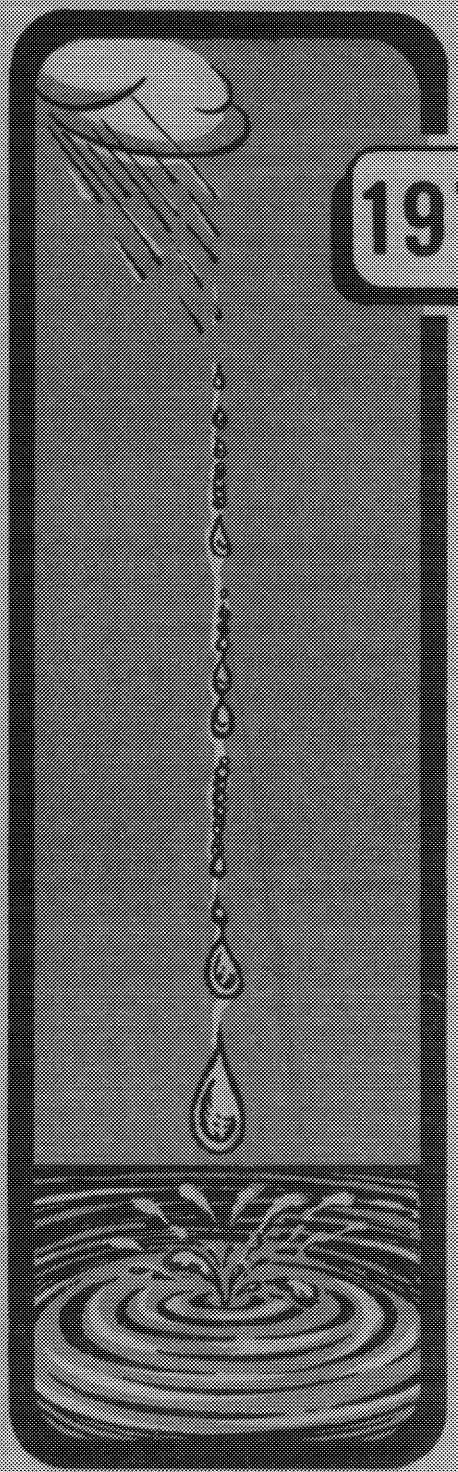
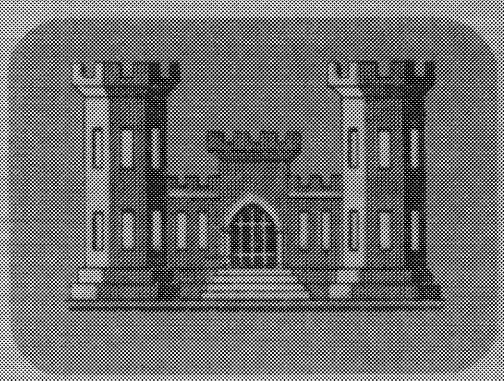


water resources development

by the
U.S. ARMY
CORPS OF ENGINEERS



in NEW HAMPSHIRE

DEPARTMENT OF THE ARMY · CORPS OF ENGINEERS
NEW ENGLAND DIVISION · WALTHAM, MASS. 02154

1973

NOTE:

General descriptions of works of improvement, presented in the text in order of river basin or coastal area, are followed by tables showing specific data on costs, benefits, and usage of each project.

Flood plain information report applications should be coordinated with the New Hampshire Water Resources Board, Concord, New Hampshire.

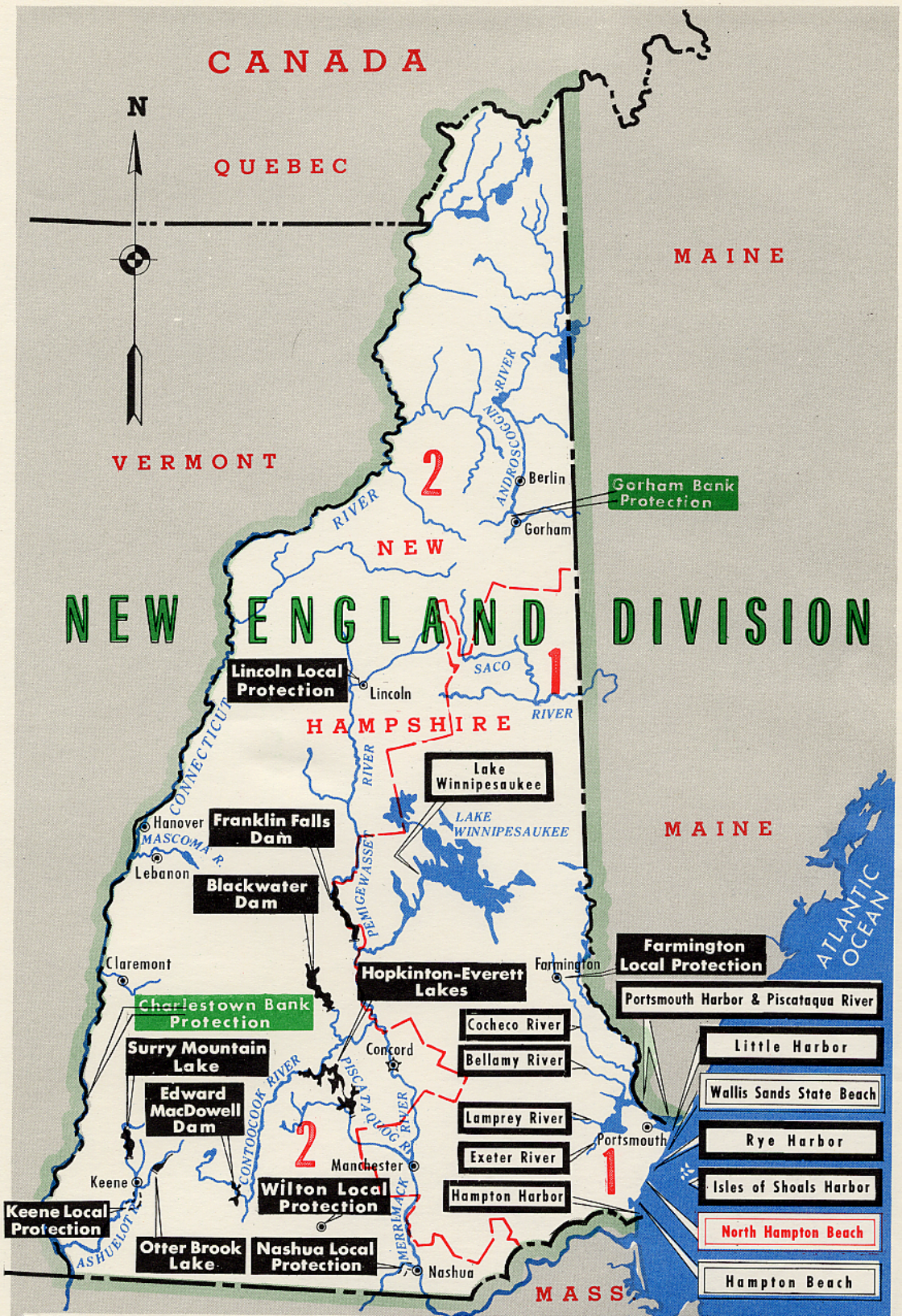
THE WORK OF THE CORPS OF ENGINEERS IN NEW HAMPSHIRE

This booklet provides information on the scope and progress of the Corps of Engineers water resources development program in the state.

If you would like further information on particular projects, activities and areas, please address inquiries to:

The Division Engineer
New England Division,
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

PROJECT MAP UNDERLEAF



Legend

	COMPLETE	UNDERWAY	NOT STARTED
NAVIGATION		(NONE)	(NONE)
FLOOD CONTROL			(NONE)
SHORE PROTECTION		(NONE)	

* MULTIPLE-PURPOSE PROJECT

authorized federal projects in NEW HAMPSHIRE

10 5 0 10 20 30
MILES

1973

1 2 CONGRESSIONAL DISTRICTS (2)

DEPARTMENT OF THE ARMY • NEW ENGLAND DIVISION • CORPS OF ENGINEERS

ENVIRONMENTAL QUALITY

TO OUR READERS:

Many responsible citizens are concerned today about the conservation and enhancement of our environment. We in the Army Corps of Engineers are concerned also. For almost two centuries the Corps, as the principal planner and developer of America's water resources, has responded to the changing needs of the Nation for the various benefits of water resources development. In this tradition, we are determined to remain sensitive to the American people's growing awareness of the importance of environmental quality. We are scrutinizing and revising our planning techniques to insure that they accurately reflect our concern for environmental values. The problems, while complex, are not insurmountable.

The Corps will continue to seek balance in meeting the environmental and developmental needs of our Nation. Merely determining whether or not a specific engineering solution is economically justified is not enough. We shall encourage and support efforts to bring the best existing ecological knowledge and insights to bear on planning, developing, and managing the Nation's water and related land resources. Environmental values will receive full consideration along with economic, social, and technical factors.

To realize the goals of environmental conservation, we must have active public participation in the planning process. We shall provide governmental and nongovernmental agencies and the public with timely information opportunities, consequences, benefits and costs – financial and environmental. Before making recommendations, we shall actively solicit the views of those affected by our proposals.

As a citizen interested in the future of this State's water resources, you have opinions that are of value to the Corps of Engineers. Any steps we take must be taken together.

F. J. CLARKE
Lieutenant General, USA (Ret)
Former Chief of Engineers

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MAPS

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CORPS OF ENGINEERS ACTIVITIES

SCOPE

Water resources development by the Corps of Engineers in the New England States began in the early 1800's with improvements of waterways for navigation and protection of land from the sea. Activities have since expanded to include improving harbors and navigable channels; making engineering reports on the streams, shores, and flood plains of the states, providing shore protection, flood plain management services, flood insurance studies, flood control and related works such as for water supply, stream regulation and water-oriented outdoor recreation; and administering laws relating to preservation of navigable waters, water quality and environmental quality. The planning for conservation and efficient use of the vital water and related land resources of the region reflects the needs and aspirations of the people in keeping with the finite availability of resources, and the need for enhancing the quality and productivity of the environment.

AUTHORIZATIONS

Each Federal project must be specifically authorized by Congress or approved under the provisions of special continuing authorities established by Congress. The basic Congressional authority pertaining to water resources lies in the "commerce clause" of the Constitution. Subsequent participation by the Corps of Engineers in the development of water resources has been directed by Congress since the 1820's to include the wide range of activities discussed in this booklet. All new work requires the preparation and approval of a report on the need and justification for improvements, including the receipt of favorable comments and subsequent assurances from the states and municipalities affected. Funds for initiating the authorized improvements are not provided by the authorizing act, but are allocated from subsequent Congressional appropriations. Projects are designed and built in accordance with authorizing acts and such general laws and environmental guidelines as may be applicable after appropriation of funds. Information concerning the authorization of studies and project formulation is discussed in subsequent sections.

Isles of Shoals

STUDIES

Study inquiries generally originate at the community level from individual citizens or from municipal or semi-public organizations in either of two ways:

(1) If local citizens or agencies believe there is need for provision or improvement of water resource projects, particularly those of broad scope, they may present their views through their representatives in Congress for consideration by the appropriate Congressional committee. If consideration proves favorable, Congress directs the Corps of Engineers to make an engineering and economic study of the proposed improvements, and report its findings and recommendations back to Congress (together with comments by the Governors of the states affected and by other Federal agencies) for consideration of the need for Federal participation in the proposed improvement.

(2) Should the desired improvements appear to be within Federal cost limitations for smaller projects, as discussed in the next section under "Small Projects and Emergency Work," citizens may ask their City or Town Council, or Board of Selectmen (if fully empowered under State law to provide all required local cooperation) to submit a request for a small project study directly to the Division Engineer, New England Division, Corps of Engineers.

SMALL PROJECTS AND EMERGENCY WORKS

In addition to large projects which are authorized directly by Congress, the Corps of Engineers may accomplish small projects and emergency work under special continuing authorities established by Congress and with general funds appropriated annually. These projects are subject to the same principles of feasibility and requirements of local cooperation as Congressionally authorized projects. The Chief of Engineers, under the direction of the Secretary of the Army, may authorize and construct those small projects which are complete in themselves and do not commit the United States to any additional improvement to insure successful operation. The Federal cost limitation for such projects is $1 million for small navigation projects (Section 107 authority of 1960 River and Harbor Act as amended through 1970), $1 million for small beach erosion projects (Section 103 authority of 1962 River and Harbor Act as amended through 1970), and $1 million for small projects for flood control and related purposes (Section 205 authority of 1948 Flood Control Act as amended through 1962). The Corps of Engineers may spend up to $50,000 for emergency bank-protection measures at any single locality to prevent flood damage to public buildings, highways, water supply and sewage treatment works. The Corps also may spend up to $100,000 for snagging, clearing and straightening of any stream channel to prevent flood damages. The Corps also has authority to spend up to $1,000,000 for the prevention or mitigation of shore damages attributable to existing Federal navigation project works.

Typical small flood control project

BASINWIDE AND REGIONAL PLANNING

Because water is a regional problem, each river basin for which Congress has authorized an investigation is studied as a unit, as well as by subunits (sub-basins), in formulating long-range plans for the improvement of each major watershed. This important concept insures economical use of water resources, in keeping with Senate Document 97, 87th Congress. It also permits consideration of the necessary constraints so that the demands of individual communities will not have an adverse effect upon neighboring communities or an adverse effect upon the need for preserving or conserving adequate resources for the future well-being of man, his environment and the unique ecology of the region, in keeping with the provisions of the 1969 National Environmental Policy Act. These studies include consideration of flood control, navigation, shore and bank protection, domestic and industrial water supply, watershed management, flood plain management, generation of hydroelectric power, low flow augmentation, water quality improvement, fish and wildlife conservation and enhancement, recreation, conservation of other environmental resources, as well as economic base studies and ecological base studies. Close cooperation is maintained with local interests and other Federal agencies during the plan formulation and subsequent detailed design phases, and the plans of other agencies are considered.

In addition to comprehensive river basin studies, investigations also are made to assess water resources needs of regional or national scope. Recent and present studies encompass such topics as water supply in metropolitan centers, shore and bank erosion, flood insurance analyses, economic development analyses, environmental and water quality improvement, flood plain management and establishment of master plans for regional multiple-purpose water resource development and management.

Although flood control has been a major function of most Corps of Engineers reservoir projects, regional or basin needs may require the development of multiple-purpose reservoirs or alternative measures to serve other necessary or potential functions. River basin planning may also require consideration of needs in contiguous basins to meet the ever changing needs and use of water resources within the region. The Corps of Engineers endeavors to evaluate all water needs and develop a comprehensive plan that will provide the greatest benefit to both the local area and the nation.

URBAN STUDIES

The Urban Studies Program of the Corps of Engineers is a response to the newly emerging national development priority — solution to the critical problems of urban areas. The basic objective of the Urban Studies Program is to develop water and related resources plans for specified urban areas of the United States that not only offer realistic prospects for solving specific urban problems, but equally important, also have the potential to serve as a catalyst for solving other related problems. The program, in the context of proposed public action by the Federal government, State, and local interests is directed to the achievement of the general welfare through contributions to national economic development, regional development, social well-being and environmental quality. Alternative water and related resources plans are considered to be the primary vehicle by which contributions are made to these four components.

The established criteria for the development of such plans require that each plan be formulated to:

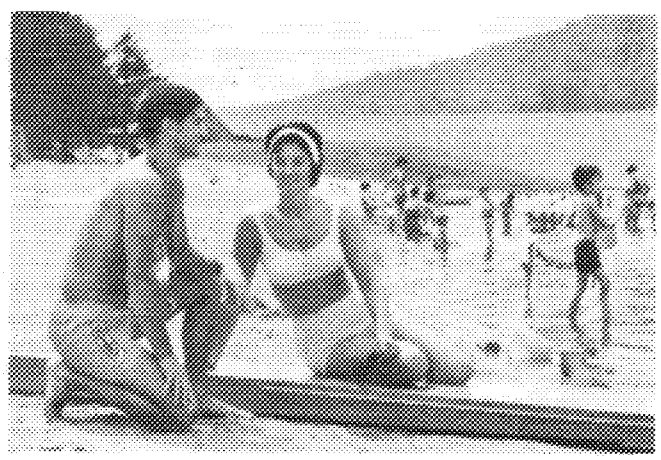
- meet the specified needs and concerns of the public within the study area ("public" may be defined as any non-Corps of Engineers agency or group)
- respond to expressed public desires and preferences
- be flexible to accommodate changing economic, social, and environmental patterns and changing technologies
- integrate with and be complementary to other urban development and management programs
- be fully coordinated with affected public agencies at all levels
- develop through an orderly structure and open planning process
- be implementable with respect to financial and institutional capabilities and public consensus
- where appropriate, be certifiable by applicable State and Federal agencies

The specific kinds of problems which will receive attention by the Corps of Engineers under this program include, but are not necessarily limited to the following: urban flood control and flood plain management; municipal and industrial water supply wastewater management; bank and channel stabilization; lake, ocean, and estuarine restoration and protection; recreation management and development at civil works projects; and regional harbor and waterway development. It should be noted that the wastewater management portion must satisfy all requirements of Public Law 92-500, the Federal Water Pollution Control Act of 1972, as amended, which imposes upon municipalities the requirements of zero discharge of pollutants by 1985.

PROJECT FORMULATION

The Corps of Engineers functions as an engineering consultant to Congress and the people and, as such, must assure a full degree of participation by the people and their governmental officials in the development of water resource projects. In fact, maximum cooperation and coordination with other Federal, State and local agencies is required under the law, from the beginning of investigation. It is the responsibility of the Corps of Engineers to study as completely as necessary for sound conclusions all aspects of local and general needs and the fullest practicable use of water resources and projects sites, consonant with full consideration of unique and vital environmental values.

Unless a report shows that a proposed project will meet both immediate and future resource needs of the people concerned, has their support and produces the best use or combination of uses of natural resources, the study has not achieved its objective. Project formulation and report recommendations are based on the principle that the benefits expected to accrue to each project purpose must exceed the cost of incorporating each project purpose in the proposed work. In order to balance the increasing demands for resource development with the need to conserve and enhance our natural environment, it is necessary that alternative solutions including nonstructural measures receive full consideration. Each realistic alternative must be evaluated to assure that the best solution, where warranted, will have minimum impact on environmental values. Environmental impact statements and other pertinent public information must clarify the choices available so that the public through its representatives may narrow the alternatives (including preservation of the status quo) to a single choice.



Multiple-purpose use of water resource project area

MULTIPLE-PURPOSE WORKS

In addition to single-purpose projects for navigation, shore protection, flood control, major drainage, hydroelectric power generation, or reclamation (irrigation), the Corps of Engineers may participate in the development of a wide range of water resource projects. Present authorities stipulate that other project purposes may be incorporated as part of dual- or multiple-purpose projects only if they are developed in conjunction with one or more of the basic project purposes noted above, where applicable. These other purposes may include outdoor recreation; fish and wildlife conservation and enhancement; municipal and industrial water supply, streamflow augmentation, watershed protection and management, water quality control, restoration and enhancement of environmental quality, and preservation of unique archeological, historical and natural resources.

FLOOD CONTROL WORKS

Basically, all means of controlling floods can be divided into three broad classifications — first, those which change the channel in which the water flows, second, those which control the amount of water in the channel at time of flood and, third, those which limit the extent and types of development within the flood plains. Dikes, floodwalls, conduits and channel improvements confine floodwaters to the channel. Dams and reservoirs, in contrast, temporarily hold back floodwaters. Gated outlet works permit orderly release of the stored water after the flood crest has passed all potential downstream damage centers. Dikes, floodwalls and channel improvements are designed to give protection along limited stretches of a river. Dams and reservoirs, balanced with nonstructural measures such as flood plain management, generally comprise the most practical and economical means of protecting long stretches of a river valley. Usually a combination of structural and nonstructural measures is necessary for basin protection.

Local protection works, upon completion, are turned over to local authorities for operation and maintenance. Flood control reservoirs, on the other hand, are usually operated and maintained by the Corps of Engineers unless the protection they provide is mainly local as in the case of reservoirs controlling very small drainage areas. Corps of Engineers operation of major reservoirs is desirable because reservoirs in a given basin provide greater flood flow reductions when operated as an integrated unit.

NAVIGATION WORKS

River and harbor improvements have been directed by the Congress for the development of waterborne commerce, the reduction of navigation difficulties and hazards, and for increased utilization of our waterways. Consisting essentially of the deepening of harbors and inland waterways so that ships and other craft can be accommodated, these improvements provide an economical means of transportation where it can be made available and furnish superior means of moving such products as coal, steel, petroleum and other bulk commodities. Integrated with rail and truck transportation, improved waterways meet the ever growing needs of industry and commerce. Other navigation works include the development of safe entrance channels, major access channels, and maneuvering and turning basins for the rapidly increasing number of recreational boats and for fishing and other craft.

Recreational boating activity

SHORE PROTECTION WORKS

The purpose of shore protection works is to prevent shore damage and promote and encourage the healthful recreation of the people by construction of works for the restoration and protection of shores against erosion by waves and currents. Congress has established a Federal policy of assistance in the construction of remedial and protective works along coastal shores, such as seawalls, stone groins and mounds, riprap, sand replenishment and sand fences. This assistance involves the contribution of funds generally not exceeding 50 percent of the cost of a project, with the remainder to be paid by the State, municipality or other political sub-

division in which the project is located. Federal participation in the protection of publicly owned shore parks and conservation areas may be 70 percent of the total cost, exclusive of land costs, while the full cost of protecting Federal property is met by Federal funds. Federal assistance is normally limited to publicly owned shores but consideration may also be given to shores open to full public use or essential to the protection of nearby public facilities or highways.

Recreational use of shore protection project

HYDROELECTRIC POWER

Hydroelectric power has long been an important part of our economic system and, as our population increases, the need becomes more urgent. By a series of laws and resolutions, dating back to the River and Harbor Act of 1909 and sustained by the Supreme Court, power development may be included by the Chief of Engineers in multiple-purpose projects when it is collateral to the major objectives of flood control and navigation.

Accordingly, in the evaluation of over-all water resources, the Chief of Engineers makes comprehensive plans, which include consideration of power, and submits them to Congress for adoption. As a result, many multiple-purpose projects involving hydropower development have been authorized.

WATER SUPPLY

Water supply is of vital interest to the national economy and security, and full attention is given to this subject in the planning of river basin works. Under Section 6 of the Flood Control Act of 1944, the Secretary of the Army is authorized to make contracts with States, municipalities, private concerns, or individuals for domestic and industrial uses for surplus water that may be available at Corps of Engineers projects. The Water Supply Act of 1958 makes further provision for water-supply storage in Federal navigation, flood control, irrigation, or multiple-purpose projects. Under terms of the Water Supply Act local interests may reimburse the Federal Government for the costs involved over a period of 50 years.

AQUATIC PLANT CONTROL

A program for control and progressive eradication of certain obnoxious aquatic plant growths is authorized by Section 302 of the River and Harbor Act of 1965. This program is administered by the Chief of Engineers in cooperation with other Federal and State agencies. Local interests are required to pay 30 percent of the cost and to hold and save the Federal Government free from claims that may occur as a result of these operations.

The principal aquatic plant problems in New England are usually related to eutrophication as algae blooms. Generally, plant growth related to eutrophication is excluded from this program.

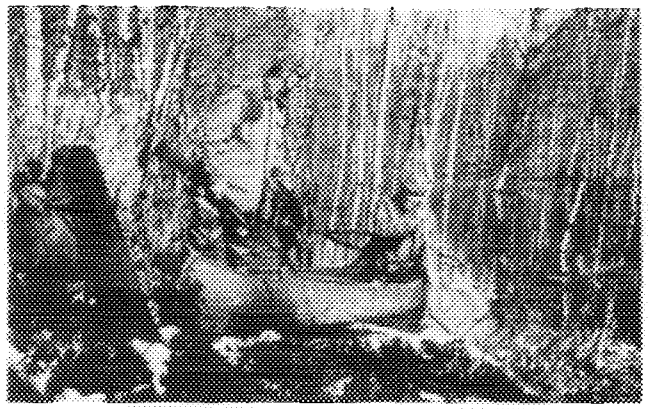
PUBLIC USE, RECREATION AND CONSERVATION

Land and water areas of Civil Works projects are administered for maximum sustained public benefits compatible with authorized purposes. With the continued expansion of urban areas and attendant loss of natural recreational areas, the development of recreational facilities becomes an increasingly important function of existing and prospective projects. Management, use and appropriate development of project areas for this purpose are encouraged. Under the 1965 Federal Water Project Recreation Act (P.L. 89-72, 89th Congress), recreational and fish and wildlife enhancement features may be developed as part of any Federal water resource project if economically justified and if non-Federal public entities agree to administer the project land and water areas for recreation or fish and wildlife and agree to bear 50 percent of the separable costs allocated to either or both purposes.

Facilities which are necessary for the public enjoyment of the full recreation potential are provided. These facilities are those necessary for information and guidance, observation and sightseeing, boat launching, picnicking, swimming and bathing, fishing and camping as well as those necessary for public safety, public health and the preservation and protection of natural resources.

Public hunting and fishing are encouraged consistent with applicable State laws. Conservation measures to improve these resources are undertaken in cooperation with Federal and State fish and game agencies.

In some New England States the Corps of Engineers administers Federally owned land and water areas at a number of civil works projects and leases portions of the areas to the respective states for recreation, forestry, and fish and wildlife conservation purposes. The acreage of land administered and leased in each state is tabulated below:



Conservation and recreation are major considerations in water resource projects

FEDERALLY OWNED LAND AND WATER AREAS

CIVIL WORKS PROJECTS IN NEW ENGLAND

STATE	ADMINISTERED BY CORPS OF ENGINEERS (acres)	LEASED (acres)	PROJECTS
New Hampshire	18,618	15,000	6 Reservoirs
Vermont	9,462	3,000	8 Reservoirs
Massachusetts	16,872	12,500	11 Reservoirs and Cape Cod Canal
Connecticut	8,841	4,083	8 Reservoirs

FLOOD PLAIN MANAGEMENT SERVICES

The flood plain is an integral part of a river system, a reserve area carved out by the river itself to hold surplus water in times of flood. Damage occurs where man has trespassed on the river. Continuing encroachment on the flood plain reduces the hydraulic efficiency of river channels and tends to offset the gains earned by flood control dams, floodwalls, dikes and associated improvements. A solution to the problem of reducing flood damage can be effected by the exercise of wiser use of flood plains through adequate knowledge of the flood hazard. Cooperative action by local, State and Federal governments and private interests is essential. At the Federal level, continuing efforts through existing programs seek to limit future increases in flood damages.

Section 206 of the 1960 Flood Control Act (P.L. 86-645), as amended, authorizes the Corps of Engineers to compile and disseminate information on floods, flood damage potentials and general criteria for guidance of Federal and non-Federal interests in the use of flood plains. The Flood Plain Management Services program provides guidance to Federal agencies concerned with site location of Federal improvements, disposal of Federal properties in flood hazard areas and proper consideration of flood hazard in all Federal grant, loan, mortgage insurance and land use programs.

The program provides assistance and guidance to State and local agencies, by means of the following:

a. **Flood Plain Information Reports.** These are prepared to provide information to State and local governmental agencies for wide public dissemination. The information is intended to be put to use through planning groups, zoning boards, private citizens, engineering and planning firms, real estate and industrial developers, and others to whom it would be valuable. This engineering assistance includes identification and mapping of areas subject to flooding; compiling hydrologic, flood frequency and flood damage information; and establishing general criteria on flood plain use to aid State and local agencies in developing land use plans and regulating the use of flood plain areas.

Showing need for flood plain management

A study request may be initiated by a local or State agency having jurisdiction under State law in flood plain regulation and planning. The requesting agency is expected to furnish available data, publicize the findings of the study, make the information available for inspection by interested parties and encourage appropriate action by planning, zoning and other regulatory agencies. Applications should be coordinated with the appropriate state agency, as noted on page 1, prior to submission to the Corps of Engineers.

b. Technical Services and Guidance. Technical assistance is given State and local governments in the preparation of flood plain regulations. Interpretation of flood data in the reports, provision of additional data, suggestions for floodway areas and evaluation of the effect of those floodways on flood heights, and related assistance are given planners and officials as they prepare and adopt flood plain regulations.

Assistance is also given to State and local governments in evaluating and using flood data for making individual decisions concerning flood hazards. This includes brief, flood plain information reports, where necessary, for specific sites. Necessary flood information and guidance are provided, on request, to permit wise decisions concerning locations of public buildings, subdivisions and other land uses. Technical assistance is also given on flood proofing.

c. Guides, Pamphlets, Related Research. Pamphlets and guides pertaining to flood plain regulations, flood proofing and other related actions are made available for use by Federal, State and local governments, and citizens in planning and taking action to reduce their flood damage.

d. Comprehensive Flood Damage Prevention Planning. Comprehensive flood damage prevention planning, at all appropriate governmental levels, is the ultimate objective of the program. This brings State and local officials into the planning action to a greater degree and insures increased consideration of alternative measures, both structural and nonstructural, for flood damage reduction.

