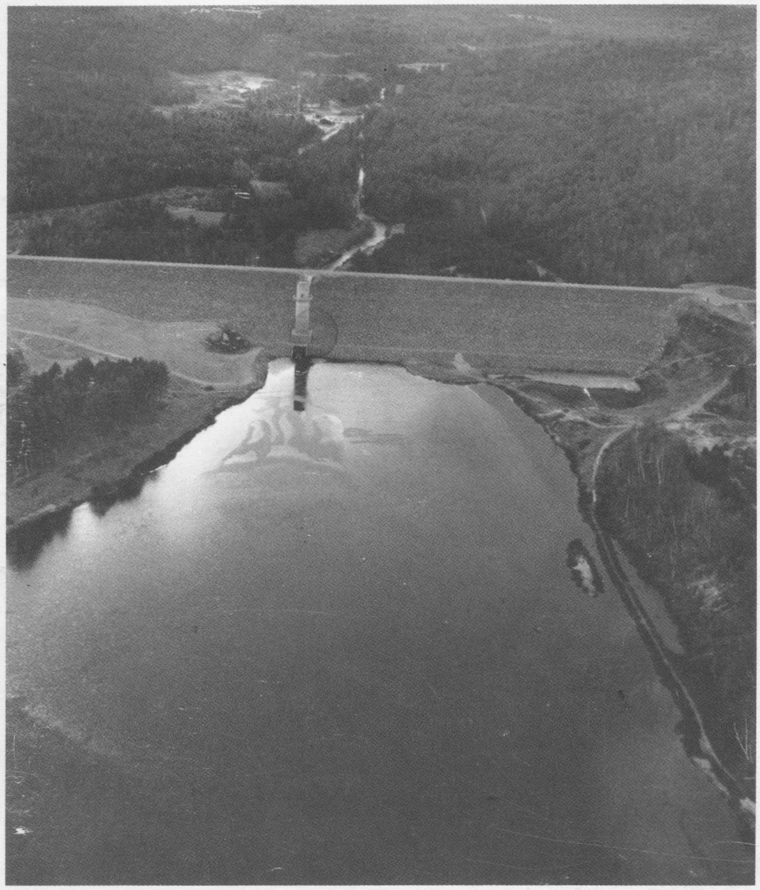
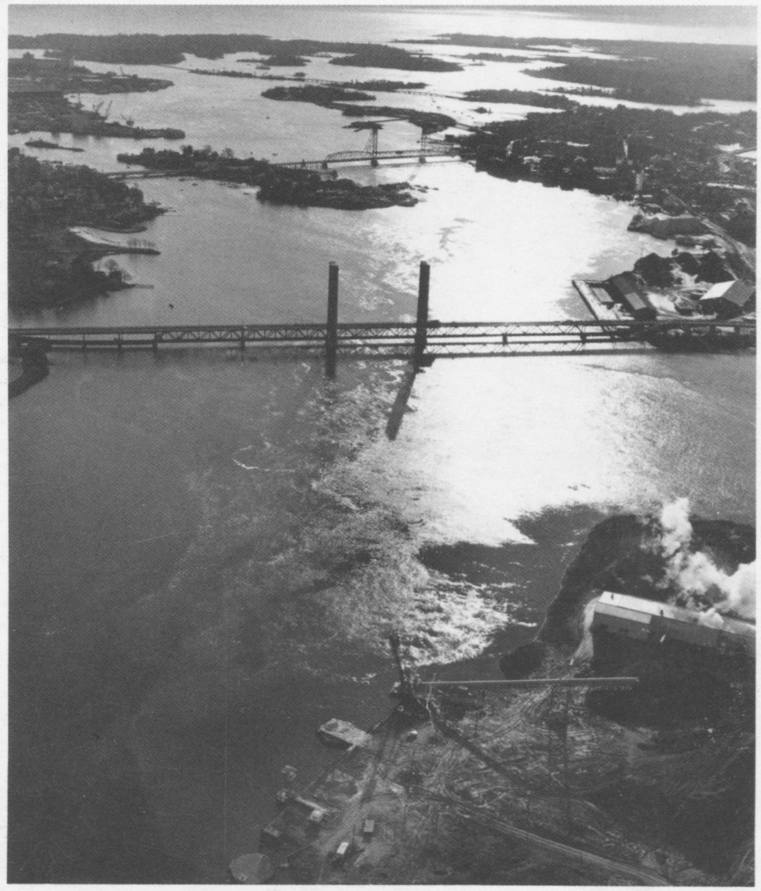
US Army Corps of Engineers
New England Division

Water Resources Development in New Hampshire 1989





The work of the U.S. Army Corps of Engineers in New Hampshire 1989

This booklet presents a brief description of water resource projects completed by the U.S. Army Corps of Engineers in New Hampshire. It describes the role of the Corps in planning and building water resource improvements and explains the procedure leading to the authorization of such projects.

For ease of reference, the material is arranged according to the type of project, i.e. flood damage reduction, navigation, or shore and bank protection. There is also a reference at the end of the booklet that lists Corps' projects by community. A map showing the location of all Corps' projects in the state is provided on the next page.

The Corps of Engineers water resources development program exerts a significant impact on New Hampshire's physical, economic, and social environment. This publication affords citizens the opportunity to learn about the various projects and to determine how they can participate in decisions regarding present and future activities.

For further information, call the Corps of Engineers at 617-647-8777, or write:

U.S. Army Corps of Engineers
New England Division
Public Affairs Office
424 Trapelo Road
Waltham, MA 02254

US Army Corps of Engineers
New England Division

This publication is authorized by the Secretary of the Army as required by PL 99-662.

ON THE COVER:

Everett Lake (top left) in Weare, which is operated in conjunction with Hopkinton Lake in Hopkinton, provides flood protection to residential, commercial, and industrial property; Portsmouth Harbor (top right) is New Hampshire's sole deep draft harbor and handles about 3.5 million tons of shipping a year; Hampton Beach in Hampton is a favorite vacation spot of New Englanders.

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254-9149

REPLY TO
ATTENTION OF

May 1990

Public Affairs Office

Enclosed is the 1989 Water Resources Development in New Hampshire booklet that describes U.S. Army Corps of Engineers water resource projects and activities in the state. These encompass flood damage reduction, navigation, and shore and bank protection work.

This book contains the most up-to-date information on Corps' projects and proposed projects in New Hampshire through 1989.

If you would like additional copies of this booklet or booklets about our projects in other New England states, call us at 617-647-8777, or write:

Public Affairs Office
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02254-9149

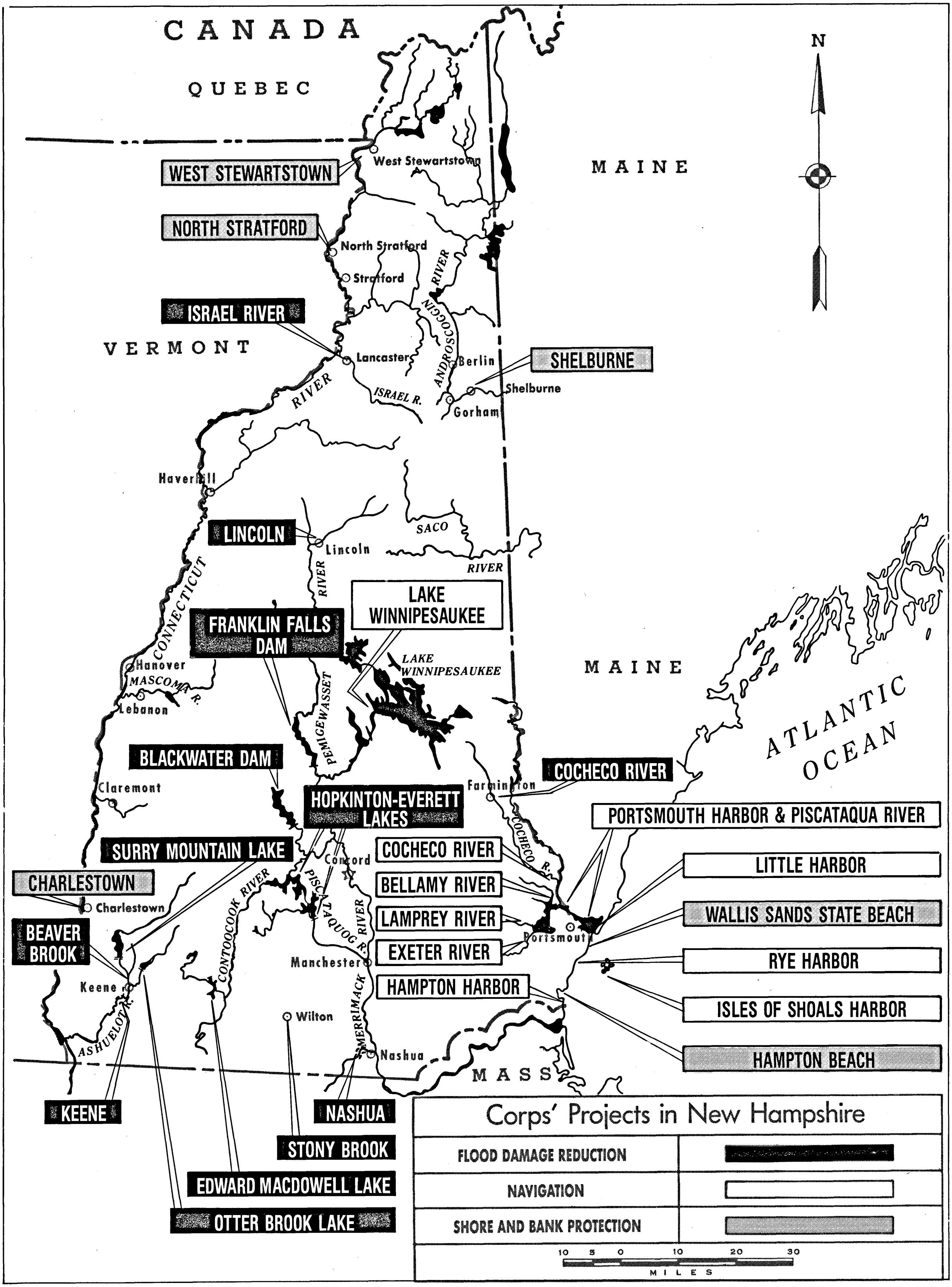
Please inform us if the name and/or address of your agency or company is incorrect. Other comments and suggestions are appreciated.

Sincerely,

Warren E. Nordman

WARREN E. NORDMAN
Chief, Public Affairs

Enclosure


CANADA
QUEBEC
MAINE
VERMONT
N
WEST STEWARTSTOWN
West Stewartstown
NORTH STRATFORD
North Stratford
Stratford
ISRAEL RIVER
Lancaster
ISRAEL R.
ANDROSCOGGIN RIVER
Berlin
SHELBURNE
Shelburne
Gorham
RIVER
Haverhill
LINCOLN
Lincoln
SACO RIVER
RIVER
CONNECTICUT
FRANKLIN FALLS DAM
LAKE WINNIPESAUKEE
LAKE WINNIPESAUKEE
MAINE
Hanover
MASCOMA R.
Lebanon
PEMIGEWASSET
ATLANTIC OCEAN
BLACKWATER DAM
COCHECO RIVER
Claremont
HOPKINTON-EVERETT LAKES
Farmington
PORTSMOUTH HARBOR & PISCATAQUA RIVER
SURRY MOUNTAIN LAKE
COCHECO RIVER
COCHECO R.
LITTLE HARBOR
CHARLESTOWN
Concord
BELLAMY RIVER
Charlestown
CONTOOCOOK RIVER
PISCATAQUOG R.
RIVER
LAMPREY RIVER
WALLIS SANDS STATE BEACH
BEAVER BROOK
Portsmouth
EXETER RIVER
Manchester
RYE HARBOR
HAMPTON HARBOR
Keene
ISLES OF SHOALS HARBOR
ASHUELOT R.
Wilton
MERRIMACK
Nashua
HAMPTON BEACH
MASS
KEENE
NASHUA
STONY BROOK
EDWARD MACDOWELL LAKE
OTTER BROOK LAKE
Corps' Projects in New Hampshire
FLOOD DAMAGE REDUCTION
NAVIGATION
SHORE AND BANK PROTECTION
10 5 0 10 20 30
MILES

US Army Corps of Engineers
New England Division

Leaders in Customer Care

The U.S. Army Corps of Engineers entered a new era with the passage of the Water Resources Development Act of 1986. The act's nonfederal cost sharing provisions focused on an entirely different manner of doing business. With our cost sharing partners, we are finding new and innovative ways to manage water resources projects and reduce costs to American taxpayers.

Our partners are not only bearing half, or more, of the construction costs, but also those associated with studies of water resources problems. Over the past three years, this partnership has completed a smooth transition that will provide a healthy water resources program for the future.

In the summer of 1988, a natural disaster brought home the importance of such a program. America was in the middle of a massive drought, one that rivaled the "dust bowl" days of the 1930s. But there was a difference. The nation didn't totally dry up. Aided by water resources projects built since the years of the Great Depression, the Corps was able to do a lot of things to aid navigation, water supply and hydropower operation—even recreation.

If it were not for the massive reservoirs throughout the tributaries of the Mississippi River, navigation on that mightiest of rivers would have stopped in June—absolutely! During the summer and into the fall, some 65 percent of the flows into the Mississippi, past Memphis, came from U.S. Army Corps of Engineers' reservoirs.

In addition, our lakes and dams enhance our national stewardship of the environment. Nine of the 191 finalists in last year's "Take Pride in America" awards program helped protect public lands at U.S. Army Corps of Engineers' projects. These finalists were selected from 530 nominations representing 44 states, the District of Columbia, and Puerto Rico.

We are proud of our "Take Pride in America" finalists, and we are proud of our projects. But most of all, we are proud of the new-found partnerships that will continue to build and operate our vital water resources for our future generations.

This booklet is one of a series detailing water resources programs in the 50 states and U.S. possessions. I hope you find it interesting and feel some pride of ownership.

HENRY J. HATCH
Lieutenant General, USA
Chief of Engineers

Partnership has changed the way we do business. It has committed us to pursue new strategies to deal with old problems. We are also finding that partnerships mean results.

With a program of more than $3 billion annually for civil works projects, the Army Corps of Engineers is the largest water resources development and management agency in the federal government. The civil works program consists of water resources project activities—planning, design, construction, operation and maintenance, and regulatory program activities.

Numerous navigation and flood control projects serve additional purposes. The Corps produces nearly 30 percent of the nation's hydropower. One hundred fifteen Corps' lakes store 275.2 million acre-feet of water for agricultural, municipal and industrial use.

In the 1930s and 1940s, many of the Corps' reservoirs were built for a host of benefits, including reducing flood stages on the Lower Mississippi River. Last year the drought clearly illustrated the capability of Corps' multiple purpose reservoirs to respond in a water shortage situation. Undertakings such as the "Pick-Sloan" plan, with its six mainstem dams in the Missouri River, bequeathed an unforseen legacy to the nation—stable, low-water flows on the Lower Mississippi.

We, in the Army, look forward to continuing this public service. The Corps of Engineers' qualifications to provide construction management services to other military and civilian federal agencies is greatly bolstered by our major new management initiatives. Commitment to efficient project management—making solid cost estimates, delivering projects on schedule and within the estimate, controlling costs—demonstrate our resolve to responsibly serve the nation. We are counting on you, as partners, to help us make sure the nation's resources are put to good use.

ROBERT W. PAGE, SR.
Assistant Secretary of the Army
(Civil Works)

The Corps at a glance

Flood Damage Reduction

The Corps builds dams, hurricane protection barriers, and other structures that save lives and limit damage caused by floods. Nonstructural measures, such as floodproofing and wetland preservation, are also considered.

Navigation

In order to facilitate commercial trade and local commerce, the Corps maintains and improves the depths of harbors, rivers, and various waterways.

Shore and Bank Protection

Corps' projects retard erosion by restoring shores and beaches damaged by wind and water and stabilizing riverbanks weakened by flooding.

Hydroelectric Power

As an alternative to nuclear power and oil-related energy sources, the Corps operates hydroelectric power plants at several of its flood control dams.

Natural Resources Management

At each of its dam and reservoir sites, the Corps protects woodlands and lakes that serve as important habitats for fish and wildlife. Many of these projects also provide the public with opportunities to enjoy swimming, hiking, camping, and other recreational activities.

Emergency Response and Recovery

When disaster strikes, the Corps stands ready to supplement state efforts by mobilizing its resources to provide quick and timely disaster relief assistance.

Other Programs and Services

The Corps controls aquatic plants that hinder navigation, ensures that water at its reservoirs meet stringent criteria, and lends its water resource expertise to state governments. More recently, the Corps has teamed up with the EPA to clean up hazardous wastes.

Table of Contents

U.S. Army Corps of Engineers Programs and Services

Introduction

Scope

The U.S. Army Corps of Engineers plays a major role in developing and managing our country's water resources. Corps projects reduce flood damage, facilitate navigation in rivers and harbors, protect streambanks and the coastline, generate hydroelectric power, provide outdoor recreational opportunities, and conserve and safeguard the environment. The water resource activities conducted by the Corps are as diverse as the needs of the public they serve.

This publication examines the role and responsibilities of the Corps in:

- Flood Damage Reduction
- Navigation
- Shore and Bank Protection
- Hydroelectric Power
- Natural Resources Management
- Emergency Response and Recovery

Roots

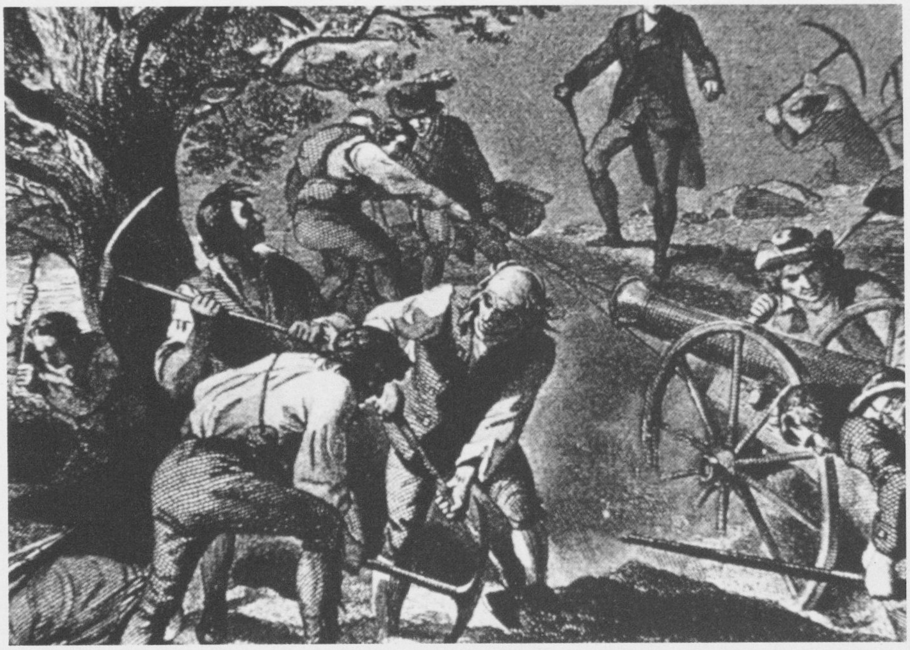
The Corps traces its history back to April 26, 1775, seven days after the first shots of the American Revolution were fired at Lexington, Massachusetts. Recognizing that the need for military engineering skill would be important in the war with England, the Massachusetts Provincial Congress appointed Boston native Richard Gridley to the rank of Colonel and chief engineer of the troops being raised in the colony.

In the early morning hours of June 17, 1775, Gridley, working under the cover of darkness, constructed a well-designed earthwork on Breed's Hill that proved practically invulnerable to British cannon. The British eventually took the hill (later called the Battle of Bunker Hill) when the patriots ran out of gunpowder, but at a cost in casualties greater than any other engagement of the war.

Gridley was to play other critical roles in the early days of the Revolution. On the evening of March 4, 1776, Gridley, along with 2000 men and 360 oxcarts loaded with entrenching materials, moved into Dorchester Heights. By daylight, two strong protective barriers looked down at the British. An astonished General Howe, commander of the British forces, reportedly remarked that the Americans had done more in one night than his entire army would have done in six months. Exposed to the American batteries on Dorchester Heights and not strong enough to fight Washington's troops in other parts of Boston, the British army and fleet departed Boston on March 17, never again to occupy Massachusetts.

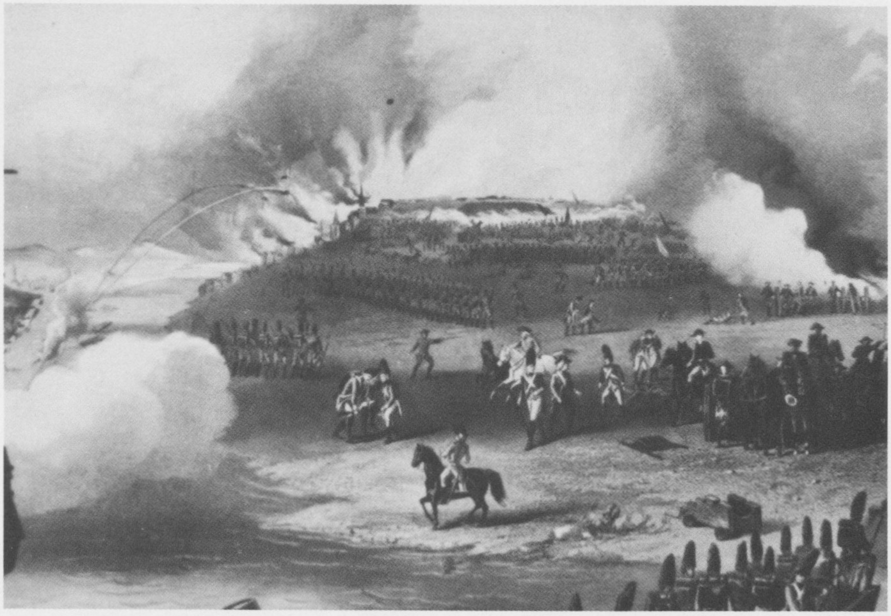
Most of the pre-Revolutionary War engineers in this country were British. Recognizing a need for American engineers to provide the expertise needed by a growing nation, Congress provided for a Corps of Cadets in 1802 to be educated at West Point, New York. This became the first engineering school in America and is now the United States Military Academy.

From the ranks of these first cadets came the Army engineers that explored the west; improved canals, waterways, and harbors; and built lighthouses, roads, bridges, and railways for rapidly expanding territories.



Under the direction of Colonel Richard Gridley, American patriots worked diligently throughout the early morning hours of June 17, 1775, designing a stout earthwork fortification that helped protect American soldiers from British cannonade in the historic Battle of Bunker Hill.

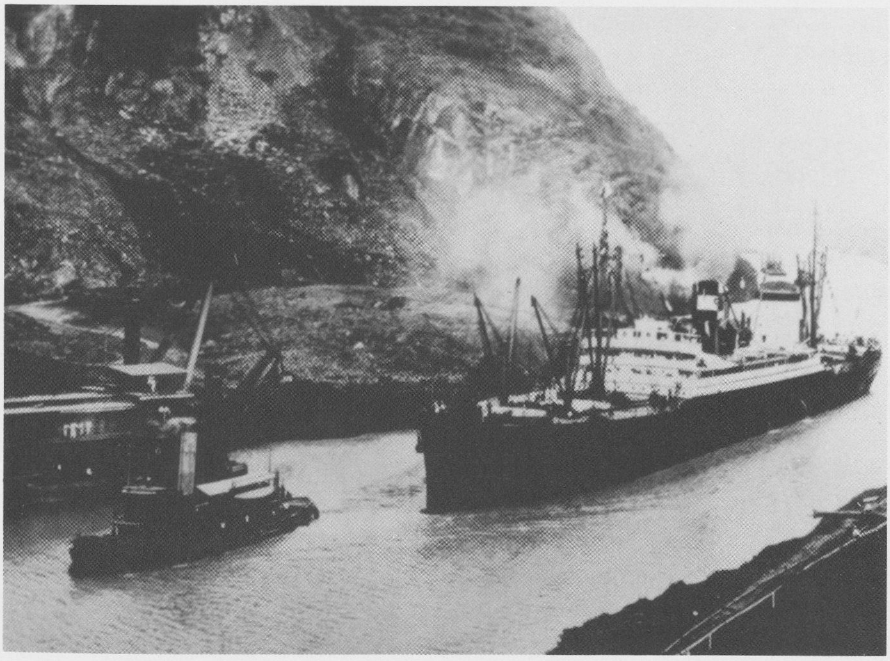
In the Battle of Bunker Hill, June 17, 1775, the British lost more men than in any other encounter of the Revolutionary War. The strategic defenses built by Colonel Richard Gridley and his men were instrumental in keeping American fatalities to a minimum.



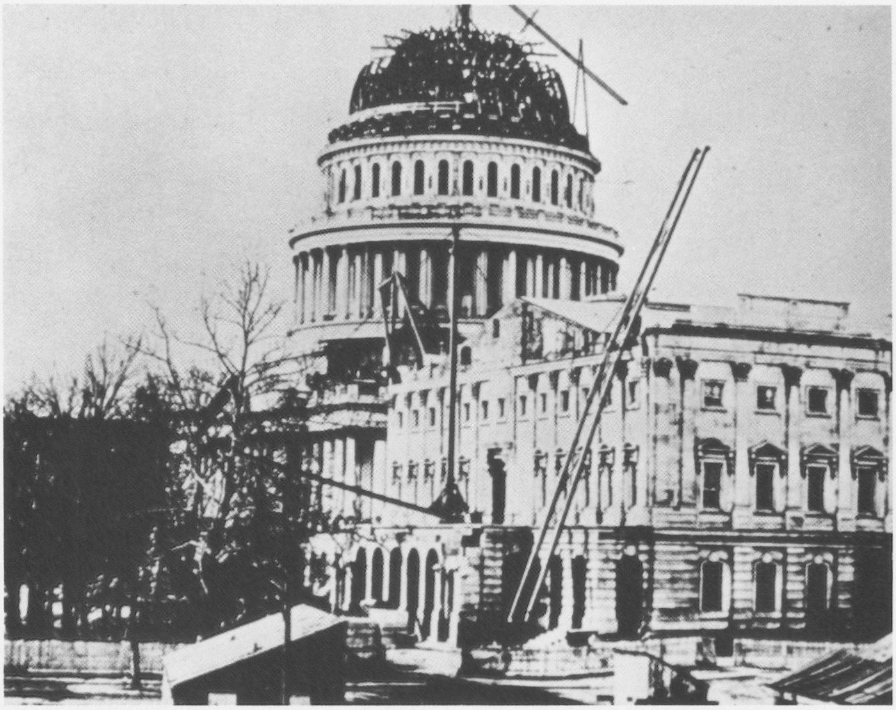
Today's Corps

The foresight and innovative spirit of the Corps' earliest days have served the public interest and contributed to America's rapid ascent to world leadership. Today, the Corps' civil works activities add to our quality of life and support our nation in many ways. In addition to water resource projects built both in America and abroad, such as the Panama Canal and the St. Lawrence Seaway, the Corps has constructed NASA facilities and provided military engineering support for our nation's allies. The Corps provides our armed forces with modern facilities to strengthen the country's defensive capability and ensure combat readiness. The military and civil (nonmilitary) works missions of the Corps complement each other, allowing our engineers to develop in peacetime the skills the nation would need in a defense mobilization or other national emergency.

There are 13 Corps division offices worldwide, 12 of which are located in the U.S., including one in New England. Civilian employees account for 98 percent of the Corps' civil works staff, with military officers and noncommissioned officers making up the remainder. The Corps' New England Division oversees a wide variety of engineering and construction activities in the six-state



In August 1914, Army engineers—succeeding where two previous attempts failed—completed construction of the Panama Canal, connecting the Atlantic and Pacific Oceans. Construction of the canal's locks, dams, and piers, shown above, was an astounding engineering feat, and the canal stands today as a monument to the determination and skill of the Corps.



Army engineers contributed to both planning and construction of our nation's capital. When the Capitol Building had to be reconstructed in 1857, the Corps built two new wings and redesigned the dome with cast and wrought iron. The completed dome, which weighed almost nine million pounds, was used by President Abraham Lincoln during the Civil War as a symbol of his intention to preserve the Union.

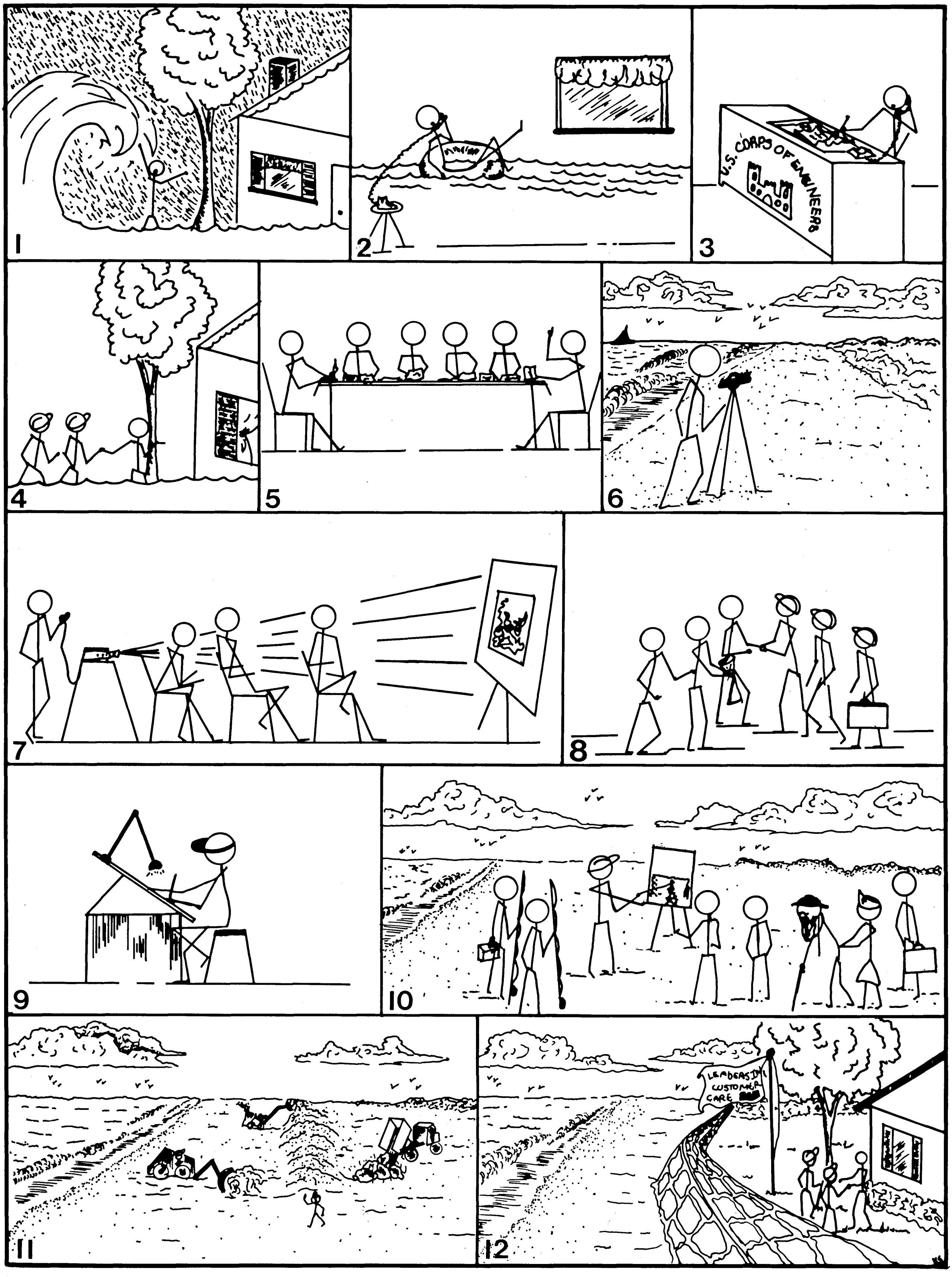
region (Western Vermont falls under the jurisdiction of the Corps' North Atlantic Division). New England has 6100 miles of coastline and 19 principal river basins that lie entirely or partially within its borders. Although it represents only two percent of the nation's land area, New England contains nearly five percent (12 million) of the population. Its water resource needs reflect the diverse priorities of both urban and rural residents, and its four-season climate presents a wide variety of water resource challenges.

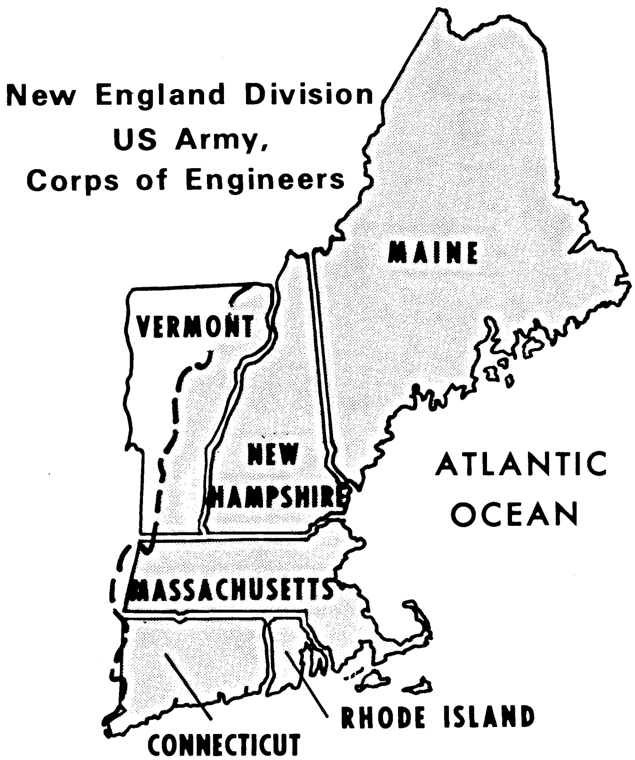
Project Formulation

There are several systematic steps involved in the implementation of every Corps of Engineers project. Local citizens or agencies normally first identify a water resource problem, such as persistent flooding or the need to improve a harbor. They contact the Corps or their congressional representative to discuss the problem. Upon receiving the request, Corps engineers will make a field visit to the area and verify the need. From this field visit and evaluation of other information, the Corps can determine whether the problem warrants Corps' participation and can be addressed with a small project, which does not require specific congressional authorization, or a large project, which must receive specific congressional authorization and appropriation of funds.

For a small project, the Corps will first conduct a reconnaissance study. This study examines a wide range of potential solutions, each of which is reviewed for its economic and engineering practicality, acceptability, and impact on the environment. Once completed, the reconnaissance phase findings are released to the public. The Corps then arranges cost-sharing agreements for further planning with the nonfederal sponsors, such as the local or state government or other public entity. When cost-sharing agreements are finalized, a Definite Project Report, which describes the recommended solution and includes an evaluation of the project's expected impacts, is prepared. After appropriate review from federal and state officials, nonfederal sponsors, and other public agencies, and approval by the Assistant Secretary of the Army for Civil Works, a project can then be designed and constructed. All small projects are planned, designed, and constructed under the Corps' Continuing Authorities Program.

There are several steps involved in the construction of Corps' projects, as illustrated on the following page. After citizens identify a water resource problem, such as persistent flooding (one), they contact the Corps of Engineers (two and three). Corps' officials then verify the need by visiting the affected area (four), and determine if the problem warrants Corps' involvement (five). If so, the Corps conducts a reconnaissance study (six), which examines a wide range of potential solutions, then releases those findings to the public (seven). Cost-sharing agreements for further planning are arranged with the nonfederal sponsors (eight). At this point, a Definite Project Report, which recommends a specific solution, is prepared (nine). After the report is reviewed and approved by all appropriate officials (ten), a project can then be designed and constructed (eleven). Corps' work stands as testimony to its theme, "Leaders in Customer Care" (twelve).


U.S. CORPS OF ENGINEERS
LEADERS IN CUSTOMER CARE



If a larger and more comprehensive project is warranted, a congressional resolution must first be obtained. This resolution authorizes the Corps to study and resolve the water resources problem. Congress then appropriates the funds required for the Corps to conduct a reconnaissance study. The rest of the planning process is similar to that of smaller projects. Construction of large projects, however, must be specifically authorized by Congress.

