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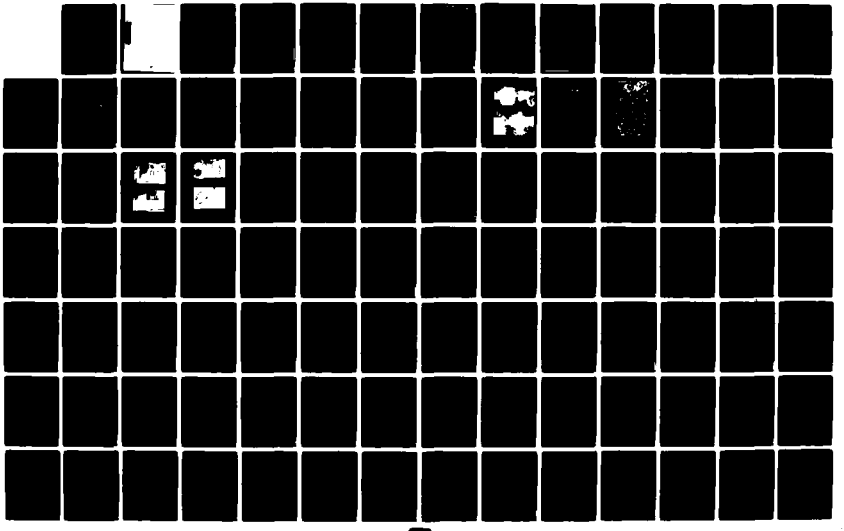

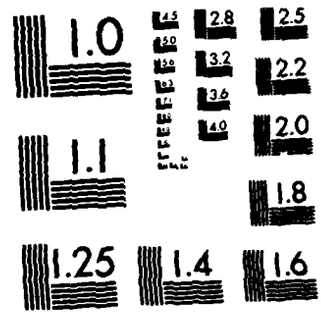

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Cover Title Reads: Flood Damage Reduction

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Flood control	Flood routing	Pawtucket River
Flood forecasting	River Basins	
Floods	Rivers	

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This Detailed Project Report presents the results of an investigation of flooding conditions along the Pawtuxet River in the city of Warwick, R.I. Recurring flood damages to property has caused structures to deteriorate. Purpose of study is to develop solution to the flood problems. This report has resulted in the selection of a propsed plan of local protection. This has been set forth as guidance in the formulation of the water resources development project.

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LOCAL FLOOD DAMAGE REDUCTION STUDY

PAWTUXET RIVER

WARWICK, RHODE ISLAND

DETAILED PROJECT REPORT

FOR

WATER RESOURCES DEVELOPMENT

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS 02254

JUNE 1982

SYLLABUS

This study is authorized under the special continuing authority contained in Section 205 of the 1948 Flood Control Act, and investigates a variety of flood control measures to reduce recurring flood damages in the Norwood section of Warwick, Rhode Island, locally referred to as Belmont Park.

Flooding occurred most recently in January 1979 when a combination of above normal temperatures and precipitation caused the Pawtuxet River to overflow its banks, inundating about 30 acres of land in the Belmont Park area. Isolation from public services and the loss of utilities forced numerous families to temporarily evacuate their homes. The flooding problem in Belmont Park has worsened in recent years due to upstream development. Residents of the area have stressed that prompt action must be taken if a disaster is to be avoided.

Flood damage surveys revealed that under present conditions, losses from the recurrence of the 1979 flood would total $750,000. The frequency of this event was estimated at 5 percent (once in 20 years). If a flood having a magnitude of once in 100 years were to occur, it would result in approximately $2 million in losses.

The flooding problem at Belmont Park was initially identified during the Congressionally authorized study of the Pawcatuck River and Narragansett Bay (PNB) Drainage Basin. During these earlier studies, numerous structural alternatives were developed to reduce flooding along the Pawtuxet River, including the Belmont Park area. However, these structural plans did not receive public support and were eliminated from further investigation. Earlier studies did determine that economic justification existed for a nonstructural plan, consisting of acquiring flood plain properties in Belmont Park, and recommended that this alternative be investigated further.

Recent efforts have concentrated on developing nonstructural plans that are both economically justified and publicly acceptable. This report recommends a four-part plan involving the following measures:

(1) The acquisition and demolition or removal of 59 homes and associated site work;

(2) The acquisition of 19 privately-owned vacant lots;

(3) The construction of 17 utility room additions; and

(4) The installation of an automated flood forecasting and warning system.

The total estimated first cost of this plan is $3,760,000 (January 1982 price levels), of which $3,008,000 would be a Federal cost and $752,000 non-Federal. The annual cost of this plan would be $295,300. When compared to the annual benefits of $401,700, the benefit-to-cost ratio is 1.4 to 1. Annual operation and maintenance costs are currently estimated at $1,300.

APPENDICES

LIST OF PLATES AND FIGURES

LIST OF PHOTOGRAPHS

INTRODUCTION

This Detailed Project Report presents the results of an investigation of flooding conditions along the Pawtuxet River in the city of Warwick, Rhode Island. Recurring flood damages to property located in the Norwood section of Warwick, locally referred to as Belmont Park, has caused structures to deteriorate, resulting in a severe financial and social burden to the owners and residents. The purpose of this report is to develop solutions to the flood problem and provide sufficient information on the suggested alternative plans to enable the choice of a sound, economical and desirable flood damage reduction program for Belmont Park.

The flooding problem in Belmont Park has worsened in recent years, as a result of upstream development. Residents of the area have stressed that prompt action must be taken if a disaster is to be avoided. In a letter, dated 26 November 1979, the Office of the Chief of Engineers (OCE) suggested that, given the scope of the flood problem and its probable solution, detailed study of the flooding problem in Belmont Park might best be expedited under Section 205 authority. Mayor Joseph W. Walsh endorsed this approach in a letter dated 8 December 1980. This Detailed Project Report is a result of his request for assistance under Section 205 of the 1948 Flood Control Act.

STUDY AUTHORITY

This report has been prepared under the special continuing authority contained in Section 205 of the 1948 Flood Control Act, as amended by Section 133(b) of the Water Resources Development Act of 1976 (PL 94-587). The full text of this authority is contained in Appendix 1. The Office of the Chief of Engineers authorized preparation of this Detailed Project Report on 15 May 1981.

SCOPE OF STUDY

This report has resulted in the selection of a proposed plan of local flood protection for the Belmont Park area of Warwick. Specific problem and opportunity statements and planning considerations have been set forth as guidance in the formulation of this water resources development project.

Detailed hydrologic and economic studies were performed to determine feasibility and the optimum method and level of flood protection. Although the hydrologic analysis encompasses the entire Pawtuxet River Basin, flood control measures formulated during the study focus specifically on the Belmont Park area of Warwick.

The economic analysis included detailed field surveys to assess the total monetary value of flood damages experienced during past flood events. Using stage-frequency curves, developed in the hydrologic studies, these damages have been correlated to floods of varying magnitude to assess the full range of damages likely to be experienced. This information provided the basis for a benefit analysis of each proposed structural and nonstructural alternative.

An engineering analysis was performed to determine the cost of each alternative. Estimated costs for nonstructural alternatives were based on real estate property appraisals.

Investigation of social impacts was of particular importance because of the number of families which would be relocated under nonstructural alternatives. Close contact was maintained with residents who would be relocated to determine their feelings and attitudes toward the proposal. The feedback received as a result of these social investigations provided a useful means of plan evaluation. (See Appendix 2 - Social and Economic Impact Assessment)

The study includes an examination of the environmental characteristics of the Belmont Park area and presents a projection of future conditions. Plan evaluation is further facilitated by a comparison of these future conditions, both with and without the implementation of a flood protection plan.

The Detailed Project Report presents each of these studies in complete form in the appendices. The main report draws on their conclusions to systematically formulate, screen and ultimately select the most appropriate flood protection project for Belmont Park.

STUDY PARTICIPANTS AND COORDINATION

Throughout the planning process coordination of the study has been maintained with Federal, State, and local officials, as well as with concerned individuals. Meetings have been held to exchange information concerning the flood problem in Belmont Park and to discuss possible solutions, as well as clarify the authorities of the Corps of Eningeers in providing assistance.

A workshop meeting was held on 1 June 1981 with local officials and citizens to present our plans for conducting the study and to discuss alternatives developed during previous studies. In September 1981, a questionnaire was circulated to those who would be affected by a nonstructural flood control plan, in order to gather information and reaction to the proposal. Subsequent meetings were held with local officials and citizens, as well as Congressional representatives on 20 November 1981 and 12 December 1981.

A brochure containing information on proposed alternatives was circulated to residents of Belmont Park in March 1982 to acquaint them with our study efforts and solicit their input.

The draft Detailed Project Report and Environmental Assessment were distributed to Federal, State and local agencies for their review during May 1982. Responses to this distribution are summarized in Appendix 3. Coordination with the U.S. Fish and Wildlife Service has resulted in a planning aid letter, which is also exhibited in Appendix 3.

OTHER STUDIES

An Interim Report on Big River Reservoir in the Pawtuxet River Basin was released for public review in July 1981. It presents the results of a study of the flooding and water resources problems in the Pawtuxet River Basin (see Plate 1 - Watershed Map). The Pawtuxet River Watershed Report was submitted in partial response to seven Congressional resolutions combined under one resolution adopted by the Committee on Public Works of the United States Senate. These resolutions authorized the Pawcatuck River and Narragansett Bay Drainage Basin (PNB) Study, which includes the Pawtuxet River Basin.

Numerous alternative plans for flood control and allied purposes at various problem areas along the Pawtuxet River were evaluated during the Pawtuxet River Basin Study. Plans included upstream tunnel diversion, construction of levees and floodwalls in the Warwick Avenue and Belmont Park areas, flood control storage at the proposed Big River Reservoir and nonstructural measures to reduce flood damage.

The Pawtuxet River Watershed Report determined that economic justification existed for the Warwick Avenue Local Protection Project (levees and floodwalls for the Warwick Industrial Park) and a nonstructural plan consisting of acquiring flood plain properties in the Belmont Park area. Study of the Big River Reservoir proposal remains within the framework of the PNB Study. The Warwick Avenue Local Protection Project was not recommended because of a lack of local support.

Numerous reports have been prepared focusing on the Pawtuxet River watershed. Some of the more pertinent reports are listed below:

Flood Control Survey Report of 1939

The New England-New York Inter-Agency Committee Report, March 1955

Narragansett Bay Area Hurricane Survey Reports, August, 1957

Rhode Island Water Supply Reports, June, 1967

Northeastern United States Water Supply Study Feasibility Report, November, 1969

Flood Control Reconnaissance Report, December, 1971

North Atlantic Regional Water Resources Study Report, June, 1972

Cranston Flood Hazard Analysis Report, September, 1973

Flood Control Project Environmental Reports, February, 1975

Southeastern New England Study, March, 1976

EPA Water Quality Study, September 1975

PNB Water Supply, Study, January 1979

U.S.G.S. Water Resources Investigations

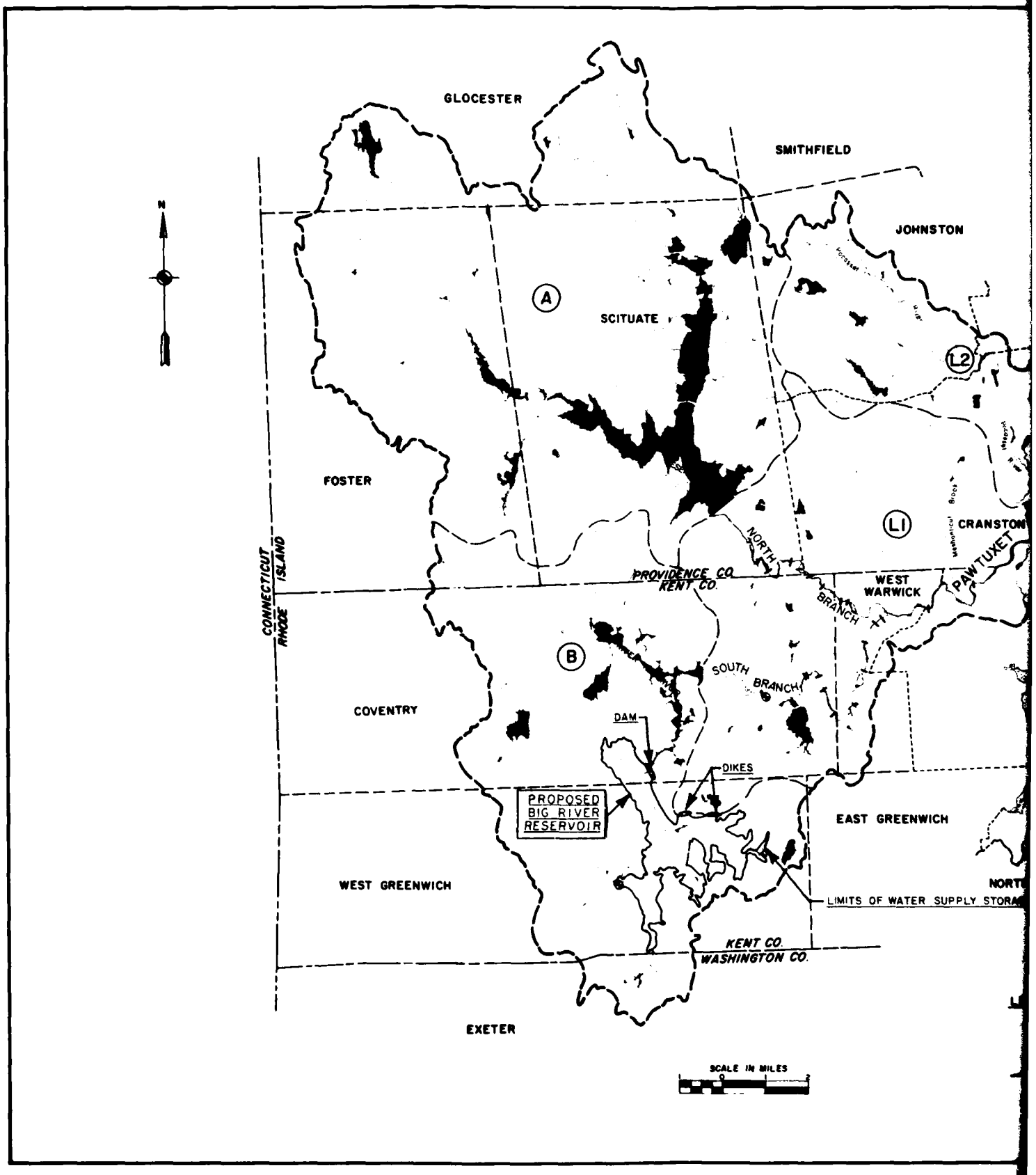
Flood Insurance Studies under the authority of the National Flood Insurance Act of 1968 have been completed for Coventry, Cranston, Providence, Exeter, Johnston, Warwick, West Warwick and West Greenwich, Rhode Island. These communities are now in the Regular Program.

THE REPORT AND STUDY PROCESS

This Detailed Project Report is the basis on which the Chief of Engineers authorizes a project for construction. The main report reflects the planning process: beginning with an identification of the flood problems, followed by the development of alternative measures of flood control, and concluding with an assessment of each final alternative and the selection of a recommended plan. Technical and nontechnical information is presented throughout the main report to support the essential analysis and conclusions recommending Federal participation in a local flood protection project. The appendices contain detailed reports that more readily facilitate engineering review.

The level of detail and extent of engineering work in the design appendix is sufficient to proceed directly to the preparation of final plans and specifications.

The problems and needs of the community have been addressed at meetings with State and local officials, residents of Belmont Park, and other interested citizens. An impact assessment has been performed to determine both short and long range effects of project implementation. A system of accounts evaluation is included as a viable assessment of all economic and environmental issues investigated during the study.


GLOCESTER
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A
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L2
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NORTH
BRANCH
PROVIDENCE CO.
KENT CO.
WEST
WARWICK
PAWTUXET
CONNECTICUT
RHODE ISLAND
B
SOUTH BRANCH
COVENTRY
DAM
DIKES
PROPOSED
BIG RIVER
RESERVOIR
EAST GREENWICH
WEST GREENWICH
LIMITS OF WATER SUPPLY STORA
KENT CO.
WASHINGTON CO.
EXETER
SCALE IN MILES
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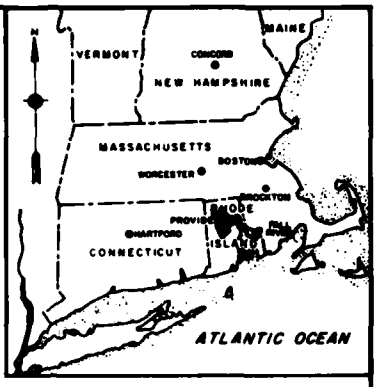


LOCATION MAP

SCALE IN MILES
0 10 20 30 40 50

BASIN SUB-DIVISIONS		
AREA	DESCRIPTION	DRAINAGE AREA SQUARE MILES
A	Scituate Reservoir	92.8
B	Flat River Reservoir	56.7
L1	Local to USGS Gage Cranston	50.5
L2	Local From Cranston Gage to Mouth	30.4

JOHNSTON
PROVIDENCE
EAST PROVIDENCE
L2
PROVIDENCE CO.
BRISTOL CO.
PROVIDENCE RIVER
PAWTUXET RIVER
PAWTUXET COVE
L1
CRANSTON
ELMWOOD AVE
BELMONT PARK
PAWTUXET
WEST WARWICK
WARWICK
NARRAGANSETT BAY
GREENWICH BAY
KENT CO.
WASHINGTON CO.
NEWPORT CO.
T GREENWICH
NORTH KINGSTOWN

OF WATER SUPPLY STORAGE

LEGEND

- Stream Gaging Station
- Existing Dams
- Basin and Sub-area Limits

REVISION	DATE	DESCRIPTION	BY

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

WATER RESOURCES DEVELOPMENT PROJECT

PAWTUXET RIVER BASIN

WATERSHED MAP

PAWTUXET RIVER RHODE ISLAND

APPROVED DATE

SCALE SPEC NO

SHEET

PLATE 1

2

PROBLEM IDENTIFICATION

A precise definition of the flood problem in the Belmont Park area of Warwick is essential to the formulation of an effective water resources project. This section of the report draws on hydrologic, economic, environmental, and cultural studies to obtain the definition. The flood problem was also verified at several meetings with local and state officials as well as Belmont Park residents that have experienced flooding in the past.

THE STUDY AREA

The city of Warwick is located on the westerly side of Narragansett Bay in central Rhode Island, approximately 10 miles south of Providence. The city has a land area of about 33 square miles. Its population of approximately 87,123 (1980 Census) makes it the second most populous city in the State.

The proposed project area involves approximately 38 acres of land in the Belmont Park section of Warwick. The area is bounded by the Pawtuxet River on the west, north, and east and by the limits of the 100-year flood plain on the south (see Plate 2). Delineation of the 100-year flood plain was estimated using available information; additional survey will be required before final plans and specifications can be prepared. The study area encompasses the entire city of Warwick, but particular attention has been directed toward the Belmont Park area.

Climatology

The Pawtuxet River Basin has a variable climate but, due to its proximity to Narragansett Bay, escapes the severity of cold and depth of snowfall experienced in the higher elevations of the interior areas of New England. It frequently experiences periods of heavy precipitation produced by local thunderstorms and intense "lows" of tropical and extratropical origin that move northeasterly up the coast. The basin also lies in the path of the prevailing "westerlies" which generally travel across the country in an easterly or northeasterly direction producing frequent weather changes.

The average annual temperature of the Pawtuxet River Basin is about 50° Fahrenheit. Extremes in temperature range from occasional highs of 100° to lows of -15° Fahrenheit. Freezing temperatures may be expected from the latter part of October until the middle of April.

The mean annual precipitation over the Pawtuxet River Basin varies from about 40 inches in the lower coastal areas to about 48 inches in the uplands. Distribution of the precipitation is quite uniform throughout the year. However, extremes in monthly values range from a high of more than 12 inches to less than 0.20 inch on several occasions.

The average annual snowfall over the Pawtuxet River Basin is about 40 inches. Water content of the snow cover usually reaches a maximum about the first of March but rarely exceeds 2 to 3 inches due to the moderating effect of Narragansett Bay.

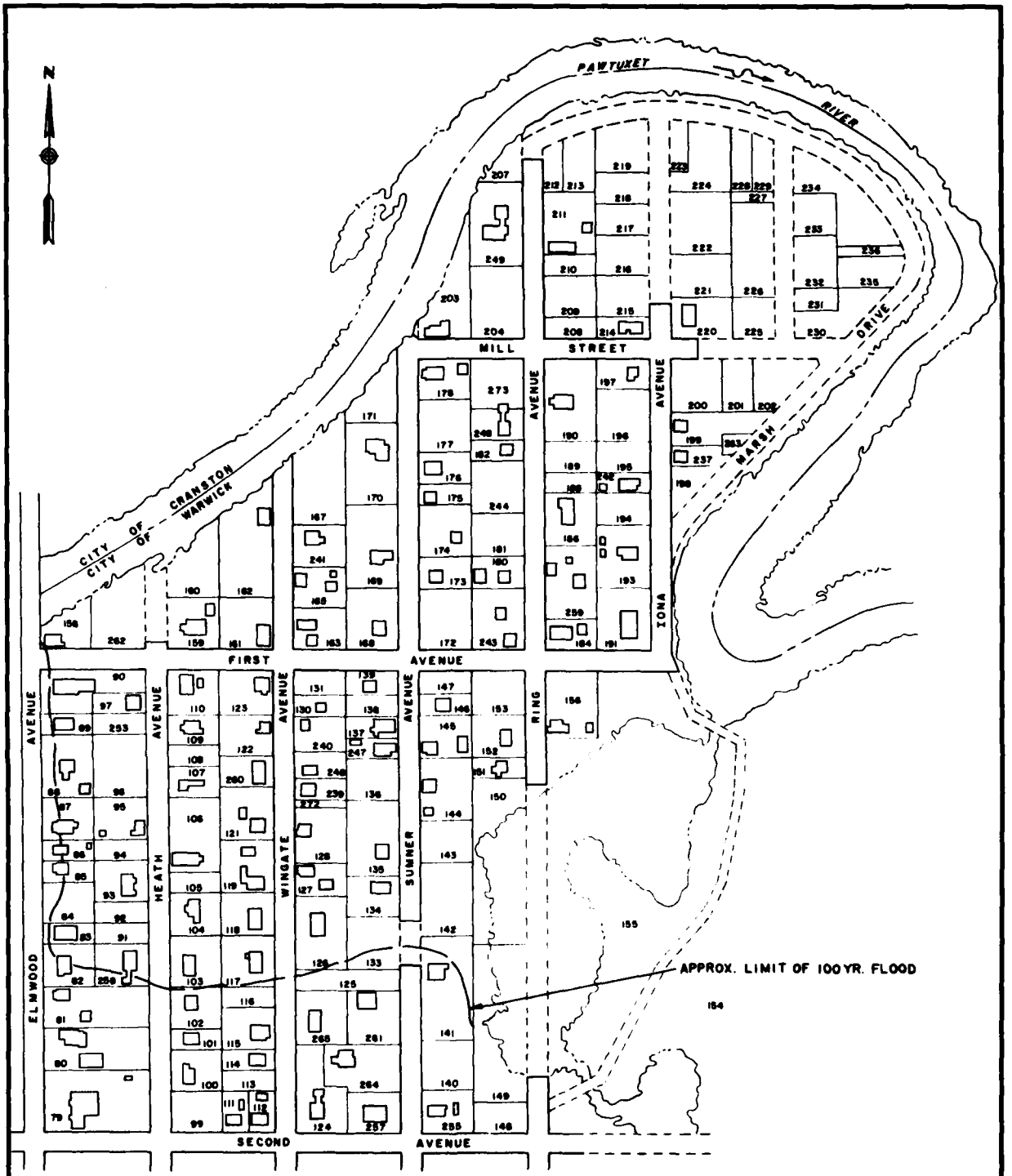
Basin Description

The Pawtuxet River Basin (see Plate 1) lies entirely within the State of Rhode Island and covers a total area of 230 square miles. The drainage area of the river at the Belmont Park site is about 224 square miles. The basin is generally triangular in shape with a north-south base of 23 miles and an east-west length of about 18 miles. Drainage in the basin is generally west to east and the watershed has a variable hydrologic character. The westerly headwater region is quite hilly with little urban development, whereas the lower easterly portion is very flat and quite highly urbanized. The water resources of the westerly headwater region have been extensively developed for domestic and industrial water supply. Scituate Reservoir on the North Branch, with a surface area of 3,400 acres at spillway crest and a drainage area of 93 square miles, is the dominating water supply system in the region. There is little water resource development in the lower basin. Elevations in the basin vary from a high of about 800 feet National Geodetic Vertical Datum (NGVD) at the westerly divide to a low of 10 feet NGVD near the mouth of the river.

The Pawtuxet River consists of two tributary branches which merge to form a 10.9-mile long mainstem. The North Branch rises in the hilly uplands of Foster and Glocester near the Connecticut border and flows in a generally southeasterly direction through Providence and Kent Counties toward Narragansett Bay. The South Branch originates in the slightly lower uplands of Coventry, West Greenwich and Exeter in Kent County, Rhode Island, and flows easterly to West Warwick where it merges with the North Branch to form the mainstem of the Pawtuxet River. The mainstem flows in a northeasterly direction, through West Warwick, Warwick and Cranston before it discharges into Narragansett Bay at Pawtuxet Cove. The main river averages about 100 feet in width and 4 feet in depth and has a total fall of about 50 feet. Approximately 3 miles of the lower reach of the mainstem was tidal estuary, however, in 1870 the Pawtuxet Dam was constructed near the mouth of the river to prevent salt water intrusion. The primary tributaries to the mainstem are Meshanticut Brook and Pocasset River.

Streamflow

The U.S. Geological Survey maintains three stream gaging stations within the Pawtuxet River watershed. One is located on the Pawtuxet River at Cranston, about 2 miles upstream of Belmont Park. The drainage areas at the gage and Belmont Park are 200 and 224 square miles, respectively. The second gage is on the South Branch downstream of Flat River Reservoir in Washington. These two gages have been in operation since 1940. The other remaining gage is located on a headwater tributary. Location of the gages is shown on Plate 1.



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS

BELMONT PARK

100-YEAR FLOOD PLAIN

PLATE 2

Flood History

The flood history of the Pawtuxet River reveals that major floods can occur during any season of the year as a result of intense rainfall alone or in combination with snowmelt. The Flat River and Scituate Reservoirs control over 66 percent of the Pawtuxet watershed and have a significant modifying effect on flood development. The magnitude of floods on the Pawtuxet River are a function of storm rainfall and the resulting runoff from the 80.9 square miles of watershed downstream of the reservoirs, and the initial storage capacity in the reservoirs. Historic flood levels at Belmont Park and corresponding flows at the Cranston gage are listed in Table 1.

TABLE 1

HISTORIC FLOODS
MAINSTEM PAWTUXET RIVER

Date	Estimated Flood Stages at Belmont Park NGVD	Discharge at Cranston, RI cfs
Feb 1886	25	14,000*
	23	11,000**
July 1938	19	6,300*
March 1936	18	5,300*
Jan 1979	17	4,000
March 1968	16	3,110
Jan 1978	16	3,040

* estimated (The Cranston gage was not in existence)
** as modified by Scituate Reservoir, which was not in existence at time of flood

EXISTING CONDITIONS

The following section provides a brief summary of the existing social and environmental characteristics of Warwick. Background information is presented in its entirety in Appendix 2.

Environmental Setting

The city of Warwick is located on the westerly side of Narragansett Bay in central Rhode Island. The project area lies within the seaboard lowland section of the New England physiographic province. The region is generally flat with some gently rolling hills. Belmont Park is located in the flood plain of the Pawtuxet River along Warwick's northern border with the city of Cranston at the junction with Cranberry Bog Brook.

Cranberry Bog Brook is contained in a drainage basin of some 750 acres in Warwick. The brook begins at Falcon Avenue and flows northerly to Cranberry Bog and from the Bog northerly to the Pawtuxet River, for a total length of 1.7 miles. Prior to emptying into the Pawtuxet River, the brook flows through a wetland of about 18 acres, which separates Belmont Park from housing developments to the east.

Belmont Park is primarily a medium-density residential neighborhood of single family houses. Vegetation here is the usual residential mix of lawns and ornamental trees and shrubs. Areas near the riverbank are undeveloped and overgrown with mixed hardwoods and an understory of high brush. Bordering the peninsula on the southeast is a wetland of freshwater marsh and wooded swamp.

Land Use

Developed land in Warwick is predominated by residential uses as indicated in Figure 1. Commercial, industrial, and institutional uses have tended to cluster in the western and central part of the city, with the residential uses closer to the shoreline. While most of the city's land is developed, more than a third is still vacant.

Census tract 211 is comprised of three distinct areas (see Figure 2). The area designated Norwood is primarily residential and is the portion of the tract encompassing Belmont Park. The area south of Norwood is an area of mixed residential, commercial and industrial uses known as Hillsgrove. Bordering this area is the Theodore F. Green State Airport which comprises 918 acres, or 42.6 percent of this tract. Excluding the airport acreage, residential use accounts for 41.3 percent of the land area, topped by vacant area which accounts for 43.4 percent. Commercial and industrial uses comprise 9.6 percent and 5.7 percent respectively.

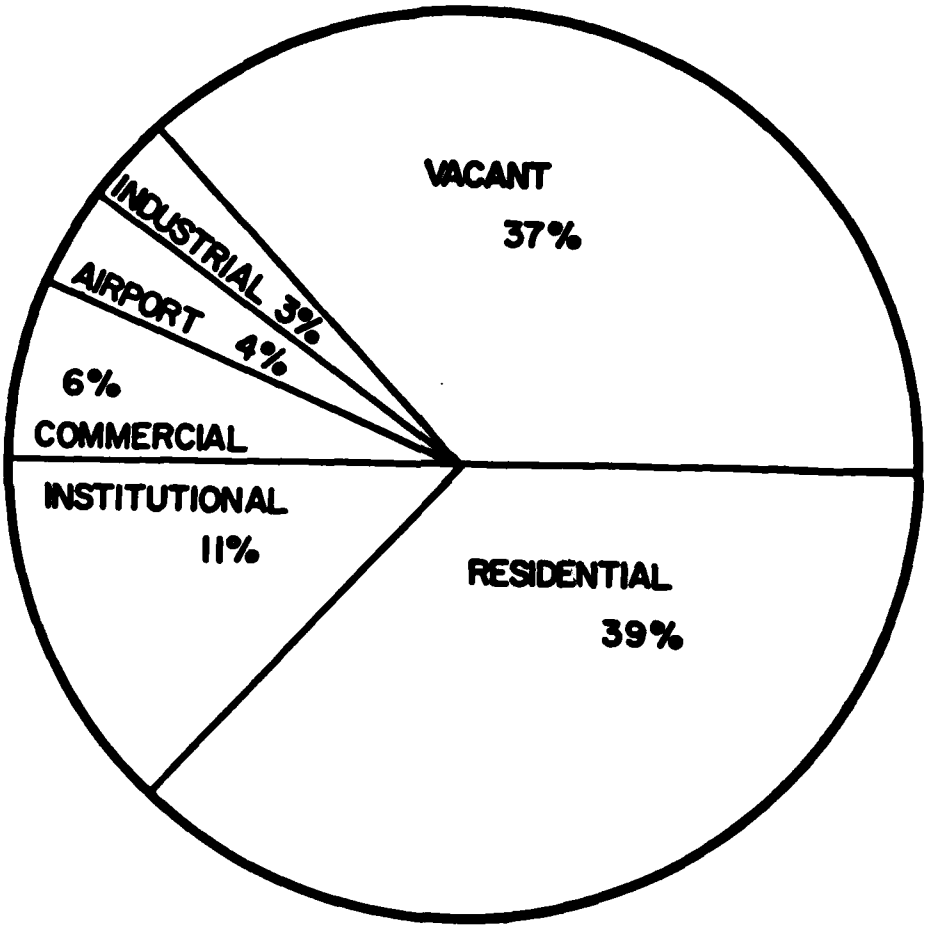
Flood History

Flood damages in Belmont Park occurred most recently during January 1979 when several families had to be evacuated from houses situated on the low lying peninsula. Not only were physical losses to property and furnishings experienced by homeowners, but a real threat to health and safety was also experienced. Resolution of the flood problem is the primary need and concern of residents, property owners, and city officials.

BELMONT PARK, FLOOD OF JANUARY 1979

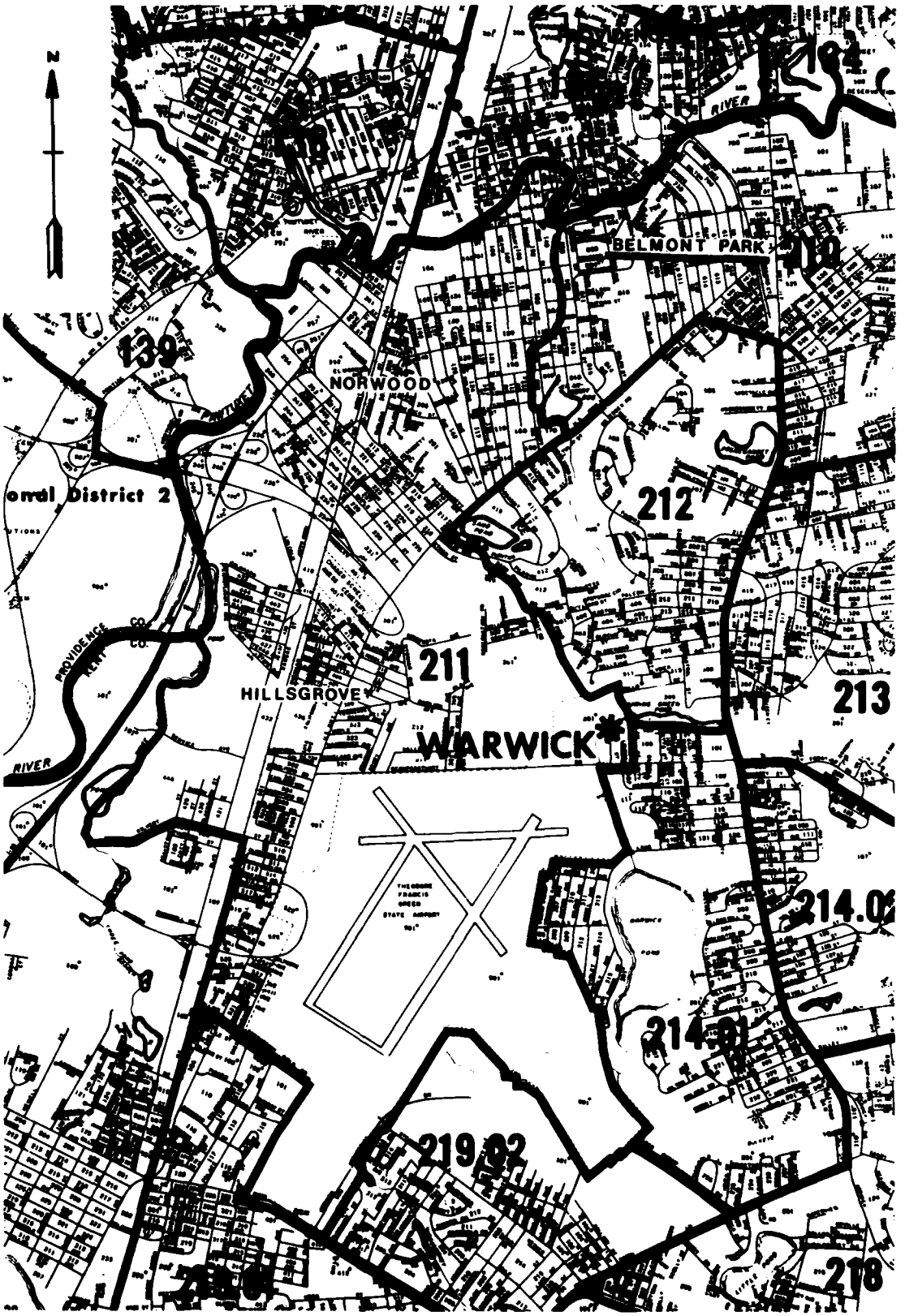
EXISTING LAND USES

Warwick, 1972



SOURCE: Land Use Plan, Warwick, RI, 1976

FIGURE 1



Census Tract 211

FIGURE 2

It was reported that flood stages of the January 1979 event reached elevation 17.0 NGVD, inundating about 30 acres and flooding the basements of numerous houses. The frequency of this event is estimated at 5 percent (20-year), while the elevation of the 1 percent (100-year) event is estimated at 20.4 NGVD. Flooding of existing roadways necessitated removal of some residents by amphibious vehicles. Existing septic tanks and cesspools were inundated causing severe pollution problems.

Population

The city of Warwick is part of the heavily urbanized Greater Providence metropolitan region. It is the second most populous city in the State, with a 1980 population of 87,123. Over the last 50 years, Warwick's population has increased by about 276 percent. Warwick and State population changes are displayed in Table 2.

TABLE 2

POPULATION

WARWICK AND RHODE ISLAND
1930 - 1980

	Warwick		Rhode Island	
	Number	Percent Change from previous decade	Number	Percent Change from previous decade
1980	87,123	4.1	947,154	-0.3
1970	83,694	22.2	949,723	10.5
1960	68,504	59.2	859,488	8.5
1950	43,028	49.6	791,896	11.0
1940	28,757	24.0	713,346	37.6
1930	23,196		687,497	

SOURCE: U.S. Census

Using Warwick's average household size of 3.33, population in the 100-year flood plain of the Belmont Park area can be estimated at 250.

Economy

Early economic growth in Rhode Island centered in Providence but since World War II major shifts, both spatial and functional, have occurred in the regional economy. The spatial shift has been the dispersion of

industry from Providence to outlying communities such as Warwick. The functional shift has been a continual decline of the old textile industries and the emergence of metal products manufacturing industries. In addition, the Providence region is part of the national trend of increasing employment in service industries, with a proportional decrease in employment in manufacturing industries.

According to the Rhode Island Department of Employment Security (DES), manufacturing, wholesale, and service industries are the largest employers in Warwick. Together they provide about 87 percent of the 30,611 jobs available in Warwick. Warwick is similar to the State in its distribution of employment by industry. Data on employment covered by the DES for Warwick and Rhode Island is presented in Table 3.

TABLE 3

EMPLOYMENT BY INDUSTRY, 1980

	Warwick		Rhode Island	
	Employed	Percent of Total	Employed	Percent of Total
Agric., Forestry, Fisheries	117	0.4	2,233	0.7
Mining	17	0.1	181	0.1
Construction	959	3.1	12,589	3.7
Manufacturing	9,364	30.6	129,479	37.8
Trans., Comm., & Utilities	583	1.9	12,472	3.6
Trade	10,000	32.7	81,910	23.9
Wholesale	1,400	4.6	17,806	5.2
Retail	8,600	28.1	64,104	18.7
Finance, Insurance, and Real Estate	2,454	8.0	20,873	6.1
Services	7,117	23.2	82,601	24.1
Total	30,611	100.0	342,338	100.0

SOURCE: R. I. Dept. of Employment Security

In 1980, Warwick had a labor force of 42,598. Of this total 39,922 were employed, yielding an unemployment rate of 6.3 percent. This falls below that of the state's 7.2 percent, and Kent County's rate of 6.9 percent. Employment data for these three areas are shown below in Table 4.

TABLE 4

1980 LABOR FORCE ESTIMATES

	Labor Force	Employment	Unemployment	Unemployment Rate
Warwick	42,598	39,922	2.676	6.3
Kent County	74,640	69,474	5,166	6.9
R.I.	462,000	429,000	33,000	7.2

SOURCE: Rhode Island Dept. of Employment Security

Recreation

The Belmont Park peninsula is located on the northern edge of Warwick in a district of the city where recreation facilities are somewhat limited. Some neighborhoods totally lack any adequate outdoor recreation areas. Figure 3 locates existing recreation facilities within one mile of Belmont Park.

Fish and Wildlife

Extensive urbanization of the Warwick area has eliminated or reduced most native wildlife. Approximately two-thirds of the land in the city has now been developed. The most prevalent habitat areas which remain are best suited for birds and aquatic life. These habitat areas are primarily wetland types, including marshes, ponds, streams and rivers. The Belmont Park area is bordered on three sides by river and wetland habitats. Undeveloped parcels at the northern end of the peninsula provide some upland habitat for birds and small mammals.

Existing dams, combined with stream pollution, preclude anadromous fisheries. The existing fish population consists of small, mostly non-game species.

Review by the U.S. Fish and Wildlife Service shows that except for occasional transient individuals, there are no known federally listed or proposed endangered species that exist in the project area. See Appendix 3 for coordination letter.

Water Quality

The mainstem of the Pawtuxet River is presently rated as Class E, indicating that the water is unsuitable for most uses. This poor rating is attributed to inadequate septic tank systems, urban runoff, sluggish flow conditions caused by numerous dams, leachate from solid waste disposal areas, and inadequate streamflow to assimilate the effluents from existing treatment facilities. There are three municipal wastewater treatment plants along the mainstem of the Pawtuxet in West Warwick, Warwick and Cranston, as well as a State sewage treatment facility at Cranston and several industrial treatment plants within the basin. All of these facilities provide the equivalent of secondary treatment. The Cranston facility is being upgraded to advanced treatment, but additional advanced treatment measures or low flow augmentation will be required if higher water quality ratings are to be achieved.

WITHOUT PROJECT CONDITION

This section describes the most probable future conditions for the study area assuming no new federal water resources project. Alternatives presented later in this report are assessed and evaluated by comparing them to the "without project" condition.

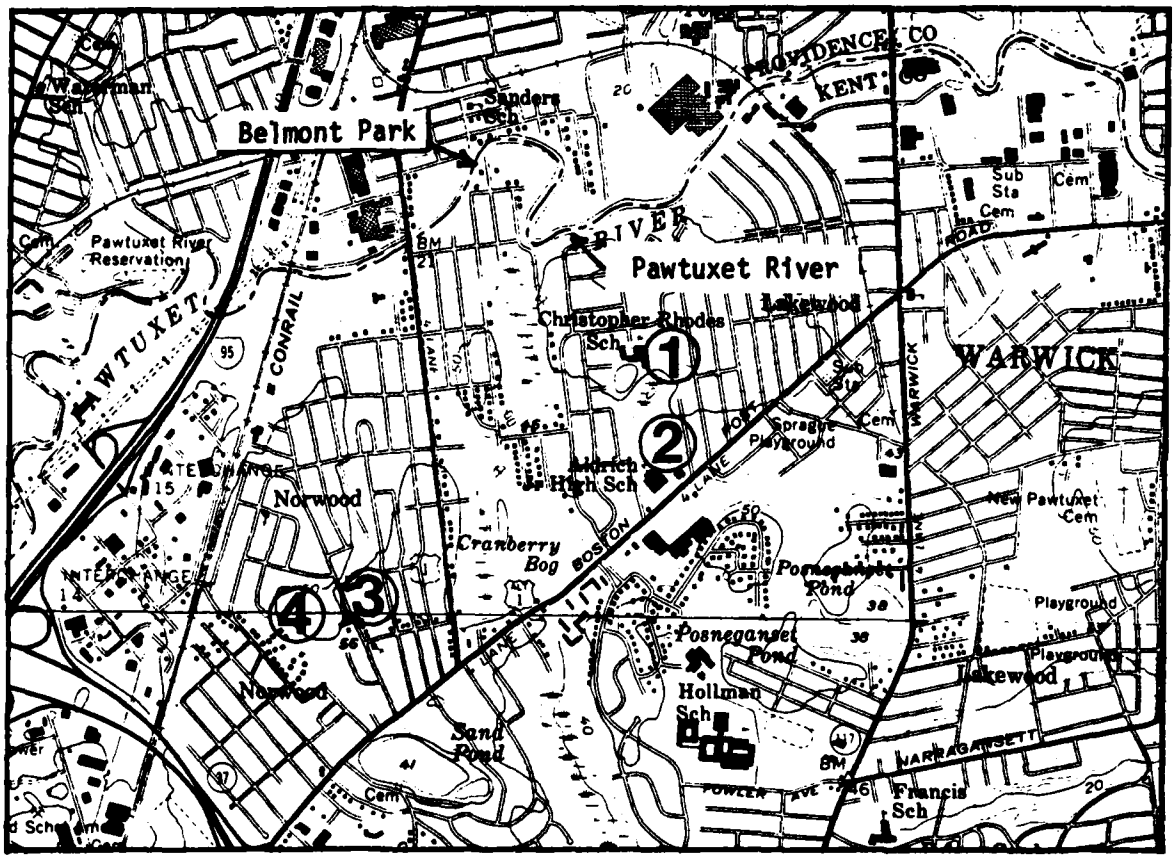
Future Population

Population projections provided by the Rhode Island Office of State Planning show population growth for Warwick in 2000 and 2030. A population of 97,600 was indicated for 2000 and 101,600 for 2030. Projected population for 2000 would represent a 12 percent increase from Warwick's 1980 population; projected population for 2030 would represent a 17 percent increase.

Future Growth and Development

Warwick is expected to continue to grow in its present role as a residential community and satellite city. Warwick's economy has shown a continuous growth trend. The potential for continued growth exists with the availability of land for development , existing public facilities network, availability of transportation, and the programming of future capital improvements.

Unlike the rest of the city, no future growth is expected within Belmont Park. Zoning regulations, adopted by the city, restrict development within the 100-year flood plain. In addition little out-migration is anticipated for the area. Those who have tried to sell their homes have been unable to find a buyer. Banks in the area are unwilling to give mortgages on floodprone property, making it difficult for prospective buyers to purchase homes in the area.



Scale: 1"= 2000'

Belmont Park Area
Recreation Facilities

1 - Christopher Rhodes School

- 1 Ballfield
- 1 Basketball Court

2 - Aldrich High School

- 1 Ballfield
- 2 Tennis Courts
- 1 Playfield

3 - Norwood School

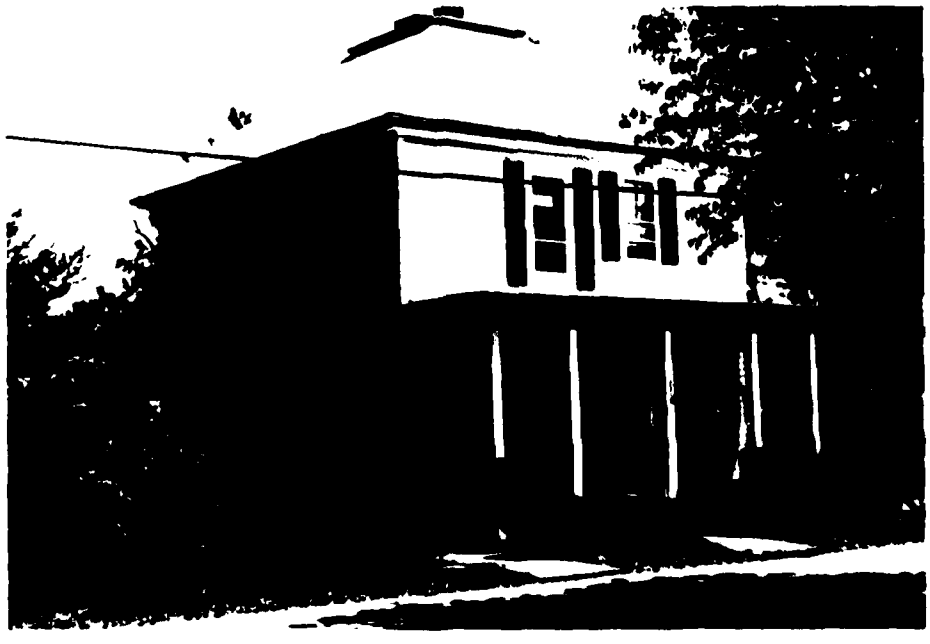
- 1 Playfield

4 - Norwood Field

- 2 Ballfields
- 1 Basketball Court
- 1 Playfield

FIGURE 3

#40 SUMNER AVENUE



#33 FIRST AVENUE

TYPICAL BELMONT PARK HOUSES

#41 IONA AVENUE

#51 RING AVENUE

TYPICAL BELMONT PARK HOUSES

Warwick's most recent master plan for future growth sets forth some general goals followed by more specific objectives. The city's basic goals are to make efficient use of available land and water, accommodate urban growth, and enhance and build upon human resources to incorporate a sense of community for all residents. Residential objectives involve the provision of safe and decent housing for various income levels. Economic objectives involve the provision of a balanced and diversified economy and the encouragement of the growth of new employment opportunities and commercial and industrial growth. Land development will be encouraged in a manner that suggests wise and orderly growth and protects critical environmental areas.

Future Flooding

In the absence of flood control improvements, periodic flooding will continue to threaten the health and safety of Belmont Park residents. Property owners will continue to suffer the economic hardships that result from flood losses. At current price levels flooding is estimated to cause $322,000 in damages annually. If a flood having a magnitude of once in 100 years were to occur, it would result in approximately $2,000,000 in losses.

Future Recreation

The city of Warwick owns 21 vacant lots in the Belmont Park area. These lots, however, are dispersed among privately owned residential and vacant lands. Without the implementation of a flood protection program that involves the acquisition of additional land, the city would have little opportunity to improve recreational opportunities at Belmont Park.

Future Fish and Wildlife

In the absence of a flood protection plan, the future environmental value of Belmont Park as a wildlife habitat is not expected to change significantly.

Future Water Quality

Future floods will continue to inundate septic tanks in the Belmont Park area resulting in public health hazards and further degradation of the already poor water quality of the Pawtuxet River.

PROBLEMS AND OPPORTUNITIES

The problems and opportunities presented in this section were identified through interaction with the public and other agencies.

Flooding Problem

The January 1979 flood caused property damage, loss of heat and utilities and losses to the economy from the disruption of work schedules. Many residents were evacuated and out of their homes for a week. Adults missed work and their children could not attend school. A 1979 flood damage survey revealed that under present conditions, losses from a recurring 1979 flood would total $750,000. An assessment of these damages is contained in Appendix 6 "Economics."

The magnitude of these losses and the frequency of flooding illustrate the need for a solution to the flooding problem along the Pawtuxet River at Belmont Park. In the absence of flood protection measures, continued flooding will cause further economic hardships and possible loss of life. Plate 2 shows the extent of flooding that would occur during the 100-year flood.

Meetings with local residents, city and State officials verified the need for a flood protection program for Warwick. The notice to proceed with the Detailed Project Report has provided the opportunity to address these flooding problems and formulate solutions that are acceptable to local citizens.

Recreational Opportunity

The Environmental Master Plan prepared by the Warwick Department of City Plan in 1973 recommends that city land in the Belmont Park area be developed as a conservation and passive recreation area. Recent meetings with the Warwick Planning Department and the Parks and Recreation Department have indicated that if additional land were acquired, a neighborhood minipark could be developed. This park could offer both active and passive recreation opportunities such as soccer and baseball fields, a canoe launching area and tennis and basketball courts (see Figure 4).

Fish and Wildlife Opportunity

Extensive urbanization has eliminated most areas of wildlife habitat in Warwick. The remaining areas are best suited for birds and aquatic life. Undeveloped parcels of land at the northern end of the Belmont Park peninsula provide some upland habitat for birds and small mammals. As mentioned in the previous paragraph, city officials have recommended that this area be retained as a conservation area. Every effort should be made to preserve and enhance this area for wildlife habitat.

Water Quality Problem

One of the many factors contributing to the poor water quality of the mainstem of the Pawtuxet River is inadequate septic systems. During past floods many of the existing septic tanks and cesspools in the Belmont Park area were inundated causing severe pollution problems and public health hazards.

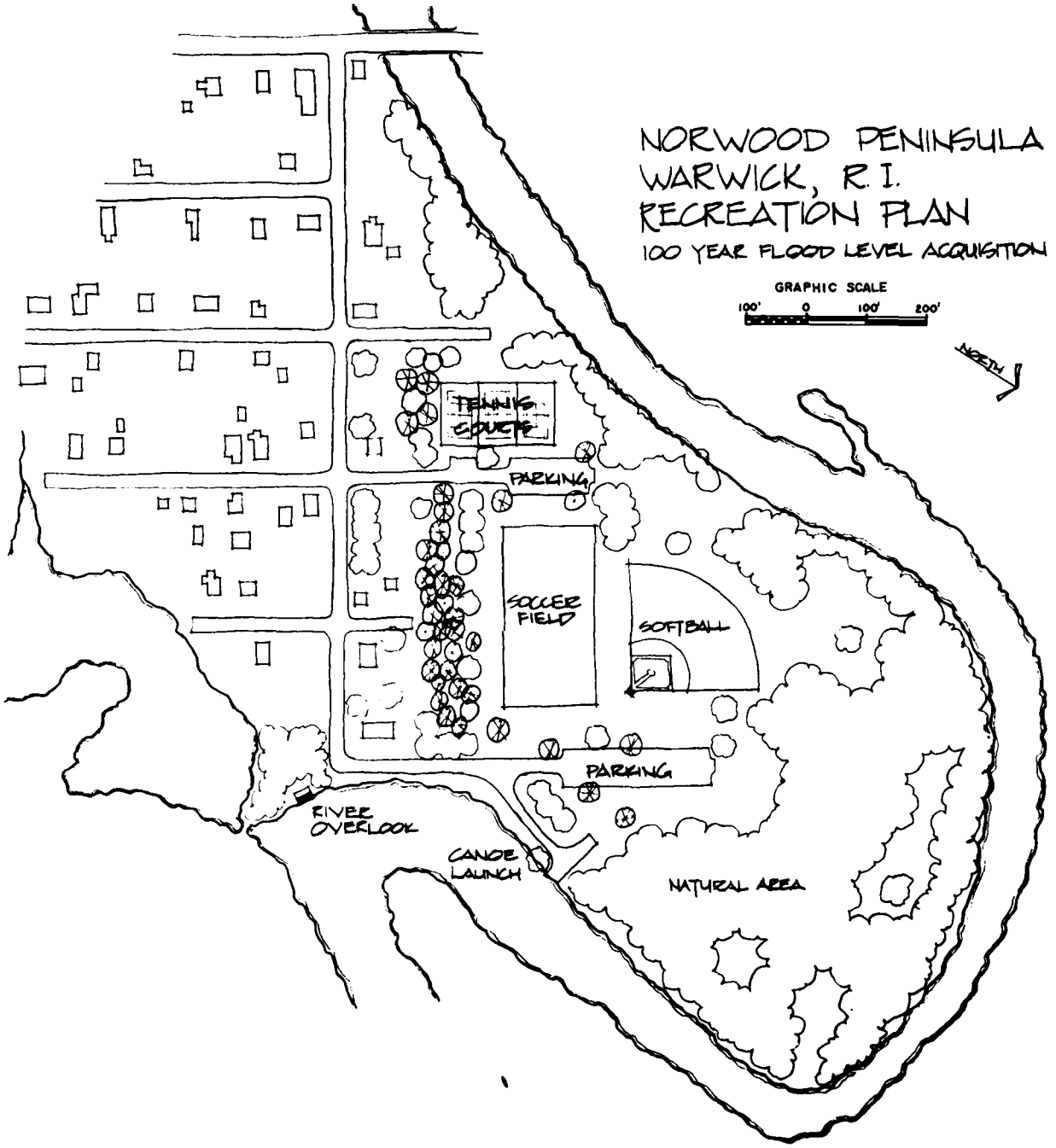

NORWOOD PENINSULA
WARWICK, R.I.
RECREATION PLAN
100 YEAR FLOOD LEVEL ACQUISITION
GRAPHIC SCALE
100' 0 100' 200'
NORTH
TENNIS COURTS
PARKING
SOCCER FIELD
SOFTBALL
PARKING
RIVER OVERLOOK
CANOE LAUNCH
NATURAL AREA

FIGURE 4

PLANNING CONSIDERATIONS

During the course of the study, three significant items were considered during the plan formulation process. The most important of these was the extent of investigations of the recently completed Pawtuxet-Narragansett Bay (PNB) watershed study. This large scale study determined that structural plans were not acceptable to local citizens. Consequently, nonstructural plans were determined to be worthy of further investigation and are, emphasized in this report. Although structural plans are described under the "Assessment and Evaluation of Detailed Plans," detailed descriptions included in the PNB report were omitted.

The second planning consideration concerns the availability of non-Federal funds to meet the Federal requirements of local participation. Mayor Walsh, in his original endorsement of the Section 205 study, stated that because of limited city funds, he would need financial assistance from the State of Rhode Island. State funding would be a logical contribution to the non-Federal cost share because flooding problems in Warwick have been aggravated by development in other upstream communities in the watershed.

The final planning consideration involves the concern expressed by local residents that unless prompt action is taken, further damages and possible loss of life is likely to result. Many of the residents have been waiting for a conclusion of the PNB study for several years. Some owners have attempted to sell their homes only to find that banks would not provide mortgages to buyers because of the susceptability to flood damage. Residents of Belmont Park have lived with the threat of flooding for years and will be forced to remain unless action is taken.

PROBLEM AND OPPORTUNITY STATEMENTS

The following problem and opportunity statements were developed with an understanding of the present and future needs of Warwick's citizens and the economic, social, and environmental characteristics of the community. These statements provided guidance in the formulation of a complete water resources project, as well as a standard for comparison in the evaluation of each proposal's achievements throughout a 50-year period of analysis beginning in 1980. The problem and opportunity statements are:

a. Increase the economic strength of property owners in Belmont Park, by reducing flood damages and the resulting financial hardships that result from flooding of the Pawtuxet River.

b. Provide greater security for people living in Belmont Park whose lives are threatened by flooding from the Pawtuxet River.

c. Preserve and enhance the environmental and aesthetic value of wildlife habitat located on the northern end of the Belmont Park peninsula.

d. Improve the water quality of the Pawtuxet River by reducing the inflow of sewerage from septic tanks in the Belmont Park area.

e. Increase the value of the recreational experience in the Belmont Park area.

FORMULATION OF ALTERNATIVE PLANS

Alternatives were investigated in sufficient detail to determine their economic and engineering feasibility, the impacts of their implementation and public acceptance. Most of these measures were addressed in previous studies, but are reiterated here to summarize earlier findings. This section describes the range of alternative plans considered and the evaluation process used to screen them. Those alternatives that warranted further study are presented at the end of this section.

MANAGEMENT MEASURES

Flood Protection

Flood protection measures fall into two basic categories: structural and nonstructural. Structural measures are those that reduce overbank flooding, while nonstructural measures reduce or mitigate the damages caused by flooding. The two general categories of flood protection measures are shown in Table 5 and described in further detail in this section.

TABLE 5

Alternative Flood Protection Measures

I. Structural - Measures to Reduce Flooding
   - A. Reduce Flooding Prior to Reaching Critical Damage Area
     1. Reservoirs
     2. Bypasses
     3. Land Treatment
   - B. Reduce Flooding at Critical Damage Area
     1. Levees and Floodwalls
     2. Channel Modification
     3. Preflood Emergency Flood Fighting

II. Nonstructural - Measures to Reduce or Mitigate Flood Damage
   - A. Reduce Actual Damages
     1. Floodproofing
     2. Relocation
     3. Land Use Regulations and Zoning
     4. Flood Warning and Emergency Evacuation
   - B. Mitigate Damages
     1. Flood Insurance

PLAN FORMULATION RATIONALE

The plan formulation process involves the development and evaluation of those management measures just described. Each measure was assessed in terms of social, environmental and economic impacts and public acceptance. Some of the above measures were evaluated in other studies and in those cases we have utilized the previous findings. Alternatives that did not address the problems and opportunities of the study area were eliminated. The subsequent sections provide information on plan description, evaluation and comparison which lead to the selection of plans warranting more detailed analysis.