The success of any flood plain management program depends upon thorough public understanding of the nature of the program. Equally important are local support, administration and enforcement of zoning regulations. In areas where flood plains are being encroached upon by urbanization, the consequences of early action (or inaction) by municipal governments may be observed in the near future.

FLOOD INSURANCE STUDIES PROGRAM

Flood insurance studies are carried out to map eligible communities by risk zones and to determine insurance rates. The studies are made under

the provisions of Public Law 90-448, Title XIII, The National Flood Insurance Act of 1968. This statute, administered by the Federal Insurance Administration of the Department of Housing and Urban Development (HUD), utilizes services of the private insurance industry and provides for Federal subsidization of flood insurance on one to four family dwellings, small business properties and their contents. The insurance covers damage caused by overflow of either inland or tidal waters on flood-prone land and/or by mudslides.

The initiative in obtaining flood insurance coverage must be taken by a community through its legislative body. One requirement is that zoning be enacted which would necessitate construction of the first livable floor above the level of the 100-year flood, that is a flood that has a one-percent chance of occurrence each year. Studies to establish actuarial rates or to determine the extent to which flood protection measures affect such rates are conducted by several agencies of the Federal government, including the Corps of Engineers.

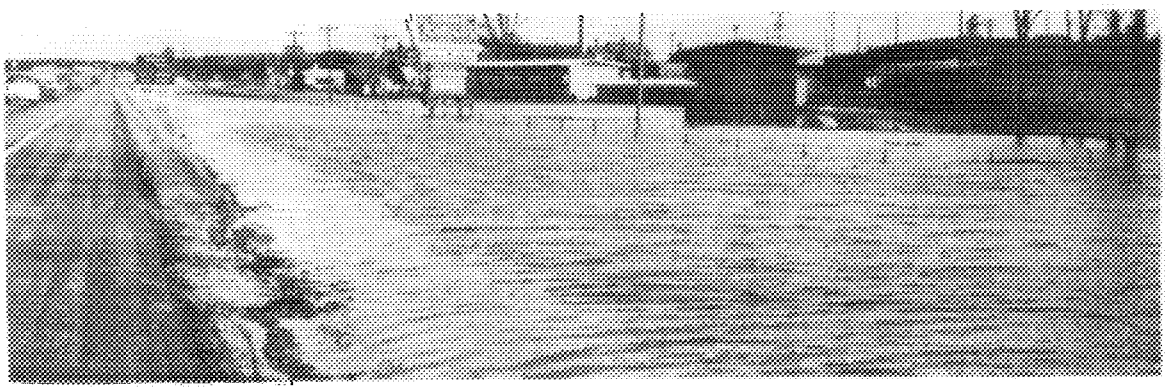
PERMITS PROGRAM

One of the missions of the New England Division is to administer the regulatory functions program. This program concerns the issuance of permits for activities in navigable waters, a function carried out under the provisions of the River and Harbor Act of 1899, the Federal Water Pollution Control Act Amendments of 1972, and the Marine Protection, Research, and Sanctuaries Act of 1972. These laws prohibit unauthorized obstruction or alteration of any navigable water of the United States. The Division Engineer, under authority delegated by the Secretary of the Army, may, after determining that the work is in the best public interest, issue a permit authorizing the work.

Permits must be obtained for any construction performed seaward of the mean high water line in navigable waters. Navigable waters have been defined as any waters which have been in the past, currently are, or may be in the future suitable for the purpose of interstate or foreign commerce. Permits are applicable to the construction of piers, overhead and submarine cables, bulkheads, outfall structures, groins, jetties, booms, fill, dredging, and discharge of dredged or fill material in navigable waters.

Although the permit program has been in existence since 1899, the law was historically interpreted to provide consideration of the effects of a project on the navigability of the waterway. In recent years, additional legislation has been enacted to provide consideration of the total public interest including water quality, economics, aesthetics, environmental factors, ecology, navigation and other factors. This has also resulted in an increased emphasis on the enforcement phase of the program. Over 1,200 rivers, harbors, coves and other waterways within New England are now considered navigable waterways. Based on recent changes in the definition of navigability, these determinations are being updated. It is expected that many more waterways will soon be classified as navigable.

The processing requirements of the permit application are extensive. Each application is reviewed for adequacy and completeness of the information. A preliminary determination is made as to whether an Environmental Impact Statement should be prepared. A public notice is prepared and circulated to approximately 40 Federal, State and local officials and agencies who review the project for aspects within their jurisdiction. Abutting property owners and other special interest groups receive notices, while additional coverage is provided by posting a copy in the local post office and



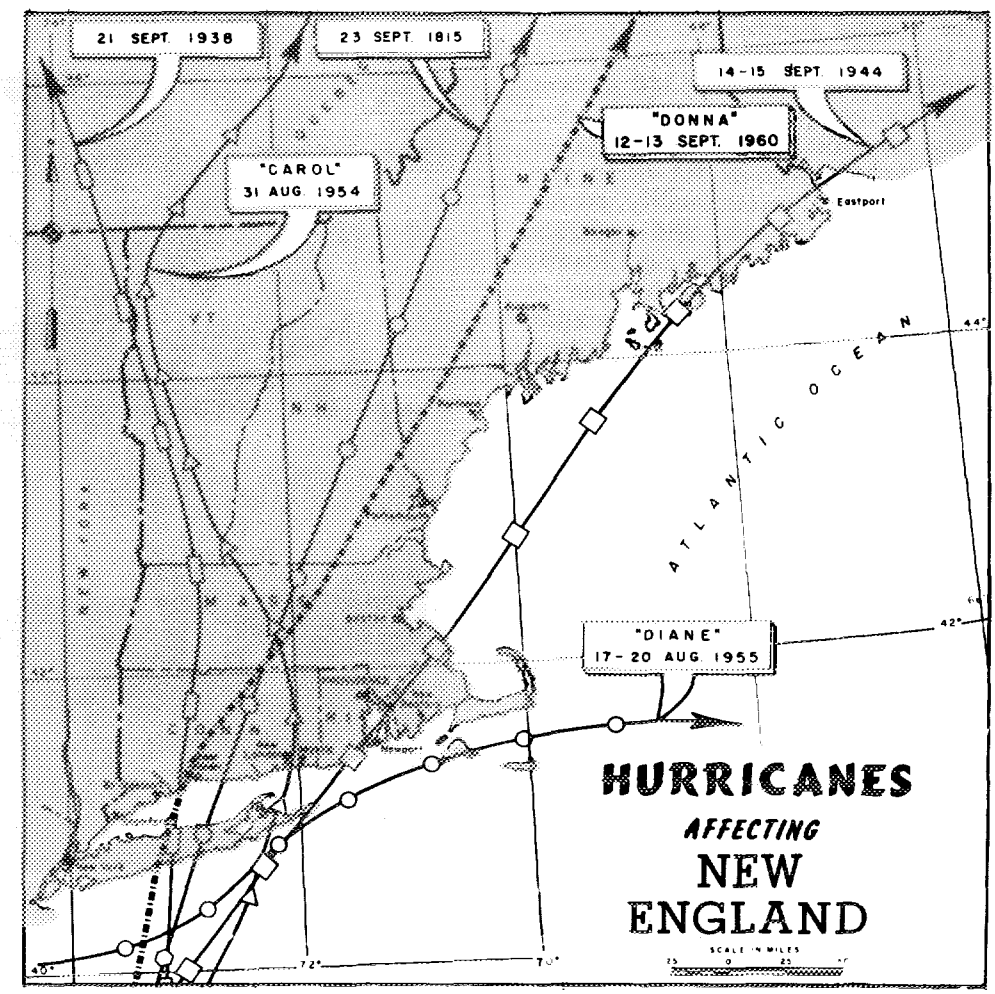
Showing urbani zation of flood plain

publishing the details in a local newspaper. Controversial proposals may also require a formal public hearing. A review is then made of the information or objections received in response to the public notice, and of the problem area resolved, and an impact statement is prepared, if appropriate. If the project is deemed to be in the best public interest, the permit may be issued. The time required to process an application varies widely depending upon its complexity. It takes from six weeks for a routine application, to over a year for projects requiring preparation of an Environmental Impact Statement.

Assistance is available to applicants including advice as to the need for a permit, instructions on the preparation and submission of applications, and assistance in revising projects to meet requirements requested by other parties. Also, pamphlets with narrative and graphic instructions are available on request.

HURRICANE AND TIDAL FLOOD PROTECTION WORKS

The purpose of tidal flood protection works is to prevent loss of life and damages resulting from salt water flooding by hurricane surge and other storm-driven waves. Damages resulting from tidal flooding can be significantly reduced in some cases by adequate protective structures. Such structures include dams or barriers (often with openings for navigation and other purposes) to close off the waterway to the entry of hurricane tides, dikes or walls along the shore to hold back high water, or a combination of barriers, dikes and walls. Breakwaters are an effective means of reducing wave heights but are usually ineffective in preventing the flooding of shore properties. In some areas effective protection may be obtained by raising the natural beaches and sand dunes. Navigation, beach erosion and tidal-flood protection improvements may often be accomplished at lesser total cost, through savings in construction costs if developed as part of dual- or multiple-purpose coastal projects.



NED RESERVOIR CONTROL CENTER

New England rivers have overflowed their banks since time immemorial. In recent years they have produced increasing flood destruction. As the valleys were settled and portions of the flood plains became densely occupied by industrial, commercial and residential developments, the flood problems increased. Rapid industrial and urban expansion for the burgeoning population greatly increased the potential for flood damage. In the coastal shore areas, construction of year-round homes and summer cottages and expansion of commercial, industrial and seaport facilities increased the potential damage from abnormally high tides. Major flooding of all types caused loss of life, damage to property and soil and beach erosion.

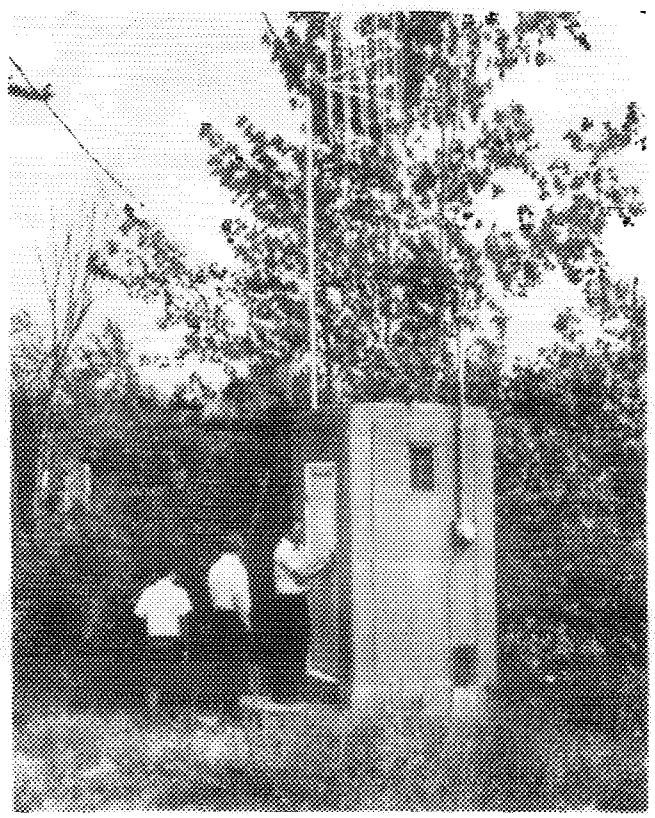
These problems were focused by the disastrous floods of March 1936, September 1938, August 1954 and August 1955 at which time only 9 reservoirs and 14 local protection projects were in operation. The New England Division has since expanded these projects with the addition of 25 reservoirs, 23 local protection projects and 4 hurricane barriers. The latter structures, all located in coastal communities, provide tidal flood protection from severe coastal storms and hurricanes. Construction of these 75 completed projects represents a Federal investment of about $330 million.

In earlier years, most reservoirs were constructed almost exclusively for flood reduction purposes; now the majority include storage for other purposes such as water supply, water quality, recreation and enhancement of fish and wildlife. Reservoir operating problems have significantly increased not only with the greater number of projects, but also with the increased complexities of functional requirement. All 35 reservoir projects contain flood control storage and all but 14 are multiple-purpose in nature. In order to cope with the ever-increasing operational and management problems of regulations both within the Corps and with State, Federal and private agencies, NED established a Reservoir Control Center (RCC) in January 1969.

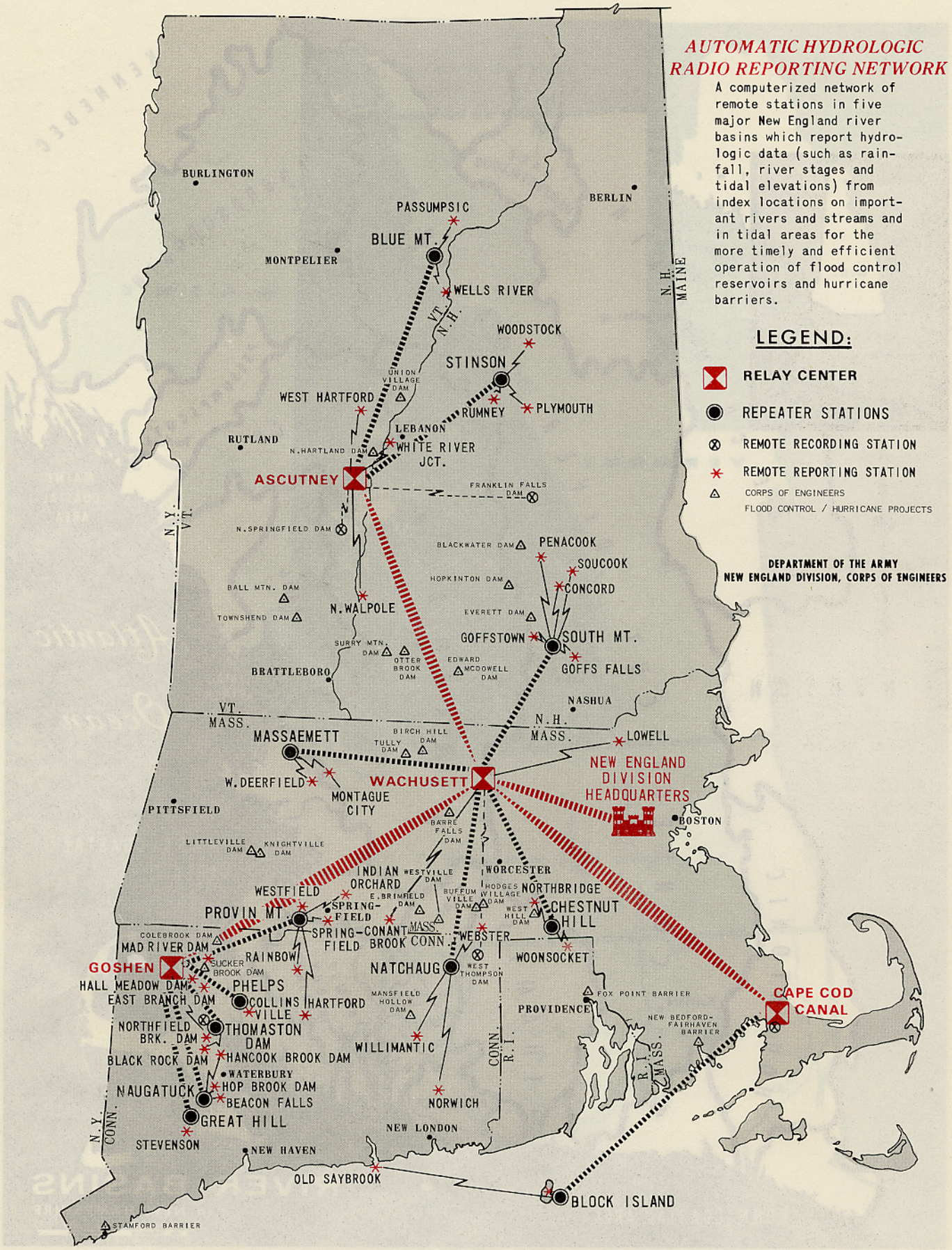
RCC performs all necessary functions to regulate the reservoirs and hurricane barriers in accordance with approved regulation plans. Personnel at most of the reservoir and hurricane barrier projects report directly to the RCC by radio or telephone for instructions regarding gate settings for both flood and low-flow operations. An invaluable tool used by RCC personnel is its automatic Hydrologic Radio Reporting Network, which transmits data from 41 radio operated, remote reporting stations to RCC in about four minutes under computer control. The hydrologic and meteorological information received includes rainfall, river and reservoir levels from five major river basins in which Corps reservoirs are located (none in Maine) and tidal levels, wind direction and velocity and barometric pressure from two key coastal locations. The range of the existing network is shown on the accompanying map. During flood emergency periods, additional information is obtained by telephone, teletype and radio from field parties and other agencies.

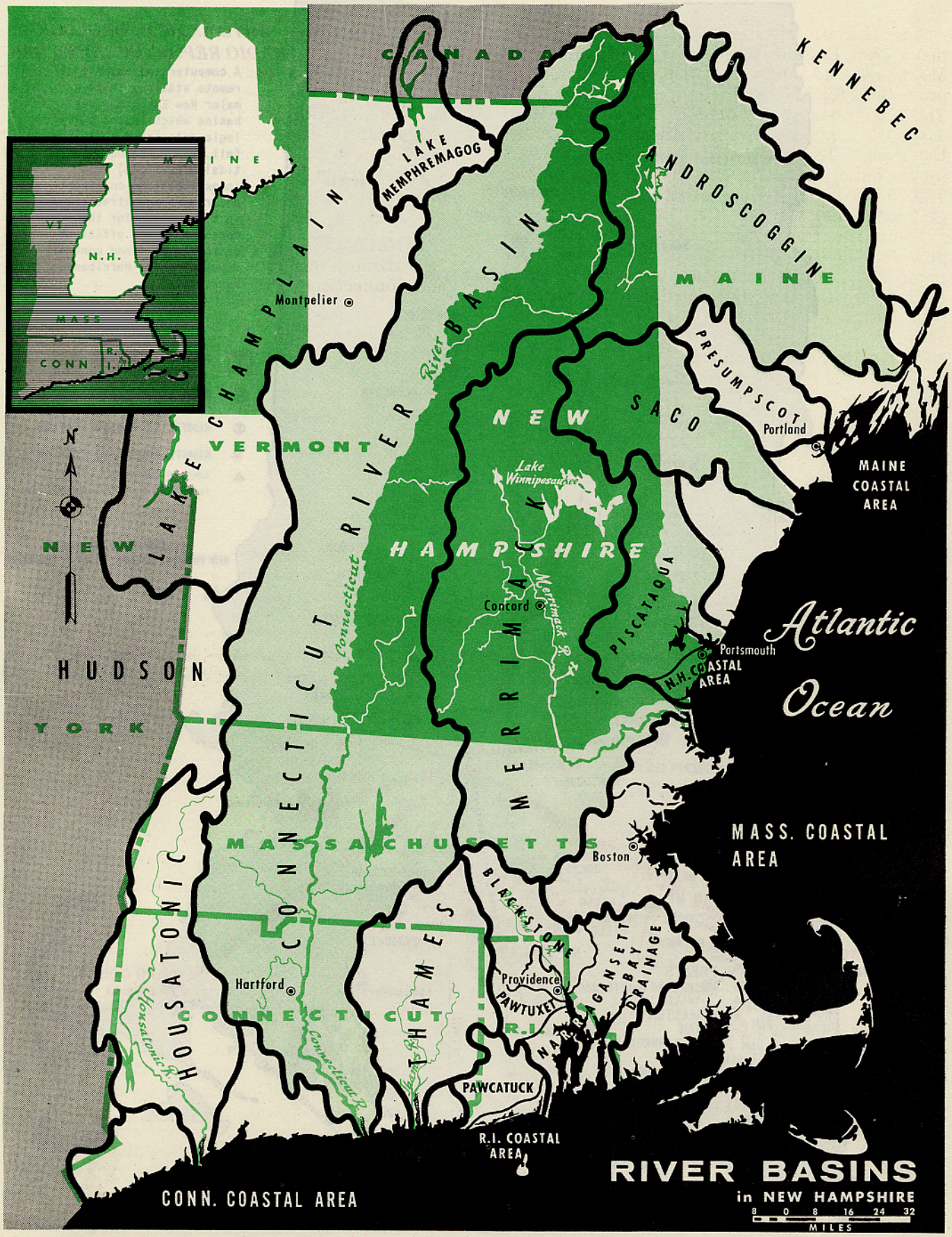
The central control station consists of an interface between the radio equipment and a computer. It automatically interrogates the entire network at selected time intervals and provides a complete printout in about three minutes. Manual interrogation also may be initiated at any time. A computer-plotter combination allows analysis of a large store of data in a short time and expedites timely regulation, assuring early warning of high stream flows and/or tidal surges for immediate operation of flood control dams and hurricane barriers.

The reporting system can be expanded to 100 stations. It also has the capability of interrogating water quality monitoring stations for use in low flow augmentations.



River gaging station


AUTOMATIC HYDROLOGIC RADIO REPORTING NETWORK
A computerized network of remote stations in five major New England river basins which report hydrologic data (such as rainfall, river stages and tidal elevations) from index locations on important rivers and streams and in tidal areas for the more timely and efficient operation of flood control reservoirs and hurricane barriers.
LEGEND:
RELAY CENTER
REPEATER STATIONS
REMOTE RECORDING STATION
REMOTE REPORTING STATION
CORPS OF ENGINEERS FLOOD CONTROL / HURRICANE PROJECTS
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
BURLINGTON
BERLIN
PASSUMPSIC
BLUE MT.
MONTPELIER
WELLS RIVER
N.H.
MAINE
VT.
N.H.
WOODSTOCK
STINSON
UNION VILLAGE DAM
WEST HARTFORD
RUMNEY
PLYMOUTH
LEBANON
RUTLAND
N.HARTLAND DAM
WHITE RIVER JCT.
ASCUTNEY
FRANKLIN FALLS DAM
N.Y.
VT.
N.SPRINGFIELD DAM
BLACKWATER DAM
PENACOOK
SOUCOOK
HOPKINTON DAM
CONCORD
BALL MTN. DAM
TOWNSHEND DAM
N.WALPOLE
EVERETT DAM
GOFFSTOWN
SOUTH MT.
SURRY MTN. DAM
OTTER BROOK DAM
EDWARD MCDOWELL DAM
BRATTLEBORO
GOFFS FALLS
NASHUA
VT.
MASS.
N.H.
MASS.
MASSAEMETT
BIRCH HILL DAM
TULLY DAM
LOWELL
NEW ENGLAND DIVISION HEADQUARTERS
W.DEERFIELD
WACHUSETT
MONTAGUE CITY
PITTSFIELD
BARRE FALLS DAM
BOSTON
LITTLEVILLE DAM
KNIGHTVILLE DAM
INDIAN ORCHARD
WESTVILLE DAM
WORCESTER
WESTFIELD
E.BRIMFIELD DAM
BUFFUM VILLE DAM
HODGES VILLAGE DAM
NORTHBRIDGE
PROVIN MT.
SPRING-FIELD
WEST HILL DAM
CHESTNUT HILL
COLEBROOK DAM
MADRIVER DAM
SPRING-FIELD
CONANT BROOK
MASS.
CONN.
WEBSTER
RAINBOW
SUCKER BROOK DAM
GOSHEN
NATCHAUG
WEST THOMPSON DAM
WOONSOCKET
HALL MEADOW DAM
PHELPS
EAST BRANCH DAM
COLLINS VILLE
HARTFORD
MANSFIELD HOLLOW DAM
FOX POINT BARRIER
PROVIDENCE
CAPE COD CANAL
NORTHFIELD BRK. DAM
THOMASTON DAM
NEW BEDFORD-FAIRHAVEN BARRIER
BLACK ROCK DAM
HANCOCK BROOK DAM
WILLIMANTIC
CONN.
R.I.
R.I.
MASS.
WATERBURY
HOP BROOK DAM
NAUGATUCK
BEACON FALLS
NORWICH
N.Y.
CONN.
GREAT HILL
NEW LONDON
STEVENSON
NEW HAVEN
OLD SAYBROOK
BLOCK ISLAND
STAMFORD BARRIER


CANADA
KENNEBEC
LAKE MEMPHREMAGOG
ANDROSCOGGIN
MAINE
LAKE CHAMPLAIN
Montpelier
RIVER BASIN
PRESUMPSCOT
Portland
SACO
NEW
VERMONT
Lake Winnipesaukee
MAINE COASTAL AREA
HAMPSHIRE
Connecticut River
Merrimack R.
Concord
PISCATAQUA
Atlantic Ocean
Portsmouth
N.H. COASTAL AREA
NEW
HUDSON
YORK
MERRIMACK
MASSACHUSETTS
Boston
MASS. COASTAL AREA
HOUSATONIC
CONNECTICUT
BLACKSTONE
THAMES
Providence
PAWTUXET
NARRAGANSETT BAY DRAINAGE
Hartford
CONNECTICUT
R.I.
Housatonic R.
Connecticut R.
Thames R.
PAWCATUCK
R.I. COASTAL AREA
CONN. COASTAL AREA
RIVER BASINS
in NEW HAMPSHIRE
8 0 8 16 24 32
MILES
MAINE
VT.
N.H.
MASS.
CONN.
R.I.

RIVER BASIN SYSTEMS

New Hampshire contains large portions of three major New England river basins, the Connecticut, Merrimack and Androscoggin basins, which comprise about four-fifths of the total area of the state. The headwaters of two other river basins, the Saco and Piscataqua basins, rise within eastern New Hampshire. The state has a total area of 9,304 square miles. The estimated 1970 population was 722,753 and the average population density, 78 per square mile.

While this booklet discusses the water resources program by the Corps of Engineers for New Hampshire, nature is no such respecter of State boundaries. The interstate relationship of the five river basins is shown by the accompanying map. These five river basins have great potential for water resource conservation and use.

These river systems have had a long history of floods, especially along the Connecticut, Merrimack and Androscoggin Rivers. The flood of March 1936, which resulted from rapid snowmelt accompanied by very heavy rainfall, constitutes the record flood for each of the five basins, except for variations along some tributary streams where the record flood occurred in November 1927, September 1938, March 1953 or October 1959. Disastrous losses were experienced in March 1936, particularly in the Connecticut and Merrimack basins. At that time no Federal projects for flood control had been constructed in New Hampshire.

While floods cannot be prevented, they can be controlled by comprehensive flood protective and storage works at and above critical damage centers, in conjunction with flood plain management measures. Six flood control reservoirs and five local protection projects have been completed in New Hampshire. Although there are still major needs for additional flood reduction measures for protection of specific damage centers, local interests have indicated greater need in recent years for water pollution abatement, environmental protection, water supply facilities and regional development, including navigation and recreation improvements.

A deep-draft commercial navigation project has been completed for Portsmouth Harbor and the Piscataqua River, seven small-boat harbor projects have been completed in the seacoast region and two beach restoration projects have been completed along the coast. A third beach restoration project has been authorized for the coastal area.

Areas in New England available and suitable for water-based recreation are rapidly being converted to other uses, but demand for outdoor recreation grows year by year. Most of the Corps reservoir projects in New Hampshire provide permanent pools and water-oriented facilities for recreational usage.

The five major river basins in New Hampshire are discussed in the following order: Connecticut, Merrimack, Androscoggin, Saco and Piscataqua. These are followed by a discussion of the New Hampshire coastal area. A national shoreline study and two regional studies are discussed at the end of this booklet. The first regional study concerns the establishment of a master plan for water resources development and management. The second regional study pertains to the development of major systems to meet regional water supply needs.

CONNECTICUT RIVER BASIN
New Hampshire, Vermont, Massachusetts, and Connecticut

The Connecticut River Basin, the largest river basin in New England, stretches from the northernmost part of New Hampshire to Long Island Sound. It includes, also, 114 square miles of the Province of Quebec in Canada. Of the 11,250 square miles in the basin area, 3,047 square miles, or some 27 percent, lie in New Hampshire; 3,928 square miles, or 35 percent, in Vermont; 2,726 square miles, or 24 percent, in Massachusetts; and 1,436 square miles, or about 13 percent of the area in Connecticut.

