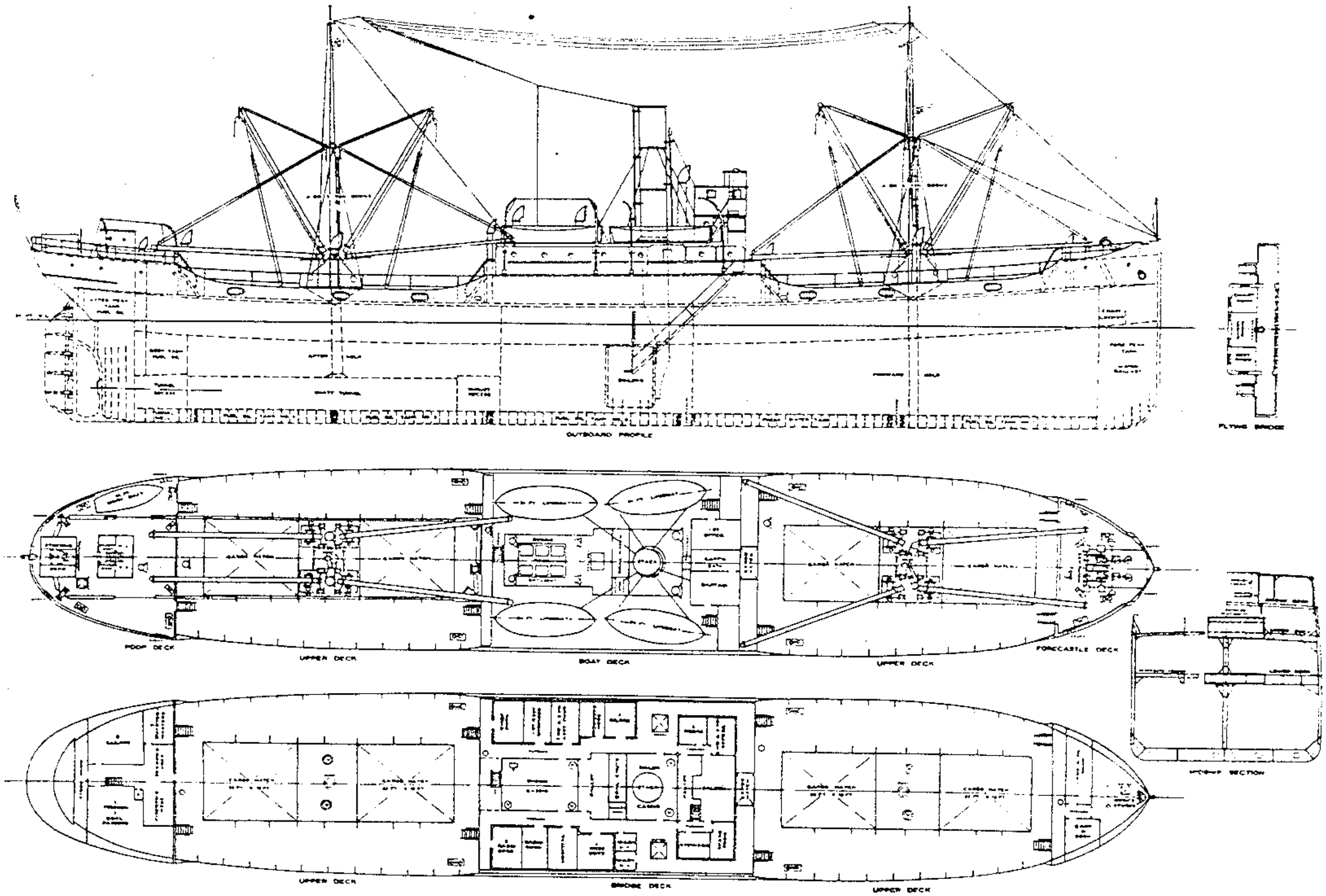


Figure 7. United States Shipping Board Design No. 1099-A (Oil Burners) Steel Cargo Vessel.

Figure 8. MUNLEON ran aground in a dense fog nearly ramming into Sail Rock. The proximity of the vessel to Sail Rock and general orientation of the wreckage, even as it exists today, is clearly shown by this 1931 photo of the grounded vessel. Photo courtesy of National Maritime Museum, San Francisco.

of the area were the first pieces of data generated. The underwater work focused on two objectives: (1) the development of a preliminary base map of the site to aid in interpretation and analysis, and (2) familiarization of the park diving staff with both the resource and the mapping techniques used by the Submerged Cultural Resources Unit.

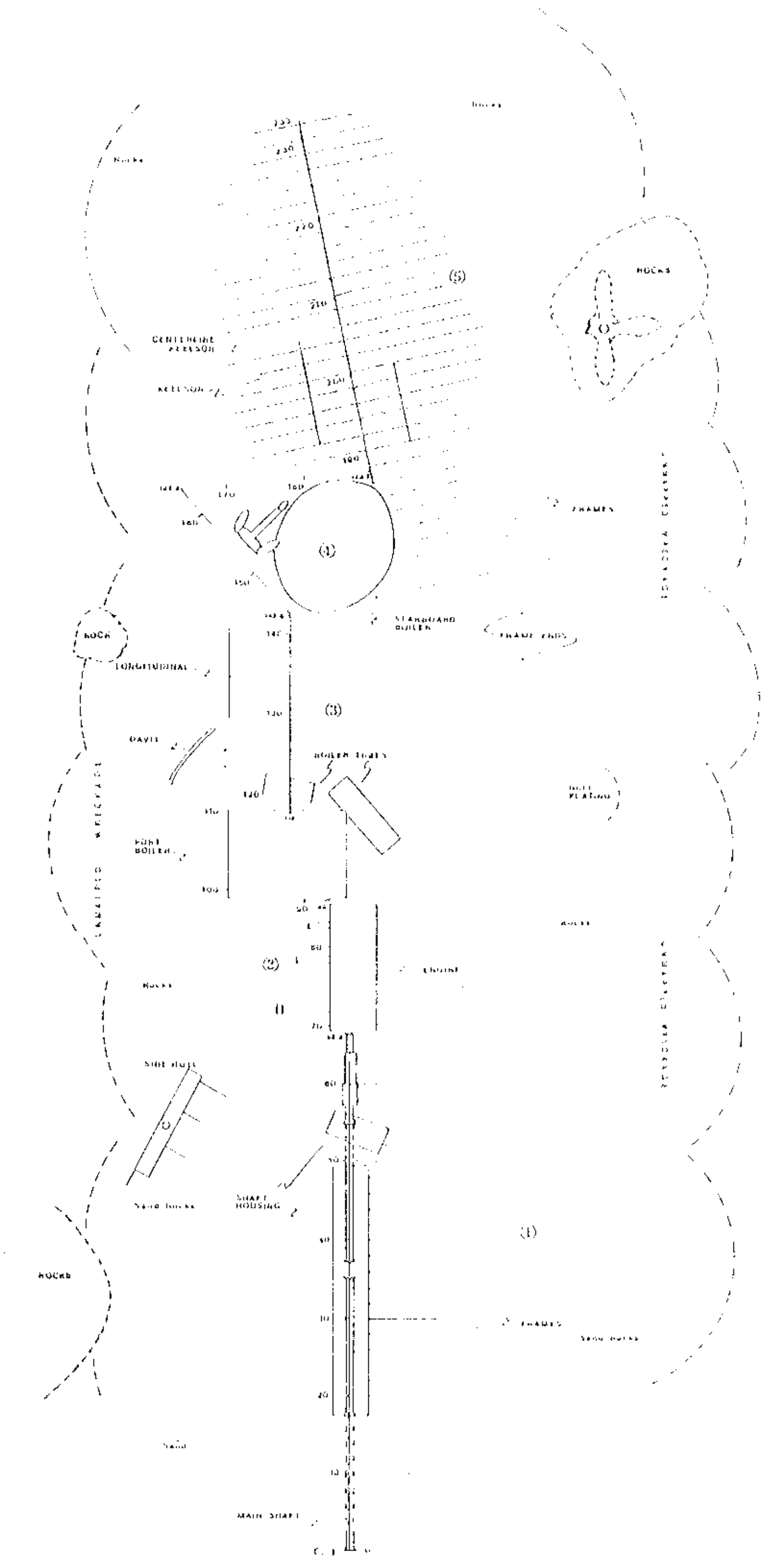
The vessel's remains consist of five major components which were included in the preliminary base map (Figure 9) as well as numerous additional pieces or sections which were not mapped in this initial effort due to the limited time available.

A baseline was laid from a main shaft flange, located at the farthest extent of known wreckage in the area of the ship's stern, along the shaft tunnel housing, passed the engines, boilers and along an exposed portion of the centerline keelson toward the bow. The baseline, consisting of number 18 nylon line, was measured off in 10-foot increments beginning at the shaft flange in the stern and marked with numbered Plexiglas tags. In all, 233 feet of baseline were laid. The overall area of the site is approximately 20,000 square feet or .45 acres.

The arrangement of the various components gives the impression of a vessel which finally settled listing to port; photographs of the stranded vessel confirm this interpretation (Figure 8). As wave action and surge ground the bow on shallow rocks, the vessel began the normal wrecking processes by breaking apart along lines of structural weakness, in this case at the turn of the bilge. However, apparent discrepancies were observed in the relationships of vessel components, in the deposition of a great quantity of materials to starboard and in the fact that a large portion of the vessel connot be accounted for. Together, these suggest that intervention in the normal wrecking process occurred; one plausible explanation for the discrepancies is salvage operations.

For purposes of clarity and this discussion, the major components have been numbered 1 through 5 and indicated on the preliminary base map, Figure 9. In addition, each has been reproduced as separate figures for convenience.
Component 1 (Figure 10) is the longest articulated piece of wreckage on the site. This section includes over 50 feet of bottom hull, sections of the shaft and shaft tunnel housing, thrust bearing and couplings up to, but not including, the engine.

The zero point on the baseline is at the aft shaft flange which is 14 inches in diameter. The shaft is 12 inches in diameter and is laying on the sand bottom. The lower portion only of the shaft mount, 2 feet away on the port side, is 2 feet wide at the base and 12 inches across inside the cradle. The top portion of the mount was not visible in the immediate vicinity, although it may be buried in the sand bottom nearby. This first section of shaft lays partially buried and at a very slight angle to the baseline. It is not attached to



MUNLEON

POINT REYES NATIONAL SEASHORE
and
POINT REYES–FARALLON ISLANDS
NATIONAL MARINE SANCTUARY

Submerged Cultural Resources Unit

Figure 9.