OTHER PLANS

Plans that address or affect the problems and opportunities of the study area that have been or are proposed to be implemented by Federal or non-Federal agencies are described below:

A report was prepared in 1952 for the Rhode Island Water Resources Board proposing construction of the Big River Reservoir for the purpose of supplementing existing water supplies. In 1957 a report was made which reviewed additional data and made further recommendations regarding this proposal. These two reports were again updated in June 1967 to reflect the drought conditions in the early 1960's. During this time the Corps of Engineers identified the Big River Reservoir as a means of providing flood control in addition to water supply. In January 1978 the Governor of Rhode Island requested that the Corps of Engineers study this proposal. The Corps has prepared a report recommending that the Big River Reservoir be constructed as a Federal project. If authorized, construction of the project would reduce flood stages along the Pawtuxet River by approximately 1 foot for the 100-year flood, however, this project may not be constructed and fully operational until 1995. In addition, recent Federal and State budget cuts may further delay its construction. If the project is constructed, it would provide the Belmont Park area with slightly greater flood protection.

DEVELOPMENT OF ALTERNATIVE PLANS

This section discusses each of the flood protection measures outlined in Table 5, as it would be applied in a plan of local flood protection for Belmont Park. Each plan was screened for its feasibility, economic justification, and public support. Depending on the findings, it was either eliminated from the study or recommended for further detailed analysis.

Reservoirs. Within the Pawtuxet River Basin numerous reservoir sites were investigated for the purpose of flood control and other water resource needs. However, all but the Big River Reservoir site were eliminated from further consideration. It was found that small reservoirs only offer a limited degree of protection and that their costs would far exceed accrued benefits. Large reservoir sites would have many engineering, social, and

environmental constraints. The Big River Reservoir project investigated by the Corps was recommended for construction. Additional investigation of this alternative during this study was not required, except to evaluate the impact of reduced flood stages and discharges on flood prone properties in Warwick.

Bypasses. Another method of modifying floodflows before they reach Belmont Park would be to divert excessive flow around the area. Preliminary studies indicated that a surface bypass would not be feasible due to the dense development in the study area. Investigation of a tunnel diversion plan during the PNB study found it to be feasible for carrying floodflows from upstream of the Pontiac Dam to Apponaug Cove. Although this plan was economically feasible and would not adversely affect downstream flood stages because of its discharge to the ocean, it was environmentally unacceptable to local residents and city officials. Because of the lack of local support, diversion measures were eliminated from further study.

Land Treatment. Although adopted primarily to further good agriculture and forestry practices, land treatment and watershed management measures have beneficial effects on flood conditions. Modifying or preserving vegetation cover conserves water by increasing infiltration and reducing surface runoff. The effect on flood discharges varies with the watershed, the characteristics of flood producing storms, and antecedent surface conditions. In general, land treatment has a greater effect on preventing flood conditions from worsening as development occurs than on reducing existing flood stages. Inasmuch as land treatment would have a limited effect on reducing flood stages in Belmont Park, this alternative was eliminated from further consideration. Continued use of this measures by other public and private interests would, however, improve and protect upstream agricultural and forest lands.

Levees and Floodwalls. A plan for levee and floodwall construction at Belmont Park, referred to as the "Elmwood Avenue Local Protection Project," had been determined by the PNB study to be an effective means for providing flood protection to high risk flood prone properties. These structural measures had marginal economic justification, but were not acceptable to local citizens. Because of the lack of local support this measure was eliminated from further investigation.

Channel Modification. Channel modificiations that were considered include channel widening and deepening and the elimination of abrupt turns and oxbows in numerous mainstem and tributary reaches. These measures, however, were not economical or able to significantly reduce flood stages at Belmont Park due to the flat hydraulic gradient of the riverbed. For these reasons, channel modification was not selected for more detailed analysis.

Preflood Emergency Flood Fighting. When a flood is imminent, the construction of temporary levees can help a community survive a flood. Successful flood fighting depends upon many variables, including flood

characteristics, warning time, the physical nature of the problem area and the quantity of manpower, supplies, and equipment required. In the case of Belmont Park, the maximum amount of warning time that could be realistically planned for would be about three hours. Construction of a temporary levee in this time period would involve such a vast commitment of manpower, equipment, and material that it would not be feasible. This alternative was not retained for further study.

Floodproofing. There are a total of 76 homes in the Belmont Park area which would experience flood losses during the 100-year event. Of these, 59 would sustain damage to the first floor. It was determined that the most economical method of floodproofing these homes would be to raise them. A visual inspection was performed to determine the size, type and general condition of these homes and whether or not raising would be possible. Structures within Belmont Park are primarily single-family, wood-frame residences with concrete block foundations and full basements. Most homes appear to be in fair to good condition; however, many are over 25 years old and have been inundated several times in the past causing permanent structural damage. It was determined, without a detailed engineering analysis of each home, that only about half of these homes were structurally sound and could be raised. Although raising would be effective in preventing damage to many structures, not all flood prone homes could be protected. For this reason, floodproofing alone would not be an acceptable solution.

A plan involving the raising of 29 homes in combination with the acquisition and demolition of the 30 structures which could not be floodproofed, was found to be an economical and acceptable solution. An additional 17 homes in the Belmont Park area would experience basement flooding. Utilities located in the basements of these homes would be relocated above expected flood stages to a first floor utility room addition. Because many of the homes that would be floodproofed would be surrounded with water during a flood, an adequate flood warning and evacuation program would be required to give residents time to leave the area prior to flooding. Floodproofing in combination with relocation, flood warning and evacuation was considered worthy of further study.

Relocation. This measure would involve the acquisition and demolition of 59 structures in Belmont Park which would sustain damages to the first floor from the 100-year flood, and the removal of appurtenant utilities. An additional 17 homes in the Belmont Park area would experience basement flooding. Utilities located in the basements of these homes would be relocated above expected flood stages to a first floor utility room addition. Because the basements of these 17 homes would be allowed to flood, an adequate flood warning and evacuation plan would be required to give residents time to move damageable property and evacuate their homes. This plan is economically justified and local citizens have expressed their support for this alternative. Relocation, in combination with floodproofing basements and flood warning and evacuation, was selected for further investigation.

Land Use Regulation and Zoning. As part of their participation in the regular phase of the National Flood Insurance Program, the city of Warwick has adopted management regulations which limit construction within the 100-year flood plain. Although this will prevent any future construction in Belmont Park and other flood prone areas of Warwick, it has little or no effect on reducing flood stages. In addition, only about 5 percent of the Pawtuxet River Basin lies within Warwick, and the city has no control over upstream development which continues to worsen existing conditions. The State of Rhode Island can control upstream construction in the flood plain, but this is only a portion of the problem. Most construction in the basin increases runoff and adds to the already dangerous flooding conditions in Belmont Park. Given these circumstances, land use regulation and zoning would do little to reduce damages; therefore, this measure was not selected for additional investigation.

Flood Warning and Emergency Evacuation. A system of forecasting floods, and warning and evacuating residents would protect the lives and enhance the safety of those within the flood plain. Although some items, such as valuable perishable property, could be moved above expected flood heights, the majority of flood losses would still occur. This plan could be implemented in a relatively short time at minimal expense. Flood forecast information is available through the National Weather Service, but operation and maintenance of such a plan is a non-Federal responsibility.

Under this alternative residents of the area would still suffer the majority of flood losses and the resulting financial hardships. They have indicated that this alternative would not be an acceptable solution by itself. However, a plan combining relocation, floodproofing, and flood warning and evacuation could prevent the majority of flood damages and enhance the safety of residents living in Belmont Park. The public has indicated support for this type of plan. Flood warning and evacuation, in combination with relocation and floodproofing, was selected for further investigation.

Flood Insurance. The city of Warwick is currently participating in the regular phase of the National Flood Insurance Program, making all property owners in Belmont Park eligible for coverage. The risk zone in which the property is located determines the rate for this coverage. Because of the relatively high flood risk in Belmont Park, flood insurance premiums are expensive. Residents of the area have complained of escalating insurance costs and fear further increases. Many property owners with mortgages are required by their banks to purchase flood insurance.

Flood insurance provides a method of reimbursement for most losses incurred as a result of flooding. Because flood insurance is presently available, it is part of the "without project condition" and was not studied further. Purchasing of flood insurance is recommended in the absence of a plan that reduces actual damages.

CONCLUSIONS OF INITIAL SCREENING

Based on detailed analysis performed during the FNB study and the initial screening of alternatives, two nonstructural flood control measures were selected for further investigation:

PLAN A, Acquisition
PLAN B, Acquisition/Floodproofing

These measures would be supplemented with a flood forecasting and warning system.

ASSESSMENT AND EVALUATION OF DETAILED PLANS

This section describes those alternatives warranting further study and examines the impacts likely to result from their implementation. In order to formulate the most feasible acquisition or combination acquisition and floodproofing plan, various options were investigated for protection from the 100, 50 and 20-year flood events. From this analysis two options, the 100 and 50-year plans, the ones maximizing net benefits, were selected for more detailed analysis.

PLAN A-1, 100-YEAR ACQUISITION PLAN

Plan Description

To provide protection from the 100-year flood, which has an estimated design height of 20.4 feet NGVD, 59 residential homes in the Belmont Park area would be acquired by the city and demolished or relocated. These homes have a first floor elevation below 21.4 feet NGVD, and would sustain damage to the first floor and/or floor joists during the 100-year flood. An additional 17 homes in Belmont Park would experience various levels of basement flooding. Utilities located in the basements of these homes would be relocated above expected flood stages to a first floor room or addition. Because these structures would be surrounded by flood waters and their basements allowed to flood, an adequate flood warning and evacuation plan would be required to give residents time to move damageable property and to safely evacuate their homes.

As part of this plan, the city of Warwick would also acquire 19 privately owned vacant lots in the Belmont Park area of which 18 are zoned residential and 1 is zoned commercial. This land, combined with the 59 residential lots that would be acquired and city-owned land, would provide approximately 22 acres of open land north of First Avenue for future recreation and/or wildlife habitat.

The total acquisition and relocation assistance costs for this plan were estimated at $3,200,000, as summarized in Table 6.

TABLE 6

PLAN A-1, ACQUISITION COSTS

59 Improved Residential Tracts	$1,636,000
19 Unimproved Tracts	60,000
City Owned Land	0
Severance Damages	0
SUBTOTAL	$1,696,000
Contingencies	334,000
Total Estimated Cost of Land and Improvements	$2,030,000
Relocation Assistance Costs	863,000
Acquisition Costs	207,000
	$3,100,000
Administrative Costs	100,000
TOTAL ESTIMATED ACQUISITION COST	$ 3,200,000

Site work associated with the demolition of 59 structures would include: removal of debris, backfilling foundations and septic tanks, removing and disposing of walks and driveways, terminating utilities, and loaming and seeding disturbed areas. Utility poles, telephone wires, and fire hydrants would be removed. Water lines would be plugged and capped at designated locations.

The total cost of site work associated with demolition and site reclamation was estimated at $340,000. A breakdown of these costs is presented in Table 7.

TABLE 7

PLAN A-1, DEMOLITION AND SITE WORK COSTS

Item	Quantity	Unit	Unit Price	Cost
Termination of Utilities				
Remove hydrants, plug and cap existing water lines	1 JOB	L.S.	$ 1,000	$ 1,000
Remove telephone and electrical service and fire alarm box	1 JOB	L.S.	$11,000	11,000
Building Demolition/Disposal				
Houses, garages and sheds	726,000	C.F.	@ $0.14	101,640
Foundations	153,000	C.F.	@ 0.18	27,540
Backfill Basements	10,000	C.Y.	@ 4.00	40,000
Sewage Systems				
Excavation	130	C.Y.	@ 7.00	900
Pumping	59	Tanks	@ 100.00 ea.	5,900
Filling	1,500	C.Y.	@ 100.00 ea.	15,000
Topsoil and Seeding	5,000	S.Y.	@ 4.50	22,500
			SUBTOTAL	$225,480
			Contingencies	45,520
			Construction Costs	$271,000
			Engineering and Design	42,000
			Supervision and Administration	27,000
			TOTAL	$340,000

Basement utilities would be relocated to an 8-foot by 12-foot first floor addition. Utilities to be raised include furnaces, electric switch boxes, electric meters and water tanks. Space would also be made available for relocating washers and dryers. The total cost of 17 utility room additions was estimated at $170,000 (see Table 8).

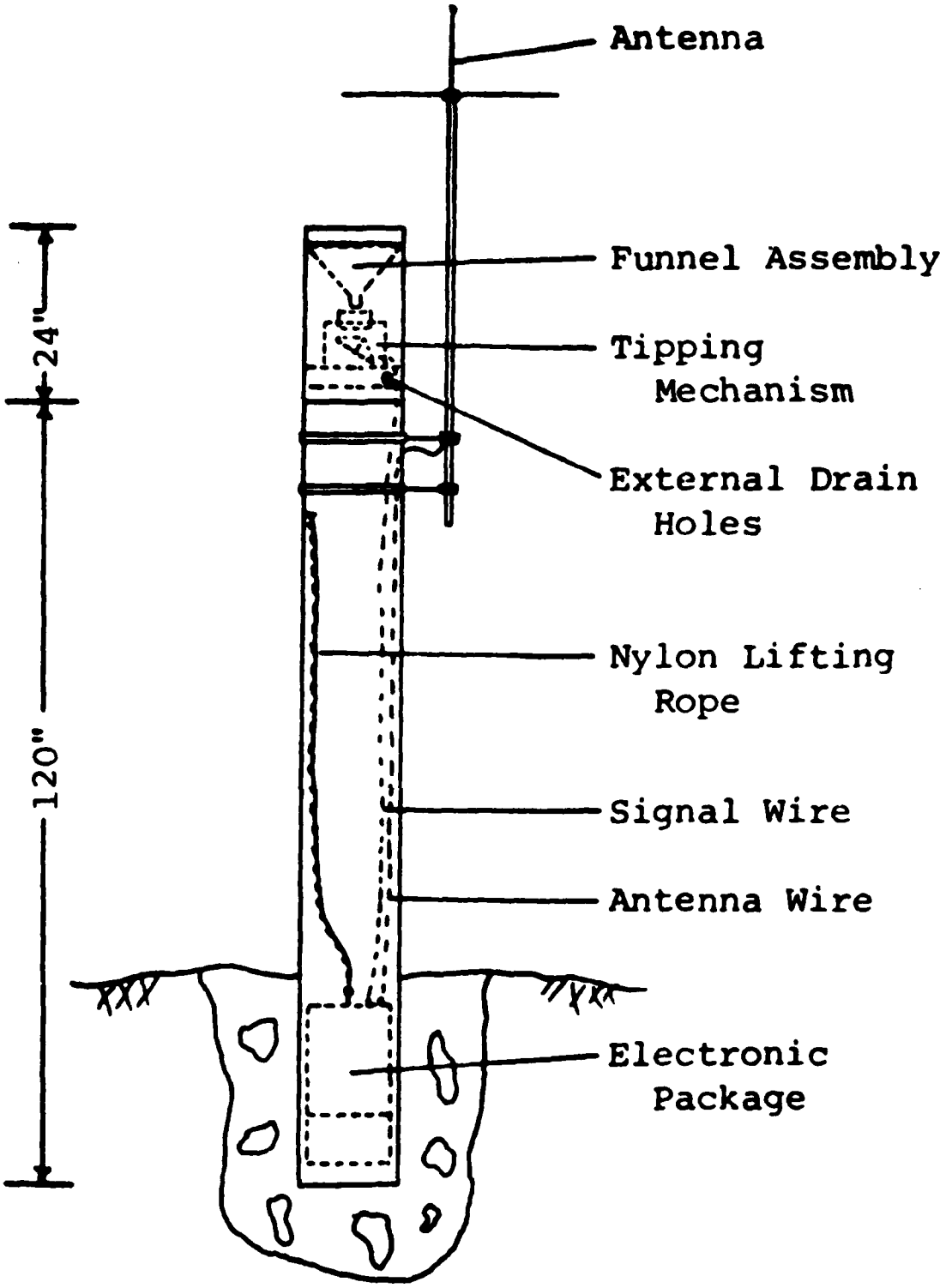
TABLE 8

PLAN A-1, COSTS OF UTILITY ROOM ADDITIONS

Item	Quantity	Unit	Unit Price	Cost
Utility Room Construction Including Excavation, Foundation, Framing, Siding, Roofing, Doors, Windows, Gutters, Painting, Electrical Work, Backfill, and Landscaping	96	S.F.	$40	$3,840
Relocation of Equipment	1	JOB	L.S.	1,000
Install Basement Floor Drain	1	EA	100	100
Install Sewer Check Valve	1	EA	500	500
Anchor Fuel Tank	1	JOB	L.S.	600
Install Booster Pump, Motor, and Supply Tank	1	JOB	L.S.	500
			SUBTOTAL	6,640
			Contingencies	1,360
			TOTAL	$ 8,000
			17 Utility Room Additions @ $8,000 ea. =	$136,000
			Engineering and Design	20,000
			Supervision and Administration	14,000
			TOTAL	$170,000

A system of automated flood forecasting equipment would provide the community of Warwick with timely and accurate forecasts of potential flooding along the Pawtuxet River. Warwick would be served by a system of four precipitation gages (see Figure 5), three river gages, and a microcomputer. The gages would be located throughout the Pawtuxet River Basin and would automatically respond to changes in rainfall or streamflow and report back to the microcomputer, located at the city's flood forecasting center (FFC). From this hydrologic data, the microcomputer would then generate potential flood stages along the Pawtuxet River. When flooding is imminent, the microcomputer would print out a warning, light a warning signal and sound an audible alarm. The microcomputer would also be able to transmit data and messages between it and the National Weather Services' (NWS) central computer in Bloomfield, Connecticut, to obtain weather forecasts.

The following table summarizes the basic equipment and costs of the automated flood forecasting system for Warwick.



EVENT REPORTING PRECIPITATION GAGE

FIGURE 5

TABLE 9

FLOOD FORECASTING EQUIPMENT

Flood Forecast Center Equipment	
Microcomputer with Video Display, Printer, Telephone Interface, and Cabinet	$ 7,000
Radio Receiver	$ 2,700
Battery Power Supply	$ 1,000
Field Equipment	
4 Event Reporting Precipitation Gages (4 x $3,100)	$12,400
3 Event Reporting River Gages (3 x $3,100)	$ 9,300
Radio Repeater	$ 5,000
SUBTOTAL	$37,400
Contingencies	6,600
TOTAL CONSTRUCTION COST	$44,000
Engineering, Design, Supervision, and Administration	6,000
TOTAL FIRST COST OF FLOOD FORECASTING EQUIPMENT	$50,000

A site for the city of Warwick's FFC has not been selected. Among the items to be considered when choosing this facility are the following:

a. operational and staffed on a 24-hour basis;
b. adequate communications capability;
c. located outside flood plain; and
d. auxiliary power supply

Tentative locations for precipitation and river gage sites have been selected (see Figure 6). Consideration was given to a number of factors when selecting these sites. Field equipment had to be located so that it would provide the necessary hydrologic data to accurately predict potential flood stages along the Pawtuxet River. Because field equipment requires annual maintenance, the sites would have to be easily accessible. To reduce the risk of vandalism, existing sites or locations near existing facilities were selected when possible.

Two of the river gages would be located at existing sites along the Pawtuxet River and the third just downstream of the Scituate Reservoir. The following locations were tentatively selected for precipitation gage sites:

1. Simmons Reservoir, Johnston, RI
2. Barden Reservoir, Scituate, RI
3. Flat River Reservoir, Coventry, RI
4. J.L. Curran Park, Cranston, RI

The radio repeater, which would relay messages transmitted from the gages to the microcomputer, would be centrally located.

As shown in Table 10, the total estimated first cost of Plan A-1 is $3,760,000 (based on January 1982 price levels). Amortizing this cost over 50 years at a 7-5/8 percent interest rate, the annual cost is $294,000.

TABLE 10

PLAN A-1, FIRST AND ANNUAL COSTS

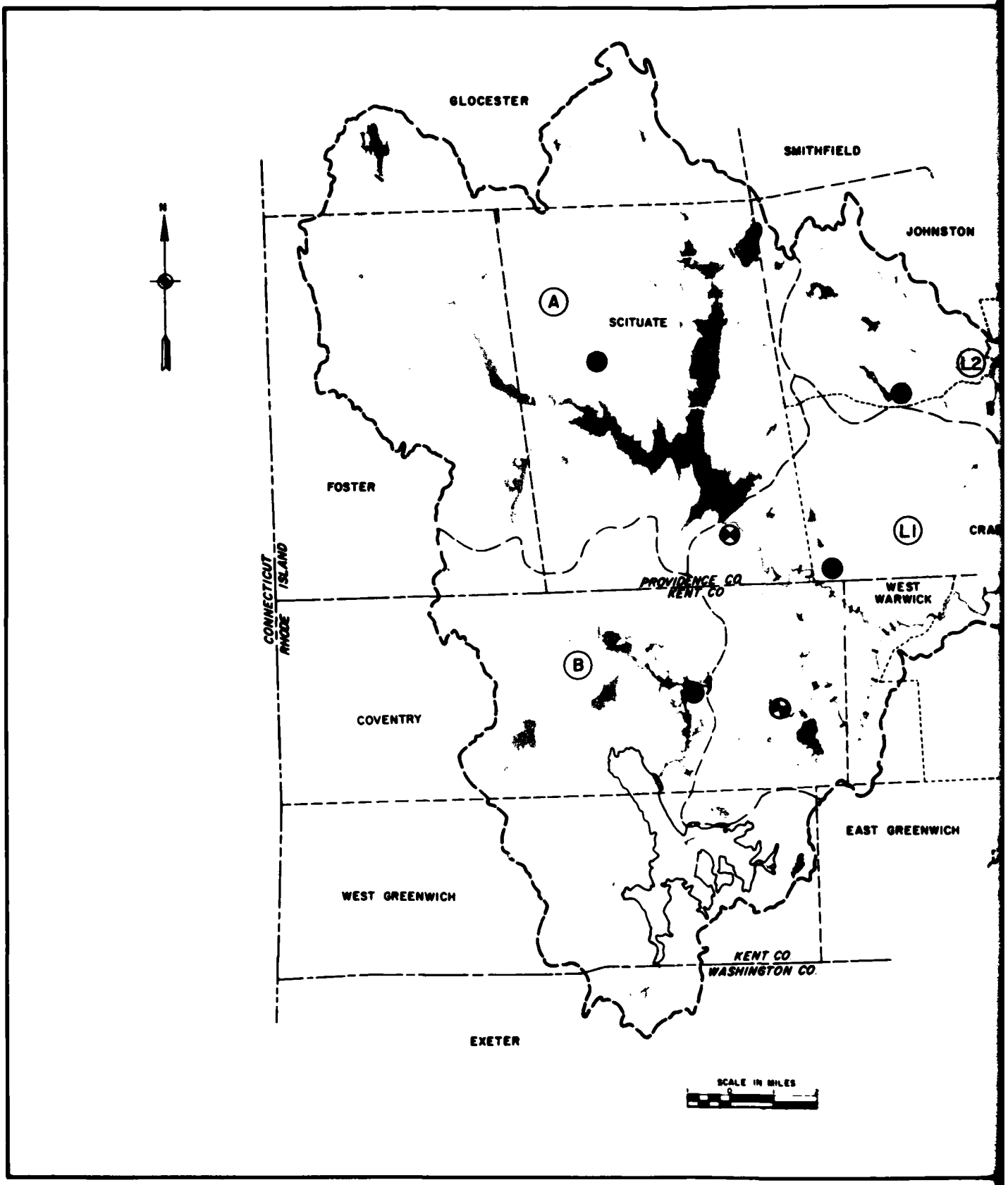
	Estimated First Cost	Estimated Annual Cost
Acquisition	$ 3,200,000	$250,000
Demolition and Site Work	340,000	27,000
17 Utility Rooms	170,000	13,000
Flood Forecast System	50,000	4,000
TOTAL	$3,760,000	$294,000

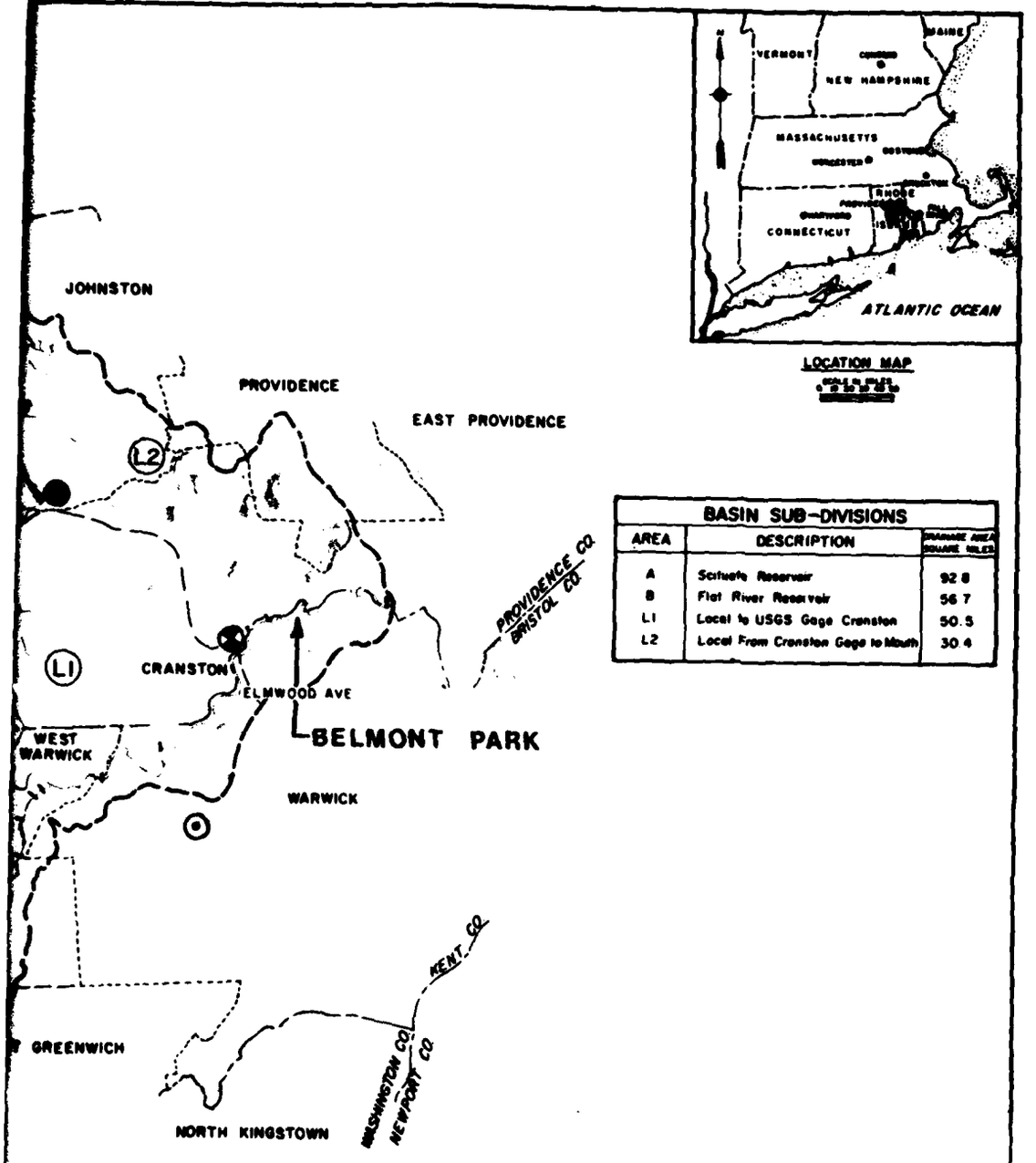
Impacts

Impacts of varying magnitude and longevity can be expected during the two phases of project implementation: construction and postconstruction. Impacts likely to occur during construction are generally short term and site-specific. Postconstruction is characterized by long term impacts that are expected to extend over the life of the project and may have regional as well as site-specific implications.

Short Term Impacts - Adverse temporary environmental impacts would include some noise and dust pollution during the demolition of buildings and construction of utility rooms. An increase in traffic, noise and dust would also occur as trucks carry debris to disposal areas and haul fill material to the site.

Relocated residents would be inconvenienced with the task of finding a new home and making the necessary arrangements for moving their belongings. However, once relocated and settled in their new homes, residents would be free from the threat of floods. Residents would be reimbursed for most expenses incurred when buying a new home or relocating.


GLOCESTER
SMITHFIELD
JOHNSTON
N
A
SCITUATE
L2
FOSTER
L1
CRA
CONNECTICUT
RHODE ISLAND
PROVIDENCE CO
KENT CO
WEST WARWICK
B
COVENTRY
EAST GREENWICH
WEST GREENWICH
KENT CO
WASHINGTON CO.
EXETER
SCALE IN MILES
0



BASIN SUB-DIVISIONS		
AREA	DESCRIPTION	DRAINAGE AREA SQUARE MILES
A	Scituate Reservoir	92.8
B	Flat River Reservoir	56.7
L1	Local to USGS Gage Cranston	50.5
L2	Local From Cranston Gage to Mouth	30.4

LEGEND

- PRECIPITATION GAGES (4)
- STREAM GAGES (3)
- FLOOD FORECAST CENTER (1)

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CORPS OF ENGINEERS
WALTHAM, MASS

WATER RESOURCES DEVELOPMENT PROJECT

TENTATIVE LOCATION OF FLOOD FORECAST EQIUP.

PAWTUXET RIVER RHODE ISLAND

FIGURE 6

Public Law 91-646, the Uniform Relocation Assistance Act of 1970 provides for uniform and equitable treatment of persons displaced from their homes, businesses, or farms for Federal and Federally assisted programs. In accordance with this law homeowners would be given fair market value for their homes based on the size, age, location, quality of construction and condition of the house. Homeowners with mortgages would be entitled to interest differential, which is a payment based on the difference between the interest rate of their existing mortgage and current interest rates. In addition, homeowners and tenants are entitled to be reimbursed for moving and other expenses incurred when relocating.

Residents of the 17 homes that would have utility rooms added to the first floor, would not be temporarily relocated during construction. Work would be performed in a manner that would minimize the length of time residents are without utilities, allowing residents to remain in their homes and to continue their usual schedules.

A positive impact of the plan would be an influx of temporary workers who would purchase goods and services, thereby stimulating the local economy.

Plan A-1 would have no adverse short term effect on natural riverine resources as no work would be accomplished in the river or adjacent wetlands.

Long Term Impacts - The most significant impact of Plan A-1 would be the substantial reduction of future economic losses in Belmont Park during flooding. This plan would free 59 families from the constant threat of flooding and resulting financial hardships. Although 17 homes would still be susceptible to basement flooding during the 100-year flood event, utilities would be relocated above estimated flood stages to reduce damages. Implementation of a flood warning system would allow these families time to move some damageable property and evacuate the area.

Plan A-1 would permanently alter the character of the Belmont Park neighborhood. However, most residents have indicated that relocation would not cause any significant hardships.

Implementation of this plan would not eliminate the need to evacuate the area during major flooding, but does reduce the number of families involved from 76 to 17.

Implementation of this plan would provide the city with 22 acres of open land, north of First Avenue, which could be kept as a greenbelt and wildlife habitat with possible future development as a recreational area.

The adverse effects of leachate, from domestic septic systems in the Belmont Park area, on the water quality of the Pawtuxet River would be greatly reduced. Most of the septic tanks that have caused problems during past floods would be pumped and permanently filled.

Economics

When analyzing the economics of this plan, only the benefits derived from reducing flood damages were evaluated. Benefits for the increased protection to the life and safety of flood plain residents were not quantified.

Inundation reduction benefits are measured as the reduction in the amount of flood damages and related costs that would have occurred without any plan. Using this approach, the annual flood inundation benefits assigned to Plan A-1 are $401,700 (see Appendix 6). When compared to an annual cost of $294,000 the resultant benefit-to-cost ratio is 1.4 to 1.

Implementation Responsibilities

The measures proposed in this plan are single purpose flood control and all costs are allocated as such. Cost sharing between Federal and non-Federal interests for nonstructural alternatives to reduce flood damages is specified in Section 73b of the 1974 Flood Control Act, as amended. Under this legislation, non-Federal interests are required to provide 20 per centum of the project costs along with other assurances of local cooperation (see Appendix 1).

The Federal and non-Federal share of Plan A-1's first costs are shown in Table 11.

TABLE 11

PLAN A-1, COST SHARING

	Cost	Percent
Federal	$3,008,000	80
Non-Federal	752,000	20
TOTAL ESTIMATED COST	$3,760,000*	100

* Does not include preauthorization costs of $100,000.

After implementation of Plan A-1, the city of Warwick would be responsible for the cost of operating and maintaining the flood forecasting system.

This system was designed to be fully automated and will operate around the clock. When flooding is imminent, the microcomputer will print out a warning and initiate visual and audible alarms. To insure that flood alerts are received the microcomputer would have to be monitored 24 hours/day.

Field equipment has been engineered to provide dependable service at a low operation and maintenance cost. River and precipitation gages and the radio repeater operate on a battery power supply that must be replaced annually. The antifreeze solution contained in the precipitation gages would also have to be changed yearly. The microcomputer and the field equipment would require electronic maintenance once every 3 years to adjust the signal frequency.

Estimated annual operation and maintenance costs are shown in Table 12.

TABLE 12

ANNUAL OPERATION AND MAINTENANCE COST
FLOOD FORECASTING SYSTEM

Microcomputer	$ 300
4 Event Reporting Precipitation Gages (4 x $150)	600
3 Event Reporting River Gages (4 x $100)	300
Radio Repeater	100
TOTAL	$ 1,300

In addition to operation and maintenance costs, the city of Warwick would be responsible for developing a warning and emergency evacuation program. After a plan is developed, the city would be required to maintain a state of readiness through periodic testing and public education of the plan's procedures and drills. Included in this educational program would be a strong recommendation that owners of the remaining flood-prone properties purchase flood insurance. Flood insurance coverage would not only reduce individual economic hardship, but would also assist in the overall postflood recovery of the area.

Public Views

Plan A-1 has received strong support from the city of Warwick. This support was conveyed to the Corps through meetings with city officials and residents of Belmont Park.

PLAN A-2, 50-YEAR ACQUISITION PLAN

Plan Description

To provide protection from the 50-year flood, which has an estimated design height of 18.8 feet NGVD, 44 residential homes in Belmont Park would be acquired and demolished (see Plate 4). These homes have a first floor elevation below 19.8 feet NGVD and would sustain damage to the first floor and floor joists during the 50-year flood. An additional 7 homes would be acquired and demolished to provide contiguous lands for future environmental and recreational use and because many of these homes would become isolated during flooding. Utility rooms would be constructed for 18 homes that experience various levels of basement flooding. An automated flood forecasting system would provide residents of Belmont Park with time to move damageable property out of their basements and to evacuate their homes.

As part of this plan, the city of Warwick would acquire 18 privately owned vacant lots, all zoned residential, in the Belmont Park area. These lots, combined with the 51 acquired residential properties and city owned land, would provide approximately 21 acres of open land north of First Avenue for future recreation and/or wildlife habitat.

The total acquisition and relocation assistance costs for this plan were estimated at $2,770,000, and are summarized in the following table.

TABLE 13

PLAN A-2, ACQUISITION COSTS

51 Improved Residential Tracts	$1,403,000
18 Unimproved Tracts	59,000
City Owned Land	0
Severance Damages	0
SUBTOTAL	$1,462,000
Contingencies	300,800
Total Estimated Cost of Land Improvements	$1,762,800
Relocation Assistance Cost	749,200
Acquisition Costs	183,000
	$2,695,000
Administrative Costs	75,000
TOTAL ESTIMATED ACQUISITION COST	$2,770,000

Site work associated with the demolition of 51 homes in Belmont Park was estimated at $138,000. This work would be similar to the work performed under Plan A-1.

Plan A-2 would involve the construction of 18 utility room additions at an estimated cost of $180,000.

The same system of automated flood forecasting equipment as described under Plan A-1 would be included in this plan and was estimated at $50,000.

Table 14 lists the estimated first and annual cost of each element of Plan A-2, based on January 1982 price levels and amortizing costs over 50 years at a 7-5/8 percent interest rate.

TABLE 14

PLAN A-2, FIRST AND ANNUAL COSTS

	Estimated First Cost	Estimated Annual Cost
Acquisition	$2,770,000	$216,000
Demolition & Site Work	290,000	23,000
18 Utility Rooms	180,000	14,000
Flood Forecast System	50,000	4,000
TOTAL	$3,290,000	$257,000

Impacts

The short and long term impacts resulting from the implementation of this plan would be similar to those discussed for Plan A-1.

Economics

The annual flood inundation benefits assigned to Plan A-2 are $338,900 (see Appendix 6). When compared to an annual cost of $257,000 the resultant benefit-to-cost ratio is 1.3 to 1.

Implementation Responsibilities

The Federal and non-Federal share of Plan A-2's first costs are shown in Table 15.

TABLE 15

PLAN A-2, COST SHARING

	Cost	Percent
Federal	$2,632,000	80
Non-Federal	658,000	20
TOTAL ESTIMATED COST	$3,290,000	100

After implementation of Plan A-2, the city of Warwick would be responsible for the cost of operating and maintaining the flood forecasting system, which was estimated at $1,300 annually.

Public Views

The city of Warwick expressed interest in this plan; however, preferred the additional flood protection provided by Plan A-1.

PLAN B-1, 100-YEAR ACQUISITION/FLOODPROOFING PLAN

Plan Description

This plan involves raising 29 of the 59 homes in Belmont Park which would sustain damage to the first floor during the 100-year flood (see Plate 3). The remaining 30 homes would be acquired and demolished. An additional 17 homes in Belmont Park would experience basement flooding. Utilities located in the basements of these homes would be relocated above expected flood stages to a first floor addition. Because many of the homes that would be floodproofed would be surrounded with water, an adequate flood warning and evacuation plan would be required to give residents time to move damageable property and to evacuate their homes.

As part of this plan, the city of Warwick would also acquire 17 privately owned lots, all residential, in the Belmont Park area. These lots, combined with the 30 residential properties that would be acquired and city owned land, would provide approximately 20 acres of open land north of First Avenue for future recreation and/or wildlife habitat.

The total acquisition and relocation assistance costs were estimated at $1,690,000 and are summarized in the following table.

TABLE 16

PLAN B-1, ACQUISITION COSTS

30 Improved Residential Tracts	$ 799,000
17 Unimproved Tracts	57,000
City Owned Land	0
Severance Damages	0
SUBTOTAL	$ 856,000
Contingencies	171,200
Total Estimated Cost of Land and Improvements	$1,027,200
Relocation Assistance Costs	421,800
Acquisition Costs	141,000
	$1,590,000
Administrative Costs	100,000
TOTAL ESTIMATED ACQUISITION COST	$1,690,000

Site work associated with the demolition of 30 homes was estimated at $172,000.

Raising homes would involve disconnecting the utilities, jacking up the structure, adding additional height to the old foundation, and reconnecting the utilities. Only the homes that were determined to be structurally sound and in good condition would be raised. All basement windows and doors would be kept as openings so that during flooding the water pressure inside and out would be equalized and not cause structural damage. The cost of raising 29 homes was estimated at $955,000. This cost is summarized in Table 17. Included in this figure is the cost of temporary housing for residents while their homes are being raised.

TABLE 17

PLAN B-1, HOUSE RAISING COSTS

Raising Costs (29 homes)	$587,540
Temporary Housing	49,300
	$636,840
Contingencies	127,160
SUBTOTAL	$764,000
Engineering & Design	115,000
Supervision & Administration	76,000
TOTAL FIRST COST OF RAISING	$955,000

Similar to Plan A-1, 17 utility room additions would be constructed at an estimated first cost of $170,000.

The cost of automated flood forecasting equipment was estimated at $50,000.

As shown in Table 18, the total estimated first cost of Plan B-1 is $3,037,000 (based on January 1982 price levels). Amortizing this cost over 50 years at a 7-5/8 percent interest rate, the annual cost would be about $237,000.

TABLE 18

PLAN B-1, FIRST AND ANNUAL COSTS

	Estimated First Cost	Estimated Annual Cost
Acquisition	$1,690,000	$132,000
Demolition & Site Work	172,000	13,000
Raising 29 Homes	955,000	75,000
17 Utility Rooms	170,000	13,000
Flood Forecast System	50,000	4,000
TOTAL	$3,037,000	$237,000

Impacts

The impacts resulting from demolishing homes and the construction of utility rooms would be similar to those discussed under Plan A-1. The short term impacts of floodproofing structures in Belmont Park would result from the temporary relocation of residents while their homes are being raised. The usual schedules of family members would be disrupted for an average of 1 week as this work is performed. However, this disruption would not be significant considering the short period of time involved and that families would be reimbursed for the cost of temporary lodging.

Over the long term, raising structures could have a negative effect on the aesthetics of the homes. Redesign of the exterior, including facing the raised portion with materials to match or complement the existing structure, would lessen this impact.

Economics

The annual flood inundation benefits assigned to Plan B-1 are $324,200 (see Appendix 6). When compared to an annual cost of $237,000 the resultant benefit-to-cost ratio is 1.4 to 1.

Implementation Responsibilities

The Federal and non-Federal share of Plan B-1's first costs are shown in Table 19.

TABLE 19

PLAN B-1, COST SHARING

	Cost	Percent
Federal	$2,429,600	80
Non-Federal	607,400	20
TOTAL ESTIMATED COST	$3,037,000	100

The city of Warwick would be responsible for the annual cost of operating and maintaining the flood forecasting system, which has an estimated cost of $1,300 a year, after project completion.

Public Views

City officials anticipate that this plan may result in problems with some residents who would not be satisfied with floodproofing if their neighbors were relocated.

PLAN B-2, 50-YEAR ACQUISITION/FLOODPROOFING PLAN

Plan Description

This plan involves raising 20 of the 44 homes in Belmont Park which would sustain damage to the first floor during the 50-year flood (see Plate 4). The remaining 24 homes would be acquired and demolished. Utility rooms would be constructed for an additional 25 homes that experience various levels of basement flooding. Because many of the homes that would be raised, would be surrounded with water during flooding, an adequate flood warning and evacuation plan would be required to give residents time to move damageable property and to evacuate their homes.

As part of this plan, the city of Warwick would also acquire 17 privately owned vacant lots, all residential, in the Belmont Park area. These lots, combined with the 24 residential properties that would be acquired and city owned land, would provide approximately 18 acres of open land north of First Avenue for future recreational and/or environmental use.

The total acquisition and relocation assistance costs equal $1,350,000 and are summarized in Table 20.

TABLE 20

PLAN B-2, ACQUISITION COSTS

24 Improved Residential Tracts		$ 640,000
17 Unimproved Tracts		41,000
City Owned Land		0
Severance Damages		0
	SUBTOTAL	$ 681,000
	Contingencies	137,600
		$ 818,600
Relocation Assistance Costs		333,400
Acquisition Costs		123,000
		$1,275,000
	Administrative Costs	75,000
	TOTAL ESTIMATED ACQUISITION COST	$1,350,000

Table 21 lists the estimated first and annual cost of each element of Plan B-2, based on January 1982 price levels.

TABLE 21

PLAN B-2, FIRST AND ANNUAL COSTS

	Estimated First Cost	Estimated Annual Cost
Acquisition	$1,350,000	$106,000
Demolition & Site Work	138,000	11,000
Raise 20 Homes	583,000	46,000
25 Utility Rooms	250,000	20,000
Flood Forecast System	50,000	4,000
TOTAL	$2,371,000	$187,000

Impacts

The short and long term impacts resulting from the implementation of this plan would be similar to those discussed under Plans A-1 and B-1.

Economics

The annual flood inundation benefits assigned to Plan B-2 are $283,800 (see Appendix 6). When compared to an annual cost of $187,000 the resultant benefit-to-cost ratio is 1.5 to 1.

Implementation Responsibilities

The Federal and non-Federal cost share of Plan B-2 are shown in Table 22.

TABLE 22

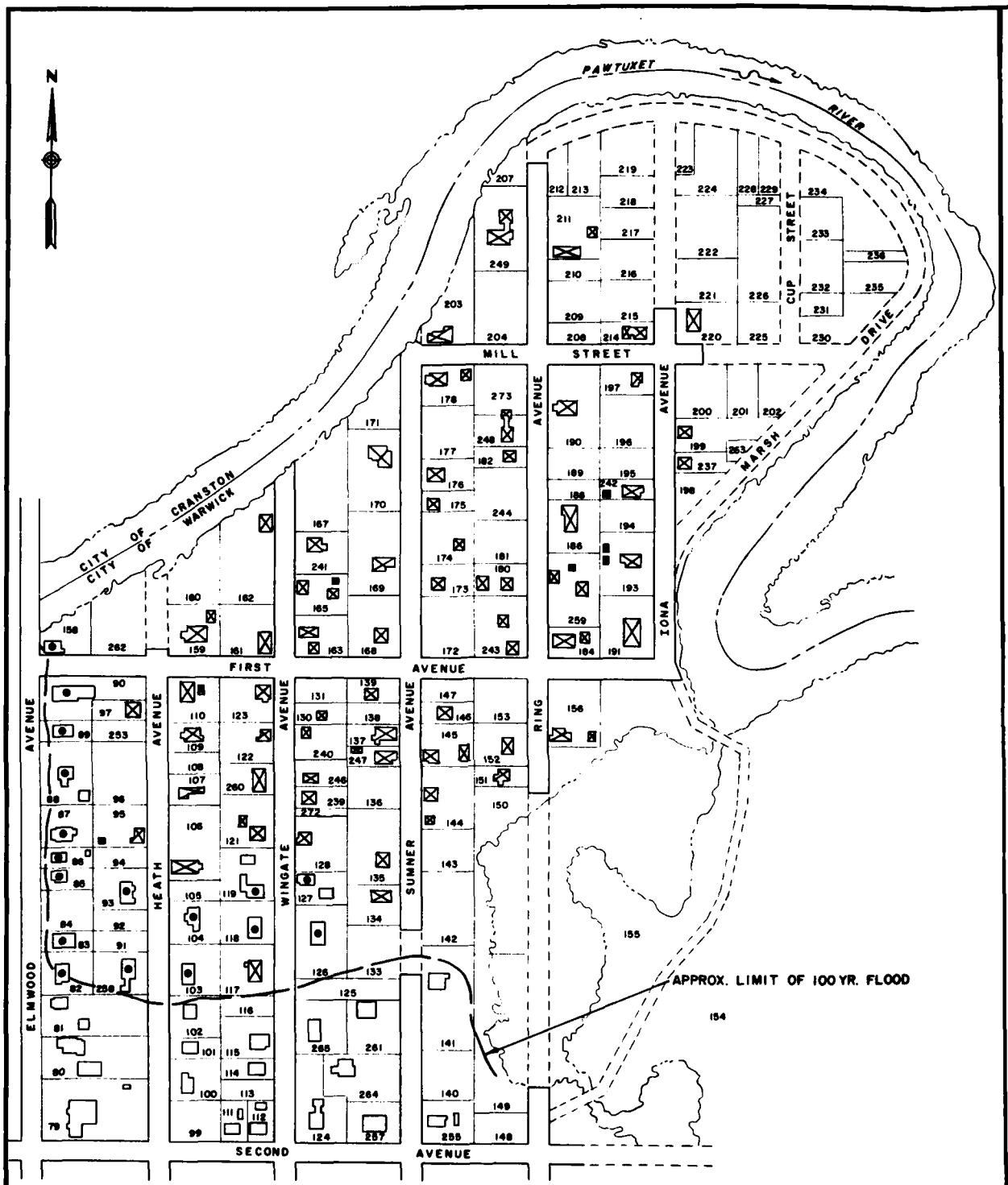
PLAN B-2, COST SHARING

	Cost	Percent
Federal	$1,896,800	80
Non-Federal	474,200	20
TOTAL ESTIMATED COST	$ 2,371,000	100

The city of Warwick would be responsible for the annual cost of operating and maintaining the flood forecasting system, which has an estimated cost of $1,300 a year after project completion.

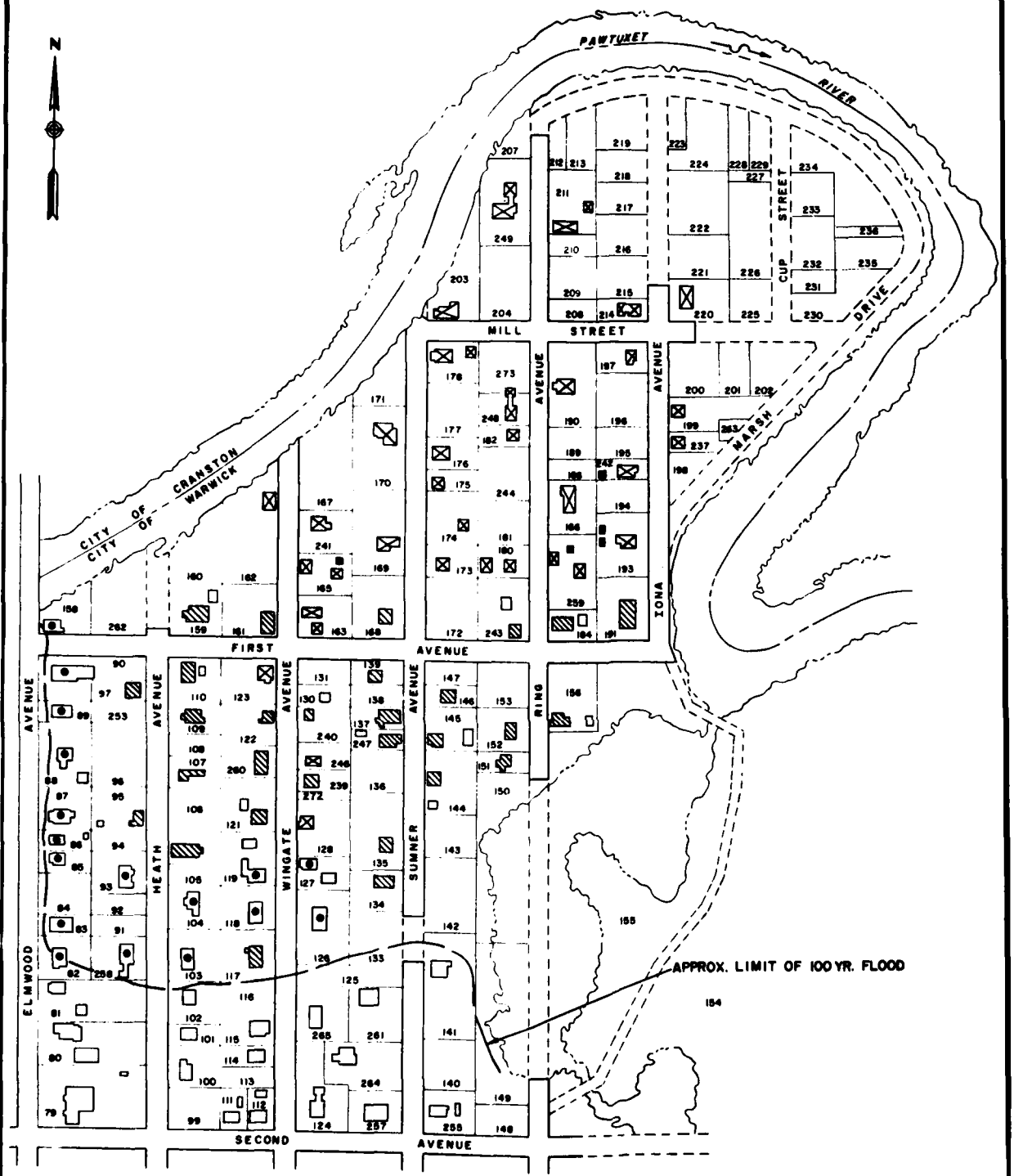
Public Views

Residents of Belmont Park and city officials preferred plans that provided a higher level of protection.



PLAN A-1

LEGEND	
SYMBOL	DESCRIPTION
	EXISTING STRUCTURES
	STRUCTURES TO BE DEMOLISHED AND DEBRIS REMOVED
	STRUCTURES TO BE RAISED AND A FIRST FLOOR UTILITY ROOM ADDED
	FIRST FLOOR UTILITY ROOM ADDED



PLAN B-1

GRAPHIC SCALE

100' 0 100' 200'

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

WATER RESOURCES DEVELOPMENT PROJECT

BELMONT PARK - WARWICK, R.I.

100 YR. FLOOD EVENT-NATURAL

FLOOD EL. 20.4 N.G.V.D.

PLANS A-1 AND B-1

PAWTUXET RIVER RHODE ISLAND

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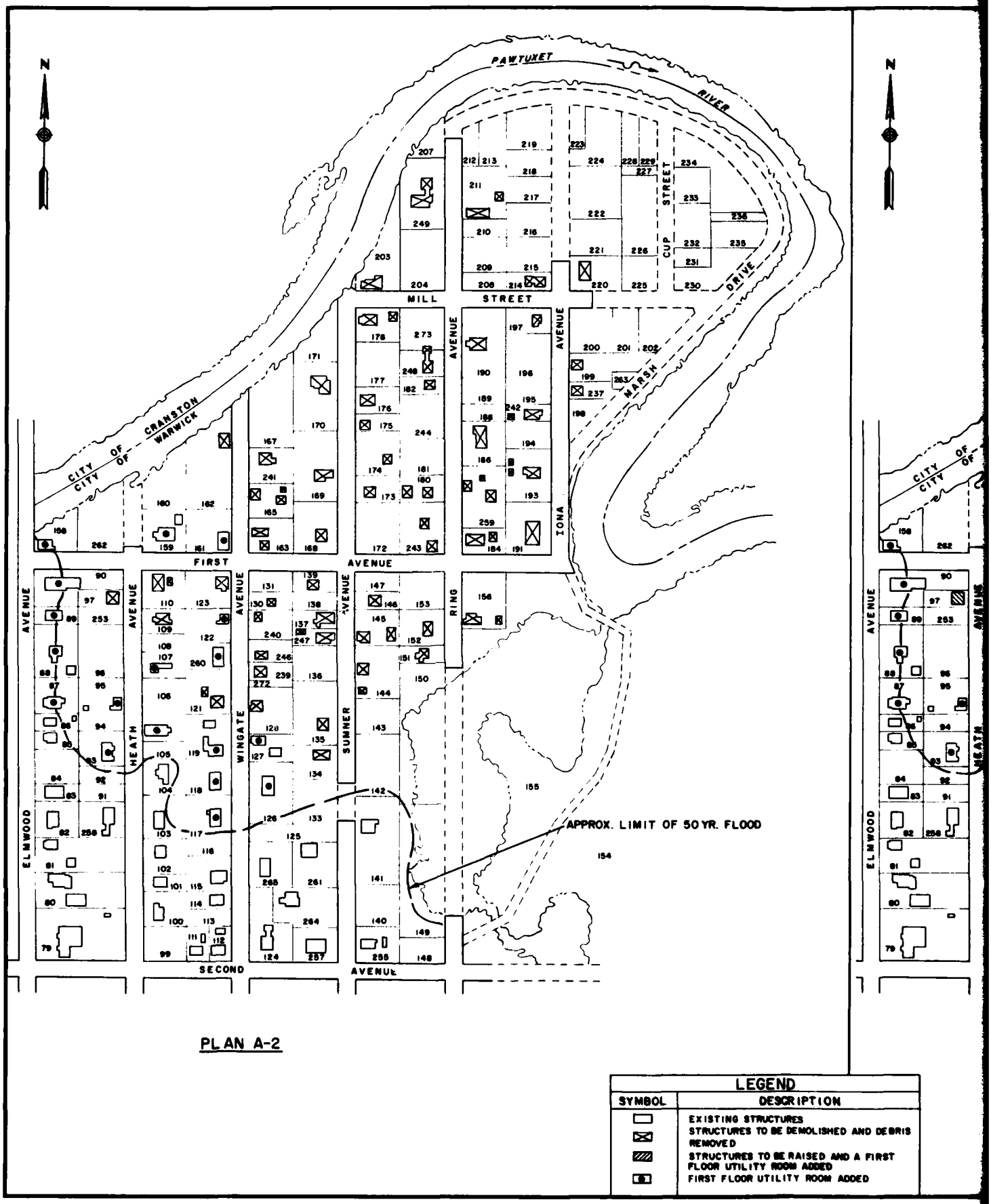
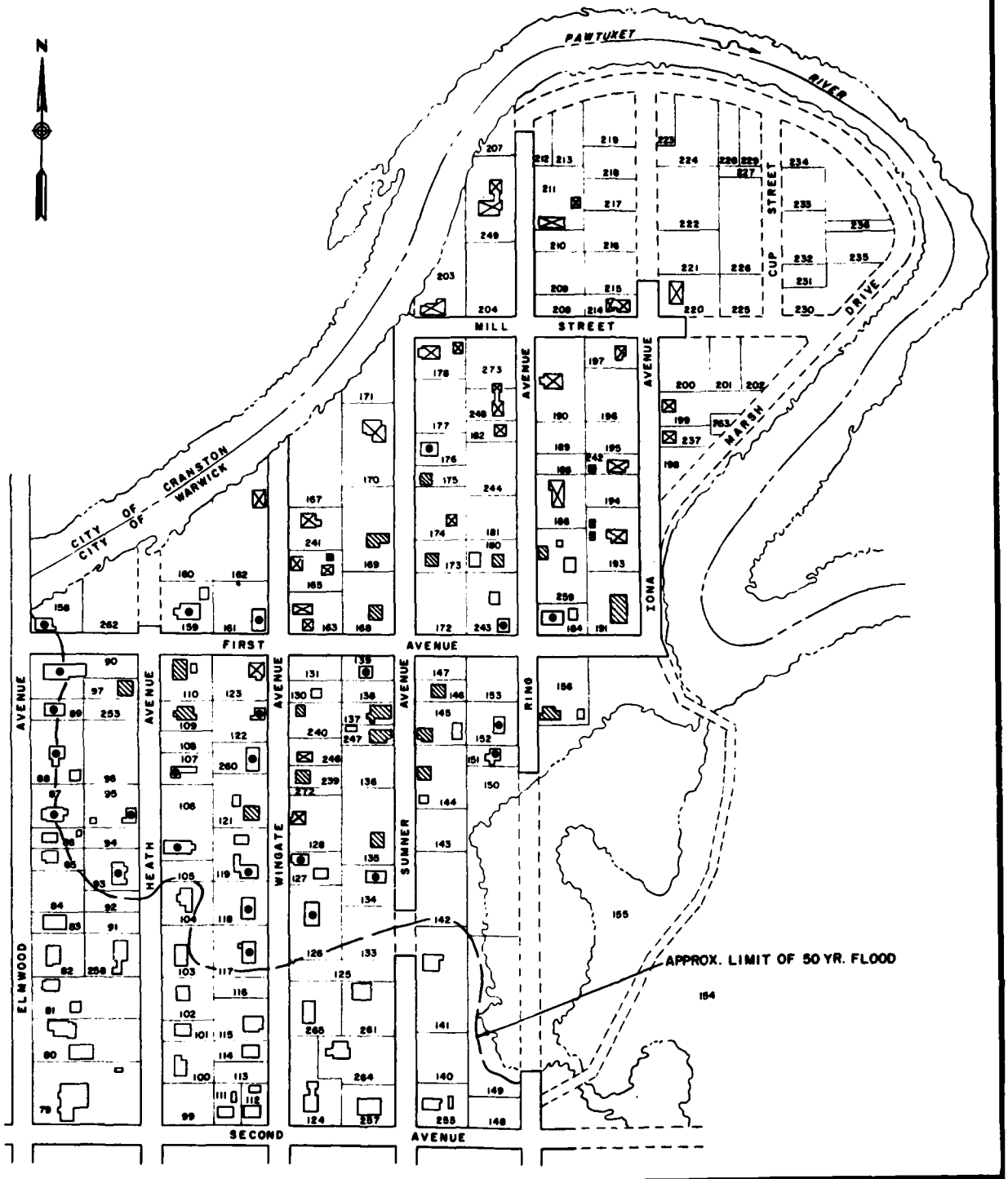
2

PLATE 3.



PLAN A-2

LEGEND	
SYMBOL	DESCRIPTION
	EXISTING STRUCTURES
	STRUCTURES TO BE DEMOLISHED AND DEBRIS REMOVED
	STRUCTURES TO BE RAISED AND A FIRST FLOOR UTILITY ROOM ADDED
	FIRST FLOOR UTILITY ROOM ADDED



PLAN B-2

GRAPHIC SCALE

100' 0 100' 200'

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

WATER RESOURCES DEVELOPMENT PROJECT

BELMONT PARK - WARWICK, R. I.

