Section 1: Introduction

This section provides an introduction to this Multi-Jurisdictional Flood Mitigation Plan for the Non-Tidal, New Jersey section of the Delaware River Basin. It is broken down into the following six sections:

- Purpose and Scope of Plan
- Goals and Objectives
- Authority
- Participating Jurisdictions
- Profile of the Delaware River Basin
- Profile of the Study Area

Purpose and Scope of Plan

Between mid-September 2004 and late July 2006, three major floods caused severe and repeated damage to thousands of structures, and disrupted the lives of many in the Delaware River Basin. The flooding was the worst experienced since the record flood of 1955.

This Plan is the result of a multi-agency and local partnership that formed following those three Delaware River main stem flood events. The purpose of this partnership was to capitalize on resources at the federal, state and county level and assist local municipalities in completing a regional flood hazard mitigation plan.

The partnership that formed to produce this Plan includes the Delaware River Basin Commission (DRBC), the New Jersey Department of Environmental Protection (NJDEP), the New Jersey Office of Emergency Management (NJOEM) and county emergency management and planning departments.

This Plan contains flood mitigation actions and projects developed by municipalities that if implemented would reduce future flood loss and support sustainable communities. Some universal comments and actions were voiced by

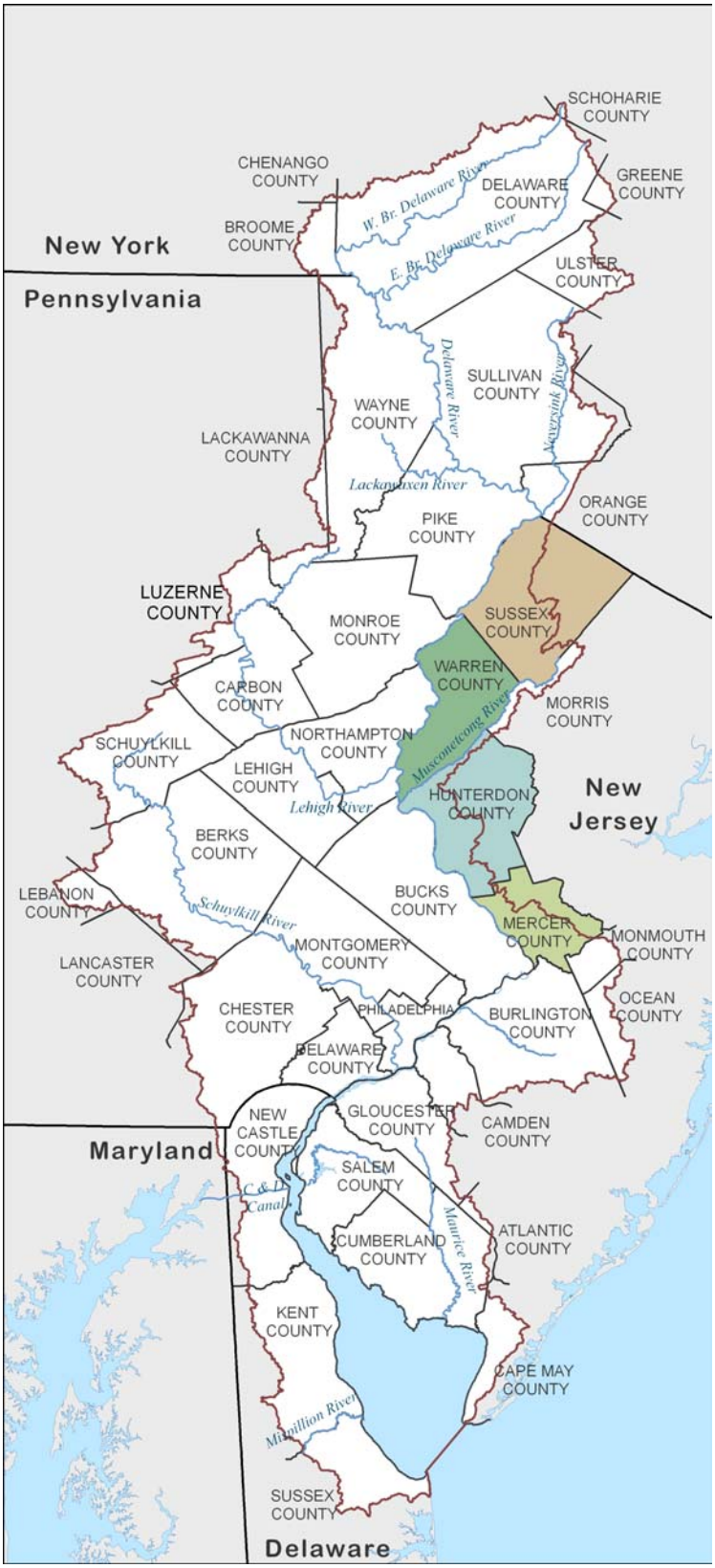


Figure 1-1. Delaware River Basin

municipalities throughout this planning process. Through this Plan, these local issues will be elevated to the county, state and regional level. County, state and regional actions are identified in this Plan with the aim of making the Delaware River Basin more disaster resilient and reducing long-term risks to loss of life and property damage from flooding.

This Plan is unique in that while it will meet the flood mitigation plan requirements of each municipality and also employ a watershed management approach to ensure that final mitigation actions address both local jurisdictional needs and regional multi-jurisdictional needs. Flooding is a hazard that does not recognize political boundaries. However, to effectively govern the floodplains, direct mitigation funds, manage rescue and response operations, and organize and deliver disaster relief, policy is often administered within politically defined boundaries. As political boundaries seldom coincide with watershed boundaries, this Plan encourages municipalities to consider their watershed and consult with their upstream and downstream neighbors when identifying mitigation actions. Local collaboration and partnership are effective and necessary means in reducing future flood loss.