The basin is feather shaped with a length of 280 miles and a maximum width of 62 miles. It is bounded on the west by the Lake Memphremagog and Lake Champlain Basins in northern Vermont, the Hudson River Basin in Vermont and Massachusetts, the Housatonic River Basin in Massachusetts and Connecticut, and by the Connecticut Central Coastal Area along the extreme lower basin. On the east, it is bounded by the Androscoggin River Basin in northern New Hampshire, the Merrimack River Basin in New Hampshire and Massachusetts, the Thames River Basin in Massachusetts and Connecticut, and by the Connecticut Eastern Coastal Area along the extreme lower basin.

The basin occupies most of Essex, Caledonia, Orange, Windsor and Windham Counties and minor portions of Orleans, Washington, Addison, Rutland and Bennington Counties in Vermont. In New Hampshire, it occupies the western halves of Coos and Grafton Counties, most of Sullivan and Cheshire Counties and the western fringes of Merrimack and Hillsborough Counties. Within Massachusetts, it occupies all of Franklin and Hampshire Counties, most of Hampden County, the eastern third of Berkshire County and the western portion of Worcester County. In Connecticut, the basin occupies most of Hartford and Middlesex Counties and minor portions of Tolland, Litchfield, New London and New Haven Counties.

The topography varies from the rugged terrain of the White Mountains in New Hampshire through the rounded hills and mountains of both the Green

Mountains in Vermont and the Berkshire Hills in western Massachusetts to the lowlands of the flood plains of Massachusetts and Connecticut. The basin varies in landscape patterns. A forest-wildland landscape is the predominate pattern in the White Mountain, Green Mountain and headwater sections in New Hampshire and Vermont, as well as the western half of the Pioneer Valley area of Massachusetts, the upland area westward of the main river. Most of the lower half of the upper basin, generally between the towns of Lancaster and Hanover, New Hampshire, has a farm-forest pattern. Nearly three-quarters of the middle basin has a forest-town pattern, with the remainder consisting of a town-farm strip between the White River watershed and the town of Brattleboro in southern Vermont. In the lower basin, most of the watershed eastward of the main river and the estuary area south of Middletown, Connecticut has a forest-town pattern, as does the upper half of the Farmington River watershed in Massachusetts and Connecticut westward of the main river. The remainder of the lower basin, a strip about 20 miles wide and 80 miles long between Greenfield, Massachusetts and Middletown, Connecticut, is dominated by the urban-suburban complexes centered on Springfield, Massachusetts and Hartford, Connecticut. These two complexes are beginning to merge into a single metropolitan area. Nearly half of this area still has a town-farm landscape, principally along the east bank (excluding the urban centers of Springfield and Chicopee, Massachusetts and East Hartford and Manchester, Connecticut) and along the west bank between Greenfield and Northampton, Massachusetts.

Rising in the semi-mountainous area of northern New Hampshire, the Connecticut River traverses 409 miles before emptying into Long Island Sound at Old Saybrook, Connecticut. The river drops more than half of its total fall of 2,650 feet in the first 30 miles of its course. In much of this reach, the river passes through the Connecticut Lakes and Lake Francis in New Hampshire. Six miles further downstream, the river reaches the northeast corner of Vermont; where its low watermark on the west bank marks the start of the entire length of the New Hampshire-Vermont boundary. Passing through several dammed lakes and stretches of rapids, the river flows through highly scenic country in the upper and middle reaches, before passing through the spectacular French-King Gorge in northern Massachusetts. In central Massachusetts, the river passes through the Holyoke-Chicopee-Springfield urban area and then through the suburban section of northern Connecticut before it reaches the fringe of the Hartford-East Hartford complex, which the river divides. Downstream it passes through a smaller urban area at Middletown and flows through the last natural gorge at Bodkin Rock. After that it feels the increasing effect of the ocean tides in its 30-mile passage through scenic forested hills, which merge into broad marshlands near the river mouth.

In its course, the river swells with the discharge from numerous tributaries. Of these, 14 have drainage areas of at least 200 square miles. The 15 tributaries with the largest drainage areas are: the Upper Ammonoosuc, Ammonoosuc, Mascoma, Sugar and Ashuelot Rivers in New Hampshire, the Passumpsic, White, Ottauquechee, Black and West Rivers in Vermont, the Millers River in New Hampshire and Massachusetts, the Deerfield River in Vermont and Massachusetts, the Westfield and Chicopee Rivers in Massachusetts, and the Farmington River in Massachusetts and Connecticut. The main river and its tributaries comprise one of the hardest working systems in the United States, in terms of waterpower development. Excluding the 17 dams on the main river and the 16 federally constructed, floodwater storage reservoirs on 9 tributary streams, there are over 300 waterpower dams on the tributary streams. The main river structures, mostly privately owned, consist of 4 headwater storage reservoirs, 7 large hydroelectric dams and 6 smaller dams. The two largest dams are located at Littleton, New Hampshire and other large dams are located at Wilder, Bellows Falls and Vernon, Vermont and at Turners Falls and Holyoke, Massachusetts.

The estimated 1970 population of the Connecticut River Basin is 1,875,000, with 133,000 estimated for New Hampshire, 118,000 for Vermont, 717,000 for Massachusetts and 907,000 for Connecticut. This represents an increase of 13 percent over the 1960 basin population of 1,655,000, reflecting an increase of 8 percent in the New Hampshire population, 4 percent in Vermont, 8 percent in Massachusetts and 20 percent in Connecticut.

The population density varies widely throughout the basin, with 44 persons per square mile in New Hampshire, 30 in Vermont, 263 in Massachusetts and 631 in Connecticut. The projected population for the year 2020 is 3.1 million, an increase of 60 percent over the 1970 population. The lower basin contains four urban areas which have been delineated by the U.S. Census Bureau as Standard Metropolitan Statistical Areas. The central cities for these four urban areas are Holyoke-Chicopee-Springfield (Mass.), Hartford (Conn.), New Britain (Conn.) and Meriden (Conn.), of which the latter is located only partly within the basin.

A diverse mix of manufacturing, trade, finance, agriculture, recreation and tourism forms the economic base of the basin. Manufacturing employs the greatest numbers and adds more product value than any other category. While concentrated in the Massachusetts and Connecticut portions of the

basin, manufacturing is also of great importance in New Hampshire and Vermont. Higher education is an important economic activity throughout the basin. In the two northern states, tourism and recreation are of immense importance. Over two-thirds of the 530,000 acres (830 square miles) preserved in Federal and state parks, forests and reservoir areas within the basin are located in the two northern states.

Over 3.5 million tons of waterborne commerce, mostly petroleum products, were carried in 1972 by barges and small coastal tankers in the 52-mile long tidal section of the river in Connecticut between Long Island Sound and Hartford, which is now maintained to a 15-foot navigation project depth. In addition to this commercial navigation channel project, the Corps has completed recreational navigation improvements at Wethersfield, Lyme, Essex and Old Saybrook, all in Connecticut. Recreational boating improvements have been recommended for consideration in future authorization reports for the main river reaches between Hartford, Connecticut and Northampton, Massachusetts. As discussed later in this section, these improvements are part of a wide variety of specific projects and basin programs recommended for initiation within the next 15 years as the result of the Connecticut River Basin Comprehensive Study.

Average annual precipitation over the entire basin is 43 inches. It ranges from 36 inches in the valley lowlands to 74 inches in the higher elevations. Snowfall averages 90 inches annually in the upper basin, 75 inches in the middle basin and 45 inches in the lower basin. The average water content of the snow cover reaches a maximum of 10 inches in March in the upper basin, 9 inches in the middle basin and 6 and 3 inches, respectively, in the Massachusetts and Connecticut portions of the lower basin.

Old Saybrook lighthouse at entrance of Connecticut River

The flood history in the basin goes back more than 300 years. The great floods in the basin have resulted from excessive rainfall or a combination of runoff from snowmelt and rainfall. Four of the most disastrous floods in basin history, occurring in 1927, 1936, 1938 and 1955 took a total of 74 lives and caused reported monetary damage totaling $263 million.

The currently authorized comprehensive plan for flood protection for the Connecticut River Basin presently consists of 27 reservoirs and 21 local protective works. Sixteen reservoirs and 17 local protective works have been completed and put into operation. The flood control reservoirs reduce flood flows from Connecticut River tributaries and with the series of dikes, floodwalls and channel improvements, principally along the main stream, protect many highly developed downstream damage centers in the four states.

The grades of dikes and floodwalls along the main river are designed for a flood somewhat greater than that of March 1936, reduced by the authorized system of reservoirs, which is yet to be completed. Passage of a recurring March 1936 flood under existing conditions, with only 16 flood storage reservoirs completed out of a previously authorized system of 28 reservoirs, would threaten most of the local protective works. Such a condition over an extensive period of time would impose a risk of both undermining and overtopping many of the existing protective works, as the foundation design and freeboard design (the latter representing the height between the anticipated maximum water surface elevation and the top of the structure) were based on passage of a maximum river flow having a lower water surface. Furthermore, the storm which accompanied Hurricane Diane in August 1955 could have caused a flood much greater than the record flood of March 1936 had it continued up the Connecticut Valley instead of curving out to sea over eastern Massachusetts.

The Beaver Brook Lake multiple-purpose project in southwestern New Hampshire, authorized by the 1968 Flood Control Act, was reclassified to the inactive category on April 19, 1973 after the City of Keene withdrew support of the project. The Claremont Lake multiple-purpose project was deauthorized by the 1970 Flood Control Act. Measures to augment the Connecticut basin protective system were recommended as a result of the Connecticut River comprehensive study, which is discussed near the end of this section.

A tabulation of the authorized flood control program follows this text. Details of those individual projects completed, under construction or

authorized may be found in their respective state booklets.

The basin states have agreed in an interstate compact to cooperate in solving their flood control problems. The Connecticut River Flood Control Compact was approved by the United States Congress in 1953. Without this Compact, construction of the existing reservoir system would have been seriously impeded. Few towns in which flood control reservoirs are located receive sufficient flood control benefits to compensate for tax and economic losses. Under the Compact, the downstream states benefiting from flood protection have agreed to pay to the affected state equitable portions of the tax and economic loss.

AUTHORIZED FLOOD CONTROL PROJECTS Connecticut River Basin

OPERATIONAL DAMS AND LAKES

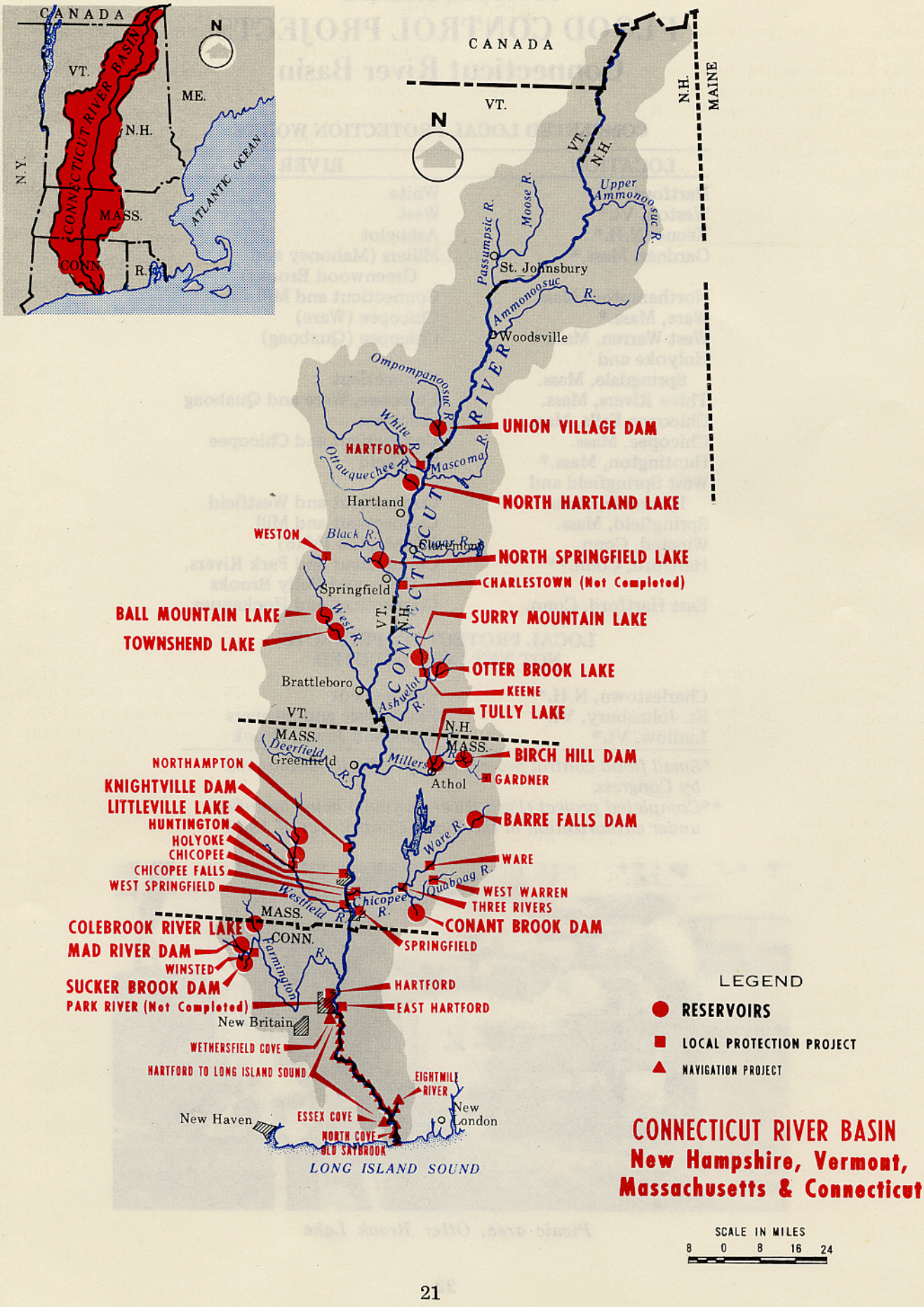
NAME	RIVER AND STATE	DRAINAGE AREA (sq. mi.)	FLOOD CONTROL STORAGE (ac. ft.)
Union Village	Ompompanoosuc, Vt.	126	38,000
No. Hartland	Ottauquechee, Vt.	220	71,400
No. Springfield	Black, Vt.	158	50,600
Ball Mountain	West, Vt.	172	54,600
Townshend	West, Vt.	278	33,200
Surry Mountain	Ashuelot, N.H.	100	32,500
Otter Brook	Ashuelot (Otter Brook), N.H.	47	17,600
Birch Hill	Millers, Mass.	175	49,900
Tully	Millers (Tully), Mass.	50	22,000
Barre Falls	Chicopee (Ware), Mass.	55	24,000
Knightville	Westfield, Mass.	164	49,000
Littleville*	Westfield (Middle Br.), Mass.	52.3	23,000
Conant Brook	Chicopee (Conant Brook), Mass.	8	3,740
Colebrook River*	Farmington (West Br.), Conn.	119	50,800
Mad River	Farmington (Mad), Conn.	18.2	9,510
Sucker Brook	Farmington (Still), Conn.	3.4	1,480

DEFERRED OR INACTIVE RESERVOIR PROJECTS

Victory* *(1)*	Passumpsic (Moose), Vt.	75	24,000
The Island *(1)*	West, Vt.	40	19,400
Alt. for Sugar Hill	Ammonoosuc, N.H.	—	—
So. Tunbridge	White (First Br.), Vt.	102	32,600
Gaysville*	White, Vt.	226	77,800
West Canaan	Mascoma, N.H.	80	51,000
Ludlow	Black, Vt.	56	23,900
Brockway	Williams, Vt.	101	37,700
Cambridgeport	Saxtons, Vt.	58	21,600
Honey Hill	Ashuelot (South Br.), N.H.	70	26,200
Beaver Brook*	Ashuelot (Beaver Brook), N.H.	6	5,750

**Multiple-purpose reservoirs*

(1) Deferred


CANADA
VT.
ME.
N.H.
N.Y.
MASS.
CONN.
R.I.
CONNECTICUT RIVER BASIN
ATLANTIC OCEAN
N
CANADA
VT.
N.H.
MAINE
Passumpsic R.
Moose R.
Upper Ammonoosuc R.
St. Johnsbury
Ammonoosuc R.
Woodsville
CONNECTICUT RIVER
Ompompanoosuc R.
White R.
HARTFORD
Ottauquechee R.
Mascoma R.
UNION VILLAGE DAM
Hartland
NORTH HARTLAND LAKE
WESTON
Black R.
Sugar R.
NORTH SPRINGFIELD LAKE
Springfield
CHARLESTOWN (Not Completed)
BALL MOUNTAIN LAKE
West R.
SURRY MOUNTAIN LAKE
TOWNSHEND LAKE
OTTER BROOK LAKE
Brattleboro
KEENE
Ashuelot R.
TULLY LAKE
VT.
MASS.
N.H.
Deerfield R.
Greenfield
Millers R.
BIRCH HILL DAM
Athol
GARDNER
NORTHAMPTON
KNIGHTVILLE DAM
LITTLEVILLE LAKE
HUNTINGTON
HOLYOKE
CHICOPEE
CHICOPEE FALLS
WEST SPRINGFIELD
BARRE FALLS DAM
Ware R.
WARE
Quaboag R.
WEST WARREN
THREE RIVERS
Westfield R.
Chicopee R.
MASS.
CONN.
COLEBROOK RIVER LAKE
MAD RIVER DAM
WINSTED
SUCKER BROOK DAM
PARK RIVER (Not Completed)
CONANT BROOK DAM
SPRINGFIELD
Farmington R.
HARTFORD
EAST HARTFORD
New Britain
WETHERSFIELD COVE
HARTFORD TO LONG ISLAND SOUND
EIGHTMILE RIVER
New London
New Haven
ESSEX COVE
NORTH COVE
OLD SAYBROOK
LONG ISLAND SOUND
LEGEND
RESERVOIRS
LOCAL PROTECTION PROJECT
NAVIGATION PROJECT
CONNECTICUT RIVER BASIN
New Hampshire, Vermont, Massachusetts & Connecticut
SCALE IN MILES
8 0 8 16 24

AUTHORIZED FLOOD CONTROL PROJECTS
Connecticut River Basin

COMPLETED LOCAL PROTECTION WORKS

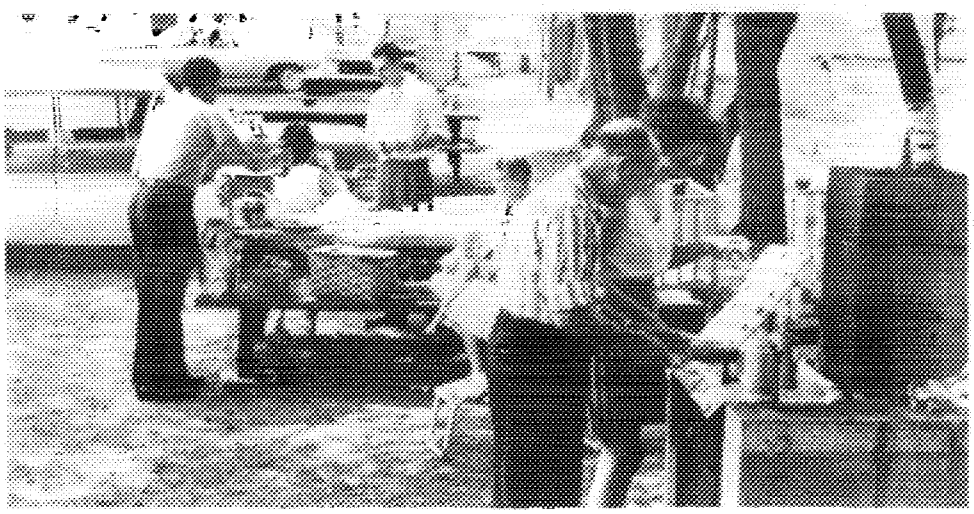
LOCATION	RIVER
Hartford, Vt.*	White
Weston, Vt.*	West
Keene, N.H.*	Ashuelot
Gardner, Mass.*	Millers (Mahoney and Greenwood Brooks)
Northampton, Mass.	Connecticut and Mill
Ware, Mass.*	Chicopee (Ware)
West Warren, Mass.*	Chicopee (Quaboag)
Holyoke and Springdale, Mass.	Connecticut
Three Rivers, Mass.	Chicopee, Ware and Quaboag
Chicopee Falls, Mass.	Chicopee
Chicopee, Mass.	Connecticut and Chicopee
Huntington, Mass.*	Westfield
West Springfield and Riverdale, Mass.	Connecticut and Westfield
Springfield, Mass.	Connecticut and Mill
Winsted, Conn.	Farmington (Mad)
Hartford, Conn.**	Connecticut and Park Rivers, Gully and Folly Brooks
East Hartford, Conn.	Connecticut and Hockanum

LOCAL PROTECTION PROJECTS NOT YET CONSTRUCTED

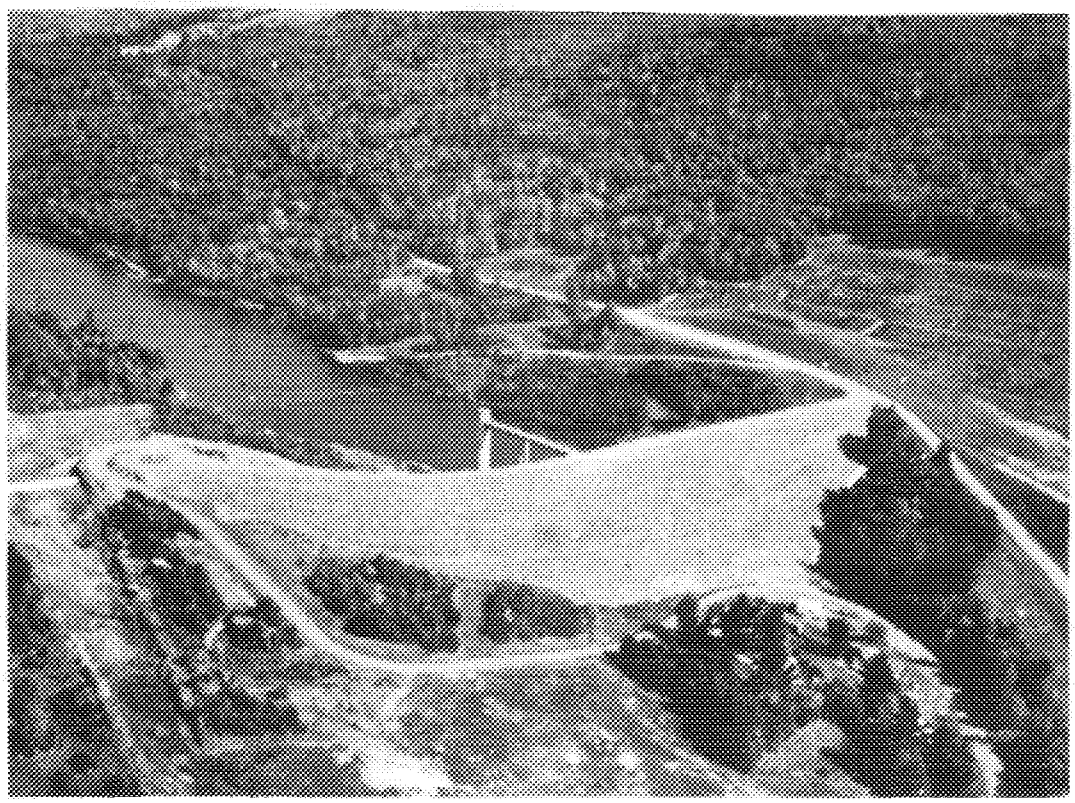
Charlestown, N.H.*	Connecticut
St. Johnsbury, Vt.	Passumpsic and Sleepers
Ludlow, Vt.*	Black and Jewell Brook

**Small flood control project not specifically authorized by Congress.*

***Completed project (Park River Conduit) being modified under authorization in the Flood Control Act of 1968.*



Picnic area, Otter Brook Lake



Otter Brook Dam and Lake

CONNECTICUT RIVER, at Charlestown

An emergency bank protection project (under authority of Section 14 of the 1946 Flood Control Act) has been designed to prevent further damage to the riverbank in the vicinity of the Charlestown sewage treatment plant. The project includes about 1,000 linear feet of rock slope protection along the riverbank. Construction has been delayed by a lack of local cooperation from non-Federal interests.

OTTER BROOK LAKE, Keene

Otter Brook Dam is located on Otter Brook, principal tributary of The Branch, which in turn is a tributary of the Ashuelot River. The site is in the northeastern section of the city of Keene, about 4.9 miles above the confluence of The Branch with the Ashuelot River.

Construction of the project was started in the summer of 1956 and completed in August 1958. The project includes a rolled-earthfill dam 133 feet high and 1,288 feet long, gated outlet works founded on bedrock under the dam, a concrete spillway 145 feet long in a natural saddle in the west abutment, access road, a utility building and dam operator's quarters. The project required relocation of New Hampshire Route 9 and Branch Road, both in the State highway system.

The reservoir is operated for flood control purposes and has a flood storage capacity of 17,600 acre-feet, equivalent to 7.0 inches of run-off from the drainage area of 47 square miles. It is normally kept empty except for a small permanent pool. When full, a 375-acre flood pool would extend about 2.3 miles upstream in Keene and Roxbury. The reservoir is operated as a unit in the comprehensive plan of flood protection for the Connecticut River Basin. In addition to its part in reducing flood stages at damage centers along the Connecticut River, it also augments the existing flood protection provided the city of Keene by Surry Mountain Reservoir.

The permanent pool, with an area of 85 acres, greatly increases the recreational and fish and wildlife benefits of the reservoir. The reservoir supports a park type area with facilities for picnicking, boating, and swimming. A 25-year lease was issued in July 1964 to the New Hampshire Department of Resources and Economic Development for management of the recreational facilities and resources of the reservoir.

SURRY MOUNTAIN LAKE, Surry

Surry Mountain Dam is located on the main branch of the Ashuelot River, 5 miles north of Keene. The dam, completed in June 1942, is of rolled-earthfill with a dumped rock shell. The dam is 86 feet high and 1,670 feet long.

The reservoir is operated for flood control purposes and has a storage capacity of 32,500 acre-feet, which is equivalent to 6.1 inches of runoff from its drainage area of 100 square miles. The reservoir is normally kept empty except for a permanent pool of 265 acres. Control gates in the outlet structure, located on the west abutment of the dam, are operated to store floodwaters in the reservoir during time of flood.

A side channel uncontrolled spillway, 338 feet in length, with its crest elevation 18 feet below that of the dam, would protect the dam from overtopping during passage of a maximum probable flood.

The project provides flood protection for the downstream communities of Keene, West Swanzey, Westport, Winchester, and Hinsdale within the drainage basin of the Ashuelot River. In conjunction with other flood control reservoirs in the Connecticut River Basin, it contributes to the flood protection of downstream damage centers in New Hampshire, Massachusetts and Connecticut.

A permanent pool for public recreation use was established in 1958 at the request of local interests. The project has a large picnic and day-use area on the shores of the 265-acre lake. There is a beach and a boat launching ramp. The waters are stocked for fishermen and hunting is popular in the fall. Overnight camping sites are available at a nearby privately owned campground.

KEENE LOCAL PROTECTION WORKS

(Small Flood Control Project not Specifically Authorized by Congress)

The Keene local protection project is located along the Ashuelot River from the railroad bridge in Keene to the covered bridge at Swanzey Station, a distance of 22,800 feet as measured along the original channel.

Work on the project consisted of removal of trees, snags, and debris and excavation of two cutoff channels. The total length of the cutoff channels is 1,800 feet and they bypass 5,600 feet of the meandering river channel.

This improvement, by increasing the channel capacity, permits more rapid emptying of Surry Mountain Reservoir, shortens the period of high river stages and lowers the ground water table, improves the functioning of the drainage and sewerage systems and increases the usability of farmlands located along the river.

The project was completed in August 1954. The City of Keene is responsible for operation and maintenance.

CONNECTICUT RIVER COMPREHENSIVE STUDY

The Committee on Public Works of the United States Senate on 11 May 1962 adopted a resolution requesting the Board of Engineers for Rivers and Harbors to review the reports on the Connecticut River, Massachusetts, New Hampshire, Vermont, and Connecticut, published as House Document 455, 75th Congress, 2nd session, and other reports, to determine the advisability of modifying the existing project at the present time, with particular reference to developing a comprehensive plan of improvement for the basin in the interest of flood control, navigation, hydroelectric power development, water supply, and other purposes, coordinated with related land resources. The other purposes include water quality control, stream flow augmentation, watershed treatment, fish and wildlife, and recreation.

A Coordinating Committee, comprised of representatives of the New England River Basin Commission; the Departments of Agriculture, Commerce, Interior, Health, Education and Welfare; the Federal Power Commission; and the Governors of Connecticut, Massachusetts, New Hampshire, and Vermont, assisted the Division Engineer, New England Division, Corps of Engineers in guidance of the study. In addition, each of the above organizations participated actively in the investigations.