50 YR. FLOOD EVENT - NATURAL

FLOOD EL. 18.8 N.G.V.D.

PLANS A-2 AND B-2

PAWTUXET RIVER RHODE ISLAND

PLATE 4

ON

NED AND DEBRIS

AND A FIRST

ADDED

2

SUMMARY

The following table summaries the 4 plans described in this section.

TABLE 23

SUMMARY OF ALTERNATIVE PLANS

PLAN	DESIGN FLOOD FREQUENCY (recurrance interval, years)	HOMES ACQUIRED	VACANT LOTS ACQUIRED	HOMES FLOODPROOFED (Raised)	UTILITY ROOMS
A-1	100	59	19	—	17
A-2	50	51	18	--	18
B-1	100	30	17	29	17
B-2	50	24	17	20	25

NOTE: A flood forecasting, warning and evacuation system would be included in each of the four plans.

COMPARISON OF DETAILED PLANS

This section compares the four plans discussed in the previous section and provides the basis for the designation of an NED plan, and the rationale for the selection of a recommended plan.

A condensed system of accounts, Table 25, is included to display differences between alternatives based on beneficial and adverse contributions to the various accounts.

COMPARISON OF DETAILED PLANS

Plans were compared based on the following parameters: (1) fulfillment of problem and opportunity statements, (2) economic efficiency, (3) impacts, (4) public acceptance.

(1) Fulfillment of Problem and Opportunity Statements

Implementation of any of the four plans would provide an increase in the economic strength and safety of residents living in Belmont Park, by reducing recurring losses and the threat of future flooding. However, Plans A-1 and B-1 are more responsive to these planning statements because they provide 100-year protection as opposed to Plans A-2 and B-2 which provide 50-year protection. Each of the plans would create new open land which could be used to increase the recreational experience at Belmont Park and to preserve and enhance the environmental and aesthetic value of wildlife habitat located on the northern end of the peninsula.

The number of acres made available for environmental and/or recreational use under each plan is shown below.

PLAN A-1	22 acres
PLAN A-2	21 acres
PLAN B-1	20 acres
PLAN B-2	18 acres

As part of each plan, the domestic septic tanks of homes that are acquired would be pumped and permanently backfilled. These septic systems have caused severe pollution problems during past floods. Their removal will help to improve the water quality of the Pawtuxet River. The number of septic tanks to be backfilled under each plan is as follows:

PLAN A-1	59
PLAN A-2	51
PLAN B-1	30
PLAN B-2	24

(2) Economic Efficiency

The economics of each plan is summarized in the following table.

TABLE 24

ECONOMIC EFFICIENCY OF DETAILED PLANS

	Annual Cost	Annual Benefits	Net Benefits	B/C Ratio
PLAN A-1	$295,300	$401,700	$106,400	1.4 to 1
PLAN A-2	258,300	338,900	80,600	1.3 to 1
PLAN B-1	238,300	324,200	85,900	1.4 to 1
PLAN B-2	188,300	283,800	95,500	1.5 to 1

The above table indicates that all four plans are economically justified and that Plan A-1 maximizes net benefits.

(3) Impacts

Negative impacts that are common to all plans would include an increase in noise, dust and traffic resulting from the demolition of structures, the construction of utility rooms, and/or the raising of houses. All plans would require the relocation of some residents. However, many have indicated that relocation would not cause serious hardships and that it would be better than remaining in Belmont Park with the threat of future flooding.

The most noted positive impact would be the added flood protection which would reduce recurring flood damages, community disruption, and provide residents with a greater sense of security. All plans would create new open space that can be used for wildlife habitat and/or future recreational development. The amount of land available for such purposes varies with each alternative. Implementation of these plans would help improve the water quality of the Pawtuxet River by eliminating a number of inadequate septic tanks that have caused severe pollution problems during past floods.

These plans do not involve construction along the river or adjacent wetlands, and therefore, would have no adverse effect on natural riverine resources.

(4) Public Acceptance

Neighborhood residents and city officials have been very active during this study, and have continually expressed the hope that a Federal program to reduce flood losses in Belmont Park would be implemented as expeditiously as possible. All four plans have received strong public support; however, Plan A-1 was the most widely received since it offered the greatest amount of protection.

RATIONALE FOR NED PLAN

As indicated in Table 15, all four plans provide net positive National Economic Development benefits. However, Plan A-1 maximizes these benefits and should be considered as the NED plan.

RATIONALE FOR SELECTED PLAN

The selection of a plan is based on its effectiveness, economic efficiency, environmental considerations, and public acceptance. Based on these factors, Plan A-1 is the selected plan. Plan A-1 reduces future flood damages and adds to the security of flood plain residents. It is the NED plan and has been selected by local officials and residents of Belmont Park as the preferred plan. Plan A-1 provides the largest amount of open space which can be used for wildlife habitat and/or future recreational development. It also involves filling the greatest number of septic tanks, thus providing the most benefits to water quality in the Pawtuxet River and to public health.

TABLE 25

SUMMARY COMPARISON OF ALTERNATIVE PLANS

WARWICK, RHODE ISLAND

	WITHOUT CONDITION	PLAN A-1	PLAN A-2	PLAN B-1	PLAN B-2
A. PLAN DESCRIPTION	Most probable future condition.	100-year Acquisition Plan	50-year Acquisition Plan	100-year Acquisition/Floodproofing Plan	50-year Acquisition/Floodproofing Plan.
B. IMPACT ASSESSMENT					
(1) NATIONAL ECONOMIC DEVELOPMENT (NED)					
a. PROJECT FIRST COST					
Federal	-	$ 3,008,000	$ 2,632,000	$ 2,429,600	$ 1,896,800
Non-Federal	-	$ 752,000	$ 658,000	$ 607,400	$ 474,200
Total	-	$ 3,760,000	$ 3,290,000	$ 3,037,000	$ 2,371,000
b. FLOOD DAMAGES					
Average Annual Flood Damage	NA	$ 322,000	$ 322,000	$ 322,000	$ 322,000
Annual Residual Damages	NA	$ 34,000	---	$ 149,000	---
Annual Flood Damage Reduction	NA	$ 288,000	---	$ 173,000	---
c. AVERAGE ANNUAL BENEFITS	NA	$ 401,700	$ 338,900	$ 324,200	$ 283,800*
d. AVERAGE ANNUAL COST	NA	$ 295,300	$ 258,300	$ 238,300	$ 188,300

* Includes emergency benefits

	WITHOUT CONDITION	PLAN A-1	PLAN A-2	PLAN B-1	PLAN B-2
e. NET BENEFITS	NA	$ 106,400	$ 80,600	$ 85,900	$ 95,500
f. BENEFIT COST RATIO	NA	1.4 to 1	1.3 to 1	1.4 to 1	1.5 to 1
(2) ENVIRONMENTAL QUALITY (EQ)					
a. * AIR QUALITY	No change	Increase dust levels during construction.	Same as Plan A-1	Same as Plan A-1	Same as Plan A-1
b. ARCHAEOLOGICAL/HISTORICAL RESOURCES	No change	No known impact	No known impact	No known impact	No known impact
c. BIOLOGICAL RESOURCES	No change	Temporary disruption of vegetation and wildlife during construction	Same as Plan A-1	Same as Plan A-1	Same as Plan A-1
d. * NATURAL AND MANMADE RESOURCES	No change	Commits natural & manmade resources for plan implementation. Conserves natural and manmade resources that would have been damaged in future floods.	Same as Plan A-1	Same as Plan A-1	Same as Plan A-1
e. * WATER QUALITY	Water quality will continue to improve with the construction of treatment facilities, however, flooding of Belmont Park would temporarily degrade water quality.	Removal of homes & septic tanks from the flood plain will reduce the amount of pollutants released into the Pawtuxet River during flooding.	Same as Plan A-1	Same as Plan A-1	Same as Plan A-1

	WITHOUT CONDITION	PLAN A-1	PLAN A-2	PLAN B-1	PLAN B-2
(3) OTHER SOCIAL EFFECTS (OSE)					
a. * AESTHETIC VALUES	Deterioration of homes in Belmont Park due to flooding.	Converts the urban residential neighborhood of Belmont Park to open space.	Same as Plan A-1	Same as Plan A-1	Same as Plan A-1
b. * NOISE	No change	Temporary increases at site during construction.	Same as Plan A-1	Same as Plan A-1	Same as Plan A-1
c. * DISPLACEMENT OF PEOPLE	Possible short term displacement as a result of flooding.	Requires the relocation of 59 families. Temporary displacement of 17 families during flooding.	Requires the relocation of 51 families. Temporary displacement of 18 families during flooding.	Requires the relocation of 30 families. Temporary displacement of 46 families during flooding.	Requires the relocation of 24 families. Temporary displacement of 45 families during flooding.
d. * COMMUNITY COHESION	Disrupted by flooding.	Reduces disruption by relocating many flood plain residents and promoting community cooperation during flood events.	Same as Plan A-1	Same as Plan A-1	Same as Plan A-1
e. * LIFE, HEALTH AND SAFETY	Continued threat to residents.	Reduces the number of families in the flood plain. Provides greater protection to those remaining in the flood plain through timely warning & evacuation.	Same as Plan A-1	Same as Plan A-1	Same as Plan A-1

	WITHOUT CONDITION	PLAN A-1	PLAN A-2	PLAN B-1	PLAN B-2
f. * PUBLIC FACILITIES & SERVICES	Potential damage to utilities and disruption of public services during flooding.	Reduces damage to utilities by removing them from the flood plain. Provides limited emergency services during flooding.	Same as Plan A-1	Same as Plan A-1	Same as Plan A-1
g. * DESIRABLE COMMUNITY GROWTH	No change	Removes uncompatible development from the flood plain and provides open space for suitable uses, consistent with the desires of Warwick.	Same as Plan A-1	Same as Plan A-1	Same as Plan A-1
h. RECREATIONAL	No change	Provides area for future recreational development.	Same as Plan A-1	Same as Plan A-1	Same as Plan A-1
i. TRANSPORTATION	Short term disruption during floods.	Temporary increase in truck and other traffic during construction.	Same as Plan A-1	Same as Plan A-1	Same as Plan A-1
(4) REGIONAL ECONOMIC DEVELOPMENT (RED)					
a. * TAXES AND LOCAL GOV'T EXPENDITURES	Increase in expenditures as a result of flooding.	Reduction in expenditures for emergency services during flooding.	Same as Plan A-1	Same as Plan A-1	Same as Plan A-1

	WITHOUT CONDITION	PLAN A-1	PLAN A-2	PLAN B-1	PLAN B-2
b. EMPLOYMENT	Temporary strain on local employees during flooding.	Increase in employment during plan implementation.	Same as Plan A-1	Same as Plan A-1	Same as Plan A-1
c. INCOME	Reduced by flooding.	Increase in net income of area from expenditures by construction workers. Provides temporary market for construction materials. Reduction of losses during flooding.	Same as Plan A-1	Same as Plan A-1	Same as Plan A-1
C. PLAN EVALUATION					
(1) CONTRIBUTION TO PROBLEM AND OPPORTUNITY STATEMENTS					
a. MINIMIZE THREAT TO LIFE & SAFETY	Potential loss of life.	Relocates many flood plain residents. Provides flood warning system to minimize the threat to life & safety of remaining residents.	Same as Plan A-1	Same as Plan A-1	Same as Plan A-1
b. REDUCE FLOOD DAMAGES	Possible purchase of flood insurance.	Removes and relocates most damageable property from the 100-year flood.	Removes and relocates most damageable property from the 50-year flood.	Relocates and floodproofs most damageable property from the 100-year flood.	Relocates and floodproofs most damageable property from the 50-year flood.
c. ENHANCE RECREATIONAL OPPORTUNITIES	No change	Provides 22 acres of open land, north of First Avenue, for future development of recreational activities.	Provides 21 acres of open land, north of First Avenue, for future development of recreational activities.	Provides 20 acres of open land, north of First Avenue, for future development of recreational activities.	Provides 18 acres of open land, north of First Avenue, for future development of recreational activities

	WITHOUT CONDITION	PLAN A-1	PLAN A-2	PLAN B-1	PLAN B-2
(2) NET (WITH VS. WITHOUT) BENEFICIAL & ADVERSE EFFECTS					
a. NATIONAL ECONOMIC DEVELOPMENT (NED)	Potential for losses during flooding.	Annual net benefits greater than annual costs, B/C Ratio - 1.4 to 1.	Annual net benefits greater than annual costs, B/C Ratio - 1.3 to 1.	Annual net benefits greater than annual costs, B/C Ratio - 1.4 to 1.	Annual net benefits greater than annual costs B/C Ratio - 1.5 to 1.
b. ENVIRONMENTAL QUALITY (EQ)	No significant change	Would provide 22 acres of open space north of First Avenue for wildlife habitat and passive recreational activities.	Provides 21 acres of open space.	Provides 20 acres of open space.	Provides 18 acres of open space.
c. OTHER SOCIAL EFFECTS (OSE)	Flood plain residents would continue to live with the threat of flooding.	Relocates many flood plain residents. Increase in security of those remaining in the flood plain.	Same as Plan A-1	Same as Plan A-1	Same as Plan A-1
d. REGIONAL ECONOMIC DEVELOPMENT (RED)	Improvements and repairs to existing structures.	Net gain during construction.	Same as Plan A-1	Same as Plan A-1	Same as Plan A-1
(3) PUBLIC ACCEPTANCE		Most acceptable	Acceptable	Acceptable	Aceeptable
(4) RANKINGS OF PLANNED CONTRIBUTIONS					
a. NED OBJECTIVES		Greatest contribution	Least contribution.	Positive contribution.	Positive contribution.
b. EQ ACCOUNT		Greatest contribution	Positive contribution.	Positive contribution.	Least contribution.

	WITHOUT CONDITION	PLAN A-1	PLAN A-2	PLAN B-1	PLAN B-2
c. OSE ACCOUNT		Greatest contribution.	Positive contribution.	Positive contribution.	Least contribution.
d. RED ACCOUNT		Greatest contribution.	Positive contribution.	Positive contribution.	Least contribution.
D. IMPLEMENTATION RESPONSIBILITY		Corps of Engineers, Commonwealth of Rhode Island, City of Warwick, and National Weather Service.			

DESCRIPTION OF THE SELECTED PLAN

DESCRIPTION

The selected plan, presented in this report as Plan A-1, c[illegible]sts of acquiring and demolishing 59 residential structures in the Belmo[illegible] Park section of Warwick, Rhode Island, which would sustain damage to the first floor during the 100-year flood. An additional 17 homes would experience various levels of basement flooding. Utilities located in the basements of these homes would be relocated above expected flood stages to a first floor addition. Because basements would be allowed to flood, an adequate flood forecasting system would be included as part of this plan to give residents time to move damageable property and to evacuate their homes. In addition, the city of Warwick would acquire 19 privately owned vacant lots in the Belmont Park area. This land, combined with the 59 residential lots and city owned land, would provide approximately 22 acres of open space north of First Avenue for future recreation and/or wildlife habitat.

OPERATION AND MAINTENANCE

The city of Warwick will be responsible for the project after its implementation. This would involve operating and maintaining flood forecasting equipment. The proposed flood forecasting system is fully automated and operates around the clock. It has been engineered to provide dependable service at a low annual cost. Table 12 lists the annual operation and maintenance costs of the proposed flood forecasting system, which totals $1,300 a year. The city of Warwick would also be required to maintain a state of readiness through periodic testing and public education of the flood warning and evacuation program.

ECONOMICS

The total estimated first cost of the selected plan equals $3,760,000. Amortizing this cost over 50 years at a 7-5/8 percent interest rate results in an annual cost of $294,000. The first and annual costs of the selected plan are summarized in Table 26.

TABLE 26

FIRST AND ANNUAL COSTS OF SELECTED PLAN

	FIRST COST	ANNUAL COST
Acquisition	$3,200,000	$250,000
Demolition and Site Work	340,000	27,000
Utility Rooms	170,000	13,000
Flood Forecast System	50,000	4,000
TOTAL FIRST COST	$3,760,000*	$294,000
Operation & Maintenance	---	1,300
TOTAL ANNUAL COST		$295,300

* Does not include preauthorization costs of $100,000.

Of the $3,760,000 estimated first cost, the Federal government would be responsible for 80 percent and the local sponsor 20 percent.

Federal	$3,008,000 (80%)
Non-Federal	752,000 (20%)
TOTAL FIRST COST	$3,760,000

The estimated annual costs of the selected plan are shown in Table 27.

TABLE 27

ESTIMATED ANNUAL COST OF SELECTED PLAN

Federal Annual Cost

Amortization 50 yr. life, 7-5/8 percent interest ($3,008,000 x .07823)	$235,300
Federal Total	$235,300

Non-Federal Annual Cost

Amortization 50 yr. life, 7-5/8 percent interest ($752,000 x .07823)	$ 58,700
Operation and Maintenance	$ 1,300
Non-Federal Total	$ 60,000
TOTAL ANNUAL COST	$295,300

Benefits accrued from implementation of the recommended plan total $401,700 and are shown in Table 28.

TABLE 28

ANNUAL BENEFITS OF SELECTED PLAN

Reduction of Insurable Flood Damages	$271,400
Reduction of Flood Insurance Overhead	1,400
Reduction of Emergency Costs	65,000
Reduction of Damages to Public Utilities	40,100
Reduction of Damages to Home Utilities	19,600
Flood Warning and Evacuation Benefits	4,200
TOTAL ANNUAL BENEFITS	$401,700

An economic analysis of the selected plan is contained in Table 29.

TABLE 29

ECONOMIC ANALYSIS OF SELECTED PLAN

	FIRST COST	ANNUAL COST	ANNUAL BENEFITS	NET BENEFITS	B/C RATIO
Selected Plan	$3,760,000	$295,300	$401,700	$106,400	1.4 to 1

EFFECTS OF SELECTED PLAN ON NATIONAL RESOURCES

Table 30 shows the effects of the selected plan on resources of principal national recognition. Information concerning the compliance of the selected plan with the Water Resources Council's designated environmental statutes is contained in the Environmental Assessment.

TABLE 30

EFFECTS OF THE SELECTED PLAN ON NATIONAL RESOURCES

Types of Resources	Principal Sources of National Recognition	Measurement of Effects
Air Quality	Clean Air Act, as amended (42 U.S.C. 1857h-7 et seq).	No effect.
Areas of Particular Concern Within the Coastal Zone	Coastal Zone Management Act of 1972, as amended (16 U.S.C. 1451 et seq.)	Not present in planning area.
Endangered and Threatened Species Critical Habitat	Endangered Species Act of 1973, as amended (16 U.S.C. 1953 et seq.)	Not present in planning area.
Fish and Wildlife Habitat	Fish and Wildlife Coordination Act (16 U.S.C. Sec. 661 et seq.)	About 22 acres of residential land would be converted to wildlife habitat.
Flood Plains	Executive Order 11988, Flood Plain Management	Fifty-nine structures would be removed from the flood plain. The open area created would then be used for wildlife habitat, recreation, and other suitable uses.

TABLE 30 (Cont'd)

Types of Resources	Principal Sources of National Recognition	Measurement of Effects
Historic and Cultural Properties	National Historic Preservation Act of 1966, as amended (16 U.S.C. Sec. 470 et seq.)	No effect.
Prime and Unique Farmland	CEQ Memorandum of 1 August 1980: Analysis of Impacts on Prime or Unique Agricultural Lands in Implementating the National Environmental Policy Act	No effect.
Water Quality	Clean Water Act of 1977 (33 U.S.C. 1251 et seq.)	Fifty-nine domestic septic systems, which have released pollutants into the Pawtuxet River during past floods, would be pumped and permanently filled.
Wetlands	Executive Order 11990, Protection of Wetlands Clean Water Act of 1977 (42 U.S.C. 1857h-7 et seq.)	No effect.
Wild and Scenic Rivers	Wild and Scenic Rivers Act, as amended (16 U.S.C. 1271 et seq.)	Not present in planning area.

PLAN ACCOMPLISHMENTS

The selected plan would contribute to the economic strength of Belmont Park property owners and provide flood plain residents with a greater sense of security. This plan would create 22 acres of open land which the city can use to enhance the environmental and recreational value of Belmont Park. The water quality of the Pawtuxet River would be improved by the removal of 59 domestic septic tanks which have caused severe pollution problems during past floods. Implementation of an automated flood forecasting system would provide the city of Warwick with timely and accurate forecasts of possible flooding along the Pawtuxet River. This would give local officials time to deploy temporary flood fighting measures, warn and evacuate flood plain residents, and maintain vital services. Property owners would be able to prevent some losses by moving some damageable property above expected flood stages, and prepare for a safe and orderly evacuation.

PLAN IMPLEMENTATION

Following the review and approval of this document by the Chief of Engineers and the allocation of funds, plans and specifications for the demolition of acquired homes and associated site work; the construction of utility room additions; and the purchasing and installation of automated flood forecasting equipment would be prepared by the New England Division. At this time a formal document would be required from the city of Warwick and/or the State of Rhode Island reaffirming their intent to support the selected plan and fulfill the requirements of local cooperation. Following the receipt of this formal document, the city of Warwick could begin acquiring homes in Belmont Park. As homes are acquired and demolished, site work performed, and utility room additions constructed; the Federal government would reimburse the city for 80 percent of its expenditures.

In implementing the flood forecasting system, the city would be required to obtain all easements necessary for the location of field equipment. The Corps would invite bids for the award of a contract to purchase and install flood forecasting equipment, provide 80 percent of the total first cost of this equipment, and act as liaison between the city and the National Weather Service. It is the current policy of the National Weather Service to assist communities in implementing automated flood forecasting systems by providing the necessary software, locating field equipment, and training personnel in the operation of equipment.

It is anticipated that all work will be completed by the end of Fiscal Year 1986. Upon completion of the recommended plan, the city of Warwick would be responsible for operation and maintenance of the project.

SUMMARY OF PUBLIC COORDINATION

Close coordination with the public was maintained throughout the study. Frequent meetings were held with officials from the city of Warwick, residents of Belmont Park, and State and Congressional representatives to explain the details of the various flood control alternatives and to answer questions.

As part of the public involvement program, questionnaires (see Appendix 2) were distributed to the residents of Belmont Park. The questionnaires provided a social assessment of the area, obtained information on past flooding, and asked residents for their reactions towards acquisition and relocation plans. In addition to the questionnaire, a newsletter was sent to each property owner and resident of Belmont Park. This newsletter contained a brief history of the study, a description of the flood control alternatives, and the Federal and local costs of each plan. It informed residents of the alternatives and gave them the opportunity to express their opinion.

As a result of coordination efforts, residents of Belmont Park and city officials selected Plan A-1 as the most favorable alternative. Support for this acquisition plan was conveyed to the Corps during local meetings and in a letter from the Mayor of Warwick dated 14 May 1982 (see Appendix 3).

RECOMMENDATIONS

I recommend that the local flood protection measures described as Plan A-1 in this report, be authorized for implementation as a Federal project, with such modifications as in the descretion of the Chief of Engineers may be advisable. Total project first costs amount to $3,760,000, Federal first costs were estimated at $3,008,000, while the non-Federal first costs total $752,000.

The non-Federal sponsor of this project would be the city of Warwick, which would be responsible for the following items of local cooperation:

1. The city agrees that, if the Government shall commence implementation of the Belmont Park Flood Damage Reduction Project, Warwick, Rhode Island, substantially in accordance with the approval of the Chief of Engineers under Section 205 of the 1948 Flood Control Act, as amended, and Section 73 of the Water Resources Development Act of 1974, Public Law 93-251, the city shall in consideration of the Government commencing such project, fulfill the requirements of non-Federal cooperation, to wit:

a. Provide all lands, easements, rights-of-way, utility relocations and alterations necessary for project implementation pursuant to an agreed schedule of land acquisition with the Government. This subparagraph shall be construed to mean that the city of Warwick will acquire unencumbered fee title to all designated real property within the flood plain and floodproof certain select dwellings.

(1) Agree that the value of the lands, easements and rights-of-way to be acquired by it shall be determined by an independent appraiser or appraisers, the selection of whom shall be approved by the Division Engineer, U.S. Army Engineer Division, New England.

(2) Agree that the appraised value of any lands, easements, or rights-of-way to be acquired shall be approved by the Division Engineer, U.S. Army Engineer Division, New England, prior to the commencement of negotiations for purchase with the owners.

(3) Agree that in conducting negotiations for purchase with owners, payments in excess of the approved appraised value will not be made unless concurrence in such excess payments is received from the Division Engineer, U.S. Army Engineer Division, New England.

(4) Agree that in exercising its authority to acquire by condemnation pursuant to Section 46-2-9 of the Rhode Island General Laws, stipulated settlements will not be made with the landowners unless prior concurrence for such stipulated settlements is obtained from the Division Engineer, U.S. Army Engineer Division, New England. Court judgment and jury awards will be fully recognized for cost sharing purposes.

b. Hold and save the United States free from damages due to the construction, operation, and maintenance of the project except where such damages are due to the fault of the United States or its contractors.

c. Maintain and operate the project after completion without cost to the United States in accordance with regulations prescribed by the Secretary of the Army. This subparagraph shall be construed to apply to all aspects of the project including lands acquired within the flood plain which must be maintained in a manner that prevents future encroachment which might interfere with proper flood plain management and the functioning of the project for flood control. Annual operation and maintenance costs are currently estimated at $1,300.

d. Bear 20 percent of the total cost of the project provided that the Government's share of project costs shall in no event exceed the statutory limitation of $4,000,000 and that the city shall bear 100 percent of all costs in excess of said statutory limitation which includes costs of all investigations, planning, engineering, supervision, inspection, and administration involved in development and project implementation. Total Government participation including investigations and planning costs is estimated to equal $3,108,000. The city's share is presently estimated at $752,000. All costs shall be computed on the basis of actual costs at the completion of the project and not on the basis of estimates contained in this report.

e. Maintain separate books, records, documents and other evidence pertaining to costs and expenses incurred in the project to the extent and in such detail as will properly reflect all net costs of whatever nature involved therein. The city shall make available at its offices at reasonable times, the accounting records for inspection and audit by an authorized representative of the Government.

f. The Government shall credit or reimburse the city for its participation only upon receipt of properly certified invoices, in quadruplicate, supported by such evidence of payment as may be required by the Government and upon approval of the work performed. Such invoices must be submitted within one calendar year from the date of completion of the project, as determined by the Government.

g. Insure an adequate evacuation plan through public education, testing, and updating as required.

h. Comply with the requirements of non-Federal cooperation specified in Sections 210 and 305 of Public Law 91-646 approved 2 January 1971 entitled the "Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970."

1. Comply with Section 601 Title VI of the Civil Rights Act of 1964 (Public Law 88-352) to the end that no person shall be excluded from participation in, denied the benefits of or subjected to discrimination in connection with the project on the grounds of race, creed, or national origin.

2. The city hereby gives the Government a right to enter, at reasonable times and in a reasonable manner, upon land which it owns or controls, for access to the project for the purpose of inspection. If inspection shows that the city for any reason is failing to operate, repair, manage, or maintain the project in accordance with the assurances hereunder and has persisted in such failure after a reasonable notice in writing by the Government delivered to the Mayor of Warwick, the Government may enter upon said lands to operate, repair, manage, or maintain the project and bill the city for costs incurred. No operation, repair, management, or maintenance by the Government in such event shall relieve the city of responsibility to meet its obligation as set forth in paragraph 1 of this agreement, or to preclude the Government from pursuing any other remedy at law or equity.

I recommend that funding in the amount of $70,000 be provided to prepare plans and specifications for the following:

a. the demolition or removal of 59 homes and associated site work,

b. the construction of utility room additions, and

c. the purchase and installation of flood forecasting equipment.

An additional $2,938,000 in funds would be required to install flood forecasting equipment and reimburse the local sponsor for 80 percent of its expenditures as the plan is implemented.

8 June 1982
DATE

C. E. EDGAR, III
Colonel, Corps of Engineers
Division Engineer

ACKNOWLEDGEMENTS

This report was completed by the New England Division, Army Corps of Engineers, under the general direction of Colonel C. E. Edgar, III, Division Engineer. It was prepared by Mr. David Goodrich, Project Manager, under the supervision of Mr. William Swaine, Chief, Special Programs Section; Mr. Carmine Ciriello, Chief, Plan Formulation Branch; and Mr. Joseph Ignazio, Chief, Planning Division.

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ENVIRONMENTAL ASSESSMENT
FLOOD DAMAGE REDUCTION
PAWTUXET RIVER
BELMONT FARK AREA OF WARWICK, RI

I. NEED FOR ACTION

The Belmont Park area of Warwick, Rhode Island, is situated within a bend of the Pawtuxet River, about 2.5 miles upstream from Pawtuxet Cove on Narragansett Bay (See Figure EA-1).

Continued urbanization within the Pawtuxet River Basin has increased runoff and made several areas more susceptible to flooding, resulting in frequent community disruption and property damage.

In the Belmont Park area 59 homes have first floor joist elevations below the 100-year flood level and damages have occurred as recently as 1978 and 1979. A small levee, constructed by the Corps in 1970 with Emergency Operations Funds, only provides protection to about a 15-year flood level. Without this levee, flooding would occur annually.

Alternative plans involve floodproofing or acquisition of these homes for demolition or removal. Acquired land would be used for recreation and open space purposes.

Authorization for study of the Belmont Park area is derived from an earlier authority for study of the Pawcatuck River and Narragansett Bay (PNB) Drainage Basin, which was vested in seven Congressional resolutions combined under one resolve adopted by the Committees on Public Works of the U.S. Senate and House of Representatives in 1968.

Following the PNB Study in 1980, the Belmont portion of the study was forwarded for further detailed investigation under the authority of Section 205 of the 1948 Flood Control Act, which authorizes the construction of projects without Congressional action when the Federal cost is limited to $4 million.

II. ALTERNATIVES

The proposed plans were developed as a result of investigating numerous alternatives to solve flooding problems in the Pawtuxet River Watershed. Those alternatives which were eliminated from further consideration are documented in the Pawcatuck River and Narragansett Bay (PNB) Drainage Basin Study (Volume VII, Attachment I, of the Big River Reservoir Interim Report) completed in 1980 by the Corps.

The proposed plans, summmrized in Table EA-1, are various combinations of three measures:

1) acquiring flood prone homes and associated buildings and demolishing or relocating these structures.

2) floodproofing sound homes by elevating these structures an average of 1 to 3 feet so that the first floor elevation is at least 1 foot above the 100-year flood level.

3) relocating flood-prone basement utilities to newly constructed rooms above the 100-year flood level.

Included as part of these plans, the city of Warwick would acquire privately-owned vacant lots in the area to provide contiguous lands for future recreational development.

TABLE EA-1

SUMMARY OF ALTERNATIVE PLANS

PLAN	FLOOD FREQUENCY	HOMES ACQUIRED	VACANT LOTS ACQUIRED	HOMES FLOODPROOFED	UTILITY ROOMS
A-1	100	59	19	--	17
A-2	50	51	18	--	18
B-1	100	30	17	29	17
B-2	50	24	17	20	25

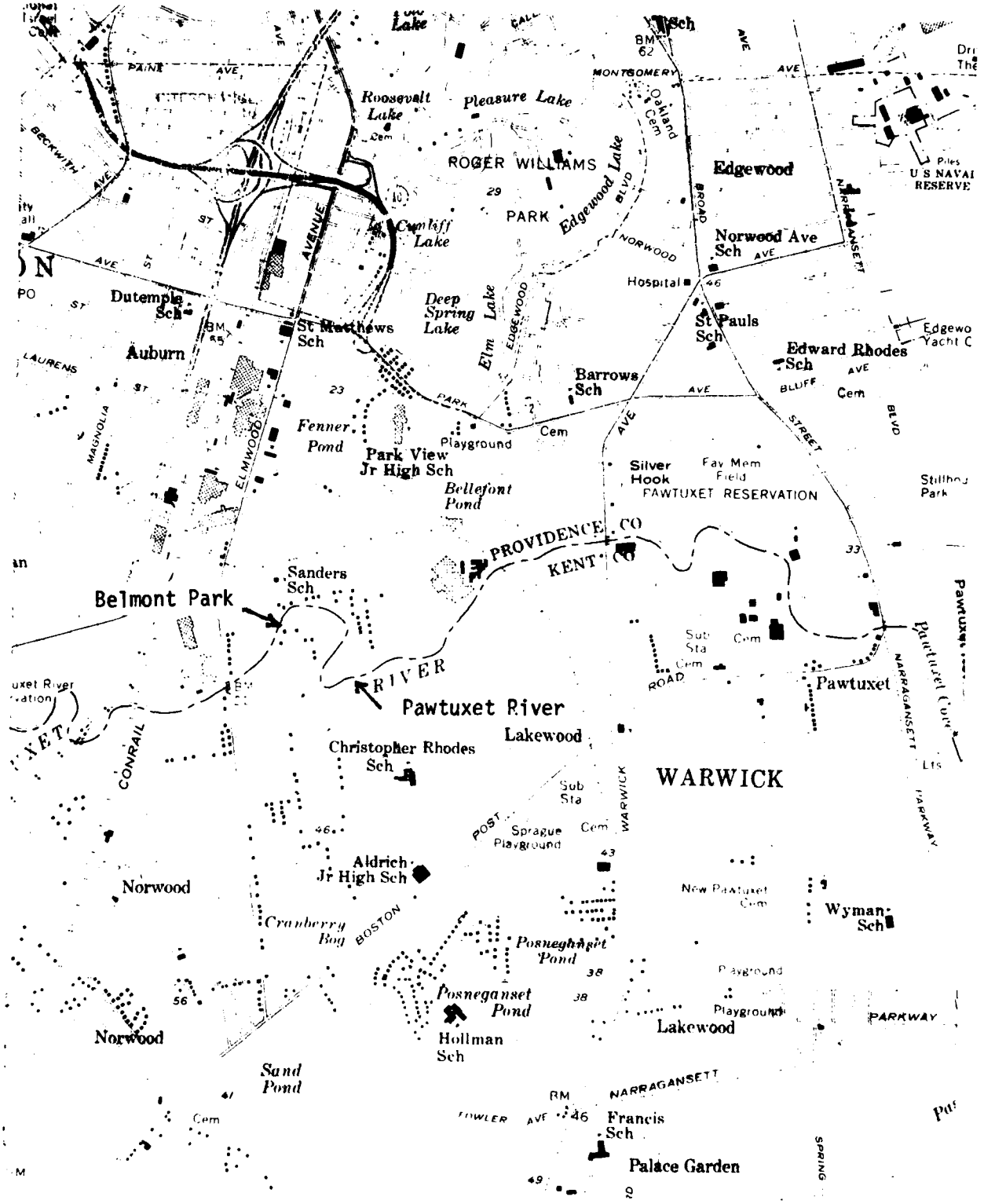
Because many of the homes that are not acquired would be subject to basement flooding, an adequate flood warning and evacuation program would be implementated as part of these plans. The flood forecasting system would give residents time to move some damageable property and to evacuate their homes.

III. AFFECTED ENVIRONMENT

A. PHYSICAL SETTING

The 230-square mile Pawtuxet River Basin is located in central Rhode Island. The river originates in the hilly uplands between Rhode Island and Connecticut and flows easterly to its mouth at Pawtuxet Cove in Narragansett Bay. The watershed contains numerous swamps, a few natural lakes and many ponds and reservoirs. Elevations in the watershed range from sea level at Pawtuxet Cove to as high as 800 feet at the western divide.

The North Branch of the Pawtuxet River originates at Scituate Reservoir, a major source of water for Providence. Gainer Memorial Dam (formerly Kent Dam) impounds the Moswansicut and Ponaganset Rivers to form this reservoir. The South Branch of the Pawtuxet River originates at Flat River Reservoir. From there the river flows generally northeast for 9.0 miles until it joins the North Branch, in the city of Warwick. From there the main stem of the Pawtuxet River flows generally northeast for approximately 11 miles to Pawtuxet Cove.



LOCATION MAP

BELMONT PARK
PAWTUXET RIVER
WARWICK, RHODE ISLAND

Scale: 1"= 2000'

FIGURE EA-1

The Belmont Park is located in the flood plain of the Pawtuxet River along the city of Warwick's northern border with the city of Cranston, Rhode Island, 2.5 miles upstream from Pawtuxet Cove, at the junction with Cranberry Bog Brook.

Cranberry Bog Brook is contained in a drainage basin of some 750 acres in Warwick. The brook begins at Falcon Avenue and flows northerly to the Cranberry Bog and from the Bog northerly to the Pawtuxet River, for a total length of 1.7 miles. Prior to emptying into the Pawtuxet River, the brook flows through a wetland of about 18 acres, which separates Belmont Park from housing developments to the east.

B. GEOLOGY & SOILS

The Belmont Park area of the Pawtuxet River flood plain consists of alluvial deposits of fine to medium sand, interbedded with gravel. This linear alluvial deposit is bordered by a coastal lowland outwash plain of sorted sand and local deposits of course gravel, with Merrimac fine sandy loam the predominant soil.

C. FISH & WILDLIFE

Extensive urbanization of the Warwick area has eliminated or reduced most native wildlife. Approximately half of the land in the city has now been developed. The most prevalent habitat areas which now remain are best suited for birds and aquatic life. These habitat areas are primarily wetland types, including marshes, ponds, streams and rivers. The Belmont Park area is bordered on three sides by river and wetland habitats, and undeveloped parcels at the northern end of the peninsula provide some upland habitat for birds and small mammals.

Existing dams, combined with stream pollution, preclude anadromous fisheries. The existing fish population consists of small, mostly non-game species.

D. WATER QUALITY

The main stem of the Pawtuxet River is presently rated as Class E, indicating that the water is unsuitable for most uses.

This poor rating in the main stem is attributed to inadequate septic tank systems, urban runoff, sluggish flow conditions caused by numerous dams, leachate from solid waste disposal areas, and inadequate streamflow to assimulate the effluents from existing treatment facilities. There are three municipal wastewater treatment plants along the main stem of the Pawtuxet in West Warwick, Warwick and Cranston, as well as a State sewage treatment facility at Cranston and several industrial treatment plants within the basin. All these facilities provide the equivalent of

secondary treatment. The Cranston facility is being upgraded to advanced treatment, but additional advanced treatment measures or low flow augmentation will be required if higher water quality ratings are to be achieved.

E. ARCHAEOLOGICAL & HISTORICAL RESOURCES

Although several recorded prehistoric archaeological sites exist within the present bounds of Warwick, there are none known within the project impact area. Most of the project area may be described as medium density residential land. Excavation for building foundations, utility lines, streets, etc. has disturbed the original land surface over most of the project area. Areas near the riverbank, particularly in the northeast corner of the project, are undeveloped and overgrown with mixed hardwoods and brush. Soils are of typical floodplain type, well drained but subject to occasional flooding. These conditions indicate that a moderate archaeological potential prior to modern development was probably greater on the higher terraces to the south.

Historic occupation of the area appears to have begun in the early 20th century, with most development occurring in the 1920's and 1950's.

F. VEGETATION

Belmont Park is primarily an urban residential neighborhood of single family houses. Vegetation here is the usual residential mix of lawns and ornamental trees and shrubs. The northern edge of the peninsula is undeveloped and vegetation is a more natural mix of native flood plain trees and shrubs such as red maple, silver maple, slippery elm, red ash, aspen, and swamp white oak, with an understory of high bush blueberry, alder, willow, arrowood burnum, sweet pepperbush, and greenbriar. Bordering the peninsula on the southeast is a city owned wetland of freshwater marsh and wooded swamp. The marsh is primarily tussock grass and cattail. The wooded swamp is primarily red maple.

IV. ENVIRONMENTAL IMPACTS

The environmental impacts of the four alternative plans displayed in Table EA-1 would vary in degree with the number of homes floodproofed or acquired. With each acquisition alternative, homes would be acquired and either moved or demolished, basements would be filled and each site would be loamed and seeded. In some homes not acquired, basement utilities would be relocated to new attached utility rooms above the 100-year flood stage. Plan A-1 would acquire the most homes (59), while Plan B-2 the least (24). With the two combination plans of acquisition and floodproofing, impacts would be lessened as fewer homes would be acquired. Negative impacts common to all plans would be related to the demolition or relocation of structures, which would result in a temporary localized increase in noise, dust, and traffic.

With project completion, a beneficial impact would be the creation of new open space for potential use as recreation land and wildlife habitat. The amount of land available for such purposes would vary with each alternative.

Land acquired, plus land already city owned would provide up to 26 acres of open space (Plan A-1). Land actually utilized for recreation and/or wildlife habitat would probably be limited to north of First Avenue. This land area would total 22 acres under Plan A-1, 21 acres under Plan A-2, 20 acres under Plan B-1 and 18 acres under Plan B-2. The city of Warwick has indicated a need for neighborhood recreation facilities in the Belmont Park area, and has proposed that if the project were implemented, open land created north of First Avenue would be used for siting of tennis courts, a soccerfield, softball fields, a canoe launch, a seating area overlooking the river and a natural area in the lowest portion of the site.

Property acquisition and floodproofing measures would reduce recurring flood damages, community disruption and emergency services required during local flooding events.

V. COORDINATION

The Corps of Engineers has consulted with several organizations and agencies to gather information for the study and to inform these groups as to the nature of the project. This coordination will be continued up through the time of project implementation. Table EA-2 summarizes the findings of this coordination.

TABLE EA-2

RELATIONSHIP OF PLANS TO ENVIRONMENTAL REQUIREMENTS PROTECTION STATUTES AND OTHER ENVIRONMENTAL REQUIREMENTS

	Plan A-1	Plan A-2	Plan B-1	Plan B-2
Federal Statutes				
Archeological and Historic Preservation Act, as amended, 16 U.S.C. 469 et seq.	FC	FC	FC	FC
Clean Air Act, as amended, 42 U.S.C. 7401, et seq.	NA	NA	NA	NA
Clean Water Act, as amended, (Federal Water Pollution Control Act) 33 U.S.C. 1251 et seq.	NA	NA	NA	NA
Coastal Zone Management Act, as amended, 16 U.S.C. 1451, et seq.	NA	NA	NA	NA
Endangered Species Act, as amended, 16 U.S.C. 1531, et seq.	FC	FC	FC	FC
Estuary Protection Act, 16 U.S.C. 1221, et seq.	NA	NA	NA	NA
Federal Water Project Recreation Act, as amended, 16 U.S.C. 460-1(12), et seq.	NA	NA	NA	NA
Fish and Wildlife Coordination Act, as amended, U.S.C. 661, et seq.	FC	FC	FC	FC
Land and Water Conservation Fund Act, as amended, 16 U.S.C. 4601, et seq.	NA	NA	NA	NA
Marine Protection, Research and Sanctuaries Act, 22 U.S.C. 1401, et seq.	NA	NA	NA	NA
National Historic Preservation Act, as amended, 16 U.S.C. 470a, et seq.	FC	FC	FC	FC
National Environment Policy Act, as amended, 42 U.S.C. 4321, et seq.	FC	FC	FC	FC
Rivers and Harbors Act, 33 U.S.C. 401, et seq.	NA	NA	NA	NA
Watershed Protection and Flood Prevention Act, 16 U.S.C. 1001, et seq.	NA	NA	NA	NA
Wild and Scenic Rivers Act, as amended, 16 U.S.C. 1271, et seq.	NA	NA	NA	NA
Executive Orders, Memoranda, etc.				
Flood Plain Management (E.O. 11988)	FC	FC	FC	FC
Protection of Wetlands (E.O. 11990)	FC	FC	FC	FC
Environmental Effects Abroad of Major Federal Actions (E.O. 12114)	NA	NA	NA	NA
Analysis of Impacts on Prime and Unique Farmlands (CEQ Memorandum 30 Aug. 76)	NA	NA	NA	NA
Land Use Plans				
Environmental Master Plan, Warwick, R.I.	FC	FC	FC	FC

NOTES: The compliance categories used in this table were assigned based on the following definitions:

a. (FC) Full compliance - All requirements of the statute, E.O., or other policy and related regulations have been met.

b. (PC) Partial compliance - Some requirements of the statute, E.O., or other policy and related regulations remain to be met when plan is authorized for construction.

c. (NA) Not Applicable - N/A statute, E.O., or other policy not applicable.

FINDING OF NO SIGNIFICANT IMPACT

The proposed Flood Damage Reduction Project for the Belmont Park area of Warwick, Rhode Island, will reduce recurring flood damages to 76 existing residences through relocation of 59 families, removal of 59 structures, and floodproofing of 17 other homes. Vacated property would be made available for wildlife habitat, recreation, and open space.

In my evaluation, the proposed project will not have any significant impacts which would necessitate the preparation of an Environmental Impact Statement.

8 June 1982
DATE

C. E. EDGAR, III
Colonel, Corps of Engineers
Division Engineer

APPENDIX 1

STUDY AUTHORITY

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APPENDIX 1

STUDY AUTHORITY

Background information concerning the authorization of this study and the requirements of local cooperation are presented here to supplement the main report.

STUDY AUTHORITY

This study was accomplished under the authority of Section 205 of the Flood Control Act of June 1948, as amended, which states:

> "The Secretary of the Army is authorized to allot from any appropriations heretofore or hereafter made for flood control, not to exceed $30,000,000 for any one fiscal year, for the construction of small projects of flood control and related purposes not specifically authorized by Congress, which come within the provisions of Section 1 of the Flood Control Act of June 22, 1936, when in the opinion of the Chief of Engineers such work is advisable. The amount allotted for a project shall be sufficient to complete Federal participation in the project. Not more that $4,000,000 shall be allotted under this section for a project at any single locality. The provisions of local cooperation specified in Section 3 of the Flood Control Act of June 22, 1936, as amended, shall apply. The work shall be complete in itself and not commit the United States to any additional improvement to insure its successful operation, except as may result from the normal procedure applying to projects authorized after submissions of preliminary examination and survey reports."

Alternatives considered by the Corps of Engineers in the Belmont Park study are governed by Section 73b of the 1974 Water Resources Act (33 U.S.C. 7016-11) which states:

> Where a nonstructural alternative is recommended, non-Federal participation shall be comparable to the value of lands, easements, and rights of way which would have been required of non-Federal interests under Section 3 of the Act of June 27, 1936 (Public Law Numbered 738, Seventy-fourth Congress), for structural protection measures, but in no event shall exceed 20 per centum of the project costs.

In addition to these measures, Public Law 91-646, the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 contains provisions which affect alternatives examined in this Detailed Project Report.

AD-A122 646 PAWTUXET RIVER WARWICK RHODE ISLAND LOCAL FLOOD DAMAGE REDUCTION STUDY DE..(U) CORPS OF ENGINEERS WALTHAM MA NEW ENGLAND DIV JUN 82 2/3

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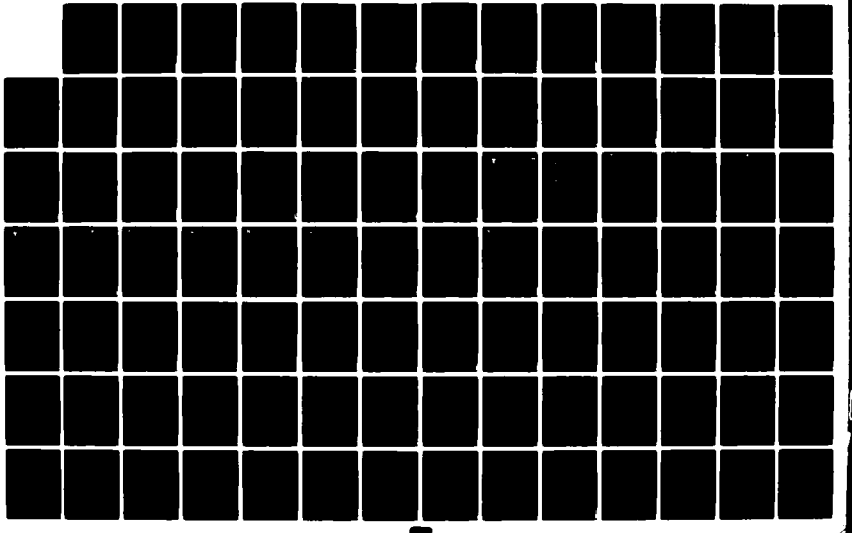
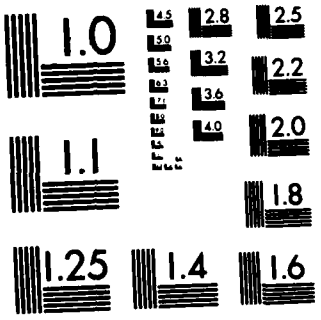




REQUIREMENTS OF LOCAL COOPERATION

Formal assurances of local cooperation similar to those required for regularly authorized projects must be furnished by a local sponsoring agency. The local sponsor must be fully authorized under state laws to give such assurances and financially capable of fulfilling all measures of local cooperation. The non-Federal sponsor of this project would be the city of Warwick.

1. The city agrees that, if the Government shall commence implementation of the Belmont Park Flood Damage Reduction Project, Warwick, Rhode Island, substantially in accordance with the approval of the Chief of Engineers under Section 205 of the 1948 Flood Control Act, as amended and Section 73 of the Water Resources Development Act of 1974, Public Law 93-251, the city shall in consideration of the Government commencing such Project, fulfill the requirements of non-Federal cooperation, to wit:

a. Provide all lands, easements, rights-of-way, utility relocations and alterations necessary for project implementation pursuant to an agreed schedule of land acquisition with the Government. This subparagraph shall be construed to mean that the city of Warwick will acquire encumbered fee title to all designated real property within the flood plain and floodproof certain select dwellings.

(1) Agree that the value of the lands, easements and rights-of-way to be acquired by it shall be determined by an independent appraiser or appraisers, the selection of whom shall be approved by the Division Engineer, U.S. Army Engineer Division, New England.

(2) Agree that the appraised value of any lands, easements, or rights-of-way to be acquired shall be approved by the Division Engineer, U.S. Army Engineer Division, New England, prior to the commencement of negotiations for purchase with the owners.

(3) Agree that in conducting negotiations for purchase with owners, payments in excess of the approved appraised value will not be made unless concurrence in such excess payments is received from the Division Engineer, U.S. Army Engineer Division, New England.

(4) Agree that in exercising its authority to acquire by condemnation pursuant to Section 46-2-9 of the Rhode Island General Laws, stipulated settlements will not be made with the landowners unless prior concurrence for such stipulated settlements is obtained from the Division Engineer, U.S. Army Engineer Division, New England. Court judgment and jury awards will be fully recognized for cost sharing purposes.

b. Hold and save the United States free from damages due to the construction, operation, and maintenance of the project except where such damages are due to the fault of the United States or its contractors.

c. Maintain and operate the project after completion without cost to the United States in accordance with regulations prescribed by the Secretary of the Army. This subparagraph shall be construed to apply to all aspects of the project including lands acquired within the flood plain which must be maintained in a manner that prevents future encroachment which might interfere with proper flood plain management and the functioning of the project for flood control. Annual operation and maintenance costs of flood forecasting equipment is currently estimated at $1,300.

d. Bear 20 percent of the total cost of the project provided that the Government's share of project costs shall in no event exceed the statutory limitation of $4,000,000 and that the city shall bear 100 percent of all costs in excess of said statutory limitation which includes costs of all investigations, planning, engineering, supervision, inspection, and administration involved in development and project implementation. Total Government participation including investigations and planning costs is currently estimated at $3,108,000. The city share is presently estimated at $752,000. Final apportionment of costs will be made when actual costs have been determined and approved by the Government.

e. Maintain separate books, records, documents and other evidence pertaining to costs and expenses incurred in the project to the extent and in such detail as will properly reflect all net costs of whatever nature involved therein. The city shall make available at its offices at reasonable times, the accounting records for inspection and audit by an authorized representative of the Government.

f. The Government shall credit or reimburse the city for its participation only upon receipt of properly certified invoices, in quadruplicate, supported by such evidence of payment as may be required by the Government and upon approval of the work performed. Such invoices must be submitted within one calendar year from the date of completion of the project, as determined by the Government.

g. Insure an adequate evacuation plan through public education, testing, and updating as required.

h. Comply with the requirements of non-Federal cooperation specified in Sections 210 and 305 of Public Law 91-646 approved 2 January 1971 entitled the "Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970."

i. Comply with Section 601 Title VI of the Civil Rights Act of 1964 (Public Law 88-352) to the end that no person shall be excluded from participation in, denied the benefits of or subjected to discrimination in connection with the project on the grounds of race, creed, or national origin.

2. The city hereby gives the Government a right to enter, at reasonable times and in a reasonable manner, upon land which it owns or controls, for access to the project for the purpose of inspection. If inspection shows that the city for any reason is failing to operate, repair, manage, or maintain the project in accordance with the assurances hereunder and has persisted in such failure after a reasonable notice in writing by the Government delivered to the Mayor of Warwick, the Government may enter upon said lands to operate, repair, manage, or maintain the project and bill the city for costs incurred. No operation, repair, management, or maintenance by the Govenrment in such event shall relieve the city of responsibility to meet its obligation as set forth in paragraph 1 of this agreement, or to preclude the Government from pursuing any other remedy at law or equity.

APPENDIX 2

SOCIAL AND ECONOMIC IMPACT ASSESSMENT

APPENDIX 2

SOCIAL AND ECONOMIC IMPACT ASSESSMENT

I. Introduction

This portion of the flood damage reduction study assesses the social and economic impacts related to implementation of a project in the Belmont Park area of Warwick. The first section of this assessment contains a description of the general social and economic characteristics of Warwick, as well as Belmont Park. In the next section the without project condition of Belmont Park is identified, followed by a brief desciption of the alternatives presently under consideration. The impacts resulting from the implementation of these alternatives are then discussed. In the final section the results of a social survey in Belmont Park are presented.

II. Base Condition

A. Early Development

The city of Warwick was originally established as an agricultural community in the mid-1600's. In addition to agricultural activities, sawmills and gristmills were operated along the town's brooks and creeks. Warwick participated in maritime trade as well.

Early in the nineteenth century, factory-based textile manufacturing was introduced into the local economy. With its many potential power sites along the Pawtuxet River, Warwick was destined to become one of the State's major manufacturing centers. During this period, Warwick experienced phenomenal population growth as industrialization attracted people from the rural areas to the mill villages. The semi-autonomy of these villages resulted in the growth of several business districts in the city rather than one identifiable center.

The development of steam engine technology gave a new impetus to growth in Warwick, facilitating transportation and permitting industrial development beyond water-power sources. This new industrial development attracted immigrant laborers, the first sizeable group being the Irish. The English, Scottish, Welsh, Swedish, and Norwegians were other major ethnic groups arriving in Warwick during the late nineteenth century.

Aside from the mill villages and summer resort development in Rocky Point, Conimicut, and Oakland Beach, Warwick remained rural farmland until the advent of transportation to Providence produced the suburban trend. With most growth concentrated in Providence in the early 20th century, Warwick saw little development until Providence reached its saturation, exerting pressures on Warwick to accommodate increased suburbanization.

B. Population and Housing

The city of Warwick is located in central Rhode Island and is part of the heavily urbanized Greater Providence metropolitan region. With a 1980 population of 87,123, it is the second most populous city in the State.

Over the last 50 years, Warwick's population has increased by about 276 percent. Much of this growth is attributed to the rapid suburbanization of the city beginning in the mid-forties. Economic prosperity following World War II made both home and automobile ownership available to many people. Thus, suburbanization began and continued through the 1950's and 1960's giving Warwick its greatest period of growth. The old mill villages became the subcenters of neighborhoods and large portions of vacant farmland became the sites of single family units. Following the national pattern, suburbanization gave way to decentralization of industry and commerce. Since 1970, growth in Warwick has stabilized.

Warwick's population changes are displayed with the State's in Table 2-1.

Table 2-1

Population
Warwick and Rhode Island
1930-1980

	Warwick		Rhode Island	
	Number	Percent Change from Previous Decade	Number	Percent Change from Previous Decade
1980	87,123	4.1	947,154	-0.3
1970	83,694	22.2	949,723	10.5
1960	68,504	59.2	859,488	8.5
1950	43,028	49.6	791,896	11.0
1940	28,757	24.0	713,346	37.6
1930	23,196		687,497	

SOURCE: U.S. Census

Census tract 211 contains the residential area of Norwood, which encompasses Belmont Park; the mixed residential, commercial, and industrial area of Hillsgrove; and the Theodore F. Green State Airport. Population in this tract totalled 6,323 in 1970, 7.5 percent of the city's population for that year. Using Warwick's average household size for 1970 of 3.33, population in the 100-year flood plain of the Belmont Park area can be estimated at 250.

Housing units in Warwick totalled 32,450 in 1980, an increase of 23.8 percent from the 1970 total of 25,219. In 1970 the Norwood-Hillsgrove neighborhood contained 1,947 housing units; 1,535 were owner occupied with 364 renter occupied. Eighty-three percent of total housing units were single family homes.

Fifty percent of the housing in census tract 211 was constructed before 1940, ranking this area as the 6th oldest in the city. Although the average house value in this tract stands below the city average, physical improvements can be observed throughout the area.

C. Economy

Early economic growth in Rhode Island centered in Providence but since World War II major shifts, both spatial and functional, have occurred in the regional economy. The spatial shift has been the dispersion of industry from the central city to outlying communities such as Warwick. The functional shift has been a continual decline of the old textile industries and the emergence of metal products manufacturing industries. In addition, the Providence region is part of the national trend of increasing employment in services industries with a proportional decrease of employment in manufacturing industries.

According to the Rhode Island Department of Employment Security (DES), manufacturing, wholesale, and services industries are the largest employers in Warwick. Together they provide about 87 percent of the 30,611 jobs available in Warwick. Warwick is similar to the State in its distribution of employment by industry. Data on employment covered by the DES for Warwick and Rhode Island is presented in Table 2-2.

Table 2-2

Employment by Industry, 1980

	Warwick		Rhode Island	
	Employed	Percent of Total	Employed	Percent of Total
Agric., Forestry, Fisheries	117	0.4	2,233	0.7
Mining	17	0.1	181	0.1
Construction	959	3.1	12,589	3.7
Manufacturing	9,364	30.6	129,479	37.8
Trans., Comm., & Utilities	583	1.9	12,472	3.6
Trade	10,000	32.7	81,910	23.9
Wholesale	1,400	4.6	17,806	5.2
Retail	8,600	28.1	64,104	18.7
Finance, Insurance, Real Estate	2,454	8.0	20,873	6.1
Services	7,117	23.2	82,601	24.1
TOTAL	30,611	100.0	342,338	100.0

SOURCE: R.I. Dept. of Employment Security

In 1980, Warwick had a labor force of 42,598. Of this total, 39,922 were employed, yielding an unemployment rate of 6.3 percent, falling below that of the State's 7.2 percent, and Kent County's rate of 6.9 percent. Employment data for these three areas are shown in Table 2-3.

Table 2-3

1980 LABOR FORCE ESTIMATES

	Labor Force	Employment	Unemployment	Unemployment Rate
Warwick	42,598	39,922	2,676	6.3
Kent County	74,640	69,474	5,166	6.9
R.I.	462,000	429,000	33,000	7.2

SOURCE: Rhode Island Dept. of Employment Security

D. Land Use

With an area of approximately 33 square miles, Warwick has a population density close to 2,640 persons per square mile. Developed land in Warwick is predominately residential as indicated in Figure 1 of the main report. While most of the city's land is in use more than a third is still vacant. Table 2-4 shows acreage in each use.

Table 2-4

Land Use By Major Categories

	Acres	Percent of Total
Residential	8,323	39
Commercial	1,134	6
Industrial	747	3
Public	2,352	11
Vacant	7,765	37
Total	21,296	100

The census tract containing Belmont Park is comprised of three distinct areas, as indicated earlier. The area designated Norwood is primarily residential and is the portion of the tract encompassing Belmont Park. South of Norwood is an area of mixed residential, commercial and industrial uses known as Hillsgrove. Bordering this area is the Theodore F. Green State Airport which comprises 918 acres, 42.6 percent of this tract. Excluding the airport acreage, residential use accounts for 41.3 percent of the land area, topped by vacant area which accounts for 43.4 percent. Commercial and industrial uses comprise 9.6 percent and 5.7 percent respectively.

