NOAA Plan for Nautical Charting

U. S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Ocean Survey

ROCKVILLE, MD.
January 1972

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PREFACE

A nautical chart is a document published to serve the navigational requirements of marine navigation. It shows the nature and form of the coast, depths of the water and character of the bottom, aids to navigation, channels, landmarks, hazards to navigation, marine limits, electronic positioning lines, magnetic variations, port and harbor facilities, cultural details, and it must constantly be maintained to assure safe marine navigation. Nautical charts vary in scale with the importance of the area, purpose for which the chart is designed, and necessity for showing clearly all the dangers within the area.

FOREWORD

The purpose of the Nautical Charting Plan is to enable management officials of the National Ocean Survey and its parent organization, National Oceanic and Atmospheric Administration (hereinafter referred to as NOS and NOAA, respectively) to allocate available resources for the orderly and efficient implementation of its marine charting responsibilities. The plan is also intended to acquaint other interested institutions and individuals, both public and private, with current and planned NOS charting programs and thus enable such organizations to make use of the data gathered and to avoid or minimize duplication of work falling within the purview of the NOS.

Upon the recent formation of NOAA, the Lake Survey of the U.S. Army Corps of Engineers was incorporated into NOS. The charting requirements of the Great Lakes area have not been integrated into this plan but will be done so in the near future.

The scope, content, and management of the plan are premised on current national goals and are subject to modification and revision in light of relevant changes of these objectives, technological advances, and/or Executive or Legislative Branch directives. This plan documents NOAA's planned intentions and proposals which will be implemented as the whole or segments of the plan are authorized and funded by Congress.

Don A. Jones
Director
National Ocean Survey

Approved:

National Oceanic and
Atmospheric Administration

Administrator

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I. SUMMARY

The production of charts and maps is required to satisfy navigational needs and to contribute to national goals, such as managing ocean resources, developing basic science and improving national defense. In order to reap maximum benefits from full and effective use of the sea, it is necessary to first describe the marine environment. As observed by the Committee on Oceanography of the National Academy of Sciences, "Maps are basic tools of all the sciences that deal with the earth. To understand and use the oceans, we must first map them."

A. Types of Charts

The graphic portrayal of data required for safe navigation has brought about the development of two types of nautical charts. These are: 1) the conventional chart, which was designed to meet the requirements of most mariners; and 2) the compact small-craft chart, which was conceived to satisfy the particular needs of recreational or amateur boatmen.

While charts were originally devised to enable mariners to travel safely from place to place, they are now used for a multiplicity of purposes, such as in the planning of marine ventures, the exploitation of ocean resources, the management and use of the coastal zone, implementation of pollution control measures, etc.

B. User Groups

As indicated above, charts are used for numerous purposes by all walks of society. However, for convenience, users may be categorized as being either "navigation-oriented" or "nonnavigation-oriented". In the first group are those individuals having a chart dependency in moving a waterborne craft across the water, whereas, all other users need charts for planning legal, historic, economic, or similar purposes.

1. Navigators

The largest user of charts is the Government itself. The Navy takes over 50 percent of the total production

of nautical charts and the U.S. Coast Guard also uses large quantities. Other agencies such as the Army Corps of Engineers, National Marine Fisheries Service, etc., make extensive use of charts for navigational purposes.

The U.S. Coast Guard relies on NOS charts in carrying out operations in the Bering and Chukchi Seas.

The largest user of charts in the private sector is marine shipping, which has formed an integral part of the national economy from colonial days to the present. Nautical charts are vital in safeguarding passengers and the huge volume of shipping represented from the many dangers besetting waterborne transportation.

Commercial fishing is no longer centered in the Northeast, but is found in practically all waters of the Nation. No group has greater need or is more chart-oriented than fishermen, who use charts to determine bottom conditions, potential feeding grounds, as well as for navigation.

Recreational boating is a unique category of navigators, and no event within recent history has more profoundly influenced the format and use of nautical charts than has the explosive growth of out-of-doors recreational activities of the U.S. citizens. In the period extending from 1950 to 1969, the number of pleasure boats has increased from approximately 3½ million to over 8½ million. This increase has markedly affected the requirement for nautical charting and has created the need to modernize existing charts and extend the entire coverage to include additional waterways used by the swelling millions of pleasure boatmen.

2. Nonnavigators

Basic sources of energy, such as ores, minerals, and fossil fuels, as well as construction materials, chemicals, and fertilizers are needed by the insatiable industrial economy. Offshore exploration for these and other select minerals has already been initiated.

As the economic attractiveness of offshore ventures increases, it will stimulate development and production capabilities. The key to offshore production of any of these commodities lies in their actual delineation by surveys and in the advancement of extraction technology.

The depletion of oil producing sources ashore has intensified the search for crude petroleum and natural gas fields beneath the sea. Geologists searching for oil-bearing reservoirs under the ocean floor, as well as those individuals concerned with drilling, pipe-laying, etc., need the data portrayed on NOS charts in the analysis and planning stages, as well as in the movement of equipment. Federal resource management agencies rely on charts for decision-making purposes, to prepare leases, permits, rights-of-way, and related legal instruments.

Competition for the use of our limited coastal zone is intense. Innumerable waterfowl and shore birds depend on the plant and animal organisms found here for their food. Over 90 percent of U.S. fishery yields begin life in the marshes and wetlands at the edge of the sea. In order to manage and protect this most bountiful of nature's gifts, detailed charts are a necessity

in developing comprehensive land use plans and in the implementation of zoning and conservation measures.

Toxic effluents poured into the sea, pesticides flushed down our rivers, and sudden accidents--as oil spills from tankers--have created ecological and environmental havoc in our tideland sanctuaries.

A new philosophy has arisen, however, calling for stricter regulations and control of these abuses. In the replacement or relocation of sewage outfalls, the elimination of industrial waste lines, and similar noxious appurtenances, designers and engineers utilize data included on large scale charts in their efforts to restore our polluted marginal waters to a healthy and viable condition.

C. Mission

A primary mission of NOAA continues to be the production of nautical charts of the Nation's navigable waterways. In addition to supporting commerce and industry, the work and activities carried out by the NOS provide basic data required by the engineering and scientific community, contribute to the safety and protection of the boating public, and add strength to the Nation's military capability. The Marine Resources and Engineering Act of 1966, states the policy of the U.S. is "to develop, encourage, and maintain a coordinated, comprehensive and long-range national program in marine sciences for the benefit of mankind."

1. Objectives

The aim of NOAA's nautical charting program is to provide mariners with an ample and adequate set of up-to-date, safe, and efficient nautical charts, as well as a supplementary suite of related navigational aids. These will enable each voyage to be accomplished swiftly, economically, and with a maximum degree of safety.

2. Goals

The nautical charting program has been in existence, with but little change, since the mid-19th century and, during that period, charts have been published covering the vast expanse of our territorial seas and even beyond. The evolution of revised and stricter chart standards has

resulted in many charts being classified as inadequate. In order to enable NOAA to correct this deficiency, the present charting plan has been developed. It incorporates:

a. Timeliness

To insure the validity of the data delineated on charts, a resurvey cycle will be established. Stable areas will be investigated at a minimum frequency, whereas less stable areas, such as those subject to severe disturbances, will need more frequent surveys. The particular survey frequency will depend upon availability of resources and area rate of change.

Coastal damage caused by waves and surf--the destructive element of the sea.

Unless a chart precisely depicts the existing configuration and characteristics of a particular area of the sea, it does not satisfy established criteria. To acquaint mariners with changing navigational circumstances affecting a chart, the time interval between chart printings will

be reduced from the present average of two years to an average of one year by 1980. The updating of charts between printings will be accomplished through use of Notices to Mariners.

b. Products

A continuing study is required to improve and modernize existing charts and develop new or additional types of charts and publications that are necessary to meet changing user requirements. Based on projected user requirements, the products and services which will be required over the next decade are developed in this plan.

c. Methodology

Surveying and charting instrumentation has made tremendous strides since World War II and particularly so as regards computer/plotter equipment. As a result of this advanced technology, field work is accomplished much more rapidly than heretofore. These techniques have obsoleted manual modes of work to a great extent and because of the inherent economy and productivity involved, have made it almost mandatory to make use of machine methods of surveying. In order to process and plot the wealth of information gathered, automated cartographic methods have been introduced. Only through automation is it possible to process the huge volume of field data in a timely and efficient manner and make it ready for reproduction.

3. Implementation

To attain the objectives of the nautical charting program during a period of increasing marine activity will require additional resources, and improved surveying and charting equipment and techniques. Provisions are described in the plan which, by 1980, will enable NOAA to provide mariners traversing U.S. waters with improved charting services designed to achieve economical and safe marine navigation.

II. INTRODUCTION

It is difficult to conceive that charts were once either nonexistent or so crudely constructed as to be practically worthless. Yet, such was the case, and in colonial days shipwrecks and strandings were commonplace events. In order to protect its fledgling merchant marine from danger and to advance the economic potential of a young Nation, Congress passed legislation creating an agency to survey and chart the coasts. The agency was later named Coast and Geodetic Survey.

The Survey's marine oriented missions were initially defined by Congress in 1807 and greatly expanded with the passage of time. Public Law 373 passed by the 80th Congress describes the present agency authorities which accrued to the parent organization upon creation of the National Oceanic and Atmospheric Administration in October 1970.

Charting is not a job that can be done once, then be forgotten. In addition to natural changes, economic, socioeconomic and technological changes cause the nautical charting program to be a dynamic and constantly moving activity. Man busily and continually modifies his surroundings. He establishes new ports, straightens rivers, dredges channels, adds docks, builds bridges, deepens harbors, extends breakwaters, changes landmarks, lays underwater cables and pipelines, erects overhead powerlines, and fills in marginal lands. Natural changes occur from the interaction of wind and tide, the onslaught of storms and hurricanes, earthquake subsidence and emergence, from scouring on one hand and sediment deposition on the other. All of these changes, both natural and manmade, must be continually monitored, resurveyed, and recharted if safe and effective use of our waters for commerce, recreation, and defense is to continue.

Not only is the marine environment continually being altered, but man's use of the environment is likewise constantly changing. With the advent of a greatly increased amount of leisure time and a period of affluence, vast numbers of people have turned to the outdoors and the sea in their search for amusement and relaxation. This has resulted in an explosive growth

in the production of pleasure craft and has lent impetus to the expansion of salt water sports activities. To escape the crowded condition of heavily traveled waterways, recreational boatmen and sports enthusiasts frequently sail to out-of-the-way or distant places which formerly were deemed to be either too shallow or too far off the beaten track to require detailed surveys. High-speed engines and racing hulls have radically altered old habits and concepts.

As an organization, the Coast and Geodetic Survey responded to the mensural surveying and charting requirements of a steadily growing Nation for over a century and a half.

To understand and use the oceans we must first map them.

During that period the objectives of the nautical charting program have emphasized the need for describing the physical characteristics of land and sea to promote the maritime industries of the Nation.

Goals have been established which will allow NOAA to continue and improve the high quality government service originated by the C&GS, and described herein is a plan outlining a course of action and alternate methods of achieving those goals. The plan will:

A. Determine the requirements for a nautical charting service.

B. Describe the current nautical chart program and evaluate its effectiveness in fulfilling those requirements.

C. Establish program goals and describe improvement measures to better meet those goals.

D. Outline systematic procedures and orderly program developments necessary to achieve maximum effective management of the current program and recommended improvements.

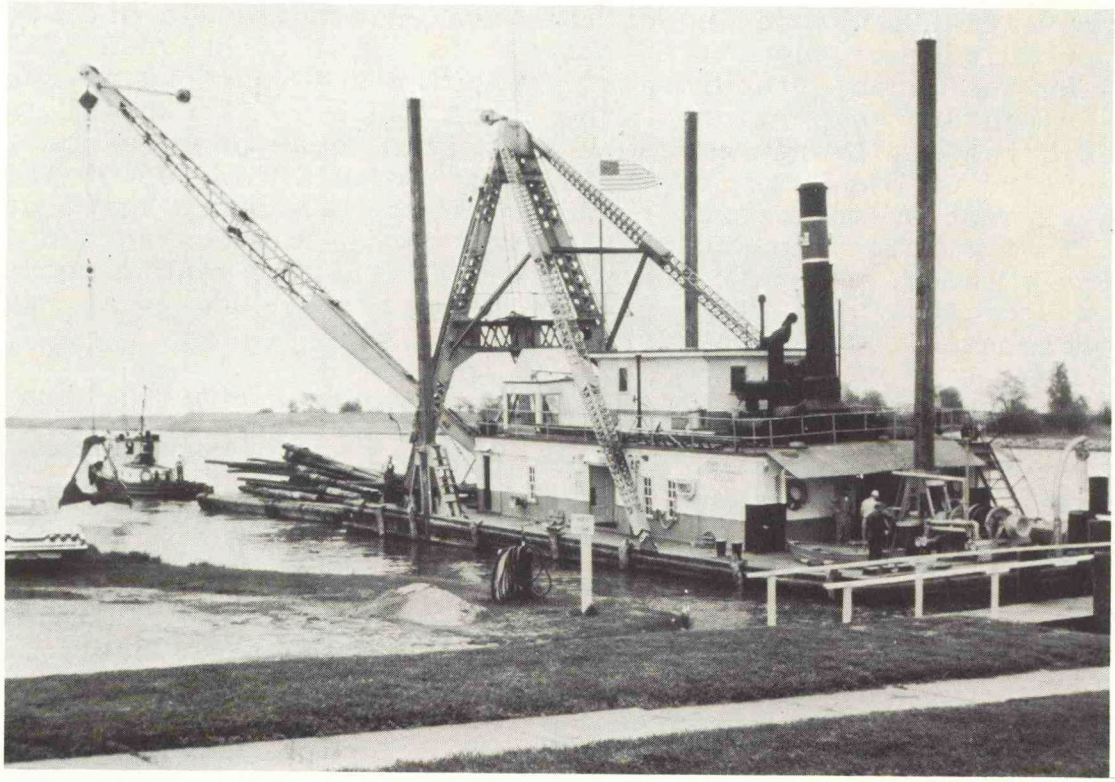
It is anticipated that the demand for charts and related navigational products will multiply and expand in proportion to the growth of the Nation's activities in the marine environment. This plan expresses the program requirements necessary to satisfy that demand.

The NOAA Ship DAVIDSON is one type of coastal survey vessel used for making hydrographic surveys in inshore waters.

III. ROLE OF FEDERAL AGENCIES

Continuing a long tradition of technical and scientific public service, NOAA is active in exploring, describing, and charting the relatively unconquered and ever-challenging environment of the sea. The nautical charting program of the Nation has been in effect for a century and a half, and, more so today than yesterday, charts provide information to move ships, cargo, and passengers from place to place with safety and efficiency.

At the present time approximately 23 Federal agencies are engaged in oceanography or marine-oriented activities. The Department of Commerce and the Department of Defense have primary responsibility for carrying out extensive and comprehensive programs in ocean exploration, mapping, and charting.



Responsibility for the maintenance of navigable rivers and harbors is assigned to the U.S. Army Corps of Engineers.

Within the Department of Defense, the Naval Oceanographic Office carries out surveys to provide naval operating forces with environmental data they need to effectively operate their ships and weapons systems, and to provide for the security of the Nation. Unclassified data, developed by the Navy, such as charts, atlases, etc., of foreign waters are made available to the Merchant Marine and to the oceanographic community.

The Department of the Army, Corps of Engineers also needs environmental data to plan, design, construct, operate, and maintain nonmilitary projects. While essentially all of the Navy programs are concluded in foreign or high seas areas, the Corps of Engineers' work is principally in the harbor or harbor-approach areas of the country, in areas of coastal erosion, and along intracoastal and inland waterways.

While the publication of charts of "foreign" areas is essentially a function of the Naval Oceanographic Office, production of "domestic" charts is divided between NOAA and the Corps of Engineers. Mapping and charting of the United States portion of the Great Lakes, Lake Champlain and the St. Lawrence Seaway and River became the responsibility of NOAA when the U.S. Lake Survey District of the Corps of Engineers was transferred to NOAA at the time of its formation in October 1970. Within the contents of this program plan, only those charting requirements associated with the previous Coast and Geodetic Survey responsibilities are discussed.

NOAA conducts surveys and prepares nautical charts, both conventional and small-craft, tidal current charts, Coast Pilots, and annual tide and current tables to promote the safety and efficiency of marine navigation. The job of providing nautical charts of the harbors, coastal and offshore waters of conterminous United States, Alaska, Hawaii, and island possessions is almost uniquely that of the Survey. However, both the Corps of Engineers and NOAA are authorized to publish maps, charts, and related publications covering the inland waters of the Nation. Uniform policies and procedures for dissemination of navigation and chart data have been developed to enable continuous coordination between the two agencies and to avoid duplication.

Hydrographic data in coastal and other important waterway areas are collected by the NOS; specialized information regarding aids to navigation (buoys, lighthouses, etc.) is furnished by the Coast Guard; controlling depths and related information of navigable rivers and channels are supplied by the Corps of Engineers; bridge clearances, dredging, and other pertinent information are obtained from the Department of Transportation, other Federal, state, and local government agencies as well as private contributors. Additionally, the descriptive information contained in the Coast Pilot series, such as aids to navition, regulations, restricted areas, etc., is gathered from various government agencies and other private sources.

NOAA provides consultant services to other Federal agencies, the states, local governments, and the public in matters pertaining to agency specialization covering higher surveying, earth sciences, ~~and physical oceanography~~. Among these services would be the furnishing of technical advice and assistance in regard to the demarcation of shore and sea boundaries; the use and interpretation of NOS hydrographic and geodetic surveys covering coastal waters and the adjacent shore, spanning more than a century and a half in time; and special instruction and training in surveying and charting techniques to foreign nationals, to personnel from other government agencies and to members of engineering and scientific organizations.

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On October 19, 1969, the Vice President, as Chairman of the National Council on Marine Resources, designated the Department of Commerce to provide national coordination of all agencies with programs in marine charting, mapping, geodesy, and data storage.

Coordination of the hydrographic charting requirements of international users is accomplished through the International Hydrographic Organization which has a membership of 43 maritime nations whose headquarters are located in Monte Carlo, Monaco.

The Naval Oceanographic Office and NOAA represent the U.S. membership in the International Hydrographic Organization, in setting the hydrographic standards as they are agreed upon by the member nations.

The principal objectives of the International Hydrographic Organization are: to establish a close association between hydrographic offices; to encourage and effect the adoption of the best methods and programs for executing hydrographic surveys and coordinating hydrographic effort in support of safer and easier navigation throughout the world; to obtain uniformity insofar as possible in hydrographic documents of all nations; and to facilitate the free exchange of hydrographic charts and information between nations.

NOAA conducts surveys and prepares nautical charts to promote the safety and efficiency of marine navigation.

IV. USER REQUIREMENTS AND POTENTIAL SERVICE VALUE

Charts tailored to a singular format and having area coverage exactly suited to the needs of each individual user is a cartographic ideal not possible of attainment. Charts delineating areas and having a format which satisfies a major segment of the marine public is a reasonable goal to attain, however, and one that has been the standard on which cartographic endeavors of NOAA are patterned.

The first nautical charts published by the Coast Survey were constructed to serve mariners of the sailing vessel era and, subsequently, were revised at periodic intervals in order to update data, to make necessary corrections, and to effect recommended improvements. Elimination of clutter, the addition of color tints, enhanced clarity, increased reliability, and greater accuracy are but a few of the changes which have taken place in the evolution of the NOS's nautical charts.

Representing conditions peculiar to a segment of the globe at some particular time frame, charts require constant maintenance in order to remain dynamic and viable. In pursuance of these aims, agency personnel collaborate with national and international mapping organizations in the exchange of information and in cooperating in areas of mutual interest. Close communication is maintained with Federal, state, and local entities for the purpose of standardizing, revising, updating, and improving the quality of charts.

A. Determining the User

Fundamental to any business venture is an exact knowledge of the market and estimated sales of products and services, both now and at some future time. By use of polls and user requirements surveys, it is possible to document actual requirements and recommended improvements suggested by the various classes of users, and to judge the degree of acceptance by the private and public sectors of the maritime fraternity.

Since 1962, 3 independent studies conducted by private research organizations have included user opinion surveys

to define nautical chart deficiencies and needs, as well as to establish direction for corrective action. The findings of the contractors also were used to establish better allocation of resources, development of systems, and the utilization of capabilities to improve the Nautical Charting Plan. In addition, results of the studies by the Reed Research, Inc., the Battelle Memorial Institute, and Arthur D. Little, Inc., have helped resolve contradictory evidence on requirements and priorities, as well as to determine user requirements for established or new products and services.

Agency exhibits are displayed at boat shows across the Nation each year. These exhibits serve a dual purpose, not only in introducing boating enthusiasts to charts and their use but, equally, in enabling NOAA management personnel to interview the boating public and obtain constructive criticism of charts and related publications. User reaction represents an invaluable input to the nautical charting program.

In accordance with elementary marketing theory, statistics have been compiled in regard to the principal marine-oriented user groups concerning their present level of business activity as well as their estimated 1980 growth level. The results of these investigations are summarized in the following user categories.

1. Maritime Transportation

Of all the users of the sea, the one which is indispensable to modern society is maritime transport. Today's maritime trade routes form lifelines for the exchange of raw materials and manufactured goods vital to the economy of almost every nation. Figure IV-1 depicts the principal trade routes of particular importance to the U.S.

The floating ton is still the cheapest ton to move, and the sea is the major highway for the transportation of heavy and bulky materials.

While air movement is becoming increasingly important, especially for high value, low density cargo, the bulk of worldwide intercontinental commerce and military goods still moves over the sea because of the low cost per ton mile as shown in Table IV-1.

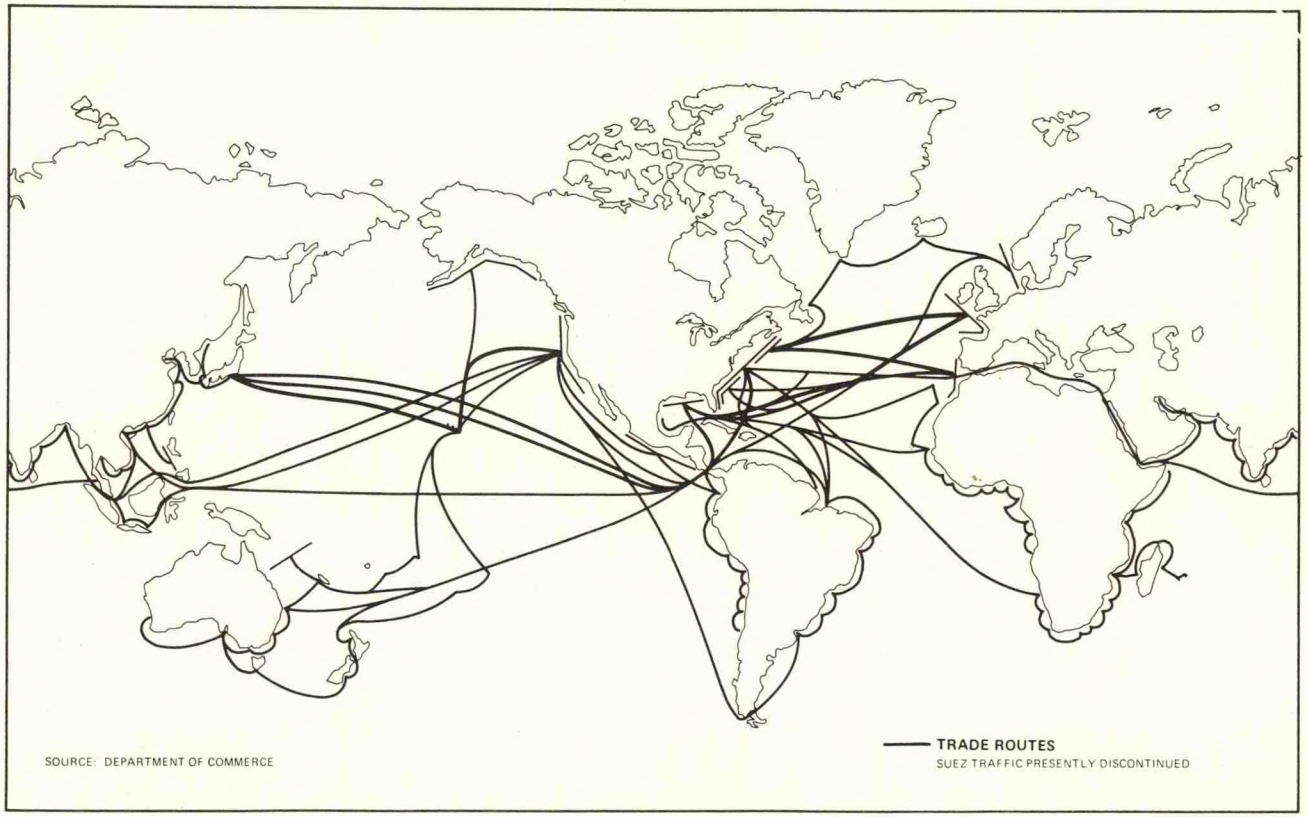


Figure IV-1 - Principal Oceanic Liner Trade Routes Directly Related to U.S. Interests

The need for maritime transportation is increasing. The growth of world population, the expansion of economic activity, and the accompanying increase in the coastal U.S. and international exchange of goods and services inevitably enlarge the U.S. requirements for transporting goods and people over the principal oceanic trade routes.

Table IV-1 - Costs Per Ton Mile of Various Ships and Aircraft

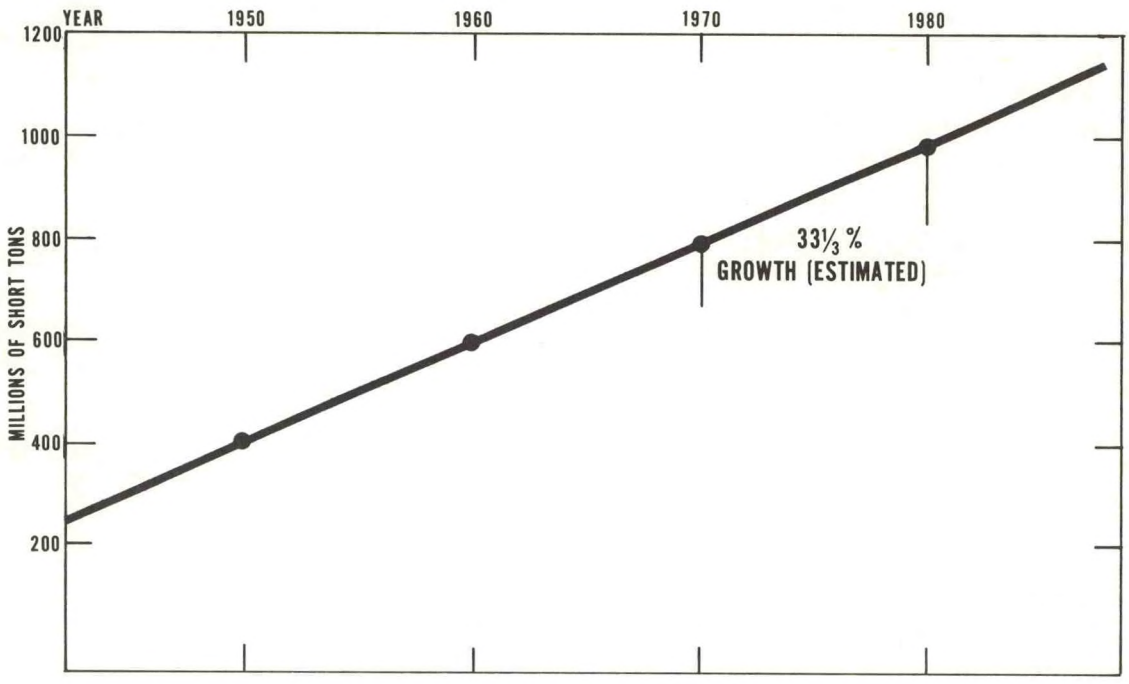
Vehicle	Speed in knots	Cost in cents per ton mile
1970 Airfreight	550	20
Convention Cargo Lines	20	1.0
Container Ship	20	0.65
50,000 DWT Tanker	16	0.18
100,000 DWT Tanker	16	0.11
200,000 DWT Tanker	16	0.08

NOTE: Costs for unsubsidized ship and aircraft for typical trans-Atlantic route, including handling the cargo on and off the vehicle, but not including packaging or inland transportation.