The investigations led to the formulation of a detailed plan of development which will serve as a guide to the best use, or combination of uses, of water and related land resources of the basin to meet foreseeable short and long-term requirements.

The completed nine-volume report was submitted by the Coordinating Committee to the New England River Basins Commission in October 1970 for coordination of review by the heads of the Federal Departments and the Governors of the four basin states. The final plan includes projects and programs recommended for initiation in the next 10 to 15 years. Of major interest in the basin plan is the reformulation of the comprehensive plan for flood protection in the basin. Potential measures were also identified to meet the basin needs through the year 2020. After the plan has been reviewed and submitted through the Water Resources Council and the President to Congress, future budgetary requests will be made for the preparation and submission to the Congress of project authorization reports.

Connecticut River Supplemental Study

The Water Resources Council, on reviewing the Connecticut River Comprehensive Study, determined that further studies of flood control for the Connecticut River Watershed were needed. Accordingly, the Council asked the New England River Basins Commission to chair a study which would: firstly, develop a body of information on environmental and economic characteristics, processes and values useful for future decision making in the Basin generally, and to be applied specifically in the re-examination of flood management alternatives; and secondly, formulate a flood management program for the Basin based on re-examination of need for additional flood protection and rigorous examination of the full range of environmental, economic, engineering and other features.

The study was begun in 1972. A final report is scheduled for submission to the Water Resources Council by June 1975.

SMALL PROJECT STUDIES FOR FLOOD CONTROL AND RELATED PURPOSES

During the past two years, reconnaissance studies have been made or initiated to determine the need for Federal participation in providing local flood protection measures at the localities in the New Hampshire portion of the river basin, as follows:

Connecticut River, at Northumberland
Connecticut River, at Lyme
Sugar River, at Claremont

The three reconnaissance studies have been completed and indicate a lack of economic justification to permit Federal assistance.

Israel River, at Lancaster
(Under Design, Detailed Project Report)

This report on a project providing local ice jam flood control along the Israel River at Lancaster, under the authority contained in Section 205 of the 1948 Flood Control Act, as amended, has been essentially completed. The proposed project provides for a low, concrete overflow dam to be constructed on the Israel River just below its confluence with Otter Brook. The dam will impound a 56-acre pool which will allow floating river ice to spread out over adjacent fields during periods of thaw.

LYME, HANOVER, PLAINFIELD, AND LEBANON FLOOD PLAIN INFORMATION STUDY

A flood plain information study was completed in May 1972 for the Connecticut River in Lyme, Hanover, and Plainfield and along the Connecticut and Mascoma Rivers in Lebanon. The study compiled data for local guidance in developing land use plans and regulating the use of flood plains within the communities. Copies of the study may be obtained at the local administrative office.

KEENE FLOOD PLAIN INFORMATION STUDY

A flood plain information study was completed in November 1972 for the Ashuelot River in Keene. The study compiled data for local guidance in developing land use plans and regulating the use of flood plains within the city of Keene. Copies of the study may be obtained at the local administrative office.

Flood at Lancaster, caused by ice jam, March 1968

MERRIMACK RIVER BASIN
New Hampshire and Massachusetts

The Merrimack River Basin extends from the rugged White Mountain region of northern New Hampshire southward into the east-central part of Massachusetts. The fourth largest river basin in New England, it has a maximum length of 134 miles and a maximum width of 68 miles. Of the 5,010 square mile basin area, 3,810 square miles, or 76 percent of the area, lies in New Hampshire and 1,200 square miles, or 24 percent, in Massachusetts.

The basin topography is varied, with peaks and steep slopes in the upper basin rising to elevations between 4,000 and 5,000 feet; with rough bedrock hills and ridges in the central portion; with plains and gentle, rolling hills seldom more than 300 feet in elevation, south and east of Manchester, New Hampshire. The upper basin is forested and of a high quality landscape.

The Merrimack River proper is formed by two tributaries, the Pemigewasset and Winnipesaukee Rivers, meeting at Franklin, New Hampshire in the upper basin. The Pemigewasset rises at Profile Lake in Franconia Notch, an outstanding scenic attraction of the state, and flows 64 miles southerly to the confluence. The Winnipesaukee flows from the lake of that name, first southerly and then westerly through the hilly central basin topography, a distance of 23 miles, to join the Pemigewasset.

The main river passes through a mix of rural and town landscapes for 25 miles until bisecting the city of Concord and, at about fifteen mile intervals, passing through the cities of Manchester and Nashua, New Hampshire. In Massachusetts, the river flows southerly to the city of Lowell; there it turns northeasterly to the urban areas of Lawrence and Haverhill, thence entering and continuing through a town and farm landscape to the Atlantic Ocean at Newburyport. In its course, the river falls a total of 254 feet over a rather uniform slope in the 94 miles above the head of tidewater at Haverhill, 22 miles above the river mouth. Besides the formative tributaries, the major tributary streams are the Contoocook, the Piscataquog, the Nashua and the Concord Rivers.

There are over 100 water power developments in the Merrimack River Basin. On the main stem, below Franklin, New Hampshire, 18 plants utilize 161 feet of the total river fall and account for nearly half of the total hydroelectric power supplied within the basin. About 80 percent of the existing developments in the watershed are on tributary streams, including three plants operated by the Metropolitan District Commission of Massachusetts for their water supply needs.

The estimated 1970 population of the Merrimack River Basin is 1,304,000, with 415,000 estimated for New Hampshire and 889,000 for Massachusetts. This represents an overall increase of 27 percent over the 1960 basin population of 1,023,000, with a rise of 38 percent in the New Hampshire portion and 23 percent in the Massachusetts portion of the basin. The projected basin population for the year 2020 is 2,100,000, an increase of 61 percent over the 1970 population.

These figures show a present density averaging 109 people per square mile in New Hampshire and 735 in Massachusetts. The basin contains four urban areas which have been delineated by the U.S. Census Bureau as Standard Metropolitan Statistical Areas. The central cities for these four urban areas are Manchester (N.H.), Lowell (Mass.), Lawrence-Haverhill (Mass.) and Fitchburg-Leominster (Mass.).

The economy of the basin is based largely on manufacturing and service industries, such as wholesale and retail trade, medical and professional services, public administration and utilities. About 84 percent of total basin employment in recent years has been divided nearly equally between these two categories, with most of the remaining in construction, agriculture, fisheries, forestry and mining. Manufacturing is predominant in the southern half of the basin, in lower New Hampshire and the Massachusetts portion of the basin, where the major urban centers are located. Recreation and tourism are of great importance in the upper basin where the natural features have made the area one of the leading vacation spots of the Northeast. Recreation in the lower portion of the basin, also important, has a significant base in numerous landmarks and buildings of historical interest.

Three navigation channel improvements have been made within the basin, all for the passage of small craft. These projects consist of the Weirs channel at Lake Winnipesaukee, New Hampshire, and two projects in Massachusetts, one at the river mouth at Newburyport Harbor and the second in the 16-mile tidal reach between Newburyport and Haverhill. Only limited waterborne commerce has been received at Newburyport Harbor in recent years, and none at Haverhill. Recreational boating is continuing to increase in the 20-mile reach between Plum Island, at the river mouth, and Haverhill, with marine and launching facilities available at six localities in this tidewater reach.

Average annual precipitation in the basin is 43 inches. The annual snowfall varies from 90 inches in the headwaters to 45 inches near the coast. Average water content of the snow cover in the upper basin reaches a maximum of 8 inches in March. The average maximum water content of the

snow in the lower basin near the Massachusetts-New Hampshire line is 5 inches.

The basin has a long flood history, with most major floods being caused by a combination of heavy rainfall and melting snow in the months of March, April or May. These conditions, along with unseasonably warm temperatures, produced the basin flood of record in March 1936. Four flood control reservoirs, all in the New Hampshire portion of the basin, have been completed since that date. These are Franklin Falls Dam, partially controlling the Pemigewasset River, Edward MacDowell and Blackwater Dams, on tributaries of the Contoocook River; and Hopkinton-Everett Lakes, controlling the Contoocook and Piscataquog Rivers. Local protective works at Lincoln and Nashua, New Hampshire, and at Lowell, Haverhill and Fitchburg, Massachusetts, provide additional protection at concentrated damage centers.

The 1966 Flood Control Act authorized additional protection in the Merrimack River Basin. In the North Nashua River basin, this consisted of 3 multiple-purpose dams (2 in Westminster and 1 in Leominster); 1 flood control dam in Fitchburg; rehabilitation of the existing local protection project at Fitchburg; and 2 channel improvement projects (1 in Fitchburg and 1 in Leominster). The dam in Leominster and these local protection projects authorized in 1966 were classified as "inactive" or "deferred" several years ago since local interests no longer wished to participate in the projects or else had failed to approve urban renewal work critical to justification of the projects. The 1966 Act also authorized a local protection project at Saxonville, in the town of Framingham along the Sudbury River (tributary to the Concord River). This project is now under design.

A study to determine what added flood control and allied facilities should be provided in other sections of the Merrimack River Basin has been completed. Another study, with particular reference to the Winnipesaukee River, has been authorized. Other studies include several flood plain management studies underway or completed, and a wastewater management study, described at the end of the Merrimack River Basin Section.

The State of New Hampshire and the Commonwealth of Massachusetts have entered into an interstate compact to solve their mutual flood problems and share more equitably the costs of flood protection by apportioning the tax and economic losses resulting from acquisition of lands for reservoirs.

A tabulation of the authorized flood control program follows this text. Details of those individual basin projects completed, under construction or authorized are described in downstream order in their respective state booklets. Two projects are listed as inactive as economic changes since their inclusion in the basin plan make their present feasibility questionable.

Winter recreation in Merrimack River Basin

AUTHORIZED
FLOOD CONTROL PROJECTS
Merrimack River Basin

DAMS AND LAKES

NAME	RIVER AND STATE	DRAINAGE AREA (sq. mi.)	FLOOD CONTROL STORAGE (ac. ft.)	STATUS
Franklin Falls	Pemigewasset, N.H.	1,000	154,000	Operational
Edward MacDowell	Contoocook (Nubanusit Brook), N.H.	44	12,800	"
Blackwater	Contoocook (Blackwater), N.H.	128	46,000	"
Hopkinton-Everett	Contoocook and Piscataquog, N.H.	490	157,300	"
Whitmanville*	North Nashua (Whitman), Mass.	17.5	6,700	Under design
Nookagee*	North Nashua (Phillips Brook), Mass.	11	4,700	" "
Monoosnoc*	North Nashua (Monoosnoc Brook), Mass.	2.5	800	Deferred for restudy
Phillips	North Nashua (Phillips Brook), Mass.	5	1,600	Authorized
Mountain Brook	Contoocook (Mountain Brook), N.H.	13	5,300	Inactive

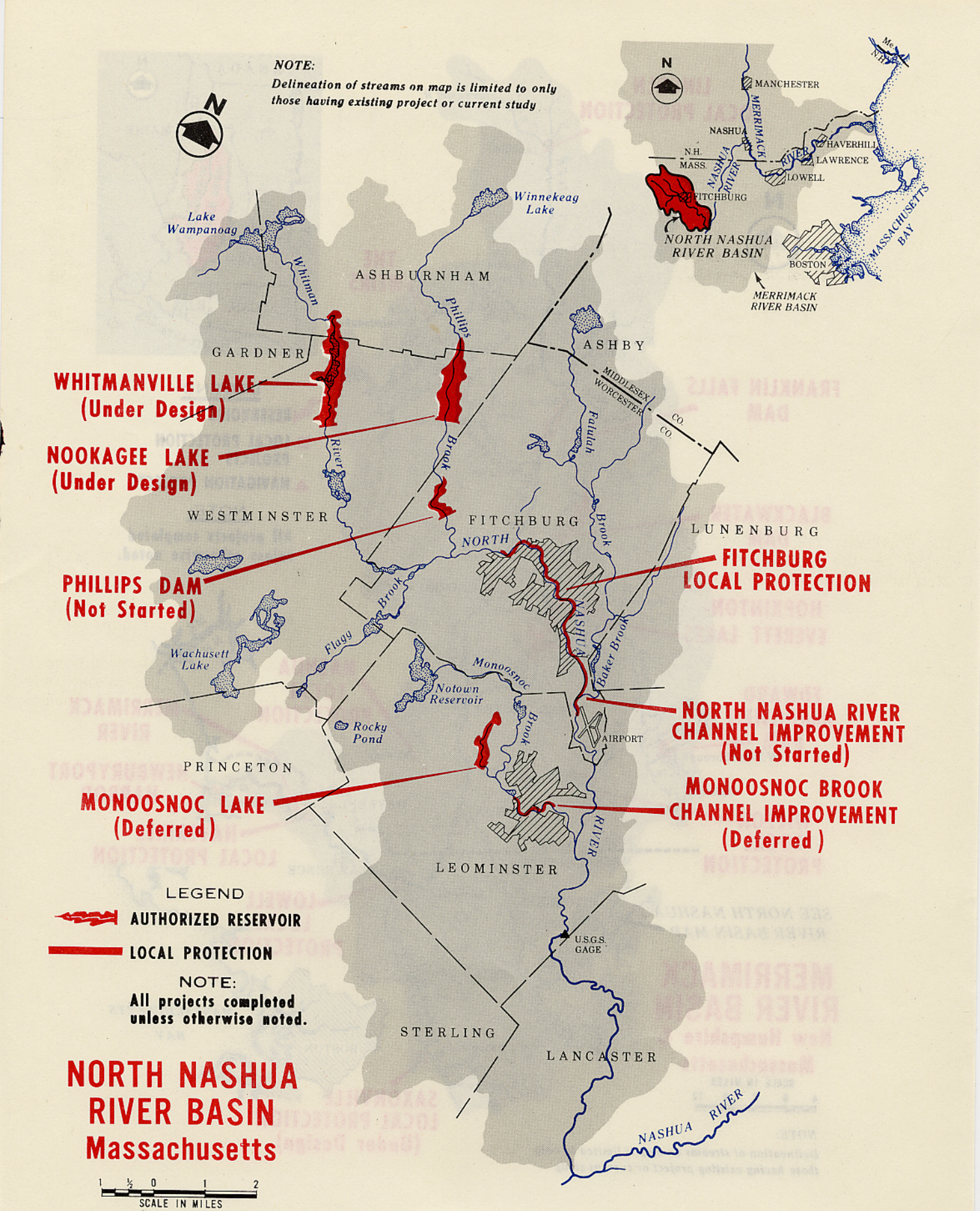
**Multiple-purpose reservoirs*

LOCAL PROTECTION WORKS

LOCATION	RIVER	STATUS
Lincoln, N.H. (2)	E. Br. Pemigewasset	Completed
Nashua, N.H.	Merrimack and Nashua	"
Wilton, N.H.	Stony Brook	"
Lowell, Mass.	Merrimack	"
Haverhill, Mass. (1)	Merrimack and Little	"
Fitchburg, Mass. (1, 2 and 3)	North Nashua	"
Saxonville	Sudbury	Under design
Fitchburg	North Nashua	Authorized
Leominster, Mass.	North Nashua (Monoosnoc Brook)	Deferred for restudy
North Andover and Lawrence, Mass.	Merrimack and Shawsheen	Inactive
Fitchburg-Lunenburg, Mass.	North Nashua (Baker Brook)	"

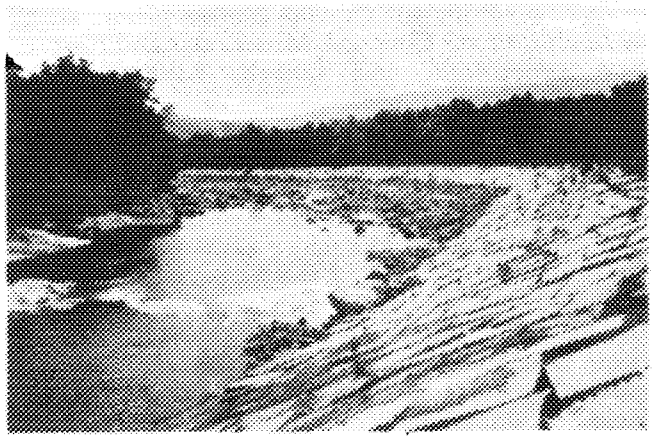
(1) Emergency Relief Appropriation projects (1937-39)
(2) Small flood control project accomplished under emergency authority
(3) Rehabilitation of existing project authorized

LINCOLN LOCAL PROTECTION
E. Br. Pemigewasset R.
Lincoln
PEMIGEWASSET RIVER
N
Squam Lake
THE WEIRS
Lake Winnipesaukee
Newfound Lake
The Weirs
FRANKLIN FALLS DAM
Smith River
Winnisquam Lake
Laconia
Winnipesaukee R.
Andover
Blackwater
Franklin
MERRIMACK
BLACKWATER DAM
River
Penacook
Contoocook
CONCORD
HOPKINTON-EVERETT LAKES
Henniker
Hopkinton
Contoocook River
Piscataquog River
Weare
Goffstown
EDWARD MacDOWELL DAM
Nubanusit Brk.
Stony Br.
MANCHESTER
W.Peterborough
Souhegan River
Jaffrey
Wilton
WILTON LOCAL PROTECTION
NASHUA
NEW HAMPSHIRE
MASSACHUSETTS
SEE NORTH NASHUA RIVER BASIN MAP
FITCHBURG
Nashua River
North Nashua R.
MERRIMACK RIVER BASIN
New Hampshire & Massachusetts
SCALE IN MILES
4 0 4 8 12
NOTE:
Delineation of streams on map is limited to only those having existing project or current study
CANADA
N
N.H.
VT.
MAINE
MERRIMACK RIVER BASIN
N.Y.
MASS.
CONN.
R.I.
OCEAN
ATLANTIC
LEGEND
RESERVOIRS
LOCAL PROTECTION PROJECTS
NAVIGATION PROJECTS
NOTE:
All projects completed unless otherwise noted.
NASHUA LOCAL PROTECTION
Derry
ME.
N.H.
MERRIMACK RIVER
NEWBURYPORT HARBOR
HAVERHILL
Newburyport
HAVERHILL LOCAL PROTECTION
LAWRENCE
LOWELL
LOWELL LOCAL PROTECTION
Concord R.
Sudbury R.
Concord
MASSACHUSETTS BAY
BOSTON
Saxonville
SAXONVILLE LOCAL PROTECTION (Under Design)


NOTE:
Delineation of streams on map is limited to only those having existing project or current study
N
MANCHESTER
MERRIMACK
NASHUA
N.H.
MASS.
NASHUA RIVER
HAVERHILL
LAWRENCE
LOWELL
FITCHBURG
NORTH NASHUA RIVER BASIN
BOSTON
MASSACHUSETTS BAY
MERRIMACK RIVER BASIN
Lake Wampanoag
Winnekeag Lake
Whitman
ASHBURNHAM
Phillips
GARDNER
ASHBY
MIDDLESEX
WORCESTER
CO.
WHITMANVILLE LAKE
(Under Design)
NOOKAGEE LAKE
(Under Design)
River
Brook
Falulah
WESTMINSTER
FITCHBURG
NORTH
Brook
LUNENBURG
PHILLIPS DAM
(Not Started)
FITCHBURG
LOCAL PROTECTION
Flagg
Brook
Wachusett Lake
Monoosnoc
Notown Reservoir
Baker Brook
NORTH NASHUA RIVER
CHANNEL IMPROVEMENT
(Not Started)
Rocky Pond
Brook
AIRPORT
PRINCETON
MONOOSNOC LAKE
(Deferred)
MONOOSNOC BROOK
CHANNEL IMPROVEMENT
(Deferred)
RIVER
LEOMINSTER
LEGEND
AUTHORIZED RESERVOIR
LOCAL PROTECTION
NOTE:
All projects completed unless otherwise noted.
U.S.G.S. GAGE
STERLING
LANCASTER
NASHUA RIVER
NORTH NASHUA RIVER BASIN
Massachusetts
1 ½ 0 1 2
SCALE IN MILES

LINCOLN LOCAL PROTECTION WORKS
(Emergency Work)

A project approved and authorized under the provisions of Public Law 99, 84th Congress, for the repair and restoration of flood control works was completed in December 1960 on the East Branch of the Pemigewasset River (Merrimack basin), in the town of Lincoln. The project provides flood protection along the north bank of the East Branch in the vicinity of the Franconia Paper Company and extends for a distance of 1,450 feet downstream from the diversion dam of the Franconia Paper Company. It consists of minor channel excavation, 230 feet of new flank dike and 1,350 feet of dike restoration and riprapping. The project is maintained and operated by the Town of Lincoln.



Lincoln Local Protection, looking downstream from industrial diversion dam

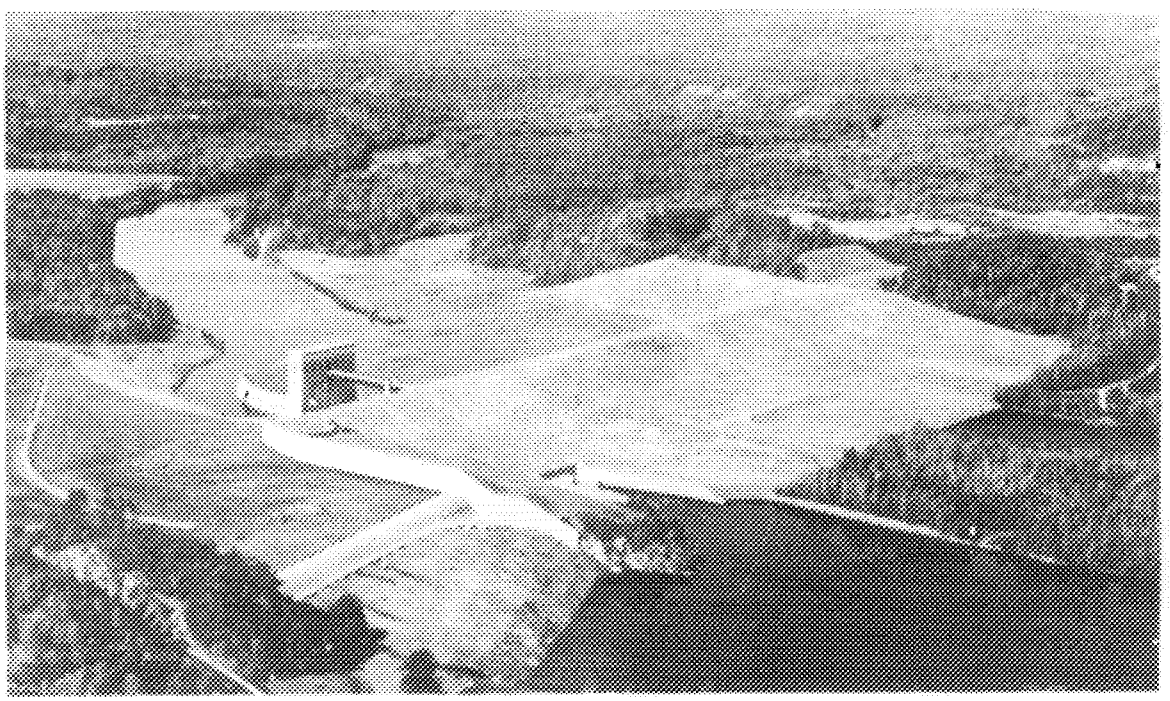
FRANKLIN FALLS DAM

Franklin Falls Dam is located on the Pemigewasset River, the main tributary, which joins with the Winnipesaukee River about three miles downstream to form the Merrimack River. The dam, completed in 1943, is situated about 2.5 miles upstream of Franklin and 19 miles upstream of Concord. It is of rolled earthfill with a dumped rock shell 140 feet high and 1,740 feet long.

The reservoir is operated for flood control purposes and has a storage capacity of 154,000 acre-feet, which is equivalent to 2.9 inches of runoff from its drainage area of 1,000 square miles. The reservoir is normally kept empty. Control gates in the outlet structure are operated to store floodwaters in the reservoir during time of flood. When full, a narrow 2,800-acre reservoir would extend upstream about 12.5 miles.

A concrete spillway, founded on rock and 546 feet long, is located on the west abutment. The spillway, with its crest elevation 27 feet below that of the dam, would protect the dam from overtopping during passage of a maximum probable flood.

The project provides flood protection along the entire length of the Merrimack River and is a key unit in the comprehensive plan of flood



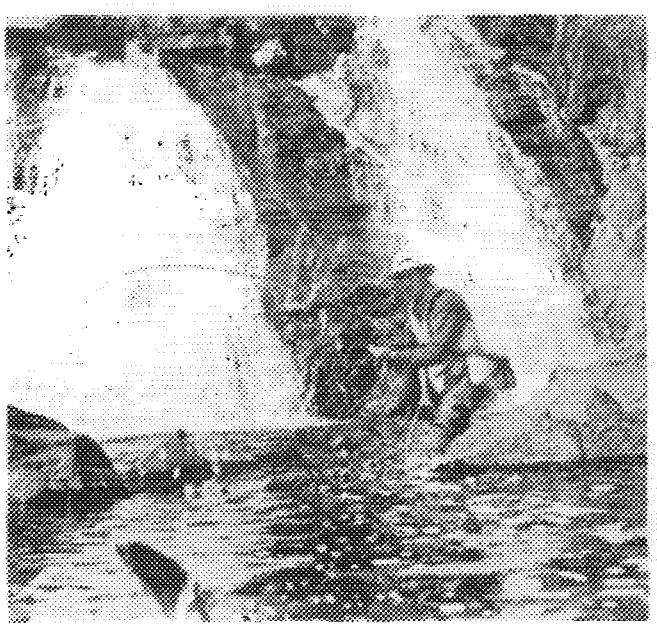
Franklin Falls Dam

protection. Principal damage centers protected by its operation are Concord, Manchester and Nashua, New Hampshire, and Lowell, Lawrence, and Haverhill, Massachusetts.

A license has been issued to the New Hampshire Department of Resources and Economic Development for use of the reservoir area for a long-term forestry improvement, fish and wildlife, and public recreation program. The major activity of the State has been improvement of the forestry resources of the reservoir. Abundant fish resources are supported in the 12-mile section of the Pemigewasset River that flows through the reservoir. Tributary streams provide an excellent environment for trout.

LAKE WINNIPESAUKEE, Laconia

Lake Winnipesaukee lies wholly within the Merrimack River basin about 30 miles northeast of Concord and about 40 miles northwest of Portsmouth. The lake has an extreme length of approximately 20 miles and a width varying from 1 to 8 miles and averaging about 5 miles. Discharging into Paugus (Long) Bay and the Winnipesaukee River, its outlet is located at the southwestern end of the lake at The Weirs, Laconia. The project, adopted in 1879, provided for the removal of shoals in The Weirs channel outlet into Paugus Bay. A 50-foot wide channel was dredged to a depth of 5 feet at the lowest known stage of the water. The channel is approximately 3,000 feet long. The project was completed in 1882. It is used principally by a mail boat, by lake passenger boats and by numerous recreational craft.



Trout fishing at Profile Falls, Franklin Falls reservoir area

BLACKWATER DAM, Webster

Blackwater Dam is located in the town of Webster on the Blackwater River 8.6 miles above its confluence with the Contoocook River. The dam, placed in operation in November 1941, consists of a rolled-earthfill section with a dumped rock face and a concrete gravity spillway section across the river section. The total length of the dam is 1,150 feet, of which 240 feet is along the spillway, and maximum height is 75 feet above the streambed. There are five small dikes on the west perimeter of the reservoir.

