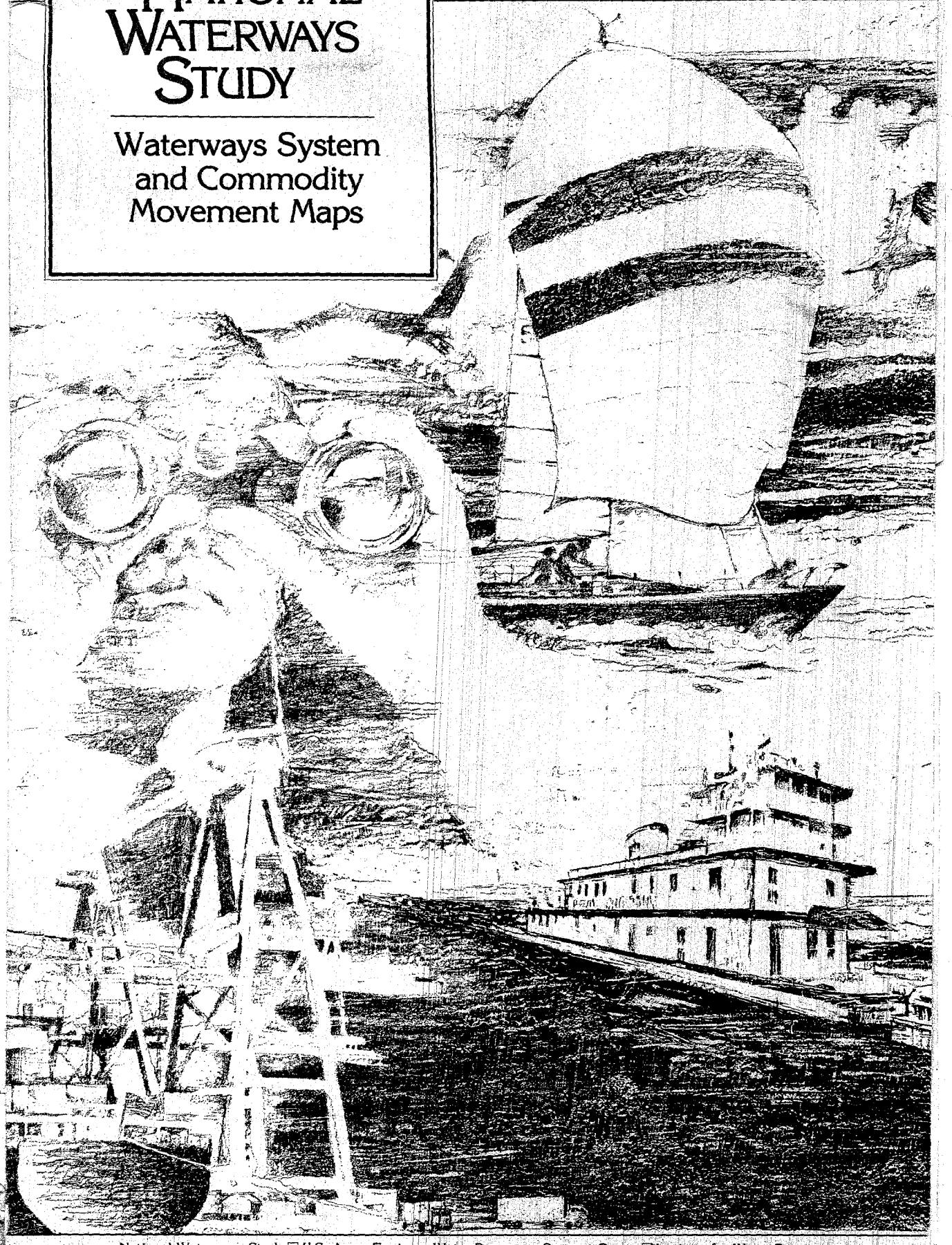
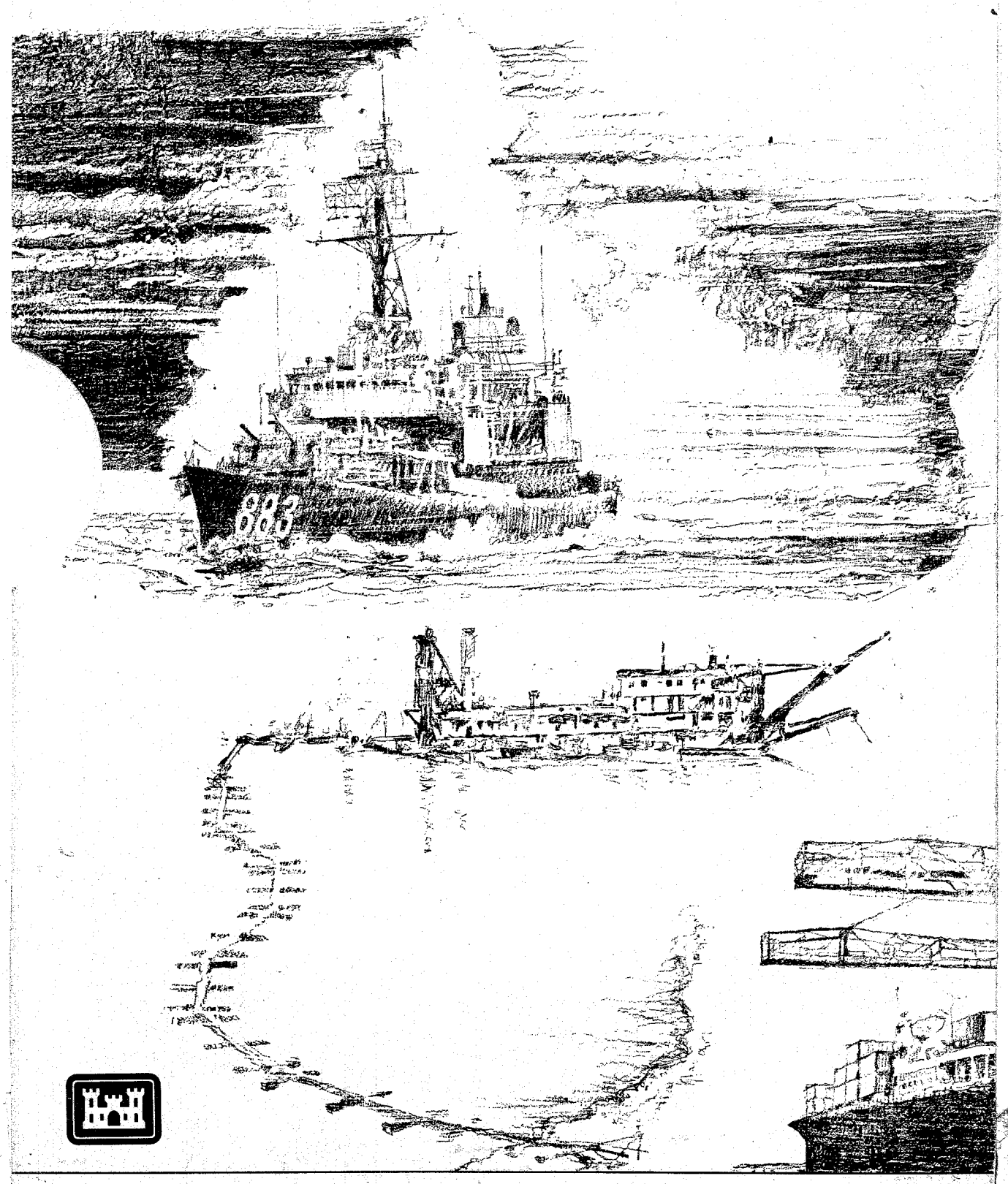
National Waterways Study

Waterways System and Commodity Movement Maps



January 1981
Final Report Maps NWS-81-2



NATIONAL WATERWAYS STUDY

FINAL REPORT MAPS

Waterways System and Commodity Movement Maps

TRENDS IN WATERBORNE COMMERCE OF THE UNITED STATES

1947 - 1979

National Waterways Study, U.S. Army Engineer Water Resources Support Center, Institute for Water Resources

This paper discusses the volume and characteristics of foreign and domestic waterborne commerce of the United States and is an updated revision and enlargement of the statement which originally accompanied the set of 19 maps published in 1979 by the National Waterways Study.[1] A new map No. 20 entitled, "*Energy Commodity Movement by Water: 1976*" has been added to the set. A general discussion of the history of U.S. waterborne commerce is pursued to establish the historical perspective for viewing the current flow patterns of U.S. waterborne commerce.

A. Trends in Waterborne Commerce, 1947-1979

Over the 32 years from 1947 to 1979, the total waterborne commerce of the United States has risen from 0.7 billion tons to 2.1 billions tons, a compound annual rate of increase of about 3.1 percent.[2] This steady growth trend in total waterborne commerce for the U.S. is shown in Figure 1, which also depicts the U.S. foreign commerce and domestic commerce for the 1947-1979 period. U.S. domestic waterborne commerce has shown consistent growth from 579 million tons in 1947 to 1,079 million tons in 1979. Foreign commerce, however, has grown rapidly from 188 million tons in 1947 to 994 million tons in 1979, or 5.5 percent annually. Presently, it is almost one-half of the U.S. total.

Figure 2 shows trends in imports of crude petroleum and petroleum products. Since 1971, U.S. foreign trade has increased rapidly due to a very sharp increase in the imports of crude petroleum. Crude petroleum as the major import commodity, increased slowly from 44 million tons in 1953 to 90 million tons in 1970, jumped dramatically to 404 million tons in 1977 and declined to 379 million tons in 1979. The next in importance among major import commodities is petroleum products which includes gasoline, residual fuel oil, distillate

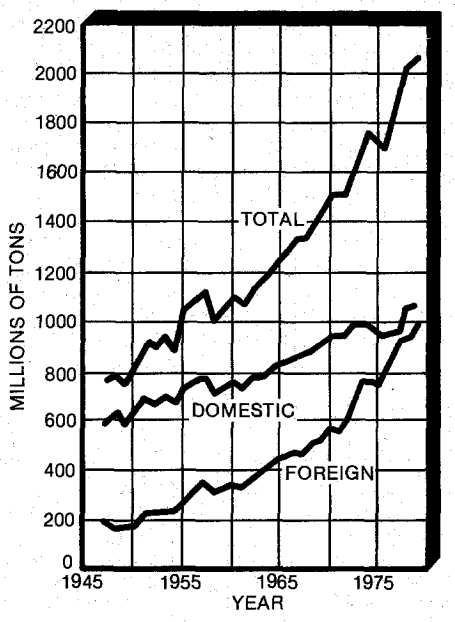


Figure 1. Net Total Waterborne Commerce of the United States, 1947-1979

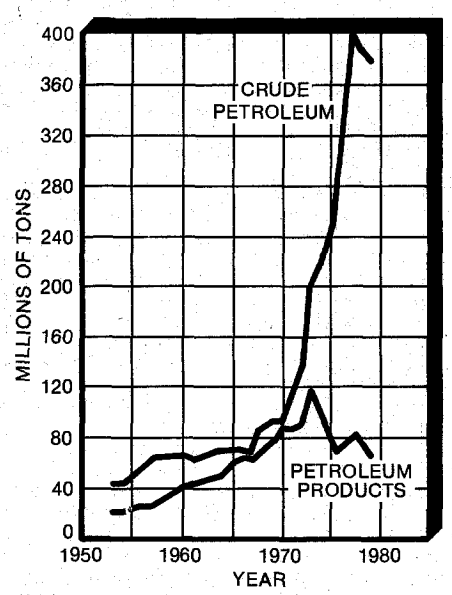


Figure 2. U.S. Waterborne Imports of Crude Petroleum and Petroleum Products, 1953-1979.

[1]U.S. Army Engineer Institute for Water Resources, National Waterways Study, *Waterways System and Commodity Movement Maps*, 1979.

[2]The 1979 data shown in this paper are preliminary estimates provided by the Waterborne Commerce Statistics Center of the U.S. Army Engineer Water Resources Support Center.

fuel oil, and jet engine fuel. The plot for petroleum products imported is shown in Figure 2. Trade in petroleum products grew from 23 million tons in 1953, to a peak of 121 million tons in 1973, and decreased to 66 million tons in 1979. Residual fuel oil has been the major component of petroleum products imports.

The major export waterborne commerce commodities—grains, coal and petroleum products, are charted in Figure 3 for the 1953-1979 period. The leading export commodity is grain; the dominant export grains are corn, wheat, and soybeans. Export shipments of the dominant grains have increased by a factor of 10 in volume from 10 million tons in 1953 to 115 million tons in 1978 and a slight decline to 100 million tons in 1979. Exports of coal have shown dramatic surges, declines, and increases from about 30 million tons in 1953 up to 73 million tons in 1957, then declining to 25 million tons in 1959, again increasing to 70 million tons in 1970, dropping to 40 million tons in 1978 and a sharp increase to a 1979 total of 66 million tons. In comparison with the imports graph, Figure 2, the exports of petroleum products, Figure 3, were about 10 million tons annually in the early 1950's and declined to about 1 million tons in 1979. Other commodities exported from U.S. ports in significant volume are chemicals, phosphate rock, logs, woodchips, lumber and manufactured items.

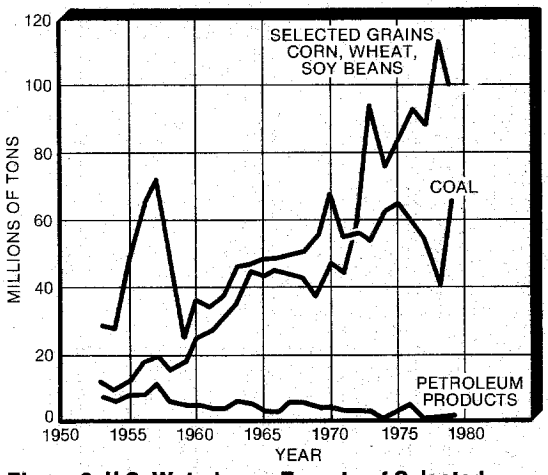


Figure 3. U.S. Waterborne Exports of Selected Grains, Coal and Petroleum Products, 1953-1979.

Total U.S. domestic waterborne commerce—internal, coastwise and Great Lakes-has shown a generally steady growth from 579 million tons in 1947 to 1,079 million tons in 1979. The major component of growth in domestic traffic, as shown in Figure 4, has been the traffic on inland waterways designated as internal traffic. This traffic has increased dramatically from 150 million tons in 1953 to 540 million tons in 1979, or at an annual rate of 4.3 percent. Coastwise traffic between ocean coastal ports increased moderately over the period from about 153 million tons in 1947 to 303 million tons in 1979. Domestic traffic on the Great Lakes shows a slight decline from about 163 million tons in 1947 to about 145 million tons in 1979. The decline shown for 1977 was an aberation due to a labor dispute that interrupted the shipments of iron ore—the number one commodity on the Great Lakes.