SOURCE: Marine Science Affairs--The Third Report of the President to the Congress on Marine Resources and Engineering Development, January 1969.

Exclusive of internal commodity movements, the coastal water transportation in the United States has been increasing in tonnage during the last two decades at about 2.9 percent a year. The volume of coastal domestic and foreign waterborne commerce is projected to rise from a 1969 tonnage of 681 million to 900 million tons in 1980, or the comparison in dollars would equal $6.0 billion for 1969 and more than $7.0 billion in 1980.

FIGURE IV-2—PROJECTIONS OF COASTAL WATERBORNE TRADE



Nautical charts contribute to the efficiency of the maritime industry by portraying the safest, shortest, and most economical water routes. Large areas remain to be charted, however, and as ocean traffic increases, so do its hazards. Statistics on commercial vessel casualties and associated deaths for FY 1968 are presented in Table IV-2. They provide an insight of the implications of growing ocean traffic and the urgency of greater safety measures.

Table IV-2 - Commercial Vessel Casualties and Associated Deaths and Injuries, FY 1968

	Nature of Casualty		
	Collisions	Groundings	Heavy Weather Damage
Vessel casualty (ships)*			
Number of casualties	409	525	164
Number of vessels involved	742	656	175
Number of deaths/injuries	2/7	0/1	0/0
Vessels totally lost	10	39	29

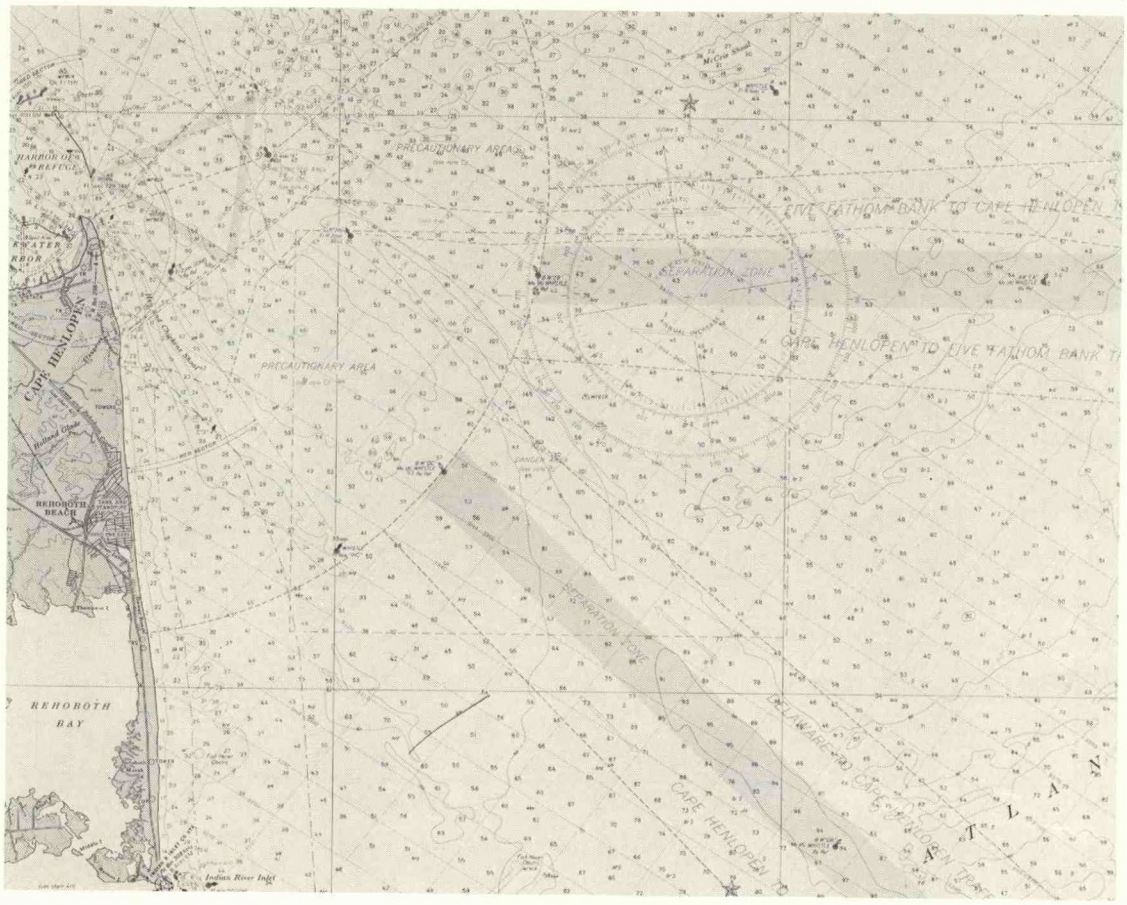
*In general, includes vessels over 100 gross tons.

SOURCE: Department of Transportation

Improved cartographic portrayal of a myriad of marine information will become increasingly important as the waterborne commerce increases. The recent establishment of directed traffic lanes, for entering and departing the busier ports of the U.S., is one of the newest safety measures used to separate shipping. These lanes are shown on approach charts to New York Harbor, Delaware Bay, San Francisco Harbor, Santa Barbara (California) Channel and Chesapeake Bay.

Shipping lanes are established and maintained on Lake Survey charts and statistics show that the collision rate on the Great Lakes is considerably lower than on any other U.S. waterway system.

Over the past two decades, in the U.S., there has been a steady increase in the number of offshore oil wells in the Gulf of Mexico, along the west coast, and in Alaska. The huge oil well platforms are steadily advancing further into the sea, and each step seaward potentially increases their hazard to marine navigation. The Gulf of Mexico area is becoming so congested with oil well structures that the Federal Government has established "Shipping Safety Fairways" to help guide vessels safely through some 2,000 oil well structures which pose a problem to ocean shipping enroute to 29 ports in the Florida, Alabama, Mississippi, Louisiana, and Texas area.

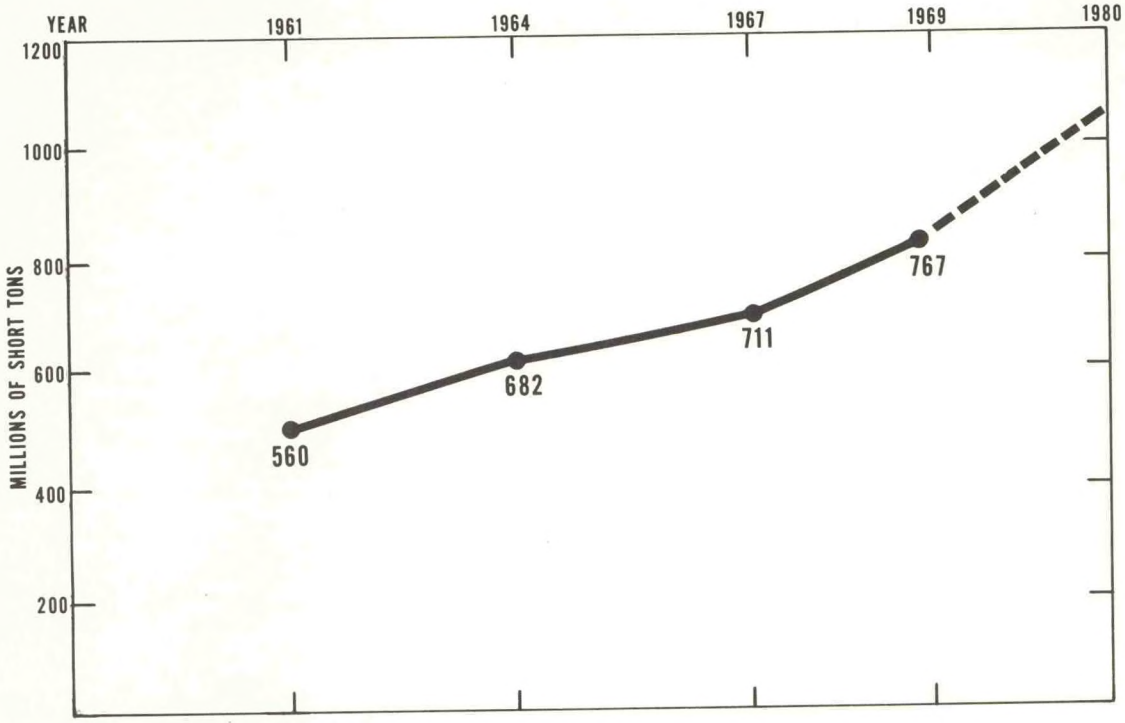


Shipping safety fairways are being established to prevent collisions by vessels entering and leaving a harbor.

2. Inland Waterway Transportation

Since colonial times the inland and lakewise waterway systems of the United States have provided the commercial umbilical cord necessary to transport principal commodities of the Nation's industries. Today these waterway systems are invaluable to the transport of bulk cargo such as petroleum, coal, coke, iron ore, iron, steel, sand, gravel, and stone, etc. Figure IV-3 shows the growth in inland waterborne commerce in the U.S. between 1961 and 1969. This growth is expected to continue through the next decade to double that of the 1961 figure.

FIGURE IV-3—INLAND WATERBORNE COMMERCE



In addition to the Great Lakes, there are over 25,000 miles of navigable inland channels with depths greater than six feet which are useable for commercial transportation. Many areas of these channels are either uncharted or are in need of additional charting to provide for their safe use by more operators. Included in this category are:

- Mississippi River - Port Allen to Baton Rouge, Louisiana
- Pearl River, Mississippi
- Tombigbee River Complex, Alabama
- Apalachicola and Flint Rivers, Florida
- Cross Florida Barge Canal, Florida
- Pee Dee, Black, and Santee Rivers, South Carolina

- Upper Cooper River, South Carolina
- Cape Fear River, North Carolina
- Neuse River, North Carolina
- Tar River, North Carolina
- Roanoke River, North Carolina
- Susquehanna River, Maryland and Pennsylvania
- Umpqua and Smith Rivers, Oregon
- Columbia River, Washington
- Snake River, Idaho
- Kuskokwim and Yukon Rivers, Alaska

Total = 16

3. Recreation

Boating is the largest recreation industry in the U.S. One out of every five Americans participates in recreational boating each year. In 1969 with over 8½ million recreational boats, the U.S. boating public spent over $3 billion for equipment, services, insurance, fuel, mooring and launching fees, and boat club memberships. In numbers, this group is expected to increase to 12 million boats by 1980.

According to 1969 figures assembled by the Boating Industry, there are well over 43 million recreational boaters, skin divers, sport fishermen, surfboard enthusiasts, and numerous others who use our coastal waters annually. The chart requirements of these users greatly varies from those of the deep-draft vessel operator, and the conventional charts were found to be inadequate for their purpose. This led to the design of the popular small-craft chart which has been published to satisfy their demands.

Especially tailored to the requirements of the coastal and inland boaters, these charts are accordion-folded for easy use in the small cockpits of recreational and inland commercial vessels. They show the location

of boating facilities and the availability of supplies and services, as well as information on marine approaches and pier depths. The charts also contain local tide, wind speed, and weather broadcast information.

The multi-purpose small-craft chart has gained wide acceptance because of these special features and has created a demand by many states, boaters, and regulatory agencies responsible for the safety of navigation and the maintenance and improvement of rivers and harbors to extend small-craft chart coverage into the inland U.S.

In addition to those navigable inland waterways listed on pages 22 - 23, area requirements for small-craft charts include:

- Lake Powell, Arizona
- Clear Lake, California
- Coeur D'Alene Lake, Idaho
- Franklin D. Roosevelt Lake, Washington

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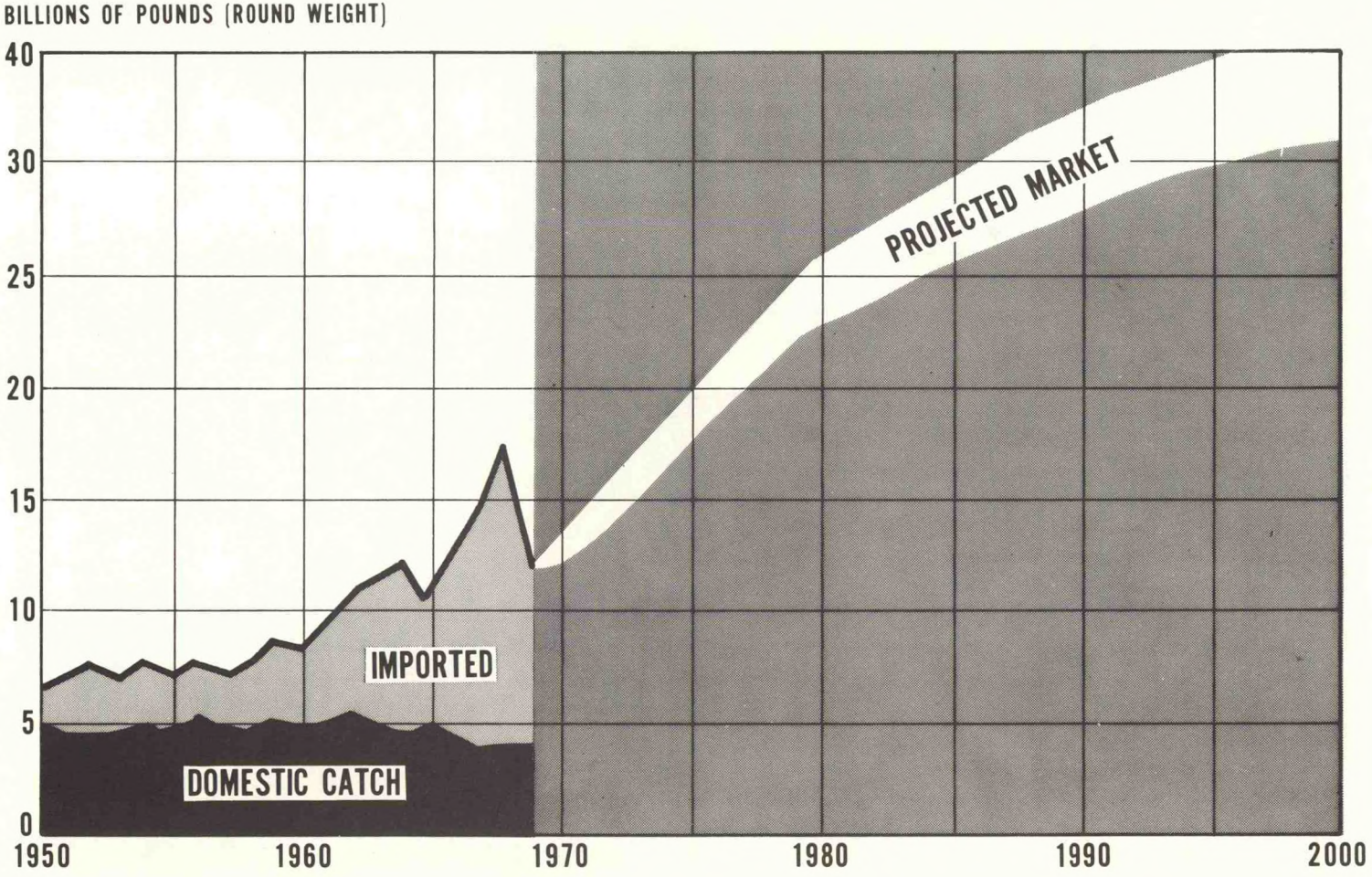
4. Commercial Fishing

One of the ocean's great resources is food. More effective use of the living resources of the ocean can stimulate economic opportunities at home and abroad by a competitive fishing industry.

The use of fishery products in the U.S. for all purposes has increased steadily over the years in both absolute and per capita terms. The 1969 annual U.S. fish utilization of 59 pounds per person is among the highest in the world. While the U.S. fish catch has remained relatively constant for the past 30 years, the processing and marketing portions of the industry have grown steadily, supplied by increasing U.S. fish imports and expansion of U.S. fish processing firms into areas abroad for raw materials. Figure IV-4 shows the growth of the U.S. market and the mounting share of the U.S. demand for fish being satisfied by imports.

The U.S. fishing industry has not maintained its relative competitiveness among the fishing nations over

FIGURE IV-4—U.S. MARKET FOR FISHERY PRODUCTS



SOURCE: DEPARTMENT OF INTERIOR

the last 10-12 years. This has in part occurred because of advances in fishing technology among the other nations.

The U.S. fishing industry is, however, beginning to diversify from the low-yield fishing techniques of the last generation to more technologically advanced methods. More and more fishing gear is being used either on or immediately above the ocean floor. The employment of various types of trawls and dredges requires intimate and accurate information of bottom conditions, consistency, as well as configurations.

Existing navigational charts are not prepared for the uses many fishermen desire, such as closely spaced depth markings, frequent and reliable bottom samples, prevailing currents, sufficient location of snags, wrecks, and other hazards to bottom fishing gear. Reliable charts decrease search time spent looking for suitable fishing locations and reduce the high cost associated with loss of fishing equipment sustained on rough bottoms and obstructions.

Development of fish locating and catching equipment and methodology will produce larger catches and help alleviate world food problems.

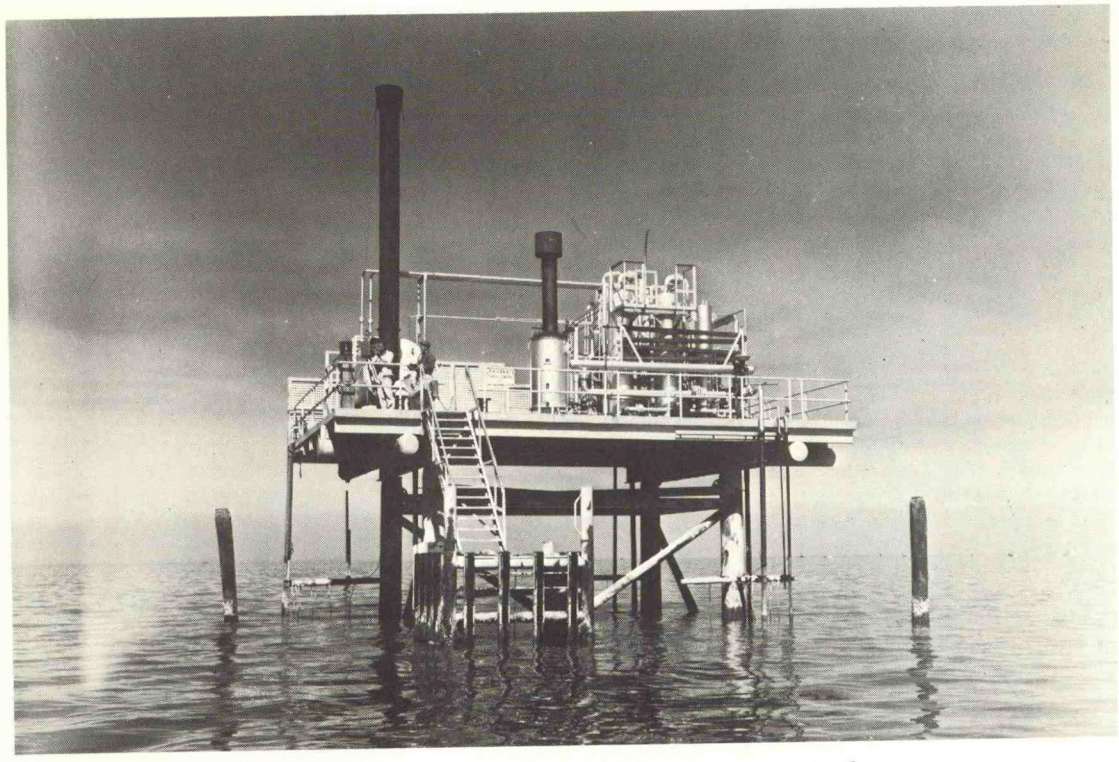
A better chart product, tailored to the needs of commercial fisheries in selected important fishing areas would improve the performance, efficiency, and safety of commercial vessel operations.

5. Oil Industry

The production of oil and gas in offshore waters had a 1967 value of $1.6 billion; production by 1980 is expected to almost triple and attain a value of $4.4 billion.

The discovery of oil and other valuable mineral resources in offshore waters has triggered a boom that is yet in its infancy. In addition to oil fields presently under development, it is known that many other coastal areas hold vast untapped reserves.

Not only is the petroleum industry itself avidly interested in obtaining charts showing detailed bathymetric data, but governmental regulatory agencies also require such charts to identify, inventory, and execute mineral leases of vast areas falling within their jurisdiction.



Offshore drilling platforms must be accurately charted so that mariners may be aware of their existence and avoid striking them.

6. Offshore Mining

As dryland deposits of sand, gravel, etc., become depleted, offshore mining operations to recover minerals located in abundant supply on the ocean floor will become greater. Value of offshore mineral production is expected to double from a 1967 level of $270 million to an estimated $545 million in 1980. Recovery of bulk deposits and the more plentiful minerals will accelerate and increase with refined recovery procedures and large-scale operations.

7. Marine Construction and Services

Offshore marine construction activity was valued at about $1.2 billion in 1967 and is expected to reach about $2.9 billion a year in 1980, expressed in constant 1967 dollars.

8. Federal Government

Undoubtedly the largest market for NOAA products and services is the U.S. Government itself. While both the Coast Guard and Navy are heavy users of nautical charts and related marine data, the Navy is by far the greatest single user. The exact percentage used varies in accordance with Naval defense activities, but, over a long-term average, has accounted for over 50 percent of NOS total output. If present trends continue, it is reasonable to expect that approximately 60 percent of the total output will be required to satisfy the Navy Department's needs. Operating in all areas of the world, under all conditions, charts are essential instruments of navigation to the fleet. Such cruises cover training and defense exercises that range from water areas close inshore, over the continental shelves, to the ocean depths of distant and remote seas. The extensive use of modern navigation equipment and tactical defense techniques makes it essential that accurate and up-to-date charts are maintained in our coastal and territorial waters for defense purposes.

9. Coastal Zone Management

Critical to the economy and national well-being are the estuarine waters which wash our shores. A region of transition between land and sea, the continental margins comprise one of man's most valuable resources. Not only does one-third of the U.S. population dwell within 50 miles of the seacoast, but 40 percent of our Nation's manufacturing plants are concentrated here. Undoubtedly, the most abused and mistreated of nature's gifts, these waters are used by birds and fish for hatching and rearing their young and by man as a dump for his pollutants, as a coolant for electric generating plants, as a food storehouse, and as a recreational playground. It has been estimated that the population of the country will double by the end of the present century, and intensified use of the coastal zone is inevitable. Detailed charts and maps are an undisputed necessity in the development of a sound estuarine management program.

The rocketing cost of land, particularly when located adjacent to the sea, has resulted in a demand for

Charting one of nature's most valuable regimes is essential to the development of a sound coastal zone management plan.

impartial, accurate delineation of early day property boundaries. Courts of law and similar judicial bodies, almost without exception, accept the historic topographic and hydrographic sheets of the National Ocean Survey as prima facie evidence of actual conditions in boundary disputes. In addition, geologists, ecologists, and many others make growing use of these documents in their studies.

10. Scientific Users

An unparalleled effort is underway at innumerable universities and research laboratories to unlock and solve the ocean's mysteries. Charts and related data are basic tools to the studies of the scientific community in depicting environmental factors which affect the interpretation and understanding of theories and scientific discoveries.

11. International Users

To satisfy a long standing need for a series of charts constructed with a uniform format, to support safer and more efficient navigation throughout the world, the member nations of the International Hydrographic Organization have agreed to initiate a program which will provide an international series of charts. In accordance with that agreement, the hydrographic charting agencies of the member nations have collectively agreed to construct and maintain the series of international charts as part of their individual national responsibilities. The NOS has agreed to provide five charts of the international series, within the next 10 years.

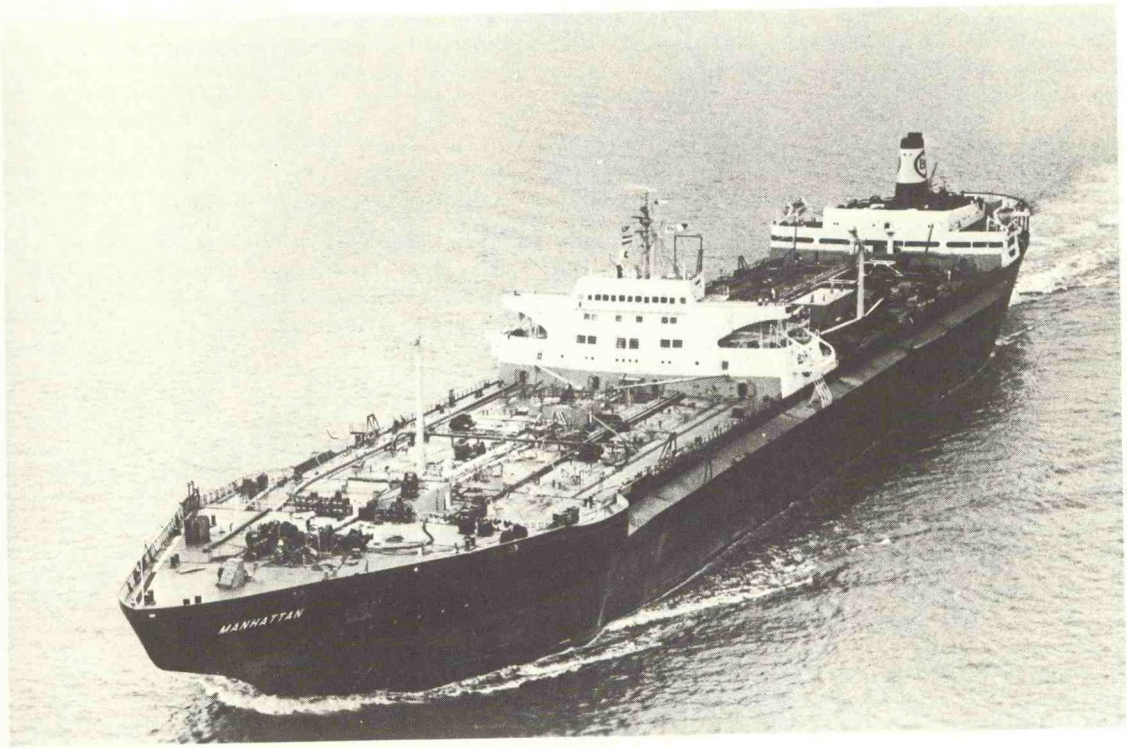
B. Conclusions

Regardless of the magnitude of the operation, all of the activities discussed in this chapter have a common need for charts to either safely navigate some type of seagoing craft or to plan operations in the marine environment. It is, therefore, of paramount importance that highly accurate descriptive material, tailored to satisfy specific maritime operating or planning needs, be produced and kept up-to-date as manmade and natural changes occur in the charted area. This requirement can be realized only by a vigorous charting program. In order to avoid reprinting of obsolescent data as these changes occur, it is imperative

that an adequate resurvey, recompilation, and reproduction cycle be instituted to assure an up-to-date suite of navigational aids, as well as to maintain them at a high degree of currency.

Based upon an analysis of expressed need, documented evidence, and projected area demand, the present suite of NOS charts must be modified or otherwise changed to better satisfy the requirements of the various classes of users discussed in this chapter.

New or reconstructed charts are required in the following areas to fulfill present and future maritime needs over the next decade.



The deep draft and massive size of today's containerized freighters and supertankers have created a need for specialized navigational data and charts of inshore waters.

Photo courtesy of Humble Oil and Refining Company.

