DELINEATION OF FLOOD HAZARD AREAS

Raritan River Basin

Gift Camden

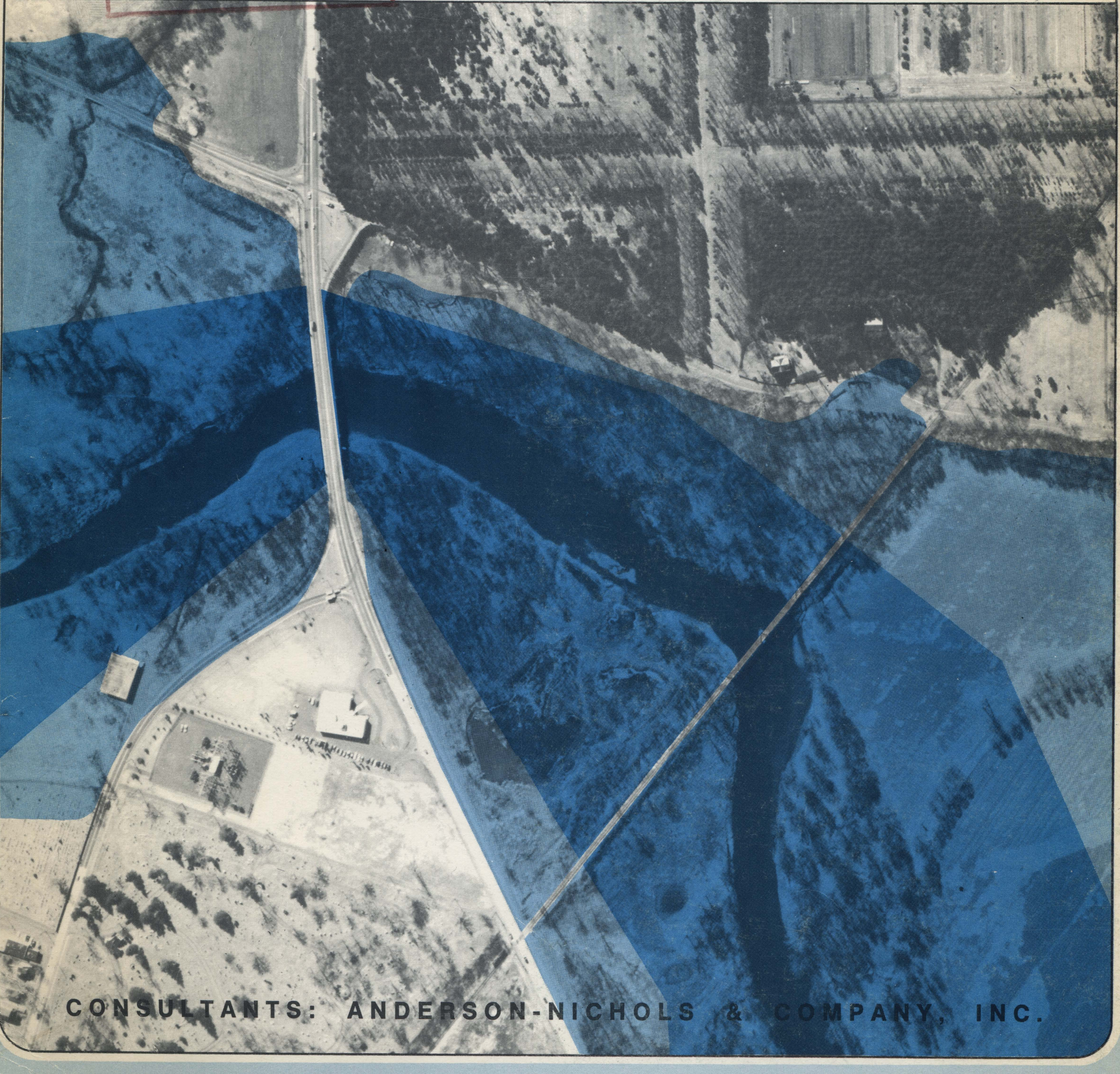
STATE OF NEW JERSEY

Department of
Environmental Protection
Division of Water Resources

NOVEMBER 1972

Flood Hazard Report No. 10

DRAKES BROOK



CONSULTANTS: ANDERSON-NICHOLS & COMPANY, INC.

Flood Hazard
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STATE OF NEW JERSEY

DEPARTMENT OF ENVIRONMENTAL PROTECTION
Richard J. Sullivan, Commissioner

DIVISION OF WATER RESOURCES
Charles M. Pike, Director

BUREAU OF WATER CONTROL
Dirk C. Hofman, Chief

FLOODPLAIN MANAGEMENT SECTION
Nazir Baig, Principal Hydraulic Engineer

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Boston, Massachusetts 02114

TABLE OF CONTENTS

EXHIBITS

FIGURES

TABLES

PLATES

PREFACE

A significant amount of information is available concerning FLOODS AND POTENTIAL FLOOD HAZARDS. To date, very little of this valuable information has been made available, in meaningful form, to local community governments – the level which can use the information to best advantage.

To remedy this situation, as a part of their overall floodplain management program, the Division of Water Resources of the New Jersey Department of Environmental Protection has initiated a Statewide Program of Flood Hazard Area Delineation under authority of Chapter 19, Public Law 1962, 58:16A (50-54). The Division has been empowered to prepare maps showing areas subject to flooding and to mark such areas in the field so that public agencies, private organizations and citizens may be adequately alerted to the inherent danger to the safety, health, and general welfare involved in improper development of flood hazard areas. A further objective is to reduce future increased governmental expenditures for the construction of flood control structures to protect property unwisely located in flood hazard areas.

In response to requests of officials of municipalities in the Raritan River Basin, the implementation of the Statewide Program was undertaken. The delineation of the flood hazard areas is intended to facilitate planning and regulations by the community to achieve intelligent utilization of its water and related land resources.

This report was prepared as part of the requirements of Contract W. R. No. 22 as amended between the State of New Jersey Department of Conservation and Economic Development, Division of Water Policy & Supply (now known as the Department of Environmental Protection, Division of Water Resources) and Anderson-Nichols & Company, Inc., of Boston, Massachusetts. This contract was entered into on February 16, 1968, under the authority vested in the Division of Water Resources by NJSA 58:16A-50 et. seq. (an act concerning the delineation and marking of flood hazard areas) to delineate and mark flood hazard areas and to coordinate effectively the development, dissemination and use of information on floods and flood damage.

The work under this contract was commenced under the overall supervision of Mr. George R. Shanklin, Director and Chief Engineer, Division of Water Policy & Supply and continues under the overall supervision of Mr. Charles M. Pike, Director, Division of Water Resources, with the general supervision provided by Mr. Robert E. Cyphers, Chief of the Bureau of Planning and Management.

The direct supervision and coordination for the State was provided by Mr. Dirk C. Hofman, Chief, Bureau of Water Control, assisted by Mr. Nazir Baig, Principal Hydraulic Engineer, Floodplain Management Section, with the direct supervision and coordination for Anderson-Nichols & Company, Inc. provided by Mr. Jerome Degen, Senior Vice President, and Mr. Robert G. Field, Vice President.

The thoughts and assistance of others in the preparation of the data contained in this report are greatly appreciated. Special thanks is extended to the staff of the Trenton office of the U. S. Geological Survey and the Floodplain Management Section of the New York District of the U. S. Army Corps of Engineers.

HURRICANE DORIA (Aug. 1971) *Photo Courtesy : Paterson Evening News*

INTRODUCTION

GENERAL

A flood damage problem of staggering proportions exists today in parts of New Jersey. The problem has resulted over the years from continuing improper development by man in flood hazard areas. All areas of the State will undoubtedly be subject to far greater pressures for increased land utilization to meet the needs of an expanding population. The flood damage problem will be greatly aggravated unless intelligent land use is made of flood hazard areas throughout the State.

Two major factors have, in the past, been primarily responsible for New Jersey's large flood damage potential. Many people chose to develop land near a river, totally unaware that this normally peaceful neighbor, during time of flood, is capable of widespread damage and destruction. A far smaller group, planners and local officials, recognized the river to be a dangerous neighbor, like a temporarily inactive volcano. However, they lacked specific information concerning the extent of the flood hazard area and were unable to plan or regulate the proper use of the area.

NATURE AND OBJECTIVES

Floodplain management includes a full range of tools, programs and policies all working harmoniously together toward a common goal — flood damage prevention. These tools, programs, and policies include a broad range of alternatives such as those illustrated on Exhibit A.

The comprehensive floodplain management program initiated by the State of New Jersey is a continuing program of:

a. Collection and analysis of data
b. Planning
c. Evaluating in an unbiased manner the full range of alternative measures or combinations for reducing future flood damages
d. Coordinating the activities of various levels of government
e. Implementing both structural and non-structural flood damage reduction measures
f. Disseminating vital information
g. Providing advice and assistance to county and local governments and interested individuals

Some of the specific flood damage-prevention objectives of floodplain management include the following:

a. Protection to human life, health and general welfare of the public
b. Prohibition of floodplain uses such as fill, dumping, storage of materials, structures, buildings and any other works which, acting alone or in combination with other existing or future uses, will increase potential flood heights and velocities by obstruction to flows and loss of valley storage.
c. Minimization of public and private property damage.
d. Minimization of surface and ground-water pollution which will affect human, animal or plant life.
e. Control of development which, acting alone or in combination with similar developments, will create an additional demand for public investment in flood control works.
f. Control of development which, acting alone or in combination with similar development, will create an additional burden on the public to pay the costs of rescue, relief, emergency preparedness measures, sandbagging, pumping and temporary dikes or levees.
g. Control of development which acting alone or in combination with similar development, will create an additional cost burden on the public because of business interruptions, factory closings, disruption of transportation routes, interference with utility services and other factors that result in loss of wages, sales and production.
h. Provisions for public awareness of the flooding potential and to discourage the victimization of unwary land and home buyers.
i. Maintenance of a stable tax base through the protection or enhancement of property values for future floodplain development. In addition, development of future flood blight areas on floodplains will be minimized and property values and the tax base adjacent to the flood plain will be preserved.
j. Protect and enhance the environmental integrity of the area.

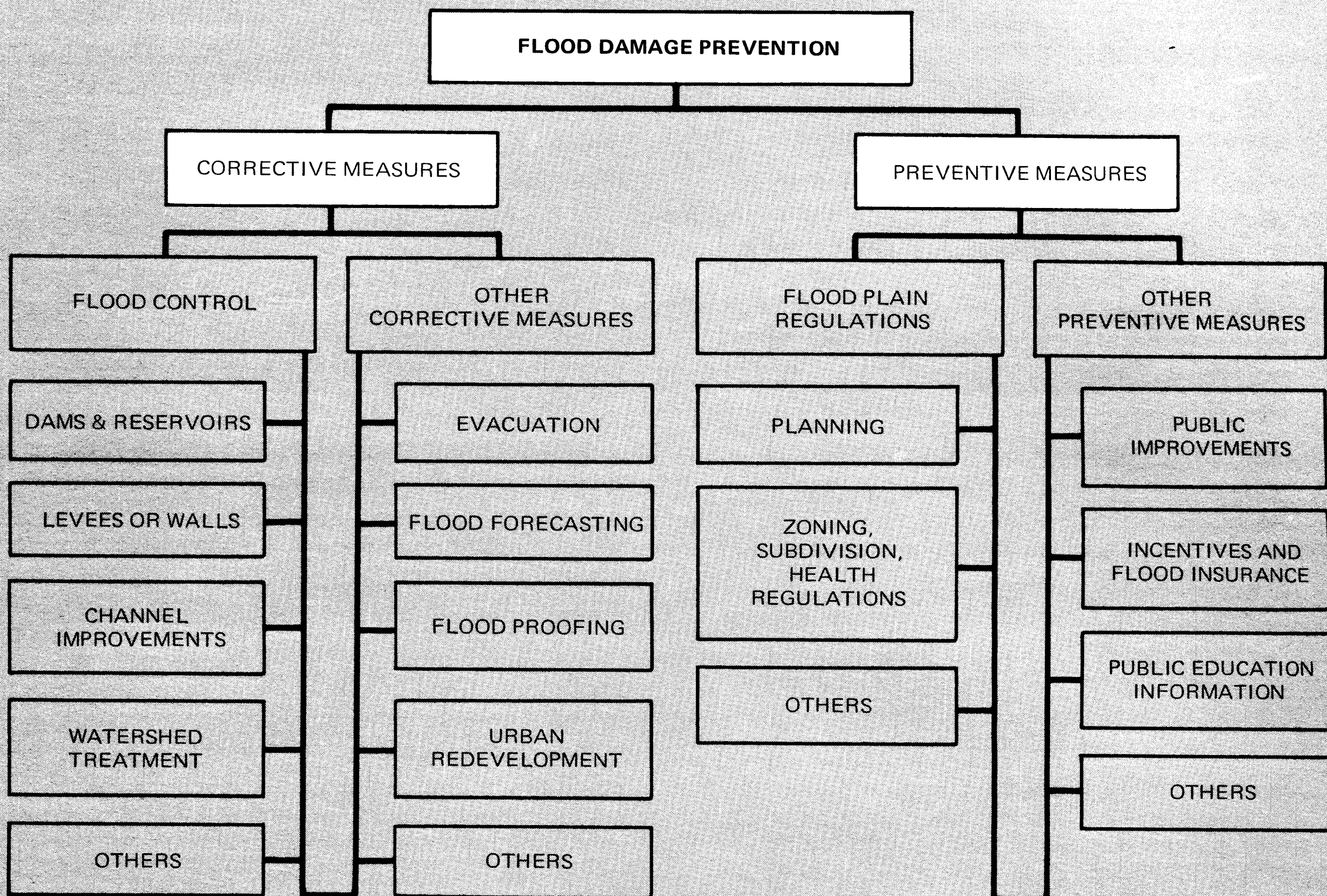


EXHIBIT A – CORRECTIVE AND PREVENTIVE MEASURES FOR FLOOD DAMAGE PREVENTION

PURPOSE

The purpose of this report, undertaken as part of the Statewide Floodplain Management Program, is to assist communities in achieving wise utilization of their flood prone areas.

The initial step in the Floodplain Management Program is the delineation of the flood hazard areas. This report presents a section describing the general flood damage situation – to promote greater public understanding and awareness, a section describing the Raritan River Basin and a section describing the procedures and mapping of the delineation of the flood hazard areas.

Future flood damages can be significantly reduced by preventive actions ***before*** the next major flood occurs. This requires the cooperative efforts of the State and the communities. This report and its accompanying drawings provide the communities detailed information concerning flood elevations and the areas inundated (Flood Hazard Areas). The communities should use this information in land use planning and regulations to assure the proper use of the flood hazard areas.