There are two types of natural hazard mitigation plans recognized by the Federal Emergency Management Agency (FEMA): a Flood Mitigation Plan and an All Hazards Mitigation Plan. As the name suggests, a Flood Mitigation Plan is specific to flooding. For participating municipalities, this Flood Mitigation Plan is an important and significant step towards completion of the required All Hazards Mitigation Plan. It also is a stand-alone document that details regional, county-wide and municipal mitigation actions that when implemented will reduce future flood loss.

One of the purposes of the Flood Mitigation Plan is to enable participating municipalities to get one step closer to becoming eligible to compete for FEMA funding aimed at flood mitigation. Following a municipal or county-led process to expand this document into an All Hazards Mitigation Plan, municipalities will become eligible for future mitigation funding opportunities through FEMA's Grant Programs. The grant programs include the Flood Mitigation Assistance (FMA) program, the Pre-Disaster Mitigation (PDM) program, the Repetitive Flood Claims (RFC) program, the Severe Repetitive Loss (SRL) program and the post disaster Hazard Mitigation Grant Program (HMGP). As a note, an All Hazards Mitigation Plan is not required for the RFC program.

In addition to FEMA, this Plan will be reviewed by the United States Army Corps of Engineers (USACE), the Natural Resources Conservation Service (NRCS), New Jersey Department of Environmental Protection (NJDEP), New Jersey Department of Transportation (NJDOT), legislative officials and other organizations along the Delaware to convey the impact of flooding at a regional and local level, as well as, provide an outline of local mitigation projects and actions that can be implemented to reduce future flood loss. It is hoped that this Plan will leverage the expertise and resources of these organizations in solving local problems.

"There is no one set of mitigation measures that will stop flooding along the Delaware, it is only through a combination of local and regional measures that resiliency to flooding in the basin will be improved."

-Delaware River Basin Interstate Flood Mitigation Task Force, July 2007 Action Agenda

Goals and Objectives

The overall goal of this Flood Mitigation Plan is**:**

"To make the Delaware River Basin more disaster resilient by reducing long-term risks to loss of life and property damage from flooding.

The aim is to empower local communities to mitigate and support a sustainable community plan so that, when confronted by a natural disaster, they will sustain fewer losses and recover more quickly."

