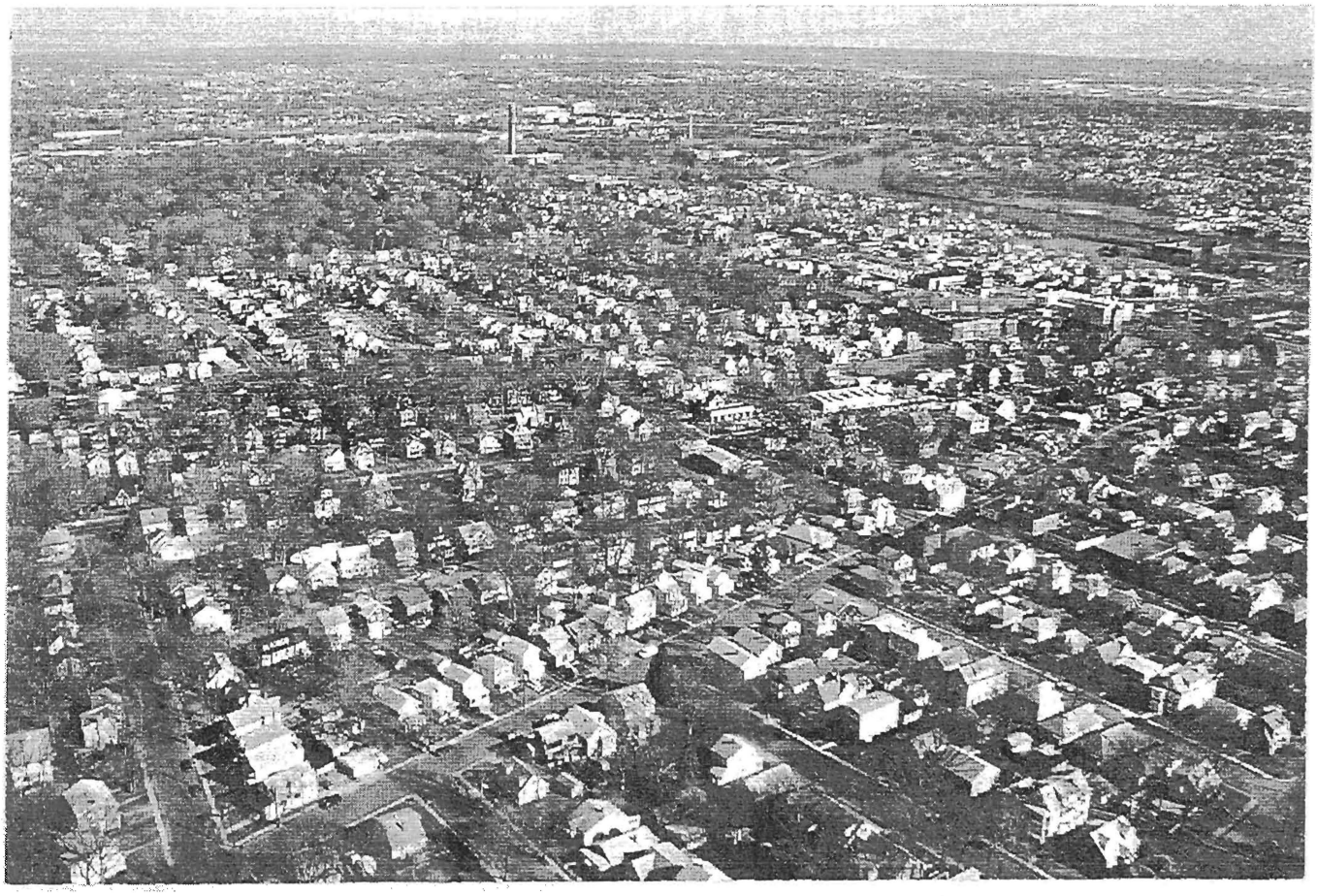
US Army Corps
of Engineers
New York District

DRAFT

General Design Memorandum

Passaic River
Flood Damage Reduction Project

Appendix H - Real Estate
Appendix I - Economics



Lower Valley, Passaic River Basin

September 1995

#11

US Army Corps
of Engineers
New York District

DRAFT

General Design Memorandum

Passaic River
Flood Damage Reduction Project

Appendix H - Real Estate
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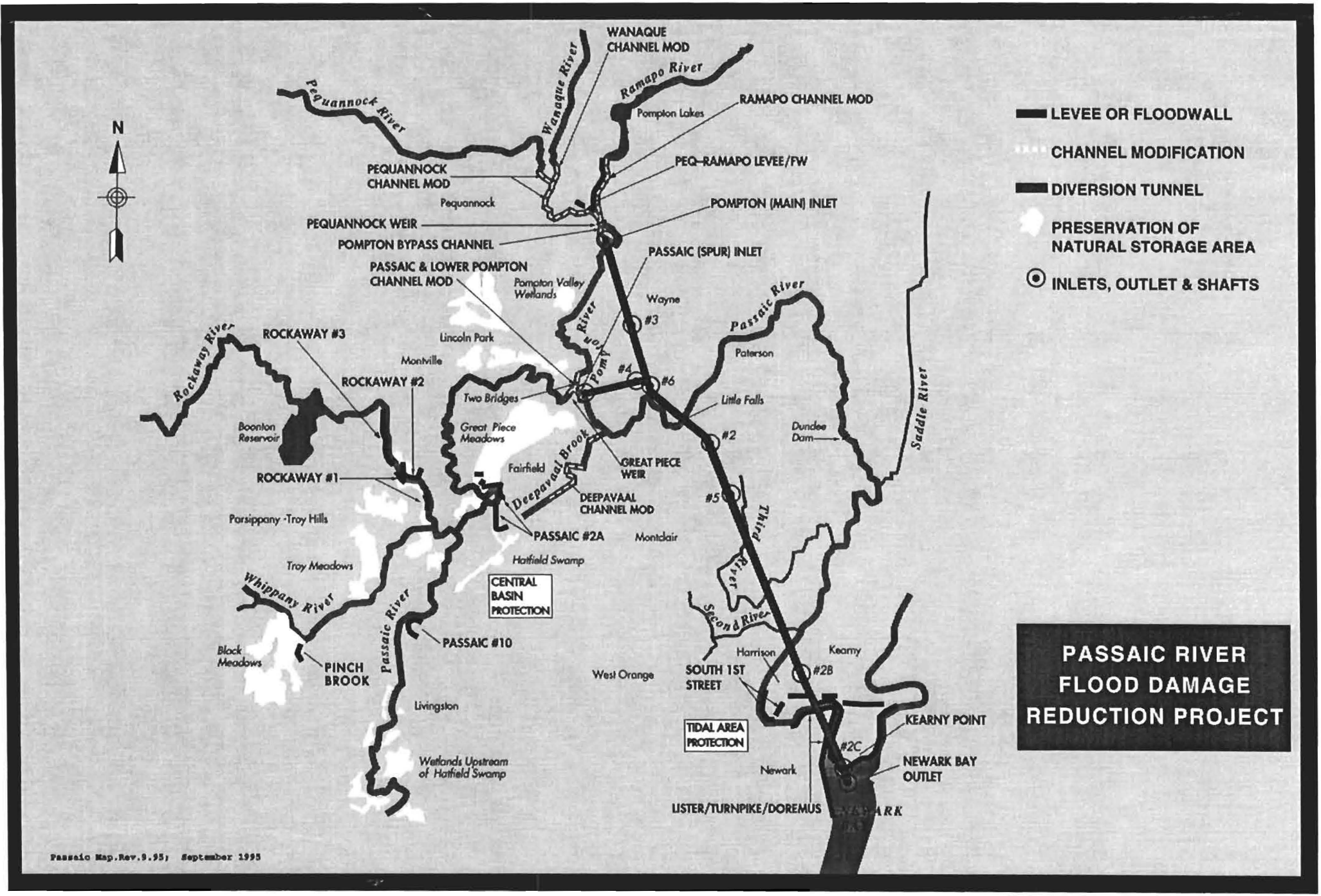
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WANAQUE CHANNEL MOD
Wanaque River
Ramapo River
Pequannock River
Pompton Lakes
RAMAPO CHANNEL MOD
PEQUANNOCK CHANNEL MOD
PEQ-RAMAPO LEVEE/FW
Pequannock
POMPTON (MAIN) INLET
PEQUANNOCK WEIR
POMPTON BYPASS CHANNEL
PASSAIC (SPUR) INLET
PASSAIC & LOWER POMPTON CHANNEL MOD
Pompton Valley Wetlands
Wayne
Pompton River
#3
Passaic River
Rockaway River
ROCKAWAY #3
Lincoln Park
Montville
Paterson
ROCKAWAY #2
#4
#6
Two Bridges
Little Falls
Saddle River
Boonton Reservoir
Great Piece Meadows
#2
Dundee Dam
Fairfield
GREAT PIECE WEIR
Deepavaal Brook
ROCKAWAY #1
DEEPAVAAL CHANNEL MOD
#5
Third River
Parsippany -Troy Hills
PASSAIC #2A
Montclair
Hatfield Swamp
Troy Meadows
CENTRAL BASIN PROTECTION
Whippany River
Second River
Passaic River
PASSAIC #10
Harrison
Kearny
Black Meadows
PINCH BROOK
West Orange
SOUTH 1ST STREET
#2B
Livingston
TIDAL AREA PROTECTION
KEARNY POINT
#2C
Wetlands Upstream of Hatfield Swamp
Newark
NEWARK BAY OUTLET
LISTER/TURNPIKE/DOREMUS
LEVEE OR FLOODWALL
CHANNEL MODIFICATION
DIVERSION TUNNEL
PRESERVATION OF NATURAL STORAGE AREA
INLETS, OUTLET & SHAFTS
PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT
Passaic Map.Rev.9.95; September 1995

PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

REAL ESTATE PLAN

APPENDIX H

APPENDIX H

REAL ESTATE PLAN

1.1 GENERAL

This Real Estate Plan is for the Passaic River Flood Damage Reduction Project, General Design Memorandum. The major elements of this project consist of two tunnels (the main tunnel and a spur tunnel), and associated surface works consisting of channel modifications, levees and floodwalls, designed to protect against the 100-year flood event. The project also includes measures for the preservation of natural floodplain storage areas and fish and wildlife mitigation.

The project area is a large part of northern New Jersey,

just west of New York City. The project area generally is densely developed. The Phase I General Design Memorandum entitled "Flood Protection Feasibility - Main Stem Passaic River" dated December 1987 was approved by the Chief of Engineers in February 1989.

1.2 REAL ESTATE REQUIREMENTS

1.2.1 General Requirements

1.2.1.1 Tunnel

The tunnel features span ten communities which are located in Essex, Hudson, and Passaic Counties, New Jersey.

The property required for the Upper Tunnel and the Lower and Spur Tunnel totals approximately 218 acres. No surface rights are required, except for usage restrictions imposed on the surface property. All mineral rights will be acquired below 150' along the tunnel corridor, extending 42' on either side of the Upper Tunnel center line and 32' on either side of the Lower & Spur Tunnel center line. Restrictions will also be placed to prevent construction of any wells or borings below that depth. This will require a non-standard estate.

The property required for the Pompton (Main) Inlet, located in Wayne, New Jersey, is generally wooded and undeveloped. Fee title (Estate No. 1) will be required for the footprint of the cofferdam and inlet structure and a 10' buffer, and a stoplog storage building, for a total of 4.1 acres. The area will be fenced and locked. A road easement (Estate No. 11) approximately 20' wide will be required for access to the site from the south, totalling 0.40 acres. During construction, a temporary work area easement (Estate No. 15) will be required for an additional 10' outside of the cofferdam buffer, offices for the Corps and

its contractor, 10' additional width on the permanent access road corridor, a quality assurance lab, equipment storage and muck handling. These easements, totalling 6.5 acres, will be required for a two year period.

The property required for the Passaic (Spur) Inlet is in a residential area of Wayne, New Jersey. Fee title (Estate No. 1) will be required for the footprint of the inlet structure plus a 10' buffer, totalling 5.6 acres. Included in this fee area are two residential structures, and a third residential structure that is used as a business office. A road easement (Estate No. 11) will be required for the Fairfield Road relocation, including the approach embankment and bridge, totalling 0.2 of an acre. Temporary work area easements (Estate No. 15) will be required for a two year period for the Corps and contractor construction offices and staging areas, totalling 6.6 acres.

The property required for the Newark Bay Outlet is located at Kearny Point. Fee title (Estate No. 1) will be required for the outlet structure, including 10' buffer area, totalling 1.7 acres. A temporary work area easement (Estate No. 15) will be required for an additional area 10' outside of the fee buffer area, totalling 2.0 acres. Corps and contractor offices will be located on a construction barge at the confluence of the Passaic and Hackensack Rivers. Since this is in navigable waters, no real estate interest need be acquired.

The property required for Work Shaft 2, Montclair State College, consists of a 72-foot diameter circular area centered on the work shaft, and an area for construction of the control center building and parking, to be acquired in fee (Estate No. 1), totalling 1.02 acres. A road easement (Estate No. 11) will also be required for access to the site, consisting of 0.48 acres. A utility easement (Estate No. 13) will be required for elevator power, to follow along the access road corridor. A

temporary work area easement (Estate No. 15) will be required for a spoil disposal area to be located on the floor of the quarry, contractor and Corps offices and lab space. Total area of the temporary work area easement is 1.25 acres. Muck handling will be by train, on a rail line adjacent to the site which is used as a commuter line during the day, and used by Conrail at night for deliveries. A switch yard area totalling 1.25 acres will be established. An agreement with the railroad will be required, with a possible non-standard estate for the switchyard.

The property required for Work Shaft 2B, Keegan Landfill, Bergen Avenue, Kearny, consists of fee title (Estate No. 1) for a 0.52 acre fenced area around the work shaft at the end of Bergen Avenue. Access will be from Bergen Avenue, a public road. A temporary work area easement (Estate No. 15) of approximately 1.9 acres will be required for Corps and contractor offices, material stockpiling and equipment storage, muck stockpiling, and a concrete batch plant. Muck handling may be by truck or train. A switch yard area totalling 1.9 acres will be established. An agreement with the railroad will be required if muck is to be handled by train. This agreement may possibly require a non-standard estate.

The property required for Work Shaft 2C, near the Sewage Treatment at Kearny Point, consists of fee title (Estate No. 1) to approximately 1.5 of an acre for the work shaft, the discharge pipe to Newark Bay, and a pump station. A road easement (Estate No. 11) will be required for a 30' wide access corridor, totalling 1.37 acres. A temporary work area easement (Estate No. 15) totalling 1.13 acres will be required for contractor and Corps offices, equipment storage, a muck laydown area, and a concrete batch plant.

For Work Shaft 3, near the Wayne Department of Public Works yard, fee title (Estate No. 1) will be required for the area

around the shaft measuring 0.18 of an acre. The site is in a heavily wooded area near an industrial park and a golf course. A road easement (Estate No. 11) will be required totalling 0.08 of an acre. A temporary work area easement (Estate No. 15) totalling 0.38 of an acre will be required for limited office space, construction storage, slurry reconditioning pits, equipment storage and a concrete batch plant.

Work Shaft 4, East of the Routes 80, 46 and 23 interchange, is located adjacent to a commercial area. Fee title (Estate No. 1) will be required for a fenced area measuring 0.14 of an acre, for the work shaft. A road easement (Estate No. 11) will be required for a 20' access corridor, totalling 0.41 of an acre. A temporary work area easement (Estate No. 15) will be required for contractor and Corps offices, an additional 10' in width for the access road, a concrete batch plant, material storage, muck stockpiling, reconditioning pits, contractor staging and laydown. Total area required is 2.50 acres.

Vent/Hook Hole Shaft 5, Broad Acres Drive @ the Garden State Parkway, Bloomfield, is located in a wooded area adjacent to the Garden State Parkway and a rest stop. Fee title (Estate No. 1) is required for an area measuring 0.02 of an acre for the shaft. A road easement (Estate No. 11) is required for a 10' access corridor through the Baptist Church parking lot, totalling 0.10 of an acre. A temporary work area easement (Estate No. 15) is required for an additional 20' width for access, contractor staging and laydown, crane operation, and a concrete batch plant, totalling 0.35 of an acre.

Vent Shaft 6, East of Routes 80, 46 & 23 interchange, is located in a heavily wooded area near commercial properties. Fee title (Estate No. 1) is required for an area of about 0.12 of an acre for the shaft. A road easement (Estate No. 11) is required off of the public road for Work Shaft 4, totalling 0.08 of an

acre. A temporary work area easement (Estate No. 15) is required for contractor staging and a concrete batch plant, totalling approximately 0.50 of an acre.

1.2.1.1.2 Pequannock - Ramapo Levee/Floodwall

The proposed Pequannock-Ramapo Levee/Floodwall is located in northern New Jersey in Passaic County (Pompton Lakes Borough). Approximately 2,200 feet of levee and 2,910 feet of floodwall are proposed in an area reaching from the intersection of River View Drive and the Paterson-Hamburg Turnpike at the north to the vicinity of the Pompton Lakes Sewage Treatment Plant at the south. The impacted area is primarily residential in nature. The single-family homes along the river are, for the most part, set back far enough from the river's edge to minimize the impact to the properties.

Approximately 3.36 acres of flood protection levee easement (Estate No. 9) will be required for construction, operation and maintenance of the levee/floodwall. An additional 0.70 of an acre will be required for two ponding areas for runoff from the drainage area behind the levee/floodwall, for which a flowage easement (Estate No. 6) will be acquired. During the period of construction, a temporary work area easement (Estate No. 15) of approximately 2.96 acres will be required for a two year period for contractor access and staging.

1.2.1.1.3 Channels and Weirs

Another component of the tunnel system is a series of channel modifications and weirs designed to direct the flood flows into the two tunnel inlets, and to aid in flood damage reduction in the areas upstream of the main tunnel inlet.

The Pequannock Channel Modification would deepen and widen the channel upstream of the main tunnel inlet. Real estate requirements include a channel improvement easement (Estate No. 8) for a total of 41.5 acres through residential and commercial properties and parklands. An additional 11.48 acres will be required during construction for a temporary work area easement (Estate No. 15) for contractor staging and access for a two year period.

The Wanaque Channel Modification would extend from the mouth of the Wanaque River upstream about 1.1 miles, to just beyond the Paterson-Hamburg Turnpike. Approximately 14.30 acres of channel improvement easement (Estate No. 8) will be required over residential properties and parklands. An additional 5.20 acres will be required during construction for a temporary work area easement (Estate No. 15) for a two year period.

The Ramapo Channel Modification would start at the proposed Pequannock Weir and end at the Paterson-Hamburg Turnpike, a distance of approximately 1.3 miles. A total of 24.84 acres of channel improvement easement (Estate No. 8) will be required over commercial and residential properties, and 6.08 acres of temporary work area easements (Estate No. 15) will be necessary during the two year construction period.

The Pompton Inlet Bypass Channel, approximately 0.5 of a mile in length, will be cut into existing parklands to connect flood waters to the main tunnel inlet. A total of 16.32 acres of channel improvement easement (Estate No. 8) and 2.60 acres of temporary work area easement (Estate No. 15) will be required for a two year period.

The Passaic and Lower Pompton Channel Modification is a transition channel to direct flows into the spur tunnel inlet. The modifications would extend in the Passaic River 0.4 miles

upstream of Two Bridges to the Route 80 Bridge, and 0.3 miles along the lower Pompton River, with a sediment pilot channel 1.25 miles long to prevent sediment from accumulating in front of the spur tunnel inlet. The real estate required includes 26.9 acres of riverbed channel improvement easements (Estate No. 8) and 5.08 acres of temporary work area easements (Estate No. 15) for staging and access during the two year construction period.

Great Piece Weir crosses the Passaic River from Fairfield in Essex County to Lincoln Park in Morris County, New Jersey, near the point where the Passaic and Pompton Rivers converge. The area is primarily residential on the Fairfield side and parkland on the Lincoln Park side. An area of 0.77 of an acre of riverbed will be required in fee (Estate No. 1) for the weir structure itself, which includes a 50' buffer on either side for operation and maintenance. A road easement (Estate No. 11) will be required totalling 1.00 acre for access to the weir from public roads on either side. During construction, temporary work area easements (Estate No. 15) will be required over 7.75 acres for a two year period.

Pequannock Weir will be linked to the main tunnel inlet by the proposed bypass channel. Approximately 2.25 acres will be required in fee (Estate No. 1) for the weir structure and buffer. Access will be by public road. During construction, an additional 3.76 acres will be required under temporary work area easement (Estate No. 15) for a two year period.

1.2.1.4 Central Basin Protection

Central Basin Protection in Essex and Morris Counties consists of a series of levees/floodwalls and channel improvements designed to provide 100-year flood protection in that area.

The Rockaway #1 Levee/Floodwall consists of 3,239' of levee and 521' of floodwall, situated along the west bank of the Rockaway River in Parsippany-Troy Hills Township. Lands in the project area consist of residential and commercial uses. A total of 5.47 acres of flood protection levee easement (Estate No. 9) will be required for construction, operation and maintenance of the levee system. An additional 2.70 acres of temporary work area easement (Estate No. 15) will be required for construction staging and access for a two year period.

The Rockaway #2 Levee/Floodwall consists of 3,172' of levee situated along the eastern bank of the Rockaway River in Montville Township. Lands in the project area are mainly residential in nature, with some open space and commercial uses. Approximately 4.98 acres land will be required for the levee system. The majority of the land will be acquired under a flood protection levee easement (Estate No. 9); however, there are four multi-family housing structures and one single-family home which will be acquired in fee. An additional 2.05 acres of temporary work area easement (Estate No. 15) will be needed during the two year construction period.

The Rockaway #3 Levee/Floodwall consists of 825' of levee and 6,638' of floodwall. It extends along the western bank of the Rockaway River in the Township of Parsippany-Troy Hills, in an area called Lake Hiawatha. There is an existing levee/floodwall system in that area which will be modified and incorporated into the project. Most of the land area is residential or undeveloped. A total of 3.47 acres of land will be required for construction of the levee system, under a flood protection levee easement (Estate No. 9). Also, 7.15 acres of temporary work area easement (Estate No. 15) will be required for a two year period.

The Pinch Brook Levee/Floodwall consists of 2,397' of levee and 415' of floodwall. The area is adjacent to the Pinch Brook and Black Brook confluences, in East Hanover Township. Approximately 2.95 acres of flood protection levee easement (Estate No. 9) will be required for the levee system, and 1.97 acres of temporary work area easement (Estate No. 15) will be required for two years during construction.

The Passaic #2A Levee/Floodwall is located in Fairfield and West Caldwell Townships. It consists of 4 segments, with a total of 6,216' of levee and 3,082' of floodwall. Land use in the area is varied. Land requirements include 9.41 acres of flood protection levee easement (Estate No. 9) and 6.04 acres of temporary work area easement (Estate No. 15) for a two year period.

The Deepavaal Channel Modification will increase the depth and width of the Deepavaal Brook for a distance of approximately 7,600' from the Fairfield/West Caldwell boundary to Jersey City. Land use in the area is primarily industrial and commercial. A total of 15.98 acres of channel improvement easement (Estate No. 8) will be required for this segment of the project, along with 6.72 acres of temporary work area easements (Estate No. 15) for two years during construction.

1.2.1.5 Tidal Area Protection

A series of levees and floodwalls will be constructed along the banks of the Passaic River in Newark, Harrison and Kearny Town, to provide 100-year flood protection to those areas.

The Lister/NJTurnpike/Doremus Levee/Floodwall system is located in Newark on the right bank of the Passaic River. Land use in the area is mainly industrial. The system consists of a total of 5,599' of levee and 17,657' of floodwall. A total of

21.48 acres of flood protection levee easement (Estate No. 9) and 6.02 acres of temporary work area easement (Estate No. 15) will be required for this segment of the project. Temporary work area easements are for a two year period.

The South First Street Levee/Floodwall is located in Harrison and the Borough of East Newark, on the left bank of the Passaic River. The system consists of 1,750' of levee and 5,700' of floodwall. Land usage in the area is primarily industrial and commercial. An area of approximately 10.0 acres will be acquired in fee (Estate No. 1). Due to setback requirements associated with stabilization, the levee from Stations 20+00 to 30+00 will significantly impact two business properties, currently used as a parking lot and a commercial storage area. The remainder of the land required for the levee and floodwall will be acquired under a flood protection levee easement (Estate No. 9), totalling 4.49 acres. An additional 1.42 acres will be required under a temporary work area easement (Estate No. 15), for a two year period during construction.

The Kearny Point Levee/Floodwall will be located on the left bank of the Passaic River, continuing around Kearny Point and along the right bank of the Hackensack River in Kearny. It consists of approximately 3,908' of levee and 33,771' of floodwall. A total of 21.48 acres of flood protection levee easement will be required (Estate No. 9) for construction of this segment, as well as 13.35 acres of temporary work area easements (Estate No. 15) during the two year construction period.

1.2.1.6 Preservation of Natural Storage Areas

As part of the overall plan for the basin, 5,350 acres of critical floodplain storage areas will be purchased to preserve

the natural floodplain storage and the level of protection afforded by the project. These storage areas are located in 15 different municipalities in Passaic, Essex and Morris Counties. These lands are currently unimproved, and most are wetlands. Surrounding land uses are mainly agricultural and recreational. These lands will be acquired in fee (Estate No. 1).

1.2.2 Federally-owned land There is no known Federally-owned land to be used for this project.

1.2.3 Navigational Servitude

The applicability of navigational servitude to the various rivers and tributaries included in this project was researched by New York District Counsel, and a copy of the opinion rendered is attached at H.1.1.

Basically, the Passaic River is considered a navigable waterway from its mouth to a point 23.8 miles upstream at Straight Street in Paterson. The remainder of the Passaic River, the Pompton River, the Wanaque River, the Pequannock River, and the Rockaway River are not considered navigable waterways.

Throughout this report, property within the navigational servitude (below the ordinary high water mark on the navigable portion of the Passaic River) was not included in the real estate acreage calculations and cost estimates.

1.3 PUBLIC LAW 91-646 RELOCATIONS

There are only three project features which will require relocations under Public Law 91-646, as amended: The Passaic (Spur) Inlet, the Rockaway #2 Levee/Floodwall, and the South First Street Levee/Floodwall.

For the Passaic (Spur) Inlet, three residential structures will be taken in fee. Two of the three are used for residential purposes, and the third houses an office for a landscaping business.

For the Rockaway #2 Levee/Floodwall, 4 multi-family residential dwellings containing a total of 9 units, and 1 single family home will be taken in fee .

For the South First Street Levee/Floodwall, two business properties will be acquired in fee. One tract is now used as an employee parking lot for an adjacent business, and the other is a commercial storage yard.

There is an ample supply of replacement housing for the residents to be displaced by the project. For the cost estimates used in this report, the maximum purchase supplement ($22,500) was assumed for each owner-occupant, the maximum rental differential/downpayment assistance payment ($5,250) was assumed for each tenant, and a moving cost of $5,000 was used for each family. For businesses, estimates for moving and reestablishment were based on the type of business to be relocated, and minimal costs are anticipated. A total of $30,000 was estimated for the landscaping business, and $20,000 each for the parking lot and storage yard.

1.4 NON-FEDERAL SPONSOR'S ACQUISITION ABILITIES

The non-Federal sponsor for this project is the State of New Jersey, acting through the Department of Environmental Protection (NJDEP). NJDEP has indicated that, because of the magnitude of the project, it does not have the manpower to accomplish the required real estate acquisition and Public Law 91-646 relocations. NJDEP has indicated that it may request the Corps to perform those services on a reimbursable basis, under a

Memorandum of Agreement.

1.5 BASELINE COST ESTIMATE FOR REAL ESTATE

A detailed real estate cost estimate for each feature, in MCACES format, is included in Appendix D - Cost Engineering. The total project real estate cost estimate, with contingencies, is $32,982,426. A summary of the real estate costs for each feature is provided below.

Feature	Land Payments	Admin. Costs	Total* (w/cont.)
Tunnel	$ 21,800	$ 6,081,740	$ 7,019,072
Pompton (Main) Inlet	4,594	9,760	16,507
Passaic (Spur) Inlet	971,872	16,140	1,136,215
Fairfield Road Bridge	16,160	13,140	33,696
Newark Bay Outlet	1,688	3,380	5,829
Work Shaft 2	98,805	3,380	117,514
Work Shaft 2B	847	3,380	4,862
Work Shaft 2C	1,565	3,380	5,688
Work Shaft 3	38,417	3,380	48,068
Work Shaft 4	741	3,380	4,740
Vent/Hook Hole Shaft 5	36,342	3,380	45,681
Vent Shaft 6	226	3,380	4,148
Pequannock-Ramapo L/F	199,356	135,725	385,343
Pequannock Channel Mod.	187,587	250,875	504,232
Wanaque Channel Mod.	11,439	170,200	208,886
Ramapo Channel Mod.	220,543	69,725	333,808
Pompton Inlet Bypass Channel	14,218	6,380	23,689
Passaic/Lower Pompton Ch. Mod.	23,933	3,860	33,352
Great Piece Weir	165,912	19,900	222,974
Pequannock Weir	1,960	6,380	9,592

Rockaway #1 L/F	79,047	46,940	144,886
Rockaway #2 L/F	941,339	87,755	1,183,459
Rockaway #3 L/F	265,954	300,570	651,503
Pinch Brook L/F	143,508	24,435	193,135
Passaic #2A L/F	579,387	92,925	773,159
Deepavaal Channel Mod.	347,577	81,235	493,134
Lister/NJTurnpike/Doremus L/F	2,688,786	102,955	3,210,502
Lister/NJTurnpike/Doremus Ext.	1,586,914	72,865	1,908,746
South First Street L/F	2,854,982	94,215	3,391,577
Kearny Point L/F	4,466,697	138,090	5,295,506
Natural Storage Areas	4,654,500	191,520	5,572,923

*This column is the total with contingencies, and is therefore not the sum of the first two columns, which do not include contingencies. Contingencies for each feature vary from 10% to 20%, depending on various factors such as the number of privately-owned tracts to be acquired and the completeness of the design drawings.

It should be noted that each feature was estimated separately, with the assumption that surveys, title work and appraisals would be done on all properties. When preliminary acquisition work commences, some administrative cost savings can be expected if the project features are grouped. Further administrative cost savings can be realized on low value tracts (under $2,500) where appraisals are determined to be unnecessary.

1.6 REAL ESTATE MAPPING

Real estate mapping will be prepared during the Feature Design Memorandum phase for each project feature.

1.7 MINERAL ACTIVITY

There is no known mineral activity in the vicinity of the project.

1.8 PROPOSED ESTATES

The proposed estates to be acquired for the project, as referenced in Section 1.2, are listed below.

Fee (Estate No. 1): The fee simple title to the land described in Schedule A, Tract No. _____, subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

Channel Improvement Easement (Estate No. 8): A perpetual and assignable right and easement to construct, operate, and maintain channel improvement works on, over and across the land described in Schedule A, Tract No. ____, for the purposes as authorized by the Act of Congress approved _____, including the right to clear, cut, fell, remove and dispose of any and all timber, trees, underbrush, buildings, improvements and/or other obstructions therefrom; to excavate, dredge, cut away, and remove any or all of said land and to place thereon dredge or spoil material; and for such other purposes as may be required in connection with said work of improvement; reserving, however, to the owners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

Flood Protection Levee Easement (Estate No. 9): A perpetual and assignable right and easement in the land described in Schedule A, Tract No. ____, to construct, maintain, repair, operate, patrol and replace a flood protection levee, including

all appurtenances thereto; reserving, however, to the owners, their heirs and assigns, all such rights and privileges in the land as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

Road Easement (Estate No. 11): A perpetual and assignable easement and right-of-way in, on, over and across the land described in Schedule A, Tract No. ___, for the location, construction, operation, maintenance, alteration, and replacement of a road and appurtenances thereto; together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions and other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the owners, their heirs and assigns, the right to cross over or under the right-of-way as access to their adjoining land at the locations indicated in Schedule B, subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

Utility Easement (Estate No. 13): A perpetual and assignable easement and right-of-way in, on, over and across the land described in Schedule A, Tract No. ___, for the location, construction, operation, maintenance, alteration, repair and patrol of (overhead) (underground) (specifically name the type of utility); together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions and other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to exiting easements for public roads and highways, public utilities, railroads and pipelines. (Note: Items in parentheses will be described for

each type of utility easement to be acquired.)

Temporary Work Area Easement (Estate No. 15): A temporary easement and right-of-way in, on, over and across the land described in Schedule A, Tract No. ___, for a period not to exceed two years, beginning with the date possession of the land is granted to the United States, for use by the United States, its representatives, agents, and contractors as a work area, including the right to move, store and remove equipment and supplies, and erect and remove temporary structures on the land and to perform any other work necessary and incident to the construction of the Passaic River Flood Damage Reduction Project, together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions, and any other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however to existing easements for public roads and highways, public utilities, railroads and pipelines.

The recommended non-standard estate for the tunnel is a modified restrictive easement: A perpetual and assignable easement for the construction, maintenance, and operation of a tunnel and a restricted area in, on, over and across the land described in Schedule A, Tract No. _____, consisting of the right to prohibit placement of any wells or borings deeper than 150' below the surface; and including the rights to any minerals in and under said land and all appurtenant rights used in connection with the exploration, development, production and removal of said minerals; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired.

On lands required for the project that are already publicly-owned, it is likely that the NJDEP will request that title remain with the local municipalities, and that a right-of-entry be granted to the Government for construction of the project. Operation and maintenance responsibilities may also be delegated to the local municipalities through a sub-agreement. These details have not yet been finalized. If this occurs, a request for approval of any non-standard estate to be used will be forwarded for approval. Also, if a non-standard estate for the switchyards is required, suggested language will be processed for approval.

1.9 ACQUISITION SCHEDULE

The PCA is scheduled to be executed by 1 Nov 97. Current project milestones show a sequence of Feature Design Memorandum (FDM) completion for each feature or group of features, followed by preparation of Plans and Specifications concurrent with the real estate acquisition. Approximately one year is scheduled for real estate acquisition for each feature or group of features.

This schedule assumes that design will be sufficiently complete after the FDM phase to begin acquisition, and that no changes to the design will be made during Plans and Specifications. For most projects, this is not a valid assumption. During the FDM phase, the schedule for each feature will be refined to show real estate acquisition beginning after completion of Plans and Specifications. An adequate amount of time for completion of the acquisition will be allotted, which may be more or less than one year. Sufficient information does not currently exist to accurately estimate the time required for acquisition. Construction contract advertisement and award schedules will be adjusted accordingly. All real estate

milestones will be coordinated with the non-Federal sponsor.

1.10 UTILITY AND FACILITY RELOCATIONS

There will be some utility and facility relocations required in connection with this project. However, the details of the relocations have not been finalized to the point where the real estate requirements can be firmly established. During the FDM phase, the relocation requirements will be further investigated, and Attorney's Opinions of Compensability will be prepared.

1.11 ENVIRONMENTAL CONCERNS

Hazardous, toxic, and radioactive waste (HTRW) investigations have been performed at the sites. There are a significant number of sites within or adjacent to the project area that have been identified as known or potential HTRW sites. However, the gross appraisals have been prepared considering project lands as either clean or remediated.

1.12 ATTITUDE OF AFFECTED LANDOWNERS

Numerous public meetings have been held during the GDM phase to advise the public of the proposed project. Further meetings with the landowners directly affected by the project will be held during later phases of the project. This is a very controversial project, and a mixed reaction from the landowners is expected.

ATTACHMENT H.1.1
OPINION ON NAVIGATIONAL SERVITUDE

CENAN-OC 16 Mar 1995

MEMORANDUM FOR: Chief, Real Estate Division

SUBJECT: Response on Navigability of several rivers in New Jersey

1. This department, in the administration of the laws enacted by Congress for the protection and preservation of the navigable waters of the United States, has determined the Passaic River is a navigable water of the United States from the mouth to a point 23.8 miles upstream at Straight Street in Patterson. Actions which modify or otherwise affect those waters are subject to the jurisdiction of this Department, whether such actions occur within or outside the navigable areas.

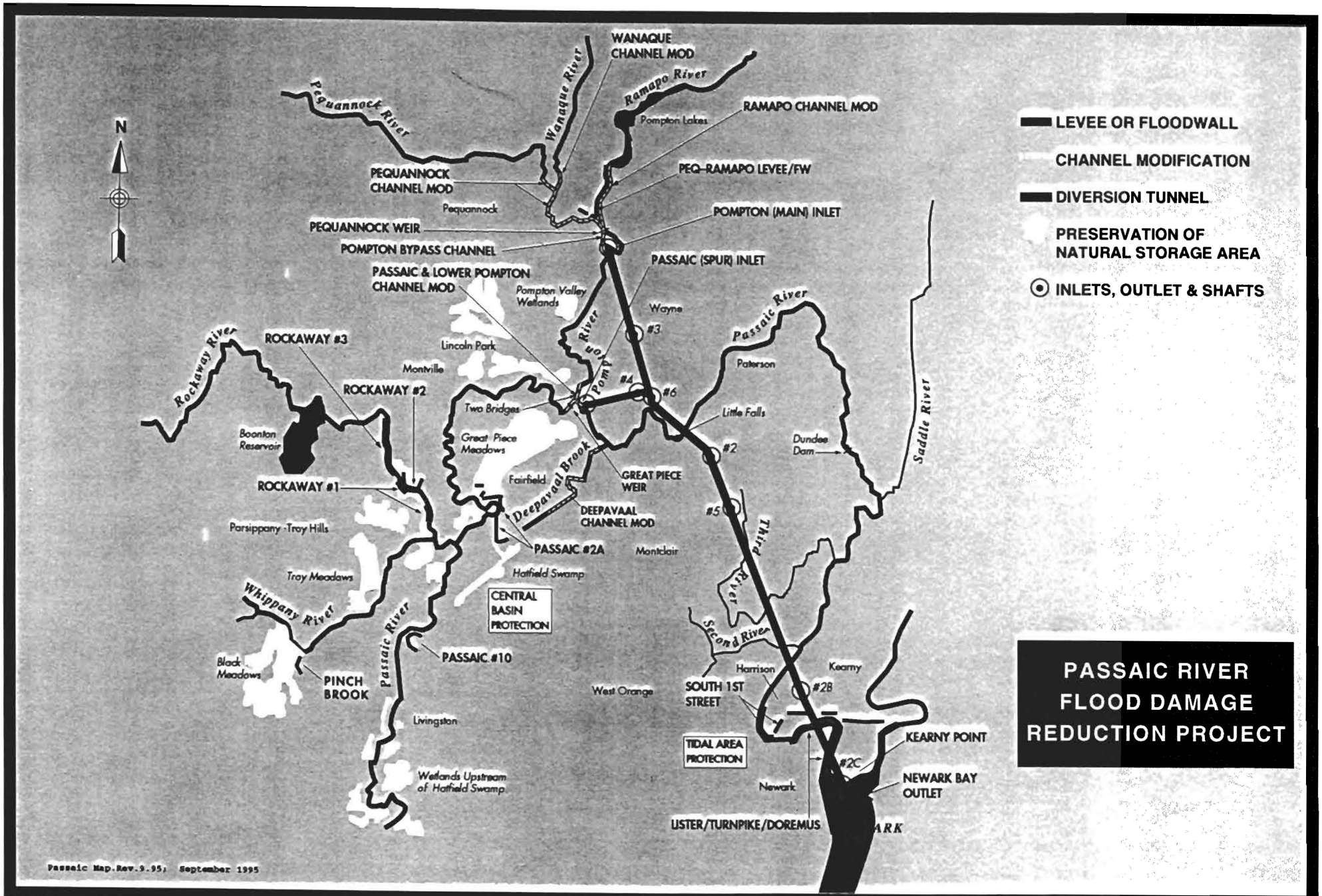
2. This department, in the administration of the laws enacted by Congress for the protection and preservation of the navigable waters of the United States, has determined the ~~Passaic~~ Pomptom River is not a navigable water of the United States.