III. Without Project Condition

A. Flooding

The without project condition would be charactized by continued flooding in Belmont Park. From the social survey responses it appears that most residents are content with their neighborhood except for the threat of future flooding. Most residents indicated that they had considered selling their homes, but because of the flood problem were uncertain if buyers could be found. Some have had their houses on the market and have not had any prospective buyers. Little out-migration is anticipated; therefore, these residents would continue to face the flood threat and "inconveniences" caused by actual floods. Flooding also creates a safety and health hazard for the neighborhood residents.

Past flooding events have resulted in loss of utilities, necessitating evacuation of residents. Many residents were out of their homes for approximately one week during the January 1979 flood. While removed from their homes, adults missed work and children missed school. Residents suffered substantial economic losses and damages to utilities and miscellaneous items stored in their basements. Although residents were removed from their homes, many were able to find accommodations with relatives and friends.

During floods, the delivery of public services including medical, fire, and police would be interrupted. Septic systems would be inundated and caused to overflow. Electricity and water would be turned off.

After flooding has subsided and residents return to their homes, they are faced with the tasks of cleaning up and having utilities repaired.

B. Future Population

Population projections provided by the Rhode Island Office of State Planning show a population for Warwick in the year 2000 and 2030 as 97,600 and 101,600, respectively. These populations represent an increase from Warwick's 1980 population of 12 percent for the year 2000 and 17 percent for 2030. Population increases between 2000 and 2030 are predicted to occur at a much slower rate than those for previous decades.

C. Future Growth and Development

Warwick will continue in its present role as a residential community and satellite city. Warwick's economy has shown a continuous growth trend. The potential for continued growth exists with the availability of land for development, existing public facilities network, availability of transportation, and the programming of future capital improvements.

Warwick's most recent master plan for future growth sets forth some general goals followed by more specific objectives. The city's basic goals are to make efficient use of available land and water, accommodate urban growth, and enhance and build upon human resources to incorporate a sense of community for all residents. Residential objectives involve the provision of safe and decent housing for various income levels. Economic objectives involve the provision of a balanced and diversified economy and the encouragement of new employment opportunities and commercial and industrial growth. Land development will be encouraged in a manner that suggests wise and orderly growth and protects critical environmental areas.

IV. Alternatives

Twelve plans were initially evaluted for flood protection for Belmont Park. Basically, there are three measures that are being examined; acquisition, raising homes, and relocating basement utilities to a first floor addition. However, by varying the level of protection for 20, 50 and 100-year flood events and considering these proposals both with and without the implementation of flood control storage at the Big River Reservoir, the investigation resulted in the evaluation of 12 plans. The plans are summarized in Table 2-5.

Table 2-5

SUMMARY OF ALTERNATIVES

Plan	Flood Frequency	Homes Acquired	Homes Floodproofed	Utility Rooms
A-1	100	59	-	17
A-2	50	51	-	18
A-3	20	27	-	30
A-4*	100	58	-	18
A-5*	50	35	-	27
A-6*	20	10	-	41
B-1	100	30	29	17
B-2	50	24	20	25
B-3	20	7	11	39
B-4*	100	30	27	19
B-5*	50	21	10	30
B-6*	20	2	7	41

*Assuming construction of Big River Reservoir.

NOTE: A flood forecasting system would be included as part of these plans

The first iteration of basic options indicated that only four plans required further detailed study. This was due to the fact that construction of the Big River Reservoir is questionable and flood storage at this site would only reduce 100-year flood stages by 1 foot at Belmont Park. In addition, the 20-year flood plans do not provide an adequate level of protection and were considered to be unacceptable by residents of Belmont Park. Therefore, Plans A-1, A-2, B-1 And B-2 were the only plans carried into the next study phase. These plans are more thoroughly described in the "Assessment and Evaluation of Detailed Plans" section of this report.

V. Impacts

The most noted positive impact would be the added protection offered by a flood control project. However, the level of flood protection varies with the different alternatives.

All plans require some relocation of residents. The social survey conducted in Belmont Park indicates that the residents are in favor of an acquisition plan.

The survey gave residents an opportunity to indicate how a relocation plan would affect themselves and their families. Overall, the residents who responded to this question did not indicate that the relocation would cause any significant hardships. The most common responses were that it would be better than remaining in Belmont Park with the threat of flooding or would have no effect. Most residents indicated that they would like to remain in the Warwick area. Therefore, transition for these residents (assuming that they actually would remain in Warwick) would not be as difficult as if they moved out of the city altogether.

Residents would, however, be inconvenienced with the task of finding a new home and making the necessary arrangements for moving their belongings. Residents would be reimbursed for some expenses that they would incur with buying a new home.

Once relocated and settled in their new homes, residents would be free from the threat of flooding and the constant fear of recurring flood damages. Residents would no longer be evacuated from their homes as a result of flooding.

Extensive acquisition of properties would also result in construction activities. Acquired homes would be demolished and debris would have to be removed. This activity would require the movement of large equipment, introducing safety hazards in the neighborhood. The acquisition process could take up to 3 years to complete.

Removal of residents from Belmont Park would permanently alter the character of the Belmont Park area. Conceptual recreation plans have been created. Any recreation development would have to be pursued by

the city of Warwick. No new development other then recreation or other compatible uses would be permitted in Belmont Park if the area were cleared.

Raising individual homes would have different impacts from relocation. Residents would have to temporarily relocate for approximately one week during the construction activities. They would be reimbursed for alternative lodging. All family members, however, would experience some disruption in their usual schedules. This disruption is not considered to have significant impact since it would persist for an average of one week.

Over the long term, house raising would change the current appearance of those homes raised. Raising a home may alter the aesthetics of the current setting. Redesign of the exterior, including facing the raised portion with materials to match or complement the existing structure, would lessen this impact.

Although flood damages would be reduced, residents remaining in the flood plain would continue to face the flood threat. Under flood conditions, residents would still have to be evacuated, because utilities to the area would be shut off and residents would be isolated.

Constructing a utility room on the first floor or adjacent to the existing building would also prove disruptive to residents. The presence of construction equipment and materials would present some risk to residents' safety. Similar to raising a home, constructing a utility room would reduce economic damages and some hardship that residents currently face, but the flood threat remains.

The above discussion has generally identified the impacts of the three nonstructural measures individually. However, combining these measures would raise additional concerns. These plans suggest that some residents remain in the flood plain with raised homes or utilities while their immediate neighbors may be relocated. It is anticipated that some residents would not be satisfied with floodproofing if their neighbors were relocated.

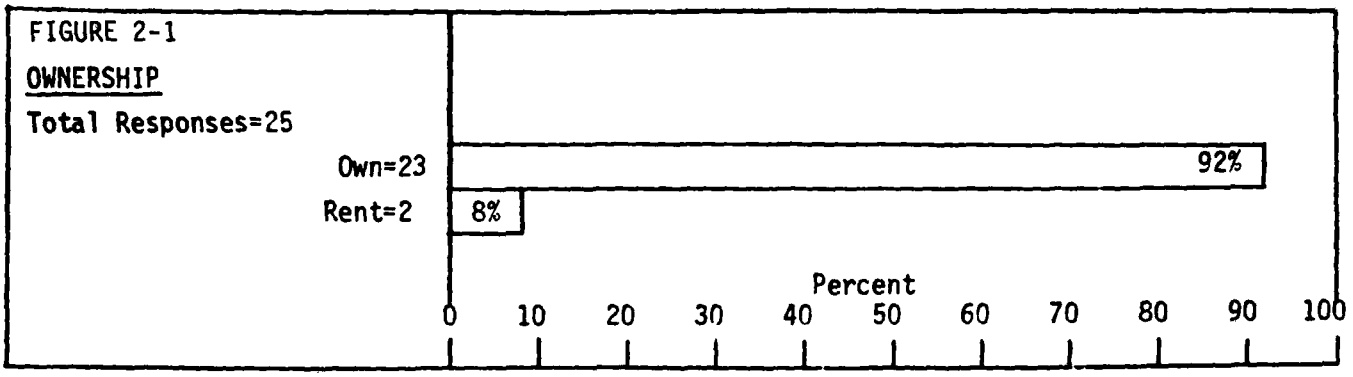
VI. Social Survey Results

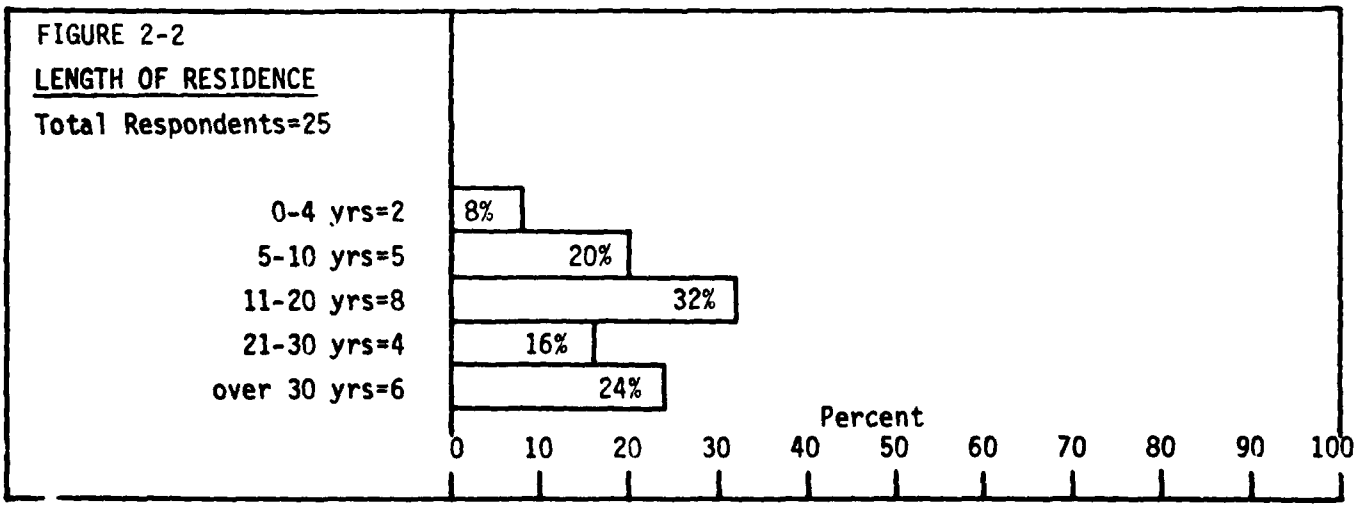
Questionnaires were sent to Belmont Park residents on 18 September 1981 to provide them with information about the study, to let them know that the Corps needs their input, and to collect information for the social assessment. A copy of the questionnaire is contained at the end of this appendix (see Figure 2-13).

The questionnaire was utilized as a tool to initiate the communication process with individual residents. From each Belmont Park resident, the Corps sought information about: their home and neighborhood, their experiences with flooding, and their feelings toward an acquisition program.

A total of 25 questionnaires, 38 percent of the total mailed, were returned to the Corps and included in this analysis. For those residents with absentee owners, questionnaires were sent to both the owner and the occupant. Therefore, the 25 questionnaires actually represent responses from 46 percent of the homes that were surveyed.

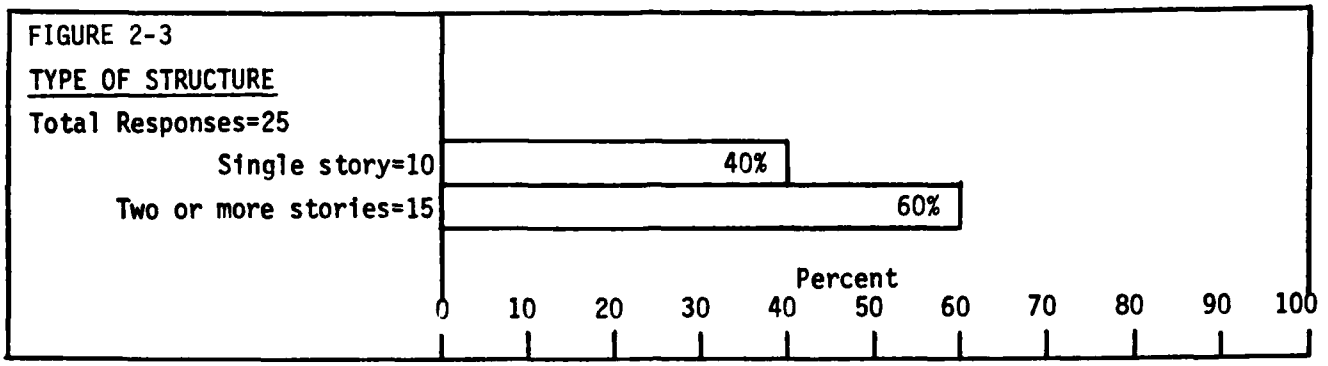
Questions about residents' homes permitted the development of a brief profile of the neighborhood. All 25 respondents answered questions about ownership and length of residency. The survey results showed that an overwhelming majority of homes, 92 percent, are owner occupied (Figure 2-1). The results also indicated that residents in the Belmont Park area have lived there an average of 19 years (Figure 2-2).

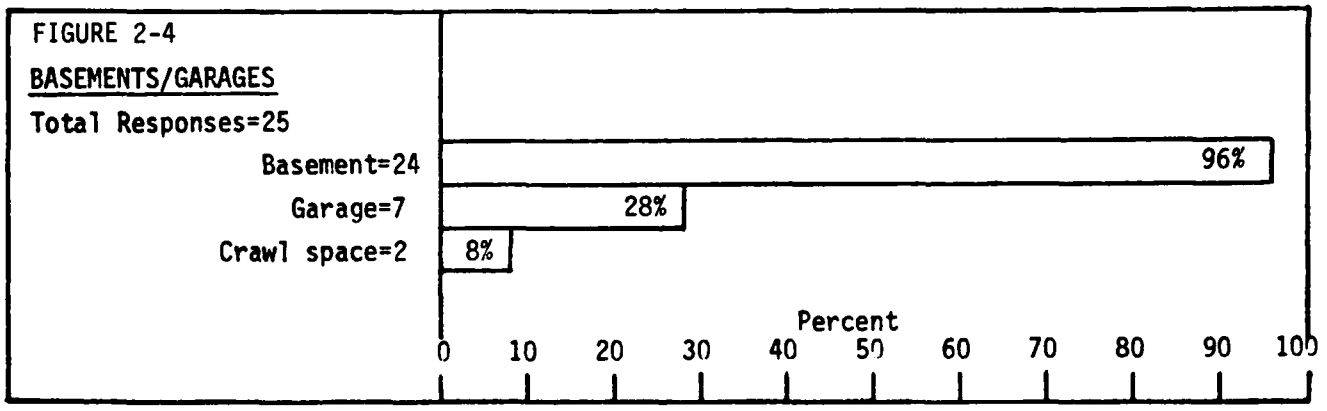




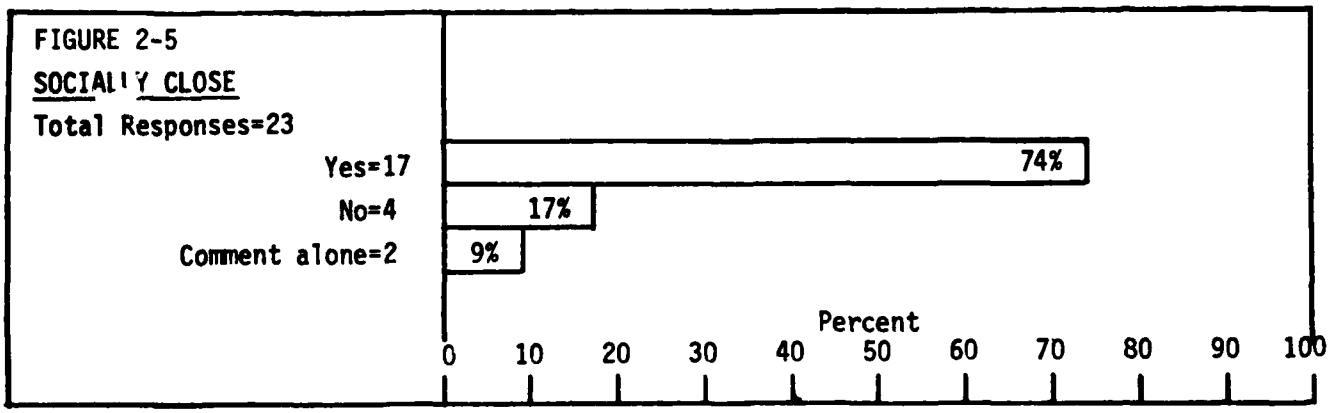
Sixty percent of the 25 respondents live in homes with two or more stories. The remaining 40 percent live in single story residences.

Ninety-six percent or 24 of the 25 respondents indicated that their homes have basements. Twenty-eight percent of the respondents have garages on their property. Figures 2-3 and 2-4 display this data graphically.

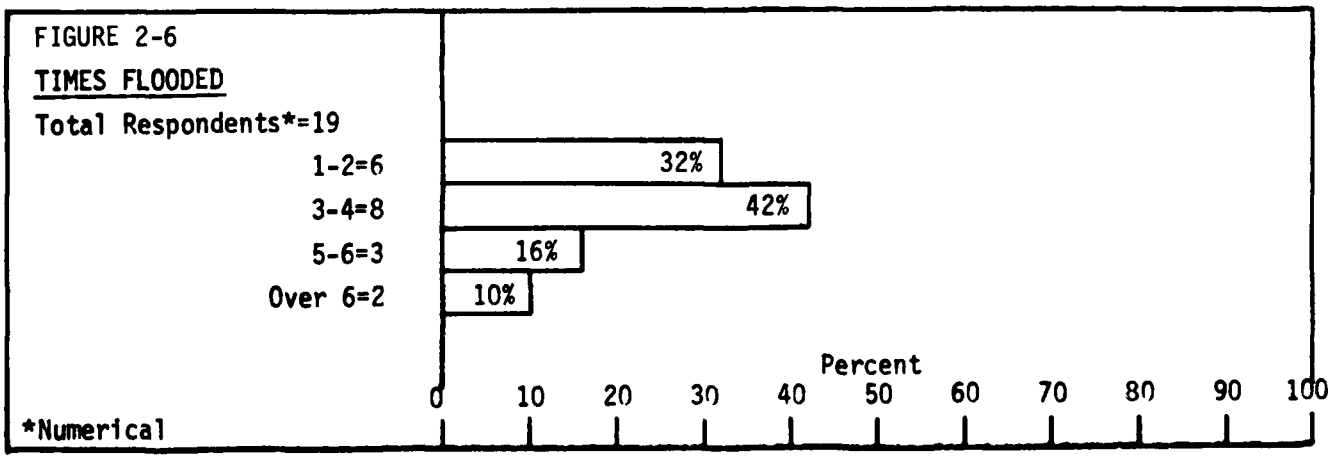




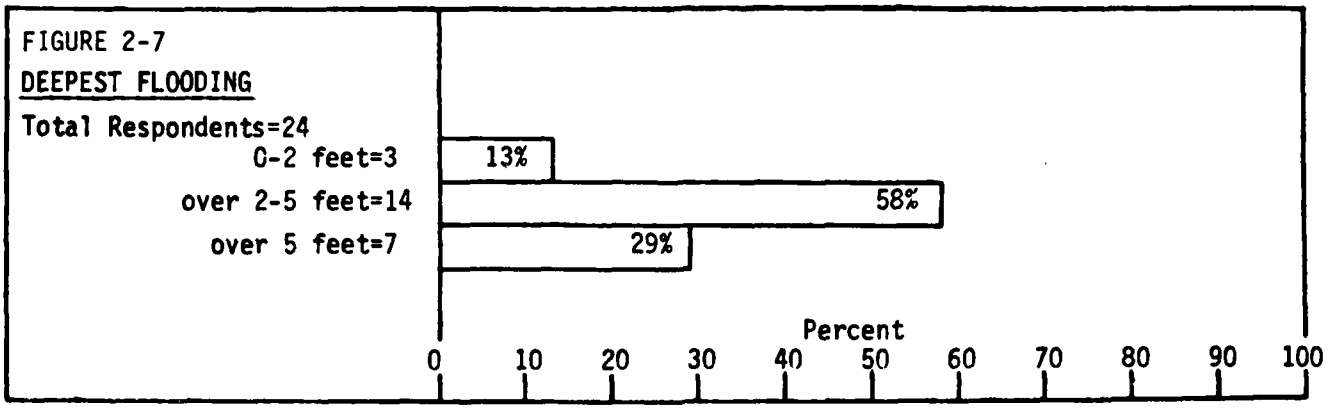
When asked, "Do you think Norwood is a socially close neighborhood?" 17 of the 23 respondents (74%) answered yes; 4 (17%) indicated no; 1 (5%); average, and 1 (5%) did not indicate a preference (Figure 2-5). The important thing here is that well over half of the respondents did indicate that they felt Norwood was socially close. The two most common thoughts as to why they felt this were: everyone respects and helps one another (35%), and people here are friendly (29%). Two other comments were: everyone knows one another (18%), and people have lived here a long time (12%). Of the 17 percent indicating that Norwood is not socially close, one-half of the respondents stated that people work and don't have time to socialize with neighbors.



Residents were then asked several questions relating to their flooding experiences in Belmont Park. The question, "How many times has your present residence been flooded since you have lived there?" was answered by 22 respondents. Nineteen gave a numerical response which averaged 3.7 or 3 to 4 times. The remaining 3 who answered the question indicated that they had been flooded "numerous" or "several" times (Figure 2-6).



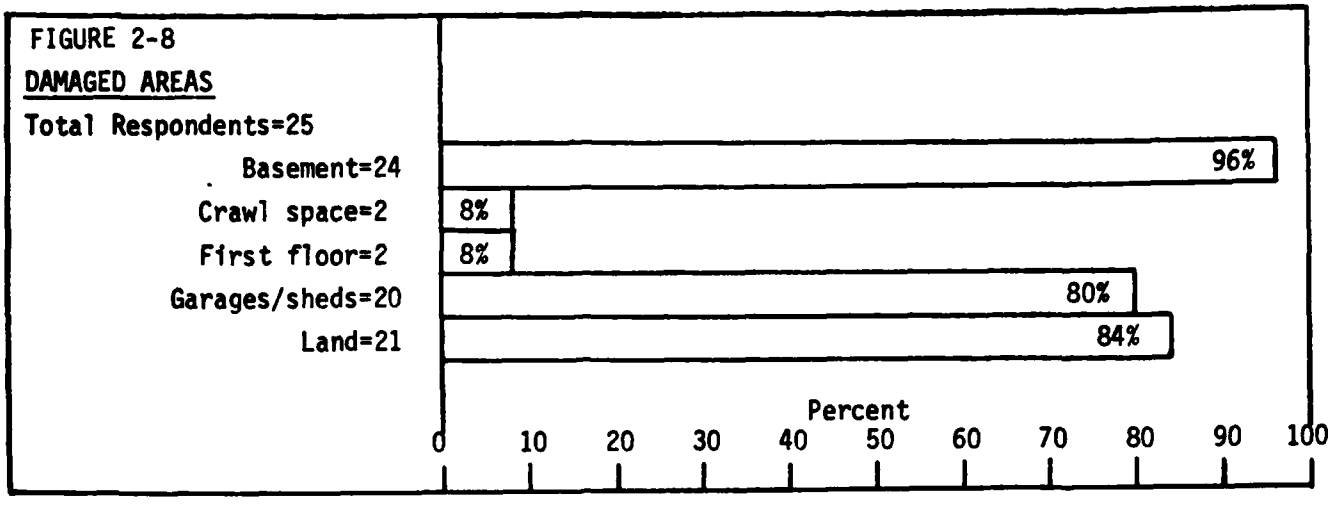
Residents were questioned as to the depth of the deepest flooding they experienced at their present residence. Of the 25 returned questionnaires, 24 had responses to this question. An average of these responses indicated flooding of 4 feet. The deepest flooding indicated was 8 feet, a response which occurred once (Figure 2-7).



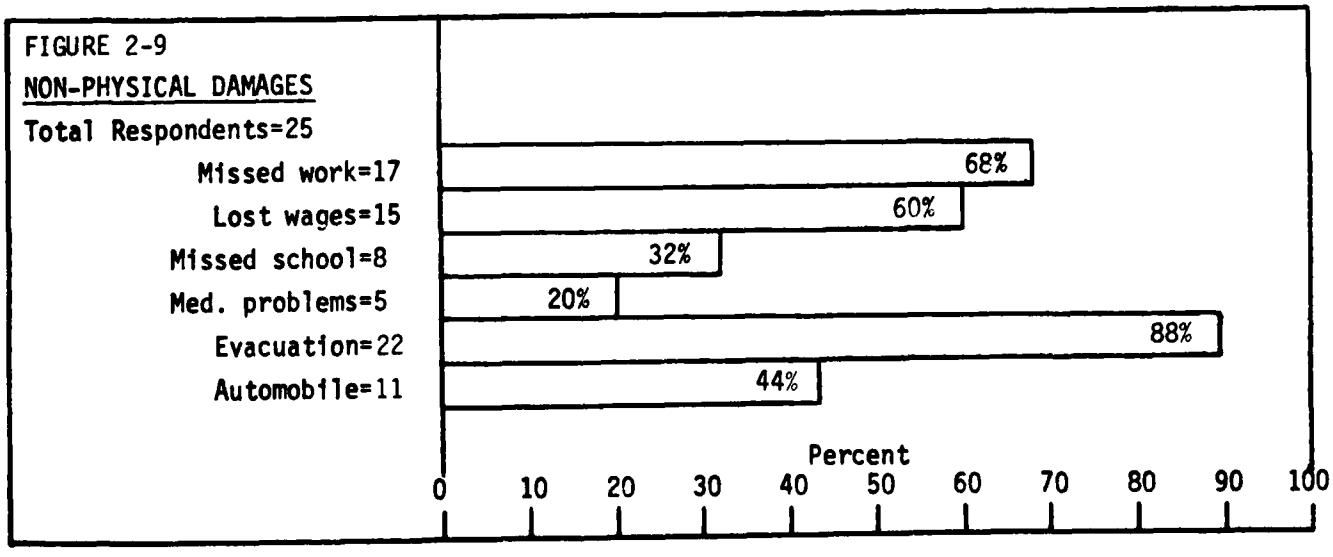
When asked the date of worst flooding, some respondents seemed unsure and indicated either of two dates. However, of a total of 30 dates mentioned within the 24 responses, 13 or 43 percent indicated January 1979 as the month and year of the worst flooding event. February 1978 was next most often mentioned at 5 times, followed by February 1979 at 4 times. January 1978 followed with three. Five additional dates were each mentioned once.

Several questions were asked to learn how residents may have been inconvenienced by flooding in the past. For the most part, their responses were referenced to the worst flooding that was experienced.

Residents were asked to indicate which of the following areas experienced flood damages: basement, crawl space, first floor, garages, sheds, outbuildings, and land. All questionnaires had responses to this question. Twenty-four of the 25 respondents or 96 percent indicated flooding in the basement. The response given most frequently after basement was land. Twenty-one or 84 percent indicated that their land experienced flood damage. Land was followed by garages, sheds, outbuildings which was checked off by 20 or 80 percent of the respondents. Crawl space and first floor were at the bottom of the list, each receiving 2 responses (Figure 2-8).

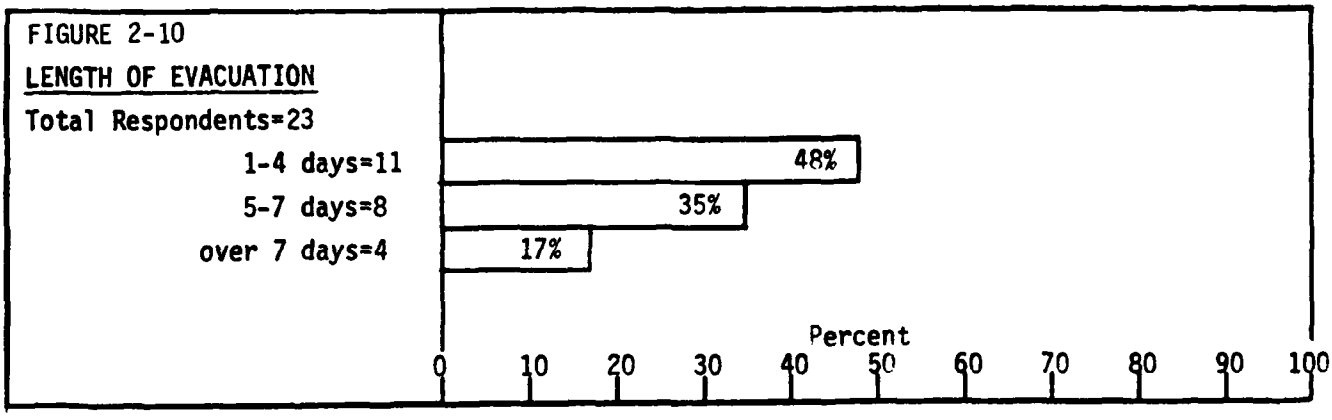


Residents were asked to check off other problems flooding has caused other than physical damages, including the following: missed work, lost wages, missed school, medical problems, evacuation from home, automobile. Of all the responses, 88 percent of the residents indicated they were evacuated. Of those listed, evacuation was the most common problem to the residents. The questionnaires also indicated that members of 68 percent of the households missed work, 60 percent lost wages, 44 percent had automobile problems, 32 percent missed school, and 20 percent indicated medical problems (Figure 2-9).



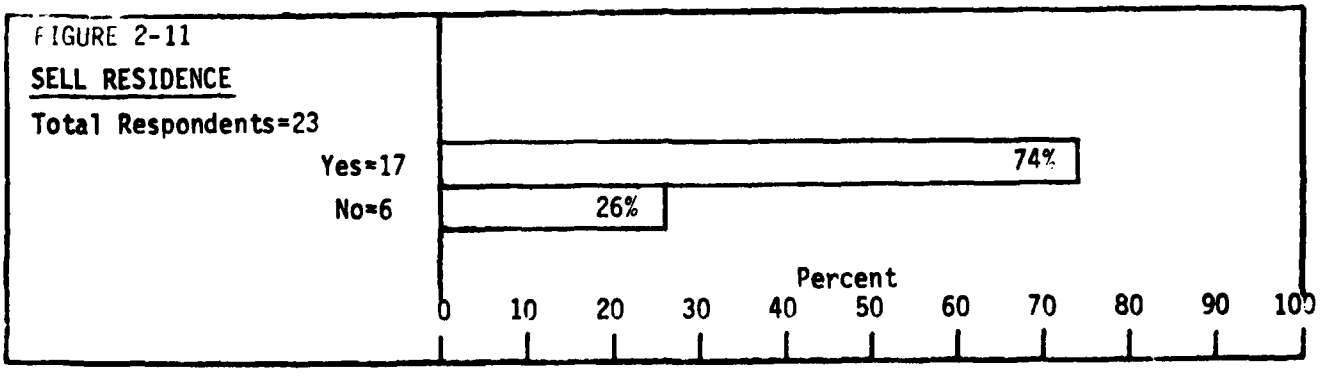
Residents who had to evacuate their homes indicated the length of time away (Figure 2-10). An average of this time was 6 days. Because most residents managed to stay with friends or relatives, they incurred limited expenses for lodging and meals. At the same time, residents indicated disruption of services such as drinking water, gas, telephone, electricity, and oil delivery. Half the residents were away during the entire period when there were no services. Electric power was the most commonly cited service that was lost by 96 percent (24) of the respondents.

FIGURE 2-10



The questionnaire attempted to collect some general information as to what residents think about an acquisition/relocation program. The first question residents were asked regarding this was, "Have you considered selling your residence because of flooding problems?" Twenty-three responses were given to this question to which 74 percent answered yes and 26 percent answered no (Figure 2-11). To those who answered yes was posed a further question, "Why haven't you?" The most common answer was that there just wasn't anyone who would buy their home. This reason was given by 13 of the 15 respondents who answered this portion of the question. Seven of these specifically indicated the flooding problem as the deterent. The other two respondents indicated that they were hoping that the flooding problem would be resolved.

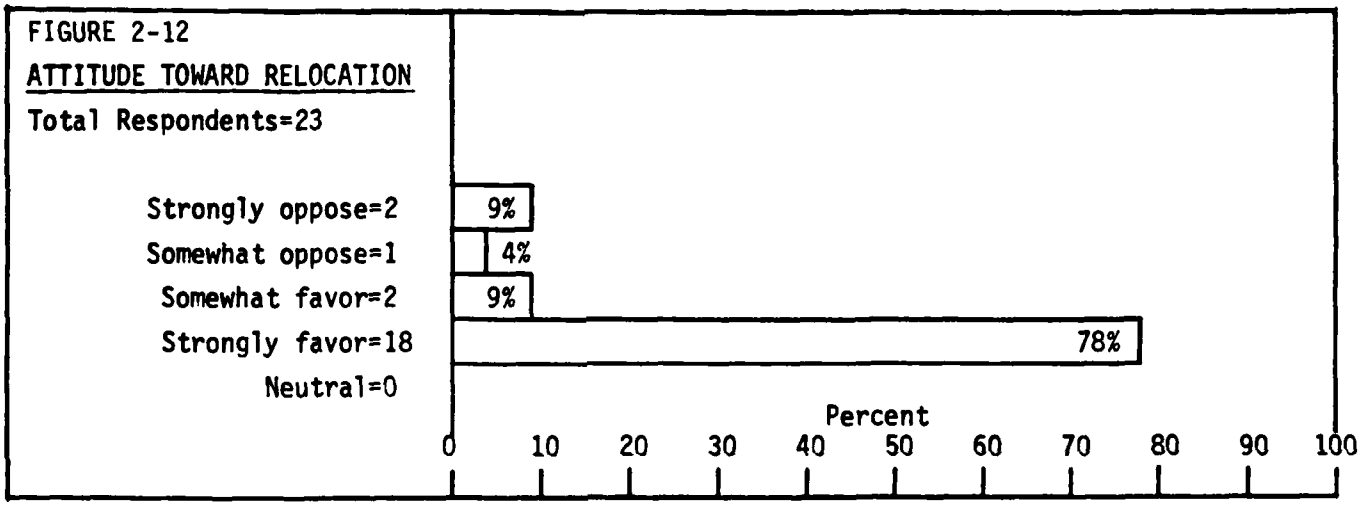
FIGURE 2-11



Six respondents (25%) indicated that they had not considered selling their homes. Although reasons for not selling were not solicited, two respondents said that they liked it "here" and have always lived "here". A third respondent felt that the occasional inconvenience was worth putting up with.

Twenty-three responses were given to the questions, "How do you feel about the relocation of Belmont Park residents . . .?" The responses broke down as follows: 78 percent strongly favor, 9 percent somewhat favor, 4 percent somewhat oppose and 9 percent strongly oppose (Figure 2-12).

FIGURE 2-12
ATTITUDE TOWARD RELOCATION
Total Respondents=23



Residents were then asked if they favor moving their present house to a new site. Eighty-one percent indicated no; 19 percent said yes. One yes response was qualified with "if there was no damage done to it."

The next thing that residents were asked was, "If you were to relocate, what would be the most acceptable site or location?" Eleven of the 20 responses given to this question mentioned specific towns and neighborhoods. Ten of these were locations in Warwick. The other responses suggested characteristics of the places where they would like to live, such as, no flooding, convenient to stores, something like Norwood.

The questionnaire then posed some rather open-ended questions asking if relocation would affect any particular groups or individuals, how it might affect each residents' family, and would it impose any adverse effects upon Warwick.

Twenty-two responses were given to the question, "Do you think the relocation will impose unusual costs or problems upon particular individuals or groups?" Forty-five percent answered yes, forty-five percent answered no, and although it wasn't offered as a choice the remaining respondents gave "don't know" as an answer. Explanations were requested for these responses. Two-thirds of those who gave yes responses, indicated that purchasing a new home with today's high interest rates would be a substantial burden. No common reasons were given by those responding no.

Eighteen responses were given to the question, "How might the relocation affect you and your family?" Although responses to this question were not conclusive, the most common responses were, it would be better (22 percent) or no effect (22 percent). Other effects mentioned by one or two respondents were such things as further commute to work, send child to another school, change in lifestyle, mortgage rates, lost income from rental property.

Residents were then asked what they thought the attitude of people living in Warwick was toward the relocation of Belmont Park residents. Twenty-two responses were given, but consensus was limited. Thirty-two percent thought the Warwick residents were generally in favor of a relocation plan, twenty-three percent responded that they didn't know. Other responses included: they are unaware of our problems, they don't care, okay, poor.

Finally the residents were asked, "Do you think the proposed relocation will impose any adverse effects upon Warwick?" Twenty-two responses were given. Seventy-seven percent of the respondents indicated no, 14 percent answered yes, 5 percent don't think so, and 5 percent who cares. Very few explanations were given as to why individual respondents answered as they did. The yes explanations indicated lost tax revenue as an adverse cost to Warwick. On the no side, higher taxes was indicated as a benefit since most residents would buy other property in Warwick. Other no responses indicated that relocation would more likely benefit Warwick and the area could be used as a playground.

Space was given for respondents to make any additional comments on the study or questionnaire. Sixteen or 64 percent of the respondents offered further comment. The most popular idea offered was that the residents have been waiting a long time for something to be done, they really want something to be done, and they would like it done soon. Although some expressed that it would be hard to leave Belmont Park, it would certainly be worth it if they wouldn't have to worry about flooding any longer.

VII. Summary

The Belmont Park area of Warwick, Rhode Island, is subject to almost annual flooding. The 100-year flood plain has been identified as almost exclusively residential containing approximately 76 homes and ancillary structures. Census data supplemented with information collected during the social survey indicates that the Belmont Park area is a stable neighborhood composed of single family homes, many of which were built before 1940.

Length of residency for Belmont Park residents responding to the questionnaire has been long enough to allow well over half of the respondents to have experienced more than two flooding events in their present homes. Almost all of the respondents (96 percent) indicated that they have experienced damages as a result of basement flooding. Two percent indicated first floor flooding. Outside of physical damages, the most common problem of respondents (88 percent) was evacuation from their homes during and after a flood event.

The twelve flood control alternatives under consideration are basically composed of three nonstructural measures; acquisition, raising homes, and providing utility rooms. Reactions to acquistion were solicted through the questionnaire. Residents responded favorably; 78 percent strongly favored the relocation of Belmont Park residents. Although most residents have lived in Belmont Park for several years and feel some attachment to the neighborhood, flooding is serious enough for them to wish to live elsewhere.

Because most residents indicate a desire to remain in Warwick, if their homes were acquired, relocation would not be expected to have any signif ·ant adverse effects. The one exception to this may result from the high interest rates at which residents would be purchasing new homes.

Both short and long term impacts would occur with implementation of any of the nonstructural measures. The most obvious impact would be flood damage reduction. Acquisition however, completely removes the resident from the flooding situation whereas raising the home and/or providing utility rooms decrease the residents' damages although their homes would continue to be surrounded by water during flood events. A flood under these circumstances would still require the evacuation of residents. Short term effects would be felt as a result of construction activities which would include the demolition of homes and removal of debris, as well as activity around the homes remaining in the flood plain. There is little doubt that acquisition provides a more comprehensive solution to the flooding situation.

QUESTIONNAIRE

WARWICK LOCAL FLOOD PROTECTION

(BELMONT PARK) PAWTUXET RIVER

WARWICK, RHODE ISLAND

SECTION A - FLOOD PROBLEM

In this section we would like to gather general information about your home and how you may have been affected by past flooding.

A.1. What is your residential address?_____

A.2. Do you own or rent your present residence? (Check one)

a._____Rent

b._____Own

c._____Rent, with option to buy

d._____Other, please specify_____

_____

A.3. How long have you been at this address?_____years

A.4. What type of structure are you living in?

_____Single story _____Two or more story

_____Split level _____Duplex

A.5. Does the house have a:

_____Full basement _____Slab

_____Crawl space _____Garage

If you have a basement, how is it utilized? (Furnished playroom, storage, etc.)_____

A.6. How many adults (over 18 years of age) are living in this household?_____

FIGURE 2-13

A.7. Do you think Norwood is a socially close neighborhood?

_____Yes

_____No

a. If yes, why is it a close neighborhood?

b. If no, why is it not a close neighborhood?

A.8. How many times has your present residence been flooded since you have lived there? _____

A.9. While at this residence, which of the following areas experienced flooding damage from the Pawtuxet River? CHECK ALL THAT APPLY.

_____Basement

_____Crawl space

_____First floor

_____Garages, sheds, outbuildings

_____Land

_____Other (please describe)_____
_____
_____

_____None

Questions A.10. through A.15. relate to the worst flood experienced at your residence.

A.10. While at this residence approximately what was the deepest flooding experienced?

a._____Feet

b. Location where depth was measured_____

A.11. On approximately what date did you experience the worst flooding?

_____ _____Month, _____Year

A.12. Outside of physical damage to your residence, what problems did the water cause to you (and your family)?

_____Missed work (Number of days_____)

_____Lost wages (Amount $_____)

_____Missed school (Number of days_____)

_____Medical problems

_____Evacuation from home

_____Automobile

_____Other_____

A.13. If you were required to leave your residence during a flood, please answer the following:

a. Length of time away_____

b. Expense of lodging and meals $_____

c. Other costs resulting from displacement $_____

A.14. Did you incur any emergency expense associated with preparing for the flood (sandbagging, truck rental, storage, etc.)_____

Estimated amount $_____

A.15. Did you experience any loss of services?

_____Yes _____No.

If yes, indicate which

_____Drinking water _____Electricity

_____Gas _____Oil

_____Telephone _____Other_____

_____

If yes, how long was the disruption?_____

Did the disruption cause you any expense?_____

If so, how much? $_____

SECTION B - RELOCATION PROPOSAL

In this section we would like to obtain information about your feelings towards relocation as a solution to your flooding situation. As indicated in the cover letter, the relocation proposal would involve the purchase of homes in the Belmont Park area by the city of Warwick. The city would carry out the acquisition program under procedures required by Public Law 91-646, "Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970." The procedures of such an acquisition program and the relocation benefits are described in the inclosed booklets.

B.1. Have you considered selling your residence because of flooding problems?

a._____No

b._____Yes - Why haven't you?_____

_____

B.2. How do you feel about the relocation of Belmont Park (Norwood) residents which is being considered under this study?

a._____Strongly oppose

b._____Somewhat oppose

c._____Neutral

d._____Somewhat favor

e._____Strongly favor

B.3. Would you favor moving your present house to a new site?

a._____No

b._____Yes

B.4. If you were to relocate, what would be the most acceptable site or location?_____

a. What attracts you to that location?_____

_____

B.5. If the property where you live is purchased, would you prefer to rent or buy another residence? Check one.

_____Rent

_____Buy

B.6. Do you think the relocation will impose unusual costs or problems upon particular individuals or groups?

a._____No b._____Yes

Please explain_____

_____

B.7. How might the relocation affect you and your family? (e.g., possible effect on your job, commuting patterns, income, schools children now attend, lifestyle, etc.) _____

_____

_____

_____

B.8. Overall, what do you think is the attitude of the people of Warwick toward the proposed relocation of Norwood residents?

_____

_____

B.9. Do you think the proposed relocation will impose any adverse effects upon Warwick?

a._____No b._____Yes

Please explain_____

_____

B.10. If you wish, use the space below for any comments, questions and concerns you wish to raise regarding the study, the project or the questionnaire.

OMB APPROVAL NO. 49-R0363

APPENDIX 3

PUBLIC INVOLVEMENT

TABLE OF CONTENTS

AGENCY	DATE
Mayor of Warwick Warwick, Rhode Island	14 May 1982
Residents of Belmont Park Warwick, Rhode Island	15 May 1982
Resident of Belmont Park Warwick, Rhode Island	19 May 1982
Department of Environmental Management State of Rhode Island	28 May 1982

APPENDIX 3

PUBLIC INVOLVEMENT

Public participation was solicited throughout the study to arrive at a plan of local flood protection most appropriate to the needs of Belmont Park residents. This involvement was initiated on 1 June 1981 when members of the Corps met with city officials, congressional representatives, and residents of Belmont Park to inform local interests of the study, present preliminary plans, and introduce Federal cost sharing requirements. At this meeting points of contact were established between the Corps and the city of Warwick to insure that local interests are kept informed as the study progressed.

On 23 July 1981, members of the Corps met with local officials to discuss the need of recreation facilities in the Belmont Park area. At this meeting the city expressed a willingness to develop passive recreation activities in Belmont Park should additional land become available.

A meeting with the National Weather Service was held on 5 October 1981 to discuss the features of an automated flood forecasting system. This system would provide the city of Warwick with timely and accurate forecasts of potential flooding along the Pawtuxet River and allow city personnel time to warn and evacuate flood plain residents. This system would be used to supplement nonstructural alternatives.

Questionnaires (see Appendix 2) were distributed to the residents and property owners of Belmont Park on 18 September 1981. These questionnaires provided us with information on past flooding and gave residents an opportunity to express their feelings towards the acquisition of flood prone property in Belmont Park. Responses to the questionnaires are summarized in Appendix 2.

Members of the Corps met with State and Congressional representatives and local officials on 20 November 1981 to inform local interest of the results of our studies to date, including cost estimates for the various nonstructural alternatives and non-Federal cost sharing requirements. The Mayor of Warwick expressed the city's difficulty in obtaining funds to cover the non-Federal cost of proposed plans and questioned if additional assistance was available such as State or Federal monies. He also recommended a second meeting be arranged to discuss ways to reduce the city's share of project costs.

On 11 December 1981, members of the Corps met with local officials, State and Congressional representatives, and residents of Belmont Park. This meeting was held as a follow-up to the 20 November 1981 meeting. Discussion centered on how the city's cost share might be reduced. A representative from the State of Rhode Island said that State aid was not available. A representative from Congresswoman Claudine Schneider's office stated that legislation had been introduced to increase the Section

205 Federal cost limit to $3,000,000. She said this legislation might be enacted during April 1982. A representative from Senator Chafee's office stated that an amendment to the Water Project Deauthorization Bill was added to increase the Federal cost limit to $4,000,000 and would be enacted in January 1982. Mayor Walsh again expressed the difficulty in raising money to fund the city's share of the project costs.

In March 1982, an information digest was sent to each property owner and resident of Belmont Park. This digest contained a brief history of the study, a description of the flood control alternatives, and the Federal and local costs of each plan. It informed residents of the alternatives and gave them the opportunity to express their opinion.

On 23 April 1982, members of the Corps met with local officials and State and Congressional representatives. The purpose of this meeting was to discuss cost sharing requirements and the possibility of beginning construction of the project in fiscal year 1982. At the meeting, the Mayor of Warwick indicated his desire to begin implementation of the project as soon as possible and suggested that the Corps try to obtain a 1982 start.

The report was circulated for a 30-day public review period in May 1982. During this time we received 2 written (see letters dated 15 and 19 May 1982) and 2 telephone inquiries from residents of Belmont Park requesting that the recommended plan be modified so that their homes would not have to be acquired but could either be raised or have a utility room constructed. These inquiries came from residents living on the perimeter of the 100-year flood plain who have only experienced minor flooding in the past.

Although the recommended plan has been indorsed by the city of Warwick, it should be emphasized that the actual details of the proposed project can only be finalized as the city initiates negotiation proceedings. This office would like to maintain some flexibility as the project is implemented so that the requests of property owners may be considered, provided these requests are feasible and can be provided at a reasonable cost.

FUTURE PUBLIC INVOLVEMENT AND COORDINATION

This report will be reviewed by the Office of the Chief of Engineers. Upon approval, a formal document would be required from the city of Warwick supporting the recommended plan and legally binding them to fulfill the requirements of local cooperation. During this time meetings will be held with the city to finalize plans. Coordination between Warwick and the NWS will be established to help implement the flood forecast system.

PERTINENT CORRESPONDENCE

Joseph W. Walsh
Mayor
City Hall • Warwick, Rhode Island 02886

December 8, 1980

Colonel William E. Hodgson, Jr.
Acting Division Engineer
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02254

Dear Colonel Hodgson:

This is to inform you that the City of Warwick supports detailed planning of the land acquisition proposal for the Norwood area of Warwick and requests that the study be continued under the authority of Section 205 of the 1948 Flood Control Act as amended.

The City has been advised that under the 80% - 20% cost sharing formula for this project, non-Federal costs would be 20% of the estimated $2,500,000, or $500,000. The City has been further advised that the Federal cost limitation under the Section 205 authority is currently $2,000,000, and therefore, any increases above this Federal limitation must be provided by non-Federal interests. However, if said cost limitation increases, and if the project should cost more than $2,5000,000, any non-Federal share in excess of $2,000,000 will decrease accordingly.

It is understood that this letter is not a formal binding document and that it only indicates the intent of the City of Warwick to provide local cooperation agreements at a later date, depending on future approval and Federal appropriation by the Chief of Engineers and availability of the non-Federal funds.

Sincerely,

Joseph W. Walsh

Joseph W. Walsh
MAYOR

JWW:gbc

CITY OF WARWICK, RHODE ISLAND

DEPARTMENT OF CITY PLAN
CITY HALL 02888
401-738-2000 EXT. 1[illegible]

JOHN PIRO
CHAIRMAN
ROBERT SARAD

BARBARA SOKOLOFF
DIRECTOR

March 25, 1981

Colonel C. Ernest Edgar III
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02254

Dear Colonel Edgar:

This letter is to inform you of a specific concern of the City of Warwick relative to the initial plans for the acquisition of flood-plain property in the Belmont Park section of Warwick. As presented, the plans call for the acquisition and removal of all but two houses in the general area.

The attached map clearly indicates the relationship between the two homes (in red) and the project limits (outlined in black). It should be noted that although shown on the map, Ring Avenue does not extend south of the above referenced properties.

These two houses located at 109 and 115 Ring Avenue have first floors at or above the 100 year floodplain elevation, hence their exclusion during the initial planning process. However, the only access to these homes is by way of First Avenue which would be completely inundated during a 100 year storm event. During such a storm these residents would be virtually stranded in their homes surrounded by flood waters.

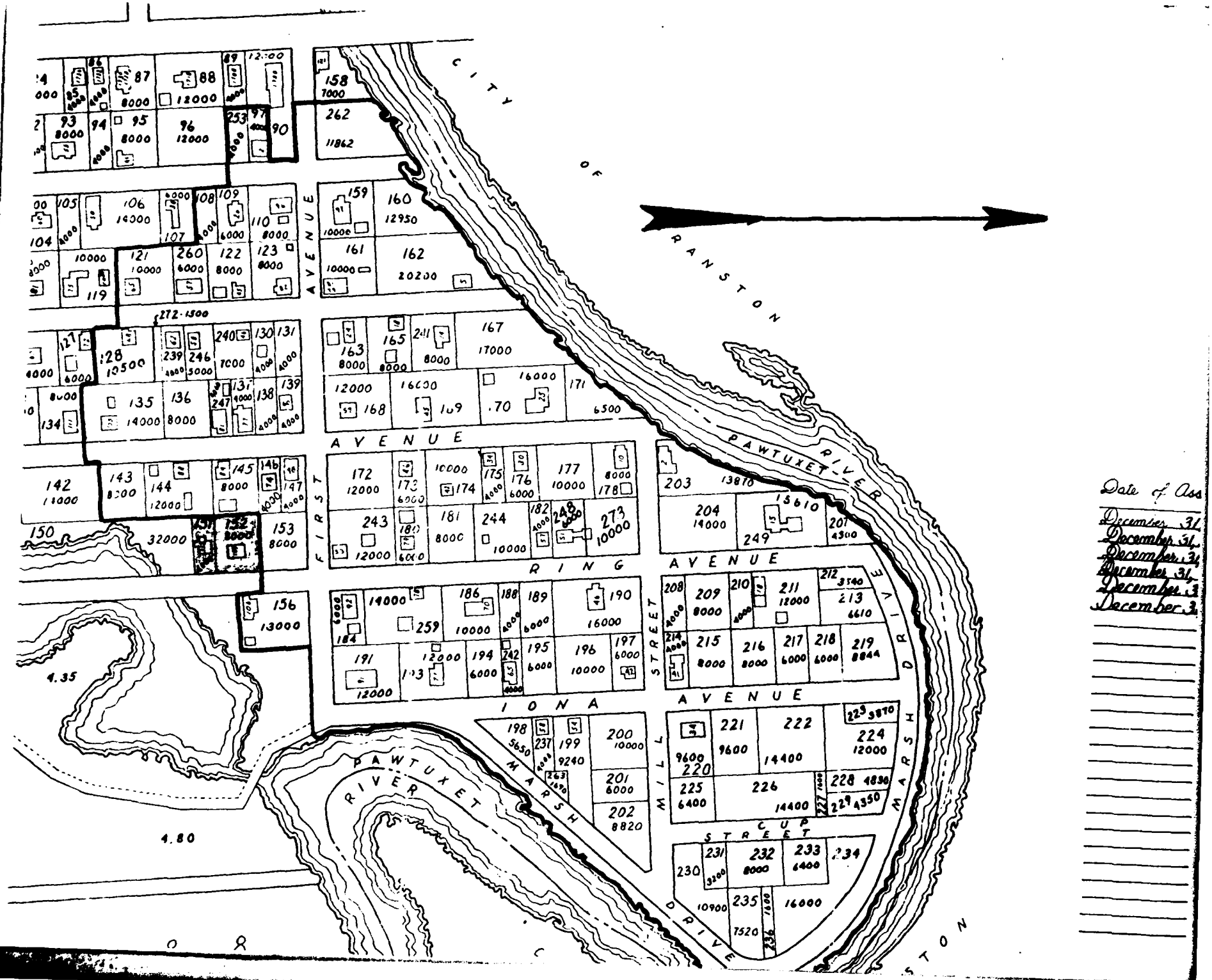
We feel strongly that to preclude these two parcels from the project is not in the best interests of the public welfare and safety and certainly does not represent sound planning practice. We therefore request the reconsideration of these two parcels during the Detail Project Report Phase.

If I can provide further information or assistance please call my office.

Sincerely,

Barbara Sokoloff

BS/lp
Enc.



Date of Ass

December 31,
December 31,
December 31,
December 31,
December 3
December 3

CITY OF WARWICK
WARWICK, RHODE ISLAND

WILLIAM T. MURPHY

COUNCILMAN WARD TWO
212 NEGANSETT AVENUE
Res: 785-2083
Bus: 463-9500

CHAIRMAN: CIVIC AFFAIRS COMMITTEE
MEMBER: SPECIAL LEGISLATION COMMITTEE

April 14, 1981

Colonel C. Ernest Edgar, III
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254

RE: Inclusion of two lots in Detail Project Report Phase

Dear Colonel Edgar:

I am writing to you to make a specific request regarding the Detail Project Report Phase dealing with the acquisition of floodplain property in the Belmont Park Section of Warwick. In your initial plans for said acquisition it called for the acquisition and removal of all but two houses in the general area.

The two houses located at 109 and 115 Ring Avenue have first floors at or above the 100-year flood plan elevation, and I believe this is the reason for their exclusion in the initial planning process. However, it is important to not that the only access to these homes is by way of First Avenue which would completely be inundated during a 100-year storm. The Flemming and Johnston families would be virtually stranded in their homes surrounded by flood waters and most likely without electricity.

I know that the City Planner has written to you, and as councilman for that area I also strongly urge that you reconsider the inclusion of these two parcels during the Detail Project Report Phase.

Very truly yours,

William T. Murphy

bs
cc: Barbara Sokoloff
Mr. and Mrs. Arnold Fleming
115 Ring Avenue, Warwick
Mr. and Mrs. Howard Johnston
109 Ring Avenue, Warwick

JOHN H. CHAFEE
RHODE ISLAND

FINANCE COMMITTEE

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

SELECT COMMITTEE ON INTELLIGENCE

United States Senate

WASHINGTON, D.C. 20510

PROVIDENCE OFFICE:
301 John O. Pastore
Federal Building
Kennedy Plaza
Providence, Rhode Island 02903
(401) 528-5294

Toll Free Number
In Rhode Island
1-800-662-5188

April 22, 1981

Army Corps of Engineers
Trapelo Road
Waltham, Massachusetts 02154

Dear Sirs:

A constituent living on Sumner Avenue in Warwick, Rhode Island, has contacted me regarding questions she has about the time schedule for condemning property in that area to correct a flooding problem.

According to my constituent, uncertainty over plans of the Army Corps of Engineers is affecting property values in the area and making it difficult to sell houses there.

While I realize it is difficult to provide definite information on condemnation or construction schedules, I would appreciate receiving any data to pass on to people whose lives are being affected.

As always, I am grateful for your cooperation in this important matter.

Sincerely yours,

John H. Chafee

John H. Chafee
United States Senator

JHC:dw

APR 24 1981

WASHINGTON OFFICE:
SUITE 1431
LONGWORTH HOUSE OFFICE BUILDING
PHONE: (202) 225-4735

DISTRICT OFFICE:
77 JOHN O. PASTORE BUILDING
WARWICK, RHODE ISLAND 02903
PHONE: 529-4661

Congress of the United States

HOUSE OF REPRESENTATIVES
WASHINGTON, D.C. 20515

AND FISHERIES

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FISHERIES AND WILDLIFE CONSERVATION AND THE ENVIRONMENT

OCEANOGRAPHY

SCIENCE AND TECHNOLOGY

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ENERGY DEVELOPMENT AND APPLICATIONS

NATURAL RESOURCES, AGRICULTURAL RESEARCH, AND ENVIRONMENT

April 23, 1981

Lt. Gen. Joseph K. Bratton
Chief of Engineers
Army Corps of Engineers
Washington, D.C. 20314

Dear Lt. Gen. Bratton:

I am writing to voice my concern over the current situation in the Belmont Park section of Warwick, Rhode Island.

As I am sure you are well aware, the Corps began studying the Belmont Park flooding problems in 1969. Since then several projects have been proposed but for one reason or another their completion was not realized. At the present time, this situation has not yet been corrected.

Flooding occurred in 1978 and then a January, 1979 flood caused severe damage to area homes and thus the rebuilding process had to begin all over again. As you can well imagine, Belmont Park residents are angry, frustrated, and dispirited by the length of time it has taken for improvements to be made.

The latest proposal calls for the government to acquire the affected properties at a cost of approximately $2.5 million. This cost is much lower than the $59.3 million plan to divert flood water through an underground tunnel from the Pawtuxet River to Narragansett Bay. In addition, it is less expensive than the 1979 proposal which called for a $7 million dike to be built along the Pawtuxet River in Belmont Park.

I strongly urge that you commence the Detailed Project Report of Belmont Park so that government acquisition of the area can begin as quickly as possible. The longer the government delays action on this matter, the greater the cost becomes to all parties involved.

I would greatly appreciate it if you would keep me informed of future developments that arise in regard to Belmont Park in order that I may keep my constituents abreast of the situation. I look forward to hearing from you.

Sincerely,

Claudine Schneider

Claudine Schneider
Member of Congress

CS:ry
cc: Ms. Alice Golden
Ms. Barbara Pierce
Ms. Rose Thibeault

CLAUDINE SCHNEIDER
2D DISTRICT, RHODE ISLAND

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Congress of the United States

HOUSE OF REPRESENTATIVES
WASHINGTON, D.C. 20515

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ENERGY DEVELOPMENT AND APPLICATIONS
NATURAL RESOURCES, AGRICULTURAL RESEARCH, AND ENVIRONMENT

May 19, 1981

Colonel George R. Kleb
Corps of Engineers
Office of the Chief of Engineers
Department of the Army
Washington, DC 20314

Dear Colonel Kleb:

Thank you for your letter of May 5, 1981 regarding the Belmont Park flooding problems in Warwick, Rhode Island.

As the congressional representative of Belmont Park, I was hoping to establish an ongoing dialogue with the appropriate representatives of the Army Corps of Engineers in order that I might be regularly informed of the Corps' plans for the area and that I might receive regular updates on the progress in the preparation of the Detailed Project Report.

As I would also like to work closely with the administration of the City of Warwick, Mayor Joseph W. Walsh and I would appreciate it if you would furnish him with copies of your correspondence on this matter.

Through the combined efforts of you, Mayor Walsh and myself, hopefully a satisfactory resolution to the flooding problems of Belmont Park will be found. I look forward to hearing from you at your earliest convenience.