The objectives of this Flood Mitigation Plan are to:

- Increase the coordination and cooperation among intergovernmental entities in carrying out flood mitigation;
- Demonstrate a firm local commitment to flood mitigation;
- Leverage a wide array of funding opportunities to implement actions;
- Comply with federal legislative requirements for local mitigation plans;
- Protect life, safety and property by reducing the potential for future damages and economic losses that result from flooding;
- Safeguard essential public facilities and infrastructure;
- Promote a sustainable regional and local economy;
- Heighten public awareness of flood risk; and
- Support natural resource protection.

Authority

This Flood Mitigation Plan for the non-tidal, New Jersey section of the Delaware River Basin was prepared by the 43 jurisdictions covered by the Plan, with technical support and coordination provided by the Delaware River Basin Commission, the New Jersey Department of Environmental Protection and county emergency management and planning departments. It was developed in accordance with the provisions of the Disaster Mitigation Act of 2000 (Public Law 106-390) and the Pre-Disaster Mitigation Grant Program, Federal Regulations (44 CFR 206).

This Flood Mitigation Plan has been prepared to meet the requirements of 44 CFR Part 201, Hazard Mitigation Planning, which establishes criteria for State and local hazard mitigation planning authorized by Section 322 of the Stafford Act, as amended by Section 104 of the Disaster Mitigation Act. This rule specifies requirements that must be satisfied in developing State and local multi-hazard mitigation plans which are a requirement to maintain eligibility for future mitigation project funding under FEMA.

A Local Mitigation Plan Crosswalk, found in Appendix A, provides a summary of FEMA's current minimum standards of acceptability and notes the location within the Plan where each planning requirement is met. In addition, specific requirements of 44 CFR Part 201 will be identified throughout the Plan by shaded boxes.

Currently, local governments applying for FEMA's Flood Mitigation Assistance (FMA), Pre-Disaster Mitigation (PDM), Severe Repetitive Loss (SRL) or post disaster Hazard Mitigation Grant Program (HMGP) funds through the States are required to have an approved local mitigation plan to apply for local mitigation project grants. States are also required to have an approved State mitigation plan to receive funds for State or local mitigation projects after November 1, 2004. The State of New Jersey has an approved Standard State mitigation plan, dated April 2008.

Requirement §201.6: *The local mitigation plan is the representation of the jurisdiction's commitment to reduce risks from natural hazards, serving as a guide for decision makers as they commit resources to reducing the effects of natural hazards. Local plans will also serve as the basis for the State to provide technical assistance and to prioritize project funding.*

In 2006, the Delaware River Basin Commission received a Flood Mitigation Assistance (FMA) Planning grant from FEMA, through NJOEM, with NJDEP contributing necessary local matching funds. The purpose of the grant was to complete a multi-jurisdictional plan covering municipalities in Mercer, Hunterdon, Warren and Sussex Counties that are located either partially or entirely within the Delaware River Basin. A strength of this Plan is its watershed approach, but in addition, the Plan will meet the requirements for each participating municipality in its entirety. Therefore, other watersheds, such as the Wallkill, South Branch of the Raritan and Millstone River will be mentioned in this Plan.

Requirement §201.6(a)(4): *Multi-jurisdictional plans (e.g. watershed plans) may be accepted, as appropriate, as long as each jurisdiction has participated in the process and has officially adopted the plan.*

This flood mitigation plan is a substantial step towards the completion of an All Hazards Plan. This Plan solely focuses on flooding as flooding is by far the area's most substantial natural hazard. Following adoption of this flood mitigation plan, each municipality or county will be responsible for incorporating this Plan into an All Hazards Mitigation Plan by evaluating remaining natural hazards.

Participating Jurisdictions

The geographic scope (e.g. the study planning area) for the Plan includes New Jersey municipalities located in Mercer, Hunterdon, Warren and Sussex counties. Because this is a watershed based plan, only municipalities that are either entirely or partially located within the Delaware River Basin were invited to participate. Out of the 64 eligible municipalities, the following 43 municipalities chose to participate in plan development and have satisfactorily completed the required planning requirements. Participating municipalities are listed below and shown in Figure 1-2.