3. There is no file for either the Wanaque or Pequannock Rivers. However, they both are tributaries of the non-navigable Pomptom River. Logic tells us that if a navigable river flows into another, the second river will also be navigable, therefore the two tributaries are non-navigable.

4. There is no file for the Rockaway River either. However, here too, the Rockaway River flows into the Passaic River above the point where it becomes navigable. Therefore, it is logical to assume that you can designate it non-navigable.

5. The official determination of navigability is determined first by the Federal Courts and administratively, subject to the courts, by the Division Engineer, as described in 33 CFR Section 329.14(b).

Leonard R. Lichtblau
Assistant District Counsel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PEQUANNOCK WEIR
POMPTON (MAIN) INLET
POMPTON BYPASS CHANNEL
PASSAIC (SPUR) INLET
PASSAIC & LOWER POMPTON CHANNEL MOD
Pompton Valley Wetlands
Wayne
#3
Pompton River
Passaic River
Rockaway River
ROCKAWAY #3
Lincoln Park
Montville
#4
#6
ROCKAWAY #2
Two Bridges
Paterson
Little Falls
Boonton Reservoir
Great Piece Meadows
#2
Dundee Dam
Saddle River
ROCKAWAY #1
Fairfield
GREAT PIECE WEIR
Deepavaal Brook
DEEPAVAAL CHANNEL MOD
#5
Parsippany-Troy Hills
PASSAIC #2A
Montclair
Third River
Troy Meadows
Hatfield Swamp
Whippany River
CENTRAL BASIN PROTECTION
Second River
Passaic River
PASSAIC #10
Harrison
Kearny
Black Meadows
PINCH BROOK
West Orange
SOUTH 1ST STREET
#2B
Livingston
TIDAL AREA PROTECTION
KEARNY POINT
#2C
Wetlands Upstream of Hatfield Swamp
Newark
NEWARK BAY OUTLET
LISTER/TURNPIKE/DOREMUS
LEVEE OR FLOODWALL
CHANNEL MODIFICATION
DIVERSION TUNNEL
PRESERVATION OF NATURAL STORAGE AREA
INLETS, OUTLET & SHAFTS
PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT
Passaic Map.Rev.9.95; September 1995

PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

ECONOMICS

APPENDIX I

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Passaic River Main Stem, New Jersey
Flood Damage Reduction Project

I Economics

1. INTRODUCTION

The Passaic River Flood Damage Reduction Project was authorized for design and construction by Section 101(a)(18) of the Water Resources Development Act of 1990 (P.C. 101-640) on 28 November 1990 and amended by Section 102(p) of the Water Resources Development Act of 1992 (P.C. 102-580). The authorized flood damage reduction project to be implemented is based on the report of the Chief of Engineers dated February 3, 1989, except that the main diversion tunnel has been extended to include an outlet in Newark Bay. The streambank restoration measures authorized in subsection B are the subject of a separate report and are, therefore, not addressed in this report.

The purpose of this report is to present the results and findings of an economic benefit analysis performed for the Passaic River Basin Flood Damage Reduction Project. This section is consistent with guidance outlined and presented in Planning Guidance Engineering Regulation (ER) 1105-2-100 dated 28 December 1990.

1.1 Basin Description

The Passaic River Basin occupies portions of the following counties: Bergen, Essex, Hudson, Morris, Passaic, Somerset, Sussex and Union in New Jersey and Orange and Rockland in New York (See Figure 1). The portion of these counties actually lying within the Basin ranges from practically all, in the case of Passaic, to only a minor fragment, as in Sussex and Hudson counties. For purposes of this study, the service area is defined as the counties listed above in their entirety, plus the nearby New Jersey counties of Hunterdon and Middlesex.

Access to all Federal, State and county recreation sites is very good. Major highways leading into the region are U.S. Routes 202 and 46, and New Jersey Routes 17, 23, and 3. In addition, the Garden State Parkway and the New Jersey Turnpike also provide easy access. Locally, many hard-surfaced roads provide an all weather network in the

immediate vicinity of the sites. The New York Thruway bisects the New York portion of the basin. Interstate Highways 78, 80, 287 and 280 cross the Passaic River Basin, making it more accessible to a greater number of people. Travel studies indicate that about 20 percent of the people passing through also use outdoor recreational facilities in the area. Access roads connect with the major highways at points of intersection.

Bergen County - Because of its immediate proximity to the New York City - Newark-Hudson County core area, Bergen County felt the impacts of urbanization and suburbanization sooner and more intensely than most other New Jersey counties. The eastern and southern portions of Bergen County had already been extensively suburbanized when the post-World War II boom occurred.

While large tracts of land in the northern section of the county underwent new development, areas closer to New York City were undergoing a change to higher densities. Commercial activities intensified in areas where major highways intersected. Paramus, in the central portion of Bergen County, became the focus of major shopping center activity. Industry was also developing in Bergen County. Marginal land fringing the meadowlands attracted light industry and distribution firms because of the county's highway access to New York and urbanized northern New Jersey.

The western portion of Bergen County is located in the Passaic River Basin. Three northwestern municipalities, Mahwah, Oakland, and Franklin Lakes, are in the highland area. These towns have the greatest reserves of vacant land left in the county but the terrain is rugged throughout much of the area. Low density residential use is the dominant form of development. The lower valley portion of Bergen County extends from the north, which is characterized by the availability of vacant land and low density use, to the center and south of the county, where residential, commercial and industrial uses are intense.

Essex County - The county is densely populated and extensively developed. It is the keystone of the industrial belt along the eastern part of the State that borders Newark Bay and Arthur Kill. It functions as the industrial and financial center of northeastern New Jersey. Newark, the largest city in the state, is located in the southeastern corner of the county. The eastern portion of Bergen County, developed almost entirely before the depression, is today

undergoing a degree of redevelopment. As the older industrial heartland of the county, it contains the central business area of Newark, the Newark Airport, the Newark Seaport, and vast areas of older residences (which become progressively less dense toward the north).

Central Bergen County is characterized by large parks and recreational areas, combined with the rugged topography of the Watchung Mountains. This portion of the county also contains older, more affluent suburbs, which presently are experiencing various stages of transitional change.

The Western portion of Bergen County consists of tier communities between the Watchung Mountains and the Passaic River. This area, characterized by one-family homes and new subdivisions, lies in the central basin of the Passaic River. Most of the county's vacant land is located in this section.

Hudson County - Hudson County is an aging urban area characterized by an old and densely settled residential sector, and a large concentration of heavy industry.

There is little vacant land remaining in the county. Practically no growth in population has been projected for the county other than that entailed in development of the Hackensack Meadowlands. Secaucus and eastern Kearny contain most of the county's vacant land. Some high rise residential development has occurred in the northern Hudson communities. Three of Hudson County's municipalities, Harrison, Kearny, and East Newark, are located within the Lower Valley of the Passaic River Basin.

Hunterdon County - Hunterdon County, which lies southwest of the Passaic River Basin, is still primarily rural. The pattern of development has been random and sporadic. Almost all developed land is devoted to residential use, which is predominantly single family and low density (1-5 acre lot zoning). Commercial and industrial use take up a very small portion of the county's land.

Middlesex County - Middlesex County, which lies south of Union County, is outside of the Passaic River Basin. During the past quarter century, Middlesex County has been one of the fastest growing areas in New Jersey. This growth stem from its central location in the New York-Philadelphia transportation corridor. Large amounts of vacant land and extensive public water and sewer networks suggest that the county will remain attractive for future development.

In the recent past the predominant trend in land development has been toward construction of low density housing and industry in scattered rural sites away from major transportation corridors. By its very nature, residential development is almost exclusively upper income. Some low income housing is being located along major highways but most is found in such older urban centers as New Brunswick and Perth Amboy.

Morris County - The majority of Morris County's development is low density residential, though of late, industrial and commercial uses have become increasingly important. The intensity of development is greater in the eastern section of the county (that area roughly contained in the center of the Passaic River Basin) which contains most of the county's older urban areas. The central portion of the county (which lies in the highland area of the Passaic River Basin), and the western portions of the county (which are not part of the basin) have begun to feel development pressures where concentrations of housing are sparse. It is in the western portion where most of the county's industry is located. The increasing spread of suburbanization from New York City, along with the recent and projected completion of various highways in the county, is placing increased pressure for development on Morris County. The fact that Morris County is one of northeast New Jersey's less densely developed counties acts as a further inducement to development.

Passaic County - Passaic County lies almost entirely within the Passaic River Basin. The southeastern portion lies in the lower valley, the central portion (Wayne) in the central basin, and the northwestern portion in the highland area. The lower valley section was developed first and contains the older urban areas of Paterson and Passaic and the dense, older suburbs. Most of the county's industry is also located in this area. Wayne is also extensively developed, but residential use is of a lower density, with relatively little of the multifamily housing development that can be found in the lower valley. Much of the regional shopping and industrial activity is located in the southwestern corner of Wayne, along Routes 23, 46 and 80. Office development has sprung up at various locations throughout this township. The highland area contains most of the county's vacant land. The hilly terrain and limited transportation access have constrained growth in the upper county, limiting its development relative to central and

lower Passaic County. So far development has been almost totally low density residential.

Somerset County - The most intensive development in Somerset County has occurred along the east-west transportation corridor (Routes 22, 28, 202 and the southern portion of 287) that crosses the middle of the county. To a lesser extent, development has occurred in the north in the towns of Bernards and Bernardsville.

The major, active land uses are residential and agricultural. Residential development is practically all low density, single family, with at least one acre zoning found in most towns. A substantial portion of residential development is scattered throughout the county, centering around lakes.

Sussex County - Of the county's entire land mass, approximately 90 percent is either used for farming or recreational purposes, or is unoccupied and undeveloped. Residential land use constitutes 7.4 percent of the total land area and 67.9 percent of all developed areas. Areas in Sussex County developed for commercial, industrial, institutional, transportation and utility purposes constitute only 3.4 percent of the total land uses in the county.

Patterns that characterize urban development in the county are: commercial, industrial and residential development occurring in linear or strip fashion along major thoroughfares such as U.S. Route 206 and State Routes 23 and 15; and low density residential dispersal ("sprawl"). Urban or dwelling unit concentrations either provide nuclei for various farming areas or are in the form of metro resort developments centered around lakes at vacation sites, where the development of first and second homes has often put considerable strain on the environment. The increase in the county's residential base has had a great impact on agriculture, which often occupies the land most suited for development. The Sussex County Planning Board estimates that since 1972, land in active agricultural use has declined at a rate of three percent per year.

The county has limited highway access and rugged terrain tends to inhibit large scale development, especially industrial. Only parts of three Sussex County towns lie within the Passaic River Basin (specifically, the highland area). These towns are Hardyston, Sparta and Vernon.

Union County - Union County was among the first of the New Jersey counties to feel the impact of the suburban movement. Union County's 103 square miles are densely settled, with 85% of the land area currently developed.

2. DEMOGRAPHIC AND SOCIAL CHARACTERISTICS OF THE PROJECT AREA

Demograhic Characteristics- The project area consists of 35 communities whose boundaries are wholly or in part within the 500 year floodplain of the Passaic River Basin (see Table 1). These communities lie in a five county region that includes Bergen, Essex, Hudson, Morris, and Passaic Counties. The entire five county region during the decade of 1980-1990 experienced an overall decline of 0.49% in population, from 3,110,677 to 3,033,080 according to census figures. For the Passaic River Basin counties, 1980 and 1990 census figures are not entirely comparable, since the latter were based upon census block and track data.

2.1 Demographic Characteristic

The 35 community project area, encompassing 246 square miles, experienced a 5.52 percent decrease in population between the 1980 and 1990 Censuses. The greatest loss in population during the decade occurred within Essex and Bergen Counties (8.57 percent and 2.37 percent, respectively), while modest gains in the project area were seen within Hudson, Morris, and Passaic Counties. The greatest single population decrease occurred in Newark, which lost almost 55,000 residents during the period.

Overall density within the project area declined from 4,592 persons per square mile in 1980 to 4,340 persons per square mile in 1990. The densest of these communities were Passaic (18,663 persons per square mile), and Paterson (16,733 persons), both of which lie in older, urbanized areas of Passaic County. More sparsely settled were newer suburbs like Fairfield (729 persons per square mile) and Montville (823 persons).

The majority of Essex County's project area population loss was found in Newark, which declined by 16.41 percent during the decade, from 329,248 to 275,216 persons. Other older, urbanized areas within Essex County like Roseland, Nutley, and West Caldwell also declined. Of the eight Essex County municipalities within the project area, only two (Fairfield and North Caldwell), experienced any population gains during the decade.

Newark's density dropped as its population decreased, declining from 13,817 to 11,549 persons per square unit. It remained, however, the densest community within Essex County's portion of the project area. The two Essex County project area communities (Fairfield and North Caldwell) which grew in population also grew in density.

The Bergen County portion of the region also declined in population by (2.37 percent) during the decade. The majority of this decrease came in the two older, urbanized towns of North Arlington (16.86 percent) and Lyndhurst (10.15 percent). Other older communities close to the major urban areas of New York and Newark that also lost population include Fair Lawn (5.22 percent), and Rutherford (6.7 percent). In the project area portion of Bergen County, only Wallington and East Rutherford saw small (less than 1 percent) population gains.

All of the Bergen County communities within the project area have relatively small (approximately 5.5 square miles) land areas; Wallington is the smallest at slightly over one square mile. Densities range from 2,074 persons per square mile in East Rutherford to 12,548 persons in more heavily urbanized Garfield.

The three municipalities within Hudson County which fall within the project area experienced an overall population gain of `1.11 percent. Harrison grew by 10.14 percent, and tiny East Newark added a small number of residents for a large percentage increase. Because of its small land area (0.1 square mile), it is the densest of the Hudson County project area communities. Kearny, with the largest land area and the lowest density (3,807 persons per square mile), declined by 2.41 percent.

While some Morris County communities within the project area declined during the 1980s, others grew. Lincoln Park (which grew 24.67 percent to 10,978), Montville (9.22 percent to 15,607), and East Hanover (5.7 percent to 9,850) are all located outside of urban areas and have good highway access. Those which lost population, including Riverdale (6.32 percent) and Pequannock (6.77 percent), tend to be closer to the older suburbs.

Several of the Morris County communities have large land area (Montville and Parsippany-Troy Hills). The lowest overall density found in these communities is 823 persons per square mile in Montville.

Passaic County's portion of the project area experienced almost a 22 percent population decrease during the last decade. The only increases were in the towns of Passaic (10.2 percent), Paterson (2.18 percent), and Wayne (1.18 percent). Towns showing the largest declines include Totowa (11.1 percent) and Hawthorne (6.13 percent). Densest of the County's communities were Passaic (18,663 persons per square mile), Paterson (16,733), and Prospect Park (10,527), while Wanaque (1,220) was the least densely populated.

The overall population density of 8,722 persons per square mile is much higher than the density of other subbasin locations due, in most part, to the inclusion of Newark. Next to Newark the largest town is Passaic with a 1990 population of 140,891. These two cities alone make up 45 percent of the subbasin's total population.

2.2 Social Characteristics

This section discusses three aspects of social characteristics for each geographic area. They include Household and Family Characteristics, Households Moved, and Age, which consists of the percentage of people over age 65 and over age 18.

2.2.1 Household and Family Characteristics

The social characteristics of the project area are similar to those in the rest of the Passaic River Basin. The total number of families in the project area decreased by 7.41 percent between 1980 and 1990, while the total number of households decreased by 3.83 percent. In 1980, 75 percent of the project area households were family households; by 1990 this percentage had decreased to 72 percent. Communities with the greatest increases in families were found mostly in Morris County, such as Montville (16.57 percent) and Florham Park (15.69 percent). Those with the greatest decreases include communities in Essex County, such as Newark (19.96 percent).

Combining family data with household data provides a good indicator of social change. The number of households increased or decreased in the same pattern as number of families; however, overall, the number of households increased or decreased at a slower rate. The biggest increases in number of households occurred in Lincoln Park, Parsippany-Troy Hills, and Wayne. Significant decreases occurred in the communities of Newark and Paterson.

2.2.2 Households Moved

The project area experienced a total of 151,378 households moved between 1980 and 1990. As a percentage of the population, this figure is similar to the other geographic areas.

2.2.3 Age

The increased age of the Passaic River Basin population reflects the aging of the region and the counties. The percent of the population over 18 increased from 71.97 percent to 76.29 percent of the total. In addition, the percentage over 65 increased from 10.91 percent to 12.79 percent of the total.

The percent of population over 18 and over 65 has risen during the 10-year period, even though the overall age of the project area is lower than the five county region and the floodplain. On average, communities in Bergen County have the highest percentages of people over 18 and over 65 with Elmwood Park (81.00 percent and 19.30 percent), Fair Lawn (78.90 percent and 20.00 percent), and North Arlington (83.22 percent and 21.01 percent).

Other communities with a high proportion of older residents include Clifton and Totowa.

2.3 Income Characterisitics

In this section the following income characteristics were analyzed for all of the geographic areas: Per Capita Income, Percent of Families above and below $15,000 and Total number of Housing Units.

2.3.1 Per Capita Income

Per capita income in the project area rose from $11,056 in 1980 to $15,867 in 1990, which is lower than both the five county region and the floodplain. Influencing the low per capita income figure for the project area are the communities of Newark ($9,476) and Paterson ($10,538). Only three other communities have per capita incomes lower than $15,000; however, these communities' large population have a big influence. Communities with the highest 1990 per capita incomes include Livingston ($34,174) and North Caldwell ($40,848).

2.3.2 Percent of Families above and below $15,000

As expected, the project area also has the highest percentage of families with incomes below $15,000 (12.93 percent). This percentage has decreased since 1980 at roughly the same rate as for the region and the floodplain. In 1990, the communities with the highest percentage of families with income below $15,000 were Newark, Passaic and Paterson, in addition to East Newark (12.68 percent) and Harrison (13.44 percent). The lowest percentages were found in the communities of Livingston (1.68 percent), North Caldwell (1.59 percent), Lincoln Park (1.80 percent), and Montville (1.81 percent).

2.3.3 The Total Number of Housing Units

The total number of housing units in the project area decreased from 406,534 in 1980 to 397,665 in 1990. This 2.18 percent decrease compares with an overall five county region increase of 2.5 percent and a floodplain increase of 2.69 percent.

Newark's decline in total housing units of 18,922 units has a large influence on the project area. Only six other communities had a decline in total number of housing units, and only one, Paterson (-4.1 percent), had over a four percent decrease.

2.4 Employment Characteristics

This section discusses three aspects of employment characteristics, Total Labor Force, Percent Unemployed, and Occupation Types.

2.4.1 Total Labor Force

The five counties touched by the Passaic River Basin had a total labor force of 1,637,341 persons in 1990. Bergen County had the largest labor force with 456,693 workers and Hudson County the smallest with 169,781 workers.

2.4.2 Percent Unemployed

The overall unemployment rate of the five county region was 7.01 percent in 1990, which is lower than the project area (7.89 percent), but higher than the floodplain rate of 6.59 percent. Contributing to the unemployment rate of the

overall region is Essex County with the highest rate of 8.84 percent. Morris County's rate of 3.45 percent is the lowest of the five counties. Those counties that had a higher percentage of professional and managerial persons in the labor force generally had lower unemployment rates.

2.4.3 Occupation Types

Within the five county area, the single largest occupation was administrative/support (18.47 percent). Next in order of magnitude were executive, administrative, management, and professional, each with slightly over 15 percent of the total employment.

Bergen County and Morris County were both very similar in their occupational characteristics. Both had the highest percentage in executive/administrative/management and professional specialty occupations along with the lowest percentage of workers in administrative support. These two counties also have the highest percentage in sales occupations: 14.27 percent for Bergen, and 13.14 percent for Morris County.

The percentages in Essex County are influenced by Newark, and thus have the highest percentages among the other counties in areas of service (10.18 percent) and administrative support (20.56 percent).

Hudson County and Passaic County are similar in their employment characteristics, with the lowest percentages of the five counties in the areas of professional and managerial persons, and higher than average percentages in occupations such as machine operator/assemblyman/inspector and transportation/materials/moving.

3. RECREATIONAL DATA

As populations change, so do their recreational needs and the facilities desired. To evaluate the existing and potential recreational environment of the study area, several sources of information were analyzed. The Passaic River Basin Flood Protection Feasibility Report (1987) was reviewed and compared with information received from current sources. These include the 1992 Skylands Greenway Plan, various publications made available through the Association of New Jersey Environmental Commissions (ANJEC) Resource Center and, most importantly, the 1994 (Draft) New Jersey Open Space and Outdoor Recreation Plan (SCORP). The 1988 version of SCORP

was also reviewed to gain insight into changes that have occurred in the recreational environment over the last several years.

The information sources cited above are generally focused at the county level. Therefore, it is difficult to characterize the recreational environment of individual municipalities. The data, overall, was analyzed for the State as a whole, the Passaic Basin areas as a whole, and then by individual counties within the study area. More specific information, such as independent facility locations, floodplain information and individual tract data, was not analyzed.

The Passaic River Basin Stage 2 Report (1980) included a larger study area than is currently being assessed; however, much of the regional information in that report remains valid. New Jersey is still the most densely populated state in the nation. The Passaic basin region is one of the most densely populated areas of the State. Although more recreational land is now available than in 1988, the demand for recreational facilities within the basin, as well as in the State, still exceeds the supply. (It is important to note that the current data on recreational availability reflects better reporting procedures, and therefore comparisons can be misleading. While it may seem from statistics that 60,999 acres of recreational land have been acquired since 1988, some of this "new" acreage simply was not accounted for previously.)

3.1 Existing Conditions

There are many types of recreational opportunities in New Jersey, since the State and the Passaic River Basin are favored with a wealth of natural features, such as forests, mountains, valleys, fields, streams, lakes and floodplains. The varying climate also provides for a large variety of seasonal recreational opportunities, some of which require developed facilities, while other, more passive activities, merely require open space. Nearly any type of recreational activity is available in New Jersey: skiing, boating, fishing, golfing and bird watching are some examples. All of these activities require a location at which to participate. Some of these are available on public lands while many are found on printed owned space.

Federal lands and facilities that are open to the public include parks, forests and preserves, most of which are geared toward more passive recreational activities. Parks

may contain bikeways, and swimming, picnic and playground facilities, while forests and preserves provide open, and often quiet, space in which to walk, observe wildlife and enjoy the natural environment.

The State manages its own public parks, forests and preserves, as well as camp grounds, historic sites, trails, lakes and reservoirs. State recreational areas range from undeveloped open spaces to developed facilities, such as ski areas, tennis and basketball courts, ice skating rinks and docks.

Local municipalities generally have their own playgrounds, public pools, and parks for citizens to use and enjoy. Municipal facilities tend to be more developed, leaving the provision of open space opportunities to the Federal and State Governments.

Recreational opportunities afforded by the private sector include golf courses, pools, ski resorts, marinas, race tracks, amusement parks, skating rinks, campgrounds, private hunting grounds and privately owned watershed lands.

In the Passaic region, which has been highly urbanized, demand for recreational opportunities is strongly related to the availability and accessibility of both land and available facilities.

New Jersey now uses the Balanced Land Use Guidelines to assess the amount of land necessary to satisfy the recreational needs of its population. The guidelines call for a percentage of developable open space to be dedicated to recreational needs.

New Jersey (1993 Recreation Open Space Needs) has a current deficit of 282,008 acres of public recreational open space, even though 788,659 acres of public open space, recreational areas exist. It is policy of the SCORP to "protect the critical natural, cultural, recreational and scenic resources of the Highlands and Skylands (of which the Passaic River Basin is a part) to promote balanced growth and development." Of the counties in the study area, only Morris County (the most affluent) has a surplus of recreational open space, based on the Balanced Land Use Guidelines.

In urbanized areas, where many people do not drive, accessibility to public open space is often severely limited. Those who do drive may have to travel great distances to reach desired open space areas. This applies particularly to

the Passaic River Basin project area communities in this study. Although public areas are accessible via the highways that traverse the Passaic River Basin, people in urbanized areas rely more heavily on local sources of recreation, which provide different (usually more developed) amenities than State forests or parks. In addition, many facilities are still not accessible to the disabled population (as required by the Americans with Disabilities Act).

3.2 Recreation In The County Areas

The Passaic basin counties studied were Bergen, Essex, Hudson, Morris and Passaic. The counties in the study area contain a total of 134,156 acres of open space. All five counties are currently running a deficit of local open space. Table 13 presents an open space inventory, by facility type, for each of the study area counties.

Bergen County - Bergen County contains 22,036 acres of recreational open space, including 5,692 acres of private recreational facilities. The majority of public open space (7,716) acres is provided by county parks. There are close to 13,000 acres of contiguous public open space in northern Bergen County. The county has financed a campaign to protect its last 2,500 acres of mountainous open space in response to a halving of open space (from 12 percent to 6 percent) between 1982 and 1988. Based upon the Balanced Land Use Guidelines (BLUG), Bergen County falls 12.6 percent (1647 acres) short of its local (county and municipal) goal for recreational open space.

The county population has experienced a 2.4 percent decrease since 1980. However, in 1993, the county ranked second in New Jersey in terms of tourist dollars spent. Accessibility to public space by roadway is enhanced by the major arteries - Garden State Parkway, NJ Turnpike, Interstates 80, 95, and 287, and State highways 17, 4 and 3 - that traverse the county.

Bergen County is currently developing a growth management plan and new model ordinances to support open space preservation in close coordination with four towns within its borders. There is strong citizen support for comprehensive environmental planning. Large majorities favor zoning to protect open space, critical habitats, watershed steep slopes, stream corridors and scenic resources. Over 93 percent of the residents polled expressed a desire to manage growth to control burgeoning congestion.

Essex County - Essex County, which established the first county park system in New Jersey in 1985, provides its citizens with 5,720 acres of recreational open space through the system. The county currently enjoys a total of 8,053 acres of public open space. Of the counties in the study area, Essex contains the least Federal and State recreational open space. However, based on the BLUG, Essex has the second smallest deficit of local recreational open space (331 acres - 4.4 percent short of goal).

Essex County contains many historic and cultural features even though it is nearly completely urbanized. Newark is the State's largest city and is currently undergoing several redevelopment projects. The western portion of the county contains West Essex Park, Great Piece Meadows, Hatfield Swamp, and large freshwater wetlands and floodplain complexes that border the Passaic River. The Watchung Mountains are preserved by the Eagle Rock and South Mountain Reservations. County population has decreased by over 8 percent since 1980. Major roads include the Garden State Parkway, NJ Turnpike, and Interstates 280, 78 and 95. Port Newark and Newark Airport are major transportation centers.

Hudson County - Hudson is the smallest county in the State with a population of 533,099. It also contains the smallest amount of recreational open space. The Hackensack Meadowlands and Liberty State Park provide many of the recreational opportunities in the County.

The county itself provides 21 percent (612 acres) of its recreational open space; another 1,688 acres are provided by the State. Hudson County falls 1,696 acres (66 percent) short of its local recreation open space goal, making it by far the most recreation poor county in the study area.

According to the county parks director, the parks are consistently filled to capacity; there is far more demand than supply. Because the municipal parks are quite small, the county parks are invariably filled to saturation.

Morris County - Morris County is a recreation leader in the State, largely due to the extensive acreage of Federal and State lands. Morris contains over 10,000 acres of county recreational open space, with almost as much matched by the State and private recreational open space. Using a base of substantial Federal holdings and watershed lands, the county

is actively pursuing a comprehensive, recreational open space program.

Morris County is ranked second in the nation for family income and has an open space tax. Most of the county lies in the highlands region. Interstates 287 and 80 cross through Morris County, along with several State highways. The northwestern section of the county is heavily forested and contains critical watershed lands. The eastern section is suburbanized.

Morris County, which contains the most recreational open space in the study area, is also the largest county in the study area. Based upon the BLUG, it is running at a local deficit of 818 acres. This is still the smallest deficit (4.2 percent) of the five counties studied; however, this is due to a surplus of municipal open space. The County open space deficit is 23 percent. While a location analysis has not been performed for this study, it is likely that the most affluent municipalities contain the greatest acreage of recreational open space.

Passaic County - Passaic County located in both the highlands and skylands regions, is highly urbanized and densely populated in the southeast. It has extensive State public open space lands in the northwest. County recreational open space tends to be centered around the Paterson and Clifton areas. The county severely lacks local recreational open space, with a golf deficit of 64 percent.

The Ramapo Mountains and Pequannock Watershed are also in the county along with Paterson, is New Jersey's third largest city and the location of The Great Falls. Passaic County recently acquired over 2,000 acres of the Sterling Forest, and the State is assembling lands for the Skylands Greenway.

Open space and recreation are important issues to the population. The county and its municipalities have been active in the Green Acres Program.

3.3 Summary Of New Jersey 1994 SCORP Findings

The single most important factor in providing recreational opportunities is suitable land resources. While gains have been made since 1988, New Jersey still suffers from a deficit of recreational open space. Over 282,000 acres of additional open space are needed to serve the States's

requirements. Acreage currently available includes publicly accessible private lands (e.g. watershed lands).

Open space should be located where people live. A trend toward closer-to-home recreation is being experienced due to the high cost of living in this region. In urban areas, where the State-wide lack of water related recreational facilities is especially severe, county parks account for a large percentage of the recreational opportunities.

The Federal government supplies approximately 90,000 acres of public recreational open space in New Jersey, the State provides approximately 528,000 acres, and county and municipal governments supply approximately 134,000 acres. With approximately 100,000 acres of open space in private hands, is inevitable. Cooperation with commercial and nonprofit providers will be invaluable in the face of continuously limited government funding for recreation.

The frequency with which people participate in particular activities does not always reflect the "most popular" activities. A recreational preference study showed that numerous inadequate facilities were frequently encountered with adults pursuing all of the most popular outdoor activities. Swimming, currently the most popular activity, registered the largest availability deficit.

The State and its citizens are committed to open space acquisition, as evidenced by voter approval of Green Acres bond issues, which help finance land acquisition and facility development. However, funding for recreation is still inadequate and this inadequacy is expected to continue.

3.4 New Considerations

Suburban sprawl has consumed the resources for urban infrastructure investments. The New Jersey State Development and Redevelopment Plan has as a goal the revitalization of urban areas. This will include the provision of recreational opportunities through the expansion of open space and facilities, and rehabilitation of existing facilities. Special emphasis will address waterfronts. An Urban Aid category of the Green Acres Program is available to eligible municipalities (currently 50), for 50 percent grants.

Contiguous open space is an important issue. The concept of Greenways is catching on rapidly. Executive order No. 224 created a Skylands Greeways Task Force. This task force has recommended, the establishment of a Skylands National

Greeway. Many groups have recommended, or are working on, developing a regional trail system. Interconnection of recreational areas will be an important part of future planning.

Because the population is both aging and experiencing a "baby boom echo," it will require different recreational opportunities to satisfy varying needs (e.g., senior oriented services). Seniors are expected to represent a larger portion of the population by the year 2010. Additionally, more consideration is being given to providing access for the disabled population, in accordance with the American with Disabilities Act.

Watershed lands and other open space in private hands if sold for general development, would remove many acres of suitable open space from recreational use. Government must maintain a cooperative relationship with the owners of these important open areas.

Water quality depends strongly upon the intensity of surrounding land use. Watershed lands lend themselves, in addition to water supply, to broad multiple uses, including recreation. There are few tools as effective for managing growth, and protecting watersheds, as the acquisition of public open space. As suitable land continue to be developed, there is a greater need for, and less availability of, open public space for recreation. This has become apparent throughout the State, but is especially evident in the highly urbanized Passaic Basin.

4. HISTORICAL FLOOD DATA

Historical data on flood damages throughout the Passaic River Basin has been compiled beginning with the flood of 1903 and ending with the March 1993 flooding. (A map of the municipalities in the basin is shown on Figure 1). The search for information regarding past floods was conducted in two phases:

1. Newspaper search, and

2. Federal post-flood reports.

Because of the general nature of most newspaper reporting, the first search phase usually yields only the location of significant damage areas and broad estimating of the losses involved.

During the second phase of the search, an examination of Federal post-flood reports often supplied more detailed information, including an estimate of flood damages by type and specific location. In addition, a narrative description of major floods in the basin was obtained.

In certain cases, damage estimates for a municipality based upon either newspaper searches or Federal post-flood reports, did not identify the stream causing the flooding. Therefore, certain flood damage estimates could not be related with certainty to a presumed source of flooding.

4.1 Major Floods

The 1903 flood is the flood of record for most of the Passaic River Basin, while the flood of July 1945 and other more recent floods are the floods of record for several tributaries. The basin experienced severe flooding in 1810, 1819, 1882, 1902, 1917, 1936, 1938, 1951, 1955 and 1960. More recently, heavy flooding occurred in 1968, 1971,1972, 1973, July and September 1975 (for each of these six events portions of the Basin were declared Federal disaster areas). Additionaly, major flooding occured in November 1977, January 1979, March 1983, April 1984 and December 1992 (also declared a Federal disaster). A summary discussion of the major floods in the Basin follows below.

4.1.1 October 1903

The October 1903 flood resulted from an extratropical type storm centered over Paterson, N.J. where 15.5 inches of rainfall were recorded. During the October 1903 flood, the greatest runoff from the headwater regions was contributed by the Ramapo, Wanaque and Pequannock Rivers at their confluence with the Pompton River. In this vicinity the destruction by floodwaters was far greater than along the Rockaway, Whippany and Upper Passaic Rivers. The major source of floodwaters in the entire watershed was the Ramapo River, which is the largest of the upland tributaries. On the Ramapo, destruction was virtually total along several stretches of the valley. With only one exception, every bridge across the river was washed away. Several small villages were entirely destroyed. Extensive portions of the town of Ramapo, N.Y. were practically obliterated. The riverfront property of the Ludlum Steel and Iron Company was scoured out, the warehouse washed away, and its coal docks along the Morris Canal feeder destroyed.

Along the Pequannock River, the principal damage consisted of road washouts and damaged bridges. Despite the storage afforded at Greenwood Lake, the damages along the Wanaque River were comparable to those on the Pequannock. Inundation over the floodplain along the Pompton River was also severe. All bridges but one were washed away and over 100 houses were flooded.

In the Great Piece Meadows area, all of the swamplands and some farmlands were under considerable depths of water. Heavy damage to crops was experienced and because of the long-continued presence of the water over the land, the growth of coarse meadow grasses was fostered at the expense of desirable feed grasses which were destroyed. Upstream of Little Falls, the total area flooded exceeded 31,800 acres.

From Little Falls to Paterson, flooding was generally over the river's banks, and almost all the bridges over the Passaic River in Passaic, Essex and Bergen Counties were damaged or destroyed.

In Paterson, where the center of precipitation occurred, all bridges were severely damaged and 10 were completely destroyed. All low-level bridges were completely inundated, and extensive damages were caused by overbank flows which rose 10 feet over the lower streets of the city. A highly developed area of nearly 200 acres was flooded in Paterson, and over 10 miles of streets were rendered impassable. More than 1,200 persons were fed and housed in the armory.

In the City of Passaic, damage was also severe, especially to manufacturing plants. Additional damage was caused by high water on the main stream which burst the banks of the Morris Canal a few miles east of Passaic and overflowed into Weasel Brook, which washed out every culvert and bridge in its course. Downstream of Passaic, damage to bridges, roads, and industrial plants was extremely severe.

4.1.2 March 1936

The March 1936 flood was caused by a general transcontinental storm which occurred during March 10-12 and 17-19. In the Passaic River Basin, flood damages were most severe upstream of Dundee Dam. Downstream of the dam, the Federal navigation channel afforded sufficient channel capacity to permit passage of the flood crest with only minor losses.

Areas most severely damaged included the lower business and manufacturing districts on the right bank of the Passaic River in Paterson. The Manhattan Shirt Company, one of Paterson's oldest industrial establishments, was one of the heaviest flood victims. Other areas affected were the residential and business districts on the left bank of the river in Paterson, residential districts in Totowa, Little Falls, and Singac, and farmlands and bungalow colonies upstream of Little Falls. Many streets along the Passaic River were under several feet of water, and traffic across the river was halted everywhere except over a few high-level bridges. Trolley and bus services in and near Paterson were interrupted and normally heavy vehicular traffic was rerouted over lengthy detours. Several hundred automobiles were damaged by muddy flood waters. It is estimated that 25 industrial plants and 20 public utility plants were flooded wholly or in part, and about 250 families were evacuated from their homes.

Agricultural losses in the territory upstream from Little Falls consisted of the extra cost resulting from a delay in spring planting, losses to chicken hatcheries because of an interruption to incubator operation, and the cost of moving livestock to safer locations. No permanent damage was inflicted upon agricultural lands as a result of silting or erosion.

4.1.3 July 1945

The July 1945 flood was caused by a storm which extended over northern New Jersey, southeastern New York and the New England States. Moderate precipitation started over the Passaic River Basin on July 15, continued with increasing intensity to July 20, then stopped almost completely for two days. On the night of July 22, torrential rainfall accompanied by thunderstorms reached such intensity that 30% of total storm rainfall fell within an 18-hour period.