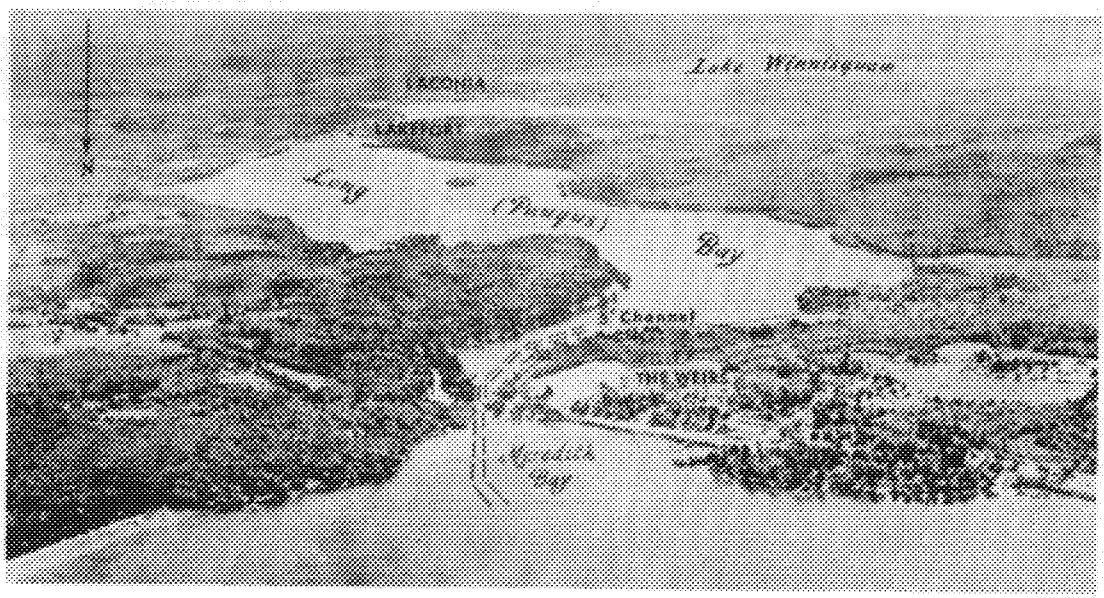
The reservoir is operated for flood control purposes and has storage capacity of 46,000 acre-feet, which is equivalent to 6.7 inches of run-off from its drainage area of 128 square miles. The reservoir is normally kept empty. Control gates, located in the spillway section, are operated to store floodwaters during time of flood. When full, a 3,140-acre reservoir would extend upstream about 7 miles with a maximum width of about one mile. The spillway, with its crest elevation 18 feet below that of the dam, would protect the dam from overtopping during a maximum probable flood.

Blackwater Reservoir is operated in conjunction with Franklin Falls Reservoir to reduce floods on the Merrimack River. In addition, it is regulated to reduce flood stages on the Blackwater and Contoocook Rivers. Total damages prevented since completion of the project have been $3,275,000. With recurrence of the 1936 basin flood of record the project would prevent $15.8 million in damages.

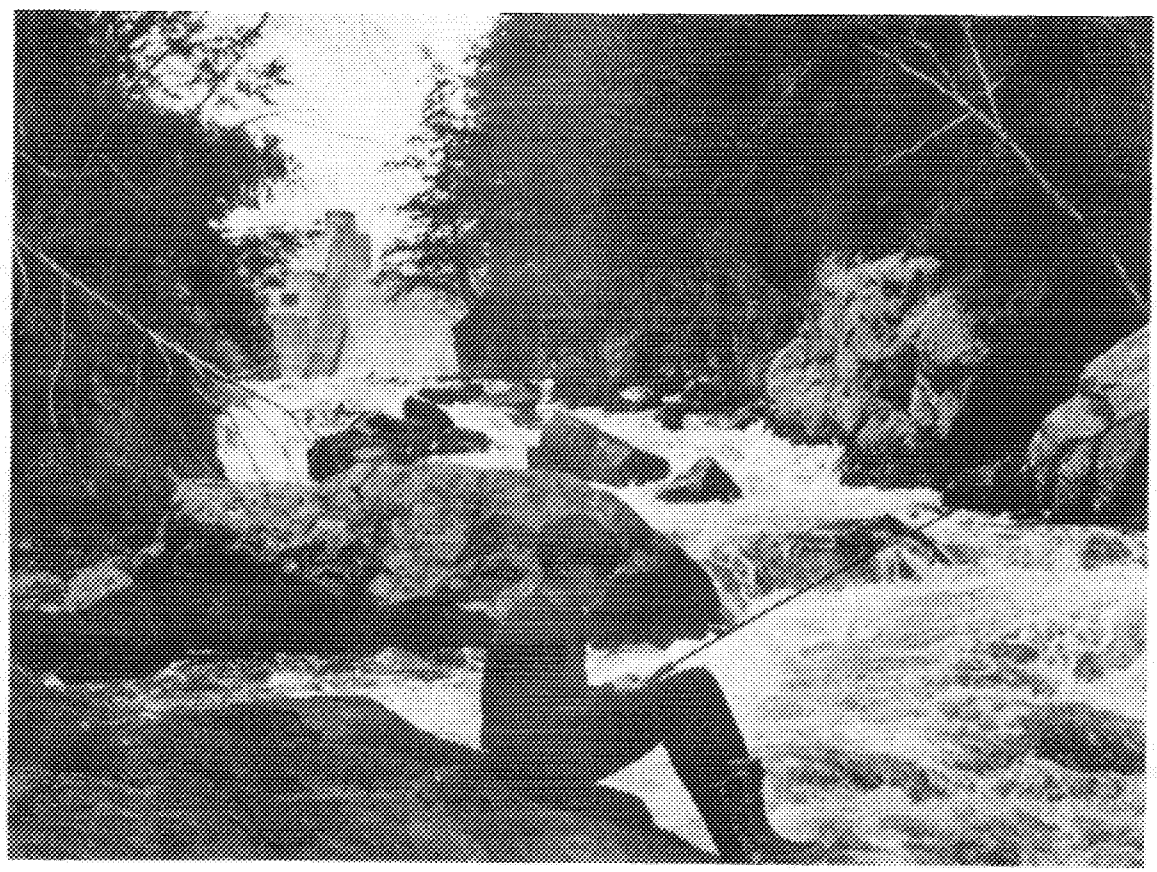
A license has been issued to the New Hampshire Department of Resources and Economic Development for use of the reservoir area for long-term forestry improvement, fish and wildlife conservation and for public recreation purposes. Intensive forestry management practices in the reservoir area have resulted in a high-quality, sustained-yield harvest program. The 14-mile section of the Blackwater River that meanders through the reservoir area is an excellent canoe stream. It is heavily stocked with trout each spring.

HOPKINTON-EVERETT LAKES

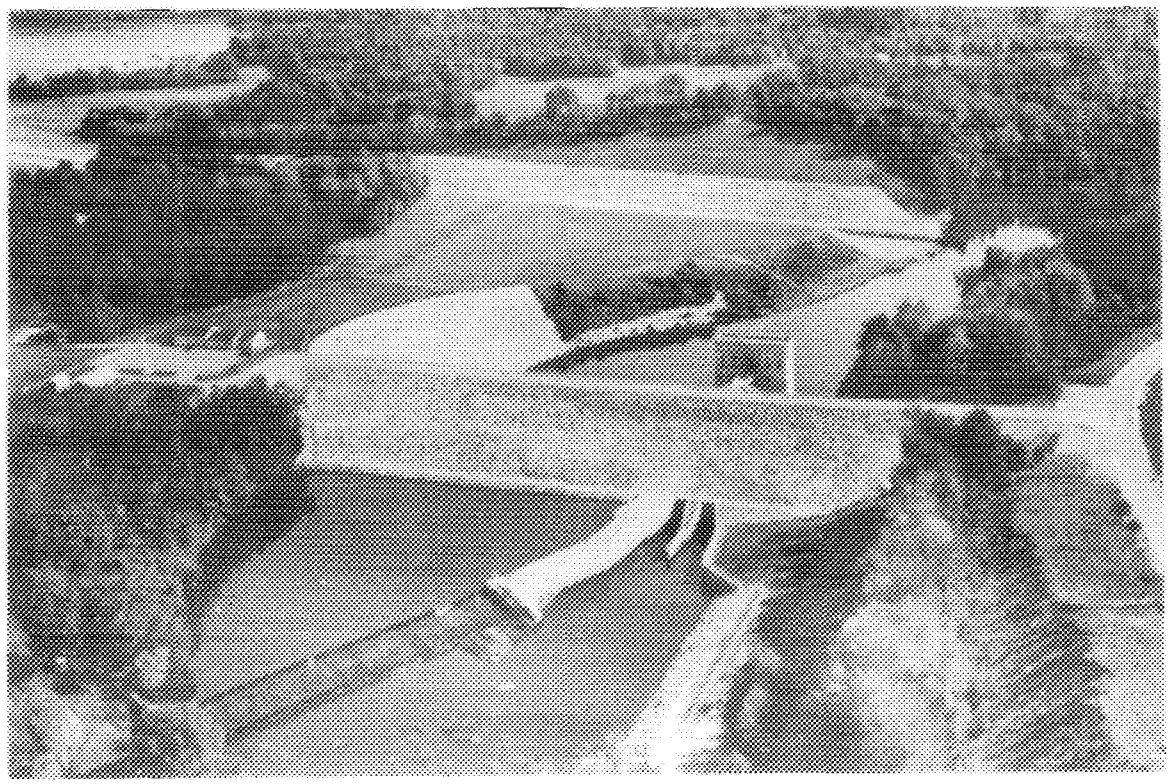
The Hopkinton-Everett lakes are located within the towns of Hopkinton, Henniker, Weare and Dunbarton. The project consists of a dam, a canal, two large dikes, and a spillway in the Contoocook River watershed and a dam, a spillway, and two large dikes in the Piscataquog River watershed. The two storage areas thus formed have a capacity of 70,800 acre-feet in the Contoocook watershed and 86,500 acre-feet in the Piscataquog watershed.



Lake Winnipesaukee, Weirs Channel, Laconia



Fishing downstream from Blackwater Dam



Hopkinton Lake

They are connected by a second canal, 13,900 feet long, so that the floodwaters may be transferred from one area to another and the areas may function as a single unit. The total storage capacity of 157,300 acre-feet is equivalent to 6.0 inches of runoff from the drainage area of 490 square miles.

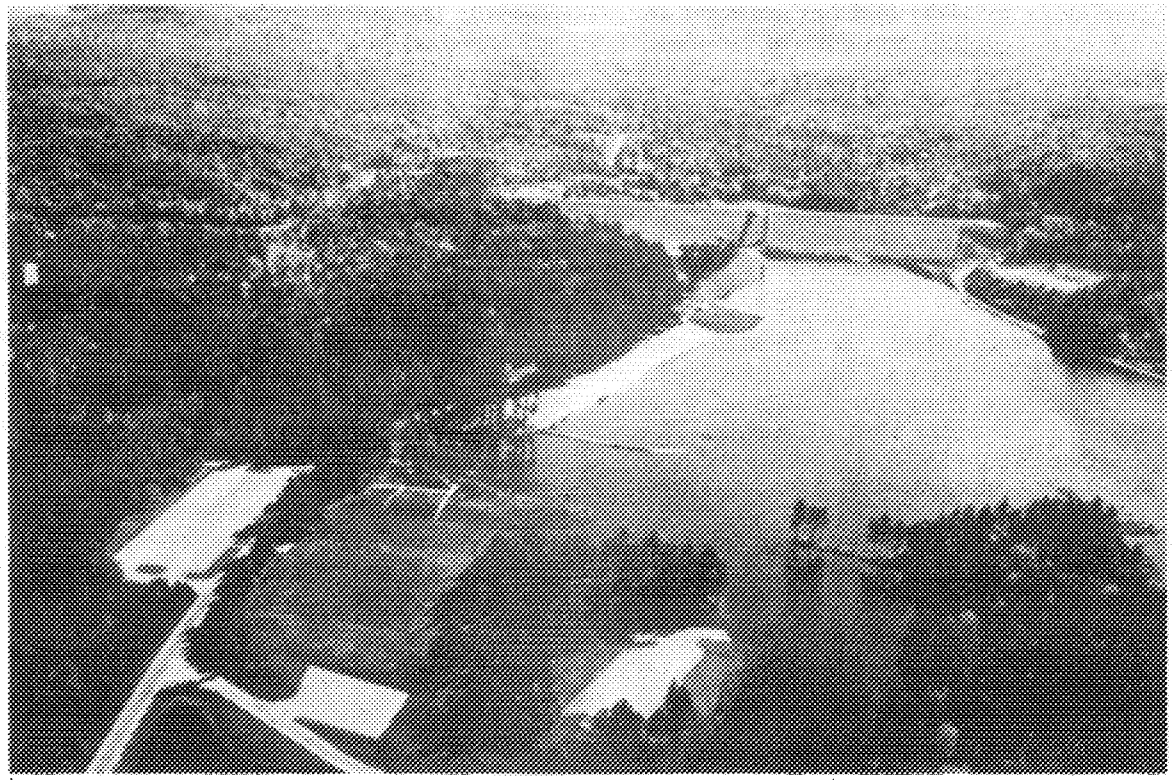
The Hopkinton Dam, on the Contoocook River about 500 feet upstream of the Hoague-Sprague Dam in the village of West Hopkinton, is a rolled-earthfill about 76 feet high and 790 feet long. A spillway about 300 feet long is located in a saddle about 1.8 miles east of West Hopkinton.

The Everett Dam, on the Piscataquog River about 1.5 miles southeast of the village of East Weare, features a rolled-earthfill about 115 feet high and 2,000 feet long with an adjacent 180-foot long concrete spillway. This spillway is at an elevation higher than that of the Hopkinton Dam spillway to prevent excessive discharge into the Piscataquog River basin.

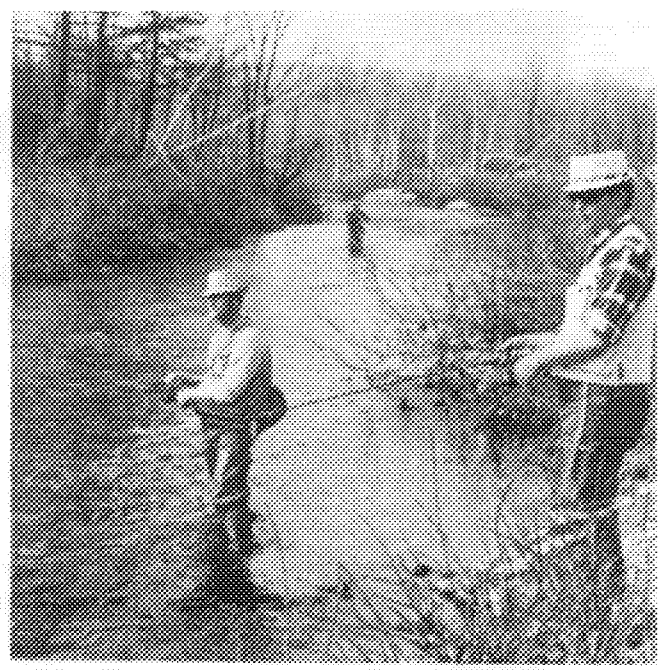
Construction was started in April 1959 and was substantially completed in December 1962. It required the acquisition of properties in Hopkinton, Henniker, Weare and Dunbarton and extensive highway, utility and cemetery relocations. The Everett Dam was operational in March 1962; the Hopkinton Dam was fully operational in December 1962.

The project provides general flood protection for residential, commercial, and industrial property downstream along the Contoocook and Piscataquog Rivers and along the main stem of the Merrimack River in New Hampshire and Massachusetts.

The Hopkinton-Everett Reservoir, with 7,342 acres of land and 650 acres of water, offers excellent potentials for recreational and fish and wildlife uses. These potentials are continually being developed for maximum public use. Major recreational developments have been completed at the 120-acre Everett Pool behind Everett Dam (Clough State Park) and the 160-acre Elm Brook Pool behind Hopkinton Dam. A 25-year lease was issued in July 1964 to the New Hampshire Department of Resources and Economic Development for management of the recreation, fish and wildlife, forestry and agricultural resources of the reservoir. However, Elm Brook Park, bordering Elm Brook Pool, will be deleted from the lease and be managed by the Corps, starting in September 1973.



Everett Lake



Recreational use at Hopkinton-Everett Lakes

Clough State Park has become a popular area since its completion in 1964 and has averaged an attendance of over 100,000 annually in its seven years of operation. Three separate areas, containing 275 acres of water developed by project construction, are managed by the State as waterfowl refuge areas. The State has instituted a forestry improvement program for the entire reservoir area.

EDWARD MACDOWELL DAM,
West Peterborough

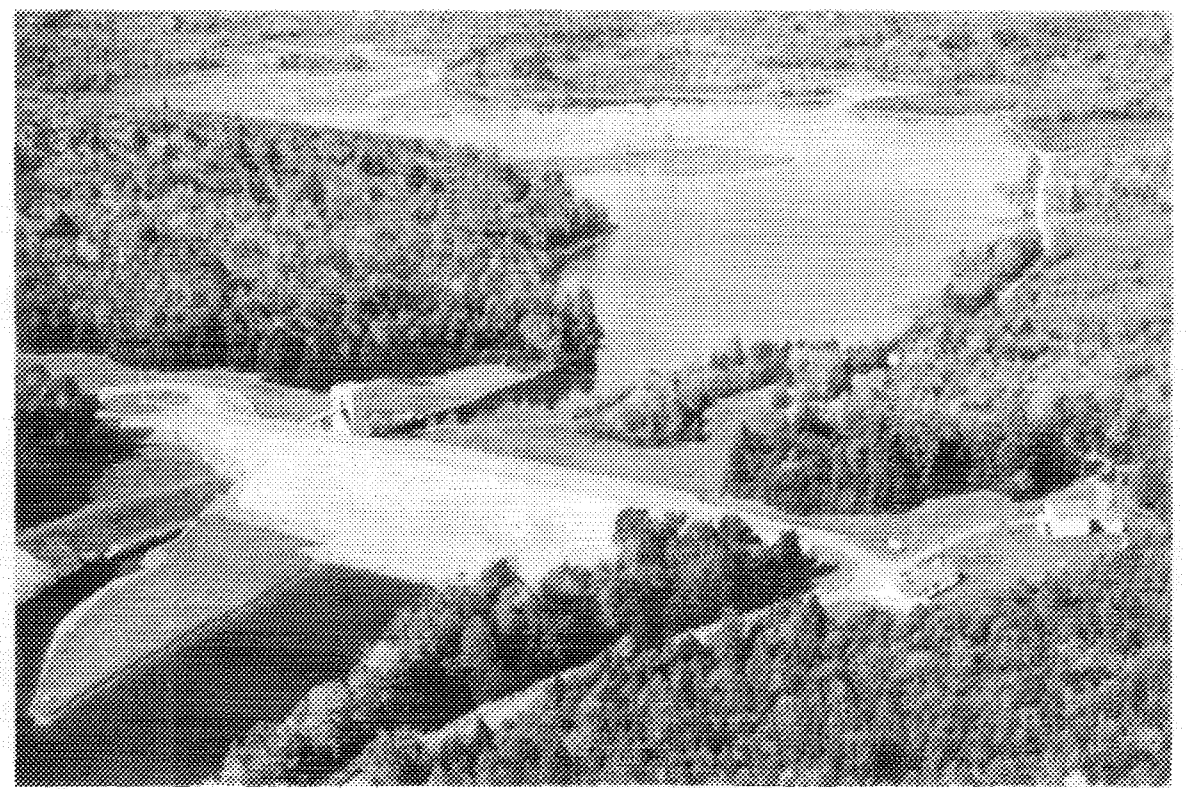
Edward MacDowell Dam is located on Nubanusit Brook, a tributary of the Contoocook, one-half mile upstream from the village of West Peterborough and 14 miles east of Keene. The dam, completed in March 1950, is a rolled-earthfill with a dumped rock blanket. The dam is 67 feet high and 1,030 feet long.

The reservoir is operated for flood control purposes and has a storage capacity of 12,800 acre-feet, which is equivalent to 5.5 inches of runoff from its drainage area of 44 square miles. The reservoir is normally kept empty. Control gates in the outlet works, located near the east side of the dam, are operated to store flood-waters in the reservoir during time of flood. When full, an 840-acre reservoir would extend about 9 miles upstream.

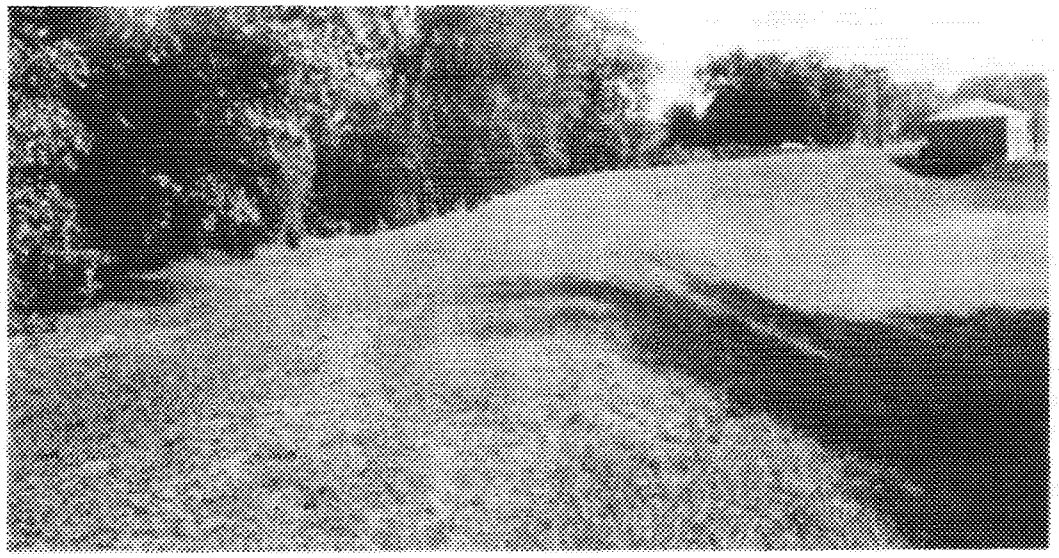
A concrete spillway, consisting of a low weir 100 feet in length, is located in a natural saddle on the north side of the reservoir. Discharges from this spillway go into Ferguson Brook which, in turn, discharges into the Contoocook River downstream from Peterborough.

The project provides flood protection for Peterborough and other communities in the upper Contoocook River basin. Integrated with other Merrimack River basin reservoirs, it also provides a measure of protection to damage centers on the lower Contoocook River.

The reservoir area is being maintained, under license, by the New Hampshire Fish and Game Department as a waterfowl habitat and for fish and wildlife purposes.



Edward MacDowell Dam



Nashua Local Protection, dike and pumping station along Merrimack River

STONY BROOK CHANNEL IMPROVEMENT, Wilton

A channel excavation project, under the authority of Section 208 of the 1954 Flood Control Act, was constructed late in 1971 along 1,000 feet of Stony Brook to prevent ice jam flooding in Wilton. This project provides protection for residential, commercial and industrial properties essential to the welfare of the town. The project is operated by the State of New Hampshire Water Resources Board.

NASHUA LOCAL PROTECTION WORKS

The project is located on the right bank of the Nashua and Merrimack Rivers at their confluence in the city of Nashua, 55 miles above the mouth of the Merrimack River. The protective structures consist of approximately 3,300 linear feet of dike and 350 feet of concrete floodwalls. The dike is constructed of rolled-earthfill. Where the river velocities are high, hand placed riprap is provided on the riverside slope of the dike in place of topsoil.

A pumping station, having two 30-inch propeller pumps and one 12-inch volute pump, handles interior storm and sanitary drainage from 615 acres within the city. The station is located behind the dike at East Hollis Street and discharges through a conduit into the Merrimack River.

The Nashua Dike is designed to protect an area of 70 acres which is occupied by major industrial establishments and many residences. This area was flooded to depths ranging from 10 to 17 feet in 1936 and 5 to 8 feet in 1938. The works provide protection against a flood of the magnitude of the record flood of 1936 as modified by completed Merrimack basin reservoirs. The project was completed in November 1948. Local contributions included lands and rights-of-way for construction, the cost of necessary relocations and other miscellaneous work.

MERRIMACK RIVER BASIN STUDIES

MERRIMACK RIVER, New Hampshire and Massachusetts

The Senate Public Works Committee adopted a resolution on 9 February 1961, requesting the Board of Engineers for Rivers and Harbors to review previous reports on the Merrimack River, New Hampshire and Massachusetts, with a view to determining the need for modification of the recommendations contained in such reports, and the advisability of adopting further improvements for flood control and allied purposes in view of the heavy damages and loss of life caused by recent severe storms in the Merrimack River basin. In response to this resolution, a public hearing was held in Concord, New Hampshire on 13 June 1962.

On 9 April 1964, the Senate Public Works Committee adopted a resolution requesting the Board to consider smaller multiple-purpose reservoirs on the headwater tributaries of the Merrimack River (i.e. streams in the Pemigewasset River watershed) in lieu of the Livermore Falls reservoir

considered in House Document 689, 75th Congress.

Both structural and nonstructural measures were considered in view of the basin needs. The study was completed in August 1972.

WINNIPESAUKEE RIVER

The committee on Public Works of the House of Representatives adopted a resolution on 14 July 1970, requesting the Board to review previous reports on the Merrimack River, Massachusetts and New Hampshire, with specific reference to the Winnipesaukee River, New Hampshire, with a view to determining the advisability of improvements in the interest of flood control and allied purposes.

Funds received in fiscal years 1972 and 1973 provided for preliminary reconnaissance, a public meeting and preparation of a plan of study. Overall program fiscal constraints have precluded further funding of the study at this time. Continuation of the study is subject to future congressional appropriations.

CONCORD FLOOD PLAIN INFORMATION STUDY

A study, completed in August 1972 for the Merrimack River within the city of Concord, compiled data for local guidance in developing land use plans and regulating the use of flood plains within the city. Copies of the study may be obtained from the local administrative office.

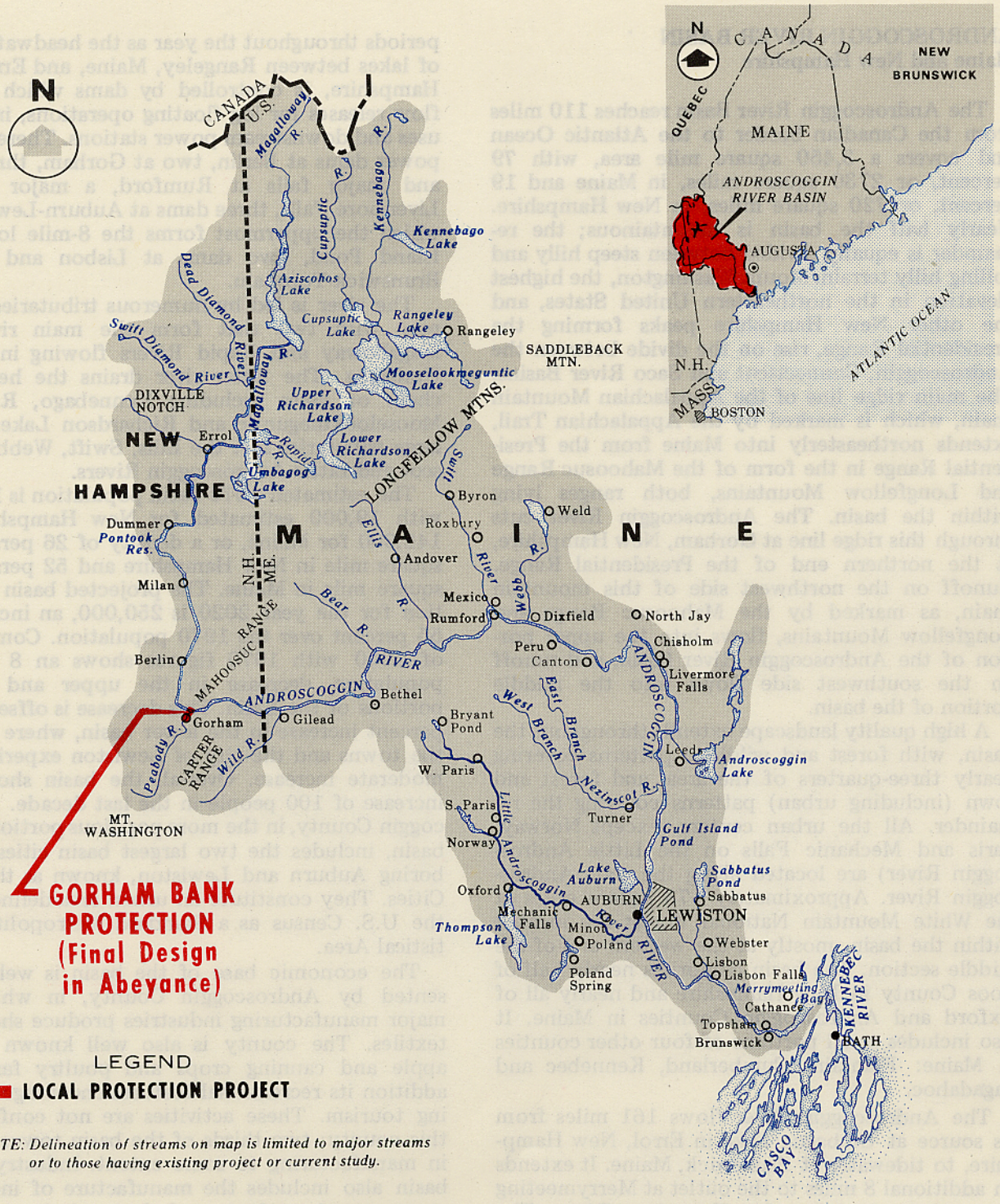
LITCHFIELD, MERRIMACK, AND PETERBOROUGH FLOOD PLAIN INFORMATION STUDIES

Studies of the flood plains along the Merrimack River in the town of Litchfield, the Merrimack and Souhegan Rivers in Merrimack, and the Contoocook River and Nubanusit Brook in Peterborough are in progress. The reports are scheduled to be published in October 1973 and January 1974, respectively.