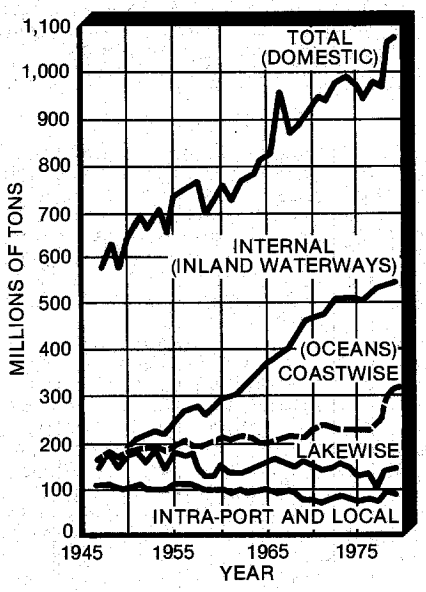


Figure 4. U.S. Domestic Waterborne Commerce by Type of Traffic, 1947-1979

Figure 5 shows the major commodities which move on the inland waterways. Coal, the number one commodity in tons moved, is followed by petroleum products, crude petroleum, and grains. The amount of coal moved shows a steady increase from 58 million tons in 1953 to 130 million tons in 1979. Petroleum products increased from 52 million tons in 1953 to 113 million tons in 1977 but decreased to 103 million tons in 1979. Crude petroleum increased from 24 million tons in 1953 to 60 million tons in 1972. After 1972, crude petroleum traffic declined to the 1979 level of 47 million tons. Grains, on the other hand,

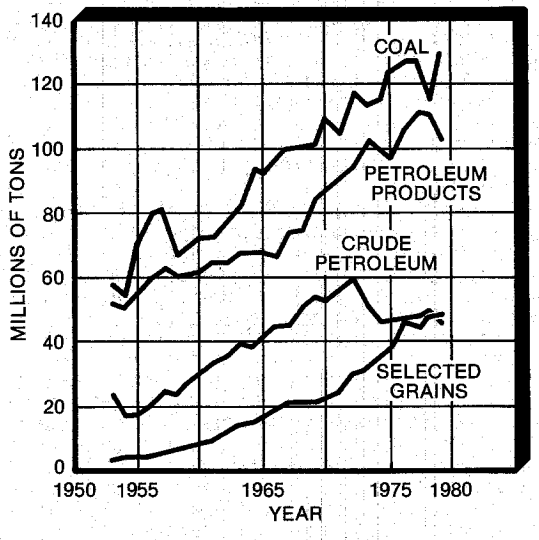


Figure 5. Leading Commodities in U.S. Domestic Waterborne Commerce on Inland Waterways, 1953-1979.

showed substantial growth in the last quarter century, increasing over 12 fold from 4 million tons in 1953 to 50 million tons in 1979.

A summary of the major commodities in the U.S. waterborne commerce for 1977 is shown in Figure 6. The energy commodities consisting of (1) petroleum and products and (2) coal and coke are clearly the dominant commodity groups in both foreign and domestic trade, accounting for 61 percent of all U.S. waterborne commerce in 1977. Petroleum and products are about 49 percent of the total traffic, 53 percent of the foreign traffic, and 46 percent of domestic traffic. Coal is slightly over 12 percent of all commerce, approximately 16 percent of domestic commerce and about 8 percent of foreign commerce. Grains, iron, iron ore and steel, chemicals, logs and lumber, sand and gravel, and other commodities comprise the remaining waterborne commerce.

The waterborne commerce trends for the last three decades that are discussed in the preceding section are the sum of diverse movements of a great variety of commodities. To aid in visualizing these many commodity flows, a set of commodity movement maps for a single year has been prepared. This cross-section of traffic or snap-shot of one year's pattern of commodity flows is discussed in the section that follows.

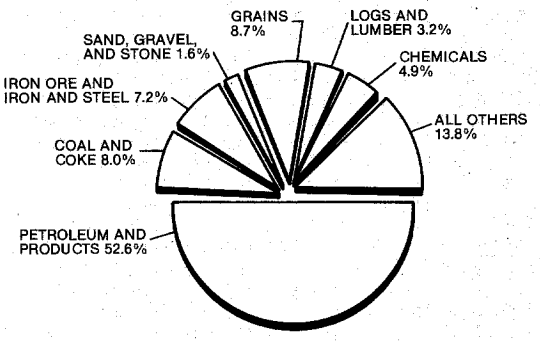
B. Waterways System and Commodity Movement Maps

A set of 19 maps published in 1979 as part of the National Waterways Study depicts the physical characteristics of the United States waterways system and the major commodity movements on that system. The six-page statement containing technical notes that originally accompanied the set of maps has been replaced by this pamphlet. In addition to containing expanded technical notes this pamphlet includes a description of the major patterns of those commodities and a discussion of Map No. 20 which depicts the waterborne movements for 1976 of the major energy commodities: coal, crude petroleum, and petroleum products.

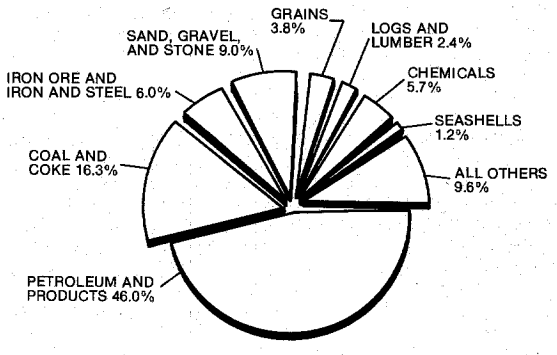
Sources of Information

The maps portray both physical information about waterways and ports and major waterborne commodity movements. The National Waterways Study inventory is the source of information about physical characteristics, depths and other dimensions of the existing waterway system channels, and the coastal, inland and Great Lakes ports shown on Maps 1, and 16 through 19. Basic data contained in the inventory, for which 1978 is the base year, was provided by U.S. Army Corps of Engineers Division and Districts.

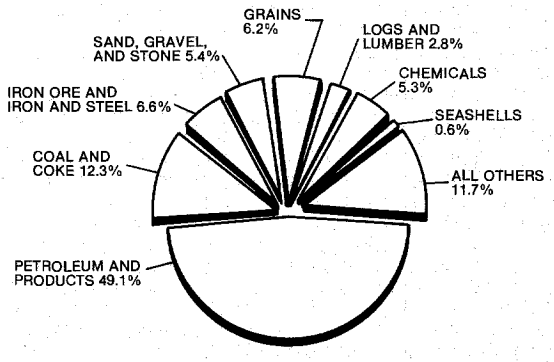
Waterborne commerce data, commodity movements, tonnages and distribution of types of traffic at ports for 1976 shown on Maps 1, 6, and 11 through 20 were provided by the Waterborne Commerce Statistics Center, formerly part of the U.S. Army Engineer Division, Lower Mississippi Valley and currently a unit of the U.S. Army Corps of Engineers Water Resources Support Center. The data for domestic commerce were compiled by the Waterborne Commerce Statistics Center, however, the foreign waterborne commerce



Foreign Commerce



Domestic Commerce



Total Commerce

Figure 6. Principal Commodities in U.S. Waterborne Commerce, 1977.

data were collected by the Bureau of the Census and furnished to the Waterborne Commerce Statistics Center. Base maps used for the series were developed by the United States Geological Survey and are used in the *National Atlas*, a continuing project of the Survey.

Waterborne commerce density flow data for rivers were compiled by the Waterborne Commerce Statistics Center on a river or waterway mile basis for the Mississippi River and Tributaries and the Gulf Intracoastal Waterway. Similar commodity flow data for other rivers were obtained from reports published annually by the Waterborne Commerce Statistics Center.

Commodity movement data for coastal ports are shown for each entire Corps of Engineers District, not for individual ports located within districts. Data are summarized to show total shipments between Corps Districts, each of which usually contains one major port complex, and between districts and foreign destinations.

Data for the Great Lakes-St. Lawrence Seaway system were based upon shipments among the five Great Lakes, the St. Lawrence River, and overseas areas. These data which were processed by the Corps North Central Division ADP Center, were further refined to show commodity movements for the United States and Canadian shores of the Great Lakes and the St. Lawrence River.

Commodity movement data are depicted in the following ways: (1) flow arrows indicate the quantity and direction of movement of major commodities; (2) the tonnage of port traffic is shown numerically on Map No. 1; and (3) tonnage and percentage distribution of type of traffic is shown in circular graphs on Maps 16 through 19. Port and tonnage data are published in *Waterborne Commerce of the United States—1976*, Part 5, Tables 3 and 4.

The data shown on Maps 2 through 5 are based on the preliminary findings of a study entitled, *Domestic and International Transportation of U.S. Foreign Trade; 1976*, conducted by the U.S. Bureau of the Census. The study was jointly sponsored by the U.S. Army Corps of Engineers Institute for Water Resources; the Office of the Secretary and the St. Lawrence Seaway Development Corporation of the Department of Transportation; and the Maritime Administration of the Department of Commerce.

Maps 7 through 10 were originally prepared by the United States Geological Survey for the study entitled, *National Energy Transportation*. This study was prepared by the Congressional Research Service of the Library of Congress for the Senate Committee on Commerce, Science, and Transportation.

Notes for Individual Maps

Map No. 1, Existing Major Waterways and Ports of the United States. In order to emphasize the commercial system as it existed in 1978, only completed phases of currently active projects are included. Excluded are those waterway projects that are authorized by Congress but not under construction as well as projects that are in some stage of construction. Moreover, waterways that are exclusively used for recreation are not shown.

Waterways shown on the map generally are U.S. Army Corps of Engineers projects or other facilities that have a channel length of 10 miles or more. This applies both to access channels and channels leading inland from a port or harbor. The only exceptions to the 10-mile limitation are approach channels which connect the Gulf Intracoastal Waterway with coastal ports.

Depth data used are those reported as controlling at the time of the inventory in 1978. Authorized project depths may be greater than controlling depths. Exceptions to this occur where a decrease in depth, usually from shoaling, results in a temporary change for a limited stretch of channel.

Waterways shown are grouped into 8 depth categories selected to emphasize major systems such as the Mississippi River and major tributaries, the Columbia-Snake River system and the Great Lakes-St. Lawrence Seaway system. The categories range from under 8 feet to over 40 feet for commercially navigable waterways. The same depth categories are used to organize port data depicted on the maps.

Ports shown on the map are those listed in Tables 3 and 4 of Part 5, *Waterborne Commerce of the United States—1976*, which lists ports with annual freight tonnage exceeding 250,000 tons. In addition, other ports where 1976 commerce totalled 200,000 tons are shown if they were recommended by a U.S. Army Corps of Engineers District. Waterborne commerce statistics are shown on the map for ports with cargo in 1976 of one million tons or more. The weight of the domestic and foreign commerce is numerically portrayed in circles located near each port. In addition to major ports, the map shows location of cities or town which are at or near the head of navigation. More detailed information related to that shown on Map No. 1 is depicted by regions on Maps 16 through 19.

Maps No. 2 through 5, U.S. Waterborne Foreign Trade. The domestic movement of United States foreign trade is depicted by symbols which show the states where exports originated and where imports were destined as well as by the customs region of the port of shipment. Export origins are shown by states as the places where exports are acquired. That location might be the same as or different from the place of production. The destination of imports is the state into which the import first moves from the port of entry.

The survey, which developed the data, included all commodities in foreign trade except the exports and imports of wheat, corn, soybeans, barley and rye and the imports of crude petroleum. Those commodities were excluded because grains and crude petroleum are fungible commodities. Shipments of such commodities from many locations commingle and it is impossible to trace an individual shipment.

The definitions used in the study regarding the package of various commodities are based largely upon findings by the study entitled, *Domestic and International Transportation of U.S. Foreign Trade: 1970*. General cargo is a commodity shipment that is handled as a discrete unit in boxes, bags, barrels, or other types of containers and can be counted. Bulk commodities are those shipments that are not packaged for shipment but are loaded unpackaged into the open hold of a vessel.

Ports are aggregated by United States Customs Regions as a means of summarizing the foreign trade data for mapping. A customs region, designated by a port name, is an area of the country served by a Bureau of Customs regional headquarters which also is a major port. For example: the Boston Customs Region includes all of New England and western and northern New York state; the New York Customs Region contains the New York Metropolitan Area and Albany, New York. The San Francisco Customs Region includes San Francisco, Northern California and the Pacific Northwest. The customs regions shown for exports are

based on the ports of lading and the customs region for imports are based on ports of unlading.

The weight and value of exports and imports are shown diagrammatically on the maps for each state and for each customs region (representing the port used) as spokes which represent poundage and dollar value of the shipments. The black line indicates weight and red line value. If both lines are of equal length, the value of a shipment is $1 per pound.

The growing importance of foreign trade to the economy of the United States is well known. The nation today is more dependent on natural resources from abroad than ever before. Likewise there is a strong foreign demand for United States agricultural commodities, a growing demand for our coal, and a continuous need for the nation's manufactured goods. The distribution of export and import trade by states and custom regions is not so well known. Data computed for the National Waterways Study show that every state is influenced by the exports and imports of general cargo and that almost every state has a role in the foreign trade in bulk commodities. The exports and imports of general cargo are shown on the left side in Figures Nos. 2 and 3, and the data for bulk commodities are shown on the right side of the sheet, Figures Nos. 4 and 5.

From examination of Maps Nos. 2 and 3, it is apparent as noted that the origins of exports and the destinations of imports of general cargo are widely spread throughout every state in the nation. It is also evident that the higher the unit value of the commodity the greater distance from the entry port that commodity is shipped inland. The entire eastern half of the United States to the Great Plains is very productive as a producer of exports and as a consumer of imports. There is also a distinct concentration of the origins and destinations of foreign trade in the western states at those points where there are major concentrations of population and industrial activity. If the point of production of exports was shown rather than the place of acquisition, the dispersion of origins of exports would be even farther inland and would show even greater concentration of foreign trade origins in the interior states.

Maps Nos. 4 and 5 show that the bulk commodities, except for grain and crude petroleum, tend to be exported and imported through the ports nearest the state of origin or destination. The conclusion is drawn that the lower unit value bulk commodities do not withstand as much transportation cost as general cargo commodities, and hence are produced or consumed near the port used for export or the port used for import.

In summary, Maps Nos. 2 and 5 demonstrate that foreign trade is distributed nationally throughout the United States. The ports on the U.S. ocean coasts and the Great Lakes serve wide multistate areas. Often these areas include transcontinental movements to the port of export or from the port of import. The international water transportation system and the ports, as the intermodal links with overland and domestic water transportation system, provide the dynamic quality necessary for United States foreign trade flows.

Maps No. 6, Total Commodity Movement by Water: 1976. The flow patterns of all commodities are combined to show total movement. Illustrated are foreign imports and exports and domestic receipts and shipments at coastal areas as well as upstream and downstream movements on rivers and on the Great Lakes.

The patterns of total commodity movement by water show high concentrations at the northeast Atlantic Coast, the Gulf Coast, the Mississippi River and Tributaries, the Great Lakes-St. Lawrence River area, the Pacific Northwest and central and southern California. Traffic on the rivers is dominantly domestic commerce, while flows of traffic on ocean coasts are dominated by domestic oceanborne commerce and foreign trade. Commerce on the Great Lakes-St. Lawrence Seaway system is a combination of domestic lakewise trade and foreign trade with Canada and overseas areas. Commodity flows that total to form the patterns shown in Map No. 6 will be discussed in paragraphs that follow.