Extensive flooding occurred throughout the watershed when the flood crests of July 23 were superimposed upon the lesser flood stages occasioned by the initial rainfall. Flood stages throughout most of the basin were the highest since the 1903 flood. At the S.U.M. Dam at Paterson the peak flood stage was only 1.75 feet below that of the record 1903 flood.

Widespread disruption of traffic and communications occurred throughout the watershed as floodwaters inundated and seriously damaged the extensive rail and highway network

which forms an integral part of the New York City metropolitan area. General disruption of activities throughout the region occurred from interruptions to industry and commerce. Damages incurred along the smaller tributary streams in Bergen and Passaic Counties between Little Falls and Passaic were approximately equal to those inflicted in the highly developed areas along the main stream in this reach.

On the Passaic River, in the Cities of Passaic, Clifton and Paterson, about 1,000 persons were evacuated from their homes, and numerous industrial plants incurred extensive damage to power and production equipment and supplies, with consequent cessation of operations. Some of the larger plants in the area were seriously affected including several plants of the Wright Aeronautical Corp., the Manhattan Shirt Co., Allied Textile Printing, Inc., Barbour Linen Thread Co., John Royal and Son Machine Co., Burton Carton Co., Dreyers Furniture Co., and the Lazarus Baking Corp. At Totowa, 300 residences were flooded.

Along the Passaic mainstem upstream from Little Falls, between Mountain View and Canoe Brook, several bridges were damaged but most of the damage was confined to crops. In Fairfield, about 200 residential cellars were flooded. Along the Pompton River and its tributaries in Lincoln Park and Pequannock, about 800 residences were affected.

Passaic River minor tributaries, along which extensive damages were inflicted, included Weasel Brook, the Saddle River, Hohokus Brook, Diamond Brook, Goffle Brook, Molly Ann's Brook, Slippery Rock Brook, the Peckman River and Singac Brook, all in the Lower Valley. In the principal damage reaches of these tributaries, it is estimated that approximately 1,700 dwellings, 250 business establishments, 40 industrial plants, and 30 utility plants and public institutions were inundated.

On Weasel Brook, nine bridges were damaged. Approximately 10 industrial plants and 230 residences and small business establishments were affected in the communities of Clifton and Passaic. Extensive damages were suffered by the Tobin Paper Box Co., the Mountain Ice and Coal Co., Clifton Swimming Pool, and the Eureka Press.

Flooding from this event exceeded the 1903 flood in the Saddle River Basin. On the Saddle River and Hohokus Brook, six bridges were damaged and 11 destroyed. Approximately 10 industrial plants, 80 small business establishments and 500

residences were affected. Major damages were suffered by the United Piece Dye Works and Fine Organics, Inc., in Lodi, when floodwaters inundated supplies and equipment. The New Jersey State Fish Hatchery at Saddle River suffered considerable loss when floodwaters washed out cages and stock and damaged operating equipment and the piping system. Considerable damage was inflicted on the residential areas of Waldwick and Hohokus when three small private dams on Hohokus Brook failed and the release of impounded waters flooded the communities.

On Diamond Brook, the greatest damage was sustained by the Wright Aeronautical Corporation plant near the stream's mouth. Damage upstream was restricted to 16 residences and one commercial establishment.

On Goffle Brook, two bridges and five dams were damaged. Six industrial plants and approximately 100 residences and small business establishments were affected. The Vitromar Piece Dye Works, Inc., Wright Aeronautical Co., Normandy Silk Co., American Coating Co., R & E Textile, Inc., and tenants of a group of buildings in Hawthorne near the mouth of the brook suffered severe flood damage when about nine feet of water damaged equipment and stock on the first floor. In this same section, Goffle Brook Park along the lower reach of the brook suffered damage from erosion, deposition of debris, and damage to rustic footbridges.

On Molly Ann's Brook, flooding caused extensive damages in several communities north and west of Paterson. Twelve bridges were damaged and two were completely destroyed. Part of a building housing valuable machinery of the Seyer Silk Dyeing Co. in Haledon was washed out. Other industrial, commercial and residential developments suffered severely from flood depths of up to four feet. Approximately 500 homes were inundated, most of which were located in Paterson near the mouth of the brook and in Haledon.

On Slippery Rock Brook, one bridge was washed out, service was disrupted on the DL&W Railroad, roads and utilities were seriously damaged, and scores of homes were inundated.

On the Peckman River, a culvert blocked by debris caused the final failure of a high embankment supporting the Erie Railroad's Greenwood Lake Branch. Traffic on this line, which services commuters of the suburban and large resort area west of Cedar Grove, was completely destroyed. Approximately 150 residences and small business establishments were affected. Extensive losses occurred at

the Little Falls Laundry Storage Plant near the mouth, where four feet of water washed away 1,500 tons of coal, flooded the power plant, damaged stored supplies and garments and disrupted operations for four weeks. One death occurred in Little Falls when a home was swept from its foundations.

On Singac Brook, four bridges were damaged and one was destroyed. Approximately 150 residences and small business establishments were affected when floodwaters reached lowland sections.

4.1.4 September 1960

On September 12, 1960, as a result of Hurricane Donna, there was tidal flooding along the Passaic River to Dundee Dam. Damage occurred principally to industrial and commercial property. Many low-lying streets were under several feet of water, resulting in long traffic delays.

4.1.5 May 1968

During the 1968 flood, all the major and most minor tributaries of the Passaic River overflowed. Towns along the river from the headwaters to the City of Passaic suffered the most damage; other communities sustained damage to a lesser extent. Damages to the entire Passaic River Basin were estimated at $19,323,000 in 1968 dollars. At 1994 price levels these damages total $98,800,000; updated to include both 1994 prices and 1994 levels of development, damages would be $268,189,290.

Flooding occurred on the Passaic River and all major and most minor tributaries, from the headwaters to the City of Passaic (about 12 miles upstream of the mouth). The Great Swamp area was flooded. Severe damage was caused by flooding from the two large tributaries, the Whippany and Rockaway Rivers. In Fairfield, 150 residents were evacuated. Flooding by the Whippany River caused severe damage at Hanover and Morristown and flooding of the Rockaway River brought extensive damage to Parsippany-Troy Hills. There was damage to the Boonton Dam of the Jersey City water supply system and silting of the water supply line. Other communities were affected by flooding of these rivers to a lesser extent.

The Pompton River and its tributaries, the Ramapo, Wanaque and Pequannock Rivers, caused severe damage in all the communities through which they flowed. In Totowa, 50 families were evacuated; in Wayne Township, 500 residents

were evacuated. The Wanaque River caused damage to residential, recreational and public property in Ringwood, Wanaque and West Milford. Along the Ramapo River there was severe damage in Mahwah, Franklin Lakes, Oakland and Suffern, New York. At Oakland, some dwellings were so badly damaged that they could not be repaired. The Pequannock and Pompton Rivers caused severe damage in Pequannock, Riverdale, Butler, Bloomingdale and Pompton Lakes (The latter community was flooded by all three rivers.) Over 200 families were evacuated in Pompton Lakes and 100 persons were evacuated in Pequannock.

The Peckman River caused severe damage to residential, commercial and industrial property in Little Falls and West Paterson. Over 200 families in Little Falls were evacuated. Molly Ann's Brook caused severe damage in Hawthorne, Haledon and Paterson.

In Wayne and Totowa there was severe damage to all classes of property. About 50 families in Totowa and 500 residents of Wayne were evacuated. Several large industries had to close their plants for several weeks. Routes 23 and 202, important highways, were closed to vehicular traffic for two days.

In Paterson there was severe damage to industrial and commercial property as well as residential property; over 200 persons were evacuated. Two bridges over the Passaic River were closed for a week. Fleisher's Brook caused severe damage to dwellings in Garfield and East Paterson.

The Saddle River caused damage in every community from its headwaters in New York to the mouth of the river. Lodi suffered severe damage to all classes of property. Hohokus Brook, a tributary of the Saddle River, caused damage in Ridgewood and Waldwick.

4.1.6 August-September 1971

Extensive flooding took place throughout the basin. Damages along the tributaries were estimated (1971 dollars) at:

Mainstem	$ 2,201,000
Rockaway and Whippany	1,560,000
Ramapo and Pompton	3,143,000
Saddle	1,281,000
Other Tributaries	2,216,000
Total	$10,401,000

4.1.7 August 1973

The most severe damage from this flood was a result of the local tributaries and drainage systems not being able to handle the intensity of the storm. Damages were estimated at $1,000,000 (1973 dollars) for the Basin.

4.1.8 November 1977

New Jersey suffered what was considered its worst storm since the August/September storms in 1971. Most communities along the Passaic River had substantial flooding. Traffic snarled, houses and basements flooded, many commercial and industrial structures were damaged considerably. The National Weather Service reported that the 8.25 inches of rain that fell in the area over the two day period was an all time high, surpassing the 7.8 inches that fell during the August/September 1971 storm. Police in many communities were planning to evacuate people in low-lying areas but large scale basin-wide evacuation generally proved unnecessary. However, more than 600 families were evacuated along the Saddle Brook in Lodi and the Pompton River in Wayne. Numerous bridges and road, were closed as power was out in many areas due to the flood. Felician College in Lodi experienced substantial damage when retaining walls and earthen banks along the Saddle River failed. Damage from this flood was estimated to exceed $246,200,000 (October 1994 dollars).

4.1.9 January 1979

The flood of January 1979 was extensive throughout northeastern New Jersey. A continuous downpour of over four inches on frozen, saturated ground led to the worst flooding some areas experienced in over a decade. In the Rockaway River Basin the communities of Denville, Dover, Lake Hiawatha, Mine Hill, Montville, Parsippany-Troy Hills, Rockaway Borough and Rockaway Township were most seriously affected. Garfield on the Saddle and Passaic Rivers, Lodi on the Saddle River, Morristown on the Whippany River, Oakland on the Ramapo River, and Wayne on the Pompton and Passaic Rivers also suffered flood related damages. Five hundred families were evacuated in Dover and Denville, and 200 in Lake Hiawatha. Hundreds of people were evacuated in Morristown, Wayne and Lodi. One person drowned at Lodi and several were rescued from floodwaters. Numerous roads and bridges were flooded, isolating several areas and structures, including St. Clare's Hospital in Denville.

4.1.10 March-April 1983

Low pressure systems moving across the northeast brought heavy rainfall repeatedly to northern and western New Jersey. Though none of the storms' rainfall exceeded that of a two year flood event, each week's precipitation imposed higher water stages on prior weeks' rainfall. Precipitation generally ranged between one and two inches. Sustained high water elevations reached flood stages at several locations in the basin.

In the central basin the municipality of Fairfield experienced significant street flooding. Families were evacuated in Lincoln Park in the vicinity of Two Bridges and along River Edge Road, Midwood Road and Beaver Brook Road. Fayette Avenue was under water. In Wayne Township, at the confluence of the Pompton and Passaic Rivers, families were evacuated and water stages reached heights of four to five feet above the streets.

Along the Ramapo River in Oakland, homes near the Doty Road Bridge and along Island Terrace were inundated. Along the Saddle River, Main Street in Lodi was closed for several hours at the Route 46 overpass. Floodwaters topped the banks of the Saddle River at the Lodi Boy's Club and at Felician College though no significant damage ocurred.

The numerous spring storms left much of the basin's floodplain underwater for weeks.

4.1.11 April 1984

Flooding occurred when a two day storm which brought approximately five inches of rain to the basin combined with the runoff of the snowmelt from the previous week's one foot snowfall. The flooding was the worst to occur in 45 years throughout the Passaic River Basin. Nineteen communities along the Pompton River, Pequannock River, Lower Ramapo River, Wanaque River and Passaic River from Elmwood Park upstream to the Borough of Chatham sustained substantial flood damages. In addition, communities along the Upper Ramapo River and Saddle River also experienced flooding. The worst flooding occurred in Pompton Lakes, Wayne, West Paterson, Paterson, and Little Falls in Passaic County; Riverdale, Pequannock, Lincoln Park, and Montville in Morris County; Oakland, Fair Lawn and Lodi in Bergen County; and Fairfield in Essex County.

The April 1984 flood was declared a National Disaster on April 12, 1984. Evacuations totaled approximately 9,400 people. Flood relief involved many State of New Jersey agencies including the Departments of Health, Community Affairs, Human Services, Labor, and Transportation, as well as the state police and the Bureau of Floodplain Management. Federal agencies, such as the National Guard, U.S. Army Corps of Engineers, Environmental Protection Agency and Civil Defense, also supplied aid along with such national volunteer organizations as the Red Cross and the Salvation Army.

Evacuees took emergency shelter in schools, churches, fire stations, friends' and relations' homes, and hotels. Approximately 2,500 customers of Jersey Central Power and Light Company lost electricity and 1,200 customers of Public Service Electric and Gas Company went without power. Disruptions in electric service of up to three weeks prevented people from returning to their homes, caused damage to heating systems, and extensive losses in refrigerated food supplies. Electric and gas meters were completely destroyed by floodwaters. Water seepage into gas meters and broken seals caused explosions in several areas, damaging both the exterior and interior of structures. Approximately 6,400 residential, commercial, utility, and industrial establishments were significantly damaged by floodwaters. Numerous street and bridge closings were reported, creating massive traffic delays throughout the basin. Major highways were impassable for days. Three lives were lost due to the April 1984 flood.

The April 1984 flood was not a significant flood event in the Lower Valley. Flooding was estimated at an approximate 25 year storm. More than 500 Paterson residents were taken by National Guard and fire division boats from low-lying areas around President Boulevard to River Street. About 100 residents stayed in an emergency shelter at John F. Kennedy High School until they could return to their homes. Flooding along the Passaic River in the lower valley forced the closing of the Monroe Street and Wall Street Bridges between Garfield and Passaic County.

Inundation also caused serious damage to driveways, lawns and garages. Water entering structures through garage doors, basement windows and foundations caused severe damage to floors, walls, washers, dryers and heating systems.

In the central basin where flooding was much more severe, approximately 1,700 residential and 300 commercial and industrial structures were inundated during the April 1984

flood. Water heights reached an estimated 12' above many main floor elevations. Major highways, including Routes 23 and 46, were closed to traffic for three days. Many inundated roads were closed in Morris County including sections of Route 10 near Troy-Hills Road in Parsippany; a portion of Blackwall Street, Dover's main street; Salem Street in Randolph, Franklin Rock in Denville and the Hamburg Turnpike from Riverdale to Bloomingdale in Passaic County. Long traffic delays and detours resulted when roadway retaining walls, shoulders and walkways were washed-out by floodwaters. Ringwood Avenue bridge in Wanaque was weakened by floodwaters. The Willowbrook Mall, Willow Square and West Belt Plaza in Wayne were left inaccessible for approximately three days. Parking lots, inundated with four feet of water forced approximately 200 retail outlets and restaurants to close and lose sales. Businesses forced to close included major retail stores such as Sears Roebuck and Company, Ohrbachs, Bambergers, Stern Brothers, Fortunoff and J.C. Penney. Damages to roadways, parking lots, landscaping and walk ways were extensive. All merchandise in Bambergers' furniture store was virtually destroyed. West Belt Plaza, which includes 13 stores, estimated damages due to loss of sales, clean-up costs and property damage alone, totaled over $1,000,000 (Oct 1985 price levels). Overall basin damages for the April 1984 flood were approximately $462,070,528 (October 1994 dollars).

4.1.12 December 1992

Due to the severe northeastern storm that pounded the coastal areas of New Jersey and New York, tidal areas of the Passaic River Basin experienced storm surges, heavy rainfall and sustained gale force winds of
up to 50 mile per hour.

Areas most severely damaged included businesses and homes on both banks of the Passaic River in Kearny, Harrison, Newark and East Newark. Businesses and manufacturers in Kearny Point had over two feet of water above their main floors. Roads in this area were blocked due to high flood water making vehicular traffic impossible for several days. Doremus Avenue in Newark was blocked off by the Newark Fire Department and only passable by large trucks. Industries in this area had up to three feet of water above their ground levels. Lister Avenue in Newark was also closed. The Benjamin Moore Paint Company experienced severe flood damages with water height up to three feet above the ground level.

Flood damages were also severe in Harrison. Along Day,

Sand and Warren Streets, emergency vehicles moved residents out of homes, which in this area experienced flooding in garages and basements. The driveways of most of the residential structures sloped downward allowing floodwater to rush in. Numerous cars were trapped on the streets as well as inside garages. The proprietor of Michael's Auto Body Shop on Passaic Avenue in East Newark, indicated that the parking lot was inundated with up to two feet of water. Flooding inside the facility reached an estimated two feet above the main floor. Automobiles parked in the parking lot suffered severe damage; in many cases cars were totally destroyed. Total damages to this facility alone were estimated between $50,000 and $75,000.

4.1.13 March 1993

The flood of March 1993 was the result of a snowmelt that saturated the ground, coupled with a drenching two inch rainfall on consecutive days. In the central basin flooding in the towns of Wayne and Lincoln Park was most severe. The hardest hit of these towns was Wayne, where the residents of 620 homes were forced to evacuate for five to seven days. Many of these people were sent to the local high school until the waters receded to a safe level. The Hoffman Grove section of Wayne incurred the most damage; it was covered with approximately four to five feet of water. Numerous cars were inundated and destroyed. Other sections of Old Wayne saw one to three feet of water in streets, yards and basements. Homes along Fayette Avenue and Fairfield Road were inundated with approximately one to two feet of water above the main floor. The parking lot at Willowbrook Mall was partially inundated and service roads surrounding the south side of the mall were impassable. Riverside and River Lawn Drives between the mall and the Passaic River were also impassable due to floodwaters. These roads were inundated with two to four feet of water. The Wayne Police Department estimated flood damages at $5.7 million (October 1994 prices) for Wayne alone.

Damage occurred in Lincoln Park in the Midwood Road section of the municipality which is adjacent to the Hoffman Grove area. Roads were made impassable by the four feet of water present throughout the neighborhood. Cars were totally destroyed by flood waters. Homes along Riveredge Drive on the west side of the Pompton River were also flooded. Yard damage was most prevalent, although basement damage also occurred.

The Township of Pequannock experienced relatively minor flooding along its streets. However, North Pequannock Avenue incurred serious damage, with all homes on this street sustaining one to two feet of flooding, causing the avenue to be closed. Total damage for all municipalities was estimated at approximately $15.6 million (October 1994 prices).

5. CURRENT FLOOD DAMAGE ESTIMATES

5.1 Nature of Damages

Flood damages create tangible and intangible losses to several categories of development. Current flood damage estimates are computed based on single and independent storm events. Damages specific to residential structures include physical damage to buildings, heating and cooling systems, electrical installations and fixed or built-in equipment and similar items.

Damageable contents within residential structures include and are defined as floor coverings, appliances, household furnishings, auxiliary buildings, furnishings, equipment, clothing, personal property, food supplies, and the cost of emergency shelter and temporary living quarters during the period of repair.

Commercial operations in the study area include most components of the retail industry, professional offices and some light production work such as auto body repair shops. Examples of components of the retail industry include restaurants, hardware stores, gift shops and supermarkets. Commercial losses include damage to the physical plant (both structure and property), equipment, stock inventory, and non-recoverable fixed costs.

Industrial operations in the study area include print shops, warehouses, industrial offices, manufacturing and light industry operations. Flood damages to industrial property include the net physical losses of economic value to land, buildings, machinery, equipment, materials and supplies, and other items used in study area industries.

Public property includes schools, recreation areas and similar development for public and quasi-public use. Public losses include damage to structures, inventory, ledgers, books, equipment and supplies, and if necessary, the cost of temporary housing.

Municipal facilities include roads, streets, highways, transportation facilities, water and sanitary lines, gas lines, stormwater lines, and electrical and communication lines. Municipal losses include damage to roadways, roadbeds, fill ballast, culverts, bridges, and mechanical and electrical equipment.

Municipal emergency costs include the cost of evacuation and reoccupation, flood fighting, disaster relief, increased expense of normal operation during a flood event, and increased costs of police, fire or military patrols.

5.2 Damage Survey Methodology

As part of the work accomplished in the Passaic River Basin study, a wealth of data was assembled on each structure.

Examples of structure data inventories include structure type and first flood elevation. This information, consisting only of data that could be determined from visual inspection, was needed in order to be able to: a) determine which structural characteristics are responsible for explaining the potential dollar damages at certain flood heights for given structures; and b) determine the type of physical similarity across structures. Utilizing the structural characteristics collected, residential and commercial structures were stratified into groups. The more uniform the group, the smaller the sample size that was taken.

Specific structures were then selected for interviews. The purpose of the interviews was to determine both actual historic damages and potential damages at storms greater than those experienced. The interview developed historical as well as potential damages and divided them into three basic groups: (1) structural damage, (2) contents damage and (3) other damage. Damage assessment was based upon the owner/occupant's estimate of the value of various items and their potential for damage. The estimate was based upon a survey of retail prices conducted early in the study, estimates of local contractors, and repair and remodeling costs published in standard estimating books. Additional questions dealt with land size, assessed values of structure and land, average sales, payroll, number of employees and questions designed to elicit information on potential intensification and location benefits.

Based on the data collected, standardized stage-damage curves by structure type were developed for residential structures and certain commercial establishments. Interviews were conducted for all unique structures and all industrial structures except where access was not possible. Data was then field verified by economists and was supplemented with additional site specific interviews where necessary. Industrial damages were calibrated using the historical information obtained by field interviews. Therefore, actual depth damage data for industrial establishments was utilized whenever possible.

It is noted that the degree to which the floodplain homes have been maintained has not always been uniform. A residential structure is assumed to go through various cycles of ownership where the degree of upkeep can vary from low to high maintenance. When viewed over time, the lesser maintained residences go through

cycles of ownership during which dramatic improvements are often made. The reason for this assumption was that although an economic life of up to 100-years is usually assumed for real estate purposes, the actual life of quality built structures can go well beyond that period.

The Marshall & Swift Valuation Service was retained to update structure values used in the stage-damage relationships to October 1994 levels. Marshall & Swift assesses structure value on a square foot basis. Selected residential and commercial structures were evaluated via a windshield survey to determine such physical characteristics as size, condition and type of structure.

Using the Hydrologic Engineering Center's (HEC) Flood Damage Analysis (FDA) Package on the Microcomputer program, (manual dated July 1988) stage-damage relationships were developed on a reach by reach basis. The primary function of the Structure Inventory for Damage (SID) analysis version of the FDA package is to generate elevation-damage functions by designated damage category and reach.

The stage-damage relationships derived were used to compute expected annual damages using HEC's Flood Damage Analysis (FDA) computer programs. Stage-frequency data was integrated with stage-damage data for existing conditions in 1993 and future impacts for 2040. Based on the prevailing discount rate of 7-3/4% and a 100-year period of analysis, average annual equivalent damages were generated.

5.3 Economic Calibrations 1985-1995

All economic damage reaches were reviewed by the members of the Planning and Public Impact Branch of the Passaic River Division (PRD). Variables, such as the 100-year and 500-year floodplains and the respective structures lying within, were identified. Expected annual damage per structure and start of damage were also identified. Based on these variables, parameters were developed to determine if further calibration and analysis were needed. Damage per residential structure is deemed a crucial parameter for judging the worthiness of the economic model's effectiveness or accuracy within any one specific economic reach.

There were a number of economic reaches that raised certain questions about the model based on structure. That is, certain reaches had residences that exceeded an acceptable level of expected annual damage per structure. Calibration of the economic model in the affected reaches was performed, as well as possible hydrologic and hydraulic and locational issues. Approximately 35

reaches throughout the basin fell into this category. Most reaches, however, were found in the Pompton River Basin.

Beginning in the fall of 1991 and continuing through the winter of 1992, an extensive assessment of the land use conditions in the Passaic River basin was performed. The assessment was performed over the course of six months, utilizing windshield surveys to visually identify land use changes, particularly within the 500 year floodplain. New developments, as well as commercial and industrial land use changes, were documented. Actual land use conditions were compared to those recorded on topographic mapping.

New development in the 500 year floodplain was found to be present. Over 300 new residential structures and 200 new non-residential structures were found and entered into the structure file. Structural characteristics, such as size, land use type and main flood elevation, were recorded. Subsequently, appropriate modifications were made to the structure file. However, new land use was deemed to have an insignificant impact on overall damage since all new development is required to place main floor elevation above the 100 year water surface elevation. Most land use changes occurred in commercial and industrial sectors. Shopping plazas and industrial parks were common areas for land use modifications.

During the course of the land use reassessment, it was determined that a large number of bungalows in low lying areas were assigned inappropriate damage function codes. Some residential structures were assigned damage functions normally reserved for unusual housing types, such as Tudor or A-Frame houses. As a result, all bungalows within the central basin, Pompton River Basin and the Lower Ramapo River Basin were assigned a bungalow damage function for structure, content and other damage. This damage function was derived from the bungalow function utilized in the Ramapo River at Oakland, New Jersey study. This resulted in an accurate stage damage relationship for bungalow structures which lowered the damage estimates.

Over the course of the calibration process, it was determined that certain main floor elevations in the structure file contained a degree of error in some critical economic reaches. Topographic mapping indicated some main floors that were below grade elevation. Site visits confirmed higher main floor elevations in all suspected cases.

During the windshield survey, it was discovered that a large number of homes, especially bungalows, were demolished and removed from the floodplain. Further research indicated a State buyout program was in effect from 1987 through 1989. Over 40 homes were

bought out during this period in the municipalities of Fairfield, Lincoln Park, Pequannock, Pompton Lakes and Wayne. These structures were all subsequently removed from the structure file. There are no further plans for additional buyout programs.

The Structure Inventory of Damages (SID) program was utilized in the generation of elevation-damage relationships for all economic reaches.

5.4 Expected Annual Damages

Stage damage relationships were developed as detailed previously from SID for use in the FDA program. Existing expected annual damages were developed from the FDA program described earlier.

5.4.1 Aggregate Reach Areas

A general description of the areas of interest to the Main Stem Passaic River including the aggregate Lower Passaic (01), Central Passaic (02), Pompton (60), and Lower Ramapo, Wanaque, Pequannock (66-68) damage areas is provided below. This is followed by a description of eight selected reaches within these areas. These reaches were selected because they either were significant damage areas in terms of total EAD, or they were typical of a number of reaches for that portion of the mainstem. Table 2 provides a summary of the Expected Annual Damage, as well as damage at the 10 year, 25 year, 50 year, 100 year and 500 year stages. The Expected Annual Damage Tables 4 through 11 exclude municipal damages.

Reaches 01 - Lower Passaic. The Passaic River Main Stem reaches, 010011 thru 010272, plus backwater areas on Molly Ann's Brook (400011 and 400012), backwater areas on the Peckman River (500011, 500012, 500014, and 500016) and backwater area on the Saddle River (010106, 010107, 010108, 010109, 010113, 010115, 010117, 010118, 010119, 300011 and 300012) are grouped together to form the Lower Passaic damage reaches. The area extends from Beatties Dam, downstream to the mouth of the Passaic River (see Figures 2 through 9). The Lower Passaic reaches contain 6,103 residential structures and 1,881 commercial, utility and industrial establishments in the 500 year floodplain, (See Table 3). Commercial structures include retail shopping malls and extensive strip highway development. The industrial establishments in the Lower Passaic are primarily large complexes containing more than one structure per establishment. Damages in this area due to a 100 year flood event would be approximately

$645 million while damages for a 500 year event would be approximately $1.6 billion, (See Table 2).

Major damage areas extend through the industrialized cities of Newark, Kearny, and Harrison near the mouth, Clifton, Passaic and Wallington downstream of Dundee Dam, Paterson in the vicinity of S.U.M. Dam, and Little Falls, West Paterson and Totowa below Beatties Dam. For further details on significant damage reaches see the discussion of selected damage reaches.

Reaches 02 - Central Passaic. The Passaic River Main Stem reaches, 020011 through 020230 plus backwater areas on the Preakness Brook (600013, 600015 and 600017) are grouped together to form the Central Passaic damage reaches. The area extends from above Beatties Dam, upstream to the U.S.G.S. Passaic River gage at Chatham Borough, (see Figures 9 through 17, 19 through 24 and 28 through 32). Central Passaic reaches contain 5,686 residential structures and 1,593 non-residential establishments in the 500 year floodplain, as displayed on Tables 3. Non-residential establishments include retail commercial centers, large indoor shopping malls, industrial structures and complexes and utility structures. Damages in these reaches due to a 100 year flood event and a 500 year flood event are approximately $522 million and $1 billion, respectively, (see Table 2). Major damage centers exist in the municipalities of Wayne and Little Falls near the Willowbrook Mall Shopping Center, Fairfield and West Caldwell along Deepavaal Brook and along the lower Rockaway River in Parsippany-Troy Hills, East Hanover and Lake Hiawatha. Further details of significant damage reaches can be found in the discussion of selected reaches.

Reaches 60 - Pompton; Reaches 66 - Lower Ramapo; Reaches 67-Wanaque; Reaches 68 - Pequannock. Reaches along the Pompton, Lower Ramapo, Wanaque and Pequannock Rivers (see Figures 9 and 10, 24 through 27, 34 and 35) were analyzed with the main stem Passaic due to the interdependence of their flow. The number of residential structures and non-residential establishments in the 100 year floodplain and the 500 year floodplain in each of the tributary areas can be found on Table 3. Damages for these areas for a 100 year flood event and a 500 year flood event are found on Table 2. The Pompton River reaches contain critical damage areas. For a description of several significant damage areas see the discussion of selected damage reaches.

5.5 Selected Damage Reaches

Selected damage reaches Expected Annual Damages are displayed on Tables 4 through 11. Total expected annual damages figures exclude municipal damages.

5.5.1 Reach 010102

As shown on Figure 16, reach 010102 is located in the City of Passaic and is bordered by the lower Passaic River in the east and south and by Passaic Street in the north. There are 64 residential structures and 30 commercial and industrial establishments in the 500 year floodplain. Several of the industrial establishments incorporate more than one structure. Total expected annual damages in the reach are approximately $977,000, (see Table 4). Damages incurred by a 100 year flood event would be approximately $21.7 million. These figures include municipal damages, whereas the figures presented on Table 4 do not include municipal damages. Damages estimated for a 500 year flood event are over $38.4 million. Over 90% of these damages are incurred by commercial and industrial structures. Flooding due to 500 year flood event would produce stages of five to 10 feet above the main floor levels.

5.5.2 Reach 010171

Reach 010171 is located in the Town of Fair Lawn and is bordered on the south and west by the lower Passaic River and in the north by Fair Lawn Avenue, (see Figure 7). There are 320 residential structures and several industrial and commercial establishments in the 500 year floodplain. The reach includes a public school and an athletic field. During the 1968 storm approximately 30 residential structures had damages to their cellars and grounds. During August and September of 1971 overflowing of the river caused flooding of grounds and basements along River Road. As displayed on Table 5, total expected annual damages in the reach, including municipal damages, are approximately $847,400. Damages incurred by a 100 year flood event and a 500 year flood event would be approximately $10.1 million and $20.9 million, respectively. Approximately one third of all residential structures are located in the 50 year floodplain. Flooding due to a 500 year flood event would produce possible stages of seven to nine feet of water at the main floor of residential structures.

5.5.3 Reach 010203

Reach 010203 is located in the City of Paterson bordered by the lower Passaic River on the east, Goffle Brook on the North and Christopher Columbus Drive on the southwest (see Figure 8). There are approximately 400 residential structures, five apartment complexes and 90 commercial and industrial establishments within the 500 year floodplain in this reach. Flooding during the May 1968 flood caused large amounts of damage to the residential, commercial and industrial areas located in this reach on the left bank of the river. Two bridges sustained damage to their abutments and had to be closed for a week. As displayed on Table 6 total expected annual damages in this reach are estimated at $3.4 million. Damages incurred during a 100 year flood event would be in excess of $40.6 million. Damages due to a 500 year flood would approximate $86.1 million. Approximately 63% of these damages would be incurred by non-residential structures.

5.5.4 Reach 020021

Reach 020021, as shown on Figures 9 and 10, is located in the municipality of Wayne and lies within a major bend of the Passaic River. Historically, Wayne has experienced significant flood damage due to the overflowing of the Passaic River. The reach contains approximately 129 residential structures and 29 non-residential structures within the 10 year floodplain. Residential structures most impacted by flooding are located along Riverlawn Drive only, which runs parallel to the Passaic River. The most significant non-residential establishment is the Willowbrook Shopping Mall, which with its total business areas and parking lots comprises a majority of the reach. The Willowbrook Shopping Mall is one of the largest retail centers in the State of New Jersey. Currently there are over 175 establishments in the mall which include three major department stores, many specialty shops and restaurants. Total expected annual damage in the reach is approximately $14.9 million (see Table 7). Total damages for the 100 year flood event and the 500 year flood event are $86.8 million and $160.5 million, respectively. Commercial damages incurred account for approximately 93% of the total expected annual damages in this reach.

5.5.5 Reach 020102

Reach 020102 is located in Parsippany-Troy Hills and Montville Township, southeast of Lake Hiawatha, (see Figures 22 and 23). The reach is bordered by the Rockaway River on the east, Shore Road on the north and a drive-in movie area on the south. The reach is

flooded by the Rockaway River due to backwater stages on the central Passaic River. During the May 1968 flood the local police department evacuated 30 homes along River Drive, Rockaway Avenue and Lakeshore Drive. Many parked cars were damaged when streets were inundated. Sewer backup in poorly drained areas caused extensive damages in many residential structures. Approximately 152 homes are located within the 500 year floodplain. Expected annual damages are estimated at approximately $171,400 (see Table 8). All of these damages are residential in nature. Total damages for the 100 year event approximate $2.3 million. Damages incurred during a 500 year flood event are over $3.8 million. Water would reach stages of one foot to seven feet above the main floor during a flood of this magnitude.

5.5.6 Reach 600025

Reach 600025 is located on the left bank of the Pompton River in the Township of Wayne between the Erie-Lackawanna Railroad and Packanack Lake. The southern border extends along Packanack Brook. Reach delineations are shown on Figures 24 and 25. Within the 500 year floodplain, there are approximately 135 residential structures, 42 non-residential. Damages during a 10 year, 100 year and 500 year flood event would be over $3 million, $28.1 million and $41.7 million, respectively. Total expected annual damages would be approximately $1.8 million (see Table 9). Damages for this reach will start at the five year flood event. Water stages due to a 25 year flood event would reach elevations of two feet to three feet above ground level and approximately six feet above main floor level for a 500 year event. Almost 75% of the total expected annual damages is incurred by commercial structures. Commercial structures in this reach, which are concentrated in the vicinity of the intersection of the Newark and Pompton turnpike and Routes 23 and 202, include businesses such as Bremen Mazda (new cars), Brickete Co. (landscaping), GBC Sales and Services (binding). Commercial expected annual damages would approximate $1,787,000.

5.5.7 Reach 600034

Reach 600034, (see Figure 25 and 26), is located on the right bank of the Pompton River in the Borough of Lincoln Park and the Township of Pequannock. This reach is bounded by Ackerson and Franklin Avenues to the north, Beaver Dam Brook to the south, West Ditch to the west and the Pompton River to the east. The reach contains 1,267 residential and 28 non-residential structures within the 500 year floodplain. A 10 year flood would cause over $6.2 million in damages while damages for a 100 year flood would be approximately $27 million. Damages for a 500 year flood would

approximate $57.6 million. Over 75% of the damages incurred at each of the noted flood events is due to residential structures. Total expected annual damages for reach 600034 are approximately $2.3 million (see Table 10).

5.5.8 Reach 600042

Reach 600042 is located on the right bank of the Pompton River in the Borough of Lincoln Park and the Township of Pequannock. As shown on Figure 25 and 26, this reach is bounded on the north by Nicholas Road and Tillet and Alexander Avenues, on the south by Ackerson and Franklin Avenue, on the west by the West Ditch, and on the east by the Pompton River. There are 1,421 residential and 64 commercial structures within the 500 year floodplain. As displayed on Table 11, damages in this reach would be approximately $11.6 million for a 10 year flood, $46.8 million for a 100 year flood, and $65.5 million for a 500 year flood. Total expected annual damages for reach 600042 are approximately $4 million.

6. FUTURE LAND USE: RESULTS

Future land use results and analyses used are consistent with methodology developed during the feasibility phase of study. Recent aerial photography was employed to reflect current 1990 land use conditions which were then used as a basis for projecting future conditions.

According to the Bureau of Economic Analyses (BEA) "Regional Projections to 2040, Volume 2," metropolitan statistical areas that overlay the Passaic River Basin will experience increased growth rates for both population and employment from 1995 to 2040. Based upon these population and employment increases, the Passaic River Basin is expected to be fully developed by 2040 as predicted in the feasibility level of study. Methodology for future land use development areas is discussed in Appendix C, Section XVII.

The results of the future land use analysis are consistent with the future characteristics of the basin as a whole. Since the land use projections were an outgrowth of population and employment projections, areas of the basin, specifically the highland area, currently consisting of lower levels of development, are those which are expected to see the greatest increases in land development. Despite the projected growth in population and employment between 1990 and 2040, the explosive growth of the years 1950 to 1970 will not recur. Land use projections reflect this. Compared to historical growth in the Passaic River Basin, the future acreage projected to develop is relatively small. Nonetheless, the incremental effect of frequent flooding and the extension of floodplain areas is relatively more significant. Projected increases in flood stages in 1990 and 2040 over those in existing conditions were analyzed and equivalent annual damages were calculated.

6.1 Future Land Use Service Area Counties

Land use projections were reviewed in the four categories of land development: residential, commercial, industrial and other (i.e., public developed areas) in all of the service area counties lying partly or wholly in the Passaic River Basin. The acreage reviewed includes only those acres which fall in the county areas within the Passaic River Basin drainage areas.

Bergen County - The county has approximately 14,300 acres available for future development, less than 20% of the total acreage in the county. Large areas of land in the northern section of the county consist primarily of medium density

residential development, while areas nearer to New York City are high density areas. The greatest amount of vacant land is located in the highland area, primarily the three northwestern municipalities of Mahwah, Oakland and Franklin Lakes, where much of the terrain is rugged. The central portion of the county contains most of the commercial activity, and residential, commercial and industrial use in the central and southern portions of the county is intense.

Based on population projections, it is estimated that an additional 200 acres will be developed for residential use by the year 2040. Approximately 800 commercial and 100 industrial acres are also projected to be developed by 2040 based on employment trends. The greatest increase in development will be for urban and institutional usages consisting of approximately 700 acres; however, this is less than a one percent increase from total developed acres under existing conditions.