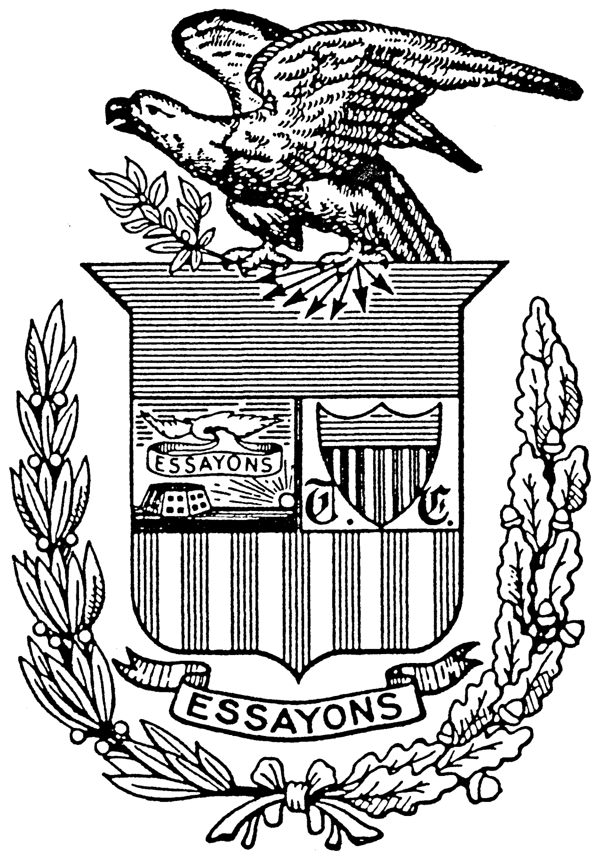
For all projects, large and small, the anticipated benefits must outweigh the economic and environmental costs of their implementation. The construction costs of all projects are shared between the federal government and nonfederal sponsor, based on the project's purpose. Many projects designed and constructed by the Corps are turned over to municipalities or states for operation and maintenance.

A fundamental and vital part in the planning of all projects is public involvement. Public input often helps generate useful information and comment from local and state officials and other interested parties, such as fishermen, environmental organizations, and civic groups. In New England, the "town meeting" tradition is much in evidence through lively citizen involvement. The public has many opportunities to review and comment on Corps' project recommendations. Meetings, conferences, forums, and informal workshops are held with the public throughout the planning period. The concerns and expectations of the public and possible solutions are discussed and incorporated into all phases of project development.

The Corps of Engineers encourages full participation by the people and their elected officials and is committed to an open planning process. The Corps can only reach sound conclusions on the best use of water resources with the active involvement and strong support of the public, and takes pride in its theme for the 1980s, "Leaders in Customer Care."

Environmental Commitment

The Corps maintains a strong commitment to our environment. It strives for a proper balance between developing projects and conserving our country's natural resources in its search for the best possible solution to a water resource need.



The crest of the Army Corps of Engineers. The olive branch, held in the eagle's right claw, connotes the peaceful nature of the Corps' mission and its concern for the environment. The arrows, held in the left claw, indicate the Corps' readiness to defend the nation. The oak branch, lower right, stands for fortitude. The Corps' motto, "Essayons," means "Let Us Try."

In this regard, the Corps conducts its civil works program in full compliance with the National Environmental Policy Act (NEPA) of 1969. This law encourages a productive and enjoyable harmony between people and their environment and the understanding of how ecological systems and natural resources enrich our nation. The Corps upholds the spirit of NEPA with established planning principles, quality engineering standards, and professional operating procedures.

Concern for the integrity of the environment begins at the planning stage. All studies of proposed projects, as well as alternative plans, include an Environmental Assessment, which examines the impacts each potential solution may have on the environment. If the effects of a project on the area's ecology are expected to be significant, a more detailed Environmental Impact Statement may be prepared. All practical options and alternatives, including measures that preclude construction, are considered from the outset in selecting a solution that best resolves the water resources problem while protecting the quality of the environment. If the construction of a water resource project is the Corps' recommended option, the facility is carefully planned to minimize environmental damage. Consideration is given toward blending a project's features with the surrounding natural and man-made landscape.

Baker Cove in Groton, Connecticut, is a wetland that houses several different forms of life. Before building a proposed project in a given area, the Corps looks closely at the effects such a project may have on the environment and surrounding wetlands. The Corps considers all options, including those that preclude development, in finding a solution to a water resources problem.

Flooding in New England

Rain.

So important for the sustainment of life, rain enhances all living things. When it first begins to rain, the terrain absorbs the precipitation. Rivers and streams welcome rainfall's replenishing value.

Yet too much rain can be destructive. The saturated ground soon overflows. Rivers and streams, peaceful only days earlier, become swift-moving torrents. Cities and towns along the riverbanks fall victim to the onrushing water, which destroys everything in its path—automobiles, bridges, property, lives. Hurricanes can cause similar destruction, producing turbulent winds and heavy rains that lift the sea to a dangerous height several feet above normal.

New England has a long history of flooding. Through the years it has been hit with various storms that have caused millions of dollars in damages. Some of the more destructive hurricanes and floods the area has experienced since 1900 occurred in November 1927; March 1936; September 1938; September 1954; and August 1955. However, some of the highest flood levels in New England history occurred in April 1987 and gave many Corps dams their most serious test since they were built. Despite having six dams channel excess water through their emergency spillways because their reservoir capacity had been reached, the 35 dams under the jurisdiction of the Corps' New England Division held back billions of gallons of water that otherwise would have caused severe flooding downstream. The amount of water held back by these dams from this heavy rainfall was equivalent to a reservoir that could put the entire state of Rhode Island under more than one foot of water. Damages prevented by Corps flood control projects during the April 1987 storm amounted to $474 million.

The following pages depict some of the damages inflicted by these storms and explain why the Corps actively pursues its responsibilities to reduce flood damage. (Information on the Corps' Flood Damage Reduction Program begins on page 16).

1927 *Floodwaters swirl around homes and trees in this Vermont community during the November 1927 flood. The storm claimed 21 lives and caused $29.3 million in property damage.*

1936 *The rampaging waters of the North Nashua River ripped through the downtown area of Fitchburg, Massachusetts, during the March 1936 flood, taking with it homes, automobiles, and commercial and industrial property. Eleven lives were lost from this flood and damages were estimated at $66.4 million.*

1936 *Waters from the Connecticut River surround the Hartford South Meadows Power Station (center) and cover much of Hartford, Connecticut, during the March 1936 flood. The spring floods of 1936 brought widespread disaster from Maine to Maryland and helped mold political and public opinion that culminated in the Flood Control Act of 1936, which recognized the proper involvement of the federal government in flood control. (Copyright 1936* The Hartford Courant*).*

1938

The heavy rains of the September 1938 hurricane caused the Contoocook River to flood a section of East Jaffrey, New Hampshire. This storm, with its 121 m.p.h. gusts, took the lives of eight people in New England and caused damages of $48.6 million (about $740 million in today's dollars).

1954

Hurricane Carol, which struck the New England coast in August 1954, caused damages estimated at $186 million ($685 million in today's dollars). The storm achieved its greatest fury in a band stretching from New London, Connecticut to the Cape Cod Canal. All that remains of the Rhode Island Yacht Club (above) in the Pawtuxet Neck section of Warwick, Rhode Island, is a cradle of piles after the structure was destroyed by Carol's high winds and waves. (Copyright 1954 The Providence Journal Company.*)*

1954

A section of Providence lies under water from the rains of Hurricane Carol.

1954 *The call "all ashore" was taken literally at the Quonset Naval Air Station in North Kingstown, Rhode Island, when Hurricane Carol whisked this air-sea rescue boat out of the water and on to Quonset Highway in August 1954. (Copyright 1954* The Providence Journal Company.*)*

1955 *The Blackstone River overflows its banks and floods several businesses and homes in Pawtucket, Rhode Island as a result of the heavy rains of Hurricane Diane in August 1955.*


DELUXE
BILT-WELL


RUBINO'S
GRINDERS
LA PIZZA
STRAND
WALT DISNEY'S
LADY and TRAMP
SWITZERLAND
JEWELRY
REPAIRS
STRAND THEATRE

1955

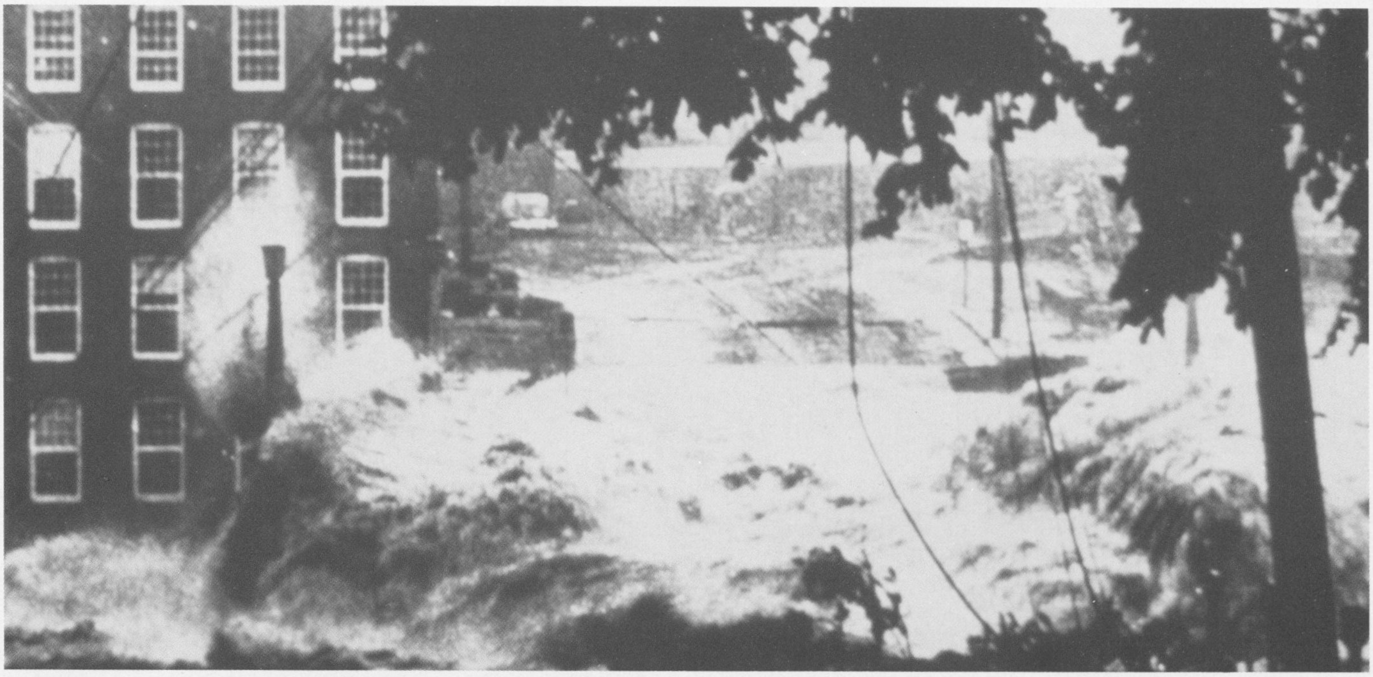
No natural disaster in New England history compares with the devastation caused by the sudden and torrential rainfall which accompanied Hurricane Diane in August 1955. The disaster killed 90 people and caused almost $458 million (about $1.82 billion in today's dollars) in property damage throughout the six-state region. In Connecticut alone, Diane's floodwaters killed 47 people and caused damages totalling about $370 million (about $1.3 billion in today's dollars). The rains of Hurricane Diane fell on ground already saturated by the rains of Hurricane Connie one week earlier.

One of the communities that sustained heavy damage was Winsted, Connecticut. The waters of the Mad River overflowed its banks and roared through Main Street (top photo, opposite page), uprooting foundations and flooding homes and businesses. When the floodwaters receded, the devastation became apparent (bottom photo). Main Street had become a pile of rubble, cluttered with debris ripped from its understructure.

The storm also forced hundreds of New Englanders to evacuate their homes, including a Connecticut woman (above) who was dramatically rescued from ravaging floodwaters. (Copyright 1955 The Hartford Courant*).*

Only two months later, as Connecticut was getting back on its feet, another severe flood disrupted rehabilitation measures and caused losses estimated at $6.5 million.

In response to these major floods, the Corps built several dams and local protection projects that, in a recurrence of the August 1955 flood today, would prevent damages of $1.04 billion.




GULF

1955

As these photos from August 1955 demonstrate, floodwaters pose a powerful threat to property and lives.

On the opposite page:

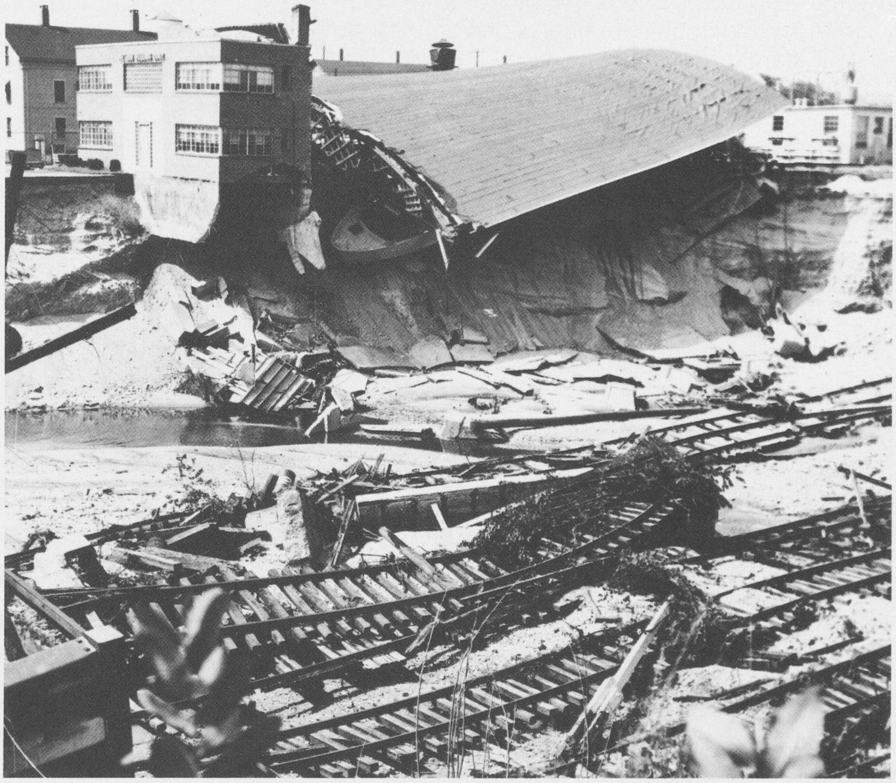
(Top) Water from the Quinebaug River pours over the Pomfret Street Bridge in Putnam, Connecticut during the height of the storm.

(Center) This Southbridge, Massachusetts home was toppled when the floodwaters of the Quinebaug River weakened its foundation. Note the overturned automobile on the left; its only identifiable remains are its tires.

(Bottom) The roofs of automobiles seem to float like lily pads in this Weymouth, Massachusetts parking lot.

(Above) Floodwaters from the Blackstone River roar through Webster Square in Worcester, Massachusetts.

(Right) The Metal Sellings plant in Putman, Connecticut, which had been constructed only a short time before the 1955 flood, collapsed when floodwaters from the Quinebaug River washed away its underpinnings.



Flood Damage Reduction

Structural and Nonstructural Measures

Water covers most of our planet, defines our boundaries, washes our shores, and dots our countryside. It's as common as the afternoon thunderstorm and the puddle under foot. Our country has been blessed with abundant water resources that help feed our people, transport our goods, generate power, and provide recreational opportunities. Yet as life-sustaining and enhancing as water is, its destructive potential is enormous and tragic.

Flooding is part of the natural hydrologic cycle of the earth. Excess precipitation, such as driving rainstorms or a combination of excessive rainfall and melting snow, can transform streams into swollen rivers. The violent winds and heavy rains of hurricanes can whip oceans and lakes into furies that devastate the shoreline. In the 1930s, parts of the U.S. experienced disastrous floods that caused loss of life, damaged property, and disrupted transportation systems. Recognizing that the federal government should help state and local governments find solutions to serious flood problems, Congress called on the Corps in 1936 to establish a policy on controlling floodwaters. Today procedures taken by the Corps to limit flood damages are known as its Flood Damage Reduction Policy.

There is no flood-free season in New England. Melting snows abetted by rainfall can cause problems in winter and early spring. Hurricanes can occur during summer and fall, and coastal storms can wreak havoc at any time. The Corps' Flood Damage Reduction Program is aimed at reducing the effects of floods, thereby limiting flood damage.

The Corps has built several different types of structures designed to reduce flooding in commercial and residential areas. These include:

- *Dams*—barriers, usually consisting of earthfill (sand and clay) covered with rock, that are constructed across a river or stream to impound water or create a reservoir. Dams temporarily hold back excess water to relieve swollen downstream waterways of further potential flooding, then gradually release the stored water after the flood crest has passed. Reservoirs can also be used for other purposes, such as water supply, hydropower, conservation, boating, and other recreation. Since 1935, the Corps has built 38 dams in New England, and presently operates and maintains 31. Nationwide, the Corps has constructed over 600 dams, with about 400 of these having flood control as their primary purpose.
- *Hurricane Protection Barriers*—earthfill structures covered with rock, built across harbors or parallel to the shoreline, that protect the coast from tidal surges and coastal storm flooding. They are sometimes constructed with openings for navigation and recreational purposes. The Corps has constructed five hurricane barriers in New England. All are operated and maintained by local communities, except for the navigation gates at the barriers in New Bedford, Massachusetts, and Stamford, Connecticut, which are operated by the Corps.
- *Local Protection Projects*—structures that provide flood protection to specific communities. Unlike dams, which protect wide regions of a state, a local protection project helps safeguard the residential, commercial, and industrial areas of a particular city or town from flood damage. Local protection projects often consist of earthen dikes and concrete floodwalls that confine floodwaters to a river channel. Conduits, or diversion tunnels that divert floodwaters around or under potential flood damage sites, can also be part of a local protection project. Other works that can be part of a local protection project include pumping stations, which pump floodwaters through or over a dike or floodwall into the river, and channel modification, which deepens, widens, and/or realigns a river channel to improve water flow and increase capacity. Local protection projects are operated and maintained by local communities.

Corps' Flood Damage Reduction works, while costing about $23 billion nationwide, are credited with preventing damages of more than $150 billion—almost $7 in damages prevented for every $1 spent. In New England, Corps' projects have cost about $482 million while preventing flood damages of almost $2.3 billion. (Descriptions of Flood Damage Reduction projects in New Hampshire begin on page 50).

Corps-operated works, such as dams and hurricane protection barriers, are managed, operated, and maintained in accordance with high professional standards. All Corps' works, including local protection projects, are regularly inspected by Corps engineers for signs of structural weakness or distress.

While structural works provide many flood control benefits, they are not the only solution in some cases. Many times a nonstructural measure is the best approach

*The Corps built several projects in response to the severe flooding caused by Hurricane Carol in August 1954 (*The Boston Post*), and extremely heavy rainfall from Hurricane Diane in August 1955 (*Boston Sunday Herald*). Hurricane Diane had already been declassified as a hurricane when it struck New England, but its drenching rains caused the most severe flooding in New England history. Corps structures, such as dams, hurricane protection barriers, and local protection projects, help reduce the disastrous effects of floods by saving lives and limiting property damage.*

TODAY'S THOUGHT
I hear September call — her words like music lure with golden harmony.—'Tis Autumn's overture.—*Charles L. H. Wagner.*

The Boston Post

Fair
Sunny and mild today; moderate winds. Cool tonight. Tomorrow, fair.
(Full Weather Report on Page 26)

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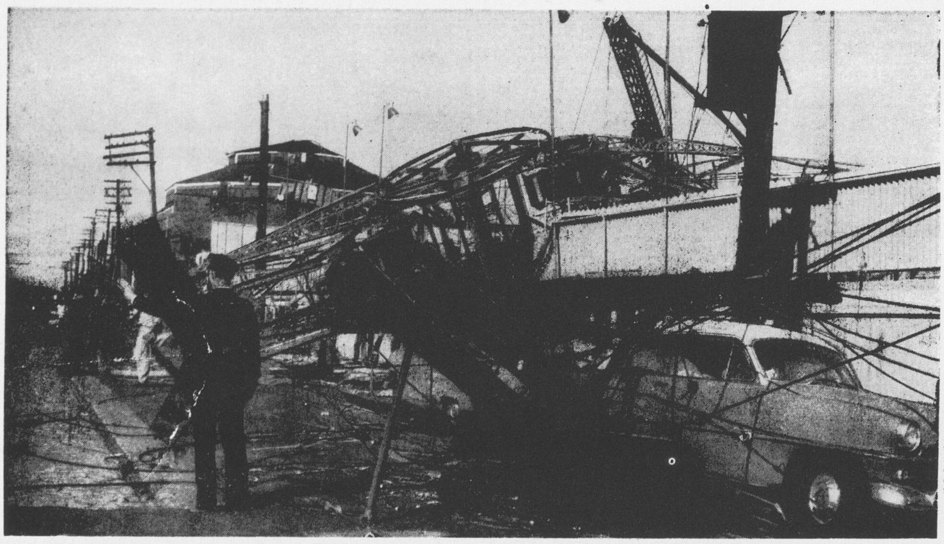
35 DEAD, 500 MILLION DAMAGE

100 Mile an Hour Hurricane Ravages N.E.
Score Missing---Thousands Left Homeless
Hundreds of Beach Cottages Swept Away



Revere Wreckage in Hurricane Wake Giant double ferris wheel lies a mangled wreck and shattered power pole entangled in broken wires over roof of trapped automobile on Ocean ave., Revere, after disastrous hurricane lashed the beach city with 100 mile an hour winds. Cutting a wide swath through New England, the howling storm caused damage which, it is estimated will run into hundreds of millions of dollars. Power failures were reported in all sections. (Post Photo by John Hurley)

By BEN GRAY

New England counted 35 dead and surveyed a staggering $500,000,000 property loss by wind, flood and fire last night after the hurricane passed leaving tragedy and shambles in its wake.

It was the greatest property loss in the six-State area by a hurricane. Loss of life was far below the hurricane of Sept. 21, 1938, but damage was greater.

Hurricane Carol—so labeled by the weather bureau—roared with up to 100-mile-an-hour winds from Long Island Sound to the Canadian border.

Its belt of destruction and devastation lay heavily on all New England States.

Continued on Page 10—Col. 1

(Other hurricane stories and pictures on Pages 2, 3, 4, 6, 7, 8, 9, 10, 15, 16.)

Winds, Flood and Fire Wreak Havoc on Cape

By EDWARD T. MARTIN
Post Staff Reporter

WAREHAM, Aug. 31—A weird pattern of death and destruction was spread tonight across southeastern Cape Cod, and where the hurricane's brutal fury left several dead, whole communities isolated and in darkness and thousands of vacationists temporarily homeless.

Towns are without phones, transportation and light. Food supplies are growing scarce in some places. A state of emergency exists practically everywhere. National guardsmen, the army and the air force, along with private citizens, are patrolling the streets.

Continued on Page 10—Col. 7

Insurance Firms to Start Damage Payments at Once

Hot, Humid
—High Temperatures In Middle 90's
(Official U. S. Forecast)
Details on Page 3

BOSTON SUNDAY HERALD

Editorials
Minot, Mullins, Devin, Allen
Sect. IV, Pages 2, 3

VOL. CCXIX, NO. 52 | LATE CITY EDITION | HA 6-3000 | BOSTON, SUNDAY, AUGUST 21, 1955—**ONE HUNDRED EIGHTY PAGES** | **** | With "This Week" Colorgravure Magazine | TWENTY CENTS

57 N.E. DEAD--SCORES MISSING

70 More Feared Lost in Conn. Horror, Ike Lists State Among Disaster Areas

Resort Problems Face Cape, Maine

By BILL CUNNINGHAM

The two hurricanes, Connie and Diane, neither of hich actually hit New England, nevertheless cost the w highly specialized and very important resort indusy of New England X millions of dollars. In terms of the

Services Rushing Food, Medicines

Flood stories and pictures on pages 6, 9, 16, 20, 29, 30, 31, 35, 37, 44; 53, 61, 62.

President Eisenhower late last night declared Massachusetts a "major disater area" as 57 persons were known to be dead and more than 100 others to a flood problem. Nonstructural measures include:

- *Wetland Preservation*—this involves the acquisition of wetlands by the federal government to prevent development. Wetland preservation eliminates potential long-term flooding problems, thereby preserving the wetlands' environmental and water retention values.
- *Floodproofing*—lessens the potential for flood damage in existing and planned buildings. For example, existing structurally sound buildings could have their basement windows blocked, reducing the likelihood for damage. New structures can be built on elevated foundations, allowing floodwaters to pass below.
- *Emergency Evacuation*—provides for the temporary evacuation of people and movable goods from the floodplain to safer ground. This measure is usually accompanied by flood warnings issued by the National Weather Service or local governments.
- *Permanent Evacuation*—permanently removes structures, buildings, and other damageable properties from the floodplain. The vacated property could then be used for parking, recreation, or other open space purposes compatible with the flood risk.

The Corps considers both structural and nonstructural measures when developing plans for flood damage reduction.

Floodplain Management Services

New England rivers, lakes, and streams sometimes overflow their banks and spill their waters into adjacent low-lying areas. These areas, known as the floodplain, are an integral part of a river system. They are reserve areas carved out by the river itself to hold surplus water—nature's safety valve for the discharge and overflow of its streams and channels. Flooding in these riverine and coastal locations caused little damage until they were developed and occupied by industrial, commercial, and residential interests. When development occurs on the floodplain, there is a risk that the river will reclaim its right of passage, damaging roads, buildings, homes, and posing threats to life.

Flood-prone communities across the U.S. have learned the lesson that flood protection works alone are not the answer to flood problems. As part of its flood damage reduction efforts, the Corps encourages the wise use and management of floodplains through proper planning. This support is called the Floodplain Management Services Program.

Through the Floodplain Management Services Program, the Corps uses its technical expertise in water resource planning to furnish state and local officials with floodplain information. This data helps a community enact floodplain zoning regulations, which limit new construction on the floodplain and regulate the use of floodplain lands. For example, lowlands stretching along a riverbank that may seem ideal for high density development might be best used as a park, golf course, or for other open space purposes. The decision on floodplain usage rests with each community. The Corps cannot require local interests to implement floodplain regulations. However, if the Corps has constructed flood control works in that community, the adoption and enforcement of zoning regulations may be required to achieve expected flood reduction benefits.

Under the Floodplain Management Services Program, the Corps can:

- Survey and map the floodplain;
- Assist cities and towns in preparing floodplain regulations and flood emergency plans;
- Provide architectural, engineering, and other technical assistance for the floodproofing of buildings, structures, or properties located on the floodplain;
- Assist states in developing hurricane evacuation plans for densely populated coastal areas; and
- Provide information on flood-related issues, such as the effects urbanization may have on rivers and streams.

The Corps also provides available hydrological information, such as previous flood levels of the floodplain, to private organizations and individuals upon request. Those who may find this information valuable include engineering firms, real estate agencies, and residential and industrial developers.

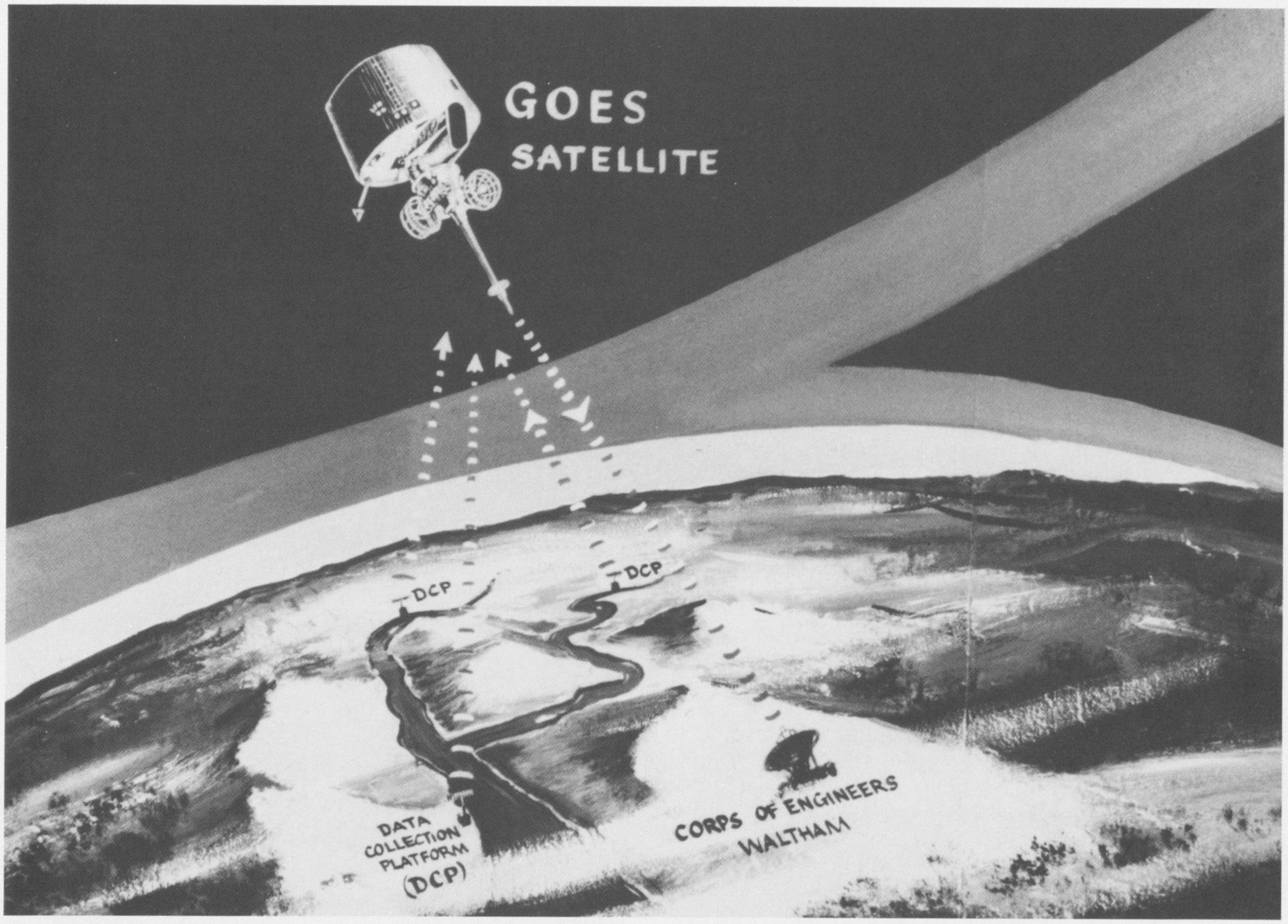
The purpose of the Floodplain Management Services Program is not to discourage development on the floodplain, but rather to encourage the most appropriate use of flood-prone areas. Floods will cause damage as long as people claim land that has historically belonged to streams and rivers. By managing development of the floodplain, fewer lives and less property are exposed to the flood risk, thereby decreasing the social and economic costs of flood damage.

Reservoir Control Center

As a flood situation develops, considerable judgement and experience are required to efficiently manage Corps dams and reservoirs. Weather conditions, reservoir storage capacity, and the flood levels of rivers are important factors when operating dams that maximize the protection of downstream communities and minimize flood damage. The nature of New England weather requires the region's dams and reservoirs be professionally managed by trained engineers and hydrologists. These skilled technicians, using sophisticated communications equipment, form an integral part of the Corps' flood control efforts known as the Reservoir Control Center (RCC).

The RCC is located at the Corps' New England headquarters in Waltham, Massachusetts. From this site, Corps engineers closely monitor precipitation, river levels, and tidal levels in New England. The state-of-the-art communications equipment used by RCC personnel is complemented by the Geostationary Operational Environmental Satellite (GOES) System. The GOES system

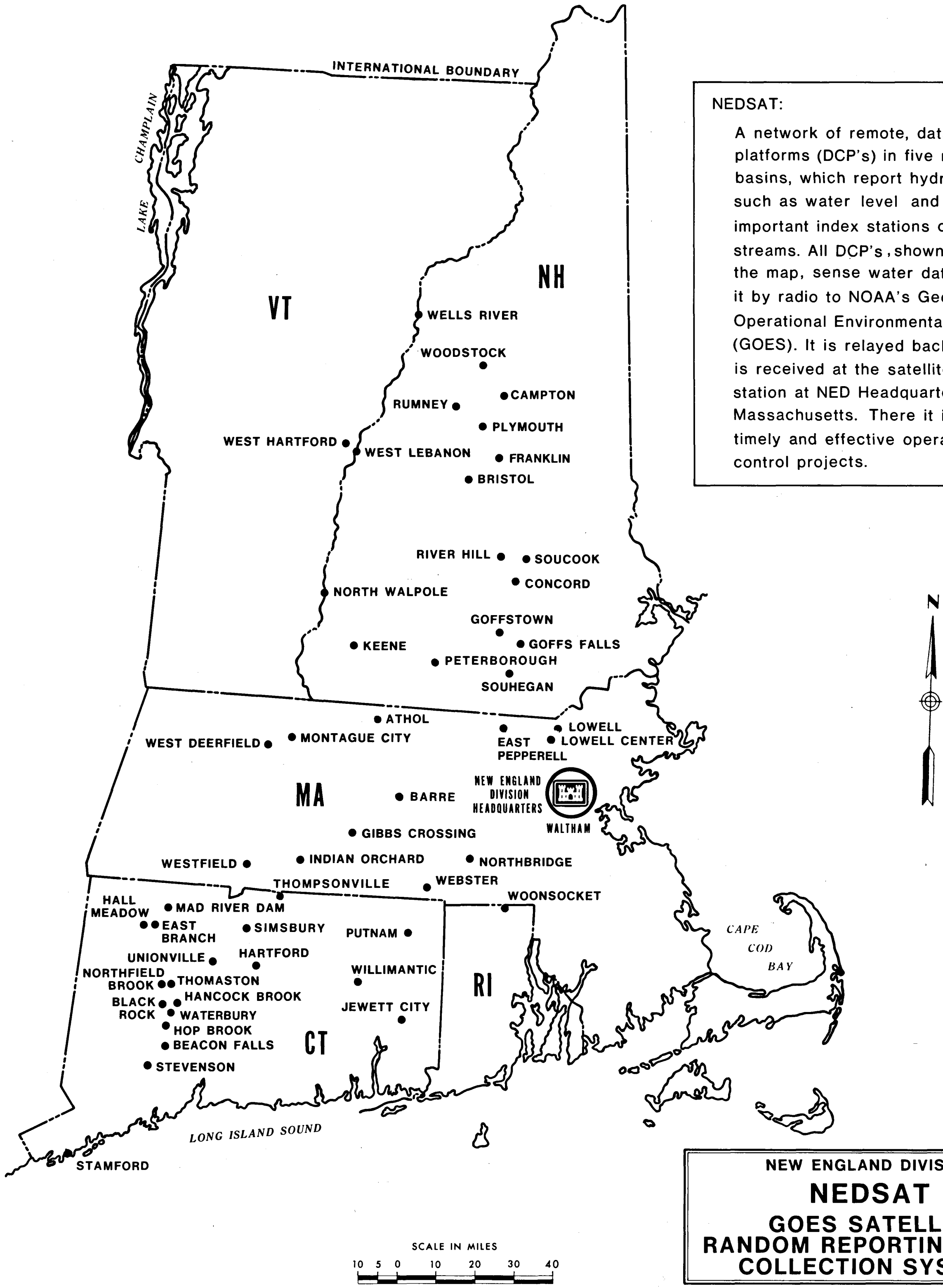
These photos demonstrate reasons why development on the floodplain is unwise. The top photo shows the undeveloped floodplain of the Quinnipiac River in North Haven, Connecticut. The river can be clearly defined, with the adjacent low-lying areas inundated with water. The bottom photo shows the developed floodplain of the Concord River in Bedford, Massachusetts, after the heavy rains and snowmelt of March 1968. The house was eventually bought by the state five years later and removed.



serves as a communication link for the relay of hydrologic and meteorological data. Information from about 50 data collection platforms at key locations along rivers, streams, and other bodies of water is relayed to a stationary satellite, which transmits this data by radio signal to the RCC. Engineers then examine and analyze this hydrologic information for potential flood conditions. This data indicates when to open or close flood control gates and when to release stored floodwaters from reservoirs once downstream flood conditions have receded. During flood emergency periods, additional information is obtained by telephone, teletype, and radio from field personnel and other agencies, such as the National Weather Service and the U.S. Geological Survey.