Sincerely,

Claudine Schneider

CS:dgr

CITY OF WARWICK, RHODE ISLAND

DEPARTMENT OF CITY PLAN
CITY HALL 02886
401-738-2000 EXT. 183

BARBARA SOKOLOFF
DIRECTOR

August 11, 1981

Colonel Edgar
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Mass. 02154

Dear Colonel Edgar:

The City of Warwick Planning and Parks and Recreation Department held a recent meeting with members of the U.S. Army Corps of Engineers to discuss the Belmont Park area acquisition project and the future use of that property.

City officials have discussed possibilities of developing a mini-complex of recreational services within the Belmont Park region, and believe that the potential for such use is significant. At the present time, there are no recreational opportunities convenient to the citizens of this area, and young and old alike must instead cross major, busy highways to reach available parks and playgrounds. This compounded by the fact that there is a heavy population of residents involved in local recreational activities, clearly indicates the need to provide a mini-park within that neighborhood.

Specifically, this mini-park would offer active and passive opportunities alike consisting of soccer and ballfields, a canoe launching area; possible tennis and basketball courts, depending upon space; and a sitting area for residents which overlooks the Pawtuxet River.

Considering its potential recreational use, the Belmont Park acquisition project holds important, productive and far reaching impact for this community.

If you have questions in this regard or would like to discuss this further, please do not hesitate to call.

Sincerely,

Barbara Sokoloff
Planning Director

BS:jm

2ND DISTRICT, RHODE ISLAND

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Congress of the United States

HOUSE OF REPRESENTATIVES
WASHINGTON, D.C. 20515

MERCHANT MARINE AND FISHERIES

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NATURAL RESOURCES, AGRICULTURAL RESEARCH, AND ENVIRONMENT

August 24, 1981

William R. Gianelli
Assistant Secretary of the Army for Civil Works
Department of the Army
The Pentagon
Room 2E569
Washington, D.C. 20301

re: Small Flood Control Project Authority (Section 205)

Dear Mr. Gianelli:

I am writing to request draft language for legislation to increase the ceiling on the Army Corps of Engineers Small Flood Control Project Authority (Section 205) from $2 million to $3 million (plus $1 million where the project area has been declared a major disaster area during the five year period preceding the authorization date).

As stated in Section ACW 97-1-B7 of the Army Civil Works Legislative Program for the First Session of the 97th Congress, some of the provisions of the small project authorities were enacted in the 1930's and periodically require increases in dollar limits as a result of inflation.

In the Belmont Park section of Warwick, Rhode Island, the Corps is proposing the acquisition of 54 properties because of severe flooding problems in the area. These efforts, however, face a potential roadblock as a result of the $2 million dollar federal cost limitation of Section 205. Therefore, I concur with the opinion of Commanding Colonel C.E. Edgar III of the Corps' New England Division that the suggested federal cost limitation should be increased to $3 million because construction cost indices for potential Section 205 projects such as Belmont Park have increased by 1½ times since Section 205 was last amended in 1976.

Thank you in advance for your attention to this matter.

Sincerely,

Claudine Schneider

Claudine Schneider
Member of Congress

CS:ry

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS

HISTORICAL PRESERVATION COMMISSION
Old State House
150 Benefit Street
Providence, R.I. 02903
(401) 277-2678

September 16, 1981

Mr. Joseph L. Ignazio, Chief
Planning Division
Army Corps of Engineers
424 Trapelo Road
Waltham, Mass. 02254

RE: Norwood Land Bank,
Warwick

Dear Mr. Ignazio:

Thank you for your letter of 9 September 1981 describing the above project. We concur with your finding of no effect to historic or archeological properties, with the understanding that demolition and earthmoving will be strictly confined to existing buildings and cellars.

Sincerely,

Eric Hertfelder
Deputy State Historic
Preservation Officer

/dn

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
New England Area Office
P. O. Box 1518
Concord, New Hampshire 03101

Colonel William D. Hodgson
Deputy Division Engineer
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254

DEC 2 ? 1981

Dear Colonel Hodgson:

This information concerning endangered species is intended to assist you in planning for local flood protection at Warwick, Rhode Island.

Our review shows that except for occasional transient individuals, no Federally listed or proposed species under our jurisdiction are known to exist in the project impact area. Therefore, no Biological Assessment or further consultation is required with us under Section 7 of the Endangered Species Act. Should project plans change, or if additional information on listed or proposed species becomes available, this determination may be reconsidered.

This response relates only to endangered species under our jurisdiction. It does not address other legislation or our concerns under the Fish and Wildlife Coordination Act.

Sincerely yours,

Gordon E. Beckett

Gordon E. Beckett
Acting Area Manager

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS

COASTAL RESOURCES MANAGEMENT COUNCIL
60 Davis Street
Providence, R.I. 02908

25 January 1982

Mr. Joseph L. Ignazio, Chief
Planning Division
Corps of Engineers
New England Division
424 Trapelo Road
Waltham, Mass. 02254

Dear Mr. Ignazio:

Thank you for the opportunity to review the proposed flood damage reduction plan alternatives for the Belmont Park section of Warwick. None of the alternatives reviewed - flood proofing, or acquisition for demolition, or removal - fall within the jurisdiction for the Rhode Island Coastal Resources Management Program.

Very truly yours,

John A. Lyons

John A. Lyons, Chairman
Coastal Resources Management Council

JAL/drc

CC: A-95 Clearinghouse
Ms. Kathryn Cousins, OCZM

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
P.O. Box 1518
Concord, New Hampshire 03301

Colonel William E. Hodgson
Deputy Division Engineer
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, MA 02254

FEB 1 1982

Dear Colonel Hodgson:

This planning aid letter is intended to assist in your study of possible flood protection measures on the Pawtuxet River at Belmont Park, Warwick, Rhode Island. This letter is submitted in accordance with the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 USC 661 et. seq.).

The proposed project consists of measures to eliminate flood damages in the Belmont Park area, located about two miles upstream from the mouth of the river. Four alternate plans are being considered and each plan includes acquiring and removing structures such as residences; protecting utility rooms of other buildings, a floodwarning system, raising houses and providing for temporary relocations.

The Pawtuxet River formerly supported substantial runs of anadromous fish including American shad, rainbow smelt, alewives and Atlantic salmon. These runs have been eliminated by the construction of dams and pollution. Interest in restoring them remains active, however, and with progress in pollution abatement, restoration of shad and alewives could eventually be successful. The reach of the river in the project area has potential habitat for largemouth bass, northern pike, chain pickerel, yellow perch and other warm-water species. If pollution from upstream chemical plants and other sources is diluted sufficiently by the time it reaches the project site, some bullheads and common suckers could be present. The fish population, however, has not been surveyed for many years. There is little public fishing or other use due to pollution and because access is limited. The project as planned will have little impact upon fishery resources other than to improve access to the river and reduce pollution by contaminants washed from streets and driveways and possibly from septic systems.

Intense urbanization in the greater Providence area has resulted in confining natural habitat to small pockets of wetlands and floodplains and severely restricts the availability of open space. These open areas support cottontain rabbit, ruffed grouse, gray squirrel, woodcock, mallard duck (along the river), mourning dove and many species of songbirds, small mammals, reptiles and amphibians. Overstory vegetation includes red and silver maples, several species of oaks, aspen and black cherry and scattered white pine. Groundcover and the understory include greenbriar, sweet pepper bush, arrow-wood, dogwood, alder, and young red maple and willow.

The project site now has a fairly dense vegetative cover, especially along some sections of the streambank and in vacant lots, including city-owned lots along the streambank and around the two, two-to-three acre ponds at the southeastern side of the pennisular.

Returning the area, except for two ball fields and a canoe landing, to natural habitat would result in providing open space for people to observe and enjoy wildlife. Bare soil where the houses, foundations, driveways and streets are removed would eventually be invaded by vegetation. In contrast to the previously considered structural measures (a diversion tunnel or a dike along the river), the proposed project will restore wildlife habitat, preserve open streambank and public access thereto, and further encourage restoration of the aquatic habitat.

This Service supports the proposed measures for flood damage elimination. We recommend that Plan A-1, which will remove the largest number of homes and open up the largest area, about 28 acres, be adopted. The additional open area will provide greater opportunities for outdoor recreation and provide more habitat for wildlife. Excluding the proposed ball fields about 20 acres should return to natural conditions.

We further recommend that your plan for this project be modified to include the following measures:

Restoration of the area to more natural conditions should be accelerated by planting a conservation mix of ground cover plants on bare areas where house foundations, paved driveways and streets are removed. Planting shrubs such as dogwoods and viburnums where lawns now exist would provide some food and cover for wildlife. If left to revegetate naturally, endemic floodplain species would eventually colonize the available sites. Existing apple trees would be maintained by releasing and pruning, if necessary, and the ornamental shrubs left onsite to add variety. The Rhode Island Division of Fish and Game should be contacted for their planting and management advice.

The intensive use of the proposed baseball and soccer fields will detract from wildlife habitat in the open area. Clearings around the play fields should be as small as possible and bounded by a hedge or fence. If possible, the fields should be located elsewhere so that there will be less disturbance in the natural area.

The small pond at the southeast corner of the site is less than a hundred feet from the river. The area is periodically flooded by water backing up from the river and receives some local drainage. Construction of a small dam with a stoplog water level control could improve the aesthetic quality and wildlife potential of this pond and another small pond just

upstream and at about the same elevation. They would not be large or deep enough to develop significant fish populations but might be used by spawning alewives when the run is restored. The average river level for late May or early June should be considered as a summer pool as long as there is sufficient freshwater inflow to prevent stagnation. The stoplogs will allow pool level changes as needed for fish and wildlife management.

We commend you for your environmentally sound approach to eliminating flood damage at this site.

Sincerely,

Gordon E. Beckett

Gordon E. Beckett
Supervisor

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS

HISTORICAL PRESERVATION COMMISSION
Old State House
150 Benefit Street
Providence, R.I. 02903
(401) 277-2678

May 6, 1982

RE: Belmont Park Flood Damage Reduction -- Warwick

Mr. Charles Freeman
Impact Analysis Branch
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02254

Dear Mr. Freeman:

The above project will have no effect on significant historic or archeological properties.

Sincerely,

Eric Hertfelder
Deputy State Historic
Preservation Officer

/dn

Joseph W. Walsh
Mayor
City Hall • Warwick, Rhode Island 02886

May 14, 1982

Colonel C.E. Edgar, III
Division Engineer
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254

Dear Colonel Edgar:

This letter provides the intent of the City of Warwick to meet items of local cooperation for the acquisition of property in the Belmont Park section of Warwick, Rhode Island. The proposed flood damage reduction plan along the Pawtuxet River will give much needed relief from future flooding to 59 families in this area.

A description of the preliminary items of local cooperation was provided to the City on 23 April 1982. We understand that a formal declaration of these assurances will be required after the Detailed Project Report is approved by the Chief of Engineers.

I cannot overemphasize the need for the proposed project to relieve the burden of recurring flooding to the long suffering residents of Belmont Park. The upstream development of the Pawtuxet River watershed in recent years has increased the frequency and severity of flooding to such an extent that an extreme hardship is placed on Belmont Park residents. They are not the cause of the upstream development, but they are the ones that experience the consequences of this situation.

We look forward to working closely with the Corps of Engineers in obtaining a fair and equitable solution to the flooding problem at Belmont Park.

Sincerely,

Joseph W. Walsh

JOSEPH W. WALSH
Mayor of Warwick

JWW/lap

111 Sumner Avenue
Warwick, Rhode Island 02888
May 15, 1982

Plan Formulation Branch
U. S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254

Mr. David Goodrich

Dear Mr. Goodrich:

We are residents in the Belmont Park section of Warwick, Rhode Island. Our home or property has never been directly flooded as a result of the land development in the Pawtuxet River watershed.

Having studied the Proposed Flood Damage Reduction Project report, we would like our home at 111 Sumner Ave., Warwick, Rhode Island, to be considered for having an utility room added to it rather than having it demolished.

We ask that consideration be given to our request, and we look foward to hearing from you.

Sincerely yours,

Maurice A. O'Brien Sr.
Delia T. O'Brien
Maureen P. O'Brien

May 19, 1982

Mr. David Goodrich
c/o Plan Formulation Branch
U. S. Army Corps of Engineers
424 Trapelo Road
Waltham, Mass. 02254

Dear Sirs:

I am writing to you in regard to your nonstructural flood damage reduction plan recommended for the Belmont Park area of Warwick, Rhode Island.

My residence is located approximately on the fringe, of the area containing homes scheduled for aquisition and demolition. (lots #105 & #106 on your layout)

I am 85 years of age and have resided in this house at 50 Heath Avenue since 1941, a total of appoximately 41 years. It is a good house, well constructed, and has been properly maintained.

I have never experienced any actual above ground flooding from the Pawtuxet River as my house is located considerable distance from it, (refer to layout), and have contended with the water table in this area by the use of a sump pump which has proven to be adequate when needed.

I request that you exclude my house from your list of houses to be demolished, and based on my forty-plus years of residence at 50 Heath Avenue, I believe a utility room would be sufficient to withstand the threat of flooding from the Pawtuxet River.

Thank you for your consideration,

Sincerely yours,

Alice M. O'Connell

Alice M. O'Connell

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS

Department of Environmental Management
DIVISION OF PLANNING AND DEVELOPMENT
83 Park Street
Providence, R. I. 02903

May 28, 1982

Colonel C.E. Edgar, III
New England Division
Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02254

Re: Flood Damage Reduction Study for Pawtuxet River, Warwick, RI
Detailed Project Report/Environmental Assessment

Dear Colonel Edgar:

The Department of Environmental Management has reviewed the subject report and is in agreement with the Corp's finding of need for the project and the selection of Plan A-1 as the most desirable alternative. This plan offers the greatest degree of protection and a favorable benefit/cost ratio based on flood damage reduction.

The open space created in this heavily developed area will be valuable as wildlife habitat for species tolerant of human activity. Belmont Park is also an excellent location for both passive and active recreation, as proposed by the City of Warwick. Any development in the flood plain, either for recreational facilities or exterior utility rooms, must be reviewed by the DEM Division of Land Resources, Wetlands Section to be sure that development is compatible with the flood plain and that the flood capacity of this wetland is maintained.

We are very pleased with the non-structural approach taken by the Corps in seeking to alleviate flood damages in this area. Please do not hesitate to contact me at (401)277-2776 if we can assist you in further stages of this project.

Sincerely yours,

Lorraine Jombert

Lorraine Jombert
Environmental Planner

LJ:fh
CC: Rene Fontaine
Mal Grant
Bob Bendick

APPENDIX 4

HYDROLOGY

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APPENDIX 4

HYDROLOGY

1. PURPOSE AND SCOPE

This report presents the hydrologic analysis of the Pawtuxet River pertinent to the planning of a Local Flood Protection Project, consisting of flood plain evacuation in the Belmont Park area of Warwick, Rhode Island. The flood plain peninsula is located on the right bank of the Pawtuxet River just downstream of the Elmwood Avenue bridge crossing and about 2.5 miles upstream from the mouth of the Pawtuxet River at Broad Street bridge.

A basin-wide hydrologic analysis of the Pawtuxet River was performed and reported in "Pawcatuck River and Narragansett Bay Drainage Basin Study, Pawtuxet River Watershed Draft Interim Report", July 1975. Further hydrologic analysis was performed in studies for the proposed Big River Reservoir Project and reported in: "Big River Reservoir Project, Interim Report", July 1981. This appendix presents hydrologic description and a review of analysis applying to the establishment of flood levels and frequencies in the Belmont Park project area.

2. BASIN DESCRIPTION

The Pawtuxet River basin shown on Plate 4-1 lies entirely within the State of Rhode Island and covers a total area of 230 square miles. The drainage area of the river at the Belmont Park site is about 224 square miles. The basin is triangular in shape with a north-south base of 23 miles and an east-west length of about 18 miles. Drainage in the basin is generally west to east and the watershed has a variable hydrologic character. The westerly headwater region is quite hilly with little urban development, whereas the lower easterly portion is very flat and quite highly urbanized. The water resources of the westerly headwater region have been extensively developed for domestic and industrial water supply. Scituate Reservoir on the North Branch, with a surface area of 3,400 acres at spillway crest and a drainage area of 93 square miles, is the dominating water supply system in the region. There is little water resource development in the lower basin. Elevations in the basin vary from a high of about 800 feet NGVD at the westerly divide to a low of 10 feet NGVD near the mouth of the river.

The mainstem Pawtuxet River originates at the confluence of the North and South Branches at River Point in West Warwick, Rhode Island. It then flows northeasterly between low banks for 10.9 miles to its mouth in Pawtuxet Cove. The river averages about 100 feet in width and about 4 feet in depth throughout its length and has an average slope, excluding drops at three existing run-of-river dams, of approximately 2.6 feet per mile. From its origin to the mouth, the river has a total fall of about 50 feet. Originally, approximately 3 miles of the lower reach of the

river through the Belmont Park area was a tidal estuary until the construction in 1870 of the Pawtuxet dam near the mouth of the river to prevent salt water intrusion. In the lower reach, but upstream of Belmont Park, the main river is joined by two other tributaries from the north, Meshanticut Brook and Pocasset River, at river miles 9.0 and 3.8, respectively. A main river profile is shown on Plate 4-2 and a profile of the North and South Branches is shown on Plate 4-3. Pertinent data on the Pawtuxet River and its tributaries are listed in Table 4-1. A plan and flood profile of the Pawtuxet River at the Belmont Park area is shown on Plate 4-8.

TABLE 4-1

PAWTUXET RIVER PERTINENT DATA

Location - Stream	Distance Above Pawtuxet Dam (river miles)	Total Drainage Area (sq. mi.)	Length (miles)
Pawtuxet River	0.0	230.4	10.9
(Belmont Park Project Site)	2.5	224	-
Pocasset River	3.8	20.8	11.6
USGS Gage	4.5	200	-
Meshanticut Brook	9.0	15.0	6.5
North and South Branch Confluence	10.9	179.0	-
North Branch	10.9	106.0	6.8
Kent Dam (Scituate Reservoir)	17.7	92.8	
South Branch	10.9	73.0	9.0
Flat River Reservoir	19.9	56.7	

3. CLIMATOLOGY

The Pawtuxet River basin has a variable climate but, due to its proximity to Narragansett Bay, escapes the severity of cold and depth of snowfall experienced in the higher elevations of the interior areas of New England. It frequently experiences periods of heavy precipitation produced by local thunderstorms and intense "lows" of tropical and

extratropical origin that move northeasterly up the coast. The basin also lies in the path of the prevailing "westerlies" which generally travel across the country in an easterly or northeasterly direction producing frequent weather changes.

The average annual temperature of the Pawtuxet River basin is about 50° Fahrenheit. Extremes in temperature range from occasional highs of 100° to lows of -15° Fahrenheit. Freezing temperatures may be expected from the latter part of October until the middle of April.

The mean annual precipitation over the Pawtuxet River basin varies from about 40 inches in the lower coastal areas to about 48 inches in the uplands. Distribution of the precipitation is quite uniform throughout the year. However, extremes in monthly values range from a high of more than 12 inches to less than 0.20 inch on several occasions.

The average annual snowfall over the Pawtuxet River basin is about 40 inches. Water content of the snow cover usually reaches a maximum about the first of March but rarely exceeds 2 to 3 inches due to the moderating effect of Narragansett Bay.

4. STREAMFLOW

The U.S. Geological Survey maintains three stream gaging stations within the Pawtuxet River watershed. One is located on the Pawtuxet River at Cranston only 2 miles upstream from the project site at Belmont Park. The drainage areas at the gage and the Project site are 200 and 224 square miles, respectively, The second gage is on the South Branch downstream of Flat River Reservoir at Washington, Rhode Island. These two main river gages have both been in operation since 1940. The other remaining gage is located on a headwater tributary. Pertinent data for the three stations is summarized in Table 4-2 and locations of the stations are shown on Plate 4-1.

TABLE 4-2

GAGING STATION RECORDS
PAWTUXET RIVER WATERSHED

Gaging Station	Drainage Area (sq. mi.)	Period of Record	Discharge (cfs) Mean	Maximum	Minimum
Nooseneck River at Nooseneck, R.I.	8.23	1963-present	19.4	587 (8/4/79)	0.81
So. Br. Pawtuxet R. at Washington, R.I.	63.8	1940-present	136	1,860 (3/18/68)	2.8
Pawtuxet River at Cranston, R.I.	200	1939-present	345	4,000 (1/26/79)	22**

**Minimum daily flow

Average annual runoff from the Pawtuxet watershed is about 27 inches or approximately 60 percent of average annual precipitation. Monthly runoff at the Cranston gage is listed in Table 4-3, and peak annual discharges in Table 4-4.

TABLE 4-3

MONTHLY STREAMFLOW
PAWTUXET RIVER AT CRANSTON
(41 year of record)

Drainage Area = 200 square miles
Mean Discharge in Cubic Feet per Second and Inches

	Observed Mean		Adjusted for Diversion thru 1975 (inches)		
Month	CFS	Inches	Mean	Maximum	Minimum
January	469	2.73	3.11	6.56	0.78
February	491	2.58	3.25	7.38	1.34
March	589	3.43	4.66	8.96	2.56
April	561	3.16	3.86	7.01	1.24
May	398	2.31	2.70	5.38	1.34
June	252	1.42	1.45	3.96	0.24
July	168	0.98	0.83	2.52	0.002
August	177	1.03	0.79	3.43	0.06
September	182	1.02	0.90	4.96	0.11
October	192	1.02	1.11	6.48	0.20
November	268	1.51	2.09	6.93	0.43
December	388	2.26	3.06	8.31	0.67
Annual	344	23.56	27.81	46.23	12.75

TABLE 4-4

PEAK ANNUAL DISCHARGES
PAWTUXET RIVER AT CRANSTON, RHODE ISLAND
D.A. = 200 Square Miles

Date	Annual Peak Discharge (cfs)	Date	Annual Peak Discharge (cfs)
15 Jan 1940	1960	19 Feb 1960	1520
8 Feb 1941	1960	21 Sep 1961	1800
9 Mar 1942	1430	13 Mar 1962	1950
30 Dec 1943	1450	6 Oct 1963	1960
15 Sep 1944	1620	15 Apr 1964	1530
27 Feb 1945	1640	26 Feb 1965	1820
7 Feb 1946	1510	14 Feb 1966	695
3 Mar 1947	1320	27 May 1967	2480
19 May 1948	1910	18 Mar 1968	3110
6 Apr 1949	1170	25 Mar 1969	2050
23 Mar 1950	1140	4 Apr 1970	2710
3 Apr 1951	1430	14 Feb 1971	1190
21 Dec 1952	1600	19 Mar 1972	2080
16 Mar 1953	1830	8 Dec 1973	2730
13 Dec 1954	2010	17 Fec 1974	2320
19 Aug 1955	1490	28 Jan 1975	2070
6 Nov 1956	2090	3 Apr 1976	1630
9 Apr 1957	1080	24 Mar 1977	1820
28 Feb 1958	1770	26 Jan 1978	3040
7 Mar 1959	1770	26 Jan 1979	4000
		22 Mar 1980	2510

5. TIDES

Two high and two low tides occur each lunar day in the Narragansett Bay area with a mean high water of 2.47 feet NGVD and mean low water of -2.13 feet NGVD at Providence. The Pawtuxet Dam, constructed at the mouth of the river in 1870 with a crest elevation of 5.3 feet NGVD, prevents normal tides from affecting the lower Pawtuxet River; however, the dam is overtopped by abnormal storm tides. Therefore, the lower Pawtuxet River downstream of the Belmont Park project site is subject to flooding from either freshwater or storm tides, or a combination of the two. The Belmont Park site is at the very upstream end of this tidally affected reach. The two greatest tides of record in recent years at Providence occurred as a result of hurricanes in September 1938 and August 1954, with the maximum tidal levels at 15.7 and 14.7 feet above NGVD, respectively.

6. HISTORIC FLOODS

a. General. The flood history of the Pawtuxet River demonstrates that major floods can occur any season of the year as a result of intense rainfall alone or in combination with snowmelt. Flat River and Scituate reservoirs exert control over 66 percent of the Pawtuxet watershed and Scituate in particular has a significant modifying effect on flood development in the Pawtuxet basin. Pertinent data on Scituate and Flat River reservoirs is listed in Table 4-5. The magnitude of freshwater floods on the mainstem Pawtuxet are a function of: (1) storm rainfall and resulting runoff from the 80.9 square miles of watershed downstream of the reservoirs and (2) the initial storage capacity in the reservoirs and the resulting magnitude and timing of discharges from the reservoirs. Floods are also produced on the lower Pawtuxet by abnormal tides in Narragansett Bay. Following are discussions of some of the more notable floods that have occurred in the 19th and 20th centuries.

TABLE 4-5

SCITUATE AND FLAT RIVER RESERVOIRS
PERTINENT DATA

	Scituate	Flat River
Drainage Area (sq. mi.)	92.8	56.7
Spillway Length (feet)	412	169
Spillway Elevation (ft msl)	284	248
Top of Flashboards (ft msl)	285.5	N.A.*
Storage Capacity		
Spillway Crest (acre-feet)	113,600	5,150
Spillway Crest (inches)	23	1.7
Top of Flashboards (acre-feet)	118,500	N.A.*
Top of Flashboards (inches)	24	
Surface Area at Spillway Crest (acres)	3,400	850
Top of Dam Elevation (ft msl)	298	256

*Not applicable

b. 11-14 February 1886. This flood was the greatest ever known on the mainstem Pawtuxet River, resulting from 7 to 8 inches of rainfall over the basin, and augmented by snowmelt with an estimated water equivalent of 2 inches. Experienced flood levels were 6 to 7 feet higher than any other known flood before or since this event. There were no record of flows on the mainstem but previous studies by the Corps estimated the discharge of the river was about 14,000 cfs in the vicinity of the present USGS gage site in Cranston.

Scituate Reservoir was not in existence at the time of this flood. If it had been built and initially filled, it is estimated that the resulting flood at Cranston would have been modified to about 11,000 cfs. A

recurrence of such a flood today, with present levels of development in the lower basin would result in a catastrophic-type disaster. Experienced flood levels in the project area were estimated to have been about 25 feet NGVD. A recurring flood with Scituate would produce an estimated level of 23 feet NGVD.

c. 2-4 November 1927. The heaviest rainfall associated with this major storm system occurred outside the Pawtuxet basin. Rainfall amounts varying from 2 to 7 inches were reported within the watershed. Scituate Reservoir stored 100 percent of the runoff from its watershed and only a minor flood freshet developed in the lower basin.

d. 9-21 March 1936. The New England floods resulting from this storm were caused by a combination of heavy rainfall, deep snow cover, and unusually high temperature for the season. Rainfall in the Pawtuxet basin was about 3.4 inches for the period 9-12 March and 3.1 inches for the period 18-22 March. Water equivalent of the snow cover, which was depleted during the period, was estimated at about 1 inch. The flood was significantly modified by storage capacity initially available in the upstream reservoirs and the resulting peak flow of the Pawtuxet River in the vicinity of the present USGS gage in Cranston was estimated at about 5,300 cfs. This flow would produce a flood stage in the Belmont Park project area of about 18 feet NGVD.

e. 18-24 July 1938. This flood, the greatest experienced on the mainstem Pawtuxet since the construction of Scituate Reservoir in 1926, was the result of a coastal storm producing an average of 7 inches of rainfall over the Pawtuxet basin. This event occurred at a time when both Flat River and Scituate Reservoir were initially almost full; therefore, the only modifying effect was due to surcharge storage. The resulting peak discharge at Cranston has been estimated at about 6,300 cfs. Flow components making up the July 1938 flood hydrograph at Cranston are graphically presented on Plate 4-5. A flow of 6,300 cfs would produce a computed flood level of about 19 feet NGVD in the Belmont Park project area.

f. 17-22 September 1938. The hurricane of September 1938 produced an abnormal tide level in Narragansett Bay of 15.7 feet above NGVD in the vicinity of the mouth of the Pawtuxet River. This tide was 10.2 feet above the crest of the Pawtuxet dam and resulted in extensive tidal flooding in the lower reaches of the Pawtuxet River. Rainfall of the preceding four days averaged 5 inches over the Pawtuxet watershed, but upstream reservoir levels were low and Pawtuxet River flows were not considered a major contributor to experienced floods.

g. 31 August 1954. Hurricane "Carol" passed over the western portion of the basin creating abnormally high tides to elevation 14.7 feet above NGVD in Narragansett Bay near the mouth of the Pawtuxet River. Overtopping of Pawtuxet dam resulted in flood stages of approximately 12.5 feet NGVD upstream of the dam. Wind gusts over 100 mph were recorded at

Providence during this hurricane. Precipitation associated with this storm was only about 3 inches over the basin and freshwater flooding was not a major factor.

h. 17-18 March 1968. The 1968 event was produced by 4 to 7 inches of rainfall occurring in a 48-hour period. A preceding storm on the 12th and 13th of the month plus some snowmelt provided high antecedent runoff conditions. The resulting peak discharge at the USGS gage in Cranston was 3,110 cfs and flood levels were about 16 feet NGVD in the Belmont Park project area. Though flood damages were not major, the event occurred after a period of very intesive development in the lower basin, and brought attention to the great flood damage potential to which most of this development was exposed, the 1968 flood discharge on the mainstem Pawtuxet River was significantly modified by storage capacity initially available at Scituate Reservoir. If the reservoir had been initially full, it is estimated the peak flow at Cranston would have been about 6,500 cfs or comparable to the experienced July 1938 flood when reservoirs were full.

Detailed analysis of the development of the March 1968 flood is graphically presented on Plate 4-4. Pertinent data on the effects of Scituate and Flat River Reservoirs on some historic floods are summarized in Tables 4-6 and 4-7.

TABLE 4-6

FLOOD STORAGE BY UPSTREAM RESERVOIRS

		Scituate Reservoir (D.A. = 92.8 sq. mi.)				Flat River Reservoir (D.A. = 56.7 sq. mi.)			
		Initial Storage Capacity		Surcharge Storage		Initial Storage Capacity		Surcharge Storage	
		Inches	% Runoff	Inches	% Runoff	Inches	% Runoff	Inches	% Runoff
February	1886	Before Construction				0.48	10	1.51	30
November	1927	3.72	100	0	0	1.06	30	0.27	7
March	1936	3.21	60	1.47	28	0	0	0.76	14
July	1938	0	0	1.30	37	0.11	5	0.43	19
March	1968	2.24	100	negligible	negligible	0	0	.81	38

TABLE 4-7

ESTIMATED EFFECT OF UPSTREAM RESERVOIRS
ON PEAK FLOWS AT CRANSTON, RHODE ISLAND

Flood		Flat River & Scituate Initially Filled To Spillway Crest (cfs)	With Complete Storage in Flat River and Scituate (cfs)	Experienced Discharge (cfs)
February	1886	11,000	7,000	14,000*
July	1938	6,300	3,300	6,300
March	1968	6,800	2,700	3,110
SPF		19,000	13,000	-

*Scituate Reservoir not in existence

i. 25-26 January 1979. The January 1979 flood was the result of two rainfall events occurring 4 days apart following a period of above normal precipitation and temperatures. Rainfall at Providence, for the month was 11.6 inches or 3 times the normal. On the 21st, 2.7 inches of rain was recorded at Providence in a 24-hour period followed by 2.6 inches in a 24-hour period on the 25th. The river crested at Cranston on the 26th with a flow of 4,000 cfs. Reservoirs were at high levels during this event and, unlike the March 1968 flood, discharge from Scituate Reservoir was a significant contributor to the peak flow at Cranston.

7. ANALYSIS OF FLOODS

The hydrology of flood development in the Pawtuxet basin was studied through analysis of the experienced March 1968 and July 1938 flood events. First, analysis of the 1968 flood and then the 1938 event follows:

a. Known Scituate and South Branch hydrographs were "lag-average" routed to Cranston, combined, and subtracted from the recorded Cranston hydrograph. The resulting residual hydrograph represented the runoff from the intervening 50.5 square mile local.

b. The 50.5 square mile local hydrograph was used as a guide in estimating a hydrograph for the remaining 30.4 square mile local from the Cranston gage to the mouth of the river.

c. Using the above information, unit hydrographs were developed for the two locals and the South Branch and Scituate watersheds. The 1968 rainfall excess was applied to the unit graphs, inflow hydrographs were routed through Scituate and Flat River Reservoirs by modified Puls, outflow hydrographs were routed to Cranston and combined with locals. The resulting computed hydrograph was then compared with the recorded hydrographs for verification of the procedure.

d. Having verified the flood model, further analysis was made assuming various starting storage levels at Scituate Reservoir to assess its relative effect on flood peaks at Cranston.

e. The July 1938 flood was studied by applying storm rainfall excess to the developed unit hydrographs and repeating the above flood routings.

The March 1968 flood analysis is graphically illustrated on Plate 4-4 and the July 1938 analysis is shown on Plate 4-5. Pertinent data on the effects of Scituate and Flat River Reservoirs on historic floods is summarized in Tables 4-6 and 4-7.

The potential modifying effect of the proposed Big River Reservoir, a combination water supply and flood control project in the headwaters of the South Branch, was assessed as follows: Big River Reservoir would

control 50 percent of the drainage area above the South Branch gage, therefore, flood hydrographs at the South Branch gage were assumed to be reduced 50 percent and the modified hydrographs were routed to Cranston. The flood hydrographs at Cranston, for a range of floods, were found to be modified from about 16 to 24 percent. The magnitude of the percent reduction was highly dependent on the initial storage conditions at Scituate Reservoir. An average modification percentage of 20 percent was therefore adopted and applied to the developed natural discharge frequency curve at Cranston to derive the discharge frequency as modified by Big River. Natural and modified discharge and stage frequency curves at the Belmont Park project site are shown on Plate 4-9.

8. FLOOD FREQUENCIES

Discharge frequencies, both recorded and computed, of the Pawtuxet River at the Cranston gage were derived from analysis of historical flood data. Due to the complexity of the effect of upstream reservoirs on floodflows at Cranston, conventional statistical analysis such as Log Pearson Type III distribution was not considered applicable. Instead, recorded data for the period 1940 to 1979, and computed historical events (with varying antecedent Scituate storages), were plotted using Weibull plotting positions. A discharge frequency curve was then fitted through the plotted data as shown on Plate 4-6.

The discharge frequency curve for the Pawtuxet River at the Belmont Park project site was derived by increasing the computed discharges at Cranston in proportion to the relative contribution of the intervening local area as determined from analysis of historic floods. The increase in flow frequencies from Cranston to the mouth varied from about 20 percent in the lower more frequent range to about 17 percent in the upper portion. The developed frequency curve for the river at the Belmont Park project site is shown on Plate 4-9.

9. STANDARD PRDJECT FLOOD

a. General. The standard project flood (SPF) represents the flood discharge that may be expected from the most severe combination of meteorologic and hydrologic conditions that are considered reasonably characteristic of the region, excluding extremely rare combinations. The SPF represents a "standard" against which the flood potential of a river can be judged, as contrasted to an analysis of flood records which may be misleading due to abnormal sequences of events during the period of record. The SPF for the Pawtuxet River was developed using standard project storm rainfall, as described in EM 1110-2-1411, and unit hydrographs derived from analysis of recorded floods in the basin.

b. Rainfall. The standard project storm was oriented over the Pawtuxet watershed with its center near the junction of the two branches and with its long axis running in a southwest to northeast direction. The storm pattern is shown on Plate 4-7.

The standard project storm index rainfall for 24 hours over a 200 square mile area is 11 inches. A summary of the adopted standard project storm contribution for a drainage area of 200 square miles is as follows:

	Inches
SPS Rainfall (24 hrs)	11.0
Losses	2.3
Rainfall Excess	8.7
Maximum 3-hour Rainfall Excess	5.3

Losses were assumed at the rate of 0.1 in studies for the New England area. The rainfall over each tributary and local area was obtained by planimetering between the isohyets and respective watershed divides.

c. Unit Hydrographs. Unit hydrographs were derived, through analysis of the March 1968 flood, for the watersheds of (1) Flat River Reservoir, (2) Scituate Reservoir and (3) the two downstream local areas. The peaks of all developed unit hydrographs were increased 25 percent, in accordance with EM 1110-2-1405, to reflect the increased runoff rates expected under standard project storm conditions. A typical unit hydrograph development is shown on Plate 4-5.

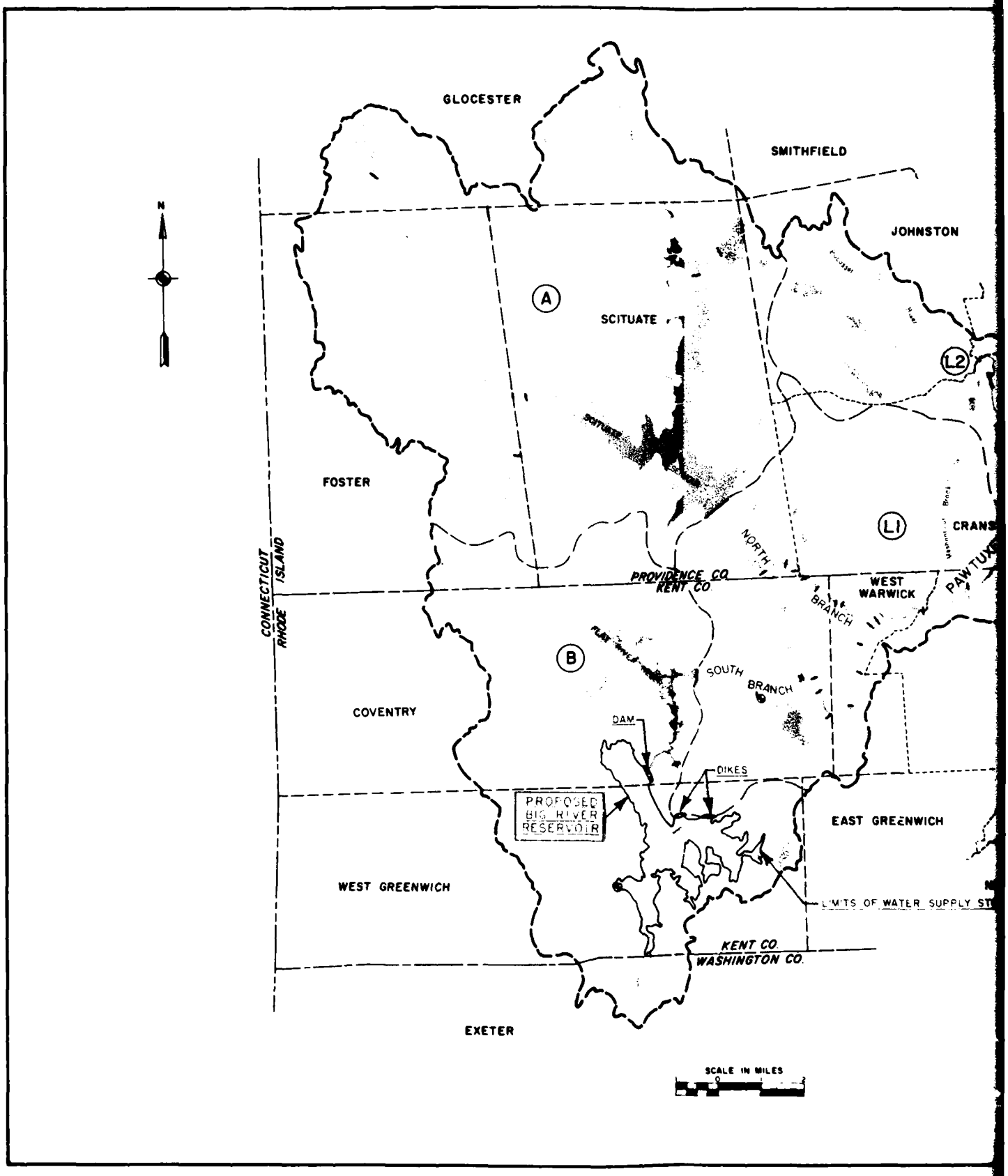
d. Standard Project Flood. Rainfall excess was computed for each subwatershed and applied to the adopted unit hydrographs. The resulting hydrographs for Flat River and Scituate Reservoirs were routed through surcharge storage assuming the reservoirs initially filled to spillway crest. The resulting outflow hydrographs were then routed downstream and combined with the component hydrographs from the local areas. Development of the SPF for the Pawtuxet basin is graphically illustrated on Plate 4-7.

10. FLOOD PROFILES

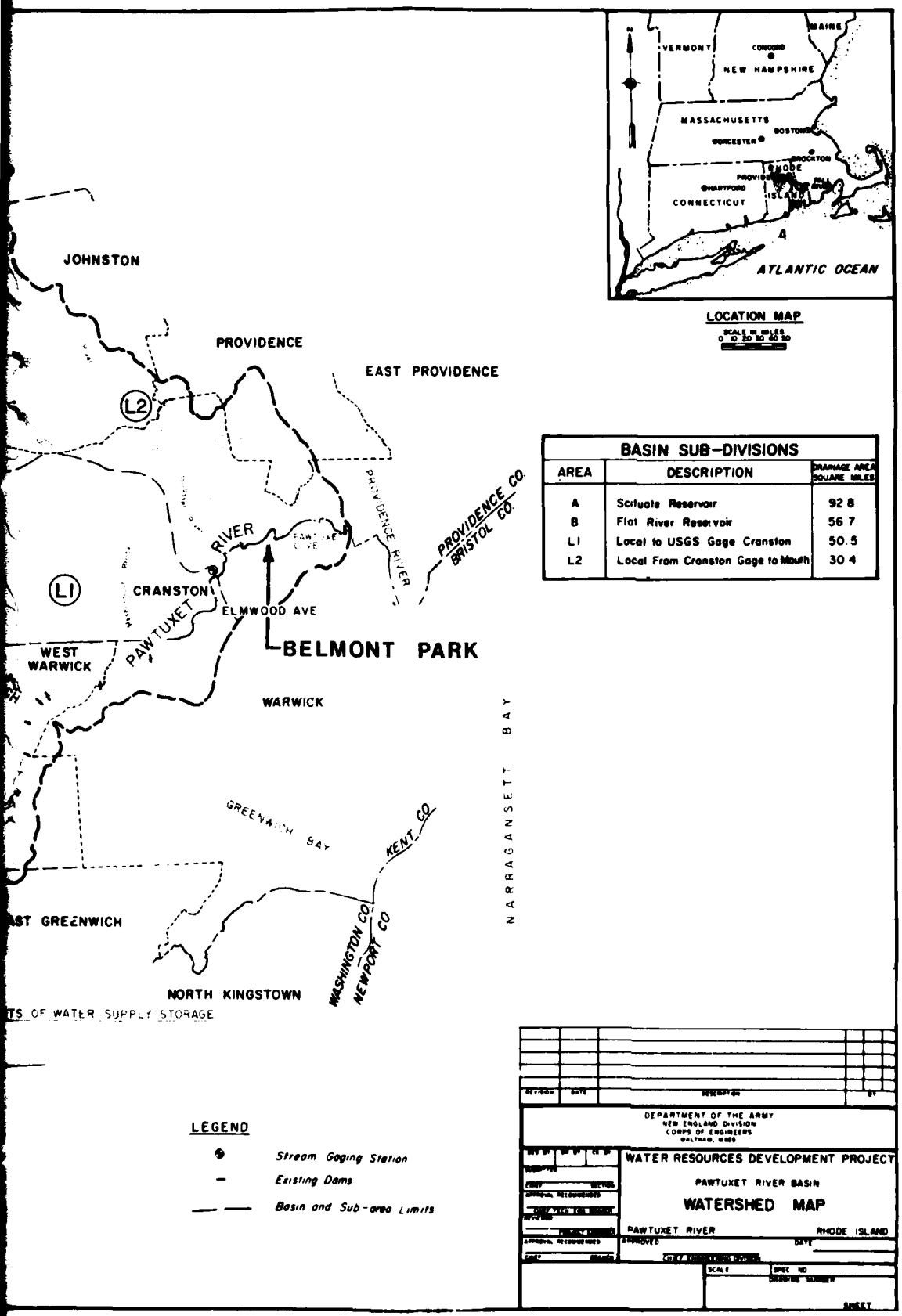
Flood profiles for the mainstem of the Pawtuxet River are shown on Plate 4-2. Profiles were computed by standard backwater procedures using a minimum of surveyed cross sections of the river and the computer program, HEC-2, developed by the Hydrologic Engineering Center in Davis, California. The computer model was calibrated, to the extent possible, against historic flood elevations. In many instances the computed profile for a historic flood discharge was somewhat higher than observed and this was attributed largely to reduced hydraulic capacity of the river due to accelerated development. Backwater computations were made for a range of floods using a Manning's "n" of 0.05 for channel and 0.08 for overbank. Assumed contraction and expansion loss coefficients were 0.3 and 0.5, respectively.

11. FLOOD STAGE FREQUENCIES

A stage frequency curve of the Pawtuxet River at the Belmont Park project site was developed using the adopted discharge frequency curve and a stage discharge rating curve. The stage-discharge curve was derived from the backwater computations and is shown on Plate 4-9 and the stage frequency curve for the Belmont Park site is also shown on Plate 4-9.


GLOCESTER
SMITHFIELD
JOHNSTON
N
A
SCITUATE
L2
FOSTER
L1
CRANS
NORTH
BRANCH
PROVIDENCE CO.
KENT CO.
WEST
WARWICK
PAWTUX
CONNECTICUT
RHODE ISLAND
B
SOUTH
BRANCH
COVENTRY
DAM
DIKES
PROPOSED
BIG RIVER
RESERVOIR
EAST GREENWICH
WEST GREENWICH
LIMITS OF WATER SUPPLY ST
KENT CO.
WASHINGTON CO.
EXETER
SCALE IN MILES
0

1



BASIN SUB-DIVISIONS		
AREA	DESCRIPTION	DRAINAGE AREA SQUARE MILES
A	Scituate Reservoir	92 8
B	Flat River Reservoir	56 7
L1	Local to USGS Gage Cranston	50.5
L2	Local From Cranston Gage to Mouth	30 4

LEGEND

- Stream Gaging Station
- Existing Dams
- Basin and Sub-area Limits

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

WATER RESOURCES DEVELOPMENT PROJECT

PAWTUXET RIVER BASIN

WATERSHED MAP

PAWTUXET RIVER RHODE ISLAND

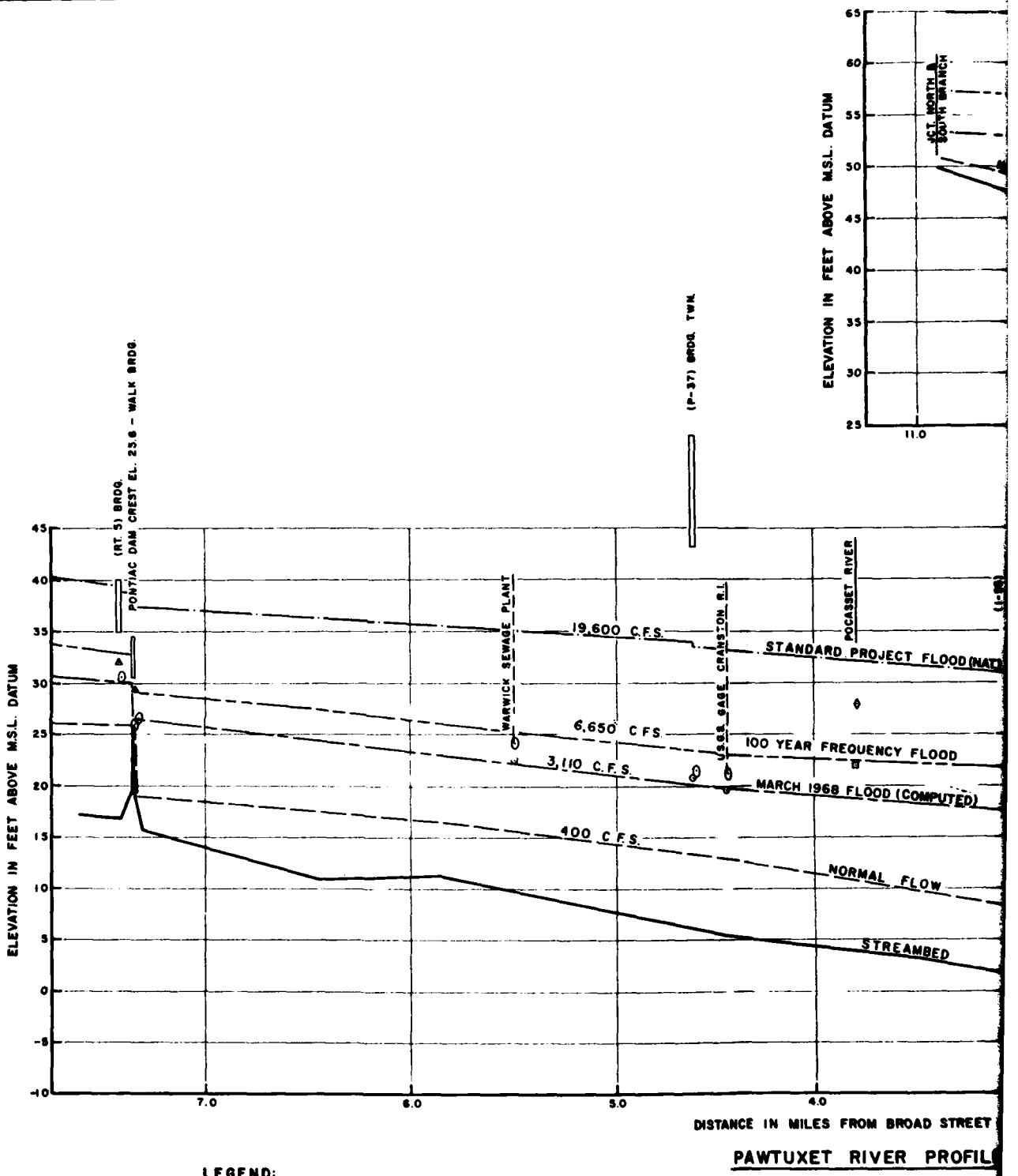
APPROVED DATE

SCALE SPEC NO

SHEET

PLATE 4-1

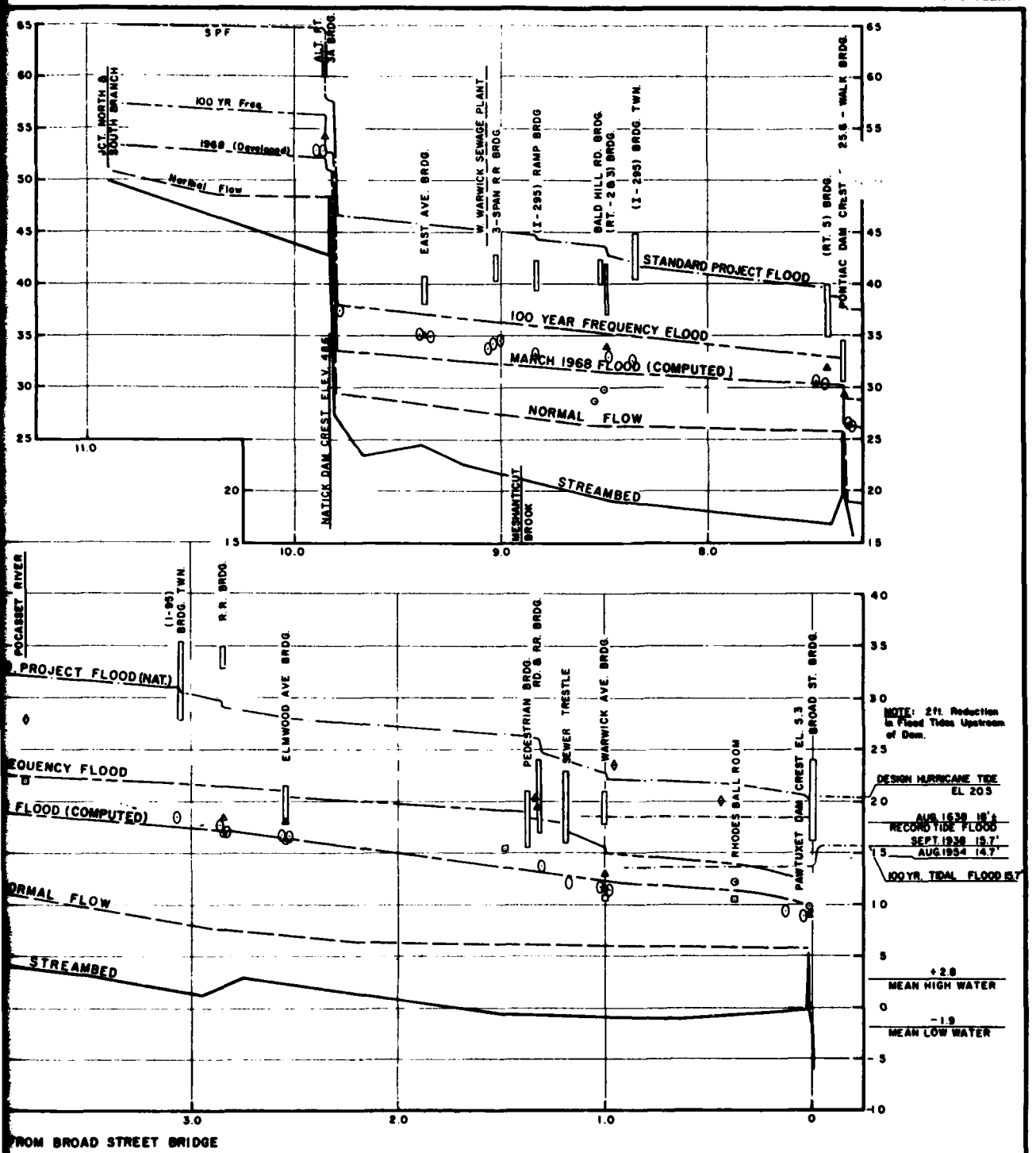
2



PAWTUXET RIVER PROFIL

LEGEND:

- △ INDICATES H.W.M. JULY 1938
- ⊙ INDICATES H.W.M. MARCH 1968
- ⊡ INDICATES H.W.M. MARCH 1936
- ◊ INDICATES H.W.M. FEB. 1886
- ⊙ INDICATES H.W.M JAN. 1979



FROM BROAD STREET BRIDGE

RIVER PROFILE

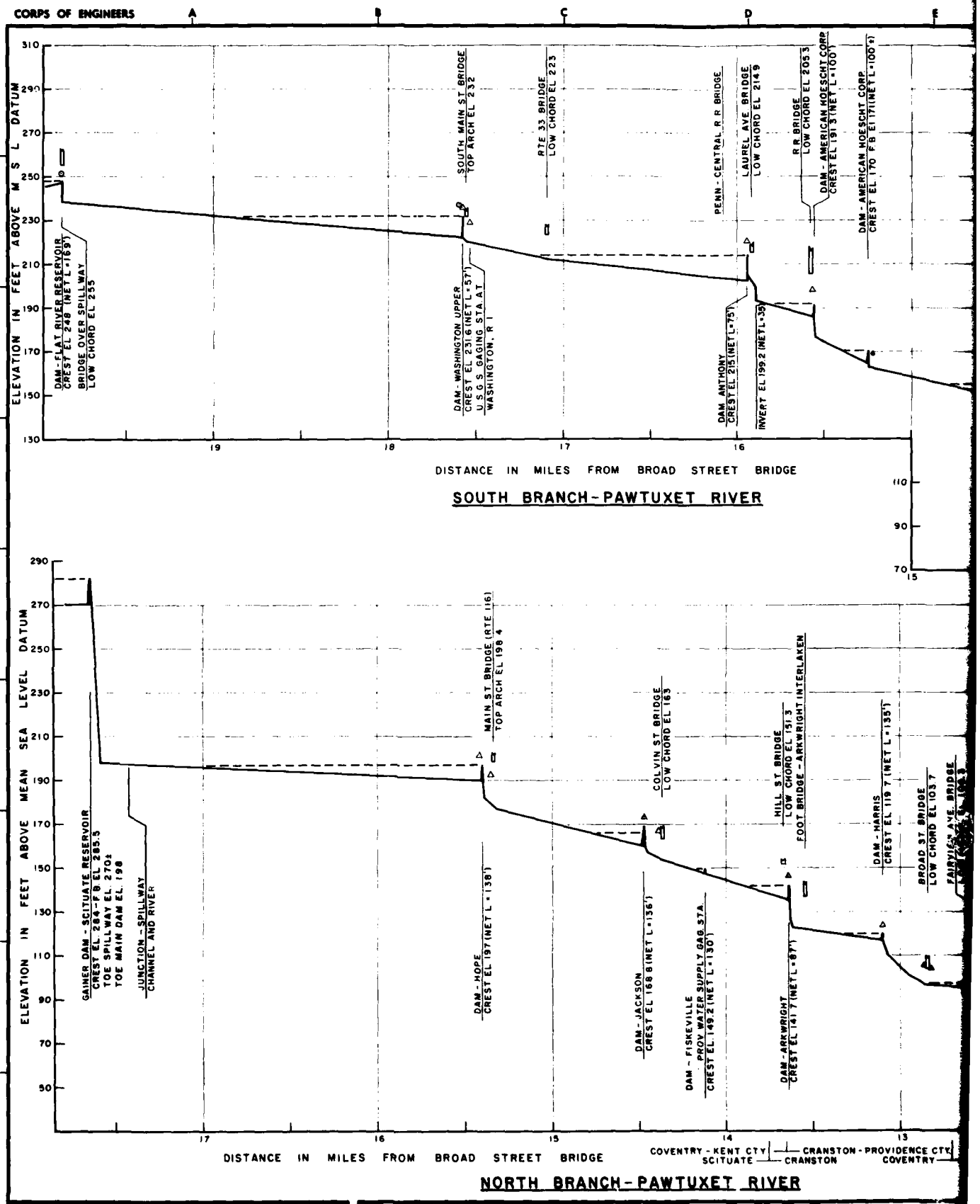
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

WATER RESOURCES DEVELOPMENT PROJECT
PAWTUXET RIVER BASIN
MAIN STEM
FLOOD PROFILES
PAWTUXET RIVER RHODE ISLAND

APPROVED DATE

SCALE DRG. NO.