Essex County - Essex County is densely populated and extensively developed, functioning as the industrial and financial center for northeastern New Jersey. Based on employment projections, it is expected that approximately 2,000 additional acres will be developed for commercial use by 2040. No additional industrial development is projected for that year. Based on population projections, an additional 300 residential acres are expected to be developed in Essex County by 2040. The total increase in residential development by the year 2040 is less than one percent of total existing development. This is consistent with the fact that Essex County is already highly developed. Approximately 1,800 acres will be developed for urban and other institutional usage by 2040.

Hudson County - Hudson County, characterized as an older, high density urban area, has little vacant land available. Eastern portions of Kearny, a community adjacent to the Passaic River, contain most of the existing open land areas. Since population growth is projected to be minimal in the county, approximately 30 acres of residential development are used for other urban and institutional developments are projected by 2040. Based on employment trends, no additional industrial acreage is projected and only an approximate 200 acres are forecasted for commercial use by 2040. Approximately 310 additional acres will be developed by 2040 which is less than 10% of the county's total basin acreage.

Morris County - Morris County is one of northeast New Jersey's least developed counties, with the majority of existing development consisting of low density residential use.

Industrial and commercial development have also become increasingly important to Morris County. Using population and employment projections, it is anticipated that the county will develop approximately 26,000 acres by 2040. The majority of these acres will be residential in nature (over 80%, or approximately 21,300 acres). Additional commercial development will approximate 4,100 acres while industrial development will only increase by over 80 acres. Increases in land use for urban and institutional purposes will also occur on approximately 600 acres by 2040.

Passaic County - Passaic County can be divided into three general areas reflecting land use. The southeastern portion, which lies within the lower valley, is basically an urban and dense suburban area. Most of the county's industry is located in the central basin, in Wayne Township. The township also contains residential and commercial development. The majority of the county's vacant land is in the highlands area in the northwestern portion of the county. This land has rough terrain, therefore, development in the highlands areas has been almost totally low density residential. New development in Passaic County, based on population and employment projections, is expected to consist of approximately 7,500 additional acres by 2040. The developed acres constitute approximately 6% of the county's basin acreage. The majority of these acres will be developed for residential and commercial use. Approximately 70 acres of industrial development is anticipated while an estimated 700 additional acres will be used for urban and institutional purposes.

Somerset County - The most intensive development in the county has been along the east-west transportation corridor that crosses the middle of the county and to a lesser extent in the northern areas. The primary land use in Somerset is residential development. Strong growth is anticipated in this county, as indicated by the large areas of open land, which approximate 8,500 available acres. Utilizing population trends, over 4,800 acres of residential development is forecasted by 2040. Employment projections indicate that approximately 900 additional acres of commercial development will take place; however, no additional industrial land use is projected. No acres of the county will be developed for other urban and institutional uses. Total development by 2040 utilizes approximately 28% of the county's total acreage.

Sussex County - Sussex County currently has a high proportion of undeveloped acres relative to total acreage (approximately 78%). The majority of the existing land use consists of residential development. Future population

projections indicate that by 2040 approximately 2,600 acres of additional residential development will take place. The increase in residential usage will most probably impact on agricultural lands which are currently the areas most suitable for intensive development. The county has limited highway access and most of its land area is rugged terrain which prohibits large scale development. Based on employment trends, no additional industrial development is forecast through 2040. However, approximately 1,100 acres will be developed for commercial use, while over 40 acres will be developed for other urban and institutional uses. Approximately 3,700 acres will be developed by 2040, roughly 25% of the county's total basin acreage.

Union County - This county is a densely settled area with approximately 89% of it currently developed. There are many residential neighborhoods; commercial development tends to be concentrated in central business districts. Industrial land use is directly related to transportation facilities. Union County has less than 400 acres available for future development. Based on population projections, an additional 40 acres of residential land development is projected to occur by 2040. Employment trends indicate that approximately 100 acres will be used for commercial purposes. No industrial and other urban or institutional development is expected to take place by 2040.

Orange County - Growth has been dynamic in this county. The majority of new development has taken place in the unincorporated towns. New residential development has occurred while many research facilities and corporate headquarters have been lured to the area by the inexpensive cost of rural land and the low cost for site preparation and development. This is especially true for cleared farmland. Orange County has over 42,800 acres available for future development. Based on population trends, approximately 11,900 acres of additional land will be developed for residential usage. Employment trends indicate that over 400 acres will be developed for industrial usage and an additional 1,000 acres will be commercially developed by 2040. Over 1,700 additional acres will be utilized for other urban and institutional uses. Total projected development constitutes over 26% of the county's basin acreage.

Rockland County - Rockland County has felt the pressure of urbanization and suburbization in recent years. The surge of development away from municipal centers has been spurred largely by the proximity of the New York State Thruway. Projected population growth indicates that 2,000 additional acres will be used for residential development by 2040. Based on employment trends, commercial and industrial land use will increase by

approximately 500 and 400 acres respectively. Development for other urban and institutional usage will utilize another 1,100 acres by 2040. Total projected development will utilize approximately 11% of the county's basin acreage.

7. WITHOUT PROJECT CONDITIONS SUMMARY

The existing conditions in the Passaic River Basin and the most probable future conditions are reflective of the historical socioeconomic characteristics of the area. The favorable climate for economic growth that historically existed in the basin is still strong in the majority of the basin's service area counties. Almost half the basin's communities will be suburban-urban by 2040. The projected continual growth is likely to increase expected annual damages due to worsening flood conditions. Impacts of future economic growth upon expected annual damages under without project conditions can be viewed on Table 12. Expected annual damages for 2040 reflect no growth in economic activity during the decade of 2040 to 2050. Urbanization was projected to occur in the highland area and in the remaining undeveloped natural storage areas of the central basin.

8. BENEFIT UPDATES

The benefit updates have been performed in accordance with ER 1105-2-100 dated 28 December 1990. All applicable regulations are consistent with procedures outlined in the Planning Guidance Notebook for the computation of National Economic Development (NED) benefits. The benefits derived from the plans of protection along the Passaic River consist of the annual benefits from flood damage prevention including future urbanization impacts, affluence residential intensification, recreation, traffic delays, or from industrial contents growth, and reduction in the administrative costs of Federal Emergency Management Agency (FEMA) Flood Insurance Program. Port Authority-Trans Hudson (PATH) delay benefits were found to be no longer applicable.

Protection of National Register Historic Properties and Districts - Many historic sites and districts remain above the surface throughout the potential project area. Near the mouth of the Passaic River, a National Historic District includes the Pulaski Skyway and contiguous areas. The riverside areas below the Pulaski Skyway to within 0.5 miles of Great Falls are likely to be nominated as additional historic districts. The area from 0.5 miles downstream of Great Falls to 0.4 miles upstream is currently deemed a National Historic District. Much of the reminder of the potential project area has been predicted to have

a high potential for historic districts that may be nominated to the National Register. This high probability exists because Passaic River-related uses of land in the potential project areas are well documented. In addition, the Morris Canal, a National Historic District, closely parallels the Passaic River in Little Falls and West Paterson. These sites, located in the potential project area, are currently deteriorating because of continual flooding.

9. FLOOD DAMAGE REDUCTION

Flood damage reduction benefits, including the effects of future urbanization, were developed by evaluating damages with and without the proposed project under both existing and future conditions. The plan considered diversion tunnels, channel modifications, levees and floodwalls, and the preservation of natural storage. Damage reaches affected by both tidal and fluvial flooding were analyzed using a combined frequency analysis. Prior to the base year (2009) flood damage reduction benefits would be generated from the levee/floodwall, tunnel and preservation elements of the project. Computations of flood damage reduction benefits in advance of the base year due to these elements are discussed in this section. The construction schedule for advance of base year elements can be viewed in Supporting Documentation, Part IV, Cost Estimates Section, Figure IV-1. The equivalent annual flood damage reduction benefits that accrue as a result of the flood control plan are shown on Table 13.

Urbanization effects from flood damage reduction benefits were evaluated under 2009 and 2050 future conditions. This analysis of future damage reduction is reflective of 2000 and 2040 hydrologic conditions resulting from the future land use and development projected in the Passaic River Basin. Significant future development is not expected between the years 2040 and 2050 under most probable future conditions. Future land usage was projected in concurrence with State and local guidelines and was fully coordinated at the State and municipal levels, as previously discussed in the Future Land Use and Development Section of the report.

For this report, levee benefits were based on the design level of protection for each system. Interior flooding analysis consideration can be viewed in the Hydrology and Hydraulics Appendix C Levee Floodwall Design, Section 35.4. Flood damage prevention benefits in the freeboard range were excluded from the levee/floodwall benefit analysis. With project condition reflects the relocation of 10 structures. For the Passaic (Spur)

Inlet, two residential buildings and one office building will be taken in fee. For the Rockaway #2 and the South First Street levee/floodwall systems, five residential structures and two businesses will be taken in fee. With project conditions reflect removal of these structures.

10. AFFLUENCE

Affluence benefits are calculated to account for future growth of residential content value, and are characteristic of increases in reproducible wealth. Because the extent of future flood damage to residential contents is directly related to the accumulation of wealth, trends in future contents damage can be derived from future growth rates in per capita income. Components of the affluence calculation include the growth rate, the interest rate for the project, the ratio of existing contents' value to residential structure value, and the project life. Growth in income in the Passaic River Basin is projected to increase at the same rate as that of per capita income in 1990. The office of Business Economic Analysis (BEA) and 1990 Primary Metropolitan Statistical Areas (PMSA), which overlay the study area, were used to project growth in income for the Passaic River Basin. The economic study area is part of the Bergen-Passaic, NJ (0875), Newark, NJ (5640) and Jersey City, NJ (3640) PMSA. For this analysis, the appropriate or conservative per capita income growth rate was used for each subbasin area.

The residential contents-to-structure value ratio was computed based upon a two-step process: (a) first the ratio of content value to structure value was determined for each type of residential structure in the study area, and (b) these ratios were then weighted by the number of each specific structure type in the inventory area. To account for different levels of development throughout the watershed, affluence factors were calculated separately for each major tributary in the Passaic River Basin, see summary Table 14. The current value of content susceptible income was calculated, with the limitation that content value not exceed 50% of structure value. A 50% allowable limit was based upon Planning Guidance, ER 1105-2-100, dated 28 December 1990, which allows the content-to-structure value ratio to grow to 50%. With the interest rate at 7-3/4% and a content-to-structure ratio of 50%, the average annual equivalent factor for growth in contents value over a 100-year period of analysis was found. These factors were applied to the contents portion to estimate growth in residential benefits. Affluence benefits were estimated at $3,697,200.

11. RESIDENTIAL INTENSIFICATION

Potential benefits due to residential intensification were investigated in reference to ER 1105-2-100 dated 2 December 1990. The intensification benefit created by a flood control project is the net value of activities which results from the more efficient use of the structure. This study found that there is a reduction in the use of residential basement space and an accompanying reduction in market value due to the flood hazard, thus indicating a potential for intensification if the flood hazard is reduced. Such benefits do not duplicate benefits already credited for flood damage reduction or affluence. Flood damage reduction benefits, which are based on the basement use reflected under existing conditions, can only reflect increases in market value consistent with current use. Likewise, affluence benefits reflect growth of reproducible wealth based on content values derived from existing use, and do not include changes of utility or expansions of use. Restoration of residential market value associated with full utilization of basement areas due to reduction of the flood hazard represents a measure of intensification potential. This approach ensures that benefits computed for flood damage reduction and affluence are not duplicated.

Methodology - Residential intensification benefits were previously investigated as part of the Interim Feasibility Study for the Ramapo and Mahwah Rivers, Mahwah, N.J. and Suffern, N.Y., November 1983. That study considered residential intensification effects for structures lying in the 100 year floodplain in Suffern, N.Y., based on data gathered from flood damage survey interviews for that area.

The analysis used in the Ramapo and Mahwah Rivers Feasibility Study attempted to utilize a direct measure of the difference in flood damage potential for unmodified and modified (intensified) basements. This difference, then, would be equivalent to the benefit the homeowner would derive from intensified usage. This was based on the concept that the marginal cost of the flood losses the homeowner would incur, would be equivalent to the marginal utility (benefit) the homeowner would derive from the intensification. Reducing the flood hazard would reduce the expected value of the losses, therefore reduce the marginal cost, and induce more people to intensify their usage. The Board of Engineers for Rivers and Harbors (BERH) had several problems with the analysis. They included:

a. The homeowner's decision to fully utilize the basement

may be unrelated to the flood damage threat because of flood insurance subsidies.

b. While the District based its analysis on field data, the flood threat would not be totally eliminated. There is some statistical probability of the project's design level being exceeded.

c. The benefits were apportioned over the whole floodplain, thereby overstating the potential benefits.

d. When project design is exceeded, additional losses will occur due to intensified use; this effect should be considered as negative benefits.

e. A direct measure of market value differences would be a better measure of potential intensification benefits.

These concerns were carefully considered in the development of the revised analysis. As described below, market value change was utilized as a direct measure of the value of intensified use for homes in flood hazard areas as compared to those in areas of less frequent flooding. The number of homes and the extent of the floodplain within which intensification would most likely occur were analyzed and substantially limited to those areas which had the highest likelihood of intensifying. This was based upon home size, frequency of flooding, severity of flooding and field data as to the potential number of structures which would intensify. Finally, the numbers presented were adjusted by the percent of residential content damages occurring above the design level of the project in order tosubtractt out any negative benefits. The analysis presented herein for the main stem Passaic River has been modified to address the BERH/OCE concerns on the Mahwah/Suffern study.

Residential structures analyzed for intensification benefits were limited to those having unfinished basements within the 10 year floodplain in the lower valley, central basin and Pompton Basin.

These structures are subject to frequent flooding and therefore suffer the greatest extent of reduced basement use as a result of the flood hazard. In this sense the main stem analysis provides a conservative estimate of potential intensification with project.

Modified use was defined as the underutilization of basement areas due to flooding. An analysis was made of the increase in market value that would result when the modified use of the

basement area would be altered (i.e., intensified) because of a reduction of the flood threat. Market value was analyzed for with and without project conditions (homes lying outside of flood hazard areas were used as a proxy for flood prone homes under with project conditions). This direct measurement identified changes in basement value that would be directly related to the elimination of the flood risk. Increases in basement values due to a reduction of the flood threat is a quantification of the intensification benefits.

The underlying assumption is that the basement utility for a home under with project conditions provides a measurable increased increment of value to the overall market value of a home compared to the without project conditions. Of course, the overall market value for the home is depressed by the flood hazard. In order to quantify the basement intensification benefits the incremental contribution of basement use to the increase in market value was developed. The relationship between the market value of homes under with and without project conditions and the increment of value provided by basement utility were developed directly from data gathered from local realtors.

Application - Approximately 50 realtors in the communties of Wayne, Chatham, Fairlawn, Clifton, Montville, Parsippany, Pompton Plains, Denville, Dover, Little Falls, Paterson, Totowa and Garfield were randomly selected. These realtors were contacted and asked specific questions in regard to reduction in market values and basement values for residential structures located in a flood hazard area. Approximately 40 realtors stated that the market values of existing structures in the floodplain were measurably lower due to the flood hazard and that part of this reduction was due to decreased basement utilization. Approximately seven realtors expressed no idea of the effect the flood hazard has upon market values. The remaining realtors stated that market values would not change with a reduction of the flood hazard.

To develop the potential increase in basement values due to the reduction of the flood hazard, realtors were then asked what percent of market value would equal basement value. Responses were listed and the basement value was found to average approximately 6% of the market value. Realtors stated that this percentage could be used for existing residential structures in and out of the flood hazard area.

Realtors were also asked to estimate the portion of potential increase in residential market values attributable to reduction of the flood hazard. Responses were listed and the

potential increases in residential market values due to reduction of the flood hazard were tabulated. To properly quantify this increase in residential market values, percentages were tabulated separately for the lower valley, central basin and Pompton Basin. Increases in residential market values due to reduction of the flood hazard were 38%, 37%, and 32%, respectively.

Realtors were asked to quote average market values for residential structures located in a flood hazard area for the lower valley, central basin and Pompton Basin, respectively. For this report, market values were updated to current price levels using Rutgers Regional Report, Volume II, New Jersey Home Prices. These average market values were increased by the appropriate lower valley, central basin and Pompton Basin percentages to reflect the increase in market values due to the reduction of the flood hazard. Utilizing 6% of residential market values, the incremented basement values were tabulated. Increases in basement values were compounded and annualized. The annual increments for the lower valley, central basin and Pompton Basin were estimated at $7,500, $10,700 and $8,300, respectively, per 10 year floodplain home with an unfinished basement.

Based upon structure counts of 10-year residential structures with full or partial basements, and interview data, the number of structures that had intensification potential were found.

Residential intensification benefits for the lower valley, central basin and Pompton Basin approximate $179,400, $157,000, and $184,000, respectively. The computation of residential intensification benefits is displayed on Table 15. Potential benefits for all three study subbasins are approximately $520,400. Total residential intensification benefits do not exceed the increased flood damage potential of unfinished basements compared to the finished basements.

12. FEDERAL INSURANCE ADMINISTRATION (FIA) COST REDUCTION

According to the Memorandum for Distribution, Subject: Economic Guidance Memorandum 95-4 National Flood Insurance Program Operating Cost, date 18 January 1995, the current cost to administer a flood insurance policy is $115 annually. Currently there are 7,747 policyholders in the study area's existing 100 year floodplain.

Expressing savings of these administrative` costs as project benefits is appropriate for properties within the 100 year floodplain in communities that participate in, or are expected to participate in, the Federal Flood Insurance Program under the

without project conditions. All floodplain communities in the Passaic River Basin are participating in the program.

With project conditions have the effect of shrinking the 100 year floodplain and removing structures from the hazard area, thus eliminating these structures from the FIA program. Based on the number of structures in the 100 year floodplain, and administration cost savings for each policy to be eliminated, the annual benefit for complete 100 year protection is $890,900.

13. TRAFFIC FLOW BENEFITS

An assessment was made of the additional costs (i.e., damages) incurred by vehicular traffic due to the inundation of major arteries in the Passaic River basin. The evaluation of such costs required an identification of the major routes utilized by vehicles in the Basin under existing conditions without flooding, and the flood frequencies, depths, durations and impacts on these roads.

Essentially, two major categories of benefits were considered: benefits resulting from loss of time, and benefits from additional cost of operating the vehicle through diversion of traffic. Traffic delay takes the form of using an alternate route. The alternative route will be one which minimizes inconvenience and, therefore, costs.

In order to determine alternate routes for the traffic, consideration was given to the purpose for using the original route. A distinction was made between major east-west routes and major north-south routes so as to determine the predominant origin and destination of the traffic flow on each route. Utilizing New Jersey Department of Transportation (NJDOT) traffic data, vehicular traffic counts were reviewed and associated with three patterns of travel: 1) through traffic; 2) feeder traffic; and 3) local on-off traffic. This procedure confirmed that the north-south routes in the Passaic River Basin act predominantly as feeders into the east-west routes. The major east-west routes, specifically I-80, U.S.46 and I-280, provide uninterrupted flow between the western-most portion of New Jersey and the New York City area.

Traffic data for north-south routes, such as NJ-23, U.S.202 and I-287, indicates that much traffic on these routes feeds into the major east-west routes. Traffic counts at access and egress points along the routes were utilized to determine how much traffic is through traffic and how much is local traffic. This resulted in a conservative count of vehicles passing through the alternative detours. Different detour routes were chosen for the

diverging of detouring traffic. This influenced the selection of the least costly alternative routes for detouring traffic. These procedures resulted in a conservative count of vehicles and mileage, reflecting the traffic detoured to alternative routes.

Since this analysis focuses on significant flood events, inundated roadways would cause major disruptions of traffic flow. Blockages along highways due to flooding and the subsequent detours established would be coordinated by state and local officials, police departments and emergency units. The detour would start at the nearest interchange prior to the inundated roadway and divert traffic onto another passable major route. The end of the detour would be represented by reentry onto the original highway. This procedure applied directly to through traffic. Local traffic that enters or exits a highway by any number of local, medium or light duty roads between the nearest interchange and the area of inundation would take local roads to the closest alternate highway. Once on the alternate route, the local traffic would travel only far enough to access the original highway at a point beyond any flood hazard.

In some cases traffic counts vary along an original route that has more than one point of potential flood blockage. The peak through traffic statistics were used in a detour route beginning at the outermost impassable flood location, since traffic would not be able to access the original route between the inundated locations.

Using the methodology described, traffic detours were analyzed. Flood elevations and depths were examined for major highways which cross the Passaic River's floodplain, located in the lower valley, central basin and Pompton Basin, for the five year, 10 year, 50 year, 100 year and 500 year events. Highways which experience flooding during any or all of these flood frequencies include several portions of U.S.46, I-80, I-280, (east-west highways) and several locations along NJ 23 and U.S.202 (north-south highways).

The water surface elevations at the five year, 10 year, 50 year, 100 year and 500 year flood events were determined. One foot of water above the ground elevation of the highway was used as the threshold of when a road becomes impassable. During a one year flood event, water heights would be less than one foot above ground elevation and traffic would be passable. The corresponding stream discharge for the ground elevation plus one foot was obtained and the duration of flooding above the one foot elevation was derived from HEC-1 hydrograph data for each frequency of flooding.

The traffic data compiled by NJDOT was used to compute the total number of vehicles affected by each inundated, impassable highway location. The traffic data consisted of average annual daily traffic (A.A.D.T.) counts representing the total volume in both directions during a 24 hour period. The average annual daily traffic counts developed by the NJDOT reflect factor adjustments to account for seasonal changes, and because they are developed over a 24 hour period, they include factor adjustments due to time of day. The nature of this data precluded the need for any seasonal traffic count analysis. Traffic counts were available for data years 1980 through 1981. These figures were then increased to reflect 1985 traffic counts and, therefore, are conservative in number since recent increases in traffic counts are not included.

13.1 Vehicular Operating Costs

Upon selecting the least costly alternative route for detouring traffic during the five year, 10 year, 50 year, 100 year and 500 year flood events, the increase in mileage between the original route and alternate route was computed. The resulting increase in mileage due to the traffic detour for each frequency of flooding was multiplied by the government automobile estimate of $0.30 per mile for passenger vehicles and $0.40 per mile for trucks. These figures include total expenditures associated with vehicle use such as gasoline, oil, maintenance, insurance and registration costs. (Traffic data for trucks was also available from NJDOT). A sample computation for the increased cost of vehicular operation for Route 46 in Wayne, N.J. is presented for the 100 year flood frequency on Table 16.

13.2 Traffic Delay Cost

Other costs associated with traffic detours are traffic delay costs represented by the dollar value of a person's time spent in increased travel time due to road blockages, detours and increased traffic congestion. The following steps were used to compute these delay costs. The traffic delay data, including original and alternate route mileage and total vehicles affected (trucks and passenger vehicles), previously developed for vehicular operation costs were used in calculating the delay costs. At each frequency of flooding for which data was developed, the total additional time that vehicles would spend on the alternate (detour) route versus the original flooded route was determined. The additional time consists of the difference between the following: (1) the original route mileage times the total number of vehicles affected by a flood blockage on that

route (over the duration of the flood condition) divided by the average speed of traffic flow under a non-flood condition; and (2) the alternate route mileage times the number of vehicles detoured (same as in (1), divided by the average speed of traffic flow under flooding conditions in the Passaic River Basin. The average traffic speed used for the non-flood condition was 45 miles per hour and that used under flooding conditions was 10 miles per hour. The reduced speed takes into consideration the much heavier traffic volumes along the detour route. These steps were taken for trucks and passenger vehicles separately for each affected roadway and totaled for each flood frequency data point.

The next step consisted of the application of the number of persons determined to be in each passenger vehicle under both commuter and non-work related travel conditions (this is the total number of persons affected) and the average dollar worth of those persons' time. For trucks, however, a flat average wage rate was applied to the total number of trucks affected by the flood event, since no distinction was made between work and non-work related activities, as had been done for passenger vehicles.

For automobiles the character of the population affected by traffic detours and delay is a mixture of public commuters to place of employment and public vehicular travel for private purposes (i.e., shopping trips, travel to school, and leisure activities). Because of the nature of the inundated routes in the Passaic Basin (major commuter highways), a weighted value for a person's time was derived utilizing the average rate for commutation trips, one-third of the average wage rate for adult non-work related travel and one-fourth of the adult value (one-twelfth of the average wage rate) for children. This resulted in a weighted dollar value totalling $8.88 per hour, and reflects the procedure suggested to determine time value in the Water Resource Council's Principles and Standards, Subpart K - NED Benefit Evaluation Procedure.

The rate of $8.88 incorporates the gross average earnings of production, professional, and managerial workers in the New York-northeastern New Jersey area. This average hourly rate is $14.70 according to the latest data available from the Bureau of Labor Statistics (BLS 1994).

An average of two adult passengers was determined to ride in commuting vehicles, while one adult and one child per automobile was estimated for non-work related trips.

Trucks delayed during flood events and the cost to drivers was estimated at $13.61 per hour, the basic hourly wage rate for

drivers of service trucks in Bergen, Hudson and Passaic Counties as listed in the Federal Register. One truck driver per truck was calculated in the total delay costs.

Once determined, these average hourly rates ($8.88 per person-hour for passenger vehicles and $13.61 per person-hour for trucks) were multiplied by the total additional time spent on all detours for each frequency event. This final step represents the total delay cost for all affected vehicles on major highways under flooding conditions.

Traffic delay costs were not calculated to address flood conditions of one foot or less on the roadways subject to inundation. Although it is reasonable to assume that traffic flow would continue under such conditions, traffic would continue at a reduced speed and, therefore, traffic delays would occur.

Total average daily delays and benefits were assessed for travel under existing conditions. The AADT figures utilized were not modified to reflect travel which might not occur during flood conditions (trips avoided) since it is recognized that much of the basin's through traffic is destined for employment centers outside of the watershed and lost wages incurred by employers located outside of the basin are not accounted for in existing damage data.

The sum of the increased vehicular operation costs and the traffic delay costs is the total cost of the interrupted traffic flow during flood events. Sample calculations of the traffic delay costs are shown on Table 17. The total cost or damage due to each flood event was utilized to compute a damage frequency curve which was then integrated to compute expected annual damages. Flood control plans of improvement which alleviate highway flooding and which provide 100 year flood protection would accrue traffic flow benefits totaling $1,666,700 annually.

14. INDUSTRIAL CONTENT GROWTH BENEFITS

Over the project life utilized for the analysis of flood damage reduction measures for the main stem Passaic River, existing industries will experience internal growth if they are to remain competitive. Internal growth is defined to be the extent of capital deepening and the resulting increases in the quantities of raw materials, goods in process, and finished goods within the existing plant. Capital deepening and/or increase in productivity can be measured by economic indicators such as capital expenditures and value added. The collection and analysis of available data on the values of output and new capital in the areas subject to flooding within the Passaic River

Basin, i.e. the floodplain, have indicated that industries have experienced capital deepening, and industries will continue to experience such growth in the future with or without a project. To assess the extent of capital deepening that did occur in the floodplain, data was collected using field interviews (about 700 industries) integrated with data from the Census of Manufacturers for 1977 through 1987 with monetary values being in millions of 1991 dollars. The focus of this data was the Counties of Bergen, Essex, Hudson, Morris and Passaic in the State of New Jersey. These counties were chosen because they primarily contain the industrial centers located in the Passaic main stem floodplain. About 70% percent of the five counties are in fact located within the Passaic River Basin Study Area (PRBSA). Also, industries in the counties are fairly evenly distributed throughout. This means that more than 50% of the industries within the counties are located in the Passaic River Basin Study Area. Of the total industries in the study area, data collected and used in this analysis indicated that about 17% are found within the floodplain. Therefore, from this point on in the discussion, aggregates for the five counties will serve as proxies for the Passaic River Basin Study Area (PRBSA).

It is hypothesized that the value of industrial contents is a function of industrial activity. It is also hypothesized that the floodplain is very similar in industrial composition to the Passaic River Basin Study Area, which is similar to the State of New Jersey. To prove both hypotheses a series of linear regression equations was used.

1. N.J. Manufacturing Production = f (U.S. Manufacturing Production)

2. PRBSA Manufacturing Production = f (N.J. Manufacturing Production)

3. PRBSA Industrial Contents = f (PRBSA Manufacturing Production)

Due to a lack of appropriate information for the floodplain, it was impossible to use linear regression analysis to show the correlation between the Passaic River Basin study area and the floodplain. This resulted in the use of deductive reasoning to show the similarities between the Study Area and the floodplain. Following from this, a rate of capital deepening was obtained for the Passaic River Basin Study Area and applied to the floodplain.

The assumption was made that in the long run the performance of New Jersey's manufacturing sector would parallel that of the national manufacturing sector. It was initially presumed that a

linear relationship existed over time between New Jersey's manufacturing production and that of the nation. The equation took the form:

N.J. Manufacturing Production = a+b (U.S. Manufacturing Production)

Statistical analysis of the relevant data resulted in the following:

N.J. Manufacturing Production = 33203 + 0.044 (National Manufacturing Production)

R^2= .9 n = 3

All coefficients are significant at the .05 level. The t - Statistic derived for this equation indicated that the Beta value (0.035) was significantly different from zero. This means that the equation is defined and specifies a true relationship between New Jersey's manufacturing production level and the nation's manufacturing production level. Statistical analysis also indicated that the national value of production is a good predictor of New Jersey value of production. The next step was to relate production in the State of New Jersey to production in the Passaic River Basin Study Area (PRBSA). Again a linear relationship was postulated. Similar variables for the years 1977 through 1987 were used to test this relationship. The following is the resulting equation and its statistical validity.
PRBSA Manufacturing Production = 2171 + 0.352 (N.J. Man.Prod.)

R^2= .9 n = 3

All coefficients are significant at the .05 level. The t - Statistic derived for this equation showed that the Beta value (0.318) was significantly different from zero. This also means that the equation is defined and specifies a true relationship between manufacturing production level in the Passaic River Basin Study Area and New Jersey's manufacturing production level.

Data collected for the Passaic River Basin Study Area from the Census of Manufacturers for New Jersey between 1977 and 1992 indicated that the value of new capital increased by 108%, output increased by 77%, the labor force declined by 16% and the number of establishments declined by 8%. Also, data collected for the floodplain from interviews indicated that of the total number of firms in the floodplain, over 50% of these firms have been in operation in this area for over 10 years. In fact, over 80% of these firms have been in operation in this area for over five years. Research also indicated that new firms came into the

Study Area between 1977 and 1992. The electric and electronic industry (SIC Code 36) showed 26% numerical growth; paper and allied products (SIC Code 26) showed 60% numerical growth; fabricated metal products (SIC Code 34) showed 17% numerical growth; the chemical industry (SIC Code 28) showed 15% numerical growth; and instruments and related products (SIC Code 38) showed 62% numerical growth. This means that the decline in number of establishments in the Passaic River Basin Study Area between 1977 and 1987 was not specific to the floodplain. The decline in the labor force and the total number of establishments, along with the increase in output and the value of new capital, clearly indicates that capital deepening took place in the study area between 1977 and 1992.

The industrial complexion of the Passaic River Basin is very similar to that of the floodplain. Research shows that of the 867 industrial firms that are located in the floodplain, 10% belong to the fabricated metal products industry (SIC Code 34); three percent belong to the paper and allied product industry (SIC Code 26); three percent belong to the instruments and related product industry (SIC Code 38); nine percent belong to the chemical industry (SIC Code 28); two percent belong to the textile industry (SIC Code 22); and another two percent belong to the transportation industry (SIC Code 37). This distribution of firms over time in the floodplain mirrors the distribution of firms in the Passaic River Basin Study Area. Therefore, if firms over time are to remain in operation they must remain competitive. Since they not only continue to operate but have maintained their overall standing vis-a-vis non-floodplain industries, they must be changing at a rate comparable to growth of firms in the study area. Furthermore, because firms in the study area have experienced capital deepening as defined in preceding paragraphs, similar firms in the floodplain will also experience capital deepening. If existing firms in the floodplain are to remain competitive given changes in technology, they must upgrade their productive facilities to match those of other firms within the study area. The fact that the floodplain totals have remained consistent over the years is a clear indication that new firms have entered, and existing firms have improved their technology, at the same rate as firms in the study area.

Internal growth was defined as the extent to which capital deepening and the resulting increases in the quantities of raw materials, goods in process, and finished goods within the existing plant were taking place. In the floodplain over 70% of industrial damage is allocated to damages to raw materials, goods in process and finished goods. It is reasonable to expect that as capital deepening takes place in the floodplain the real value

of industrial damages will rise. This statement gains strength when the results of interviews of firms in the floodplain are analyzed. Over 95% of all the firms interviewed indicated that floodproofing does not take place as a result of the threat of future flooding. In fact, these same firms indicated that they would continue to modernize because the marginal cost of reducing flood hazard on an individual firm basis is greater than their individual marginal benefits of new investment. This confirms that firms have not responded to the threat of flooding in the past by refusing to modernize. Entrepreneurs are rational and are expected to act in a rational manner. This being so, there is no basis to postulate that they will change their past behavior in the future with respect to the continued threat of flooding under without project condition.

It is reasonable to project increases in flood damages, by projecting increases in the amount of real value of industrial content and their damage susceptibility. In any economy, as internal growth takes place, the level of productivity rises. This increase in productivity gives rise to an increase in the value of production as more raw materials and capital are used. As the value of production increases so does the manufacturer's cost of materials and capital not consumed in production, which indicates that there is a direct relationship between industrial content and the value of production.

$$\text{PRBSA Industrial Content} = \frac{\text{Value of Production - Value Added}}{\text{(\# of Establishments)}}$$

The above definition of industrial content represents the average individual manufacturer's cost of materials and capital not consumed in production and is a reasonably good proxy measure of industrial content. Time series data from New Jersey Census of Manufacturers for the years 1977 through 1987 comprised the data base. The model resulted in the following equation:

$$\text{PRBSA Industrial Content} = -0.57845 + 0.000095\ (\text{PRBSA Manufacturing Production})$$

$$R^2 = .9 \qquad n = 3$$

All coefficients are significant at the .05 level. The t - Statistic derived for this equation indicates that the Beta value (0.000066) is significantly different from zero. The t - Statistic therefore indicates that the relationship between the Passaic River Basin Study Area industrial content and production in the Passaic River Basin Study Area is clearly defined, meaning

that one can be used to explain the other. The independent variable is the Passaic River Basin Study Area value of production. The model indicates that industrial activity has been a good predictor of the value of industrial content for the individual firm.

Projected output for the manufacturing sector of the United States was not available, thus it was decided to use projections of either Gross Domestic Product (GDP), Gross National Product (GNP) or labor and proprietors' income for the manufacturing sector as a proxy for deriving a projected growth rate for manufacturing output. It is somewhat justified to look at GDP and GNP, as manufacturing output accounted for 20% of both GDP and GNP for the United States in 1978.

Projections of Gross National Product, Gross Domestic Product, and labor and proprietors' income for the manufacturing sector, for the United States for the period 1978 to 2030, were reviewed with the specific intention of finding growth rates for the respective categories over this period (BEA Regional Projections, 1980 OBERS Volume 1, U.S. Department of Commerce). It was found that between 1978 and 2030, GNP and GDP would grow by 2.6% per annum, and labor and proprietors' income in the manufacturing sector would grow by 2.9%. The growth rate of 2.6% was adopted, and used to project the value of New Jersey's manufacturing production between the years 1982 and 2040 with 1982 serving as the index year. The projected value of New Jersey's manufacturing production was then used to find the value of the study area's manufacturing production for the year 2040. Based on the linear equation showing the relationship between manufacturing content and manufacturing production in the study area, the content value for the study area for the year 2040 was found. Applying the formula for continuous growth over a period, in this case 1983 to 2040, industrial content in the study area was calculated to grow at a rate of 1.3% per annum.

Capital deepening includes the replacement of outdated and less productive machinery with more sophisticated equipment. Capital deepening also includes the addition of sophisticated and in most cases more expensive equipment to the present capital stock. The use of more sophisticated and advanced equipment would result in an increase in the firm's productivity. This productivity is characterized by the firm's increased usage of raw materials, and increases in goods in process and finished goods within the existing plant per manufacturing period. To the extent that there is a direct relationship between industrial flood damages and industrial contents, future benefits from the execution of a project to alleviate flooding, will increase. This increase in flood damages is further strengthened by the

fact that over 90% of the interviews of managers in the floodplain show that floodproofing does not increase as a result of capital deepening.

The previous analysis clearly indicates that firms in the floodplain are "extremely similar to" firms in the Passaic River Basin Study Area. The rate of growth of capital deepening for firms within the floodplain is consistent with the rate of growth of capital deepening for firms within the Passaic River Basin Study Area. Historically, internal growth in the floodplain has taken place within the existing plant facilities either through intensification of capital and/or labor or utilization of more sophisticated and efficient means of production. Research on firms in the floodplain indicates that they are operating near full capacity. This means that the operational growth rate of firms in the floodplain is expected to be close to the calculated 1.3% specified in the preceding paragraphs. This trend is expected to continue in the future with or without a project.

15. RECREATIONAL IMPACTS

Recreational benefit tabulations are only for increases in the recreational experience under with project conditions. These increases are net of any existing condition recreational use under without project condition. In the analysis of the with project conditions, it was determined that changes would occur in the recreational use of reaches in the project area. With the project in place, mitigation measures would include a system of walkways that would be built along the top of the levees and floodwalls. Creating a new linear recreational trail amounts to 7.7 miles. (See Table 18) In addition to the increased distance that would be made available for recreation, many reaches of the riverside that are now inaccessible to the public would be made available for recreational uses.

Unit day values were used to quantify the recreational losses under with project condition. They are displayed on Table 19. Unit day values were determined as specified in the planning Guidance ER 1105-2-100, NED Benefits Evaluation Procedures: Recreation 28 December 1990, updated to FY 1995 values per letter from the Chief of the Planning Division, Director of Civil Works. The value determined reflects the anticipated recreational experience, the availability of opportunity, the site carrying capacity, the accessibility of the site and the environmental and esthetic quality of the experience.

The estimates of recreational usage are displayed in Table 20. They were based on professional judgement, field trips and a sampling of recreational experience and adjacent areas. The

assumptions that were made follow:

1. Only the recreational use of existing trails was itemized and forecast, since these are the only areas of the parks which would be directly impacted by the construction of the levees and floodwalls.