The Reservoir Control Center has helped minimize or prevent severe and damaging floods in many New England communities. The Corps is proud of its commitment to provide the public with improved flood protection through the professional management of its dams and hurricane protection barriers.

The GOES network, or the New England Division Satellite System (NEDSAT), plays a key role in helping the Corps reduce flood damage. About 50 data collection platforms (DCPs) are situated on various rivers and streams throughout the five New England states (opposite page) where the Corps has dams and hurricane protection barriers. Hydrologic and meteorological data from these DCPs are relayed to a satellite stationed above the earth (top photo). The satellite then transmits this information by radio signal to the Corps' Reservoir Control Center in Waltham, Massachusetts. The data tell Corps' engineers when to open or close the floodgates of Corps' dams and hurricane protection barriers, thus limiting damage to communities downstream. The GOES system also provides the national weather maps displayed by local TV weathermen during their forecasts.



NEDSAT:

A network of remote, data collection platforms (DCP's) in five major river basins, which report hydrologic data, such as water level and rainfall, from important index stations on rivers and streams. All DCP's, shown by dots on the map, sense water data and transmit it by radio to NOAA's Geostationary Operational Environmental Satellite (GOES). It is relayed back to Earth, and is received at the satellite ground station at NED Headquarters in Waltham, Massachusetts. There it is used for timely and effective operation of flood control projects.

NEW ENGLAND DIVISION

NEDSAT

GOES SATELLITE RANDOM REPORTING DATA COLLECTION SYSTEM

REVISED 4/86

Navigation

Since colonial times, harbors and rivers have played important roles in the nation's settlement, defense structure, and industrial growth. Today, along with air, rail, and truck transportation, the waterways of the United States provide a vital link in our country's commercial trade chain. Channels, canals, and intracoastal seaways provide an efficient and economical means of moving cargo within the U.S. and to and from foreign nations. The Corps develops, maintains, and improves these waterways as part of its navigational responsibilities.

Improvements of U.S. navigable waters are intended to promote industrial production, develop and expand waterborne commerce, facilitate the harvest of seafood, reduce navigational difficulties and hazards, and meet the requirements of recreational boating. Federal interest in navigation improvements stems from the Commerce Clause of the Constitution and from subsequent decisions of the U.S. Supreme Court. Congress first assigned the Corps the responsibility for improving rivers and harbors for navigation in 1824. Today, U.S. commercial waterways are one of the world's most extensive navigational systems, covering over 25,000 miles and linking about 350 Corps-maintained ports and harbors, including more than 160 harbors and 11 major ports in New England.

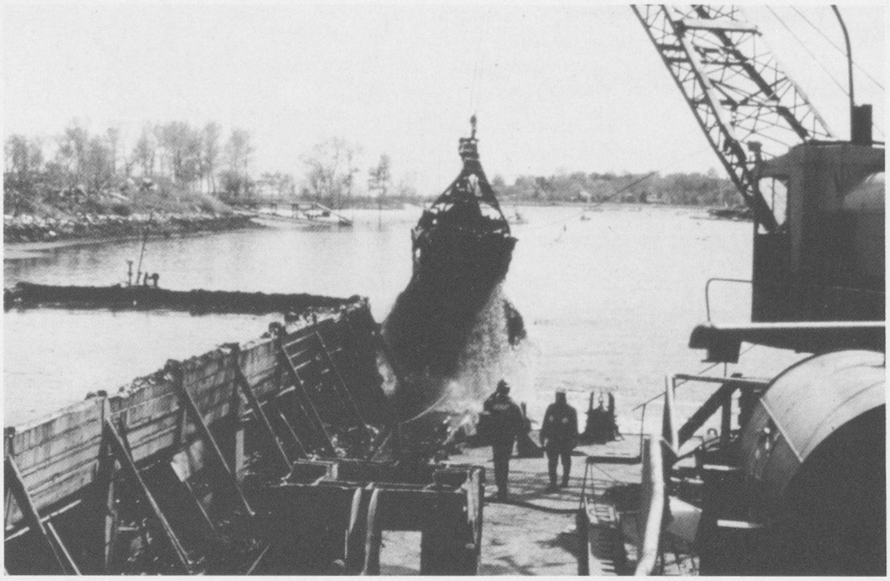
Navigational activities undertaken by the Corps include:

- Constructing major harbors and enlarging river channels to meet the requirements of commercial shipping.
- Developing canals, harbors for small boats, and other inland waterways to meet the needs of commercial and recreational navigation.
- Building water-related structures and dredging certain areas to provide safe channels, harbors, and mooring basins for commercial and recreational vessels. These can include:

  —*Anchorages.* These are areas dredged to certain depths allowing boats and ships to moor or anchor.
  —*Breakwaters.* Usually built offshore, breakwaters protect harbors, channels, anchorages, and the shoreline by intercepting the energy of approaching waves.
  —*Jetties.* These structures stabilize a channel by preventing the buildup of sediment and directing and confining the channel's tidal flow. Jetties are usually built at the mouth of rivers and extend perpendicular from the shore.
  —*Training Dikes.* Extending from riverbanks or estuarine shores into the water, training dikes redirect the current, preventing sediment from settling and ensuring that adequate depths are maintained.

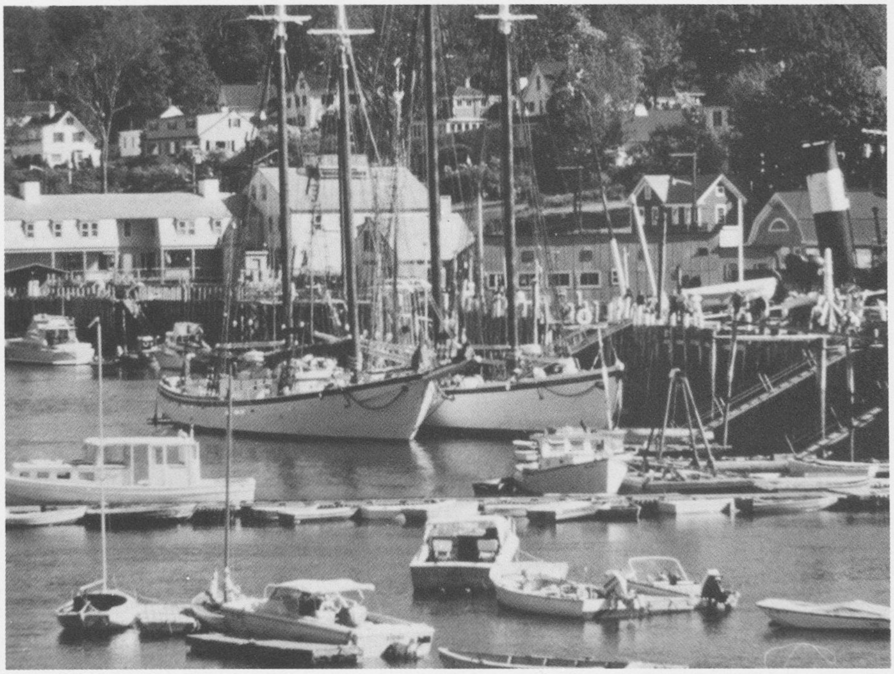
- Monitoring and maintaining the dimensions of federal waterways to ensure continuing vessel safety, consistent with the needs of user traffic.
- Removing obstructions, such as sunken vessels or snags, that endanger general navigation.

Navigational improvements must be made in the public interest and be equally accessible and available to everyone. Feedback from individuals, harbormasters, and port authorities regarding activities in federal channels is always welcomed. All reported navigational hazards and obstructions are investigated and removed, if warranted. The Corps also reviews statistics on the use of New England ports to identify areas that may need maintenance or improvement. (Descriptions of Corps' Navigation projects in New Hampshire begin on page 90).



One of the Corps' navigational responsibilities is to ensure that the dimensions of river channels and harbors, such as Black Rock Harbor in Bridgeport, Connecticut, continually meet the requirements of marine interests.

Jetties help provide safe channels for commercial and recreational vessels. The jetties at Saquatucket Harbor in Harwich, Massachusetts, also help prevent the buildup of sediment in the channel by directing and confining the tidal flow.



The Corps develops harbors, like Camden Harbor in Camden, Maine, for small boats to meet the needs of commercial and recreational navigation.

The three breakwaters (above) at New Haven Harbor in New Haven, Connecticut, help protect the harbor (left) from storm-driven winds and waves.

Shore and Bank Protection

Shore Protection

The shoreline is where land and ocean meet. Its charm attracts a growing number of people every year who enjoy its recreational value. The greatest concentration of New England's population exists along or near the coastline, and the preservation of the region's shores and beaches is essential to the healthy growth of its economy. New England's 6100 miles of coastline are recognized as one of its most valuable resources.

However, water and wind can erode the shoreline which, if not checked, can cause serious damage. Corps' shore protection works help protect shores and restore beaches eroded by storm-driven waves.

The Corps' work in shore protection began in 1930, when Congress directed it to study ways to reduce erosion along U.S. seacoasts and the Great Lakes. Recommendation for federal participation is based on shore ownership, use, and benefits derived. If there is no public use or benefit, Corps' participation is not recommended. Maintenance of the restored shore is a nonfederal responsibility.

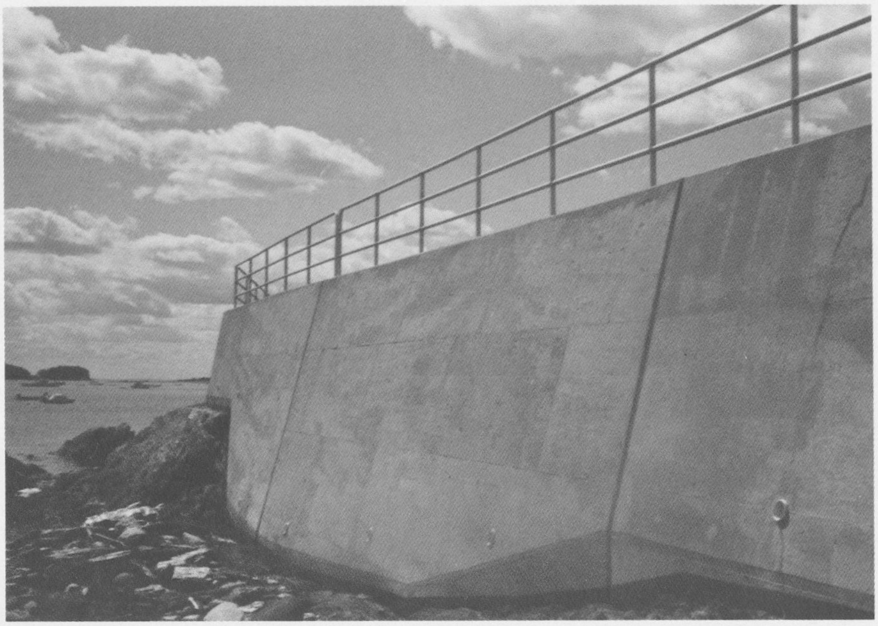
The Corps of Engineers uses both structural and nonstructural methods to control shore erosion. These include:

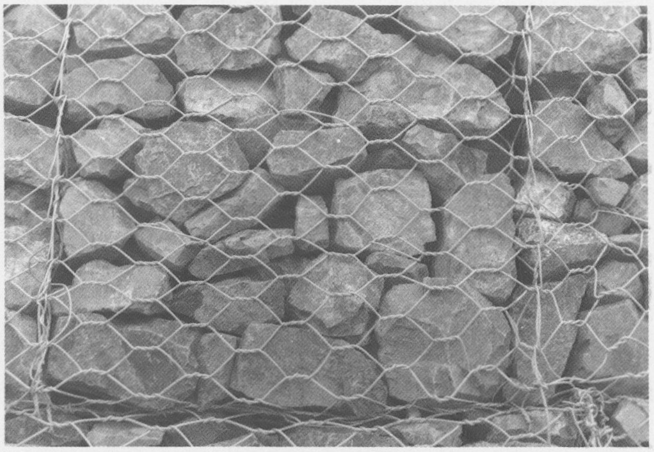
- *Groins.* They extend perpendicular from the shore in a fingerlike manner to trap and retain sand, thereby retarding erosion and maintaining shore alignment and stability.
- *Jetties.* Usually built at the mouth of rivers and extending perpendicular from the shore, jetties are designed to prevent channel shoaling by directing and confining stream or tidal flows.
- *Sand Replenishment* or *Beach Nourishment.* Quantities of sand placed on the shoreline widen and restore beach areas and retard the ocean's inland advance. Sand replenishment helps protect the backshore by moving the high waterline further away from the shore, and the enlarged beach areas add to recreational enjoyment.
- *Seawalls.* Built along a shoreline, seawalls protect the land against erosion, flooding, and other damages due to wave action. Seawalls are constructed of various materials, including reinforced concrete.
- *Training Walls.* These are built along channel banks to narrow the channel area, thereby accelerating the velocity of the water's flow and preventing the buildup of sediment.
- *Vegetation.* Planted beach grass and other plants

Groins help preserve New England's fragile shores and beaches that are subject to strong winds and waves. These Corps-built groins, at Clark Point in New Bedford, Massachusetts, retard erosion and help to maintain the stability of the shore.

This shore protection project at Oakland Beach in Warwick, Rhode Island, is a good example of how Corps' works help protect shores and restore beaches. Sand replenishment, which widened and restored the two beach areas on the far left and far right, slows the ocean's inland advance. The four groins maintain shore alignment by trapping and retaining sand. The stone revetment, in the center of the photograph between two groins, retards erosion.

Seawalls protect the shoreline against erosion and flooding. At Merriconeag Sound in Harpswell, Maine, storm currents were eroding the shoreline and threatened to wash away a 19th century burial ground when the Corps built this 270-foot-long seawall to stem the erosion process and protect the valued historical site.





The retaining wall on the Nonewaug River in Woodbury, Connecticut (left) is made of gabion, or wire mesh baskets filled with stone. The right photo shows gabion in closer detail.

trap sand and catch windblown sediment with their long stems. The roots help retain existing sand deposits. Vegetation stabilizes eroding areas not exposed to direct wave action and increases the soil's infiltration rate. Like sand replenishment, vegetation enhances the symmetry and splendor of the landscape and provides stability to backshore areas.

By protecting the backshore, shore protection works enhance property values and reduce or prevent the loss of historic or scenic aspects of the environment. The Corps has constructed 33 shore protection projects along New England's 345 miles of publicly owned beaches.

One of the major concerns of the Corps is the preservation and management of natural shoreline areas, such as coastal marshes and dunes. These areas form a first line of defense, dissipating the energy of the breaking waves and reducing the flooding effects of storm-driven waves and tides, and are crucial to maintaining proper ecological balance.

While erosion is principally caused by natural elements such as wind and water, its rate and severity can be intensified by heavy use and unwise development. Pedestrian and vehicular traffic can also contribute to the destruction of shoreline defenses by destroying vegetation, degrading dunes, and weakening bluffs and banks. Groins, jetties, and other structures, while protecting the shoreline, can sometimes interrupt natural shoreline processes, such as sediment transport. Corps' shore protection works restore eroded shores and preserve the natural beauty of our coastal areas. (Descriptions of Corps' Shore and Bank Protection projects in New Hampshire begin on page 100).

Bank Protection

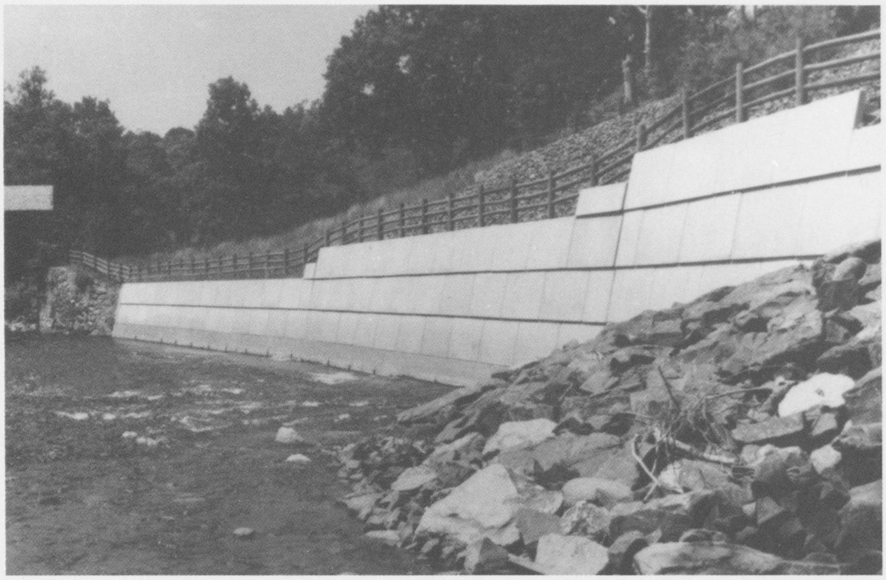
Like the shoreline, inland riverbanks and streambanks can slowly erode from wind and water. Flooding of streams can take its toll on streambanks, causing accelerated erosion and weakening their ability to hold back floodwaters. Riverbanks and streambanks weakened by erosion pose threats to adjacent land and structures.

When this occurs, the Corps can help threatened public property by strengthening these banks, thereby stabilizing nearby roads and highways. Because work of this nature does not require major study, the Corps' can act under Section 14 (Emergency Streambank or Shoreline Protection) of its Continuing Authorities Program and construct small projects that expedite relief to weakened riverbanks. Section 14 also strengthens coastal areas weakened by wind and water.

Structures built by the Corps that protect streambanks include:

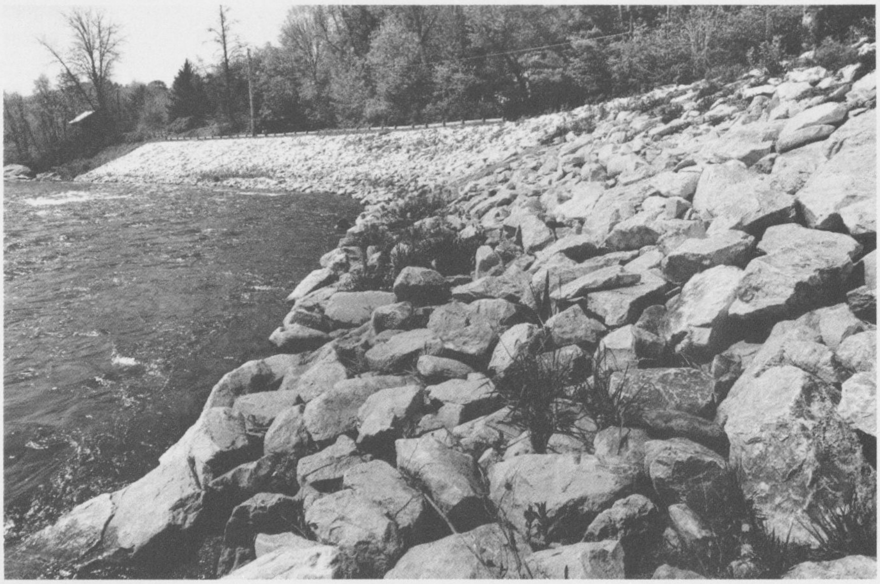
- *Retaining Walls.* Constructed of stone, reinforced concrete, precast concrete blocks, or gabion (wire mesh baskets filled with stone), retaining walls support streambanks weakened by erosion.
- *Revetments.* A facing of stone or concrete, a revetment is constructed along the bank or the shoreline to protect against erosion and flooding.
- *Stone Slope Protection.* A layer of large stones, usually underlain by a layer of gravel bedding, stone slope protection is designed to prevent erosion from streamflow, wave attack, and runoff.
- *Bulkheads.* Made of timber or steel sheet piling, bulkheads prevent sliding of the land and protect the streambank or shoreline from erosion.

More information about Section 14 and the Continuing Authorities Program is available on page 30.



Retaining walls, like this one made of precast concrete blocks on the Salmon River in Colchester, Connecticut, support streambanks and riverbanks weakened by erosion.

Stone slope protection, a layer of large stones usually underlain by a layer of gravel bedding, reduces erosion from streamflow and waves. The stone slope protection on the Housatonic River in Salisbury, Connecticut, strengthens a 350-foot reach of the riverbank and stabilizes the roadway.



The timber bulkhead at Squantz Pond State Park in New Fairfield, Connecticut, prevents sliding of the land and protects the bank from erosion.

Hydroelectric Power

As the population of the United States increases, so does its need for electric power. Because dependence on foreign oil contributes to economic uncertainty, alternative sources of power are being sought both in the U.S. and abroad. One of the nation's most reliable energy alternatives is hydroelectric power—electricity produced by flowing water. As the nation's primary agency for water resources development and management, the Army Corps of Engineers plays a significant role in meeting the nation's power needs by operating hydroelectric power plants at a number of its large, multipurpose dams throughout the country.

In a series of laws and resolutions dating back to 1909, Congress has directed the Corps to give consideration to the various uses of water, including hydroelectric power, when planning dams and reservoirs. Today, the Corps of Engineers owns and operates 71 hydropower plants nationwide that help provide hydroelectric power to industry and consumers. These plants, located on Corps project sites developed for flood control or other purposes, generate approximately 90 million megawatt hours worth of electricity every year. To produce the same amount of electricity using alternative sources of energy, it would require 150 million barrels of oil, 900 billion cubic feet of natural gas, or 44 million tons of coal. Corps' hydropower energy production is equivalent to the output of almost 16 average-sized nuclear power plants. The Corps of Engineers is the nation's single largest generator of hydroelectric power, producing 30 percent of all hydropower in the U.S. This figure represents four percent of all U.S. electric energy.

Most hydropower facilities at Corps' projects today are developed by nonfederal interests without Corps' assistance. The Corps becomes involved with planning, constructing, and operating hydropower projects only when it is impractical for nonfederal interests. In New England, the Corps does not operate any hydroelectric power facilities, but there are seven hydroelectric power plants at Corps flood control dams which are owned and operated by nonfederal interests. These plants are located in:

—North Hartland, Vermont, about 500 feet downstream of the dam at North Hartland Lake. This facility produces 4 megawatts of power. All power generated at this plant is used by the Vermont Electric Cooperative or is sold to other utilities.

—Quechee, Vermont, 2.5 miles upstream of the dam at North Hartland Lake and within the reservoir area. Built on Corps land, this plant produces 1.8 megawatts. Power is sold to the Central Vermont Public Service Corporation.

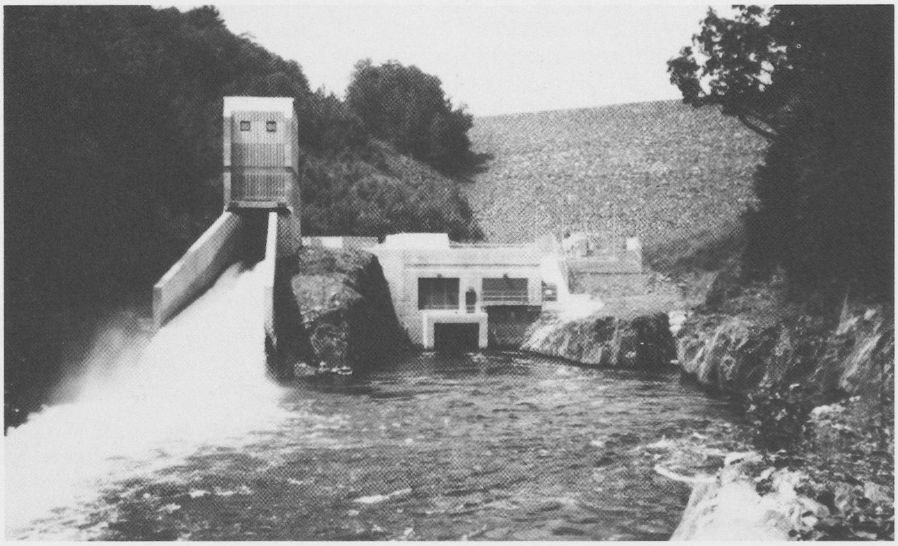
—Waterbury, Vermont, at the base of the dam at Waterbury Reservoir. This facility generates approximately 5.5 megawatts of power, which is used by the Green Mountain Power Corporation.

—Montpelier, Vermont, approximately 200 feet downstream of the dam at Wrightsville Reservoir. The plant has the capacity to produce 1.2 kilowatts of power, which is used by the Washington Electric Cooperative.

—Franklin, New Hampshire, on Salmon Brook. Built on Corps land within the reservoir area of Franklin Falls Dam, this facility produces 0.2 megawatts of power. Power is sold to the Public Service Company of New Hampshire.

—Bristol, New Hampshire, on the Newfound River. This plant produces 1.5 megawatts and lies on private property but within the reservoir area of Franklin Falls Dam. Power is sold to the Public Service Company of New Hampshire.

—Colebrook, Connecticut, at the base of the dam at Colebrook River Lake. This facility will begin producing 3.3 megawatts of power sometime in 1989. The power will be sold to the Connecticut Light and Power Company.



Although the Corps does not presently operate any hydroelectric power plants in New England, there are five hydropower plants located at Corps flood control projects in the region that are owned and operated by nonfederal interests. The North Hartland hydropower facility in North Hartland, Vermont, located 500 feet downstream of the Corps-operated North Hartland Lake Dam, is one such facility.

Continuing Authorities Program (Small Projects)

Many large and comprehensive projects built by the Corps require both congressional approval and appropriation of funds. However, the Corps can plan, design, construct, and maintain smaller projects without specific congressional authorization. This allows the Corps to provide a more rapid response to certain local flood control, navigation, and erosion problems. The design and construction of small projects fall under the Corps' Continuing Authorities Program.

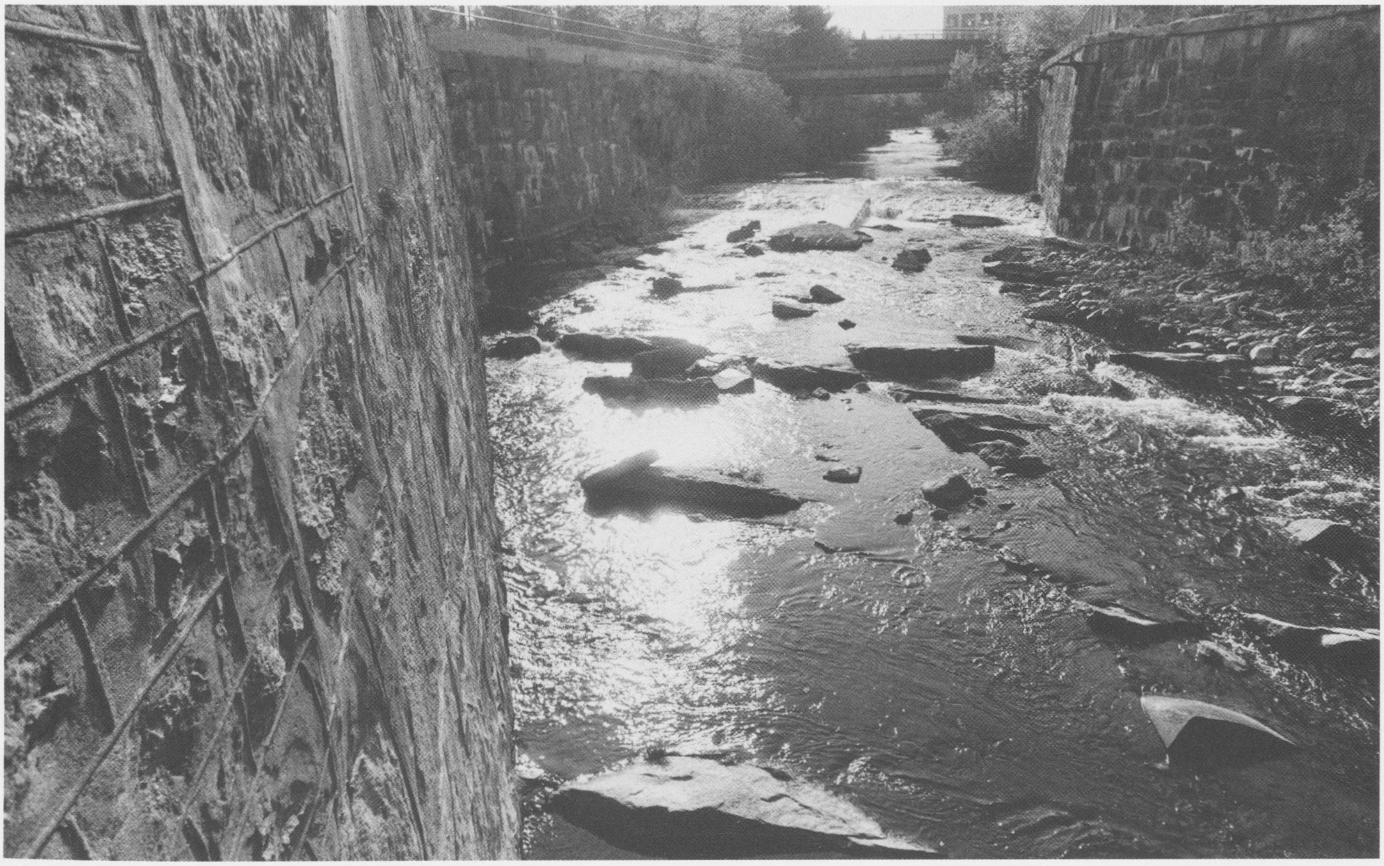
Small projects must constitute complete solutions in themselves and not commit the Corps to any additional improvement to ensure successful operation. As with congressionally authorized projects, small projects must be economically justified and environmentally acceptable. Construction costs are shared with state or local governments according to the purpose of the project. There is a federal cost limitation to all small project construction.

Small projects are constructed by the Corps for the following purposes:

- *Flood Control* (Section 205)—permits the construction of small flood damage reduction projects. Proposed projects must not have been previously authorized by Congress. Both structural and nonstructural measures are considered.
- *Navigation* (Section 107)—allows for the construction of small navigation improvement projects. These projects can benefit commercial interests and/or provide recreational opportunities.
- *Emergency Streambank* or *Shoreline Protection* (Section 14)—permits the construction of emergency streambank or shoreline protection works that help prevent damage to highways, bridges, public works, churches, hospitals, schools, and other public or privately owned nonprofit facilities. Shoreline protection works can consist of groins, revetments, or seawalls. Emergency streambank protection, which helps stabilize the streambank and prevent further erosion, usually consists of revetments or retaining walls.
- *Beach Erosion Control* (Section 103)—provides for the construction of small beach restoration and protection projects. These small projects reduce damage and losses to backshore development.
- *Snagging and Clearing for Flood Control* (Section 208)—allows for the removal of accumulated debris and other obstructions and the straightening of stream channels when in the interest of flood damage reduction.
- *Snagging and Clearing for Navigation* (Section 3)—permits the clearing and removal of obstructions from rivers, harbors, and other waterways when in the interest of navigation.
- *Mitigation and Prevention of Shore Damage due to Federal Navigation Projects* (Section 111)—provides for the construction of facilities that minimize shoreline damages caused by existing federal navigational works, such as breakwaters, jetties, or groins.

The Continuing Authorities Program allows the Corps to build small projects in response to a community's more immediate needs. In August 1955, the devastating floodwaters of the Naugatuck River ripped through Torrington, Connecticut, causing millions of dollars in damage (above). One of the ways the Corps responded to this flood was to build concrete floodwalls (below) and stone slope protection along the banks of the river, giving the community added protection. While this project, Torrington (West Branch), was constructed under Section 205 (the flood control authority) of the Continuing Authorities Program, other sections allow the construction of small navigation and shore and bank protection projects.


GULF
H.O. HAMMOND
INSURANCE
REAL ESTATE
PARK DINER
SQUIRES
PAINT
GLASS



Natural Resources Management

Fish and Wildlife

While the Corps has been developing and safeguarding the nation's water resources for nearly 200 years, it has a lesser known but equally important commitment to conserve and protect our country's woodlands and lakes at its project sites. Lands owned by the Corps to primarily store occasional flood waters also serve as important habitats for fish and wildlife.

The Corps manages a diversity of terrestrial and aquatic habitats in New England. Its reservoirs offer a mixture of woodlands, fields, marshes, streams, and ponds that support a variety of native wildlife populations, such as deer, beavers, wood ducks, foxes, songbirds, trout, and bass.

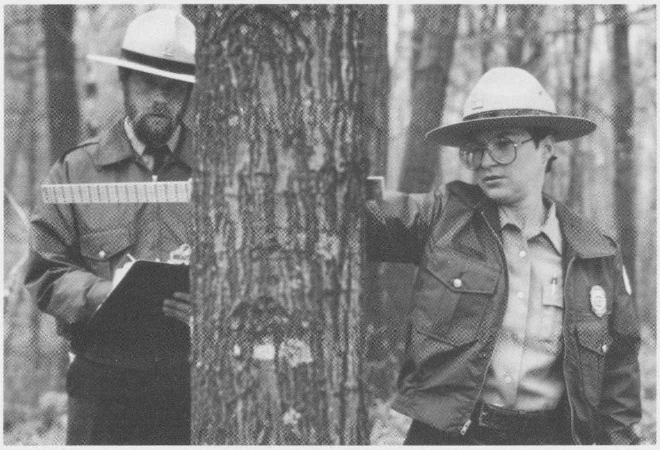
The Corps promotes wildlife habitat by:

- Planting wildlife food plots, trees, and shrubs for food and shelter;
- Thinning overcrowded forest stands to increase wildlife food and cover;
- Fertilizing, reseeding, and mulching eroded sites;
- Planting tree seedlings for reforestation;
- Mowing fields for the benefit of wildlife; and
- Installing nest boxes for birds and small mammals.

There are 31 Corps-operated dams and reservoirs in New England totalling more than 50,000 acres. This land area provides good habitat for wildlife when in its natural state.

The Corps encourages aquatic habitat by:

- Conducting tests on rivers and lakes to ensure high quality water for aquatic mammals and birds; and
- Carefully protecting environmentally sensitive areas that might house rare or endangered species, such as the Golden Club aquatic plant found in the Conant Brook Reservoir in Monson, Massachusetts.



Thinning overcrowded forest strands—removing less desirable trees to make room for new ones—increases wildlife food and cover. Corps' rangers measure the height and width of a less desirable tree at Hodges Village Dam in Oxford, Massachusetts, to determine its volume of lumber, which will be sold to a contractor.

The Corps employs specialists who help protect the environment and oversee the effective management of the area's woodlands and lakes. These people include foresters, biologists, ecologists, geologists, and landscape architects.

Recreation

Corps recreation areas, such as parks and campgrounds, allow people to appreciate the full recreational potential at each of its dams and reservoirs without damaging the environment. These leisure activities vary from project to project, but can include sight-seeing, birdwatching, boating and canoeing, picnicking, swimming, walking, hiking, camping, and in-season fishing and hunting. The 31 Corps-operated dams and reservoirs in New England contain six campgrounds, 21 parks and picnic areas, 18 boat ramps, and designated trails for hiking, horseback riding, trail bikes, snowmobiling, and cross-country skiing. State fish and game agencies stock reservoirs with trout for sport fishing. Hunting varies from site to site, but can include deer, duck, quail, rabbit, partridge, grouse, squirrel, and stocked pheasant. Over six million people visit Corps-owned lands in New England every year.