CONVENTIONAL CHART REQUIREMENTS
(1971 - 1980)

Harbor Charts

Area

(R) Ipswich Bay to Gloucester Harbor - Massachusetts

(N) Scituate - Massachusetts

(N) Cape Cod Bay North of Cape Cod Canal - Massachusetts

(N) Cape Cod - Southwest Coast - Massachusetts

(N) Fall River Harbor & Taunton River - Rhode Island - Massachusetts

(N) Long Island - Port Jefferson Eastward - New York

(N) Port Jefferson and Smithtown Bay - New York

(N) Delaware Bay - Delaware and New Jersey

Area

(R) Potomac River - Lower Cedar Point to Mattawoman Creek - Maryland and Virginia

(N) Beaufort Inlet - North Carolina

(N) Altamaha Sound - St. Simons Sound - Brunswick Harbor and Turtle River - Georgia

(N) St. Augustine Inlet - Florida

(N) Cape Kennedy - Florida

(N) Port Everglades - Florida

(N) Mobile Bay - Alabama

(N) Matagorda and Lavaca Bays - Texas

(N) St. Thomas Island - Virgin Islands

(N) NEW CHARTS --- (R) RECONSTRUCTED CHARTS

15 2

CONVENTIONAL CHART REQUIREMENTS
(1971 - 1980)

Harbor Charts

Area

(N) Southeast Coast of Puerto Rico

(N) South Coast of Puerto Rico

(N) Southwest Coast of Puerto Rico

(N) San Juan Harbor - Puerto Rico

(N) Calenta Parquera - Puerto Rico

(R) San Diego Bay - California

(R) Pfeiffer Point to Point Cypress - California

(R) Mare Island Strait - California

(R) Cape Sebastian to Humbug Mountain - Oregon

(N) Puget Sound - Olympia - Washington

(N) Puget Sound - Tacoma - Washington

(N) Puget Sound - Whidbey Island - Admiralty Inlet - Saratoga Passage - Possession Sound - Washington

Area

(N) Dungeness Point to Port Townsend - Puget Sound Entrance - Washington

(N) Smith Island to Orcas Island - Rosario Strait - Washington

(R) Bellingham Bay - Washington

(N) Strait of Georgia - Orcas Island to Simiahmoo Bay - Washington to British Columbia

(R) Kendrick Bay to Shipwreck Point - Prince of Wales Island - Alaska

(R) North End of Cordova Bay and Hetta Island - Alaska

(N) Clarence Strait - Tolstoi and Union Bays - Alaska

(N) Etolin Island - Clarence Strait - Alaska

(N) West of Etolin Island - Alaska

(N) NEW CHARTS --- (R) RECONSTRUCTED CHARTS

14 7

CONVENTIONAL CHART REQUIREMENTS
(1971 - 1980)

Harbor Charts

Area

(N) Wrangell Harbor and Approaches - Alaska

(N) Sumner Strait - Point Baker to Zarembo Island

(N) Sumner Strait - Point Baker - Alaska

(N) Sumner Strait - Port Malmesbury - Affleck Canal - Port Beauclerc - Alaska

(N) Mitkof Island - Dry Strait - Alaska

(N) Keku Strait - Northern Part - Alaska

(N) Frederick Sound - Port Houghton - Alaska

(N) Hobart and Gambier Bays - Alaska

Area

(R) Salisbury Sound and Peril Strait to Emmons Island - Sergius Narrows - Peril Strait - Alaska

(N) Stephens Passage - Alaska

(N) Stephens Passage - Taku Harbor - Alaska

(N) Port Frederick - Icy Strait - Alaska

(N) Lynn Canal - Alaska

(R) Knick Arm - Fire Island to Goose Creek - Alaska

(R) Port Graham and Seldovia Bay - Cook Inlet - Alaska

(N) Aleutian Islands - Umnak Island - Vsefidof - Alaska

(N) NEW CHARTS --- (R) RECONSTRUCTED CHARTS

13 3

CONVENTIONAL CHART REQUIREMENTS
(1971 - 1980)

Harbor Charts

Area

(N) Aleutian Islands - Umnak - Island - Nikolski Bay - Alaska

(N) Aleutian Islands - Great Sitkin Island - Sand Bay - Alaska

(R) Hana Bay - Maui - Hawaii

Sailing and General Charts

Area

(N) Cape St. George to Mississippi Passes - Gulf of Mexico

(N) NEW CHARTS --- (R) RECONSTRUCTED CHARTS

Total Harbor Charts = 3/45

1/13

CONVENTIONAL CHART REQUIREMENTS
(1971 - 1980)

Coastal Charts

Area

(R) Cape Cod Bay - Massachusetts

(R) Nantucket Sound and Approaches - Massachusetts

(R) Long Island Sound - Eastern Part - Connecticut - New York

(R) Cape Henry to Currituck Beach Light - Virginia and North Carolina

(R) New River Inlet to Cape Fear - North Carolina

(R) Approaches to Cape Fear River - North Carolina

(R) Little River Inlet to Winyah Bay Entrance - North Carolina - South Carolina

(R) Fowey Rocks to Alligator Reed - Florida

Area

(R) Mississippi Sound and Approaches - Dauphin to Cat Island - Alabama - Mississippi

(R) Rollover Bayou to Calcasieu Pass - Louisiana

(R) Calcasieu Pass to Sabine Pass - Louisiana and Texas

(R) Sabine Pass to East Bay, Including Heald Bank - Texas

(R) Galveston Bay and Approaches - Texas

(R) San Louis Pass to East Matagorda Bay - Texas

(N) Strait of Juan de Fuca (entrance) - Washington - British Columbia

(N) Chatham Strait Entrance - Alaska

(N) NEW CHARTS --- (R) RECONSTRUCTED CHARTS

2 14

CONVENTIONAL CHART REQUIREMENTS
(1971 - 1980)

Coastal Charts

Area

(N) Sumner Strait - Kupreanof Islands - Alaska

(N) Glacier Bay and Tarr Inlet - Alaska

(N) Cape St. Elias - Gulf of Alaska - Alaska

(N) Upper Cook Inlet - Alaska

(N) Cook Inlet - Tuxedni Bay to the Forelands - Alaska

(N) Cook Inlet - Chinitna Bay to Tuxedni Bay - Alaska

(R) Gore Point to Anchor Point - Alaska

(N) Cook Inlet - Kamishak Bay - Alaska

(N) Alaska Peninsula - Kulak Bay to Cape Douglas - Alaska

Area

(N) Alaska Peninsula - Puale Bay to Kulak Bay - Alaska

(N) Alaska Peninsula - Wide Bay - Alaska

(N) Alaska Peninsula - Shelikof Strait to Shumagin Island - Alaska

(N) Alaska Peninsula - Port Heiden - Alaska

(N) Bristol Bay - North Coast of Alaskan Peninsula - Alaska

(N) Alaska Peninsula - Chiachi Island - Alaska

(N) Sulwik Island to Port Wrangell - Alaska

(N) Alaska Peninsula - Port Moller - Alaska

(N) NEW CHARTS --- (R) RECONSTRUCTED CHARTS

16 1

CONVENTIONAL CHART REQUIREMENTS
(1971 - 1980)

Coastal Charts

Area	Area
(N) Alaska Peninsula - Chiachi Island to Nagai Island - Alaska	(N) Alaska Peninsula - Unimak Pass
(N) Alaska Peninsula - Nagai Island to Unga Island - Alaska	(N) Alaska Peninsula - Big Koniuji Island - Alaska
(N) Alaska Peninsula - Sunak to Unimak Island - Alaska	(N) North Coast of Bristol Bay - Alaska
	(N) Nome and Sedge Island - Alaska
	(N) Port Hilo - Hawaii

(N) NEW CHARTS --- (R) RECONSTRUCTED CHARTS

8 — 0

Total Coastal Charts = 26

15

SMALL-CRAFT CHART REQUIREMENTS
(1971 - 1980)
New Charts

Area

Frenchman Bay and Mount Desert Island - Maine

Approaches to Penobscot Bay - Maine

Blue Hill Bay - Maine

Approaches to Blue Hill Bay - Maine

Casco Bay - Maine

Kennebec River - Maine

Saco to Portsmouth Harbor - Maine and New Hampshire

Cape Cod to Boston - Massachusetts

Block Island Sound - Massachusetts

Connecticut River - Connecticut

Shelter Island Sound and Peconic Bays - Long Island and Mattituck Inlet - New York

Area

Block Island Sound and Gardiners Bay - Long Island - New York

East River - New York

Hudson River - New York to Troy - New York

Raritan River - New York

Susquehanna River - Pennsylvania

Maurice and Cohansey Rivers - Delaware Bay - Delaware

Delaware River - Pennsylvania - New Jersey

Delaware Bay Entrance - New Jersey - Delaware

Chester and Choptank Rivers - Chesapeake Bay - Maryland

Chesapeake Bay - Potomac River - Maryland - Virginia

SMALL CRAFT CHART REQUIREMENTS
(1971 - 1980)

New Charts

Area

Virginia Inside Passage - Virginia - Maryland

Chesapeake Bay - Pocomoke and Tangier Sound - Maryland - Virginia

Chesapeake Bay - Virginia

York River - Virginia

Chesapeake Bay - Mobjack Bay and New York River Entrance - Virginia

Chesapeake Bay - Wolf Trap to Pungoteague Creek - Virginia

James River - Chesapeake Bay-- Virginia

James River - Newport News to Jamestown Island - Virginia

Pamlico Sound - North Carolina

Neuse and Pamlico Rivers - North Carolina

Area

Cape Fear River - North Carolina

Georgetown - South Carolina

Cooper River - South Carolina

St. Johns River - Florida

Tampa Bay to Tarpon Springs - Florida

Apalachicola and Flint Rivers - Florida - Alabama

Tombigbee River Comples - Alabama - Florida

Pearl River - Louisiana - Mississippi

Mississippi Gulf Outlet Channel - Louisiana

Mississippi River - Louisiana

Mississippi River - New Orleans to Baton Rouge - Louisiana

SMALL-CRAFT CHART REQUIREMENTS
(1971 - 1980)

New Charts

Area

Catahoula Bay to Wax Lake Outlet - Intracoastal Waterway - Including Houma Navigation Canal - Louisiana

Atchafalaya River, Intracoastal Waterway - Morgan City to Port Allen - Louisiana

Wax Lake Outlet to Forked Island - Intracoastal Waterway - Including Bayou Teche, Vermilion River, and Freshwater Bayou - Louisiana

Lake Arthur and Bayou Teche - Louisiana

Lake Charles to Galveston - Texas - Louisiana

Matagorda Bay and Lavaca Bay - Texas

Carlos Bay to Redfish Bay - Intracoastal Waterway - Including Copano Bay - Texas

Corpus Christi Approach - Texas

Corpus Christi Harbor - Texas

Redfish Bay to Middle Ground - Intracoastal Waterway - Including Baffin Bay - Texas

Area

Virgin Islands - Virgin Gorda to St. Thomas and St. Croix

Virgin Passage and Sonda de Vieques - West Indies

Lake Powell - Arizona - Utah

San Diego to Los Angeles - California

Los Angeles, North - California

California Coast - Point Conception - California

California Coast - Estero Bay - California

California Coast - Point Sur - California

California Coast - Monterey Bay - California

San Francisco Bay - California

California Coast - Shelter Cove - California

Sacramento and San Joaquin Rivers - California

SMALL-CRAFT CHART REQUIREMENTS
(1971 - 1980)
New Charts

Area

Sacramento River - Andrus Island to Sacramento - California

California Coast - Point Arean - California

California Coast - Rockport - California

Clear Lake - California

California Coast - Mendocino - California

California Coast - Crescent City - California

Cape Blanco to Yaquina Bay - California and Oregon

Oregon Coast - Oregon

Umpqua River - Oregon

Yaquina Bay Entrance - Oregon

Columbia River - Oregon - Washington

Area

Willamette River - Washington

Columbia River - Washington

Snake River - Little Goose Reservoir - Washington

Columbia River - John Day Dam to Pasco Oregon - Washington

Snake River - Lower Monumental Dam and Pool - Washington

Coeur D'Alene - Idaho

Franklin D. Roosevelt Lake - Washington

Nichols Passage and Tongass Narrows - Alaska

Wrangell Narrows to Frederick Sound - Alaska

Stephens Passage - Alaska

Raku Inlet to Lynn Canal - Alaska

SMALL-CRAFT CHART REQUIREMENTS
(1971 - 1980)
New Charts

Area	Area
Chilkoot and Chilkat Inlets - Alaska	Hawaii - Keahole Point to Upolu Point
Hawaiian Islands - Interisland Coverage	Kauai - Hawaiian Islands

4

44

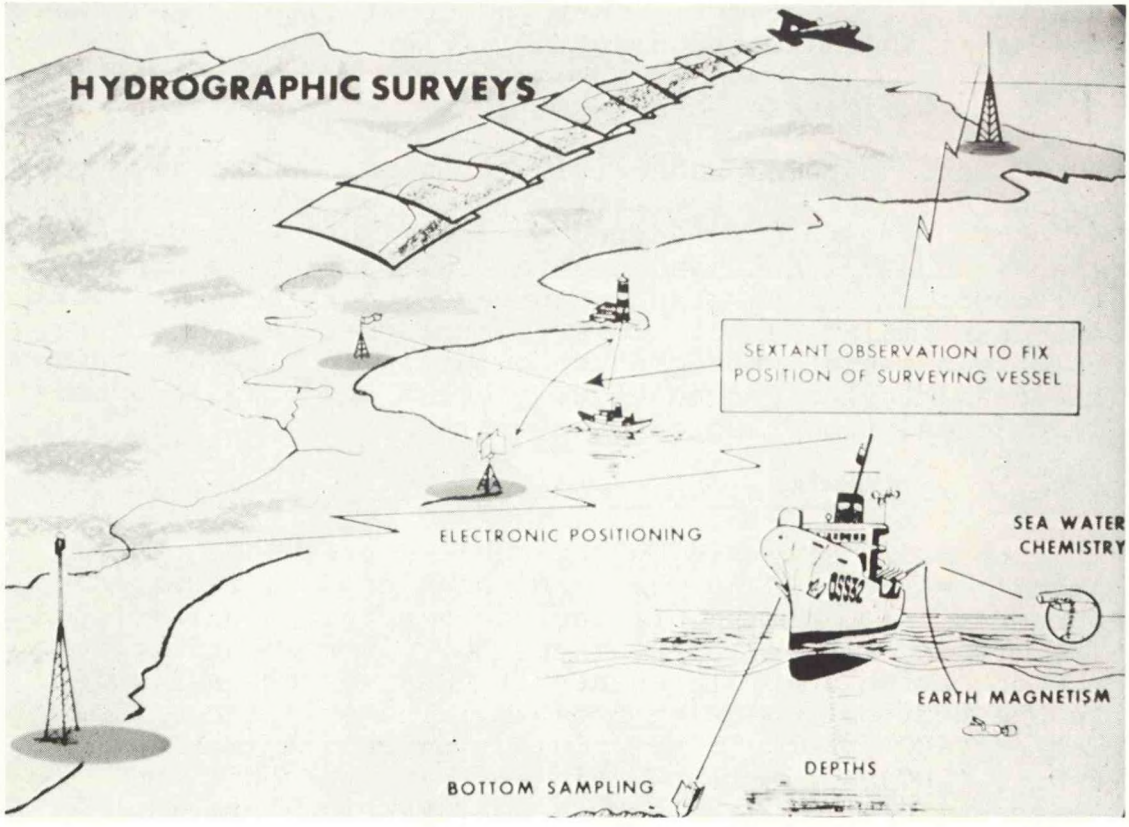
Total New Small-craft charts = 89

V. PRESENT NAUTICAL CHARTING SERVICE

The mission of the Nautical Charting Program directly aids the Department of Commerce in carrying out its mandate from Congress to promote, foster, and develop the industry and commerce of the U.S.

The program objectives are to complete, and maintain on an up-to-date basis, the charting of coastal areas, intra-coastal waterways and certain rivers and lakes of the U.S. and its possessions to meet the requirements for safe navigation.

The program provides nautical charts and related information for the safe and efficient navigation of marine commerce, the fishing fleet, recreational small craft, defense shipping and fleet operations. To accomplish this task, 821 existing nautical charts covering the navigable waters of the U.S., its possessions and territories must be continuously updated and maintained to keep pace with that group of expanding maritime users.



Of foremost importance to the execution of a series of coastal and inland charts is a basic, integrated geodetic network, which provides a single horizontal control datum for relating the charts to the surface of the earth in position, scale, and orientation.

This prerequisite to charting the waters of the U.S. and adjacent areas is provided by the National Horizontal Control Network, maintained by the NOS.

Similarly, a vertical control datum is required to establish a consistent reference for hydrographic data.

In tidal areas, the vertical datum is provided by an extensive network of control tide stations maintained by the NOS. Other water levels of lakes and rivers may be referenced to sea level datum.

A. Program Service Configuration

Major subprograms are identified as Coastal Mapping, Nautical Chart Surveys, Chart and Coast Pilot Production, and Research and Development.

1. Coastal Mapping

The Coastal Mapping subactivity provides photogrammetric support services to the marine chart program and consists of photogrammetric surveying and compilation of hydrographic control data and coastal delineation required for the conduct of hydrographic surveys, chart compilation, and chart maintenance. This program operates aircraft to obtain aerial photographs, maintains photogrammetric field and office personnel to process and compile hydrographic and topographic survey data.

2. Nautical Chart Surveys

Ship operations, basic hydrographic surveys and other activities related to the furnishing of data required for nautical charting are included in this program. The Office of Fleet Operations, NOS, is responsible for the operation and maintenance of NOAA vessels assigned to the nautical charting program. The Atlantic Marine Center (AMC), Norfolk, Virginia, the Pacific Marine Center (PMC), Seattle, Washington, and the Ship and Ocean Engineering Facility, Miami, Florida, provide

logistic support for vessels and the highly mobile field parties which operate under the technical guidance and supervision of program manager. Table V-1 lists the name, class, and logistic base to which each unit is attached.

Table V-1

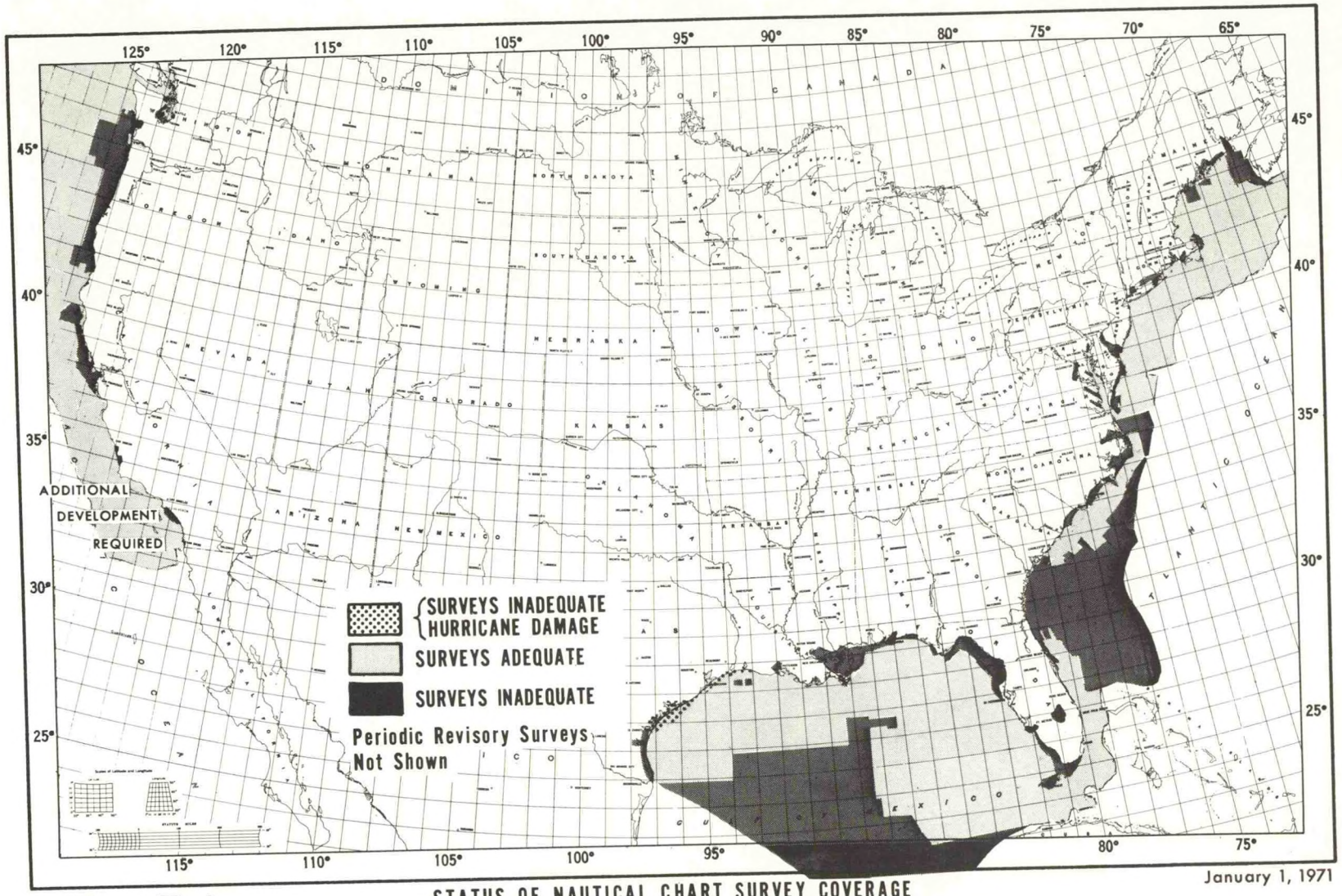
Type Unit	AMC	PMC
Class II hydro vessels (1800-2000 ton displacement)	MT. MITCHELL	PATHFINDER FAIRWEATHER RAINIER
Class III hydro vessels (760-995 ton displacement	WHITING PEIRCE	McARTHUR DAVIDSON
Class IV wire-drag investigation vessels (190 ton displacement)	RUDE & HECK	
Shore based hydrographic field parties (HFP)	HFP 742 (Surveys) HFP 745 (Investigations)	

These units are responsible for making new surveys, resurveying obsolescent surveys, and reexamining areas that have undergone changes since the last survey. Their final product is, usually, a plotted hydrographic survey sheet, complete with original data records needed for further processing purposes.

In addition, the geophysical surveying vessels, RESEARCHER and SURVEYOR, contribute some hydrographic data to the nautical chart program, gathered primarily for the continental shelf.

Laid up end FY 73

Figures V-1 — V-4 show the current status of NOS hydrographic surveys covering more than 2½ million square miles of navigable waters.