2. In reference to walking as recreation, it was assumed that an optimum recreational walk would space the participants about 100 feet apart, so that there would be 50 persons to each mile of riverside trails.

3. Turnover rates were defined as the number of different sets of recreationalists who would use the facilities each day. Since the first day of spring and fall receive 12 hours of daylight, and the summer months receive up to 16 hours of daylight, there would be three complete turnovers of participants on each capacity day.

4. Capacity day and peak day are used interchangeably. A capacity day is defined as an ordinary sunny summer Sunday, when the recreational resources would be used to capacity. Saturday is assumed to be equivalent in usage. The balance of the week was assumed to be equivalent to two additional peak days in these calculations.

5. The season for park use was assumed to be six months long. Twenty-six weeks were used in the calculations.

6. The product of these factors comprises the total number of recreational days per year per mile for each recreational activity. The unit day values derived in Table 21 were then multiplied to determine the total recreational values for each activity for each mile. In the lower valley, 18 points were equivalent to $3.19 per day. In the central basin, 25 points were equivalent to $3.56 per day.

7. The final values were multiplied by 0.4 miles, the equivalent of approximately 2,200 feet of levee paths in the Lower Valley.

8. For future conditions in the central basin the final values were multiplied by 7.3 miles, which is the linear distance of the levees and floodwalls that would be built. Total recreational benefits for the levee/floodwall system were estimated at $1,764,800 (see Table 22).

16. NAVIGATIONAL

The purpose of this report is to provide a preliminary assessment and evaluation of the possible impacts of constructing a tunnel outlet site downstream from Kearny Point in Newark Bay. The economic study area includes Newark Bay, the Hackensack River from its mouth in Jersey City upstream to its navigable end in Secaucus, and the Passaic River from its mouth upstream to the City of Passaic. The project area municipalities include Bayonne, Jersey City, Kearny, Harrison, and East Newark in Hudson County and Newark in Essex County, New Jersey.

The proposed outlet site is located approximately 1950 feet downstream of Kearny Point in Newark Bay and is adjacent to the Hackensack River shipping channel.

16.1 Without Project Condtions

A. **Dredging** - Currently, the study area requires dredging every year. However, due to limited disposal options, dredging is accomplished every 10 years.

B. **Recreational Navigation** - Recreational marinas can be found in Bayonne, Kearny, and Newark, New Jersey. There are three marinas that provide 100 slips and 28 moorings where boaters can dock their vessels. From a visual survey count, it appeared that power boats significantly outnumbered sailboats. Table 23 provides recreational data for the study area.

There is only one marina in the study area vicinity. The Elco Marina is located on Newark Bay near the southern tip of Bayonne and is adjacent to the Kill Van Kull. There are approximately 100 usable slips at the marina. On the average weekend day, there are approximately 50 boats that depart the marina. These boats typically engage in recreational activities, such as fishing in Newark Bay and Upper and Lower New York Bay. The Passaic River Yacht Club is located on the Hackensack River in Kearny. There are 28 moorings and one ramp for use by yacht club members. However, the ramp is currently unusable due to an abandoned boat blocking the incline. The members of the yacht club engage in fishing on Newark Bay and watching wildlife along the Hackensack River. In addition, there is also a small marina located on the Passaic River at Blanchard Street in Newark. This marina appears to be seldom used, based on the appearance of numerous dilapidated vessels and piers (see Table 23).

C. Commercial Navigation

Commercial navigation is extremely active along the Hackensack and Passic Rivers and in Newark Bay. There are numerous terminals, wharfs, docks, and piers located in the study area, especially along the shores of Newark Bay. There are commercial docks that are scattered from Kearny Point upstream the Passaic River to the Keller Engineering Wharf in East Rutherford, New Jersey. Commercial docks along the Hackensack range from Jersey City and Kearny upstream to the Bergen Asphalt Corporation in Bogota, New Jersey.

There are a number of users of the Hackensack River, the Passaic River and Newark Bay. The largest are McAllister Brothers Transporation, the Moran Towing Corporation and Turecamo Coastal Harbor Towing Corporation. These are towing companies that guide incoming commercial vessels from the Verrazano Narrows Bridge to the intended destination and vice-versa.

The commercial docks on Newark Bay handled 15,296,449 tons of cargo according to the 1980 Waterborne Commerce statistics. Since 1980, commercial traffic along Newark Bay has steadily increased. In 1992, total cargo rose to 22,804,000 tons. This reflects a 49 percent increase over the 12 year period.

According to the Waterborne Commerce estimates for 1980, 2,663,907 tons of material were transported to and from the commercial docks of the Hackensack River. In 1992, 2,035,000 tons of cargo were transported on the Hackensack. This is a six percent decrease from the 1980 estimate. Of the 2,035,000 tons, approximately 28 percent or 569,000 tons were coal and lignite. Sand and gravel shipments accounted for another 127,000 tons. In addition, 830,000 tons carried on the Hackensack were identified as fuel products, accounting for 41 percent of the total.

Waterborne Commerce statistics for the year 1980 indicated that 8,310,199 tons were hauled to and from the commercial docks of the Passaic River. By 1992, this number decreased by 65 percent to 5,023,000 tons. This reflects a steady 12-year decrease in commercial traffic along the Passaic River. Of the 5,023,999 tons transported in 1992, approximately 85 percent, or 4,258,000 tons, were fuel related products. Many oil companies maintain plants and commercial docks along the Passaic and hence, receive shipments of fuel-related products.

16.2 With Project Conditions

A. **Dredging** - Sedimentation from the increased water velocity is not expected to result in the need for increased dredging. The proposed location of the mouth of the tunnel with the tunnel's upward component is expected to keep sedimentation levels at a constant.

B. **Navigation** - On average it is likely that the discharge from the tunnel could impact navigation in the Hackensack channel about 2.2 hours every year. It is possible under adverse conditions that the tunnel discharge might impact navigation in the Hackensack for one day and 7 hours every year. While the above information is averaged over 500 years, most years will not be affected by the tunnel and every 25 to 100 years the tunnel could impact navigation in the Hackensack for several days (1-8 days). Impacts to navigation will be further evaluated in the FDM when a physical model study of the tunnel is conducted and when the ship simulation study is completed.

17. INDUCED DAMAGES

Flood damages induced by the project which have not been mitigated are external diseconomies to the project. A total of $387,200 in damages would be induced by the projects in the 14 reaches affected. Approximately $134,900 in damages were eliminated by mitigation works (see Table 24). The remaining $252,300 in unmitigated damages are considered an economic cost to the project. Mitigation and integral levee/floodwall benefit figures reflect totals net of induced damages eliminated.

18. INTEREST DURING CONSTRUCTION

Interest during construction (IDC) is the cost of construction money invested in a project before the beginning of the period of economic analysis and before the accumulation of benefits by the project. Interest during construction costs are added to the project cost to determine investment costs. Average annual costs are determined based on investment costs which include IDC.

Costs incurred during the construction period should be increased by adding compound interest at the applicable project interest rate from the date the expenditures are made to the beginning of the period of analysis (base year).

For purposes of this study, construction expenditures are assumed to occur in equal monthly increments and interest is

determined assuming that expenditures are made at mid-month.

Construction of the plan is estimated to be completed in 10 years, 10 months. This would include land acquisition, relocations and alterations, channel excavation, tunnel, levee/floodwall construction, and implementation of environmental and esthetic measures. Economic benefits are expected to begin to accrue for each increment upon completion of construction of the corresponding increment. The pre-base year benefits were estimated for each completed increment in advance of the base year using the Federal interest rate of 7-3/4%.

An example of an IDC calculation can be shown by the following levee system cost computation. The Pinch Brook levee system located in reach 020144 would be constructed during the first six months of the total 130 month construction period. IDC generated during the six months would be approximately $29,463 for the levee system. Using the constant dollar theory, this amount is then brought forward to the base year with a single payment compound factor. Total IDC at the base year and total investment cost would be approximately $54,202 and $1,863,338 respectively for the Pinch Brook levee system. This method was applied to all plan systems that are operational prior to the base year.

19. ADVANCE OF BASE YEAR BENEFITS

Construction of the plan, estimated to be completed in 10 years and 10 months from the present, would include all project elements. Economic benefits are expected to begin to accrue for each increment upon completion of construction of the corresponding increment. For each increment completed prior to the base year, total annual element benefits were brought forward to the base year with the single payment compound factor the amortization over the project life. The pre-base benefits were estimated for this completed increment in advance of the base year using the Federal interest rate of 7-3/4%. Total annual advance of base year benefits would be approximately $39,136,200 for the Passaic River Flood Damage Reduction Project. Benefits in advance of the base year can be shown by the following Pequannock Channel computation. The element is to be completed five months before the base year. Total annual benefits for the channel system were tabulated at $248,900. Using constant dollar theory, the total channel elements benefits were brought forward to the base year with the single payment compound factor, then analyzed over the life of the project.

Annual Channel Benefit	Amount of 1 per period	Single Payment Amount
$248,900	.4079	$101,500
Total Amount		$101,500
Amortization factor (100-years @ 7-3/4%)		.0775444

Average Annual Benefits		$ 7,900

20. BENEFIT SUMMARY

Benefit-to-Cost Ratio. Total average annual benefits for the project are $173,925,000. Based on an expected average annual cost of $127,295,000 benefit-to-cost ratio is 1.4 to 1.0 as shown on Table 25. The net benefits are $46,630,000. The annual cost is based upon the economic project cost. It includes interest during construction calculated on the total project cost. The exceptions sunk Preconstruction Engineering and Design (PED) cost $38,500,000. Planning Guidance indicates that once anticipated PED costs are actually incurred they become sunk costs and no longer should be included as a project cost. The sunk costs were therefore excluded from the benefit-to-cost analyses. The breakdown of the cost estimates presented in Appendix D - Cost Engineering.

Table 1

List of Project Area Communities

BERGEN COUNTY	HUDSON COUNTY	PASSAIC COUNTY
East Rutherford	East Newark	Clifton
Elmwood Park	Harrison	Little Falls
Fairlawn	Kearny	Passaic City
Garfield		Paterson
Lyndhurst	MORRIS COUNTY	Pompton Lakes
North Arlington		Totowa
Rutherford	East Hanover	Wayne
Wallington	Florham Park	West Paterson
	Hanover	
ESSEX COUNTY	Lincoln Park	
	Montville	
Belleville	Parsipanny-Troy Hills	
Fairfield	Pequannock	
Livingston	Riverdale	
Newark		
North Caldwell		
Nutley		
Roseland		
West Caldwell		

TABLE 2

TOTAL EXPECTED ANNUAL DAMAGES (EAD)
AND AT STAGE DAMAGES
OCTOBER 1994 PRICE LEVEL
(DOLLARS SHOWN IN THOUSANDS)

BASIN	EAD	10YR	25YR	50YR	100YR	500YR
LOWER PASSAIC	$49,164	$109,372	$223,749	$415,829	$644,583	$1,566,713
CENTRAL PASSAIC	$33,501	$59,425	$118,227	$242,707	$521,899	$1,061,335
POMPTON RIVER	$28,582	$85,814	$185,748	$266,731	$404,380	$472,219
LOWER RAMAPO RIVER	$3,952	$11,136	$21,600	$26,340	$35,358	$51,942
WANAQUE RIVER	$613	$1,762	$2,877	$3,920	$5,517	$8,758
PEQUANNOCK RIVER	$204	$677	$970	$1,353	$2,255	$4,284
TOTAL	$116,016	$268,186	$553,171	$956,880	$1,613,992	$3,165,251

TABLE 3

BASE CONDITION DEVELOPMENT FOR THE STUDY AREA

TYPE OF STRUCTURES	100 YEAR FLOODPLAIN	500 YEAR FLOODPLAIN
LOWER PASSAIC		
RESIDENTIAL	5267	6103
NON-RESIDENTIAL	1770	1881
TOTAL	7037	7984
CENTRAL PASSAIC		
RESIDENTIAL	4149	5683
NON-RESIDENTIAL	1407	1593
TOTAL	5556	7276
POMPTON RIVER		
RESIDENTIAL	4587	5283
NON-RESIDENTIAL	613	657
TOTAL	5200	5940
LOWER RAMAPO RIVER		
RESIDENTIAL	1054	1201
NON-RESIDENTIAL	76	92
TOTAL	1130	1293
WANAQUE RIVER		
RESIDENTIAL	188	233
NON-RESIDENTIAL	27	40
TOTAL	215	273
PEQUANNOCK RIVER		
RESIDENTIAL	317	328
NON-RESIDENTIAL	19	22
TOTAL	336	350
TOTAL	19474	23116

*RESIDENTIAL STRUCTURES CONSIST OF APARTMENTS AND RESIDENTALS
**NON-RESIDENTAL STRUCTURES CONSIST OF COMMERCIAL, INDUSTRIAL, AND UTILITY

Table 4

Expected Annual Damages ($1,000)

Reach 010102

++DAMAGE DATA, REACH 010102 FOR PLAN 1 -- EXISTING CONDITIONS

	FREQ	FLOW	STAGE	RES	APT	COM	IND	UTL	MISC
1	99.90	-1.	7.00	0.00	0.00	0.00	0.00	0.00	0.00
2	50.00	-1.	7.90	0.00	0.00	0.00	0.00	0.00	0.00
3	20.00	-1.	9.00	0.00	0.00	0.00	0.00	0.00	0.00
4	10.00	-1.	10.00	105.18	0.00	6.70	761.57	0.00	0.00
5	4.00	-1.	11.60	235.80	0.00	12.27	3228.99	0.00	0.00
6	2.00	-1.	13.20	428.01	0.00	19.36	6390.66	33.81	0.00
7	1.00	-1.	14.10	573.27	0.00	25.31	7834.96	70.19	0.00
8	0.20	-1.	17.40	1735.12	0.00	191.30	11916.64	168.95	0.00
EXP ANNUAL DAMAGE				34.68	0.00	2.19	385.58	1.91	0.00

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++DAMAGE DATA, REACH 010102 FOR PLAN 1 -- EXISTING CONDITIONS

	FREQ	FLOW	STAGE	RESCON	APTCON	COMCON	INDCON	TOTAL	ACC EAD
1	99.90	-1.	7.00	0.00	0.00	0.00	0.00	0.00	827.99
2	50.00	-1.	7.90	0.00	0.00	0.00	0.00	0.00	827.99
3	20.00	-1.	9.00	0.00	0.00	0.00	0.00	0.00	827.99
4	10.00	-1.	10.00	39.85	0.00	8.66	311.76	1233.71	786.85
5	4.00	-1.	11.60	86.87	0.00	13.43	2979.71	6557.09	617.19
6	2.00	-1.	13.20	147.82	0.00	20.06	7297.06	14336.77	413.40
7	1.00	-1.	14.10	188.49	0.00	25.16	9671.84	18389.22	251.87
8	0.20	-1.	17.40	640.68	0.00	325.32	17553.63	32531.65	65.06
EXP ANNUAL DAMAGE				12.41	0.00	2.79	388.43	827.99	

*FREQ	Frequency	*UTL	Utility
*RES	Residential	*RESCON	Residential Contents
*APT	Apartment	*APTCON	Apartment Contents
*COM	Commercial	*ACC EAD	Accumulated Expected Damage
*IND	Industrial		

***** Municipals Not Included

Source: Flood Damage Analysis Pacakage

Table 5

Expected Annual Damages ($1,000)

Reach 010171

++DAMAGE DATA, REACH 010171 FOR PLAN 1 -- EXISTING CONDITIONS

	FREQ	FLOW	STAGE	RES	APT	COM	IND	UTL	MISC
1	99.90	-1.	29.72	0.00	0.00	0.00	0.00	0.00	0.00
2	50.00	-1.	31.08	0.00	0.00	0.00	0.00	0.00	0.00
3	20.00	-1.	32.83	757.18	0.00	45.98	0.00	0.04	0.00
4	10.00	-1.	33.95	1171.10	0.00	88.26	0.00	9.55	0.00
5	4.00	-1.	35.38	2057.24	0.00	185.55	0.00	32.52	0.00
6	2.00	-1.	36.47	3099.10	0.00	507.09	0.00	49.74	0.00
7	1.00	-1.	37.61	4628.23	0.00	883.53	0.00	63.63	0.00
8	0.20	-1.	40.13	9613.31	0.00	1424.41	0.00	70.06	0.00
EXP ANNUAL DAMAGE				449.82	0.00	41.00	0.00	3.56	0.00

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++DAMAGE DATA, REACH 010171 FOR PLAN 1 -- EXISTING CONDITIONS

	FREQ	FLOW	STAGE	RESCON	APTCON	COMCON	INDCON	TOTAL	ACC EAD
1	99.90	-1.	29.72	0.00	0.00	0.00	0.00	0.00	718.15
2	50.00	-1.	31.08	0.00	0.00	0.00	0.00	0.00	718.15
3	20.00	-1.	32.83	262.62	0.00	63.23	0.00	1129.05	562.72
4	10.00	-1.	33.95	409.20	0.00	158.10	0.00	1836.20	419.99
5	4.00	-1.	35.38	710.83	0.00	297.36	0.00	3283.49	276.75
6	2.00	-1.	36.47	1071.51	0.00	559.00	0.00	5286.43	196.32
7	1.00	-1.	37.61	1673.54	0.00	1345.74	0.00	8594.68	130.06
8	0.20	-1.	40.13	3814.78	0.00	2797.77	0.00	17720.34	35.44
EXP ANNUAL DAMAGE				158.68	0.00	65.09	0.00	718.15	

*FREQ	Frequency	*UTL	Utility
*RES	Residential	*RESCON	Residential Contents
*APT	Apartment	*APTCON	Apartment Contents
*COM	Commercial	*ACC EAD	Accumulated Expected Damage
*IND	Industrial		

***** Municipals Not Included

Source: Flood Damage Analysis Pacakage

Table 6

Expected Annual Damages ($1,000)

Reach 010203

++DAMAGE DATA, REACH 010203 FOR PLAN 1 -- EXISTING AND FUTURE CONDITIONS

	FREQ	FLOW	STAGE	RES	APT	COM	IND	UTL	MISC
1	99.90	-1.	38.01	0.00	0.00	0.00	0.00	0.00	0.00
2	50.00	-1.	39.82	0.00	0.00	209.89	7.06	0.00	0.00
3	20.00	-1.	42.10	1080.77	0.00	732.82	86.43	0.00	0.00
4	10.00	-1.	43.52	1793.88	0.00	1457.51	186.84	0.00	0.00
5	4.00	-1.	45.11	3012.32	0.00	2183.15	401.80	0.00	0.00
6	2.00	-1.	46.28	4075.91	0.00	2698.89	848.67	0.00	0.00
7	1.00	-1.	48.07	5891.15	0.00	3594.59	2396.49	0.00	0.00
8	0.20	-1.	52.72	11242.94	2136.73	7180.90	6672.41	0.00	0.00
EXP ANNUAL DAMAGE				649.31	7.89	514.53	113.34	0.00	0.00

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++DAMAGE DATA, REACH 010203 FOR PLAN 1 -- EXISTING AND FUTURE CONDITIONS

	FREQ	FLOW	STAGE	RESCON	APTCON	COMCON	INDCON	TOTAL	ACC EAD
1	99.90	-1.	38.01	0.00	0.00	0.00	0.00	0.00	2870.31
2	50.00	-1.	39.82	0.00	0.00	256.66	36.06	509.68	2742.40
3	20.00	-1.	42.10	367.72	0.00	1041.51	437.44	3746.68	2166.29
4	10.00	-1.	43.52	626.97	0.00	2272.40	895.86	7233.46	1658.92
5	4.00	-1.	45.11	1118.35	0.00	4180.21	1937.78	12833.60	1080.63
6	2.00	-1.	46.28	1604.39	0.00	5330.31	3826.82	18384.99	784.07
7	1.00	-1.	48.07	2470.63	0.00	7159.85	12867.42	34380.12	537.55
8	0.20	-1.	52.72	5010.90	377.89	13084.86	27289.43	72996.06	145.99
EXP ANNUAL DAMAGE				237.80	1.70	813.82	531.92	2870.31	

*FREQ	Frequency	*UTL	Utility
*RES	Residential	*RESCON	Residential Contents
*APT	Apartment	*APTCON	Apartment Contents
*COM	Commercial	*ACC EAD	Accumulated Expected Damage
*IND	Industrial		

***** Municipals Not Included

Source: Flood Damage Analysis Pacakage

Table 7

Expected Annual Damages ($1,000)

Reach 020021

++DAMAGE DATA, REACH 020021 FOR PLAN 1 -- EXISTING CONDITIONS

	FREQ	FLOW	STAGE	RES	APT	COM	IND	UTL	MISC
1	99.90	-1.	163.38	0.00	0.00	0.00	0.00	0.00	0.00
2	90.00	-1.	164.04	0.00	0.00	0.00	0.00	0.00	0.00
3	80.00	-1.	164.25	0.00	0.00	0.00	0.00	0.00	0.00
4	60.00	-1.	164.61	0.00	0.00	0.00	0.00	0.00	0.00
5	50.00	-1.	164.79	0.00	0.00	0.00	0.00	0.00	0.00
6	40.00	-1.	165.15	0.00	0.00	0.00	0.00	0.00	0.00
7	30.00	-1.	165.77	0.00	0.00	0.00	0.00	0.00	0.00
8	25.00	-1.	166.16	499.35	0.00	2611.51	0.00	0.00	0.00
9	20.00	-1.	166.56	588.54	0.00	2863.17	0.00	0.00	0.00
10	10.00	-1.	167.62	815.70	0.00	3611.89	0.00	0.00	0.00
11	6.70	-1.	168.23	934.07	0.00	4137.66	0.00	0.00	0.00
12	4.00	-1.	168.99	1116.40	0.00	5603.39	0.00	0.00	0.00
13	3.00	-1.	169.42	1219.98	0.00	8973.49	0.00	0.00	0.00
14	2.00	-1.	170.04	1371.76	0.00	17198.06	0.00	0.00	0.00
15	1.00	-1.	171.14	1576.83	0.00	24584.81	0.00	0.00	0.00
16	0.50	-1.	172.23	1720.84	0.00	32624.67	0.00	0.00	0.00
17	0.20	-1.	173.64	1863.57	0.00	38946.27	0.00	0.00	0.00
18	0.12	-1.	174.39	1935.51	0.00	41989.45	0.00	0.00	0.00
EXP ANNUAL DAMAGE				219.25	0.00	1496.11	0.00	0.00	0.00

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*FREQ	Frequency	*UTL	Utility
*RES	Residential	*RESCON	Residential Contents
*APT	Apartment	*APTCON	Apartment Contents
*COM	Commercial	*ACC EAD	Accumulated Expected Damage
*IND	Industrial		

***** Municipals Not Included

Source: Flood Damage Analysis Pacakage.

Table 7 (con't)

Expected Annual Damages ($1,000)

Reach 020021

++DAMAGE DATA, REACH 020021 FOR PLAN 1 -- EXISTING CONDITIONS

	FREQ	FLOW	STAGE	RESCON	APTCON	COMCON	INDCON	TOTAL	ACC EAD
1	99.90	-1.	163.38	0.00	0.00	0.00	0.00	0.00	4217.21
2	90.00	-1.	164.04	0.00	0.00	0.00	0.00	0.00	4217.21
3	80.00	-1.	164.25	0.00	0.00	0.00	0.00	0.00	4217.21
4	60.00	-1.	164.61	0.00	0.00	0.00	0.00	0.00	4217.21
5	50.00	-1.	164.79	0.00	0.00	0.00	0.00	0.00	4217.21
6	40.00	-1.	165.15	0.00	0.00	0.00	0.00	0.00	4217.21
7	30.00	-1.	165.77	0.00	0.00	0.00	0.00	0.00	4217.21
8	25.00	-1.	166.16	0.00	0.00	3657.16	0.00	6768.03	4085.10
9	20.00	-1.	166.56	207.06	0.00	4078.31	0.00	7737.09	3726.63
10	10.00	-1.	167.62	319.02	0.00	5189.59	0.00	9936.20	2854.81
11	6.70	-1.	168.23	386.61	0.00	5840.31	0.00	11298.64	2506.68
12	4.00	-1.	168.99	484.54	0.00	7191.39	0.00	14395.73	2163.24
13	3.00	-1.	169.42	544.22	0.00	11867.91	0.00	22605.60	1995.90
14	2.00	-1.	170.04	636.93	0.00	23783.02	0.00	42989.77	1675.37
15	1.00	-1.	171.14	787.52	0.00	47856.30	0.00	74805.47	1101.40
16	0.50	-1.	172.23	895.53	0.00	70270.92	0.00	105511.95	658.99
17	0.20	-1.	173.64	987.99	0.00	96554.24	0.00	138352.06	298.96
18	0.12	-1.	174.39	1021.34	0.00	107195.79	0.00	152142.09	182.57
EXP ANNUAL DAMAGE				77.41	0.00	2424.44	0.00	4217.21	

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*FREQ	Frequency	*UTL	Utility
*RES	Residential	*RESCON	Residential Contents
*APT	Apartment	*APTCON	Apartment Contents
*COM	Commercial	*ACC EAD	Accumulated Expected Damage
*IND	Industrial		

***** Municipals Not Included

Source: Flood Damage Analysis Pacakage

Table 8

Expected Annual Damages ($1,000)

Reach 020102

++DAMAGE DATA, REACH 020102 FOR PLAN 1 -- EXISTING CONDITIONS

	FREQ	FLOW	STAGE	RES	APT	COM	IND	UTL	MISC
1	99.90	-1.	173.85	0.00	0.00	0.00	0.00	0.00	0.00
2	90.00	-1.	174.22	0.00	0.00	0.00	0.00	0.00	0.00
3	80.00	-1.	174.35	0.00	0.00	0.00	0.00	0.00	0.00
4	60.00	-1.	174.56	0.00	0.00	0.00	0.00	0.00	0.00
5	50.00	-1.	174.67	0.00	0.00	0.00	0.00	0.00	0.00
6	40.00	-1.	174.93	0.00	0.00	0.00	0.00	0.00	0.00
7	30.00	-1.	175.42	0.00	0.00	0.00	0.00	0.00	0.00
8	25.00	-1.	175.71	0.00	0.00	0.00	0.00	0.00	0.00
9	20.00	-1.	175.99	300.05	0.00	0.00	0.00	0.00	0.00
10	10.00	-1.	176.62	379.08	0.00	0.00	0.00	0.00	0.00
11	6.70	-1.	177.19	518.56	0.00	0.00	0.00	0.00	0.00
12	4.00	-1.	178.00	739.54	0.00	0.00	0.00	0.00	0.00
13	3.00	-1.	178.38	854.25	0.00	0.00	0.00	0.00	0.00
14	2.00	-1.	178.90	1046.10	0.00	0.00	0.00	0.00	0.00
15	1.00	-1.	179.91	1440.59	0.00	0.00	0.00	0.00	0.00
16	0.50	-1.	180.93	1794.23	0.00	0.00	0.00	0.00	0.00
17	0.20	-1.	182.24	2213.55	0.00	0.00	0.00	0.00	0.00
18	0.12	-1.	182.94	2408.18	0.00	0.00	0.00	0.00	0.00
EXP ANNUAL DAMAGE				110.01	0.00	0.00	0.00	0.00	0.00

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*FREQ	Frequency	*UTL	Utility
*RES	Residential	*RESCON	Residential Contents
*APT	Apartment	*APTCON	Apartment Contents
*COM	Commercial	*ACC EAD	Accumulated Expected Damage
*IND	Industrial		

***** Municipals Not Included

Source: Flood Damage Analysis Pacakage.

Table 8 (con't)
Expected Annual Damages ($1,000)
Reach 020102

++DAMAGE DATA, REACH 020102 FOR PLAN 1 -- EXISTING CONDITIONS

	FREQ	FLOW	STAGE	RESCON	APTCON	COMCON	INDCON	TOTAL	ACC EAD
1	99.90	-1.	173.85	0.00	0.00	0.00	0.00	0.00	147.78
2	90.00	-1.	174.22	0.00	0.00	0.00	0.00	0.00	147.78
3	80.00	-1.	174.35	0.00	0.00	0.00	0.00	0.00	147.78
4	60.00	-1.	174.56	0.00	0.00	0.00	0.00	0.00	147.78
5	50.00	-1.	174.67	0.00	0.00	0.00	0.00	0.00	147.78
6	40.00	-1.	174.93	0.00	0.00	0.00	0.00	0.00	147.78
7	30.00	-1.	175.42	0.00	0.00	0.00	0.00	0.00	147.78
8	25.00	-1.	175.71	0.00	0.00	0.00	0.00	0.00	147.78
9	20.00	-1.	175.99	97.22	0.00	0.00	0.00	397.27	147.78
10	10.00	-1.	176.62	118.46	0.00	0.00	0.00	497.54	107.40
11	6.70	-1.	177.19	158.44	0.00	0.00	0.00	676.99	88.36
12	4.00	-1.	178.00	234.80	0.00	0.00	0.00	974.33	66.67
13	3.00	-1.	178.38	279.90	0.00	0.00	0.00	1134.14	56.16
14	2.00	-1.	178.90	362.82	0.00	0.00	0.00	1408.92	43.66
15	1.00	-1.	179.91	557.94	0.00	0.00	0.00	1998.53	26.95
16	0.50	-1.	180.93	774.55	0.00	0.00	0.00	2568.78	15.70
17	0.20	-1.	182.24	1054.73	0.00	0.00	0.00	3268.28	7.06
18	0.12	-1.	182.94	1188.93	0.00	0.00	0.00	3597.11	4.32
EXP ANNUAL DAMAGE				37.77	0.00	0.00	0.00	147.78	

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*FREQ	Frequency	*UTL	Utility
*RES	Residential	*RESCON	Residential Contents
*APT	Apartment	*APTCON	Apartment Contents
*COM	Commercial	*ACC EAD	Accumulated Expected Damage
*IND	Industrial		

***** Municipals Not Included

Source: Flood Damage Analysis Pacakage

Table 9

Expected Annual Damages ($1,000)

Reach 600025

++DAMAGE DATA, REACH 600025 FOR PLAN 1 -- EXISTING CONDITIONS

	FREQ	FLOW	STAGE	RESCON	APTCON	COMCON	INDCON	TOTAL	ACC EAD
1	99.90	-1.	165.31	0.00	0.00	0.00	0.00	0.00	1540.54
2	80.00	-1.	166.51	0.00	0.00	0.00	0.00	0.00	1540.54
3	66.67	-1.	166.83	0.00	0.00	0.00	0.00	0.00	1540.54
4	50.00	-1.	167.23	0.00	0.00	223.73	0.00	313.82	1512.29
5	40.00	-1.	167.66	0.00	0.00	232.28	0.00	341.21	1479.66
6	35.00	-1.	167.99	0.00	0.00	238.92	0.00	362.48	1462.10
7	30.00	-1.	168.39	77.53	0.00	267.24	0.00	715.96	1432.99
8	25.00	-1.	168.86	96.81	0.00	309.15	0.00	854.19	1393.81
9	20.00	-1.	169.38	120.09	0.00	369.36	0.00	1050.76	1346.86
10	10.00	-1.	171.10	240.13	0.00	1022.47	1.91	2592.45	1189.38
11	5.00	-1.	172.67	520.84	0.00	5283.78	6.92	9471.28	918.42
12	4.00	-1.	173.12	621.09	0.00	6824.34	7.21	11884.14	811.91
13	3.00	-1.	173.65	765.04	0.00	8467.71	7.55	14555.07	680.15
14	2.00	-1.	174.33	951.17	0.00	10741.87	7.98	18198.86	518.03
15	1.00	-1.	175.30	1244.09	0.00	14545.82	8.60	24198.09	309.13
16	0.50	-1.	176.28	1609.54	0.00	18121.83	9.24	30117.14	174.55
17	0.20	-1.	177.53	2148.17	0.00	21123.73	10.32	35982.89	76.42
18	0.12	-1.	178.20	2427.20	0.00	22530.13	11.03	38813.15	46.58
EXP ANNUAL DAMAGE				95.73	0.00	833.01	0.69	1540.54	

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*FREQ	Frequency	*UTL	Utility
*RES	Residential	*RESCON	Residential Contents
*APT	Apartment	*APTCON	Apartment Contents
*COM	Commercial	*ACC EAD	Accumulated Expected Damage
*IND	Industrial		

***** Municipals Not Included

Source: Flood Damage Analysis Pacakage

Table 9 (con't)

Expected Annual Damages ($1,000)

Reach 600025

++DAMAGE DATA, REACH 600025 FOR PLAN 1 -- EXISTING CONDITIONS

	FREQ	FLOW	STAGE	RES	APT	COM	IND	UTL	MISC
1	99.90	-1.	165.31	0.00	0.00	0.00	0.00	0.00	0.00
2	80.00	-1.	166.51	0.00	0.00	0.00	0.00	0.00	0.00
3	66.67	-1.	166.83	0.00	0.00	0.00	0.00	0.00	0.00
4	50.00	-1.	167.23	0.00	0.00	90.09	0.00	0.00	0.00
5	40.00	-1.	167.66	0.00	0.00	108.93	0.00	0.00	0.00
6	35.00	-1.	167.99	0.00	0.00	123.56	0.00	0.00	0.00
7	30.00	-1.	168.39	229.59	0.00	141.59	0.00	0.00	0.00
8	25.00	-1.	168.86	285.54	0.00	162.69	0.00	0.00	0.00
9	20.00	-1.	169.38	355.04	0.00	206.23	0.00	0.05	0.00
10	10.00	-1.	171.10	703.47	0.00	623.74	0.00	0.74	0.00
11	5.00	-1.	172.67	1358.16	0.00	2300.13	0.00	1.44	0.00
12	4.00	-1.	173.12	1589.43	0.00	2840.47	0.00	1.60	0.00
13	3.00	-1.	173.65	1929.26	0.00	3383.73	0.00	1.79	0.00
14	2.00	-1.	174.33	2358.69	0.00	4137.08	0.00	2.08	0.00
15	1.00	-1.	175.30	2991.48	0.00	5405.12	0.19	2.78	0.00
16	0.50	-1.	176.28	3694.89	0.00	6675.14	1.35	5.14	0.00
17	0.20	-1.	177.53	4508.96	0.00	8161.70	3.59	26.42	0.00
18	0.12	-1.	178.20	4887.95	0.00	8901.94	5.45	49.45	0.00
EXP ANNUAL DAMAGE				252.09	0.00	358.70	0.02	0.30	0.00

*FREQ	Frequency	*UTL	Utility
*RES	Residential	*RESCON	Residential Contents
*APT	Apartment	*APTCON	Apartment Contents
*COM	Commercial	*ACC EAD	Accumulated Expected Damage
*IND	Industrial		

***** Municipals Not Included

Source: Flood Damage Analysis Pacakage

Table 10

Expected Annual Damages ($1,000)

Reach 600034

++DAMAGE DATA, REACH 600034 FOR PLAN 1 -- EXISTING CONDITIONS

	FREQ	FLOW	STAGE	RES	APT	COM	IND	UTL	MISC
1	99.90	-1.	168.66	0.00	0.00	0.00	0.00	0.00	0.00
2	90.00	-1.	169.87	0.00	0.00	0.00	0.00	0.00	0.00
3	80.00	-1.	170.26	0.00	0.00	0.00	0.00	0.00	0.00
4	66.67	-1.	170.68	0.00	0.00	0.00	0.00	0.00	0.00
5	50.00	-1.	171.20	0.00	0.00	0.00	0.00	0.00	0.00
6	40.00	-1.	171.76	0.00	0.00	0.00	0.00	0.00	0.00
7	30.00	-1.	172.68	906.78	157.44	26.91	0.73	3.02	0.00
8	25.00	-1.	173.23	1193.94	197.79	34.12	1.28	12.50	0.00
9	20.00	-1.	173.80	1585.84	246.15	43.14	1.84	21.22	0.00
10	10.00	-1.	175.21	3359.57	509.71	76.72	3.22	38.59	0.00
11	5.00	-1.	176.55	5932.91	1248.76	141.31	4.07	55.45	0.00
12	4.00	-1.	176.90	6793.95	1457.29	219.63	13.67	58.70	0.00
13	3.00	-1.	177.24	7654.58	1655.99	305.82	24.63	61.66	0.00
14	2.00	-1.	177.70	8876.41	1908.24	437.08	40.32	65.28	0.00
15	1.00	-1.	178.94	12782.77	2416.33	962.37	95.73	72.69	0.00
16	0.50	-1.	180.04	17093.88	3225.93	1575.64	182.68	109.24	0.00
17	0.20	-1.	181.34	23771.42	4862.48	2431.02	375.53	230.72	0.00
18	0.12	-1.	182.01	27916.96	5318.48	2902.59	493.86	273.08	0.00
EXP ANNUAL DAMAGE				1136.09	206.53	47.91	4.14	10.44	0.00

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*FREQ Frequency
*RES Residential
*APT Apartment
*COM Commercial
*IND Industrial
*UTL Utility
*RESCON Residential Contents
*APTCON Apartment Contents
*ACC EAD Accumulated Expected Damage

***** Municipals Not Included

Source: Flood Damage Analysis Pacakage.