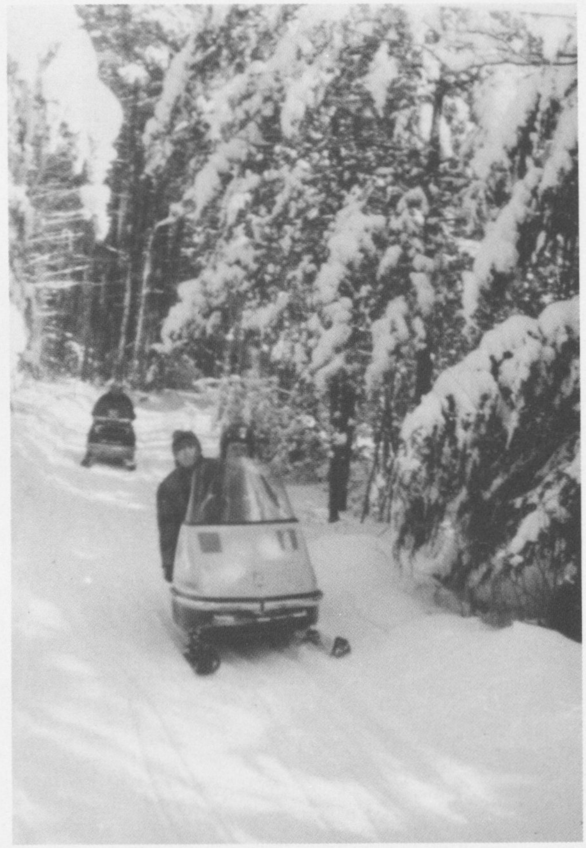
As part of its commitment to provide safe and enjoyable recreational opportunities, the Corps conducts an Interpretive Services Program. Under this program, park rangers with professional training in forestry, wildlife, or park management explain the principles of recreation safety and the importance of our natural resources through guided walks, evening campground programs, and special park demonstrations. These services are available to park visitors during the summer months and to school, library, scouting, and other groups year-round.

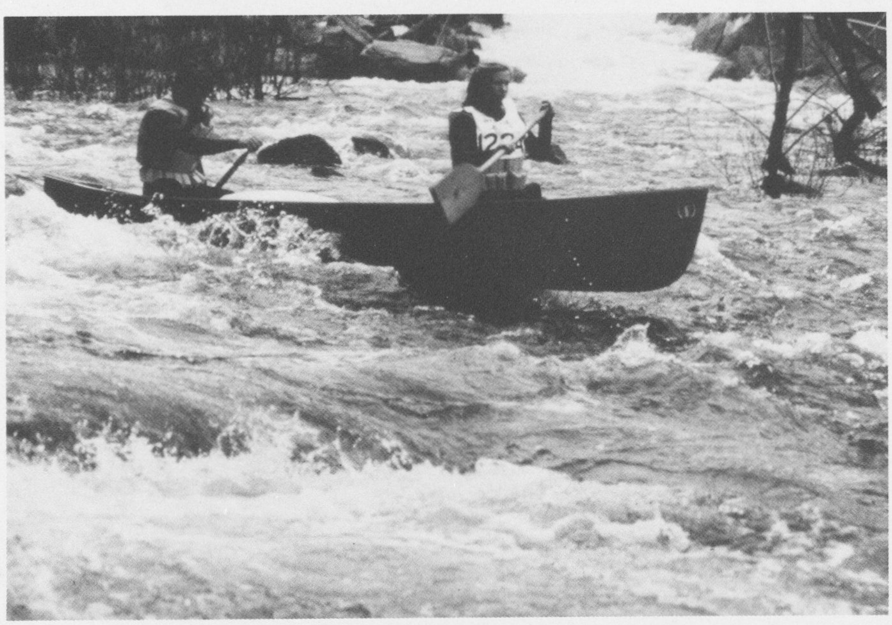
The Interpretive Services Program allows Corps' rangers to explain the principles of recreation safety and the importance of our water resources to park visitors. Above, a ranger enjoys a light moment with a young patron at the Cape Cod Canal in Bourne, Massachusetts, which is owned and operated by the Corps.

The Army Corps of Engineers supplements the woodlands at its dam sites in New England by planting tree seedlings for reforestation. Hop Brook Lake Dam in Middlebury, Connecticut, is the site of this planting.

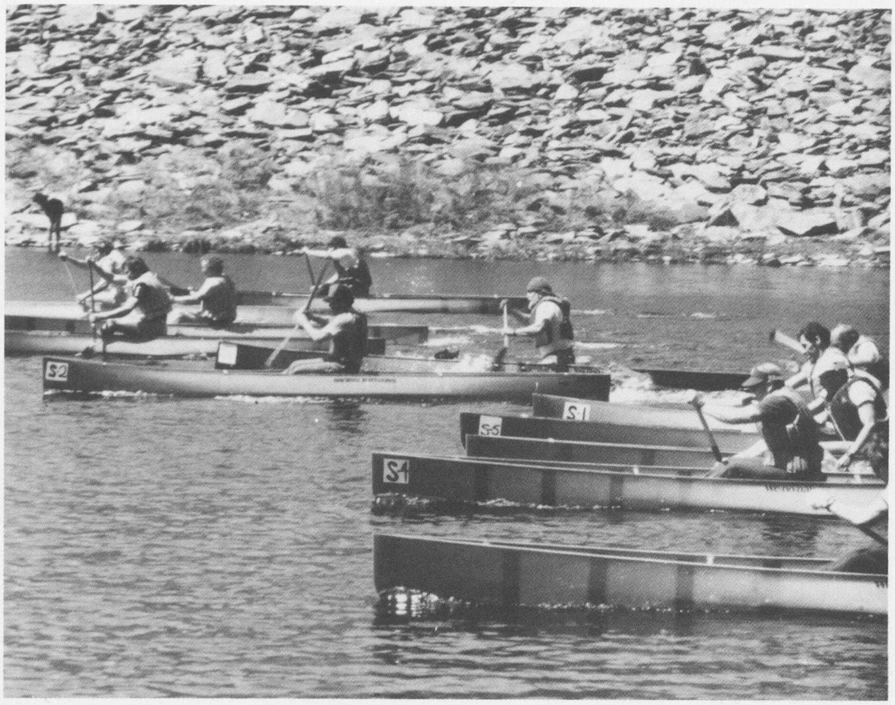
A beaver pipe allows water to pass underneath a beaver dam, preventing the flooding of nearby roads and controlling the water level. This beaver pipe was constructed and installed at Surry Mountain Lake Dam in Surry, New Hampshire.

Recreation at Corps' dams





There are many recreational opportunities available at the 35 dams and reservoirs operated by the Corps' New England Division. Clockwise, from top left: stocking trout at Hop Brook Lake Dam in Middlebury, Connecticut; snowmobiling at Blackwater Dam in Webster, New Hampshire; canoe racing at Hodges Village Dam in Oxford, Massachusetts; fly fishing at Townshend Lake Dam in Townshend, Vermont; ice fishing at East Brimfield Lake Dam in Sturbridge, Massachusetts; and white water rafting at Littleville Lake in Huntington, Massachusetts.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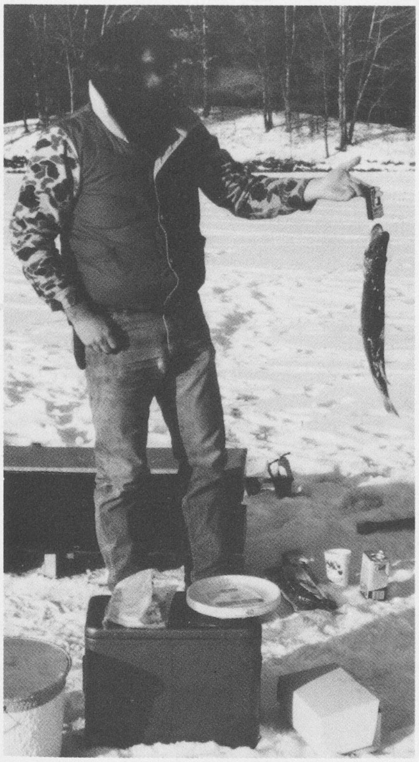


Emergency Response and Recovery

Natural disasters are both unpredictable and unavoidable. They can strike at any time with varying degrees of severity. Hurricanes, tornados, abnormally high rainfall, snowmelt from an abnormal snowpack, or failure of dams or other flood control works can take heavy tolls of life and property.

States and local communities are responsible for answering the public's emergency call for help. However, there are times, such as the Blizzard of 1978, when the nature of the disaster exceeds the resources and capabilities of local authorities. The Corps, with its expertise in mobilizing public and private resources, can respond quickly to supplement community and state efforts and efficiently and effectively provide additional assistance. This support is part of the Corps' Emergency Response and Recovery operation.

Emergency response provided by the Corps can be classified into three categories: Disaster Preparedness, Emergency Operations, and Contaminated Water/ Drought Assistance.

Disaster Preparedness

It is the responsibility of state and local governments to be prepared for natural emergencies. The Corps can assist local authorities in their preparation by taking immediate measures to protect life and property from the threat of damaging floods. These measures include:

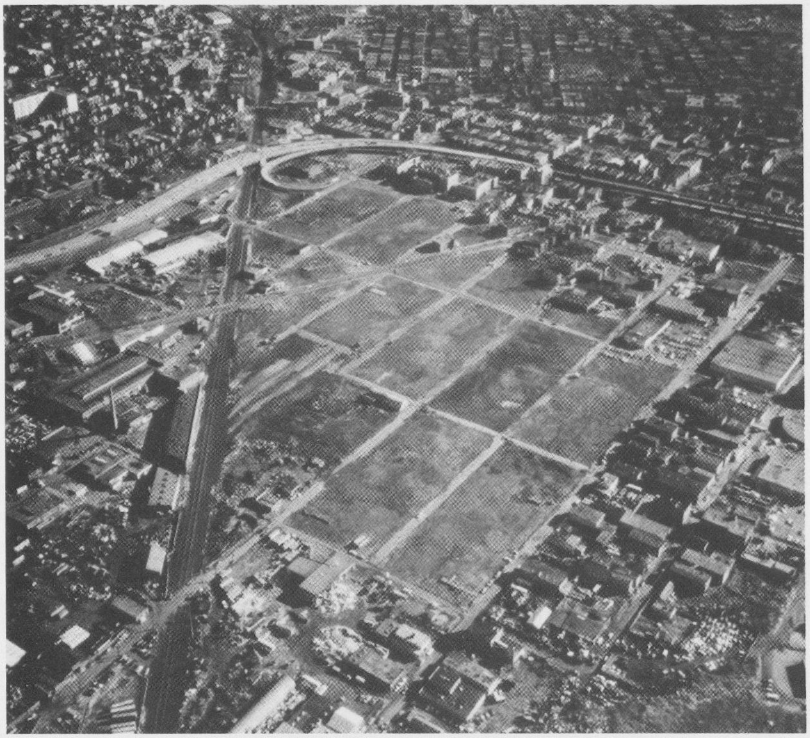
- Participating in local flood emergency seminars and exercises;
- Strengthening nonfederal flood control and shore protection works; and
- Constructing temporary levees.

These protective measures are designed to meet an imminent threat and are generally temporary in nature. The Corps considers permanent rehabilitation work that protects against the threat of future disasters to be separate from emergency measures. Local communities are responsible for maintaining or removing any emergency or temporary work constructed by the Corps.

Emergency Operations

When disaster strikes, the Corps stands ready to supplement the emergency efforts of state and local governments at their request. Disaster relief activities carried out by the Corps include:

- Flood fighting and rescue operations. When necessary, the Corps furnishes flood fighting materials, such as sandbags, lumber, pumps, or rock.



The Corps provided disaster relief assistance to residents of Chelsea, Massachusetts, when fire destroyed 18 city blocks in October 1973.

THE MIDEAST WAR: Egypt in Major Sinai Assault; Israel Punches Nearer Damascus

This, Other Stories and Photos, Page 11

PARTLY SUNNY

Report on Page 29

Boston Herald American

Combining the best features of the Herald Traveler and Record American

TELEPHONE 426-3000 ★ MONDAY, OCTOBER 15, 1973 32 PAGES FIFTEEN CENTS

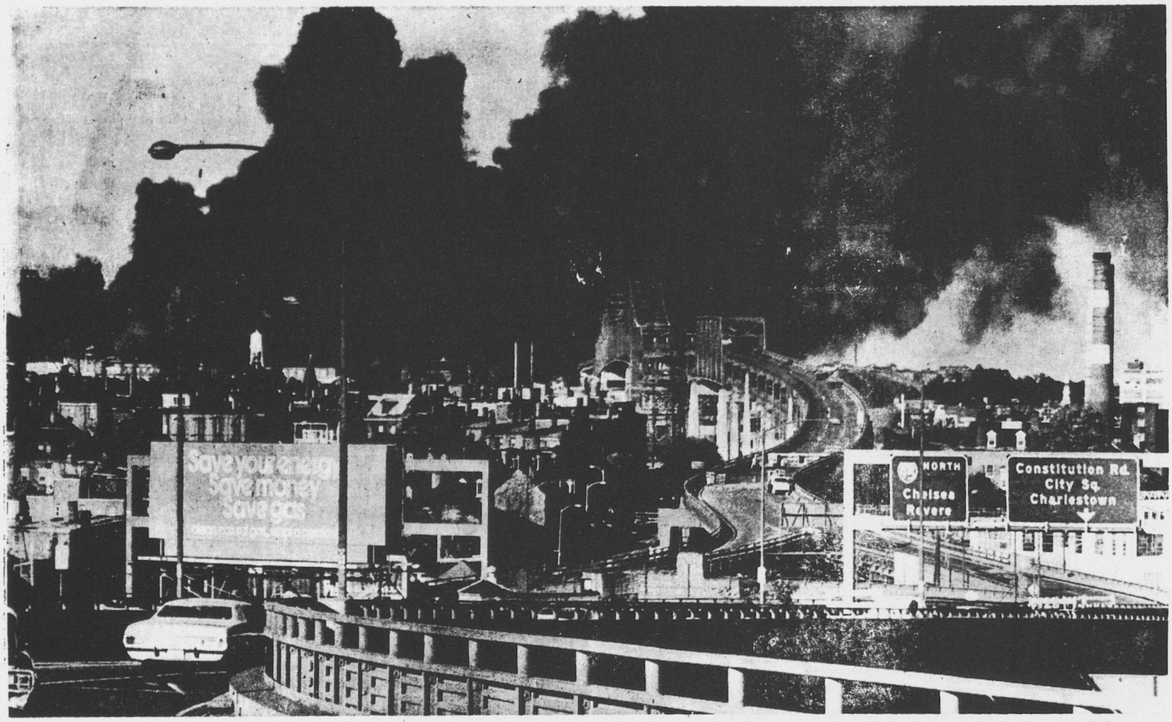
LATE COMPLETE

80 Area Communities Send in Firefighters

Billows of Smoke Seen for 50 Miles

Blaze Raged 7 Hours Before Being Held

'Hurricane' Fire Destroys 18 Blocks of Chelsea



DENSE SMOKE FROM CHELSEA FIRE billows across a miles-long front as shown in this dramatic photo taken from Boston side of the Tobin Bridge. Lower level of bridge was opened for emergency vehicles.
Staff Photo by M. Leo Tierney

1973 OCTOBER 1973

S	M	T	W	T	F	S
14	15	16	17	18	19	20
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28	29	30	31			

1973 NOVEMBER 1973

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The Story in Pictures, Page 3—Other Stories Pages 2, 4, 5, 6, 7

A fire of "historic proportions" raged through the southwest quarter of Chelsea last night, destroying hundreds of homes and businesses, damaging city hall and threatening the entire downtown business district.

The monumental blaze broke out at 3:56 p. m. in a vacant building at Second and Summer sts. and raged through 30 city blocks, destroying 18 of them and damaging 12 others in the congested area north of Boston Harbor.

The conflagration, of undetermined origin, roared out of control some seven hours before being contained shortly before midnight. Mayor Philip Spelman said at a press conference early this morning that 20 percent of the city was destroyed.

Unofficial damage estimates varied up to a high of $500 million.

In one of the most epic battles against fire in memory, firefighters from some 80 communities within a 70-mile radius of Chelsea responded, including departments from Rhode Island and New Hampshire.

The conflagaration—reported to be one of the worst in Greater Boston history—was being fed by stormy northwesterly winds, according to Chelsea Fire Chief Herbert Fothergill.

It was the second major fire disaster to strike the city this century, the other coming on Palm Sunday, April 12 in 1908 and leaving 18 dead and 17,000 homeless.

More than 50 firefighters were overcome by smoke yesterday and others suffered other injuries fighting the general alarm fire. Chelsea Fire Lt. Charles Crowley was in the intensive care unit at Chelsea Memorial Hospital early today, suffering from smoke inhalation.

(Continued From Page Two)

STAFF ON THE JOB

Herald American staff reporters and writers who covered the Chelsea fire were Richard Lamere, George Briggs, Paul Corsetti, John McGinn, Bob Killam, Earl Marchand, Jim Droney and Jack Cadigan.

Staff photographers covering the conflagration were Stanley Forman, Frank Hill, Leo Tierney, Gene Dixon and John Gillespie.

Victims Watch in Disbelief

Hundreds of Chelsea residents driven from their homes by the smoke and flames of the conflagration, gathered in Pvt. Max Address sq. on Everett st., under the approach to the Maurice J. Tobin Memorial Bridge.

They watched in horror and disbelief as block after block of industries and homes caught fire, flared up in columns of smoke and flame, and were left blackened and crumbled as the gusts of winds moved the fire ahead.

Matthew Sobolewski, 60, of 127 Spruce st. lived in one of the homes destroyed. He said he and his wife, Winifred, were lucky to get out when they did because the fire was moving so swiftly

"Mine was one of the first homes to go," he sobbed. "Winifred and I were just sitting down to Sunday dinner when sparks got the outside of the house going.

"Someone — I don't know who it was — banged on my front door and said our house was on fire.

"My wife, our dog and I got out, but I had to leave behind my parrot, three hens, my aquarium and all the money I had. I have

(Continued on Page Two)

Armory Houses Refugee Center

The Red Cross Disaster Service set up its headquarters at the National Guard Armory on Spencer ave. to care for persons driven from their homes by the fire.

More than 200 evacuees, mostly elderly persons or small children, were accommodated at the armory. Others were given shelter at the Knights of Columbus Hall, St. Rose School, St. Andrew's Social Club and the Soldier's Home.

Most had fled with few, if any, personal belongings.

The Red Cross had some 150 volunteers on the scene, according to Morris Mewnan of Newton, the shelter manager. Cots were set up and food was distributed.

The unit was in operation by 5 p.m., Mewnan said.

Volunteers for the Red Cross came from as far away as Nashua, N.H.

(Continued on Page Four)

- Removing logs, ice, and other debris that are blocking rivers and streams and could cause flooding.
- Repairing and restoring federal and nonfederal flood control and shore protection works damaged by flood, wind, or waves.
- Snagging and clearing channels affected by storms.
- Providing temporary housing for disaster victims.
- Providing technical assistance, such as ways to clear ice jams or strengthen dikes.

When requested by the Federal Emergency Management Agency, the Corps can also assess municipal damage and prepare damage survey reports, rebuild structures such as dikes and seawalls, and remove debris from public property.

Contaminated Water/Drought Assistance

The Corps provides emergency provisions of clean drinking water to communities confronted with contaminated water supplies or drought that could cause substantial threats to public health and welfare.

Water contamination can occur from deliberate, accidental, or natural events, such as flooding. For communities with contaminated water, the Corps provides water tank trucks that haul water from safe sources to points established for local distribution. If feasible, the Corps also lays temporary aboveground water lines, installs temporary filters, and provides mobile purification units.

For drought, the Corps can construct wells and transport water by truck or pipeline to farmers, livestock, and others within the distressed areas. Assistance can be provided when either life or property is threatened.

Because serious drought conditions could create water shortages for many small communities near Corps reservoirs, the Corps has developed drought contingency plans for 28 of its reservoirs in New England. During a drought emergency, the Corps, upon request from state officials, can partially fill a reservoir for emergency water supply purposes.

Requests for emergency supplies of clean drinking water resulting from either water contamination or drought are considered separately from flood and coastal storm emergency activities.

Other Programs and Services

The Corps of Engineers supports its projects with various programs and provides technical assistance on water resource activities to other federal agencies and the New England states. Some of these services are listed below.

Water Quality Control Program

To ensure the continued health and safety of the public, the Corps conducts an extensive water quality monitoring and testing program at each of its 31 reservoirs in New England. Under this service, called the Water Quality Control Program, the Corps periodically samples and analyzes reservoir waters to ensure they meet state water quality standards and are suitable for water supply, recreation, or other purposes. This information also helps to detect pollution problems.

Water Quality Control Program activities at Corps projects include:

- Testing drinking wells and beach areas for bacterial contamination;
- Monitoring the effects of acid rain in lakes, ponds, and woodlands;
- Monitoring high aluminum levels that might threaten aquatic life;
- Identifying sources of pollution that affect water quality; and
- Ensuring that the ecosystems of reservoirs are maintained.

Water Resource Planning Assistance to States

In preparing and developing their own comprehensive water resource plans, states will occasionally need to borrow the Corps' planning expertise. Recent activities conducted by the Corps at the request of states include:

—Identifying industrial and commercial water consumption from public water supply systems;

—Developing land use mapping from satellite imagery;

—Conducting an inventory of coastal structures, such as piers, wharves, and groins, at major ports; and

—Evaluating the amount of water that can be consistently and safely removed from reservoirs.

Aquatic Plant Control

Aquatic plants, such as pond lilies, algae blooms, waterweed, duckweed, and water milfoil, can sometimes threaten shipping and trade in navigable waterways. The Corps' Aquatic Plant Control Program combats widespread plant problems in navigable and other waters of the United States.

In addition to navigational interests, the Aquatic Plant Control Program can be utilized to control aquatic plant growths threatening flood control and drainage,

The Corps periodically samples and analyzes water at each of the 31 dams it operates in New England to ensure water quality standards remain high. Right, a laboratory technician at the Corps' Water Quality Lab in Barre, Massachusetts, monitors water at the Barre Falls Dam.

The Corps' Aquatic Plant Control Program limits plant problems threatening navigable waterways, drainage, and fish and wildlife. Hardys Pond in Waltham, Massachusetts, is an example of how excessive aquatic plant growth can limit the productive use of a pond.

fish and wildlife, agriculture, or public health. The program can also be administered to benefit scientific research.

Permits Program

The Corps of Engineers has a mandate to protect navigation by regulating construction by others in navigable waterways. This activity falls under the Corps' Permits Program.

Section 404 of the Clean Water Act, as well as related decisions by federal courts, have greatly broadened the Corps' regulatory authority to include the discharge of dredged or fill material into "waters of the United States," a term that includes certain wetlands and other valuable aquatic areas. Section 404 requires that the public be notified and public hearings be held before a permit is issued.

The Permits Program now focuses primarily on weighing the economic and environmental benefits of development against preserving the ecosystem when deciding whether a permit for a proposed activity would be contrary to the public interest. When reviewing permit applications, the Corps looks at all the relevant factors, including economics, fish and wildlife conservation, wetland values, environmental concerns, flood damage reduction, navigation, shore erosion, recreation, public safety, water quality, and the general welfare of the public.

The Corps has introduced a number of nationwide permits which require little or no processing, and taken other measures to streamline the permit application process while maintaining environmental safeguards.

Corps/EPA Wastewater Treatment Construction Grants Program

The Environmental Protection Agency (EPA) frequently gives municipalities grants to construct wastewater treatment facilities. The Corps and the EPA have a joint agreement whereby the Corps offers varying degrees of technical assistance to the six New England

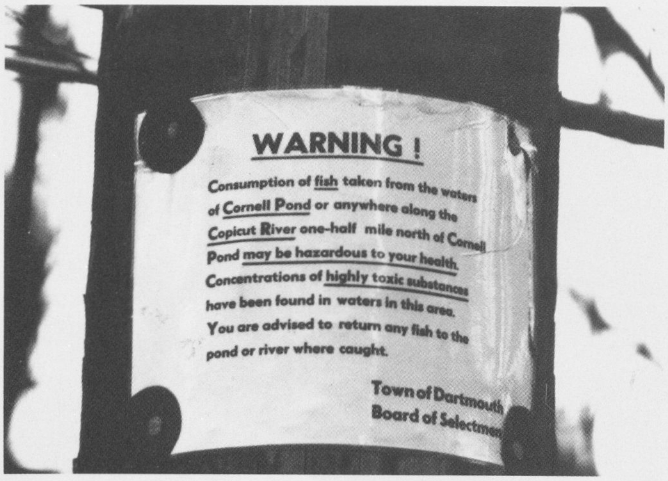
ARE WETLANDS IMPORTANT?

Some people consider wetlands, such as swamps, bogs, and marshes, areas to be filled or drained rather than conserved. However, most wetlands have value and play an important role in the ecological balance of nature. Under its Permits Program, the Corps gives special consideration to proposed construction in wetland areas, recognizing that healthy wetlands are important and productive natural resources that make significant contributions to our quality of life.

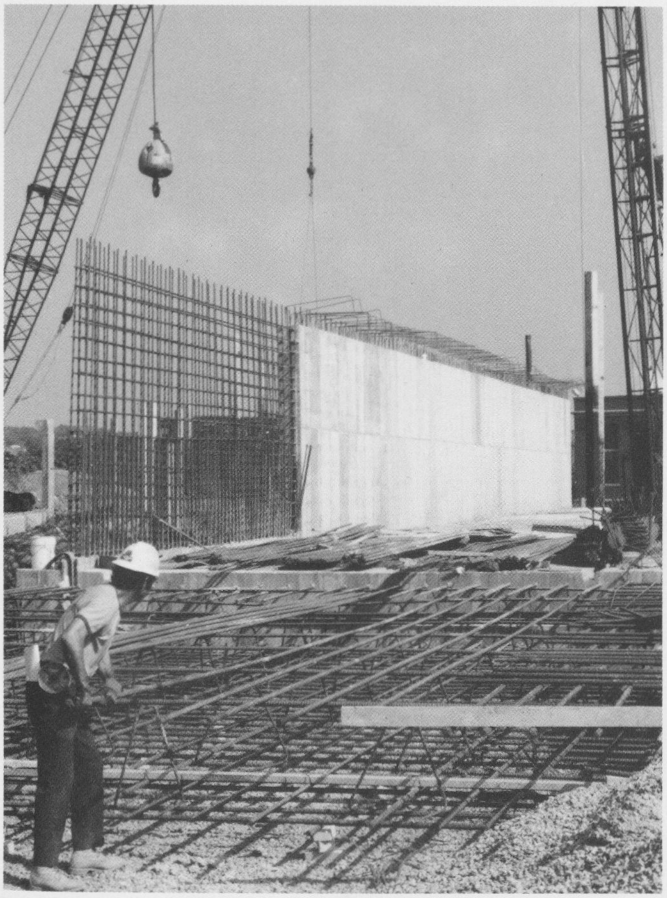
Wetlands provide a food chain resource and habitat for an abundance and diversity of life not rivaled by most other types of environments. They are breeding, spawning, feeding, cover, and nursery areas for fish. They are important nesting, migrating, and wintering areas for ducks and geese. Wetlands may not yield their crop directly to the people, but their yield is reflected in the abundance of finfish, shellfish, and waterfowl.

Wetlands are beneficial in other ways as well. They serve as buffer areas that protect the shoreline from erosion and storm damage. They act as natural water storage areas during floods and storms by retaining high waters and gradually releasing them, thereby reducing damaging effects. Wetlands contribute to the production of agricultural products and timber. Freshwater wetlands may infiltrate and help recharge underlying or nearby aquifers, often the source of local drinking water. Wetlands also purify water by filtering pollutants.

The Corps recognizes the prominent role wetlands have in our ecology and places special consideration on their value when making permit decisions.



Cleaning chemical spills at hazardous waste sites is a team project between the Corps and the EPA. An area identified as a hazardous waste location was this site in Dartmouth, Massachusetts, near Cornell Pond and the Copicut River.



Under an agreement with the EPA, the Corps offers technical assistance to those New England states that are building wastewater treatment facilities. This facility, in Lynn, Massachusetts, was completed in February 1985.

states regarding the proper construction of these facilities. The Corps has helped EPA construct 70 wastewater treatment plants in New England.

Upon request by the EPA, the Corps assists the states by providing construction management services, which includes preconstruction reviews, progress inspections during the construction period, and administrative and accounting assistance when construction is completed. The extent of Corps' participation in the construction of each wastewater treatment facility varies according to the respective state's resources and specific needs.

Hazardous Waste

The Corps and the EPA are also tackling another major environmental project: the cleanup of chemical spills in the country's most hazardous waste sites. This program is better known as "Superfund."

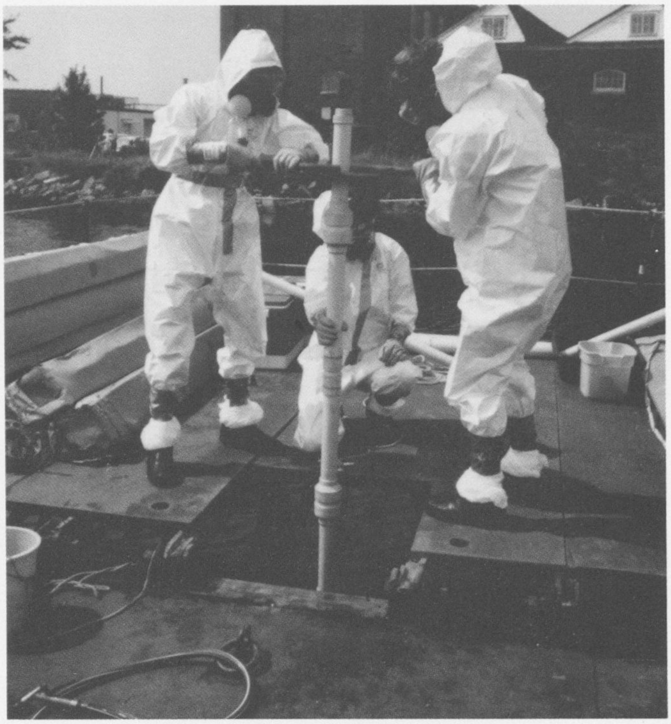
Specifically, the Corps manages the design and construction of cleanup sites that are assigned to it by the EPA. EPA identifies sites and selects the most hazardous locations for priority action. Once a site is selected, the Corps prepares design and construction contracts for private industry, which does the actual design and construction work under Corps' supervision. Once complete, projects are transferred to EPA which turns them over to states for operation and maintenance.

Other Superfund support provided by the Corps to the EPA includes:

—Technical assistance to ensure that remedial action at selected hazardous waste sites can be performed. Among some of the remedial actions that may be employed by the Corps at Superfund locations are incineration, sanitary landfills, deep well injection, land disposal, excavation and burial, and chemical or biological treatment.

—Development of health and safety plans at the site.
—Environmental monitoring during the construction of remedial measures.

Materials dumped at sites range from petroleum byproducts to toxic chemicals to explosives. Because of the danger that these materials may leak into the soil and nearby drinking water, the Corps considers its work in the Superfund Program to be among its most important.



The cleanup of hazardous waste sites is an important environmental priority of the Corps and the EPA. In the case of New Bedford Harbor in Massachusetts (above), sediment is collected from the harbor floor and tested to determine the volume of PCBs and other contaminants. Gauging the volume and location of these contaminants is a first step toward eventual cleanup.

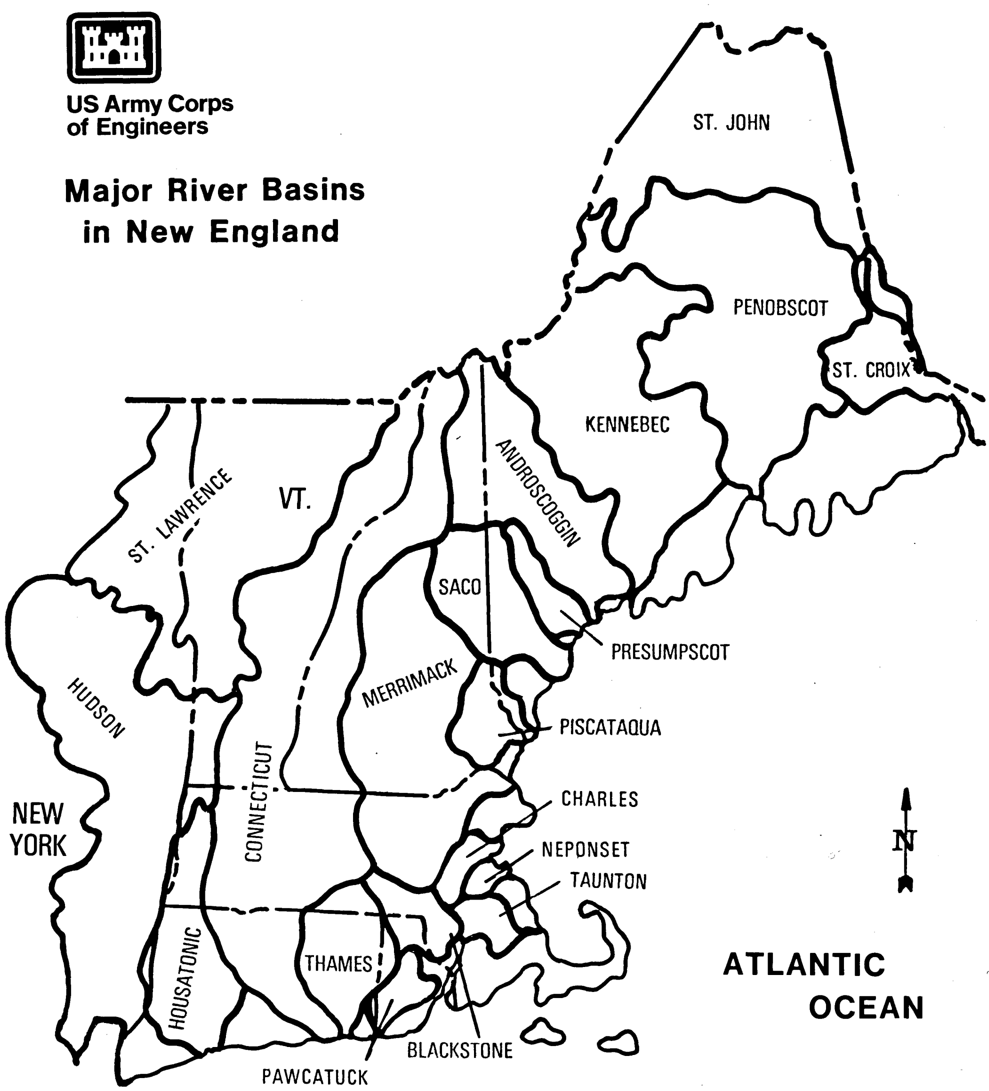
Description of Projects

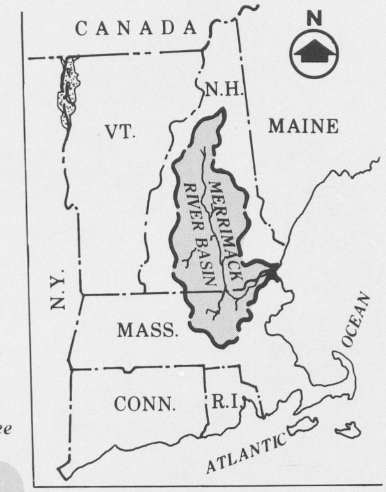
River Basins

Flooding may be caused by a combination of many factors related to the underlying river basin. Corps' Flood Damage Reduction projects, such as dams and Local Protection Projects, are designed and constructed as part of an overall plan to limit flooding in a particular river basin.

There are 19 principal river basins that lie entirely or partially in New England. Of this number, five lie in New Hampshire—the Connecticut, Merrimack, Androscoggin, Saco, and Piscataqua. Three of these basins—the Connecticut, Merrimack, and Piscataqua—have Corps' Flood Damage Reduction projects within their drainage areas. New Hampshire's 9304 square miles ranks third in New England, behind Maine's 33,215 and Vermont's 9609.

The following pages show where the five river basins lie in the state. Maps of the Connecticut, Merrimack, and Piscataqua River Basins show the location of Corps' Flood Damage Reduction projects in each.