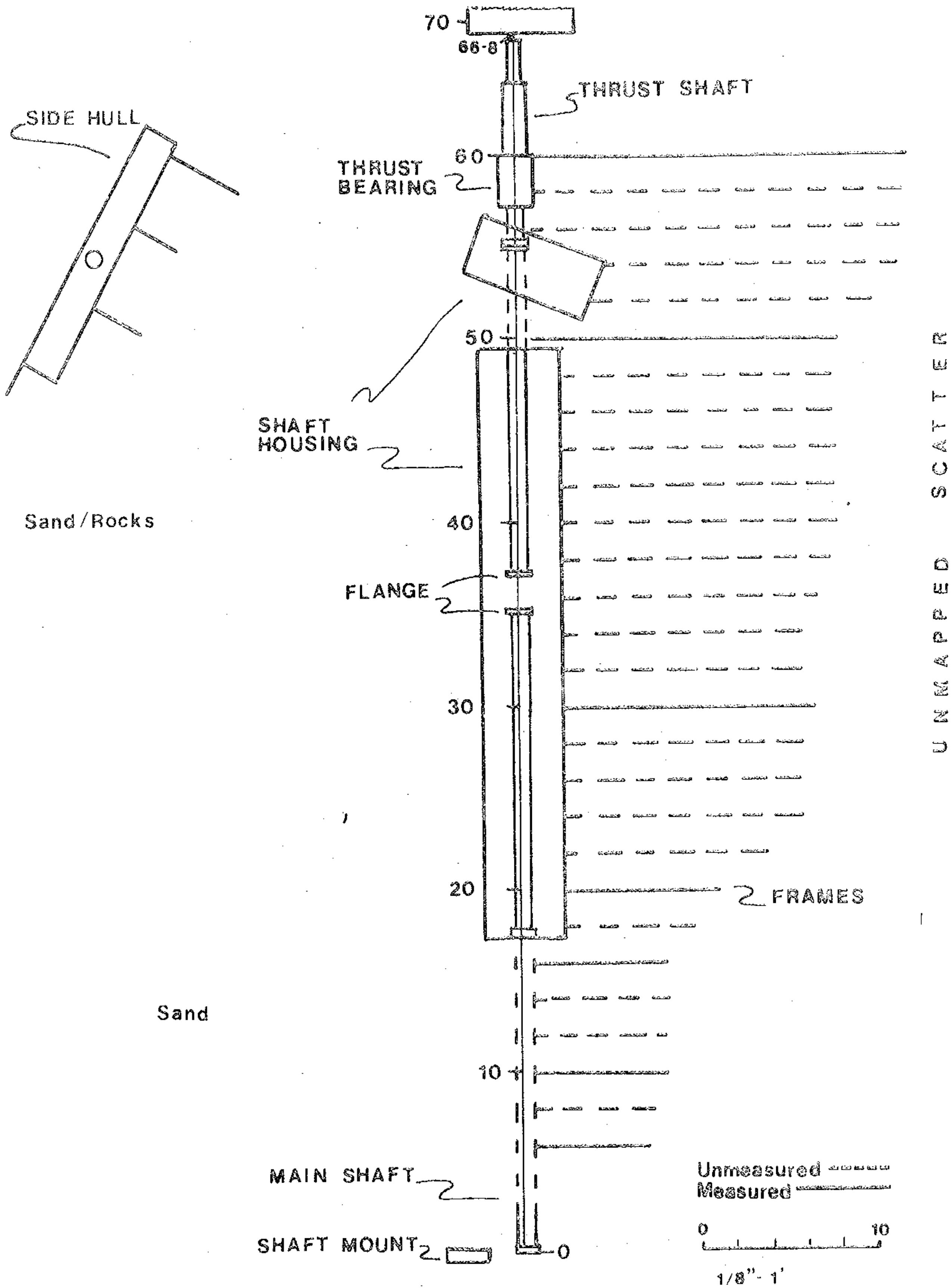


Figure 10. COMPONENT 1

another section of shaft which is still in its mount inside the shaft tunnel housing. In all, three sections of the shaft are present; each measures 18 feet long by 12 inches in diameter. The remaining two sections of shaft inside the housing are resting on their mounts, although separated by a 2 foot gap where the flanges have separated. Connecting bolts for all sections of shaft are completely missing rather than sheared off, which suggests removal rather than destruction during the wrecking process. In all, there is a total of 54 feet of shaft present.

An intact section of the shaft tunnel housing begins at point 17-6 on the baseline. The tunnel measures 4 feet 6 inches wide, 6 feet 6 inches high and 32 feet long. The tunnel is resting in its proper orientation and is attached to the hull bottom. Arches on 3-foot centers run down both sides of the housing walls. Just inside the housing near the forward end, a rack of tools remain undisturbed and in their original location. Figure 11 shows the shaft and a portion of the tunnel housing and arches near baseline point 50.

Immediately forward of the intact section of shaft tunnel housing, another twisted and bent section of the housing, 7 feet long by 6 feet 4 inches high, is torn from its mounts, upended and out of place. The main shaft and a flange can still be seen under the disjointed housing. In all, there is approximately 39 feet of shaft housing present.

The thrust bearing and thrust shaft are intact and articulated to the main shaft. The thrust bearing measures 2 feet 9 inches long by 2 feet wide and the thrust shaft 4 feet 2 inches by 1 foot 2 inches to the end of the collars and 6 feet 8 inches overall. The thrust recess housing is not present.

Comparison of the measurements taken on site and the general plans of vessels constructed with the U.S. Shipping Board design 1099-A reveals:

1. The shaft tunnel housing on this class of vessel measured close to 62 feet overall. MUNLEON's remaining housing is 39 feet long; nearly 23 feet of shaft housing is missing.

2. The length of the main shaft, from the flange just forward of the tail shaft to the flange just aft of the thrust bearing, measured approximately 72 feet. The remaining sections of MUNLEON's shaft at 54 feet overall is one 18 foot section short of this measurement.

3. The length of the thrust recess measured 10 feet. The measured length of the thrust bearing, collars and shaft are 9 feet 5 inches, which would fit into the space allocated by the general specifications.

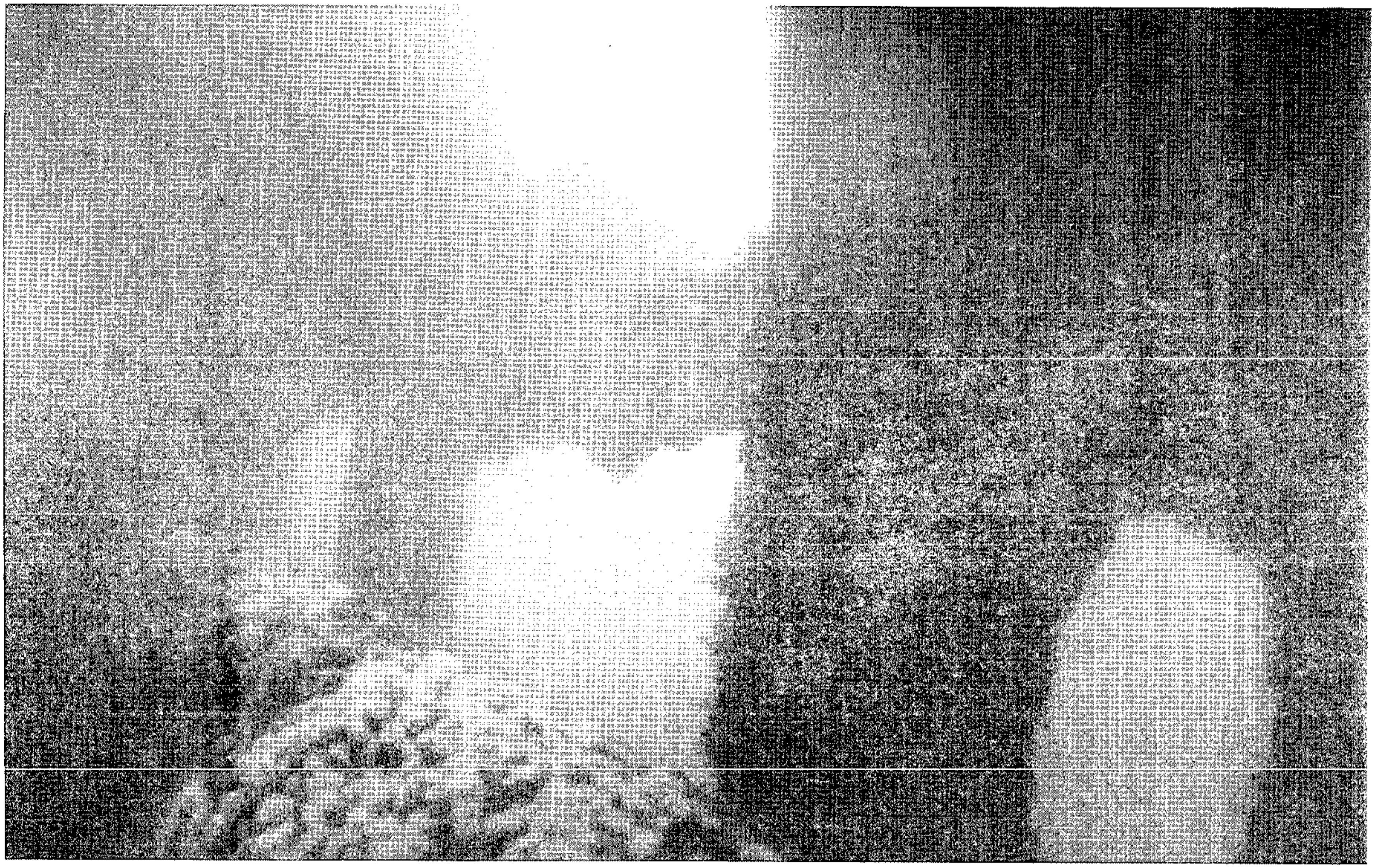


Figure 11. MUNLEON's main shaft and her arched tunnel housing seem to disappear into the turbid water at the vessel's final resting place.

4. The length of the vessel from the engine space at the forward end of the thrust recess to the after end of the stern post is approximately 91 feet. MUNLEON's remains measure 67 feet; 24 feet cannot be accounted for.

Further, there is no evidence of the tail shaft or the rudder in this area, although a broken propeller was found lying near the bow wreckage approximately 160 feet from the stern remains (see discussion of Component 5, below). If salvage did occur at the site the propeller may have been targeted for removal. In order to salvage the prop, the rudder and tail shaft are likely to be impacted during the operation.

MUNLEON and the other Lakers like her were built on a system of transverse framing, that is the frames of the vessel ran crosswise of the ship. A total of 28 frames are clearly exposed on the starboard side of the vessel. Evenly spaced at 24-inch intervals, the frames are readily identifiable up to the area of the thrust bearing. At that point, the length of the frame to the center of the thrust bearing is 21 feet 8 inches, rougly one-half the beam of the vessel. The frames are partially buried by sand and both outside hull plating and ceiling planking are present. There are no frames visible on the port side of the vessel although there is a high probability they are buried in the deep sand.

Wreckage scatter begins to appear on the port side at about the 40-foot point on all the baseline, and a section of side hull at the level of the main deck is present.

Component 2 (Figure 12) is MUNLEON's triple-expansion engine which is lying over on its side with the cylinder head on the starboard side and piston rods to port. The engine block is 16 feet long and 5 feet wide. The low pressure cylinder measured 59 inches in diameter and the rod, including the piston crosshead, is 6 feet long (Figure 13). This is the only rod which is not bent and misshapen. The intermediate and high pressure pistons and rods are bent downward and may be still attached to the crank shaft. A great quantity of wreckage is present in the engine area on both the port and starboard including hull plating, frames and machinery.

Component 3 is composed of MUNLEON's port side boiler and two sections of internal boiler tubes (Figure 12). One of the vessel's two Scotch boilers is resting in its proper orientation, that is with the furnace doors facing forward, and it appears to be on its mount. It is partially filled with sand and tilted to port at an estimated angle of 10 to 15 degrees. No evidence of the boiler uptake or funnel are readily apparent. The boiler measures 11 feet long by 15 feet in diameter. Immediately in front of this boiler are two stacks of boiler tubes, consisting of 2-inch diameter pipes. One stack, 6 feet long by 2 feet 6 inches wide, is lying immediately in front of the boiler; the second stack, 10 feet 6 inches by 2 feet 6 inches, is laying to starboard.