Map No. 7, Coal Movement by All Modes: 1974. This map shows the flow patterns of coal movement by rail, highway, and water. The dominant long-established flow pattern of coal is from the highly productive mining areas of the Appalachian region to markets in the eastern United States and to foreign areas. Water transportation presently carries about 20 percent of all coal shipments on some part of the coal's journey from mine to consumer. The Ohio, Mississippi, Illinois and Tennessee Rivers and Tributaries are major water transport routes for coal. The Great Lakes also have substantial traffic moving from established coal shipping points on Lake Erie and Lake Michigan to U.S. and Canadian Great Lakes harbors. A newly emerging pattern is created by the movement of coal from the Western Mountain states and Great Plains states to eastern, southern, and western markets. One of the new routes developed since 1974 is the movement of western coal from Wyoming by rail to the Port of Duluth/Superior and from there by the new 1,000-foot ships, popularly called superlakes, from Lake Superior to the lower Great Lakes ports such as Detroit and Chicago.

A major route for much of the U.S. export of 62 million tons of coal in 1974 was from the Hampton Roads-Norfolk, Virginia, ports to Asia, Europe and South America. Substantial exports are also shipped through Baltimore and Philadelphia. Smaller amounts of coal are exported from Mobile, New Orleans, and the Los Angeles-Long Beach area. Although it may seem strange for a country which exports over 60 million tons of coal to import coal, Map No. 7 shows that the U.S. imported slightly over 1 million tons of coal from Canada, Poland, other European countries, South Africa and Australia. Imported coal is received at ports in New England, on the Delaware River, in the Chesapeake Bay, in the Mobile area and on the Lower Mississippi River.

Map No. 8, Coal Resources, Production and Consumption: 1974. Designed to be used in conjunction with the preceding composite coal movement map, Map 8 shows state-by-state production of coal, divided by type of mine used and indicating the number of active mines, as well as consumption of coal, classified by ultimate use. It shows the geographic spread of coal resources (although not the quantities in place) subdivided into five types of coal and coking coal, known commercial and potentially commercial deposits, and percent of sulphur content by weight. Map No. 8, shows that the high producing areas of Kentucky, West Virginia, Pennsylvania, Ohio, Indiana, and Illinois are served by the Illinois and Mississippi Rivers.

Map No. 9, Crude Petroleum Movement by All Modes: 1974. This map presents the flow of crude oil both by pipeline and waterway, the production of liquid fuels by state, divided between crude oil and natural gas liquids, and inputs to refineries by states, divided between domestic crude oil and foreign crude oil.

The dominant water movement is the import of crude petroleum into the New York-New Jersey-Delaware River area on the East Coast, and the Texas-Louisiana Gulf Coast. There are also heavy volume movements into the Los Angeles-Long Beach area, the San Francisco area and the Puget Sound area. Crude petroleum movement from

Alaska goes to west coast ports in Puget Sound, San Francisco Bay, and the Los Angeles-Long Beach area. There is also a substantial movement of domestic crude petroleum from the Gulf Coast to the North Atlantic area. Although crude petroleum is the number one import, it is apparent that it enters the United States in only a limited number of areas. Also, it is obvious that the transportation of crude petroleum on the inland waterways is very limited, compared to the movement at the seaports. There is no movement of significance of crude petroleum on the Great Lakes. From inspection of Map No. 9, pipelines emerge as the dominant carrier of crude petroleum within the United States, particularly in the central part of the country.

Map No. 10, Refined Petroleum Products Movement By All Modes: 1974. The major flows of bulk long-distance modes (pipelines and water) are shown on this map. Circular graphs for each state display the production and consumption of major petroleum products.

Transportation of petroleum products shows considerable similarities to the pattern displayed by crude petroleum flows. Major differences are: (a) the heavy volume and number of destinations of shipments from the Gulf coastal ports to many ports on the U.S. East Coast and (b) the shipment of petroleum products up the Mississippi, Ohio, and Illinois Rivers and Tributaries from the Gulf area. Water transport compared to pipeline transport is proportionately more significant for petroleum products than for crude petroleum.

Map No. 11, Grain Movement by Water: 1976. The role of water transportation in the movement of grain is principally transporting grain for export.[3] The largest concentration of grain moves by Mississippi River and Tributaries to the Gulf for export. Only a small amount of waterborne grain moves to domestic markets. Map 11 shows for each state the origin of commercial grain, indicated as grain sold, destined for domestic and foreign markets.

The inland water transportation system extends into the principal grain-growing areas which are in the Mississippi River Valley and the Pacific Northwest. Illinois, the number one state for grain sales; Iowa, the second; and the states of Minnesota, Missouri and Indiana combine to provide the volume of grain export flow down the Mississippi River. Grain moves from production areas in Minnesota, North Dakota and Montana to Minneapolis-St. Paul, the head of navigation on the Mississippi River, for export via the Mississippi and Gulf. Grain also moves from these three states by rail and truck to the port of Duluth-Superior on Lake Michigan for export shipment by the St. Lawrence Seaway, or to be shipped through ports such as Buffalo for domestic use. Relative interest of the states along the Mississippi River in the transport of grain by water may be judged by the size of the circles on Map No. 11 which show grain sales by state.

The major routes, the Illinois and Mississippi River, for waterborne grain shipments to New Orleans and other lower Mississippi River ports, accounted for 46 percent of the 104 million tons of grain exported by the U.S. in 1976. Texas ports such as Houston and Galveston, are the second ranking port areas and handle about 20 percent of U.S. grain exports. East Gulf ports, including Mobile, add 4 percent for a Gulf ports total of 70 percent of U.S. grain exports in 1976. Shipments in 1976 from East Coast ports, such as Norfolk, Baltimore, Philadelphia, and New York, which combined to equal about 12 percent of grain exports, rank third in the U.S. The fourth ranking route for grain exports is the Great Lakes-St. Lawrence Seaway system which accounted for 10 percent of U.S. grain exports in 1976. The Pacific Northwest ports, including Portland and Seattle, ranked fifth, handling 8 percent of grain exports.

Map No. 12, Industrial Agricultural Chemicals Movement by Water: 1976. This map shows the two main classifications of chemicals moved by water—agricultural chemicals (phosphate rock; nitrogeneous, potassic and phosphatic chemical fertilizers; and fertilizers and materials not elsewhere classified) and industrial chemicals which include all other chemicals. The movement of these agricultural and industrial chemicals present a complex pattern. A large volume movement is phosphate rock from Florida to the Mississippi River and Tributaries and directly to export. Industrial chemicals manufactured in the Gulf area from Texas to Louisiana are shipped up the Mississippi River and Tributaries and also to export. There is substantial movement of industrial chemicals from the Gulf to both east and west coasts of the U.S. In addition to the import and export of chemicals, both industrial and agricultural chemicals originate and terminate in domestic trade on the west coast. Shipments to Puerto Rico and Hawaii are made from ports on each of the coasts.

Map No. 13, Iron Ore Movement by Water: 1976. The iron ore movement includes direct shipping ore and all ore concentrates. The water transport of iron ore is dominant on the Great Lakes-St. Lawrence Seaway system. Iron ore from mines and pelletizing plants in the Lake Superior region is moved by lakeships to steel mills in the lower Lakes region. High volumes of imported iron ore are moved from eastern Canada up the St. Lawrence Seaway to the steel mills on and near the lower Great Lakes. Served by Great Lakes ports, this region accounts for about two-thirds of the steel production in the U.S. Smaller volumes of iron ore are imported for use in steel mills on the Delaware River, the Chesapeake Bay and the Black-Warrior River system in Alabama.

Map No. 14, Iron and Steel Products Movement by Water: 1976. The flow arrows depict movements which include pig iron, iron and steel ingots and other primary forms, iron and steel bars, plates, sheets, tubes and other primary products. The map shows an unusual movement on the Mississippi and Illinois Rivers of downbound domestic and export movement and almost equal upbound import movement. The downbound movement is dominant on the Ohio River. Other large volume iron and steel movements are shown on the St. Lawrence Seaway. Although movement in both directions of imports and exports is heavy, imports are the major flow. The Great Lakes area, with its automotive, machinery and metal fabricating industries is a heavy consumer of iron and steel products, both domestic and foreign. Here also is the largest concentration of steel production in the United States. With the exception of the Baltimore region where exports of iron and steel products exceed imports, other coastal harbor areas are shown to be net importers of iron and steel products.

Map No. 15, Other Commodity Movements by Water: 1976. The category includes rafted logs; other logs and wood products; sand, gravel and crushed rock; and marine shells. Rafted logs are

[3]Grain included in the mapped flows are: (1) corn, (2) wheat, (3) soybean, (4) sorghum grains, (5) rice, (6) barley and rye and (7) oats.

shown only in the Portland, Oregon district. The export of logs and wood products from the Seattle and Portland districts in the Pacific Northwest is shown to be the most highly concentrated area in the nation for that commodity flow. The movements of sand, gravel and crushed rock and marine shells show clearly as short-haul traffic. These low value commodities are usually moved only short distances, as is well documented in Map No. 15.

Maps No. 16 through 19, Waterways and Ports by Regions. Four regions of the country are exhibited depicting physical data for waterways and harbors and waterborne commerce data for ports. Technical information described for Map No. 1 also applies to the following maps: No. 16, Atlantic Region; No. 17, Mississippi River System and Gulf Region; No. 18, Great Lakes-St. Lawrence Seaway Region; and No. 19, Pacific Region.

The regional maps are at a scale which allows presentation of more detailed information than is shown on Map No. 1. Additional information includes the name and location of each of the locks used for commercial purposes on the nation's waterways and the type of traffic. Definitions of each type of traffic—foreign, coastwise, internal, lakewise and local—is contained in the annual report entitled *Waterborne Commerce of the United States*, prepared and published by the U.S. Army Corps of Engineers.

Map No. 20, Energy Commodity Movement by Water: 1976. The energy commodities shown on Map No. 20 comprise about 60 percent of all waterborne commerce of the United States, foreign and domestic. This is also a very significant proportion of the total national movement of energy. Energy commodity classifications shown on this map are: (1) coal and lignite, (2) crude petroleum, and (3) petroleum products which are defined as gasoline, distillate fuel oil, residual fuel oil and domestic shipments of jet fuel.

The pattern of coal movement for 1976 is similar to that shown for 1974 on Map No. 7 except for one movement discussed below. The Mississippi, Ohio, Tennessee and Illinois Rivers are movers of major amounts, over 100 million tons of coal, to many destinations along the rivers. The major change in coal transport is the new movement of low sulphur Western coal which is moved by rail from Wyoming to the port of Duluth/Superior at the head of Lake Superior. There the coal is transferred to the large bulk carriers and moved either to the southern tip of Lake Michigan or to the Detroit area by way of Lake Huron. The Great Lakes provide the means of transport for about 38 million tons of coal from ports in the western half of Lake Erie to U.S. destinations on all the Great Lakes as well as to Canadian destinations in the previous pattern of movement.

The destination of combined waterborne energy commodities are concentrated in the Northeastern States from Chesapeake Bay north to Maine. The Gulf area is the dominant receiver of crude petroleum and the shipper of petroleum products. A considerable amount of crude petroleum also is shipped to destinations in the Northeastern United States.

The crude petroleum waterborne commodity flow pattern for 1976 shown on Map No. 20 is similar to that depicted for 1974 on Map No. 9 with the exception of the increased flow of crude petroleum from Alaska. Similarly, there is little difference between the pattern of petroleum products movement shown for 1974 and 1976. In summary, waterborne transport is a highly significant transporter of energy commodities and in some cases the only way in which energy commodities are moved from producing to consuming areas.

C. Waterborne Commerce at Major Atlantic, Gulf and Pacific Coast Ports: 1953-1977

Previous sections of this paper have been devoted to trends and patterns of waterborne commerce for the various types of traffic on the inland rivers, the Great Lakes and for the total United States. This section presents a comparison of the waterborne commerce at the major ports on the Atlantic, Gulf and Pacific Coasts. Major ports are defined as those with an annual total of four million tons or more of shipments and receipts (both foreign and domestic cargo) in the mid 1970s.

Average Annual Domestic and Foreign Waterborne Shipments and Receipts and Rates of Change at Major Harbors on Pacific, Gulf and Atlantic Coasts,[1] 1953-1977

Period	Pacific	Gulf	Atlantic
Average Annual Total Shipments and Receipts (Millions of Short Tons)			
1953-57	66	248	457
1958-62	70	300	428
1963-67	83	371	462
1968-72	100	435	535
1973-77	124	581	574
Average Annual Compound Rate of Change (Percent)			
1953-57 to 1958-62	1.3	3.9	1.3
1958-62 to 1963-67	3.3	4.4	1 5
1963-67 to 1968-72	3.7	3.2	3.0
1968-72 to 1973-77	4.5	5.9	1.4
Total Period			
1953-57 to 1973-77	3.2	4.4	1.1

[1]Source: Developed from data reported in Department of the Army, Corps of Engineers, *Waterborne Commerce of the United States*, Annual, 1955-1977.

The table shows that the most significant growth in commerce at the ocean ports has occurred on the Gulf Coast where shipments and receipts increased from 248 million tons in the mid 1950s to 581 million tons in the mid 1970s. This is a compound rate of growth of 4.4 percent. Commerce of Pacific Coast ports increased from 66 million tons in the mid 1950s to 124 million ton in the 1970s or at an annual rate of growth of 3.2 percent. The Atlantic ports traffic increased from 457 million tons in 1950s to 574 million tons in the mid 1970s which is an annual rate of growth of 1.1 percent. These data are based on weight of commodities moved. Data based on value could show significantly different rates of changes both over a time period and among the coastal harbors.

D. Summary

Over the past 32 years waterborne commerce has more than doubled to its present volume of 2.1 billion tons annually. The greatest growth has been in foreign trade

which now equals domestic waterborne tonnage. Traffic on the inland rivers has exhibited the most rapid growth among the types of traffic with domestic origins and destinations. Ports on the Gulf Coast have shown the most rapid growth of any of the coasts of the U.S. and at present slightly exceed the Atlantic Coast ports in total tonnage. The greatest densitites of commodity flows are shown for the west and central Gulf ports, North Atlantic ports, the Great Lakes-St. Lawrence system and the Mississippi River and Tributaries. The Pacific Coast ports presently have about one-fourth the traffic density of Atlantic or Gulf ports although they are dominant in forest and wood product commodities. The energy commodities of crude petroleum and petroleum products and coal comprise about 60 percent of the United States waterborne commerce. A significant change from 1977 to 1979 has been a decline in the imports of crude petroleum and petroleum products. Commodities consumed and produced by the agricultural, metal, chemical and construction industries account for most of the other major components of U.S. waterborne commerce. Increase in the U.S. waterborne commerce has resulted primarily from the growth in energy utilization and in the industries listed above. This is especially true for those commodities moving on the inland rivers and in foreign trade at coastal and Great Lakes harbors.