Table 10 (con't)

Expected Annual Damages ($1,000)

Reach 600034

++DAMAGE DATA, REACH 600034 FOR PLAN 1 -- EXISTING CONDITIONS

	FREQ	FLOW	STAGE	RESCON	APTCON	COMCON	INDCON	TOTAL	ACC EAD
1	99.90	-1.	168.66	0.00	0.00	0.00	0.00	0.00	2005.23
2	90.00	-1.	169.87	0.00	0.00	0.00	0.00	0.00	2005.23
3	80.00	-1.	170.26	0.00	0.00	0.00	0.00	0.00	2005.23
4	66.67	-1.	170.68	0.00	0.00	0.00	0.00	0.00	2005.23
5	50.00	-1.	171.20	0.00	0.00	0.00	0.00	0.00	2005.23
6	40.00	-1.	171.76	0.00	0.00	0.00	0.00	0.00	2005.23
7	30.00	-1.	172.68	337.06	42.14	73.75	3.22	1551.04	1912.24
8	25.00	-1.	173.23	435.39	49.61	89.48	3.39	2017.51	1823.20
9	20.00	-1.	173.80	566.45	57.36	106.38	3.57	2631.94	1709.25
10	10.00	-1.	175.21	1173.35	139.12	147.57	4.45	5452.32	1336.03
11	5.00	-1.	176.55	2152.27	542.05	230.60	5.75	10313.18	962.93
12	4.00	-1.	176.90	2490.22	667.91	321.97	45.27	12068.62	851.29
13	3.00	-1.	177.24	2828.52	789.09	421.89	90.45	13832.64	721.97
14	2.00	-1.	177.70	3308.34	931.61	607.36	160.67	16335.31	572.74
15	1.00	-1.	178.94	4827.77	1092.28	1748.80	427.54	24426.29	376.32
16	0.50	-1.	180.04	6475.32	1337.97	3226.68	745.97	33973.32	234.36
17	0.20	-1.	181.34	9064.81	2038.64	5177.59	1702.01	49654.21	113.49
18	0.12	-1.	182.01	10788.19	2425.59	6172.43	2407.31	58698.50	70.44
EXP ANNUAL DAMAGE				414.02	76.80	92.81	16.48	2005.23	

*FREQ	Frequency	*UTL	Utility
*RES	Residential	*RESCON	Residential Contents
*APT	Apartment	*APTCON	Apartment Contents
*COM	Commercial	*ACC EAD	Accumulated Expected Damage
*IND	Industrial		

***** Municipals Not Included

Source: Flood Damage Analysis Pacakage

Table 11

Expected Annual Damages ($1,000)

Reach 600042

++DAMAGE DATA, REACH 600042 FOR PLAN 1 -- EXISTING CONDITIONS

	FREQ	FLOW	STAGE	RES	APT	COM	IND	UTL	MISC
1	99.90	-1.	169.92	0.00	0.00	0.00	0.00	0.00	0.00
2	90.00	-1.	171.26	0.00	0.00	0.00	0.00	0.00	0.00
3	80.00	-1.	171.69	0.00	0.00	0.00	0.00	0.00	0.00
4	66.67	-1.	172.16	0.00	0.00	0.00	0.00	0.00	0.00
5	50.00	-1.	172.74	577.05	0.00	0.00	0.00	0.00	0.00
6	40.00	-1.	173.32	776.11	0.00	0.00	0.00	0.00	0.00
7	30.00	-1.	174.29	1258.33	0.00	103.42	0.00	0.00	0.00
8	25.00	-1.	174.90	1663.18	0.00	125.37	0.00	0.00	0.00
9	20.00	-1.	175.58	2309.51	0.00	228.12	0.00	0.00	0.00
10	10.00	-1.	177.70	5276.14	0.00	1032.22	0.00	0.00	0.00
11	5.00	-1.	179.28	8732.31	0.00	2392.09	0.00	0.00	0.00
12	4.00	-1.	179.69	9765.75	0.00	2754.15	0.00	0.00	0.00
13	3.00	-1.	180.14	10952.18	0.00	3222.00	0.00	0.00	0.00
14	2.00	-1.	180.71	12527.90	0.00	3897.83	0.00	0.00	0.00
15	1.00	-1.	181.72	15660.51	0.00	5021.84	0.00	0.00	0.00
16	0.50	-1.	182.49	18720.98	0.00	5843.31	0.00	0.00	0.00
17	0.20	-1.	183.32	22516.55	0.00	6681.13	0.00	0.00	0.00
18	0.12	-1.	183.73	24526.70	0.00	7072.82	491.23	12.47	0.00
EXP ANNUAL DAMAGE				1707.63	0.00	342.64	0.59	0.01	0.00

*FREQ	Frequency	*UTL	Utility
*RES	Residential	*RESCON	Residential Contents
*APT	Apartment	*APTCON	Apartment Contents
*COM	Commercial	*ACC EAD	Accumulated Expected Damage
*IND	Industrial		

***** Municipals Not Included

Source: Flood Damage Analysis Pacakage

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Table 11 (con't)

Expected Annual Damages ($1,000)

Reach 600042

++DAMAGE DATA, REACH 600042 FOR PLAN 1 -- EXISTING CONDITIONS

	FREQ	FLOW	STAGE	RESCON	APTCON	COMCON	INDCON	TOTAL	ACC EAD
1	99.90	-1.	169.92	0.00	0.00	0.00	0.00	0.00	3372.60
2	90.00	-1.	171.26	0.00	0.00	0.00	0.00	0.00	3372.60
3	80.00	-1.	171.69	0.00	0.00	0.00	0.00	0.00	3372.60
4	66.67	-1.	172.16	0.00	0.00	0.00	0.00	0.00	3372.60
5	50.00	-1.	172.74	0.00	0.00	0.00	0.00	577.05	3338.32
6	40.00	-1.	173.32	0.00	0.00	0.00	0.00	776.11	3272.45
7	30.00	-1.	174.29	434.61	0.00	109.47	0.00	1905.83	3159.36
8	25.00	-1.	174.90	563.23	0.00	153.74	0.00	2505.52	3049.47
9	20.00	-1.	175.58	787.07	0.00	289.67	0.00	3614.37	2897.46
10	10.00	-1.	177.70	1943.59	0.00	1725.35	0.00	9977.31	2297.67
11	5.00	-1.	179.28	3521.78	0.00	5058.04	0.00	19704.22	1588.99
12	4.00	-1.	179.69	4035.44	0.00	6121.85	0.00	22677.18	1377.25
13	3.00	-1.	180.14	4634.20	0.00	7464.67	0.00	26273.05	1133.80
14	2.00	-1.	180.71	5438.88	0.00	9374.86	0.00	31239.47	847.77
15	1.00	-1.	181.72	6967.96	0.00	12652.13	0.00	40302.44	494.62
16	0.50	-1.	182.49	8317.70	0.00	15006.27	0.00	47888.27	275.98
17	0.20	-1.	183.32	9915.18	0.00	17327.28	0.00	56440.14	121.13
18	0.12	-1.	183.73	10743.34	0.00	18380.82	754.51	61981.89	74.38
EXP ANNUAL DAMAGE				602.80	0.00	718.02	0.91	3372.60	

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*FREQ	Frequency	*UTL	Utility
*RES	Residential	*RESCON	Residential Contents
*APT	Apartment	*APTCON	Apartment Contents
*COM	Commercial	*ACC EAD	Accumulated Expected Damage
*IND	Industrial		

***** Municipals Not Included

rce: Flood Damage Analysis Pacakage

TABLE 12

BASE YEAR WITHOUT PROJECT CONDITION
IMPACT OF FUTURE HYDROLOGY ($1,000 DOLLARS)
OCTOBER 1994 PRICE AT 7-3/4% INTEREST RATE

BASIN	EAD	2009	2040	AAED
LOWER PASSAIC	$49,164	$52,628,800	$65,131,900	$60,174,400
CENTRAL PASAIC	$33,501	$34,787,800	$39,053,100	$35,712,300
POMPTON RIVER	$28,582	$30,426,000	$33,347,300	$31,504,900
LOWER RAMAPO RIVER	$3,952	$4,147,400	$4,548,800	$4,293,300
WANAQUE RIVER	$613	$647,600	$715,800	$672,700
PEQUANNOCK RIVER	$204	$217,200	$242,700	$218,300
TOTAL	$116,016	$122,854,800	$143,039,600	$132,575,900

TABLE 13
FLOOD DAMAGES WITH AND WITHOUT PROJECT CONDITIONS
OCTOBER 1994 PRICE LEVELS AT 7-3/4% INTEREST RATE

BASIN	WITHOUT PLAN AAED	WITH PLAN AAED	AAEB	PERCENT DAMAGE REDUCTION
LOWER PASSAIC	$60,174,400	$7,784,600	$52,387,800	87
CENTRAL PASSAIC	$35,712,300	$6,326,400	$29,385,900	82
POMPTON RIVER	$31,504,900	$405,300	$31,099,600	99
LOWER RAMAPO RIVER	$4,293,300	$126,500	$4,166,800	97
WANAQUE RIVER	$672,700	$143,200	$529,500	79
PEQUANNOCK RIVER	$218,300	$0	$218,300	100
TOTAL	$132,575,900	$14,786,000	$117,787,900	89

AAED – Average annual equivalent damages

AAEB – Average annual equivalent benefits

TABLE 14
SUMMARY OF AFFLUENCE FACTORS

BASIN	CV/SV	AFFLUENCE FACTOR
LOWER PASSAIC	35.4%	1.57
CENTRAL PASSAIC	35.6%	1.62
POMPTON RIVER	34.0%	1.62
LOWER RAMAPO RIVER	33.9%	1.64
WANAQUE RIVER	33.6%	1.64
PEQUANNOCK RIVER	34.3%	1.64

CV/SV = CONTENT VALUE TO STRUCTURE VALUE RATIO

TABLE 15
RESIDENTIAL INTENSIFICATION BENEFITS
OCTOBER 1994 PRICE LEVELS AT 7-3/4% INTEREST RATE

	LOWER VALLEY	CENTRAL BASIN	POMPTON BASIN
AVERAGE FLOOD HAZARD AREA RESIDENTIAL MARKET VALUES (WITHOUT PROJECT CONDITIONS)	$126,000	$178,800	$137,700
PERCENT INCREASE IN MARKET VALUE DUE TO REDUCTION OF FLOOD HAZARD	38%	37%	32%
AVERAGE RESIDENTIAL MARKET VALUES WITH REDUCTION OF FLOOD HAZARD (WITH PROJECT CONDITIONS)	$173,900	$244,900	$181,700
AVERAGE RESIDENTIAL BASEMENT VALUES (6% OF MV)			
W/ FLOOD HAZARD	$10,434	$14,694	$10,902
W/O FLOOD HAZARD	$7,560	$10,728	$8,262
NET INCREASE IN BASEMENT VALUE DUE TO REDUCTION IN FLOOD HAZARD	$2,874	$3,966	$2,640
AVERAGE ANNUAL BENEFITS PER RESIDENTIAL STRUCTURES	$200	$276	$184
NUMBER STRUCTURES	897	569	1,000
TOTAL ANNUAL BENEFITS	$179,400	$157,000	$184,000

TABLE 16

ADDITIONAL VEHICULAR OPERATING COSTS ASSOCIATED
WITH INUNDATED ROADWAY (100 YR EVENT)
JUNE 1993 PRICE LEVEL AT 7-3/4% INTEREST RATE

Location	Route 46 at Two Bridges Rd. to Route 23 and I-80 Interchange in Wayne, N.J.	
Flood Depth	4.8	feet
Duration Depth Exceeds an Elevation 1 Foot Above Roadway	120	hours
Average Annual Daily Traffic (AADT)	60,860	
A.A.D.T. per hour	2,500	
Total Vehicles Affected	300,000	
Automobiles	200,000	
Trucks	100,000	
Original Route Mileage	24.2	miles
Alternate Route Mileage	29.8	miles
Additional Mileage per Vehicle	5.6	miles
Total Additional Mileage		
Automobiles	1,120,000	miles
Trucks	560,000	miles
Total Additional Operating Costs		
Automobiles ($0.30/mile)	$336,000	
Trucks ($0.40/mile)	$224,000	
TOTAL ADDITIONAL OPERATING COSTS TO ALL VEHICLES	$560,000	

TABLE 17

DELAY COSTS ASSOCIATED WITH
INUNDATED ROADWAY (100 YR EVENT)
OCTOBER 1994 PRICE LEVEL At 7-3/4% INTEREST RATE

Location Route 46 at Two Bridges Rd. to
Route 23 and I-80 Interchange in Wayne, N.J.

Total Vehicles Affected	78,265	
Automobiles	64,177	
Trucks	14,088	
Original Route Mileage	24.2	miles
Total Travel Time on Original Route		
Automobiles	34,500	hours
Trucks	7,600	hours
Alternate Route Mileage	29.8	miles
Total Travel Time on Alternate Route		
Automobiles	191,200	hours
Trucks	42,000	hours
Additional Travel Time		
Automobiles	156,700	hours
Trucks	34,400	hours
TOTAL DELAY COSTS		
Automobiles		
($8.88/person-hour * 2 persons/vehicle	$2,783,000	
* 2 persons/vehicle)	$468,200	
TOTAL DELAY COST TO ALL VEHICLES	$3,251,200	

TABLE 18
Additional Recreational Paths

Levee/Floodway System	**Linear Feet**	**Miles**
Lower Valley System		
Lister	2,200	.4
Central Basin System		
Pequannock/Ramapo	4,435	.8
Passaic 2A	19,000	3.6
Rockaway 1	4,040	.8
Rockaway 2	3,272	.6
Rockaway 3	8,032	1.5
Total	40,979	7.7

TABLE 19

Recreational Justification
Value Per Linear Mile

	Walking	Hiking	Jogging	Bicycling
Persons	50	25	35	25
Tunover/Day	x3	x3	x8	x10
People/Day	150	75	280	250
Capacity Days/Week	x4	x4	x3	x 3
people/Week	600	300	840	750
Weeks/Year	x26	x26	x26	x26
Recr. Days/Year/Mile	15,600	7,800	21,840	19,500

Table 20

Unit Day Values and Points For General Recreation Judgement Factors

Points for the existing recreational resources follow:

Criteria	Lower Valley	Central Basin
(a) Recreation experience [1/] Total points: 30 Point value:	Several General Activities [2/] Normal & Common 9 Points	Fishing is available but parks are small. [3/] 12 Points
(b) Availability of opportunity [4/] Total points: 18 Point value:	Several within 1 hr travel time, but relatively inaccessible except by car. 2 Points	Many alternative sites nearby. 1 Point
(c) Carrying capacity [5/] Total points: 14 Point value:	Basic facilities are available 4 Points	No sanitary facilities 2 Points
(d) Accessibility Total points: 18 Point value:	Access is limited by the number of parking spaces. 2 Points	Very limited parking areas. 2 Points
(e) Environmental quality [6/] Total points: 20 Point value:	Water pollution and visible flotsam Air pollution. [7/] Dioxin in sediments. 1 Point	Above average aesthetic quality. 8 Points
Total Points	Total Points 18 = $3.19/unit day	Total Points 25 = $3.56/unit day

Footnotes for Table 20 Con't

1/ Value for water-oriented activities should be adjusted if significant seasonal water level changes occur.

2/ General activities include those that are common to the region and that are usually of normal quality. This includes picnicking, camping, hiking, riding, cycling, and fishing and hunting of normal quality.

3/ High quality value activities include those that are not common to the region and/or nation and that are usually of high quality.

4/ Likelihood of success at fishing and hunting.

5/ Value should be adjusted for overuse.

6/ Major esthetic qualities to be considered include geology and topography, water, and vegetation.

7/ Factors to be considered to lower quality include air and water pollution, pests, poor climate, and unsightly adjacent areas.

Table 21

Per Mile Summary of Recreational Days
And Unit Values In the Lower Valley and Central Basin

Lower Valley

Activity Value/Mile	Recreational Days		Unit Value		Total
Walking	15,600	x	$3.19	=	$ 49,800
Hiking	7,800	x	$3.19	=	$ 24,880
Jogging	21,840	x	$3.19	=	$ 69,670
Bicycling	19,500	x	$3.19	=	$ 62,200
Total/Mile	64,700				$206,550

Central Basin

Activity Value/Mile	Recreational Days		Unit Value		Total
Walking	15,600	x	$3.56	=	$ 55,500
Hiking	7,800	x	$3.56	=	$ 27,770
Jogging	21,840	x	$3.56	=	$ 77,750
Bicycling	19,500	x	$3.56	=	$ 69,420
Total/Mile	64,740				$230,440

Table 22
Recreation Benefit Calculations

With Project Conditions

Lower Valley	.4	x	$206,550	=	$ 82,620
Central Basin	7.3	x	$230,440	=	$1,682,200
Total Lower Valley and Central Basin					$1,764,820
Total Benefits					$1,764,800

TABLE 23
EXISTING MARINA DATA

MARINA	SLIPS (MOORINGS)	RAMPS	AVERAGE # BOATS WEEKDAY	AVERAGE # BOATS WEEKEND DAY
ELCO MARINA	100	0	20	50
PASSAIC RIVER YACHT CLUB	0 (28)	1	1	6

TABLE 24

ANNUAL INDUCED DAMAGES (AAE)
OCTOBER 1994 PRICE LEVEL AT 7-3/4% INTEREST RATE

DAMAGE REACH	TOTAL INDUCED DAMAGES	INDUCED DAMAGES ELIMINATED	INDUCED DAMAGES NOT ELIMINATED
020086	$1,100	$0	$1,100
020091	$800	$0	$800
020092	$91,500	$20,400	$71,100
020093	$76,900	$22,100	$54,800
020094	$67,200	$22,500	$44,700
020095	$23,700	$3,500	$20,200
020101	$4,600	$0	$4,600
020102	$22,900	$16,100	$6,800
020103	$4,200	$0	$4,200
020141	$19,100	$0	$19,100
020142	$200	$0	$200
020144	$50,300	$50,300	$0
020146	$14,100	$0	$14,100
020148	$10,600	$0	$10,600
TOTAL	$387,200	$134,900	$252,300

TABLE 25

BENEFIT SUMMARY
OCTOBER 1994 PRICE AT 7-3/4% INTEREST RATE

BENEFIT CATEGORIES	BENEFITS($)
INUNDATION REDUCTION	$117,819,100
TUNNEL/CHANNEL	$83,344,300
LEVEES/FLOODWALLS	$8,315,300
TIDAL LEVEE/FLOODWALLS	$23,566,700
PRESERVATION	$2,592,800
BENFITS IN ADVANCE OF THE BASE YEAR	$39,135,200
TUNNEL/CHANNEL	$19,093,400
LEVEES	$17,620,100
PRESERVATION	$2,421,700
TOTAL BENEFITS FROM INUNDATION REDUCTION	$156,954,300
OTHER BENEFITS	$17,223,000
AFFLUENCE	$3,697,200
F/A COST REDUCTION	$890,900
TRAFFIC FLOW	$1,666,700
RESIDENTIAL INTENSIFICATION	$520,400
INDUSTRIAL CONTENT	$8,683,000
RECREATION	$1,764,800
RESIDUAL INDUCED	$252,300
TOTAL ANNUAL BENEFITS	$173,925,000
ANNUAL COST	$127,295,000
BENEFIT TO COST RATIO	1.4 to 1
NET BENEFITS	$46,630,000

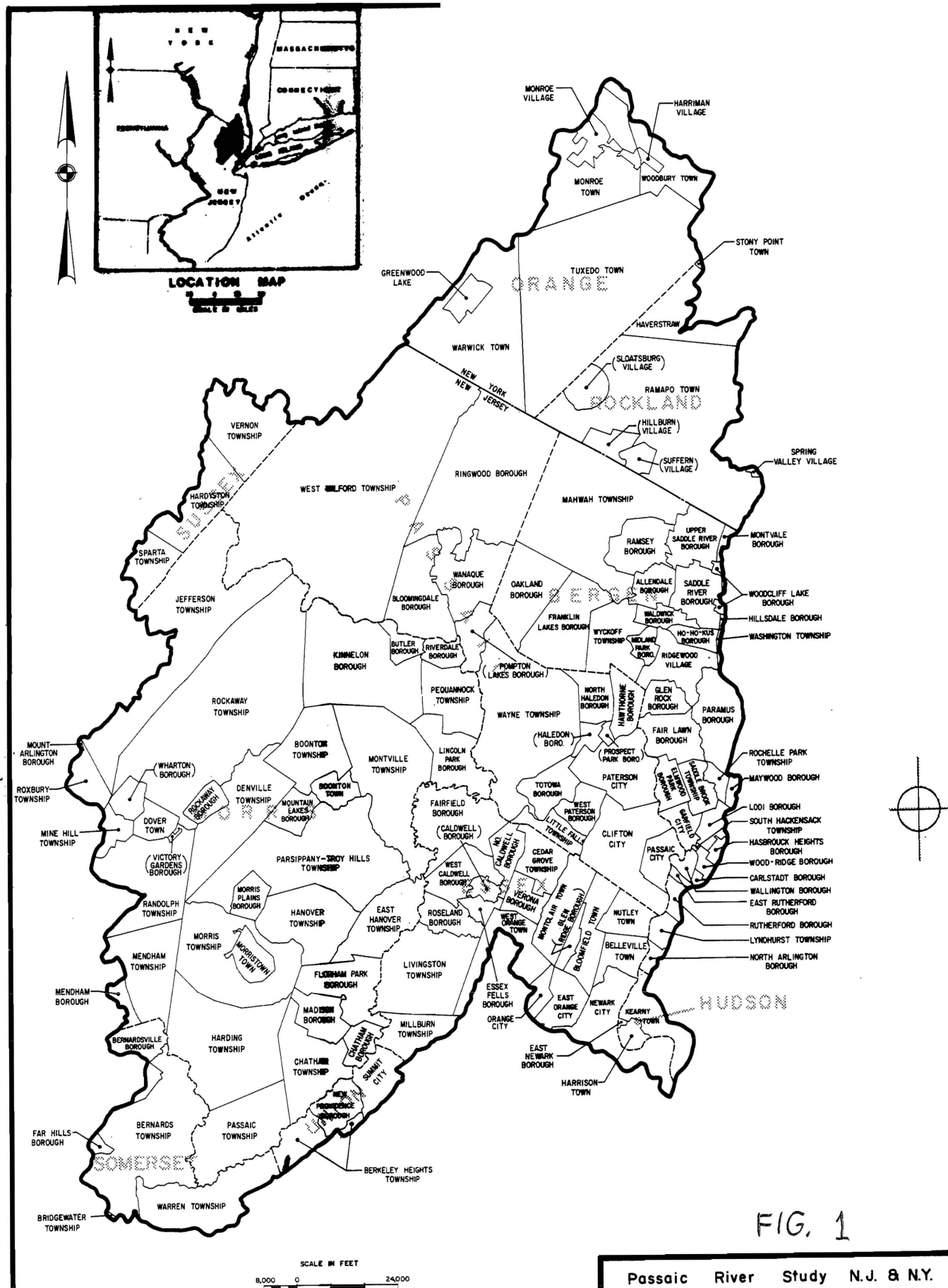
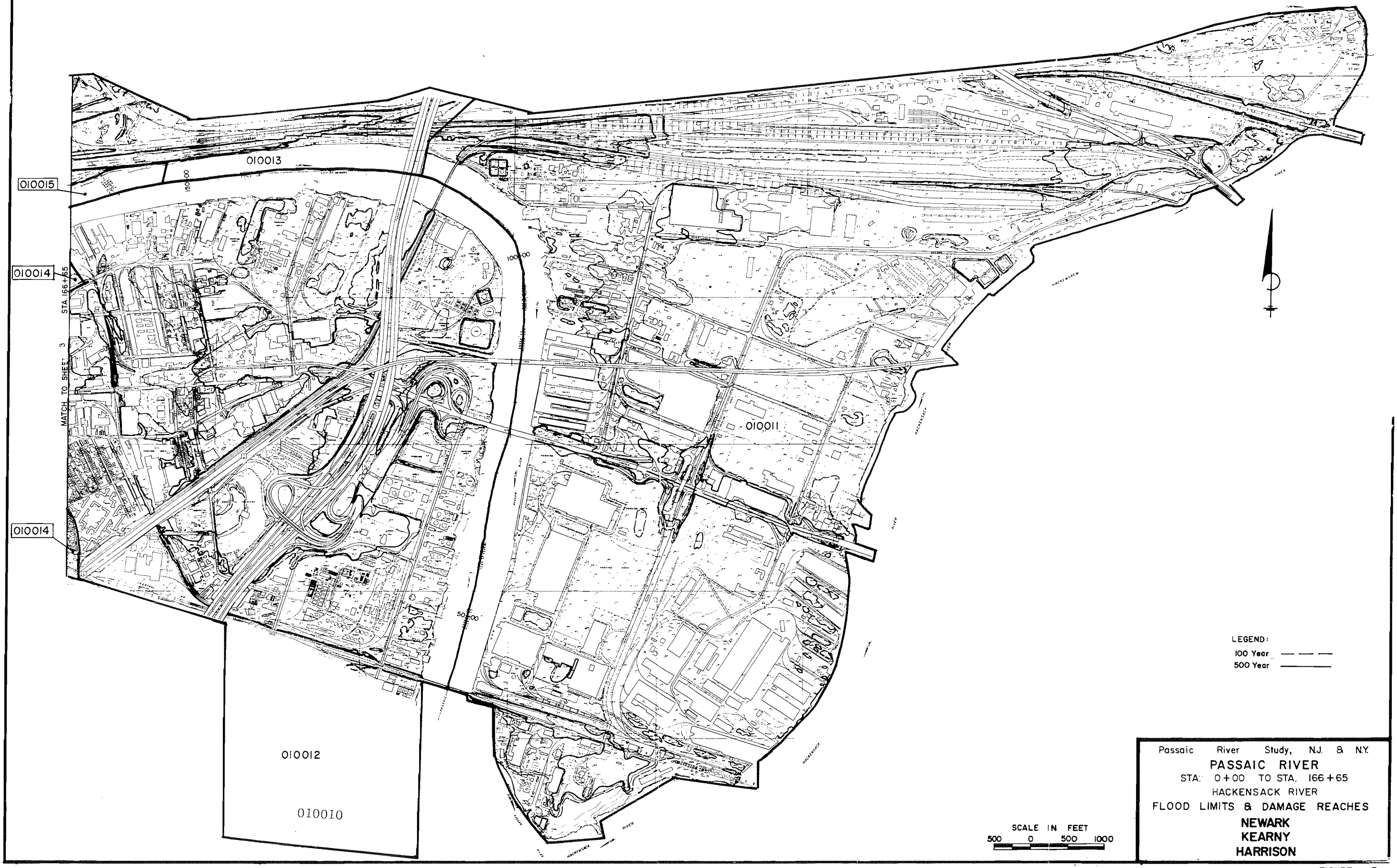


FIG. 1

Passaic River Study N.J. & N.Y.

COUNTIES AND MUNICIPALITIES



Passaic River Study, N.J. & N.Y.

PASSAIC RIVER

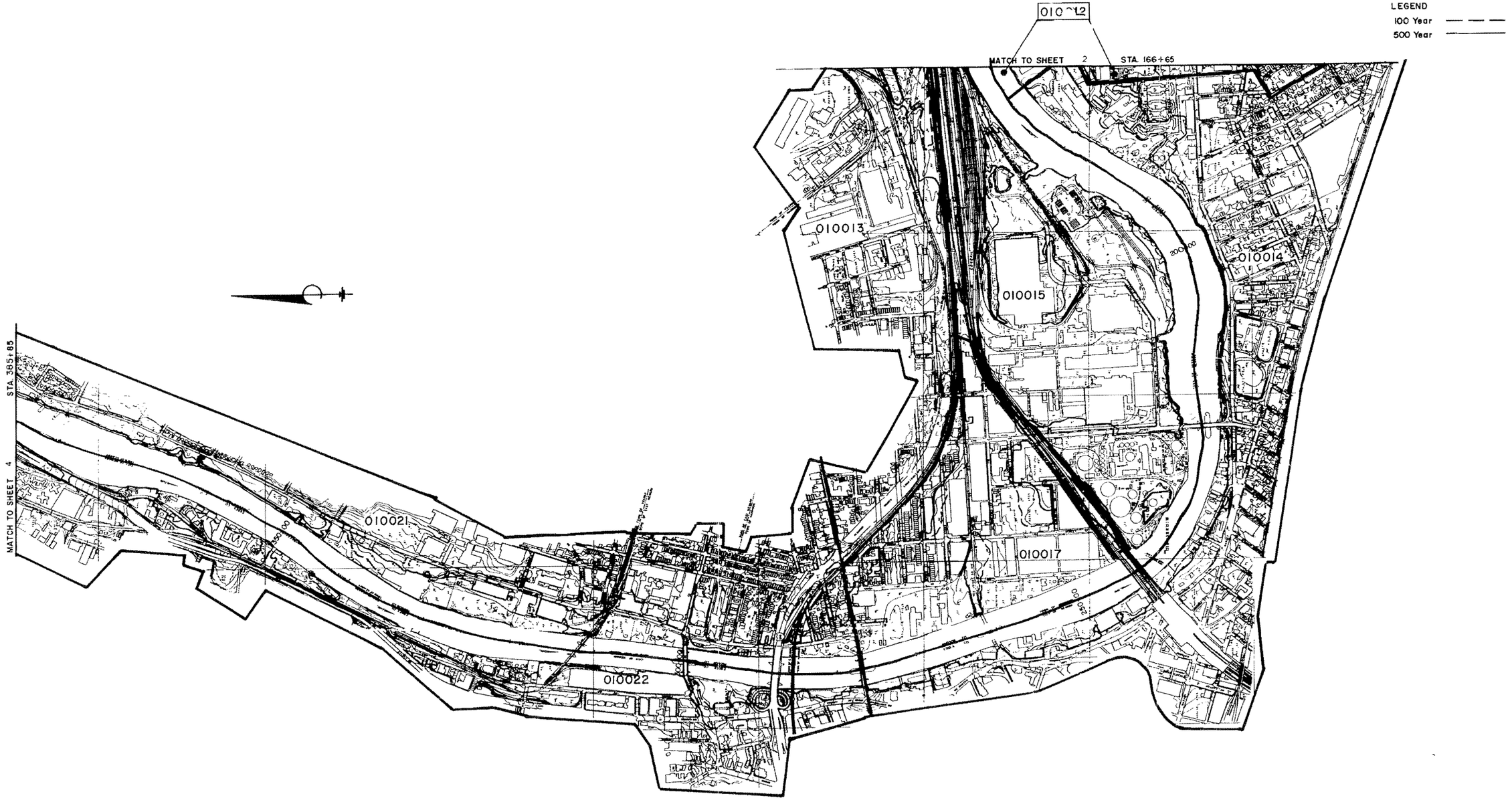
STA. 0+00 TO STA. 166+65

HACKENSACK RIVER

FLOOD LIMITS & DAMAGE REACHES

NEWARK
KEARNY
HARRISON

FIGURE 2



Passaic River Study, N.J. & N.Y.

PASSAIC RIVER

STA. 166+65 TO STA. 385+85

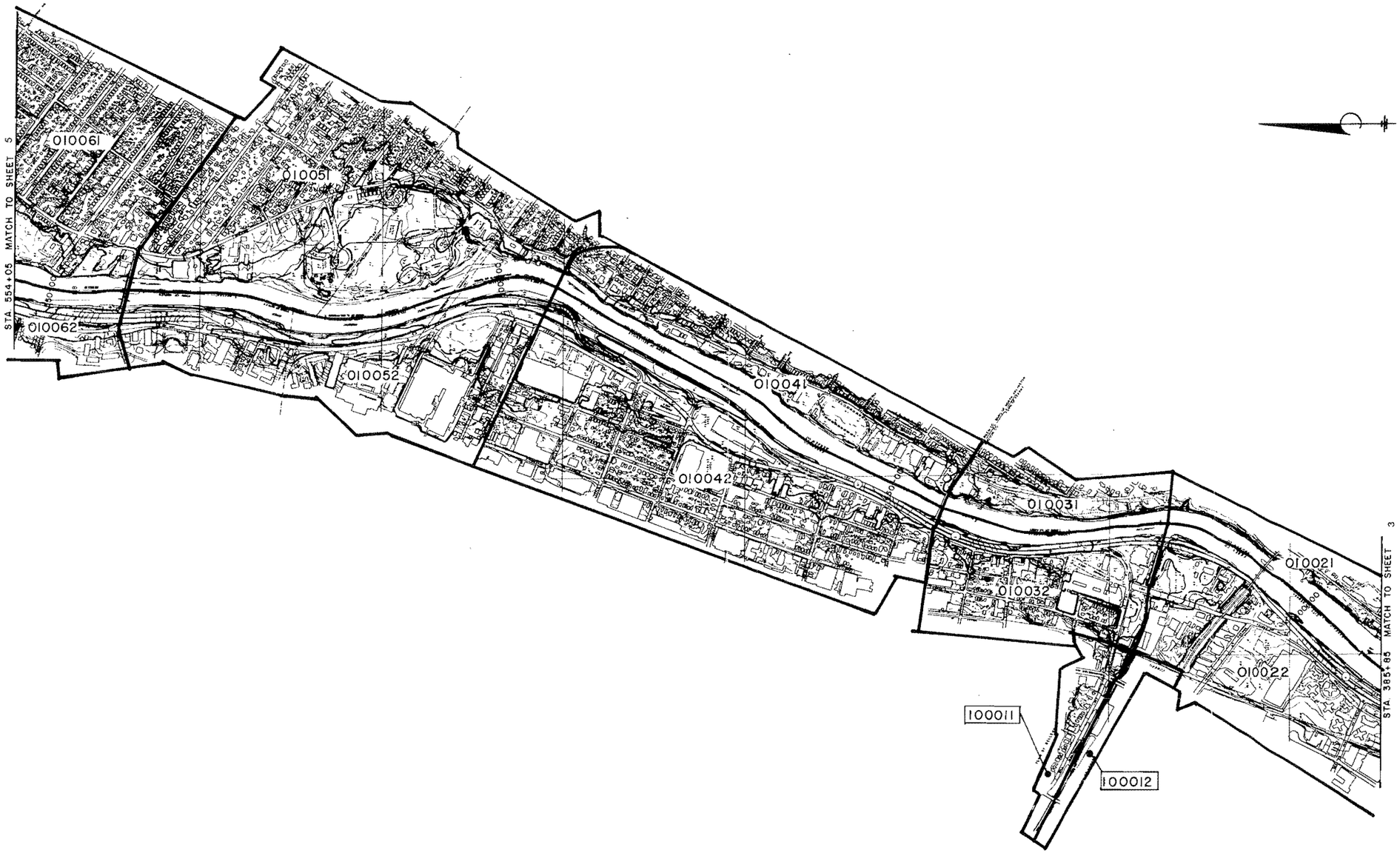
FLOOD LIMITS & DAMAGE REACHES

NEWARK **KEARNY**

HARRISON **EAST NEWARK**

FIGURE 3

LEGEND:
100 Year — — —
500 Year ———



SCALE IN FEET
500 0 500 1000

Passaic River Study, N.J. & N.Y.
PASSAIC RIVER
STA. 385+85 TO STA. 554+05
FLOOD LIMITS & DAMAGE REACHES

NEWARK	KEARNY
BELLEVILLE	NORTH ARLINGTON
NUTLEY	LYNDHURST

FIGURE 4

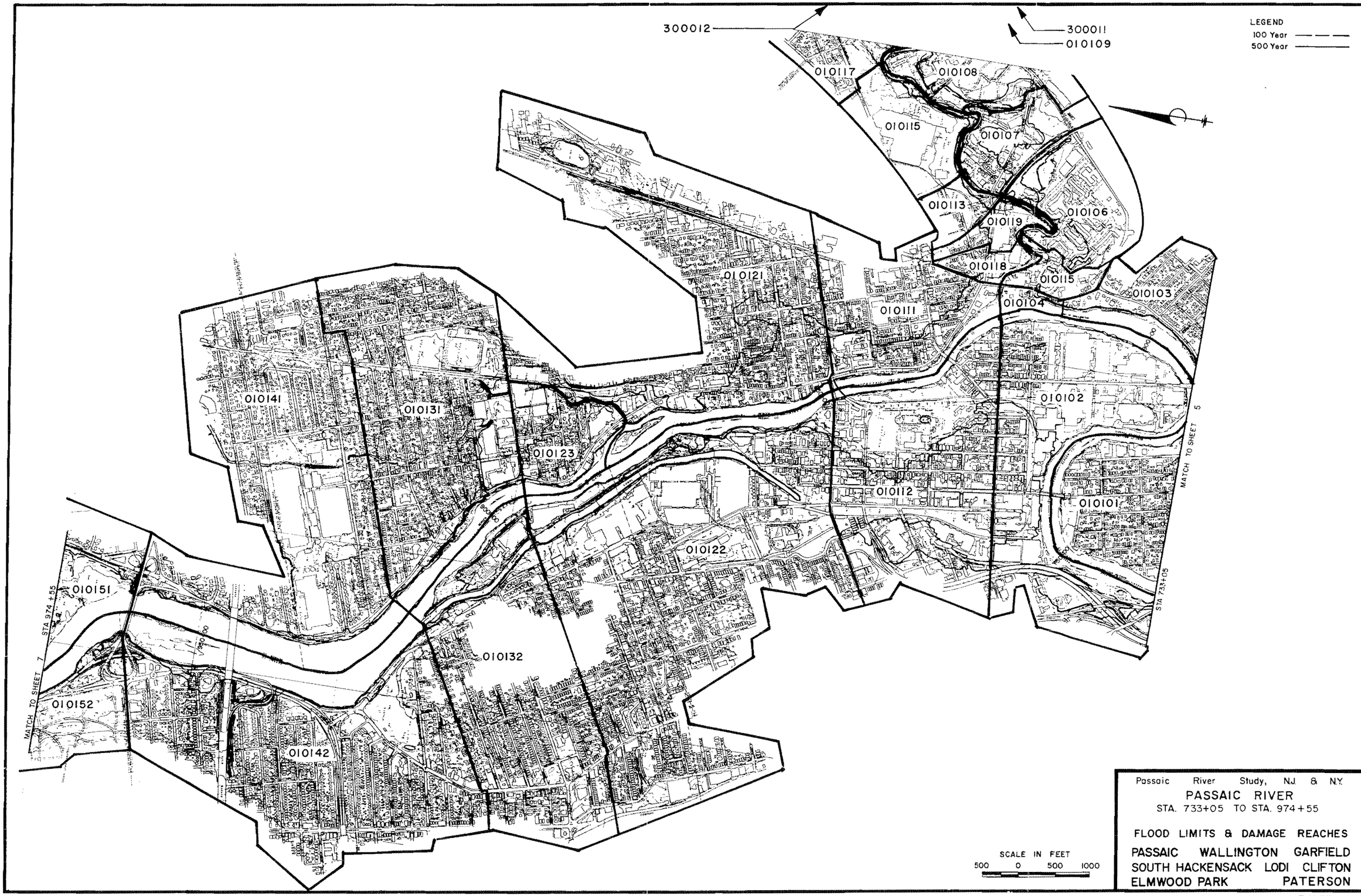
LEGEND:
100 Year — — —
500 Year ———

010103
010101
010102
01009
010092
010102
010081
010082
010071
010072
010061
010062
20001
MATCH TO SHEET 9 STA 733+05
MATCH TO SHEET 4 STA 554+05

SCALE IN FEET
500 0 500 1000

Passaic River Study, N.J. & N.Y.
PASSAIC RIVER
STA. 554+05 TO STA. 733+05
FLOOD LIMITS & DAMAGE REACHES
EAST RUTHERFORD
NUTLEY LYNDHURST RUTHERFORD
PASSAIC CLIFTON WALLINGTON

FIGURE 5



Passaic River Study, N.J. & N.Y.