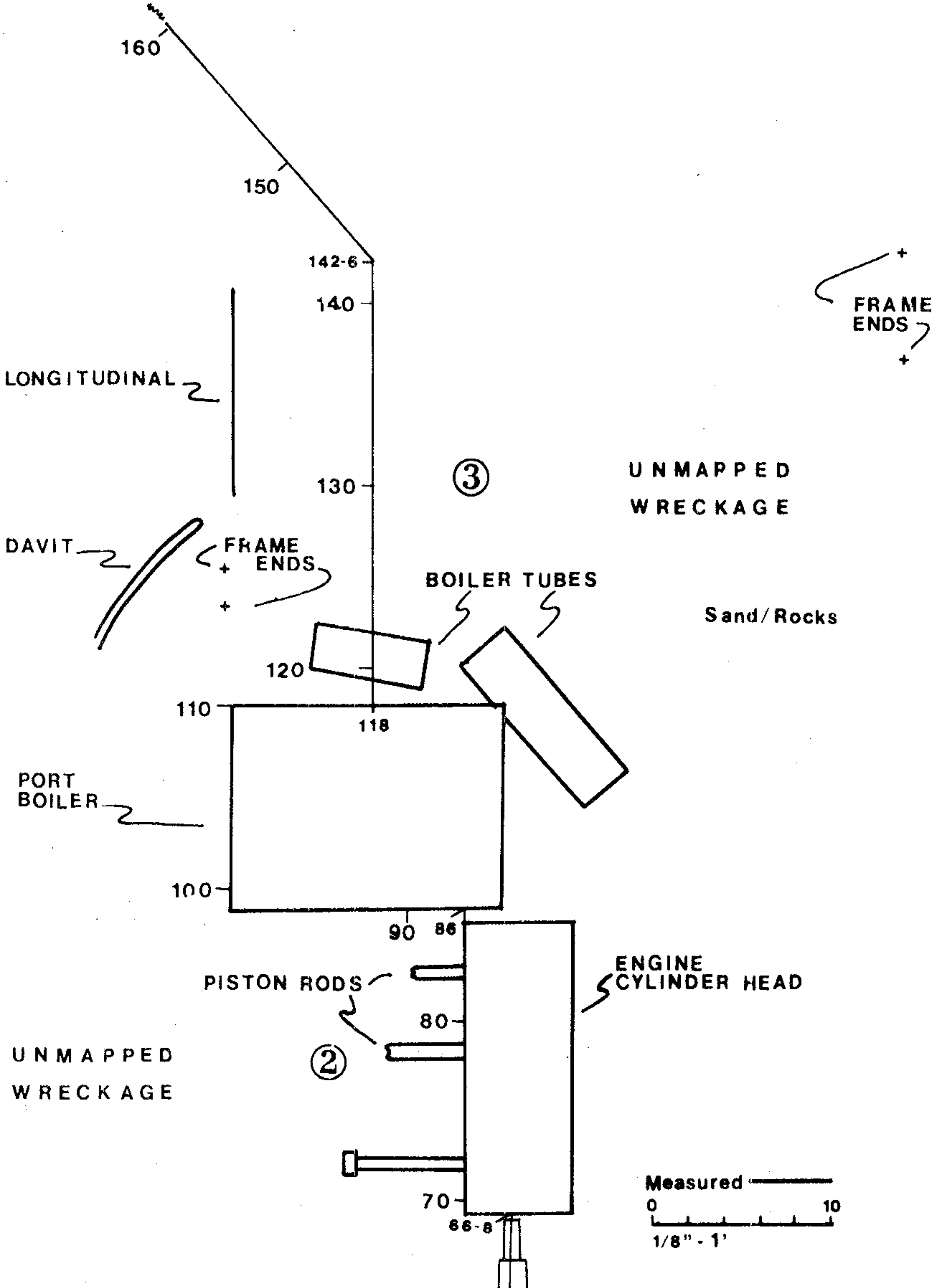


Figure 12. COMPONENTS 2 & 3

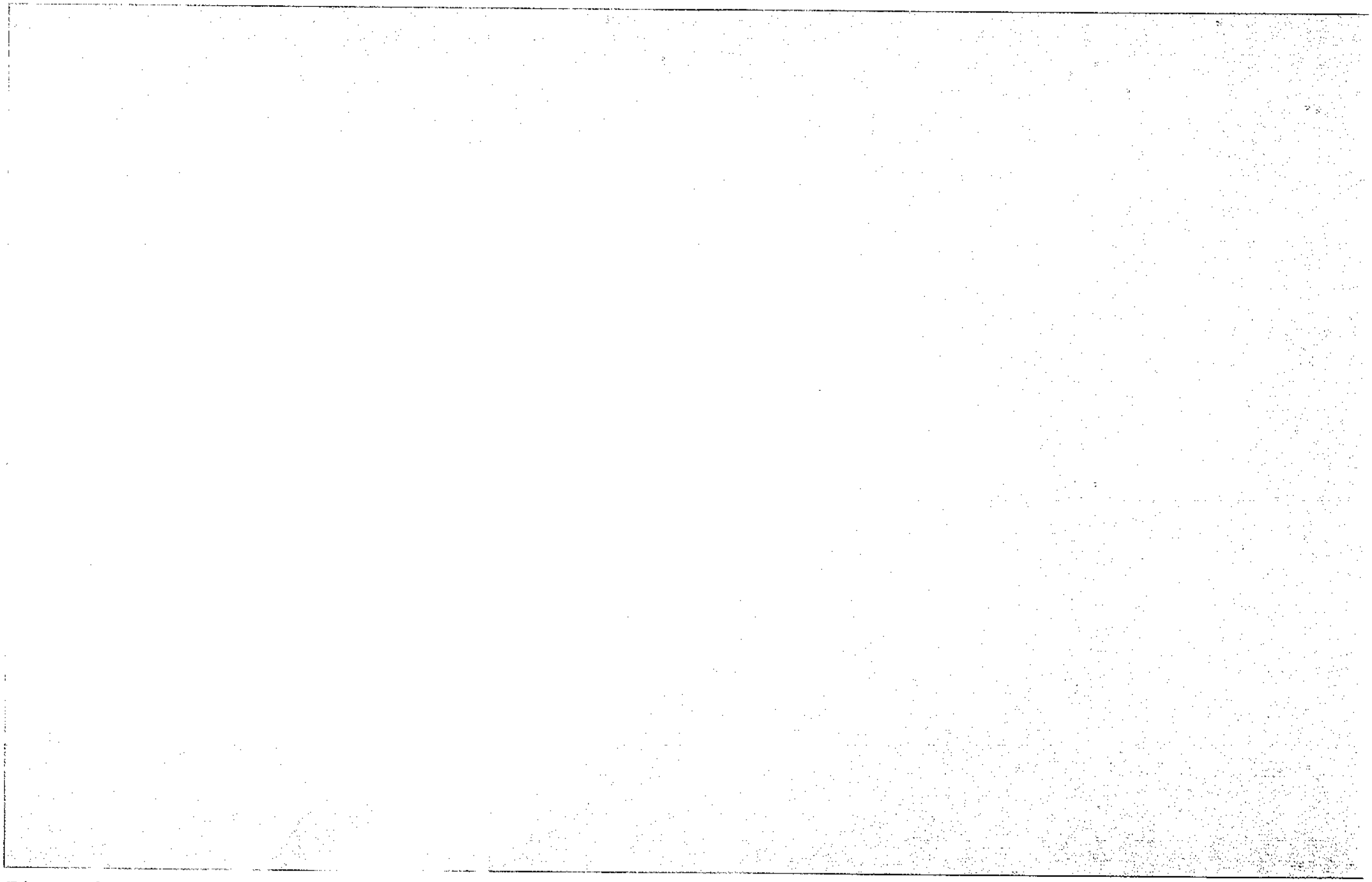


Figure 13. The low pressure cylinder and piston rod of MUNLEON's triple-expansion engine. The engine cylinder head measured 16 feet long and 5 feet high, while the low pressure cylinder was 59 inches in diameter.

Immediately forward of the boiler tubes and to port about 8 feet are two upright members which appear to be frames sticking up through the sandy bottom. A boat davit is also present. An 11-foot longitudinal member, possibly a keelson, is exposed on the port side. Hull plating and other miscellaneous materials extend more than 25 feet from the baseline on the port side. Sand and rocks partially bury these remains. It is anticipated that a good deal of additional material may be buried in the sand on the port side. This area should be carefully examined and possibly probed to determine the extent of remains. On the starboard side of the vessel, from baseline point 120 to 140, wreckage is scattered more than 70 feet. Rocks, sand, hull plating and several large structural elements are present. Frames are not clearly visible but are present as isolated points protruding from the sand and rocks. Clearly the greatest proportion of materials visible are on the starboard side.

The preponderance of materials to starboard, away from the direction the vessel was leaning when it began to breakup, raises some questions. If this vessel was located in deeper water the most expected deposition of starboard remains would be for them to collapse inward, that is to port on top of those components which are located on the port side and center portion of the vessel. However, due to MUNLEON's relatively shallow resting place other factors come into play, primarily the heavy swells which regularly roll across this site. These swells, coming from a predominantly westerly direction, move across the vessel from its port to its starboard. Swells and storm activity from the west could, therefore, account for displacement of material to starboard.

Component 4 (Figure 14) is MUNLEON's second, i.e., starboard, boiler. It is 25 feet from its normal location which would be adjacent to and on the right of the port boiler. It is torn from its mounts, upended with the furnace openings on top and tilting to port an estimated 20 to 25 degrees. The boiler is sitting on a section of bottom hull and the frames in the immediate area are out of alignment, presumably from the impact of the boiler. Wreckage is scattered on both sides of the boiler a distance of over 20 feet to port and 50 feet to starboard. Large sections of plating are present.

At the base of this boiler one of the ship's anchors, a stockless, is present (Figure 15). The anchor measures 7 feet 6 inches (shaft), 4 feet 4 inches (crown) and 2 feet 11 inches (palms); a length of chain is still attached to the anchor shackle.

This distance between the ship's boilers again raises the question of salvage. Certainly the wrecking process may account for the discrepancy, however, the wave energy which would be required to tear the boiler from its mounts, upend it and move it end over end 25 feet across a wreckage-strewn flat sandy bottom does not appear to be present. The boilers are in an area which is subject to strong surge, but the brunt of the wave force is absorbed by bedrock outcroppings