Section I

THE FLOOD DAMAGE SITUATION

THE FLOOD DAMAGE SITUATION

Floods are natural phenomena resulting from excessive amounts of precipitation! When the run-off exceeds the capacity of the rivers and streams, the adjacent lands are flooded. Major floods have occurred throughout New Jersey — and will continue to occur ***periodically*** in the future.

Flood damages, however, are a consequence of man's unwise development on these adjacent lands — in the path of floods! New Jersey is the most densely populated and urbanized state in the Nation. Existing homes, businesses and industries built in flood hazard areas are subject to flood damages of alarming proportions. In contrast to the sparse development and agricultural economy of the early settlers, we live in a complex interrelated society. As such, floods no longer affect only those properties situated in the hazard areas. Loss of taxes, jobs, revenue and services have a serious economic impact on residents of the community, region and State.

Future flood damages can be significantly reduced by proper development. Greater public awareness of both the flood damage problem and the solution is essential in view of the current trend of increasing population and further urbanization. The following narrative and graphic presentation was developed to assist the communities in achieving this greater public awareness and understanding.

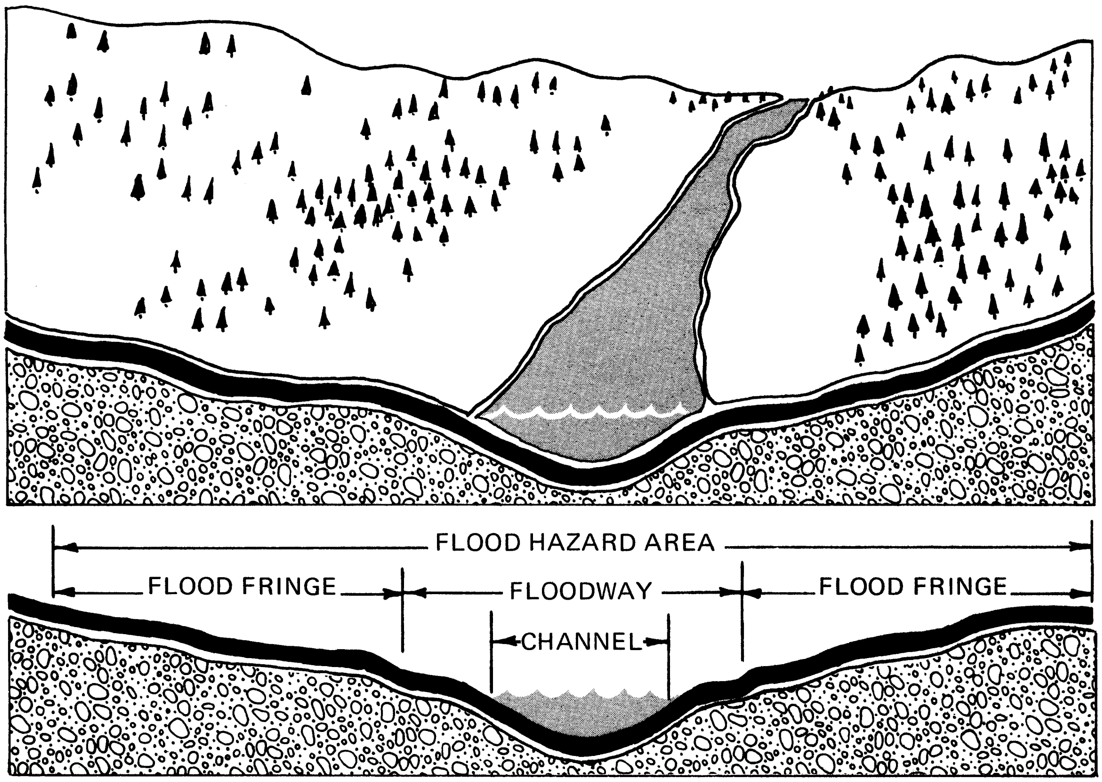


EXHIBIT I-1 NATURAL VALLEY SEGMENT

New Jersey's main rivers and principal tributaries were formed by nature and geologically consist of a channel and relatively flat adjacent areas called floodplains. The channel, as eroded over many years, conveys the normal flow of the river. During flood periods, the flow exceeds the capacity of the channel and inundates the overbank or flood hazard area; thus the entire valley is utilized by nature to carry the flood flows. The flood hazard area is made up of the Floodway and the Flood Fringe. In actuality, the channel and portions of the immediately adjacent overbank (Floodway) carry the major portion of the flood flow with correspondingly greater depths and higher velocities. As such the Floodway constitutes a ***high energy zone.*** The Flood Fringe area is inundated to a lesser degree and the velocities are not as high as those in the Floodway. This area constitutes a ***lower energy zone*** where inundation is the major problem. Some natural valley segments still exist at present in New Jersey. Unfortunately, many have been improperly developed and many more are rapidly being developed with no regard to the potential flood perils.

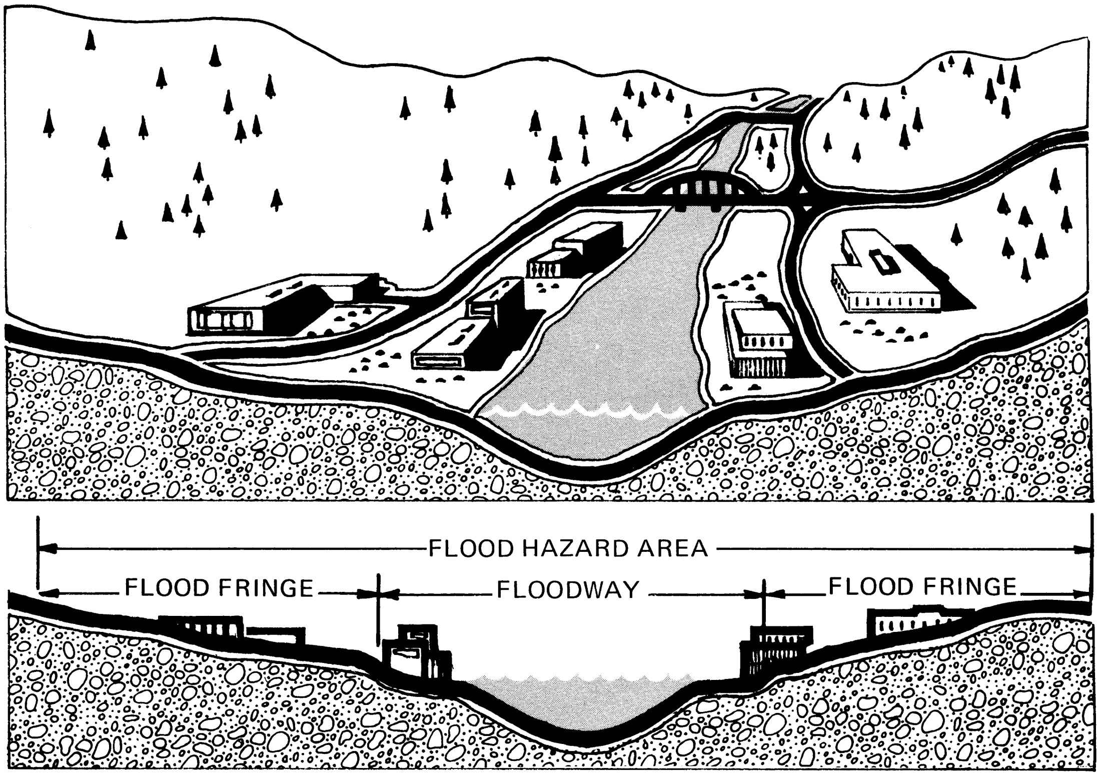


EXHIBIT I-2 DEVELOPED VALLEY SEGMENT

Dating back to his beginning, man has been attracted to floodplains. Initially, the fertile soil and flat terrain adjacent to streams supported man's agricultural needs.

With the advent of the industrial age, the river's usefulness as a means of transportation, a supplier of power, and a receptacle for wastes enticed man and industry to locate on floodplains. Subsidiary industries, businesses and services served the basic industry, and population increased. The communities expanded into towns, towns into cities, and cities into a megalopolis with highways and railroads to serve them. Nature is capricious – her extremes, both flood and drought, do not occur at any regular interval but both have and will occur in varying intensities.

Floods are natural phenomena whereas ***flood damages*** are the result of man's unwise developments in flood hazard areas.

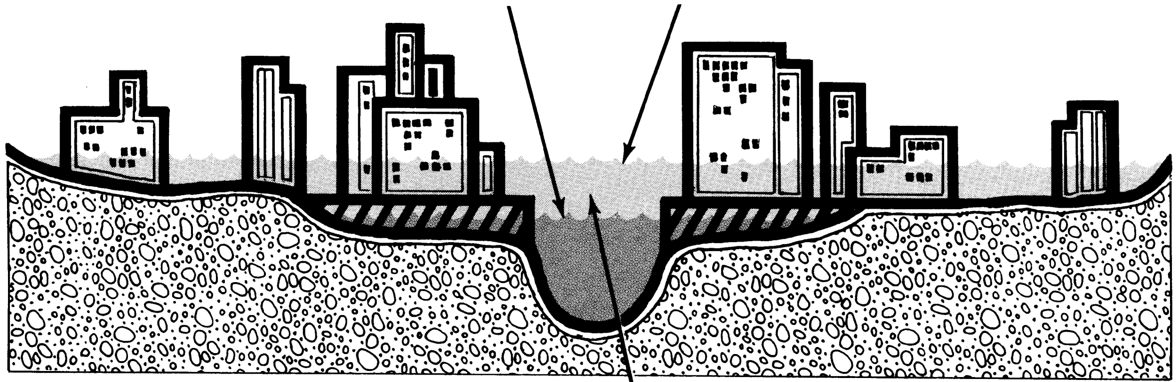


EXHIBIT I-3 EFFECTS OF IMPROPER DEVELOPMENT OF A FLOODPLAIN

Urbanization and industrialization have taken place over many years and are continuing. This invasion of nature's floodways has many detrimental effects during flood periods. As fill material (see hatched areas) is placed and buildings erected, the waterway area is reduced and the flow is obstructed. The result, similar to a large rock dropped into a full bucket of water, raises the water surface elevations of all future flood flows with increased widespread inundation. This inundation can affect not only the "offenders" but properties both upstream and downstream – and this effect multiplied several times along an urbanized reach of river results in flood damages of major proportions.

Unfortunately, the flood damages are shared by the community, region, state and Federal governments, as well as the owners of the flood ravaged property. This raises some interesting questions:

1. By his unwise actions, does an individual have the right to risk the safety and capital of others?
2. Is this individual by his actions, financially responsible for damages resulting to others?
3. Should not the local governing body protect the community against detrimental actions by individuals in flood hazard areas before the next major flood occurs?
4. Since one community cannot impose regulations outside of its geographic limits, should not the State protect one community against detrimental actions by another community?

Floods are as old as the world but ***flood damages*** are only as old as man!

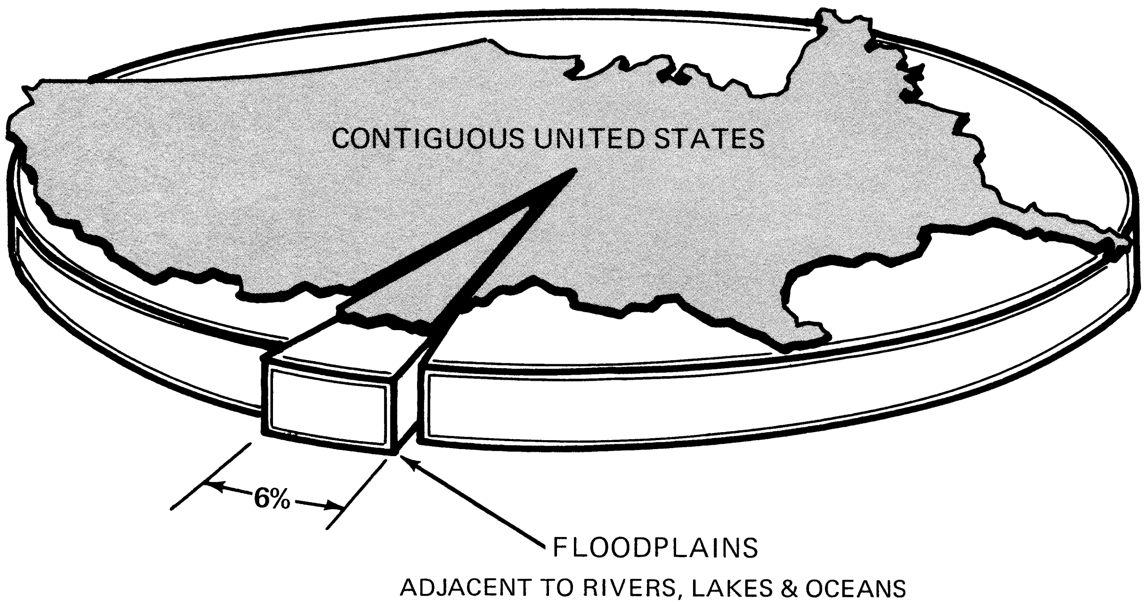


EXHIBIT I-4 FLOOD HAZARD AREAS IN THE UNITED STATES

Of the total land areas of the United States, (excluding Alaska and Hawaii), the floodplains adjacent to our rivers, lakes and oceans, constitute a mere 6 percent. Within this small portion of the nation are situated most of the largest cities — areas of highly concentrated flood damages. It is estimated that New Jersey's floodplains represent a figure somewhat greater than 6 percent.

There is every indication that urbanization will continue to increase throughout our State. With proper planning, we can reduce the potential future flood damage as well as accommodate this urbanization and industrial growth.