Acknowledgements

Many organizations and individuals contributed to the development, technical review, cartographic design, compilation, and printing of the Waterways Systems and Commodity Movement Maps. The United States Geological Survey of the Department of the Interior provided the base maps for the entire series, performed the cartographic work for Maps 1 through 15 and Map 20 and printed the entire series. Tech-Drafting and Photo, inc. of Falls Church, Virginia, was the cartographer for Maps 16 through 19. The Waterborne Commerce Statistics Center, U.S. Army Engineer Water Resources Support Center, provided the waterborne commerce data for Maps 1, 6, and 11 through 19. The Automatic Data Processing Center of the U.S. Army Engineer Division, North Central, prepared special computer tabulations for Maps 2 through 5 and 16 through 20 and for the Great Lakes-St. Lawrence Seaway Region on Maps 6, and 11 through 15 and 20. The Bureau of the Census provided information that was the basis for Maps 2 through 5. The Congressional Research Service of the Library of Congress gave permission for the use of Maps 7 through 10. Corps of Engineers Division and District offices provided the basic data and reviewed drafts of maps showing the location and depths of rivers, channels, and harbors. Personnel of the Office of the Chief of Engineers, Planning Division; The Board of Engineers for Rivers and Harbors; and Corps Division and District offices reviewed drafts of the maps and proposed suggestions which contributed to the quality of the final product.

Many people provided valuable assistance in developing the map series. Unfortunately, all of them cannot be listed in this document; however, several individuals had major responsibilities. At the Institute for Water Resources, Arlene L. Dietz, Study Manager for the National Waterways Study provided general direction for the project, Howard E. Olson was responsible for the technical content, and Thomas M. Ballentine coordinated field data input, the design, review and production of the maps. Special recognition is given to John H. Wittmann, Cartographer, and his staff in the Special Mapping Center, United States Geological Survey.

Users of these maps are invited to furnish comments and suggestions that may improve future editions of the maps. Comments should include reference to specific map numbers and notations regarding proposed additions, deletions or changes to the maps or the text.

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Alan R. Chandler, Ohio River
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*Regional Coordinator

Senior Staff

James R. Hanchey, Acting Director, Institute for Water Resources
Arlene L. Dietz, IWR, Study Manager
Samuel E. Sands, BERH, Contract Manager
Howard E. Olson, IWR, Corps Coordinator
David F. Bastian, IWR, Element Manager
Thomas R. Doran, BERH, Assistant Corps Coordinator
Robert Harrison, IWR, Element Manager
Frank Mallette, BERH, Element Manager
Thomas E. Odle, BERH, Element Manager
Richard Waugh, BERH, Element Manager

Address Correspondence to
Water Resources Support Center
Institute for Water Resources
National Waterways Study
Fort Belvoir, Virginia 22060
(202) 325-7141

ADDENDUM AND ERRATA FOR

TRENDS IN WATERBORNE COMMERCE OF THE UNITED STATES 1947-1979

NATIONAL WATERWAYS STUDY

ADDENDUM -- Page 1, add the following at the end of the first paragraph:

"Supplementing the set of 20 maps is a sheet of four new maps, titled as follows: Map No. 21, Corn Movements to Points of Export by All Modes, 1977; Map No. 22, Soybean Movements to Points of Export by All Modes: 1977; Map No. 23, Wheat Movements to Points of Export by All Modes: 1977; and Map No. 24, Corn, Soybeans and Wheat: Production and Origin of Movements to Points of Export, 1977."

ERRATA --

1. Page 2, second paragraph, third sentence -- Correct for final 1979 waterborne commerce and update for 1980 data to read:

"Export shipments of the dominant grains have increased by a factor of 10 in volume from 10 million tons in 1955 to 115 million tons in 1978, and further growth to 124 million tons in 1979 and 130 million tons in 1980."

2. Figure 3 is corrected for 1979 grain exports final data in the following figure which updates grain and coal exports for 1980, which are 130 and 91 million tons, respectively.

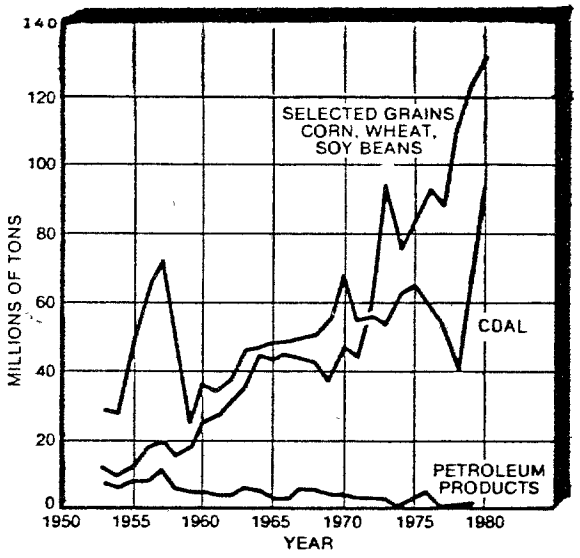


Figure 3

U.S. Waterborne Exports of Selected Grains, Coal and Petroleum Products 1953-1980

9 June 1982

-9,121—AG—Ft Belvoir

NATIONAL WATERWAYS STUDY

MAP NO 1

EXISTING MAJOR WATERWAYS AND PORTS

OF THE UNITED STATES

INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1981

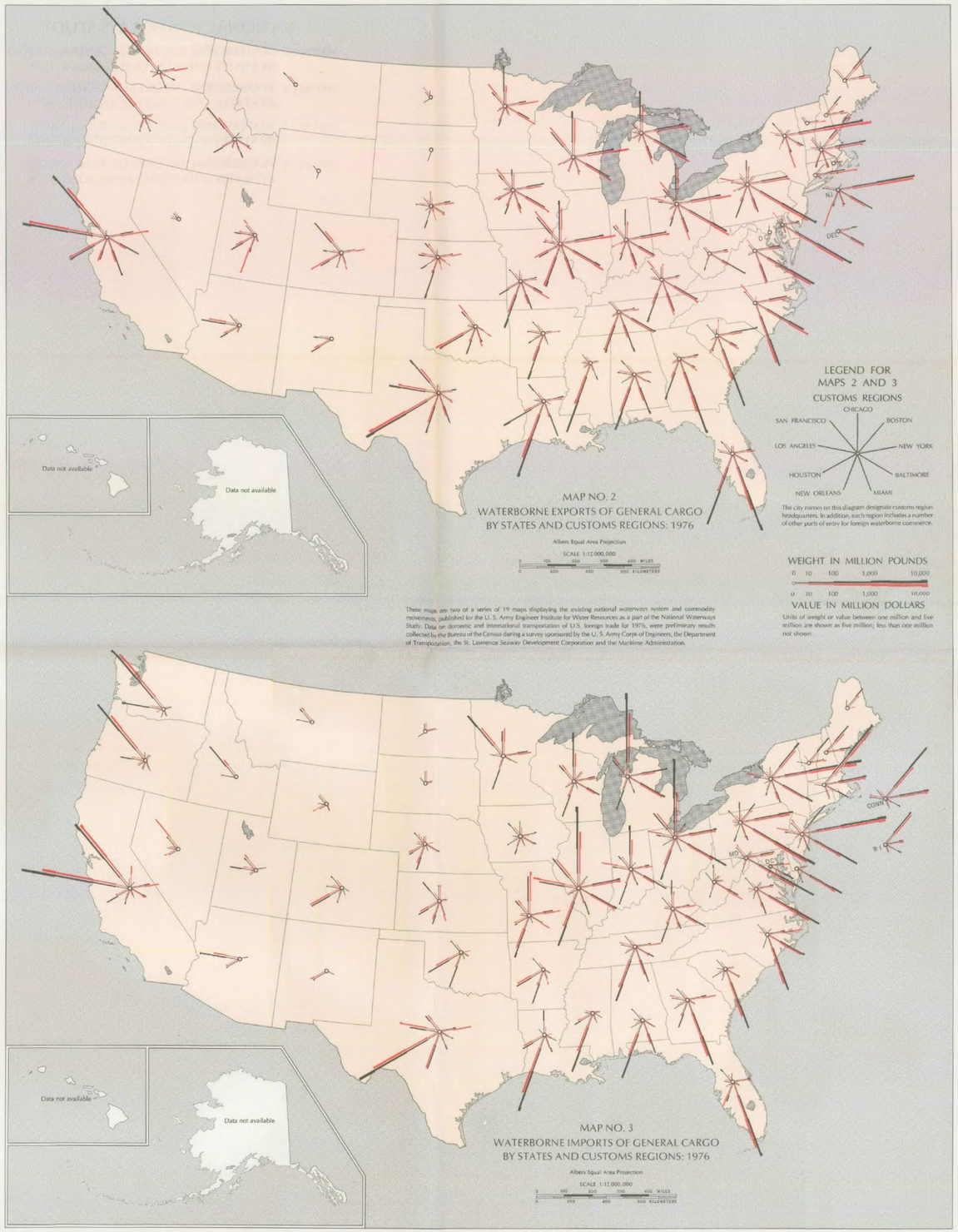
NATIONAL WATERWAYS STUDY

MAP NO. 2 WATERBORNE EXPORTS OF GENERAL CARGO BY STATES AND CUSTOMS REGIONS: 1976

MAP NO. 3 WATERBORNE IMPORTS OF GENERAL CARGO BY STATES AND CUSTOMS REGIONS: 1976

MAP NO. 4 WATERBORNE EXPORTS OF BULK CARGO BY STATES AND CUSTOMS REGIONS: 1976

MAP NO. 5 WATERBORNE IMPORTS OF BULK CARGO BY STATES AND CUSTOMS REGIONS: 1976



MAP NO. 2
WATERBORNE EXPORTS OF GENERAL CARGO
BY STATES AND CUSTOMS REGIONS: 1976

Albers Equal Area Projection

SCALE 1:17,000,000

0 100 200 300 400 MILES
0 200 400 600 KILOMETERS

LEGEND FOR
MAPS 2 AND 3
CUSTOMS REGIONS

The city names on this diagram designate customs region headquarters. In addition, each region includes a number of other ports of entry for foreign waterborne commerce.

WEIGHT IN MILLION POUNDS

0 10 100 1,000 10,000

0 10 100 1,000 10,000

VALUE IN MILLION DOLLARS

Units of weight or value between one million and five million are shown as five million; less than one million not shown.

These maps are two of a series of 19 maps displaying the existing national waterways system and commodity movements, published for the U. S. Army Engineer Institute for Water Resources as a part of the National Waterways Study. Data on domestic and international transportation of U.S. foreign trade for 1976, were preliminary results collected by the Bureau of the Census during a survey sponsored by the U. S. Army Corps of Engineers, the Department of Transportation, the St. Lawrence Seaway Development Corporation and the Maritime Administration.

MAP NO. 3
WATERBORNE IMPORTS OF GENERAL CARGO
BY STATES AND CUSTOMS REGIONS: 1976

Albers Equal Area Projection

SCALE 1:17,000,000

0 100 200 300 400 MILES
0 200 400 600 KILOMETERS

MAP NO. 4
WATERBORNE EXPORTS OF BULK CARGO
BY STATES AND CUSTOMS REGIONS: 1976
GRAINS NOT INCLUDED

Albers Equal Area Projection

SCALE 1:17,000,000

0 100 200 300 400 MILES
0 200 400 600 KILOMETERS

LEGEND FOR
MAPS 4 AND 5
CUSTOMS REGIONS

The city names on this diagram designate customs region headquarters. In addition, each region includes a number of other ports of entry for foreign waterborne commerce.

WEIGHT IN MILLION POUNDS

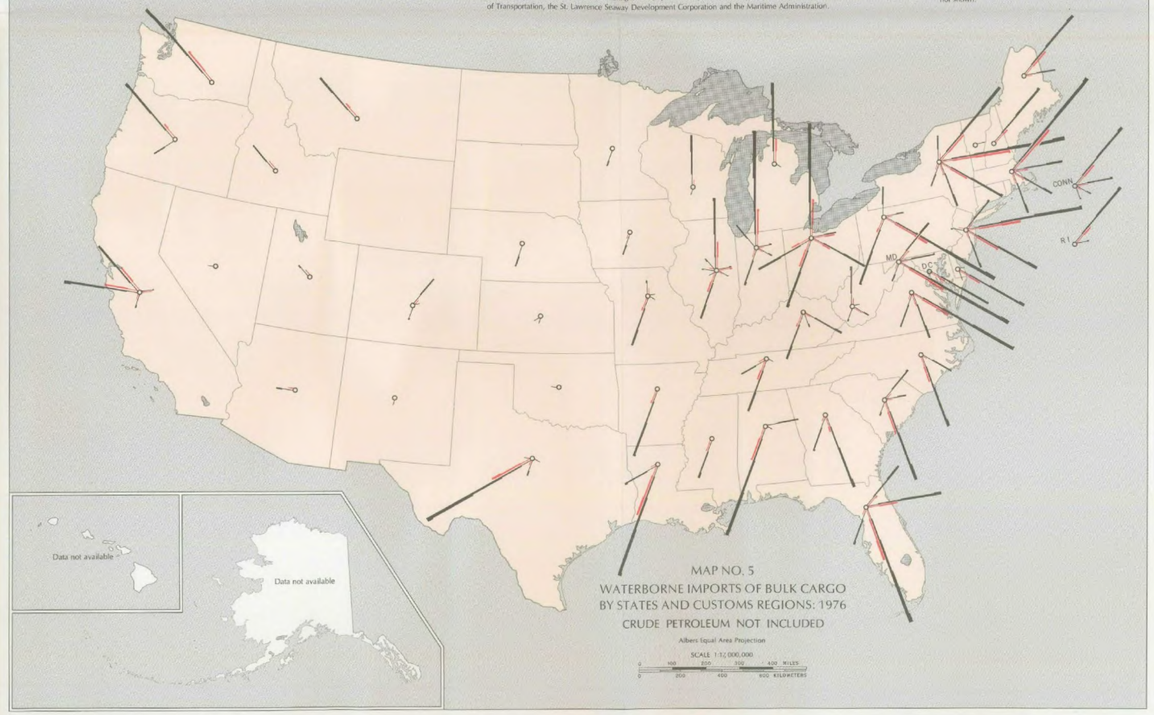
0 10 100 1,000 10,000 100,000

0 10 100 1,000 10,000 100,000

VALUE IN MILLION DOLLARS

Units of weight or value between one million and five million are shown as five million; less than one million not shown.

These maps are two of a series of 19 maps displaying the existing national waterways system and commodity movements, published for the U. S. Army Engineer Institute for Water Resources as a part of the National Waterways Study. Data on domestic and international transportation of U.S. foreign trade for 1976, were preliminary results collected by the Bureau of the Census during a survey sponsored by the U. S. Army Corps of Engineers, the Department of Transportation, the St. Lawrence Seaway Development Corporation and the Maritime Administration.



MAP NO. 5
WATERBORNE IMPORTS OF BULK CARGO
BY STATES AND CUSTOMS REGIONS: 1976
CRUDE PETROLEUM NOT INCLUDED

Albers Equal Area Projection

SCALE 1:17,000,000

0 100 200 300 400 MILES
0 200 400 600 KILOMETERS

INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1980

NATIONAL WATERWAYS STUDY

MAP NO. 6

TOTAL COMMODITY MOVEMENT BY WATER: 1976

TOTAL COMMODITY MOVEMENT BY WATER: 1976

This map is one of a series of 19 maps displaying the existing national waterways system and commodity movements, published for the U.S. Army Engineer Institute for Water Resources as a part of the National Waterways Study. The Institute for Water Resources provided technical guidance and determined the content of the maps using data developed by the Waterborne Commerce Statistics Center, U.S. Army Engineer Division, Lower Mississippi Valley.

INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1980

NATIONAL WATERWAYS STUDY

MAP NO. 7

COAL MOVEMENT BY ALL MODES: 1974

COAL MOVEMENT BY ALL MODES: 1974

This map is one of a series of 19 maps originally prepared for the National Energy Transportation System Study and published for the committees on Energy and Natural Resources and on Commerce, Science and Transportation of the U.S. Senate. The Congressional Research Service, Library of Congress, determined the content of the maps and provided the quantitative data and technical guidance.

Albers Equal Area Projection

SCALE 1:7,500,000

0 50 100 200 300 400 MILES
0 100 200 300 400 500 600 700 KILOMETERS

INTERSTATE COAL FLOW

MILLION SHORT TONS 0 1000 2000
TRILLION BTU 0 1 2

SHORT TONS	BILLION BTU
100,000–999,999	2.370–23.699
10,000–99,999	237–2.369
1,000–9,999	23.7–236.9

TYPES OF COAL TRAFFIC

- Railroad
- Highway

Waterway
- Shipping or receiving area
- Through traffic
- Local area traffic
- Flow within a principal harbor or port and its vicinity

INTRASTATE COAL FLOW

Tonnage-Btu scale is identical to that of interstate coal flow shown above

- Major flow by railroad
- Major flow by highway
- Minor flow by railroad
- Minor flow by highway

Gray lines indicate the Congressional district boundaries for the 94th Congress

Principal Islands of HAWAII
SCALE 1:7,500,000

ALASKA
SCALE 1:17,000,000
0 100 200 300 400 MILES
0 200 400 600 KILOMETERS

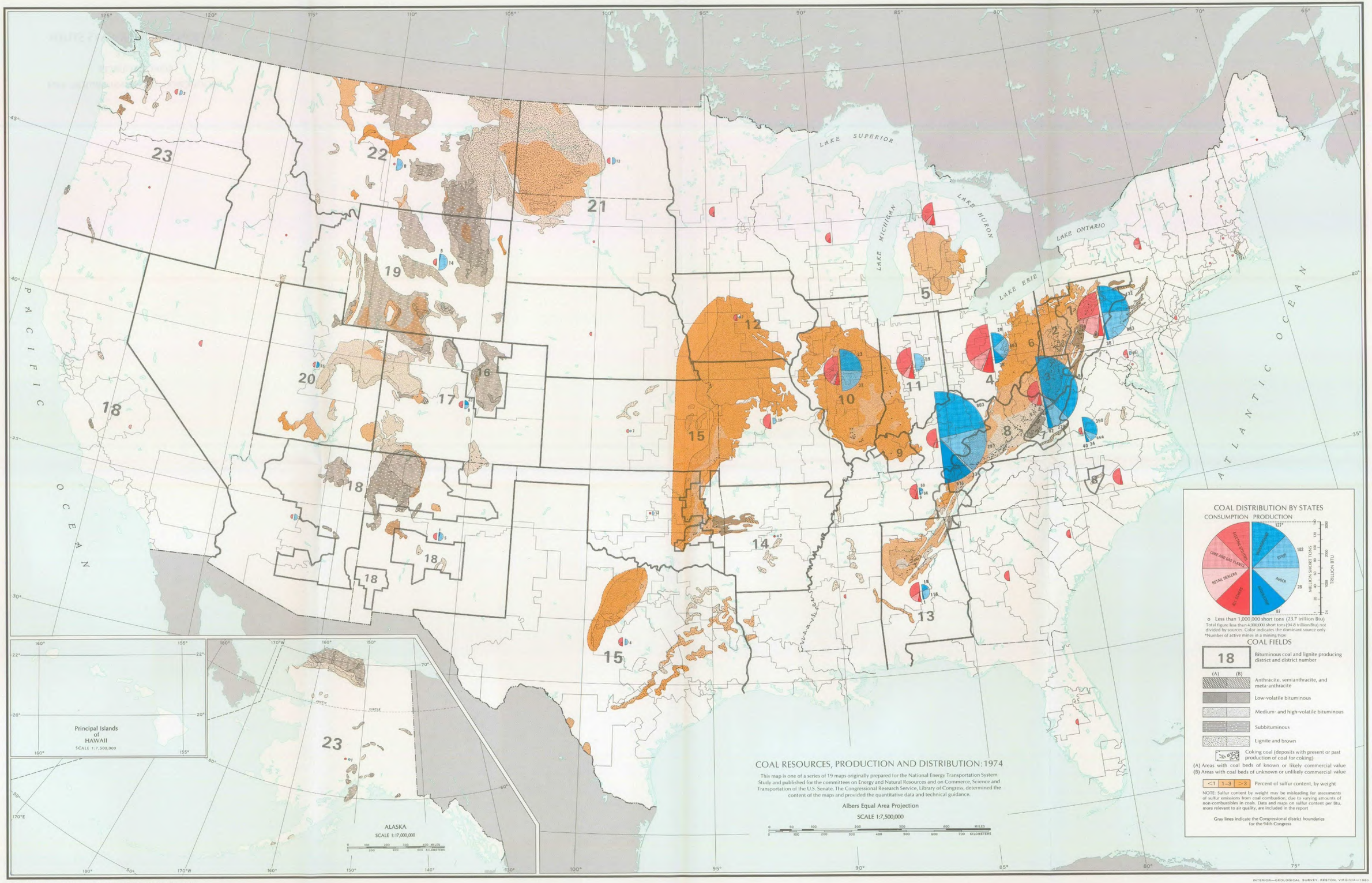
PRINTED FOR U. S. ARMY CORPS OF ENGINEERS, NATIONAL WATERWAYS STUDY

INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1980

NATIONAL WATERWAYS STUDY

MAP NO. 8

COAL RESOURCES,
PRODUCTION AND CONSUMPTION: 1974



COAL RESOURCES, PRODUCTION AND DISTRIBUTION: 1974

This map is one of a series of 19 maps originally prepared for the National Energy Transportation System Study and published for the committees on Energy and Natural Resources and on Commerce, Science and Transportation of the U.S. Senate. The Congressional Research Service, Library of Congress, determined the content of the maps and provided the quantitative data and technical guidance.

Albers Equal Area Projection

SCALE 1:7,500,000

COAL DISTRIBUTION BY STATES

CONSUMPTION PRODUCTION

o Less than 1,000,000 short tons (23.7 trillion Btu)

Total figure less than 4,000,000 short tons (94.8 trillion Btu) not divided by sources. Color indicates the dominant source only

*Number of active mines in a mining type

COAL FIELDS

18 — Bituminous coal and lignite producing district and district number

(A) (B)

- Anthracite, semianthracite, and meta-anthracite
- Low-volatile bituminous
- Medium- and high-volatile bituminous
- Subbituminous
- Lignite and brown

Coking coal (deposits with present or past production of coal for coking)

(A) Areas with coal beds of known or likely commercial value

(B) Areas with coal beds of unknown or unlikely commercial value

<1 | 1–3 | >3 — Percent of sulfur content, by weight

NOTE: Sulfur content by weight may be misleading for assessments of sulfur emissions from coal combustion, due to varying amounts of non-combustibles in coals. Data and maps on sulfur content per Btu, more relevant to air quality, are included in the report

Gray lines indicate the Congressional district boundaries for the 94th Congress

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INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1980

NATIONAL WATERWAYS STUDY

MAP NO. 9

CRUDE PETROLEUM MOVEMENT

BY ALL MODES: 1974

CRUDE PETROLEUM MOVEMENT BY ALL MODES: 1974

This map is one of a series of 19 maps originally prepared for the National Energy Transportation System Study and published for the committees on Energy and Natural Resources and on Commerce, Science and Transportation of the U.S. Senate. The Congressional Research Service, Library of Congress, determined the content of the maps and provided the quantitative data and technical guidance.

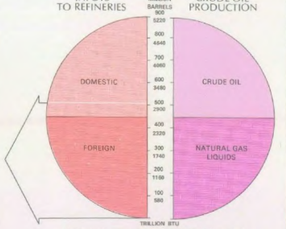
Albers Equal Area Projection

SCALE 1:7,500,000

0 100 200 300 400 MILES
0 100 200 300 400 500 600 700 KILOMETERS

TOTAL CRUDE OIL FLOW AND DISTRIBUTION BY STATES

INPUTS TO REFINERIES — MILLION BARRELS — CRUDE OIL PRODUCTION



○ 10–49.9 million barrels (58–289 trillion Btu)
○ Less than 10 million barrels (58 trillion Btu)

Total figure of production or consumption less than 50 million barrels (290 trillion Btu) not divided by sources. Color indicates the dominant source only

	MILLION BARRELS	TRILLION BTU
⟵	1.0–9.9	5.8–57.99
⟵	0.5–0.9	2.9–5.79
⟵	Less than 0.5	Less than 2.9

Flow by pipeline

Flow by water

Local traffic flow by water

IMPORTS AND REGIONS OF ORIGIN

1. Canada
2. The Caribbean
3. Central America
4. South America
5. Europe
6. Africa
7. Middle East
8. Asia
10. Virgin Islands

Gray lines indicate the Congressional district boundaries for the 94th Congress

Principal Islands of HAWAII
SCALE 1:7,500,000

ALASKA
SCALE 1:17,000,000
0 100 200 300 400 MILES
0 100 200 300 400 500 KILOMETERS

PRINTED FOR U. S. ARMY CORPS OF ENGINEERS, NATIONAL WATERWAYS STUDY

INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1980

NATIONAL WATERWAYS STUDY

MAP NO. 10

REFINED PETROLEUM PRODUCTS

MOVEMENT BY ALL MODES: 1974

REFINED PETROLEUM PRODUCTS MOVEMENT BY ALL MODES: 1974

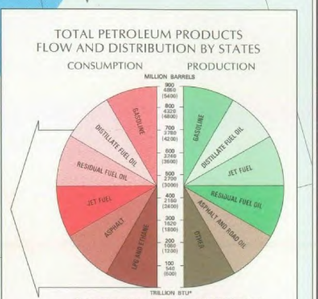
This map is one of a series of 19 maps originally prepared for the National Energy Transportation System Study and published for the committees on Energy and Natural Resources and on Commerce, Science and Transportation of the U.S. Senate. The Congressional Research Service, Library of Congress, determined the content of the maps and provided the quantitative data and technical guidance.

Albers Equal Area Projection
SCALE 1:7,500,000

0 100 200 300 400 MILES
0 100 200 300 400 500 600 700 KILOMETERS

TOTAL PETROLEUM PRODUCTS FLOW AND DISTRIBUTION BY STATES

CONSUMPTION PRODUCTION



○ 10–49.9 million barrels (54–299.9 trillion Btu)
○ Less than 10 million barrels (60 trillion Btu)

Total figure of production or consumption less than 50 million barrels (300 trillion Btu) not divided by sources. Color indicates the dominant source only

*BTU SCALE: ▮▮▮ indicates domestic petroleum products
▮▮▮▮ indicates imported petroleum products

MILLION BARRELS	TRILLION BTU
1.0–9.9	5.4–59.9
0.5–0.9	2.7–5.99
Less than 0.5	Less than 3.0

Two or more categories combined in production or consumption

Flow by water
Flow by pipeline
Local traffic flow by water
Flow within a principal harbor or port, and its vicinity

IMPORTS AND REGIONS OF ORIGIN

1. Canada
2. The Caribbean
3. Central America
4. South America
5. Europe
6. Africa
7. Middle East
8. Asia
9. Australia
10. Puerto Rico and Virgin Islands

Gray lines indicate the Congressional district boundaries for the 94th Congress

Principal Islands of HAWAII
SCALE 1:7,500,000

ALASKA
SCALE 1:17,000,000

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INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1980

NATIONAL WATERWAYS STUDY

MAP NO. 11

GRAIN MOVEMENT BY WATER: 1976

GRAIN MOVEMENT BY WATER: 1976

This map is one of a series of 19 maps displaying the existing national waterways system and commodity movements, published for the U.S. Army Engineer Institute for Water Resources as a part of the National Waterways Study. The Institute for Water Resources provided technical guidance and determined the content of the maps using data developed by the Waterborne Commerce Statistics Center, U.S. Army Engineer Division, Lower Mississippi Valley and the U.S. Department of Agriculture.

Albers Equal Area Projection

SCALE 1:7,500,000

WATERBORNE GRAIN TRAFFIC
SHORT TONS

50,000,000
40,000,000
30,000,000
20,000,000
10,000,000

500,000-999,999
100,000-499,999
1,000-99,999

Local flow

Flows less than 1,000 short tons are not shown

NEW YORK District headquarters

For purposes of graphic presentation, flow data have been combined. Commodity movements depicted are the totals of all originating and terminating waterborne commerce within each U.S. Army Corps of Engineers District.