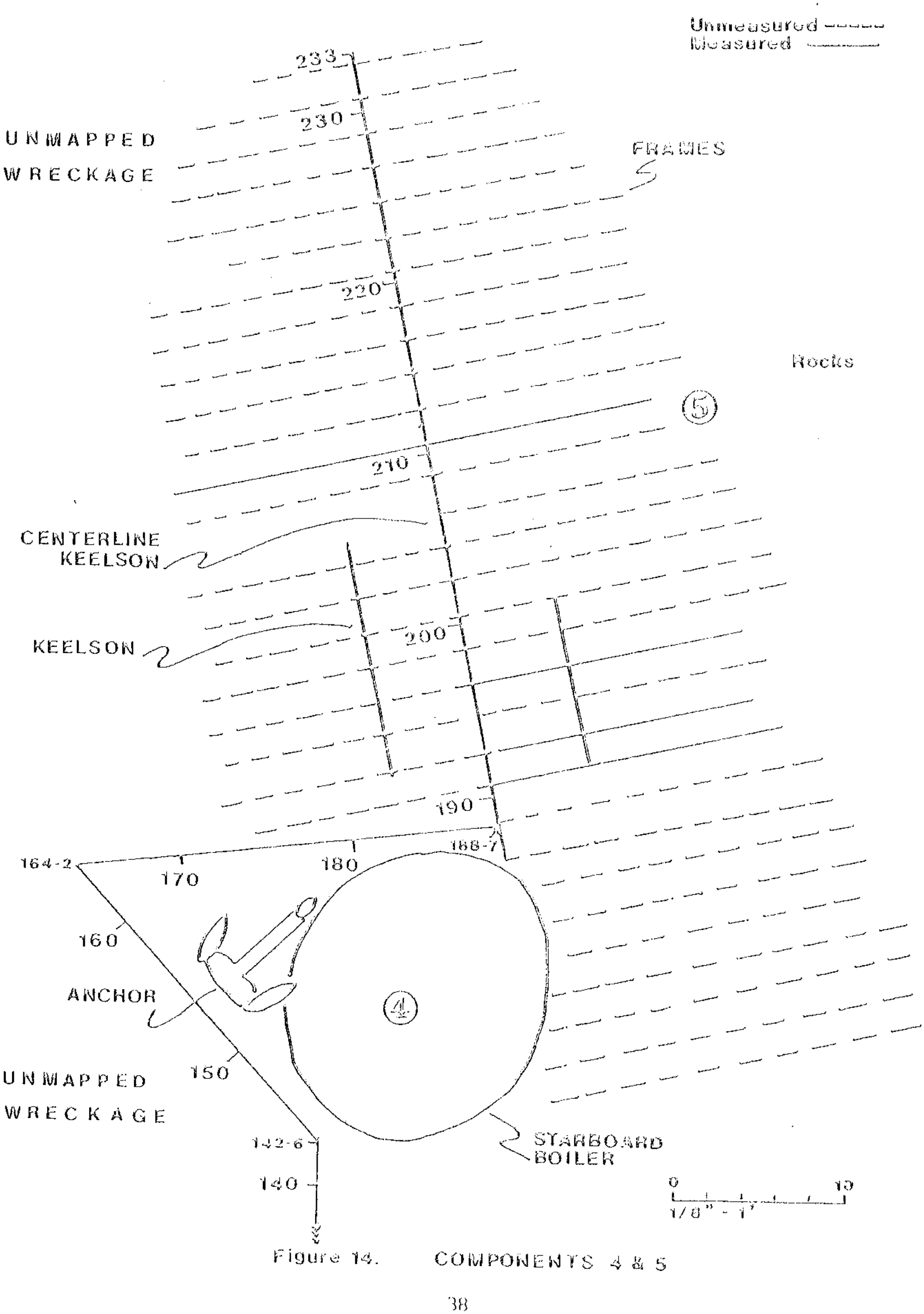


Figure 14. COMPONENTS 4 & 5

Figure 15. More than 7 feet from palm to palm, MUNLEON's stockless anchor lays adjacent to the upended starboard boiler.

approximately 20 feet to seaward (port). Further, it would be reasonable to assume that if there were sufficient energy to move the starboard boiler such a great distance, the port boiler would show greater evidence of the impact as well. Salvage operations are the most logical explanation for the movement of the starboard boiler.

Component number 5 (Figure 14) consists of 45 feet of bottom hull. The baseline runs down the centerline keelson and frames spaced 24 inches apart march unbroken toward the bow. A total of 22 frames are present and most of the ceiling plating is gone. Two keelsons, one on each side of the baseline, are present. Some buckeling of frames has occurred on the port side of the hull near baseline point 206. Frames are constructed from web plates with 1-inch by 3-inch angles, forming channels; the inside distance between the ceiling planking and outside hull plating was measured at 2 feet 9 inches. This entire section of hull appears to be slightly skewed to port in its relationship to the rest of MUNLEON's remains.

Isolated pieces of wreckage extend an estimated 50 feet into the rocks beyond baseline point 233. However, no frames or portions of hull structure were found. The wreckage field is scattered at least 30 feet to the starboard of the centerline keelson as evidenced by the presence of a broken propeller. Three of the four propeller blades are intact and lying slightly on edge in the rocks surrounded by additional pieces of wreckage. The shaft opening measured 9 inches in diameter (interior) and each blade was 7 feet 6 inches long. It is not possible to state with any certainty whether this was the propeller in use at the time of stranding or whether this was a broken spare which had yet to be replaced in the ship's locker. The discrepancy found between the 12-inch main shaft and the 9-inch propeller-shaft opening does not discount this propeller as being that of MUNLEON. The tail or propeller shaft, the last section of shaft that passes through the stern post to the propeller, can be tapered down from the main shaft to the propeller.

Overall, the total amount of bottom hull which can be reasonably accounted for at present measures about 190 feet. If the postulated 24-foot section of missing stern is added, there is still more than 35 feet of vessel to be found. Nonetheless, there is nearly 80% of bottom hull available for study.

RICHFIELD

RICHFIELD was the second vessel selected for preliminary evaluation in the 1983 field season. Although the loss of this vessel off Chimney Rock and within the park boundary had been well documented, the park staff did not have available to them sufficient information upon which to make long-term management decisions in order to protect this resource. With this need in mind and following discussion with the Submerged Cultural Resources team, it was determined that RICHFIELD would be a viable preliminary research effort within the time and funding constraints of this session.

Objectives: Five research objectives were outlined for RICHFIELD, they were: (1) pinpoint the location of the wreck; (2) identify and verify the wreckage as that of RICHFIELD; (3) determine the nature and extent of wreckage present; (4) begin process of documenting the site through mapping and photography; and (5) familiarize the park diving team with the resource.

Site Location: RICHFIELD lies at the eastern end of the Point Reyes headlands approximately 1/4 mile offshore from Chimney Rock (Figure 16) within the overlapping boundaries of Point Reyes National Seashore and Point Reyes-Farallon Islands National Marine Sanctuary. The site can be located by lining up between Chimney Rock (shoreward) and the light buoy (outside) and, using the notch in Chimney Rock as a guide, centering a cluster of trees in the notch (Figure 17). Water depth over the site is 30 to 35 feet. Loran-C readings for the site are 15946.2, 27087.5 and 43265.0. The site lies on an exposed reef which is subject to heavy surge and strong currents. Due to its unprotected location, diving on the site is difficult and only during brief periods are divers able to safely examine the wreck. Surge and currents also contribute to reduced visibility, averaging 3-5 feet.

Prior Research: The site of RICHFIELD is known to sport divers in the area and, although infrequently, sport diving is known to have occurred on the vessel. There are no records of a systematic survey ever having been conducted at the site although references to the wrecked vessel have appeared in Gibbs (1962:299), Marshall (1978:115), Evans (1969:104-106), Becker (1961:47), San Francisco Chronicle (May 9-10, 1930) and in ArcoSpark (Stephens 1983:3). More recently, a brief discussion of RICHFIELD's background up to and including her loss at Point Reyes was presented by Buller and Delgado (1983).

Historic Description: RICHFIELD was built in 1913 at the Lorain, Ohio yards of the American Shipbuilding Company. Hull number 703, originally named BRILLIANT and registered US 211,620, the vessel was 250 feet long, 43 feet wide and 26 feet deep with a gross tonnage of 2,366 and 1,436 net. In 1925 she was sold to the Richfield Oil Company of Southern California and renamed RICHFIELD, becoming the company's flagship. Richfield retained ownership of the vessel until her loss off Point Reyes on May 8, 1930 (Figure 18).

Built specifically for the bulk oil trade, RICHFIELD was steel from keel to rail (Figure 19). Designed along the lines of Great Lakes vessels, RICHFIELD carried her pilot house and crew quarters well foreward in the Texas deck and forecastle and her single stack, machinery and associated deck houses aft. She was open amidships to facilitate access to her five tanks which were divided by an oil-tight centerline bulkhead and six transverse bulkheads. She was capable of carrying 25,000 barrels of gasoline or oil. The vessel was equipped with steam