January 1, 1971

Figure V - 1

STATUS OF NAUTICAL CHART SURVEY COVERAGE
ATLANTIC, GULF, AND PACIFIC COAST

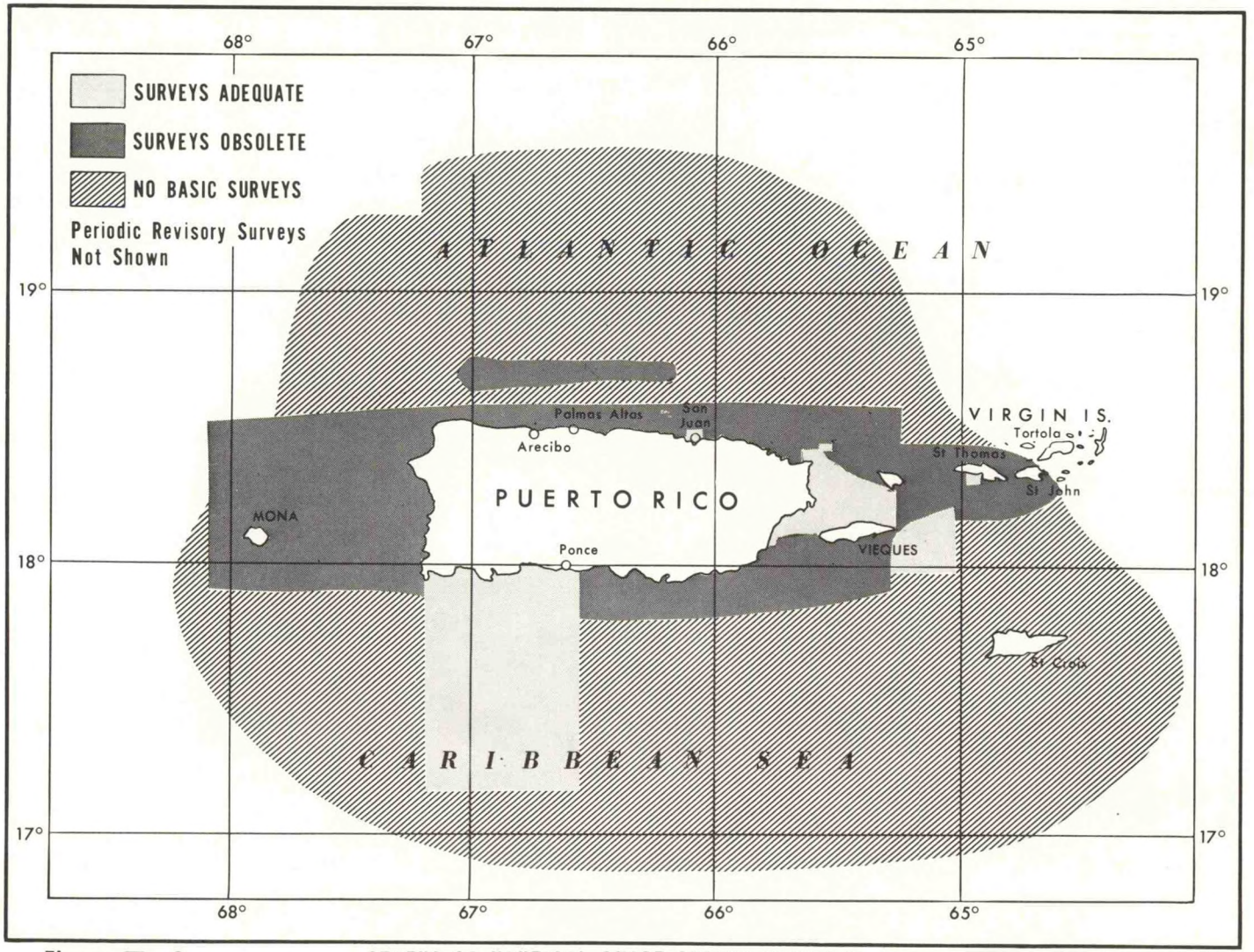


Figure V - 2 STATUS OF NAUTICAL CHART SURVEY COVERAGE PUERTO RICO January 1, 1971

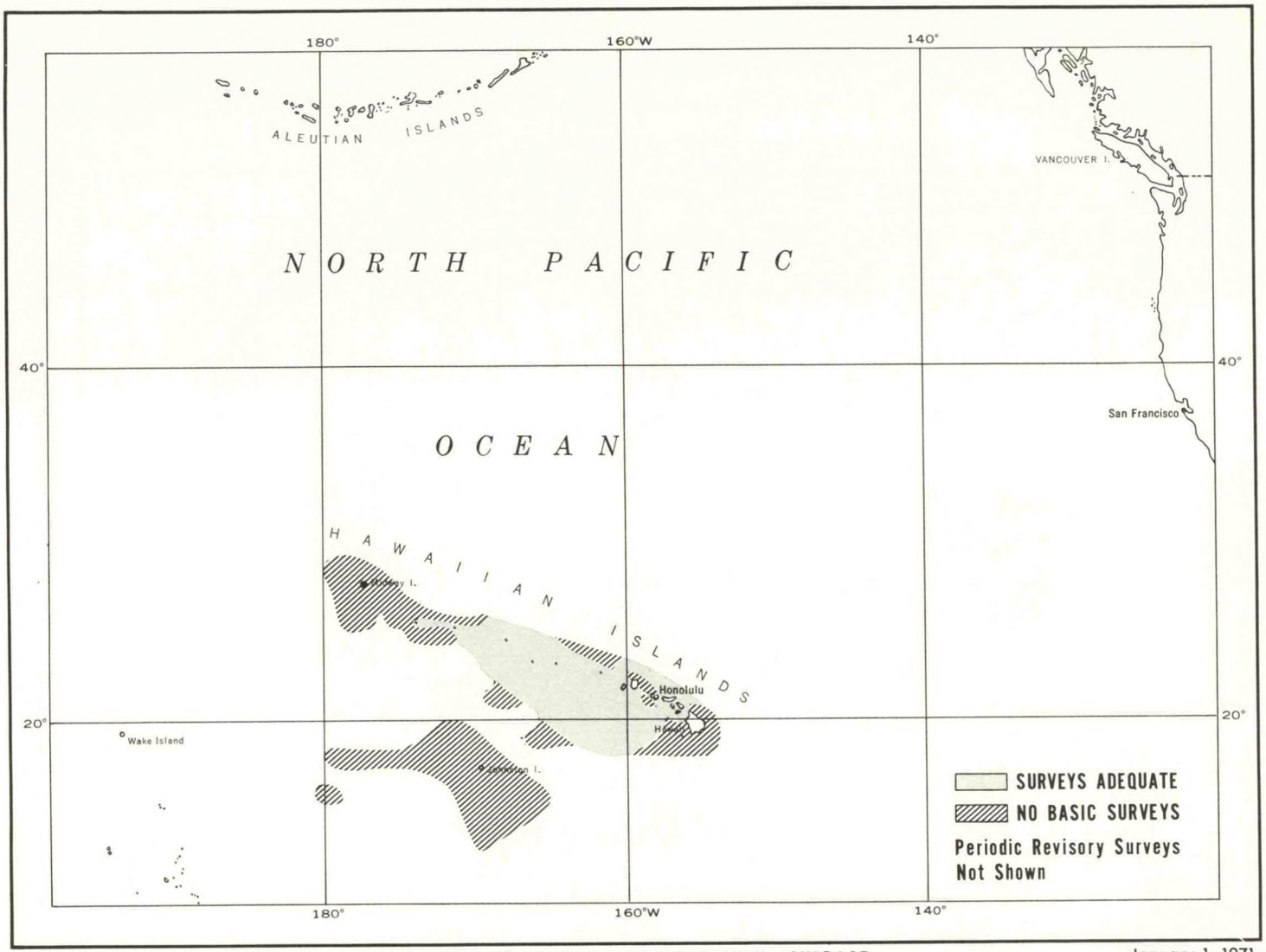


Figure V - 3

STATUS OF NAUTICAL CHART SURVEY COVERAGE
HAWAIIAN ISLANDS

January 1, 1971

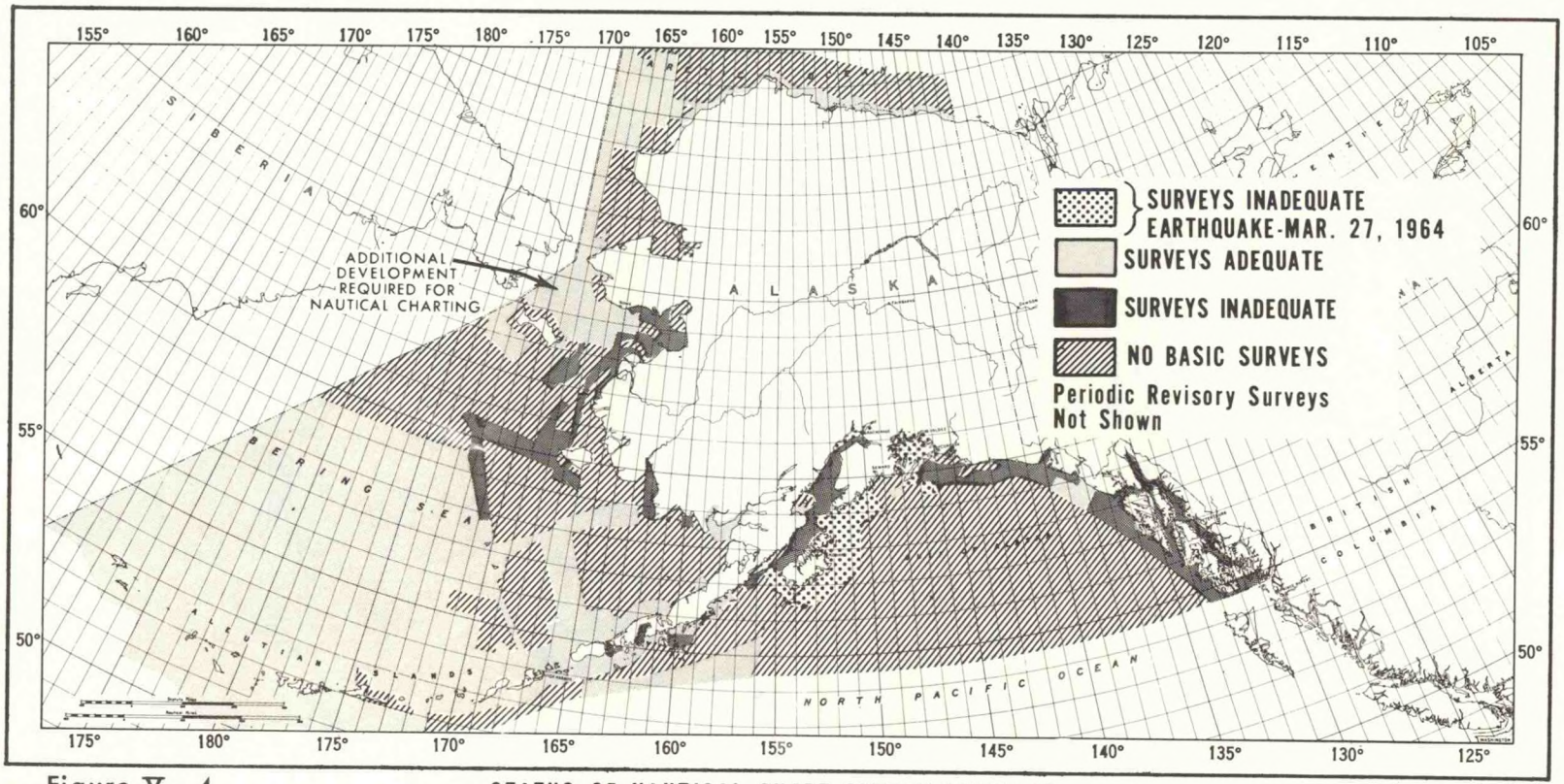


Figure V - 4

STATUS OF NAUTICAL CHART SURVEY COVERAGE
ALASKA, ALEUTIAN ISLANDS, AND BERING SEA

January 1, 1971

3. Navigational Chart Production

As marine data is generated by field units, it is transferred to a processing facility at one of the two marine centers for further processing, replotting, and verification before it is transferred to the NOS headquarters in Rockville, Maryland, for final review, application to charts, and archiving.

The Atlantic Marine Center directs the operations of east coast survey vessels and maintains facilities for ship support and processing of survey data.

a. Program Management, Data Processing, and Compilation

The Office of Marine Surveys and Maps in NOS is the operations hub of the overall program. Here, the user requirements are assembled and assessed, priorities for surveys are determined, and the final product is developed.

Two important program responsibilities managed by the Office include:

(1) Nautical Chart Maintenance

The maintenance of the existing suite of charts is a vital activity in accomplishing the program objective of providing the mariners with up-to-date information required for safe navigation.

In addition to applying survey data generated within the program, the scope of the maintenance effort includes the receipt and analysis of important hydrographic data from Federal, state, municipal, and private organizations and the timely dissemination of applicable information to the chart user. This type data consists of more than 70,000 charted aids to navigation maintained by the U.S. Coast Guard and private interests, over 20,000 miles of established channels which are surveyed and maintained by the Corps of Engineers, pipeline and cable crossing locations, offshore and inshore construction features, etc.

Cooperative programs with the U.S. Power Squadrons and the U.S. Coast Guard Auxiliary provide between 4000 and 5000 change items, used for chart maintenance annually. These programs are outstanding examples of citizen-Government cooperation and reflect a high regard for the venerable marine chart.

Changes to published charts are updated through Notice to Mariners and by a new issue of the chart itself when enough changes occur to warrant reconstruction and reprinting.

(2) New Chart Construction

The Nautical Chart Program is a viable service designed to respond to the ever-changing needs of the country. The economic and sociological development of each region in the Nation is studied with regard to adequacy of existing surveys, chart size, scale, and format. Statistics, reports, predictions, and user contacts are evaluated to plan improved services and new chart requirements. Current evaluations, however, indicate the present level of charting activity is not adequate to keep pace with the national economic developments.

Alaska and the Pacific Coast of the mainland presently need many new charts due either to the inadequacy of existing chart scales or chart coverage.

The nautical charting program must be both viable and flexible in order to respond to advanced technological needs and changing user requirements.

Extensive economic development in the Atlantic States and South Atlantic States has caused a need for new charts in those regions. New formats of information portrayed are required by many users, especially the fishing industry and the recreational and small-boat operator. If the present charts in an area are not of proper scale or coverage to allow safe and efficient marine navigation, they are evaluated to determine the need for (1) a new chart, (2) reconstruction of an existing chart, or (3) a combination of the two.

b. Reproduction and Dissemination

Following the processing of data and compilation of a new or revised chart, a new lithographic plate is made and a supply of charts are lithographed in accordance with anticipated future demands.

(1) Printing Schedules

Individual charts of very active areas which have a history of numerous and/or drastic changes require frequent printing and, hence, a smaller inventory than will those charts covering more stable areas.

Figure V-5 shows the printing intervals for 739 conventional charts during FY 1970. The time interval between printings of these charts are categorized in groups which range from six months to 48 months.

Figure V-5 - Conventional Chart Printing Schedule

Print Interval (Months)	Number of Charts	Equivalent Annual Printings
6	12	24
12	176	176
18	5	3
24	171	85
36	14	4
48	361	90
Total	739	382

In addition to the conventional charts shown in Figure V-5, the small-craft charts are generally updated and reprinted on an annual basis.

Corrections to the chart between printings must be made by the user with information distributed in Notice to Mariners. This is a serious deficiency in assuring adequate dissemination of changes to all users, because not all users subscribe to the service.

(2) Distribution

Charts and related publications may be purchased from 720 authorized sales agents in many cities of the U.S., from the NOS, Rockville, Maryland, and from independent marinas, boatyards and other marine suppliers who purchase publications for resale to the public.

4. Coast Pilot

This program consists of field investigation and office compilation activities contributing to the preparation of a narrative description of U.S. coasts, harbors, and connecting waterways that supplements the nautical charts.

In 1969 the composition and printing processes were automated in order to make Coast Pilot information available to mariners in the shortest possible time. By means of automation and photolithography, it is now possible to incorporate all corrections and changes reported in the notices to mariners on magnetic tape and reprint a completely updated publication each year. There are eight publications containing sailing directions covering the entire U.S. The first publication was computerized in 1969 and the program to automate the remaining seven is scheduled for completion by 1975.

5. Research and Development

The research and development activity of the nautical charting program is dedicated to planning, designing, and developing improved hydrographic and cartographic systems and system components. This effort includes instrumentation, equipment and related manning and operational doctrines.

At present, the major projects in research and development are associated with (1) improving the data handling steps of the program by automation of data acquisition, processing,and plotting functions and (2) developing improved and more efficient hydrographic surveying systems.

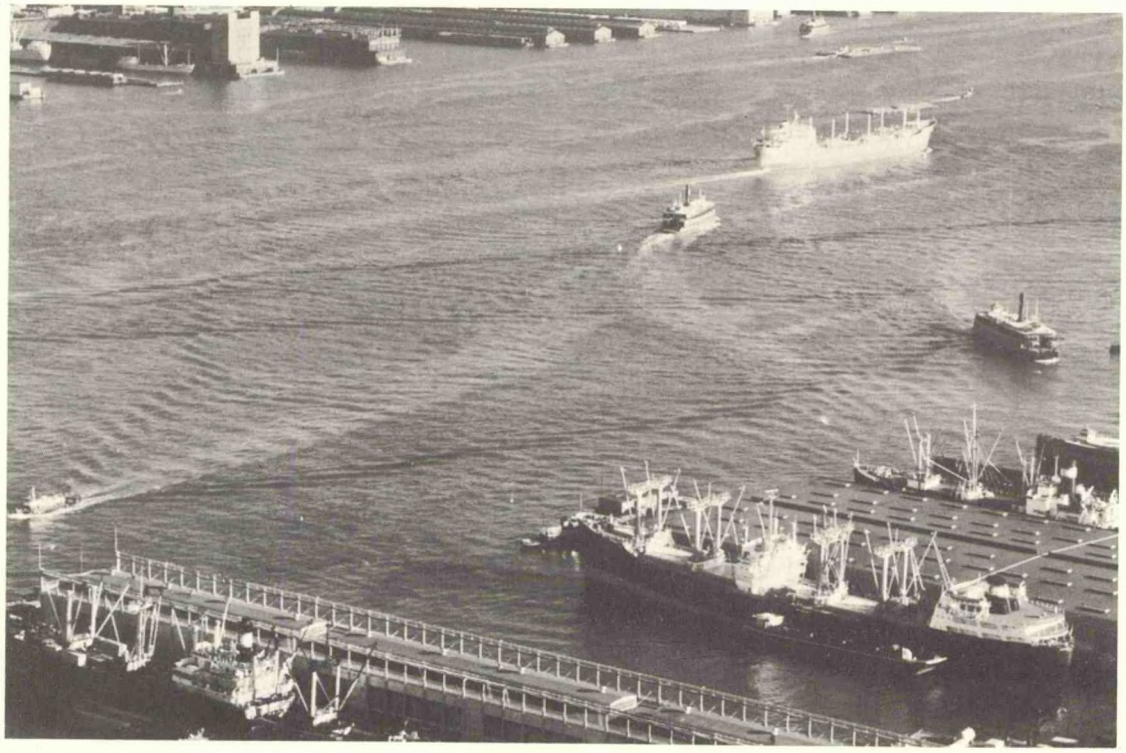
B. Products and Services

The National Ocean Survey currently publishes and distributes to the public the following marine products.

1. Conventional Nautical Charts

These are published for use as plotting sheets in planning voyages, in the safe navigation of large commercial vessels and for use in ship operations where room for display and plotting is available. They serve maritime interests in many other ways and are used by commerce, industry, science, and

government. Four classes of this type chart are published as follows:



Charts are essential to the safe navigation of shipping.

a. Sailing Charts

These are nautical charts at a scale of 1:600,000 or smaller. They are used for offshore sailing between distant coastal ports and for approaching the coast from the open sea. They show offshore soundings and the more important lights, outer buoys, and natural landmarks which are visible from considerable distances at sea.

b. General Charts

These are nautical charts of the coast at scales from 1:100,000 to 1:600,000. They are designed for coastal navigation when a vessel's course is well offshore but while her position can be fixed by landmarks, lights, buoys, and characteristic soundings.

c. Coastal Charts

These are nautical charts at scales from 1:50,000 to 1:100,000. They are intended for close coastal navigation inside outlying reefs and shoals, for use in entering bays and harbors of considerable size, and for navigating the larger inland waterways.

d. Harbor Charts

These are nautical charts at scales larger than 1:50,000; the scale depends on the size and importance of the harbor and the number and kinds of dangers existing. These charts are intended for navigation in harbors and smaller waterways, and for anchorage.

2. Small-Craft Nautical Charts

These are nautical charts at scales of 1:15,000 to 1:80,000 and designed for easy reference and plotting in limited space available aboard small craft. They emphasize details of interest to small-craft operators, including large-scale inserts of small boat harbors, tide, current, and weather data, whistle signals, marina facilities, anchorages, courses, and distances. They consist of three different formats.

a. Folio Charts

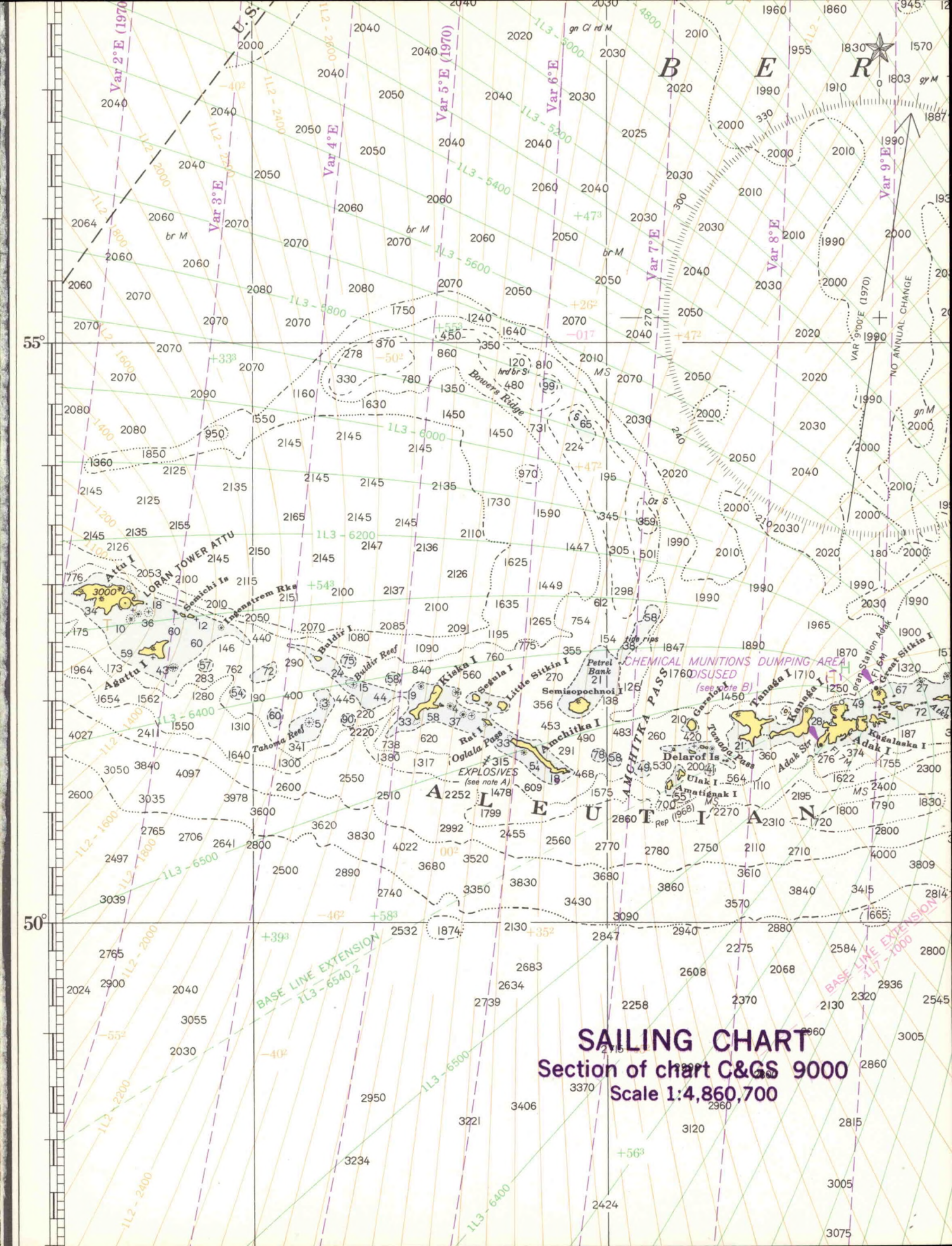
These charts consist of three or four folded sheets printed front and back and bound in a suitable jacket.

b. Route Charts

These charts consist of a folded single sheet printed front and back and issued in a suitable jacket.

c. Area Charts

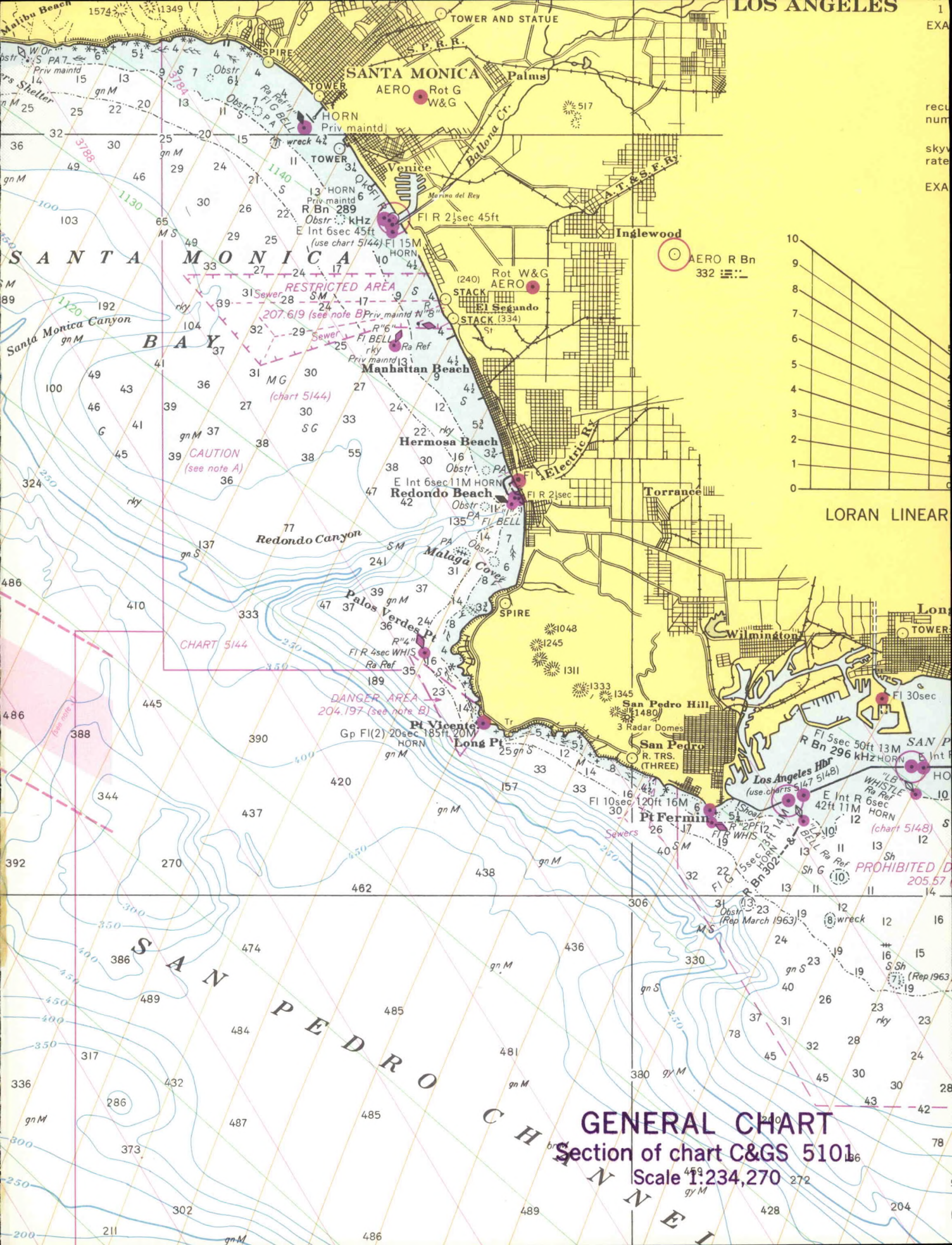
These charts are generally conventional charts over-printed with information helpful to operators of small craft. They are folded in convenient panels and issued in a protective jacket.