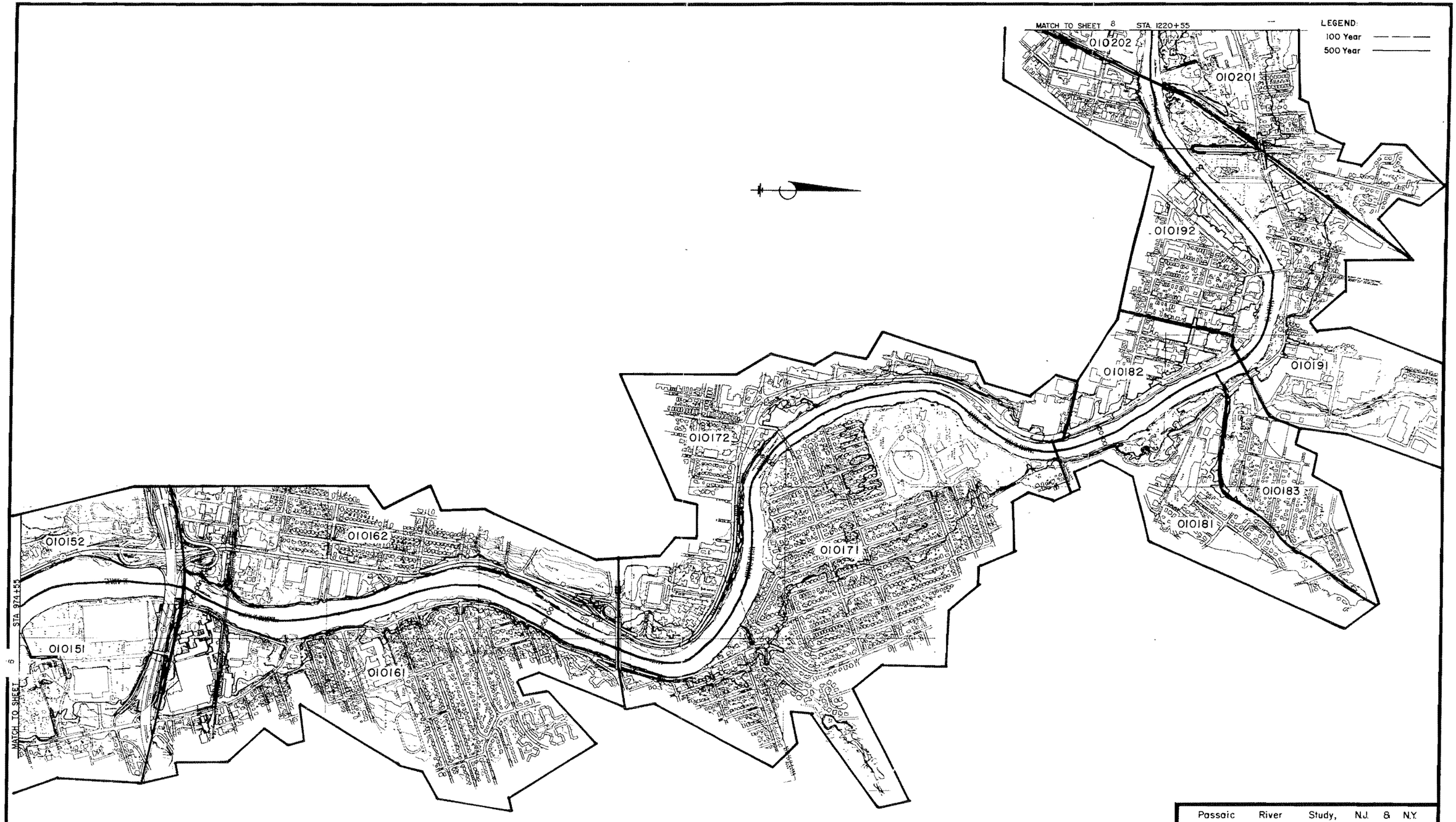
PASSAIC RIVER

STA. 733+05 TO STA. 974+55

FLOOD LIMITS & DAMAGE REACHES

PASSAIC WALLINGTON GARFIELD
SOUTH HACKENSACK LODI CLIFTON
ELMWOOD PARK PATERSON

FIGURE 6



Passaic River Study, N.J. & N.Y.

PASSAIC RIVER

STA. 974+55 TO STA. 1220+55

FLOOD LIMITS & DAMAGE REACHES

PATERSON **ELMWOOD PARK**

FAIRLAWN **HAWTHORNE**

FIGURE NO. 7

LEGEND:
100 Year ——— ——
500 Year ————

400100
400091
400082
400072
400092
400062
400081
400042
400052
400032
400061
400041
400071
400031
400051
400022
400012
400011
400021
010223
010221
010201
010203
010211
010202
010222
010212

MATCH TO SHEET V-14 STA. 1220+55

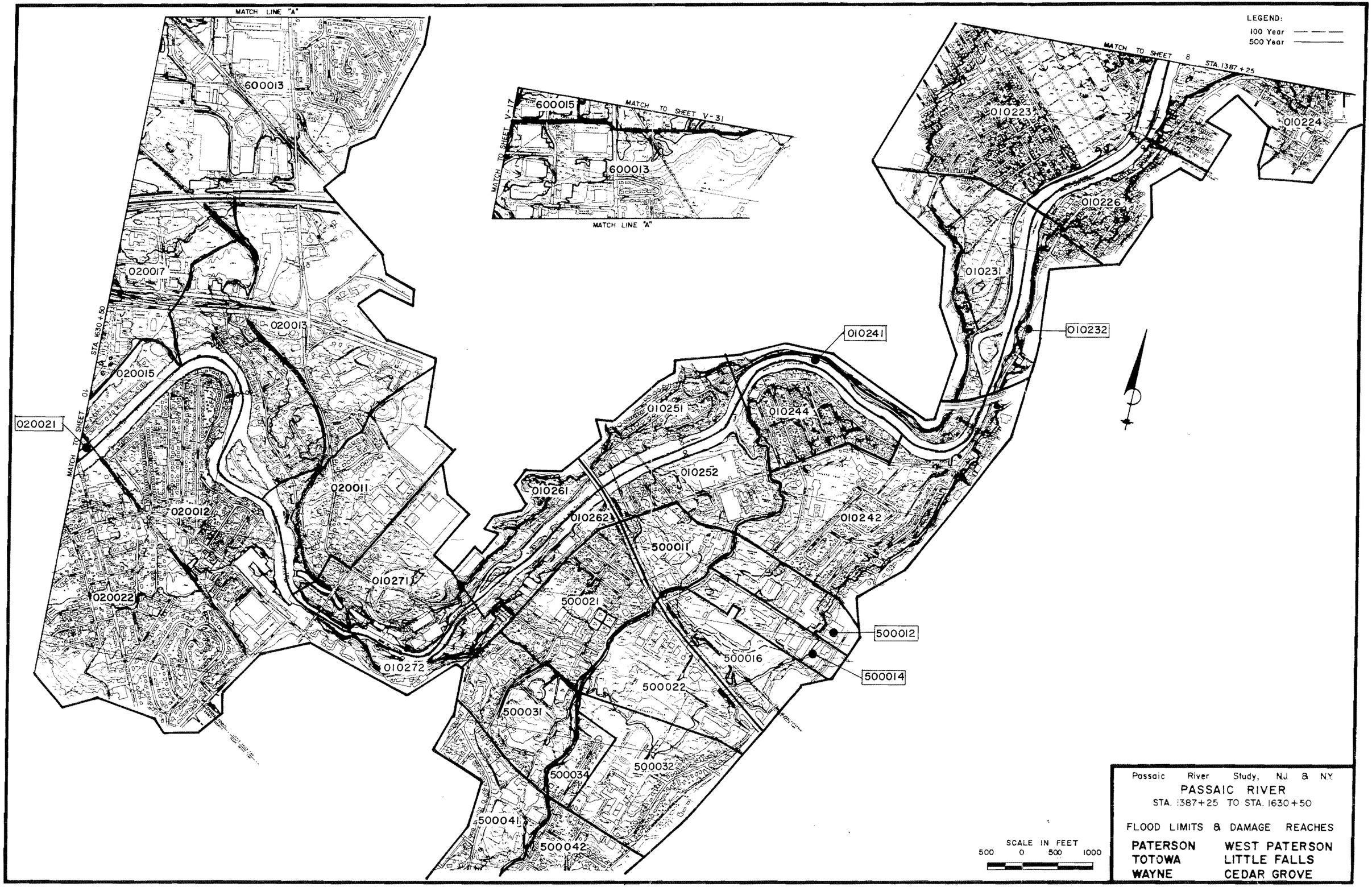
MATCH TO SHEET V-6 STA. 1387+25

SCALE IN FEET
500 0 500 1000

Passaic River Study, N.J. & N.Y.
PASSAIC RIVER
STA. 1220+55 TO STA. 1387+25

FLOOD LIMITS & DAMAGE REACHES
PATERSON
HAWTHORNE TOTOWA
PROSPECT PARK HALEDON

FIGURE NO. 8



Passaic River Study, NJ & N.Y.

PASSAIC RIVER

STA. 1387+25 TO STA. 1630+50

FLOOD LIMITS & DAMAGE REACHES

PATERSON	WEST PATERSON
TOTOWA	LITTLE FALLS
WAYNE	CEDAR GROVE

FIGURE NO. 9

MATCH TO SHEET V-31 STA.59+10

MATCH TO SHEET V-35 STA. 1845+35

MATCH TO SHEET V-35

MATCH TO SHEET 9 STA. 1630+50

MATCH TO SHEET V-35

600017
600014
600012
600018
600011
600016
600013
020040
020031
020032
020017
020029
020015
020021
020034
020036
020030
020038
020024
020022

LEGEND
100 Year
500 Year

SCALE IN FEET
500 0 500 1000

Passaic River Study, N.J. & N.Y.
PASSAIC RIVER
STA. 1630+50 TO STA. 1845+35
POMPTON RIVER
FLOOD LIMITS & DAMAGE REACHES
LITTLE FALLS
CEDAR GROVE
NORTH CALDWELL
LINCOLN PARK
FAIRFIELD
WAYNE

FIGURE NO. 10

MATCH LINE "A"

020040

MATCH LINE "A"

LEGEND

100 Year — — —

500 Year ———

2000+00

2000+00

1800+00

020040

020041

2150+00

020034

020052

020038

MATCH TO SHEET 10 STA 1845+35

MATCH TO SHEET 12 STA 2192+95

MATCH TO SHEET V-35

SCALE IN FEET

500 0 500 1000

Passaic River Study, N.J. & N.Y.

PASSAIC RIVER

STA. 1845+35 TO STA. 2192+95

FLOOD LIMITS & DAMAGE REACHES

FAIRFIELD
MONTVILLE
LINCOLN PARK

FIGURE 11

MATCH TO SHEET 30

MATCH TO SHEET V-29

STA. 169+10

STA 42+20

MATCH TO SHEET 13

STA 2453+55

MATCH TO SHEET 29

MATCH TO SHEET V-35

MATCH TO SHEET V-18

STA 2192+95

020121
020122
020082
020084
020086
020092
020093
020095
020091
020081
020071
020072
020062
020061
020051
020043
020040
020046
020044
020048
020054
020058

LEGEND

100 Year — — — —

500 Year ————

SCALE IN FEET

500 0 500 1000

Passaic River Study, N.J. & N.Y.

PASSAIC RIVER

STA. 2192+95 TO STA. 2453+55

ROCKAWAY RIVER & WHIPPANY RIVER

FLOOD LIMITS & DAMAGE REACHES

PARSIPPANY TROY-HILLS

WEST CALDWELL EAST HANOVER

FAIRFIELD MONTVILLE

FIGURE NO. 12

MATCH TO SHEET 14 STA. 2657+30

MATCH TO SHEET 30 STA. 51+25

MATCH TO SHEET 33

STA. 42+80

MATCH TO SHEET 12

STA. 2453+55

020161

020162

020151

020071

020152

020072

LEGEND

100 Year

500 Year

SCALE IN FEET

500 0 50 1000

MATCH TO SHEET 29

Passaic River Study, N.J. & N.Y.

PASSAIC RIVER

STA. 2453+55 TO STA. 2657+30

FLOOD LIMITS & DAMAGE REACHES

WEST CALDWELL ROSELAND

EAST HANOVER LIVINGSTON

FIGURE NO. 13

LEGEND:
100 Year
500 Year

020181
020182
020161
020171
020172
020191
020192
020194

MATCH TO SHEET 16
MATCH TO SHEET 13 STA. 2657+30
MATCH TO SHEET 15 STA. 2800+70

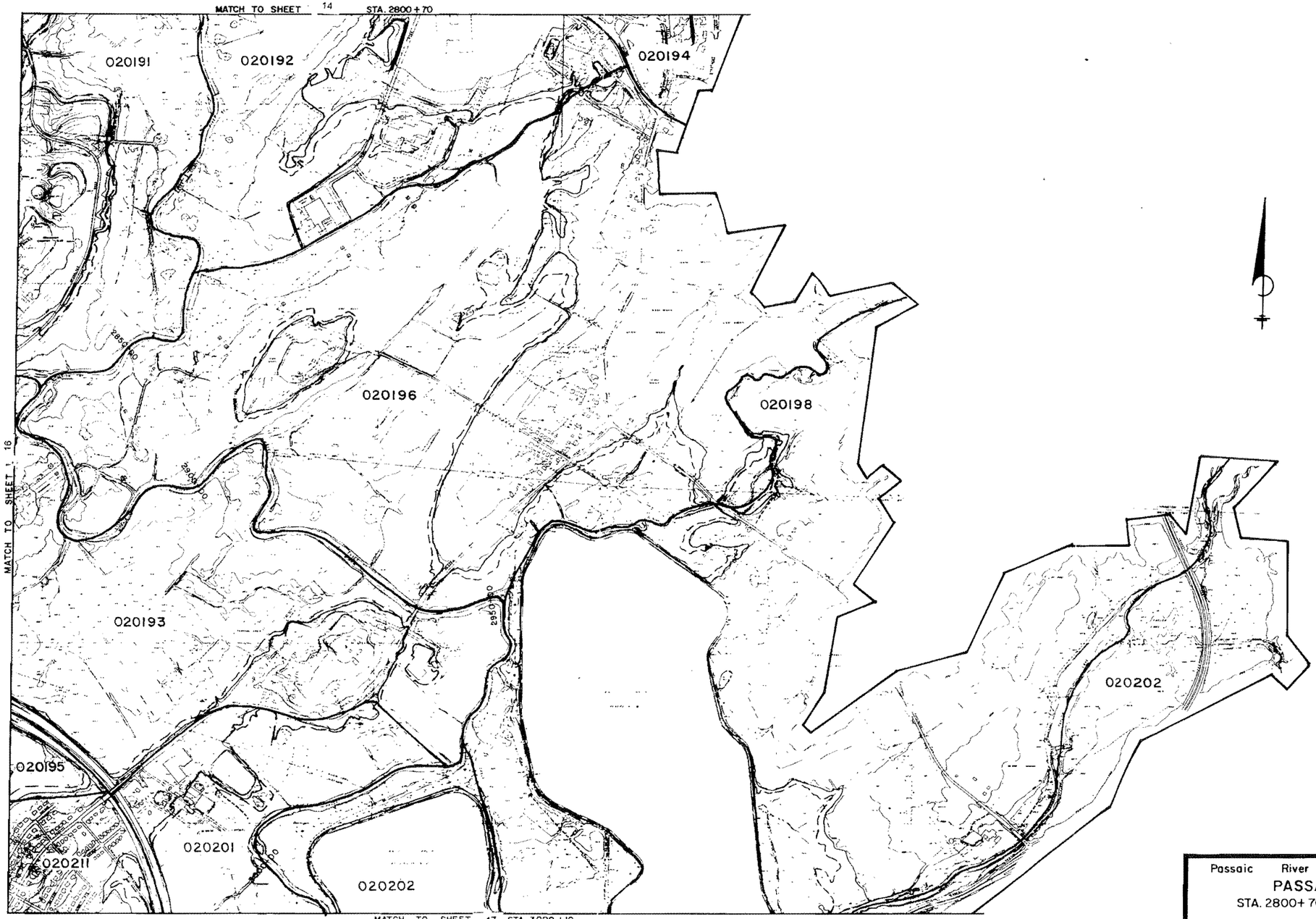
SCALE IN FEET
500 0 500 1000

Passaic River Study, N.J. & N.Y.
PASSAIC RIVER
STA. 2657+30 TO STA. 2800+70

FLOOD LIMITS & DAMAGE REACHES
LIVINGSTON
EAST HANOVER
FLORHAM PARK

FIGURE NO. 14

LEGEND:
100 Year — — —
500 Year ———



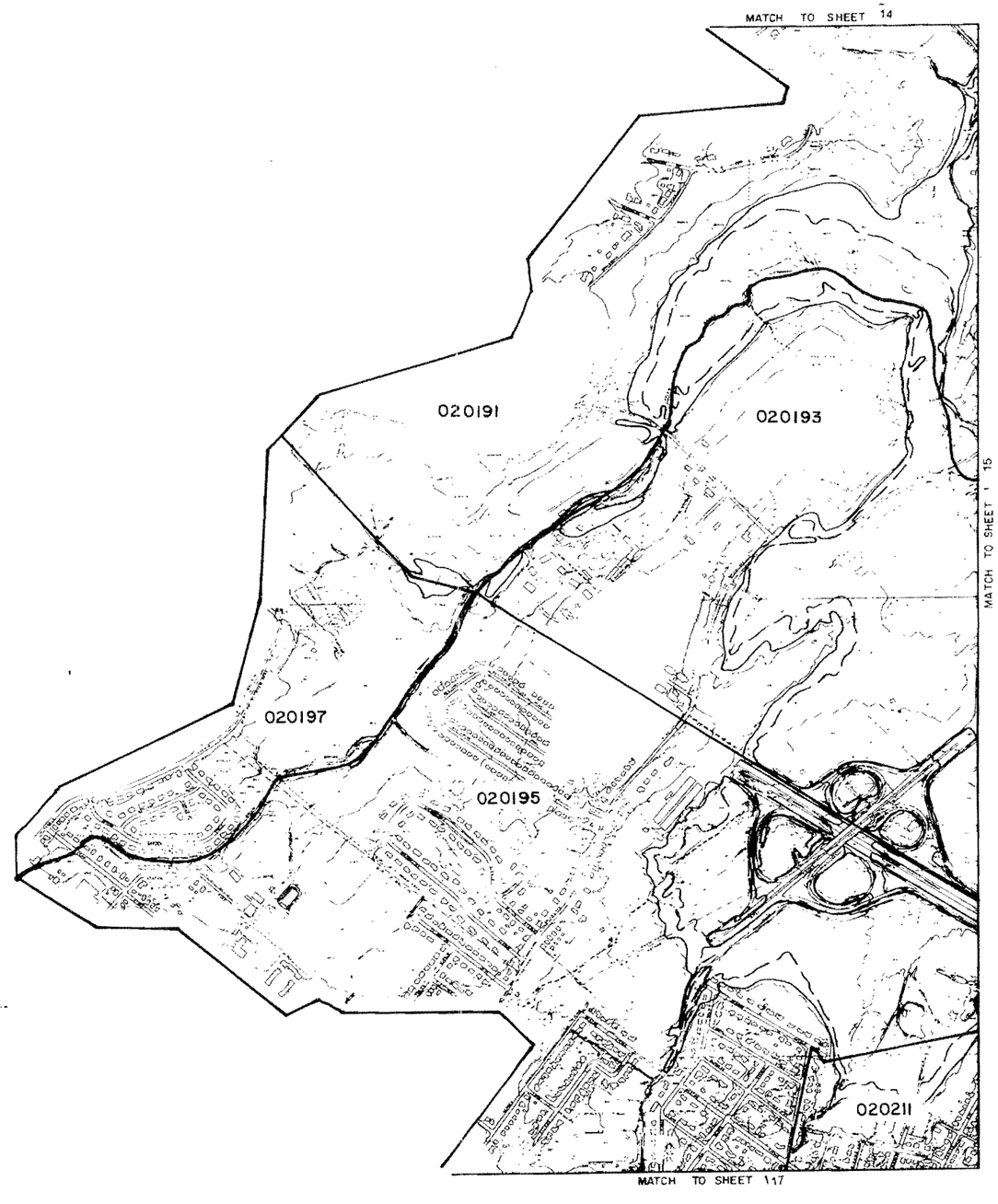
SCALE IN FEET
500 0 500 1000

Passaic River Study, N.J. & N.Y.
PASSAIC RIVER
STA. 2800+70 TO STA. 3009+10

FLOOD LIMITS & DAMAGE REACHES
LIVINGSTON FLORHAM PARK
MILLBURN CHATHAM

FIGURE NO. 15

LEGEND:
100 Year — — —
500 Year ———



SCALE IN FEET
500 0 500 1000

Passaic River Study, N.J. & N.Y.

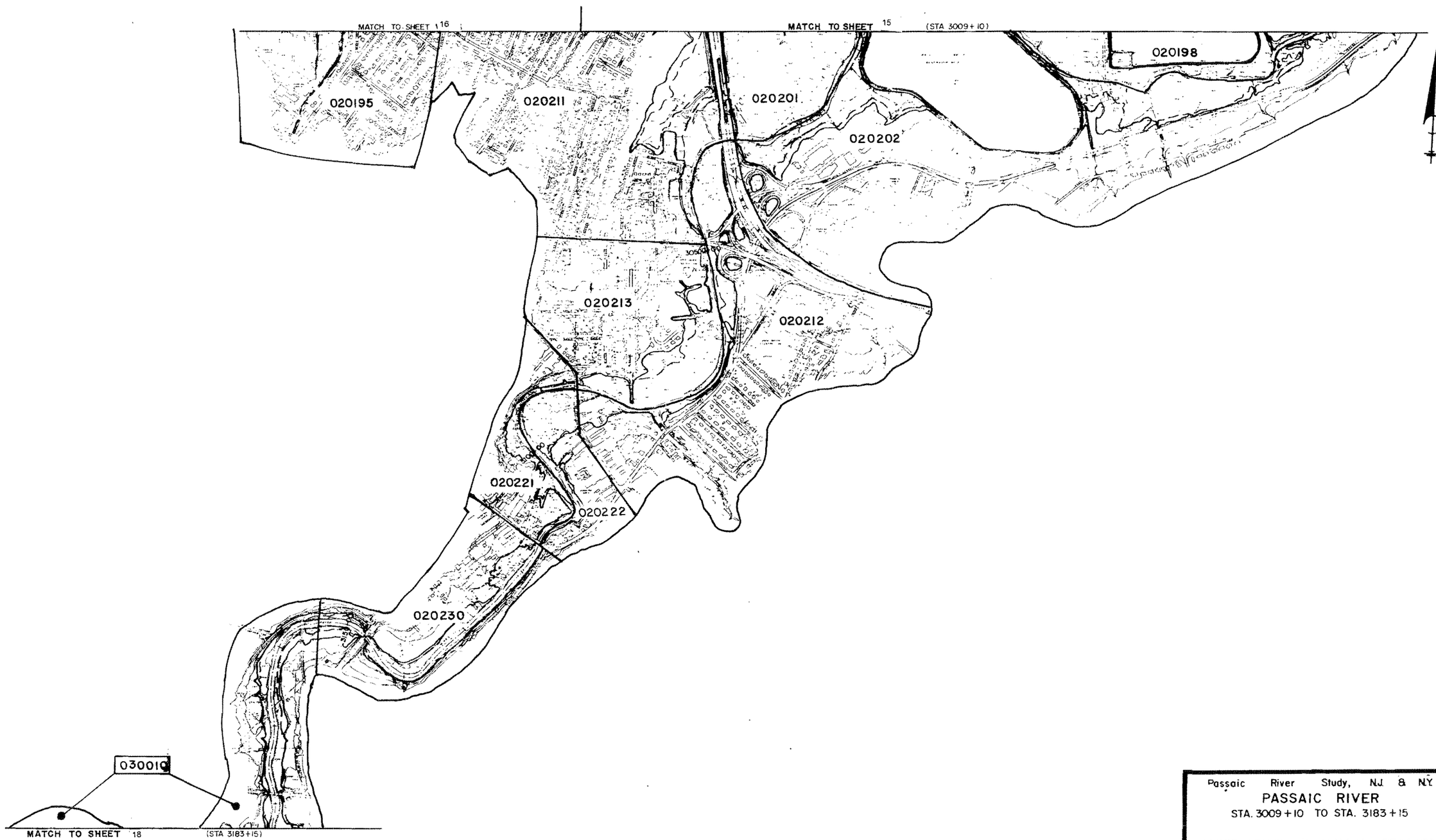
PASSAIC RIVER

FLOOD LIMITS & DAMAGE REACHES

CHATHAM FLORHAM PARK

FIGURE NO. 16

LEGEND:
100 Year — — —
500 Year ———



SCALE IN FEET
500 0 500 1000

Passaic River Study, N.J. & N.Y.
PASSAIC RIVER
STA. 3009+10 TO STA. 3183+15

FLOOD LIMITS & DAMAGE REACHES
MILLBURN BOROUGH OF CHATHAM
SUMMIT CHATHAM TOWNSHIP

FIGURE NO. 17

LEGEND:
100 Year — — — —
500 Year ————

MATCH TO SHEET 17 (STA. 3183 + 15)

030010

030021

030022

030032

030031

030040

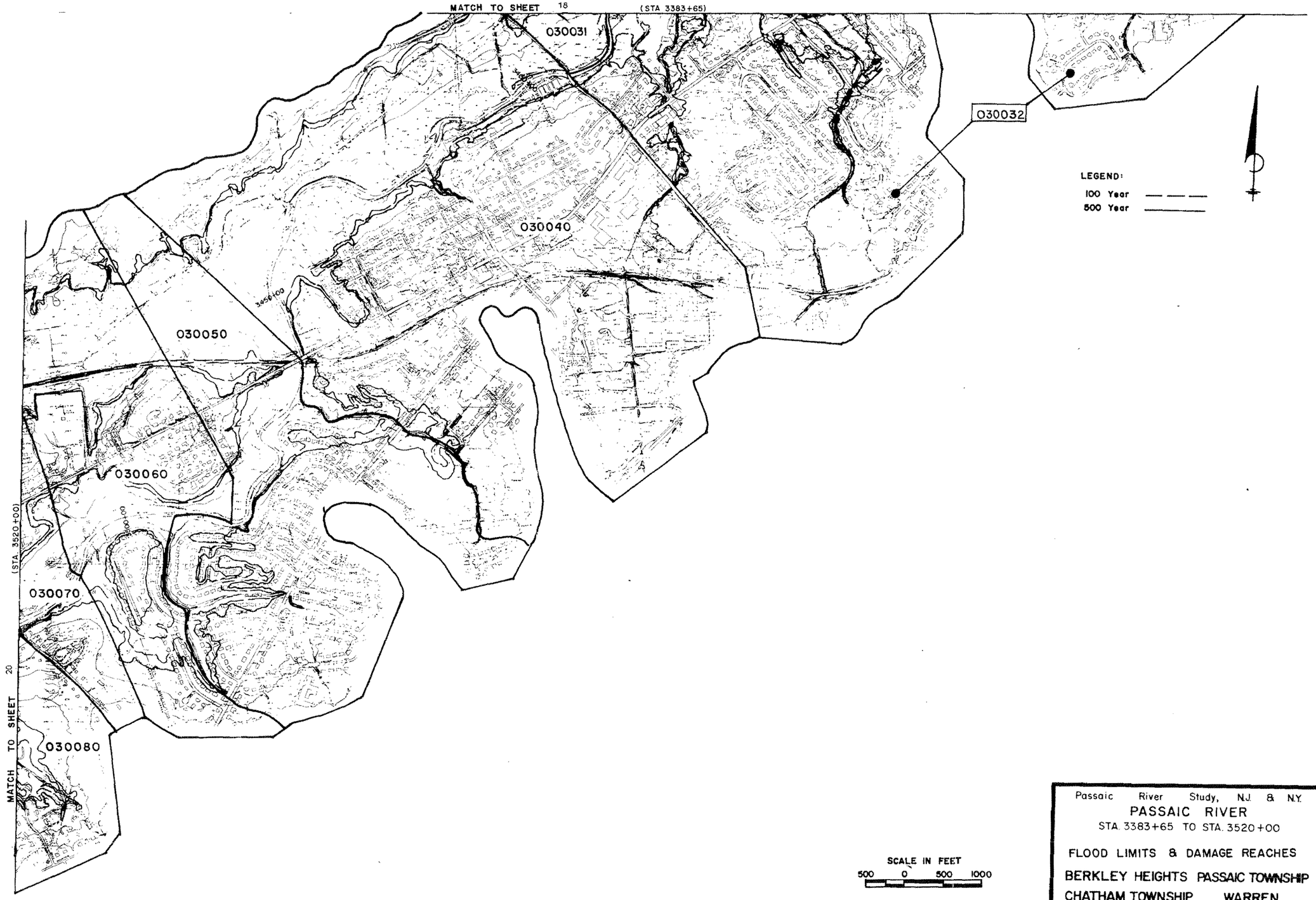
MATCH TO SHEET 19 (STA. 3383 + 65)

SCALE IN FEET
0 500 500 1000
500 250 0 500 1000

Passaic River Study, N.J. & N.Y.
PASSAIC RIVER
STA. 3183 + 15 TO STA. 3383 + 65

FLOOD LIMITS & DAMAGE REACHES
CHATHAM TOWNSHIP
SUMMIT NEW PROVIDENCE
BERKELY HEIGHTS

FIGURE NO. 18



Passaic River Study, N.J. & N.Y.

PASSAIC RIVER

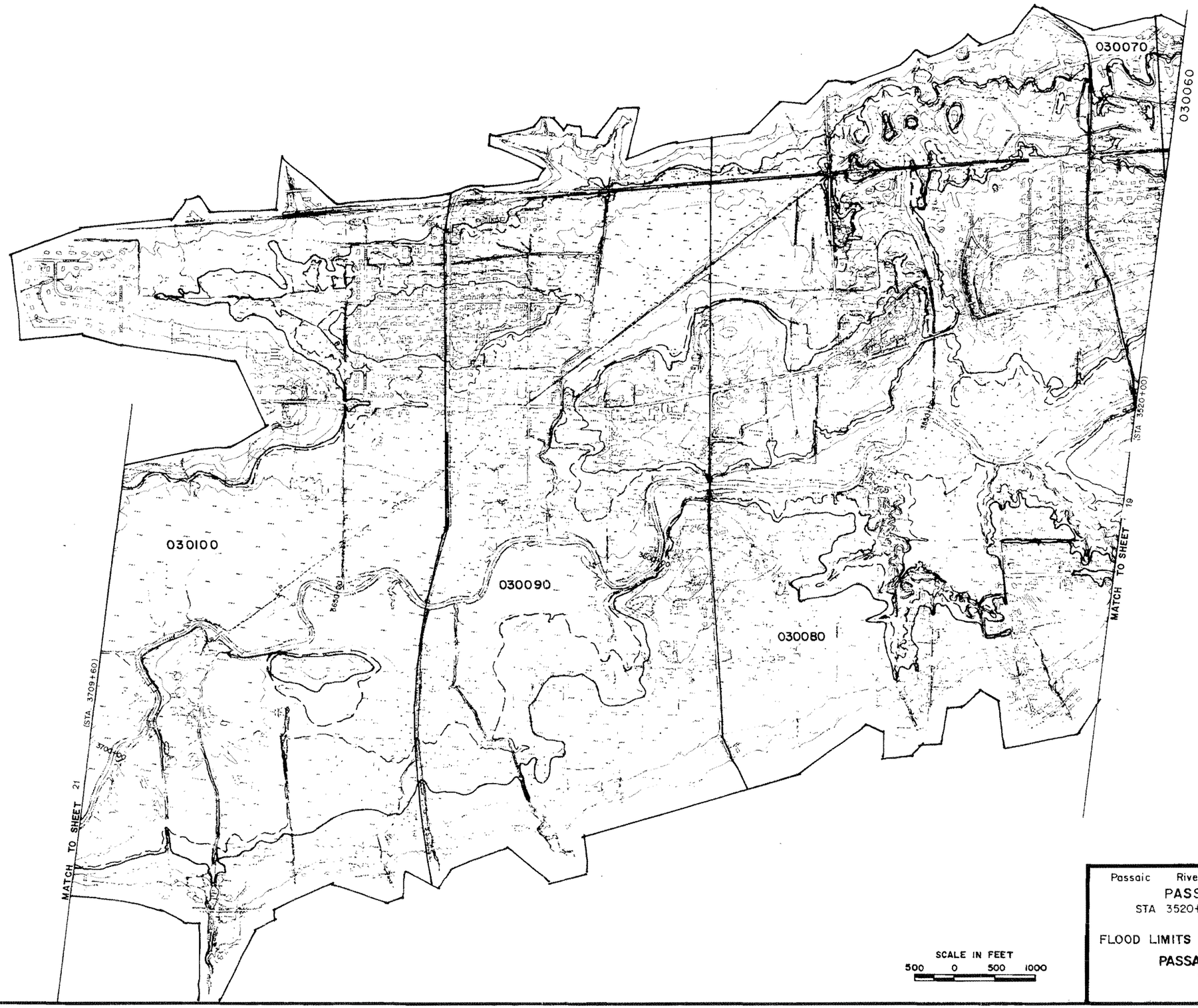
STA. 3383+65 TO STA. 3520+00

FLOOD LIMITS & DAMAGE REACHES

BERKLEY HEIGHTS PASSAIC TOWNSHIP

CHATHAM TOWNSHIP WARREN

FIGURE NO 19



Passaic River Study, N.J. & N.Y.