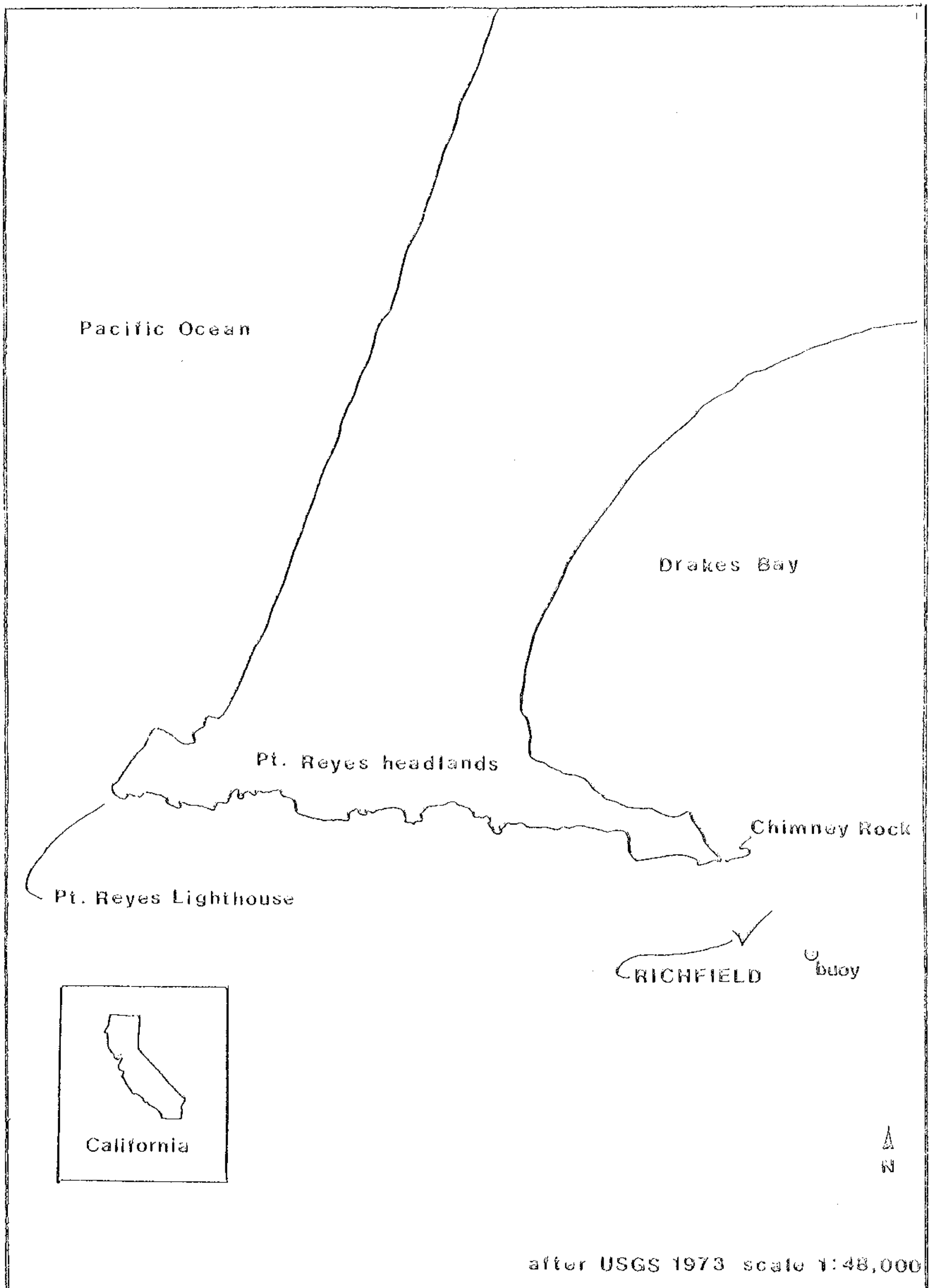


Figure 16. LOCATION OF RICHFIELD

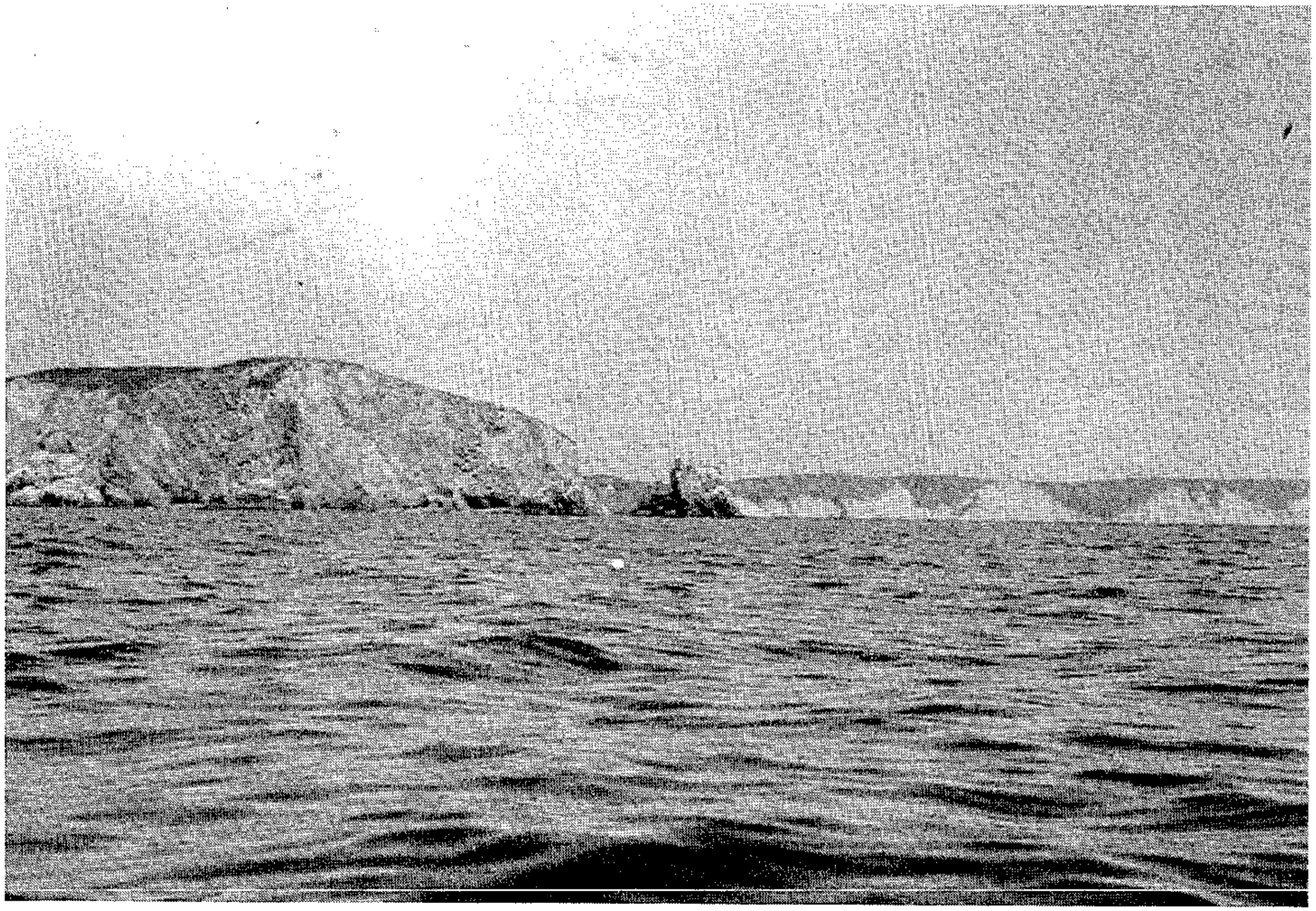


Figure 17. Chimney Rock (center, right) a prominent feature at the tip of the Point Reyes headlands, was used as a guide to the location of RICHFIELD. The vessel sank directly offshore after running aground on a shallow reef. The site, marked here by a buoy, can be relocated by lining up the clump of trees in the center of the notch between Chimney Rock and the headlands bluff.

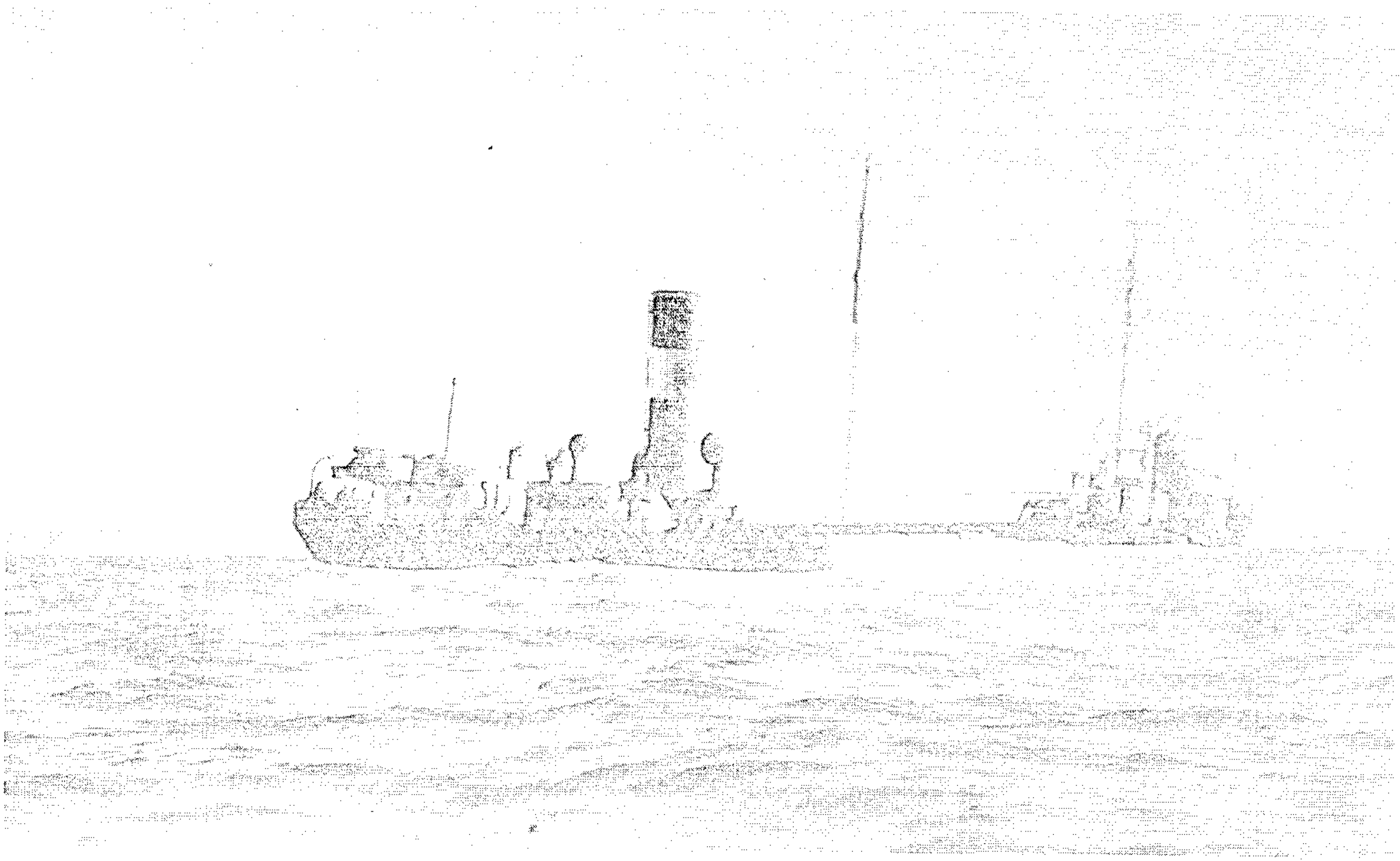


Figure 18. RICHFIELD stranded on a shallow reef just offshore from Chimney Rock on May 8, 1930. The vessel was loaded with 25,000 barrels of gasoline, most of which was pumped out by the tug SEA SALVOR. Subsequently, the Coast Guard prohibited open fires in the vicinity of the wreck until the vessel completely broke up and wind and waves had disbursed the spilled gasoline. Photo courtesy of Atlantic Richfield Company, Corporate Archives.

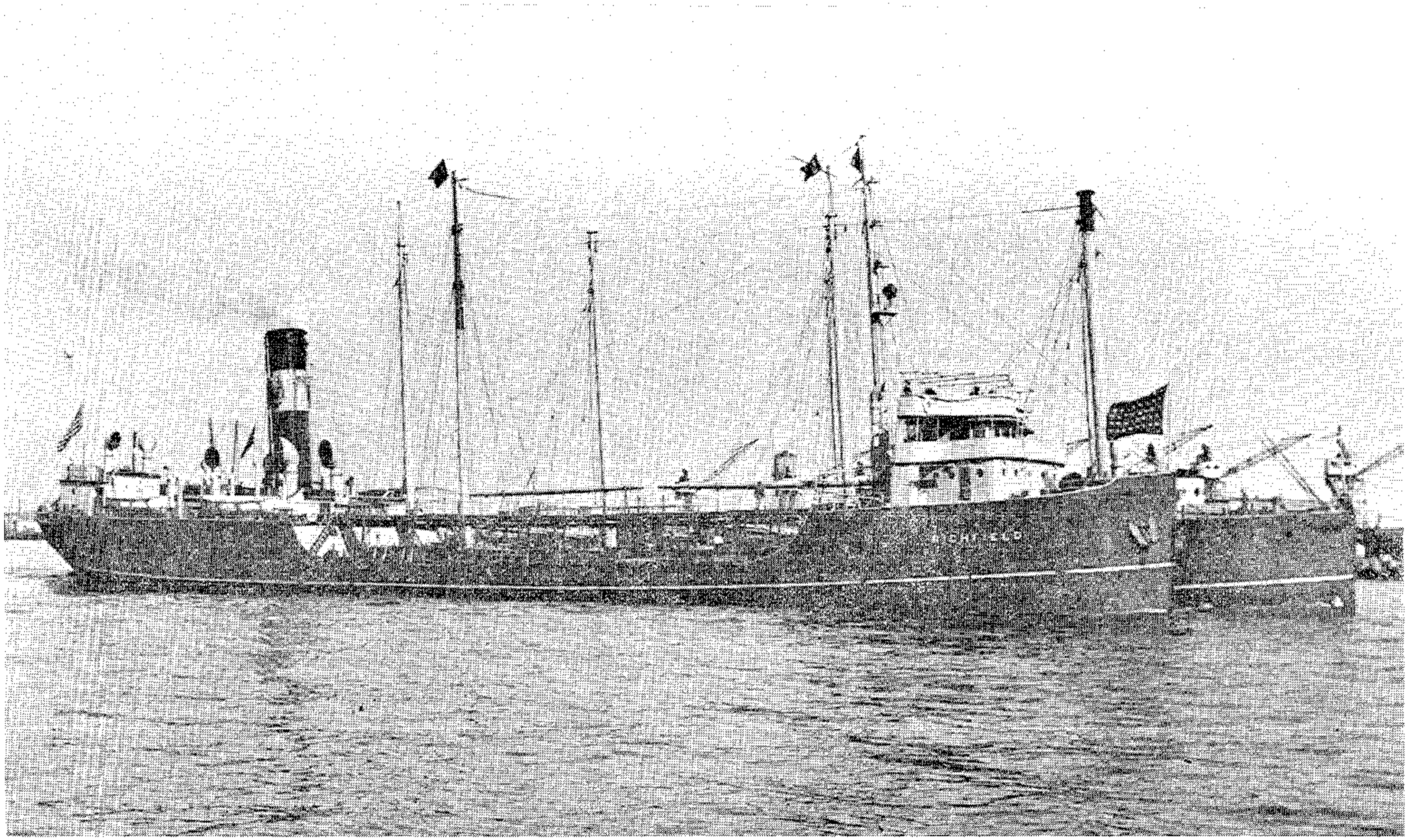


Figure 19. Built along the lines of a Great Lakes bulk carrier, RICHFIELD carried her pilothouse forward, crew quarters aft and was open amidships to facilitate access to her hold. This 1928 photo was taken just 2 years prior to her loss at Drakes Bay. Photo courtesy of Atlantic Richfield Corporate Archives, Los Angeles.

powered pumps which could discharge her cargo at the rate of 1,100 barrels per hour.

The Isherwood System of framing was used in RICHFIELD's construction. Her longitudinals were spaced 28 inches apart while her transverse members were 12 inches apart; channels were used throughout in her framing and beams. RICHFIELD was propelled by a single screw and had a steam power plant.