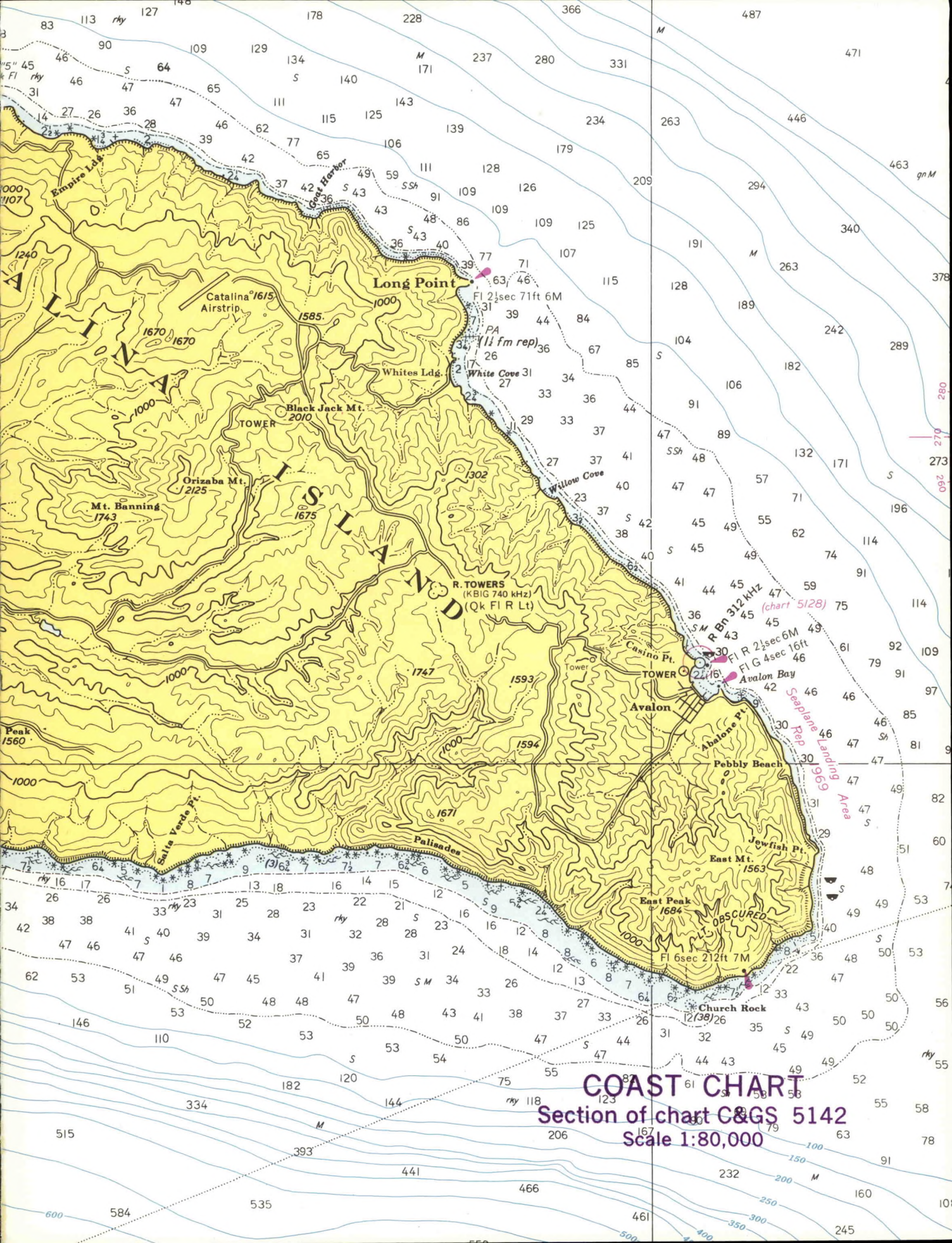


SAILING CHART

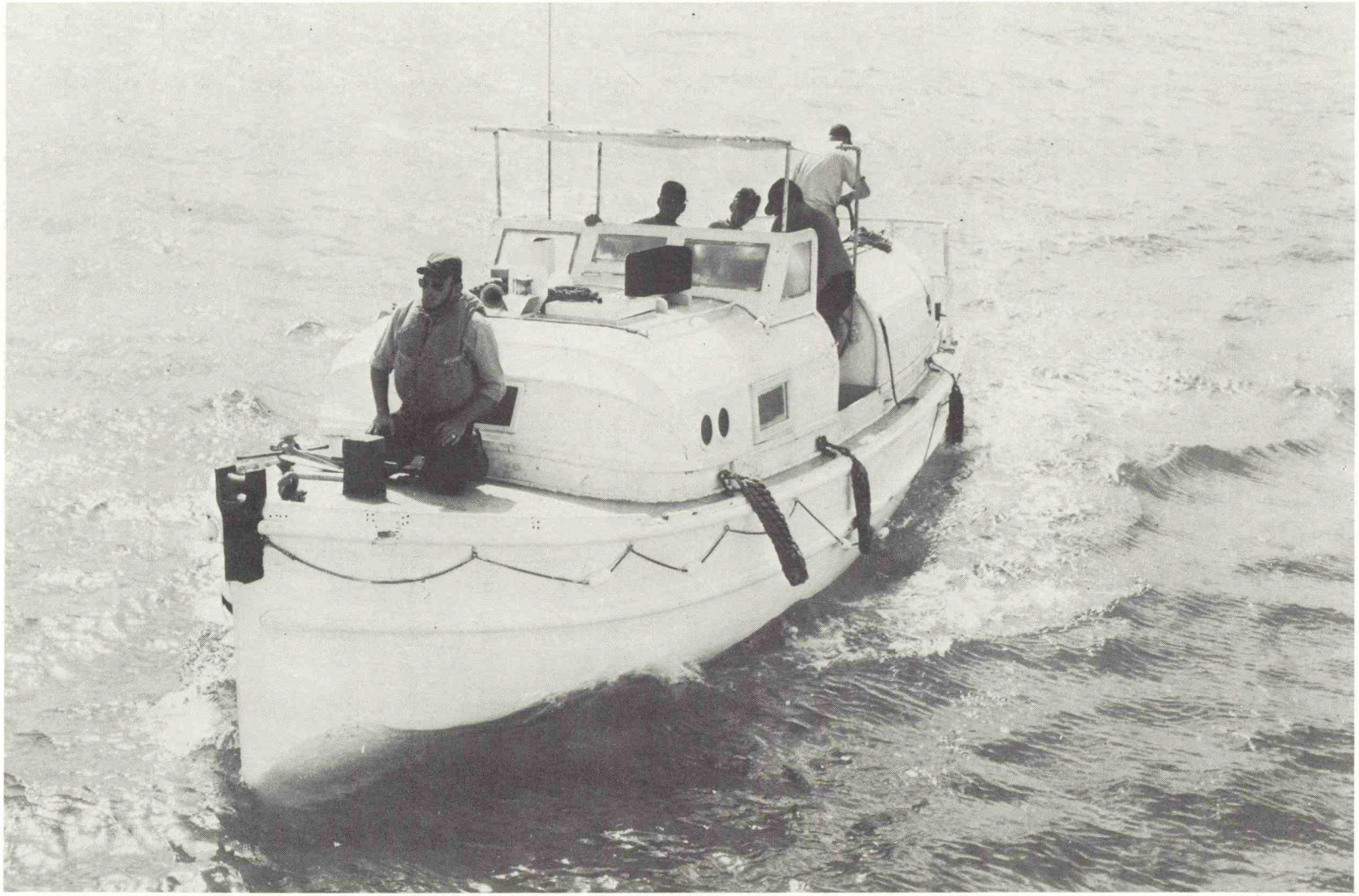
Section of chart C&GS 9000

Scale 1:4,860,700


LOS ANGELES
SANTA MONICA
SANTA MONICA BAY
SAN PEDRO CHANNEL
Malibu Beach
TOWER AND STATUE
S.P.R.R.
SPIRE
TOWER
AERO
Rot G
W&G
Palms
Ballona Cr.
Venice
Marina del Rey
A.T. & S.F. Ry
Inglewood
AERO R Bn
332
Rot W&G
AERO
(240)
STACK
El Segundo
STACK (334)
R Bn 289
Obstr
kHz
E Int 6sec 45ft
(use chart 5144)
Fl 15M
HORN
Fl R 2½sec 45ft
RESTRICTED AREA
207.619 (see note B)
Priv maintd
Sewer
Fl BELL
Ra Ref
Manhattan Beach
(chart 5144)
Hermosa Beach
CAUTION
(see note A)
E Int 6sec 11M HORN
Redondo Beach
Fl R 2½sec
Electric Ry
Torrance
Redondo Canyon
Malaga Cove
Palos Verdes Pt
R"4"
Fl R 4sec WHIS
CHART 5144
DANGER AREA
204.197 (see note B)
Pt Vicente
Gp Fl(2) 20sec 185ft 20M
HORN
Long Pt
San Pedro Hill
1480
3 Radar Domes
San Pedro
R. TRS.
(THREE)
Wilmington
Fl 30sec
Fl 5sec 50ft 13M
R Bn 296 kHz HORN
Los Angeles Hbr
(use charts 5147 5148)
E Int R 6sec
42ft 11M
HORN
Pt Fermin
Fl R WHIS
Fl G 15sec 73ft 14M
HORN
R Bn 302
Fl 10sec 120ft 16M
(chart 5148)
PROHIBITED
205.57
Sewers
Shoal
Obstr
(Rep March 1963)
wreck
LORAN LINEAR
GENERAL CHART
Section of chart C&GS 5101
Scale 1:234,270


ALINA ISLAND
Long Point
Fl 2½sec 71ft 6M
PA
(1½ fm rep)
Catalina Airstrip
1615
1585
1670
1670
1000
Empire Ldg.
Goat Harbor
Whites Ldg.
White Cove
Black Jack Mt.
2010
TOWER
Orizaba Mt.
2125
Mt. Banning
1743
1675
1302
Willow Cove
R. TOWERS
(KBIG 740 kHz)
(Qk Fl R Lt)
R Bn 312 kHz
(chart 5128)
Fl R 2½sec 6M
Fl G 4sec 16ft
Casino Pt.
TOWER
Avalon Bay
Avalon
Tower
1747
1593
1594
1671
Abalone Pt.
Pebbly Beach
Seaplane Landing Area
Rep 1969
Jewfish Pt.
East Mt.
1563
East Peak
1684
OBSCURED
Fl 6sec 212ft 7M
Church Rock
(38)
Palisades
Salta Verde Pt.
Peak
1560
COAST CHART
Section of chart C&GS 5142
Scale 1:80,000


Southwest Slip
P. E. R. R.
PIER A
TOWER
TANK
Fl G 4sec 20ft
7M"1" HORN
EAST BASIN
TURNING BASIN
(see note)
VINCENT THOMAS FIXED BRIDGE
HOR. CL. 1150 FT.
VERT. CL. 165 FT.
VERT. CL. 185 FT. FOR
MIDDLE WIDTH OF 500 FT.
Ramp
Piles
Fireboat
Slip No 228
Slip No 230
Slip No 232
MAIN CHANNEL
(see note)
Cable Area
Union Pacific R. R.
The control
for the entire ch
Reservation P
BERTH N
The numbers
waterfront are th
Under constr.
1st St.
2nd St.
4th St.
6th St.
8th St.
10th St.
12 th St.
14th St.
16th St.
Mesa St.
Center St.
Beacon St.
Harbor Blvd.
S. P. R. R.
CITY HALL
R.Tr. (lighted)
P. O.
CUSTOM HO.
N PEDRO
NEON SIGN
H.V.H.
Cable and
Pipeline Area
EAST
SAN PEDRO
TANK
FISH HARBOR
18 FT SEPT 1946-
SEPT 1963
Fireboat
Ruins
F G 15ft"5"
F R 25ft"6"
F R 10ft
Priv maintd
VIADUCT
TANK
Lighthouse
Fl G 4sec 25ft"3"
HORN
HARBOR CHART
Section of chart C&GS 5147
Scale 1:12,000



Present-day hydrographic survey launch--the workhorse of inshore hydrography operations.

3. Coast Pilots

Charts by themselves are inadequate in the presentation of all information needed by mariners, particularly while cruising in strange and/or unfamiliar waters, and a program consisting of field investigation and office compilation for developing descriptive information to fill this void is necessary. Coast Pilots are books containing a wide variety of navigational information which cannot be adequately presented on nautical charts. This information includes general and local navigation regulation; descriptions of prominent natural and cultural shoreline features; descriptions of channels, anchorages, dangers, tide and current characteristics, and weather conditions pertinent to an area; and listings of available port facilities. The Coast Pilot is presently published in eight volumes which are kept current through notice to mariners, annual supplements, and new editions.

4. Notice to Mariners

The Notice to Mariners is published weekly by the U.S. Naval Oceanographic Office (NAVOCEANO) and is prepared jointly with the NOS and the Coast Guard. The Notice is public announcement containing information, primarily of interest to navigators of oceangoing vessels, on important matters affecting navigational safety, changes in channels, navigational aids and other information specifically useful for updating the latest editions of nautical charts and publications produced by those agencies.

In addition to the NAVOCEANO Notice, each Coast Guard District publishes a Local Notice to Mariners which provides marine information of interest to both deep-draft vessels and small-craft operators within that District. The Local Notice includes additional information covering the Intracoastal Waterway and other waterways and small harbors within the U.S.

C. Areas of Potential Improvement

The foregoing description outlines the present nautical charting program which serves the maritime interests of the Nation. During recent years, user requirements for its products and services have accelerated at a faster rate than the program has had the capability to respond.

Potential improvements derived by comparing the requirements with the current services may be placed in three categories: product improvement, service improvement, and improvements requiring supporting research and development.

1. Product Improvement

Current products fall short of fulfilling the national requirements of safe navigation.

a. The present suite of charts does not provide adequate coverage of some important lakes, waterways, harbors, and commercial fishing areas.

(1) The conventional chart coverage should be modified to include 108 new or reconstructed charts of the coastal areas of the U.S.

Revised commercial fishing techniques have created a need for the development of special fishing charts.

(2) There are now 73 small-craft charts covering most areas of the East and Gulf of Mexico Intracoastal Waterway. This chart series should be expanded to over 180 charts to provide service to recreational and small-boat operators on the west coast of the U.S., Hawaii, Virgin Islands, Puerto Rico, and many waterways, rivers, and lakes in the continental U.S. and Alaska.

(3) Important fishing areas offshore of the U.S. and Alaska require more detailed descriptive information charted on a format that will enable the commercial fisherman to use bottom fishing gear with a reasonable assurance of retrieval. This improvement service is under study. As areas are determined that will be of economic benefit to the user, charts will be planned.

b. Charted information is not updated and printed with sufficient frequency to remain current and of high quality.

(1) Although critical information discovered during a field survey is reported through the Notice to Mariners and applied on the chart at the time of the next printing, complete application of the new survey information may be delayed as long as 60 months by use of manual data processing, plotting, and compiling methods. The NOS is in phase I of an improvement program to automate the data acquisition, processing, and compilation steps in order to complete full application to the chart in six months. Implementation of the automation program to expedite data handling is a high priority item in the nautical charting program and is scheduled for completion in FY 1975.

(2) Figure V-5 on page 55 shows that the time interval between updating and reprinting conventional charts ranges from six months to four years. The only mechanism available to mariners for updating these charts is the Notice to Mariners. Four, and even two years, is much too long to expect a navigator to make weekly corrections to his chart in order to keep it current. The updating and printing of charts should be done on a more frequent schedule to improve the quality of service and

product to the user. A study[1] sponsored by the National Council on Marine Resources and Engineering Development recommended that, in the interest of product improvement, the time interval between updating of NOS nautical charts be reduced to an average of six months by 1980.

Charts must reflect natural and manmade changes which affect the safety of navigation.

c. Many charted areas require resurveys. Some are needed to keep pace with natural and manmade changes which affect the safety or quality of navigation and some are required to keep up with technological and sociological changes, both in survey methodology and in mode of chart usage; e.g., supertanker navigation, submarine navigation, recreational boating, etc.

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[1] Technical Development Plan, National Data Program for the Marine Environment by Systems Development Corp., 1969.

(1) In January 1969, the Report of the Commission on Marine Science, Engineering and Resources[2] recommended the "ESSA accelerate nautical charting activities in U.S. coastal waters to ensure up-to-date charts of all areas of moderate to heavy marine activity. The civil nautical charting capability should be expanded within 15 years to a level which will sustain a basic resurvey cycle of 50 years with more frequent surveys in important areas of rapid change."

(2) A program to expand nautical charting surveys should be initiated to satisfy present and future needs for accurate and up-to-date charts. Although nautical charting has been conducted in U.S. coastal waters for more than 100 years, there still remain many areas which have not been surveyed and very substantial areas which have been surveyed using obsolete standards (Figure V-1 through V-4).

Many coastal areas have not been surveyed or have been surveyed using obsolete standards.

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[2] Our Nation and the Sea, January 1969.

Many areas of the U.S. coastal regions require an extention of the National Geodetic Network to provide an accurate horizontal control datum for new charts in those regions. Areas requiring densification of geodetic control stations include: Alaska and the east and west coasts of the U.S.

2. Service Improvement

Service improvement is required in three categories.

a. Product Dissemination

Charts and related publications may be purchased either from the NOS headquarters or from one of 720 authorized sales agents located in various cities throughout the United States.

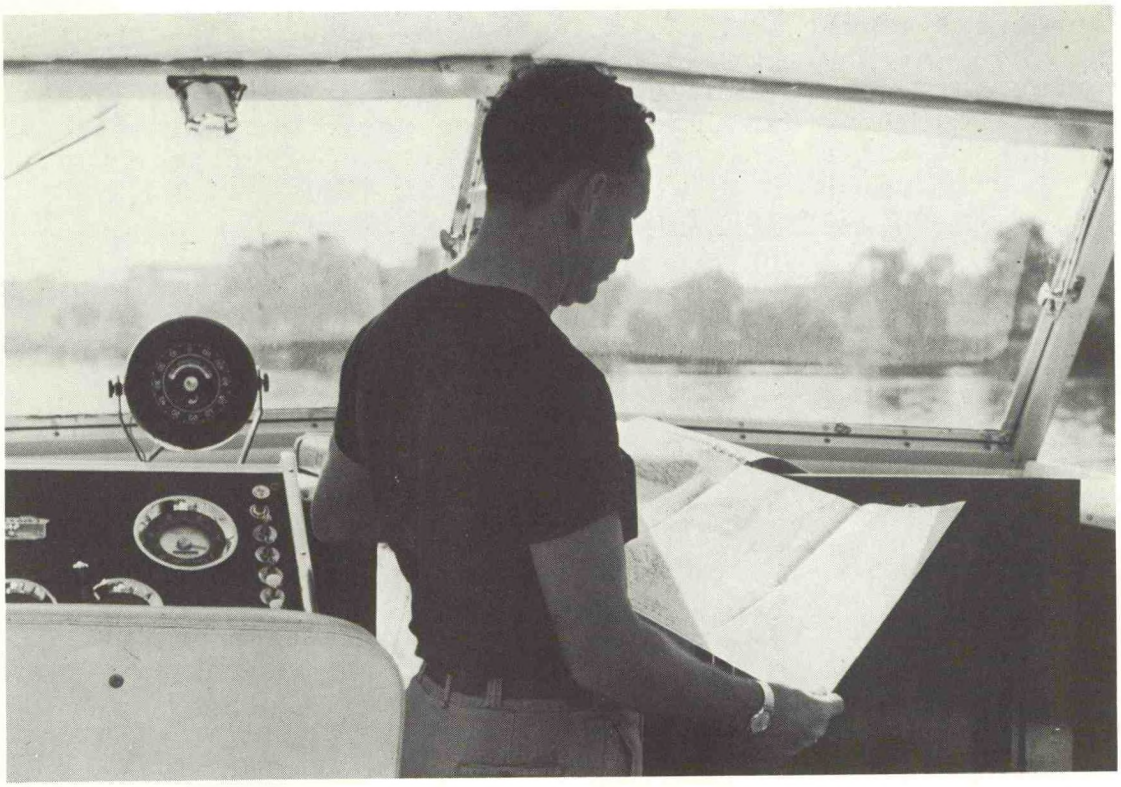
The distribution system is presently considered adequate for the dissemination of conventional charts and related publications, but as the highly popular small-craft chart series expands into more geographic areas, additional sales outlets must be established.

b. National Program Coordination

In 1969, the Department of Commerce was designated lead agency responsibility to provide national coordination of all agencies with programs in Marine Charting, Mapping, Geodesy, and Data Storage. Plans are being developed to implement that very important role in order to provide better coordination in the assessment of national requirements in those common programs and functions.

c. Public Education of Navigation Products

Mariners with experience or training in the field of navigation are usually well aware of the products and services of the nautical charting program. However, many among those increasing numbers of small-craft operators that cruise the waters of the Nation today are not well informed with regard to chart products and other navigational aids. The present effort to acquaint the public with the availability of charts and related products is minimal, and should be enhance for the protection of the lives and property of those making use of the marine environment.



Small-craft operators often expose their lives and property to danger because of a lack of knowledge regarding charts and related aids to navigation.

3. Improvements Requiring Research and Development

Future improvement of the nautical charting service depends heavily on increasing the total system efficiency through a vigorous program of supporting research and development.

a. Improved hydrographic survey techniques and equipment are needed in the following areas.

(1) Higher speed surveying methods and equipment

(2) Real time tidal zoning information in survey areas

(3) Radio position determination

(4) Calibration systems

(5) Maintenance and repair systems

(6) Quality assurance systems

b. Improved processing and chart production techniques and equipment are needed in the following areas.

(1) Automated system from sensor to product

(2) Enduring archive

(3) High speed plotter

(4) Quality assurance

4. Future Trends

Future developments and issues of priority may require changes in the charting program.

a. Metrication

The United States is considered the only major country in the world that is neither using the metric system of measurement nor has announced its intentions to adopt the system.

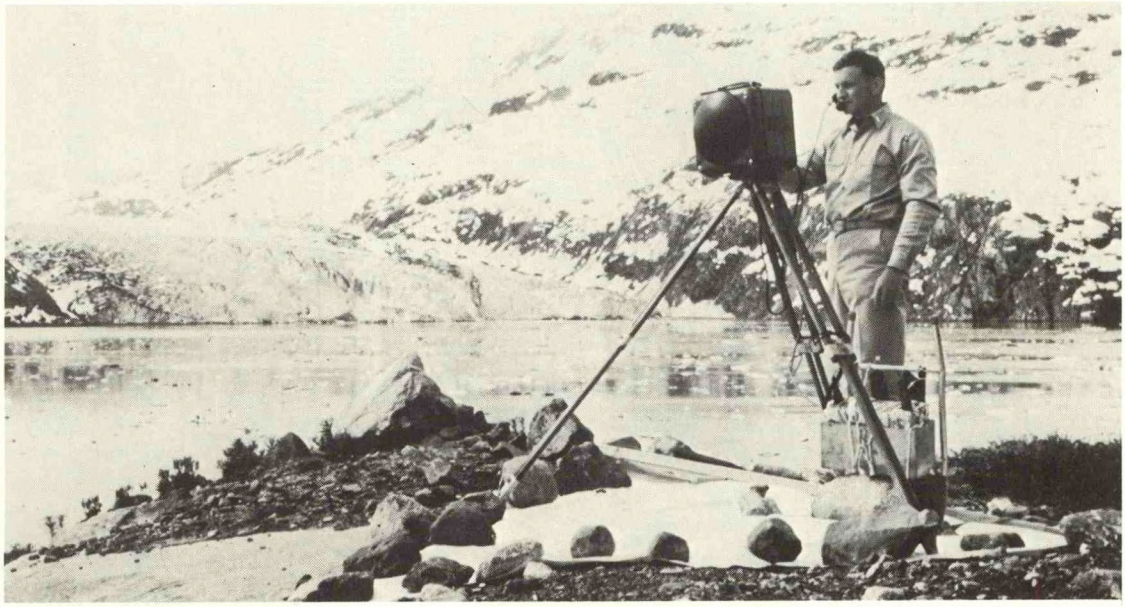
The increasing rise in metric usage in other countries prompted 1968 legislation authorizing the Department of Commerce to study the issue and determine the advantages and disadvantages of increased use of the metric system.

Except for the U.S., all major countries produce nautical charts with depth information in meters, and on January 1, 1970, the U.S. Naval Oceanographic Office adopted a policy to print all new charts, and all new editions of existing charts in meters. The NAVOCEANO charts cover areas outside the coastal regions of the U.S. The international series charts of the IHB will be constructed using the metric system.

The Department of Commerce study may reflect favorably toward metrication in the U.S. and conversion of the NOS coastal and inland charts may be required.

b. Environmental Quality

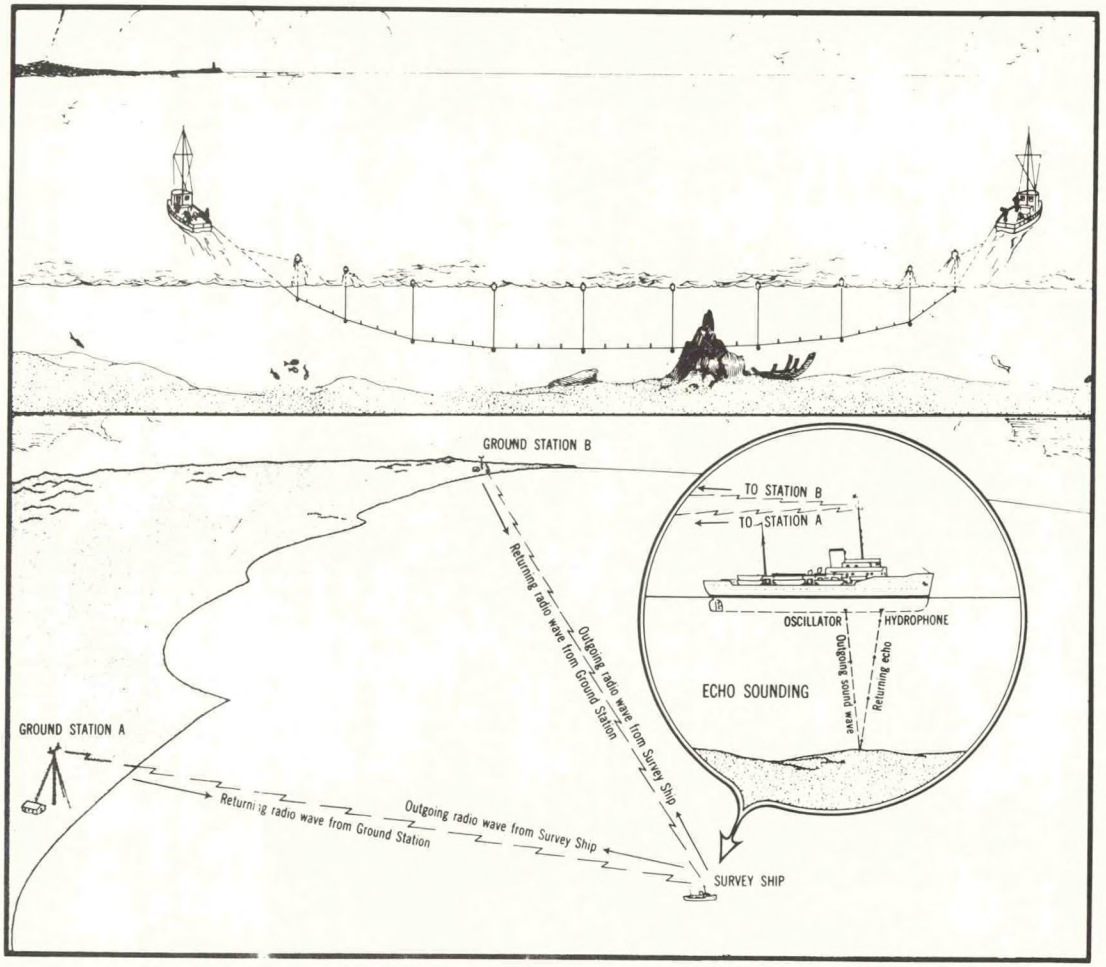
The preservation of environmental quality is an issue of paramount importance in the Nation today. As developments are made in national environmental programs, it is conceivable that a different type of descriptive product may be needed. The charting program must respond to this area of concern as the requirement develops. One such requirement being met is the charting of approved offshore dumping sites and spoil areas for disposal of dredgings.



The orderly development of nature's resources requires that they must be surveyed and mapped.

c. Economic Development

As the coastal and offshore areas of the U.S. are developed economically, there will be requirements for modern, more complete surveys and charts in those areas which may be little used today. The North Slope and other areas of Alaska are examples of future economic development and the surveying and charting service should respond commensurately with those requirements.



Gathering The Data For Nautical Charts

(Above) NOAA ships drag the waters of harbors and coasts for navigational hazards.
(Below) Electronic impulses from ship to ocean bottom measure depth of water, while radio waves from ship to shore pinpoint its location.

VI. PLANNED SERVICE IMPROVEMENT PROGRAM

NOAA plans a four-phase program over the next decade to meet the program objectives described in the previous chapters and to improve service to an expanding number of users. Goals have been established to fulfill those objectives within the next ten years, and the actions required to reach the goals are discussed in the following paragraphs.

A. Goals

1. Provide 114 additional small-craft charts covering important navigable rivers, waterways, and lakes of the U.S. by 1980.

Provide 77 new and 28 reconstructed conventional charts covering inadequately charted harbors and coastal areas of the U.S. by 1980.

Provide five new international series charts by 1980.

2. Decrease the time interval between updating and printing of charts from the present average of 2½ years to an average of one year by 1980.

3. Automate the existing manual data acquisition, processing, and compilation activities to expedite data handling by 1975.

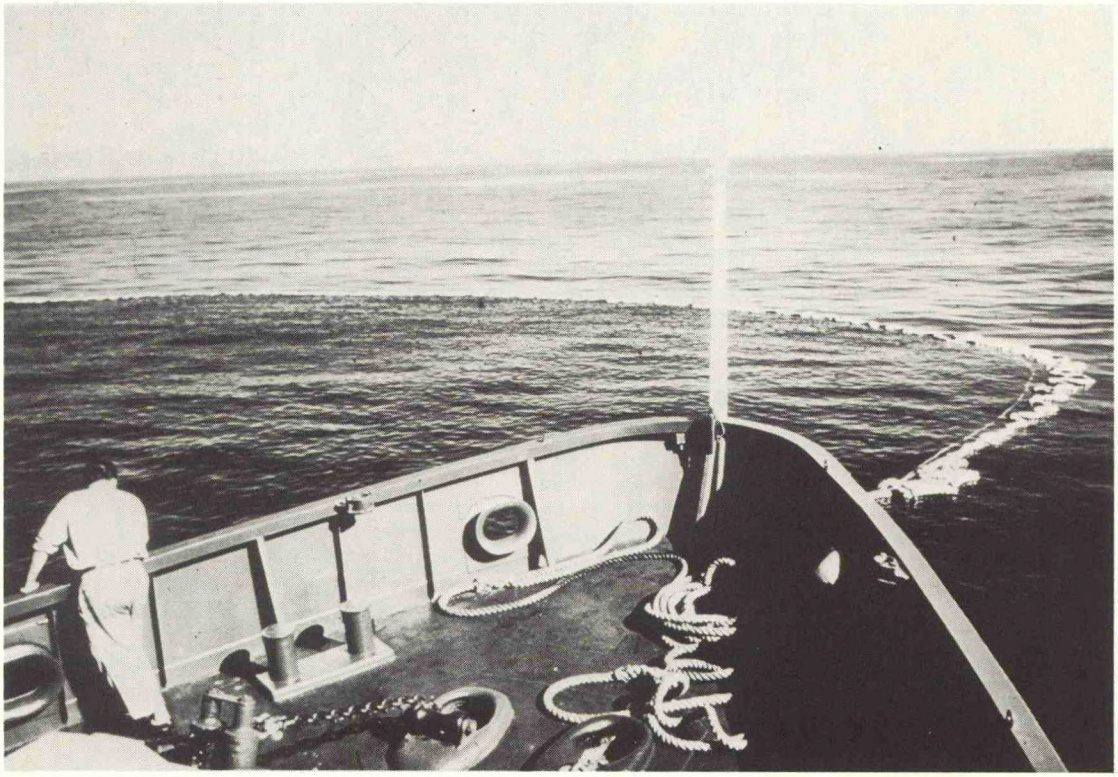
4. Accelerate nautical charting activities by 1980 to provide for resurvey and recharting of all U.S. waters on a 50-year maximum cycle with more frequent surveys as necessary in areas of rapid change.