PASSAIC RIVER

STA 3520+00 TO STA. 3709+60

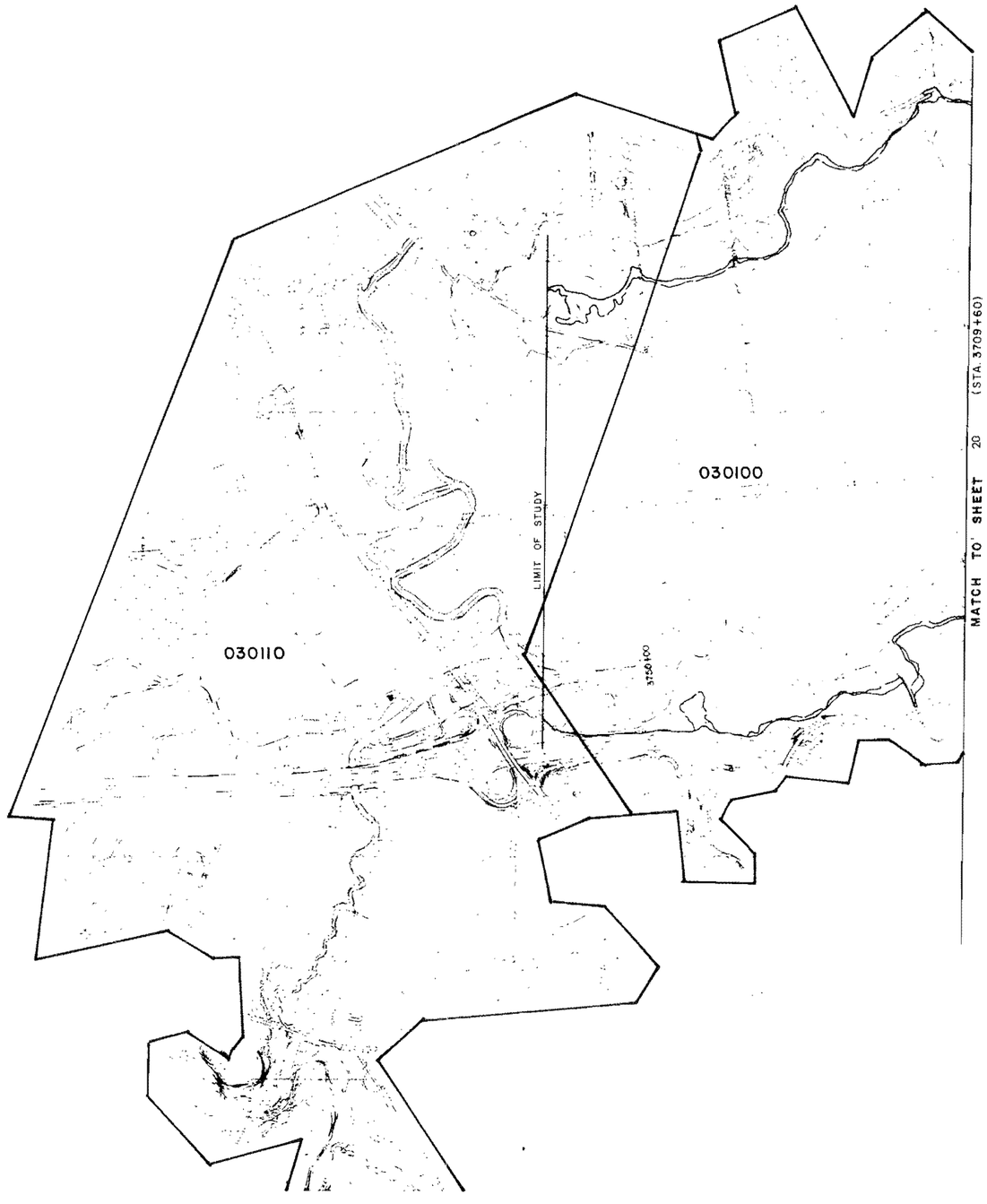
FLOOD LIMITS & DAMAGE REACHES

PASSAIC TOWNSHIP

WARREN

FIGURE NO. 20

LEGEND:
100 Year — — —
500 Year ———



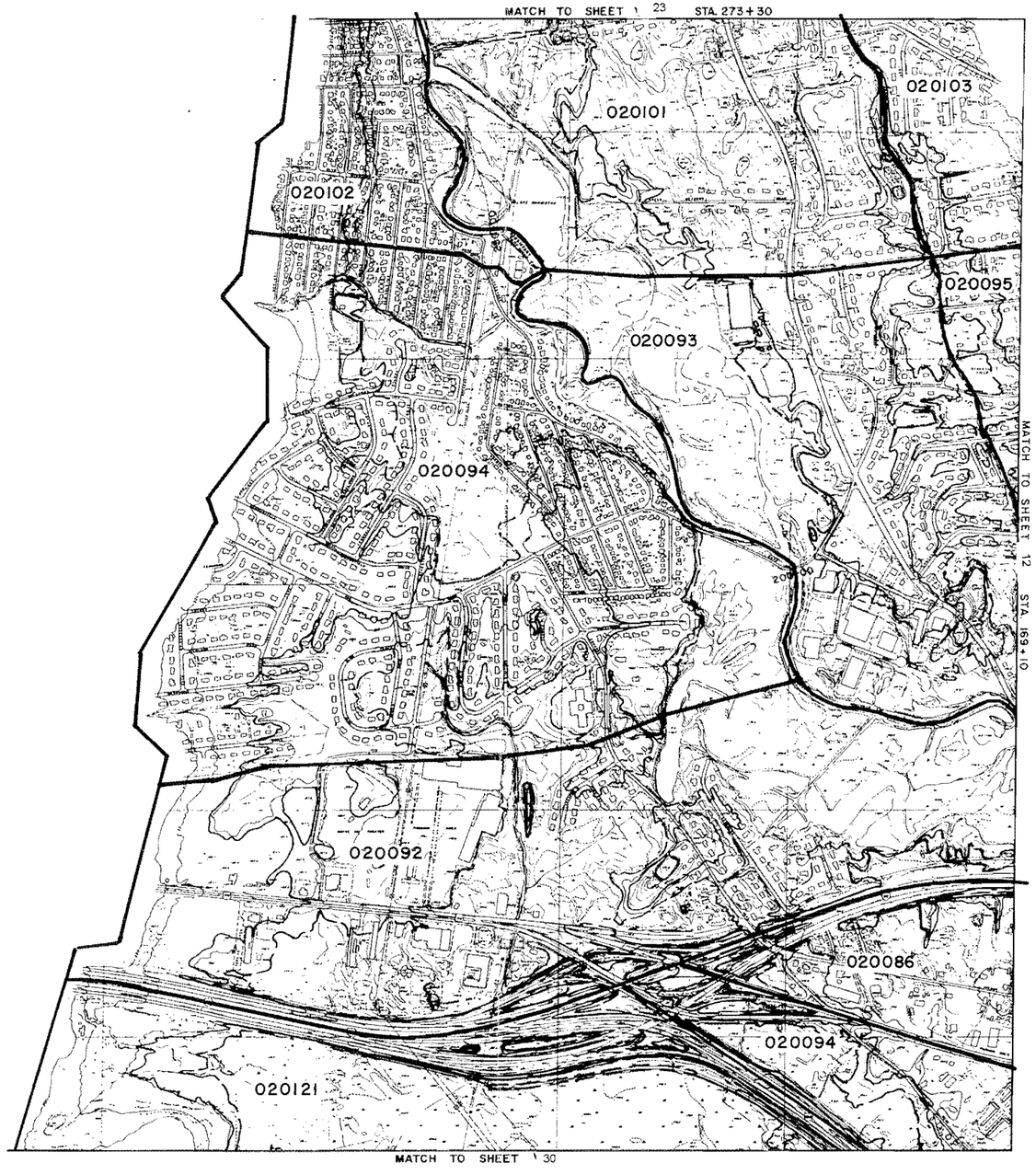
SCALE IN FEET
500 0 500 1000

Passaic River Study, N.J. & N.Y.
PASSAIC RIVER
STA. 3709+60 TO LIMIT OF STUDY
FLOOD LIMITS & DAMAGE REACHES
PASSAIC TOWNSHIP
WARREN
BERNARDS

FIGURE NO. 21

LEGEND:

100 Year — — —
500 Year ———

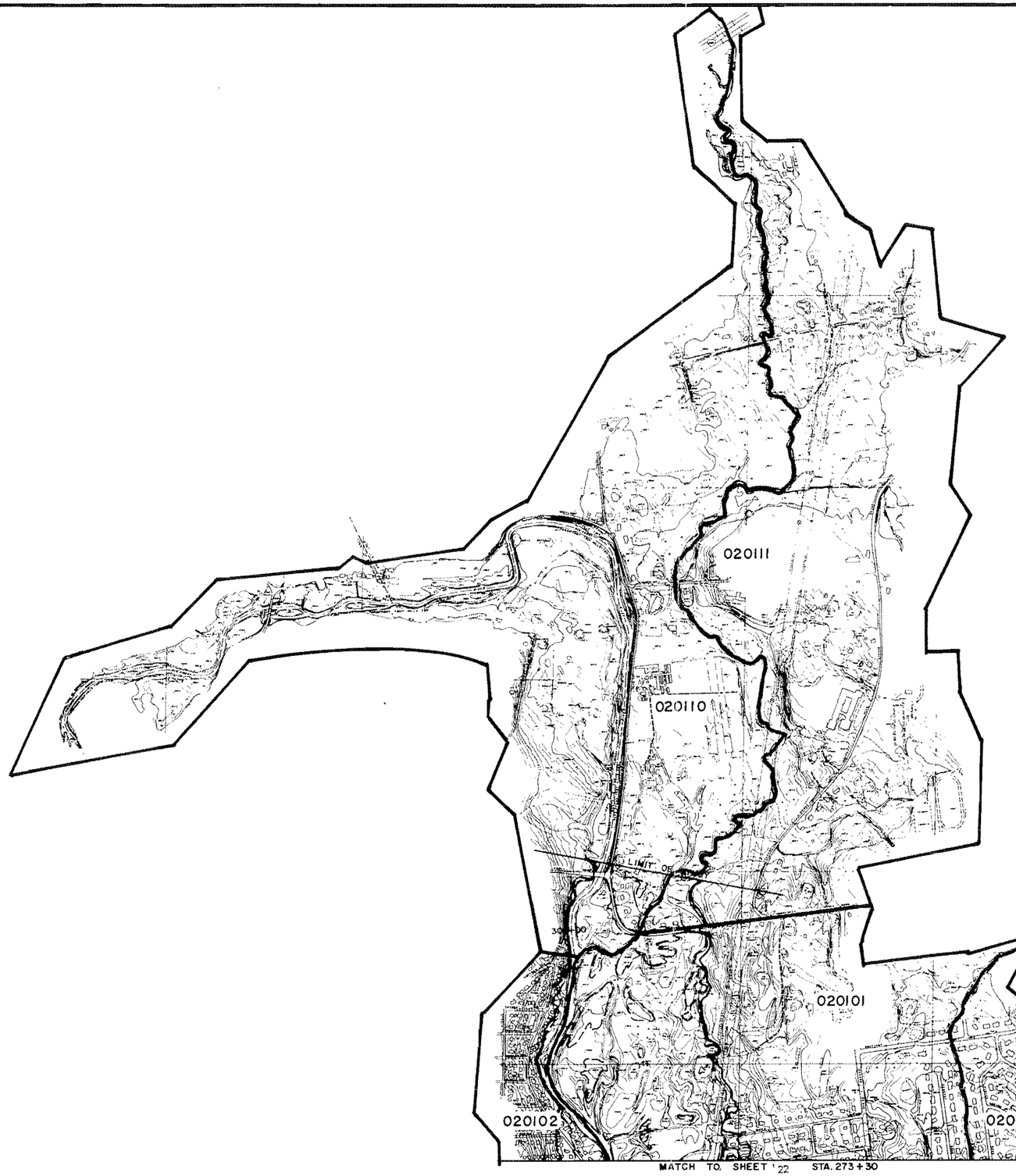


SCALE IN FEET
500 0 500 1000

Passaic River Study, NJ & NY
ROCKAWAY RIVER
STA. 169+10 TO STA. 273+30
FLOOD LIMITS & DAMAGE REACHES
MONTVILLE
PARSIPPANY-TROY HILLS

FIGURE 22

LEGEND:
100 Year — — —
500 Year ———

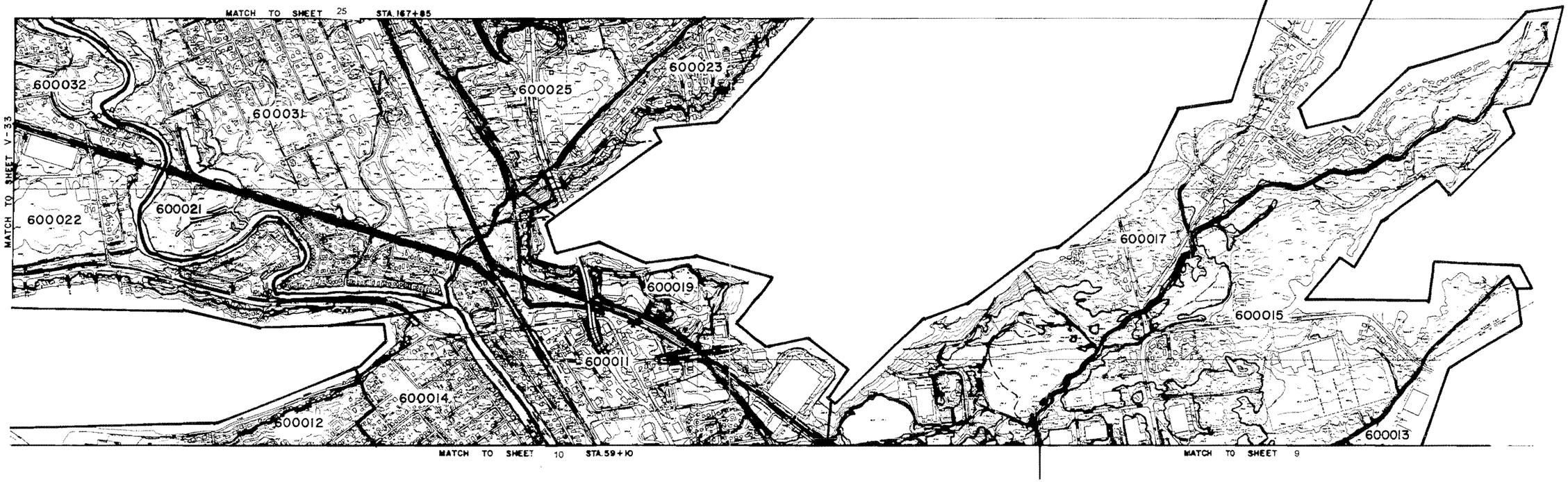


SCALE IN FEET
500 0 500 1000

Passaic River Study, N.J. & N.Y.
ROCKAWAY RIVER
STA. 273+30 TO LIMIT OF STUDY
FLOOD LIMITS & DAMAGE REACHES
BOONTON
MONTVILLE
PARSIPPANY-TROY HILLS

FIGURE 23

LEGEND:
100 Year — — —
500 Year ———



SCALE IN FEET
500 0 500 1000

Passaic River Study, N.J. & N.Y.
POMPTON RIVER
STA. 59+10 TO STA. 167+85
FLOOD LIMITS & DAMAGE REACHES
WAYNE
LINCOLN PARK
TOTOWA

FIGURE 24

LEGEND:
100 Year — — —
500 Year ———

MATCH TO SHEET 27 STA. 278+35

600042

600041

MATCH TO SHEET 26

600034

600031

600032

600029

600027

600023

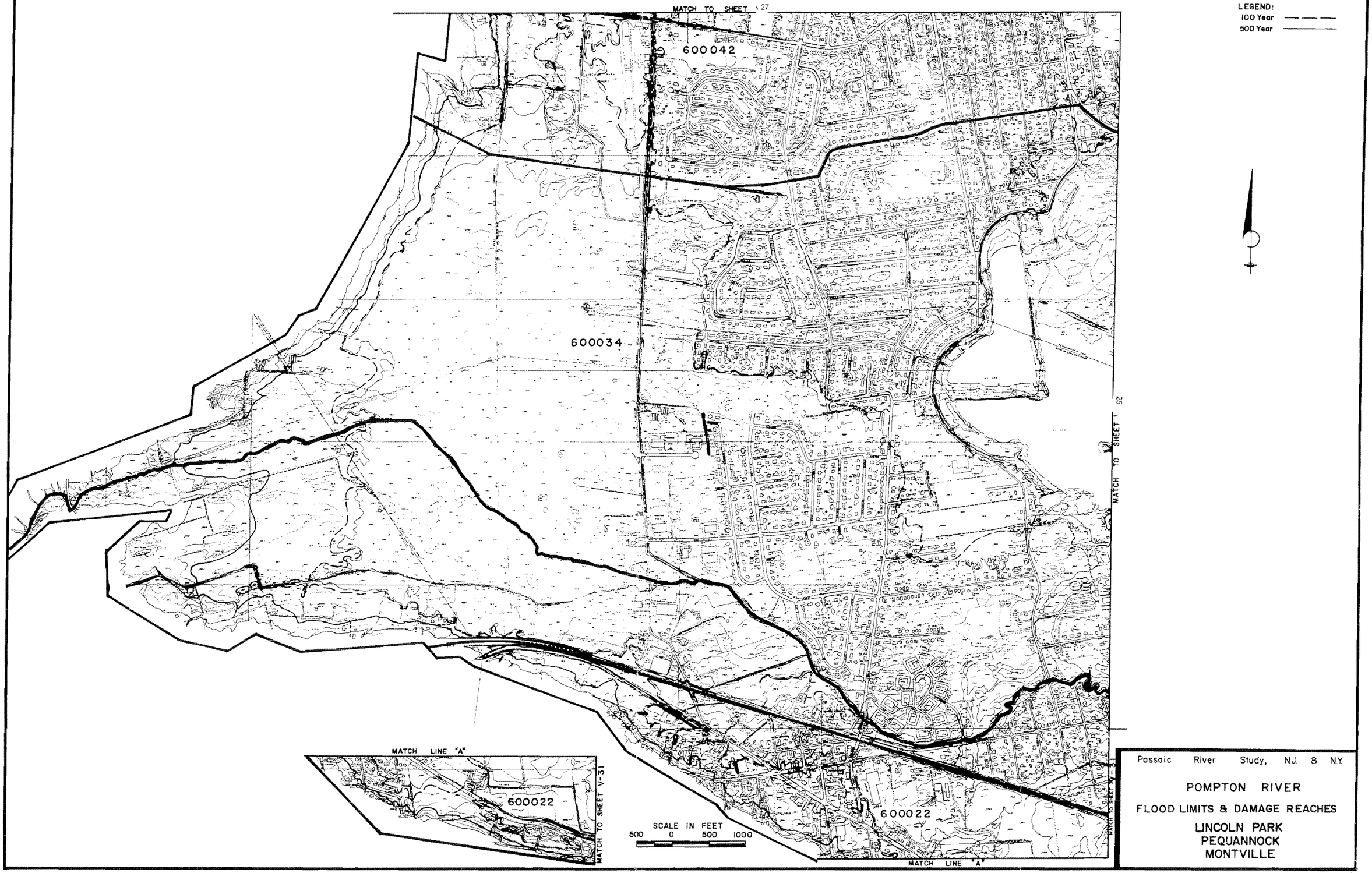
600025

MATCH TO SHEET 24 STA. 167+85

SCALE IN FEET
500 0 500 1000

Passaic River Study, N.J. & N.Y.
POMPTON RIVER
STA. 167+85 TO STA. 278+35
FLOOD LIMITS & DAMAGE REACHES
WAYNE
LINCOLN PARK
PEQUANNOCK

FIGURE 25



Passaic River Study, N.J. & N.Y.

POMPTON RIVER

FLOOD LIMITS & DAMAGE REACHES

LINCOLN PARK
PEQUANNOCK
MONTVILLE

FIGURE NO 26

STA. 69+10 MATCH TO SHEET 34 STA. 49+20

660026
660024
660022
660022
660011
600061
600061
600062
600052
600042

LEGEND
100 Year
500 Year

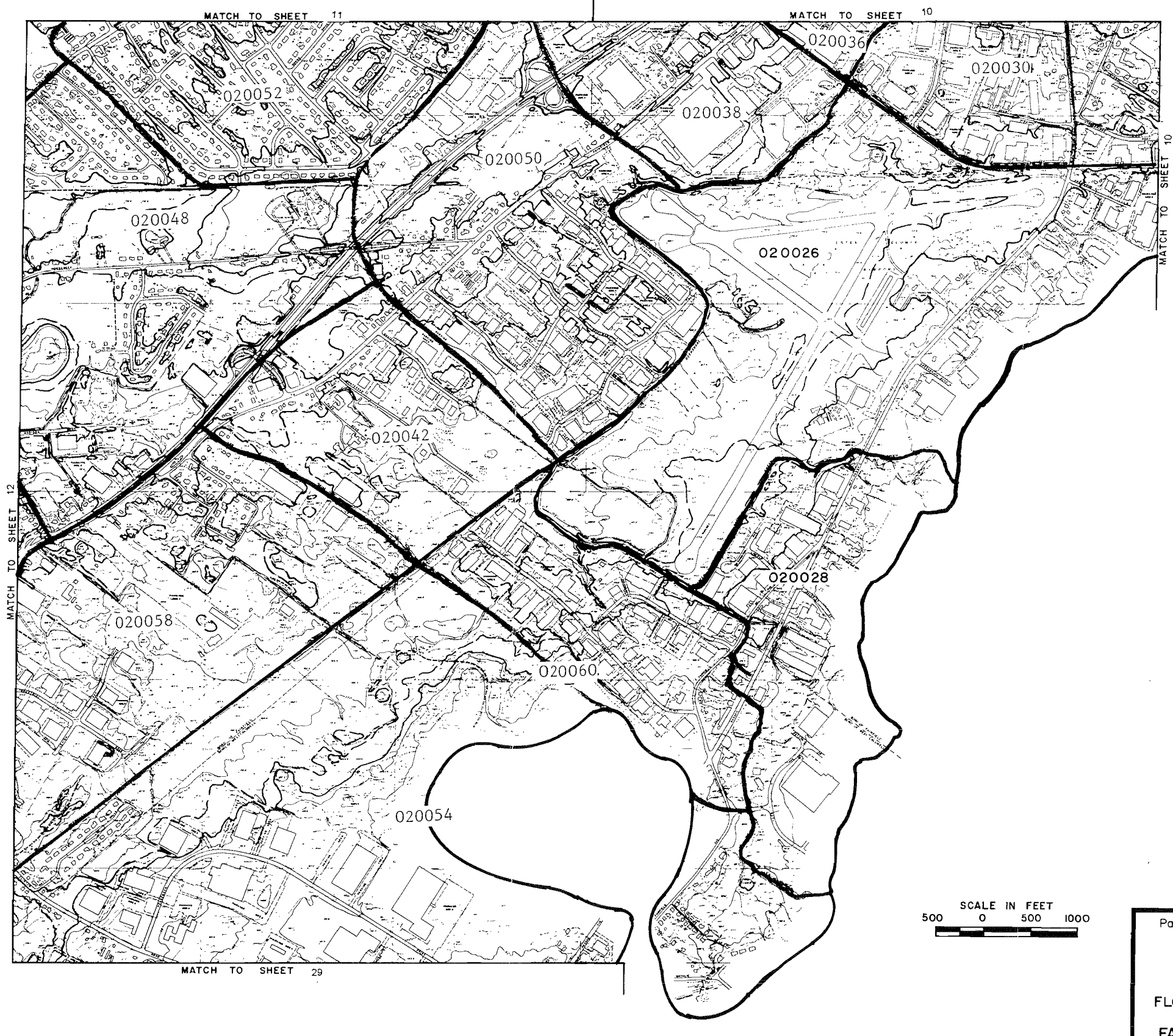
MATCH TO SHEET 26 MATCH TO SHEET 27 STA. 278+35

SCALE IN FEET
500 0 500 1000

Passaic River Study, N.J. & N.Y.
POMPTON RIVER
STA. 278+35 TO CONFLUENCE OF
PEQUANNOCK & RAMAPO RIVERS
FLOOD LIMITS & DAMAGE REACHES
POMPTON LAKES WAYNE
PEQUANNOCK LINCOLN PARK

FIGURE NO. 27

LEGEND:
100 Year — — —
500 Year ———



SCALE IN FEET
500 0 500 1000

Passaic River Study, N.J. & N.Y.

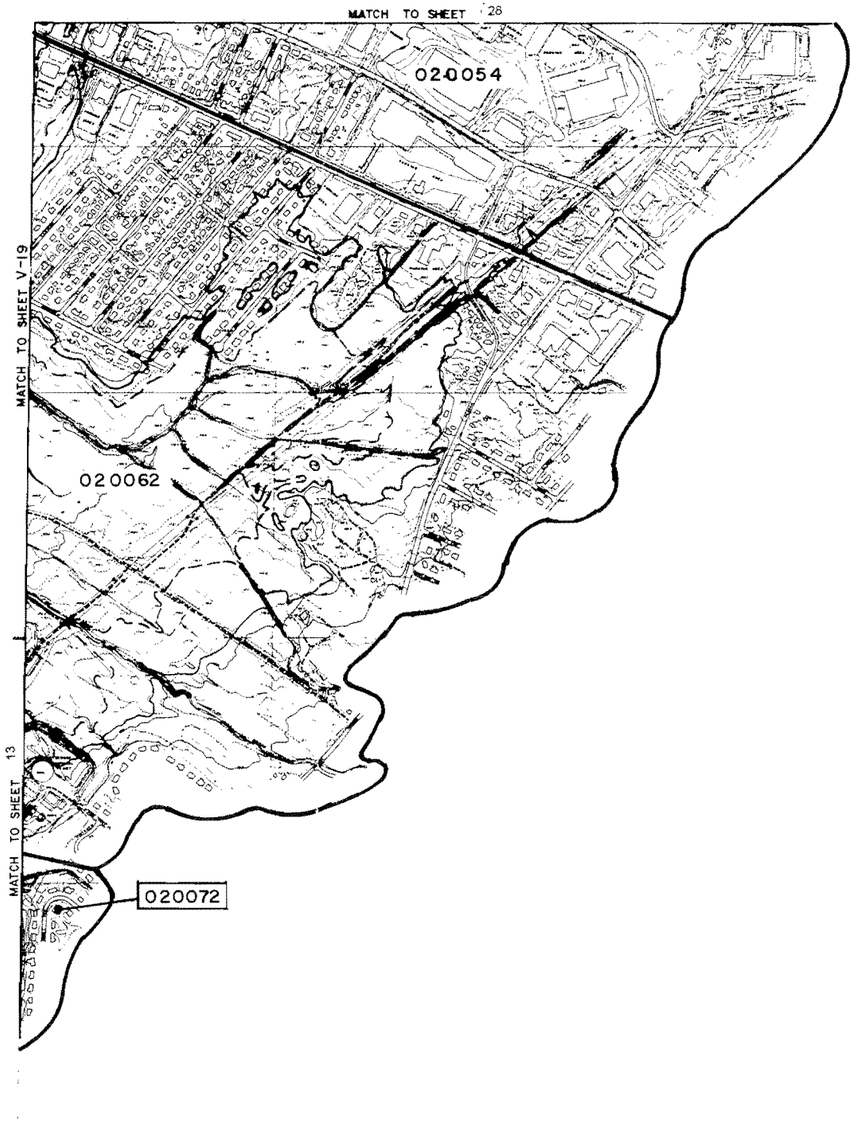
PASSAIC RIVER

FLOOD LIMITS & DAMAGE REACHES

FAIRFIELD WEST CALDWELL

FIGURE NO. 28

LEGEND.:
100 Year — — —
500 Year ———



SCALE IN FEET
500 0 500 1000

Passaic River Study, N.J. & N.Y.

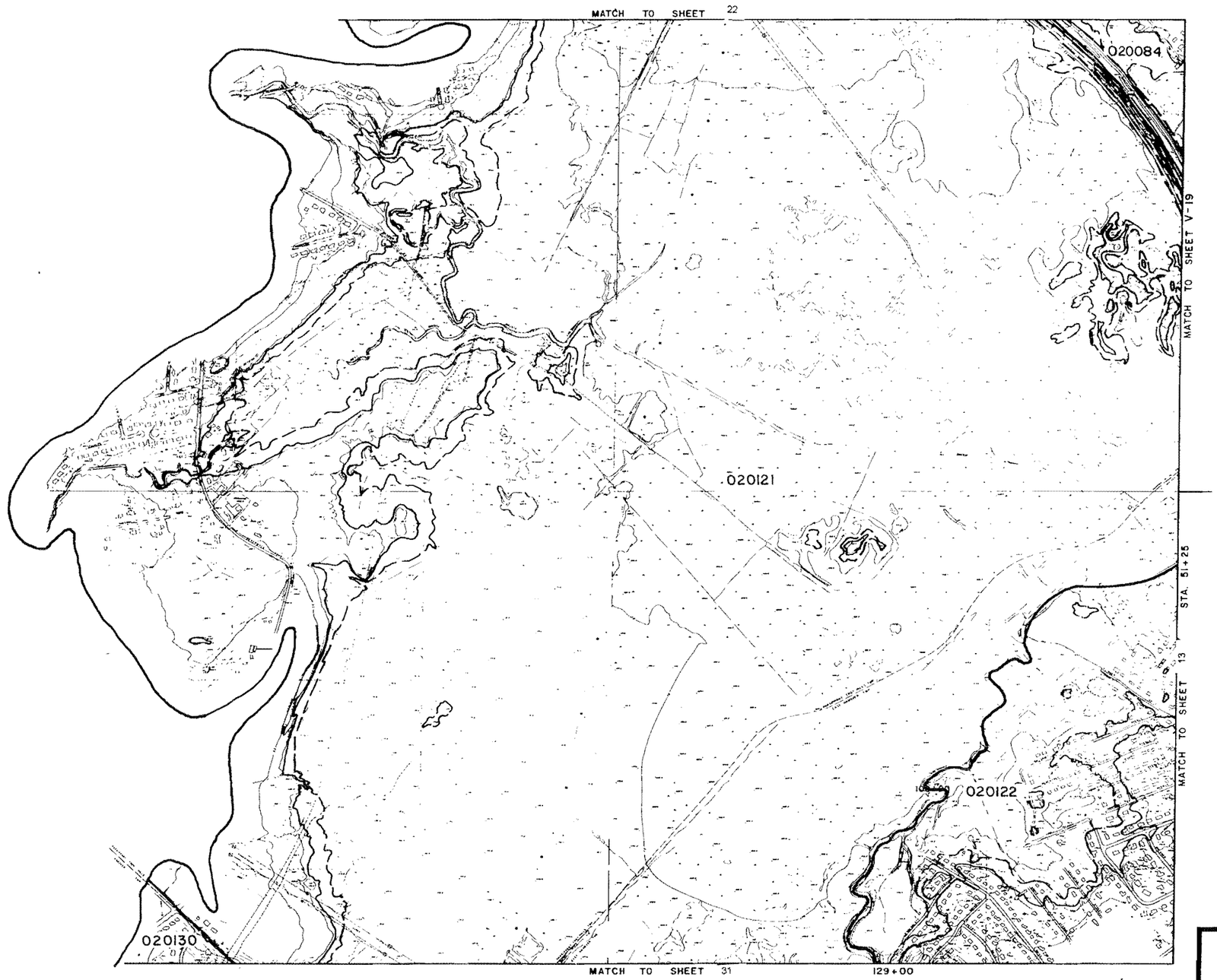
PASSAIC RIVER

FLOOD LIMITS & DAMAGE REACHE

WEST CALDWELL

FIGURE NO. 29

LEGEND:
100 Year ———
500 Year ———



SCALE IN FEET
500 0 500 1000

Passaic River Study, N.J. & N.Y.
WHIPPANY RIVER
STA. 51+25 TO STA. 129+00

FLOOD LIMITS & DAMAGE REACHES
EAST HANOVER
HANOVER
PARSIPPANY - TROY HILLS

FIGURE NO. 30

LEGEND:
100 Year ——— ——— ———
500 Year ———————

MATCH TO SHEET 30

STA 129+00

020121

020122

020130

800020

800010

020141

020142

020146

020144

020148

MATCH TO SHEET 32

SCALE IN FEET
500 0 500 1000

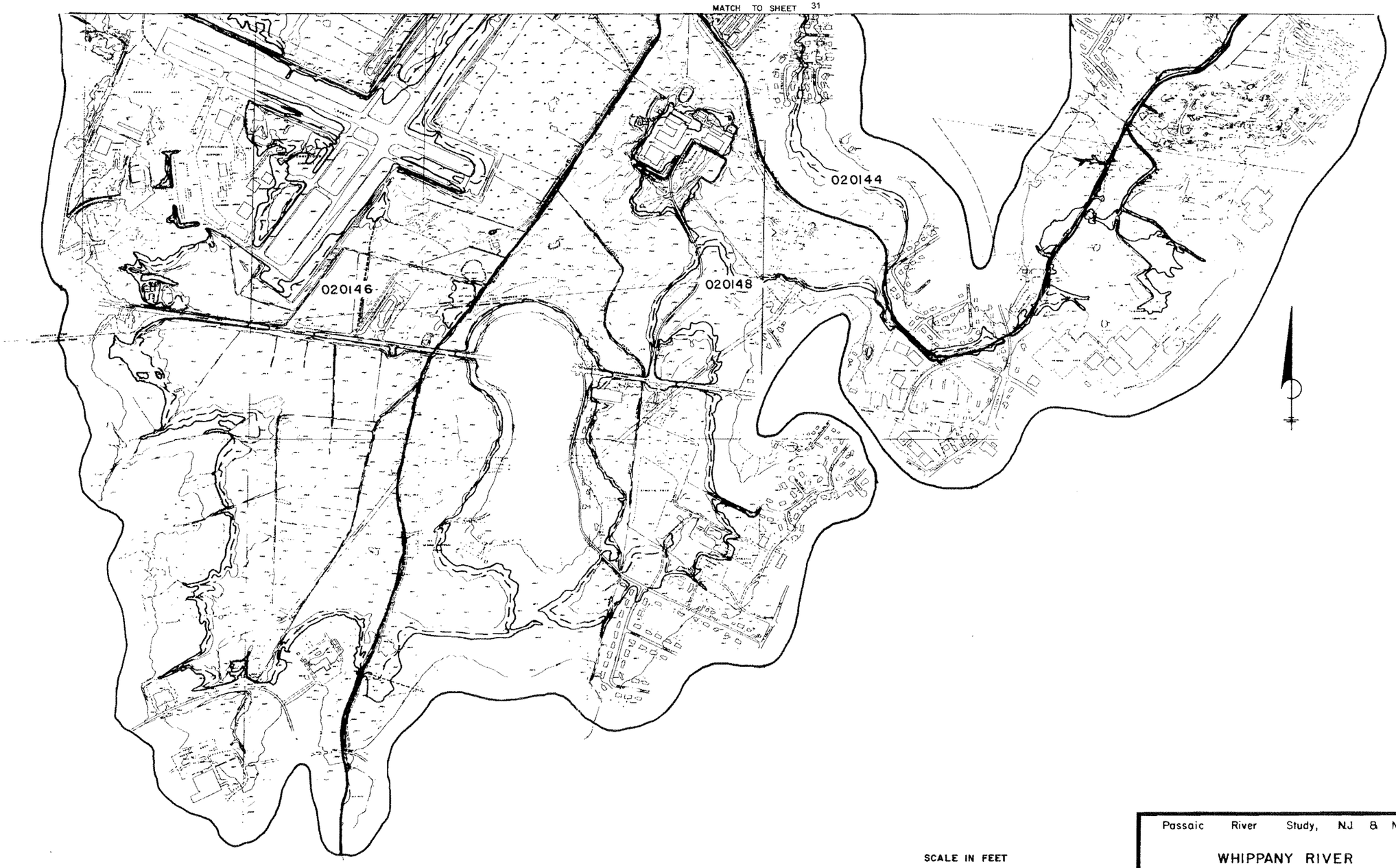
Passaic River Study, N.J. & N.Y.
WHIPPANY RIVER
STA. 129+00 TO LIMIT OF STUDY

FLOOD LIMITS & DAMAGE REACHES
FAIRFIELD
HANOVER EAST HANOVER
PARSIPPANY – TROY HILLS

FIGURE NO. 31

LEGEND:
100 Year ——— ———
500 Year ———

MATCH TO SHEET 31



SCALE IN FEET
500 0 500 1000

Passaic River Study, NJ & NY

WHIPPANY RIVER

FLOOD LIMITS & DAMAGE REACHES

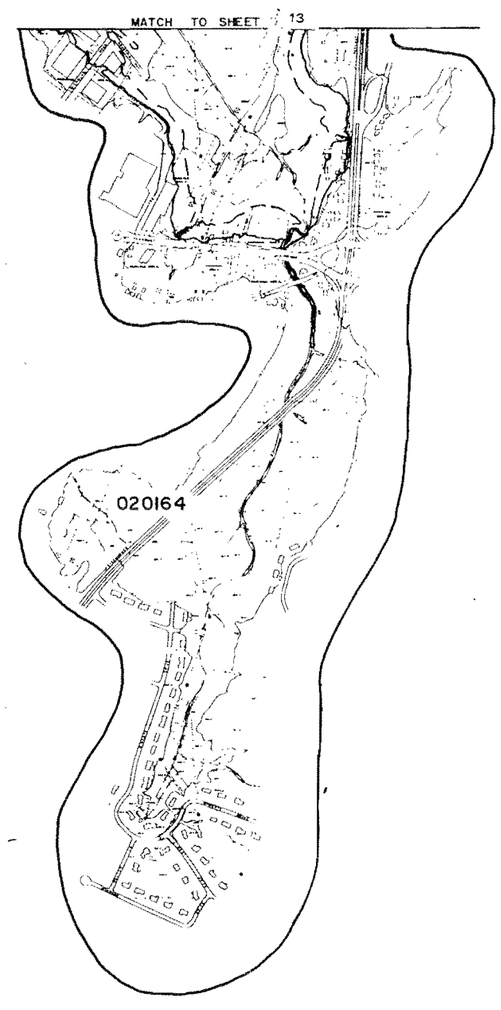
HANOVER
EAST HANOVER
FLORHAM PARK

FIGURE NO 32

LEGEND:

100 Year — — —

500 Year ————



SCALE IN FEET

500 0 500 1000

Passaic River Study, N.J. & N.Y.

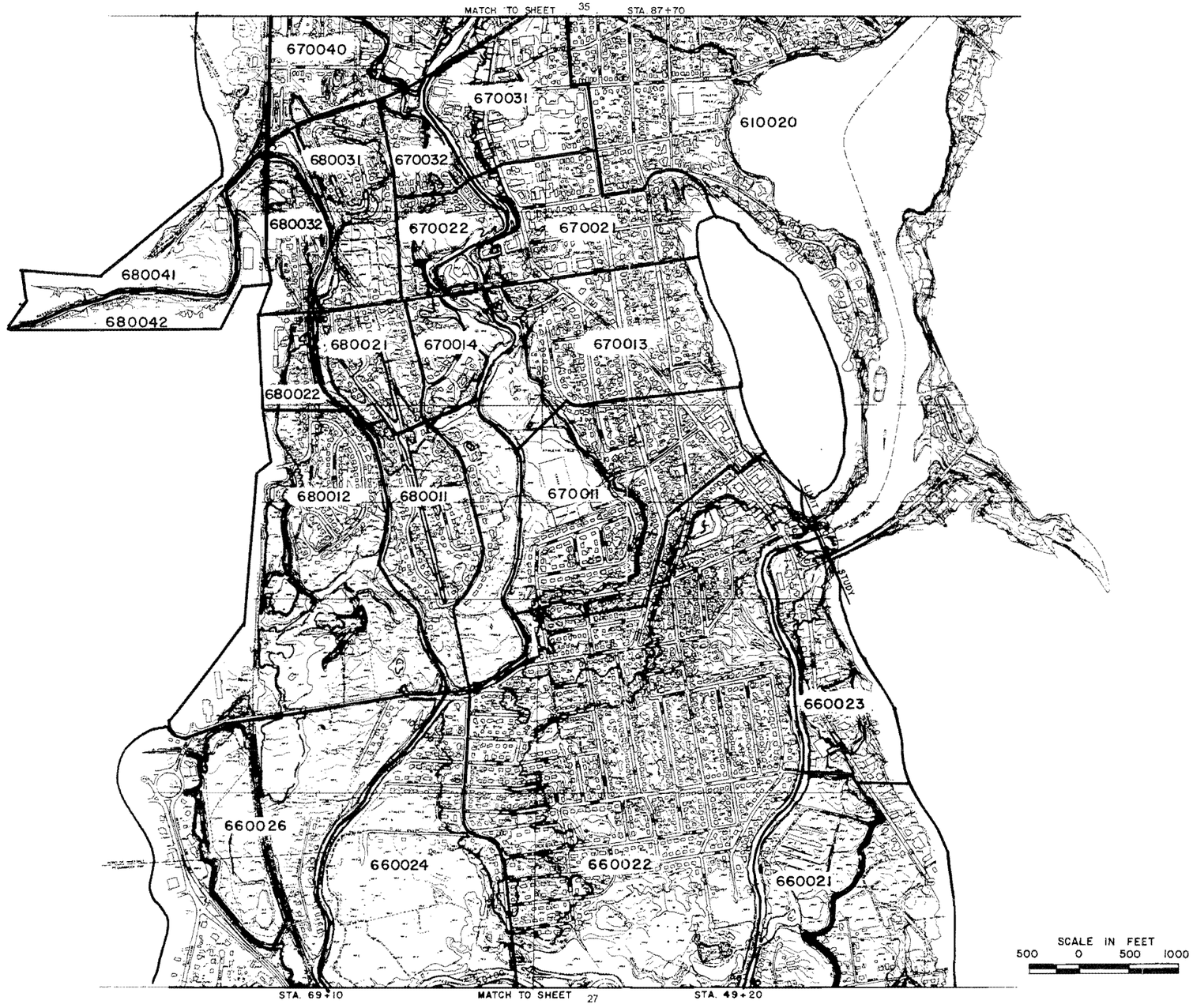
PASSAIC RIVER

FLOOD LIMITS & DAMAGE REACHES

LIVINGSTON

FIGURE NO. 33

LEGEND:
100 Year — — — —
500 Year ————



SCALE IN FEET
500 0 500 1000

Passaic River Study, N.J. & N.Y.
RAMAPO RIVER
STA. 49+20 TO LIMIT OF STUDY
PEQUANNOCK & WANAQUE RIVERS
FOOD LIMITS & DAMAGE REACES
POMPTON LAKES
PEQUANNOCK RIVERDALE
BLOOMINGDALE WAYNE

FIGURE NO. 34

LEGEND:
100 YEAR — — —
500 YEAR ———

SCALE IN FEET
500 250 0 500 1000

Passaic River Study, N.J. & N.Y.
WANAQUE RIVER
STA. 87 + 70 TO LIMIT OF STUDY
FLOOD LIMITS & DAMAGE REACHES
WAYNE
OAKLAND
POMPTON LAKES

FIGURE NO. 35