SHEET


CORPS OF ENGINEERS
A
B
C
D
E
ELEVATION IN FEET ABOVE M S L DATUM
DAM - FLAT RIVER RESERVOIR
CREST EL 248 (NET L - 169')
BRIDGE OVER SPILLWAY
LOW CHORD EL 255
DAM - WASHINGTON UPPER
CREST EL 231.6 (NET L - 57')
U.S.G.S. GAGING STA. AT
WASHINGTON, R.I.
SOUTH MAIN ST. BRIDGE
TOP ARCH EL 232
RTE 33 BRIDGE
LOW CHORD EL 223
PENN - CENTRAL R.R. BRIDGE
DAM ANTHONY
CREST EL 215 (NET L - 75')
INVERT EL 199.2 (NET L - 35')
LAUREL AVE. BRIDGE
LOW CHORD EL 214.9
R.R. BRIDGE
LOW CHORD EL 205.3
DAM - AMERICAN HOESCHT CORP
CREST EL 191.3 (NET L - 100')
DAM - AMERICAN HOESCHT CORP
CREST EL 170 F.B. ETT. (NET L - 100')
DISTANCE IN MILES FROM BROAD STREET BRIDGE
SOUTH BRANCH - PAWTUXET RIVER
ELEVATION IN FEET ABOVE MEAN SEA LEVEL DATUM
GAINER DAM - SCITUATE RESERVOIR
CREST EL 284 - F.B. EL 285.5
TOE SPILLWAY EL 270±
TOE MAIN DAM EL 198
JUNCTION - SPILLWAY
CHANNEL AND RIVER
MAIN ST. BRIDGE (RTE 116)
TOP ARCH EL 198.4
COLVIN ST. BRIDGE
LOW CHORD EL 163
HILL ST. BRIDGE
LOW CHORD EL 151.3
FOOT BRIDGE - ARKWRIGHT (INTERLAKEN)
DAM - HOPE
CREST EL 197 (NET L - 138')
DAM - JACKSON
CREST EL 168.8 (NET L - 136')
DAM - FISKEVILLE
PROV. WATER SUPPLY GAS. STA.
CREST EL 149.2 (NET L - 130')
DAM - ARKWRIGHT
CREST EL 141.7 (NET L - 87')
DAM - HARRIS
CREST EL 119.7 (NET L - 135')
BROAD ST. BRIDGE
LOW CHORD EL 103.7
DISTANCE IN MILES FROM BROAD STREET BRIDGE
COVENTRY - KENT CTY
SCITUATE
CRANSTON - PROVIDENCE CTY
CRANSTON
COVENTRY
NORTH BRANCH - PAWTUXET RIVER

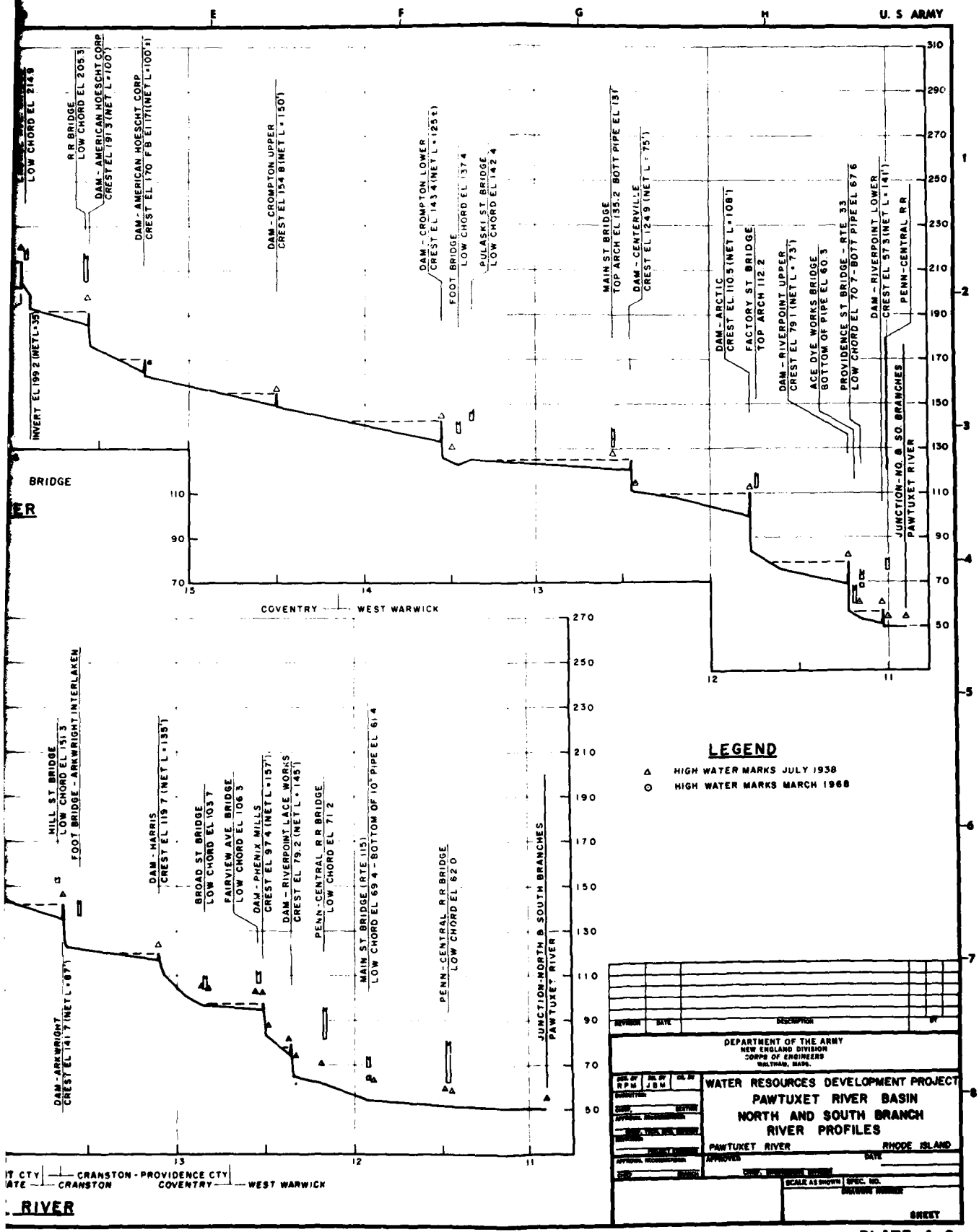
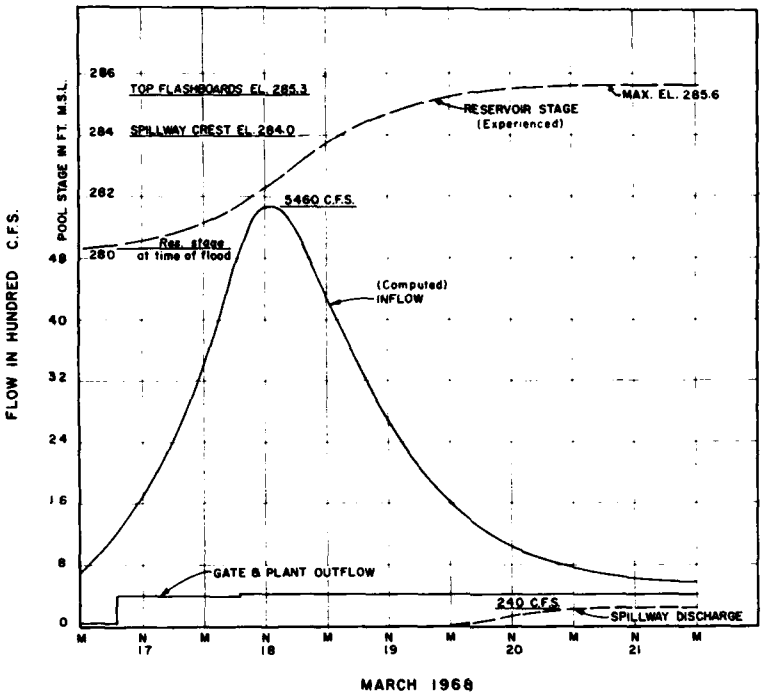
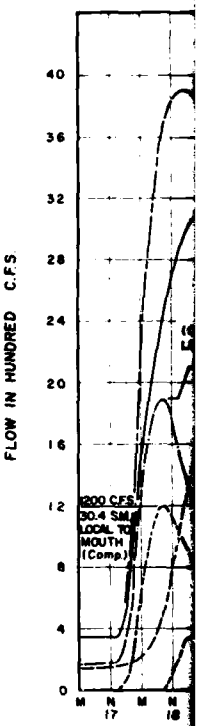

E
F
G
H
U. S ARMY
R R BRIDGE
LOW CHORD EL 205 3
DAM - AMERICAN HOESCHT CORP
CREST EL 191 3 (NET L = 100')
DAM - AMERICAN HOESCHT CORP
CREST EL 170 F B EL 171 (NET L = 100')
DAM - CROMPTON UPPER
CREST EL 154 B (NET L = 150')
DAM - CROMPTON LOWER
CREST EL 143 4 (NET L = 125')
FOOT BRIDGE
LOW CHORD EL 137 4
PULASKI ST BRIDGE
LOW CHORD EL 142 4
MAIN ST BRIDGE
TOP ARCH EL 135.2 BOTT PIPE EL 131
DAM - CENTERVILLE
CREST EL 124 9 (NET L = 75')
DAM - ARCTIC
CREST EL 110 5 (NET L = 108')
FACTORY ST BRIDGE
TOP ARCH 112 2
DAM - RIVERPOINT UPPER
CREST EL 79 1 (NET L = 73')
ACE DYE WORKS BRIDGE
BOTTOM OF PIPE EL 60 3
PROVIDENCE ST BRIDGE - RTE 33
LOW CHORD EL 70 7 - BOTT PIPE EL 67 6
DAM - RIVERPOINT LOWER
CREST EL 57 5 (NET L = 141')
PENN-CENTRAL R R
JUNCTION - NO & SO BRANCHES
PAWTUXET RIVER
INVERT EL 199 2 (NET L = 35')
BRIDGE
ER
COVENTRY
WEST WARWICK
DAM - HARRIS
CREST EL 119 7 (NET L = 135')
HILL ST BRIDGE
LOW CHORD EL 151 3
FOOT BRIDGE - ARKWRIGHT INTERLAKEN
BROAD ST BRIDGE
LOW CHORD EL 103 7
FAIRVIEW AVE BRIDGE
LOW CHORD EL 106 3
DAM - PHENIX MILLS
CREST EL 97 4 (NET L = 157')
DAM - RIVERPOINT LACE WORKS
CREST EL 79.2 (NET L = 145')
PENN - CENTRAL R R BRIDGE
LOW CHORD EL 71 2
MAIN ST BRIDGE (RTE 115)
LOW CHORD EL 69 4 - BOTTOM OF 10' PIPE EL 61 4
PENN - CENTRAL R R BRIDGE
LOW CHORD EL 62 0
JUNCTION - NORTH & SOUTH BRANCHES
PAWTUXET RIVER
DAM - ARKWRIGHT
CREST EL 141 7 (NET L = 87')
CRANSTON - PROVIDENCE CTY
CRANSTON
COVENTRY
WEST WARWICK
RIVER
LEGEND
HIGH WATER MARKS JULY 1938
HIGH WATER MARKS MARCH 1968
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.
WATER RESOURCES DEVELOPMENT PROJECT
PAWTUXET RIVER BASIN
NORTH AND SOUTH BRANCH
RIVER PROFILES
PAWTUXET RIVER
RHODE ISLAND
SCALE AS SHOWN
SHEET

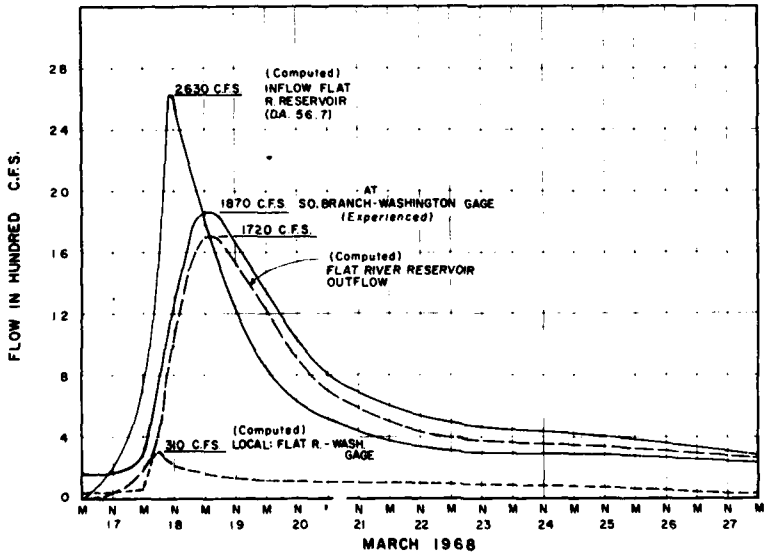
PLATE 4-3



MARCH 1968

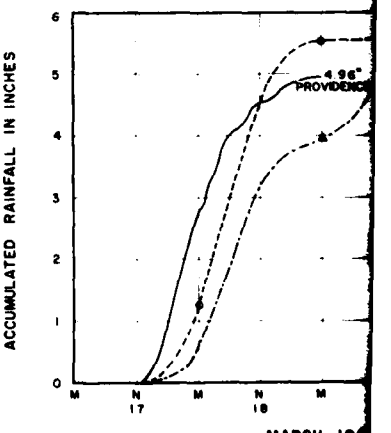
SCITUATE RESERVOIR
(DA. 92.8 Sq. Mi.)





MARCH 1968

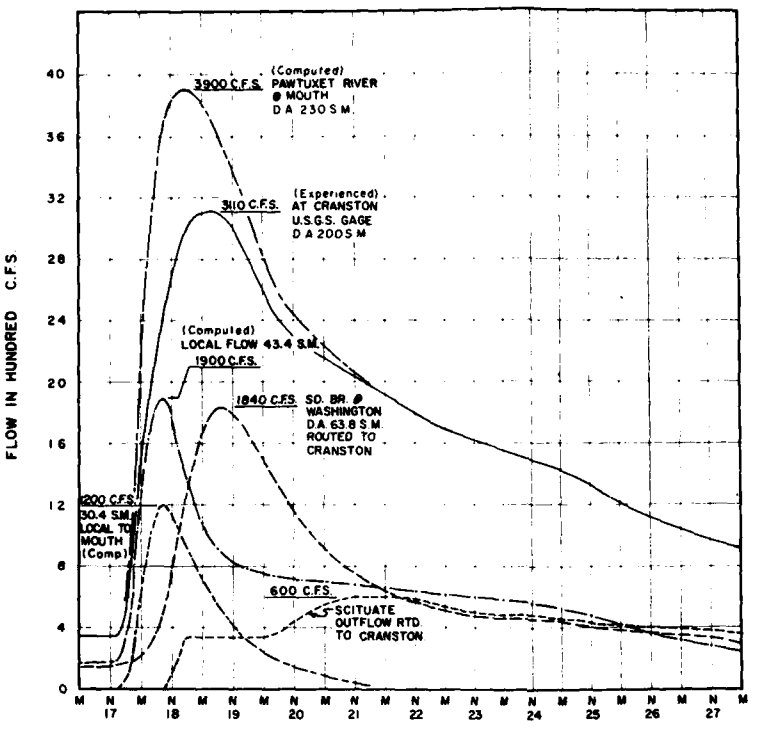
SOUTH BRANCH PAWTUXET RIVER
AT
WASHINGTON R.I. (DA 63.8 Sq. Mi.)



MARCH 19

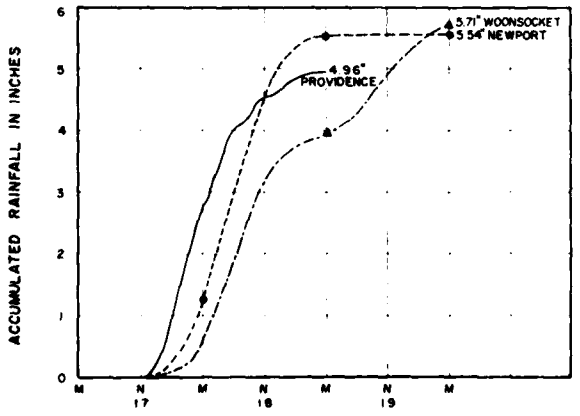
MASS. RAINFALL

(●, Δ INDICATE OBSERVED



MARCH 1968

FLOOD COMPONENTS AT CRANSTON U.S.G.S. GAGE AND AT MOUTH OF PAWTUXET RIVER



MARCH 1968

MASS RAINFALL CURVES

(●, ▲ INDICATE OBSERVED RAINFALL VALUE)

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

WATER RESOURCES DEVELOPMENT PROJECT

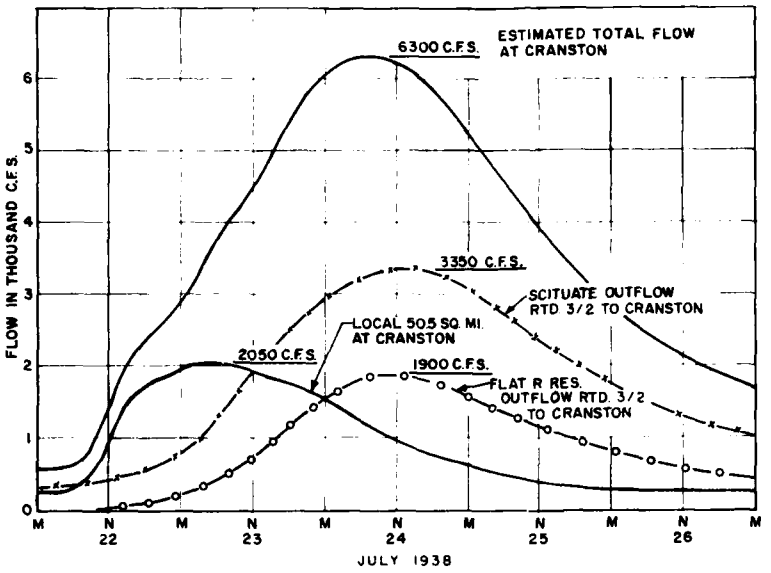
PAWTUXET RIVER BASIN
MARCH 1968 FLOOD
ANALYSIS

PAWTUXET RIVER RHODE ISLAND

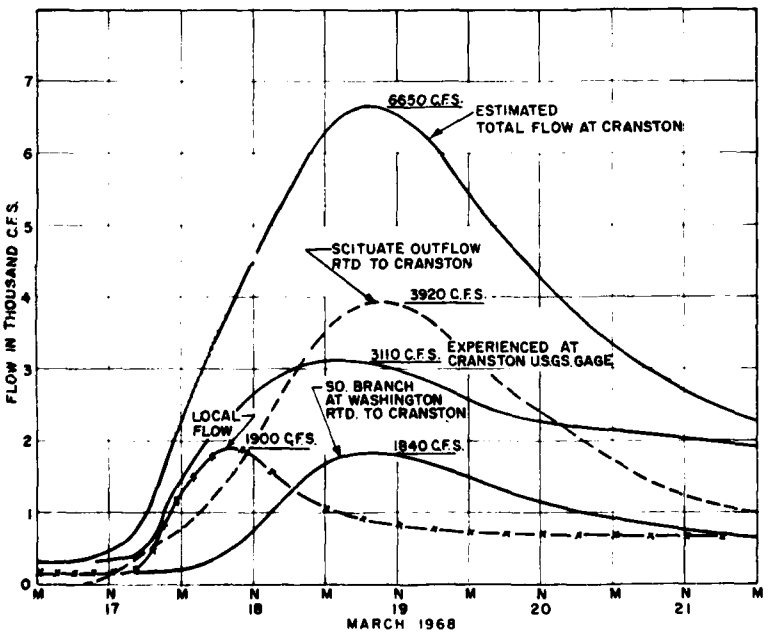
APPROVED DATE

SCALE

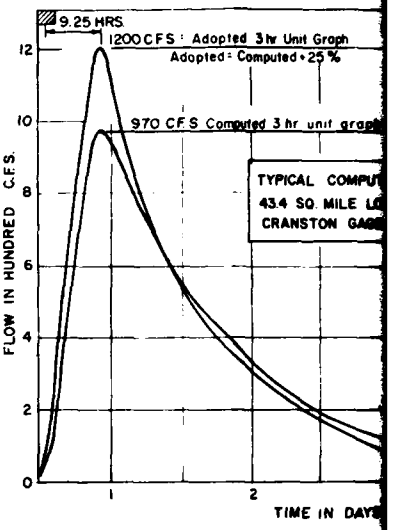
PLATE 4-4

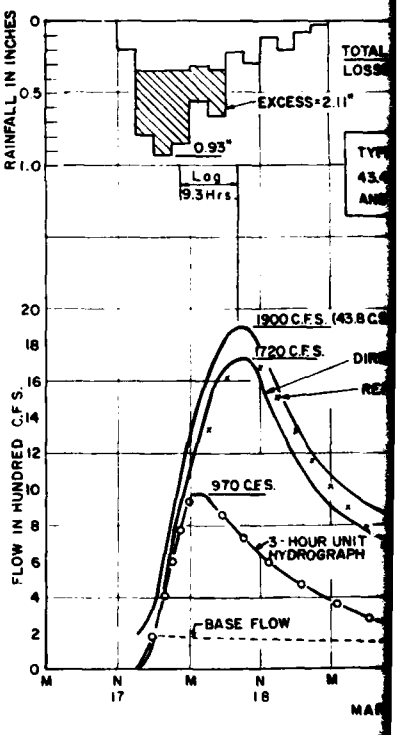


RECONSTRUCTED JULY 1938 FLOOD
AT CRANSTON R.I.

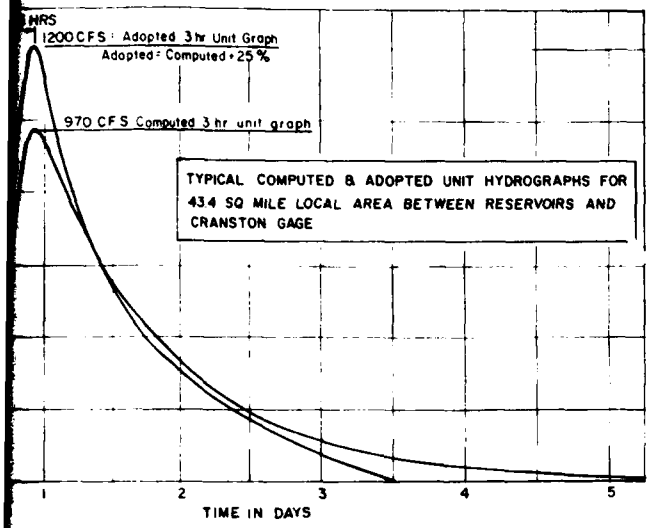


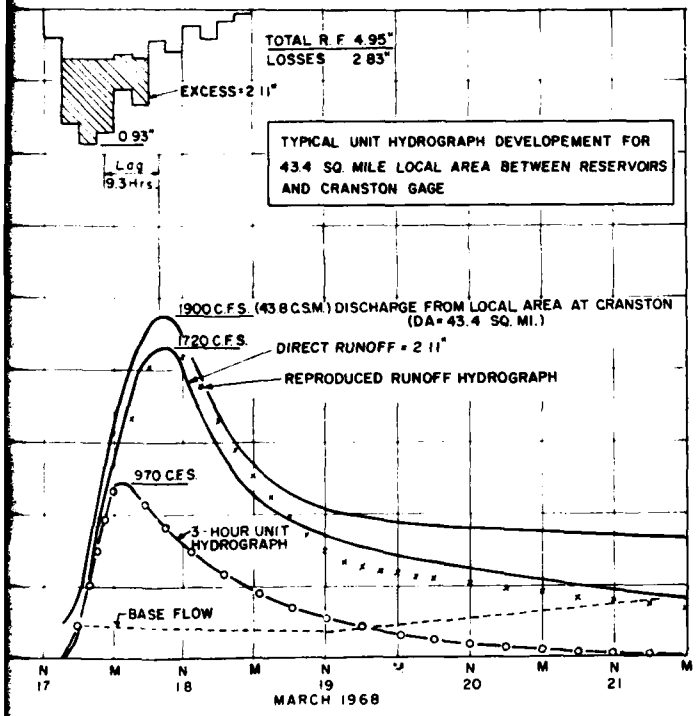
HYPOTHETICAL MARCH 1968 FLOOD
IF SCITUATE RESERVOIR WAS FULL AT START OF FLOOD





UNIT HYDR





UNIT HYDROGRAPH ANALYSIS

WATER RESOURCES DEVELOPMENT PROJECT

PAWTUXET RIVER BASIN
FLOOD COMPONENTS
AND
UNIT HYDROGRAPH
ANALYSIS

PAWTUXET RIVER RHODE ISLAND

PLATE 4-5

2

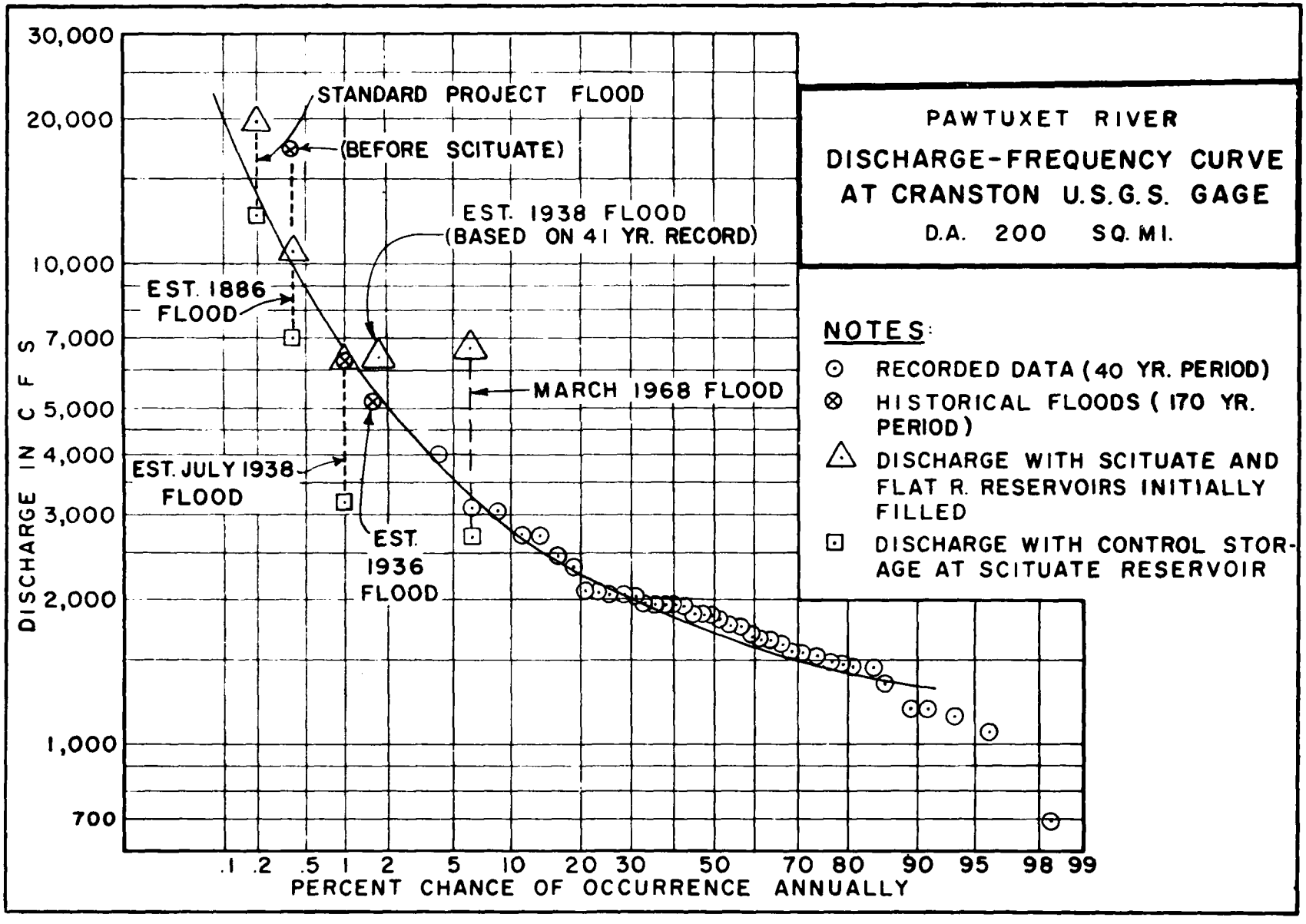
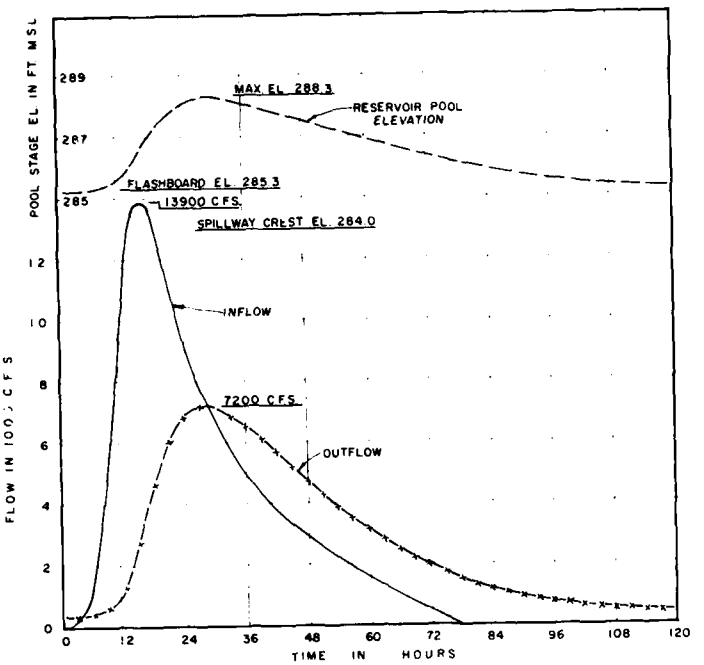
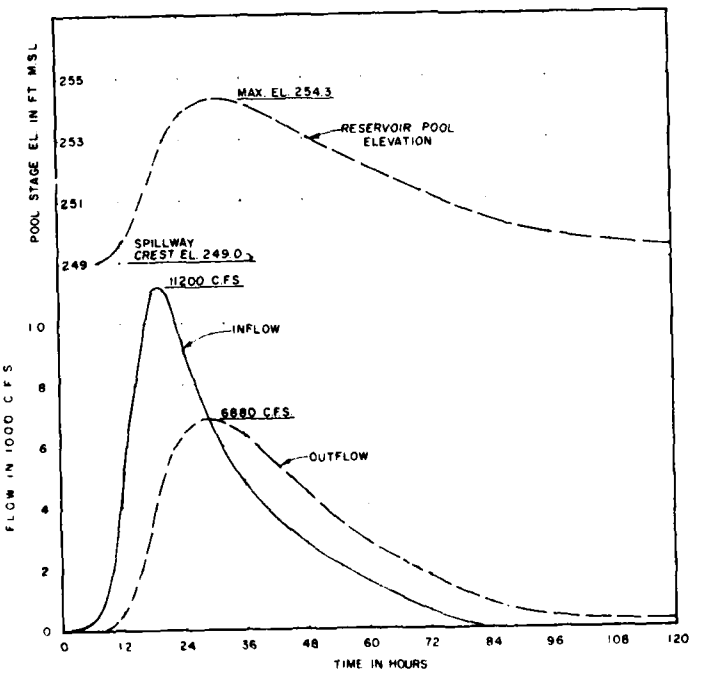

PAWTUXET RIVER
DISCHARGE-FREQUENCY CURVE
AT CRANSTON U.S.G.S. GAGE
D.A. 200 SQ. MI.
NOTES:
RECORDED DATA (40 YR. PERIOD)
HISTORICAL FLOODS (170 YR. PERIOD)
DISCHARGE WITH SCITUATE AND FLAT R. RESERVOIRS INITIALLY FILLED
DISCHARGE WITH CONTROL STORAGE AT SCITUATE RESERVOIR
STANDARD PROJECT FLOOD
(BEFORE SCITUATE)
EST. 1938 FLOOD
(BASED ON 41 YR. RECORD)
EST. 1886 FLOOD
MARCH 1968 FLOOD
EST. JULY 1938 FLOOD
EST. 1936 FLOOD
DISCHARGE IN C F S
30,000
20,000
10,000
7,000
5,000
4,000
3,000
2,000
1,000
700
.1 .2 .5 1 2 5 10 20 30 50 70 80 90 95 98 99
PERCENT CHANCE OF OCCURRENCE ANNUALLY

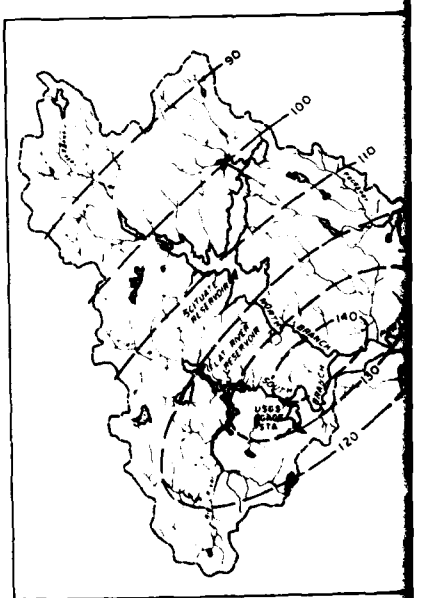
PLATE 4-6



SCITUATE RESERVOIR

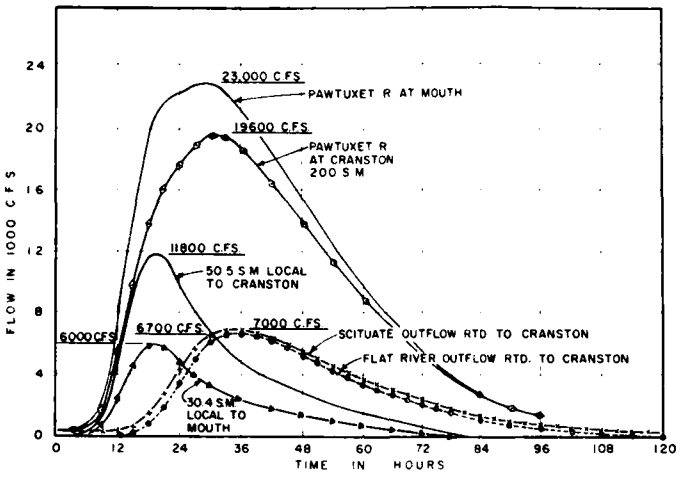


FLAT RIVER RESERVOIR

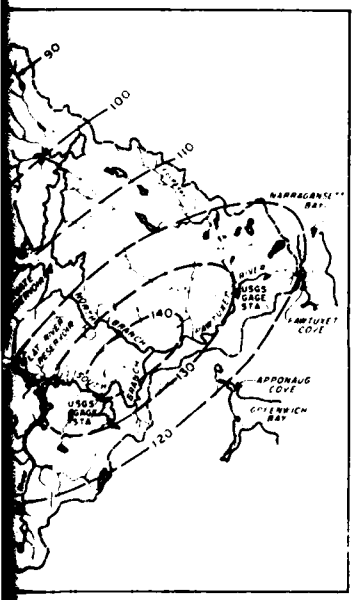


STANDARD PROJECT STORM

PATTERN IN PERCENT OF 96 HR-
SQ. MILE INDEX RAINFALL



PAWTUXET RIVER BASIN



RD PROJECT STORM
PERCENT OF 96 HR-200
LE INDEX RAINFALL

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

DES. BY | DR. BY | CK. BY

SUBMITTED

PROJECT ENGINEER

APPROVAL RECOMMENDED

CHIEF, BRANCH

WATER RESOURCES DEVELOPMENT PROJECT

PAWTUXET RIVER BASIN

STANDARD PROJECT FLOOD

PAWTUXET RIVER RHODE ISLAND

APPROVED DATE

CHIEF, ENGINEERING DIVISION

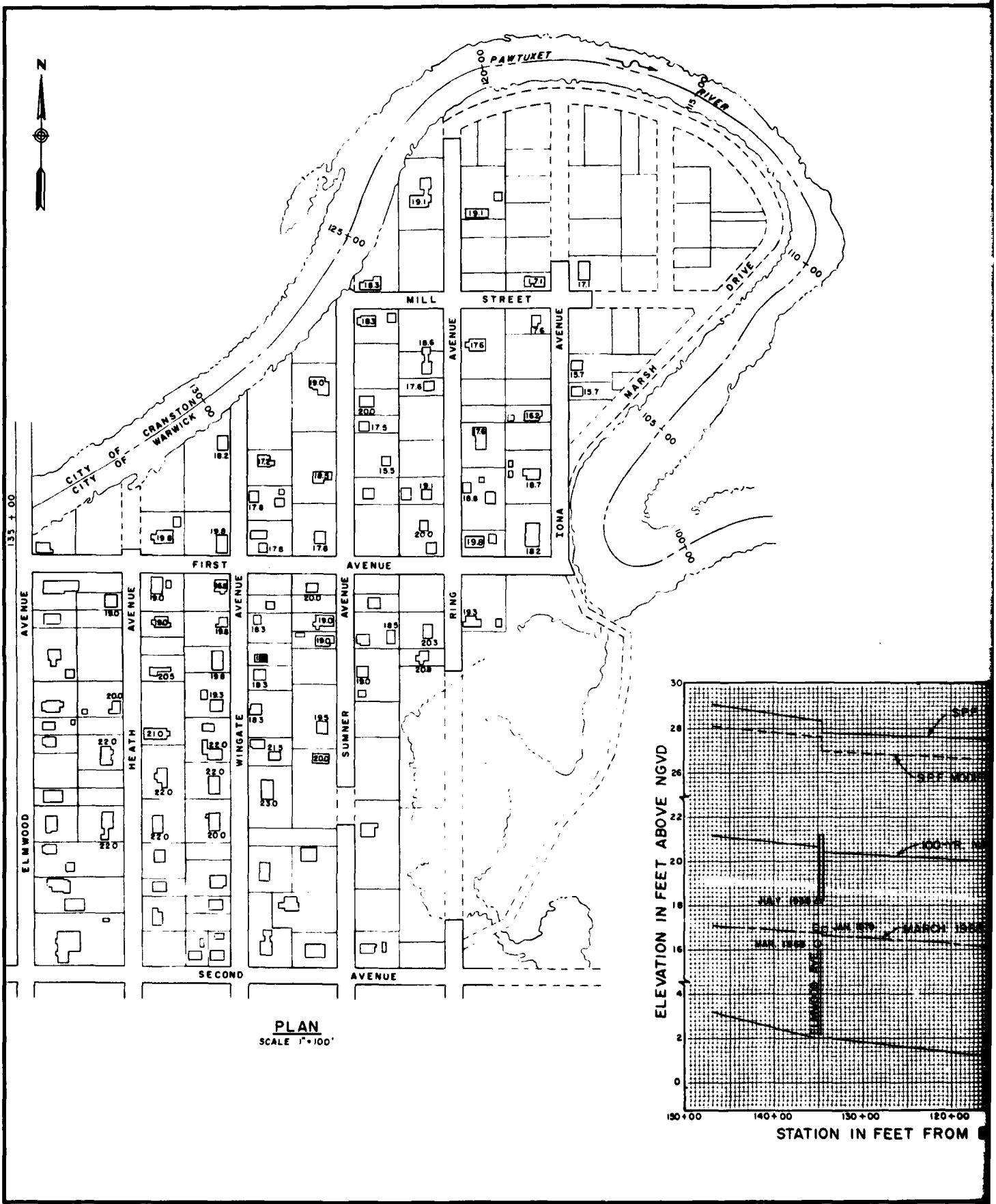
SCALE

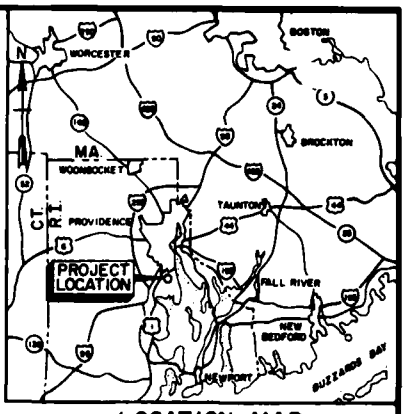
DRAWING NUMBER

SHEET

PLATE 4-7

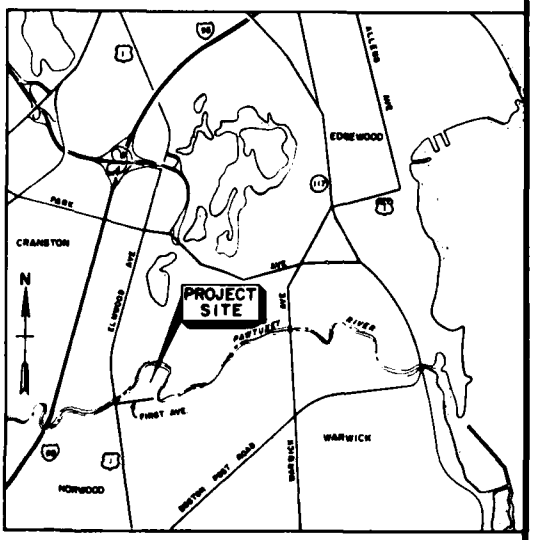
2


N
PAWTUXET
RIVER
CITY OF CRANSTON
CITY OF WARWICK
MILL
STREET
DRIVE
MARSH
FIRST
AVENUE
SECOND
AVENUE
ELMWOOD
HEATH
WINGATE
SUMNER
RING
IONA
125+00
120+00
110+00
105+00
100+00
135+00
PLAN
SCALE 1"=100'
ELEVATION IN FEET ABOVE NGVD
STATION IN FEET FROM
130+00
140+00
130+00
120+00



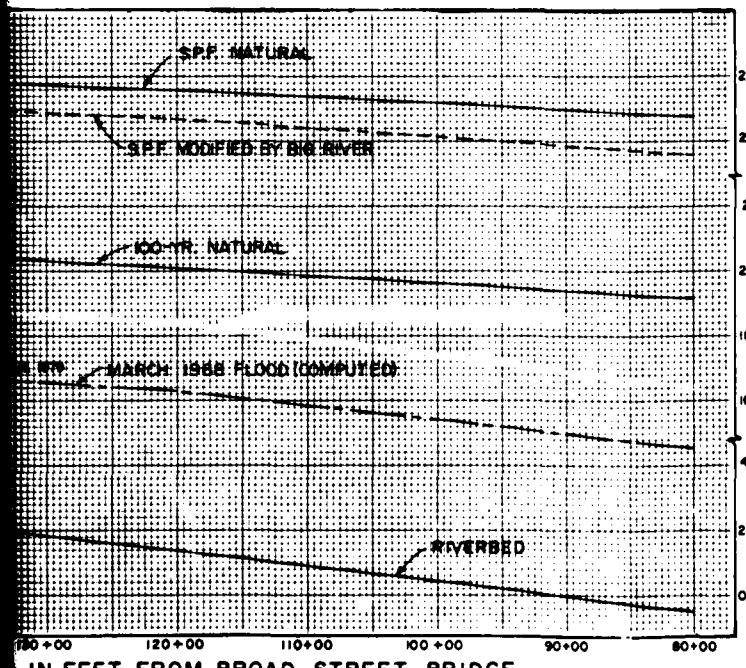
LOCATION MAP

SCALE: 1" = 10MI.



VICINITY MAP

SCALE: 1" = 2000'



IN FEET FROM BROAD STREET BRIDGE

LEGEND

185 - INDICATES FIRST FLOOR ELEVATION

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

WATER RESOURCES DEVELOPMENT PROJECT

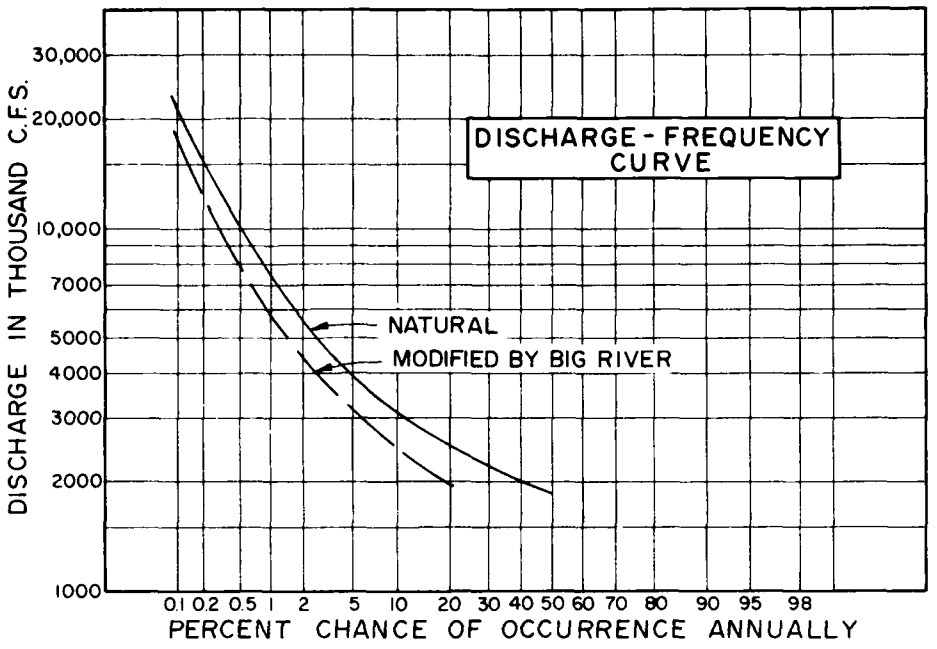
BELMONT PARK - WARWICK, R.I.

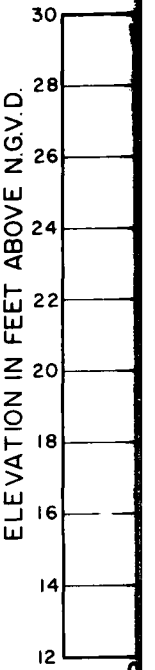
GENERAL PLAN AND PROFILE

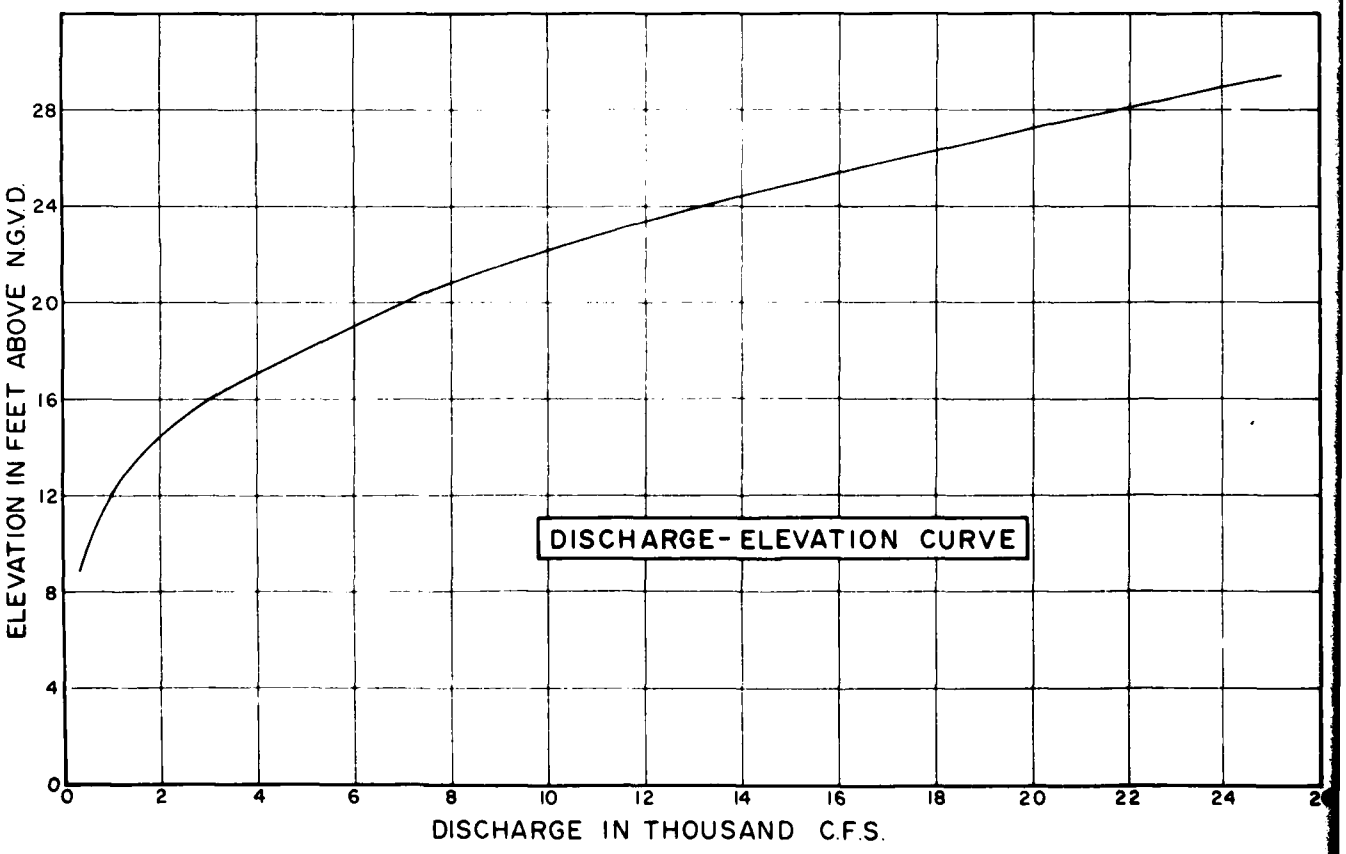
PAWTUXET RIVER — RHODE ISLAND

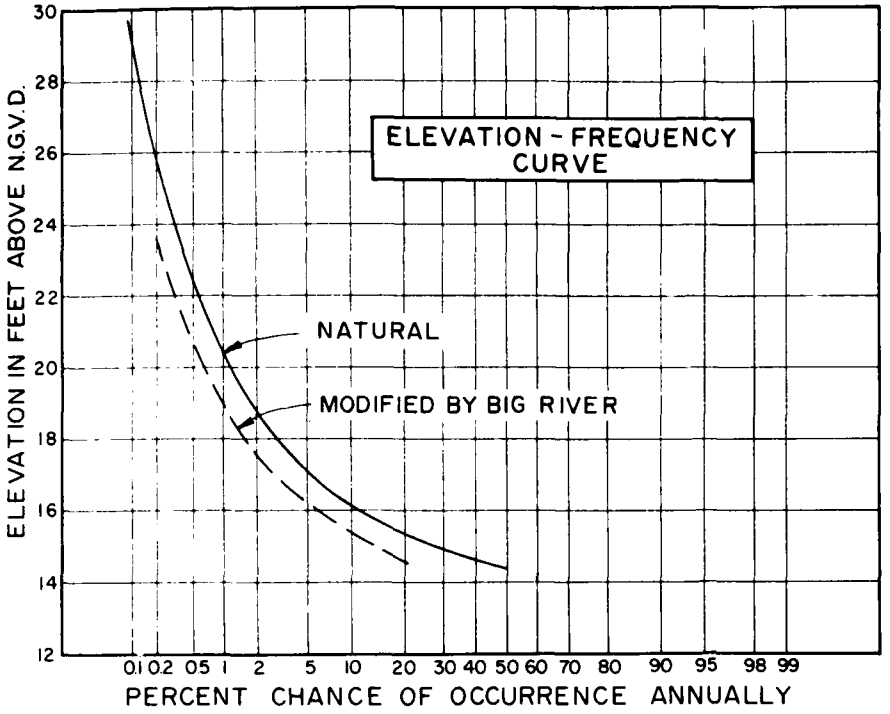
PLATE 4-8

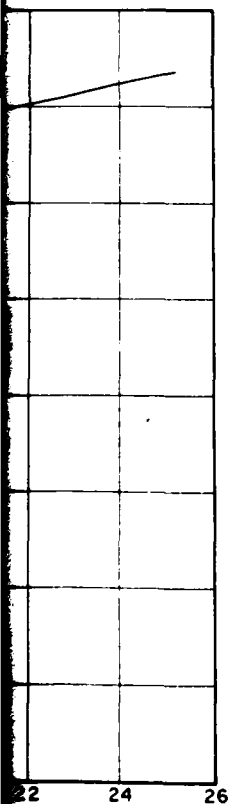
2


DISCHARGE - FREQUENCY CURVE
DISCHARGE IN THOUSAND C.F.S.
30,000
20,000
10,000
7000
5000
4000
3000
2000
1000
NATURAL
MODIFIED BY BIG RIVER
0.1 0.2 0.5 1 2 5 10 20 30 40 50 60 70 80 90 95 98
PERCENT CHANCE OF OCCURRENCE ANNUALLY


ELEVATION IN FEET ABOVE N.G.V.D.
30
28
26
24
22
20
18
16
14
12


ELEVATION IN FEET ABOVE N.G.V.D.
28
24
20
16
12
8
4
0
DISCHARGE - ELEVATION CURVE
0 2 4 6 8 10 12 14 16 18 20 22 24
DISCHARGE IN THOUSAND C.F.S.





WATER RESOURCES DEVELOPMENT PROJECT

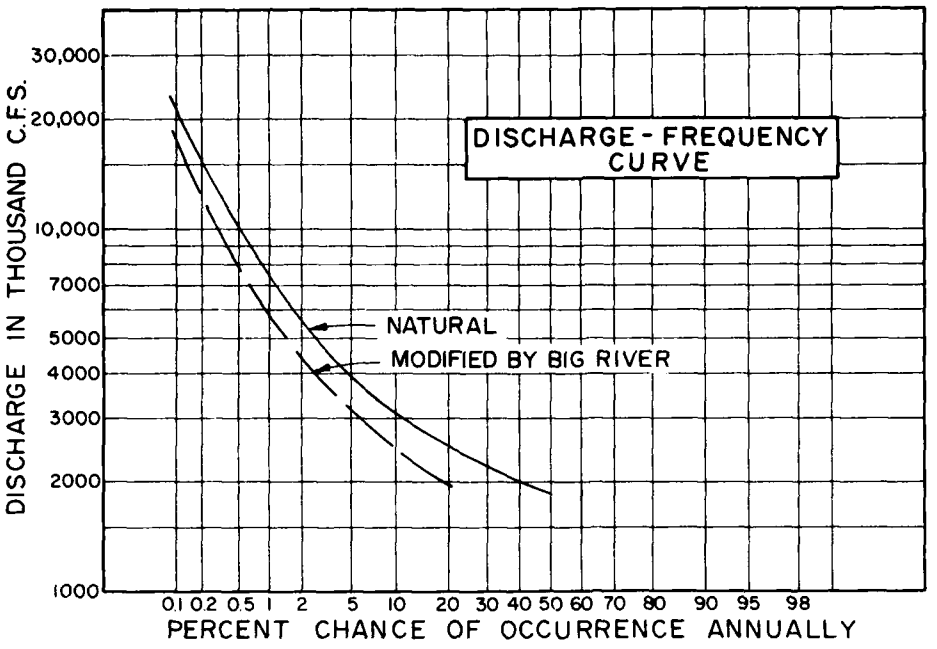
BELMONT PARK – WARWICK, R.I.

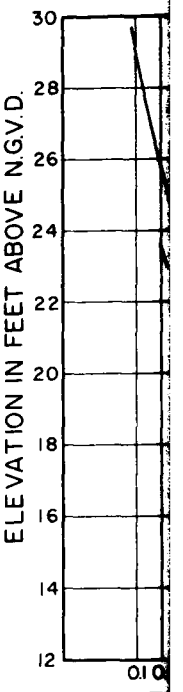
ELEVATION DISCHARGE AND FREQUENCY CURVES

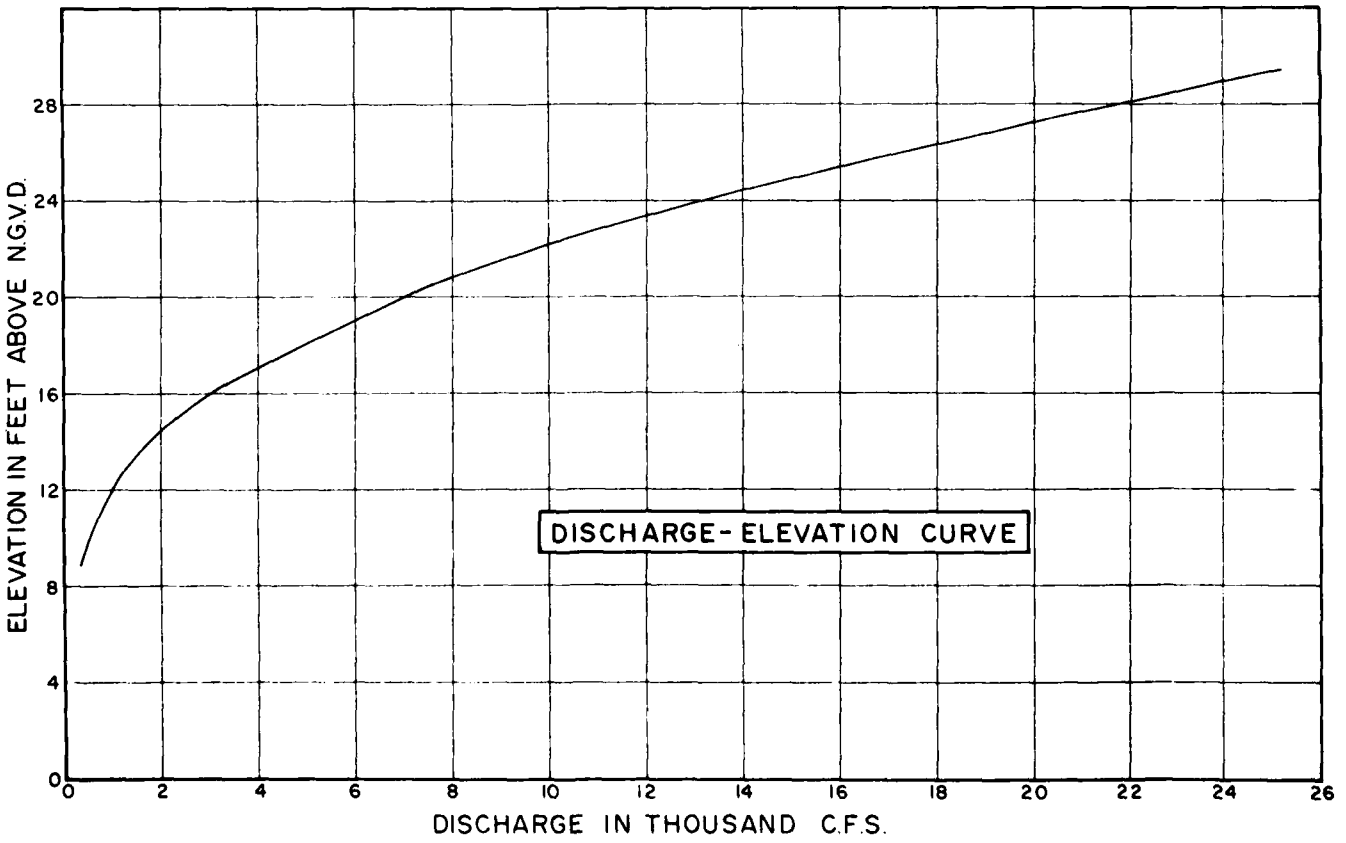
PAWTUXET RIVER RHODE ISLAND

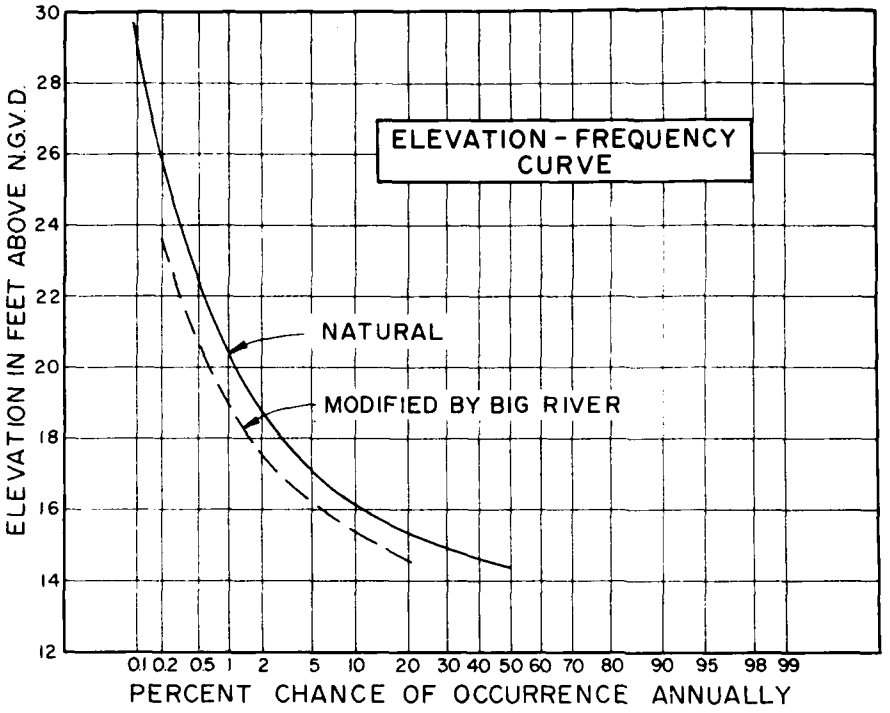
PLATE 4-9

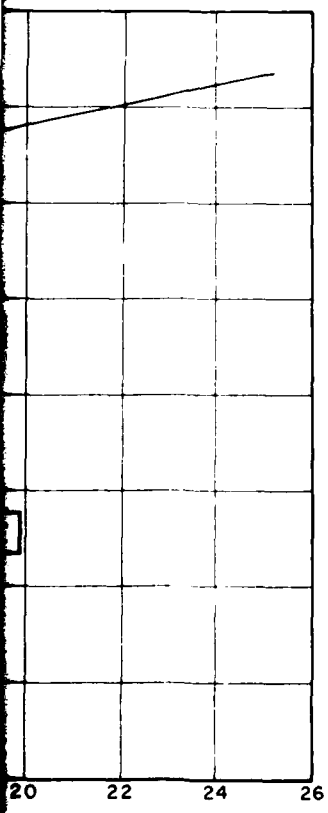
2


DISCHARGE - FREQUENCY CURVE
DISCHARGE IN THOUSAND C.F.S.
30,000
20,000
10,000
7000
5000
4000
3000
2000
1000
NATURAL
MODIFIED BY BIG RIVER
0.1 0.2 0.5 1 2 5 10 20 30 40 50 60 70 80 90 95 98
PERCENT CHANCE OF OCCURRENCE ANNUALLY


ELEVATION IN FEET ABOVE N.G.V.D.
30
28
26
24
22
20
18
16
14
12


ELEVATION IN FEET ABOVE N.G.V.D.
28
24
20
16
12
8
4
0
DISCHARGE - ELEVATION CURVE
0 2 4 6 8 10 12 14 16 18 20 22 24 26
DISCHARGE IN THOUSAND C.F.S.