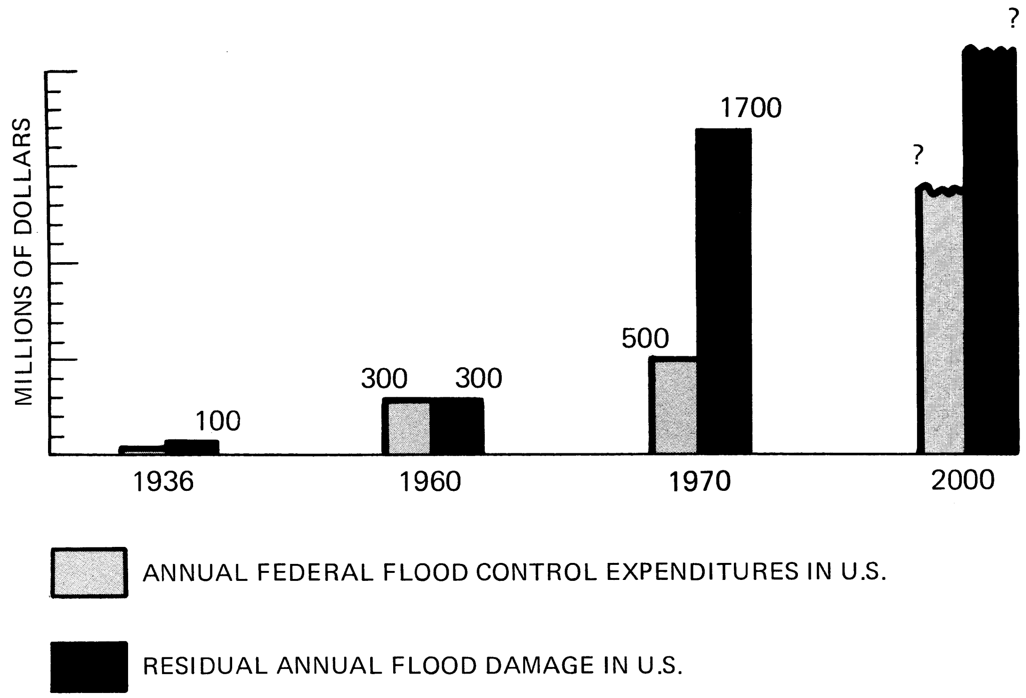


EXHIBIT I-5 GROWTH OF FLOOD CONTROL EXPENDITURES AND RESIDUAL FLOOD DAMAGE

The growth of flood damage throughout the nation has reached rather astronomical proportions. The exhibit indicates ***annual Federal*** flood control expenditures for dams, dikes, walls, channel improvements and diversion structures and the ***residual annual*** flood damages sustained ***after*** construction of the structural measures.

In 1936, when Congress authorized nationwide Federal participation in flood control works, the annual expenditures were somewhat minimal while the nationwide flood damage was 100 million dollars. By 1960, the Federal expenditures averaged 300 million dollars per ***year*** while the ***residual annual*** damage had climbed to 300 million dollars. In 1970, Federal expenditures were 500 million dollars and ***residual*** flood damages had reached ***one billion, seven hundred million dollars annually*** — all occurring in but 6 percent of our country.

The relative growth rates indicate a losing battle waged by structural measures alone — so by the year 2000, the figures are anyone's guess. To date, more than seven billion dollars have been expended for Federal flood control structures throughout the nation.

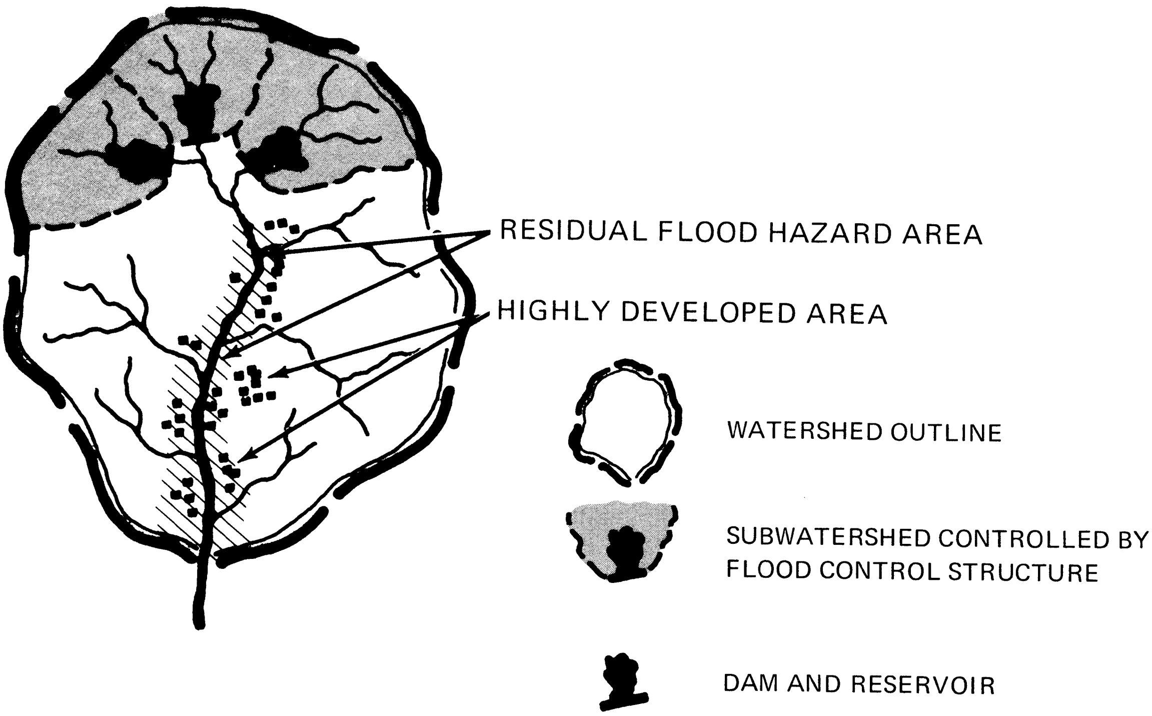


EXHIBIT I-6 TYPICAL WATERSHED MAP

This exhibit illustrates the problem faced by the floodplain management engineer in a structural program. The periphery indicates the ridge line or watershed outline and the irregular lines indicate the brooks, streams, and tributaries which drain the storm runoff into the main river. Along the main river (and the lower portion of the principal tributaries) are located the broad flat floodplains which are so attractive for man's development. After development has occurred, and particularly after a flood causing great damages, the need for flood protection becomes more apparent to all concerned.

A dam and reservoir situated immediately upstream from a damage center would be highly effective but land costs and existing development upstream of the dam usually preclude the economic feasibility of a main river dam. Therefore, it becomes necessary to find feasible dam sites on upstream tributaries. The three dams indicated on the exhibit effectively control flood runoff from the drainage areas upstream of the dams (shaded areas). A high degree of flood protection is afforded immediately downstream from the dams, but runoff from the uncontrolled (white) drainage areas can result in downstream flooding. The flood control effectiveness of these reservoirs thus decreases with the distance (and uncontrolled drainage area) downstream from the dam. The result — a residual flood hazard area along the main river. Dikes, floodwalls, channel improvements (Local Protection Measures) are sometimes feasible to protect localized flood hazard areas but are quite costly and not always esthetic.

Experience indicates that considerable time elapses between the initiation of detailed investigations and the actual construction of flood control facilities.

It appears neither desirable nor economically sound to provide local protection for ***all flood hazard areas.***

- *IGNORANCE* OF FLOOD HAZARD!
- *"IT WON'T HAPPEN TO ME"* ATTITUDE!
- *ESTHETIC* ATTRACTION OF LOCATING NEAR WATER!
- *OTHER* STRUCTURES ALREADY SITUATED ON FLOODPLAIN!
- *WILLINGNESS* TO ACCEPT CALCULATED RISK!
- *FALSE* SENSE OF SECURITY ASSOCIATED WITH UPSTREAM FLOOD CONTROL MEASURES!
- *ANTICIPATION* OF FUTURE FEDERAL FLOOD CONTROL MEASURES!
- *PROFIT MOTIVATION* BY CALCULATING LAND SPECULATOR SELLING TO UNSUSPECTING BUYER
- *AVAILABILITY* OF WATER, SEWER, AND OTHER UTILITIES SITUATED IN UNDERDEVELOPED FLOODPLAIN!

EXHIBIT I-7 FACTORS CONTRIBUTING TO IMPROPER FLOODPLAIN USE

Man has experienced much suffering, inconvenience and financial loss from his ***unwise use of nature's floodplains.*** This exhibit indicates some of man's principle motivations for occupying flood hazard areas. Since flood losses are not borne by the individual alone, each in itself is important. The first – ***ignorance*** – and the last – ***availability of utilities*** – show the complete lack of recognition of flood hazards. Ignorance on the part of an individual in our complex society may be forgiven and the situation remedied by making facts available.

By the construction of utilities in floodplains in the absence of sound land use regulations, land values are enhanced and development is actually encouraged in flood hazard areas. Since improper floodplain development is definitely not in the public interest, the situation should be remedied as a function of government.

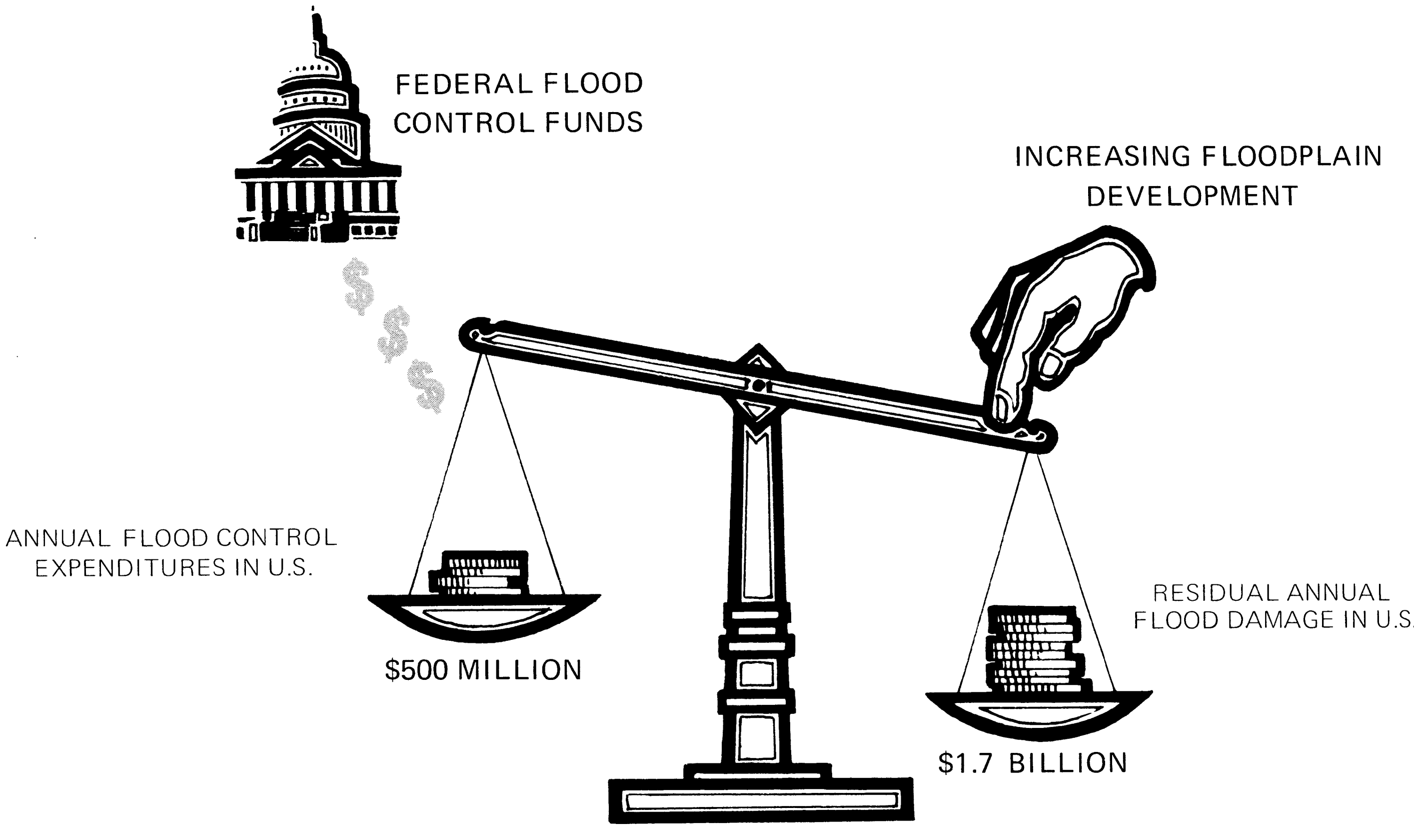


EXHIBIT I-8 ANNUAL EXPENDITURES VS RESIDUAL FLOOD DAMAGES

This exhibit portrays the present national situation of annual flood control expenditures, residual annual damages and the unbalancing force — increasing floodplain development. New Jersey is presently experiencing strong indications of continued growing development and should achieve wise utilization of its floodplains throughout the State.

Compared with other states, Federal flood control expenditures in New Jersey have been minimal and increasing floodplain development maximal.