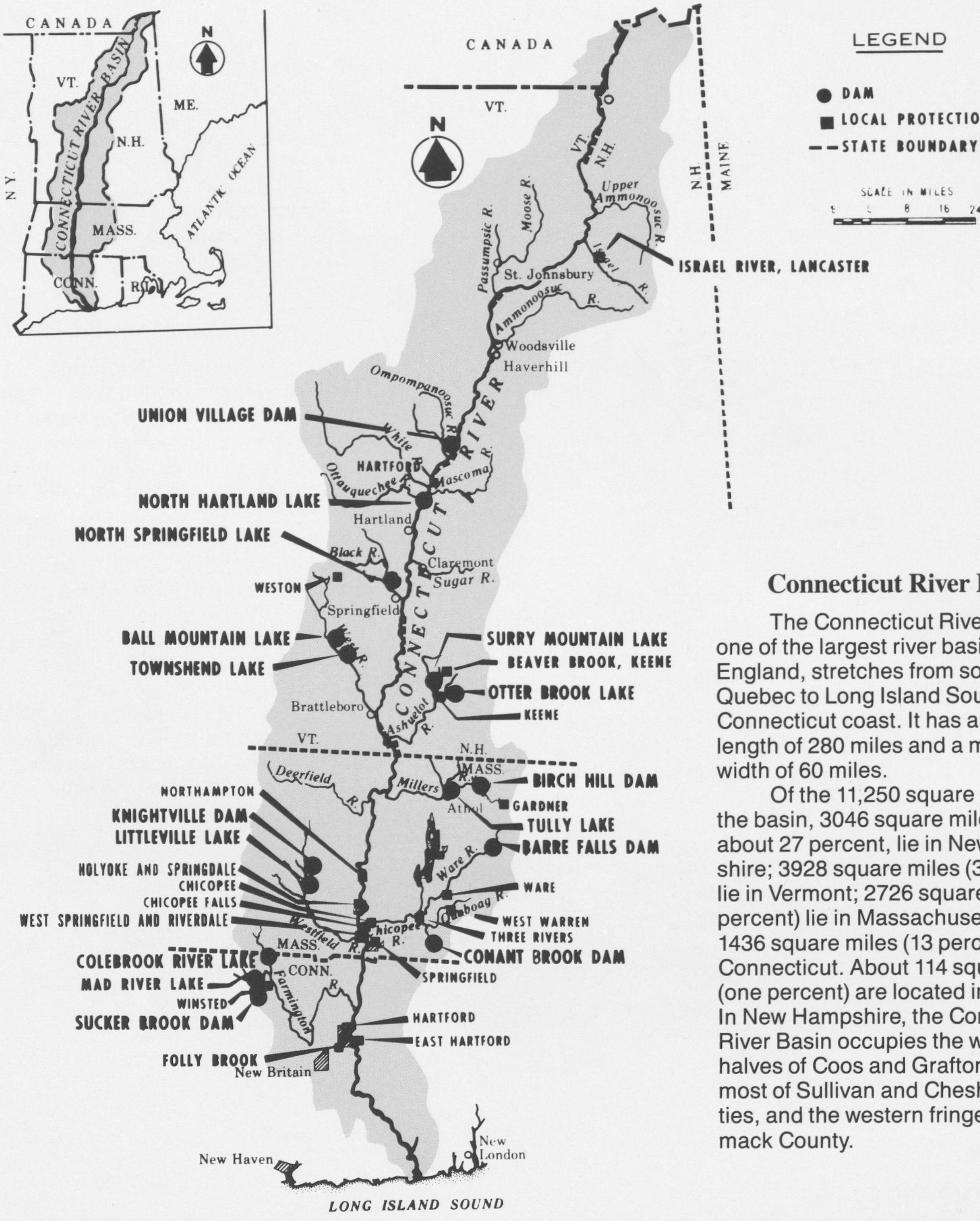




Merrimack River Basin

The Merrimack River Basin extends from the rugged White Mountain region of northern New Hampshire to northeastern Massachusetts. It has a maximum length of 134 miles and a maximum width of 68 miles.

The basin's 5010 square miles make it the fourth largest river basin in New England. About 3810 square miles (76 percent) lie in New Hampshire, and 1200 square miles (24 percent) lie in Massachusetts. The Merrimack River Basin covers parts of every county (except Coos) in New Hampshire, including all of Hillsborough and Belknap Counties, most of Merrimack County, and western sections of Rockingham County.



Connecticut River Basin

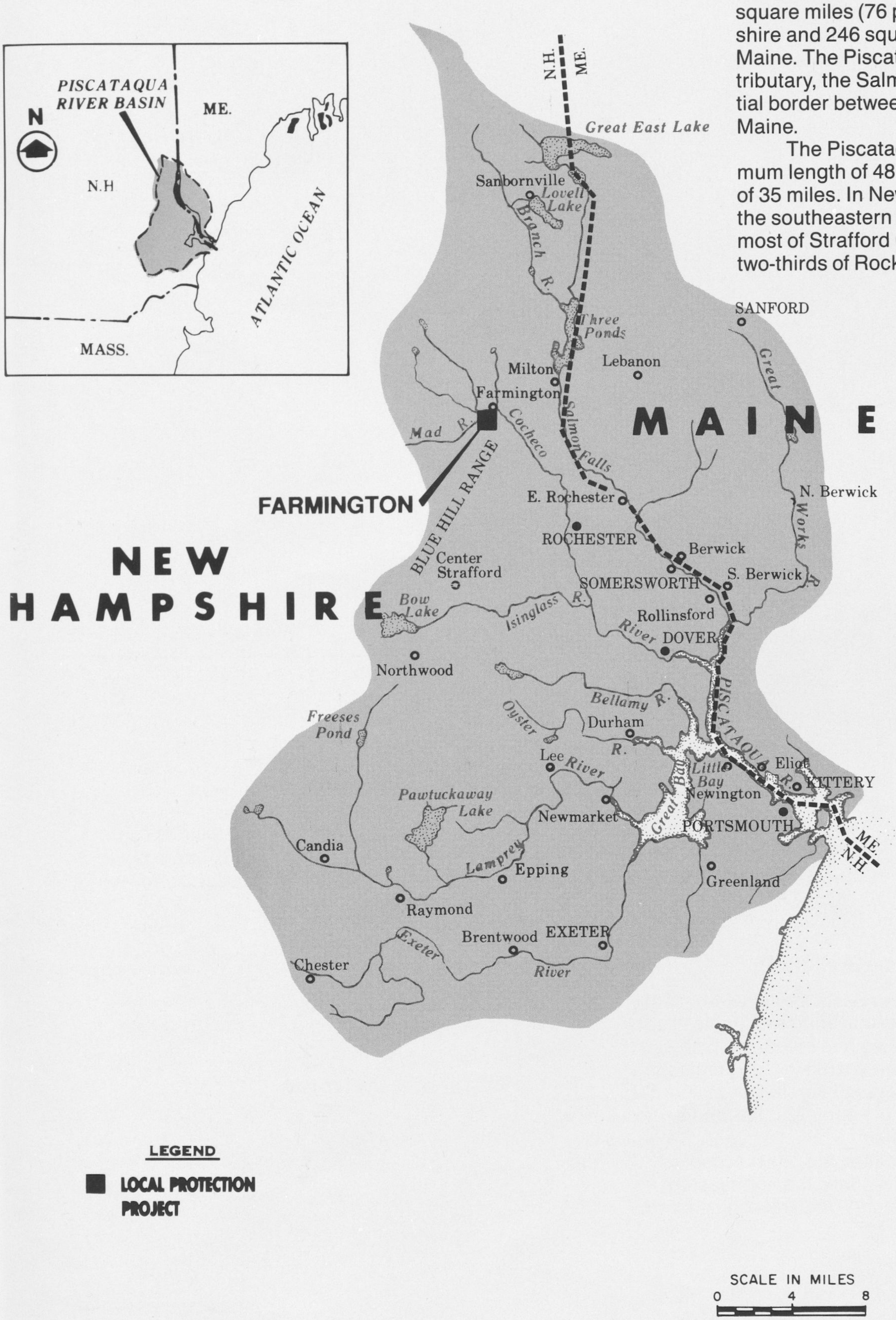
The Connecticut River Basin, one of the largest river basins in New England, stretches from southern Quebec to Long Island Sound, off the Connecticut coast. It has a total length of 280 miles and a maximum width of 60 miles.

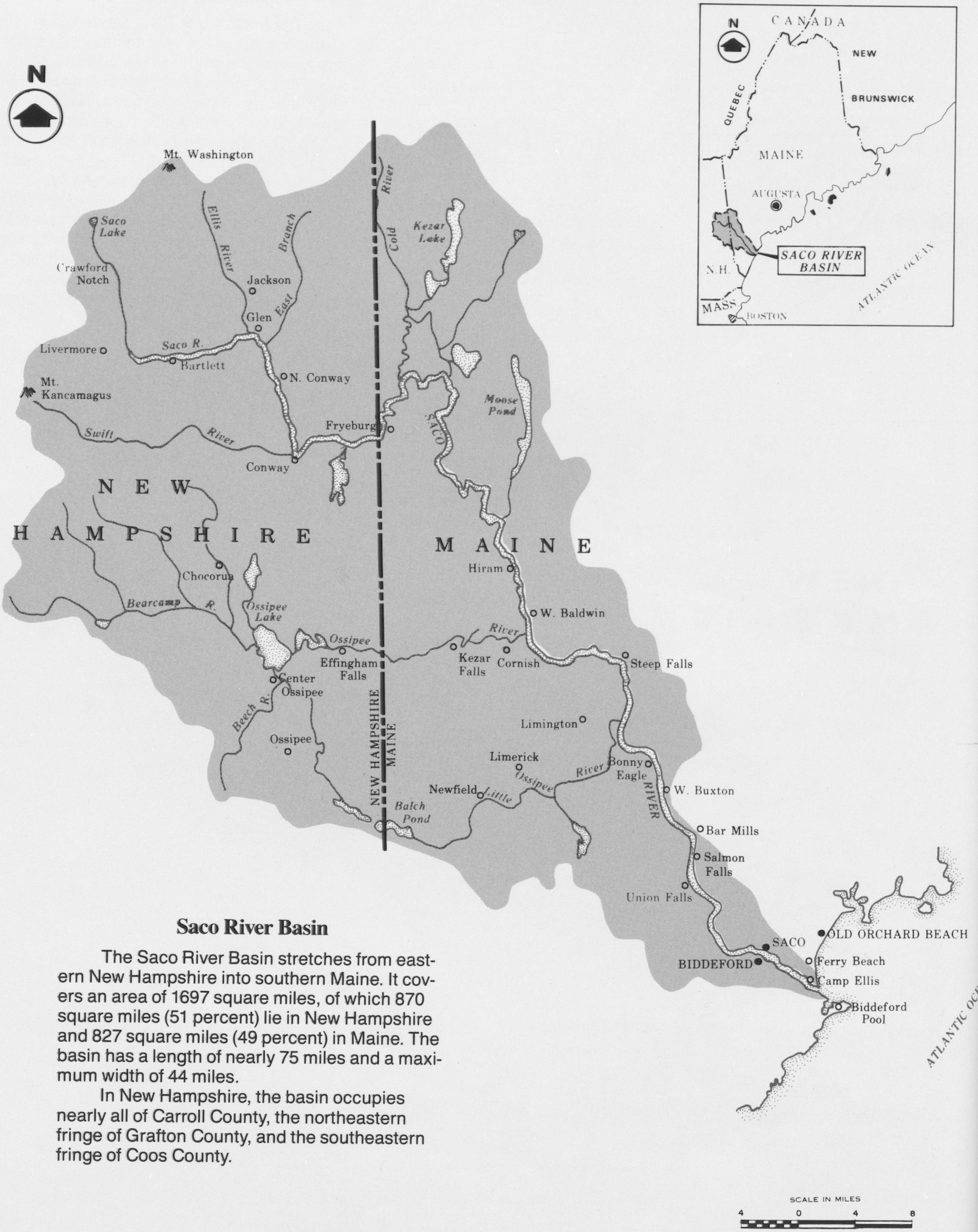
Of the 11,250 square miles in the basin, 3046 square miles, or about 27 percent, lie in New Hampshire; 3928 square miles (35 percent) lie in Vermont; 2726 square miles (24 percent) lie in Massachusetts; and 1436 square miles (13 percent) lie in Connecticut. About 114 square miles (one percent) are located in Quebec. In New Hampshire, the Connecticut River Basin occupies the western halves of Coos and Grafton Counties, most of Sullivan and Cheshire Counties, and the western fringe of Merrimack County.

Piscataqua River Basin

The Piscataqua River Basin lies mostly in southeastern New Hampshire, with a portion lying at the southern tip of Maine. Of the basin's total area of 1022 square miles, 776 square miles (76 percent) lie in New Hampshire and 246 square miles (24 percent) lie in Maine. The Piscataqua River and its largest tributary, the Salmon Falls River, form a partial border between New Hampshire and Maine.

The Piscataqua River Basin has a maximum length of 48 miles and a maximum width of 35 miles. In New Hampshire, it occupies the southeastern corner of Carroll County, most of Strafford County, and the northern two-thirds of Rockingham County.

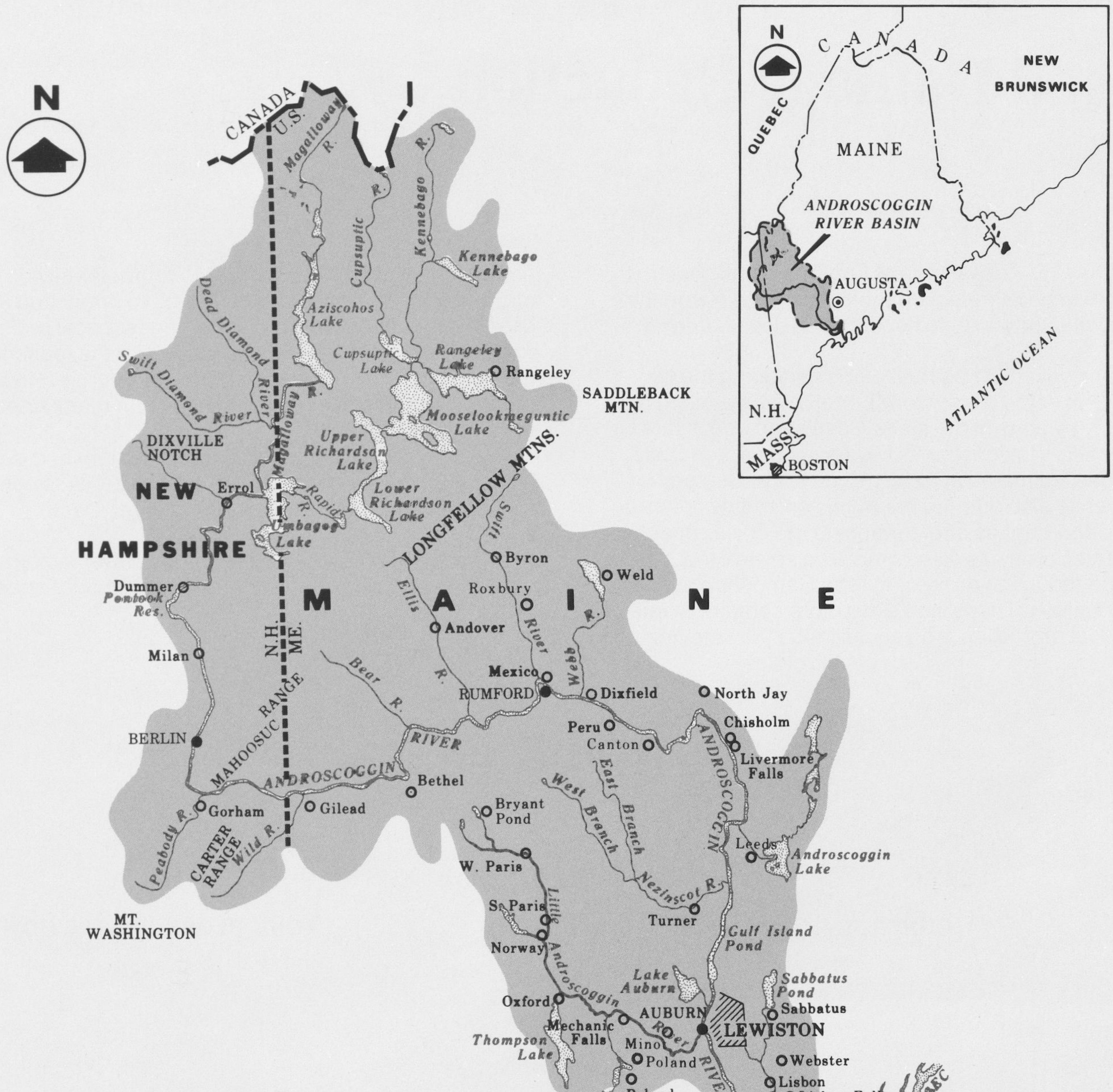




Saco River Basin

The Saco River Basin stretches from eastern New Hampshire into southern Maine. It covers an area of 1697 square miles, of which 870 square miles (51 percent) lie in New Hampshire and 827 square miles (49 percent) in Maine. The basin has a length of nearly 75 miles and a maximum width of 44 miles.

In New Hampshire, the basin occupies nearly all of Carroll County, the northeastern fringe of Grafton County, and the southeastern fringe of Coos County.



Androscoggin River Basin

The Androscoggin River Basin, which lies partly in northeastern New Hampshire and partly in western Maine, begins at the Canadian border and stretches to the Atlantic Ocean. It occupies 3450 square miles, with 2730 square miles (79 percent) lying in Maine and 720 square miles (19 percent) in New Hampshire.

The basin has a maximum length of 110 miles and a maximum width of 65 miles. In New Hampshire, the Androscoggin River Basin covers nearly half of Coos County.

SCALE IN MILES

4 0 4 8 12

Flood Damage Reduction

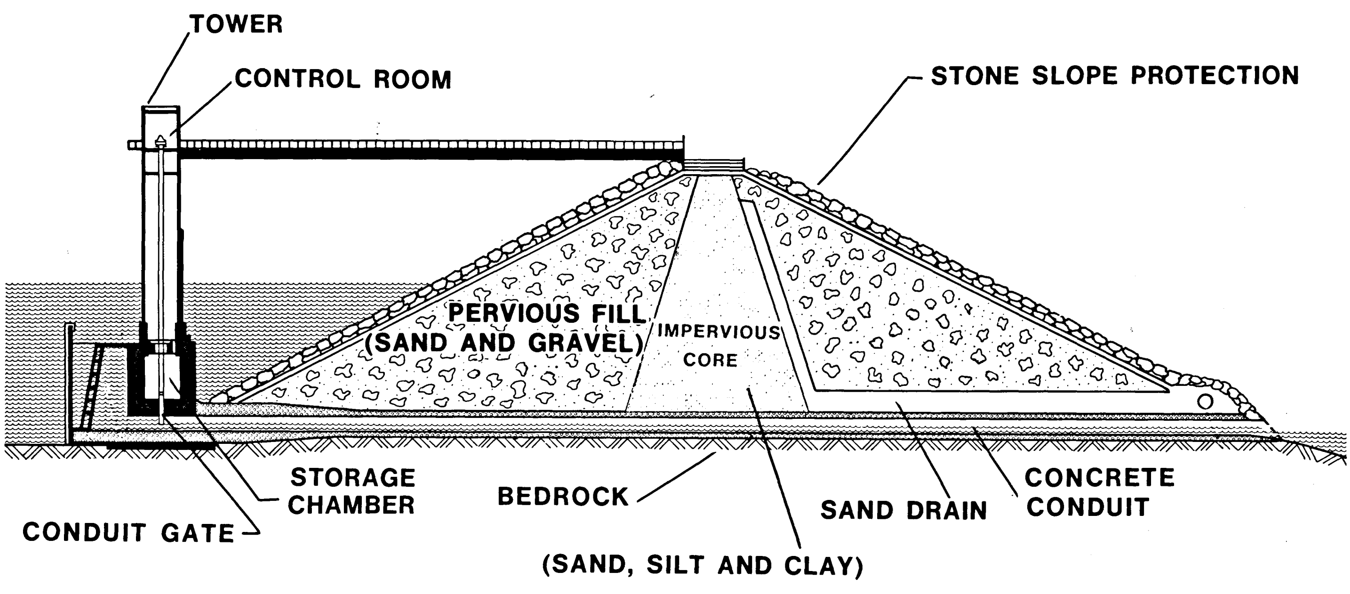
The U.S. Army Corps of Engineers has constructed 13 flood damage reduction projects in New Hampshire that significantly reduce flooding and associated damages.

The seven Corps-built dams (including the two dams built at the Hopkinton-Everett Lakes project) protect wide regions of the state. Costing an aggregate $39.9 million to construct, they have prevented flood damages estimated at $200 million (as of September 1989) while also offering the public a variety of recreational opportunities and enhancing the environment.

The Corps has also completed seven other flood damage reduction projects in New Hampshire at a cost of $3.7 million. These works are more commonly referred to as local protection projects because they provide flood protection to specific communities rather than wide areas of a state. In New Hampshire, they have prevented an estimated $1.9 million in flood damages. Local protection projects are operated and maintained by the respective municipalities, except for the Israel River project in Lancaster, which is operated by the town but maintained by the Corps of Engineers.

The following pages give a brief history and description of the flood damage reduction projects constructed by the Corps in New Hampshire.

Note: Figures given for damages prevented by each flood control project are estimated through September 1989.



TYPICAL CROSS SECTION OF AN EARTHFILL DAM

Flood Damage Reduction Projects in New Hampshire

Dams and Reservoirs

Blackwater Dam in Webster

Edward MacDowell Lake in Peterborough

Franklin Falls Dam in Franklin

Hopkinton/Everett Lakes in Hopkinton and Weare

Otter Brook Lake in Keene

Surry Mountain Lake in Surry

Local Protection Projects

Beaver Brook, Keene

Cocheco River, Farmington

Israel River, Lancaster

Keene

Lincoln

Nashua

Stony Brook, Wilton

Dams and Reservoirs

Blackwater Dam in Webster

Edward MacDowell Lake in Peterborough

Franklin Falls Dam in Franklin

Hopkinton/Everett Lakes in Hopkinton and Weare

Otter Brook Lake in Keene

Surry Mountain Lake in Surry

Blackwater Dam

Location:

Blackwater Dam in Webster is located on the Blackwater River, about 18 miles northwest of Concord. From Concord, it can be reached by taking U.S. Route 93 to U.S. Route 4 west, then south on Route 127.

Purpose:

Blackwater Dam significantly reduces flooding in the downstream communities on the Blackwater and Contoocook Rivers, including Webster, Hopkinton, and Boscawen. In conjunction with the Franklin Falls Dam (page 58) and the dams at Hopkinton and Everett Lakes (page 60), Blackwater Dam also reduces flooding in the major industrial, commercial, and residential centers on the Merrimack River, including Concord, Manchester, and Nashua, and the Massachusetts cities of Lowell, Lawrence, and Haverhill. Since its completion, Blackwater Dam has prevented an estimated $15.3 million in flood damages, including $6.1 million during the heavy rains of April 1987.

History:

Construction of Blackwater Dam began in May 1940 and was completed in November 1941 at a cost of $1.3 million. The work included relocating about three miles of Route 127 and constructing smaller roads adjacent to the project.

Description:

The project consists of:

—An earthfill dam with stone slope protection. The dam is 1150 feet long with a maximum height of 75 feet.

—Two earthfill dikes with stone slope protection totalling 1650 feet. Little Hill Dike, located about three miles northwest of the dam, is 1230 feet long and has a maximum height of 28 feet; and Dodge Dike, situated about .5 mile west of the dam, is 420 feet long with a maximum height of 20 feet.

—Three gated rectangular conduits. Each conduit measures five feet three inches high, three feet six inches wide, and 65 feet long. A fourth ungated rectangular conduit was permanently plugged in 1951 to increase the effectiveness of the reservoir during flood periods.

—A spillway cut in rock with a 240-foot-long concrete weir. The weir's crest elevation is 18 feet lower than the top of the dam.

Additional Information:

There is no lake at Blackwater Dam. The flood storage area of the project, which is normally empty and only utilized to store floodwaters, covers approximately 3280 acres and extends upstream about seven miles through Salisbury, having a maximum width of one mile. The entire project, including all associated lands, covers 3580 acres. Blackwater Dam can store up to 15 billion gallons of water for flood control purposes. This is equivalent to 6.7 inches of water covering its drainage area of 128 square miles.

The Corps has issued a license to the New Hampshire Department of Resources and Economic Development to conduct a forestry and fish and wildlife management program on 3475 acres of reservoir lands. A 10-mile section of the Blackwater River meanders through the project area and offers a pristine streamside environment popular with canoeists. Reservoir lands also offer a 19-mile-long snowmobiling trail network that is also used for hiking, horseback riding, and cross-country skiing. The Blackwater River is heavily stocked with rainbow and brown trout by the state and supports self-sustaining brook trout, perch, bass, panfish, and brown bullhead. There is in-season hunting and/or trapping for state-stocked pheasant, as well as black bear, deer, partridge, raccoon, fox, fishercat, and rabbit. Duck hunting is permitted at Greenough Pond, a 40-acre marshy area located within the project area.

Blackwater Dam

Edward MacDowell Lake

Location:

The dam at Edward MacDowell Lake is located on Nubanusit Brook in Peterborough, about 14 miles east of Keene. From Nashua, the dam can be reached by taking U.S. Route 3 to Route 101A west (which turns into Route 101) through Peterborough. Continue on Route 101 for about two miles and follow signs to the dam.

Purpose:

Edward MacDowell Lake provides flood protection primarily to Peterborough. The project also provides flood protection to the downstream communities of Hancock, Bennington, Antrim, Deering, Hillsboro, and Henniker, all on the Contoocook River. Since its completion, the dam at Edward MacDowell Lake has prevented an estimated $6.9 million in damages, including $1.8 million during the heavy rains of April 1987, when the flood storage area behind the dam was filled to capacity. During this storm, excess water had to be discharged through the spillway.

History:

Construction of the dam began in March 1948 and was completed in March 1950 at a cost of $2 million.

Description:

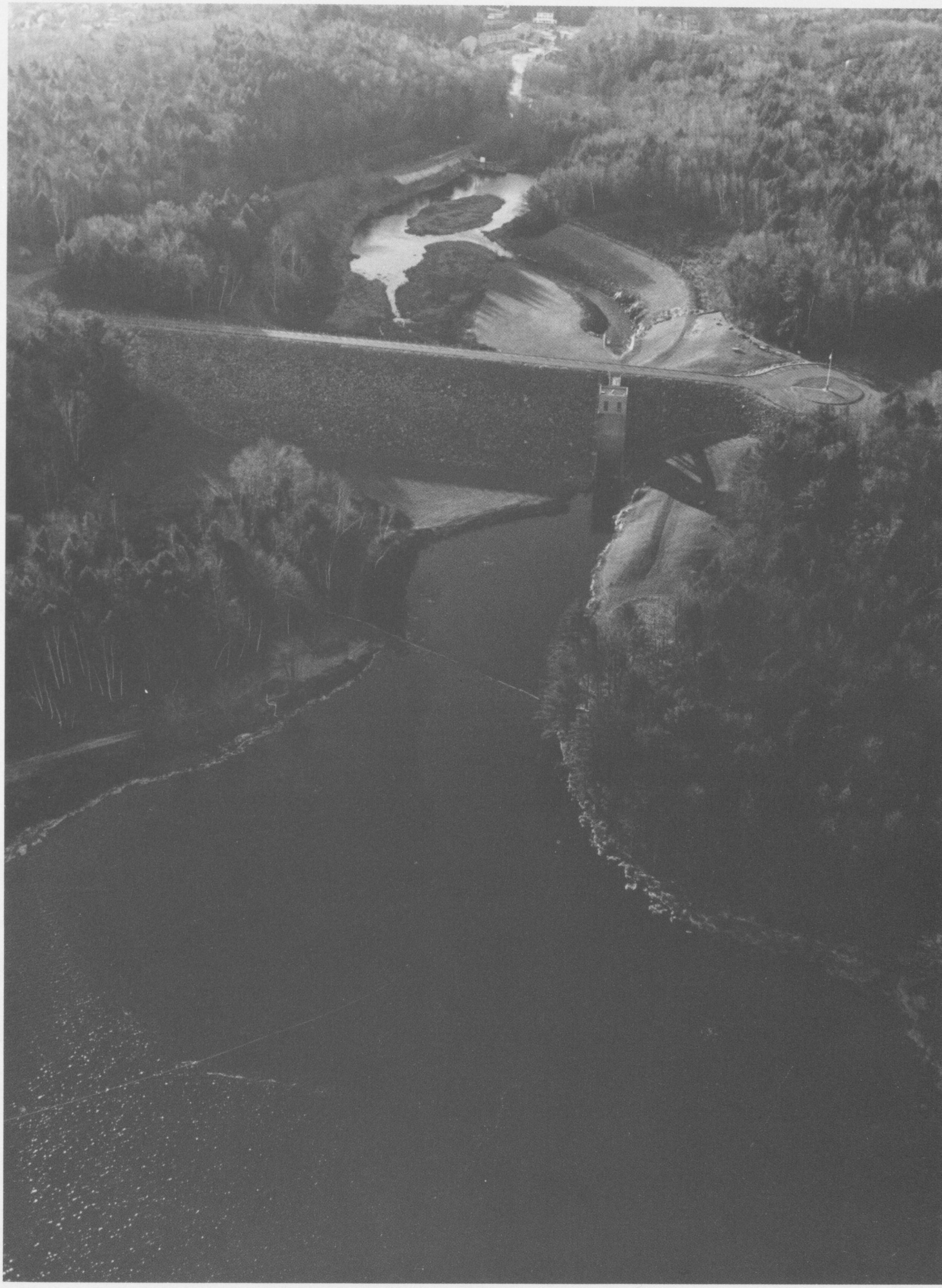
Edward MacDowell Lake consists of an earthfill dam with stone slope protection 1100 feet long and 67 feet high; a gated concrete conduit, seven feet high, seven feet wide, and 275 feet long; and a chute spillway cut in rock. The spillway at Edward MacDowell Lake is unusual in that instead of being located adjacent to the dam as most spillways are, it is located 3.2 miles northeast of the dam, at Halfmoon Pond. The spillway has a concrete weir 100 feet long with a crest elevation 21 feet lower than the top of the dam. Discharges from the spillway flow from Halfmoon Pond into Ferguson Brook which, in turn, discharges into the Contoocook River.

Additional Information:

There is a conservation pool at Edward MacDowell Lake covering an area of 165 acres and having a maximum depth of about seven feet. The flood storage area of the project, which is normally empty and utilized only to store floodwaters, totals 840 acres and covers parts of Hancock, Dublin, and Harrisville. The lake and all associated project lands cover 1469 acres. Edward MacDowell Lake can store almost 4.2 billion gallons of water for flood control purposes. This is equivalent to 5.4 inches of water covering its drainage area of 44 square miles.

The Corps operates a small picnic area at the top of the dam with seven picnic tables and 11 fireplaces. However, most of the reservoir lands (1030 acres) are licensed by the Corps to the New Hampshire Department of Fish and Game, which conducts a fish and wildlife management program. Canoes, rowboats, and boats having motors of up to three horsepower are permitted on Edward MacDowell Lake. A stream that winds through Dinsmore Swamp, which is a 600-acre marshy area located on project lands, is particularly popular with canoeists. Project lands also offer trails for hiking and cross-country skiing; snowmobile trails; undeveloped open space for ball playing and other sporting activities; drinking water; and sanitary facilities.

Edward MacDowell Lake is stocked by the state with trout and bass. The three miles of Nubanusit Brook that wind through project lands offer warm water fishing for bass, pickerel, brown bullhead, and perch. Ice fishing is permitted. The state stocks pheasant for hunters, and there is in-season hunting and/or trapping for ruffed grouse, woodcock, beaver, deer, rabbit, fox, raccoon, fishercat, and mink.



Edward MacDowell Lake

Franklin Falls Dam

Location:

Franklin Falls Dam in Franklin is located on the Pemigewasset River, which joins with the Winnipesaukee River about three miles downstream to form the Merrimack River. From Concord, it can be reached by taking U.S. Route 93 to Route 127 south, or U.S. Route 3 to Route 127 north.

Purpose:

Franklin Falls Dam is a key unit in the comprehensive plan of flood damage reduction for the Merrimack River Basin. It provides flood protection to communities along the entire length of the Merrimack River, including Franklin, Northfield, Boscawen, Canterbury, Concord, and Bow. Along with Blackwater Dam (page 54) and the dams at Hopkinton and Everett Lakes (page 60), Franklin Falls Dam also reduces flooding in the principal industrial and residential centers on the Merrimack River, including Manchester and Nashua and the Massachusetts cities of Lowell, Lawrence, and Haverhill. Since its completion, Franklin Falls Dam has prevented flood damages estimated at $55.1 million.

History:

Construction on the project began in November 1939 and was completed in October 1943 at a cost of $7.9 million.

The work involved:

—Relocating a cemetery in Hill;
—Moving several homes on the floodplain in Hill to other locations;
—Demolishing several homes located on the floodplain in Hill; and
—Relocating about nine miles of Route 3A.

Description:

The project consists of an earthfill dam with stone slope protection 1740 feet long and 140 feet high; two gated horseshoe conduits, each 19 feet high, 22 feet wide, and 542 feet long; and a chute spillway founded on rock with a concrete weir 546 feet long. The weir's crest elevation is 27 feet below the top of the dam.

Additional Information:

Franklin Falls Dam has a permanent pool of 440 acres with a maximum depth of about seven feet. The flood storage area of the project, which is normally empty and is utilized only to store floodwaters, totals 2800 acres. This acreage extends about 12.5 miles upstream through the towns of Hill, Sanbornton, New Hampton, and Bristol, and ends at Ayers Island Dam in Bristol, which is owned by the Public Service Company of New Hampshire. The project and associated lands cover 3683 acres. Franklin Falls Dam can store up to 50.2 billion gallons of water for flood control purposes. This is equivalent to 2.8 inches of water covering its drainage area of 1000 square miles, which represents the largest drainage area upstream of the 35 dams built by the Corps' New England Division.

There are two hydroelectric power plants upstream of Franklin Falls Dam, within the reservoir area, that are owned and operated by private interests. One plant, Salmon Brook Station, is situated at the Giles Pond Dam on Salmon Brook in Franklin, approximately .75 mile from Franklin Falls Dam. This facility was built on Corps land and produces 0.2 megawatts of power, which is sold to the Public Service Company of New Hampshire. The second plant, Newfound Hydroelectric, is situated at the Newfound Hydroelectric Dam on the Newfound River in Bristol, approximately 11 miles upstream of Franklin Falls Dam. This facility, which lies on private property but discharges within the Franklin Falls reservoir area, produces 1.5 megawatts of power, which is also sold to the Public Service Company of New Hampshire. A third hydroelectric power facility, Eastman Falls Station in Franklin, is situated at Eastman Falls Dam, about 1.5 miles downstream of Franklin Falls Dam. Situated on private property, Eastman Falls Station is owned by the Public Service Company of New Hampshire. The 440-acre permanent pool behind Franklin Falls Dam is created by the backwaters of the Eastman Falls Dam, which requires this pool to generate power.

The Corps has issued a license to the New Hampshire Department of Resources and Economic Development to conduct a recreation, forestry, and fish and wildlife management program on 3682 acres of reservoir lands. Designated snowmobile trails, also used for hiking, cross-country skiing, and dog sled training, are available within the project. A 12.5-mile section of the Pemigewasset River flows through project lands, offering the public canoeing and other types of boating. The Pemigewasset River also offers cold water fishing and ice fishing for bass, pickerel, perch, brown bullhead, and occasionally salmon. Trout are stocked by the state in the Smith River in Bristol, near scenic Profile Falls, a popular spot with visitors located about eight miles north of the dam. For hunters, the state stocks pheasant and partridge, and in-season hunting and/or trapping is available for deer, raccoon, woodcock, fox, beaver, duck, and occasionally bear.

Franklin Falls Dam

Hopkinton-Everett Lakes

Location:

The dam at Hopkinton Lake, located on the Contoocook River in Hopkinton, and the dam at Everett Lake, located on the Piscataquog River in Weare, are connected by a two-mile-long canal and in moderate to severe flooding are operated as a single flood damage reduction project. From Concord, the dam at Hopkinton Lake can be reached by travelling on U.S. Route 89 north to Route 9 (and 202) west to Route 127 north. From Manchester, the dam at Everett Lake can be reached by taking either Route 114 west through the Riverdale section of Goffstown, then right along River Road for about five miles, or the Everett Turnpike to Route 101 west to Route 114 west to Route 13 north.