WATER RESOURCES DEVELOPMENT PROJECT

BELMONT PARK – WARWICK, R.I.

ELEVATION DISCHARGE AND FREQUENCY CURVES

PAWTUXET RIVER RHODE ISLAND

PLATE 4-9

2

APPENDIX 5

ENGINEERING INVESTIGATION

TABLE OF CONTENTS

APPENDIX 5

ENGINEERING INVESTIGATION

PERTINENT DATA

I. Purpose: To provide residents of Belmont Park with protection from future flooding and the resulting economic hardships.

II. Selected Plan: Presented as Plan A-1 in the main report and involves the following:

1. the acquisition and demolition or removal of 59 homes,
2. the acquisition of 19 privately-owned vacant lots,
3. the construction of 17 utility room additions, and
4. the implementation of an automated flood forecasting system.

This appendix deals mainly with the structural aspects of Plan A-1, namely the demolition of 59 homes and the associated site work, and the construction of 17 utility room additions.

III. Design Elevation: Homes with first floors below elevation 21.4 NGVD, 1 foot above the estimated 100-year flood, would be acquired and demolished or removed. Homes within the 100-year flood plain with first floors above 21.4 NGVD, would have basement utilities relocated to a first floor utility room addition.

IV. Project Economics:

A.	Total Project First Cost	$ 3,760,000
	Annual Cost	$ 295,300
B.	Annual Benefits	$ 401,700
C.	Benefit-to-Cost Ratio $\frac{\$401,700}{\$295,300}$ =	1.4 to 1

LOCAL COOPERATION

Following the review and approval of this report by the Office of the Chief of Engineers, a formal document would be required from the city of Warwick reaffirming their intent to support this plan and fulfill the requirements of local cooperation.

HYDROLOGY

Belmont Park is located on the right bank of the Pawtuxet River about 2.5 miles upstream from its mouth. Located 2 miles upstream of Belmont Park, in Cranston, Rhode Island, is a stream gage that has been operated and maintained by the USGS since 1940. Information gathered at this gage was used in the hydrologic analysis of the Pawtuxet River.

A stage frequency curve of the Pawtuxet River at Belmont Park was developed to determine what water levels would be reached during various flooding events. This curve is shown on Plate 4-9 of Appendix 4 (Hydrology). From this curve it was estimated that the 100-year flood would reach an elevation of 20.4 feet NGVD at Belmont Park.

	Belmont Park, Warwick, RI	River Gage, Cranston, RI
Drainage Area	224 square miles	200 square miles
January 1979 Flood	17.0 ft. NGVD	4,000 cfs
20-year	17.2 ft. NGVD	4,000 cfs
50-year	18.8 ft. NGVD	6,000 cfs
100-year	20.4 ft. NGVD	7,500 cfs
SPF	27.0 ft. NGVD	19,600 cfs

GEOTECHNICAL CONDITIONS

I. Surficial Geology: Glacial deposits occur throughout the basin. They vary from shallow thickness at higher elevations on the sides and tops of hills, to considerable greater thickness in the valleys and at lower elevations. These deposits are essentially mixtures of sand, silt, gravel, and boulders. Moderately extensive swamps contain soft organic silt and peat.

The overburden in the vicinity of the study area is primarily of glacial origin. Till, an unsorted mixture of clay, silt, sand, gravel, and boulders is common, as are stratified, fluvio-glacial deposits of sand and gravel. Lowlying areas are characterized by recent marsh deposits of peat and organic silt. Recent stream deposits of silt, sand, and gravel are gound along streams and rivers and in flood plains. Artificial fill is found in developed areas.

II. Bedrock Geology: The bedrock of the Pawtuxet River Basin includes metamorphic igneous, and sedimentary types. In the study are it is primarily a sedimentary and metasedimentary sequence of sandstone, graywacke, shale, and conglomerate with some anthracite and schist. Granite is abundant to the west and is locally present in the study area.

OTHER PLANS INVESTIGATED

Twelve plans were initially evaluated to provide flood protection for Belmont Park. Basically, two measures were examined; acquisition and acquisition in combination with floodproofing. However, by varying the level of protection for 20, 50, and 100-year flood events and considering these proposals both with and without the implementation of flood control storage at the Big River Reservoir, investigations resulted in the evaluation of 12 plans. This first iteration of basic options indicated that

only four plans required further detailed study. This was due to the fact that construction of the Big River Reservoir is questionable. In addition the 20-year flood plans do not provide an adequate level of protection and were considered to be unacceptable by residents of Belmont Park.

Further evaluation of the four plans, A-1, A-2, B-1 and B-2 determined that Plan A-1 maximized net benefits and was preferred by local interests. It was therefore chosen as the selected plan.

DESCRIPTION OF PROPOSED IMPROVEMENTS

I. General: To determine the extent of flooding expected during the 100-year event (El. 20.4 NGVD), the limit of the flood plain was established, based on available topographic information, and is shown on Plate 3. Those structures which fell either partially or totally within the flood plain were evaluated for flood damage reduction measures. The controlling first floor elevation for real estate acquisition was determined to be El. 21.4, or one foot above the 100-year event. All structures with first floor elevations below El. 21.4 would at least experience permanent structural damage to floor joists during a 100-year event.

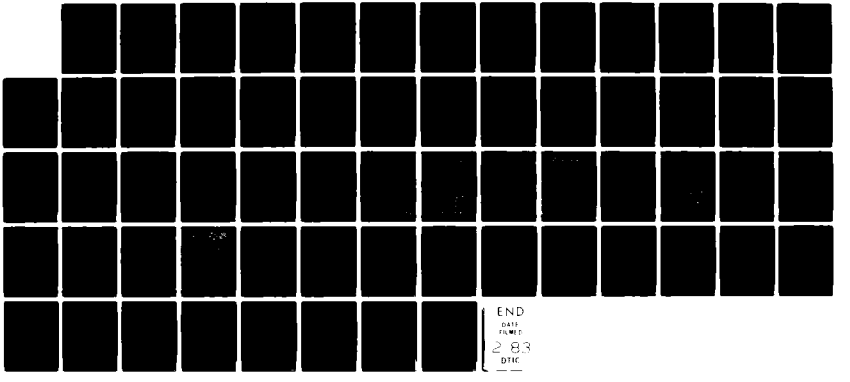
The field study determined the type, size, structural composition, first floor elevation, and condition of each structure. Structures within the study area are primarily single-family, wood-frame residences with concrete block foundations and full basements. A variety of housing styles are present including, capes, ranches and cottages. The average residence has 800 s.f. of first floor area and is situated on a 9,000 s.f. lot. Less than one-half of the structures have garages. Most of the residences exceed 25 years in age. The condition of the homes vary from poor to good with the majority falling in the fair range. Many of the homes have been expanded over the years by means of dormers and additions. In addition to telephone and electrical services, residents of the area are provided with public water for both fire protection and domestic use. There is no public sewer or gas service and most homes, if not all, are heated by oil.

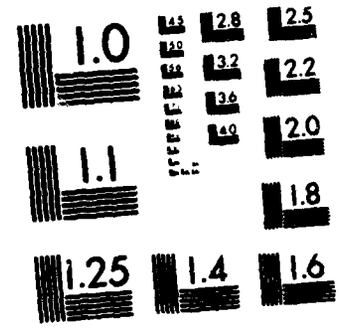
Using the controlling eevation of 21.4 NGVD, 59 structures would be acquired and demolished or relocated and their sites reclaimed (see Plate 5-1). An additional 17 homes, which would experience various levels of basement flooding only, during the 100-year flood, would be equipped with first floor utility room additions.

II. Demolition and Site Reclamation: Site work associated with demolition of structures, includes; removal of debris, backfilling the foundation and septic tank, removing and disposing of walks and driveways, terminating utilities, and topsoiling and seeding of disturbed areas. All site work shall conform to the following design criteria:

AD-A122 646 PAWTUXET RIVER WARWICK RHODE ISLAND LOCAL-FLOOD DAMAGE REDUCTION STUDY DE..(U) CORPS OF ENGINEERS WALTHAM MA NEW ENGLAND DIV JUN 82 3/3

UNCLASSIFIED F/G 13/2 NL





A. Structures to be demolished shall include houses, garages and sheds.

B. All demolition debris, except for broken concrete or concrete block, shall be removed from the site.

C. Concrete and masonry foundation walls shall be demolished to three feet below existing grade. Concrete and masonry blocks may remain if broken into the basement, but shall be at least two feet below grade after backfilling.

D. All trees and bushes which do not impede demolition of structures and termination of utilities shall remain in place.

E. Water lines are to remain in place and shall be plugged and capped at designated locations (See Plate 5-2). Electrical poles, telephone service and fire hydrants shall be removed.

F. Existing roads, catch basins, manholes and storm drains are to remain in place.

G. Basements and septic tanks shall be backfilled with gravel.

H. All disturbed areas shall be topsoiled (6") and seeded.

III. Utility Room Additions: For those structures which would experience basement flooding only, during the 100-year flood, basement utilities would be relocated to an 8-foot by 12-foot first floor utility room addition. Utilities to be raised include furnaces, electric switch boxes, electric meters and water tanks. Space would lso be made available for relocating a washer and dryer. The exterior of the addition would be architecturally treated to blend with the existing structure. When relocating utilities, it was assumed that:

A. There was no unused interior space (above the flood elevation) to relocate utilities.

B. All utilites could be moved.

C. The utility room addition would be in compliance with the local zoning code, and consideration should be given to the comfort, maintenance and fuel cost advantages of replacing the old systems with newer, energy efficient systems.

D. The work would be performed so as to minimize the interruption of service, and that temporary relocation of residents would not be required.

E. Construction of the first floor room addition and relocation of the utilities shall be done in accordance with the following design criteria:

(1) A minimum clearance of one foot is to be provided between the bottom of the utilities and the 100-year flood elevation.

(2) Shut-offs for water and electricity are to be placed in an accessible interior location above the flood level.

(3) All work shall conform to State building code requirements, especially with regard to fire rating and ventilation provisions.

(4) Relocation of water and electric meters shall be coordinated with respective utility companies.

F. Because the vacated area would be allowed to flood, several steps must be taken to reduce potential damage:

(1) All electric circuits serving basement outlets are to be wired separately so that they may be disconnected during flooding.

(2) Fuel tanks are to be secured to prevent floatation.

(3) Sanitary sewer pipe is to be provided with a check valve to prevent backflow.

(4) Floor drains are to be installed to facilitate removal of receding flood waters.

(5) All basement windows and doors are to be kept as openings so that water pressure inside and out will be equalized.

CONSTRUCTION PROCEDURE

I. Demolition: Before structures could be demolished, homes would be acquired and residents relocated. Utilities would then be terminated and structures would be demolished. Debris would then be removed and site work performed to restore the area to its natural condition.

II. Utility Room Additions: To avoid displacement of residents while additions are being added, utility rooms would be constructed and new utilities readied for installation before existing utilities are disconnected. This would minimize the length of time residents are without utilities and allow residents to remain in their homes while this work is performed.

CONSTRUCTION MATERIAL

An estimated 10,000 cubic yards of sand and gravel would be required to fill the basements of demolished homes. This material can be obtained from commercial supplers within a 20 mile radius of the project site.

All materials required to construct utility room additions are available locally.

ACCESS ROADS

Existing roads will be utilized and no improvements are required.

REAL ESTATE REQUIREMENTS

All lands required for project implementation would be acquired by the city of Warwick. A complete presentation of real estate requirements is contained in Appendix 7.

COST ESTIMATE

I. Acquisition: Site work costs associated with the demolition of 59 homes and site reclamation are presented in Table 5-1. For cost estimating purposes, it was assumed that all work would be let out as a single contract, to be performed within a single construction season. In addition, no salvage value was included. First costs are based on typical values from the Robert Snow Means Company, Inc., 1981 Building Construction Cost Data publication, including 20 percent for contingencies. The cost of removing driveway pavement and to loam and seed these areas was included under contingencies. The dump charge, if any, was not included in the cost estimate.

TABLE 5-1

SITE WORK

Item	Quantity	Unit	Unit Price	Cost
Termination of Utilities				
Remove hydrants, plug and cap existing water lines.	1 Job	L.S.		$ 1,000
Remove telephone and electrical service and fire alarm box	1 Job	L.S.		11,000
Building Demolition/Disposal				
Houses, garages and sheds	726,000	C.F.	@ $0.14	101,640
Foundations	153,000	C.F.	@ 0.18	27,540
Backfill Basements	10,000	C.Y.	@ 4.00	40,000
Sewage Systems				
Excavation	130	C.Y.	@ 7.00	900
Pumping	59	Tanks	100. ea	5,900
Filling	1,500	C.Y.	10. ea	15,000
Topsoil & Seeding	5,00	S.Y.	4.50	22,500
			Subtotal	$225,480
			Contingencies (20%+)	45,520
			CONSTRUCTION COST	$271,000

II. Utility Room Additions: The following table presents a cost estimate for the proposed utility room additions.

TABLE 5-2

UTILITY ROOM ADDITIONS

Item	Quantity	Unit	Unit Price	Cost
Excavation and Backfill Foundation Superstructure, framing, siding and roofing Doors, windows, gutters and painting Electrical Work Landscaping	96	S.F.	$40	$3,840
Relocation of Equipment	1	Job	L.S.	1,000
Install Basement Floor Drain	1	Ea	100	100
Install Sewer Check Valve	1	Ea	500	500
Anchor Fuel Tank	1	Job	L.S.	600
Install Booster Pump Motor and Supply Tank	1	Job	L.S.	500
			Subtotal	$6,640
			Contingencies (20%)	1,360
			CONSTRUCTION COST	$8,000

Total Construction Cost - 17 Utility room additions @ $8,000 = $136,000

SCHEDULES FOR DESIGN AND CONSTRUCTION

Work on plans and specifications is tentatively scheduled to begin in September of 1982 with construction occurring in the 1983 season. It is estimated that this plan can be implemented in one season, however, local officials may elect to spread the work over 3 years. The construction of the project is planned to be by contract.

OPERATIONS AND MAINTENANCE

The city of Warwick currently operates and maintains water lines and public ways in the Belmont Park area. After Plan A-1 is completed, the city's cost to operate and maintain these services would be reduced as several public roads would be abandoned and approximately 2,000 linear feet of water line terminated.

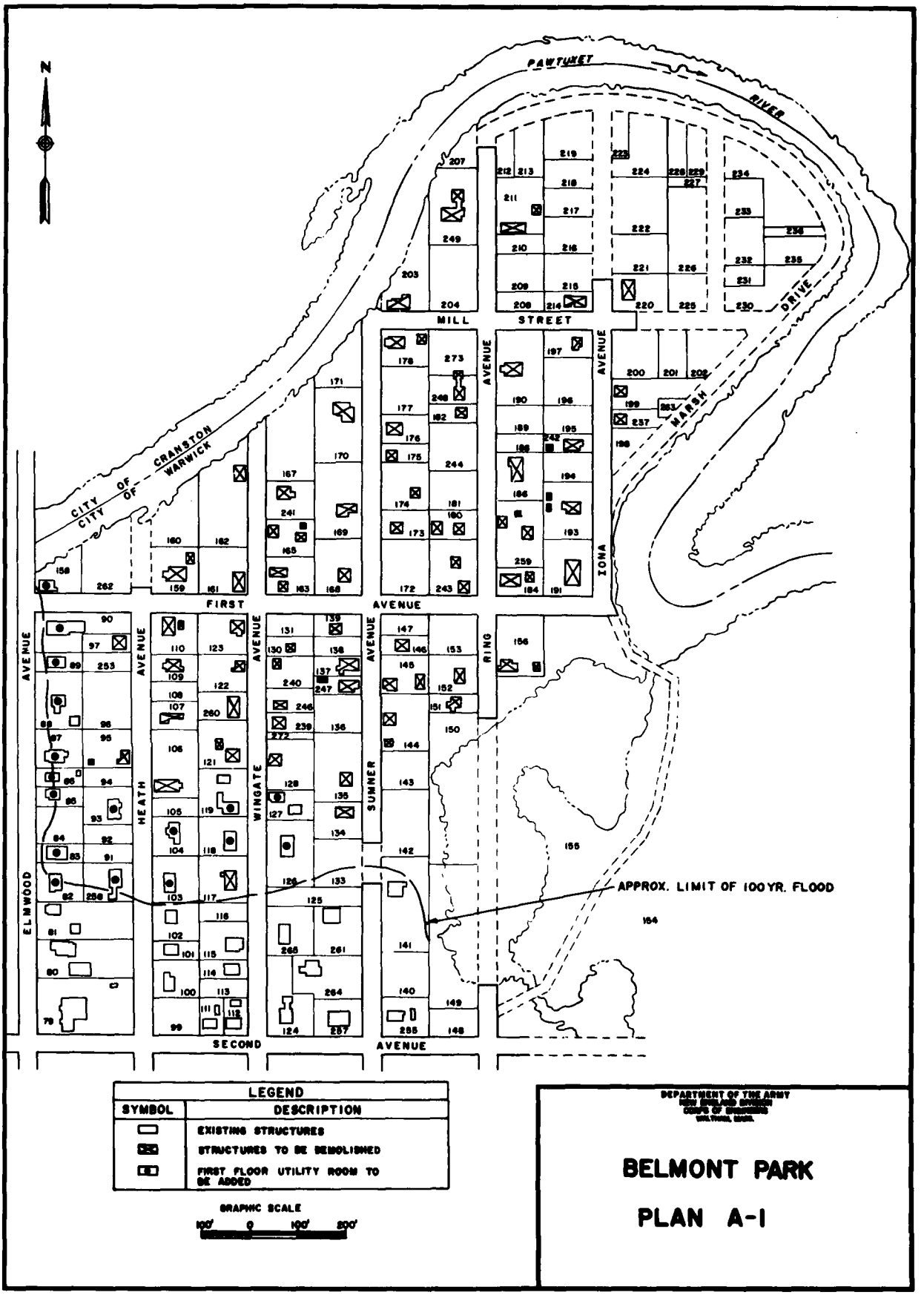
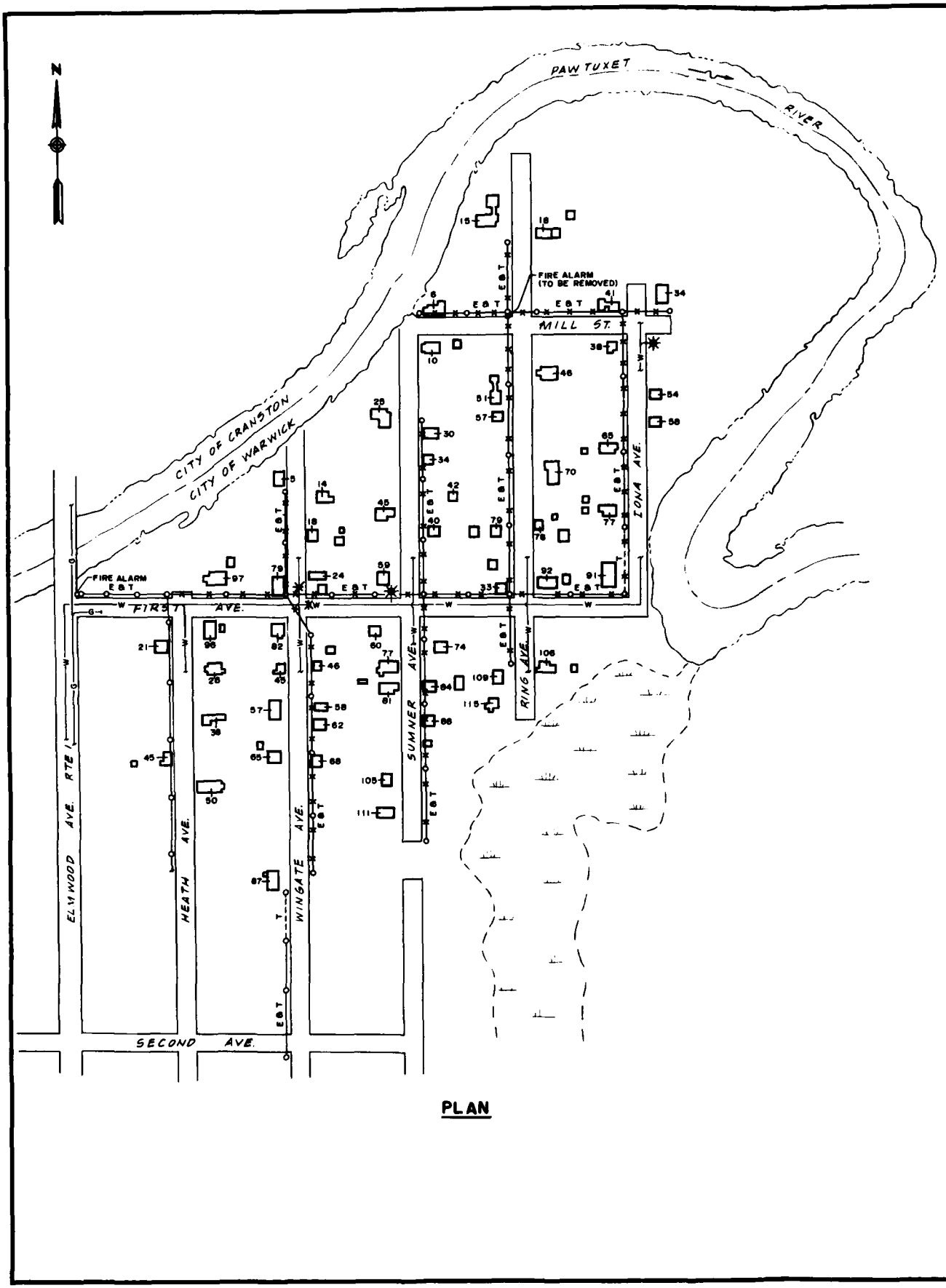

N
PAWTUXET
RIVER
CITY OF CRANSTON
CITY OF WARWICK
MILL
STREET
DRIVE
MARSH
AVENUE
FIRST
SECOND
ELMWOOD
HEATH
WINGATE
SUMMER
RING
IONA
APPROX. LIMIT OF 100YR. FLOOD
LEGEND
SYMBOL
DESCRIPTION
EXISTING STRUCTURES
STRUCTURES TO BE DEMOLISHED
FIRST FLOOR UTILITY ROOM TO BE ADDED
GRAPHIC SCALE
100' 0 100' 200'
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.
BELMONT PARK
PLAN A-1

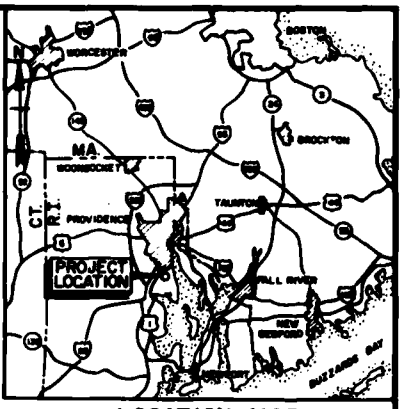
PLATE 5-1


N
PAWTUXET
RIVER
CITY OF CRANSTON
CITY OF WARWICK
FIRE ALARM
(TO BE REMOVED)
MILL ST.
FIRST AVE.
SECOND AVE.
ELMWOOD AVE. RTE 1
HEATH AVE.
WINGATE AVE.
SUMNER AVE.
RING AVE.
IONA AVE.
E & T
W
G

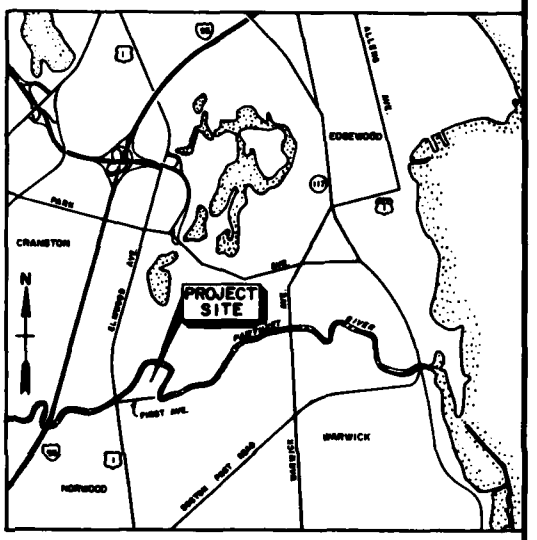
PLAN

LEGEND

SYMBOL	DESCRIPTION
▭	STRUCTURES TO BE DEMOLISHED AND DEBRIS REMOVED
E & T	ELECTRICAL, TELEPHONE SERVICES, TO REMAIN
E & T	ELECTRICAL, TELEPHONE SERVICES AND POLES TO BE REMOVED
T	TELEPHONE SERVICES TO REMAIN
T	TELEPHONE SERVICES TO BE REMOVED
✱	FIRE HYDRANTS TO BE REMOVED
—W—	WATER LINES TO BE PLUGGED AND CAPPED
—G—	GAS LINE TO REMAIN
— 45	HOUSE NUMBERS



LOCATION MAP



VICINITY MAP

NOTES.

1. Houses are the structures with number designations. Garages and/or sheds comprise the remainder of the structures.
2. Catch basins, manholes and storm drains at the intersections of Heath Ave., Wingate Ave. and Summer Ave. with First Ave. are to remain in place. Catch basins, storm drains and headwall at Mill Street and Ring Avenue are to remain in place.
3. Water lines are to remain and shall be plugged and capped at designated locations.
4. Existing roads are to remain in place.
5. Concrete or masonry foundation walls shall be demolished to 3' below the grade. Debris may remain if broken into the basement. Debris should be at least 2' below grade after backfilling.
6. All demolition debris, except for broken concrete or concrete block, shall be removed from site.
7. All trees and bushes, which do not impede demolition of structures and termination of utilities, shall remain in place
8. All disturbed areas (backfilled basements) shall be topsoiled (6") and seeded.

GRAPHIC SCALE
100' 0 100' 200'

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

WATER RESOURCES MANAGEMENT REPORT
PAWTUXET RIVER BASIN

BELMONT PARK
STRUCTURE DEMOLITION AND UTILITIES TERMINATION

SITE PLAN

WARWICK, RHODE ISLAND AUGUST 1981

PLATE 5-2

2

APPENDIX 6

ECONOMIC ANALYSIS

List of Tables

APPENDIX 6

ECONOMIC ANALYSIS

Introduction

The purpose of this section is threefold. The first is a presentation and measurement of the beneficial contributions to national economic development (NED) which are associated with the twelve nonstructural flood damage reduction plans for the Belmont Park section of Warwick, Rhode Island. Explanatory rational and supporting calculations accompany the presentation. Secondly, each plan's measure of economic justification will be determined through the calculation of its benefit/cost ratio. The estimate of total average annual benefits that would be realized over the plan's economic life is compared to the annual charges of the plan's cost. A benefit/cost ratio of 1.0 or greater is necessary for Federal participation in water resources projects. Project costs and benefits are referenced to a common time basis. The values given to benefits and costs at their time of accrual are made comparable, timewise, by conversion to an equivalent basis using the appropriate interest rate. During fiscal year 1982, the rate of 7-5/8 percent is employed in the formulation and evaluation of Federal water resource plans and projects. All dollar values in this appendix are expressed at January 1982 price level. Thirdly, net benefits (i.e. benefits minus costs) will be calculated for each plan in an effort to ascertain the plan that maximizes net benefits and therefore allocates resources in the most efficient manner and provides the greatest beneficial effects and return on public investment.

Reference documents used in the benefit estimation process were: (1) Water Resources Council, Procedures for Evaluation of National Economic Development Benefits and Costs in Water Resources Planning (Level C), Subpart G - NED Benefit Evaluation Procedures: Urban Flood Damage, December, 1979, and (2) National Economic Development Benefits for Nonstructural Measures, U. S. Army Corps of Engineers, The Hydrologic Engineering Center, October, 1980.

The Belmont Park area of Warwick, Rhode Island, has a history of flooding with the most notable events having occurred in the years 1968, 1978 and 1979. A structural plan consisting of walls and levees has been previously formulated and is presented as the Elmwood Avenue Local Protection Project in the following report: Pawcatuck River and Narragansett Bay Drainage Basins Water and Related Land Resources Study, Big River Reservoir Project, Volume IV, Attachment 1, Interim Report, Pawtuxet River Watershed, Rhode Island. The structural plan was not economically justified and would still have required relocation of 8 to 10 homes.

Extent and Character of Study Area

The Belmont Park study area is a 38 acre peninsula in the Norwood section of Warwick, Rhode Island. The area is bounded by the Pawtuxet River on the west, north and east. The southern boundary is determined by the limit of the 100-year flood plain. Land use in the area is predominantly residential. In the study area, which is basically the 100-year flood plain, are located 76 structures. Over 90 percent of the dwellings are single family homes with the remainder being two family or commercial structures. The houses are situated on lots which range in size from 4,000 sq. ft. to 20,000 sq. ft. with the average being 8,835 sq. ft. or one-fifth of an acre. In addition there are 54 vacant lots, of which 21 are city-owned and 33 are privately-owned. Nearly all of the city-owned lots are located on the tip of the peninsula and have never been developed. Fourteen of the 33 privately-owned lots are continguous to a developed property and under the same individual ownership. For the most part, the homes are well maintained and there is evidence of some recent improvements. Some home owners are repaying loans necessitated by needed repairs due to flood damage from the 1978 and 1979 events. In the social sphere, the neighborhood appears to be fairly close-knit.

Value of Structures in Study Area

Based on the examination of recent sales of comparable homes in areas near Belmont Park by New England Division Real Estate personnel, preliminary indications are that the value of the individual homes in Belmont Park range from $20,000 to $40,000.

Damage Surveys

As part of the Pawcatuck River and Narragansett Bay Drainage (PNB) study, a flood damage survey was performed during 1971 and referenced to the elevation of the 1968 event. This survey was updated periodically as the study progressed until 1979 when an entirely new damage survey was undertaken immediately after the occurrence of the 1979 flood. Damage evaluators from the New England Division conducted a property-by-property canvass, thoroughly inspecting each structure and site and interviewing available property owners. The following information was gathered: the level of water inside the structure and at the site, entry points of the water, experienced financial losses based on structural and contents damages, emergency expenses for shelter and subsistence, existence of flood insurance and loans and a perspective on historical flooding. Also obtained in the damage survey process was the elevation or stage at which damage begins for each property. Estimates of potential damages were then made from this starting point, in 1 foot increments of stage, to a level 3 feet above the elevation of the 1979 flood crest. Dollar values estimates were made for physical damages to site, structures, contents and utilities. In addition, estimates of nonphysical losses were made to include emergency costs associated with a flood such as shelter, subsistence and lost income. Potential losses were also estimated for public utilities,

transportation and communication systems. Periodic re-inspections of the area were made in 1980 and 1981 and no major changes were observed. Also in 1974, a New England Division engineering survey crew was sent to Belmont Park to obtain first floor elevations of floodprone properties.

Recurring Losses

Recurring losses are those potential damages which are expected to occur at various stages under present day development. Evidence of the susceptibility of the homes to flooding is demonstrated through comparison of the elevation of certain flooding events to the elevation of the first floor of the homes. The majority of the homes have basements.

EVENT	ELEVATION
500-year	25.8' NGVD
100-year	20.4' NGVD
50-year	18.8' NGVD
20-year	17.2' NGVD

FIRST FLOOR ELEVATION	NUMBER OF HOMES
15 - 15.9 NGVD	3
16 - 16.9 NGVD	3
17 - 17.9 NGVD	12
18 - 18.9 NGVD	13
19 - 19.9 NGVD	18
20 - 20.9 NGVD	9
21 - 21.9 NGVD	1
22 - above NGVD	17

Seventy-four percent of the homes have first floor elevation below that of the 100-year event. Comparable percentages for the 50 and 20-year events are 41 percent and 12 percent respectively. Potential total future damages that could be expected to occur in the Belmont Park area in a repeat of the 1979 flood of record (20-year event) are estimated to be approximately $750,000 in September 1981 prices. If the 100-year storm were to occur potential damages would be in the neighborhood of $2,000,000. A large and infrequent storm such as the 500-year frequency event (two-tenths of one percent chance of occurence) would have a devastating effect on the Belmont Park area. The elevation of the 500-year flood would be roughly 25,8 ft. NGVD which is 5.4 feet above the flood elevation of the 100-year event. If this flood did occur all of the homes in the study area would be inundated with water to a level at the minimum 4 feet above the first floor. Inundation would range from 4 to 11 feet above the first floor. An estimate of total protential losses from a 500-year flood would be approximately $4,900,000.

Annual Losses

Average annual losses were estimated using standard damage frequency integration techniques. Stage-damage information obtained by field survey was combined with hydrologic stage-frequency data to produce damage-frequency corelations. In simple terms, the probability of reaching each specific flood stage during a given year is multiplied by the corresponding dollar value of damage. The summation of these expected values results in potential annual losses. For the Belmont Park study area average annual losses are approximately $322,000.

BENEFIT ANALYSIS

The economic evaluation of the twelve alternative plans is based on the change in flood plain use caused by each plan and the resulting increase in national income as a result of the more efficient use of resources with versus without a project. Six of the twelve plans (Plans A-1 through A-6) involve acquisition and demolition of floodprone properties with relocation of the residents outside the Belmont Park area. The remaining six plans (Plans B-1 through B-6) are combination plans which involve some acquisition/demolition and some raising of the first floors of selected structures. Because these two measures involve different land uses under the with-project condition, benefits for the A and B plans accrue under different benefit criteria and are therefore evaluated separately.

Benefits for all plans are estimated with and without the effects of the proposed Big River Reservoir. This facility would be a water supply and flood control reservoir located along a tributary stream (Big River) of the south branch of the Pawtuxet River approximately 20 river miles upstream of Belmont Park. Currently in the planning/feasibility stage (Interim Report: July 1981), the reservoir would have 9,500 acre feet of flood control. Based on hydrologic stage-frequency curves for Belmont Park with and without Big River Reservoir in place, the ultimate effect on flood stages in the study area with the reservoir is an approximate reduction of 0.8 feet for the 20, 50 and 100-year floods and 1.5 feet for the 500-year flood. The inclusion of the with and without Big River Reservoir scenarios in the economic analysis addresses the one identifiable future impact that could affect benefit levels.

Implicit in the formulation of the twelve alternative plans are base line parameters which pertain to the 20, 50 and 100-year flooding events. Evaluation of benefits and costs on this basis provides a sensitivity analysis which aid in the measurement of economic efficiency.

ACQUISITION PLANS (A-1 through A-6)

The plans numbered A-1 through A-6 involve three flood damage reduction components. The primary component is the acquisition and demolition of those floodprone properties identified with each event with

relocation of the inhabitants outside of the flood plain. The second component relates to the remaining homes, after acquisition, that still experience basement flooding for each event. Each of these homes would be provided with a utility room addition, constructed on a concrete pad above the flood elevation of the reference event. The addition would house the utilities previously located in the basement. The third component, a flood forecasting system, would be instituted to assist in the further mitigation of flood related losses to the remaining homes. A brief summary of the acquisition plans is found in Table 6-1.

TABLE 6-1

SUMMARY OF ACQUISITION PLANS

PLAN	FLOOD EVENT (yr. frequency)	BIG RIVER RESERVOIR	HOUSES ACQUIRED	UTILITY ROOMS
A-1	100	without	59	17
A-2	50	without	51	18
A-3	20	without	27	30
A-4	100	with	58	18
A-5	50	with	35	27
A-6	20	with	10	41

The acquisition of homes in Plans A-1 through A-6 is intended to remove the damage potential from the threatened flood plain by relocating the inhabitants and their personal property. Once acquired, homes would be demolished and the Belmont Park flood plain would be restored for flood compatible use such as open space or recreation. Acquisition and relocation therefore reduces all of the damages associated with the removed activities. The benefits to be measured are the increases in net income which results from that portion of damage reduced which the without-project flood plain activities have externalized. External costs are those borne by the taxpaying public, not the flood plain occupants. The reduction in this externalized damage is an inundation reduction benefit because it reflects the dollar reduction in what the public pays for flood damages. Benefits for Plans A-1 through A-6 were estimated under the following categories:

1. Reduction of Insurable Flood Damages
2. Reduction of Flood Insurance Overhead
3. Reduction of Emergency Costs
4. Reduction of Damages to Utilities, Transportation and Communication Systems.

1. Reduction of Insurable Flood Damages

Because the city of Warwick participates in the Federal Flood Insurance Program, acquisition plans will bring about a savings in insurable flood damages. Insurable flood damages represents the amount of public (external) compensation for private flood damage incurred. Therefore, if damage prone structures and contents are removed from the flood plain, then the public compensation for potential private losses foregone are considered to be increases in national income.

To calculate insurable flood losses, projected average annual losses are reduced by subtracting (i) losses which are non-insurable either because they are not in insurable loss categories or they exceed the coverage limits of the subsidized programs, (ii) the policy deductible for each expected flood damage event and (iii) the annual cost of the premium paid by policy holders. The actual premium is less than the actuarial rate by the amount of the subsidy which represents one facet of taxpayer contribution to the flood insurance program. The above subtractions delete individual owner related costs and leave only external costs. The benefit calculations are made on the assumption that the subsidized flood insurance program covers all eligible structures.

Benefits which accrue to each of the six acquisition plans through the reduction in average annual insurable losses were calculated using the following method. Individual insurable flood losses by category were estimated by stage of flooding for each house identified to be acquired by a specific plan. These recurring losses were then projected over the project life under the without-project condition. Combining the stage-damage data with hydrologic stage-frequency relationships produces average annual insurable losses without the project. Under the with project condition the floodprone structure is acquired and demolished and the inhabitants relocated outside of the flood hazard area. Since the project entirely eliminates the future insurable damage potentiality, it follows that with-project benefits are equal to without-project losses and residual losses are zero. To arrive at net externalized costs avoided, the subsidized policy holder premium and deductible must be subtracted.

The average annual subsidized premium was calculated as follows. Subsidized rates for flood insurance under the first layer of protection are $.25 and $.35 per $100 of structure and contents value. First layer coverage limits are $35,000 for structure and $10,000 for contents. Based on estimates of value, the homes in Belmont Park do not require more than the aforementioned coverage limits, therefore it was not necessary to calculate additional coverage premiums based on actuarial rates. The annual average subsidized premium per home is estimated to be $122.50.

Structure:	$35,000/$100 X $.25	= $ 87.50
Contents:	$10,000/$100 X $.35	= $ 35.00
	Total Premium	$122.50

The deductible on a flood insurance policy per claim is $200 for structure and $200 for contents. The amount of $400 per event for the life of the project is equivalent to $200 average annual deductible.

The following table displays benefits for Plans A-1 through A-6 which accrue through the reduction of insurable flood damages.

TABLE 6-2

Reduction of Insurable Flood Damages
(in 000's)

	PLANS					
	Without Big River			With Big River		
	A-1	A-2	A-3	A-4	A-5	A-6
number of homes	59	51	27	58	35	10
Reduction of Insurable Flood Damages	$290.4	$238.6	$ 136	$218.3	$137.8	$43.3
(minus) subsidized premium	- 7.2	- 6.2	-3.3	- 7.1	- 4.3	- 1.2
(minus) average annual deductible	- 11.8	- 10.2	-5.4	- 11.6	- 7.0	- 2.0
ANNUAL BENEFIT (net reduction)	$271.4	$222.2	$127.3	$199.6	$126.5	$40.1

2. Reduction of Flood Insurance Overhead

Another externalized cost of flooding, not borne by the flood plain occupant, is the administration cost of the Federal Flood Insurance Program. Reduction of these costs are accrued to the acquisition plans. The benefit is calculated by multiplying the average overhead cost per policy of the flood insurance program by the number of policies in effect under the without project condition. Administration costs include agents commissions, servicing and claims adjusting costs. The acquisition and demolition of properties eliminates the need for insurance and therefore eliminates the associated administrative costs. The latest administration cost obtained from the Flood Insurance Administration is $35.00 per policy. Based on the latest available information approximately two-thirds of the 59 floodprone homes carry flood insurance. Table 6-3 displays the benefit which accrues to the elimination of administrative costs.

TABLE 6-3

Reduction of Flood Insurance Overhead
(in 000's)

	PLANS					
	Without Big River			With Big River		
	A-1	A-2	A-3	A-4	A-5	A-6
ANNUAL BENEFIT	$ 1.4	$ 1.2	$ 0.6	$ 1.4	$ 0.8	$ 0.2

3. Reduction of Emergency Costs

Costs associated with flood plain occupancy which are not borne by occupants and are reduced or eliminated by the acquisition plans are emergency costs. Among these costs are: those associated with evacuation and reoccupation, flood-fighting and disaster relief; increased costs of normal operations during the flood; and increased costs of police, fire or military patrol. After acquisition and demolition, emergency activities and costs would be reduced. To estimate this benefit it was necessary to first obtain historical emergency costs pertaining to a recent flooding event. Since flooding occurs on a non-regular basis and in differing intensities, data on emergency costs is difficult to obtain if not collected by one central agency. To obtain historical emergency costs which relate to the 1979 flood in Belmont Park, one city agency contacted the agencies who were affected. Dollar values for certain categories of costs which could not be obtained from the city were estimated by NED personnel. It is noted that the emergency costs for Belmont Park were empirically determined and were not estimated by applying arbitrary percentages to the estimates of physical damage. Estimates were made, based on actual cost data collected, of recurring potential emergency costs for each stage of flooding. This array of damages was combined with hydrologic stage-frequency data to produce expected average annual emergency costs without the project. Because not all flood prone property in Belmont Park would be acquired, emergency costs are not entirely eliminated but are reduced by appropriate amounts. Benefit which accrue to each plan are displayed in Table 6-4.

TABLE 6-4

Reduction of Emergency Costs
(in 000's)

	PLANS					
	Without Big River			With Big River		
	A-1	A-2	A-3	A-4	A-5	A-6
Number of Homes	59	51	27	58	35	10
ANNUAL BENEFIT	$ 65.0	$ 55.9	$ 29.9	$ 57.5	$ 34.5	$9.9

4. Reduction of Damages to Utilities, Transportation and Communication Systems

This category of flood-related damages is separate from "insurable flood losses" as those damages pertain only to private residences. Damages sustained in this category relate more to public type facilities such as roads, sewers, power lines, utilities, etc. Implementation of an acquisition plan would change land use in the flood plain so that future activities would be flood compatible thereby reducing or eliminating damage to the aforementioned facilities. Recurring losses were estimated by NED damage evaluators who consulted historical records. Recurring losses were annualized using hydrologic stage-frequency data. Once again, some residential properties will remain in the flood plain, therefore, only a portion of these losses would be reduced. Table 6-5 displays the benefits which accrue to each plan.

TABLE 6-5

Reduction of Damages to Utilities, Transportation and Communication Systems
(in 000's)

	PLANS					
	Without Big River			With Big River		
	A-1	A-2	A-3	A-4	A-5	A-6
Number of Homes	59	51	27	58	35	10
ANNUAL BENEFIT	$ 40.1	$ 34.4	$ 18.4	$ 36.0	$ 21.6	$ 6.2

5. Benefits Which Accrue to Individual Utility Relocations

Each of the acquisition plans contain certain homes not scheduled for acquisition but which do experience basement flooding. Utilities located in the basements of these homes would be relocated to a 8-foot by 12-foot addition, built at the first floor elevation. For the benefit analysis, damage to utilities in the individual homes were compared under the with and without-project conditions. Basically, relocating basement utilities shifts the start of damages from the without-project elevation to the with-project design elevation. Stage-damage relationships were estimated for both conditions and annualized using hydrologic stage-frequency data. Benefits were calculated as the reduction in average annual utility losses,as a result of comparing losses with original basement conditions versus losses with utility room additions. Benefits accrue to each plan as displayed in Table 6-6. Because these homes will not be acquired but will remain in their original locations, they will experience residual flood losses.

TABLE 6-6

Reduction of Damages to Home Utilities (Utility Room Additions)
(in 000's)

	PLANS					
	Without Big River			With Big River		
	A-1	A-2	A-3	A-4	A-5	A-6
Number of Homes	17	18	30	18	27	41
ANNUAL BENEFIT	$ 19.6	$ 20.7	$ 34.5	$ 18.5	$ 27.7	$ 42.0
RESIDUAL LOSSES	$ 34.0	$ 36.0	$ 60.0	$ 32.4	$ 48.6	$ 73.8

6. Flood Preparedness Plans (Warning & Evacuation)

Because each of the properties that are provided with utility rooms (under category #5) will continue to experience basement flooding, a flood forecasting and preparedness plan has been added to Plans A-1 through A-6. A flood preparedness plan consists of predetermined functional arrangements and emergency actions which are implemented on a response basis during floods to mitigate losses. Execution of the features of the plan can result in different types of NED benefits. The only potential benefit to evaluate for the Belmont Park area is under the category of "reduction of physical damages to structures and/or contents." Dollar values of physical damages are reduced through the act of relocating damageable contents either within the structure or outside the flood plain. The effectiveness of these actions depend upon many factors such as: the amount of time to receive and respond to a warning, time of day, public awarness, amount of time since last flood, etc. It is estimated that the maximum flood warning time for Belmont Park would be 4 hours, therefore, based on variables and uncertainties mentioned above, approximately 2 hours could be devoted to moving contents.

The actual dollar value of the benefit is measured as the difference between damages with and without the preparedness plan. To determine the baseline condition, individual damage survey sheets for the specific homes were consulted to determine the amount of recurring damage to potentially moveable items. Careful attention was paid to the nature of the different types of moveable items, the feasibility of moving them, and the actual amount of moving time available. Inspection of many of the basements of the floodprone properties in Belmont Park indicated that the residents are accustomed to wet basements and therefore do not store many damageable moveable items there. Many basements have multiple sump pumps.

Benefits were estimated for those homes that would remain in the flood plain after implementation of acquisition plans. From the damage survey records it was ascertained that moveable contents per home averaged roughly 20 percent of total recurring physical losses. It was determined that 50 percent of these items could not be moved due to constraints of

size, weight and connections. Another 50 percent reduction was taken due to the time constraint of approximately two to three hours or less moving time. If the warning was given in sufficient time and heeded by the residents, average annual damages to moveable contents would be reduced by the amounts shown in the following table.

TABLE 6-7

Damage Reduction Based on Flood Preparedness Plan
(in 000's)

	PLANS					
	Without Big River			With Big River		
	A-1	A-2	A-3	A-4	A-5	A-6
Total Homes	17	18	30	18	27	41
ANNUAL BENEFIT	$ 4.2	$ 4.5	$ 7.5	$ 4.1	$ 6.2	$ 9.3

Summary of Benefits - Acquisition Plans

The total annual benefits which accrue to each of the six acquisition plans are found in Table 6-8.

TABLE 6-8

Summary of Annual Benefits - Acquisition Plans
(in 000's)

	PLANS					
	Without Big River			With Big River		
	A-1	A-2	A-3	A-4	A-5	A-6
BENEFITS:						
- Net Reduction of Insurable Flood Losses	$271.4	$222.2	$127.3	$199.6	$126.5	$ 40.1
- Reduction of FIA Overhead	1.4	1.2	0.6	1.4	0.8	0.2
- Reduction of Emergency Costs	65.0	55.9	29.9	57.5	34.5	9.9
- Reduction of Damages to Utilities, Trans., & Comm. Sys.	40.1	34.4	18.4	36.0	21.6	6.2
- Home Utility Pads	19.6	20.7	34.5	18.5	27.7	42.0
- Flood Warning and Evacuation	4.2	4.5	7.5	4.1	6.2	9.3
TOTAL ANNUAL BENEFITS	$401.7	$338.9	$218.2	$317.1	$217.3	$107.7
TOTAL RESIDUAL LOSSES	$ 34.0	$ 35.0	$ 60.0	$ 32.4	$ 48.6	$ 73.8

COMBINATION PLANS (B-1 through B-6)

Whereas the economic evaluation of plans A-1 through A-6 involved benefits which accrued solely on the basis of acquisition, plans B-1 through B-6 were formulated utilizing combinations which feature acquisition of some properties and raising the first floor of other floodprone properties. Other components of the combination plans are: (i) utility room additions and (ii) a flood warning and evacuation plan. A brief profile of the combination plans is found in Table 6-9.

TABLE 6-9

SUMMARY OF COMBINATION PLANS

PLAN	FLOOD EVENT (yr. frequency)	BIG RIVER RESERVOIR	HOUSES ACQUIRED	HOUSES W/FIRST FLOOR RAISED	UTILITY ROOMS
B-1	100	without	30	29	17
B-2	50	without	24	20	25
B-3	20	without	7	11	39
B-4	100	with	30	27	19
B-5	50	with	22	10	30
B-6	20	with	2	8	41

The benefits which accrue to the acquisition portion of the combination plans are estimated under the same categories and methodologies as those employed in evaluating plans A-1 through A-6. The evaluation criterion is the reduction of externalized costs of flooding. Benefits are estimated under the following categories:

1. Reduction of Insurable Flood Damages
2. Reduction of Flood Insurance Overhead
3. Reduction of Emergency Costs

1. Reduction of Insurable Flood Damages

The net reduction in insurable flood damages, after subtraction of the subsidized premium and average annual deductible, for the acquisition portion of plans B-1 through B-6 is displayed in Table 6-10.

TABLE 6-10

Reduction of Insurable Flood Damages
(in 000's)

	PLANS					
	Without Big River			With Big River		
	B-1	B-2	B-3	B-4	B-5	B-6
Number of Homes	30	24	7	30	22	2
Reduction of Insurable Flood Damages	$148.1	$118.3	$ 34.2	$122.1	$ 95.2	$ 6.8
(minus) Subsidized Premium	- 3.7	- 2.9	- 0.9	- 3.7	- 2.7	- 0.2
(minus) Average Annual Deductible	- 6.0	- 4.8	- 1.4	- 6.0	- 4.4	- 0.4
ANNUAL BENEFIT (net reduction)	$138.4	$110.6	$ 31.9	$112.4	$ 88.1	$ 6.2

2. Reduction of Flood Insurance Overhead

The administration cost of the Federal Flood Insurance Program is an externalized cost which would be reduced by implementing the acquisition portion of the combination plans. Benefits would accrue in the amounts displayed in the following table.

TABLE 6-11

Reduction of Flood Insurance Overhead
(in 000's)

	PLANS					
	Without Big River			With Big River		
	B-1	B-2	B-3	B-4	B-5	B-6
ANNUAL BENEFIT	$ 0.7	$ 0.6	$ 0.2	$ 0.7	$ 0.5	$ 0.1

3. Reduction of Emergency Costs

The combination plans B-1 through B-6 reduce flood-related emergency costs in Belmont Park but to a lesser degree that the "acquisition only" plans. The lesser reduction is based in the fact that the combination plans allow many structures to remain in the flood plain, with raised first floor elevations, while the "acquisition only" plans remove more of the structures from the flood plain. Land use under these plans remains essentially residential and therefore emergency services will still be required. However, the total cost of emergency services and materials needed will be reduced, that reduction is assumed to be roughly proportional to the number of homes acquired.

TABLE 6-12

Reduction of Emergency Costs
(in 000's)

	PLANS					
	Without Big River			With Big River		
	B-1	B-2	B-3	B-4	B-5	B-6
Number of Homes	30	24	7	30	22	2
ANNUAL BENEFIT	$16.5	$13.2	$ 3.9	$14.9	$10.9	$ 1.0

The remaining benefits which accrue to the combination plans are evaluated under the categories of: (i) individual home utility relocations, (ii) first floor raising and (iii) flood warning and evacuation plan.

4. Benefits Which Accrue to Individual Utility Relocations

Benefits are calculated as the reduction in average annual losses to basement utilities which result from comparing losses with original basement conditions versus losses with utilities relocated. Benefits accrue to each plan as displayed in Table 6-13. These homes will experience residual flood losses because they remain in their original locations.

TABLE 6-13

Reduction of Damages to Home Utilities (Utility Room Additions)
(in 000's)

	PLANS					
	Without Big River			With Big River		
	B-1	B-2	B-3	B-4	B-5	B-6
Number of Homes	17	25	39	19	30	41
ANNUAL BENEFIT	$ 19.6	$ 28.8	$ 44.9	$ 19.5	$ 30.8	$ 42.0
RESIDUAL LOSSES	$ 34.0	$ 50.0	$ 78.0	$ 34.2	$ 54.0	$ 73.8

5. Benefits Which Accrue to Raising the First Floor of Existing Structures

An alternative to acquisition/demolition of floodprone properties is to leave the structure in the flood plain and raise the first floor above the flood elevation of the design event. In the plan formulation process the decision to target a house for acquisition or first floor raising was based on: depth of first floor flooding, structural soundness of the house, and geographical concerns.

Raising an existing structure changes the stage-damage relationship by placing the first floor elevation at a higher stage. The stage-damage function for the interior of the strcuture and contents begins at the new first floor elevation. It was determined in the plan formulation process that the first floor of designated homes would be raised two feet above the elevation of the design flood event. The first foot was to place the floor above the floodwaters and the second foot was to prevent water damage to the floor joists.

Evaluation of this category of benefits required a structure and site specific analysis of the stage-damage function. The start of damage relative to first floor structure and contents is shifted up from the original without-project elevation to the design elevation in effect with the project. Comparison of the average annual losses with and without the project (i.e. at the two different first floor elevations) results in the measure of annual benefits. This type of benefit differs in nature from those which accrue to acquisition in that residual losses are present.

Very low frequency events could still cause first floor damages. Higher frequency events will still cause site damage and possibly basement damages. Benefits were summed for the number of houses targeted by each plan and are presented in Table 6-14.

TABLE 6-14

Damage Reduction Based on Raising First Floor
(in 000's)

	PLANS					
	Without Big River			With Big River		
	B-1	B-2	B-3	B-4	B-5	B-6
Number of Homes	29	20	11	27	10	8
ANNUAL BENEFIT	$139.0	$119.7	$ 59.2	$103.1	$ 45.5	$ 37.8
Residual Losses	$115.0	$ 92.7	$ 69.5	$ 92.0	$ 45.4	$ 40.4

6. Flood Preparedness Plans (Warning & Evacuation)

Since implementation of any of the combination plans leaves land use essentially residential, a flood preparedness plan would be instituted at a first cost of $50,000. The annual benefits which accrue to the plan reflect a reduction in the dollar value of physical damages through the act of relocating damageable contents either within the structure or outside the flood plain. Benefits were estimated for those homes that would remain in the flood plain. This number includes those homes targeted for first floor raising and those to be provided with utility rooms. If the warning was given in sufficient time and heeded by the residents, average annual damages to moveable contents would be reduced by the amounts shown in Table 6-15.

TABLE 6-15

Damage Reduction Based on Flood Preparedness Plan
(in 000's)

	PLANS					
	Without Big River			With Big River		
	B-1	B-2	B-3	B-4	B-5	B-6
Total Homes	46	45	50	46	40	49
- first floor raised	29	20	11	27	10	8
- utility room additon only	17	25	39	19	30	41
ANNUAL BENEFIT	$ 10.0	$ 10.9	$ 13.2	$ 8.9	$ 9.1	$ 11.7

Recreation Benefits

Implementation of any of the acquistion or combination plans which provide nonstructural flood mitigation for the 50 or 100-year events would provide vacant flood plain land in a large enough area to permit development of recreational facilities. While provision of the land would be a necessary condition, it would not be a sufficient condition since recreational development is not a project purpose, but simply a local discretionary decision following project implementation. Therefore, recreation benefits were not included in total project benefits. It was decided though to estimate recreation benefits for the purpose of displaying the total beneficial effects to the community of flood compatible land use with the project.

The city of Warwick has indicated that it might undertake recreational development in Belmont Park if a plan is implemented. Implementation of any of the 50-year event plans would allow construction of one soccer field and one softball field. Any of the 100-year event plans would provide additional room for construction of three tennis courts. Estimating the annual use for each facility by the user-day method, the total annual recreation benefits amount to $32,700 for the 100-year plans and $18,900 for the 50-year plans.

Summary of Benefits - Combination Plans

The total annual benefits which accrue to each of the six combination plans are found in the following table.

TABLE 6-16

Summary of Annual Benefits - Combination Plans
(in 000's)

BENEFITS	COMBINATION PLANS (B) B-1	B-2	B-3	B-4	B-5	B-6
Net Reduction of Insurable Flood Losses	$138.4	$110.6	$ 31.9	$112.4	$ 88.1	$ 6.2
Reduction of FIA Overhead	0.7	0.6	0.2	0.7	0.5	0.1
Reduction of Emergency Costs	16.5	13.2	3.9	14.9	10.9	1.0
Utility Room Additions	19.6	28.8	44.9	19.5	30.8	42.0
Innundation Reduction (Raising first floor)	139.0	119.7	59.2	103.1	45.5	37.8
Flood Warning and Evacuation	10.0	10.9	13.2	8.9	9.1	11.7
TOTAL ANNUAL BENEFITS	$324.2	$283.8	$153.3	$259.5	$184.9	$ 98.8
TOTAL RESIDUAL LOSSES	$149.0	$142.07	$147.5	$126.2	$ 99.4	$114.2

SUMMARY OF ECONOMIC ANALYSIS

Summary of Benefits

A summary of all benefits evaluated under the seven categories for both the "acquisition only" and "combination" plans is found in Table 6-17. Additional information contained in the table (annual costs, B/C ratio and net benefits) contribute to the determination of economic justification and degree of economic efficiency of each plan.

Economic Justification and Maximization of Benefits

Table 6-17 shows that each of the twelve plans is economically justified, i.e. each has a benefit cost ratio greater than one. Because of this the plans were screened on the basis of maximizing economic efficiency. This concept is measured by the greatest amount of benefits over costs or net benefits. The plan with the highest dollar value of net benefits, even though it might not have the highest B/C ratio, is chosen as most efficient as it makes the greatest contribution to national economic development. Plan A-1, the 100-year event acquisition plan, is selected as most efficient based on the net benefit criteria. In addition, this plan causes the greatest reduction in emergency costs and public facility damages, and allows for full future recreation development.