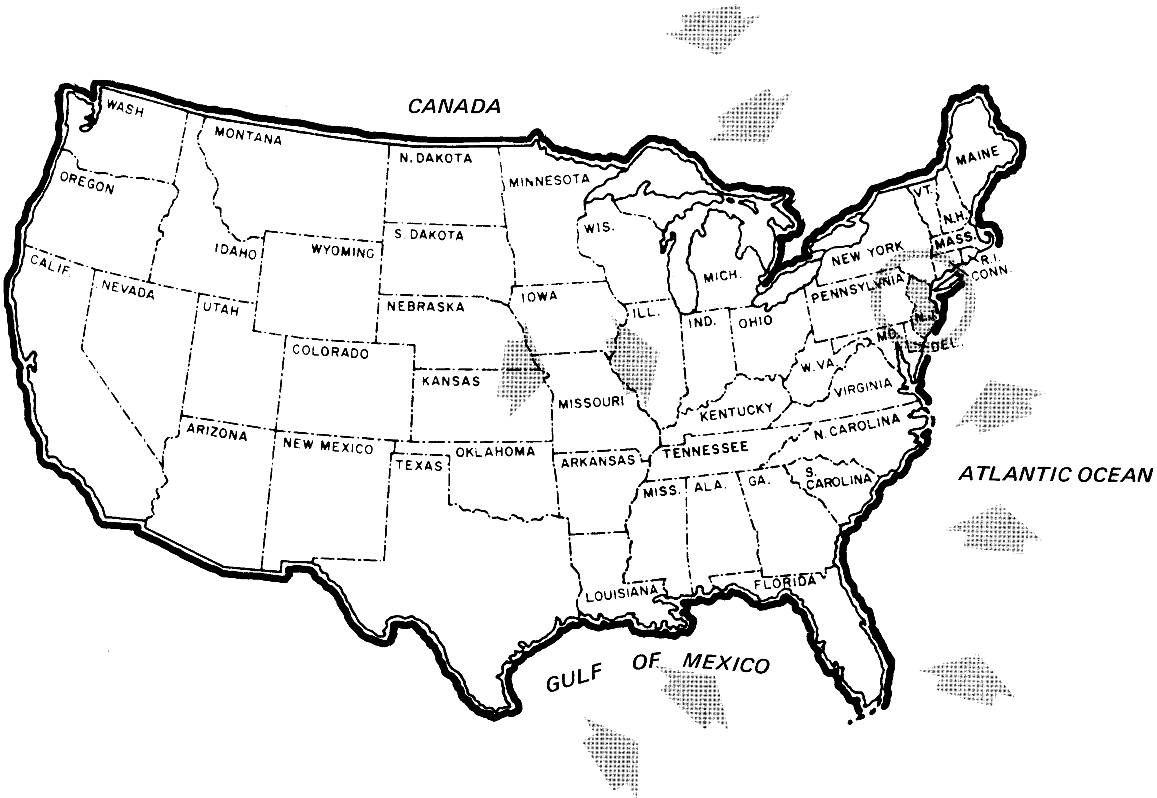
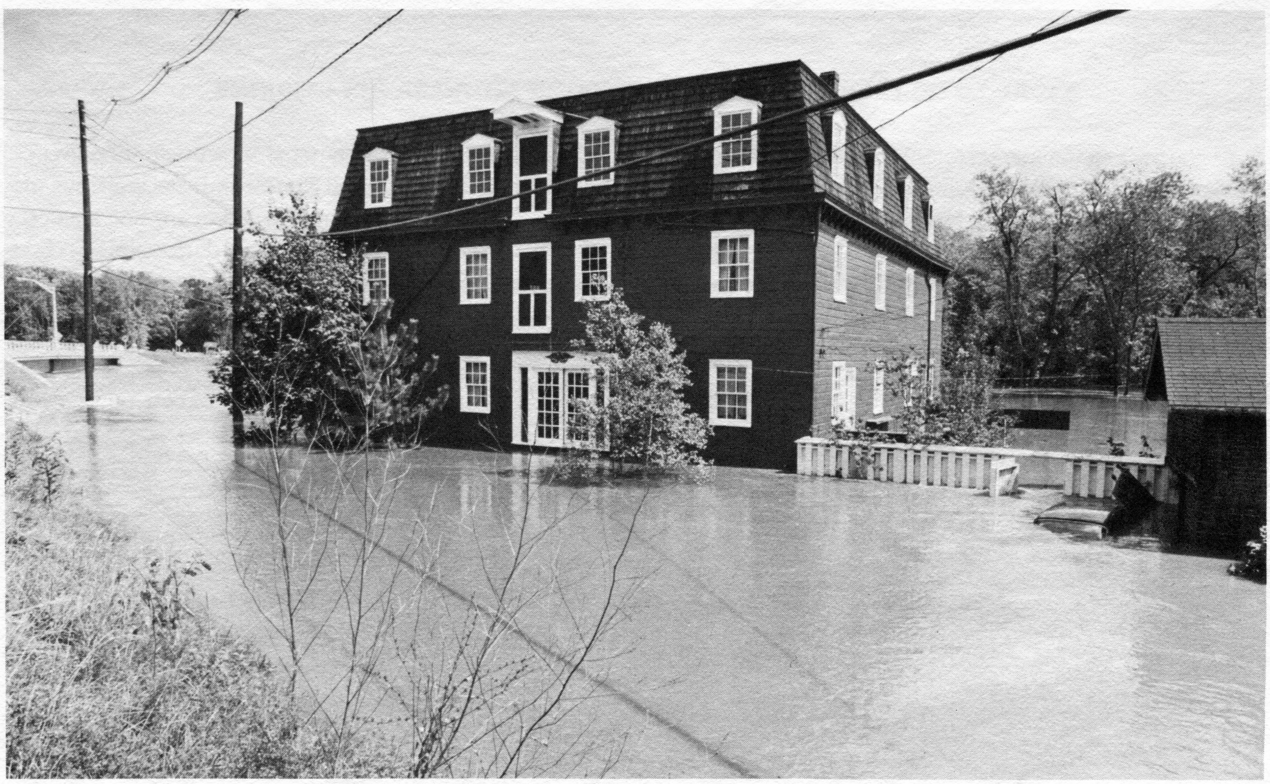


EXHIBIT I-9 FLOOD PRODUCING STORM PATHS

In contrast to the many states located elsewhere in the nation, New Jersey is situated in a "corridor" of major storm paths. As such, New Jersey can be expected to experience flood producing storms originating from many locations. The exhibit illustrates this somewhat unique situation. The storms include tropical hurricanes originating off the Carolinas; Gulf of Mexico storms; continental storms originating over land areas of the United States; and over portions of Canada and polar regions.

New Jersey's flood experience during the past 60 years is far below its potential, a fact which must not be overlooked.


HURRICANE DORIA (Aug. 1971) *Photo Courtesy : The News Tribune*


HURRICANE DORIA (Aug. 1971) *Photo Courtesy : Stony Brook-Millstone Watershed Association*

Section II

THE RARITAN RIVER BASIN

RARITAN RIVER BASIN

GENERAL

With the acceptance of Flood Hazard Report No. 1 on a 10.6 mile length of the Stony Brook tributary of the Millstone River in Princeton Township, a basin-wide study was initiated on the principal streams in the Raritan River Basin. Figure II-1 indicates the basin and its geographic location in the State. The initial phase included fifteen streams covering 265 lineal stream miles within the basin. The Division of Water Resources, however, was petitioned by several local agencies which requested that additional streams be included in the study. Subsequently, an additional 15 streams covering 66 lineal stream miles were added to the current study. This resulted in a total of 333 lineal stream miles within the Raritan River Basin to be delineated. The stream system included in the basin study is shown on Figure II-2. As the State's flood-plain management program expands, delineation of additional areas will be undertaken. The Water Policy and Supply Council intends to regulate development of the type that would restrict the water carrying capacity of the defined Floodway and create potential hazards of flooding. It is envisioned that individual ***communities will regulate the type and manner of development within the Flood Fringe Area.***

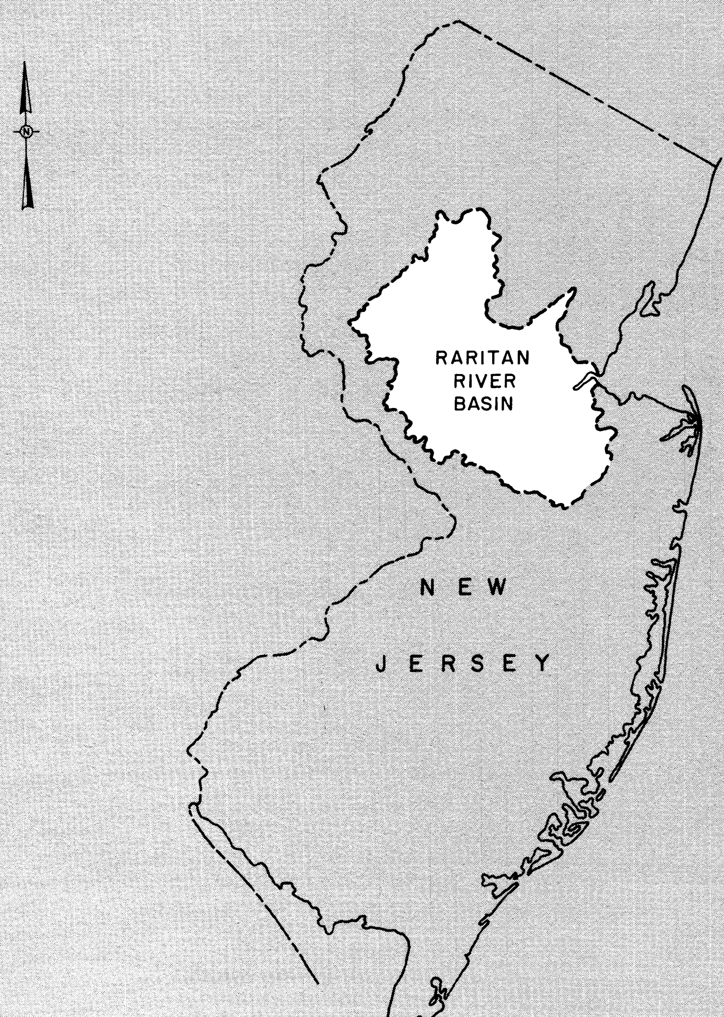


FIGURE II-1

LOCATION MAP
RARITAN RIVER BASIN

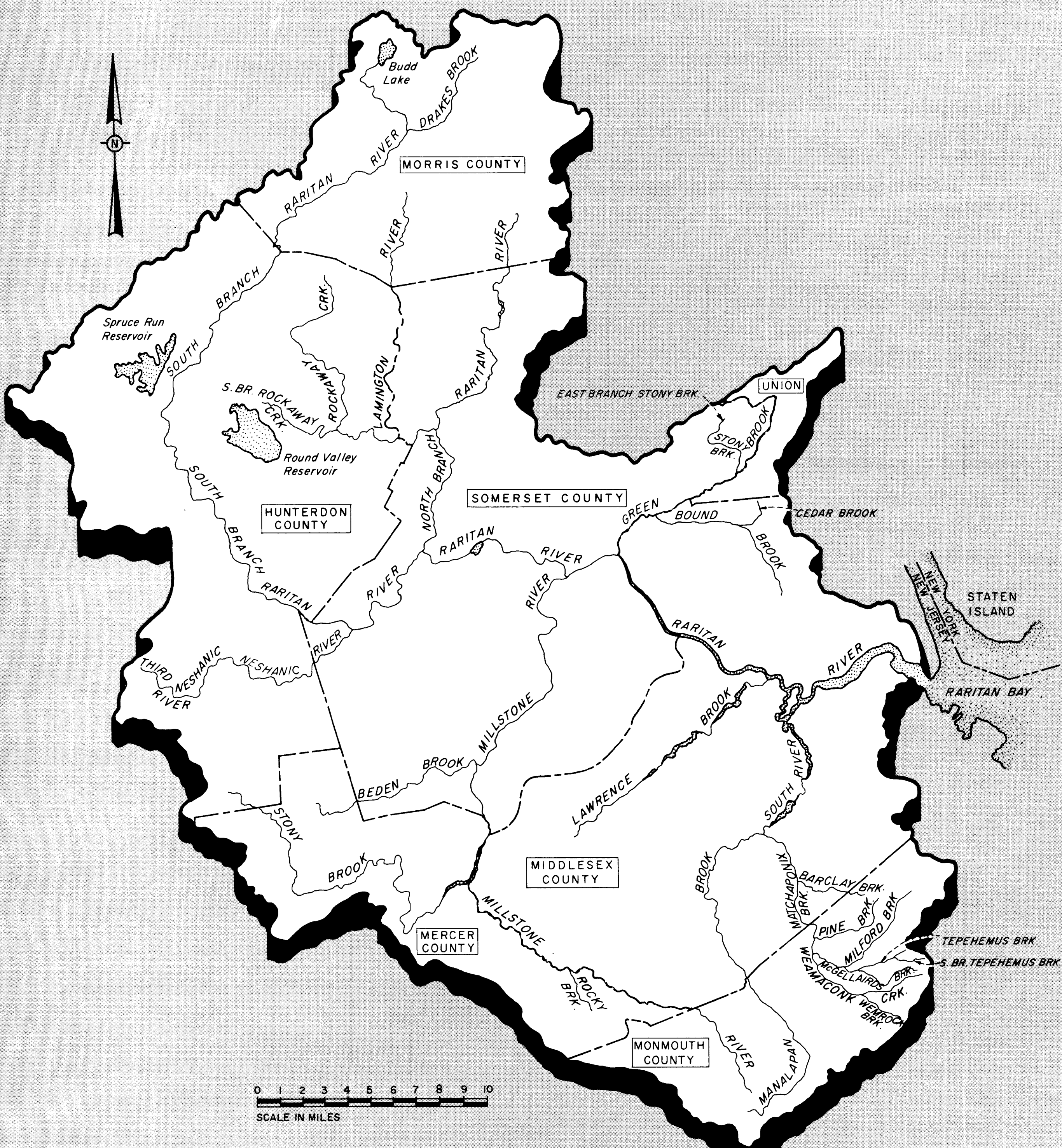


FIGURE II-2

RARITAN RIVER BASIN MAP

SCOPE OF INVESTIGATION

The extent of the investigation of the Flood Hazard Areas within the 1100 square mile Raritan River Basin covers 30 streams with 333 lineal stream miles of floodplains. The detail study area of these 30 streams range in length from the one-mile long East Branch Stony Brook in the Green Brook subwatershed to the 51-mile long South Branch Raritan River. The investigation covers the Raritan River and the following six major subwatersheds.

South Branch Raritan River
North Branch Raritan River
Millstone River
Green Brook
Lawrence Brook
South River

Ninety-eight municipalities are located within the Raritan River Basin. The floodplains of these thirty streams inundate portions of seventy-three municipalities within seven of the State's 21 counties. Listed in Table II-1 by county are the municipalities included in the current Raritan River Basin Study.

TABLE II-1 MUNICIPALITIES RARITAN RIVER BASIN

HUNTERDON COUNTY (11)

CALIFON BOROUGH, CLINTON TOWN, CLINTON TWP., DELAWARE TWP., EAST AMWELL TWP., FRANKLIN TWP., HIGH BRIDGE BOROUGH, LEBANON TWP., RARITAN TWP., READINGTON TWP., TEWKSBURY TWP.

MERCER COUNTY (8)

EAST WINDSOR TWP., HIGHTSTOWN BOROUGH, HOPEWELL BOROUGH, HOPEWELL TWP., LAWRENCE TWP., PENNINGTON BOROUGH, PRINCETON TWP., WEST WINDSOR TWP.

MIDDLESEX COUNTY (24)

CRANBURY TWP., DUNELLEN BOROUGH, EAST BRUNSWICK TWP., EDISON TWP., HELMETTA BOROUGH, HIGHLAND PARK BOROUGH, JAMESBURG BOROUGH, MADISON TWP., METUCHEN BOROUGH, MIDDLESEX BOROUGH, MILLTOWN BOROUGH, MONROE TWP., NEW BRUNSWICK CITY, NORTH BRUNSWICK TWP., PERTH AMBOY CITY, PISCATAWAY TWP., PLAINSBORO TWP., SAYREVILLE BOROUGH, SOUTH AMBOY CITY, SOUTH BRUNSWICK TWP., SOUTH PLAINFIELD BOROUGH, SOUTH RIVER BOROUGH, SPOTSWOOD BOROUGH, WOODBRIDGE TWP.

MONMOUTH COUNTY (5)

ENGLISHTOWN BOROUGH, FREEHOLD TWP., MANALAPAN TWP., MARLBORO TWP., MILLSTOWN TWP.