MERCER	***HUNTERDON***	***WARREN***	***SUSSEX***
Ewing Township	Delaware Township	Belvidere Township	Andover Borough
Hamilton Township	East Amwell Township	Blairstown Township	Branchville Borough
Hopewell Township	Franklin Township	Franklin Township	Byram Township
Lawrence Township	Frenchtown Borough	Frelinghuysen Township	Frankford Township
Pennington Borough	Hampton Borough	Town of Hackettstown	Fredon Township
Trenton City	Kingwood Township	Hardwick Township	Montague Township
6 Municipalities	Lambertville City	Harmony Township	Town of Newton
	Lebanon Township	Independence Township	Sandyston Township
	Milford Borough	Knowlton Township	Sparta Township
	Raritan Township	Lopatcong Township	Stillwater Township
	Stockton Borough	Mansfield Township	***10 Municipalities***
	West Amwell Township	Oxford Township	
	12 Municipalities	Town of Phillipsburg	
		Pohatcong Township	
		White Township	
		15 Municipalities	

Total of 43 Participating Municipalities

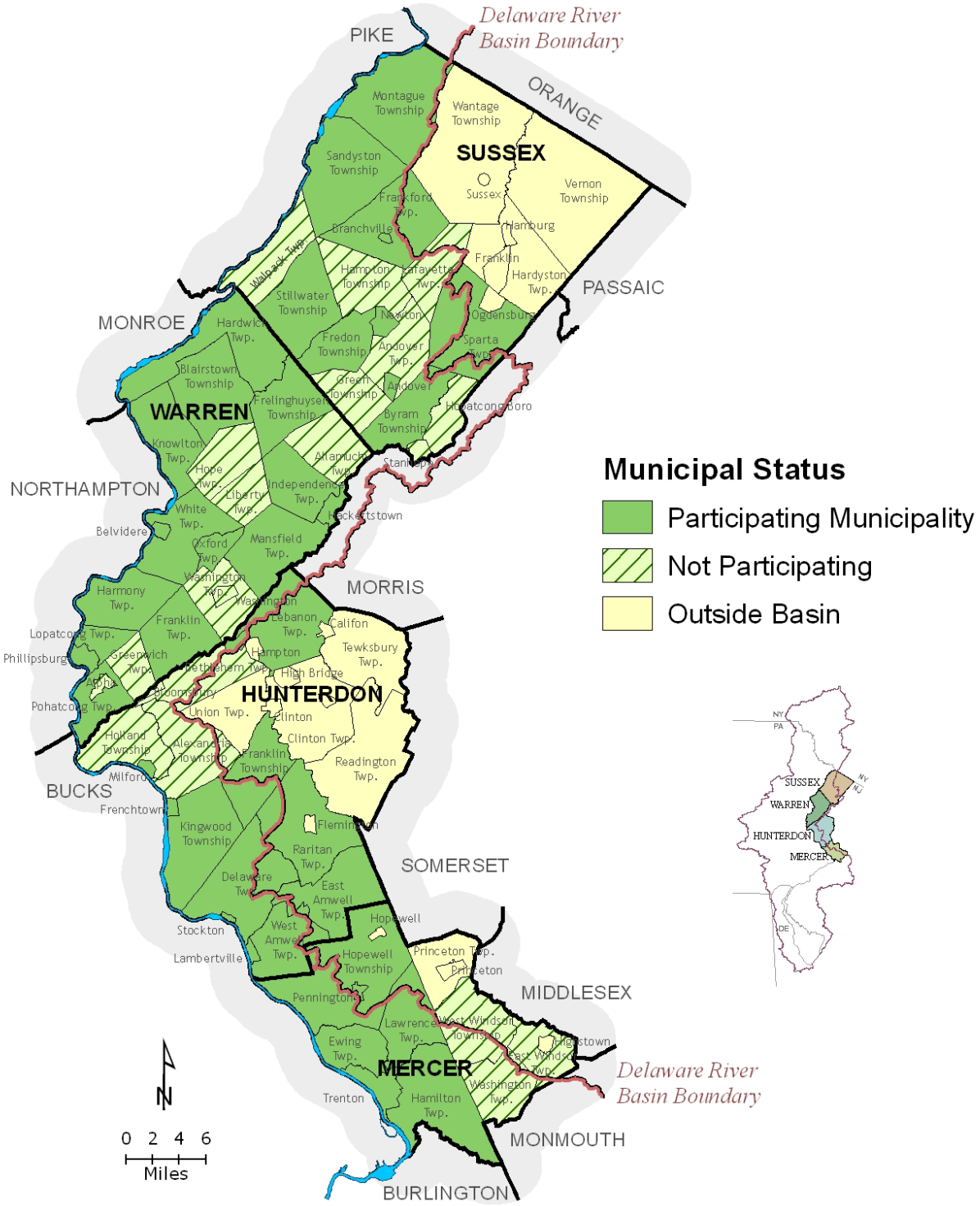
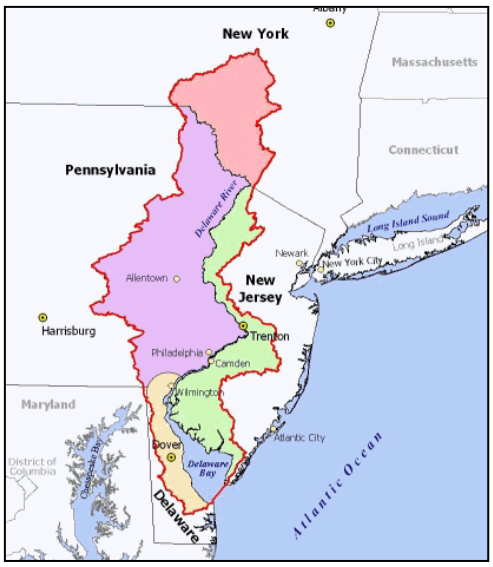