HENNIKER, HILLSBORO, SALEM, AND LACONIA FLOOD PLAIN INFORMATION STUDIES

Studies will be made of the flood plains along the Contoocook River in Henniker and Hillsboro, the Spicket River in Salem, the Winnipesaukee River in Laconia, and the Merrimack River in Manchester. Initiation of the studies is contingent upon the availability of funds.

The Presidential Range of the White Mountains forms the divide separating the Androscoggin, Connecticut and Saco River Basins



ANDROSCOGGIN RIVER BASIN

Maine and New Hampshire

ANDROSCOGGIN RIVER BASIN
Maine and New Hampshire

The Androscoggin River Basin reaches 110 miles from the Canadian border to the Atlantic Ocean and covers a 3,450 square mile area, with 79 percent, or 2730 square miles, in Maine and 19 percent, or 720 square miles, in New Hampshire. Nearly half the basin is mountainous; the remainder is equally divided between steep hilly and rolling hilly terrain. Mount Washington, the highest elevation in the northeastern United States, and the other New Hampshire peaks forming the Presidential Range, rise on the divide between the Androscoggin, Connecticut and Saco River Basins. The main ridge line of the Appalachian Mountain chain, which is marked by the Appalachian Trail, extends northeasterly into Maine from the Presidential Range in the form of the Mahoosuc Range and Longfellow Mountains, both ranges lying within the basin. The Androscoggin River cuts through this ridge line at Gorham, New Hampshire, at the northern end of the Presidential Range. Runoff on the northwest side of this mountain chain, as marked by the Mahoosuc Range and Longfellow Mountains, flows into the upper portion of the Androscoggin River Basin, and runoff on the southwest side flows into the middle portion of the basin.

A high quality landscape extends throughout the basin, with forest and wildland patterns covering nearly three-quarters of the area, and forest and town (including urban) patterns covering the remainder. All the urban centers (except Norway, Paris and Mechanic Falls on the Little Androscoggin River) are located along the main Androscoggin River. Approximately 173 square miles of the White Mountain National Forest are located within the basin, mostly at the western end of the middle section. The basin comprises nearly half of Coos County in New Hampshire and nearly all of Oxford and Androscoggin Counties in Maine. It also includes small portions of four other counties in Maine: Franklin, Cumberland, Kennebec and Sagadahoc.

The Androscoggin River flows 161 miles from its source at Umbagog Lake in Errol, New Hampshire, to tidewater at Brunswick, Maine. It extends an additional 8 miles to the outlet at Merrymeeting Bay, where it joins the Kennebec River. The Androscoggin descends a total of 1,245 feet, of which 789 have been developed by private interests for hydroelectric power purposes. There are steep descents in two reaches: one, a 2.5-mile stretch at Berlin, New Hampshire, with a 240-foot fall; the other, a 1.6-mile reach at Rumford, Maine, where the river drops 180 feet. The average river slope is nearly 8 feet per mile.

The main river has a dependable flow for most periods throughout the year as the headwater chain of lakes between Rangeley, Maine, and Errol, New Hampshire, is controlled by dams which provide flow releases for log floating operations, industrial uses and downstream power stations. There are five power dams at Berlin, two at Gorham, three dams and major falls at Rumford, a major dam at Livermore Falls, three dams at Auburn-Lewiston of which the uppermost forms the 8-mile long Gulf Island Pond, two dams at Lisbon and two at Brunswick-Topsham.

The river is fed by numerous tributaries, beginning with two that form the main river, the Magalloway and Rapid Rivers flowing into Lake Umbagog. The latter river drains the headwater chain of lakes including Kennebago, Rangeley, Mooselookmeguntic and Richardson Lakes. Other large tributaries are: the Ellis, Swift, Webb, Nezinscot and Little Androscoggin Rivers.

The estimated 1970 basin population is 161,000 with 19,000 estimated for New Hampshire and 142,000 for Maine, or a density of 26 persons per square mile in New Hampshire and 52 persons per square mile in Maine. The projected basin population for the year 2020 is 250,000, an increase of 55 percent over the 1970 population. Comparison of 1960 with 1970 figures shows an 8 percent population decrease in the upper and middle portions of the basin. This decrease is offset by a 5 percent increase in the lower basin, where most of the towns and the city of Lewiston experienced a moderate increase. Over-all the basin showed an increase of 100 people in the last decade. Androscoggin County, in the more populous portion of the basin, includes the two largest basin cities, neighboring Auburn and Lewiston, known as the Twin Cities. They constitute an urban area delineated in the U.S. Census as a Standard Metropolitan Statistical Area.

The economic base of the basin is well represented by Androscoggin County, in which the major manufacturing industries produce shoes and textiles. The county is also well known for its apple and canning crops and poultry farms. In addition its recreational features encourage a thriving tourism. These activities are not confined to this county; two thirds of the basin towns engage in manufacturing to some extent. Industry in the basin also includes the manufacture of industrial paper, wood products and electronic items; printing; dairy farming; forestry; fishing and mining. Service industries, including wholesale and retail trade, are second only to manufacturing in number of people employed in the basin.

Abundant recreational opportunities contribute to the basin economy. The headwaters area above Errol is famous for its fishing, canoeing, camping and hunting. Although access to the upper headwaters and other lakes is largely controlled by

Maine and New Hampshire pulp and paper mills to benefit selective timber production, Rangely Lake is becoming increasingly developed as a summer resort and vacation home area. Existing pollution detracts from full enjoyment of the main river throughout its course below Berlin; however, above Berlin there are two popular canoeing runs: the Rapid River offers a 4-mile, white water run above Umbagog Lake, and the main river offers a mixture of rapids and fast current upstream of Pontook Dam in the Thirteen Miles Woods reach, in Dummer and Errol.

Skiing is fast becoming a major activity in the middle basin area. Fishing, boating and swimming are popular activities in many lakes along the tributary streams, particularly in the lower basin. At the mouth of the river, Merrymeeting Bay is a major stopover for migratory waterfowl.

The average annual basin precipitation is about 40 inches. Annual snowfall varies from 80 inches near the coast to 170 inches in the headwaters. Average water content of the snow cover in the upper basin usually reaches a maximum of 8 inches during the month of March in the upper basin and decreases to 5 inches in the lower basin. In the higher peaks of the White Mountain portion of the basin as much as 10 inches of water may be present.

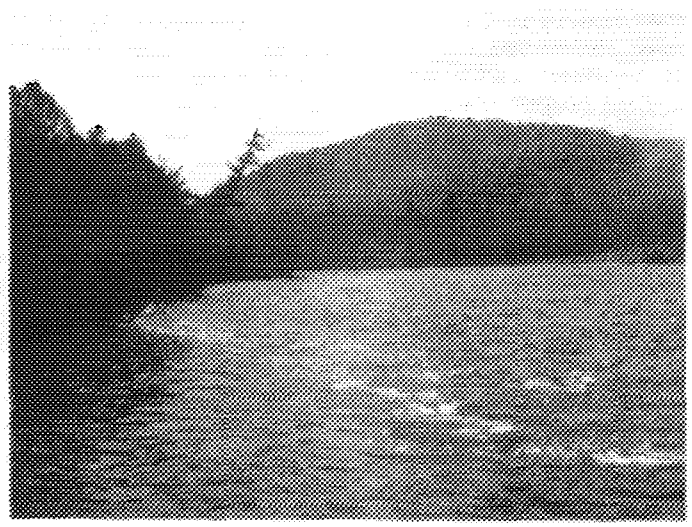
Major floods in the basin are caused principally by a combination of rainfall and melting snow in late winter or early spring. Significantly, the two largest basin floods of this century occurred in March. In the greatest flood of record, that of March 1936, four lives were lost and 1,500 families were rendered temporarily homeless. Damages were heavy, with about 40 percent of the experienced losses suffered by industrial properties. The damage centers affected, at Brunswick, Topsham, Lisbon Falls, Lewiston, Livermore Falls, Peru and Rumford, Maine, and at Berlin, New Hampshire, are all major elements in the economy of the basin. Highways, bridges, railroads and public utilities bore major damages. The second largest flood in the basin in this century hit in March 1953. Losses were experienced throughout the length of the main river and along three of the tributary streams.

A June 1967 survey report on the basin concluded that while no structural measures for flood control were economically justified, at the time, either as a single purpose or multiple purpose development, the communities affected by flood overflow should consider adopting zoning measures to reduce future flood losses.

ANDROSCOGGIN RIVER BASIN PROJECT

ANDROSCOGGIN RIVER LOCAL PROTECTION, Gorham

An Emergency Bank Protection project under authority of Section 14 of the 1946 Flood Control Act, has been designed to prevent further erosion of the riverbank along Main Street (U.S. Route 2) in the commercial center of Gorham. The project includes about 500 linear feet of stone slope protection. Final design has been delayed pending receipt of non-Federal agreements with the terms of local cooperation.



SACO RIVER BASIN
Maine and New Hampshire

The Saco River Basin covers an area of 1,697 square miles of which 870 square miles are in east-central New Hampshire and 827 square miles are in southwestern Maine. The basin is essentially conical in shape and has a maximum width of 44 miles and a length of nearly 75 miles. It extends southeastward from the main divide of the White Mountains of New Hampshire and narrows nearly to a point as it intersects the south coast of Maine about 15 miles south of Portland.

The basin is bounded by the Connecticut and Androscoggin River Basins on the north, the Presumpscot River Basin on the east, the Merrimack River Basin on the west, the Piscataqua River Basin on the south and portions of the Maine South Coastal Area along both sides of the extreme lower basin. It occupies nearly all of Carroll County, the northeastern section of Grafton County and minor portions of the southeastern section of Coos County in New Hampshire. In Maine it occupies the southwestern section of Oxford County, most of the northern third of York County and minor portions of the western section of Cumberland County.

Most of the upper basin is located within the White Mountain National Forest where the topography consists of high mountains and very steep valleys. The topography in the middle basin consists of steep hills and broad, flat valleys, with isolated, small rounded mountains. The hills become more rounded and the slopes flatter in the lower basin, but the flood plains are much narrower as the main river approaches the narrow coastal plain. Valley elevations generally range between 400 and 700 feet in the upper basin, 300 to 400 feet in the middle basin and 70 to 300 feet in the lower basin. Mountain elevations in the upper basin generally range between 1,000 and 4,000 feet, and rise to 6,288-foot Mount Washington on the north and the 2,975-foot Mount Shaw on the south. Summit elevations in the middle basin generally range between 800 and 1,500 feet, and rise to 2,877-foot Speckled Mountain on the north and the 1,416-foot Douglas Mountain on the south. Summit elevations in the lower basin generally range between 200 and 500 feet, and rise to 580-foot Oak Hill on the north and 1,058-foot Ossipee Hill on the south.

Beginning at the outlet of Saco Lake in Crawford Notch, New Hampshire, the Saco River follows a sinuous course for a distance of 125 miles to its mouth, five miles below the head of tidewater at the twin, coastal cities of Biddeford and Saco, Maine. The river has a total fall of nearly 1,900 feet. After the first 14 miles, where the river drops 1,100 feet, the river gradient becomes more gradual as the river drops 300 feet through moderate rapids and many meanders in the next 26 miles through Bartlett and North Conway, before crossing into Maine at Fryeburg. Four miles within Maine, the river spills over a low dam at Swans Falls, Fryeburg, where the first of 11 industrial or utility power dams has been developed on the main river. The river then passes through several ponds and swamps while descending only 21 feet in the 35-mile reach above Great Falls, near West Baldwin, where the river spills over a 79-foot high dam. In the next reach of 12 miles to a low dam at Steep Falls, the river falls 53 feet and increases in size from the flow of its largest tributary, the Ossipee River. Below Steep Falls, near East Baldwin, the river drops 216 feet in its final 24 miles to tidewater at Biddeford. Nearly all of this drop has been developed by small dams at Bonny Eagle, West Buxton, Bar Mills and Salmon Falls; a large dam at Union Falls; and by three dams at Biddeford.

The major tributaries are the Swift, Ossipee and Little Ossipee Rivers. The Swift flows from the north slope of Mount Kancamagus, in the southern part of the White Mountain National Forest in Livermore, New Hampshire. The eastern end of the scenic Kancamagus Highway follows the easterly course of the river for most of its 21-mile length before the Swift enters the broad flood plain of the Saco at Conway. The Swift drains an area of 100 square miles and has a total fall of over 1,400 feet. Except for provision of overlook areas and forest warden headquarters, it has been left as a wilderness area.

The Ossipee River begins at the outlet of Ossipee Lake at Effingham Falls, New Hampshire and flows easterly for 18 miles to the Saco at Cornish, Maine, with a total fall of 140 feet. It drains a 455-square mile area of small towns, summer cottages and farms. Its largest tributary is the Bearcamp River which flows, with a total fall of over 1,030 feet, 25 miles southeasterly from the south slope of the Sandwich Range to the west side of Ossipee Lake at Ossipee, New Hampshire. There are two small dams on the Bearcamp and three small dams on the Ossipee.

The Little Ossipee River rises in Balch Pond in Acton and Newfield, Maine and flows 31 miles in a meandering, easterly course to the Saco at East Limington, Maine. It drains an area of 187 square miles and has a total fall of 340 feet. There are five small dams on the Little Ossipee.

The 1970 population of the Saco River Basin is estimated as 53,000, with 12,000 estimated for New Hampshire and 41,000 for Maine. This represents a 7 percent increase over the 1960 basin population of 48,000. It increased 10 percent in the New Hampshire portion of the basin and 5 percent in the Maine portion of the basin. The

projected population for the basin in 2020 is 95,000, an increase of 83 percent of the 1970 population.

The population density for the entire basin averages 31 people per square mile. However, 45 percent of the basin population resides in a 35-square mile area within the Maine coastal cities of Biddeford and Saco, where the population density averages 685 per square mile. Excluding the 375-square mile section of the White Mountain National Forest, which occupies 43 percent of the New Hampshire portion of the basin, and excluding the Biddeford-Saco area results in a population density averaging 23 people per square mile for the remainder of the basin. This density figure is typical for both the New Hampshire and Maine portions of the basin. About 9 percent of the basin population resides in the upper basin resort town of Conway. The largest of the other small towns in the basin are Ossipee in the upper basin, Fryeburg in the middle basin and Buxton in the lower basin.

The basin is of high visual quality. Landscape patterns vary from forest-wildland in most of the upper basin, forest-town near the New Hampshire-Maine line and in the upper half of the middle basin, and farm-forest in the remainder of the basin, with the exception of the Biddeford-Saco urban area. The Biddeford-Saco area constitutes the largest industrial, commercial and service trade center in the basin. While formerly a textile center, shoe manufacturing is presently the principal industry, followed by the manufacture of electronic and automotive parts, cotton goods and machine tool products. Improvement of the 6-mile long tidal waterway to Biddeford and Saco dates back to 1824 when commercial navigation was a significant activity at the mouth of the Saco. This area now serves an active recreational boating fleet and a small lobstering fleet.

The middle basin is serviced by facilities in nearby Portland and suburbs and by facilities in Conway; the latter community is the main service center for the upper basin. Manufacture of wooden products and electronics parts, general farming and travel services are important activities in the middle basin. Many small lakes on the tributary streams throughout the basin, with the exception of the White Mountain National Forest area, have active summer colonies and children's camps along their shores. The 20-mile long, old course of the Saco River, which makes a northerly loop at Fryeburg to the outlet of Kezar Lake before turning southward to rejoin the main river, is a popular canoeing and camping area for summer camp groups.

In the upper basin, the manufacture of wooden products is overshadowed by the many retail trade and travel services associated with the year-round recreational and scenic opportunities offered by the Eastern Slopes Region, for which Conway is the gateway town. Natural scenic areas, major ski developments, year-round vacation homes and inns, and mountain streams all serve to make tourism the principal activity in the upper basin.

Average annual precipitation varies from 58 inches in the upper basin to 42 inches in the lower basin. Snowfall averages annually over 100 inches in the upper basin to 70 inches in the lower basin. The average water content of the snow cover reaches a maximum of 7 inches during the month of March in the upper basin and 4 inches in the lower basin. Major floods have commonly occurred in the spring of the year as a result of heavy rainfall combined with snowmelt. The greatest flood of record in the upper basin occurred in March 1953; the greatest in the lower basin occurred in March 1936.

The main damage areas are located in the lower basin within the small coastal cities of Saco and Biddeford, Maine. Numerous New Hampshire areas have suffered damages in the upper basin including areas along the Saco River above Glen, the Ellis River, the East Branch Saco River, feeder streams of the Swift River, the Bearcamp River and along the shores of Ossipee Lake. A September 1967 survey report on the basin recommended no structural improvements for flood control and allied purposes at that time, but did recommend nonstructural measures for lessening future flood losses. The report recommended that local interests regulate development in flood hazard areas of the basin and adopt suitable building codes providing for flood-proofing of existing structures on the flood plains.

SACO RIVER STUDY

(Small Project Study for Flood Control and Related Purposes)

A reconnaissance investigation of flooding and bank erosion at North Conway was made in late 1971. The study found insufficient economic justification to warrant Federal assistance.

NOTE: Delineation of streams on map is limited to major streams or to those having existing project or current study.

PISCATAQUA RIVER BASIN
Maine and New Hampshire

The Piscataqua River Basin occupies most of the southeastern corner of New Hampshire and part of the adjacent southwestern corner of Maine. The basin has a drainage area of 1,022 square miles of which 776 square miles are in New Hampshire and 246 square miles are in Maine. Although the basin is compact, the main river is offset near the northeastern side of the basin, resulting in many of the tributary streams entering from the west. The thread of the Piscataqua and its largest tributary, the Salmon Falls River, forms the boundary line between New Hampshire and Maine.

The basin is bounded by the Saco River Basin on the north, the Merrimack River Basin on the west and south, the Maine South Coastal Area on the northeast and the New Hampshire Coastal Area on the southeast. Within New Hampshire, it occupies the southeast corner of Carroll County, most of Strafford County and the northern two-thirds of Rockingham County. Within Maine, it occupies the west-central and southwestern sections of York County.

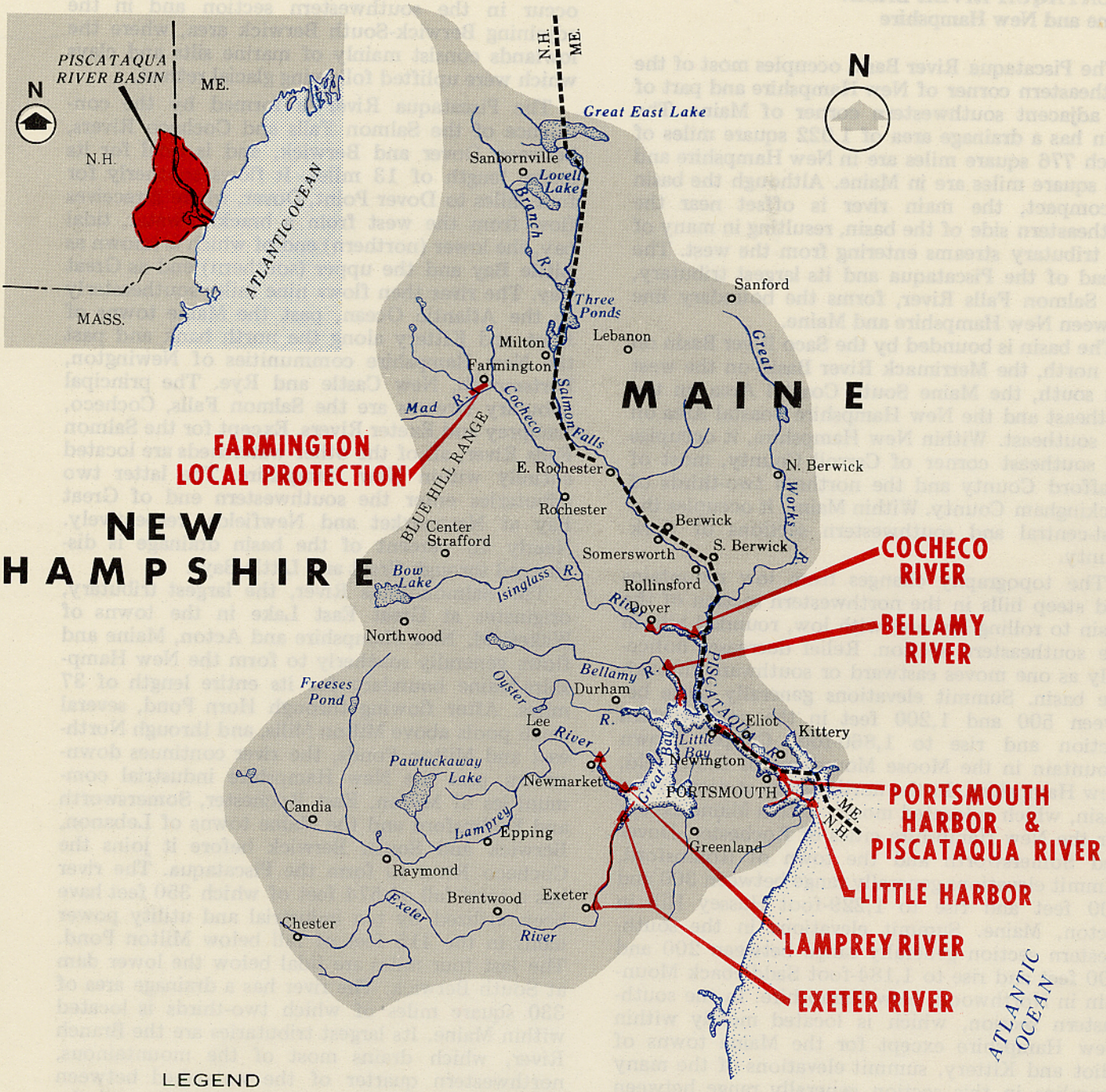
The topography changes from low mountains and steep hills in the northwestern section of the basin to rolling lowland with low, rounded hills in the southeastern section. Relief decreases noticeably as one moves eastward or southward through the basin. Summit elevations generally range between 500 and 1,200 feet in the northwestern section and rise to 1,860-foot Copple Crown Mountain in the Moose Mountains of Brookfield, New Hampshire. In the northeastern section of the basin, which is located mostly within Maine except for the New Hampshire cities of Rochester, Dover and Somersworth and the town of Rollinsford, summit elevations generally range between 300 and 900 feet and rise to 1,229-foot Hussey Hill in Acton, Maine. Summit elevations in the southwestern section generally range between 200 and 600 feet and rise to 1,184-foot Saddleback Mountain in Northwood, New Hampshire. In the southeastern section, which is located mostly within New Hampshire except for the Maine towns of Eliot and Kittery, summit elevations of the many drumlins in this section generally range between 150 and 300 feet, with 330-foot Third Hill in Eliot marking the highest summit.

Valley elevations generally range between 250 and 600 feet in the northwestern section, 150 to 400 feet in the northeastern section, 100 to 300 feet in the southwestern section and 40 to 100 feet in the southeastern section. Numerous small lakes, ponds and marshes occupy depressions in the glacial till which blankets the upland valleys in the northwestern section. Narrow marshes extend along most of the tributary streams in the southwestern section. Numerous and extensive marshes occur in the southwestern section and in the adjoining Berwick-South Berwick area, where the lowlands consist mainly of marine silts and clays which were uplifted following glacial retreat.

The Piscataqua River is formed by the confluence of the Salmon Falls and Cocheco Rivers, between Dover and Berwick, and is tidal for its entire length of 13 miles. It flows southerly for four miles to Dover Point, Dover, where it receives flow from the west from a brackish-water, tidal bay, the lower (northern) end of which is known as Little Bay and the upper (southern) end as Great Bay. The river then flows nine miles southeasterly to the Atlantic Ocean, past the Maine towns of Eliot and Kittery along the north bank and past the New Hampshire communities of Newington, Portsmouth, New Castle and Rye. The principal tributary streams are the Salmon Falls, Cocheco, Lamprey and Exeter Rivers. Except for the Salmon Falls River, all of the other watersheds are located entirely within New Hampshire. The latter two tributaries enter the southwestern end of Great Bay at Newmarket and Newfields, respectively. Nearly 45 percent of the basin drainage is discharged through Great and Little Bays.

The Salmon Falls River, the largest tributary, originates at Great East Lake in the towns of Wakefield, New Hampshire and Acton, Maine and flows generally southerly to form the New Hampshire-Maine boundary for its entire length of 37 miles. After flowing through Horn Pond, several small pools above Milton Mills, and through Northeast and Milton Ponds, the river continues downstream past the New Hampshire industrial communities of Milton, East Rochester, Somersworth and Rollinsford and the Maine towns of Lebanon, Berwick and South Berwick before it joins the Cocheco River to form the Piscataqua. The river has a total fall of 574 feet of which 350 feet have been utilized by ten industrial and utility power dams in the 415 feet of fall below Milton Pond. The last four miles are tidal below the lower dam at South Berwick. The river has a drainage area of 330 square miles of which two-thirds is located within Maine. Its largest tributaries are the Branch River, which drains most of the mountainous, northwestern quarter of the watershed between Brookfield and Milton, New Hampshire, and the Great Works River, which drains most of the rolling, southeastern quarter of the watershed between Sanford and South Berwick, Maine.

The Cocheco flows 34 miles southeasterly from Birch Ridge in the rural town of New Durham and passes through the small town of Farmington and the industrial-residential cities of Rochester and Dover. The last three miles of the river below Dover are tidal. The river has a drainage area of 182 square miles and a total fall of 850 feet. Most



LEGEND

▲ NAVIGATION PROJECTS

▬ LOCAL PROTECTION PROJECT

NOTE:

All projects completed unless otherwise noted.

Delineation of streams on map is limited to only those having existing project or current study

PISCATAQUA RIVER BASIN

Maine and New Hampshire

SCALE IN MILES

0 4 8

of the 230 feet of fall through Rochester and Dover has been utilized by eight industrial power dams. Nearly half of the watershed is drained by the Isinglass River, which flows 17 miles easterly from Bow Lake, at Bow Lake Village in Strafford, through hilly, rural sections of the towns of Strafford and Barrington before joining the Cocheco above Rochester.

The Lamprey flows in a steep course southerly from Saddleback Mountain in Northwood through Freeses Pond, Deerfield Parade and Deerfield Center into Raymond. It becomes much flatter as it flows easterly through millponds in Raymond and Epping, then northeasterly in a very wandering course through swamps and a millpond in Lee, then southeasterly to Wiswalls Falls and Packers Falls in Durham and through the millpond at Newmarket. It becomes a tidal stream in the 2-mile reach below the industrial dam at Newmarket. The river has a drainage area of 211 square miles, a length of 42 miles and a total fall of over 600 feet. Most of the 170 feet of fall below Raymond is utilized by five industrial power dams.

The Exeter, the southernmost stream in the basin, rises at Bell Hill south of the village of Chester and flows in a very twisting course generally eastward through a series of small villages to the large, residential town of Exeter, where it becomes tidal. While the watershed is only 16 miles long and drains an area of only 129 square miles, this small stream doubles back and forth for a distance of 43 miles, making it the longest stream in the basin. The 10-mile tidal section below Exeter is commonly known as the Squamscott River. The river has a total fall of 420 feet, of which half occurs in the first seven miles above Lily Pond in Sandown. It continues northeasterly through a millpond into Danville, westerly through extensive marshes in Fremont and Chester, northerly in Raymond, southeasterly through Fremont, easterly through three millponds in Brentwood to the southern part of Exeter, and finally northerly through the wide millpond at Exeter.

The basin 1970 population is estimated as 153,000, with 129,000 estimated for New Hampshire and 24,000 estimated for Maine. This represents a 12 percent increase over the 1960 basin population of 136,000. This increase was 13 percent within New Hampshire and 8 percent within Maine. The projected population for the basin in 2020 is 320,000, an increase of 103 percent over the 1970 population.

The population density within the basin averages 150 people per square mile; 166 per square mile in New Hampshire and 98 per square mile in Maine. Eighty percent of the New Hampshire population resides in 30 percent of the area within the New Hampshire portion of the basin. The population density for the 12 tidewater communities along Great Bay and the Piscataqua, plus the adjoining cities of Rochester and Somersworth, averages 438 per square mile. The seven largest communities, decreasing in size from 20,600 to 6,400, are the cities of Dover, Portsmouth, Rochester and Somersworth and the towns of Exeter, Durham and Newington. Nearly 40 percent of the Maine population resides in a 12-square mile area within the town of Kittery.