MORRIS COUNTY (4)

MENDHAM TWP., MOUNT OLIVE TWP., ROXBURY TWP., WASHINGTON TWP.

SOMMERSET COUNTY (19)

BEDMINSTER TWP., BERNARDSVILLE BOROUGH, BOUND BROOK BOROUGH, BRANCHBURG TWP., BRIDGEWATER TWP.,FAR HILLS BOROUGH, FRANKLIN TWP., GREEN BROOK TWP., HILLSBOROUGH TWP., MANVILLE BOROUGH, MILLSTONE BOROUGH, MONTGOMERY TWP., NORTH PLAINFIELD BOROUGH, PEAPACK-GLADSTONE BOROUGH, RARITAN BOROUGH, ROCKY HILL BOROUGH, SOMERVILLE BOROUGH, SOUTH BOUND BROOK BOROUGH, WATCHUNG BOROUGH

UNION COUNTY (2)

PLAINFIELD CITY, SCOTCH PLAINS TWP.

MAPS AND DATA

The essential part of the Floodplain Management program is the delineation of the flooded area on topographic maps of adequate scale. New topographic data from aerial photogrammetry were compiled for the major part of this investigation by Quinn and Associates at a scale of 1″ = 200′ with a five-foot contour inverval. Topographic maps for 34.8 miles of the Raritan River Basin study stream system utilized mapping at scales of 1″ = 200′, 1″ = 400′, 1″ = 800′ with two- and five-foot contour intervals provided by the New Jersey Division of Water Resources. All maps and data presented herein were developed according to the standard specifications utilized for such work and are referenced to Mean Sea Level Datum and the New Jersey Rectangular Coordinate System.

Field instrument surveys were performed by Van Note-Harvey Associates to obtain channel cross sections at selected locations on the Raritan River and its tributaries where computerized water surface profiles were developed.

Also utilized in the investigation were Floodplain Information reports by the U.S. Army Corps of Engineers and the Extent and Frequency of Inundation reports by the U.S. Geological Survey. Data developed for the preparation of the following published reports were used in the Raritan River Basin study:

CORPS OF ENGINEERS – FLOODPLAIN INFORMATION STUDIES

1. North Branch Raritan River and Lamington River — April 1969
2. South Branch Raritan River, Branchburg, New Jersey — March 1969
3. South Branch Raritan River, Raritan and Readington Townships, New Jersey — May 1969
4. South Branch Raritan River, Franklin and Clinton Townships, New Jersey — May 1969
5. South Branch Raritan River, Highbridge and Califon, New Jersey — Feb. 1970

GEOLOGICAL SURVEY – REPORTS

1. Extent and Frequency of Inundation of Floodplain near Raritan, New Jersey, by R. H. Tice – March 1959. (Open File)
2. Extent and Frequency of Inundation of Floodplain in Vicinity of Somerville and Manville, New Jersey, by D. M. Thomas – December 1960. (Open File)
3. Extent and Frequency of Inundation of Floodplain in Vicinity of Bound Brook in Somerset and Middlesex Counties, New Jersey, by D. M. Thomas – November 1961. (Open File)
4. Extent and Frequency of Inundation of Millstone River Floodplain in Somerset County, New Jersey, by D. M. Thomas – February 1962. (Open File)
5. Extent and Frequency of Inundation of Floodplain in Vicinity of Princeton, New Jersey, by J. A. Bettendorf – January 1966.
6. Extent and Frequency of Floods in Upper Millstone River Basin in the vicinity of Hightstown, New Jersey, by G. M. Farlekas – February 1969.
7. Extent and Frequency of Floods in the Beden Brook Basin in Somerset and Mercer Counties, New Jersey, by T. G. Ross – June 1969.

The information contained in the above reports was used to the extent applicable in facilitating the development of the water surface profiles for Floodway and Flood Hazard Area design floods.

In the development of the hydrologic data for the basin, the Geological Survey Report "Floods in New Jersey – Magnitude and Frequency" Water Resources Circular 13, by D. M. Thomas, 1964, served as the basic foundation.

DESCRIPTION OF THE BASIN

The Raritan River Basin is situated in the northern half of New Jersey and drains an area of approximately 1,100 square miles. (See Figures II-1 & 2) The six major subwatersheds that feed into the 30.6-mile-long main stem of the Raritan River are the North and South Branch Raritan Rivers, Millstone River, Green Brook, Lawrence Brook and the South River.

The North and South Branch Raritan Rivers with their tributaries – Lamington River, Rockaway Creek, South Branch Rockaway Creek, Neshanic River, Third Neshanic River and Drakes Brook – drain the northern 463 square miles of the basin. The South Branch flows generally south and east and merges with the North Branch, which flows generally south and west, to form the main stem of the Raritan River. Within the South Branch Raritan River drainage basin are located the Round Valley and Spruce Run Reservoirs. These reservoirs besides providing water for recreation and consumption also provide valuable low flow augmentation for the northern sector of the Raritan River Basin.

The Millstone River along with its major tributaries – Beden Brook, Stony Brook, and Rocky Brook – drain 283 square miles of the western and southern sectors of the basin. After flowing in a general northerly direction, the Millstone River joins the main stem of the Raritan near Manville.

Green Brook, Lawrence Brook and South River are three somewhat smaller but significant subwatersheds that drain the eastern and southeastern sectors of the basin.

The topography within the Raritan River Basin varies from gently rolling coastal plains in the southeastern section to generally hilly in the northwestern section. Elevations range from sea level at the mouth of the Raritan River to over 1200 feet above mean sea level in Mount Olive Township.

Within the Raritan River Basin there is a complete scope of land uses from such highly urban areas as New Brunswick, Bound Brook, and Plainfield to rural farming in Hunterdon County. However, most of the floodplains within the Raritan River network have remained in their natural state, untouched to any great extent by man's foolish actions. This contrasts with the Passaic River Basin to the north which has sustained loss of lives and large monetary losses from relatively minor floods. These losses are attributed to the continual encroachment on nature's floodway by filling on the one hand, and by construction without fills on the other hand. The former increases the flood damage potential of the latter.

Within the Raritan Basin, little effort has been made to modify the flood potential of the basin by constructing floodwater retarding reservoirs, making channel improvements, or initiating land treatment measures. Within the last ten years the State has constructed, within the Raritan River Basin, the Round Valley and Spruce Run Reservoirs which will develop a water supply of 160 MGD (million gallons per day) in addition to providing substantial low flow augmentation. These reservoirs, however, provide no appreciable flood control benefits.

HISTORY OF FLOODS

The past history of flooding within the Raritan River Basin indicates that floods may be experienced in any season of the year; however, the possibility of flooding during the winter months is greatly reduced. Although most severe floods have been caused by rainfall alone, the spring floods have been compounded by snow melt and moving ice. The major floods in the late summer and fall have been associated with tropical storms moving up the Atlantic coastline.

Along the Raritan and its major tributaries, the record floods since the turn of the century have been associated with the 1903, 1938, 1955 and 1971 hurricanes. Prior to 1900, the major floods occurred in 1810, 1865, 1882 and 1896. Although at least one of these latter four floods exceeded the floods of recent times, records of these floods are inconsistent and difficult to evaluate. The other major floods since 1900 occurred in 1927, 1936, 1940, 1945, 1956 and 1968. Some of these floods were of major proportions within some of the Raritan River's tributaries because they were generated by local storms or compounded by structural dam failures. Table II-2 is a listing of active and discontinued U.S. Geological Survey regular gaging stations and each associated flood of record. Table II-3 is a listing of active and discontinued U.S. Geological Survey crest stage partial record gaging stations and each associated flood of record. Although these discharges were generated by severe and rare climatic occurrences, it should be recognized that larger floods can and will occur in the future.

Of the 104 existing regular gaging stations in New Jersey, 20 are located within this river basin. It is recognized that the installation of additional gaging stations would provide an expanded data base to facilitate the implementation and development of the Statewide Floodplain Management Program.

RULES AND REGULATIONS

The methodology and procedures used in these investigations of the Raritan River Basin were conducted in accordance with the Rules and Regulations for the Delineation of Flood Hazard Areas as part of the State Floodplain Management Program. These rules and regulations adopted after public hearing by the Water Policy and Supply Council are on file in the Division Office.

BASIN HYDROLOGY

Within the Raritan River Basin, the Mean Annual Floods and design discharges were determined generally in accordance with the guidelines described in the following two reports:

1. Floods in New Jersey Magnitude and Frequency – Water Resources Circular 13 – 1964 – United States Geological Survey.
2. Hydrologic Criteria For Determination of Design Floods – Special Flood Hazard Report "B" – February 1967 – Anderson-Nichols & Co., Inc.

The Mean Annual Flood (MAF) represents the flood that occurs on the average once every 2.33 years.

TABLE II-2

RECORDED MAXIMUM KNOWN DISCHARGES FOR REGULAR GAGING STATIONS IN RARITAN RIVER BASIN

Station Name	Station Number	Period of Record	Date of Maximum Discharge	D.A. sq.mi.	Maximum Known Discharge c.f.s.
South Branch Raritan River near High Bridge, N.J.	01396500	1918-	March 15, 1940	65.30	5,160
Spruce Run at Clinton, N.J.	01396800	1959-	April 2, 1970	41.30	6,410
South Branch Raritan River at Stanton, N.J.	01397000	1903-1906 1919-	Aug. 19, 1955	147.00	18,000
Walnut Brook near Flemington, N.J.	01397500	1936-1961	July 18, 1945	2.24	645
Neshanic River at Reaville, N.J.	01398000	1930-	Aug. 28, 1971	25.70	16,000*
North Branch Raritan River near Far Hills, N.J.	01398500	1921-	Aug. 28, 1971	26.20	6,390(a)
Lamington (Black) River near Pottersville, N.J.	01399500	1921-	Aug. 28, 1971	32.80	2,700*
North Branch Raritan near Raritan (at Milltown), N.J.	01400000	1923-	Aug. 28, 1971	190.00	24,900*
Raritan River at Manville (Finderne), N.J.	01400500	1903-1907(b) 1908-1915(c) 1921-	Sept. 22, 1938	490.00	36,100
Millstone River at Plainsboro, N.J.	01400730	1964-	Aug. 28, 1971	65.80	3,780*
Baldwin Creek at Baldwin Lake, near Pennington, N.J.	01400932	1962-1970	March 7, 1967	2.52	336*
Honey Branch near Pennington, N.J.	01400953	1967-	Sept. 3, 1969	0.70	721
Stony Brook at Princeton, N.J.	01401000	1953-	Aug. 28, 1971	44.50	9,000*
Lake Carnegie at Princeton, N.J.	01401300	1924-	Aug. 28, 1971	159.00	13,000(c)(e)
Millstone River near Kingston, N.J.	01401500	1933-1949	Sept. 21, 1938	171.00	9,820
Millstone River at Blackwells Mills (Millstone), N.J.	01402000	1903-1904(c) 1921-	Aug. 29, 1971	258.00	22,200*
Royce Brook tributary at Frankfort, N.J.	01402590	1968-	July 29, 1970	0.29	122
Royce Brook tributary near Bell Meade, N.J.	01402600	1966-	Aug. 28, 1971	1.20	1,450
Raritan River at Bound Brook, N.J.	01403000	1903-1909 1944-1966	Oct. 10, 1903 Sept. 21, 1938	800.00 779.00	32,100 18,300
Raritan River below Calco Dam at Bound Brook, N.J.	01403060	1966- (d)	Aug. 28, 1971	785.00	46,100*
Green Brook at Plainfield, N.J.	01403500	1938-	July 23, 1938	9.75	2,890
Lawrence Brook at Patricks Corner, N.J.	01404500	1922-1926	April 7, 1924	29.00	1,370
Lawrence Brook at Farrington Dam, N.J.	01405000	1927-	Aug. 28, 1971	34.40	2,980*
Matchaponix Brook at Spotswood, N.J.	01405300	1957-1967	Sept. 13, 1960	43.90	2,050
Manalapan Brook at Spotswood, N.J.	01405400	1957-	May 30, 1968	40.70	1,650
South River at Old Bridge, N.J.	01405500	1939-	Aug. 28, 1971	94.60	4,880
Deep Run near Browntown, N.J.	01406000	1932-1940	Sept. 21, 1938	8.07	1,240
Tennent Brook near Browntown, N.J.	01406500	1932-1941	Sept. 21, 1938	5.25	177

* Provisional U.S.G.S. data subject to revision
(a) Discharge of about 7,000 c.f.s. from Flood Mark occurred July 23, 1919
(b) Published as "at Finderne"
(c) Gage heights only
(d) Prior to October 1966 published as Raritan River at Bound Brook (see 01403000)
(e) No historical summary available, discharge computed only for "Doria"

TABLE II-3

RECORDED MAXIMUM KNOWN DISCHARGES FOR CREST STAGE PARTIAL RECORD STATIONS IN RARITAN RIVER BASIN

Station Name	Station Number	Period of Record	Date Maximum Discharge	D.A. sq.mi.	Maximum Known Discharge c.f.s.
Walnut Brook near Flemington, N.J.	01397500	1963-	Aug. 28, 1971	2.24	1,570
Woodsville Brook at Woodsville, N.J.	01400850	1957-1958 1964-	Aug. 28, 1971	1.78	1,560*
Stony Brook at Glenmoore, N.J.	01400900	1957-	Aug. 28, 1971	17.00	**
Baldwin Creek at Pennington, N.J.	01400930	1957; 1960-	Aug. 28, 1971	1.99	1,220*
Stony Brook at Pennington, N.J.	01400947	1965-	Aug. 28, 1971	26.50	**
Hart Brook near Pennington, N.J.	01400950	1968-1970	Dec. 11, 1969	0.80	**
Honey Branch near Pennington, N.J.	01400953	1966	Feb. 13, 1966	0.70	**
Honey Branch near Mount Rose, N.J.	01400960	1968-	Aug. 28, 1971	1.50	**
Honey Branch near Rosedale, N.J.	01400970	1967-	Aug. 28, 1971	3.83	**
Duck Pond Run at Clarksville, N.J.	01401200	1965-	Aug. 28, 1971	5.21	402
Beden Brook near Hopewell, N.J.	01401520	1967-	Aug. 28, 1971	6.07	7,240
Rock Brook near Blawenburg, N.J.	01401595	1967-	Aug. 28, 1971	9.03	3,960
Beden Brook near Rocky Hill, N.J.	01401600	1967-	Aug. 28, 1971	27.60	12,100
Six Mile Run near Middlebush, N.J.	01401870	1966-	Aug. 28, 1971	10.70	**

* Provisional U.S.G.S. data subject to revision
** Discharge not determined by U.S.G.S.