5. Conduct a pilot project with the National Marine Fisheries Service and determine the advantages of producing a specially designed "fishing chart" by 1975.

6. Accelerate the continuous supporting programs in research and development, public education, and employee training to increase efficiency of operations, improve service to the public and accommodate future national requirements.

B. Implementation Plan

The additional products, and improved quality of charting services are planned over a four-phase improvement period. The actions planned within each phase are scheduled to provide balance to the data acquisition, processing, and chart production functions as well as meet projected requirements over the next decade.



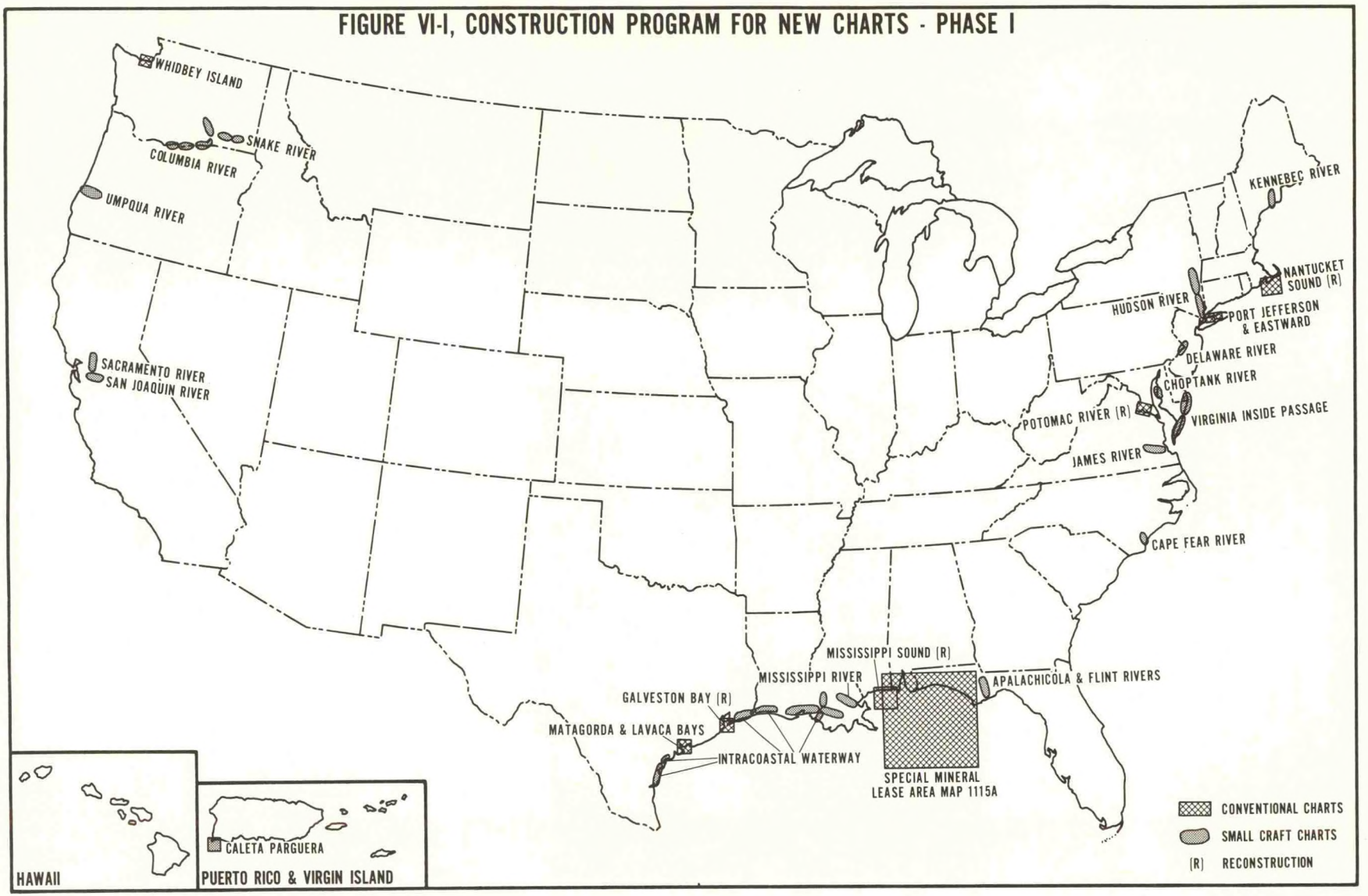
To increase the efficiency of the Nation's maritime industries, new and improved charting services and products are scheduled.

1. Extended Chart Coverage

New and reconstructed conventional and small-craft charts planned for construction during the four-phase improvement period are shown in Figures VI-1 --VI-4.

Figure VI-5 shows the five charts of the international series planned by NOAA in cooperation with the International Hydrographic Organization. Additional charts are to be published by the Naval Oceanographic Office and other member nations of the IHO.

FIGURE VI-I, CONSTRUCTION PROGRAM FOR NEW CHARTS - PHASE I



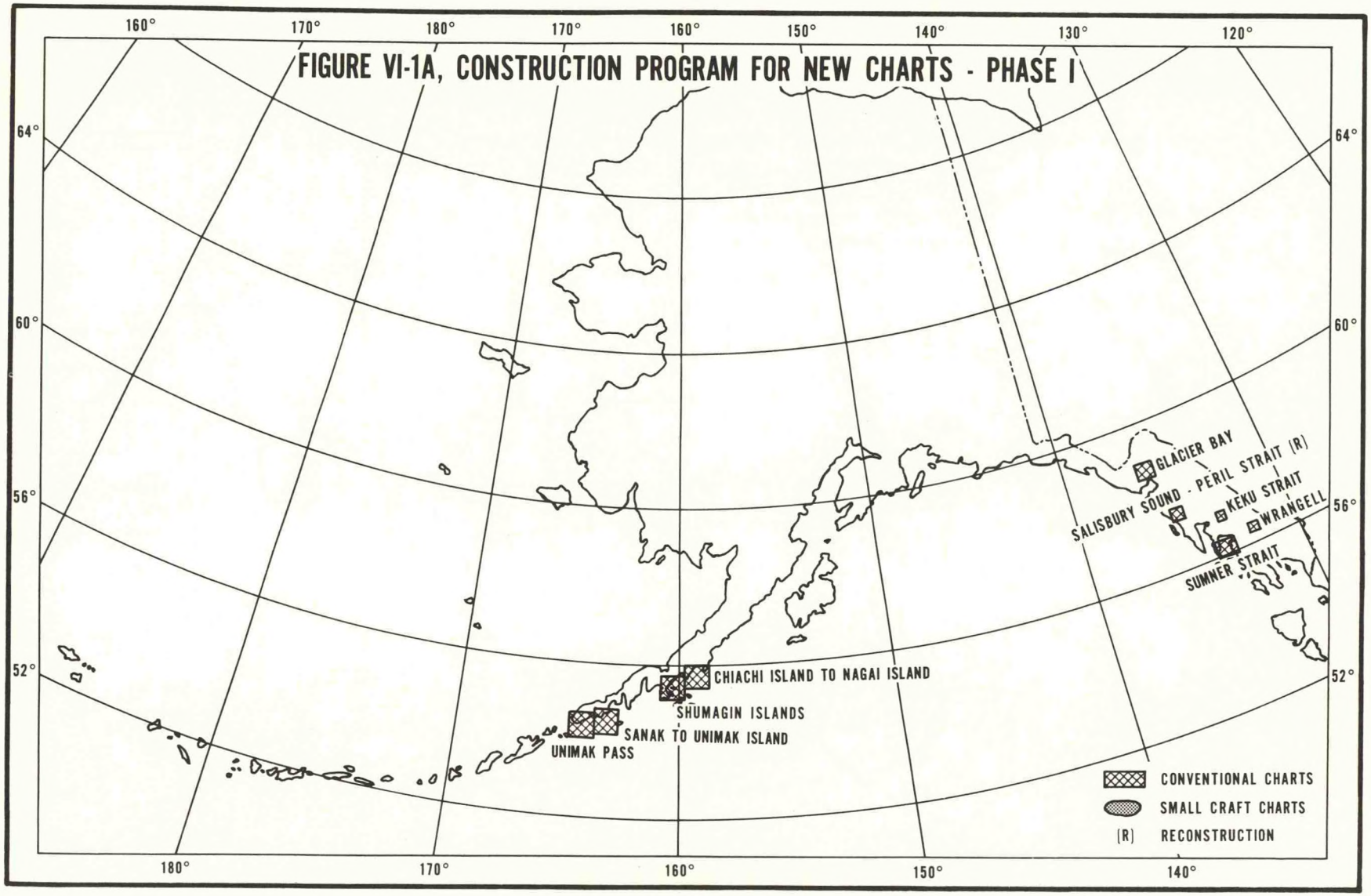


FIGURE VI-1A, CONSTRUCTION PROGRAM FOR NEW CHARTS - PHASE I
160°
170°
180°
170°
160°
150°
140°
130°
120°
64°
60°
56°
52°
GLACIER BAY
PERIL STRAIT (R)
SALISBURY SOUND
KEKU STRAIT
WRANGELL
SUMNER STRAIT
CHIACHI ISLAND TO NAGAI ISLAND
SHUMAGIN ISLANDS
SANAK TO UNIMAK ISLAND
UNIMAK PASS
CONVENTIONAL CHARTS
SMALL CRAFT CHARTS
(R) RECONSTRUCTION

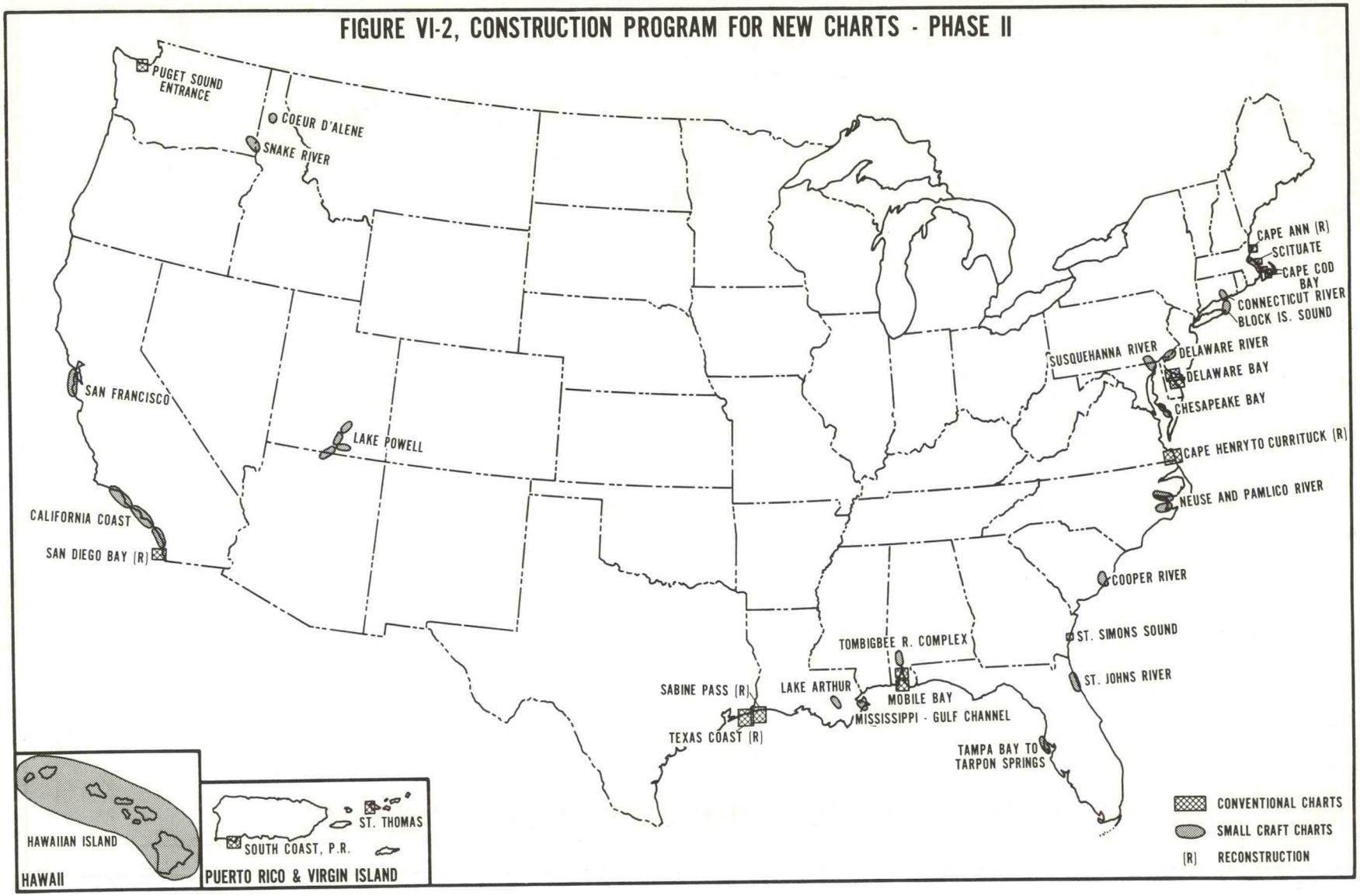


FIGURE VI-2, CONSTRUCTION PROGRAM FOR NEW CHARTS - PHASE II
PUGET SOUND ENTRANCE
COEUR D'ALENE
SNAKE RIVER
SAN FRANCISCO
LAKE POWELL
CALIFORNIA COAST
SAN DIEGO BAY (R)
CAPE ANN (R)
SCITUATE
CAPE COD BAY
CONNECTICUT RIVER
BLOCK IS. SOUND
SUSQUEHANNA RIVER
DELAWARE RIVER
DELAWARE BAY
CHESAPEAKE BAY
CAPE HENRY TO CURRITUCK (R)
NEUSE AND PAMLICO RIVER
COOPER RIVER
ST. SIMONS SOUND
ST. JOHNS RIVER
TOMBIGBEE R. COMPLEX
SABINE PASS (R)
LAKE ARTHUR
MOBILE BAY
MISSISSIPPI - GULF CHANNEL
TEXAS COAST (R)
TAMPA BAY TO TARPON SPRINGS
HAWAIIAN ISLAND
HAWAII
ST. THOMAS
SOUTH COAST, P.R.
PUERTO RICO & VIRGIN ISLAND
CONVENTIONAL CHARTS
SMALL CRAFT CHARTS
(R) RECONSTRUCTION

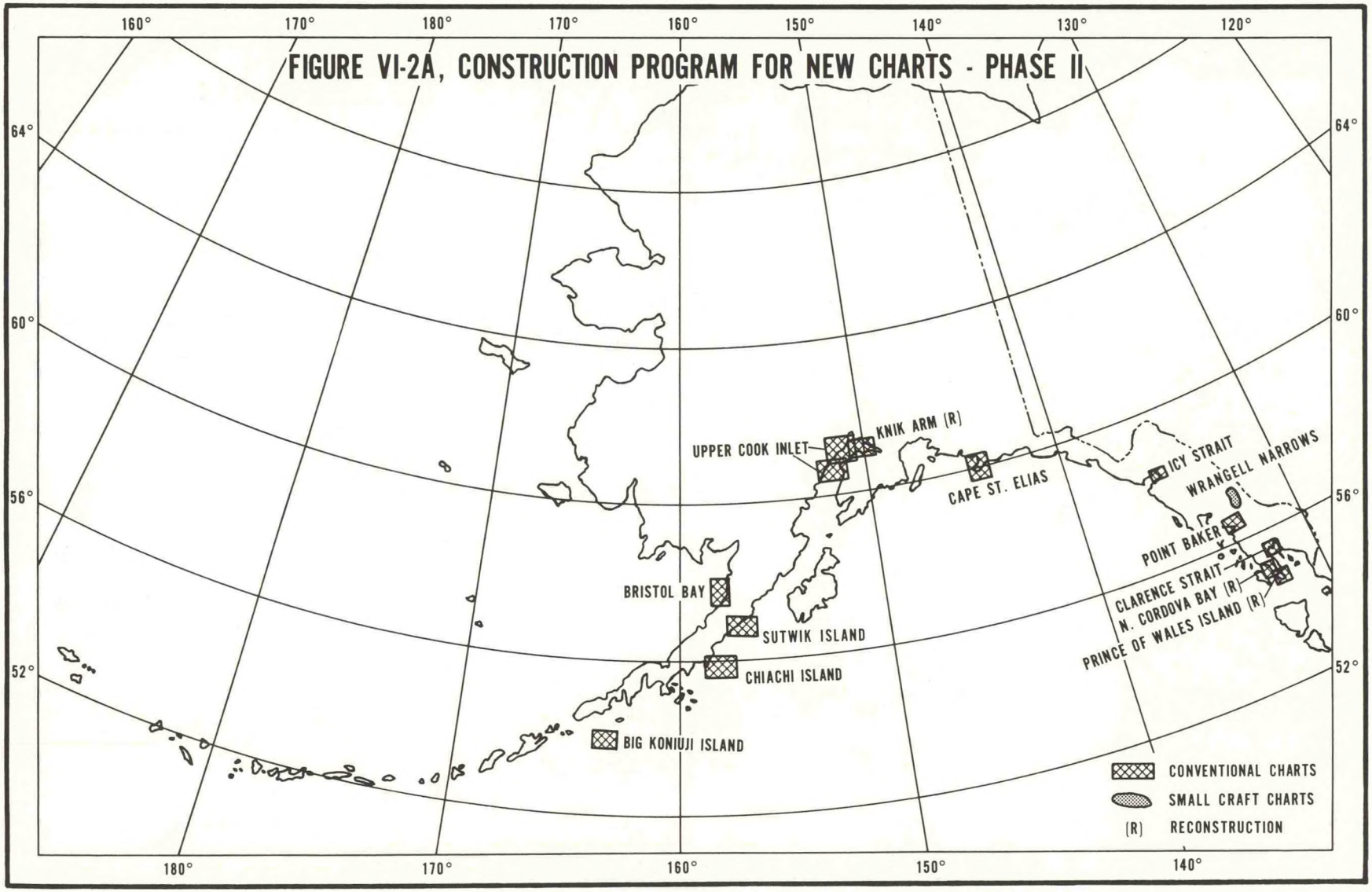


FIGURE VI-2A, CONSTRUCTION PROGRAM FOR NEW CHARTS - PHASE II
160°
170°
180°
170°
160°
150°
140°
130°
120°
64°
60°
56°
52°
UPPER COOK INLET
KNIK ARM (R)
CAPE ST. ELIAS
ICY STRAIT
WRANGELL NARROWS
POINT BAKER
CLARENCE STRAIT
N. CORDOVA BAY (R)
PRINCE OF WALES ISLAND (R)
BRISTOL BAY
SUTWIK ISLAND
CHIACHI ISLAND
BIG KONIUJI ISLAND
CONVENTIONAL CHARTS
SMALL CRAFT CHARTS
(R) RECONSTRUCTION

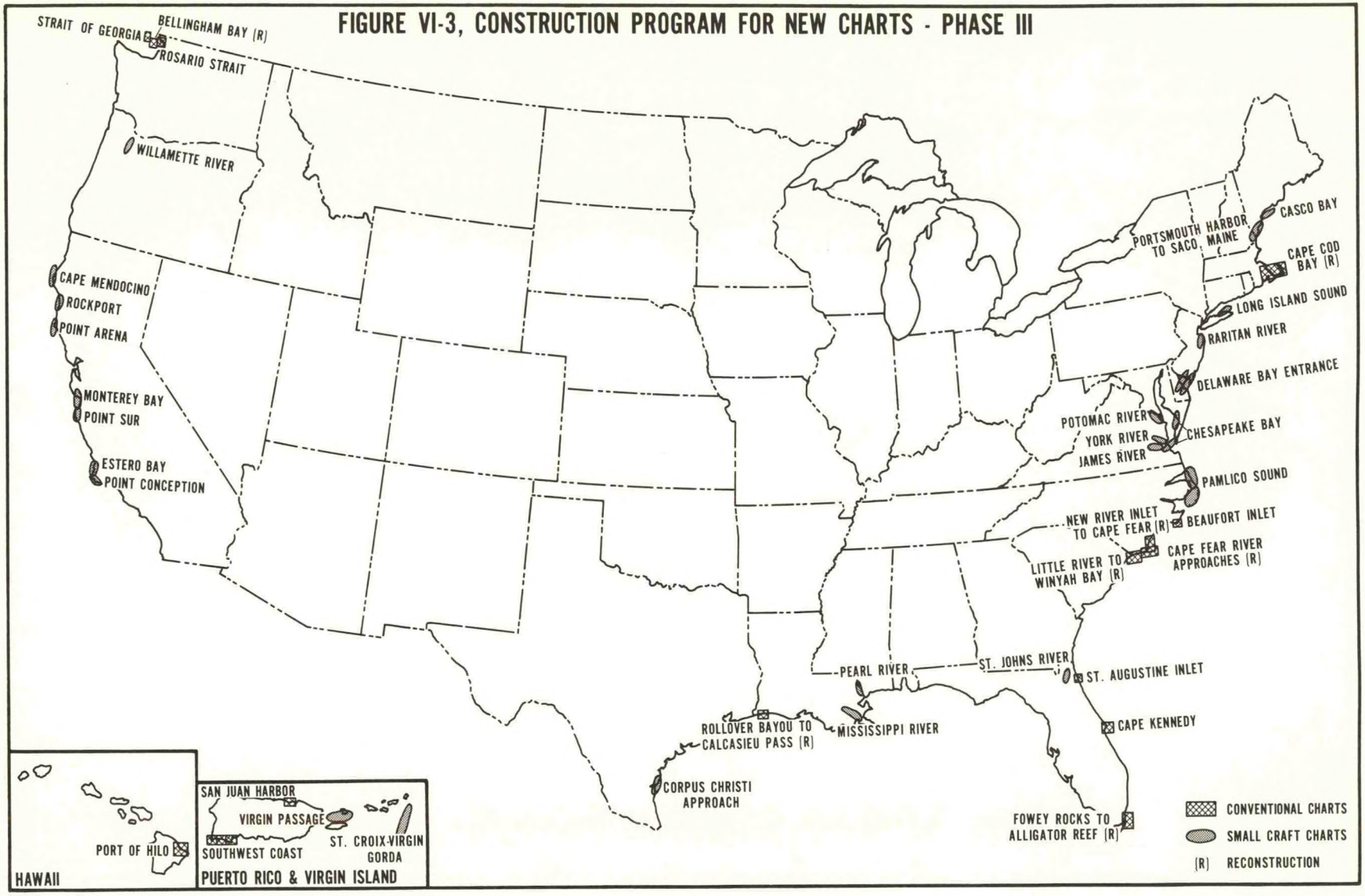
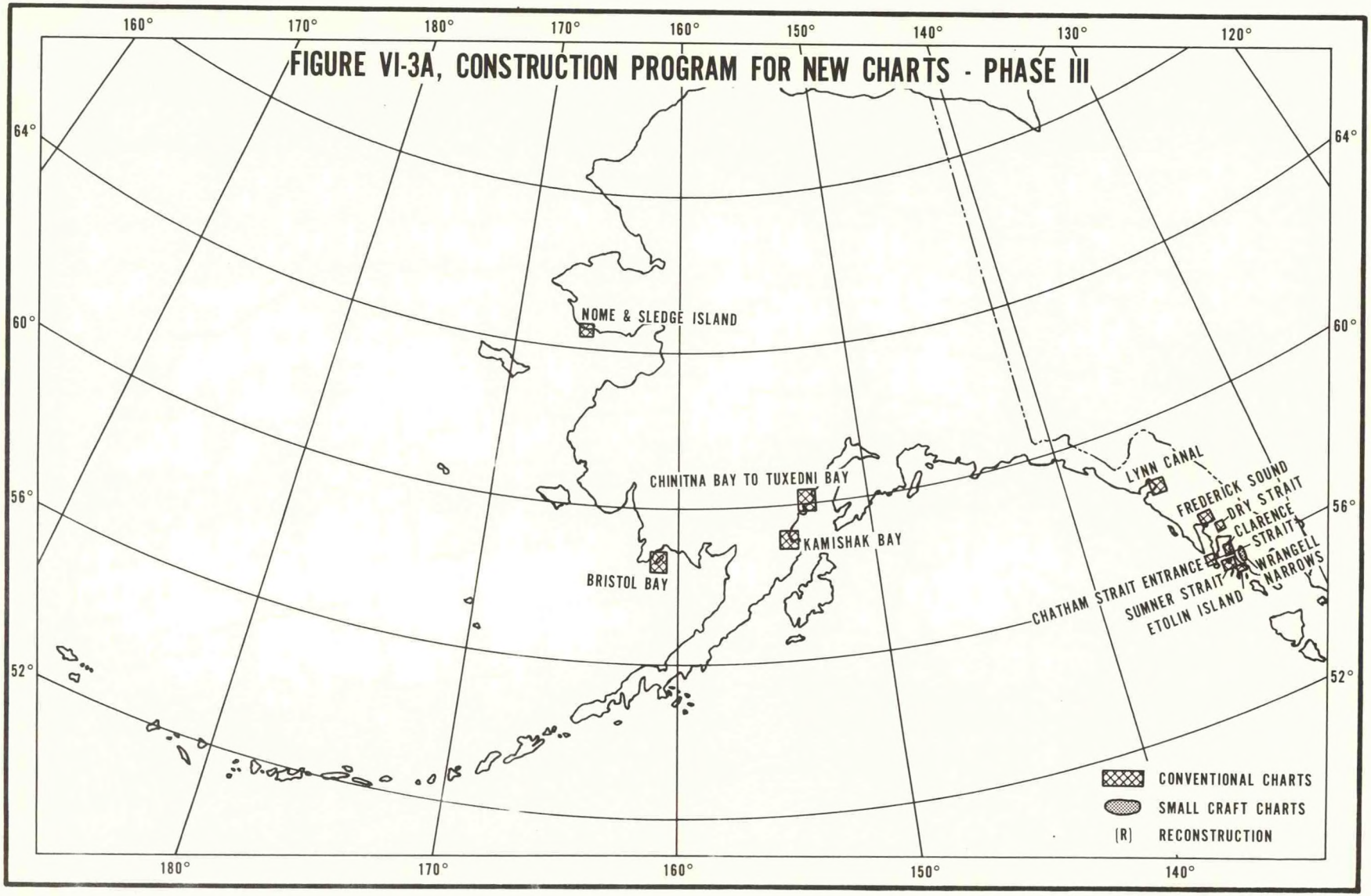


FIGURE VI-3, CONSTRUCTION PROGRAM FOR NEW CHARTS - PHASE III
STRAIT OF GEORGIA
BELLINGHAM BAY (R)
ROSARIO STRAIT
WILLAMETTE RIVER
CAPE MENDOCINO
ROCKPORT
POINT ARENA
MONTEREY BAY
POINT SUR
ESTERO BAY
POINT CONCEPTION
CASCO BAY
PORTSMOUTH HARBOR TO SACO, MAINE
CAPE COD BAY (R)
LONG ISLAND SOUND
RARITAN RIVER
DELAWARE BAY ENTRANCE
POTOMAC RIVER
YORK RIVER
JAMES RIVER
CHESAPEAKE BAY
PAMLICO SOUND
NEW RIVER INLET TO CAPE FEAR (R)
BEAUFORT INLET
CAPE FEAR RIVER APPROACHES (R)
LITTLE RIVER TO WINYAH BAY (R)
PEARL RIVER
ST. JOHNS RIVER
ST. AUGUSTINE INLET
CAPE KENNEDY
ROLLOVER BAYOU TO CALCASIEU PASS (R)
MISSISSIPPI RIVER
CORPUS CHRISTI APPROACH
FOWEY ROCKS TO ALLIGATOR REEF (R)
HAWAII
PORT OF HILO
PUERTO RICO & VIRGIN ISLAND
SAN JUAN HARBOR
VIRGIN PASSAGE
SOUTHWEST COAST
ST. CROIX-VIRGIN GORDA
CONVENTIONAL CHARTS
SMALL CRAFT CHARTS
(R) RECONSTRUCTION