GRAIN SOLD BY STATES
SHORT TONS

35,000,000
30,000,000
25,000,000
20,000,000
15,000,000
10,000,000
5,000,000
1,000,000

500,000-999,999
1,000-499,999

Gray lines indicate the Congressional district boundaries for the 95th Congress

Principal Islands of HAWAII
SCALE 1:7,500,000

ALASKA SCALE 1:17,000,000

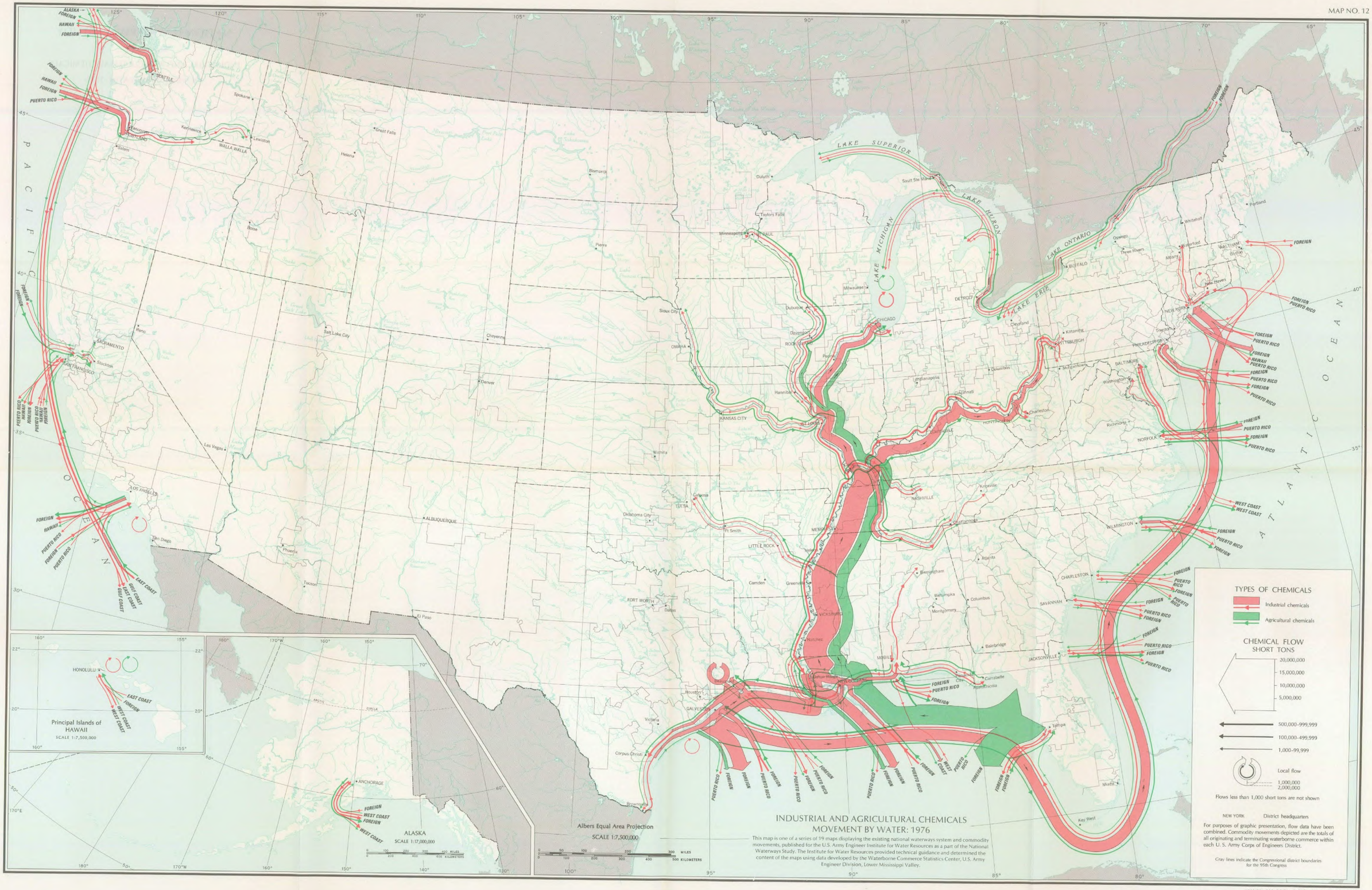
INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1980

NATIONAL WATERWAYS STUDY

MAP NO. 12

INDUSTRIAL AND AGRICULTURAL CHEMICALS

MOVEMENT BY WATER: 1976



INDUSTRIAL AND AGRICULTURAL CHEMICALS MOVEMENT BY WATER: 1976

This map is one of a series of 19 maps displaying the existing national waterways system and commodity movements, published for the U.S. Army Engineer Institute for Water Resources as a part of the National Waterways Study. The Institute for Water Resources provided technical guidance and determined the content of the maps using data developed by the Waterborne Commerce Statistics Center, U.S. Army Engineer Division, Lower Mississippi Valley.

TYPES OF CHEMICALS

- Industrial chemicals
- Agricultural chemicals

CHEMICAL FLOW
SHORT TONS

- 20,000,000
- 15,000,000
- 10,000,000
- 5,000,000
- 500,000-999,999
- 100,000-499,999
- 1,000-99,999
- Local flow
- 1,000,000
- 2,000,000

Flows less than 1,000 short tons are not shown

NEW YORK District headquarters

For purposes of graphic presentation, flow data have been combined. Commodity movements depicted are the totals of all originating and terminating waterborne commerce within each U. S. Army Corps of Engineers District.

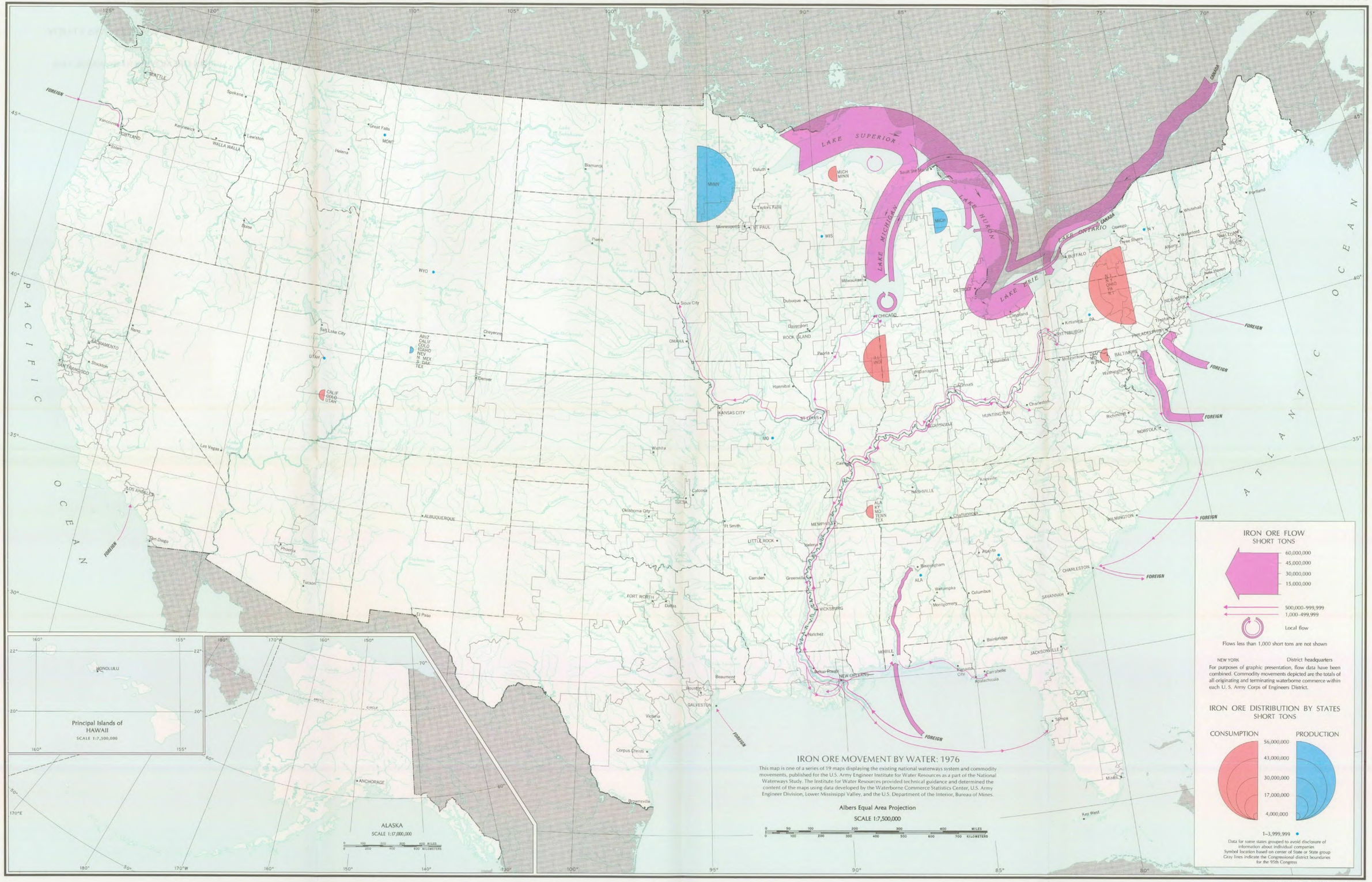
Gray lines indicate the Congressional district boundaries for the 95th Congress

INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1980

NATIONAL WATERWAYS STUDY

MAP NO. 13

IRON ORE MOVEMENT BY WATER: 1976



IRON ORE MOVEMENT BY WATER: 1976

This map is one of a series of 19 maps displaying the existing national waterways system and commodity movements, published for the U.S. Army Engineer Institute for Water Resources as a part of the National Waterways Study. The Institute for Water Resources provided technical guidance and determined the content of the maps using data developed by the Waterborne Commerce Statistics Center, U.S. Army Engineer Division, Lower Mississippi Valley, and the U.S. Department of the Interior, Bureau of Mines.

Albers Equal Area Projection

SCALE 1:7,500,000

0 50 100 200 300 400 MILES
0 100 200 300 400 500 600 700 KILOMETERS

IRON ORE FLOW
SHORT TONS

60,000,000
45,000,000
30,000,000
15,000,000

500,000-999,999
1,000-499,999
Local flow

Flows less than 1,000 short tons are not shown

NEW YORK District headquarters

For purposes of graphic presentation, flow data have been combined. Commodity movements depicted are the totals of all originating and terminating waterborne commerce within each U. S. Army Corps of Engineers District.

IRON ORE DISTRIBUTION BY STATES
SHORT TONS

CONSUMPTION PRODUCTION

56,000,000
43,000,000
30,000,000
17,000,000
4,000,000

1–3,999,999

Data for some states grouped to avoid disclosure of information about individual companies
Symbol location based on center of State or State group
Gray lines indicate the Congressional district boundaries for the 95th Congress

INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1980

NATIONAL WATERWAYS STUDY

MAP NO. 14

IRON AND STEEL PRODUCTS

MOVEMENT BY WATER: 1976

IRON AND STEEL PRODUCTS MOVEMENT BY WATER: 1976

This map is one of a series of 19 maps displaying the existing national waterways system and commodity movements, published for the U.S. Army Engineer Institute for Water Resources as a part of the National Waterways Study. The Institute for Water Resources provided technical guidance and determined the content of the maps using data developed by the Waterborne Commerce Statistics Center, U.S. Army Engineer Division, Lower Mississippi Valley, and the American Iron and Steel Institute.

Albers Equal Area Projection

SCALE 1:7,500,000

IRON AND STEEL PRODUCTS FLOW
SHORT TONS

3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000

20,000-99,999
5,000-19,999
1,000-4,999

Local flow

Flows less than 1,000 short tons are not shown

NEW YORK District headquarters

For purposes of graphic presentation, flow data have been combined. Commodity movements depicted are the totals of all originating and terminating waterborne commerce within each U.S. Army Corps of Engineers District.

PRODUCTION BY STATES
SHORT TONS

30,000,000
25,000,000
20,000,000
15,000,000
10,000,000
5,000,000
0

STATE GROUP	TOTAL PRODUCTION
1	5,870,000
2	5,403,000
3	4,109,000
4	5,079,000
5	4,431,000

Gray lines indicate the Congressional district boundaries for the 95th Congress

Principal Islands of HAWAII
SCALE 1:7,500,000

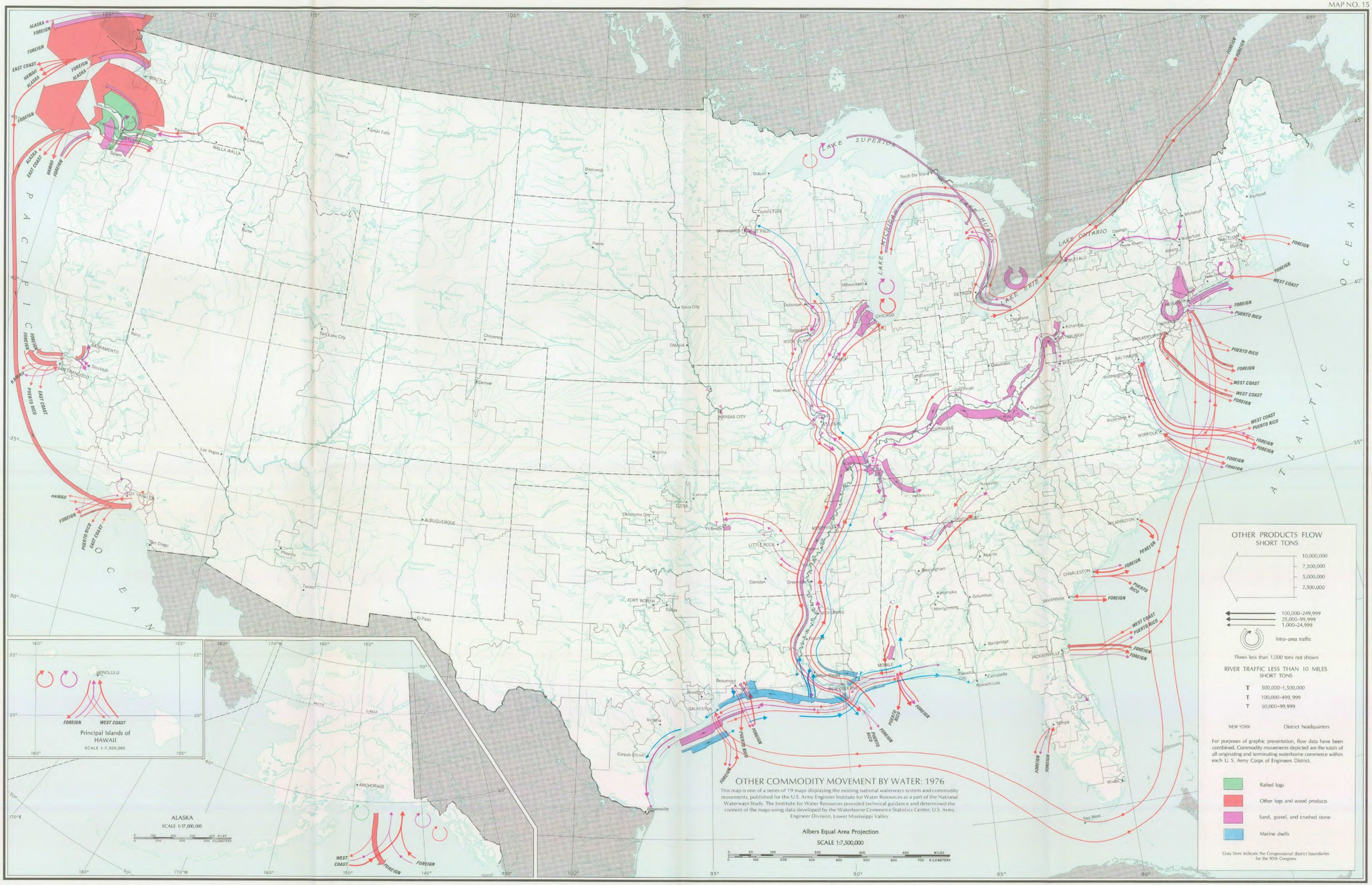
ALASKA
SCALE 1:17,000,000

INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1980

NATIONAL WATERWAYS STUDY

MAP NO. 15

OTHER COMMODITY MOVEMENT BY WATER: 1976



OTHER COMMODITY MOVEMENT BY WATER: 1976

This map is one of a series of 19 maps displaying the existing national waterways system and commodity movements, published for the U.S. Army Engineer Institute for Water Resources as a part of the National Waterways Study. The Institute for Water Resources provided technical guidance and determined the content of the maps using data developed by the Waterborne Commerce Statistics Center, U.S. Army Engineer Division, Lower Mississippi Valley

Albers Equal Area Projection

SCALE 1:7,500,000

0 50 100 200 300 400 MILES
0 100 200 300 400 500 600 700 KILOMETERS

OTHER PRODUCTS FLOW
SHORT TONS

10,000,000
7,500,000
5,000,000
2,500,000

100,000–249,999
25,000–99,999
1,000–24,999

Intra-area traffic

Flows less than 1,000 tons not shown

RIVER TRAFFIC LESS THAN 10 MILES
SHORT TONS

T 500,000–1,500,000
T 100,000–499,999
T 50,000–99,999

NEW YORK District headquarters

For purposes of graphic presentation, flow data have been combined. Commodity movements depicted are the totals of all originating and terminating waterborne commerce within each U. S. Army Corps of Engineers District.