The MAF discharge (in cubic feet per second) was determined for each reach of river in each respective subwatershed drainage area.

The design discharges for the Floodway and Flood Hazard Area were determined for each reach of river within the basin by multiplying the MAF discharge by the appropriate design flood multiple. These multiples are different for each of the four flood regions established in New Jersey. The Raritan River Basin lies within two of these four flood regions and the calculated Floodway and Flood Hazard Area design discharges are representative of major floods of reasonable expectancy – neither too large nor too small. A report on hydrologic investigations for the Raritan River Basin which provides the adopted design discharges and basis thereof by river and reach is on file with the Division of Water Resources.

HYDRAULICS

The water surface profiles associated with the Floodway and Flood Hazard Area Design Floods were obtained by either the standard computative hydraulic solution or an interpretive hydraulic solution for the various reaches of river within the Basin.

Computative Hydraulics – The water surface profiles were obtained from backwater computations based on Bernoulli's theorem for the total energy at each cross-section and Manning's formula for the friction head loss between cross-sections. The computative procedures are similar to those outlined in the U.S. Army Engineering Manual 1110-2-1409 "Backwater Curves in River Channels". The backwater computations for open channel flow and head losses at structures were performed on an electronic computer. The program used entitled "HEC-2, Water Surface Profiles" was developed by the Hydrologic Engineering Center, U.S. Army Engineer District, Sacramento, California. The roughness coefficients, Manning's "n" values, which represent the characteristics of channel and overbanks were based on field reconnaissance. Contraction and expansion coefficients of 0.25 and 0.50 respectively were utilized. These coefficients were multiplied by the absolute difference in velocity heads between the cross-sections to give the energy loss caused by the transition. Reach lengths were determined separately for the channel, left overbank, and right overbank. Rise in water surface elevations at structures were computed for the following conditions: open channel flow, pressure flow, weir flow, or any appropriate combination. The methods are explained in detail in U.S. Army Engineering Manual 1110-2-1602 and Hydraulic Design Charts 010-6 to 6/5. These methods were adapted for computer and are described in the computer program "Water Surface Profiles" on file with the Division of Water Resources.

Interpretive Hydraulics – Along various reaches of the Raritan River Basin, information in the form of water surface elevations for specific discharges published by the United States Department of the Interior, Geological Survey, in cooperation with the New Jersey Division of Water Resources was used to develop appropriate water surface profiles. The results of studies published by the U.S. Army Corps of Engineers and additional rating curves generated by the New Jersey Division of Water Resources were also used. The interpretive hydraulic procedure employed relates U.S.G.S. and Corps of Engineers stationing to the stationing used in this study. For each reach of river, an analysis of rating curves generated from U.S.G.S. and Corps of Engineers data was performed to determine the Floodway and Flood Hazard Area water surface profiles for the design discharges.

The Floodway and Flood Hazard Area Design Flood profiles were related to the topographical maps to indicate areal extent of flooding. The area inundated by the Floodway Design Flood was carefully examined in view of the topography and shallow depths of flow at the outer fringes. This examination disclosed that certain of these areas did not significantly contribute to the flood carrying capacity of the Floodway. Generally, the straight line Floodway limits were placed to include only areas which contribute significantly to the conveyance of the Floodway Design Flood. While Floodway limits generally consist of straight line segments, the Flood Hazard Area limits are irregular lines conforming to the area inundated by its design flood.

Section III

DRAKES BROOK

DRAKES BROOK

GENERAL

Drakes Brook, having a drainage area of approximately 16 square miles, has two principal tributaries; Mt. Olive Brook and an unnamed stream from the vicinity of Flanders. From its source, which is near the community of Ledgewood, Drakes Brook flows in a southwesterly direction to its junction with the South Branch Raritan River.

The Drakes Brook Basin is located in the New England physiographic province, known locally as the New Jersey Highlands. The bedrock which underlies the Drakes Brook Basin is of unknown origin. However, much of the study area is covered with sand and gravel of glacial origin from the relatively recent Quaternary Period. The topography of this area consists of rounded ridges, not more than 1200 feet above mean sea level, separated from each other by relatively narrow valleys.

FLOOD HISTORY

There are no United States Geological Survey (U.S.G.S.) recording or crest-stage gaging stations on Drakes Brook. However, it is probable that major floods which have occurred downstream of Drakes Brook also reflect flooding in the Drakes Brook Basin. U.S.G.S. gaging station (No. 01396500) on South Branch Raritan River near High Bridge is approximately 16 miles downstream of the mouth of Drakes Brook. According to this gage, which has records from 1896 to the present, the dates of eight major flooding events (3,000 cfs or more) are as follows:

February 6, 1896
February 1902
February 2, 1922
March 11, 1936
March 15, 1940
March 11, 1952
April 2, 1970
August 28, 1971

In addition to these major floods, minor floods have been a common occurrence.

FLOODPLAIN MANAGEMENT IN THE DRAKES BROOK WATERSHED

With the exception of the Sutton Gardens housing development, the floodplains of Drakes Brook are relatively undeveloped by man. These attractive areas will in time be infringed upon by commercial, industrial, and other residential developments unless limitations are established against further encroachments. Additional encroachments on Drakes Brook, similar to the Sutton Gardens housing development upstream of U.S. Route 206 on the Mount Olive-Chester Township line, would be reflected by higher discharges which would cause more severe flooding, and hence result in larger flood damages in the future. Free passage of flood water on this stream is vital.

The major transportation artery of the Drakes Brook Basin is U.S. Highway 206 which cuts north south through the center of the basin. State Route 25 provides connector and feeder service throughout the basin. The Central Railroad of New Jersey nearly parallels Drakes Brook and could easily service future industrial development in the basin.

The area covered by this study of Drakes Brook falls entirely within Morris County. The manufactured products of Morris County are chemicals, electrical goods, and machinery. The population is expected to exceed the one-half million mark by the year 1990 as indicated by Table III-1.[1]

TABLE III-1
POPULATION PROJECTIONS

County	Census 1970	Est. 1980	Est. 1990	Est. 2000
Morris	383,454	448,313	534,429	620,545

Based on these projections it is likely that the Drakes Brook Watershed will experience a population increase of more than 50 percent by the year 2000.

The people of the Drakes Brook Basin are paying a high price for ***unwise*** development of their floodplains. Nearly 135,700 dollars in public flood

[1] *Population Projections,* Office of Business Economics, Division of Planning and Research, Department of Labor and Industry, August 1, 1971.

damages were suffered in the basin by Hurricane Doria on August 27-28, 1971, causing the President to declare New Jersey a natural disaster area.

In recent years, local municipalities and residents have become more aware of the seriousness of the flooding situation in the watershed, and a number of measures are being taken to correct, regulate, and prevent conditions which cause flood damages. Flooding problems in one community can be aggravated or actually created by the activities in other communities. Thus, any meaningful solutions require a regional and broad-based approach.

As a result of past storms that caused flooding, the Townships of Washington and Mt. Olive applied for flood insurance under the National Flood Insurance Program. Mount Olive Township has become eligible for flood insurance and Washington Township was being processed by HUD at publication time of this report. The further need for the National Flood Insurance Program was vividly illustrated by Hurricane Doria.

It is encouraging to note the action taken by these communities in applying and becoming eligible for flood insurance. Roxbury Township should take similar action. In addition, the need to pass adequate zoning ordinances based on the Division's preliminary Flood Hazard Maps is highly recommended.

SCOPE OF THIS STUDY

The scope of this study of Drakes Brook includes 6.0 linear miles of stream extending from just downstream of Carey Road Bridge in Roxbury Township downstream to its confluence with the South Branch Raritan River in Washington Township. There is some variance in the slope of Drakes Brook. A steep slope is associated with the reach from Carey Road to Pleasant Hill Road (Flanders Road) in which the channel bottom drops on the average of 29.0 feet per mile (84 feet in a length of 2.9 miles). From this point to the mouth, however, the slope is milder. In this lower reach, the channel bottom drops on the average of 17.1 feet per mile (53 feet in a length of 3.1 miles).

The three communities through which Drakes Brook flows are listed in Table III-2, starting at the mouth of Drakes Brook and proceeding upstream. The communities are listed on the left and right banks as one faces upstream. Figure III-1 is an index map that shows the relationship of the communities and the Flood Hazard Maps.

TABLE III-2
DRAKES BROOK
LIST OF COMMUNITIES

(Left Bank)		(Right Bank)
	MOUTH OF DRAKES BROOK	
	MORRIS COUNTY	
Washington Township D-1		Washington Township D-1
Mount Olive Township D-1, D-2, D-3, D-4		Mount Olive Township D-1, D-2, D-3, D-4
Roxbury Township D-4		Roxbury Township D-4
	DOWNSTREAM OF CAREY ROAD BRIDGE (LIMIT OF STUDY)	

TABLE III-3

DRAKES BROOK

ADOPTED DESIGN DISCHARGES

Station* feet	Location	Floodway c.f.s.	Flood Hazard Area c.f.s.
3980+00	Mouth of Drakes Brook		
		1,600	2,000
4045+50	Mt. Olive Brook		
		1,330	1,670
4144+85	Pleasant Hill Road (Flanders Road) Bridge		
		1,170	1,460
4167+30	Ironia Road Bridge		
		1,080	1,350
4217+75	Junction Stream		
		770	970
4244+30	Central R. R. of New Jersey Bridge		
		720	900
4297+10	Downstream of Carey Road Bridge (Limit of Study)		

*Station given in distance above mouth of Raritan River in 100-foot increments (3980+00 = 398,000 feet).

BASIC DATA, DESIGN DISCHARGES AND FLOOD PROFILES

Detailed topographic maps were developed from aerial photographs (1968) using standard photogrammetric methods at a scale of 1" = 200' with a 5-foot contour interval.

Field surveys were made to obtain cross-sections of the river channel to supplement data from the topographic maps for development of composite cross-sections at selected locations. These composite cross-sections were used in computerized backwater analysis for the development of final Floodway Design Flood and Flood Hazard Area Design Flood profiles. (See Section II, Hydraulics.)

Drakes Brook is in Flood Region C.* The adopted design discharges for Flood Region C are a multiple of 3.6 times the adopted Mean Annual Flood (MAF) for the Floodway and 4.5 times the adopted MAF for the Flood Hazard Area. (See Section II, Basin Hydrology.) These design discharges are shown for hydraulic reaches in Table III-3.

The profile for the Floodway Design Flood has a starting water surface elevation of 584.3 feet above mean sea level (msl). This elevation represents the stage of the Floodway Design Flood on the South Branch Raritan River at the junction with Drakes Brook. As such, it serves as the concurrent starting water surface elevation for the Floodway Design Flood on Drakes Brook. The profile for the Flood Hazard Area Design Flood has a starting water surface elevation of 584.8 feet above msl. This elevation represents the stage of the Flood Hazard Area Design Flood on the South Branch Raritan River at the junction with Drakes Brook. As such, it serves as the concurrent starting water surface elevation for the Flood Hazard Area water surface profile on Drakes Brook. Plates D-1 through D-4 show the water surface profiles developed for the Floodway and Flood Hazard Area.

DETERMINATION OF FLOODWAY LIMITS

The elevations associated with the Floodway water surface profile were superimposed on the topographic maps to delineate the area inundated by the Floodway Design Flood. Using the area inundated by the Floodway Design Flood as a guide, the Floodway limits were developed using the rationale explained in Section II, Hydraulics.

*Rules and regulations for the delineation of Flood Hazard Areas adopted by the Water Policy and Supply Council.

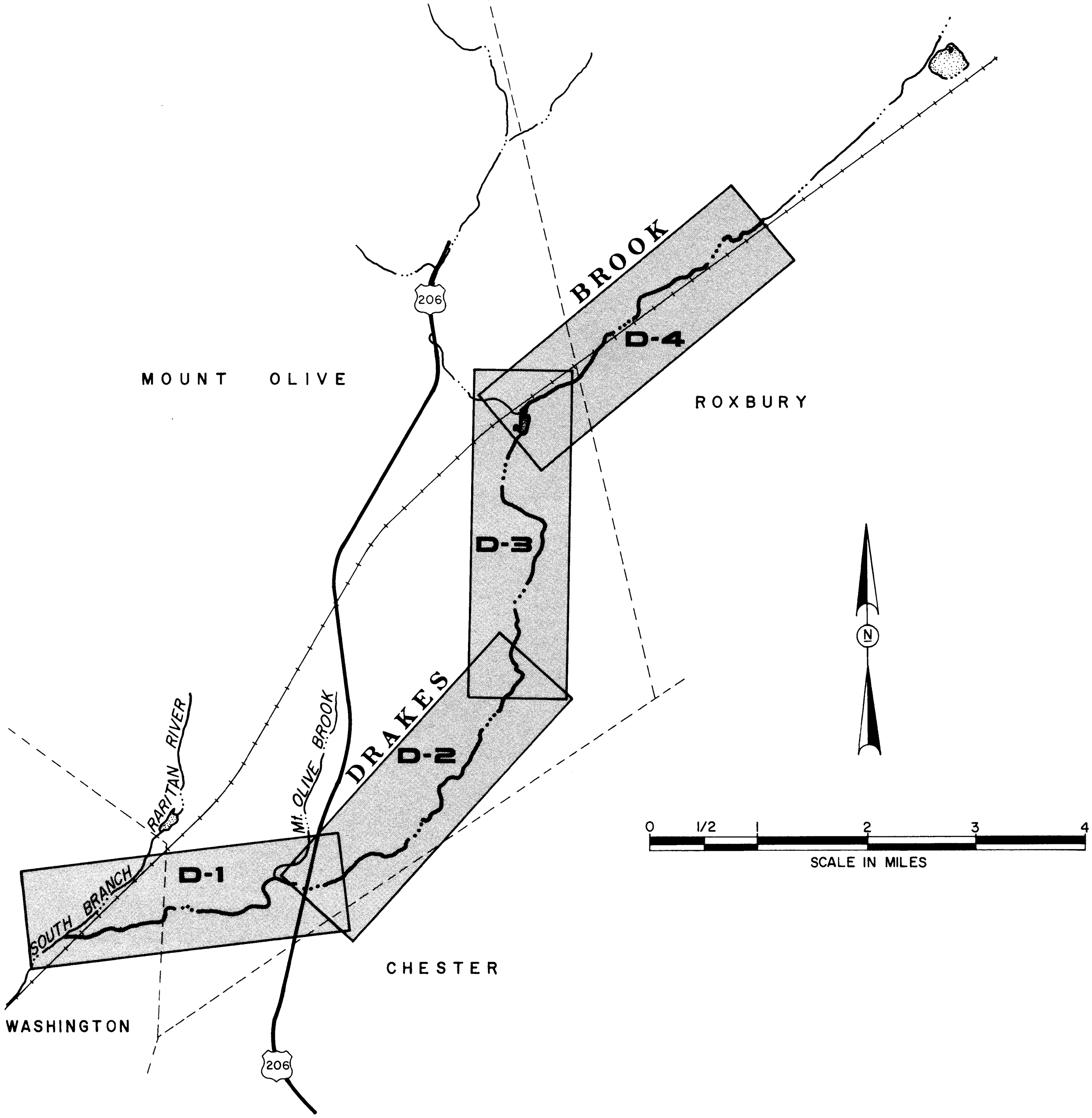


FIGURE III-1
INDEX MAP DRAKES BROOK

Floodway limits have been shown by solid straight-line segments except at junctions of tributaries or water courses not included in this study. Since no definite floodway limits could be established at these locations without engineering studies of the tributaries concerned, the floodway limits at the junction with a tributary are shown by a broken line. When these tributaries are studied the floodway limits will change in these areas.