The basin is of high to medial visual quality. Landscape patterns vary from forest-town at the head of the Salmon Falls River to urban-suburban in a 5-mile wide strip extending 22 miles southeastward from Rochester to New Castle. Eighty percent of the basin is farm-forest. Approximately one-third of the land is in open field agriculture and most of the remainder is wooded, except for the town centers which are generally 4 to 5 miles apart. The main commercial and service trade centers are Portsmouth, Dover, Rochester and Exeter in the New Hampshire portion of the basin and Kittery and Sanford in the Maine portion.

The largest industry is the Portsmouth Naval Shipyard submarine repair facilities in Kittery. Other major industrial products are shoes, electronic products, electrical equipment, automotive accessories, printing machinery and woolen goods. Other significant items are leather, synthetic textiles, submarine cables, building materials, seafood processing, dairying and poultry farming. The lower nine miles of the Piscataqua estuary provides a deep-draft harbor known as Portsmouth Harbor, where over 2.0 million tons of waterborne commerce were received in 1972.

Provision of travel and vacation services are major activities, especially in the vicinity of the New Hampshire, Spaulding and Maine Turnpikes, which are major arteries serving eastern and northern New Hampshire and southern and central Maine. The Exeter-Portsmouth-Kittery corridor and other inland communities provide many historic attractions. The scenic larger lakes in the western and northern sections of the basin offer excellent fishing, boating and swimming opportunities for an increasing number of summer residents, youth camps and day-use visitors.

In New Hampshire, small-boat harbors have been developed at Little Harbor, Sagamore Creek and along the back channel to Portsmouth Harbor, all immediately south or west of the resort town of New Castle which is situated on an island inside the river entrance. On the Maine side of the river, small-boat harbors include Pepperell Cove, Chauncey Creek and Spruce Creek, all in Kittery. Boating, fishing and hunting are moderately popular in the 12-square mile area encompassed by Great and Little Bays and their tidal tributaries. Other than serving as a major wintering area for migratory waterfowl and for limited residential

use, this area is used only to a fraction of its potential. About half of the water surface is exposed as tidal flats at low tide, the tributary channels are narrow and unmarked and public access is limited as most of the 43 miles of shoreline is undeveloped land held by year-round and summer residents.

Average annual precipitation over the basin is 41 inches. Average annual snowfall varies from more than 80 inches in the low mountains to less than 50 inches near the coast. The average water content of the snow cover reaches a maximum of 4 inches during the month of March. The March 1936 flood was the basin flood of record; although damages were spotty. The main damage areas are located at Union, Wakefield, Milton and East Rochester in the Salmon Falls watershed and at Farmington on the Cocheco River. Local protection projects have been completed at Farmington.

PISCATAQUA RIVER BASIN PROJECTS

FARMINGTON LOCAL PROTECTION WORKS
(Small Flood Control Project not Specifically Authorized by Congress)

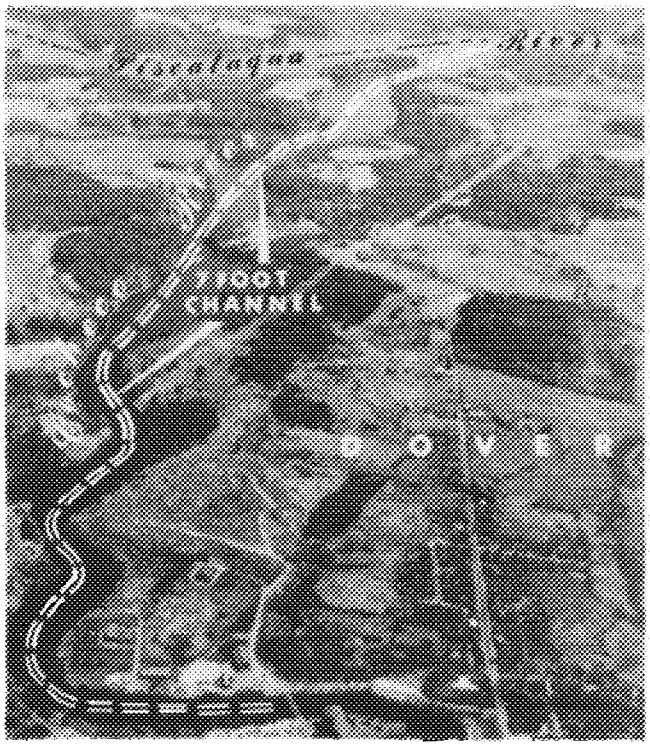
The Farmington local protection project is located along the Cocheco River in the Piscataqua River basin and extends 7,800 feet from the Central Street bridge to a point 4,700 feet below the South Main Street bridge.

The portion above the South Main Street bridge, completed in November 1956, consisted of enlarging and straightening about 3,100 feet of the Cocheco River from the Central Street bridge to the South Main Street bridge, constructing about 3,000 feet of earth dike and 150 feet of concrete floodwall along the left bank of the river, and straightening about 600 feet of the Mad River at its confluence with the Cocheco. It protects about 45 acres of the center of Farmington from a flood greater than that of 1936, the flood of record.

The portion below South Main Street bridge was completed in October 1961. The basic work had been completed in November 1959, but modification and repair of a section of the right bank was required as a result of flood damage in 1960. This channel improvement work consisted of widening and deepening about 4,000 feet of the Cocheco River downstream of the South Main Street bridge, diking about 200 feet along the left bank just downstream of the bridge, improving the lower end of Dames Brook, and snagging and clearing an additional 700 feet of channel downstream from the lower limit of the channel improvement. It provides protection for Farmington's major industry, commercial establishments, and residences. The Town of Farmington is responsible for operation and maintenance of the project.

Restoration of the protective works was started in September and completed in December 1964, and the project was turned over to the Town for operation and maintenance in January 1965. The work included channel widening and re-shaping, stone slope protection at areas subject to severe erosion, and construction of a deflecting stone groin at the confluence of the Mad and Cocheco Rivers.

Farmington Local Protection, showing Cocheco River channel improvements



Cocheco River, Dover

COCHECO RIVER, Dover

The Cocheco River, located in southeastern New Hampshire, flows 30 miles in a southeasterly direction and unites with the Salmon Falls River near Dover to form the Piscataqua River, about 8 miles upriver from Portsmouth.

This project, adopted in 1890, provided for a channel 7 feet deep and 60 to 75 feet wide in earth and 7.5 feet deep and 50 feet wide in rock, extending from the mouth of the river 3 miles upstream to the head of navigation at Dover. The project was completed in 1906. Shipments at that time were chiefly coal and building materials. No commercial navigation has been reported on the river for many years.

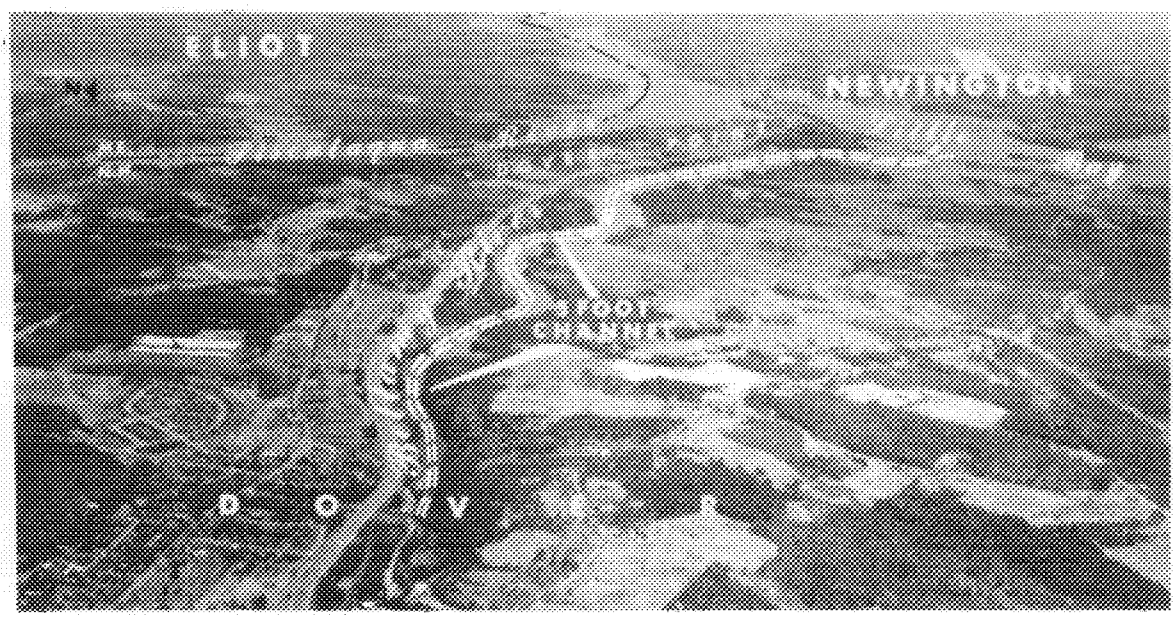
The need for small-boat improvements in the Cocheco River was recently considered as part of a comprehensive survey of navigation needs in the Great Bay area, which is discussed at the end of this section.

BELLAMY RIVER, Dover

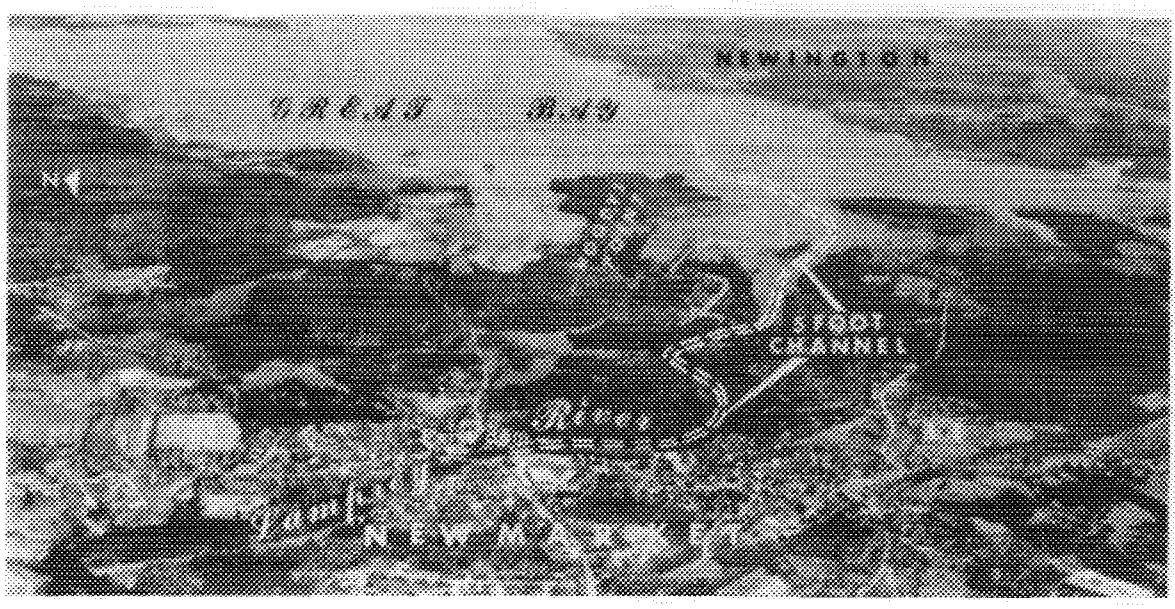
The Bellamy River, a northeastern arm of Little Bay, flows along the west side of Dover Point into Little Bay, which in turn joins the Piscataqua River, about six miles northwest of Portsmouth.

This project, adopted in 1888, provided for dredging a four-mile long channel 5 feet deep and 50 feet wide to accommodate shipping from Great Bay, Portsmouth, to Sawyer's Mill, Dover. The project was completed in 1896. In the latter part of the 19th century, the river was used principally for the shipment of brick. There has been no shipping on the river for many years.

The need for improvements in the interest of small-boat navigation in the Bellamy River was recently considered as part of a comprehensive survey of navigation needs in the Great Bay Area, which is discussed at the end of this section.



Bellamy River, Dover



Lamprey River, Newmarket

LAMPREY RIVER, Newmarket

The Lamprey River flows easterly, emptying into the western side of Great Bay, about 8 miles west of Portsmouth.

The project, adopted in 1881, provided for dredging a 2.5-mile long channel from the river mouth at Great Bay to the head of tidewater at Newmarket. The channel dimensions varied from 4 to 5 feet in depth at mean low water and from 40 to 100 feet in width. The project was completed in 1883. A small recreational fleet is based near the mouth of the river.

The need for small boat improvements in the Lamprey River was recently considered as part of a comprehensive survey of navigation needs in the Great Bay area, which is discussed at the end of this section.

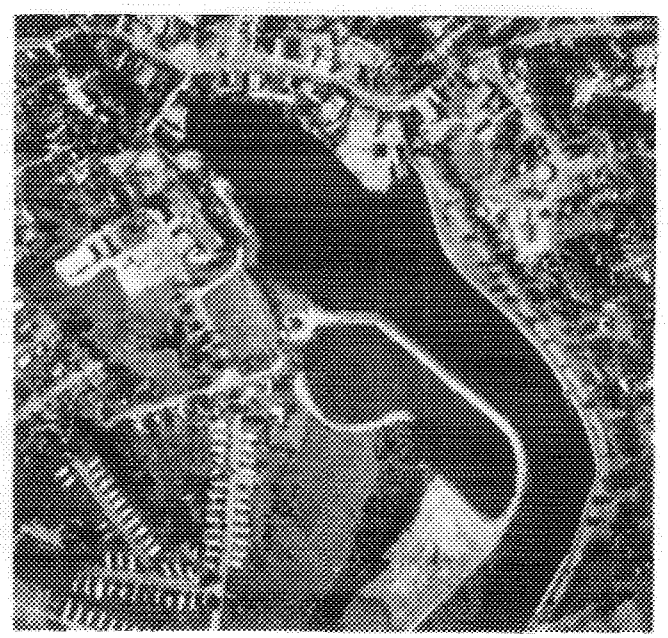
EXETER (SQUAMSCOTT) RIVER

The Exeter River (also known as the Squamscott River downstream of the town of Exeter) empties into the southwestern corner of Great Bay near the mouth of the Lamprey River, about 8 miles southwest of Portsmouth.

Improvement of the waterway began in 1880 with further work authorized in 1899. This project provided for an 8-mile long channel 5 feet deep at mean low water and 40 feet wide from Great Bay to Oxbow Cut and then 4 feet deep to the dam at Exeter, with a turning basin at Exeter.

The existing project, adopted in 1911, provided for the restoration of depths accomplished under previous work and the straightening of the channel at Strathmore Bridge (N.H. Route 108). The existing project was completed in 1911. Present use is limited primarily to small recreational craft.

The need for improvements in the interest of small-boat navigation in the Exeter River was recently considered as part of a comprehensive survey of navigation needs in the Great Bay area, which is discussed at the end of this section.



Exeter (Squamscott) River, showing slips used by crew practice shells at head of navigation

PORTSMOUTH HARBOR AND PISCATAQUA RIVER

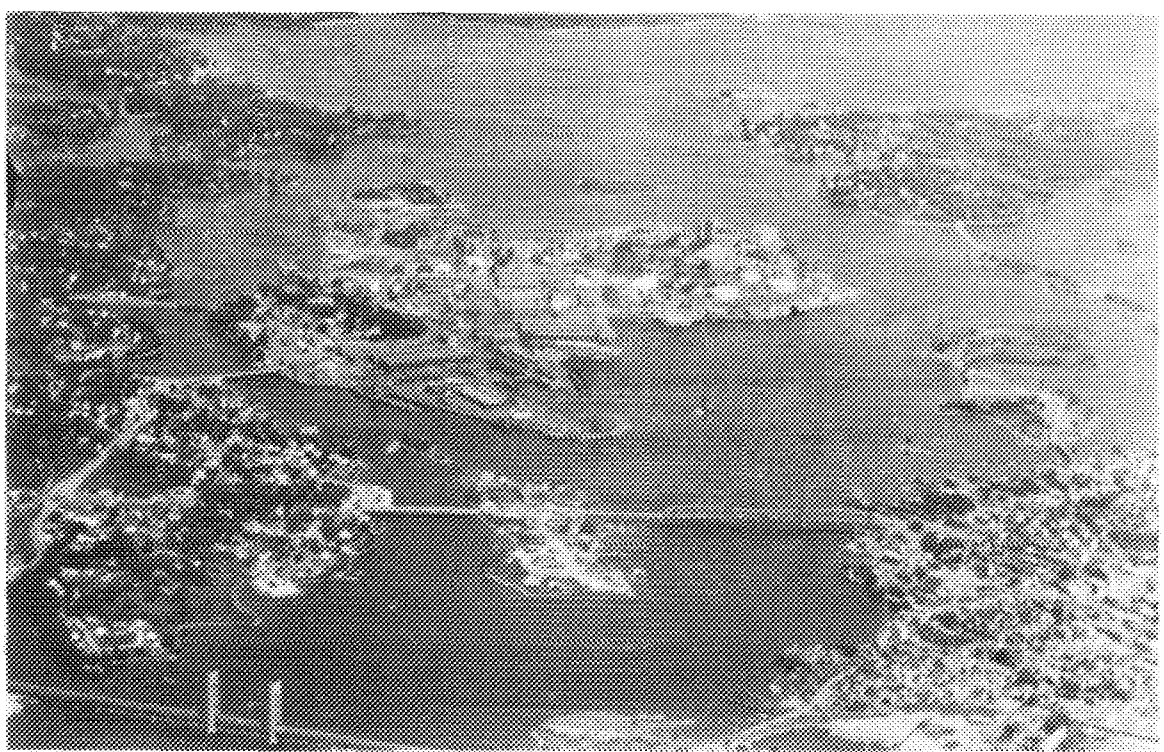
Portsmouth Harbor, formed by the mouth of the Piscataqua River along the New Hampshire-Maine boundary, is located about 50 miles northeast of Boston.

The original project for Portsmouth Harbor, authorized in 1879, provided for removal of two ledge areas west of the Portsmouth Navy Yard in Kittery (Gangway Rock and the southwestern point of Badgers Island) and for construction of a breakwater between Goat and New Castle (Great) Islands at the south side of the inner harbor. The latter now serves as a causeway for the northern access road to New Castle.

The project was modified in 1890, 1954 and 1962 to provide for a channel 35 feet deep at mean low water, generally 400 feet wide (with widening of sharp bends up to 700 feet) and extending 6.2 miles generally northwesterly from deep water in the outer harbor to above the Atlantic Terminal Sales dock in Newington. Turning basins were provided at the head of the channel and above Boiling Rock (river mile 4). Except for removal of a small shoal near the I-95 bridge in 1968, construction was completed in 1966.

A modification was approved in 1965 under Section 107 of the 1960 River and Harbor Act, calling for a main channel and two branch channels, all 6 feet deep, to serve a large recreational fleet and a small lobstering fleet based in the Back Channels area between New Castle and Leachs Islands on the northeast and the Portsmouth-Rye shore to the southwest. A 100-foot main channel extends 0.4 mile northwestward from Little Harbor through the Rye-New Castle drawbridge and swings west to deep water at the junction of two, 75-foot wide, branch channels. One branch channel extends 0.6 mile generally northward around Leachs Island to deep water south of the bridge between Shapleigh and Goats Islands connecting Portsmouth and New Castle. The second branch channel extends 0.9 mile southwesterly up Sagamore Creek to the Route 1A bridge and has a 3-acre anchorage strip, 6 feet deep, along the upper end of the channel.

Construction, initiated in August 1970, was essentially completed in December 1970. Local interests were required to share in the cost of the project and to provide two public landings (to serve each branch channel). A study has been authorized to determine the need for further deepening of the main ship channel.



Portsmouth Harbor and Piscataqua River, looking downstream from vicinity of I-95 bridge

LITTLE HARBOR, New Castle and Rye

Little Harbor is located south of New Castle Island and its entrance is about one mile west of Whaleback Light (at the east side of the entrance to the Piscataqua River and Portsmouth Harbor).

The project, adopted in 1886 and modified in 1887 and 1894, provided for the construction of two breakwaters at the harbor entrance and the dredging of a 100-foot wide channel and an anchorage basin to a depth of 12 feet. The project was completed in 1903. The harbor is used as a small-boat refuge and as an access route for recreational and fishing boats based at Sagamore Creek, a small southern arm of Portsmouth Harbor.

PISCATAQUA RIVER BASIN STUDIES

GREAT BAY AND TRIBUTARIES OF GREAT BAY AND THE PISCATAQUA RIVER

A study was authorized in 1965 to determine the advisability of providing improvements in the interest of small boat navigation and allied purposes in Great and Little Bays, their tidal tributaries, and the tidal tributaries of the Piscataqua River. The principal tributaries include the Cocheco and Salmon Falls Rivers which empty into the Piscataqua River, and the Exeter, Lamprey, Oyster, and Bellamy Rivers which empty into Great Bay.

An unfavorable report was forwarded in October 1969. It states that although the area has potential for further development, use of the waterways is hindered by lack of parking and launching areas for recreational boating. The improvements needed are those normally considered to be items of local responsibility. The report found that deepening and widening of the waterways is not needed at this time.

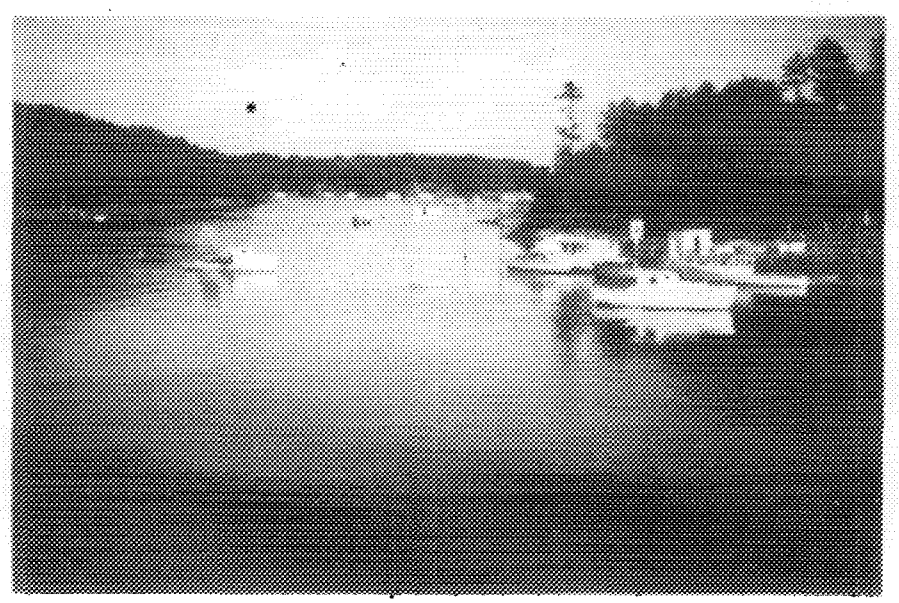
PORTSMOUTH HARBOR AND PISCATAQUA RIVER

A study has been authorized to determine the need for improving the existing 35-foot channel by deepening, widening at the bends, and increasing the areas of the turning basins.

Initiation of the study is dependent upon appropriation of funds.

EXETER RIVER, Exeter

Reconnaissance studies were made under the authority of Section 205 of the 1948 Flood Control Act to determine if Federal participation in local flood control improvements in Exeter was warranted. The studies indicated a lack of sufficient economic justification to permit Federal assistance.



Portsmouth Harbor Back Channels, Sagamore Creek

NEW HAMPSHIRE COASTAL AREA

The New Hampshire Coastal Area is a 55-square mile, triangular-shaped drainage basin at the eastern end of Rockingham County, in the extreme southeastern corner of New Hampshire. It includes all of the drainage entering the Atlantic Ocean between Odiornes Point in Rye (the south entrance point to the Piscataqua River) and the southern end of Seabrook Beach at the Massachusetts state line, 16 miles to the southward. It is bounded by the Piscataqua River Basin on the north and west, by the Merrimack River Basin on the southwest and by a narrow strip of the Massachusetts North Coastal Area to the south, the latter is the small coastal area located immediately north of the mouth of the Merrimack River. The base of this triangular area extends about 10 miles westward from the town of Seabrook to the extreme southwestern corner of the town of Kensington.

The topography consists of a gently rolling plain with a very indistinct divide separating this drainage area from the adjoining basins. Except for extensive tidal marshes at the southeastern end of the basin, the typical elevation near the coast is about 40 feet. Elevations along the divide range from 60 feet at Rye village in the north to 283-foot Hog Hill in Kensington at the southwestern end of the basin, where a series of 200-foot high drumlins rise above the coastal plain. Numerous fresh and salt water marshes occupy nearly one-third of the surface, especially in the five tidewater towns (in north to south order) of Rye, North Hampton, Hampton, Hampton Falls and Seabrook. Except for a few coastal drumlins and the cluster of drumlins at the southwestern end of the basin, most of the surficial deposits consist of marine sands and clays which were uplifted following glacial retreat.

The 1970 basin population is estimated at 18,400. This is an increase of 139 percent over the 1960 basin population of 7,700. The town of Hampton accounts for 42 percent of the population, followed by the noticeably smaller towns of Rye, Seabrook, North Hampton and Hampton Falls. The population density within the basin averages 335 people per square mile and reaches a high of 560 per square mile in the town of Hampton. The projected population for the basin in 2020 is 40,000, an increase of 117 percent over the 1970 population.

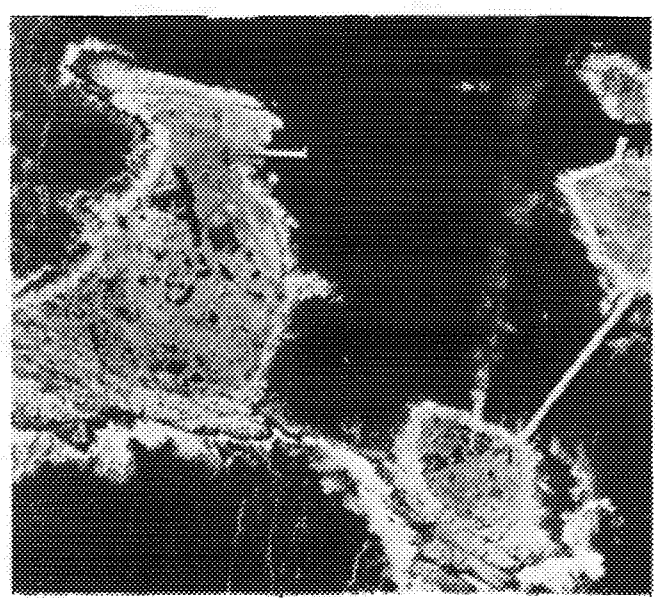
The New Hampshire Coastal Area includes a portion of a 3-mile long group of offshore islands, the Isles of Shoals, which are located 6 nautical miles east of Rye Harbor. They consist of seven small islands and numerous rocks and ledges, which lie partly in Rye, New Hampshire and partly in Kittery, Maine. They were frequented as far back as the mid-1500's by European fishermen who used the islands for the curing of fish. They were densely populated by English settlers during the 17th and 18th centuries. Except for Coast Guard personnel, they are now inhabited only by visitors and staff at the summer hotel on Star Island and by a few summer residents. Gosport Harbor, which is formed by the general cluster of islands and by four Federally constructed breakwaters, is used as an anchorage by fishermen, recreational boats and by small coastal vessels.

NEW HAMPSHIRE COASTAL AREA PROJECTS

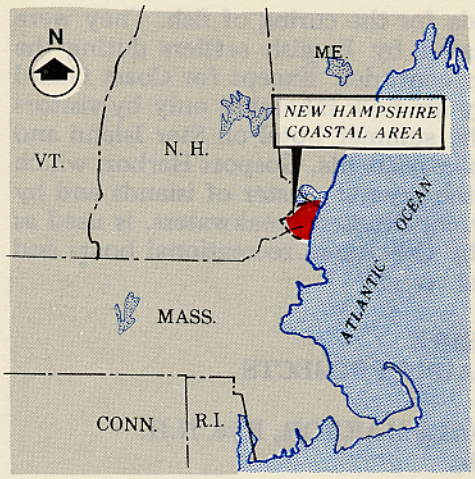
ISLES of SHOALS HARBOR, Rye, N.H. and Kittery, Me.

The Isles of Shoals, a 3-mile long cluster of seven rocky islands and numerous rocks and ledges bisected by the Maine-New Hampshire boundary, are located in the Atlantic Ocean off the coast of New Hampshire, about 7 nautical miles southeastward of Portsmouth Harbor and 6 nautical miles east of Rye Harbor. Four of these islets, Star, Cedar, Smuttynose, and Malaga, are so situated that they afford a small harbor of fair depth, open only to the west and northwest, known as Gosport Harbor.

Improvement at the Isles of Shoals began in 1821 and continued under subsequent authorizations through 1902. The work comprised construction of two breakwaters connecting Malaga, Smuttynose, and Cedar Islands to provide a safe refuge at the northeast end of Gosport Harbor.