FIGURE VI-3A, CONSTRUCTION PROGRAM FOR NEW CHARTS - PHASE III



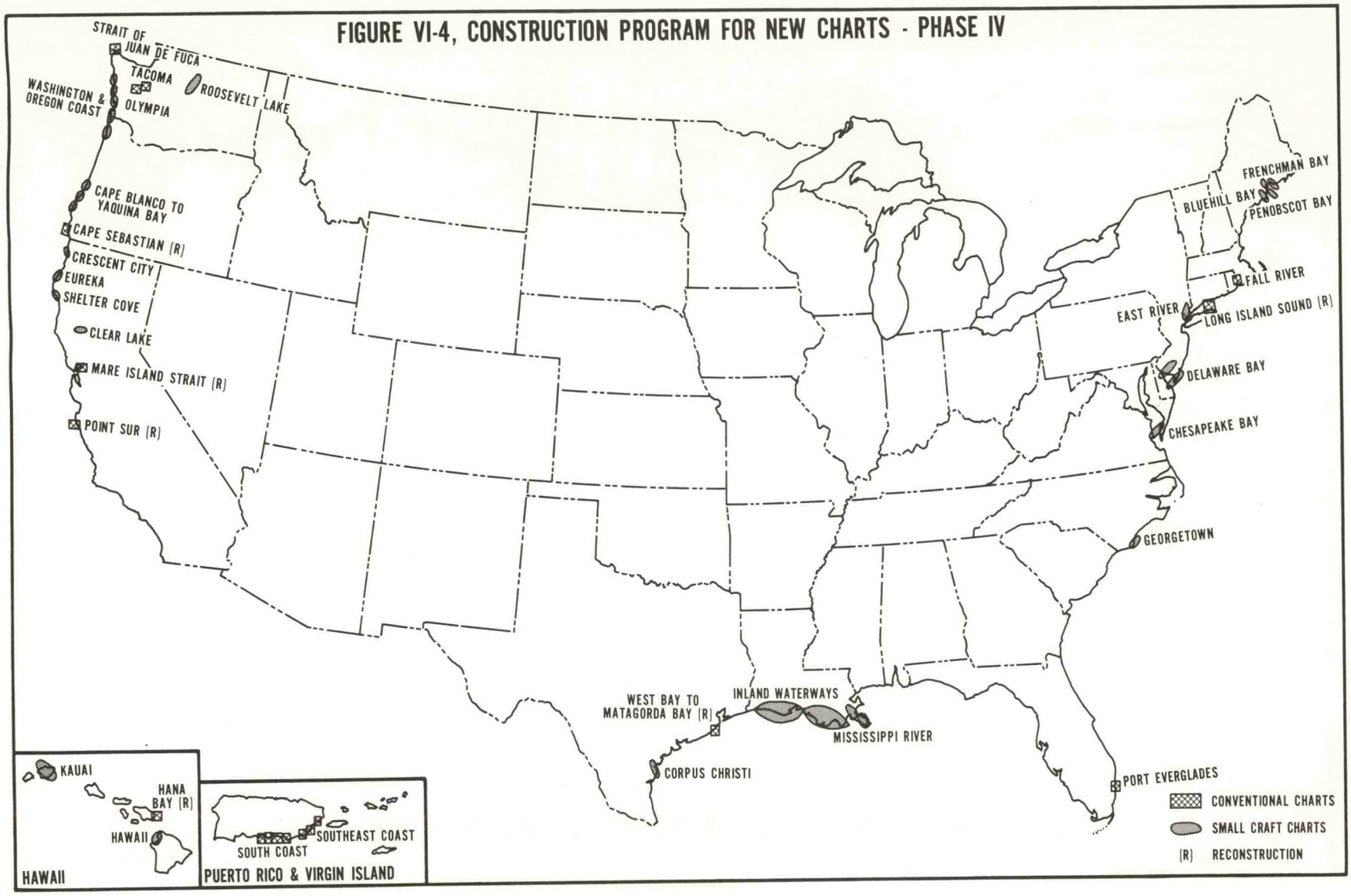


FIGURE VI-4, CONSTRUCTION PROGRAM FOR NEW CHARTS - PHASE IV
STRAIT OF JUAN DE FUCA
TACOMA
OLYMPIA
ROOSEVELT LAKE
WASHINGTON & OREGON COAST
CAPE BLANCO TO YAQUINA BAY
CAPE SEBASTIAN (R)
CRESCENT CITY
EUREKA
SHELTER COVE
CLEAR LAKE
MARE ISLAND STRAIT (R)
POINT SUR (R)
FRENCHMAN BAY
BLUEHILL BAY
PENOBSCOT BAY
FALL RIVER
EAST RIVER
LONG ISLAND SOUND (R)
DELAWARE BAY
CHESAPEAKE BAY
GEORGETOWN
WEST BAY TO MATAGORDA BAY (R)
INLAND WATERWAYS
MISSISSIPPI RIVER
CORPUS CHRISTI
PORT EVERGLADES
CONVENTIONAL CHARTS
SMALL CRAFT CHARTS
(R) RECONSTRUCTION
KAUAI
HANA BAY (R)
HAWAII
HAWAII
SOUTHEAST COAST
SOUTH COAST
PUERTO RICO & VIRGIN ISLAND

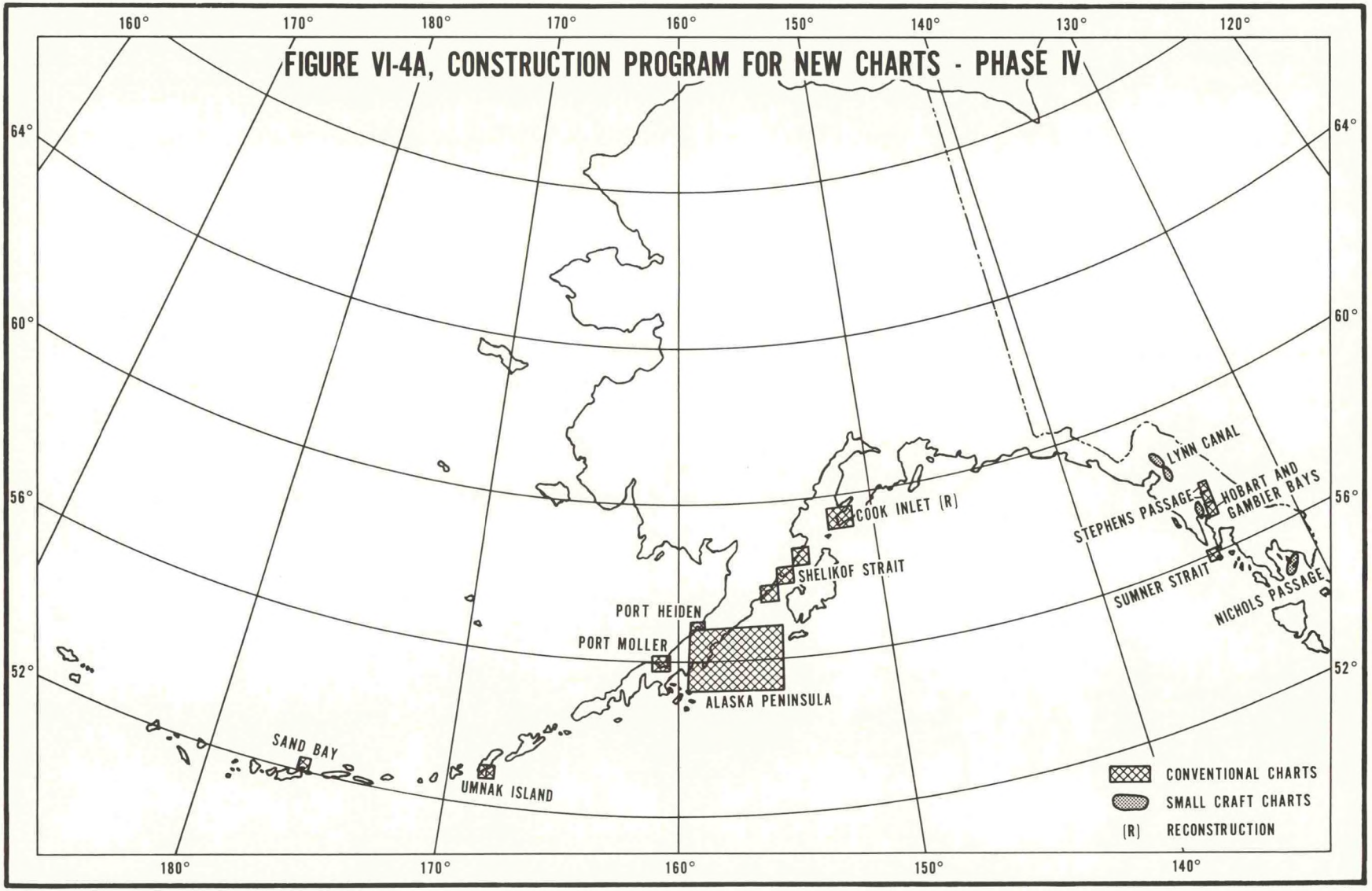
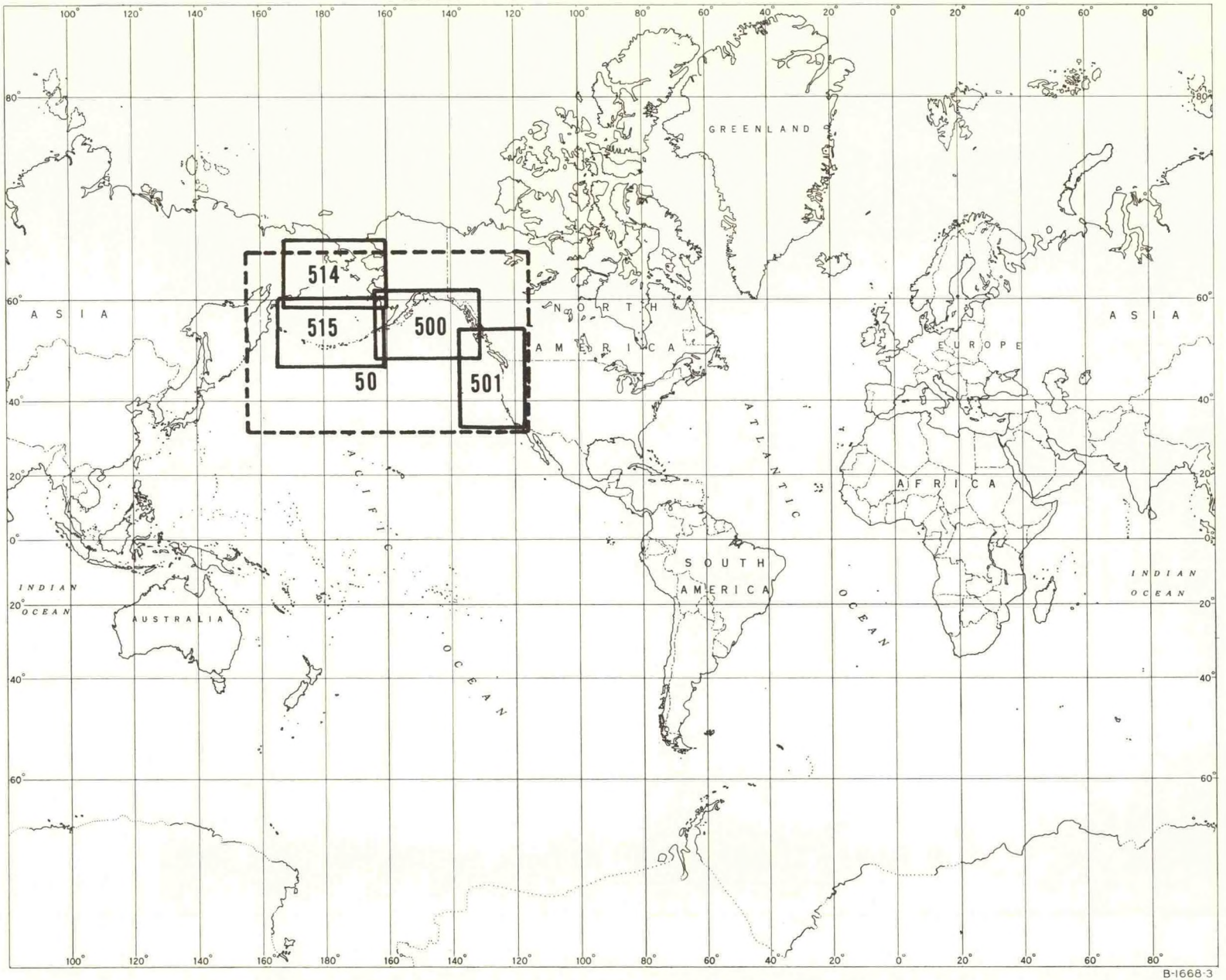


FIGURE VI-4A, CONSTRUCTION PROGRAM FOR NEW CHARTS - PHASE IV
160°
170°
180°
170°
160°
150°
140°
130°
120°
64°
60°
56°
52°
COOK INLET (R)
SHELIKOF STRAIT
PORT HEIDEN
PORT MOLLER
ALASKA PENINSULA
SAND BAY
UMNAK ISLAND
LYNN CANAL
STEPHENS PASSAGE
HOBART AND GAMBIER BAYS
SUMNER STRAIT
NICHOLS PASSAGE
CONVENTIONAL CHARTS
SMALL CRAFT CHARTS
(R) RECONSTRUCTION

FIGURE VI-5 - INTERNATIONAL CHARTS



2. Updating and Printing of Charts

Charts will be selected for more frequent updating and printing on the basis of the marine activity level in the area of the chart. Based on that information, Table VI-1 shows the phasing of new chart construction which will be required by 1980, and the increased printing needed to maintain the improved suite of charts on a one-year average printing interval.

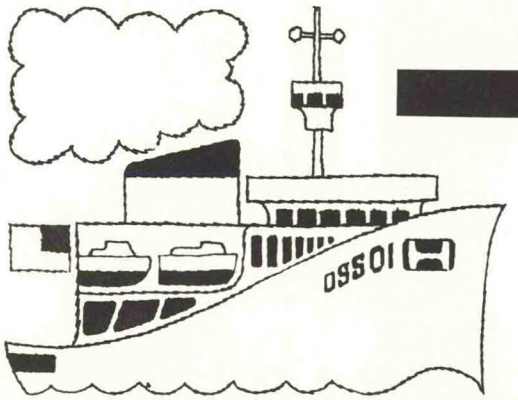
Combining a protective jacket, a special type fold, and useful piloting information, the small-craft chart is an invaluable aid to the recreational boatman.

Table VI-1 - Phasing of New Chart Construction and Increased Printing (1971 - 1980)

New Chart Construction	Present Level	Phase I	Phase II	Phase III	Phase IV
Conventional		13	21	21	22
Small Craft		27	27	28	32
International				2	3
Charts to Be Cancelled*					
Conventional		32	26	32	35
Small Craft		1			
Total Charts On Issue					
Conventional	739	720	715	704	691
Small Craft	73	99	126	154	186
International				2	5
Number of Chart Printings Per Year					
Conventional	382	470	520	580	691
Small Craft	73	99	126	154	186

* Cancellations of existing conventional charts will be made possible by construction of multipurpose small-craft charts and improved conventional chart layouts.

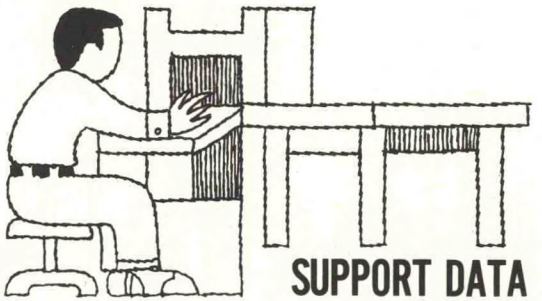
AUTOMATED HYDROGRAPHY



DEPTH RECORDING MECHANICAL
ENCODER VELOCIMETER
ELECTRONIC POSITIONING

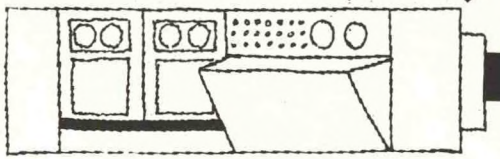
FIELD SURVEYS

DIGITAL ENCODER
(Prepares tape of Data
During Survey)

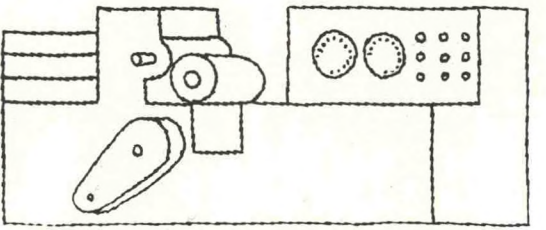


SUPPORT DATA

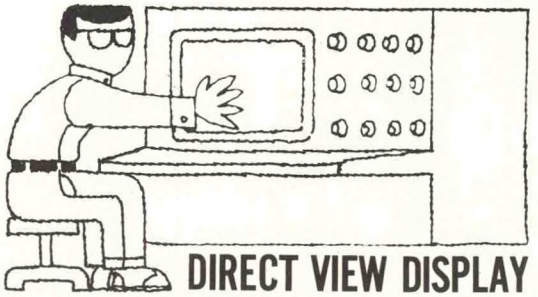
PROCESSING



COMPUTER CENTER

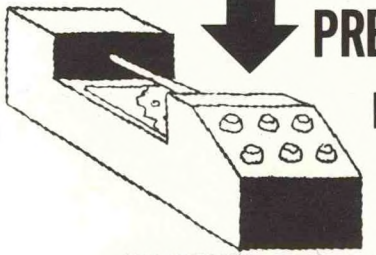


SUPER SPEED PAGE PRINTER



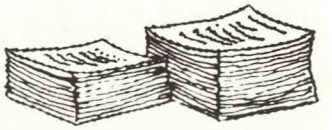
DIRECT VIEW DISPLAY

PRESENTATION



GRAPHIC DISPLAY

NAUTICAL
CHARTS



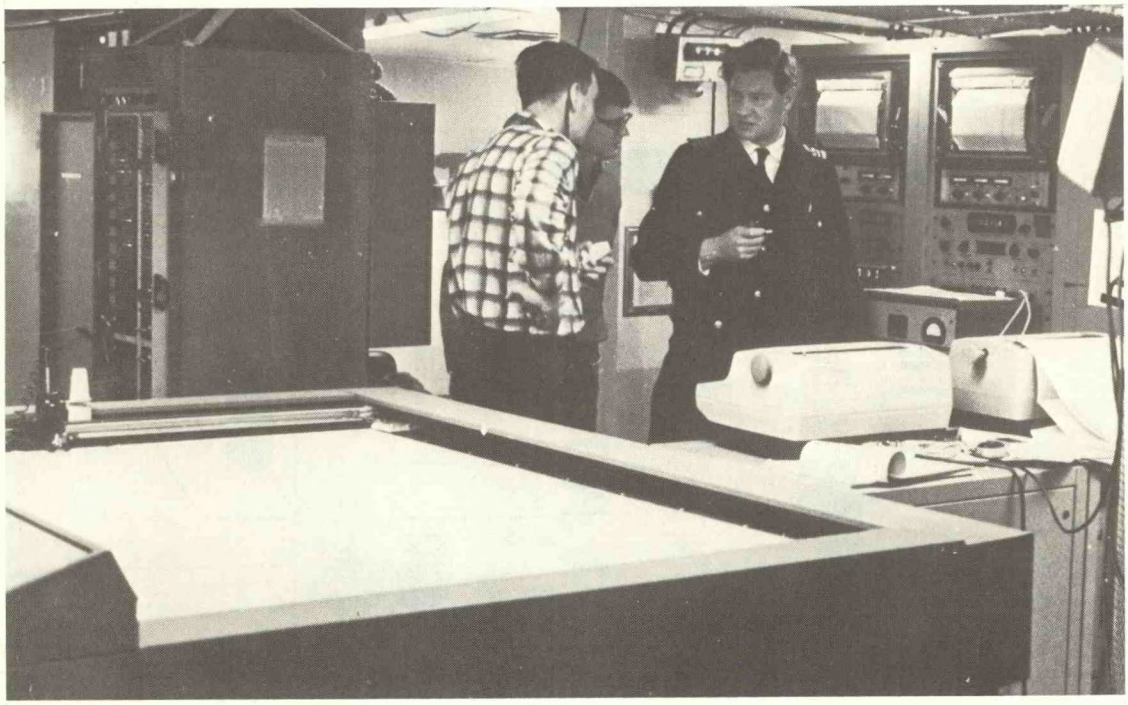
MARINE DATA
R&D REPORTS, BOTTOM CHANGES,
DANGER STUDIES

3. Automate Data Handling Activities

The actions required to provide a balanced flow of marine data from acquisition through processing to chart production involves expanded use of automation and improved management coordination.

The planning, research, development, testing, and evaluation for automating various subsystems have been underway since the mid-1950's. Recommendations of the resulting systems design plan[3] to automate marine charting activities are summarized in this chapter and the phasing of actions required are shown in Table VI-2.

a. Funds and manpower should be invested now to implement the automation of marine charting by 1975. Automation, using equipment which is currently



The use of computer/plotter equipment materially increases the effectiveness and efficiency of hydrographic survey parties.

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[3] Automated Marine Charting, A System Plan - June 1970

tested and available, will decrease future manpower requirements as well as the time required to collect, process, and publish marine charts.

b. All NOAA hydrographic vessels should be equipped with computer/plotter systems. Prototype systems have shown that such systems can speed the effective acquisition of marine survey data, reduce shipboard and marine center processing time and virtually eliminate human error.

c. The marine centers should be equipped with line-drawing computer/plotter systems to increase their production. The Atlantic Marine Center is now testing a new system which, if successful, should be installed also at the Pacific Marine Center. In addition to automatically produced survey sheets, the computer/plotter systems can be used to draw contours of the ocean bottom, highlighting unusual features, and thus speed verification.

d. The marine centers should increase the number of verifiers to remove current backlogs, to provide seasoned replacements to allow for retirement, and to expand the center capability during automation implementation to meet the increased data acquisition capacity.

e. A data base of positions and depth of all active prior survey points should be established to provide the foundation for automated charting. Non-digitized surveys and charts should be digitized for inclusion into the data base.

f. The hydrographic review staff should be increased and better equipped to meet the increased production rate of the remaining portions of the marine chart system.

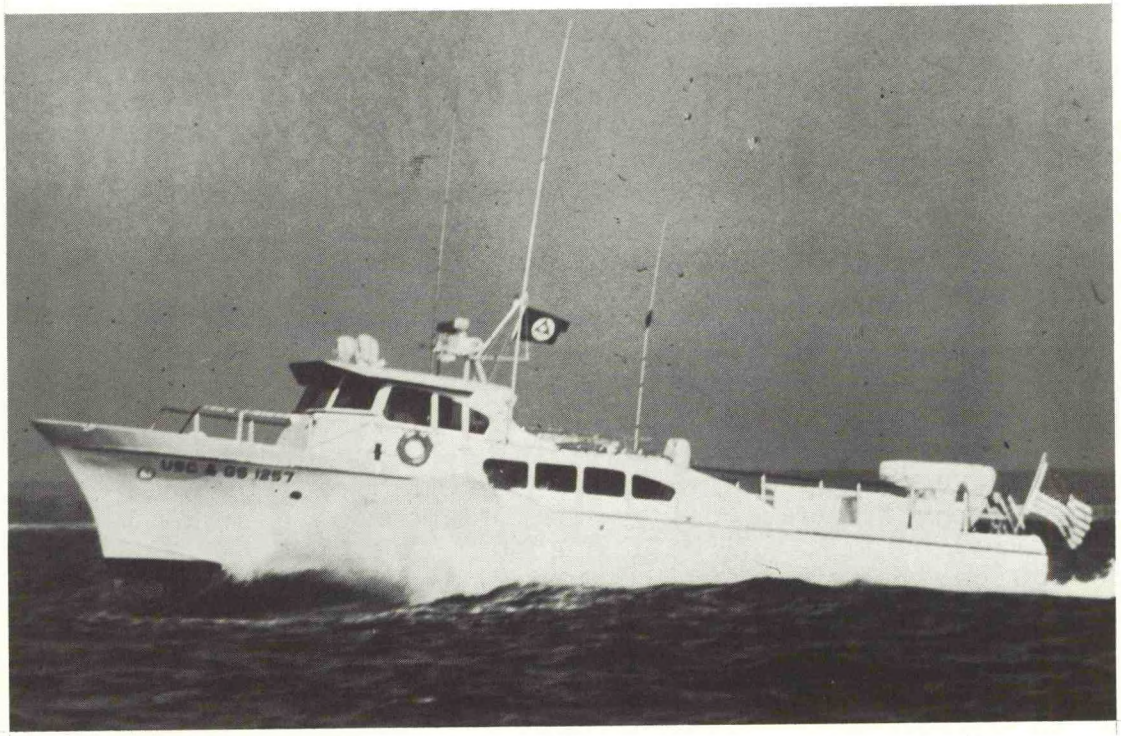
g. Marine chart negatives should be scribed with automated plotters from computer-produced input data. Automating this function will greatly speed chart negative production and, eventually, skilled negative engravers will be used chiefly for highly specialized control of automated charting functions.

h. A marine chart information system should be developed to provide management information

on the progress of data through the system. The information system would use the data base and production records to monitor system performance.

i. A Project Management Office should be established to complete the detailed system design and oversee the implementation to ensure proper performance and avoid imbalances.

j. Studies and subsequent improvements to related activities, such as photogrammetry, tide, and geodesy data systems, should be implemented to assure achieving a totally balanced marine charting system.



High speed survey launches using automated data acquisition systems will accelerate future hydrographic surveys.

Table VI-2 - Implementation of Marine Chart Automation
(1971 - 1977)

Action Required	Phase I	Phase II	Phase III
Implement data acquisition and processing subsystem.	Establish project management office to implement automation plans of marine charting program.		
	Procure and install computer/plotter equipment for three Class III ships and associated launches.		
	Implement computer assisted hydro survey verification and smooth sheet plotting system at AMC.		
	Implement new computer assisted hydrographic survey verification staffs at AMC and PMC.		

Table IV-2 - Implementation of Marine Chart Automation
(1971 - 1977)

Action Required	Phase I	Phase II	Phase III
	Staff and equip one automated hydrographic survey party.		
Implement evaluation storage and compilation subsystem.	Increase hydro survey review manpower to allow review function to keep current with marine inputs.		
	Begin to reorganize the compilation group.		
	Establish a full capability navigation chart information storage system for digital data.		
	Complete the acquisition of hardware required for automated marine charting system.		

Table VI-2 - Implementation of Marine Chart Automation
(1971 - 1977)

Action Required	Phase I	Phase II	Phase III
	Initiate contracts to digitize hydro surveys.	Complete verification and review of hydro survey backlog.	
		Complete the lithographic data files (digital) for all navigation charts.	
Implement automated graphics (replaces manual scribing)	Automate the base plate, navigation, topographic, and waterway plates for 4 geographic areas.	Develop and test automated label plates for chart production.	
		Install automated base, waterway, navigation, and topographic plates for charts in additional geographical areas.	Install automated base, waterway, navigation, and topographic plates for charts in remaining geographical areas.