Figure 1-2. Participating Municipalities

Profile of the Delaware River Basin



The Delaware River extends approximately 330 miles from its headwaters at the confluence of the East and West Branches in Hancock, New York to the mouth of the Delaware Bay, where it feeds the Atlantic Ocean. The main stem Delaware is fed by 216 tributaries the largest of which are the Lehigh and Schuylkill Rivers in Pennsylvania. It is the longest undammed river east of the Mississippi and drains 12,800 square miles from portions of New York, Pennsylvania, New Jersey, and Delaware.

The natural drainage area of the Delaware River Basin crosses many man-made boundaries in addition to the four state lines: 25 congressional districts, two Federal Emergency Management Agency (FEMA) regions, two Environmental Protection Agency (EPA) regions, five U.S. Geological Survey (USGS) offices, four Natural Resources Conservation Service (NRCS) state offices, two National Weather Service (NWS) local forecast offices, 42 counties, and 838 municipalities. Coordination of efforts is critical for effective flood loss reduction to occur within the basin.

Nearly 15 million people (approximately five percent of the nation's population) rely on the Delaware River for drinking water, of those about seven million people live in New York City and northern New Jersey, outside the basin. Within the basin, the river supplies drinking water to much of the Philadelphia metropolitan area and northern portions of New Jersey. Throughout the Basin, waters are also used for industrial and agricultural purposes.

For the river's entire length, from its headwaters in New York to the Delaware Estuary and Bay, the Delaware also serves as an ecological and recreational resource. Over the past half century, cold-water fisheries have been established in the tailwaters of the East Branch Delaware, West Branch Delaware, and Neversink rivers and the upper main stem Delaware River as the result of cold water releases from the reservoirs. In addition, most of the main stem upstream of Trenton, NJ has been designated by Congress as part of the federal Wild and Scenic Rivers system.

The Delaware River is not only a popular river for fishing and recreation, but it is also an important economic resource. The Delaware River Port Complex is largest freshwater port in the world and generates more than $19 billion in economic activity annually for the region.