Purpose:

The Hopkinton-Everett Lakes project provides flood protection to residential, commercial, and industrial property downstream on the Contoocook and Piscataquog Rivers, which are tributaries of the Merrimack River. Hopkinton Lake protects the communities of Concord (including the Contoocook and Penacook sections), Boscawen, Canterbury, and Bow, while Everett Lake protects Manchester (including the Riverdale section) and Goffstown. Operating in conjunction with other Corps dams in the Merrimack River Basin, the project also helps protect major industrial centers along the Merrimack River, including Nashua and the Massachusetts communities of Lowell, Lawrence, and Haverhill. Since their construction, the dams together have prevented an estimated $47.2 million in flood damages. Of this amount, the dam at Hopkinton Lake has prevented $38.3 million, including $18.4 million during the heavy rains of April 1987. The dam at Everett Lake has prevented damages of $8.9 million, including $6.2 million during April 1987.

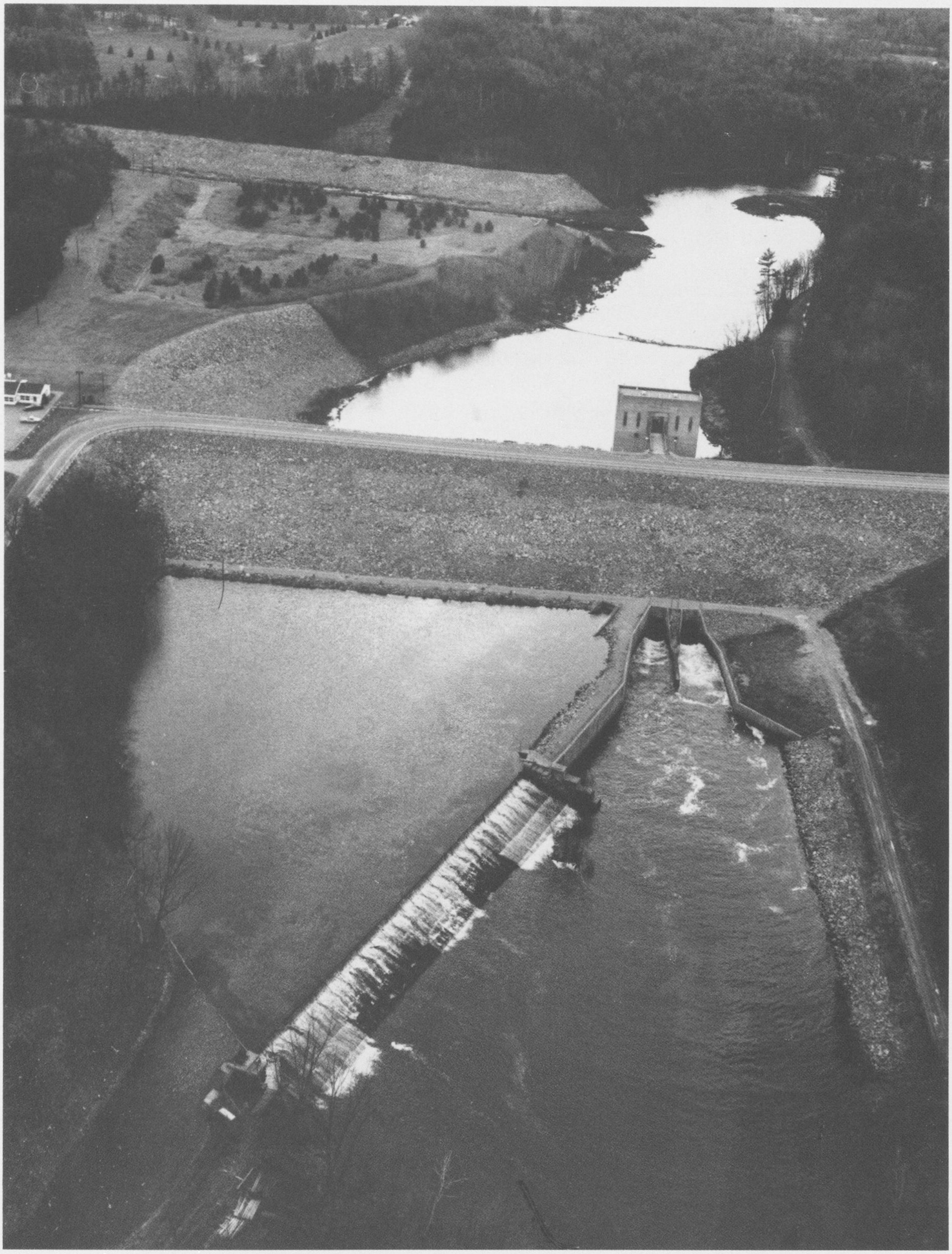
History:

In November 1927, New England rivers and streams, including the Merrimack River and its tributaries, went on a rampage. The resulting floods claimed several lives and caused serious flood damage. Less than nine years later, in March 1936, the worst flood in three centuries inundated the eastern and central United States. In New England, floodwaters claimed 24 lives, left 77,000 people homeless, and caused damage in New Hampshire and Massachusetts estimated at $36 million ($350 million in today's dollars).

As a result of this devastation, New Hampshire and Massachusetts soon initiated a comprehensive plan to reduce the Merrimack River Basin's disastrous flooding potential. In June 1938, Congress approved the construction of the Hopkinton-Everett dams as part of a coordinated system of flood control for the basin. When completed, the Hopkinton-Everett Dams would provide assurance that the horrors of the 1927 and 1936 floodwaters would not ravage communities in central and southern New Hampshire and northern Massachusetts. In September 1938, barely three months after Congress approved the project, the basin again suffered crippling flood losses when the most powerful hurricane ever to hit the region slammed into the northeast, overflowing riverbanks and causing widespread destruction. This storm served as a reminder that devastating floods could strike at any time and wreak havoc with lives and property.

Despite all good intentions, roadblocks soon appeared. One major problem revolved around reimbursement from Massachusetts to New Hampshire to compensate for the economic losses New Hampshire would incur by storing floodwaters behind the proposed dams.

It wasn't until 1957 that the state legislatures of New Hampshire and Massachusetts established the Merrimack River Valley Flood Control Commission, which cleared these roadblocks and smoothed the way for the project's construction. An interstate compact was approved and the Corps initiated design studies. Construction of the dams began in November 1959 and was completed in December 1962 at a cost of $21.5 million. The work included relocating portions of Routes 9, 202, 114, and 127; utilities; an abandoned railroad; and four cemeteries.



Hopkinton Lake

Description:

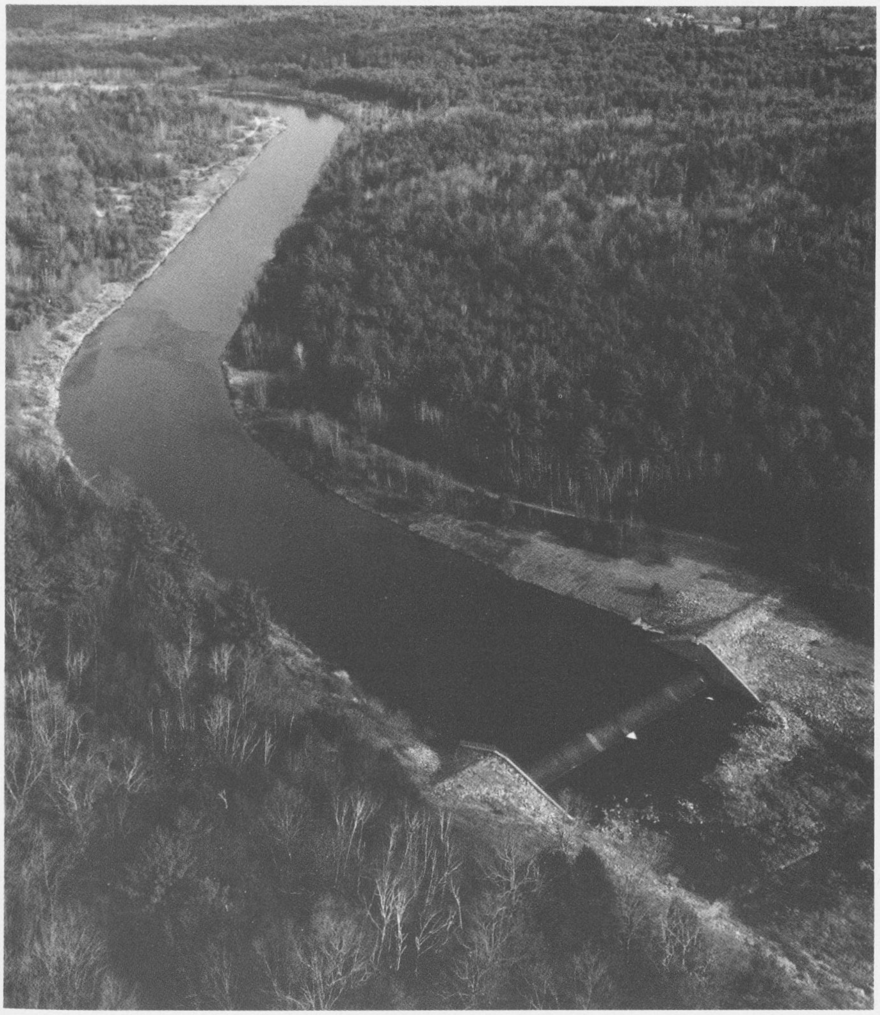
Hopkinton Lake consists of an earthfill dam with stone slope protection 790 feet long and 76 feet high; three gated square concrete conduits, each measuring 11 feet high and 11 feet wide, with two conduits 124 feet long and the third 128 feet long; and a spillway excavated in rock. The spillway at Hopkinton Lake is unusual in that instead of being located adjacent to the dam as most spillways are, it is located about 1.8 miles east of the dam. The spillway, situated across Cressy Brook, has a concrete weir 300 feet long with a crest elevation 21 feet lower than the top of the dam. Everett Lake consists of an earthfill dam with stone slope protection 2000 feet long and 115 feet high; a gated circular concrete conduit eight feet in diameter and 350 feet long; and a spillway excavated in rock with a concrete weir 175 feet long. The weir's crest elevation is 17 feet lower than the top of the dam.

The project also has four earthfill dikes with stone slope protection (two at each dam) totalling 16,300 feet in length. At Hopkinton Lake, Dike One is located on Elm Brook, about .25 mile east of the dam, and is 5220 feet long with a maximum height of 66 feet. Dike Two, located adjacent to the spillway across Cressy's Brook about 1.8 miles east of the dam, has a length of 4400 feet and a maximum height of 67 feet. At Everett Lake, Dike Three, located on Stark Brook about five miles north of the dam near the intersection of Routes 13 and Winslow Road, is 4050 feet long with a maximum height of 50 feet. Dike Four, located on Route 77 about five miles north of the dam and .5 mile west of Dike Three, is 2630 feet long with a maximum height of 30 feet.

The features that distinguish the dams at the Hopkinton-Everett Lakes project from other Corps-built dams in New England are two canals that act in conjunction to divert the floodwaters of the Contoocook River stored behind the dam at Hopkinton Lake to the flood storage area behind the dam at Everett Lake. During minor and moderate flooding, there is enough flood storage area behind the dam at Hopkinton Lake to store the floodwaters from the Contoocook River, and there is enough storage area behind the dam at Everett Lake to hold back floodwaters from the Piscataquog River. However, when major flooding occurs, there is not enough land behind the dam at Hopkinton Lake to hold the large volume of floodwaters from the Contoocook River. If not held back, these floodwaters would race downstream and threaten lives and property. There is, however, enough land behind the dam at Everett Lake on the Piscataquog River to hold not only potentially damaging floodwaters from the Piscataquog River, but also the excessive floodwaters from the Contoocook River that the dam at Hopkinton Lake cannot contain. The two canals act together to direct Contoocook River floodwaters from behind the dam at Hopkinton Lake to the flood storage area behind the dam at Everett Lake.

Canal I is located about .25 mile upstream of the dam at Hopkinton Lake and diverts water from the Contoocook River into Elm Brook Pool, situated behind the dam. The earthen canal is lined with rock and is approximately 3450 feet long and 120 feet wide. Canal II is situated roughly halfway between the two dams; it is this canal that connects the flood storage area behind the dam at Hopkinton Lake with the flood storage area behind the dam at Everett Lake, allowing the two dams to function as a single unit. This canal has a total length of 10,400 feet (about two miles), of which 8400 feet was cut in earth with a width of 160 feet. The upper 2000 feet of the canal is Drew Lake, a natural body of water with a width roughly the same as the rest of the canal. During major flooding, floodwaters pass from the Contoocook River to Canal I to Elm Brook Pool, then pass into Canal II to Everett Lake.

Most flooding on the Contoocook River is either minor or moderate and does not require the transfer of excessive floodwaters through the canals. Since the project's completion in December 1962, the diversion of Contoocook River floodwaters from behind the dam at Hopkinton Lake to the flood storage area behind the dam at Everett Lake has occurred only seven times, the last in April 1987 when the combined reservoir area of the two dams was filled to 95 percent of capacity, its highest level ever.



Canal II (both photos) connects the flood storage area behind the dam at Hopkinton Lake with the flood storage area behind the dam at Everett Lake, allowing the dams to function as a single unit. Canal II is a 10,400-foot-long strait, of which the upper 2000 feet is Drew Lake (top). Floodwaters pass from Elm Brook Pool behind the dam at Hopkinton Lake to Drew Lake/Canal II. These floodwaters then flow down the canal and empty into the flood storage area behind the dam at Everett Lake. The bottom photo shows the end of Canal II as it empties into the Everett Lake flood storage area.

Additional Information:

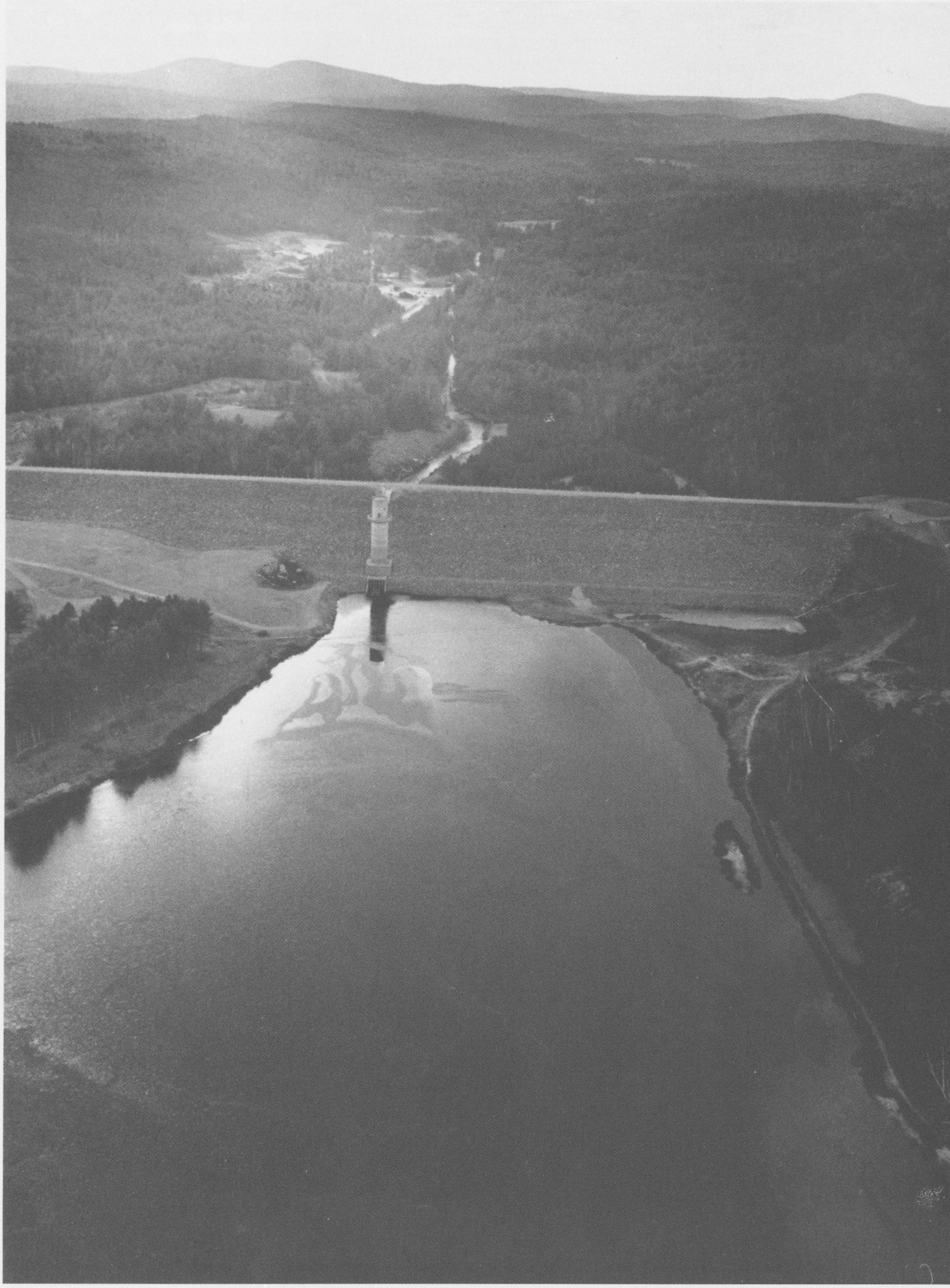
The flood storage area behind Hopkinton Lake totals 3700 acres and extends about 8.5 miles upstream through Henniker to the Contoocook Valley Paper Company. This acreage includes areas that are normally empty and areas that have permanent bodies of water. Some of the larger bodies of water behind the dam at Hopkinton Lake include the 220-acre permanent pool on the Contoocook River, which has a maximum depth of 14 feet; the 456-acre Elm Brook Pool; the 47-acre Drew Lake, which makes up the upper 2000 feet of Canal II; and two lakes, approximately 87 and 35 acres respectively, located within the confines of Stumpfield Marsh. The flood storage area behind Everett Lake totals 2900 acres and extends westerly up the Piscataquog River in Weare; northerly up Choate Brook, which lies mostly in Weare with a small portion lying in Dunbarton; and northerly up Stark Brook in Dunbarton. This acreage includes a 130-acre permanent pool with a maximum depth of 15 feet. Together, the flood storage areas behind both dams can hold 52.6 billion gallons of water, which would cover approximately 8000 acres (12.5 square miles). This is equivalent to 6.8 inches of water covering its drainage area of 446 square miles. The lakes and all associated project lands cover 9945 acres.

The Hopkinton-Everett Reservoir area offers the public a wide variety of recreational opportunities. At Hopkinton Lake, the recreational area situated behind the dam, known as Elm Brook Park, offers boating, a boat ramp, and swimming on a 300-foot-long beach. Elm Brook Park also has 130 picnic tables and 62 fireplace grills; four picnic shelters; a .5-mile-long nature trail; horseback riding over several miles of project roads; cross-country skiing; snowmobiling on designated trails; an open field for ball playing and other sporting activities; drinking water; and sanitary facilities. Other recreational activities popular at Elm Brook Park include canine field trials, which test a dog's temperament, skill, and ability for tracking, hunting, and guarding, and the flying of radio-controlled model airplanes.

The Corps has issued a license to the New Hampshire Department of Resources and Economic Development (DRED) to conduct a forestry and fish and wildlife management program on 3282 acres of land at Hopkinton Lake. As a result, Hopkinton Lake offers excellent fishing and hunting opportunities. The various bodies of water behind the dam, including Elm Brook Pool, Drew Lake, and the two bodies of water at Stumpfield Marsh, offer what many consider to be some of the best bass fishing in the state. There is also year-round fishing in these areas for self-sustaining perch, pickerel, and brown bullhead. Ice fishing is permitted. Hunters will find state-stocked pheasant, as well as ruffed grouse, quail, duck, and geese. In addition to the good fishing and hunting available at Stumpfield Marsh, this 700-acre area (including approximately 122 acres of water and 578 acres of woodlands) provides a waterfowl nesting area for species such as wood duck, mallard, hooded merganser, and black duck. One of the few blue heron rookeries in the state is located in Stumpfield Marsh, which lies undisturbed, as it was before the Hopkinton- Everett Dams were built.

Stumpfield Marsh is part of the land that is licensed by the Corps to DRED, but the marsh area itself is managed in cooperation with the Fish and Game Department. The Corps also leases about 13 acres of land at Hopkinton Lake to New England College in Henniker for baseball, football, soccer, field hockey, and outdoor basketball.

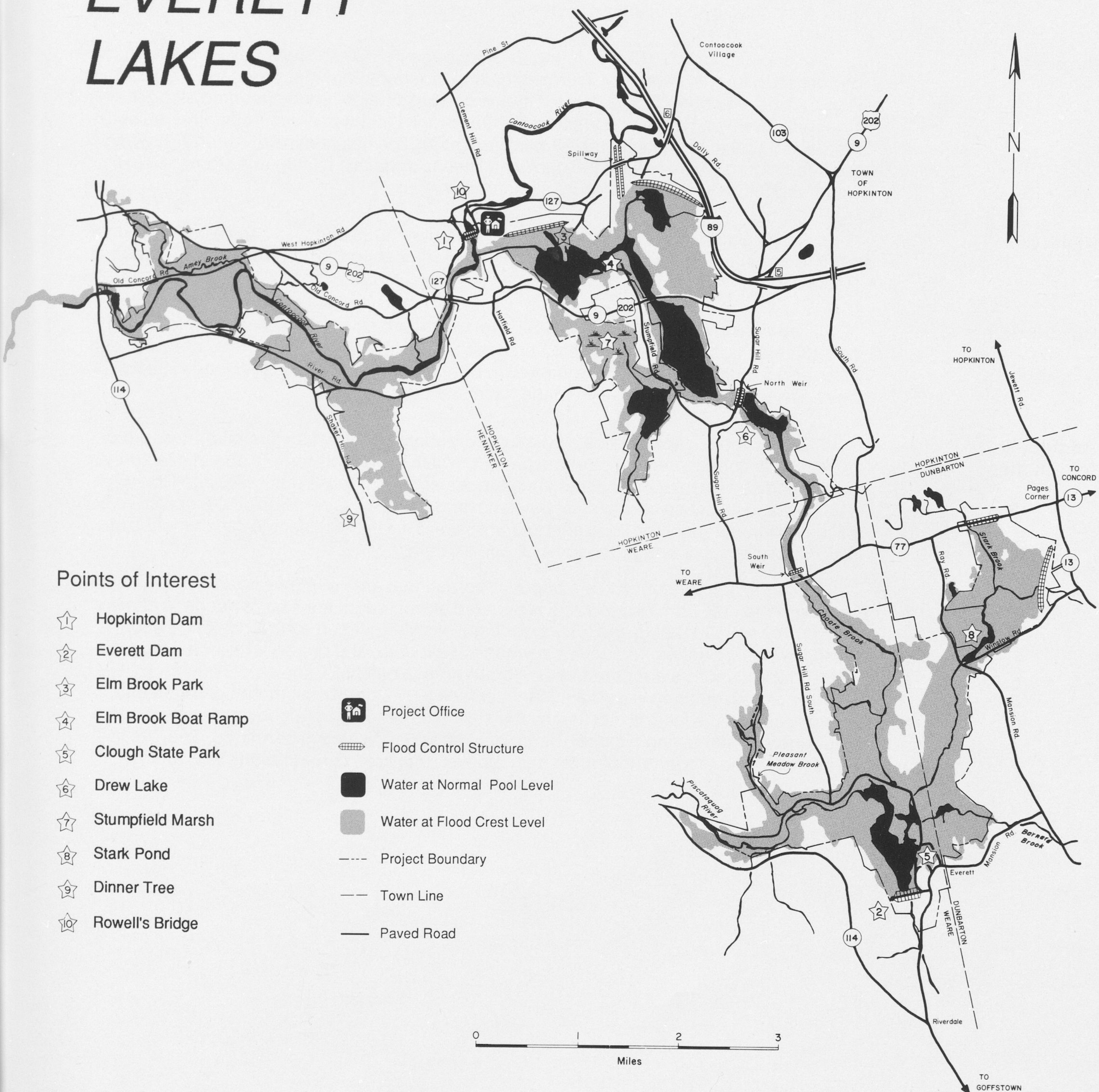
At Everett Lake, the Corps has issued a license to DRED to conduct a forestry and fish and wildlife management program on 2957 acres of land. Another 50 acres of land are leased to DRED to operate Clough State Park, which offers 110 wooden and 60 concrete picnic tables; two picnic shelters; about 80 fireplace grills; swimming on 900 feet of beach; boating for canoes, sailboats, and rowboats (boats with motors are prohibited); a boat ramp; an open field for ball playing and other sporting activities; drinking water; and sanitary facilities. About 15-20 miles of old roads at Everett Lake, including old Route 77, Bassett Mill Road, and the lower end of Sugar Hill Road, provide cross-country skiing trails and designated trails for snowmobiling.



Everett Lake

Everett Lake offers good year-round fishing for self-sustaining bass, pickerel, and brown bullhead. The state stocks brook, brown, and rainbow trout in the Piscataquog River, which empties into Everett Lake. The 19-acre Stark Pond Waterfowl Marsh Area, which lies on reservoir lands and is managed by DRED, offers fishing for self-sustaining perch, pickerel, and brown bullhead. There is in-season hunting for state-stocked pheasant, as well as ruffed grouse, woodcock, bear, deer, and rabbit.

HOPKINTON-EVERETT LAKES



Otter Brook Lake

Location:

The dam at Otter Brook Lake in Keene is located on Otter Brook, a tributary of the Branch River, which in turn is a tributary of the Ashuelot River. From Keene, the project can be reached by travelling two miles east on Route 101 to Branch Road.

Purpose:

In conjunction with Surry Mountain Dam (page 70), Otter Brook Lake provides flood protection to Keene, Swanzey, Winchester, and other communities along the Ashuelot River. Along with other Corps dams, Otter Brook Lake helps reduce flooding along the Connecticut River. Since its completion, Otter Brook Lake has prevented damages estimated at $23.9 million, including $3.6 million during the heavy rains of April 1987, when the flood storage area behind the dam was filled to capacity. During this storm, excess water had to be discharged through the spillway.

History:

Construction of the project began in September 1956 and was completed in August 1958 at a cost of $4.4 million. The work included relocating Branch Road and a portion of Route 9.

Description:

The project consists of an earthfill dam with stone slope protection 1288 feet long and 133 feet high; a gated concrete horseshoe conduit, six feet in diameter and 589 feet long; and a chute spillway founded on rock with a concrete weir 145 feet long. The weir's crest elevation is 21 feet lower than the top of the dam.

Additional Information:

Otter Brook Lake contains a 90-acre recreation pool that has a maximum depth of 20 feet. The flood storage area of the project, which is normally empty and utilized only to store floodwaters, totals 375 acres and extends about 2.3 miles upstream into Roxbury. The lake and all associated project lands cover 582 acres. Otter Brook Lake can store 5.7 billion gallons of water for flood control purposes. This is equivalent to seven inches of water covering its drainage area of 47.2 square miles.

Otter Brook Lake features a popular recreational area one mile north of the dam that is accessible only from Route 9 and is situated about four miles east of Keene. It offers a picnic area with 90 tables and 55 fireplace grills; swimming on a 400-foot-long beach; a change house; boating for canoes, rowboats, sailboats, and boats with electric motors (gas-powered motors are prohibited); a boat ramp; a ball field; snowmobiling; cross-country skiing; drinking water; and sanitary facilities. Otter Brook, both upstream and downstream of the lake, is stocked by the state with brook and rainbow trout, and supports self-sustaining pickerel, perch, and bass. Ice fishing is permitted. There is in-season hunting and/or trapping for deer, beaver, muskrat, fishercat, and wild turkey.

Otter Brook Lake

Surry Mountain Lake

Location:

The dam at Surry Mountain Lake is located on the Ashuelot River in Surry, about five miles north of downtown Keene and .5 mile north of the Keene-Surry line, on Route 12A.

Purpose:

In conjunction with Otter Brook Lake (page 68), Surry Mountain Lake provides flood protection to downstream communities on the Ashuelot River, including Keene, Swanzey, Winchester, and Hinsdale. Along with other Corps dams, Surry Mountain Lake also helps reduce flooding along the Connecticut River. Since its completion, it has prevented damages estimated at $52 million, including $7.9 million during the heavy rains of April 1987, when the flood storage area behind the dam was filled to capacity. During this storm, excess water had to be discharged through the spillway.

History:

Construction on the project began in August 1939 and was completed in October 1941 at a cost of $2.8 million. The work included relocating a portion of Route 12A and a utility line.

Description:

The project consists of an earthfill dam with stone slope protection 1800 feet long and 86 feet high; a concrete horseshoe conduit 10 feet in diameter and 383 feet long; and an L-shaped spillway excavated in rock with a concrete weir 338 feet long. The weir's crest elevation is 18 feet lower than the top of the dam.

Additional Information:

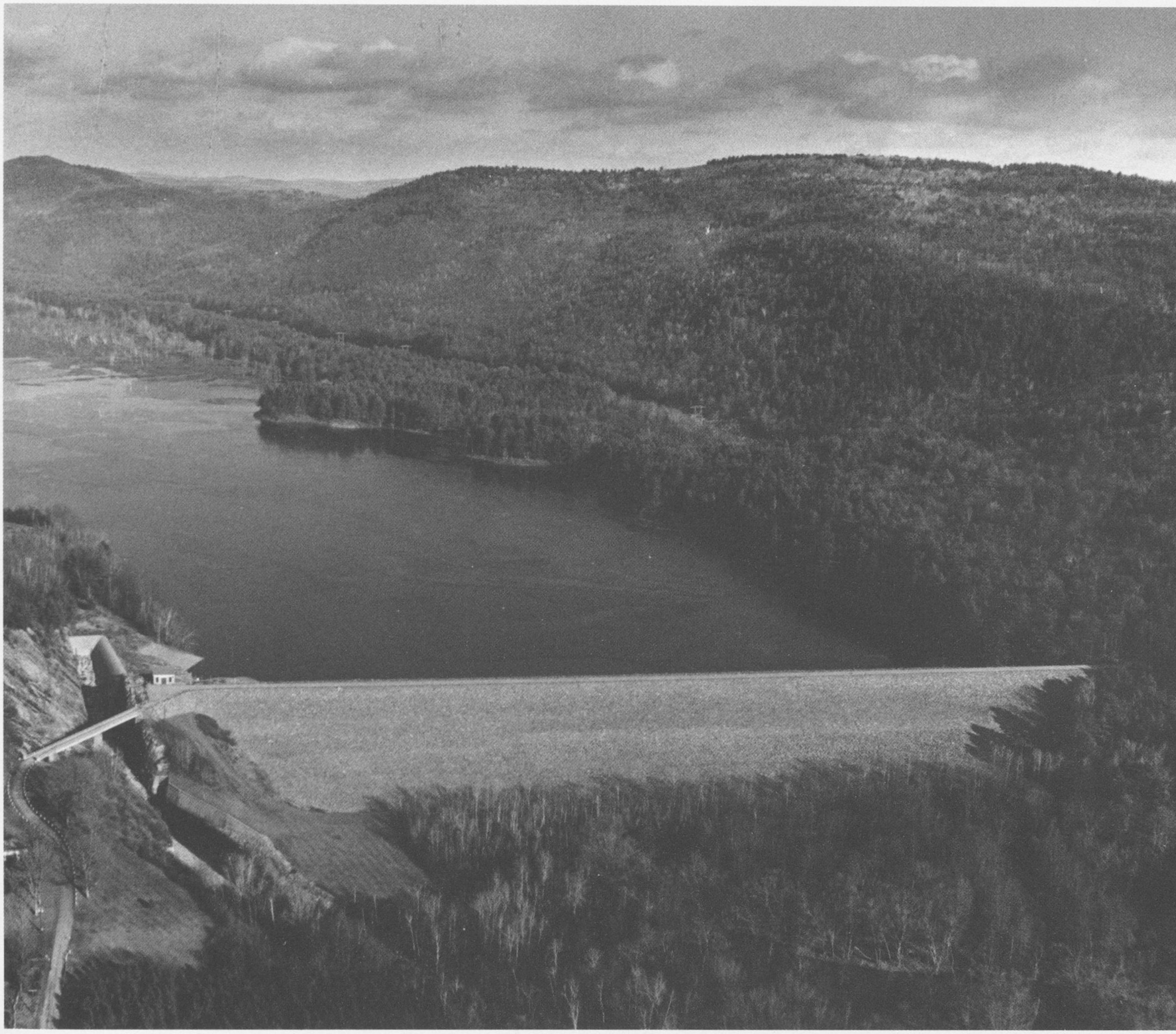
Surry Mountain Lake contains a 265-acre recreation pool with a maximum depth of 15 feet that was established in 1962 at the request of the town. The flood storage area of the project, which is normally empty and utilized only to store floodwaters, totals 705 acres and extends about five miles upstream. The lake and all associated project lands cover 1779 acres. Surry Mountain Lake can store almost 10.6 billion gallons of water for flood control purposes. This is equivalent to 6.1 inches of water covering its drainage area of 100 square miles.

The Surry Mountain Recreation Area, which is accessible on Route 12A from Keene (about .75 mile north of the dam entrance), offers visitors many recreational opportunities. A large, shady picnic area offers 80 tables and 45 fireplace grills. There is a 600-foot-long sandy beach and swimming area, and a boat ramp is available for those who enjoy canoeing, sailing, and motorboating. The .75-mile-long Beaver Lodge Nature Trail is popular with hikers. Cross-country skiers and snowmobilers enjoy the old abandoned roads and the five acres of open field, which are also used for ball playing and other sporting activities. The recreation area also has a change house, drinking water, and sanitary facilities.

Fishing opportunities abound within the project. Surry Mountain Lake offers self-sustaining largemouth and smallmouth bass, pickerel, brown bullhead, yellow perch, and bluegill. A section of the Ashuelot River that runs through project lands offers streamside fishing for state-stocked brook and rainbow trout. Ice fishing is permitted. There is in-season hunting and/or trapping for state-stocked pheasant, as well as deer, ruffed grouse, woodcock, wild turkey, raccoon, fox, fishercat, beaver, mink, and otter.

Visitors are encouraged to enjoy the panoramic view from atop the dam, which reveals the wide U-shaped valley encompassing Surry Mountain Lake. The scenery is especially spectacular during the foliage season. Wildlife is abundant throughout the project area, and several waterfowl species thrive in the shrub swamp at the upper end of the lake. The project's diverse habitat also supports many species of birds, including the broad-winged hawk, herring gull, osprey, kestrel, and songbirds. Whitetail deer and black bear have also been spotted utilizing their natural environment.

The privately-owned Surry Mountain Campground lies on nonfederal land adjacent to the project area and offers 35 campsites.



Surry Mountain Lake

Local Protection Projects

Beaver Brook, Keene

Cocheco River, Farmington

Israel River, Lancaster

Keene

Lincoln

Nashua

Stony Brook, Wilton

Beaver Brook, Keene

Location:

The Beaver Brook Local Protection Project in Keene is located on Beaver Brook, a tributary of the Ashuelot River. It is about 42 miles west of Manchester.

Purpose:

The project reduces flood damages to residential, commercial, industrial, and public property along a 3.5-mile-long reach of Beaver Brook. This reach begins at Three-Mile Swamp and flows southerly for 2.5 miles before it enters Keene's business district in the heart of the city. Beaver Brook then flows for about one mile through the business district before joining The Branch, which then flows into the Ashuelot River immediately outside of the downtown area.

History:

Flooding along this 3.5-mile-long reach of Beaver Brook, particularly along the one mile of stream that passes through Keene's business district, has been a recurring problem. The business district, from Water Street to Beaver Brook's confluence with the Ashuelot River, is home to much of the city's commerce and industry and some of Keene's oldest and more densely populated neighborhoods. Since 1927, floodwaters from Beaver Brook have caused extensive damage to this area. Four of the more damaging floods on Beaver Brook in the last 40 years occurred in November 1950, October 1959, April 1960, and December 1973. The worst flooding on record, the hurricane of September 1938, caused damages totalling $1.1 million along the Ashuelot River and its tributaries. Along Beaver Brook, these losses were estimated at $218,000 and included damage to 347 homes, 15 commercial firms, and 10 industrial plants.

The Beaver Brook Local Protection Project was built between May-November 1986. Its construction dramatically demonstrates how a project can prevent damage during unexpected flooding. Only six months after it was completed at a cost of $2.7 million, the project prevented an estimated $1.6 million in flood damages during the heavy rains of April 1987.

The project was built under Section 205 of the Continuing Authorities Program (small projects), and is operated and maintained by Keene.