Because the area outside of the floodway for the study stream may constitute the floodway for the incoming tributary, any development in these junction areas may be critical. In the adoption of zoning ordinances, due consideration should be given to this limitation.

Floodway limits are shown on the plan portions of Plates D-1 through D-4.

DETERMINATION OF FLOOD HAZARD AREA LIMITS

The elevations associated with the Flood Hazard Area water surface profile were superimposed on the topographic maps to delineate the area inundated by the Flood Hazard Area Design Flood. The Flood Hazard Area limits are also shown on the plan portions of Plates D-1 through D-4.

FLOOD HAZARD MAP

The Flood Hazard Map is the final product. It is a pictorial representation with which people can associate. The Flood Hazard Map contains a plan portion and a profile portion.

The plan portion shows the Floodway and Flood Hazard Area limits on the topography acquired for this study. Also included on this plan portion are the permits which have been issued by the Division of Water Resources under the 1929 encroachment law. These permits are included for informational purposes only and are not necessarily an indication of the current practices of the Division of Water Resources or the Water Policy and Supply Council.

The profile portion shows the elevation of Design Flood profiles and the stream channel bottom. The depth and areal extent of flooding can thus be estimated at any given point from the plans and profiles.

The topographic and planimetric data shown on the Flood Hazard Maps were developed to meet the mapping requirements of the delineation program. ***Reference should be made to the mapping specifications before considering use of these data for any other purposes.***

Bench marks and other supporting data as well as the mapping specifications used in the preparation of these maps are on file with the Division of Water Resources and are available for examination and utilization.

Full scale copies of the Flood Hazard Maps illustrated on Plates D-1 through D-4 are on file in the Division of Water Resources office and in the respective county and municipal offices.

RECOMMENDATIONS

It is recommended that:

(1) Communities along Drakes Brook should establish adequate land management regulations governing the ***permissible*** types of future land utilization within the Floodway and Flood Fringe as indicated on the accompanying Flood Hazard Maps.

(2) No fill or structure should be permitted within the Floodway limits which would ***alter*** the natural flow regimen of Drakes Brook and ***adversely affect*** upstream and/or downstream properties.

(3) The lowest floor elevation of any structure permitted at a particular location in the Flood Fringe Area be ***at least*** one foot above the elevation of the Flood Hazard Area Design Flood profile.

(4) Concerted efforts be made at all levels of government to make all interests ***aware*** of the potential dangers associated with the improper use of flood prone areas.

(5) Action be taken to ***evaluate*** structural flood control measures to remedy existing flood damage problems.

(6) An ***acquisition*** program such as (or part of) the Green Acres Program be undertaken to purchase the flood prone areas, particularly the Floodway. These lands lend themselves ideally to strip parks and other such compatible use.

(7) Information be disseminated on the various methods available for ***flood proofing*** of structures.

(8) Roxbury Township should apply for eligibility for ***flood insurance*** under the National Flood Insurance Act of 1968, Public Law 90-448 of August 1, 1968. Adopting and enforcing Floodway limits would retard the growth of flood damageable development, thereby reducing the insurance costs to the public.

(9) Mt. Olive Township and Washington Township should ***maintain their eligibility*** by following through on required land management regulations if not already accomplished.

(10) More attention be given to an expanded ***flood warning system*** and associated ***evacuation*** program.

(11) Municipalities consider making a ***tax adjustment*** on the lands which are not suitable for development because of their flood potential.

(12) Municipalities with the assistance of the Division of Water Resources undertake a program to ***delineate the tributaries*** which have not been delineated within their community and to cooperate with adjacent communities to undertake the delineation of other common tributaries.

The optimum implementation of a comprehensive land management program in these Flood Hazard Areas for the protection of the health, safety, general welfare and environmental integrity of the communities can best be achieved through proper planning, zoning, building codes, subdivision regulations, land acquisition, conservation easements and health regulations. In the interim, it is urged that ***widespread dissemination*** of the findings of this report be made to individuals, organizations, and planning agencies.

CONTINUING COOPERATION

The Division of Water Resources, as part of its designated Floodplain Management Program, will, when requested, advise and assist communities on planning, zoning, regulations and ordinances, and will also provide continuing technical advise and assistance.

The program, which provides a technical basis for implementing regulations to reduce future flood damages, is also a useful tool in many other programs of the federal, state and local agencies. A multitude of planning activities are concurrently underway to meet the needs of present and future generations.

These include highways, utilities, schools, libraries, hospitals, industrial parks, subdivisions, urban renewal, open space, parks, outdoor recreation, local and regional master planning, water and sewerage facilities, airports and others too numerous to mention. Needless to say, many of these planning activities will involve the use of floodplains. The delineation of the Flood Hazard Areas, even prior to establishing regulations, is a necessary element to achieve sound planning. Simply stated, first ***delineate*** the Flood Hazard Area and then ***plan*** for future uses which are compatible with the threat of flooding. Utilization of Flood Hazard Area delineation in land acquisition programs (e.g., Green Acres Program for Conservation, Outdoor Recreation) could achieve excellent multipurpose results in environmental enhancement.

Planning is an essential element in our society, but wise planning ***alone*** which recommends proper use of Flood Hazard Areas cannot effectively stop the growth of flood damages. The plan must be implemented with sound ***regulations.***

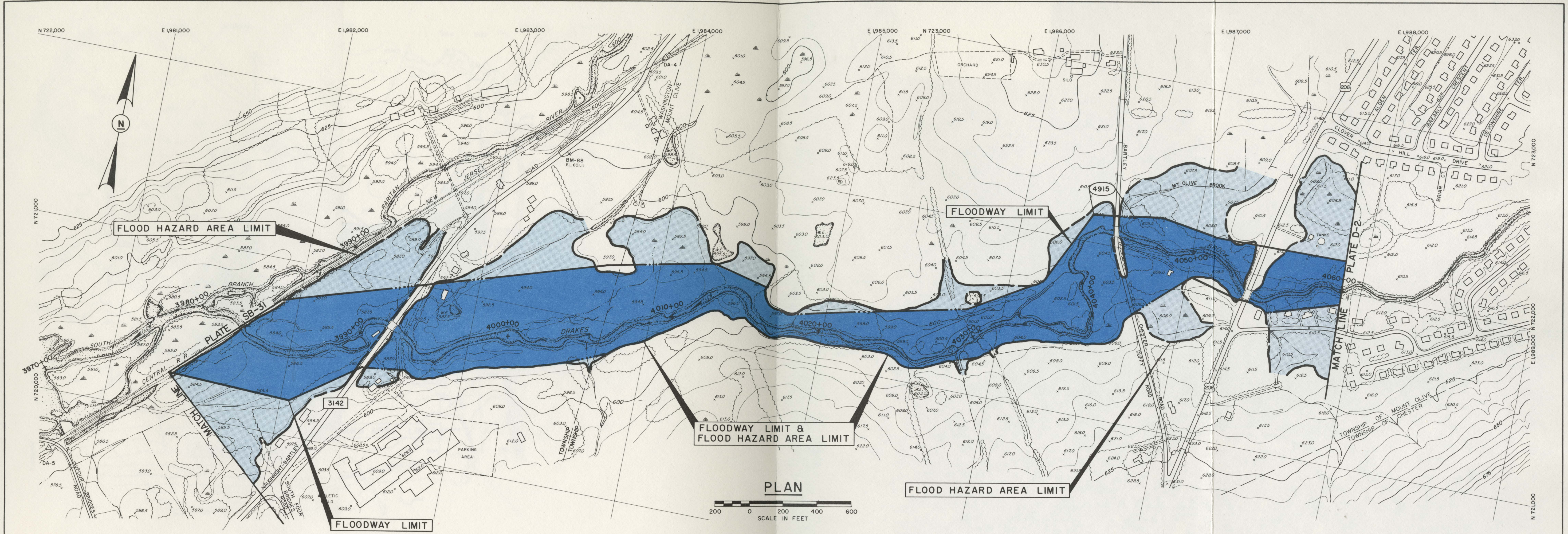
Regulations for floodplain uses must have both a sound legal and technical basis. The first encompasses the legal authority derived from the legislature which must be clearly worded stating the purpose and objective in regulating in the public interest. The second provides the factual data — the area involved, depth of flooding and flood heights — without which implementation would be unenforceable and perhaps even unconstitutional.

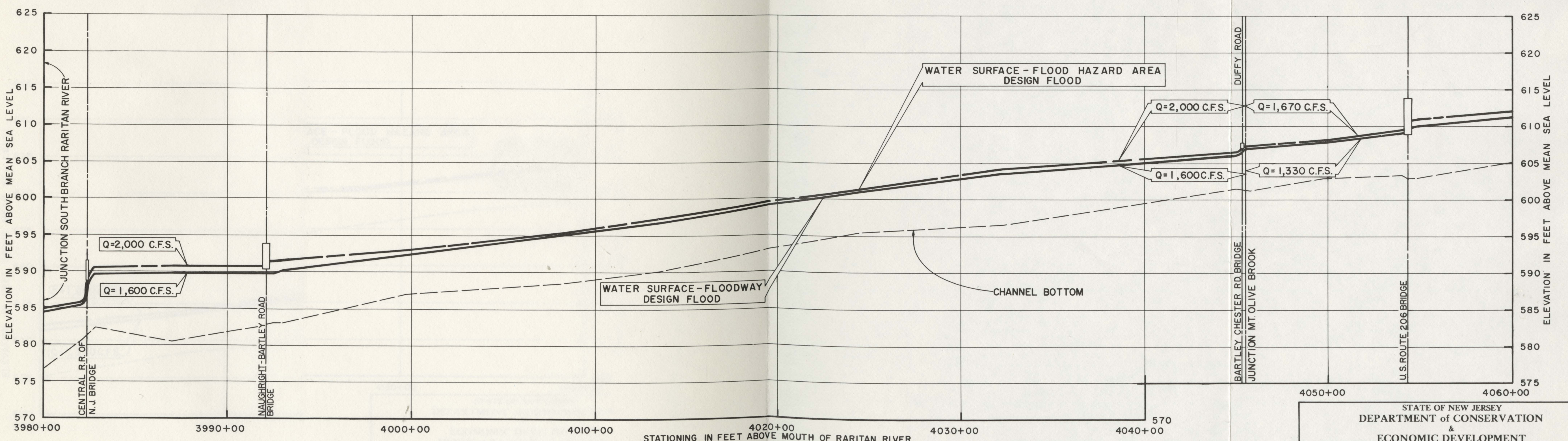
The Division of Water Resources has been designated as the State Coordinating Agency for the implementation of the National Flood Insurance Program and as such will assist municipalities to become eligible and to retain their eligibility.

The Division of Water Resources will install and maintain a series of ***flood markers*** for informational purposes to assist in informing the public of the location of lands that are flood prone. These markers will be placed at strategic locations providing an advance warning for the public. Dissemination of the locations of ***flood markers*** will be made available to local levels of government and the public.

In conclusion, it is most important to realize that the primary intent of the Division of Water Resources is not to infringe on the property rights of individuals, acquire land, or interfere with proper land management. What the Division is interested in is the promotion of proper land management. This may not solve all the flooding problems, but it is the initial step towards the prevention of future flood disasters. The dollars so saved could be utilized for other beneficial community projects.

With the documentation of the flooding situation established, now is the time for action, so that our future generations can live in a better environment.





PROFILE

200 0 200 400 600
HORIZONTAL

5 0 5 10 15
VERTICAL

SCALE IN FEET

LEGEND

FLOODWAY — FLOOD FRINGE

2726 Encroachment Permit

3002 Encroachment Line Permit

Encroachment Line

NOTES:

1. 1000 ft Grid Based on New Jersey Geodetic Plane Co-ordinate System

PHOTOGRAMMETRIC MAPPING BY QUINN AND ASSOCIATES, WYNCOTE, PA.