TABLE 6-17
BELMONT PARK, WARWICK, R.I.
NONSTRUCTURAL FLOOD REDUCTION PLANS
ANNUAL BENEFITS
(in 000's of dollars)

	ACQUISITION PLANS (A)						COMBINATION PLANS (B)					
	A-1	A-2	A-3	A-4	A-5	A-6	B-1	B-2	B-3	B-4	B-5	B-6
BENEFITS												
- Net Reduction of Insurable Flood Losses	$271.4	$222.2	$127.3	$199.6	$126.5	$ 40.1	$138.4	$110.6	$ 31.9	$112.4	$ 88.1	$ 6.2
- Reduction of FIA Overhead	1.4	1.2	0.6	1.4	0.8	0.2	0.7	0.6	0.2	0.7	0.5	0.1
- Reduction of Emergency Costs	65.0	55.9	29.9	57.5	34.5	9.9	16.5	13.2	3.9	14.9	10.9	1.0
- Reduction of Damages to Utilities, Trans., & Comm. Sys.	40.1	34.4	18.4	36.0	21.6	6.2	-	-	-	-	-	-
Utility Room Additions	19.6	20.7	34.5	18.5	27.7	42.0	19.6	28.8	44.9	19.5	30.8	42.0
Inundation Reduction (Raising 1st Floor)	-	-	-	-	-	-	139.0	119.7	59.2	103.1	45.5	37.8
- Flood Warning and Evacuation	4.2	4.5	7.5	4.1	6.2	9.3	10.0	10.9	13.2	8.9	9.1	11.7
TOTAL ANNUAL BENEFITS	401.7	338.9	218.2	317.1	217.3	107.7	324.2	283.8	153.3	259.5	184.9	98.8
Annual Costs	294.0	257.4	153.3	290.2	189.3	76.8	237.6	185.5	90.4	227.9	164.3	59.8
Benefit/Cost Ratio	1.37	1.32	1.42	1.09	1.15	1.40	1.36	1.53	1.70	1.14	1.13	1.65
Net Benefits	107.7	81.5	64.9	26.9	28.0	30.9	86.6	98.3	62.9	31.6	20.6	39.0
Residual Losses	34.0	36.0	60.0	32.4	48.6	73.8	149.0	142.7	147.5	126.2	99.4	114.2

Table 6-18 displays the twelve plans ranked in order of net benefits. Other pertinent data are also provided.

TABLE 6-18

Net Benefits of Alternative Plans
(in 000's)

PLAN	NET BENEFITS	BENEFIT/COST RATIO	RESIDUAL LOSSES
A-1	$107.7	1.37	34.0
B-2	98.3	1.53	142.7
B-1	86.6	1.36	149.0
A-2	81.5	1.32	36.0
A-3	64.9	1.42	60.0
B-3	62.9	1.70	147.5
B-6	39.0	1.65	114.2
B-4	31.6	1.14	126.2
A-6	30.9	1.40	73.8
A-5	28.0	1.15	48.6
A-4	26.9	1.09	34.2
B-5	20.6	1.13	99.4

Internal Rate of Return

A specific check included in the economic analysis of the alternative plans is the internal rate of return. The internal rate of return represents the rate of interest earned on the unrecovered balance of an investment such that the remaining balance is zero at the end of the investment life. For purposes of this analysis, it can be regarded as the rate of interest at which annual benefits equal annual costs over the period of analysis (i.e. the benefit-cost ratio equals 1). The current Federal interest rate for water resources project is 7-5/8 percent and the economic life of the Belmont Park study is 50 years.

TABLE 6-19

Internal Rates of Return for
Belmont Park Nonstructural Flood Damage Reduction Plans

Acquisition Plans	Rate of Return	Combination Plans	Rate of Return
A-1	10.6%	B-1	10.6%
A-2	10.3%	B-2	11.9%
A-3	11.0%	B-3	13.2%
A-4	8.4%	B-4	8.9%
A-5	8.9%	B-5	8.8%
A-6	10.9%	B-6	12.9%

ANALYSIS OF THE SELECTED PLAN

As previously mentioned Plan A-1 is chosen as the most economically efficient based on the following: (i) greatest dollar value of net benefits, (ii) greatest reduction in emergency costs and public facility damages and (iii) permits full recreational development. A more detailed examination of the plan's component parts in terms of disaggregated benefits and costs follows. Table 6-19 displays all pertinent first costs necessary to implement the features of Plan A-1.

TABLE 6-20

PLAN A-1, FIRST COSTS

ACQUISTION COSTS

59 Improved Residential Tracts	$1,636,000
19 Unimproved Tracts	60,000
City Owned Land	0
Severance Damages	0
SUBTOTAL	$1,696,000
Contingencies	334,000
Total Estimated Cost of Land and Improvements	$2,030,000
Relocation Assistance Costs	863,000
Acquisition Costs	207,000
	$3,100,000
Administrative Costs	100,000
ACQUISITION COST	$3,200,000
DEMOLITION AND SITE WORK	$ 340,000
UTILITY ROOMS	$ 170,000
FLOOD FORECASTING SYSTEM	$ 50,000
TOTAL	$3,760,000

Incremental Justification

Plan A-1 consists of three separate components. The first and major component is the acquisition and demolition of 59 floodprone properties with relocation of the residents outside of the Belmont Park area. An additional 19 unimproved tracts would also be acquired. The first cost of acquisition is $3,200,000. Demolition and site work costs of $340,000 bring the total first cost of acquisition related activities to $3,540,000. Amortization of total first cost at the 7-5/8 percent interest rate over the 50-year project life results in an annual cost of $277,000. Benefits accrue to acquisition in the following categories and dollar amounts.

Category	Annual Benefit
Net Reduction of Insurable Flood Losses	$271,400
Reduction of FIA Overhead	1,400
Reduction of Emergency Costs	65,000
Reduction of Damages to Utilities, Trans., and Comm. Systems	40,100
TOTAL ANNUAL BENEFITS	$377,900

The second component of Plan A-1 is the construction of utility rooms for the 17 homes which would remain after acquisition and still experience basement flooding. The total first cost of the utility rooms is $170,000 and the annual cost is $13,000. Annual benefits based on reduced home utility damages amount to $19,600 and the resulting benefit/cost ratio is 1.51.

The third component of Plan A-1 is the flood forecasting, warning and evacuation plan. The first cost of the plan is $50,000 and the annual cost is $4,000. Annual benefits which accrue to moving damageable contents amount to $4,200 and the benefit/cost ratio is 1.05. Table 6-21 summarizes all pertinent incremental data for Plan A-1.

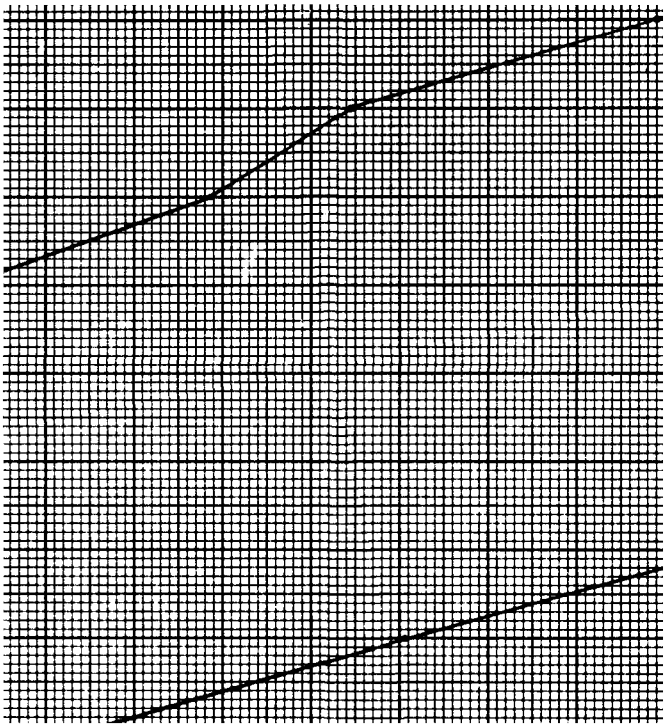
TABLE 6-21

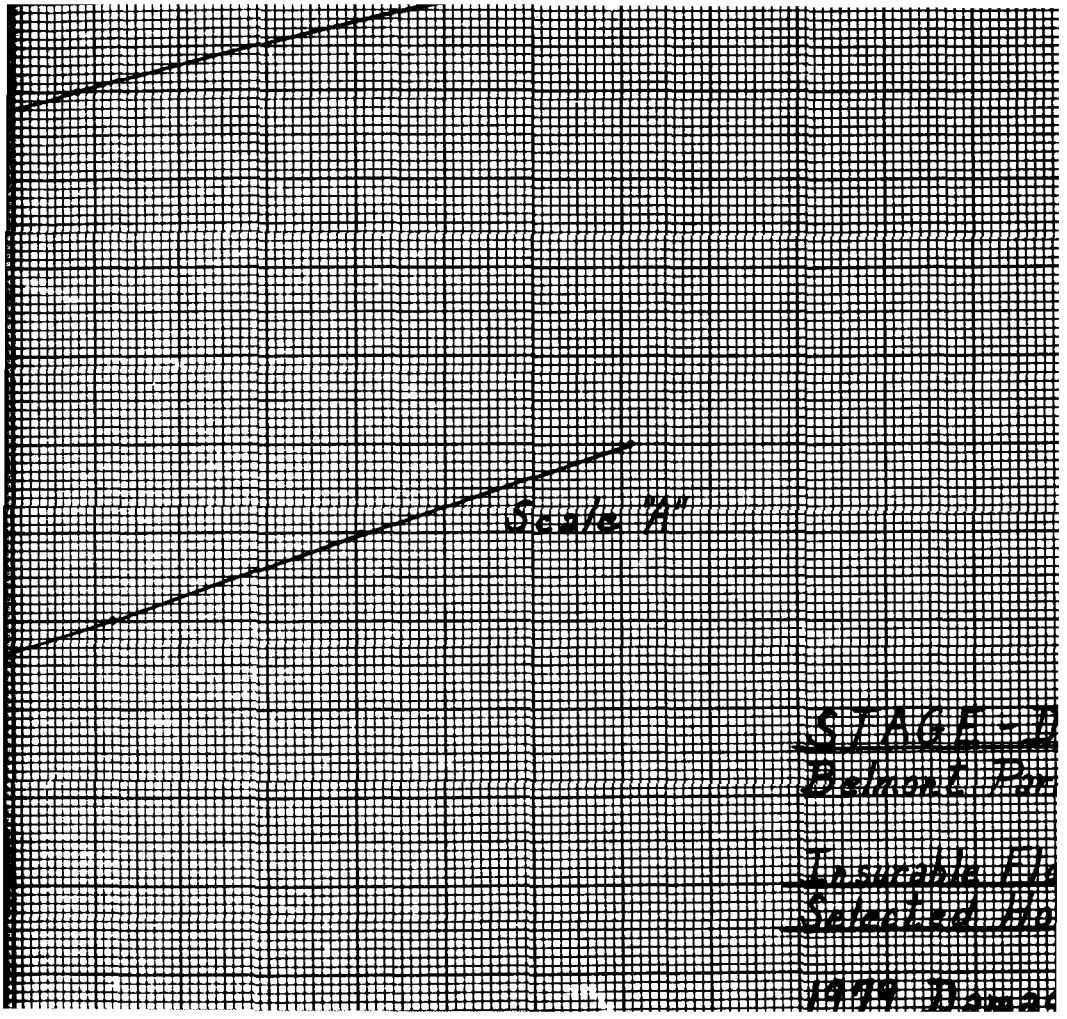
Incremental Justification of Components of the Selected Plan (A-1)
(in 000's)

Component	Annual Benefit	Annual Cost	Net Benefit	Benefit/Cost Ratio
Acquisition	$377.9	$277	$100.9	1.36
Utility Rooms	19.6	13	6.6	1.51
Flood Warning	4.2	4	0.2	1.05
TOTAL	$401.7	$294	$107.7	1.37

(Internal Rate of Return = 10.6%)

Stage-damage and damage-frequency curves are provided for the following benefit categories of Plan A-1: (i) insurable flood losses, (ii) losses to utilities, transportation and communication systems and (iii) reduction of emergency costs. Hydrologic stage-frequency relationships for the Belmont Park area are also displayed.

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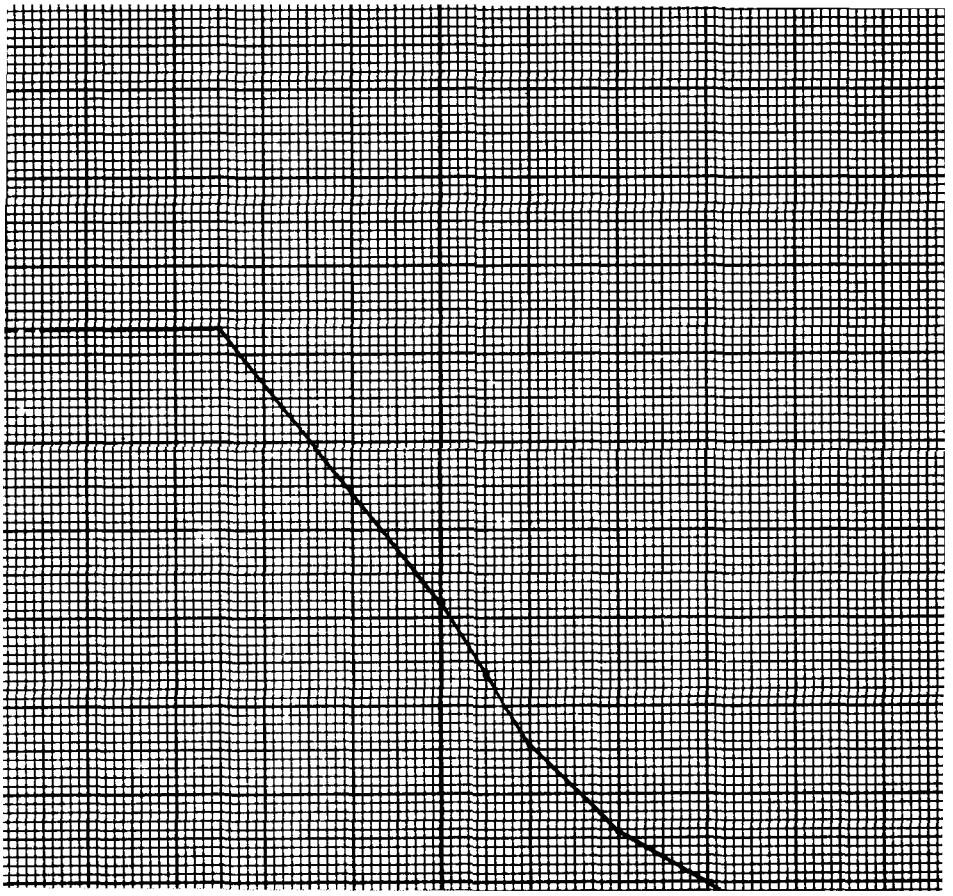

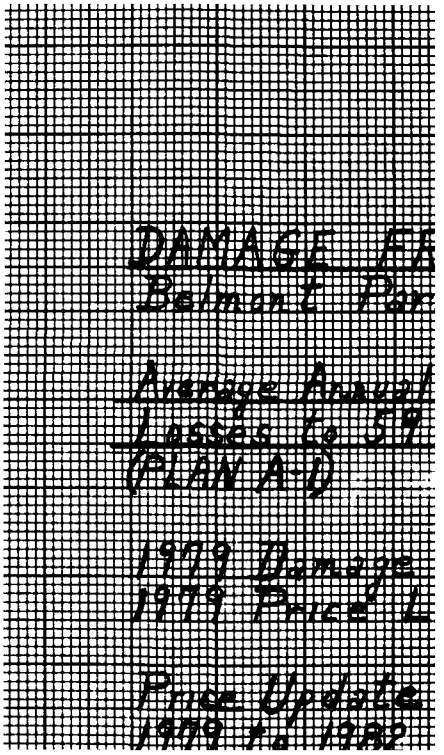
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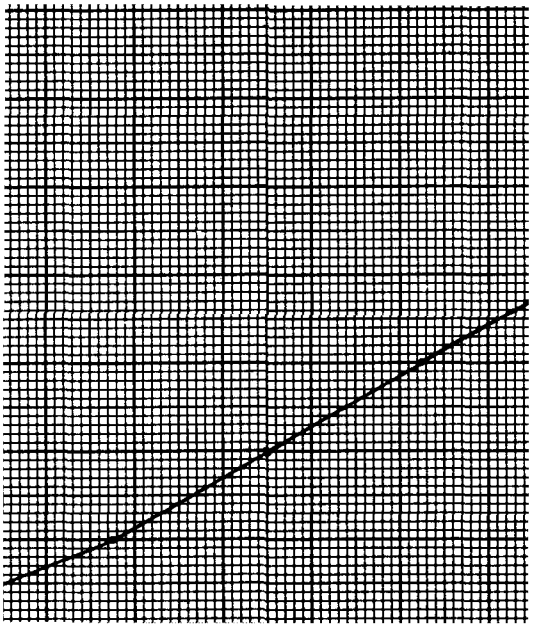
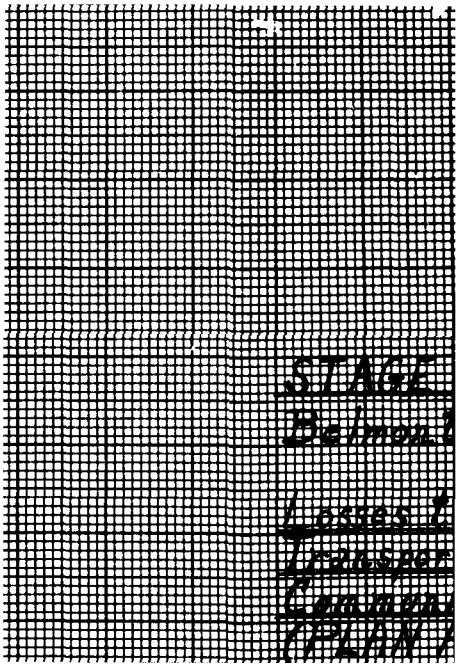
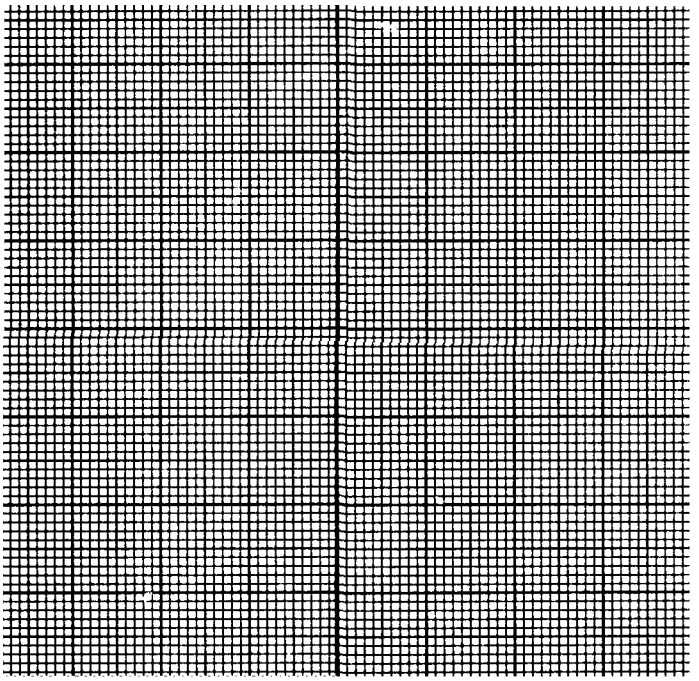
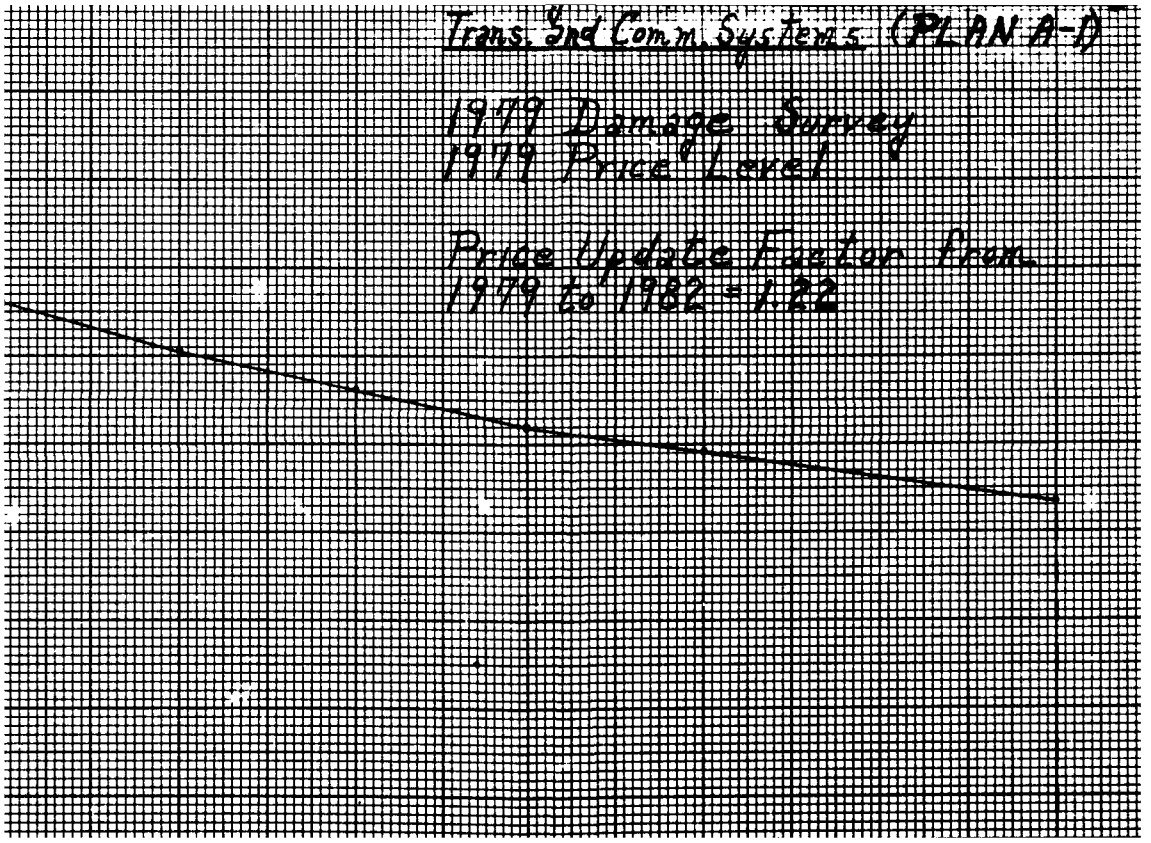
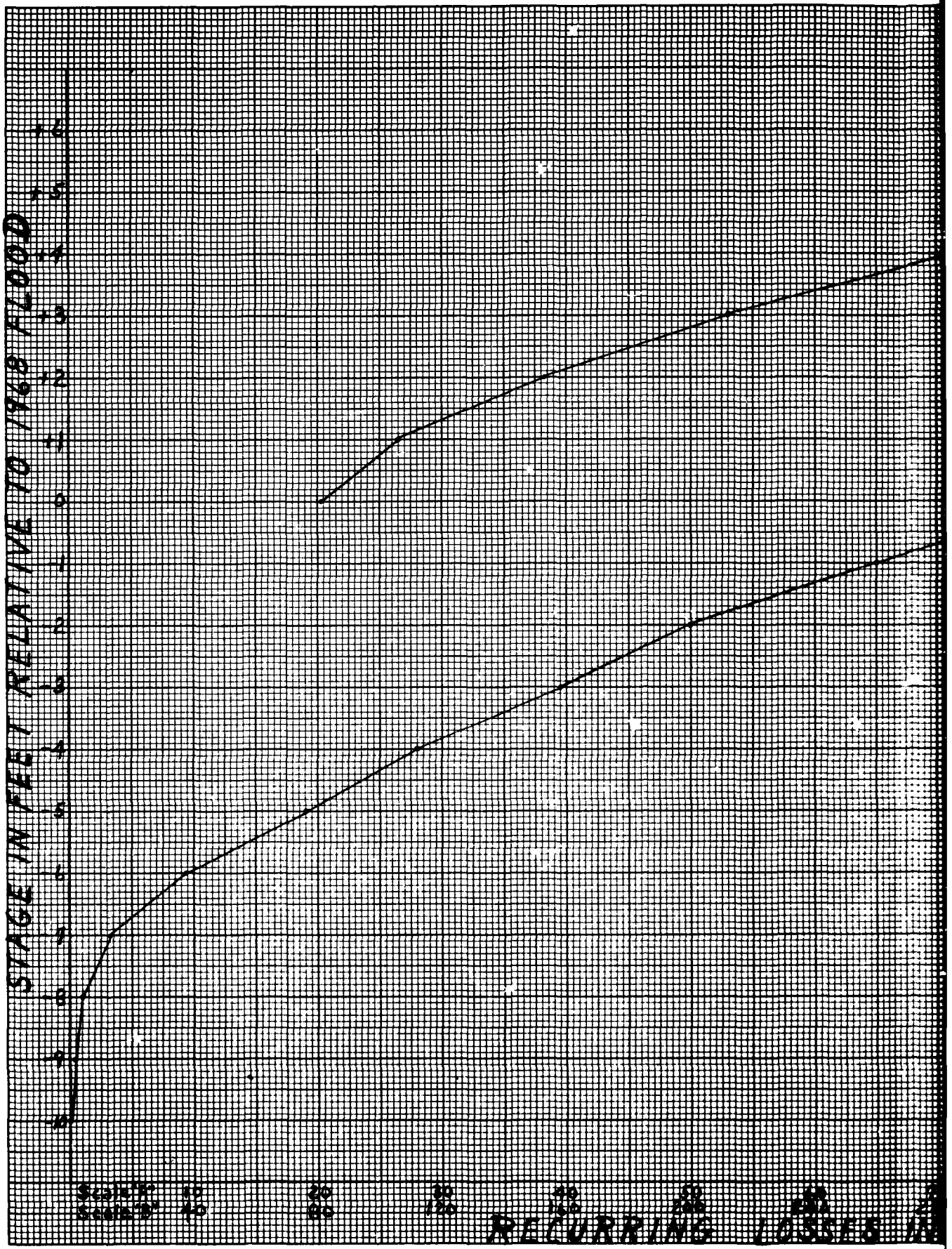
Belmont Par
Average Annual
Losses to 5%
(PLAN A-1)
1979 Damage
1979 Price L
Price Update
1979 to 1982




STAGE
Below
Losses
Transfer
Cannula
(PLAN




Trans. 2nd Comm. Systems (PLAN A-D)
1977 Damage Survey
1977 Price Level
Price Update Factor From
1979 to 1982 = 1.22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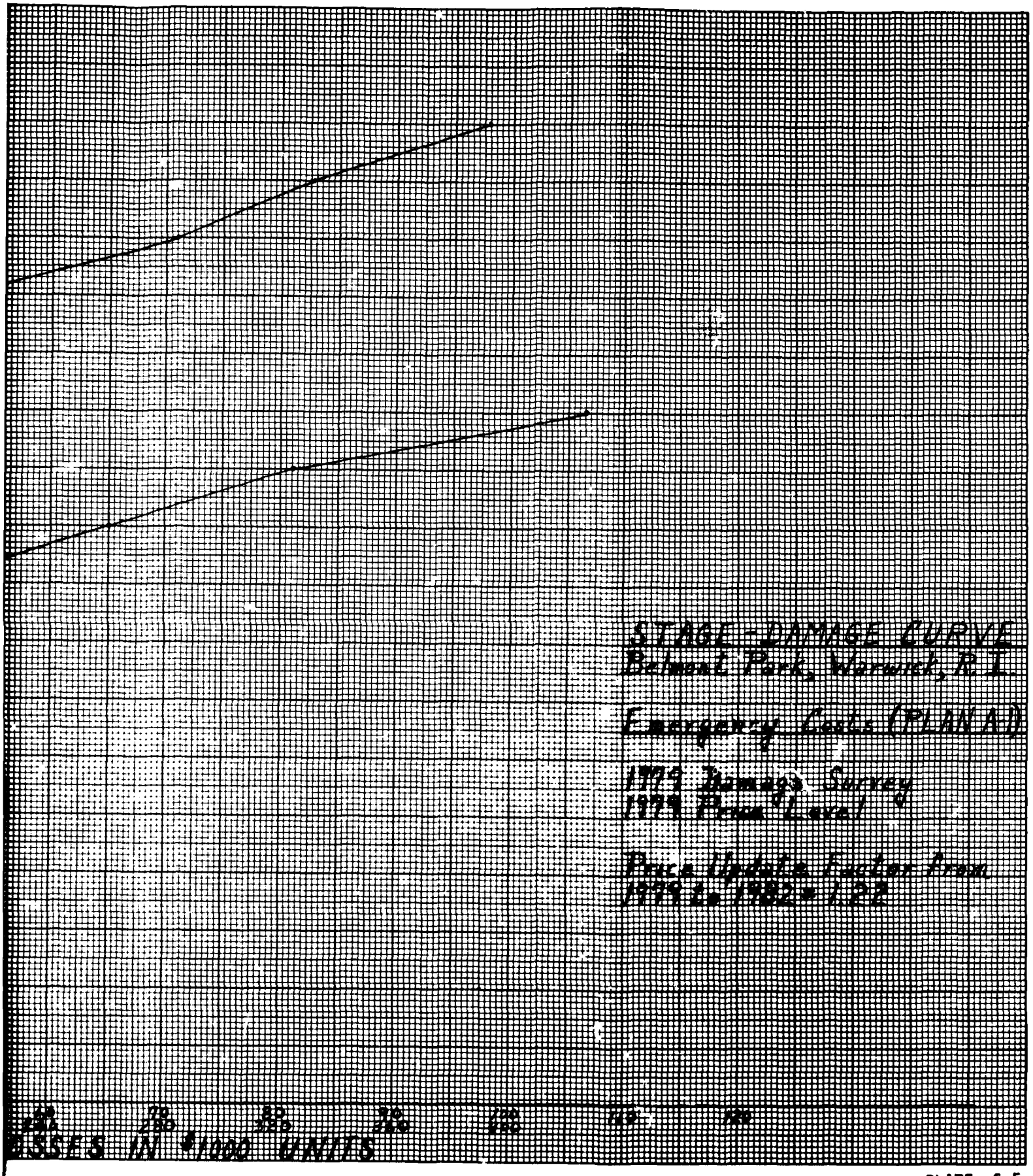
+4
+3
+2
+1
0
-1
-2
-3
-4
-5
-6
-7
-8
-10
RECURRING LOSSES IN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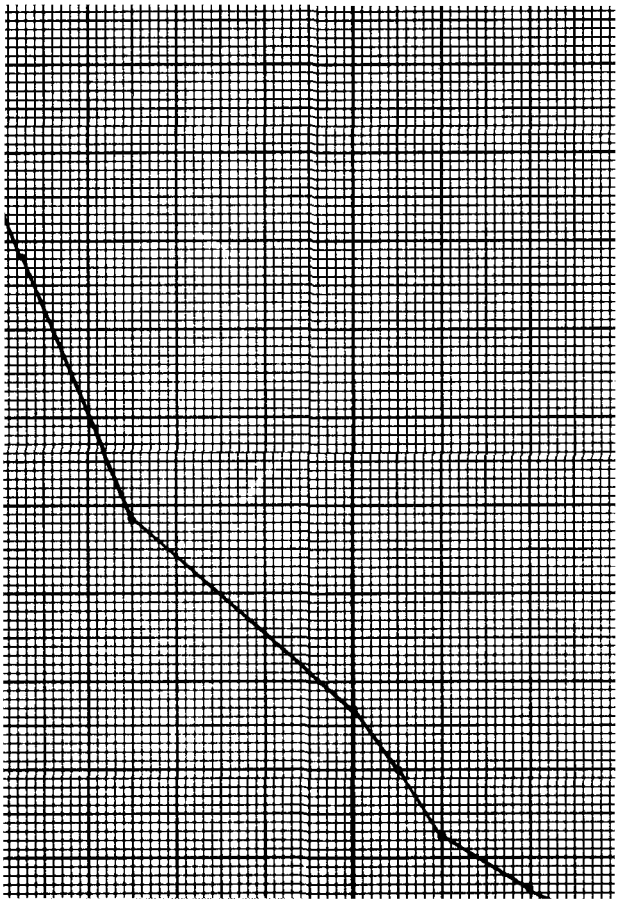
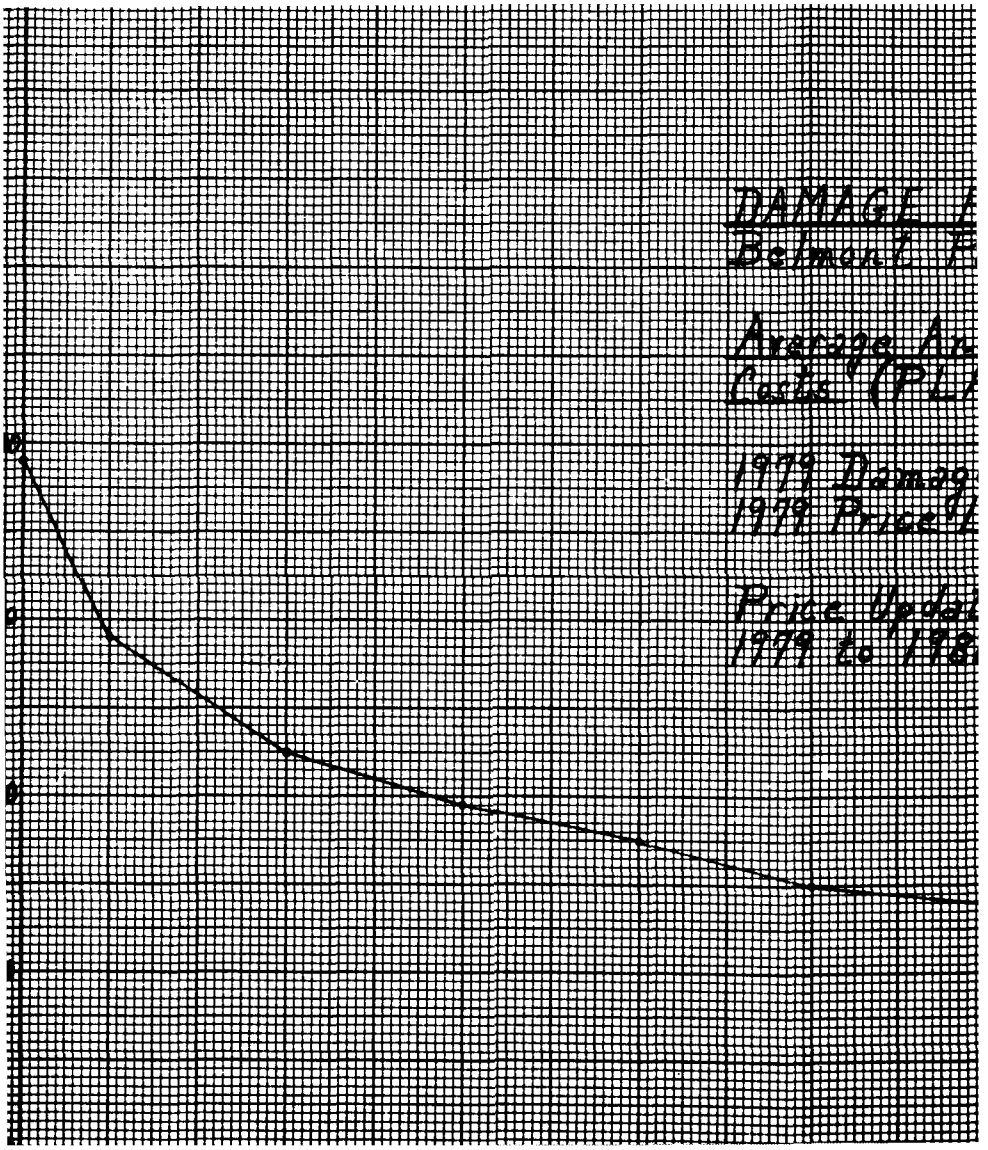
Belmont Park, Warwick, R.I.
Emergency Costs (PLANO)
1973 Damage Survey
1979 Price Level
Price Update Factor from
1979 to 1982 = 1.22
280
240
200
160
120
80
40
0
LOSSES IN $1000 UNITS

PLATE 6-5

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Belmont
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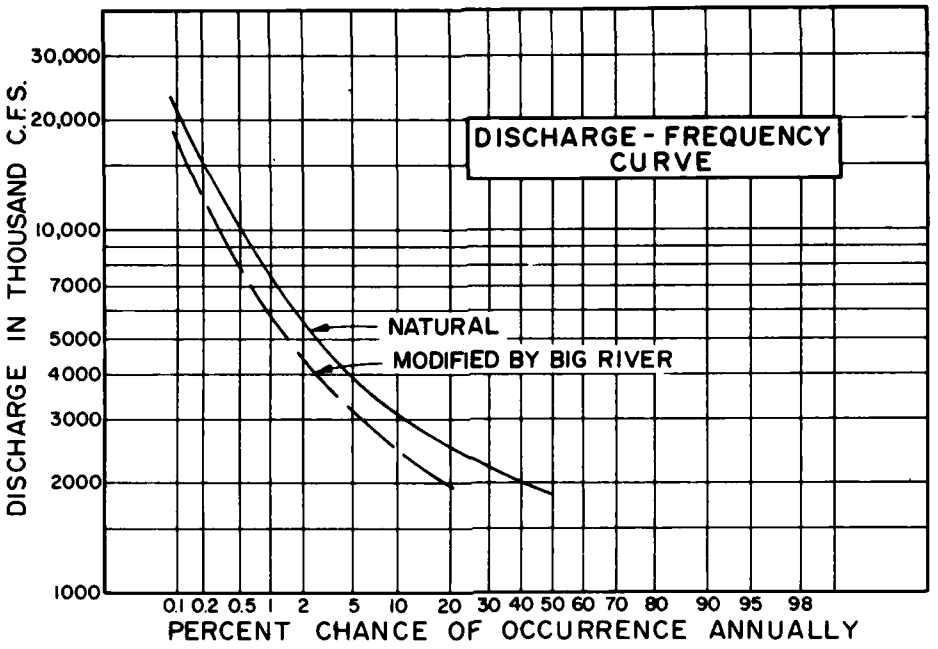
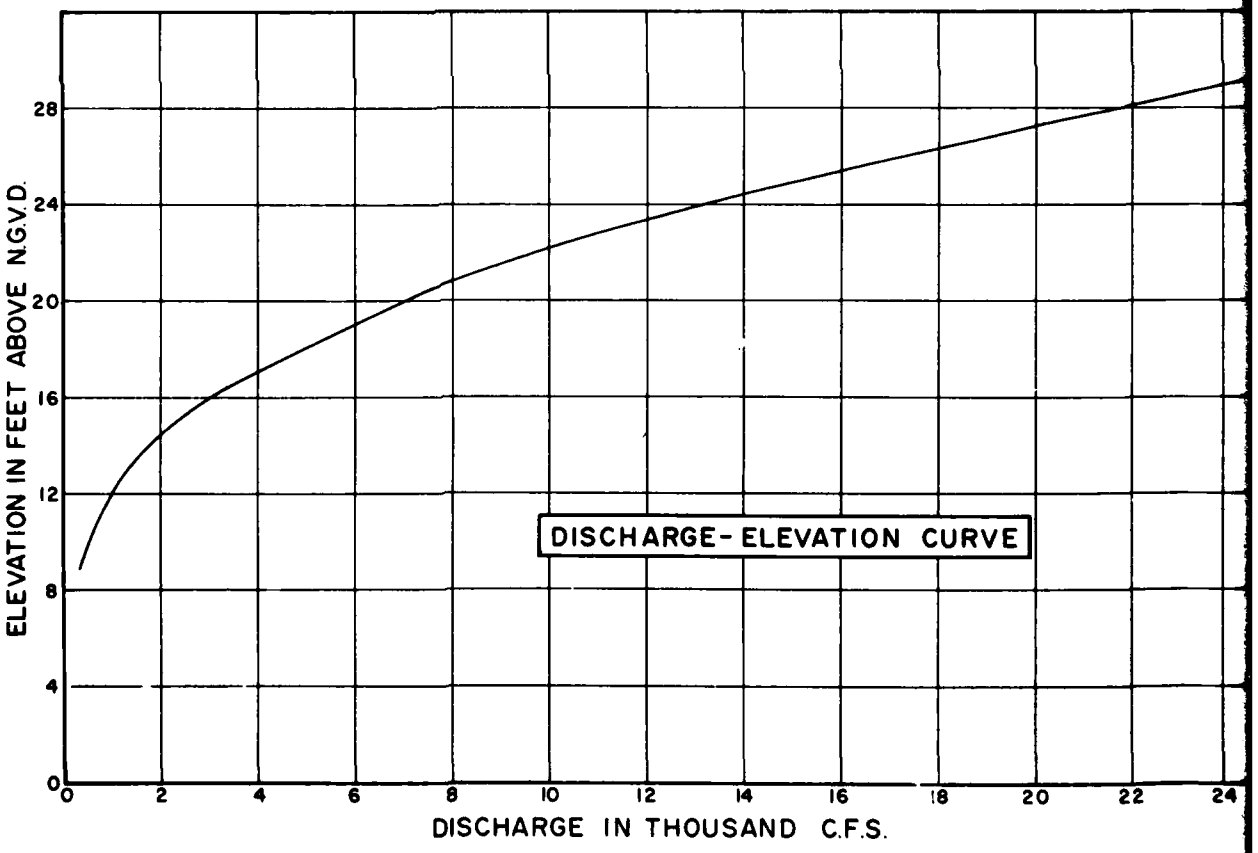
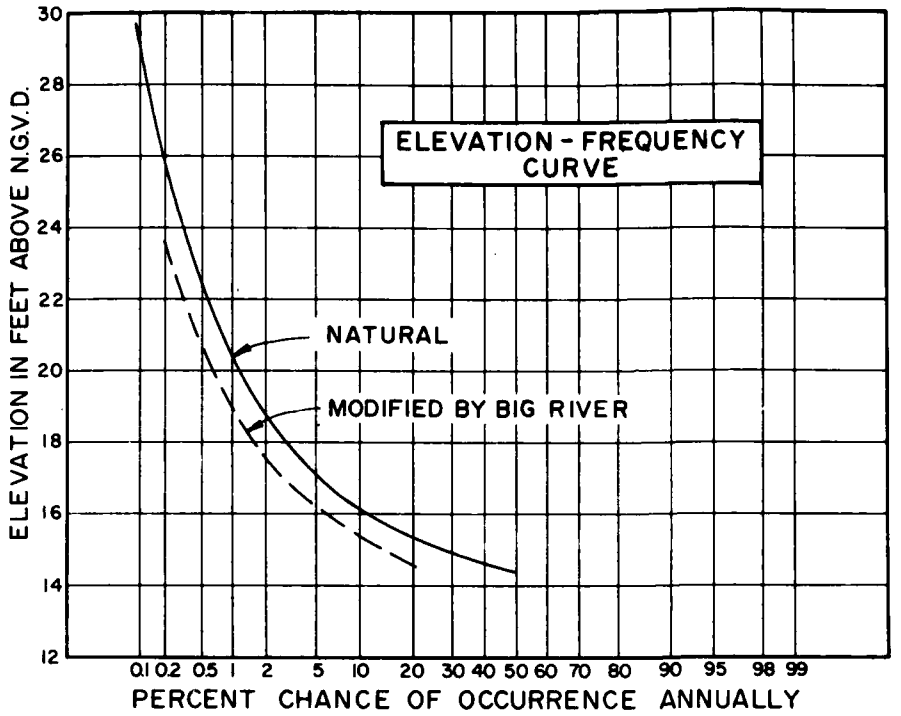
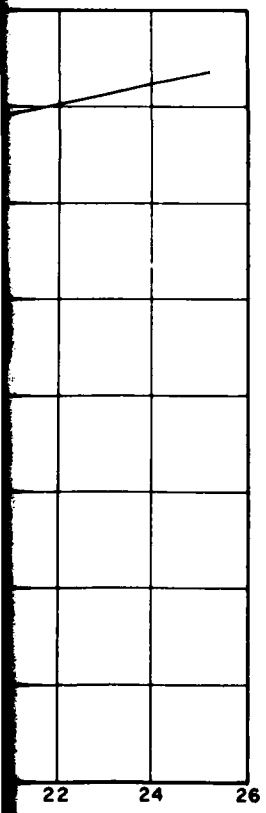
1979 Dam
1979 Price
Price Upda
1979 to 19





ELEVATION IN FEET ABOVE N.G.V.D.





WATER RESOURCES DEVELOPMENT PROJECT

BELMONT PARK – WARWICK, R.I.

ELEVATION DISCHARGE AND FREQUENCY CURVES

PAWTUXET RIVER RHODE ISLAND

PLATE 6-7

2

APPENDIX 7

REAL ESTATE

TABLE OF CONTENTS

APPENDIX 7

REAL ESTATE

PURPOSE OF THE REPORT

The purpose of this report is to estimate the preliminary real estate cost for the proposed Belmont Park Protection Project, located in Warwick, Rhode Island. The effective date of the estimates set forth in this report is August 1981.

SCOPE

Specifically set forth in this report is the estimated values of the land and improvements for two plans of acquisition and two combined plans involving acquisition and Flood Damage Reduction. The plans are identified with accompying requirements as follows:

Plan No.	Requirements	Projected Protection
A-1	Acquisition Land and Improvements	100 Years
A-2	Acquisition Land and Improvements	50 Years
B-1	Acquisition Land and Improvements and Flood Damage Reduction	100 Years
B-2	Acquisition Land and Improvements and Flood Damage Reduction	50 Years

CLARIFICATION OF TERMS

A. Acquisition is outright purchase of an improved or unimproved ownership.

B. Flood Damage Reduction provides for various measures of improvements to certain flood prone structures.

Local interests are required to furnish all lands, easements and rights of way, for the proposed project.

INSPECTION OF THE REAL ESTATE

The properties located within the proposed project area were viewed during the month of August, 1981.

LOCATION AND AREA DATA

The proposed project is located in the Belmont Park section of Warwick, Kent County, Rhode Island. The city of Warwick is adjacent to and south of Cranston and is located on the westerly side of Narragansett Bay, approximately ten (10) miles south of Providence. It is bounded by

Narragansett Bay on the east, by the city of Cranston on the north, by the town of West Warwick on the west and partially by the towns of East Greenwich and North Kingston and by Narragansett Bay on the south.

The population in 1960 was 68,500 and in 1981 it had grown to approximately 90,000 making it one of the fastest growning cities of its size in the United States. Economic development from 1960 through 1981 has grown phenominally. Warwick represents a total investment of approximately $35,000,000 in new plant construction.

Warwick ranks second and is one of Rhode Island's major commercial cities among the thirty-nine cities and towns in the state. Transportation facilities include the Conrail Railroad, major highways for auto, bus and trucks and the Theodore Green Airport. Warwick has 36 miles of shoreline which accommodates several boat yards and marinas for pleasure craft. City water and sewer systems service the area with few exceptions.

LOCATION AND PROJECT DESCRIPTION

The area being proposed for acquisition borders the Pawtuxet River which is the boundary line between the cities of Cranston and Warwick. The Pawtuxet River flows in a easterly direction discharging into the Pawtuxet Cove. The land required for the proposed project consists of residential lots (some with improvements), of varying sizes and shapes and also includes portions of existing public as well as proposed roads.

MINERALS

There are no known mineral deposits having a commercial value within the proposed project area.

GROWING CROPS AND TIMBER

None that contribute any economic value over and above underlying land value. Any tree growth is included in the estimated land value.

IMPROVEMENTS

Improvements within the study area are for the most part single family dwellings with a few two family dwellings.

ZONING

The project area is zoned residential. The residential zoning is RA 7 which requires 70 feet frontage and 7,000 square feet area.

The cited residential zone is superimposed by Special Flood Hazard District.

It is reliably reported that applicants have been denied building permits within the project area due to negative percolation tests.

HIGHEST AND BEST USE

The highest and best use of the ownerships within the project area is considered to be the present use, that of one and two family residences.

RELOCATIONS

The roads in the area will remain in place. Utilities and services will be terminated at the intersection of First Avenue and Wingate Avenue. Utilities and services will contine to be available on Heath Avenue and Wingate Avenue south of First Avenue.

UTILITIES

Electric power and telephone facilities are available to all properties within the proposed area. Sewage facilities are provided by individual owners, through use of private septic tank or cesspool systems. A city water system is available to the properties situated within the proposed project area.

TAX LOSS

Based on discussions with local assessors and a review of the assessment records, the estimated tax loss for each of the four plans follows:

Plan	Estimated Tax Loss
A-1	$45,000
A-2	$41,000
B-1	$25,000
B-2	$20,000

The above estimated tax losses were computed on an average real estate tax levy of about $800 per improved ownership and also includes the real estate tax on unimproved lands.

WATER RIGHTS

There are three residentially improved tracts and four unimproved tracts which are bordered by the Pawtuxet River. Any water rights they currently enjoy would be extinguished by the fee acquisition of those tracts.

RELOCATION ASSISTANCE COSTS

Public Law 91-646, the Uniform Relocation Assistance Act of 1970 provides for uniform and equitable treatment of persons displaced from their homes, businesses, or farms by Federal and Federally assisted programs. In accordance with this law an estimated amount for each of the four alternate plans are included in their respective summary of real estate costs which follows in this report. Included among the reimburseable items under P.L. 91-646 are the following:

a. Moving expenses
b. Replacement Housing (Homeowners)
c. Replacement Housing (Tenants)
d. Relocation Advisory Services
e. Recording Fees
f. Transfer Taxes
g. Mortgage Prepayment Costs (Existing Mortgages unknown)
h. Real Estate Tax Refunds (Pro-rata)

Within a reasonable time prior to displacement, the taking authority must certify that there will be available, in areas generally not less desirable and at rents and prices within the financial means of the families and individuals displaced, decent, safe, and sanitary dwellings, equal in number to the number of, and available to, such displaced persons who require such dwellings and reasonable accessible to their places of employment. Estimates included in accompanying summaries of Real Estate costs.

SEVERANCE DAMAGES

Where only a portion of an ownership is being acquired, the owner is entitled to the market value of the part taken, plus any severance damages to the remaining portion. Severance damage is the loss in value of the remaining parcel after the taking, as compared with the value of the remainder before the taking, when considered as part of the whole. It is anticipated that unimproved lots will be taken in their entirety. Therefore, no severance damages are expected to occur.

CONTINGENCIES

A contingency allowance of 20 percent is considered to be reasonably adequate to provide for possible appreciation of property values from the time of this estimate to acquisition date, for possible minor property line adjustments or for additional hidden ownerships which may be developed by refinement to taking lines, for adverse condemnation awards and to allow for practical and realistic negotiations.

PROTECTION ENHANCEMENT OF CULTURAL ENVIRONMENT

In accordance with instructions set forth in teletype DA (DAEN) R 191306A, dated October 1971, Subject: "E011593, 13 May 1971, Protection and Enhancement of Cultural Environmental": a study has been made in the subject areas. The study revealed that no local, State, Federally owned nor Federally-controlled property of historical significance would fall within the provisions of EO 11593.

GOVERNMENT-OWNED FACILITIES

Section III of the Act of Congress, approved 3 July 1958, (P.L. 85-500) authorized the protection, realteration, reconstruction, relocation or replacement of municipally-owned facilities. There are no such facilities located in the proposed project area.

REPLACEMENT HOUSING SURVEY

A study was conducted in the Warwick area concerning available replacement housing for those residents of the project area. The study revealed that dwellings currently offered on the market were available for sale which ranged in prices from $40,000 to $45,000. All of the houses surveyed were situated outside of flood prone areas. Active knowledgable real estate brokers in the Warwick area were interviewed during the course of this study. Rental units were found to be less available than those units available for purchase. Therefore, should the project become a reality, it is recommended that an updated survey of comparable replacement housing be conducted.

PERSONNEL AND FACILITIES

The real estate acquisition program for the project will be conducted and administered by the local authority of the city of Warwick, Rhode Island. It is contemplated that mapping, survey, legal descriptions, title evidence and appraisals will be obtained by contract. Negotiations and closings, will be accomplished by the proper officials of the city of Warwick. All appraisal contractors would be approved by the New England Division, Corps of Engineers and review of all acquisition appraisals will be conducted by New England Division, Corps of Engineers, Review Appraisers to assure fair and reasonable estimates of value.

EVALUATION ANALYSIS

A careful and thorough search of the city records were made to obtain sales data. Those sales which were considered to be similar in nature and compared favorably to the properties to be acquired were viewed and analyzed. Considerable effort was made to interview either the grantee or participating broker to establish the authenticity of each transaction. In addition, several sales were obtained through local computerized analysis sales reports. All of the sales were inspected in the field.

Knowledge of the real estate market in Warwick was obtained from this study and survey and analysis which forms the basis for estimating the cost of real estate to be acquired within the project area.

Recent transfers of real property, which occurred within the project area, in the vicinity of and outside of the project area were studied and considered in the evaluation of developed homesites, potentially developable homesites, and undeveloped acreage.

All of the improvements and unimproved lands located within the project area have been inspected from the exterior. Several of the owners and tenants were also interviewed.

The following list of sales were selected from the total studied, these are considered to be comparable to the average type of property within the project area.

TABULATION OF SUPPORTING RESIDENTIAL SALES DATA

SALE NO.	GRANTOR	GRANTEE	DATE	AREA (Acres)	SALE PRICE	TYPE PROPERTY	NUMBER OF ROOMS
1.	Brindle	Whelan	9/77	8,000SF	$24,900	1 story Bungalow	5 Rooms
2.	Theriault	Sedgley	5/78	10,000SF	$31,000	Ranch 1 story	5 Rooms
3.	Gilchrest	Gardner	6/79	4,000SF	$33,500	Garrison 2 story	8 Rooms
4.	Rivet	Desmarais	10/79	8,000SF	$32,500	2 story Cape	6 Rooms
5.	Penrotti	Pallotti	11/80	7,000SF	$39,900	2 story Cape - Gar.	4 Rooms
6.	Sarkisian	Neirenckx	11/78	5,000SF	$25,000SF	1 story Bungalow	5 Rooms
7.	Turbitt	Desjarlais	1/78	6,500SF	$27,500	1 story Ranch	5 Rooms
8.	Cambio	Rosa	6/78	3,500SF	$33,000	1 story Ranch	5 1/2 Rooms
9.	Butler	Nicora	8/80	6,500 SF	$38,500	1 story Ranch	6 Rooms
10.	Felber	Santo	10/79	9,000SF	$41,000	1 story Ranch	6 Rooms

SALE NO.	GRANTOR	GRANTEE	DATE	AREA (Acres)	SALE PRICE	TYPE PROPERTY	NUMBER OF ROOMS
11.	Moessner	Leduc	6/81	10,000SF	$44,000	2 story Garrison	7 Rooms
12.	Maggiacomo	Scott	8/77	6,000SF	$38,900	2 story Garrison	8 Rooms
13.	Lord	Wood	1/78	14,000SF	$31,500	1 story Ranch	5 Rooms
14.	Thornley	Carpenter	12/77	10,000SF	$31,000	1 story Ranch	5 Rooms
15.	Coffey	Lincoln	7/78	12,500SF	$28,000	2 story Cape	6 Rooms
16.	Diko	Defusco	8/78	6,600SF	$29,000	Cape	7 Rooms
				LAND ONLY			
1.	Lyons	Connelly	8/76	4,000SF	$2,200	Land only	
2.	Thayer	Lemieux	7/78	4,000SF	$2,500	Land only	
3.	Macklsey	Felici	3/76	10,000SF	$4,900	Land only	

CONCLUSIONS AND SUMMARIES OF REAL ESTATE COSTS

The ownerships to be acquired in fee, as set forth in the following summaries of estimated Real Estate costs are considered to be reasonably accurate. The final determination of the real property to be acquired will be predicated upon the final selection of one of the attached and identified Acquisition Plans. The preferred plan will be known as the Selected Plan of Acquisition.

This property evaluation is based on a knowledge of the general real estate market in this area which was obtained by survey and by analysis. It is predicated, however, on only an exterior inspection of the affected properties and a random interior inspection. The estimated real estate market values and total estimated real estate costs are as follows:

BELMONT PARK PROTECTION PROJECT
100-YEAR PROTECTION PLAN
ACQUISITION

SUMMARY OF ESTIMATED REAL ESTATE COSTS

PLAN - A-1

LAND AND IMPROVEMENTS (Fee Acquisition)

59 Improved Residential Tracts		$1,636,000
Unimproved Land		60,000
City Owned Land		0
Severance Damages		0
	Sub Total	$1,696,000
Contingency (20% of above)		334,000
Total Estimated Cost of Land Improvements		$2,030,000
Relocation Assistance Costs		863,000
Acquisition Costs		207,000
	Sub Total	$3,100,000
Administrative Costs (NEDRE)		100,000
Total Estimated Real Estate Cost		$3,200,000

BELMONT PARK PROTECTION PROJECT
50-YEAR PROTECTION PLAN
ACQUISITION

SUMMARY OF ESTIMATED REAL ESTATE COSTS

PLAN - A-2

LAND AND IMPROVEMENTS (Fee Acquisition)

51 Improved Residential Tracts		$1,403,000
Unimproved Land		59,000
City Owned Land		0
Severance Damages		
	Sub Total	$1,462,000
Contingency (20% of above)		300,800
Total Estimated Cost of Land Improvements		$1,762,800
Relocation Assistance Costs		749,200
Acquisition Costs		183,000
	Sub Total	$2,695,000
Administrative Costs (NEDRE)		75,000
Total Estimated Real Estate Cost		$2,770,000

BELMONT PARK PROTECTION PROJECT
100-YEAR PROTECTION PLAN
FLOOD DAMAGE REDUCTION/ACQUISITION

SUMMARY OF ESTIMATED REAL ESTATE COSTS

PLAN - B-1

LAND AND IMPROVEMENTS

30 Improved Residential Tracts (fee)		$ 799,000
Unimproved Land		57,000
City Owned Land		0
Severance Damages		0
	Sub Total	$ 856,000
Contingency (20% of above)		171,200
Total Estimated Cost of Land Improvements		$1,027,200
Relocation Assistance Costs		421,800
Acquisition Costs		141,000
	Sub Total	$1,590,000
Administrative Costs		100,000
Total Estimated Real Estate Cost		$1,690,000

NOTE: 30 homes to be acquired in fee.
29 homes to be floodproofed.

RECAPITULATION OF REAL ESTATE COSTS

1. Total Estimated Real Estate Costs		$1,690,000
2. Temporary Housing Costs 29 families @ $1700 per family of 4 (1 week)		49,300
TOTAL ESTIMATED PROJECT COST		$1,739,300
	Call	$1,740,000

BELMONT PARK PROTECTION PROJECT
50-YEAR PROTECTION PLAN
FLOOD DAMAGE REDUCTION/ACQUISITION

SUMMARY OF ESTIMATED REAL ESTATE COSTS

PLAN - B-2

LAND AND IMPROVEMENTS

24 Improved Residential Tracts (fee)		$ 640,000
Unimproved Land		41,000
City Owned Land		0
Severance Damages		0
	Sub Total	$ 681,000
Contingency (20% of above)		137,600
Total Estimated Cost of Land Improvements		$ 818,600
Relocation Assistance Costs		333,400
Acquisition Costs		123,000
	Sub Total	$1,275,000
Administrative Costs		75,000
Total Estimated Real Estate Cost		$1,350,000

NOTE: 24 homes to be acquired in fee.
20 homes to be floodproofed.

RECAPITULATION OF REAL ESTATE COSTS

1. Total Estimated Real Estate Costs		$1,350,000
2. Temporary Housing Costs		34,000
20 families @ $1700 per family of 4 (1 week)		
TOTAL ESTIMATED PROJECT COST		$1,384,000
	Call	$1,385,000

APPENDIX 8

STUDY PARTICIPANTS

APPENDIX 8

STUDY PARTICIPANTS

NEW ENGLAND STAFF

Division Engineer
COL C. E. Edgar, III

Planning Division
- Joseph Ignazio, Chief
- Lawrence Bergen, Jr., Deputy Chief
- Carmine Ciriello, Chief, Plan Formulation Branch
- William Swaine, Chief, Special Projects Section

Engineering Division
- Joseph Fryar, Chief
- Dick Reardon, Deputy Chief
- George Sarandis, Chief, Water Control Branch
- Fred Ravens, Chief, Design Branch

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- Morris Phillips, Chief
- William Coke, Chief, Appraisal Branch

Office of Administrative Services
- Henry Gatto, Chief
- Ron McGovern, Chief, Reprographics Branch

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Robert Abbott, Real Estate Studies
William Brown, Real Estate Studies
Charles Freeman, Environmental Assessment
Richard Ring, Economic Analysis
Diana Halas, Social Assessment
John Wilson, Cultural Assessment
Renzo Michielutti, Hydrology and Hydraulics
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Cathy Lee, Design and Cost Estimates
Tim Beauchemin, Geotechnical Engineering Analysis

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Laraine Bogosian	Word Processing
Donna Russell	Word Processing
Lauren Colt	Typing