Description:

Work on the project consisted of:

—Replacing an existing 190-foot-long stone dam located at Three Mile Swamp with a 250-foot-long concrete dam and spillway. Three Mile Swamp is a natural flood storage wetland that is about six feet deep. The concrete dam and spillway is designed so that Three Mile Swamp will maintain its existing water level during non-flood periods and temporarily store floodwaters during periods of heavy rainfall and/or snowmelt. When filled to capacity, floodwaters behind the dam would cover 106 acres, including lowlands that lie adjacent to Three Mile Swamp. The dam does not eliminate flooding on Beaver Brook; instead, it temporarily stores floodwaters in the natural flood storage retention area of Three Mile Swamp and the adjacent lowlands, preventing these floodwaters from racing downstream and posing threats to lives and property, especially in Keene's business district.

—Constructing a stilling basin immediately downstream of the spillway. Water coming over the spillway at a swift rate hits the stilling basin, which dispels the water's energy and considerably slows its velocity.

—Constructing two earthfill dikes totalling approximately 1285 feet. These dikes protect Route 10, situated adjacent to Three Mile Swamp, from flooding when the dam is storing floodwaters in the wetland. Dike A begins at the dam and runs parallel to Route 10. It is approximately 1100 feet long, has a maximum height of 12 feet, and has stone slope protection. Dike B, which runs perpendicular to Route 10, is about 185 feet long and has a maximum height of eight feet.

—Deepening and widening about 1750 feet of Beaver Brook channel between Water and Marlboro Streets in the heart of the city's business district. The channel was deepened to an average depth of seven feet and widened to a minimum width of 17 feet. The channel improvement increases the flow of Beaver Brook and helps keep the stream from overflowing its banks, especially during minor flooding.

Completed only in 1986, the Beaver Brook project in Keene has already prevented an estimated $1.6 million in flood damages. The project includes a 250-foot-long concrete dam across Three Mile Swamp (center) and a 1100-foot-long dike that runs parallel to Route 10 (left).

—Constructing slope protection in the section of Beaver Brook between Water and Marlboro Streets. The slope protection consists of precast concrete paving blocks (gridblock), and was built on the lower four feet of each bank. Approximately 1480 feet of slope protection was built on the left bank, and approximately 1585 feet was constructed on the right bank.

—Constructing an 80-foot-long retaining wall on the right bank of Beaver Brook, in the section between Water and Marlboro Streets. The wall consists of precast concrete blocks and has a maximum height of nine feet.

Important to the project are city-built retaining walls, situated on both banks in the section of channel between Water and Marlboro Streets. These walls, constructed in previous years to help control Beaver Brook flooding, act in conjunction with the Corps-built works to provide flood protection to Keene. On the left bank, the retaining walls consist of approximately 120 feet of granite block and about 150 feet of gabion; on the right bank, the retaining wall consists of approximately 85 feet of gabion.

Cocheco River, Farmington

Location:

The Cocheco River Local Protection Project in Farmington is located along the Cocheco River.

Purpose:

The entire project protects about 45 acres of industrial, commercial, and residential property in the center of Farmington. Since its completion, it has prevented an estimated $110,000 in flood damages.

History:

The limited channel capacity of the Cocheco River frequently caused the river to overflow, resulting in flood damage to the center of Farmington. The town suffered serious flood damage in March 1936 and May 1954. This limited channel capacity was aggravated by periodic ice jams. Cakes of ice that had lodged against obstructions in the river, such as debris and several small wooded sand bars and islands, plagued Farmington for many years and was the cause of most of the area's flooding.

To increase the channel capacity of the Cocheco River, the Corps built a project on the upper part of river between the Central Street Bridge and the South Main Street Bridge. The work, constructed as a small project under Section 205 of the Continuing Authorities Program, was completed between June-November 1956 and cost $87,500. The project was turned over to Farmington for operation and maintenance.

In January 1957, however, ice cakes, flowing from the upper part of the Cocheco River between the Central Street and South Main Street Bridges to the lower part of the river, below the South Main Street Bridge, lodged in the vicinity of Dames Brook, located about 2000 feet below the South Main Street Bridge. The river overflowed and caused considerable flood damage to one of Farmington's major industrial employers. Town officials, businessmen, and manufacturers, weary of the periodic ice jams that continually jeopardized their community, approached the Corps and emphasized the importance of a project that would extend to the lower part of the Cocheco River the same degree of protection afforded to the upper river by the existing project. The Corps responded by constructing a project on the lower river between June-November 1959 at a cost of $48,600. This work was also constructed as a small project under Section 205 of the Continuing Authorities Program, and was turned over to Farmington for operation and maintenance.

Description:

The entire project extends along a 7800-foot-long stretch of the Cocheco River. It begins at the Central Street Bridge and ends at a point 4700 feet downstream of the South Main Street Bridge.

Work completed on the upper part of the river centered mostly on the approximately 3100 feet of river between the Central Street and South Main Street Bridges. It involved:

—Constructing about 3000 feet of earthfill dike along the left bank of the river. The dike, constructed of materials excavated from the channel, begins at point about 200 feet downstream of the Central Street Bridge and ends at the South Main Street Bridge.
—Constructing approximately 125 feet of concrete floodwall, 10-12 feet high, along the left bank of the river. The wall extends from the existing masonry wall at the Central Street Bridge to the beginning of the earthfill dike.
—Constructing a concrete cap on the existing masonry wall to give the wall additional height, thereby providing an extra measure of flood protection.
—Enlarging and straightening about 3100 feet of the Cocheco River.
—Straightening about 600 feet of the Mad River at its confluence with the Cocheco River.
—Removing an abandoned wooden dam.
—Clearing and snagging about 2000 feet of the Cocheco River. This work extended from the South Main Street Bridge to the mouth of Dames Brook.

The Cocheco River Local Protection Project extends along 7800 feet of the Cocheco River and is divided into upper and lower halves by the South Main Street Bridge (center). This photo shows the entire project as it winds through Farmington.

Work completed on the lower part of the river, below the South Main Street Bridge, involved:

—Widening and deepening about 4000 feet of the Cocheco River, beginning at the South Main Street Bridge and extending downstream.
—Snagging and clearing an additional 700 feet of the Cocheco River, beginning at the point where the aforementioned widening and deepening ended.
—Constructing 200 feet of earthfill dike with stone slope protection along the left bank, just downstream of the bridge. This dike was constructed of materials excavated from the channel.
—Straightening and widening the lower end of Dames Brook, from the Elm Street Bridge to its confluence with the Cocheco River.

Additional Information:

In the early 1960's, the project suffered significant flood damage. Consequently, the Corps repaired and restored the project between September-December 1964. This work included widening and reshaping the channel; constructing stone slope protection at areas subject to severe erosion; and constructing a deflecting stone groin at the confluence of the Mad and Cocheco Rivers. The work was completed as a small project under Section 205 of the Continuing Authorities Program and cost $47,000.

In April 1984, heavy flooding significantly eroded two sections of the 3000-foot-long dike on the upper part of the river. Emergency repairs included placing stone slope protection along these eroded areas and repairing a drain pipe. This work, constructed under the Corps' emergency repairs authority (Public Law 99 of the Flood Control Act of 1941), was accomplished between September-October 1985 and cost $137,000.

The upper half of the project begins near the confluence of the Mad and Cocheco Rivers (top left) and involved constructing 3000 feet of dike along the left bank of the river, and enlarging and straightening about 3100 feet of the river channel.

The lower half of the Cocheco River Local Protection Project included widening and deepening 4000 feet of the river, beginning at the South Main Street Bridge (lower right).

Israel River, Lancaster

Location:

The Israel River Local Protection Project in Lancaster is located on the Israel River, about 93 miles north of Concord. The project is approximately 0.5-mile upstream of the Main Street Bridge, and approximately 1000 feet upstream of the covered bridge on Mechanic Street. The project was built at the site of a former wooden dam owned by the Twin State Gas and Electric Company. The Israel River flows into the Connecticut River about 1.5 miles downstream.

Purpose:

The project protects about 12 acres of commercial, industrial, and residential property in the center of Lancaster, including the Town Hall and police station, from flooding due to ice jams. Data on damages prevented are not available.

History:

The Israel River is a steep, mountainous stream that becomes relatively flat as it flows through Lancaster. During the winter, large amounts of ice form upstream and float downstream to the flatter reaches, where it adheres to the bottom of the channel, particularly in the area of the Main Street Bridge in the center of town. These ice jams reduce the channel depths and limit the flow capacity of the river, causing the river to overflow its banks and flood public and private property. Since 1895, Lancaster has suffered more than 20 ice jam floods, the most serious occurring in March 1968. In March 1970, the Corps constructed an emergency rock dike across the Israel River at a point immediately upstream from the mouth of Otter Brook. The purpose of the dike was to hold floating ice upstream until a permanent structure could be constructed.

Construction of the present project began in May 1980 and was completed in September 1981 at a cost of $552,000. It is a small project, built under Section 205 of the Corps Continuing Authorities Program.

Description:

The project consists of:

—A 160-foot-long, six-foot-high weir, made of earth and rock. The weir impounds ice and prevents it from flowing downstream and lodging against the Main Street Bridge. It is protected by layers of gabion, which are steel wire mesh baskets filled with stone, and is covered with 3-5 inches of concrete, which protects the gabion wires from cutting and other damage caused by ice and debris. A sheet of steel constructed along the center of the weir helps prevent water from flowing through the structure. Four openings in the weir, each four feet wide, provide passage for migratory fish. These openings contain slots for wooden stoplogs, which are inserted in late fall to prevent water from passing through the weir and insure a winter pool of about 56 acres behind the weir. The stoplogs are removed in the spring.

—A three-foot-deep stilling basin, lined with gabion, located immediately downstream of the weir. Water coming through the weir at a high velocity hits the stilling basin, which dispels the water's energy and considerably slows its acceleration.

—A 90-foot-long earthfill dike with stone slope protection, constructed in a low area adjacent to the weir's right abutment. The dike, with a maximum height of 10 feet, confines the river when the river is restricted by ice jamming at the weir.

Because of the project's unique design, it is monitored by the Corps of Engineers to measure its effectiveness.

A 160-foot-long weir (top left) across the Israel River in Lancaster is designed to impound ice, reducing the threat of ice jams downstream. The project protects about 12 acres of commercial, industrial, and residential property.

Keene

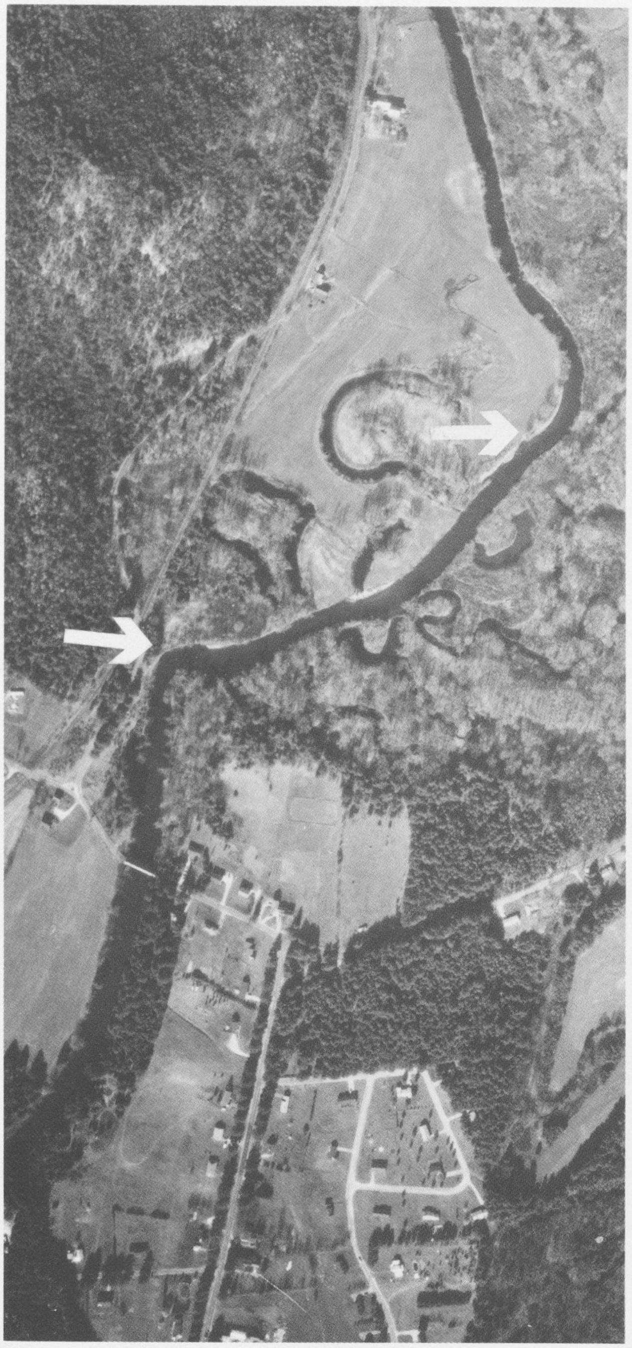
Location: The Keene Local Protection Project is located along the Ashuelot River in Keene and Swanzey.

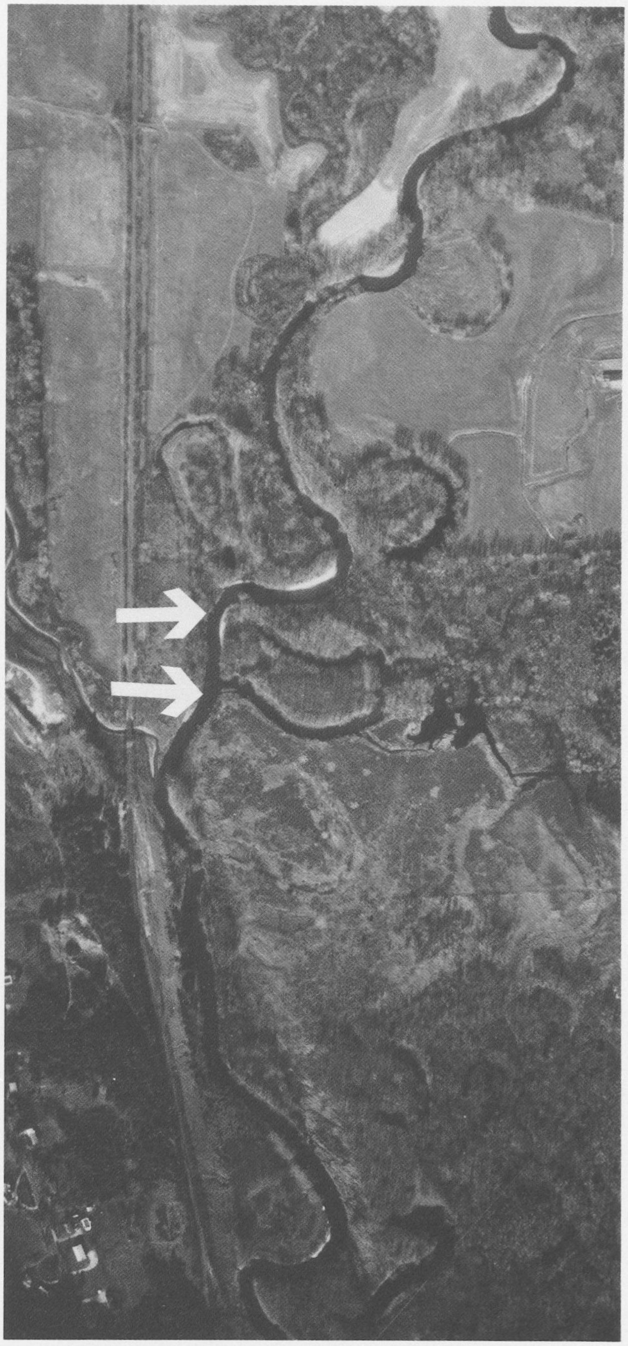
Purpose: The project increases the Ashuelot River's channel capacity, allowing the reservoir behind the dam at Surry Mountain Lake (page 70), located five miles upstream, to empty more rapidly. This increased channel capacity improves the river's flow conditions, which in turn reduces cellar flooding in Keene, improves the efficiency of drains and sewers in Keene during high water periods, and helps reduce flooding on farm fields situated along the river. Data on damages prevented are not available.

History: Construction was accomplished between June-August 1954 at a cost of $44,100. The project is maintained by Keene.

Description: The project involved snagging and clearing approximately 22,800 feet of the Ashuelot River, beginning at the railroad bridge in Keene and extending to the covered bridge at Swanzey Station in Swanzey. The work included removing trees, brush, and other debris in the river.

The work also involved the excavation of two cutoff, or "short cut" channels. The Ashuelot River flows in a north-south direction. However, two sections of the river in Keene and Swanzey meandered back and forth in an east west direction for several thousand feet. The cutoff channels bypass these winding, roving sections of channel and provide a "short cut" route for the river, allowing it to flow in a north-south direction. Where once the river meandered east-west for a total of 5600 feet, the two cutoff channels now permit the river to flow in a north-south direction for approximately 1800 feet. One cutoff channel is located in the vicinity of the mouth of the South Branch in Swanzey, and the second is 500 feet above the mouth of White Brook in Keene.





The Keene Local Protection Project involved the excavation of two "short cut" channels in the Ashuelot river that eliminated winding sections of stream. The sections of the Ashuelot River between the white arrows in the above photographs delineate the "short cut" channels. One cutoff channel is located in the vicinity of the mouth of the South Branch in Swanzey (left), and the other is 500 feet above the mouth of White Brook in Keene.

Lincoln

Location:

The Lincoln Local Protection Project is located on the East Branch of the Pemigewasset River in Lincoln, about 80 miles north of Concord. The East Branch joins with the Pemigewasset River about one mile downstream of the project.

Purpose:

The project provides flood protection along the right bank of the river in the vicinity of the Mill Shopping Mall, the site of a paper mill at the time the project was constructed. Data on damages prevented are not available.

History:

In October 1959, Lincoln and other communities in northern New England experienced severe flooding. A locally-built wooden crib dike on the East Branch of the Pemigewasset River, which provided flood protection to the former paper mill, was seriously damaged by the flood. Although the paper mill did not suffer any flood damage, it was feared that additional flooding, however minor, might cause the dike to fail and leave the paper mill vulnerable to flood damage. Lincoln officials, fearful of losing what was at that time the town's major employer, asked the Corps to repair and restore the dike. The restoration and repair work took place between July-December 1960 and cost $140,000. The project is operated and maintained by Lincoln.

Description:

The project begins at a dam that was owned by the former paper mill and extends 1450 feet downstream along the west bank of the East Branch of the Pemigewasset River. Work included:

—Restoring 1400 feet of existing dike. This dike begins at the dam's west abutment and extends 1450 feet downstream along the river's right bank. The restoration work included the placement of stone slope protection.

—Constructing 230 feet of earthfill dike with stone slope protection. The dike begins at the dam's west abutment and extends northerly.

—Excavating 1350 feet of channel. The October 1959 flood washed much of the stone protection covering the dike into the East Branch of the Pemigewasset River. The Corps removed these stones and boulders from the river, and those stones with a circumference larger than six inches became part of the stone slope protection constructed by the Corps on the restored dike.

The Lincoln Local Protection Project, located on the East Branch of the Pemigewasset River, involved restoring 1400 feet of existing dike on the right bank of the river (above) and excavating 1350 feet of channel.

Nashua

Location:

The Nashua Local Protection Project is located at the confluence of the Nashua and Merrimack Rivers in Nashua, about 18 miles south of Manchester.

Purpose:

The project protects about 70 acres of industrial and residential property in the lower section of the city. It has prevented an estimated $172,000 in flood damages.

History:

Nashua experienced serious flooding in both March 1936 and September 1938. In 1936, the lower section of the city was flooded to depths ranging from ten to 17 feet, causing damage estimated at $1.9 million. In 1938, this area was flooded to depths ranging from five to eight feet. Construction of the project began in June 1946 and was completed in May 1949 at a cost of $273,000. The project is operated and maintained by Nashua.

Description:

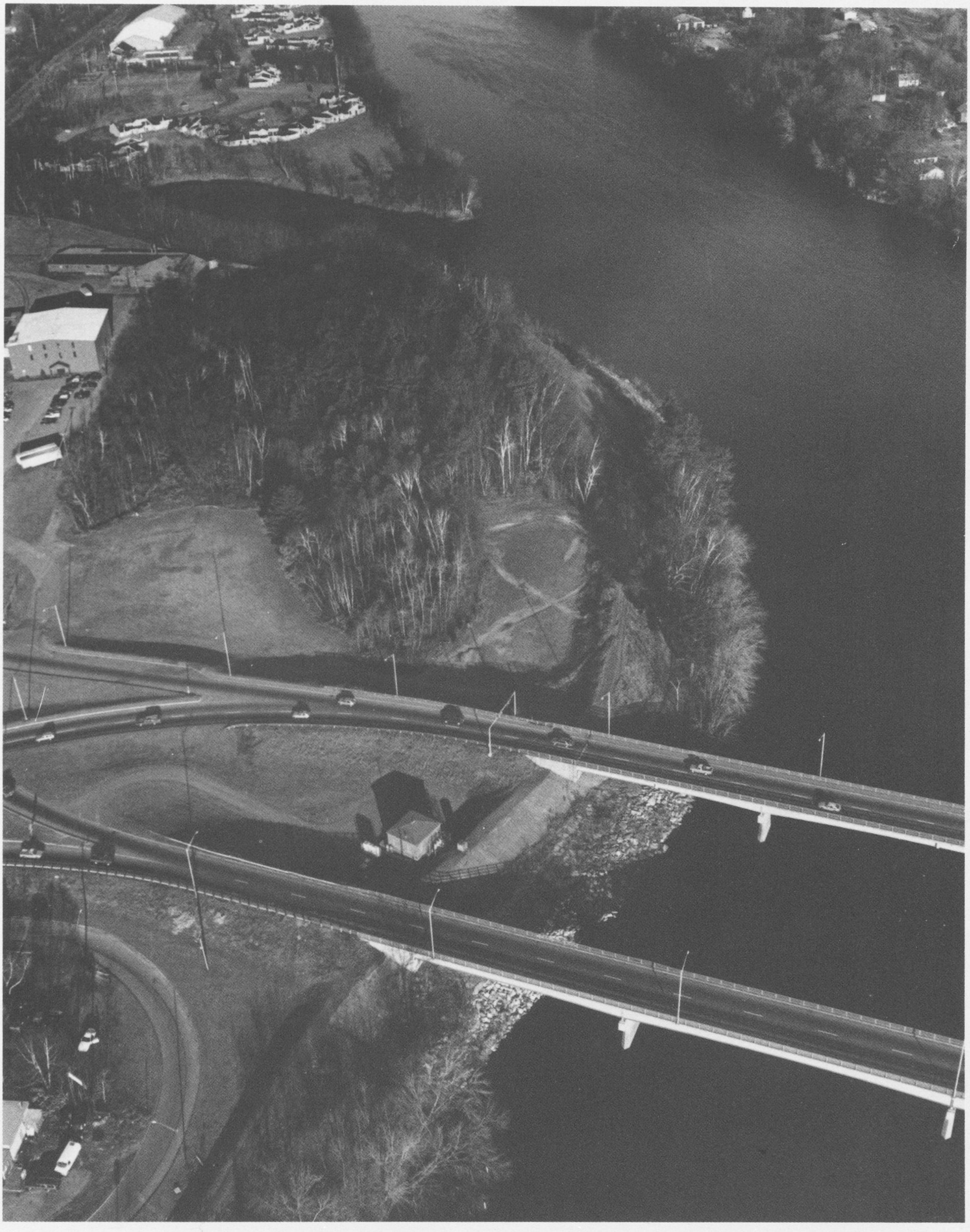
The project consists of:

—An earthfill dike approximately 3025 feet long with a maximum height of 16 feet. The dike starts at the Boston and Maine Railroad Bridge that spans the Nashua River and extends easterly along the river's right bank to the Merrimack River. The dike then continues southerly along the Merrimack River before ending at high ground south of Crown Street. The dike is continuous except for three sections of concrete floodwall. Stone slope protection was placed on the dike in areas where the river velocities are high.

—Three sections of concrete floodwall totalling approximately 400 feet. One section of wall is on the right bank of the Nashua River, near its confluence with the Merrimack River. The other two sections are on either side of the Hudson Bridge, along the right bank of the Merrimack River.

—A pumping station, located adjacent to the Hudson Bridge, behind the dike. The pumping station handles interior storm and sanitary drainage from an area of 615 acres within the city. This drainage is carried through a conduit and is discharged into the Merrimack River.

—A second earthfill dike approximately 400 feet long with a maximum height of five feet. This dike, located approximately 600 feet south of the 3025-foot-long dike's southern end, is situated several hundred feet inland from the Merrimack River. It lies perpendicular to the river, across Cinder Road.



One of the features of the Nashua Local Protection Project is a 3025-foot-long dike that helps protect 70 acres of industrial and residential property. The dike starts along the right bank of the Nashua River (top left). After the Nashua River joins the Merrimack River, the dike continues along the Merrimack River before ending several hundred feet past Route 111 (center). While much of the dike is hidden under brush, a section of dike with stone slope protection can be seen between the north and south overpasses of Route 111. The structure behind this section of dike is the pumping station.

Stony Brook, Wilton

Location:

The Stony Brook Local Protection Project in Wilton is located on Stony Brook, near its confluence with the Souhegan River. It is about 18 miles northwest of Nashua.

Purpose:

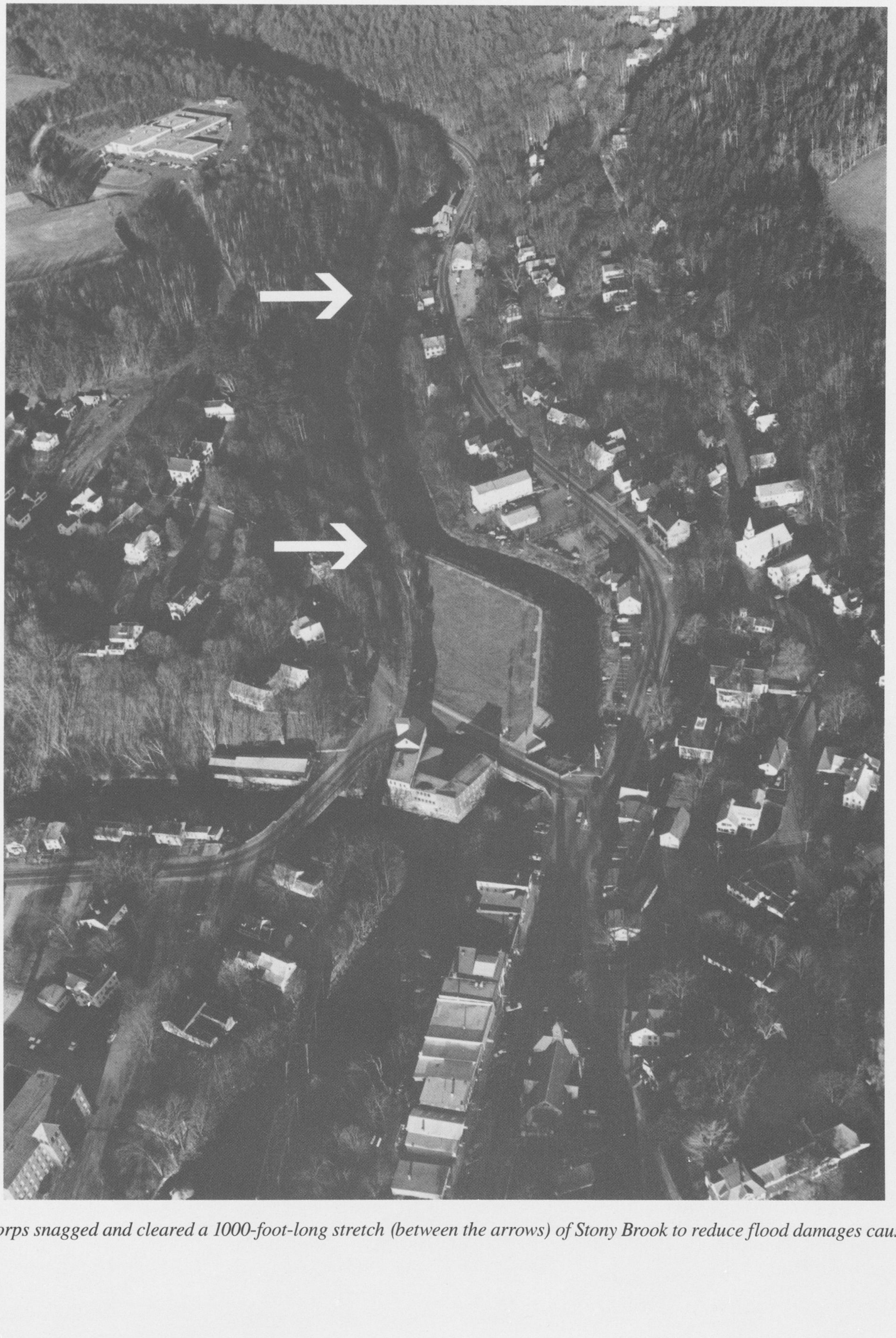
The project reduces ice jam flooding on Stony Brook, safeguarding residential, commercial, and industrial properties in Wilton's downtown area. Data on damages prevented are not available.

History:

Stony Brook was prone to flooding from heavy rainfall, which caused serious flood damage in September 1938, June 1944, and October 1955. However, most flooding on Stony Brook was caused by ice jams. In late winter and early spring, ice floating downstream on Stony Brook would lodge against obstructions in the stream, limiting its flow capacity. These obstructions included several boulders, shoals, and logs that supported a thick growth of brush; soil that had sloughed off the east bank; and masonry blocks that had fallen from adjacent walls. The ice jams caused Stony Brook to overflow its east bank, flooding residential and commercial properties. Ice jams caused serious flooding in March 1936, March 1968, January 1969, and January 1970. Following the flood of January 1970, which caused record damages, town officials contacted the Corps and requested assistance to protect property that was vulnerable to ice jam flooding. The Corps started and completed the project in November 1971 at a cost $19,500. It is a small project, built under Section 208 of the Continuing Authorities Program, and is maintained by Wilton.

Description:

The project involved snagging and clearing trees, brush, boulders, logs, and other debris from a 1000-foot-reach of Stony Brook. The project begins near the northerly of two dams on Stony Brook and extends 1000 feet downstream, ending about 600 feet above the intersection of Highland and Main Streets. The removal of this debris restored the channel to its original width of 65 feet. The gravel and soil removed from Stony Brook was placed on the east bank.



The Corps snagged and cleared a 1000-foot-long stretch (between the arrows) of Stony Brook to reduce flood damages caused by ice jams.

Navigation

The Corps has completed 10 navigation projects in New Hampshire that have improved rivers, harbors, and lakes used by commercial interests, fishermen, and the many recreational boaters that benefit from New Hampshire's coastal and inland waterways.

Initial work on some of the projects dates back to the 19th century. However, most of the navigational work in today's rivers and harbors has been constructed by the Corps within the past 50 years, costing an aggregate $6.65 million. (More information on the navigational role of the Corps is available on page 22).

The following pages describe the Corps' navigation projects in New Hampshire. Depths given for channels and anchorages are those at low tide.

The project at Lake Winnipesaukee in Laconia consists of a navigable passageway through Weirs Channel (center). Weirs Channel connects Meredith Bay (bottom) with Paugus Bay (top).

Navigation Projects in New Hampshire

Bellamy River

Cocheco River

Exeter River

Hampton Harbor

Isles of Shoals Harbor

Lake Winnipesaukee

Lamprey River

Little Harbor

Portsmouth Harbor and Piscataqua River

Rye Harbor

The entrance to the Bellamy River, which flows through Newington and Dover.

Bellamy River

The Bellamy River flows through Dover into Little Bay, which connects Great Bay to the southwest with the Piscataqua River to the east, in Newington. The river today is used only by recreational boaters.

In the latter part of the 19th and early 20th century, the Bellamy River was used as a shipping channel between Great Bay and Sawyer's Mill in Dover, with brick being the principal commodity. Completed in 1896 to accommodate commercial navigation, the project consists of a four-mile-long channel, five feet deep and 50 feet wide, extending from Little Bay to Sawyer's Mill, near the Route 108 Bridge. The project lies on the west side of Dover Point.

No shipping has been reported on the river for many years.

Cocheco River

The Cocheco River flows for 34 miles in a southeasterly direction and joins with the Salmon Falls River in Dover to form the Piscataqua River. The Cocheco River is located about nine miles northwest of Portsmouth and serves small recreational and fishing vessels.

This project, completed in 1906, consists of a three-mile channel, seven feet deep and 60–75 feet wide (7.5 feet deep and 50 feet wide in areas where rock was encountered), extending up the Cocheco River from its confluence with the Salmon Falls River to Dover's Upper Narrows area, located near the town center. The project was built to facilitate shipping, which at that time consisted chiefly of coal and building materials. However, no commercial navigation has been reported on the river for many years.

Exeter River

The Exeter River originates in Chester and follows a meandering course eastward for 43 miles before emptying into Great Bay in Newmarket, near the mouth of the Lamprey River and about eight miles southwest of Portsmouth. The Corps' project is on the lower 8.3 miles of the Exeter River, known locally as the Squamscott River, which flows through Exeter, Newfields, Stratham, and Newmarket. Used mostly by small recreational craft, boating activity today is limited primarily to the river's lower two miles.

The Corps began work on the Exeter River in 1882 to facilitate the shipment of coal from Great Bay to Exeter. This work consisted of constructing an 8.3-mile-long

The Cocheco River (left) joins with the Salmon Falls River (right) in Dover to form the Piscataqua River.

The entrance to the Exeter River in Newmarket.

channel, 40 feet wide, extending from Great Bay to the upper wharves at Exeter, in the vicinity of what is now the Phillips Exeter Academy Boathouse. For the channel's first 5.6 miles, from Great Bay to Oxbow Cut, the channel is six feet deep. From Oxbow Cut to the upper wharves at Exeter, the channel was constructed to a depth of five feet. In 1903, this latter section of channel, from Oxbow Cut to the upper wharves at Exeter, was deepened to 5.5 feet, and a five-foot-deep turning basin, 200 feet long and 110 feet wide, was constructed at the upper wharves in Exeter.

In 1911, the Corps modified the project by straightening the channel at the Stratham Bridge (Route 108).

Hampton Harbor

Hampton Harbor in Hampton is situated behind Seabrook Beach and Hampton Beach, about 1.5 miles north of the New Hampshire-Massachusetts state line. The entrance to Hampton Harbor separates Seabrook and Hampton Beaches and forms the mouth of the Hampton River. A small lobstering fleet, charter fishing boats, and numerous recreational craft are based in the harbor.

The project, completed in 1965, involved:

—Constructing a 0.7-mile-long channel, eight feet deep and 150 feet wide, extending from the ocean through the entrance to the harbor. Material dredged from the channel was placed at the northern end of Hampton Beach in conjunction with the Corps' beach replenishment project (page 102).

—Extending and raising existing state-built stone jetties on each side of the entrance to the harbor. The existing 1300-foot-long north jetty was extended another 1100 feet, and the outer 300 feet of the existing 1000-foot-long south jetty was raised. A walking surface was constructed on the top of the north jetty extension for fishing.

Work at Hampton Harbor was constructed as a small project under Section 107 of the Continuing Authorities Program.

The entrance to Hampton Harbor separates Seabrook (left) and Hampton Beaches. The Corps constructed a channel through the entrance and extended and raised the stone jetties on either side.

The three breakwaters at the Isles of Shoals form Gosport Harbor, in the center of the photo. The first breakwater connects Malaga Island, the small island at the far right, with the much larger Smuttynose Island; a second breakwater extends from Smuttynose Island across to Cedar Island (middle of photo); and the third breakwater connects Cedar Island with Star Island.

Isles of Shoals Harbor

Discovered by Captain John Smith in 1614, the Isles of Shoals are a three-mile-long cluster of eight rocky islands and ledges located off the coast of New Hampshire and Maine. Bisected by the boundary line of Rye, New Hampshire, and Kittery, Maine, the Isles of Shoals are about five miles east of Rye Harbor. Four of the islands—Star, Cedar, Smuttynose, and Malaga—are situated such that they afford a small harbor, known as Gosport Harbor. This harbor, 32 acres in area, is used by commercial and charter fishing boats and recreational vessels, as well as excursion boats from Portsmouth. It is also used by the U.S. Coast Guard out of Portsmouth during search and rescue operations. The Isles of Shoals are popular for summer conferences and are home to a marine biology center operated by Cornell University.