- Rafted logs
- Other logs and wood products
- Sand, gravel, and crushed stone
- Marine shells

Gray lines indicate the Congressional district boundaries for the 95th Congress

INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1980

WATERWAYS AND PORTS
MAP NO. 16
ATLANTIC REGION

ATLANTIC REGION
WATERWAYS AND PORTS

This map is one of a series of 19 maps displaying the existing national waterways system and commodity movements, published for the U.S. Army Engineer Institute for Water Resources as a part of the National Waterways Study. The Institute for Water Resources provided technical guidance and determined the content of the maps using data developed by the U.S. Army Corps of Engineers Division and District Offices and by the Waterborne Commerce Statistics Center, U.S. Army Engineer Division, Lower Mississippi Valley.

Albers Equal Area Projection

SCALE 1:5,000,000

0 100 200 300 MILES
0 100 200 300 400 500 KILOMETERS

EXISTING PRINCIPAL WATERWAYS
1978 DATA

WATERWAY DEPTHS	DEPTH CATEGORIES IN FEET	HARBOR DEPTHS
	greater than 40	
	35 – 40	
	28 – 34.9	
	18 – 27.9	
	13 – 17.9	
	10 – 12.9	
	8 – 9.9	
	less than 8	

Existing locks

Lock names and numbers ..... Keystone ..... (8)

WATERBORNE COMMERCE
1976 DATA

TOTAL TONNAGE CATEGORIES IN MILLIONS

50 and over
35 – 49.9
20 – 34.9
10 – 19.9
1 – 9.9

Domestic and foreign traffic are shown for ports where commodity movements were one million tons or more. These ports are listed in Waterborne Commerce of the United States-1976, Part 5, Tables 3 and 4. Traffic at other ports shown was over 200,000 and less than one million tons in 1976.

TYPE OF TRAFFIC AT PORTS
PERCENTAGE DISTRIBUTION

Foreign
Internal
Coastwise
Local

FOR DETAILED DATA SEE MISSISSIPPI RIVER SYSTEM AND GULF REGION MAP

INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1980

WATERWAYS AND PORTS
MAP NO. 17

MISSISSIPPI RIVER SYSTEM AND GULF REGION

FOR DETAILED DATA SEE GREAT LAKES AND ST LAWRENCE SEAWAY REGION MAP

FOR DETAILED DATA SEE ATLANTIC REGION MAP

EXISTING PRINCIPAL WATERWAYS
1978 DATA

WATERWAY DEPTHS	DEPTH CATEGORIES IN FEET	HARBOR DEPTHS
	greater than 40	
	35 – 40	
	28 – 34.9	
	18 – 27.9	
	13 – 17.9	
	10 – 12.9	
	8 – 9.9	
	less than 8	

Existing locks

Lock names and numbers ..... Keystone ..... (8)

TYPE OF TRAFFIC AT PORTS
PERCENTAGE DISTRIBUTION

Foreign

Internal

Coastwise

Local

Total Tonnage
(Data Not Available)

WATERBORNE COMMERCE
1976 DATA

TOTAL TONNAGE CATEGORIES IN MILLIONS

50 and over

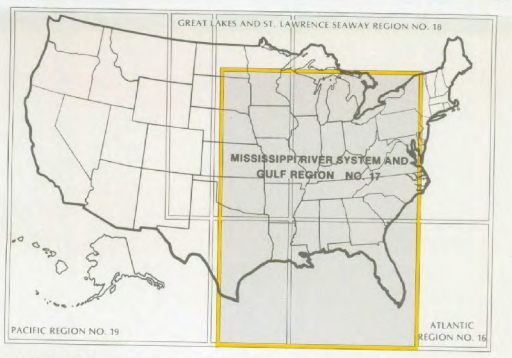
35 – 49.9

20 – 34.9

10 – 19.9

1 – 9.9

Domestic and foreign traffic are shown for ports where commodity movements were one million tons or more. These ports are listed in Waterborne Commerce of the United States-1976, Part 5, Tables 3 and 4. Traffic at other ports shown was over 200,000 and less than one million tons in 1976.



MISSISSIPPI RIVER SYSTEM AND GULF REGION
WATERWAYS AND PORTS

This map is one of a series of 19 maps displaying the existing national waterways system and commodity movements, published for the U.S. Army Engineer Institute for Water Resources as a part of the National Waterways Study. The Institute for Water Resources provided technical guidance and determined the content of the maps using data developed by the U.S. Army Corps of Engineers Division and District Offices and by the Waterborne Commerce Statistics Center, U.S. Army Engineer Division, Lower Mississippi Valley.

Albers Equal Area Projection

SCALE 1:5,000,000

0 100 200 300 MILES
0 100 200 300 400 500 KILOMETERS

INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1980

WATERWAYS AND PORTS
MAP NO. 18

GREAT LAKES AND ST. LAWRENCE SEAWAY REGION

GREAT LAKES AND ST. LAWRENCE SEAWAY REGION
WATERWAYS AND PORTS

This map is one of a series of 19 maps displaying the existing national waterways system and commodity movements, published for the U.S. Army Engineer Institute for Water Resources as a part of the National Waterways Study. The Institute for Water Resources provided technical guidance and determined the content of the maps using data developed by the U.S. Army Corps of Engineers Division and District Offices and by the Waterborne Commerce Statistics Center, U.S. Army Engineer Division, Lower Mississippi Valley.

Albers Equal Area Projection

SCALE 1:5,000,000

0 100 200 300 MILES
0 100 200 300 400 500 KILOMETERS

EXISTING PRINCIPAL WATERWAYS
1978 DATA

WATERWAY DEPTHS	DEPTH CATEGORIES IN FEET	HARBOR DEPTHS
	greater than 40	
	35 – 40	
	28 – 34.9	
	18 – 27.9	
	13 – 17.9	
	10 – 12.9	
	8 – 9.9	
	less than 8	

Existing locks

Lock names and numbers ..... *Keystone* ..... (8)

WATERBORNE COMMERCE
1976 DATA

TOTAL TONNAGE CATEGORIES IN MILLIONS

- 50 and over
- 35 – 49.9
- 20 – 34.9
- 10 – 19.9
- 1 – 9.9

Domestic and foreign traffic are shown for ports where commodity movements were one million tons or more. These ports are listed in Waterborne Commerce of the United States-1976, Part 5, Tables 3 and 4. Traffic at other ports shown was over 200,000 and less than one million tons in 1976.

TYPE OF TRAFFIC AT PORTS
PERCENTAGE DISTRIBUTION

- Overseas
- Canadian
- Local
- Lakewise
- Internal
- Total Tonnage (Data Not Available)

GREAT LAKES AND ST. LAWRENCE SEAWAY REGION NO. 18

PACIFIC REGION NO. 19 | MISSISSIPPI RIVER SYSTEM AND GULF REGION NO. 17 | ATLANTIC REGION NO. 16

FOR DETAILED DATA SEE MISSISSIPPI RIVER SYSTEM AND GULF REGION MAP

FOR DETAILED DATA SEE ATLANTIC REGION MAP

INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1980

WATERWAYS AND PORTS
MAP NO. 19
PACIFIC REGION

PACIFIC REGION
WATERWAYS AND PORTS

This map is one of a series of 19 maps displaying the existing national waterways system and commodity movements, published for the U.S. Army Engineer Institute for Water Resources as a part of the National Waterways Study. The Institute for Water Resources provided technical guidance and determined the content of the maps using data developed by the U.S. Army Corps of Engineers Division and District Offices and by the Waterborne Commerce Statistics Center, U.S. Army Engineer Division, Lower Mississippi Valley.

Albers Equal Area Projection

SCALE 1:5,000,000

0 100 200 300 MILES
0 100 200 300 400 500 KILOMETERS

EXISTING PRINCIPAL WATERWAYS
1978 DATA

WATERWAY DEPTHS	DEPTH CATEGORIES IN FEET	HARBOR DEPTHS
	greater than 40	
	35 – 40	
	28 – 34.9	
	18 – 27.9	
	13 – 17.9	
	10 – 12.9	
	8 – 9.9	
	less than 8	

Existing locks

Lock names and numbers ..... *Keystone* ..... (8)

WATERBORNE COMMERCE
1976 DATA

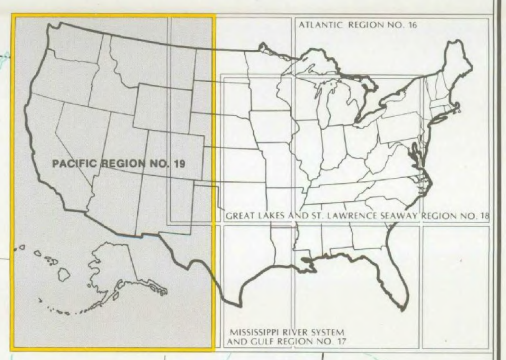
TOTAL TONNAGE CATEGORIES IN MILLIONS

50 and over
35 – 49.9
20 – 34.9
10 – 19.9
1 – 9.9

Domestic and foreign traffic are shown for ports where commodity movements were one million tons or more. These ports are listed in Waterborne Commerce of the United States-1976, Part 5, Tables 3 and 4. Traffic at other ports shown was over 200,000 and less than one million tons in 1976.

TYPE OF TRAFFIC AT PORTS
PERCENTAGE DISTRIBUTION

Foreign
Internal
Coastwise
Local



INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1980

NATIONAL WATERWAYS STUDY

MAP NO. 20

ENERGY COMMODITY MOVEMENT BY WATER: 1976

ENERGY COMMODITY MOVEMENT BY WATER: 1976

This map, one of a series displaying the existing national waterways system and commodity movements, is published for the U. S. Army Engineer, Water Resources Support Center, Institute for Water Resources, as a part of the National Waterways Study. The Institute for Water Resources provided technical guidance and determined the content of the maps using data developed by the Waterborne Commerce Statistics Center, U. S. Army Engineer Division, Lower Mississippi Valley, U. S. Department of Commerce, Bureau of the Census, and the U. S. Department of the Interior, Bureau of Mines.

TYPES OF COMMODITIES

- Petroleum Products
- Crude Petroleum
- Coal

COMMODITY FLOW
SHORT TONS

- 70,000,000
- 50,000,000
- 30,000,000
- 10,000,000
- 1,000,000–9,999,999
- 500,000–999,999
- 1,000–499,999
- Intra-District Flow

Flows less than 1,000 short tons are not shown

NEW YORK District headquarters

For purposes of graphic presentation, flow data have been combined. Commodity movements depicted are the totals of all originating and terminating waterborne commerce within each U. S. Army Corps of Engineers District.

REGIONS OF ORIGIN AND DESTINATION

1 Canada
2 The Caribbean
3 Central America
4 South America
5 Europe
6 Africa
7 Middle East
8 Asia
9 Australia
10 Puerto Rico and Virgin Islands

* Regions of origin or destination not shown

CAPACITY PER REFINERY
BARRELS PER DAY

- ▲ 200,000 and over
- ▲ 50,000–199,999
- ▲ 25,000–49,999
- ▲ 5,000–24,999

Localities of refineries producing less than 5,000 barrels per day are not identified

Gray lines indicate the Congressional district boundaries for the 95th Congress

Principal Islands of HAWAII
SCALE 1:7,300,000

ALASKA
SCALE 1:17,000,000

Albers Equal Area Projection
SCALE 1:7,500,000

INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1980

(MAP NO. 23)

The grain movements mapped on the reverse side are based on data developed from surveys of grain merchandizing, processing and exporting firms in 41 states. Members of three regional technical committees, including representatives of agricultural experiment stations in 25 states, assisted in collecting transportation flow data on wheat, corn, soybeans, sorghum, oats, barley and rye. The three regional committees participating in the surveys were the Southern Regional Committee S-115, the North Central Regional Committee NC-137, and North Central Regional Committee NC-139. In addition, surveys were conducted in 16 other states through contracts with 15 universities located in those states. The research was funded in part by the U. S. Army Engineer Water Resources Support Center, Institute for Water Resources, with supplemental support provided by three agencies of the U. S. Department of Transportation: the Federal Railroad Administration, the Maritime Administration, and the St. Lawrence Seaway Development Corporation. Administration of the study was coordinated by Lowell D. Hill, University of Illinois, Urbana-Champaign. The data were tabulated and summarized under the supervision of Mack N. Leath, Economics and Statistics Service, U. S. Department of Agriculture. The sources of the data by coastal areas of export and foreign destinations are the Canadian Grain Commission and inspections for export under the U. S. Grain Standards Act as reported in *Grain Market News*, Agricultural Marketing Service, U. S. Department of Agriculture, Volume 26, No. 5 (February 3, 1978).

Additional data are published in *Wheat Movements in the United States: Interregional Flow Patterns and Transportation Requirements in 1977*, by Mack N. Leath, Lowell D. Hill, and Stephen W. Fuller, North Central Regional Research Bulletin 274, Southern Cooperative Series Bulletin 252, and Illinois Bulletin 767, Agricultural Experiment Station, College of Agriculture, University of Illinois at Urbana-Champaign, January 1981.

(MAP NO. 24)

Sources of the data shown on the reverse side areas follows: production data are from the Economics and Statistics Service, U. S. Department of Agriculture. The grain movements data are from surveys of grain merchandizing, processing and exporting firms in 41 states. Members of three regional technical committees, including representatives of agricultural experiment stations in 25 states, assisted in collecting transportation flow data on wheat, corn, soybeans, sorghum, oats, barley and rye. The three regional committees participating in the surveys were the Southern Regional Committee S-115, the North Central Regional Committee NC-137, and North Central Regional Committee NC-139. In addition, surveys were conducted in 16 other states through contracts with 15 universities located in those states. The research was funded in part by the U. S. Army Engineer Water Resources Support Center, Institute for Water Resources, with supplemental support provided by three agencies of the U. S. Department of Transportation: the Federal Railroad Administration, the Maritime Administration, and the St. Lawrence Seaway Development Corporation. Administration of the study was coordinated by Lowell D. Hill, University of Illinois, Urbana-Champaign. The data were tabulated and summarized under the supervision of Mack N. Leath, Economics and Statistics Service, U. S. Department of Agriculture.

Additional data are in three reports dated January 1981, published by the Agricultural Experiment Station, College of Agriculture, University of Illinois at Urbana-Champaign: (1) *Soybean Movements in the United States: Interregional Flow Patterns and Transportation Requirements in 1977*, by Mack N. Leath, Lowell D. Hill, and Stephen W. Fuller, North Central Regional Research Bulletin 273, Southern Cooperative Series Bulletin 251, and Illinois Bulletin 766; (2) *Wheat Movements in the United States: Interregional Flow Patterns and Transportation Requirements in 1977*, by Mack N. Leath, Lowell D. Hill, and Stephen W. Fuller, North Central Regional Research Bulletin 274, Southern Cooperative Series Bulletin 252, and Illinois Bulletin 767; and (3) *Corn Movements in the United States: Interregional Flow Patterns and Transportation Requirements in 1977*, by Lowell D. Hill, Mack N. Leath, and Stephen W. Fuller, North Central Regional Research Bulletin 275, Southern Cooperative Series Bulletin 253, and Illinois Bulletin 768.