Field Work Results: The field work on RICHFIELD began with attempts to locate the wreck site. With the exception of Chief Ranger LeeRoy Brock, who had briefly dived the wreck several years earlier, none of the diving team had visited the site and indeed were not sure of her exact location. Using rough bearings provided by a nearby dive shop manager and the recollections of Brock, the vessel NICK was roughly positioned 1/4 mile offshore and anchored in the area believed to be where RICHFIELD sank.

Members of the dive team swam on a predetermined bearing heading from Chimney Rock toward the permanent hazard buoy in the bay. In order to be able to monitor the exact location of the divers at all times in an area of frequent boat traffic, a surface buoy was towed by the team. An unsuccessful first attempt to locate the site resulted in repositioning NICK closer to shore and a second team of divers swimming a transect toward the buoy. Both teams were hampered in their efforts by surge and a strong current running across the point forcing divers to hold on to the rocky bottom in order to maintain their position. As a result of the water conditions, visibility was reduced to approximately 4 feet. Twenty minutes into the second transect, divers began locating isolated pieces of metal wreckage. Following the ridge and a scanty wreckage trail, the team began to find scattered sections of twisted plating, piping and a small crankshaft about 5 feet long, possibly from a piece of deck machinery. The nature of these items, coupled with the documentation provided thorough oral history and local tradition strongly suggested that a portion of RICHFIELD had been located. The crankshaft was marked with buoy number 1. Later examination of RICHFIELD's deck plan revealed a small deck winch, with a crankshaft of approximately 4-1/2 feet in length, placed on the after deck behind the engine space. It is possibly the same piece of machinery located by the divers.

During subsequent dives, the wreckage field was extended by following the scatter and leap-frogging from piece to piece as visibility and currents would permit. Visibility at the site was never better than 4 feet, severly hampering efforts to determine the extent of the wreck. A total of six buoys were placed on the site, which trended in a south-easterly direction from buoy number 1 tied on the small crankshaft.

Buoy number 2 was placed on a piece of plating approximately 150 feet away on a bearing of 180 degrees from buoy number 1. Buoy number 3 was placed on a large cluster of wreckage located 75 feet from buoy 2 on an 80 degree bearing. The materials present included steel-hull plating, channels rivited in place and a possible section of bottom hull with lightening holes in the plates forming a part of an intercostal. In this same area piping, flange fittings and valves were articulated, suggesting the area near the boilers.

Buoy number 5 was placed on a piece of plating approximately 50 feet from buoy 3 and buoy 6 was placed on a large section of articulated hull approximately 75 feet from buoy 3 on a 240 degree bearing. The last piece of wreckage buoyed confirmed the wreckage as that of RICHFIELD. Described by the park divers as "long flat pieces shaped like angles or I-beams laying parallel to each other, spaced about 24 inches apart with short crosspieces, perpendicular to the angles..." (Neubacher, personal communication 1983) nicely describes the system of framing used in RICHFIELD's construction.

Water conditions, primarily extremely strong currents over the site, prevented further investigation of RICHFIELD. Over a 2-1/2 day period, several dives were made and identification of the wreckage confirmed. The materials located during the survey and their rough orientation correspond to the description of RICHFIED's loss. If she were following closer inshore than usual she would have been heading north and west. According to a local resident who saw RICHFIELD run aground, the vessel traveled in a northwesterly direction then turned toward the southeast toward the open ocean when she struck the reef (Joe Mendoza, personal communication 1983). This would explain the relationship of the possible rear deck machinery and ever increasing quantities of wreckage in a southeasterly direction across the spine of the reef.

Other Submerged Cultural Resources

Changing demographic and land use patterns of the area now encompassed by Point Reyes National Seashore has resulted in the deposition of a variety of remains in the form of archeological sites in the bay margins, estero and interior. These patterns of occupation and exploitation also hold the potential for a wide range of underwater sites represented by non-shipwreck remains associated with extensions of land-based sites, isolated special use areas and maritime support sites such as piers, landings and anchorages. Prehistoric archeological sites are recorded for the landforms bordering the estero. Since edges of midden deposits are lost through processes of natural erosion, it is assumed that larger artifacts such as ground stone tools may now be covered by estero silts, however, none have been recovered. Recent winter storms have introduced greater runoff, silting activity and erosion of banks. The estero has been used for local small boat traffic, duck hunting from blinds and oyster farming and evidence of these activities may be present as isolated items. Activities elsewhere in coastal areas of the Seashore included World War II military gunnery practice and, more recently, fishing and boating.

Potential Variety of Resources (Data Base)

A cursory review of the history of the area, focusing on occupation and use, suggests many potential underwater sites which should be considered in a comprehensive submerged resources inventory. Types of underwater sites, represented by non-shipwreck resources, which might be found in the park are:

Prehistoric Occupation (pre 1830)

1. Fishing sites, represented by dams, wiers: shallow waters of bays, lagoons, estero.

2. Shellfish collecting/processing, marine mammal and water fowl trapping/butchering sites: estero, bay, headlands, beaches, lagoons.

Early Historic (to 1900)

1. Sea otter butchering and processing camps, landings and dumps: bay, estero, beaches.

2. Rancho period butchering, hide and tallow rendering areas, landings, wharves and dumps: bay, estero below cliffs.

3. Dairy ranch landings, wharves, dumps: bay, estero, below cliffs.

Historic (1900 to Present)

1. Fishing industry wharves, anchorages, dumps: bay, estero.

2. Prohibition period landings, dumps: bay, estero, beaches.

3. Military coastal defense, wharves, landings, dumps, target practice sites: bay, estero, beaches.

4. U.S. Life Saving Service/Coast Guard wharves, landings, dumps: bay, beaches, below cliffs.

5. Point Reyes Lighthouse dump: headlands.

Clearly, the above is not exhaustive of the range of non-shipwreck sites that may be found within the park. Rather it is a starting point from which a potential data base can be built.

Objectives

In order to begin evaluation of non-shipwreck resources in Point Reyes and provide backup locations during inclement weather conditions on the primary research sites, i.e., anomalies and shipwrecks, several non-shipwreck resources were targeted for possible evaluation.

Landings and wharves have been used by both the early ranchos and later dairy ranches. "Rancho lifestyle was supported by the ships that brought manufactured goods to the area...[and] During the earliest dairy operations....ranches used wharves on Drakes Estero, including those on Schooner Bay and Home Bay; on Limantour Estero; and on Tomales Bay at White Gulch and at Lairds Landing" (Skiles 1983). The largest of the wharves built was reported to have been 200 feet long located in Schooner Bay, constructed sometime after 1879. It was this pier that was selected for relocation and mapping.

Site Location

The site is located in the northern area of Schooner Bay on a small spit of land across the bay from the Johnson Oyster Farm (Figure 20). Several pilings are clearly visible above the water surface and extend in a southerly direction from a gently sloping gravel beach into a mud and silt bottom.

The site can be reached either overland, or during suitable tide conditions, by boat. Overland access to the site is via the Sir Francis Drake Highway traveling from the park headquarters toward the seashore, passing the turnoff to the Johnson Oyster Farm on the left and continuing across a culvert at the uppermost end of the bay. The pastureland on the left of the road is fenced, private property. Remaining on the highway, as it travels up a slight grade and curves sharply to the left, a second fence line and locked gate can be seen on the left. The distance from the Johnson Oyster Farm turnoff to the locked gate is approximately 8/10 of a mile. An old access road parallels the fence which heads northeasterly back toward the oyster farm and bay. It is necessary to cross the fence at some point and head southeasterly toward the bay. The old road track fades out quickly and cross-country travel is required. The land flattens slightly here then drops off toward the bay. The buildings of the oyster farm, toward the east, can be successfully used as a rough guide. The distance from the locked gate, across the pasture to the site is approximately one mile. A drainage, wild berry thicket and remnant fence posts appear to parallel the old road or wagon track which heads toward the bay. The site is on the south side of a small spit or bar, directly on the bay across from the oyster farm. A heavily treed drainage above the farm buildings is at 105 degrees from the site.

Boat access to the site is northerly from the mouth of Drakes Estero to Schooner Bay. Barries and Creamery Bays are passed on the left while Home Bay is on the