STATE OF NEW JERSEY
DEPARTMENT of CONSERVATION
&
ECONOMIC DEVELOPMENT
DIVISION of WATER POLICY and SUPPLY

DELINEATION OF FLOODWAY AND FLOOD HAZARD AREA

DRAKES BROOK

STA. 3980+00 TO STA. 4060+00

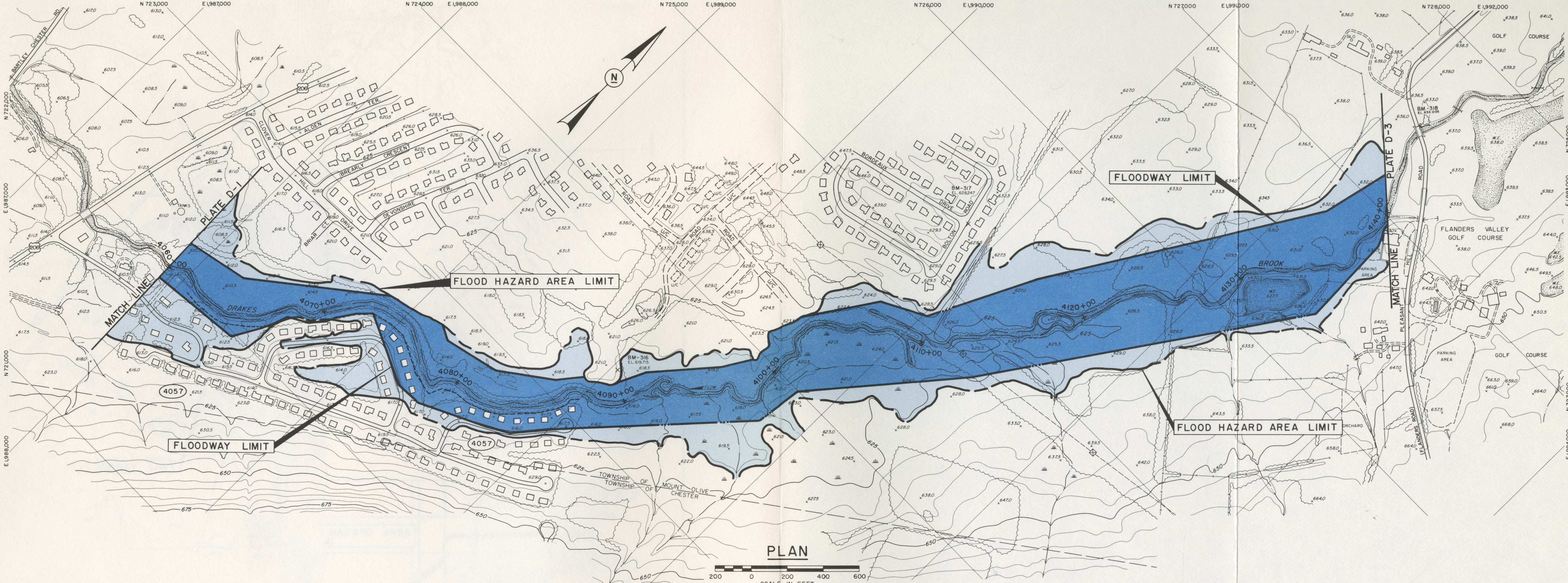
WASHINGTON TOWNSHIP, MOUNT OLIVE TOWNSHIP

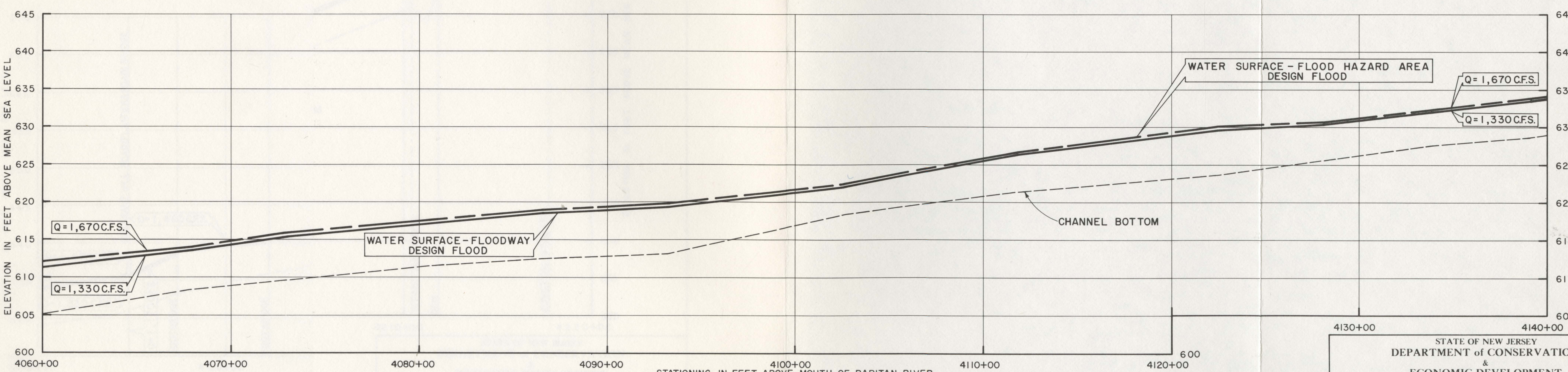
Morris County, New Jersey

Anderson-Nichols & Co.
Boston, Mass.

W-122

PLATE D-1





LEGEND

FLOODWAY — FLOOD FRINGE — (3002) Encroachment Line Permit

Encroachment Line

PROFILE

200 0 200 400 600
HORIZONTAL
5 0 5 10 15
VERTICAL
SCALE IN FEET

NOTES:
1. 1000 ft. Grid Based on New Jersey Geodetic Plane Co-ordinate System

STATE OF NEW JERSEY
DEPARTMENT of CONSERVATION
&
ECONOMIC DEVELOPMENT
DIVISION of WATER POLICY and SUPPLY

DELINEATION OF FLOODWAY AND FLOOD HAZARD AREA

DRAKES BROOK
STA. 4060+00 TO STA. 4140+00

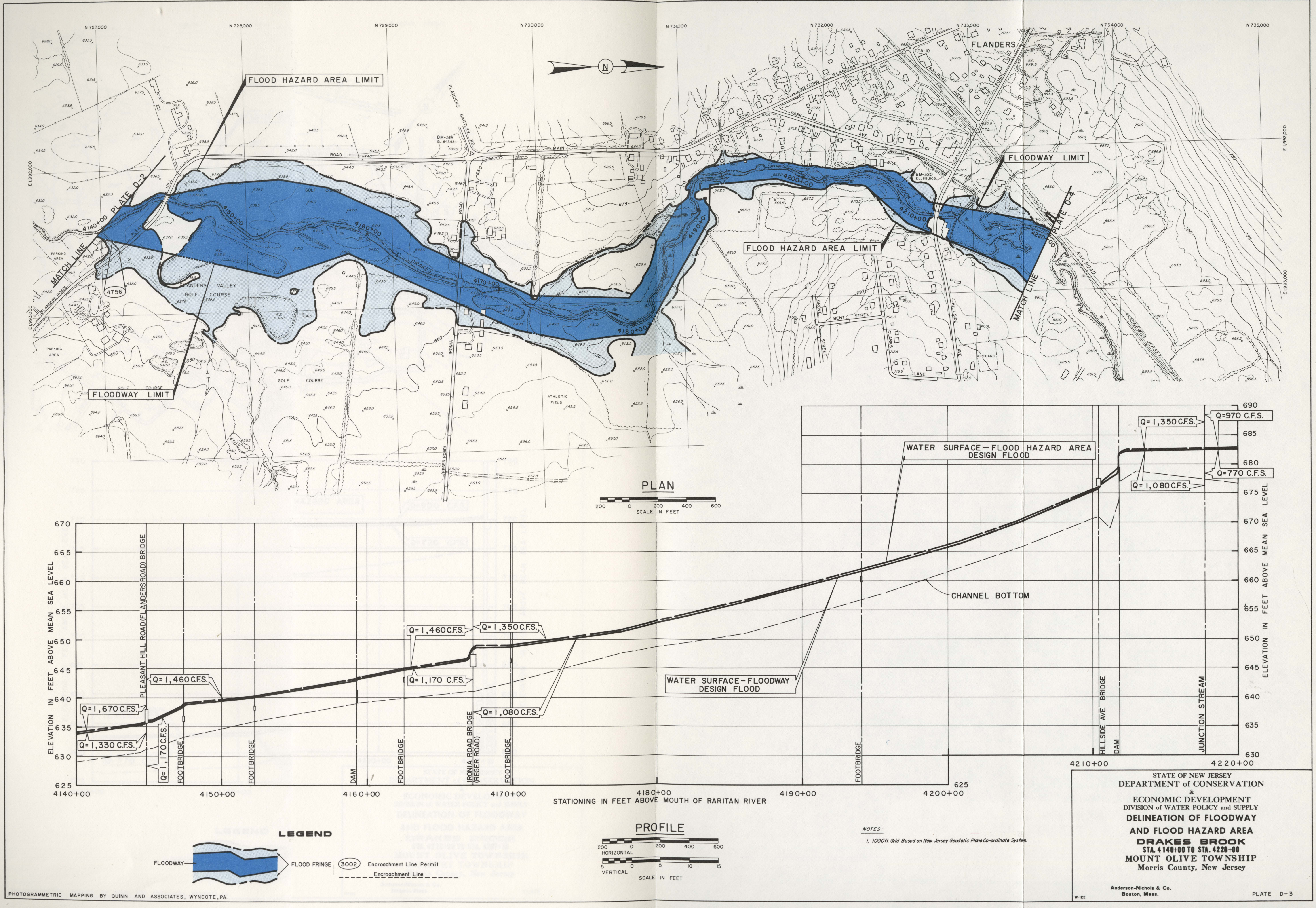
MOUNT OLIVE TOWNSHIP
Morris County, New Jersey

Anderson-Nichols & Co.
Boston, Mass.

W-122

PLATE D-2

PHOTOGRAMMETRIC MAPPING BY QUINN AND ASSOCIATES, WYNCOTE, PA.



STATE OF NEW JERSEY
DEPARTMENT of CONSERVATION
&
ECONOMIC DEVELOPMENT
DIVISION of WATER POLICY and SUPPLY

DELINEATION OF FLOODWAY AND FLOOD HAZARD AREA

DRAKES BROOK

STA. 4140+00 TO STA. 4220+00

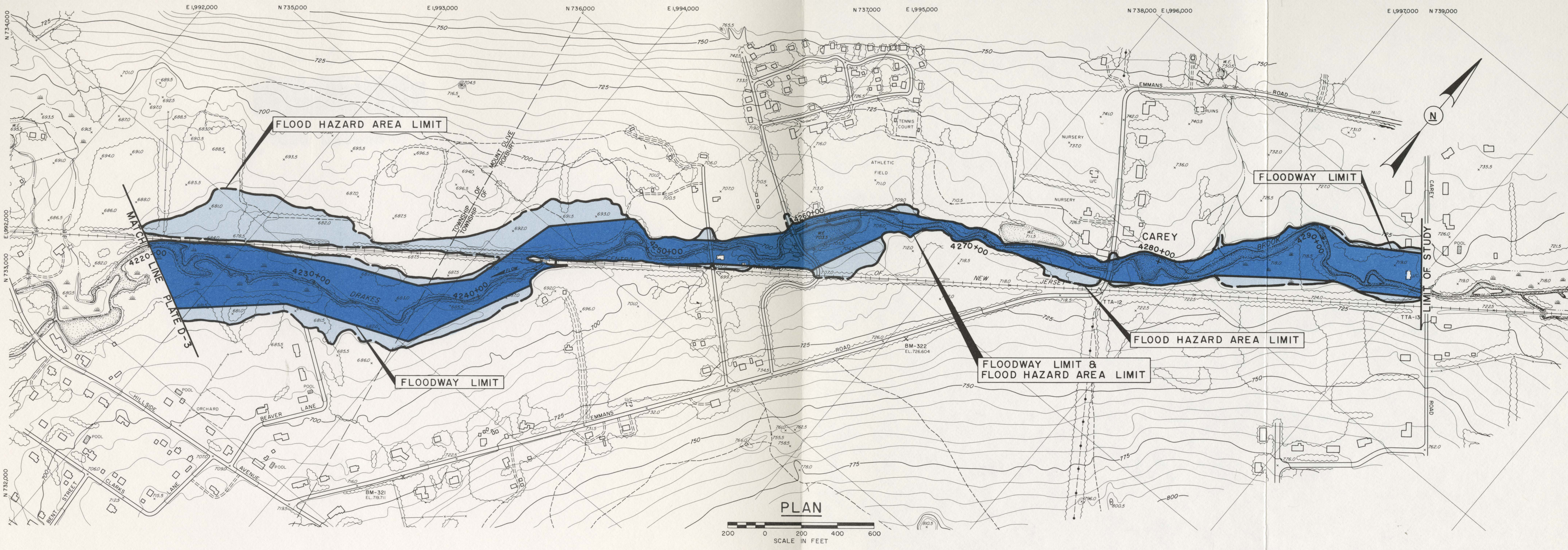
MOUNT OLIVE TOWNSHIP

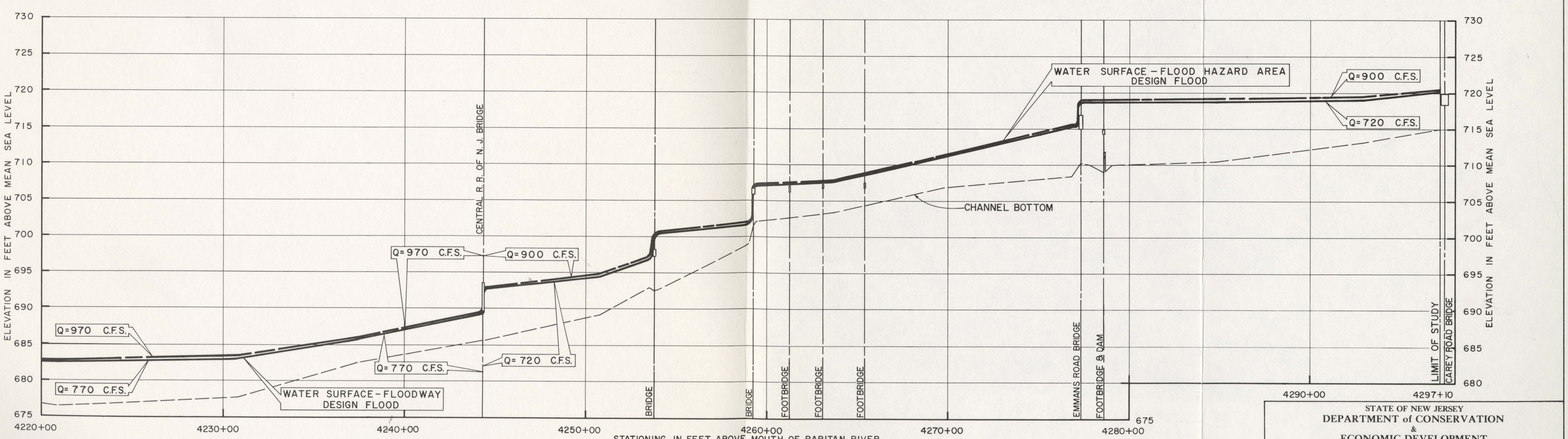
Morris County, New Jersey

Anderson-Nichols & Co.
Boston, Mass.

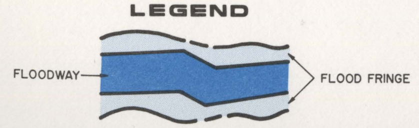
W-122

PLATE D-3





LEGEND



NOTES:

1. 1000ft. Grid Based on New Jersey Geodetic Plane Co-ordinate System

PHOTOGRAMMETRIC MAPPING BY QUINN AND ASSOCIATES, WYNCOTE, PA.

STATE OF NEW JERSEY
DEPARTMENT of CONSERVATION
&
ECONOMIC DEVELOPMENT
DIVISION of WATER POLICY and SUPPLY

DELINEATION OF FLOODWAY AND FLOOD HAZARD AREA

DRAKES BROOK

STA. 4220+00 TO STA. 4297+10

MOUNT OLIVE TOWNSHIP,
ROXBURY TOWNSHIP
Morris County, New Jersey

Anderson-Nichols & Co.
Boston, Mass.

W-122

PLATE D-4