(MAP NO. 21)

The grain movements mapped on the reverse side are based on data developed from surveys of grain merchandizing, processing and exporting firms in 41 states. Members of three regional technical committees, including representatives of agricultural experiment stations in 25 states, assisted in collecting transportation flow data on wheat, corn, soybeans, sorghum, oats, barley and rye. The three regional committees participating in the surveys were the Southern Regional Committee S-115, the North Central Regional Committee NC-137, and North Central Regional Committee NC-139. In addition, surveys were conducted in 16 other states through contracts with 15 universities located in those states. The research was funded in part by the U. S. Army Engineer Water Resources Support Center, Institute for Water Resources, with supplemental support provided by three agencies of the U. S. Department of Transportation: the Federal Railroad Administration, the Maritime Administration, and the St. Lawrence Seaway Development Corporation. Administration of the study was coordinated by Lowell D. Hill, University of Illinois, Urbana-Champaign. The data were tabulated and summarized under the supervision of Mack N. Leath, Economics and Statistics Service, U. S. Department of Agriculture. The sources of data by coastal areas of export and foreign destination are the Canadian Grain Commission and inspections for export under the U. S. Grain Standards Act as reported in *Grain Market News*, Agricultural Marketing Service, U. S. Department of Agriculture, Volume 26, No. 5 (February 3, 1978).

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(MAP NO. 22)

The grain movements mapped on the reverse side are based on data developed from surveys of grain merchandizing, processing and exporting firms in 41 states. Members of three regional technical committees, including representatives of agricultural experiment stations in 25 states, assisted in collecting transportation flow data on wheat, corn, soybeans, sorghum, oats, barley and rye. The three regional committees participating in the surveys were the Southern Regional Committee S-115, the North Central Regional Committee NC-137, and North Central Regional Committee NC-139. In addition, surveys were conducted in 16 other states through contracts with 15 universities located in those states. The research was funded in part by the U. S. Army Engineer Water Resources Support Center, Institute for Water Resources, with supplemental support provided by three agencies of the U. S. Department of Transportation: the Federal Railroad Administration, the Maritime Administration, and the St. Lawrence Seaway Development Corporation. Administration of the study was coordinated by Lowell D. Hill, University of Illinois, Urbana-Champaign. The data were tabulated and summarized under the supervision of Mack N. Leath, Economics and Statistics Service, U. S. Department of Agriculture. The sources of data by coastal areas of export and foreign destinations are the Canadian Grain Commission and inspections for export under the U. S. Grain Standards Act as reported in *Grain Market News*, Agricultural Marketing Service, U. S. Department of Agriculture, Volume 26, No. 5 (February 3, 1978).

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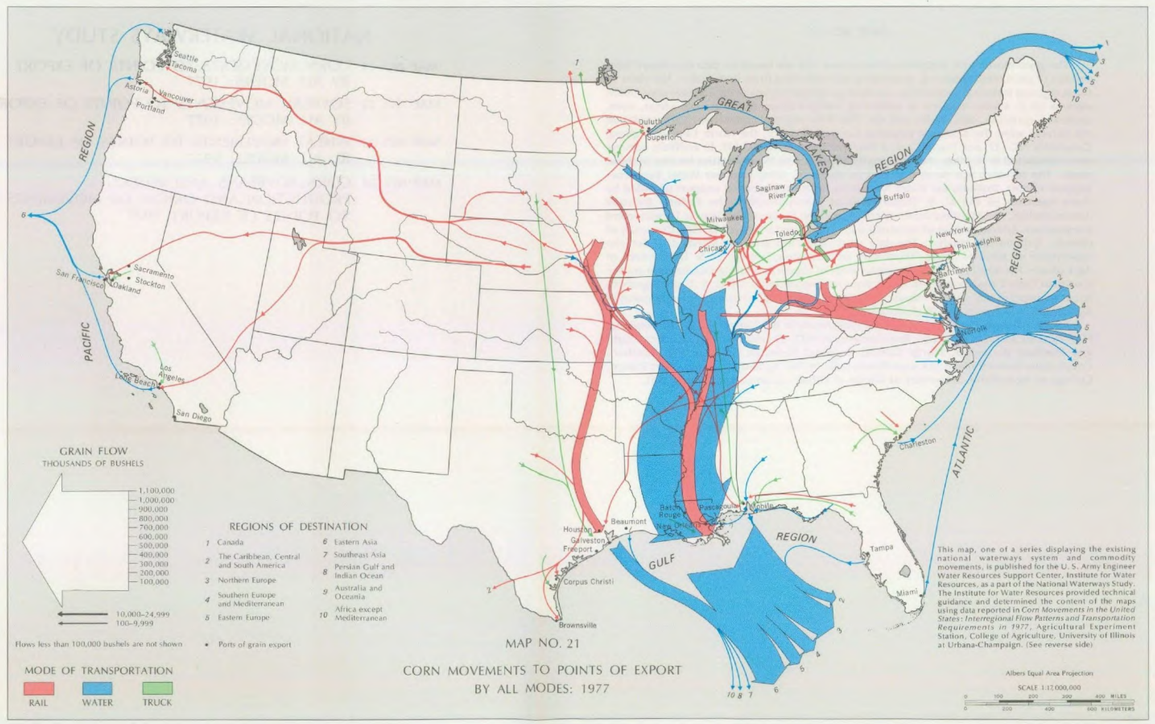
NATIONAL WATERWAYS STUDY

MAP NO. 21 CORN MOVEMENTS TO POINTS OF EXPORT BY ALL MODES: 1977

MAP NO. 22 SOYBEAN MOVEMENTS TO POINTS OF EXPORT BY ALL MODES: 1977

MAP NO. 23 WHEAT MOVEMENTS TO POINTS OF EXPORT BY ALL MODES: 1977

MAP NO. 24 CORN, SOYBEANS AND WHEAT: PRODUCTION AND ORIGIN OF MOVEMENTS TO POINTS OF EXPORT, 1977



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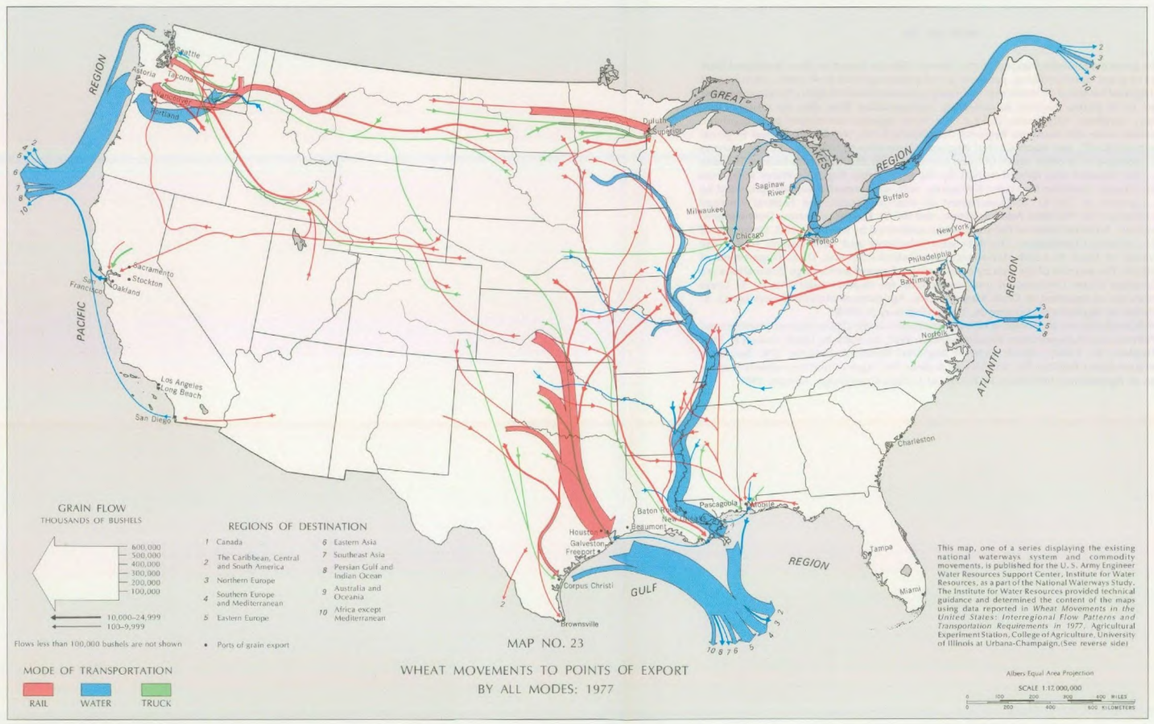
MAP NO. 21

CORN MOVEMENTS TO POINTS OF EXPORT
BY ALL MODES: 1977



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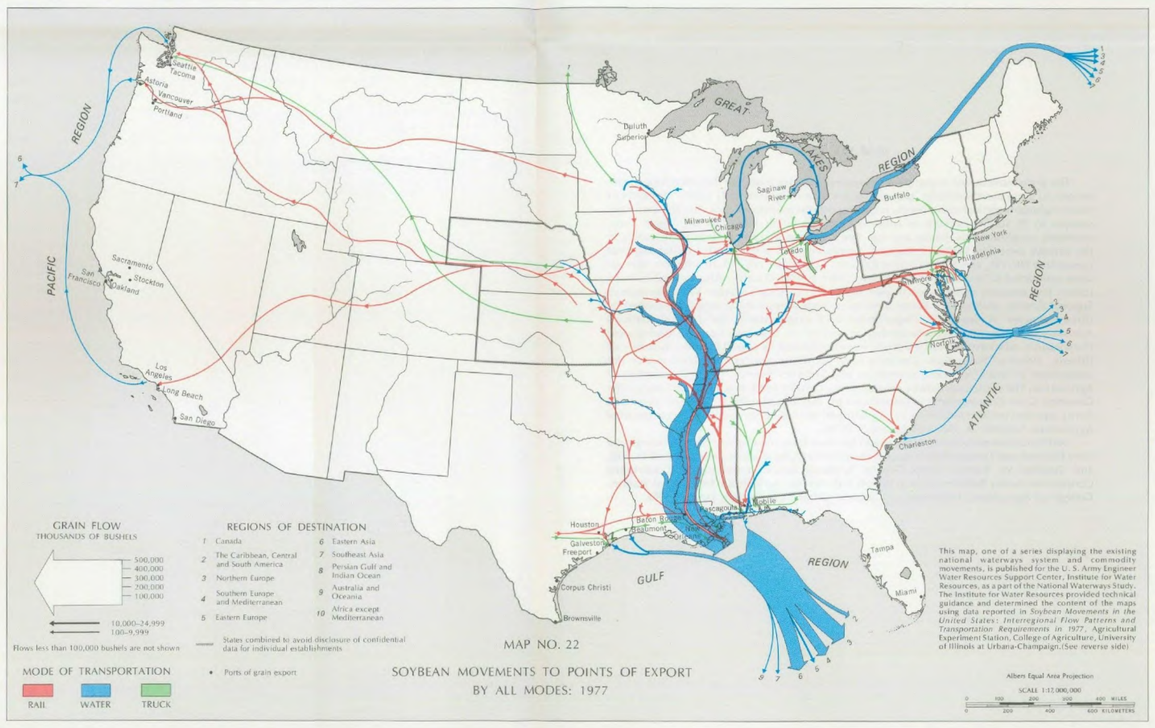
MAP NO. 23

WHEAT MOVEMENTS TO POINTS OF EXPORT
BY ALL MODES: 1977



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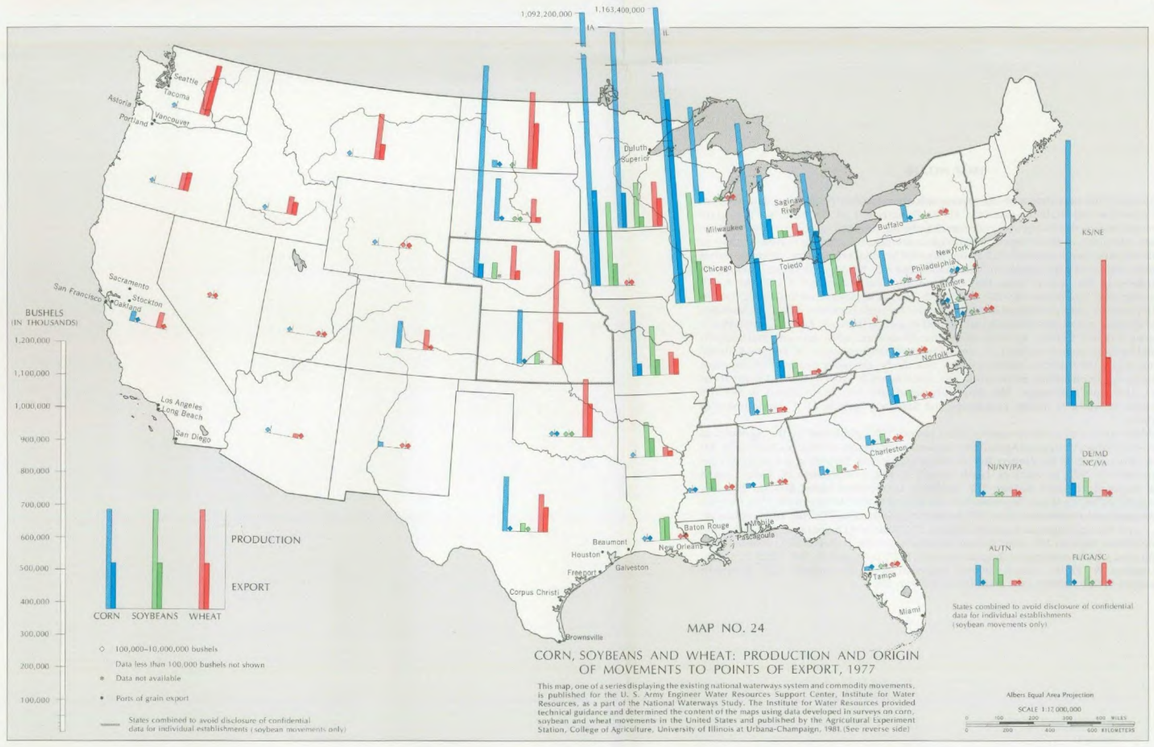
MAP NO. 22

SOYBEAN MOVEMENTS TO POINTS OF EXPORT
BY ALL MODES: 1977



MAP NO. 24

CORN, SOYBEANS AND WHEAT: PRODUCTION AND ORIGIN
OF MOVEMENTS TO POINTS OF EXPORT, 1977

This map, one of a series displaying the existing national waterways system and commodity movements, is published for the U. S. Army Engineer Water Resources Support Center, Institute for Water Resources, as a part of the National Waterways Study. The Institute for Water Resources provided technical guidance and determined the content of the maps using data developed in surveys on corn, soybean and wheat movements in the United States and published by the Agricultural Experiment Station, College of Agriculture, University of Illinois at Urbana-Champaign, 1981. (See reverse side)

INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1982