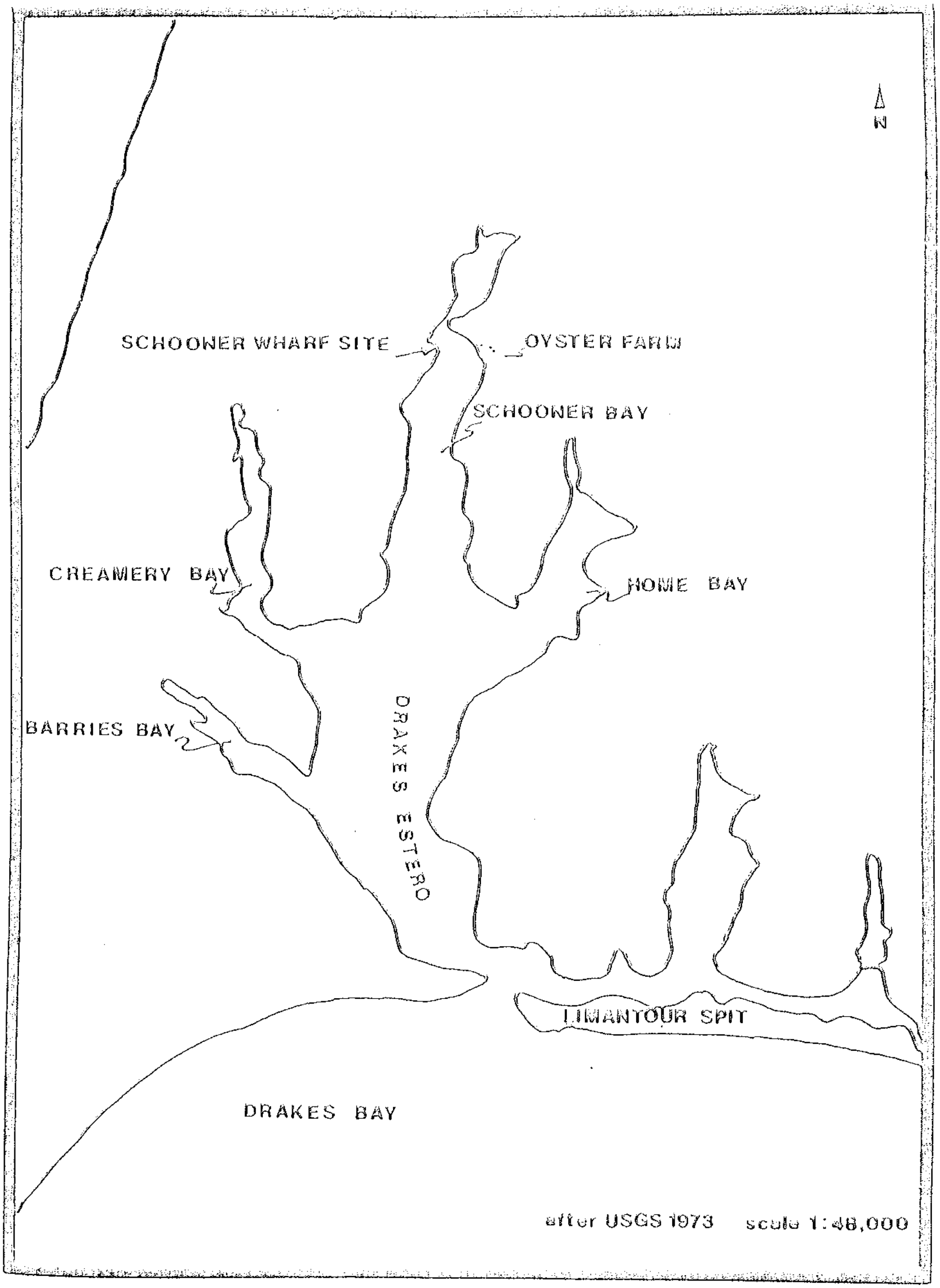


Figure 20. LOCATION OF WHARF

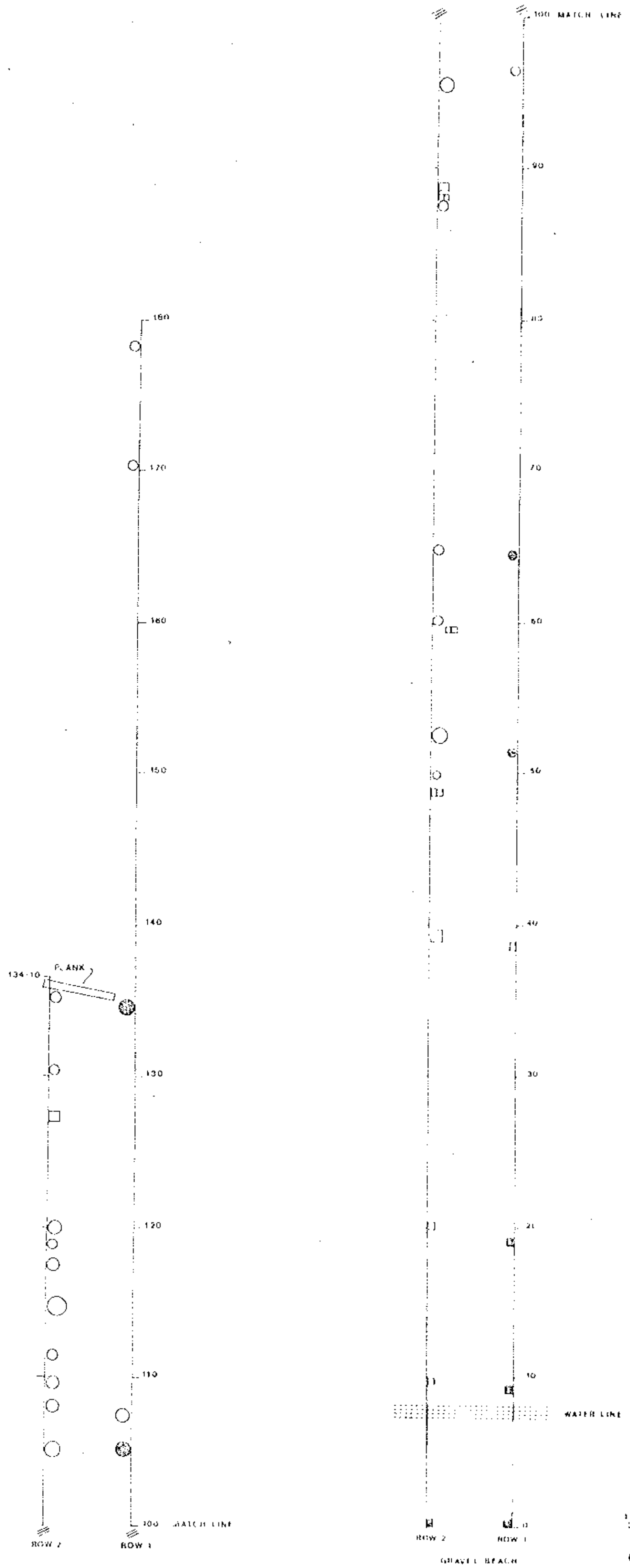
right. Mud flats may hamper travel to the upper reaches of Schooner Bay during low tide. A course heading due north (magnetic) would eventually lead directly into Schooner Bay. The site, with several pilings clearly visible, is in the upper reaches of the bay on the west shore, southwest of the oyster farm.

Site Description

The site consists of seven exposed pilings, three square and four round, in a single line extending from a gravel beach into the water and a mud and silt bottom. A second row of piling stumps or remnants below the water surface parallels the visible row. Both rows contain numerous remnants, not visible from the surface, which extend up from the bottom a few inches to as much as a foot. Figure 21 shows the distribution of the 38 pilings at the site. The site extends from shore an overall distance of 188 feet, including a small post remnant set back nearly 20 feet from the water's edge. The two rows of pilings are spaced 5 feet 10 inches apart and run nearly due north (magnetic) and south. Pilings range in size from 6-inch by 6-inch posts to 14-inch diameter poles randomly intermingled in each row.

Careful examination of the mud bottom revealed no additional piling remnants beyond the 134-feet 10-inch point in row 2 (Figure 21) while row 1 extended well beyond to the 178-foot point on the baseline. No additional materials were located either side of the dock, nor were any materials found beyond the farthest piling. There may be numerous lost items or discards in the dock area buried in the thick silty bottom.

The size of the pilings and the extent of the site suggests that this may be the wharf discussed by Skiles (1983). The preservation of this site after approximtely 100 years exposure to wind and weather, supports the likelihood that other early wharves or landings may still be located in the park.



SCHOONER BAY WHARF SITE

POINT REYES NATIONAL SEASHORE

Submerged Cultural Resources Unit

Figure 21.

N

10 0 10

POLE POST

VISIBLE ON SURFACE

III. CONCLUSIONS AND MANAGEMENT RECOMMENDATIONS

General

The intensive Phase I reconnaissance survey, initiated in 1982, resulted in the precise location of 684 anomalous readings which produced approximately 300 anomaly clusters (Murphy 1983). This underwater survey is the most extensive to be completed in a National Park to date. The documentation of the Schooner Bay Wharf Site, and the targeting of non-shipwreck resources for evaluation and inventory in conjunction with shipwrecks in the submerged resources study represents a strong, positive approach to management of shipwrecks and other submerged resources.

It is recommended that the park maintain its momentum in this area and support the active involvement of park personnel in the investigation and monitoring of these sites. Hopefully, the training received during the two sessions in 1982 and the brief field session in 1983 will encourage the continued commitment of park management to comprehensive inventory, protection and interpretation of the park's underwater cultural resources.

Shipwreck Resources

Further examination of MUNLEON is recommended. A good preliminary base map was completed that included the major structural components of the site, although, it raised more questions about the site than answers. Poor visibility hampered mapping efforts, however, the park diving team gained sufficient experience that they could continue to fill-in areas in the site map when weather and water conditions are optimal.

Eight research objectives are suggested for follow-up work on MUNLEON; they are:

1. Survey of the area aft of the main shaft flange (zero baseline point) for evidence of additional stern wreckage.

2. Survey the area forward of the bow wreckage (baseline point 233) and include these materials in the base map.

3. Determine the extent of scatter to both port and starboard and map in major elements.

4. Probe for frames on the port side near the shaft tunnel housing and look for frames on both the port and starboard side in the area between the boilers (baseline point 120 to 140).

5. Add environmental data to the base map, i.e., sand, small rocky areas and the larger bedrock outcroppings.

6. Videotape and/or photodocument the major elements when visibility is optimal. Contact with fishermen and examination of the site from the overlook may facilitate this determination.

7. Possibly re-buoy the site at the stern flange, engine and bow for use with interpretative materials placed at the overlook.

8. Undertake newspaper archival research or contact the previous owners, if possible, to determine whether salvage activities took place at the site and the extent of the activity. The Herb Madden Salvage Company of Sausilito, California is known to have been active in the Point Reyes area in the past (Joe Mendoza, personal communication 1983) and may be a source of information.

Clearly, the distinct advantage the park staff have is being able to pick the most advantageous diving days for the site rather than being locked in to a short time frame and and being forced to accept extant weather and water conditions.

Similar advantages hold for examination of RICHFIELD. This site is extremely hazardous to dive due to the currents present, boat traffic and poor visibility. More favorable water conditions would greatly increase data returns from each dive. The suggested research objectives for RICHFIELD are:

1. Buoy the site and triangulate in the site location from survey points already established on the bluffs.

2. Continue the exploration of the site to determine the extent of wreckage scatter. A southeasterly direction is suggested.

3. If possible, establish a baseline or known mapping points and intiate the process of developing a base map.

4. Videotape and/or photodocument major wreck components during optimal weather and water conditions.

5. Undertake newspaper or company archival research to determine the extent of salvage, if any, on the site.

In addition to the above activities, consideration should be given to the development of a thematic group nomination which would include all of the shipwreck resources located within the park and marine sanctuary. The background information given under vessel context, elsewhere in this report, and details provided by Buller and Delgado (1983) can be utilized for this purpose. At minimum, both MUNLEON and RICHFIELD should be included in an updated version of the determination of eligibility of the Point Reyes Archeological District.

Both MUNLEON and RICHFIELD hold the potential to be interesting sport diving locations under the proper site conditions. More significantly, they can contribute an important chapter to the story of Point Reyes National Seashore and enhance the interpretive program at the park.

Other Submerged Cultural Resources

The wharf in Schooner Bay is an example of the potential for preservation of this type of site within the park boundary. Not only was its existence confirmed through historic reference (Skiles 1983) but the general location was recorded on the Point Reyes National Seashore and Vicinity U.S. Geological Survey topographic map (1973). A cursory examination of the same map indicates another schooner landing site at the tip of the peninsula separating Home and Schooner Bays. Only moderate effort and a limited amount of equipment was required to inventory the Schooner Bay Wharf Site which can now be incorporated into the story of the park's history.

All of the potential non-shipwreck underwater resources should be examined more closely and high probability locations for these sites narrowed down. Known locations of prehistoric sites, early ranchos, dairys, the Coast Guard and military, old road or wagon tracks, early maps, land transfers and title changes, can all be used successfully to define areas within the park where these sites may occur. Interviews with long-time residents and fishermen will also aid in the process. Once likely locations have been defined and plotted on a park resources base map, which should also include known resources, it would be possible to prioritize these sites, based upon the amount of historic data available, for further attempts at relocation and inventory. If work in the park is scheduled near one of these high probability locations, it would require little additional effort to incorporate an onsite examination of the area into the work plan.

BIBLIOGRAPHY

Barry, James P.
1973 Ships of the Great Lakes: 300 Years of Navigation. Howell-North, Berkeley.

Becker, Robert H.
1961 The Point Reyes Peninsula--An Historical Survey. In Land Use Survey, Proposed Point Reyes National Seashore, pp. 35-49. United States Department of the Interior, National Park Service, Region Four.

Buller, Dave and James Delgado
1983 Losses of Vessels in Drakes Bay Survey Area. In Shipwreck Survey Point Reyes National Seashore and Point Reyes-Farallon Islands National Marine Sanctuary, edited by Larry Murphy. U.S. Department of the Interior, National Park Service, Submerged Cultural Resources Unit, Santa Fe and Western Regional Office, San Francisco.

Ericson, Bernard E.
1968 The Evolution of Ships on the Great Lakes Part II: Steam and Steel. The Society of Naval Architects and Marine Engineers, Cleveland.

Evans, Peter A.
1969 Shipwrecks and Strandings on the Coast of Point Reyes National Seashore 1840-1940. Master's Thesis, Department of Librarianship, San Jose State College, San Jose.

Frear, Hugo P.
1945 History of Tankers. The Society of Naval Architects and Marine Engineers Historical Transactions 1893-1943, 135-144, New York.

Gibbs, James Atwood
1962 Shipwrecks of the Pacific Coast, Second Edition. Binfords and Mort, Portland.

Haviland, Jean
1978 Early American Tankers. The American Neptune, A Quarterly Journal of Maritime History 38(3):175-202.

Hunter, Louis C.
1969 Steamboats on the Western Rivers, An Economic and Technical History. Octagon Books, New York.

Hurley, Edward Nash
1927 Bridge to France. Lippencott, Philadelphia.