Table VI-2 - Implementation of Marine Chart Automation
(1971 - 1977)

Action Required	Phase I	Phase II	Phase III
			Implement the automated drafting of "new generation" navigation charts using special projects compartmental group.*

* The term "new generation" used in Table VI-2, refers to navigation charts which may be modified by any one, or perhaps several, of the following changes in the near future:

1. Conversion to the metric system
2. Application of orthophoto planimetric and topographic detail (harbor and port series including inserts).
3. Changes in chart limits.
4. Modernization of a number of present charts including changes in symbology to achieve compatibility with present requirements, changes to the common datum and changes to the common chart projection.

4. Accelerate Nautical Charting Activities

The NOAA nautical charting program is responsible for over 2½ million square nautical miles of charted area. To meet the expanding requirements of the Nation and the 1969 recommendations of the Commission on Marine Sciences, Engineering, and Resources, approximately 20 percent of this area should be resurveyed on a 5-, 10-, or 25-year basis and the remaining 80 percent on a 50-year schedule.

About 10 percent of the total requirement for nautical charting bathymetry may be available from the geophysical mapping programs of NOAA covering the continental margins and deep ocean basins. However, requirements, priorities, and procedures for the two programs are sufficiently different that in large part, they must be carried out separately. The remaining inshore coastal waters will require a survey capability equivalent to 16 medium sized survey vessels, which is substantially in excess of the present hydrographic surveying fleet. The vessel utilization required to fulfill this 50-year resurvey schedule would be approximately as follows.[4]

Type of Area to Be Surveyed	Ships Required
1. Subject to extremely rapid natural change, requiring surveys on an average of every 5 years	1
2. Subject to fairly rapid natural and/or manmade change, requiring surveys on an average of once every 10 years	5
3. Subject to more gradual natural and/or manmade change requiring surveys on an average of once every 25 years	2
4. Relatively stable, requiring just one survey during the 50-year period	8
TOTAL	16

[4]Analytical Study of Utilization of ESSA Fleet, Sept. 20, 1968; Nautical Charting Program of the Coast and Geodetic Survey, April, 1969.

As new vessels and field parties are acquired, an expansion of ship bases and data processing facilities will be needed. Additional base support will be required to serve new Gulf of Mexico and Pacific based hydrographic units. The additional hydrographic surveying activities will include a corresponding increase in geodetic and photogrammetric field and office survey operations which are required to furnish control data, hydrographic and topographic information for inclusion on charts.

To accelerate nautical charting activities sufficiently to meet the goal as recommended by the Commission on Marine Sciences, the following actions are required:

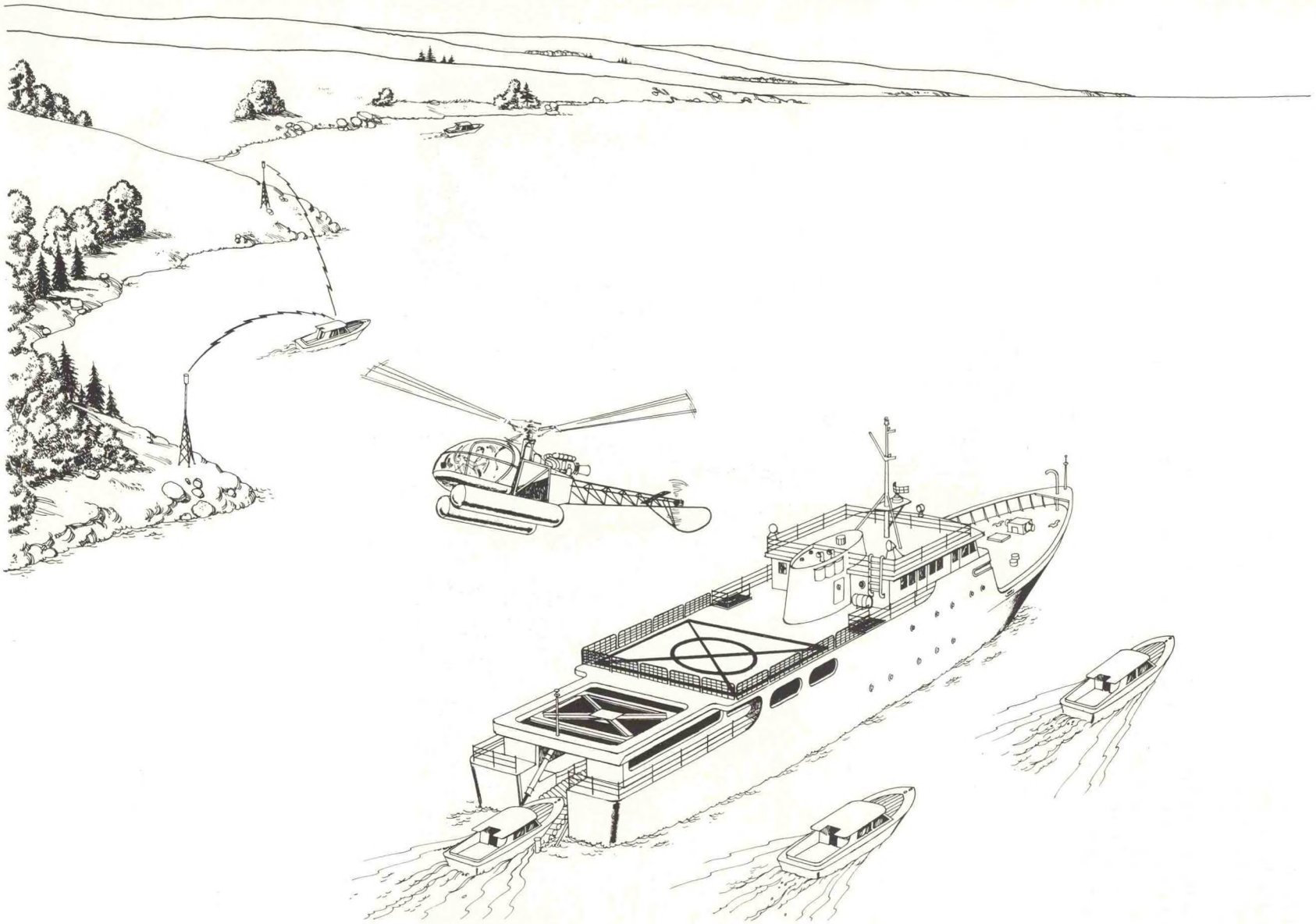
a. Provide for optimum utilization of survey vessels through use of helicopter support, crew augmentation, and expanded vessel support from the marine centers.

(1) The addition of a helicopter to assist with beach operations should increase the survey output of a vessel at least 10 percent. Helicopter support to five hydrographic vessels is planned over the next eight years.

(2) Crew augmentation to allow the fleet to operate up to 10½ months rather than the present nine-month season would increase production and circumvent the need for implementing more vessels than this plan calls for. This should be implemented during phase I.

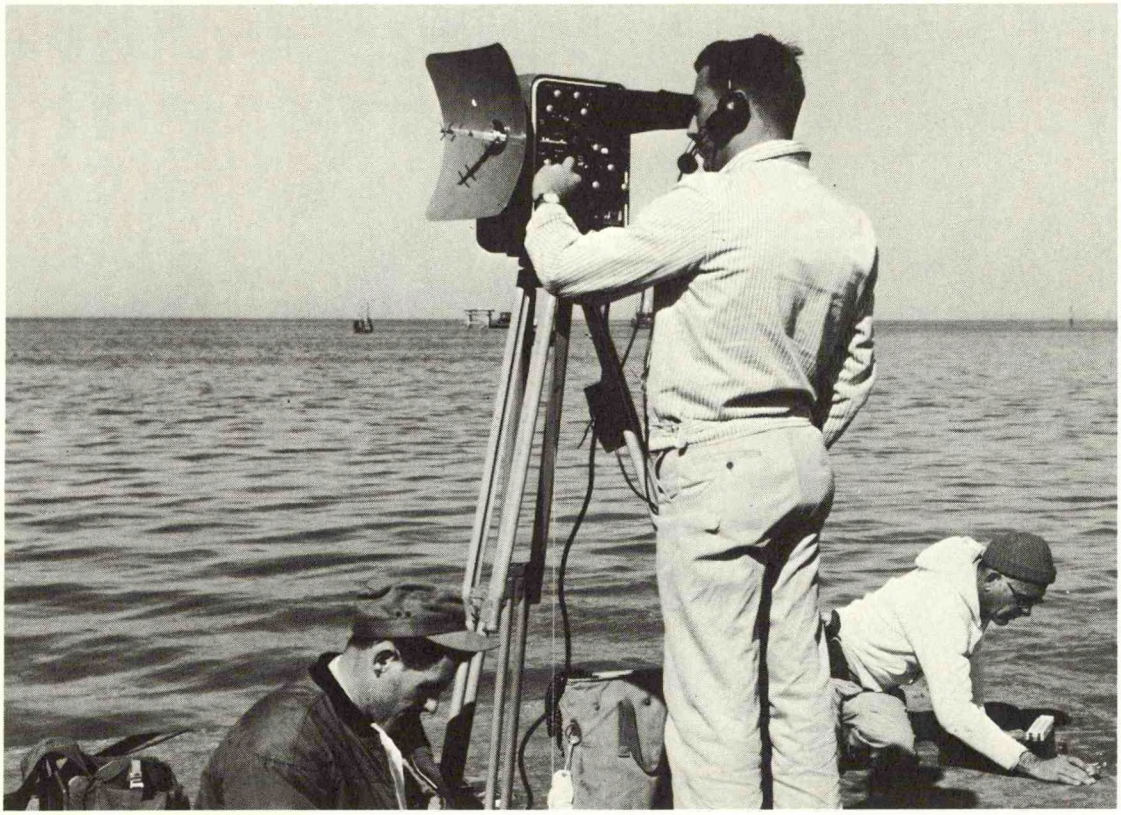
(3) A combined operations support party is required in each marine center to provide the vessels with installation and maintenance support of tide gages, electronic control shore stations, visual control signal location, and other shore-based functions which, at the present time, must be performed by the vessel and, thereby limits the vessel's productivity in terms of hydrographic survey operations.

b. Develop a series of more effective and economical hydrographic survey vessels and shore-based field parties, designed for the accomplishment of near-shore surveys. The improved survey vessels will consist of economical stock hulls, comparatively smaller, special



Modern survey units using automated data acquisition techniques, high speed launches, and helicopter support, will increase the efficiency of inshore surveys.

purpose design, and efficient units with higher speed launches utilizing digital data logging, processing, and electronically controlled position fixing equipment. At least five new vessels and four new hydrographic field parties (HFP) will be required over the next eight years. One of the vessels will replace the PATHFINDER, due for replacement about 1974 because of age. An additional two vessels will be required if the crew augmentation improvement action is not implemented.



A combined operations support party at each marine center will increase the efficiency and productivity of hydrographic survey ships.

c. Establish ship and field party operating base in Gulf of Mexico and expand Atlantic and Pacific Marine Centers to accommodate expanded activities.

d. Expand and equip new photographic laboratory and acquire an additional photo mapping aircraft to provide for increased hydrographic survey rate.

Type of NOAA aircraft used in accomplishing aerial photography.

e. Complete the automation of data acquisition, processing, and compilation activities by 1975, as described in Chapter VI-B-3.

The foregoing program operational requirements are planned for accomplishment during the three-phase improvement period as shown in Table VI-3.

To meet the horizontal control requirements of this program, expansion of the National Horizontal Control Network will be necessary in many areas of Alaska and the east and west coasts of the conterminous U.S.

An additional 25-man geodetic party will be required over the next eight to ten years to densify coastal area, geodetic stations.

Table VI-3 - Requirements for Accelerated Nautical Charting Activity (1971 - 1978)

Action Required	Phase I	Phase II	Phase III
Develop and acquire new improved series of survey vessels and hydrographic field parties (HFP)*	Implement 1 Class III (AMC) 2 Class IV (PMC) 1 HFP (AMC)	Implement 1 Class III (PMC) 1 Class IV (PMC) 2 HFP (AMC & PMC)	Implement 1 HFP (AMC)
Optimize survey vessel utilization	Augment existing vessel crews by 22% to obtain maximum productive days at sea		
	Helicopter support to 2 vessels (PMC)	Helicopter support to 2 vessels (AMC & PMC)	Helicopter support to 1 vessel
Ship bases and processing support	Expand AMC & PMC ship base & processing support	Expand PMC ship base and processing support	Implement Gulf of Mexico base and data processing
Photogrammetric and geodetic support	Implement photo field party (AMC and PMC) and headquarters support	Implement photo field party (AMC and PMC) and headquarters support	

*New efficient series of survey units include automated data acquisition systems and computer/plotter equipment.

Table VI-3 - Requirements for Accelerated Nautical Charting Activity (1971 - 1978)

Action Required	Phase I	Phase II	Phase III
	Implement 1 geodetic party in support to nautical charting program		
	Implement 2 new combined operations support parties (AMC and PMC)		
	Expand and operate new photographic laboratory		
		Implement 1 new photographic mapping aircraft	

5. Fishing Chart

In order to provide specialized charted information required by the fishing industry to improve bottom fishing operations, a pilot project will be conducted to determine chart design and areas requiring such charts.

An important bottom fishing area will be selected after consultation with the National Marine Fisheries Service (NMFS) and a chart of that area will be produced containing closer spaced depth information, bottom consistency, loran lines of positions, known obstructions, etc.

In concert with the NMFS, the chart will be field evaluated, and determination made as to the value of expanding the program into other fishing areas.

6. Supporting Programs

a. Public Education Program

In order to provide maximum effective marine charting services, an intensive and continuing program of public education must be carried out. The program will have two major objectives:

- To promote the use of navigation charting products and services to insure safety in all marine activities, including recreational boating.

- To encourage the use of marine charts and related products in the planning for, and carrying out of, marine operations.

The general public will be provided with informational material emphasizing such matters as the potential dangers of certain navigable areas and the protective advantages to be gained by procuring up-to-date charts, tide tables, and current products in areas of interest. The public will also be encouraged to volunteer constructive comments and suggestions which may disclose new user requirements and lead to further service improvements.

A special effort will be made to emphasize the inherent advantages of graphic depictions, and to invite the

suggestions of specific users as to new or improved graphic products for which a potential need exists.

The educational methods by which the program will be carried out include films, slide series, radio and TV program material, educational packets for public use, displays to be posted in marinas and other marine centers, and press and periodical stories. These methods will be applied as outlined below.

(1) Newspapers

A series of stories with photos and diagrams will be released covering currently available marine products and service improvements, as they are implemented.

(2) TV Stations

Specially prepared script and slide programs will be offered to both educational and commercial stations. Films will be offered when available.

(3) Radio Stations

Scripts and taped programs as well as one-minute announcements will be prepared for use by educational and commercial stations. Interviews with marine program personnel will be actively encouraged.

(4) Speeches

Personnel will be provided with special speech and slide outlines for talks before civic groups, boating safety organizations, and school groups. Films will be provided when available. All will stress safety.

(5) Publications

Special stories will be offered to periodicals suitable for their use. Educational packets will be prepared for public distribution.

(6) Displays

Posters emphasizing the value of marine charting services will be distributed to marinas, and other points at which users congregate.

NOAA places charts and associated publications on display in boat shows across the Nation to acquaint the public with Government-available products and services, stressing boating safety.

(7) Exhibits

Appropriate educational and safety displays will be exhibited at boat shows.

(8) Conferences

In addition to the dissemination of educational material, advantage should be taken of every opportunity to meet with marine operating personnel to identify critical local area conditions affecting operational decisions, to discuss methods for improving the applicability of marine products to these decisions, and to obtain a better understanding of the users' problems.

A concentrated program of this scope and magnitude will provide adequate familiarity with marine charting services and promote user understanding and participation.

b. Training Program

Technical and professional training of personnel is an essential part of developing and maintaining effective as well as efficient hydrographic surveying and charting services. Most of the training required in this program involves educating the employee in the use of specialized equipment and the techniques of hydrographic surveying and chart production. In addition, a small amount of full and part-time professional training is sponsored to maintain a strong management and professional position.

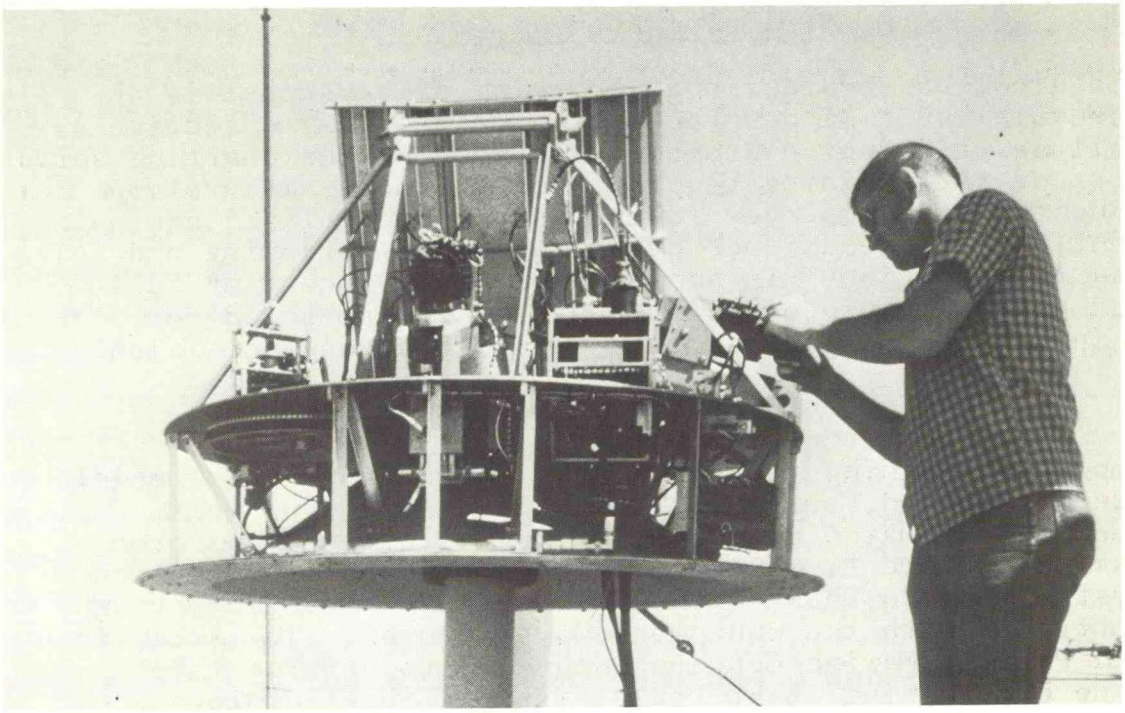
(1) Specialized Equipment

Employee training is required in a wide range of specialized shipboard, surveying, and processing equipment, such as automated data acquisition, plotting, and processing equipment, electronic positioning and navigation systems, etc. This training is usually arranged through contracts with the equipment manufacturer. The Atlantic and Pacific Marine Centers each need to provide this type of training to at least six additional employees per year for a four-to six-week course.

In addition, the automation of the marine charting system will increase the annual contracted ADP training requirement for headquarters personnel by one man year per year.

(2) Specialized Survey and Processing Techniques

The Atlantic and Pacific Marine Centers conduct training in the surveying principles and techniques used during hydrographic and geophysical surveys. Because of high employee turnover and rotation in sea-going positions, it has become necessary to enhance this type training in order to maintain the high surveying standards required for charting. In addition, the automation of data acquisition equipment has brought about changes in hydrographic surveying techniques which require new methodology. Each marine center will provide a three-to six-week course to approximately 30 or 40 employees per year in surveying and automated data handling techniques. The training of headquarters employees in automation techniques will be handled by on-the-job training supplemented with in-house classroom studies.



Because of the highly complex and sophisticated materiel used in accomplishing present-day hydrography, technical training of personnel is a requisite in the proper operation and maintenance of such specialized equipment.

(3) Full and Part-Time Professional Training

The program takes advantage of management and executive type training sponsored by Federal agencies from both Government and private facilities. The present level of activity is considered adequate. In addition, the full time, marine sciences, graduate studies sponsored by the program are also considered adequate for the immediate future.

c. Research and Development Program

The following hydrographic and cartographic systems require further development in order to achieve maximum effectiveness with state-of-the-art and advancing charting technology. The phasing of the development program is shown in Table VI-4.

Table VI-4 - Research and Development Program
(1971 - 1978)

Development Program	Phase I	Phase II	Phase III
Laser Depth Sounder	Research and analysis of laser beam to quantify and understand the physics of interaction between water and ocean bottom with beam penetration.	Select technique develop laser system, fabricate and laboratory test system.	Field test on high speed platform and determine operational system.
Telemetering Tide Gage	Design, develop, fabricate and field test telemetering shore based tide gage.	Improve and determine operational design of system.	
	Design, develop, fabricate tide gage suitable for experimenting and determining relative phase and amplitude of open sea tides.	Conduct field experiments and modify for use with actual operations.	
Radio Position Fixing Procedures	Through analysis and experimentation determine the accuracy of radio-fix positional systems. Establish operational procedures to assure operational		

Table VI-4 - Research and Development Program
(1971 - 1978)

Development Program	Phase I	Phase II	Phase III
	accuracies within a given set of standards. Through use of ancillary equipment, increase the accuracy of existing radio-fix position systems.		
Clear Channel Sounding System	Definition of equipment system characistics required for obstacle detection, location, and identification. Evaluation of alternative techniques for achieving these characteristics, identification of the advanced technology that can be used, as well as the additional applied research required, will be identified in detail. Sensors and processing and display techniques will also be considered in detail.	Conduct laboratory development work in accordance with phase 1 as it is applied to the detection, location, and identification (classification) of underwater obstacles. Perform such feasibility testing as is required.	Integrate subsystems and perform such feasibility field testing as is required to demonstrate capability of feasibility equipment. Write final report.

Table VI-4 - Research and Development Program
(1971 - 1978)

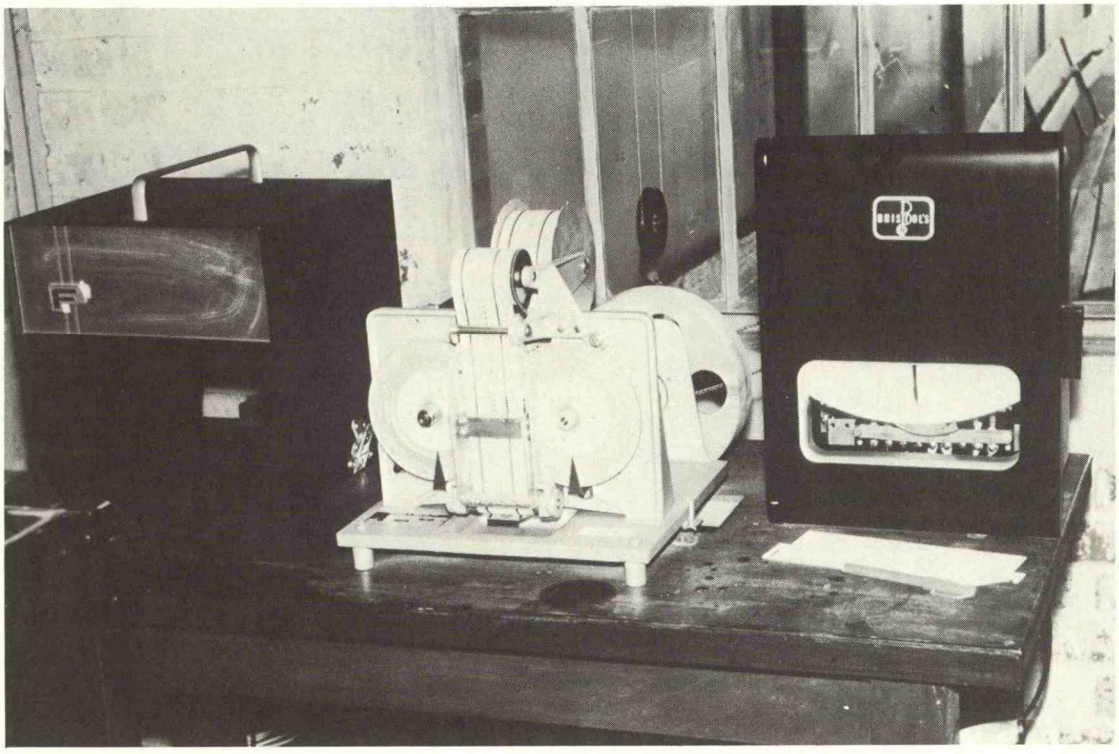
Development Program	Phase I	Phase II	Phase III
Ongoing Technology Development	Design and develop a ship and launch heave error corrector capable of providing a smoothing accuracy of less than one-half foot. Conduct field experiments for verification and integrate into the central processing unit aboard ship.	An expendable velocimeter will be designed, developed, and tested. The velocimeter will provide velocity correction information directly into the central processing unit aboard ship. Through analysis and experimentation signatures of bottom returns will be evaluated as a function of acoustic frequency and transducer angle as a means for determining the type of bottom without actually obtaining physical samples for analysis.	Synthetic aperture beam shaping techniques will be investigated to achieve beam forming and beam scanning. Narrow beam techniques using small physical radiating transducer apertures will be evaluated and coupled with processing techniques as a means of obtaining adequate signal-to-noise for digitizing the output.

(1) Laser Depth Sounder

For use in near-shore area in depths up to 50 feet or more, and used with a high-speed surface effect vessel or helicopter, the speed of surveying the difficult near-shore area may be increased by several orders of magnitude.

(2) Telemetering Tide Gages

To provide accurate and timely tidal datum plane information in the area being surveyed, during the time of the survey. For near-shore operations a shore-based tide gage will be mechanized to telemeter the tidal information in proper format to the central processing unit aboard the survey vessel.



The telemetering of tidal data on a real-time basis, combined with automated data acquisition methods, will permit hydrographic units to achieve maximum efficiency.

Open sea operations require the development mechazation of a deep-sea telemetering tide gage and the establishment of the tidal phase and amplitude relative to that at a shore-based control location.

(3) Radio Position Fixing Procedures

Propagation of radio waves studies have begun and must be expanded. Studies are required to determine:

(a) Attenuation over alongshore areas and land masses.

(b) Signal path and strength under varying physical and atmospheric conditions.

(c) Baseline signal strength and restrictions.

(d) Calibration requirements of electronic system.

(4) Sounding System for Clear Channel Determination

At the present time, a wire drag technique is used to determine the presence of obstacles in ship channels and divers descend for identification of the object. This technique, while an effective detection tool, is rather slow in its operation.

The wire drag ships are currently equipped with side and bottom scan sonars. These systems do not have the resolution to identify the underwater obstacle, nor the range and detection capability to substitute for the wire drag system.

A program is being initiated to determine the system characteristics required in terms of resolution and probability of obstacle detection as a function of range and obstacle size.

The design, development, and feasibility field test of an equipment system capable of effectively supplementing and/or replacing the present wire drag operation is planned for completion in FY 1976.

(5) Ongoing Studies

It is essential that the program keep abreast of technological improvements of hydrographic systems, automated data handling and processing equipment, and improved chart production techniques. An ongoing research and development effort will be maintained to update and modernize program technology. Constant vigilance is maintained with industry and government regarding technology improvement. For instance, the laser depth sounder and charting automation activities are two major developments being closely coordinated with the U.S. Navy to minimize duplication of effort and expense.

C. Planned Program Accomplishment

The following table lists the timetable for phasing and achievement of program goals over approximately the next 10 years.

Table VI-5 - Planned Program Accomplishments

Goals	Achievement			
	Phase I	Phase II	Phase III	Phase IV
Nautical Chart Production				
114 New Small Craft Charts	27	27	28	32
77 New Conventional Type Charts	13	21	21	22
28 Reconstructed Conventional Charts	5	8	7	8
5 International Charts			2	3
Accelerated Printing Cycle (Time Interval)	(Months)	(Months)	(Months)	(Months)
Conventional Charts	18	16	14	12
Small Craft Charts	12	12	12	12
Automated Data Acquisition, Processing and Compilation Capability	70%	85%	100%	100%
Achieve 50 Year Basic Resurvey Cycle	60%	80%	90%	100%
Development of Prototype Fishing Chart	Pilot Project			

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