Isles of Shoals (Gosport) Harbor, showing Star Island summer colony



NOTE: **All projects completed unless otherwise noted.**

WALLIS SANDS STATE BEACH

RYE HARBOR

NORTH HAMPTON BEACH
(AUTHORIZED NOT STARTED)

HAMPTON BEACH

HAMPTON HARBOR

Wallis Sands
Rye
Foss Beach
Ragged Neck Point
Rye Harbor
West Rye
Straw Point
Eel Pond
Jenness Beach
Rye Beach
Rye Beach
North Hampton
Philbrick Pond
Boss Beach
Fox Hill Point
Little Boars Head
Chapel Bk.
Little R.
North Hampton Beach
Plaice Cove
Nilus Bk.
Ash Brook
Line Swamp
Old R.
Taylor River
Hampton
Meadow Pond
North Beach
Sanborn Corners
Great Boars Head
Lamprey Corners
Hampton Falls
Tide Mill
Seat
Park
Muddy Pond
Winkley Bk.
Hampton Falls River
Dodge Ponds
Hampton R.
Hampton Beach
Hampton Beach
HAMPTON HARBOR
Seabrook
Blackwater R.
Seabrook Beach
Seabrook Beach
Cains Bk.
NEW HAMPSHIRE
MASSACHUSETTS
Smithtown
ATLANTIC
OCEAN

LEGEND
▲ NAVIGATION PROJECTS
● SHORE PROTECTION PROJECTS

SCALE IN MILES
½ 0 ½ 1

NOTE:
Delineation of streams on map is limited to only those having existing project or current study

NEW HAMPSHIRE COASTAL AREA

The existing project, adopted in 1910, provided for maintenance of the existing structures and construction of a third breakwater to close the opening between Cedar and Star Islands, at the southeast side of the harbor. The three breakwaters, completed in 1913, have an aggregate length of 1,470 feet. The harbor is used by commercial, fishing, and recreational vessels plying the coastal routes and by summer ferryboats to Star Island.

WALLIS SANDS STATE BEACH, Rye

A restoration and improvement project for the State-owned shore at the northern end of Wallis Sands Beach was authorized by the 1962 River and Harbor Act. The authorization called for widening about 800 feet of beach to a general width of 150 feet by direct placement of sandfill, and for constructing an impermeable groin at the southern limit of sandfill. The work was completed by the State of New Hampshire in 1963. Since the area qualifies as a publicly-owned shore park, the state was reimbursed for the Federal share of the project cost.

The beach and groin were seriously damaged in the record storm of 19 February 1972. As a result of this storm a large part of the eastern New England coast, including the New Hampshire Coastal Area, was declared a National Disaster Area by the President. The National Emergency Law, Public Law 99, applied and restoration of the beach was undertaken and is expected to be completed in September 1973. The entire cost of the restoration will be borne by the Federal Government.

RYE HARBOR

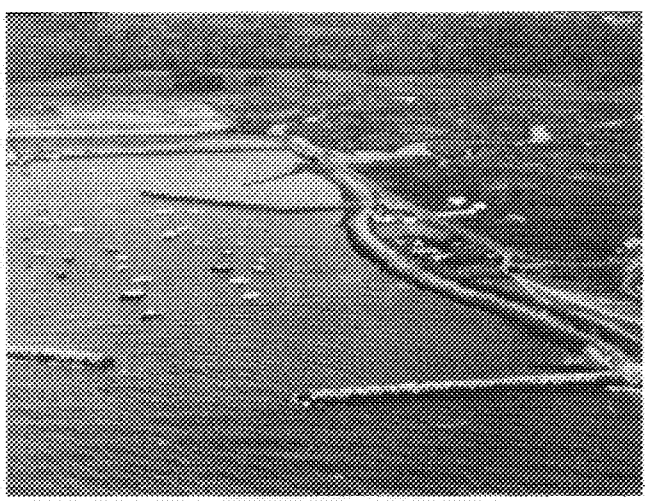
Rye Harbor is located about 5 miles south of Portsmouth Harbor. The existing project authorized by the River and Harbor Act of 1960 provides for a 10-foot deep entrance channel, an access channel 8 feet deep to the head of the harbor, an anchorage 8 feet deep over a 5-acre area at the south side of the harbor, an anchorage 6 feet deep over a 5-acre area at the north side of the harbor, and for maintenance of existing breakwaters at either side of the harbor entrance.

The waterway was dredged in 1962 and the spoil material placed on State-owned land at the head of the harbor to provide a fill area for construction of a public landing and for future expansion of shore facilities. Supplemental work was undertaken in 1964 for removal of two small ledge areas encountered during the dredging work. Local interests contributed 32 percent of the project cost and, in addition, made anchorage and shore improvements. The harbor is used by lobstering and fishing boats, as well as by recreational craft.

NORTH HAMPTON BEACH
(Authorized)

The authorized project, adopted in 1962, provides for widening about 1,600 feet of State-owned beach, immediately south of Little Boars Head in North Hampton, to a general width of 150 feet by the direct placement of sandfill, and for constructing an impermeable groin at the northern limit of sandfill. Federal participation in the project is contingent upon local interests constructing adequate parking facilities to meet and promote increased public use of the beach.

Wallis Sands State Beach, Rye



Rye Harbor

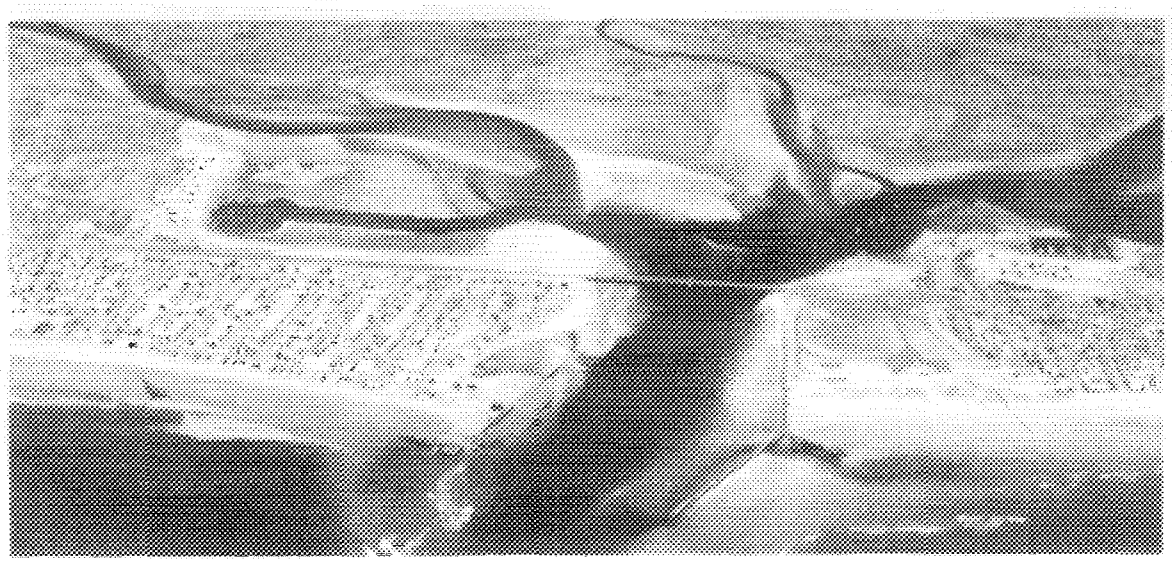
Hampton Beach State Park

HAMPTON BEACH

The original project for restoration, protection, and improvement of the State-owned public beach at Hampton was adopted in 1954 and constructed in 1955. This work was accomplished by the State by direct placement of sandfill to widen about 5,200 feet of beach north of Haverhill Street to a general width of 150 feet, with an added 25-foot widening along 1,250 feet of the northern end of the fill area. Federal participation amounted to one-third of the project cost.

The 1962 River and Harbor Act modified the project by authorizing Federal participation in the costs of nourishing the beach over a 10-year period by the periodic placement of sandfill and constructing an impermeable groin near the northern end of the beach. The groin was constructed in 1965 in conjunction with the jetty modification work at Hampton Harbor. Replenishment of the northerly 2,200 feet of beach to authorized project width was completed in 1965 by the placement of sandfill obtained from dredging within Hampton Harbor. One-half of the total cost was met by Federal funds.

The beach was seriously damaged in the record storm of February 19, 1972. This storm resulted in a large part of the eastern New England Coast, including this coastal area of New Hampshire, being declared a National Disaster Area by the President. The National Emergency Law, Public Law 99, applied and restoration of the beach was undertaken and is expected to be completed in September 1973. The entire cost of the restoration will be borne by the Federal Government.



Hampton Harbor, showing entrance channel and jetties

HAMPTON HARBOR

(Small Navigation Project not Specifically Authorized by Congress)

Hampton Harbor is a rectangular lagoon behind the barrier beach villages of Hampton Beach and Seabrook Beach. It is located at the mouth of the Hampton River, about 1.5 miles north of the Massachusetts state line. A small lobstering fleet and numerous recreational craft base at the harbor.

A project was approved in 1964, under Section 107 authority of the 1960 River and Harbor Act, providing for a channel 8 feet deep and 150 feet wide across the entrance bar, and for extension of existing State-built stone jetties at the harbor entrance. Work on the Federal project was accomplished under two contracts during 1965. Local interests contributed 49 percent of the project cost.

A third contract was accomplished in 1965, as part of the authorized nourishment of the existing Hampton Beach project, in which dredged material from channel and anchorage areas within Hampton Harbor was placed at the northern end of Hampton State Beach.

Local interests are required to maintain at least 22 acres of anchorage and access channels 6 feet deep within the harbor and maintain two public landings. A safe walking surface was provided along the top surface of the north jetty extension for use by sport fishermen.

NEW HAMPSHIRE COASTAL AREA STUDY

NORTH BEACH AND FOSS BEACH, Hampton and Rye, respectively

A study is underway to determine the most effective methods for restoring and protecting the beaches and backshore structures at North Beach, the beach north of Great Boars Head comprising the northern half of Hampton Beach State Park, and at Foss Beach, the beach immediately north of Rye Harbor State Park. Initial appropriation of funds for the study was received in the fiscal year ending June 30, 1972.

Sportfishing at Hampton Harbor jetty

PROJECT COSTS

PROJECT	COSTS TOTAL	FEDERAL	NON-FEDERAL
FLOOD CONTROL			
Connecticut River Basin			
Otter Brook Dam	$ 4,260,000	$ 4,160,000	$100,000 (1)
Surry Mountain Dam	2,720,000	2,720,000	—
Keene Local Protection	44,000	44,000	—
Merrimack River Basin			
Franklin Falls Dam	8,090,000	8,050,000	40,000 (1)
Blackwater Dam	1,420,000	1,370,000	50,000 (1)
Hopkinton-Everett Dams	21,870,000	21,575,000	295,000 (1)
Edw. MacDowell Dam	2,014,000	2,014,000	—
Lincoln Local Protection	140,000	120,000	20,000
Nashua Local Protection	273,000	270,000	3,000
Wilton Local Protection	20,000	20,000	—
Piscataqua River Basin			
Farmington Local Protection	183,000	183,000	—
NAVIGATION			
Merrimack River Basin			
Lake Winnipesaukee	8,000	8,000	—
Piscataqua River Basin			
Cocheco River	119,000	119,000	—
Bellamy River	35,000	35,000	—
Lamprey River	20,000	20,000	—
Exeter River	28,000	28,000	—
Little Harbor	133,000	133,000	—
Portsmouth Harbor	5,484,000	5,384,000	100,000
New Hampshire Coastal Area			
Rye Harbor	192,000	131,000	61,000
Hampton Harbor	394,000	200,000	194,000
Isles of Shoals	39,000	39,000	—
SHORE PROTECTION			
New Hampshire Coastal Area			
Hampton Beach	647,000	261,000	386,000
North Hampton Beach		(Not Started)	
Wallis Sands	93,000	65,000	28,000

(1) For provision of public use facilities

FLOOD CONTROL PROJECT BENEFITS

PROJECT	DAMAGES PREVENTED TO DATE	DAMAGES PREVENTABLE IN RECURRING RECORD FLOOD	DATE OF RECORD FLOOD
Connecticut River Basin			
Otter Brook Dam	$ 1,722,000	$ 3,300,000	1936
Surry Mountain Dam	4,291,000	6,800,000	1936
Keene Local Protection	—	—	1936
Merrimack River Basin			
Franklin Falls Dam	15,662,000	111,300,000	1936
Blackwater Dam	3,275,000	17,900,000	1936
Hopkinton-Everett Dams	505,000	58,400,000	1936
Edw. MacDowell Dam	470,000	7,000,000	1936
Lincoln Local Protection	—	—	1936
Nashua Local Protection	105,000	779,000	1936
Wilton Local Protection	—	—	1936
Piscataqua River Basin			
Farmington Local Protection	—	—	1936

WATERBORNE COMMERCE AT NAVIGATION PROJECTS

PROJECT	TONNAGE AVERAGE (1) 1972		PRINCIPAL COMMODITIES	RECREATIONAL BOAT USE (Legend follows Table)
Merrimack River Basin				
Lake Winnipesaukee	None reported			Heavy
Piscataqua River Basin				
Cocheco River	None reported			Light
Bellamy River	None reported			Light
Lamprey River	None reported			Light
Exeter River	None reported			Very heavy
Little Harbor	None reported			Light
Portsmouth Harbor	2,045,800	2,188,100	Petroleum products, salt, limestone	Heavy
New Hampshire Coastal Area				
Rye Harbor	300	300	Fish and lobsters	Medium
Hampton Harbor	100	100	Lobsters	Heavy
Isles of Shoals	None reported			Negligible

(1) 5-year, through 1972

LEGEND

Designation	Ave. No. of Boats
Negligible	0 - 10
Light	10 - 50
Medium	50 - 100
Heavy	100 - 200
Very Heavy	Over 200

PUBLIC USE FACILITIES IN NEW HAMPSHIRE

RESERVOIR	FRANKLIN FALLS	BLACK-WATER	HOPKINTON-EVERETT	SURRY MOUNTAIN	OTTER BROOK	EDWARD MacDOWELL
LOCATION Near Highway	Franklin US 3A	Webster NH 127	Hopkinton US 202, NH 13	Surry NH 12A	Keene NH 101, NH 9	Peterborough NH 101
Picknicking	X	X	X	X	X	X
Hiking	X	X	X	X	X	—
Swimming	—	—	X	X	X	—
Fishing	X	X	X	X	X	X
Hunting	X	X	X	X	X	X
Snowmobiling	X	X	X	—	—	X
Sightseeing	X	X	X	X	X	X
Nature Study	X	X	X	X	X	X
Sanitary Facilities	X	X	X	X	X	X
Boating	X	X	X	X	X	X
Boat Ramps	1	—	4	1	2	2
Access Points	12	5	34	8	1	3
Parking	45	15	600	270	200	18
Land Area (Acres)	3,144	3,432	7,342	1,423	373	1,094
Water Areas (Acres)	560(1)	150(1)	650	265	85	100
Stream Length (Miles)	15.0	7.0	17.0	3.2	2.2	7.2
Access Roads (Length — Miles)	18.0	11.0	34.0	2.5	2.3	1.5
1972 Attendance (Visitor Days)	64,400	22,900	311,400	148,900	65,900	32,500

(1) No permanent pool, but river has extensive water surface within reservoir.

REGIONAL STUDIES

NATIONAL SHORELINE STUDY

The increasing value and scarcity of shoreline lands have generated a need for current evaluation of the shore erosion problem as a basis for long-range comprehensive planning. In recognition of this need, the Congress authorized the National Shoreline Study by the 1968 River and Harbor Act. An appraisal has been made of shore erosion problems along the shorelines of the Atlantic and Pacific Oceans, the Gulf of Mexico, the Great Lakes and the coasts of Puerto Rico and the Virgin Islands. A comprehensive assessment of these problems also was made from the national viewpoint, recognizing the increasing threat of erosion as population grows and pressures increase for uses of coastal lands and for the conservation of fish and wildlife and other natural values.

The study was conducted by the Corps of Engineers with the cooperation of other Federal agencies and State and local governments. The first part is a Regional Inventory Report which shows the nature and extent of erosion, conceptual plans for shore protection, and general order-of-magnitude cost estimates for providing the protection. This was carried out by the Division offices. Separate inventory reports have been issued for each major coastal region. The Division Engineer, North Atlantic Division, with the cooperation of the New England Division Engineer, was responsible for conducting the inventory in the North Atlantic Region. This region covers the ten coastal states from the Virginia-North Carolina state line to the Canadian border, including Virginia, Maryland, Delaware, New Jersey, New York, Connecticut, Rhode Island, Massachusetts, New Hampshire and Maine.

A second part of the study was the development, by our Coastal Engineering Research Center in Washington, D.C., of Shore Protection Guidelines that will assist State and local authorities in planning effective programs. The guidelines describe typical methods of shore-erosion control, both structural and non-structural; examples of shore protection facilities and consider their merits and shortcomings with special reference to the impact on the environment; and develop criteria for the design and utilization of protective measures.

A third part was conducted by the Office of the Chief of Engineers, with input from field offices, which led to the development of Shore Management Guidelines. Historic and anticipated shore uses were described, including environmental needs; principles of comprehensive planning and multiple use presented with illustrative examples; and existing programs and policies explained, including principles of cost sharing.

The three parts of this study, the Regional Inventory Reports, the Shore Protection Guidelines, and the Shore Management Guidelines were completed in the first half of 1971. A report on the National Shorelines Study was submitted to Congress by the Secretary of the Army in August 1971.

NORTH ATLANTIC REGIONAL WATER RESOURCES STUDY

The North Atlantic Regional Water Resources (NAR) Study examined a wide variety of water and related land resources, needs and devices in formulating a broad, coordinated program to guide future resource development and management in the North Atlantic Region. The Study was authorized by the 1965 Water Resources Planning Act (PL 89-80) and the 1965 Flood Control Act (PL 89-298), and carried out under guidelines set by the Water Resources Council.

The NAR Study was initiated in 1966 and has been completed. The Report was issued in July 1972. It is now undergoing review by all involved States, Regional and Federal agencies, and the Water Resources Council.

The North Atlantic Region, the geographic area covered by the study, includes all river basins draining into the Atlantic Ocean north of the Virginia-North Carolina boundary, portions of the Lake Champlain drainage area within the United States, and St. Lawrence River drainage within New York State below the international boundary. The Region includes the Eastern chain of metropolitan areas from Boston to Richmond and a population of more than 45 million, approximately 25% of the national population.

The study area includes Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New Jersey, Delaware, the District of Columbia, and portions of New York, Pennsylvania, Maryland, West Virginia, and Virginia.

The recommended program and alternatives developed for the North Atlantic Region were prepared under the direction of the NAR Study Coordinating Committee, a partnership of resource planners representing some 25 Federal, regional and State agencies. The NAR Study Report presents this program and the alternatives as a framework for future action based on a planning period running through 2020, with bench mark planning years of 1980 and 2000.

Federal members of the planning team included the Department of Agriculture; the Army (Corps of Engineers); Commerce; Health, Education and Welfare; Housing and Urban Development; the Interior; Transportation and the Environmental Protection Agency and the Federal Power Commission.

Completing the planning team were representatives of the thirteen Study Area States, the District of Columbia, the Delaware River Basin Commission and the New England River Basins Commission.

The planning partners focused on three major objectives — National Income, Regional Development and Environmental Quality — in developing and documenting the information which decision-makers will need for managing water and related land resources in the interest of the people of the North Atlantic Region.

The NAR Study Report includes a Main Report

Chesapeake Bay, into Lake Ontario, and into the St. Lawrence River. The study area, stretching some 1,000 miles from the northern-most tip of Maine to the southern boundary of the James River basin in Virginia, encompasses Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New Jersey, Delaware, the District of Columbia, and parts of New York, Pennsylvania, Maryland, Virginia, and West Virginia. The area extends inland an average of 200 miles from the Atlantic Ocean and covers approximately 200,000 square miles.

The population of the Northeast is now about

REGIONAL STUDIES

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Chesapeake Bay, into Lake Ontario, and into the St. Lawrence River. The study area, stretching some 1,000 miles from the northern-most tip of Maine to the southern boundary of the James

The NAR Study Report includes a Main Report with the Study recommendations; two Annexes containing the Study findings by hydrologic area programs and by State programs; and 22 Appendices, with detailed procedures and findings.

Recommendations in the NAR Study Report include:

- A comprehensive plan as a guide for present and future water resource development.
- A division of Federal and non-Federal responsibilities in implementation of the guide plan.
- The timing and program level costs of detailed Federal and non-Federal studies and the development of specific projects to meet present and near-future needs.
- The organization for the detailed studies and for water resources management, and provisions for continuous Federal and non-Federal coordination and updating of the guide plan.

NORTHEASTERN UNITED STATES WATER SUPPLY STUDY

The drought of the 1960s, which caused unprecedented water supply emergencies and restrictions in many locations throughout the Northeastern States, led to the initiation of the Northeastern United States Water Supply (NEWS) Study.

The NEWS Study was authorized under Title I of the 1965 Flood Control Act (PL 89-298), in which the Congress recognized that assuring adequate supplies of water for metropolitan centers has become a problem of such magnitude that the welfare and prosperity of the Nation require Federal Government assistance in the solution of water supply problems. The Act directed the Secretary of the Army, acting through the Chief of Engineers, to cooperate with Federal, State and local agencies in preparing plans in accordance with the 1965 Water Resources Planning Act (PL 89-80) to meet the long-range water needs of the northeastern United States.

The NEWS Study area includes all of the river basins within the United States that drain into Chesapeake Bay, into the Atlantic Ocean north of

The population of the Northeast is now about 50 million, about 25% of the national population, and is projected to reach about 85 million by the year 2020. The present population is largely urban, with some 60% concentrated in the five metropolitan areas of Boston, New York, Philadelphia, Baltimore and Washington. Twenty of the Nation's 100 largest cities are located in this area, and its municipal water supplies serve populations ranging up to 8.5 million, the approximate number of consumers in the New York City system.

The Northeast is well endowed with average annual precipitation of 40 inches, contrasted with the 30-inch national average. The severe five-year drought that ended in early 1967, brought about precipitation deficiencies of up to 50 inches below average in some locations during the period from October 1961 to December 1965, and revealed the Northeast's vulnerability to water shortages. Some 14 million people, about 28% of the Northeast's population, were restricted to some degree in their use of water during this drought. However, drought is not the only reason for concern — although it increases public awareness of water supply problems. Even under normal conditions, available supplies in many areas will soon be inadequate to meet the needs of expanding population and industrial growth.

The objectives of the NEWS Study are:

- The establishment of guidelines for Federal participation in water supply development.
- The development of coordinated, regional plans for construction, operation and maintenance of essential water supply developments in the Northeast.
- The recommendation of action programs for Federal, State, regional and local agencies, and for public organizations.
- The selection of programs and geographic areas which may require continued planning at the Federal level.
- The development of guidelines for appropriate financial participation by the States, political subdivisions thereof, and other local interests, in the implementation and maintenance of water supply programs and projects.

The NEWS Study report will assess present and future water supply problems on a regionalized basis, and present multiple-objective, alternative plans for their solution.

The Division Engineer, North Atlantic Division, has been assigned the responsibility for the conduct of this study. He is being assisted by his District Engineers at New York, Philadelphia, Baltimore, and Norfolk; by the New England Division Engineer; and by the North Central Division Engineer and his District Engineer at Buffalo.

The study effort is being fully coordinated with concurrent regional, river basin, and other water resource studies being conducted in the Northeast. This will assure that NEWS Study plans are consistent with, and integral to, all broad water resource development programs being formulated, and that planned water supply facilities will achieve maximum benefit. The participation of all Federal, State and local government agencies and private organizations involved in the field of water supply will be vital to its success.

Initiated in 1966, the NEWS Study has progressed to a point where preliminary studies have been completed in four major areas where further water supply development is considered urgent, and for an additional 26 selected urban metropolitan areas throughout the Northeast.

The four major areas with urgent water supply problems are:

- the Northern New Jersey—New York City—Western Connecticut Area
- the Metropolitan Washington, D.C. Area
- Southeastern New England
- South-Central Pennsylvania

In two of these areas, Northern New Jersey—New York City—Western Connecticut and Southeastern New England, engineering feasibility studies which developed preliminary alternative regional solutions have been completed.

Following completion of the feasibility study for Southeastern New England two survey scope studies, on the development of the Millers River Basin and Northfield Mountain to meet water supply needs in eastern Massachusetts, were undertaken. Draft reports on these survey scope studies were completed in March 1973 and distributed for review and comment by affected local, state, and Federal agencies. Final copies of the report are presently being prepared.

The 1963 Potomac River Basin Study Report provided substantial engineering data for the development of preliminary alternative plans for the Metropolitan Washington Area. A study of the feasibility of using the Potomac Estuary as a supplemental source of water supply has been completed under the NEWS Study.

A preliminary evaluation of the South-Central Pennsylvania Area, which updates existing information and explores the potential for regional solutions, has been completed. This report includes an evaluation of the Mason-Dixon Task Force proposal for a pipeline with interconnections in the Delaware, Susquehanna and Potomac Rivers.

The NEWS planners have also completed a study of the organizational, legal and public finance aspects of implementing the solutions presented in the feasibility studies. This report presents an analysis of these potential institutional barriers, and includes alternative solutions to them.

Pilot feasibility studies of alternatives for wastewater management have been completed for the Merrimack River Basin and Codorus Creek, in the South-Central Pennsylvania Area in the Susquehanna River Basin near York. Subsequently, a survey scope wastewater study for the Massachusetts portion of the Merrimack Basin has been authorized. A survey scope study of wastewater management alternatives for the Codorus Creek Basin is nearing completion.

Major study efforts are being initiated for survey scope water supply investigations of the Northern New Jersey—New York City—Western Connecticut Area, the Metropolitan Washington Area and the Merrimack River Basin. These three studies will develop alternative project-oriented plans for solving water supply problems in these three urgent areas under a multiple-objective planning format.

The final report for the entire Northeast United States Water Supply Study is scheduled to be submitted before July 1976.

NEW ENGLAND RIVER BASINS COMMISSION

BACKGROUND

The New England River Basins Commission was established to coordinate comprehensive, joint Federal-State planning of water and related land resources of the region. It represents a partnership of the water resource agencies of the seven member states, six interstate commissions and nine Federal departments or agencies. The geographic area within the jurisdiction of the Commission and its working staff includes the six New England States in their entirety, and those portions of New York State draining to Long Island sound, with the exception of Westchester County and New York City. The Commission was established by the President in September 1967 at the request of the Governors of the six New England States and New York, under the provisions of the 1965 Water Resources Planning Act (PL 89-80).

FUNCTIONS

Operating under the guidance of the Water Resources Council, the major functions of the Commission include:

- Formulating and updating a comprehensive plan for joint Federal-state management of water and related land resources of the region.
- Coordinating Federal, state, interstate, local and nongovernmental plans for use and conservation of these resources.
- Recommending priorities for future action on individual water resource and related land use projects and programs.
- Assisting in establishing standards and procedures for Federal participants in the formulation and development of regional or river basin plans.
- Submitting an annual report to the Governors of each participating state and to the Water Resources Council for transmittal to the Congress through the President of the United States on the progress of the state and Federal action programs.
- Making studies of special problems or needs as necessary in the preparation and updating of the comprehensive plan for the management of the water and related land resources of the region.

ATLANTIC COAST DEEPWATER PORT FACILITIES STUDY

A resolution adopted on 27 October 1971 by the U.S. Senate Committee on Public Works directed the Corps of Engineers to review previous reports on commercial navigation between Eastport, Maine and Hampton Roads, Virginia, to determine the most efficient, economic and logical way of providing facilities to accommodate very large bulk carriers. The District Engineer, Philadelphia District, was given the major responsibility of performing the study under the direction of the North Atlantic Division Engineer. Overall efforts are being coordinated with affected Federal agencies, including the President's Council on Environmental Quality and the Environmental Protection Agency, and other public and private interests. The New England Division was directed to carry out the intent of the study for the New England coastline.

Criteria used in evaluating the various deep draft commercial harbors in New England and in other geographic locations which are accessible from nearby deep water include: engineering and economic feasibility, environmental effects, institutional constraints, and social well being. In addition to these criteria, public attitudes toward the development of storage and/or refinery facilities as proposed by several major petroleum interests for various sites in New England play an important role in evaluating this portion of the coastline.

Public meetings were held in Portland, Maine, Boston, Massachusetts, and other major east coast cities to allow all interests to express their opinions on this matter. Although there is a general consensus that deep water facilities are needed the exact location of such facilities is expected to encounter considerable opposition from populations in adjacent areas.

Completion of this study is scheduled for 1973.

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