Lenihan, Daniel J.
1983 Cermeno and Drake Expeditions. In Shipwreck Survey Point Reyes National Seashore and Point Reyes-Farallon Islands National Marine Sanctuary, edited by Larry Murphy. United States Department of the Interior, National Park Service, Submerged Cultural Resources Unit, Santa Fe and Western Regional Office, San Francisco.

Mansfield, J.B.
1899 History of the Great Lakes, Vol. I. J.H. Beers and Company, Chicago. Reprinted by Freshwater Press, Inc., Cleveland.

Marshall, Donald B.
1978 California Shipwrecks, Footsteps in the Sea. Superior Publishing Company, Seattle.

McCulloch, Dave S.
1983 The Geology Beneath Drakes Bay: Results of Sub-Bottom Profiler Survey. In Shipwreck Survey Point Reyes National Seashore and Point Reyes-Farallon Islands National Marine Sanctuary, edited by Larry Murphy. U.S. Department of the Interior, National Park Service, Submerged Cultural Resources Unit, Santa Fe and Western Regional Office, San Francisco.

McKellar, N.L.
1962 Steel Shipbuilding Under the U.S. Shipping Board, 1917-1921. The Belgian Shiplover, 87:272.

Murphy, Larry E.
1983 Phase I Remote Sensing Survey. In Shipwreck Survey Point Reyes National Seashore and Point Reyes-Farallon Islands National Marine Sanctuary, edited by Larry Murphy. U.S. Department of the Interior, National Park Service, Submerged Cultural Resources Unit, Santa Fe and Western Regional Office, San Francisco.

San Francisco Chronicle, May 9, 10, 1930; November 8, 9, 1931.

Skiles, Diana
1983 Early Maritime History at Point Reyes. In Shipwreck Survey Point Reyes National Seashore and Point Reyes-Farallon Islands National Marine Sanctuary, edited by Larry Murphy. U.S. Department of the Interior, National Park Service, Submerged Cultural Resources Unit, Santa Fe and Western Regional Office, San Francisco.

Stephens, Bill
1983 Diving Team Will Explore Offshore Wreck. ArcoSpark, August, 11:1.

True, Dwight
1956 Sixty Years of Shipbuilding. Paper presented at the Society of Naval Architects and Marine Engineers, Ann Arbor.

U.S. Steel News
1937 When Better Boats Are Built. September, pp. 4-5.

United States Department of Commerce, Bureau of Navigation
1907 Merchant Vessels of the United States. U.S. Government Printing Office, Washington, D.C.

1913-30 Documents of Registry and License for Brilliant/Richfield. National Archives, Judicial, Fiscal and Social Branch, Washington, D.C.

1919-31 Documents of Registry and License for Lake Fabyan/Munleon. National Archives, Judicial, Fiscal and Social Branch, Washington, D.C.

United States Geological Survey
1973 Point Reyes National Seashore and Vicinity.

United States Shipping Board
1920 Register of Ships Owned by the United States Shipping Board. Fifth Edition, August 1920. U.S. Government Printing Office.

United States Shipping Board Emergency Fleet Corporation
1925 Steel Cargo Vessels of the United States Shipping Board 5000DWT and Under. U.S. Shipping Board Emergency Fleet Corporation, Department of Ship Sales. U.S. Government Printing Office.

Wilterding, John H.
1981a Duluth-Superior Shipbuilding, 1917-18 The Pre-War Frederickstad Ships. The Nor'easter, Journal of the Lake Superior Marine Museum Association 6(2):1-5.

1981b Duluth-Superior Shipbuilding, 1918-20 The American "Lakers." The Nor'easter, Journal of the Lake Superior Marine Museum Association 6(6):1-5,8.

APPENDIX I

Horizontal Control Points for Drakes Bay, Point Reyes National Seashore Developed During Phase I Shipwreck Survey, 1982

Point 1
Name: East Point Reyes (USGS Monument)
Latitude: 37°59'25.740"
Longitude: 122°57'52.906"
Lambert: (California State Grid Zone 3) X/E=1289780.84
Y/N=552044.38
UTM (Zone 10) X=503100.065
Y=4204554.162

Central Meridian W 123
Scale Factor: 0.99960012
Convergence Angle: 01°18.230
Note: All positions are NAD-27

Point 2
Name: Satellite Point 1 (Chimney Rock)
Latitude: 37°59'35.464"
Longitude: 122°58'01.027"
UTM X=502901.872
Y=4204853.776
Scale Factor: 0.99960010
Convergence Angle: 01°13.226

Point 3
Name: 216, Commercial Survey Point 4
Latitude: 38°01'26.30"
Longitude: 122°58'02.16"
Lambert: X=1289361.44
Y=564253.68
UTM X=502873.035
Y=4208269.566
Scale Factor: 0.99994153.4
Convergence Angle: 1°29'45"

Point 4
Name: Commercial Survey Point 3 (intermediate point)
Latitude: $38^{o}01'45.88"$
Longitude: $122^{o}57'16.94"$
Lambert: X/E=1293030.45
Y/N=566138.87
UTM X=503975.14
Y=4208873.54
Scale Factor: 0.999941534
Convergence Angle: $1^{o}29'45"$

Point 5
Name: Commercial Survey Point 2 (Pacific - not USGS monument "Pacific")
Latitude: $38^{o}01'54.661"$
Longitude: $122^{o}56'28.973"$
Lambert: X=1296890.48
Y=566926.17
UTM X=505144.533
Y=4209144.723
Scale Factor: 0.999941536
Convergence Angle: 1^{o} 29'45"

Point 6
Name: Lagoon (USGS Monument 1930) (Drakes Head)
Latitude: $38^{o}02'01.464"$
Longitude: $122^{o}54'53.228"$
Lambert: X=1304566.08
Y=567415.33
UTM X=507478.36
Y=4209356.22

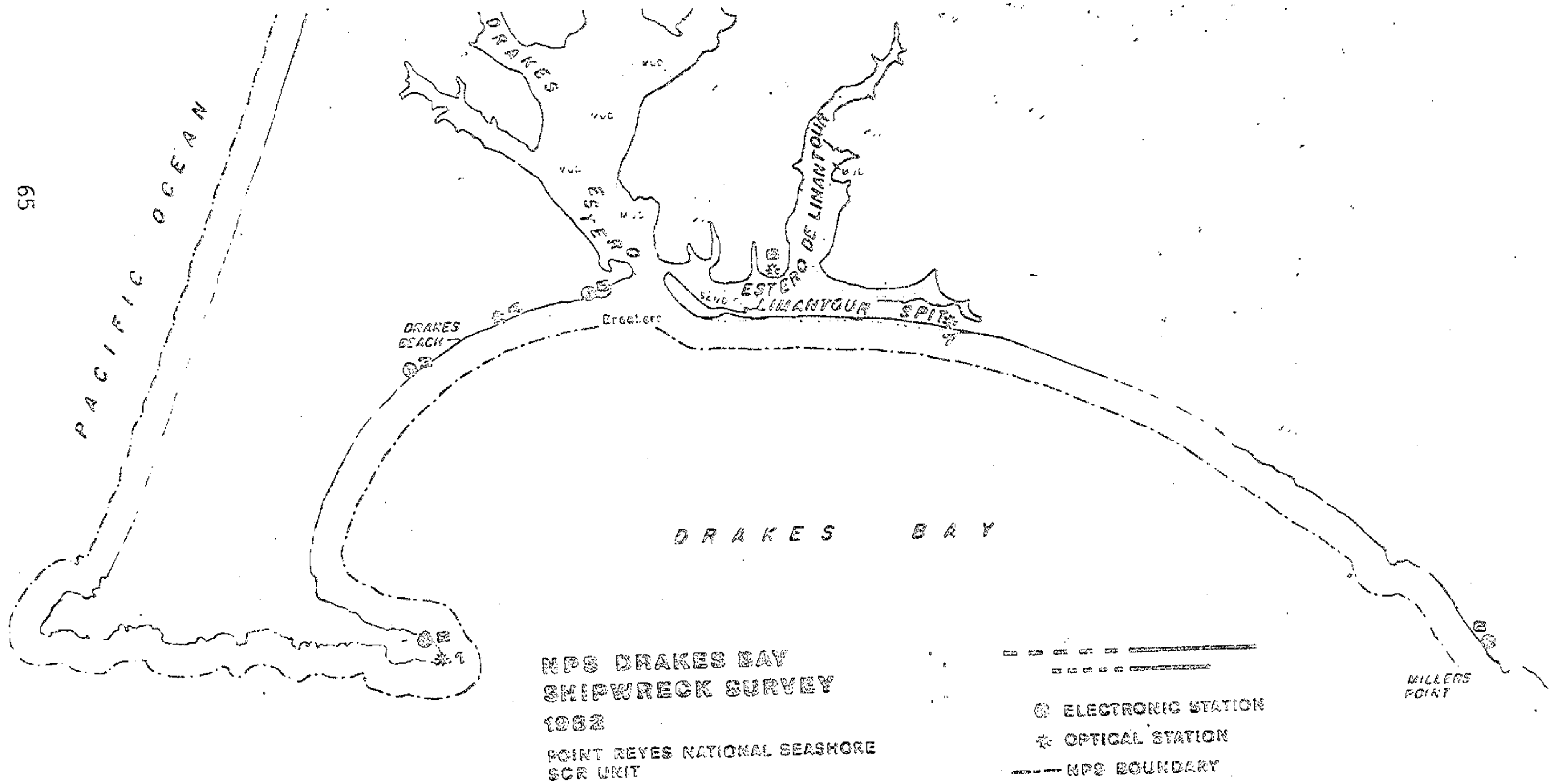
Point 7
Name: Satellite Point 3 (Limantour Spit)
Latitude: $38^{o}01'37.630"$
Longitude: $122^{o}53'.988"$
UTM X=509703.443
Y=4208624.113
Scale Factor: 0.99960116
Convergence Angle: $04^{o}05.189$

Point 8
Name: Satellite Point 2 (Arch Rock)
Latitude: 37°59'21.680"
Longitude: 122°48'49.369"
UTM X=516358.227
Y=4204444.810
Scale Factor: 0.99960330
Convergence Angle: 06°52.784

UTM Grid Azimuths between Horizontal Control Stations
At Point Reyes National Seashore

Stations	Azimuths
1-2	326°30'56"
1-3	356°30'11"
1-4	11°27'9.74"
1-5	24°0'23.19"
1-6	42°21'25.6"
1-7	58°21'9.41"
1-8	90°28'21.2"
2-1	146°30'56"
2-3	359°30'58"
2-4	14°56'56.8"
2-5	27°35'37.6"
2-6	45°28'2.17"
2-7	60°59'56"
2-8	91°44'26.8"
3-1	176°30'11"
3-2	179°30'58"
3-4	61°16'35.1"
3-5	68°55'46"
3-6	76°43'24.7"
3-7	87°1'42.97"
3-8	105°50'5"
4-1	191°27'9.74"
4-2	194°56'56"
4-3	241°16'35"
4-5	76°56'37.8"
4-6	82°9'18.28"
4-7	92°29'35.7"
4-8	109°40'45"
5-1	204°0'23.1"
5-2	207°35'37"
5-3	248°55'46"
5-4	256°56'37"

5-6	84°49'18.7"
5-7	96°30'53.1"
5-8	112°44'22"
6-1	222°21'25"
6-2	225°28'2.1"
6-3	256°43'24"
6-4	262°9'18.2"
6-5	264°49'18"
6-7	108°12'45"
6-8	118°56'48"
7-1	238°21'9.4"
7-2	240°59'56"
7-3	267°1'42.9"
7-4	272°29'35"
7-5	276°30'53"
7-6	288°12'45"
7-8	122°7'45.8"
8-1	270°28'21"
8-2	271°44'26"
8-3	285°50'5"
8-4	289°40'45"
8-5	292°44'22"
8-6	298°56'48"
8-7	302°7'45.8"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