Work in the Isles of Shoals began as early as 1821, when private interests constructed a stone breakwater between Malaga and Smuttynose Islands. In 1904, the Corps repaired and strengthened the breakwater to a length of 240 feet and constructed a second stone breakwater, 700 feet long, between Smuttynose and Cedar Islands. In 1913, the Corps repaired and strengthened the existing breakwaters and constructed a third stone breakwater, 530 feet long, between Cedar and Star Islands. The breakwaters provide vessels with a safe refuge in Gosport Harbor.

Lake Winnipesaukee

Lake Winnipesaukee in central New Hampshire is a renowned summer resort and boating center situated about 30 miles northeast of Concord. The 72-square-mile lake, the largest in the state, has a maximum length of approximately 20 miles and a maximum width of about eight miles. The western end of the lake, known as Meredith Bay, discharges into the 3000-foot-long Weirs Channel, which leads into Paugus Bay, known locally as Long Bay (Paugus Bay forms the head of the Winnipesaukee River). Located in Laconia, Weirs Channel is used principally by mail boats, passenger boats, and numerous recreational craft.

The project, completed in 1882, involved constructing a navigable passageway through Weirs Channel so that boats could travel safely from Paugus Bay to Meredith Bay. Weirs Channel was dredged to a depth of five feet and a width of 50 feet, and obstructing shoals were removed.

The entrance to the Lamprey River in Newmarket.

Lamprey River

The Lamprey River flows easterly for 42 miles and empties into Great Bay in Newmarket, about eight miles west of Portsmouth. A small recreational fleet is based near the mouth of the river.

During the 1880s, Newmarket required 5000 tons of coal annually to heat large manufacturing plants, several commercial establishments, and residential areas. Other commodities shipped to the town, including salt, iron, and cement, amounted to between 7–8000 tons annually. Completed in 1883 to accommodate commercial shipping, the project consists of a 2.5-mile-long channel, five feet deep, extending from Great Bay to the vicinity of the Route 108 Bridge in Newmarket. The first two miles of the channel, from Great Bay to the Lower Narrows, is 100 feet wide, and the channel's last 0.5 mile, from the Lower Narrows to the vicinity of the Route 108 Bridge in Newmarket, is 40 feet wide.

No shipping has been reported on the Lamprey River for many years.

Little Harbor

Little Harbor is situated between the island of New Castle to the north and Rye to the south. The harbor's northwesterly end, located at the Bascule Bridge (Route 1B), leads into the southerly end of Portsmouth Harbor. Little Harbor is used today mostly as an access route for recreational and fishing boats and other small craft based at Sagamore Creek, a popular boating center situated immediately northwest of the harbor. Small boats also use Little Harbor as a refuge.

Commercial sailing schooners operating along the coast at the turn of the century needed a safe harbor of refuge as they waited for moderate tides in Portsmouth Harbor. At that time, Little Harbor was too shallow to accommodate these schooners. The Corps began work in Little Harbor in 1887 and, after several modifications, completed the project in 1903. The project consists of:

—Two stone breakwaters, one on each side of the harbor entrance. The north breakwater, off Jaffrey Point in New Castle, is 550 feet long. The south breakwater, off Frost Point in Rye, is 900 feet long. The breakwaters were completed in 1894.

—A 3000-foot-long entrance channel, 12 feet deep and 100 feet wide, extending through the harbor to the vicinity of the Bascule Bridge (Route 1B).

—A 12-foot-deep anchorage basin, 700 feet long and 300 feet wide (about 40 acres in area), lying immediately south of the entrance channel.

The commercial sailing schooners for which the project was designed were phased out of existence in the late 1920s.

Portsmouth Harbor and Piscataqua River

Formed by the confluence of the Salmon Falls and Cocheco Rivers, the Piscataqua River originates at the boundary of Dover, New Hampshire and Eliot, Maine, and flows southeasterly for 13 miles to Portsmouth Harbor, comprising a partial border between the two states. The last 8.8 miles of the Piscataqua River constitute Portsmouth Harbor, which stretches across New Castle, Portsmouth, and Newington, and the Maine communities of Kittery and Eliot.

Located about 50 miles northeast of Boston, Portsmouth Harbor is the sole deep draft harbor in New Hampshire. It handles about 3.5 million tons of shipping a year for New Hampshire, eastern Vermont, and southern Maine. Items include petroleum products, iron and steel scrap, salt, limestone, and fish products. The harbor is used by submarines from the Portsmouth Naval Shipyard in Kittery and for fuel deliveries to Pease Air Force Base in Newington. Portsmouth Harbor is also used extensively by a large lobstering fleet, charter fishing vessels, commercial fishermen, excursion boats to the Isles of Shoals (page 95) situated nine miles offshore, and local and transient boats based at or visiting the nearly 20 boating facilities in the area.

Initial work in Portsmouth Harbor began in 1881. It consisted of:

- Constructing a 1000-foot-long breakwater between New Castle and Goat Islands. The breakwater, completed in 1881, now serves as a causeway for an access road to New Castle.
- Removing two ledge areas in the middle of the harbor. One area, Gangway Rock, was opposite the western end of the Portsmouth Naval Shipyard, on the New Hampshire side of the channel. Removal of this ledge to a depth of 20 feet began in 1881 and was completed in 1888. The second area was about 0.6 mile upstream, near the southwestern end of Badgers Island, on the Maine side of the channel. Removal of this ledge to a depth of 18 feet began in 1881 and was completed in 1891.

The Corps has more recently completed two projects in Portsmouth Harbor constructed at separate

The project at Little Harbor, situated between New Castle and Rye, included the construction of a breakwater off Frost Point (right); a breakwater off Jaffrey Point (left of the Frost Point breakwater); and an entrance channel leading up to the Bascule Bridge (bottom).

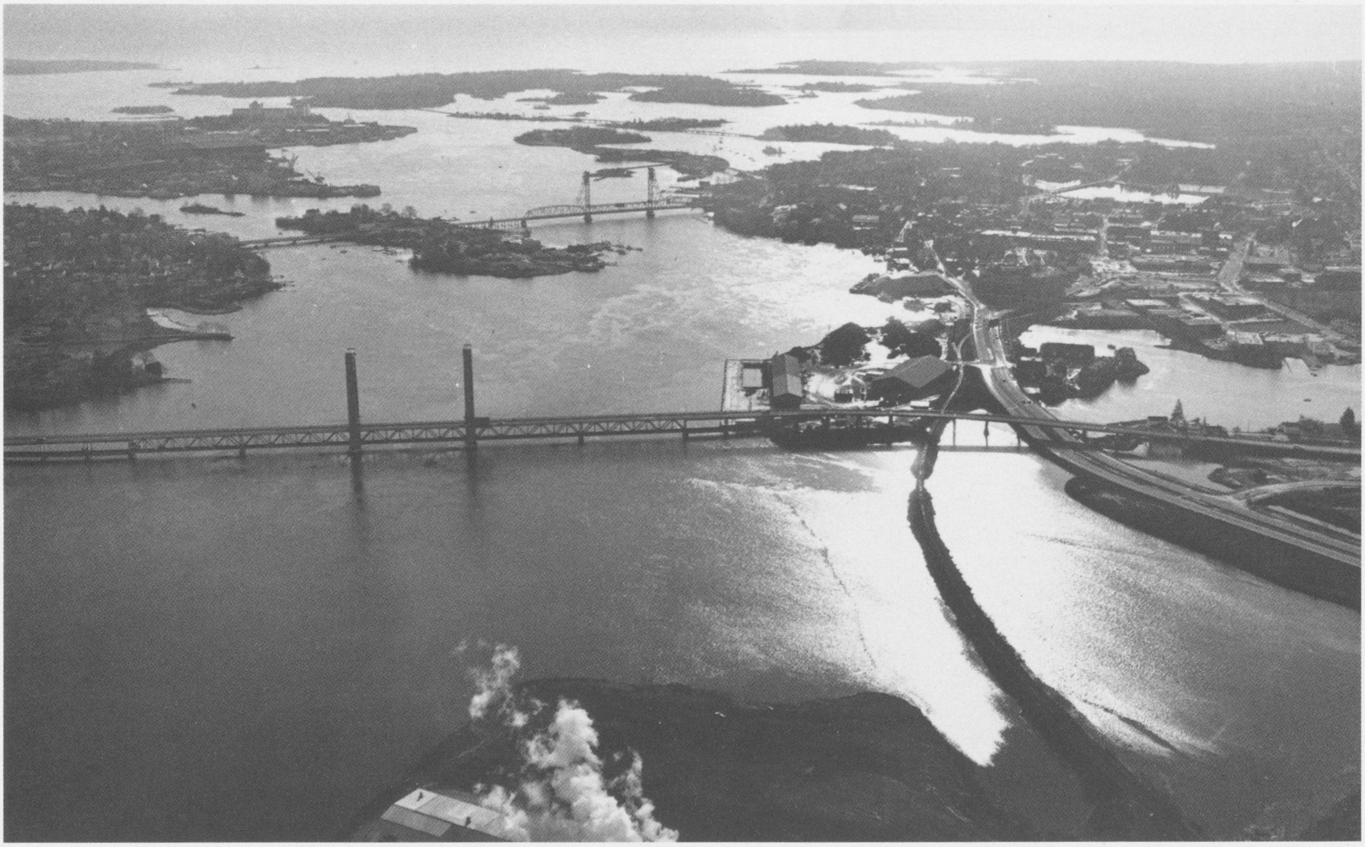
times. The first project, approved by Congress and completed in 1966, consists of:

- A 6.2-mile-long channel, 35 feet deep and generally 400–600 feet wide, extending northwesterly from deep water between New Castle and Seavey Islands (approximately 2.6 miles from the mouth of the Piscataqua River) to a turning basin located about 1700 feet past the Atlantic Terminal Sales dock in Newington. The bends were widened to approximately 700 feet by removing ledge at Henderson Point, Gangway Rock, Badgers Island, the U.S. Route 95 Bridge, and Boiling Rock (The small shoal at the U.S. Route 95 Bridge was removed in 1969).
- Two 35-foot-deep turning basins. The first turning basin is located above Boiling Rock and is 950 feet long. The second is situated at the end of the aforementioned 6.2-mile-long channel in Newington and is 850 feet long.

The Corps completed a second project in 1971 that serves a large recreational and small lobstering fleet based in the area of Sagamore Creek, a popular boating center located at the southerly end of Portsmouth Harbor. This work, constructed as a small project under Section 107 of the Continuing Authorities Program, consists of:

- A 0.4-mile-long main channel extending from Little Harbor, located immediately south of Portsmouth Harbor between New Castle and Rye, through the Bascule Bridge (Route 1B), then west to the mouth of Sagamore Creek. The channel is six feet deep and 100 feet wide. At Sagamore Creek, the channel forks into northern and westerly channels, described below.
- A 75-foot-wide northerly channel, six feet deep, extending 0.7 mile between Leachs Island and Portsmouth to deep water south of the bridge connecting Shapleigh and Goat Islands.
- A 75-foot-wide westerly channel, six feet deep, extending 0.9 mile up Sagamore Creek to the public landing at the Sagamore Avenue Bridge in Rye. A six-foot-deep anchorage, three acres in area, was constructed at the upper end of the channel.

The swift currents of the Piscataqua River make Portsmouth Harbor one of the fastest flowing commercial port waterways in the northeastern United States. Along



Portsmouth Harbor. The 6.2-mile-long channel, 35 feet deep and generally 400 feet wide, was widened by removing ledge in its bends, including one at Badgers Island, just left of center in the photo.

Rye Harbor

with a twisting channel that features sharp bends, inadequate turning basins, constricted areas, narrow lift bridges, and submerged ledges, these fast currents make navigation in Portsmouth Harbor increasingly difficult, especially for vessels approaching 700 feet in length. With petroleum representing over 60 percent of the port's commerce, an accident involving a petroleum carrier could result in an oil spill with catastrophic environmental and economic consequences. In recent years, the amount of waterborne commerce handled by Portsmouth Harbor has increased, and the harbor is expected to play a continuing and significant role in the region's economy. However, unless the harbor is improved to accommodate more and larger vessels and made safer for deep-draft navigation, it will not remain competitive.

At the request of Congress, the Corps studied the harbor's dangerous navigable conditions and designed a plan that addresses the problem. This plan includes widening the section of channel between the two vertical lift bridges from 600 to 1000 feet; widening the northern limit of the channel adjacent to Badgers Island by 100 feet; and widening the southern limit of the channel at Goat Island from 400 to 550 feet.

This work, authorized by the Water Resources Development Act of 1986 and approved by Congress, is scheduled to begin in 1989.

Rye Harbor

Rye Harbor in Rye is located about five miles south of Portsmouth Harbor. Roughly rectangular in shape, Rye Harbor is about 2000 feet long, 900 feet wide, and 39 acres in area. It is used by lobstering and fishing fleets, charter boats, and recreational craft.

In 1941, the state built an eight-foot-deep anchorage, about 10 acres in area, at the head of the harbor. The Corps project was completed in 1962 and consists of:

- A 2300-foot-long channel, 100 feet wide, extending from the ocean to the head of the harbor, immediately north of the state-built anchorage. The channel is 10 feet deep for its first 600 feet, then becomes eight feet deep for 1700 feet, to the head of the harbor.
- A six-foot-deep anchorage, five acres in area, on the north side of the channel.
- An eight-foot-deep anchorage, five acres in area, on the south side of the channel.
- The repair and restoration of two existing state-built breakwaters situated on each side of the harbor entrance. The north breakwater is 540 feet long, and the south breakwater is 530 feet long. The breakwaters were constructed in 1939.
- The removal of two small ledge areas (This work was done in 1964).

Shore and Bank Protection

Of the five New England states with a coastline on the Atlantic Ocean, New Hampshire's 40-mile coast is the shortest. About 28 miles of coastline are privately owned, 10 miles are owned by state and local government, and two miles are owned by the federal government. The state has approximately 4075 miles of rivers and streams, the lowest number in New England next to Rhode Island's 724.

The Corps has constructed six shore and bank protection projects in New Hampshire to stem erosion of the shoreline and riverbanks. Two of these projects were built to protect the shoreline and four were constructed to strengthen inland streambanks. Total construction costs amount to $1.5 million.

The following pages describe the Corps' shore and bank protection projects in New Hampshire. (More information on shore and bank protection is available on page 25).

The shore can take a beating from storm driven winds and waves. In September 1961, Hurricane Esther raised havoc with Rhode Island's Narragansett Pier, slamming waves against the seawall and flooding adjacent streets. (Copyright 1961 The Providence Journal Company*).*

Shore and Bank Protection Projects in New Hampshire

Charlestown

Hampton Beach

North Stratford

Shelburne

Wallis Sands State Beach

West Stewartstown

The 1300 feet of stone slope protection along the Connecticut River in Charlestown protects the town's wastewater treatment facility (center).

Charlestown

The project in Charlestown is located along the Connecticut River, which comprises the New Hampshire-Vermont border. Charlestown is about 25 miles north of Keene.

A section of the Connecticut River's left bank, near Charlestown's wastewater treatment facility, was eroding at the rate of 8–10 feet a year, posing a threat to the plant's stability. This section of the river is part of a pool used by the New England Power Company's hydroelectric power plant in Bellows Falls, Vermont, located about seven miles downstream. The erosion of the river's left bank was caused by the river's high velocity during flood periods, and also its oscillating water levels, which fluctuated relative to the amount of electricity being generated at the plant.

To stem the erosion and protect the wastewater treatment facility, the Corps constructed 1300 feet of stone slope protection along the east bank. The project was built between October 1974 and January 1975 at a cost of $113,000. It is a small project, constructed under Section 14 of the Continuing Authorities Program.

Hampton Beach

Hampton Beach in Hampton is one of the most popular public beaches in New England. It is approximately 12 miles south of Portsmouth and 1.5 miles north of the New Hampshire-Massachusetts state line.

The Corps first completed work at Hampton Beach in 1955 when 6450 feet of beach was restored and widened by the direct placement of sand. The work begins at Haverhill Street and heads north along the shoreline. The first 5200 feet were widened to a general width of 150 feet, and the last 1250 feet of beach were widened to 175 feet. The cost of this work was $374,300.

In 1965, the Corps completed additional work at Hampton Beach. The northern 2200 feet of beach was replenished, and a 190-foot-long stone groin was constructed. The beach nourishment starts in the vicinity of Church Street and continues northward, and consists of sand obtained from the dredging of the channel at Hampton Harbor (page 94). This additional work cost $272,200.

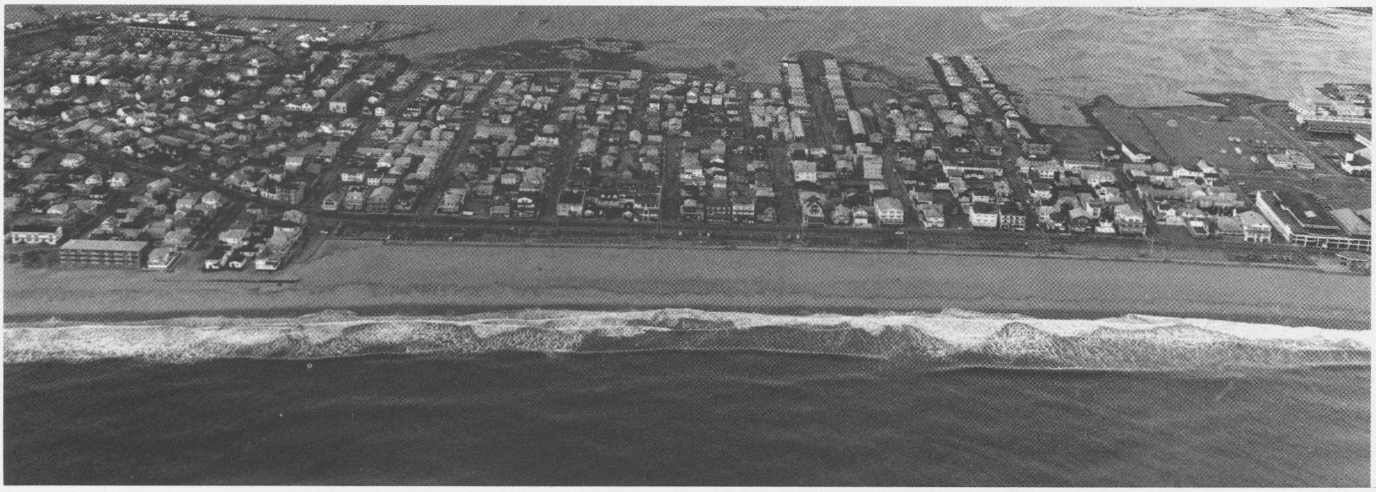
The beach was seriously damaged by a storm in February 1972, when much of the New Hampshire coastline was declared a National Disaster Area. The Corps completed a restoration of the beach in September 1973 at a cost of $415,000.

North Stratford

This project, located in the North Stratford section of Stratford, is situated along the left bank of the Connecticut River, adjacent to the Bloomfield (Vermont)-North Stratford Bridge on Route 105 and the town's fire station. The project is about 20 miles south of the Canadian border.

North Stratford suffered serious flooding from ice jams in 1964, 1970, and 1973. In March 1979, an ice jam caused record flooding, washing away 2000 feet of the Canadian National Railroad, destroying 27 homes, and causing damages estimated at $3.5 million. These floodwaters significantly undercut a section of the Connecticut River's left bank where the fire station is located, posing an immediate threat to the facility. This section of the left bank, situated at a bend in the river, is subject to ice flow abrasion and had eroded considerably since the fire station was constructed two years previously. The fire station also housed the town library and selectman's office.

To stem further erosion and safeguard the fire station, the Corps built 300 feet of stone slope protection along the riverbank. Constructed between October-December 1981, the work cost $180,000. It is a small project, built under Section 14 of the Continuing Authorities Program.



Hampton Beach

Shelburne

The project in Shelburne is located along the Androscoggin River at the Easterly Bridge, which provides access to the town's Hark Hill section. Shelburne lies on the New Hampshire-Maine border, about 95 miles north of Portsmouth.

The accumulation of silt and gravel along the right bank of the river at the Easterly Bridge narrowed the river's width from approximately 400 feet to 250 feet. The restricted channel diverted the flow of the river to the left bank, resulting in considerable erosion of the bank and the undermining of a bridge pier, which threatened the bridge's stability.

The project involved placing 200 feet of stone slope protection along the left riverbank to stabilize the bank and protect the endangered pier. The stone slope protection was constructed upstream and downstream of the Easterly Bridge and around the pier. Work took place between May-August 1977 at a cost of $37,700. It is a small project, built under Section 14 of the Continuing Authorities Program.

About 300 feet of stone slope protection along the Connecticut River in North Stratford protect a fire station that had been threatened by erosion.

Severe erosion along the bank of the Androscoggin River at the Easterly Bridge in Shelburne had seriously undermined a bridge pier. The Corps responded by constructing 200 feet of stone slope protection upstream and downstream of the Bridge and around the pier.

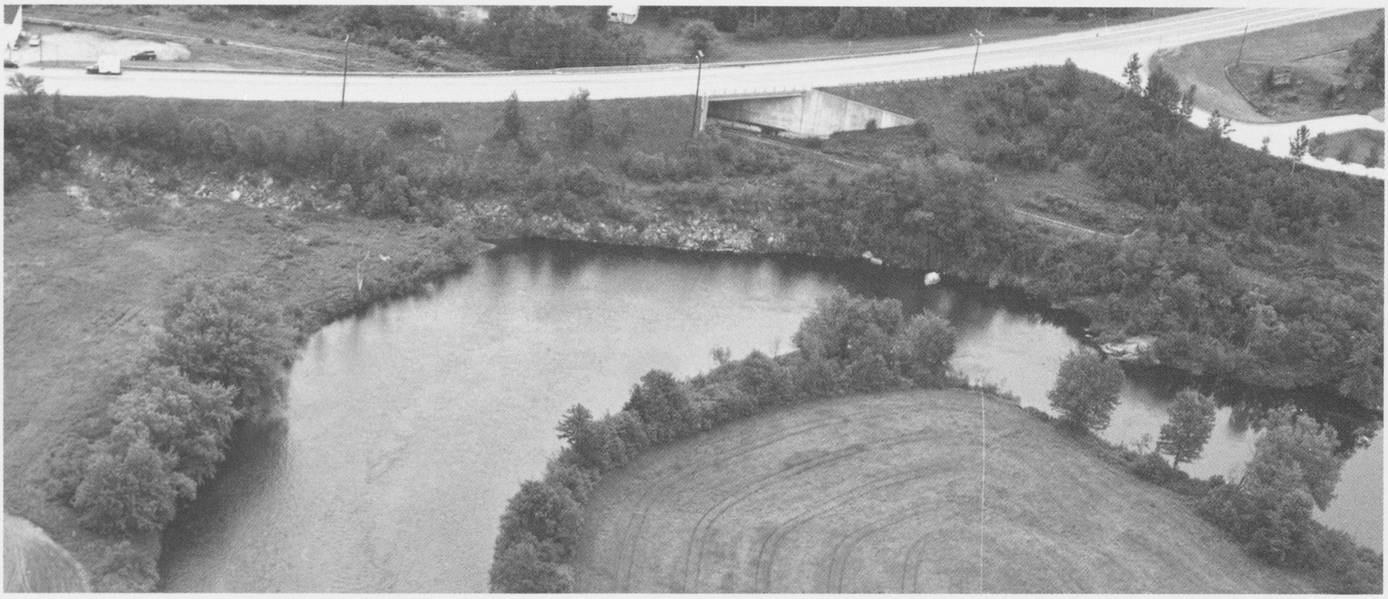
Wallis Sands State Beach

Wallis Sands State Beach in Rye is about five miles south of Portsmouth and about nine miles northeast of the New Hampshire-Massachusetts state line.

The project involved widening the northernmost 800 feet of the beach to a general width of 150 feet by the direct placement of sand, and constructing a 350-foot-long stone groin at the beach widening's southern limit. The work was completed in 1963 at a cost of $501,000.

The beach and groin were seriously damaged by a storm in February 1972, when much of the New Hampshire coastline was declared a National Disaster Area. The Corps completed a restoration of the beach in September 1973 at a cost of $95,000.

Wallis Sands State Beach in Rye.



Two sections of earthfill dike totalling 657 feet help protect the farmlands of Coos County Institution in West Stewartstown from high velocity flooding and soil erosion. The Corps-built sections of dike replace segments of privately-built dike weakened during heavy flooding in 1973 and 1974. Pictured above is the 500-foot-long northerly dike segment at a bend in the Connecticut River.

West Stewartstown

This project, located in the West Stewartstown section of Stewartstown, is situated along the Connecticut River in the northwest corner of the state, near New Hampshire's border with Canada and Vermont. It is about 150 miles north of Concord.

Three severe floods within a 13-month span caused serious crop damage at the farm division of Coos County Institution in West Stewartstown. In addition to a farm, this 1100-acre facility, established in 1867, includes a jail and nursing home. In June 1973, 200 feet of a privately-built earthfill dike was breached, resulting in high velocity floodwaters racing across the low-lying farm fields. About 60 acres of crops were flooded to an average depth of one to two feet, substantially eroding the topsoil. In December 1973 and in July 1974, the farm again experienced severe flooding, with the river trying to establish a new course through the farmlands.

To protect the farm fields and crops, the Corps constructed a total of 657 feet of earthfill dike with stone slope protection in two places along the left bank of the Connecticut River. The work replaces the section of dike that was breached and provides additional protection to the existing dike. The northerly dike work is 500 feet long, and the southerly dike work is 157 feet long. Although the project will not prevent overbank flooding, it will protect the farmlands from high velocity flooding and prevent further soil erosion and subsequent deposition downstream.

The project was constructed between November-December 1975 at a cost of $54,700. It is a small project, constructed under Section 14 of the Continuing Authorities Program.

Studies

Studies

Before taking measures to resolve a water resources problem, the Corps will study the affected area to determine if a project is feasible. The study examines a wide range of potential solutions based on their economic and engineering practicality, acceptability, and impact on the environment.

Listed below are areas in New Hampshire where the Corps has examined (since 1981) the feasibility of building major projects for flood damage reduction, navigation, or shore and bank protection purposes.

Flood Damage Reduction

Androscoggin River Basin

At the request of Congress, the Corps is studying structural and nonstructural ways to reduce flood damages in the Androscoggin River Basin (page 49). Floods usually occur in the spring from heavy rain combined with melting snow and the breakup of ice. Properties in the basin sustained extensive damages estimated between $12–25 million during the flood of April 1987. While the study's emphasis will be on flood problem areas, other related water problems and needs will also be examined.

Ashuelot River

The 64-mile-long Ashuelot River rises at North Pond in Washington and flows in a generally southwesterly direction through several towns, including Gilsum, Keene, and Winchester, before flowing into the Connecticut River in Hinsdale.

In late May and early June 1984, flooding from the Ashuelot River caused extensive damage to several residential and commercial properties in Swanzey, Winchester, Hinsdale, and particularly Keene. The Corps studied structural and nonstructural ways to alleviate potential flooding in these and 16 other southwestern communities within the river's 421-square-mile drainage area. However, it was found that Corps involvement was not economically justified.

Mascoma River

Located in west central New Hampshire, the Mascoma River rises in Dorchester and flows for 34 miles before entering the Connecticut River in Lebanon.

In late May and early June 1984, a severe storm resulted in heavy flood losses to commercial and residential properties, roads, bridges, and agricultural lands situated along the Mascoma River. The Corps studied structural and nonstructural ways to solve the potential flooding in eight communities within the river's 194-square-mile drainage area, with the more serious flood problem areas located in Canaan, Enfield, and the Mahan Flats and Riverdale sections of Lebanon.

Upon conclusion of the study, it was found that Corps involvement was not economically justified.

Saco River

The Saco River begins at the outlet of Saco Lake in the community of Hart's Location, located in New Hampshire's Crawford Notch area. The river follows a southeasterly course for 125 miles and empties into the Atlantic Ocean at a point between Maine's twin coastal cities of Biddeford and Saco.

The Saco River is subject to frequent flooding, which damages commercial and residential properties along its riverbanks. In only the past 10 years, four major floods have occurred along the river, including the flood of April 1987, which caused damages to public property estimated at $2 million.

At the request of Congress, the Corps is presently identifying flood problem areas on the river, with an emphasis on developing structural and nonstructural plans that would reduce the potential of future flood losses. Although the study's major emphasis will be on flood problem areas, other related water problems and needs will also be examined.

Spicket River

The Spicket River rises at Big Island Pond in Derry and flows in a southerly direction for about 16.5 miles, through Salem and the adjacent downstream Massachusetts communities of Methuen and Lawrence, before entering the Merrimack River in Lawrence.

The heavy rains of April 1987 caused commercial and residential flood losses in these communities from Spicket River flooding. Flood damage areas in Salem include the Haigh Avenue area, which is situated between the confluence of the Spicket River and Policy Brook, and the southern end of Route 28.

After studying ways to reduce flood damages in these communities, the Corps concluded that it was economically feasible to floodproof 30 residences along Haigh Avenue in Salem. The Corps also concluded that flood protection measures for Methuen and Lawrence were not economically justifiable at this time.

Winnipesaukee River

Flood damages often occur to property fronting Lake Winnipesaukee and property situated along the banks of the Winnipesaukee River during periods of heavy precipitation. During minor and moderate flooding, the total volume of runoff can either be stored in Lake Winnipesaukee, released from the state-operated Lakeport Dam in Laconia that borders the lake, or both. However, during periods of severe flooding, the available storage in Lake Winnipesaukee and the amount of water released from Lakeport Dam are too limited to handle the excess runoff. At Lake Winnipesaukee, major flooding results in rising water levels, which flood lakefront properties. If these floodwaters are discharged through Lakeport Dam, the channel capacity of the Winnipesaukee River would be exceeded and riverfront properties would be subject to flood damage.

A plan to reduce the risk and severity of flood damage has been developed by the Corps of Engineers. The proposal involves adjusting the schedule when Lake Winnipesaukee is filled in the spring and drawn down in the fall (this is done by the state), and constructing channel modifications along the river. The channel modifications, which include altering a bridge, deepening a channel, removing a dam, and floodproofing residences, will increase the river's flow and allow for greater discharges from Lakeport Dam during major flooding. The modifications would be constructed in the communities of Franklin, Tilton, Northfield, and Laconia.

In 1987, the Corps received approval from its Washington, D.C. headquarters to proceed with plans and specifications for the estimated $5.5 million project. However, that effort was deferred until the end of the 1989 Legislative session because local funding (over $4 million) for the project was not included in the 1988 state budget. During the 1989 Legislative session, the New Hampshire State Senate voted against providing local funding to construct the project. Consequently, the Corps terminated its involvement with the project.

(More information on the existing navigation project at Lake Winnipesaukee can be found on page 95).

Appendix

Communities with Corps Projects

The communities listed below have either Corps' lands or Corps-built projects lying within their borders. The listing indicates the project name, its purpose (Flood Damage Reduction, Navigation, or Shore and Bank Protection), and the page number in this booklet where the project is described.

Glossary

Anchorage—an area dredged to a certain depth to allow boats and ships to moor or anchor.

Bedrock—rock of relatively great thickness lying in its native location.

Breakwaters—structures, usually built offshore, that protect the shoreline, harbor, channels, and anchorages by intercepting the energy of approaching waves.

Bulkheads—steel sheet piling or timber walls that prevent sliding of the land and protect the streambank or shoreline from erosion.

Conduits—concrete tunnels or pipes that divert floodwaters around or under potential flood damage sites.

Culverts—large pipes, usually constructed below bridges and other water crossings, that allow water to pass downstream and provide support to the crossing.

Dikes—earthfill barriers that confine floodwaters to the river channel, protecting flood prone areas.

Drainage Area—the total land area where surface water runs off and collects in a stream or series or streams that make up a single watershed.

Drop Structure—a device in a stream or channel that prevents water from rising above a certain elevation. Once water reaches a certain level, excess water passes over the structure and is diverted to another body of water.

Earthfill—a well graded mixture of soil containing principally gravel, sand, silt, and clay, which is used with other materials to construct dams, dikes, and hurricane protection barriers.

Environmental Assessment—an examination of the positive and adverse impacts on the environment of a proposed water resources solution and alternative solutions.

Environmental Impact Statement—a detailed environmental analysis and documentation of a proposed water resources solution when the proposed solution is expected to have a significant effect on the quality of the human environment or the area's ecology.

Feasibility Study—a detailed investigation, conducted after the reconnaissance study is completed, that recommends a specific solution to a water resource problem.

Floodplain—the land adjoining a river, stream, ocean, or lake that is likely to be flooded during periods of excess precipitation or abnormal hightide.

Floodproofing—structural measures incorporated in the design of planned buildings or alterations added to existing ones that lessen the potential for flood damage. For example, existing structures could have their basement windows blocked, or structures in the design stage could be built on stilts or high foundations.

Floodwalls—reinforced concrete walls that act as barriers against floodwaters and confine them to the river channel, protecting floodprone areas. Floodwalls are usually built in areas with a limited amount of space.

Gabion Wall—a retaining wall constructed of stone-filled wire mesh baskets.

Groins—structures that extend perpendicular from the shore in a fingerlike manner to trap and retain sand, retarding erosion and maintaining shore alignment and stability.

Hurricane Protection Barriers—structures built across harbors or near the shoreline that protect communities from tidal surges and coastal stormflooding. They are often constructed with openings for navigational purposes.

Intake Structure—found at the entrance to a conduit or other outlet facility, an intake structure allows water to drain from a reservoir or river and is equipped with a trash rack or other feature that prevents clogging from floating debris.

Jetties—structures that stabilize a channel by preventing the buildup of sediment and directing and confining the channel's tidal flow. Jetties are usually built at the mouth of rivers and extend perpendicular from the shore.

Outlet Works—gated conduits, usually located at the base of a dam, that regulate the discharge of water.

Pumping Station—a structure containing pumps that discharges floodwaters from a protected area over or through a dike or floodwall and into a river or ocean.

Reconnaissance Study—a preliminary study that examines a wide range of potential solutions to a water resources problem, each of which is reviewed for its economic and engineering practicality, acceptability, and impact on the environment.

Recreation Pool—any permanent body of water impounded by a dam that offers recreational opportunities or promotes fishery and wildlife habitat.

Retaining Walls—walls made of stone, reinforced concrete, precast concrete blocks, or gabion that support streambanks weakened by erosion.

Revetment—a facing of stone or concrete constructed along a backshore or riverbank to protect against erosion or flooding.

Sand Drain—a layer of pervious materials, such as sand and gravel, placed beneath the downstream section of a dam that carries seepage to the dam's downstream limits and out into the stream.

Sand Replishment—quantities of sand placed on a shoreline to restore or widen a beach's dimensions. Sand replenishment strengthens beaches affected by erosion, protects the backshore from wave action, and stops the inland advance of water.

Seawall—a reinforced concrete wall built along a shoreline to protect against erosion or flooding.

Snagging and Clearing—the removal of accumulated snags and debris, such as fallen trees, dead brush, and silt, from river and stream channels. Snagging and clearing improves a channel's flow capacity and eliminates a potentially dangerous flood situation.

Spillway—a channel-shaped structure, usually made of concrete or excavated in rock, that allows water exceeding the storage capacity of a reservoir to pass through or around a dam instead of overtopping it.

Stone Slope Protection—a layer of large stones, usually underlain by a layer of gravel bedding, designed to prevent erosion from stream flow, wave attack, and runoff.

Stoplog Structure—a designed opening in a floodwall or dike that allows the passage of water during nonflood periods but closes during flood periods to prevent flooding downstream. Stoplog structures can be made of wood or steel or concrete beams.

Training Dike—a structure extending from the shore into the water that redirects the current, preventing sediment from settling and ensuring that adequate depths are maintained.

Training Wall—a structure built along channel banks to narrow the channel area, thereby controlling the velocity of the flow of water and preventing the buildup of sediment. Training walls and training dikes have the same purpose: to ensure adequate depths are maintained.

Vehicular Gate—an opening in a dike or floodwall that allows rail cars or other vehicles to pass over the structure during nonflood periods. Vehicular gates can be closed during flood periods by either stoplogs or large steel gates.

Weir—a concrete structure designed as part of the spillway that allows water to flow from the reservoir and over the spillway.

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