Delaware River Basin Commission:

The Delaware River Basin Commission (DRBC) was formed in 1961 by the signatory parties to the Delaware River Basin Compact (Delaware, New Jersey, New York, Pennsylvania, and the United States) to share the responsibility of managing the water resources of the Basin. Commission programs include water quality protection, water supply allocation, regulatory

review, water conservation initiatives, watershed planning, flood loss reduction and recreation.

Geographic Setting:

The Delaware River is very much a product of the cumulative flows from its many tributaries, which in turn take their character from the underlying geology, topography, microclimates and land uses of their watersheds.

The northernmost tributaries to the Delaware River originate in the forested western slopes of the Catskill Mountains that reach elevations of up to 4,000 feet. The East and West Branches meet at Hancock, NY where the Delaware River officially begins. The River descends about 800 feet on its journey to the sea.

The Delaware River Basin straddles two very different hydrologic provinces corresponding to major physiographic divisions: the Appalachian Highlands and the Atlantic Coastal Plain. The fall line is the natural division between these provinces, running southwest to northeast along the western edge of the River and crossing it near Trenton, NJ. Above the fall line, freshwater riverine conditions exist. Below the fall line, the River is subject to tidal influences and, with increased proximity to the Bay, estuarine conditions exist.

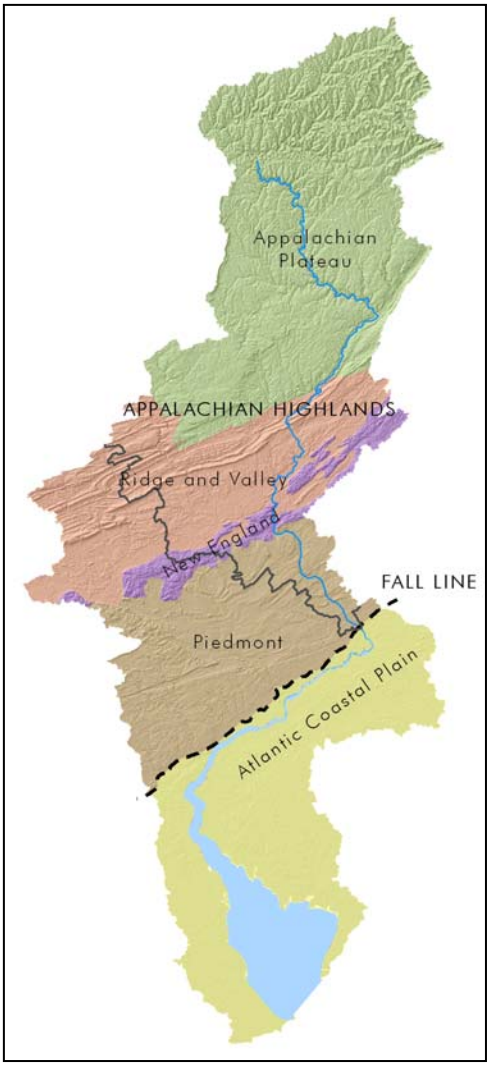


Figure 1-3: Physiographic Divisions

Conditions prior to a rainfall event greatly influence the amount of stormwater runoff delivered to waterways which directly affects whether or not a rainfall event has the duration and intensity which would cause a flood event. Topography, soil type and conditions, ground cover and land use all play important roles. Dry soil accommodates greater infiltration of rainfall and reduces the amount of runoff entering streams. Conversely, soil that is saturated as a result of previous rainfall has a lower capacity for infiltration, resulting in higher rates of surface water runoff.

Population Density:

The 2000 census reported a population of 7.76 million in the Delaware River Basin. In 2000, the average population density in the Delaware River Basin was 603 persons per square mile or about 1 person/acre. Figure 1-4 represents the population density in the Basin. Population density varies across the basin and among watersheds. Density is lowest in the uppermost headwaters of the Basin (ranging from 30 to 100 persons per square mile increasing with proximity to the River and near confluences with major tributaries. The watershed is most densely populated near the greater Philadelphia area (greater than 2,000 persons/ square mile).

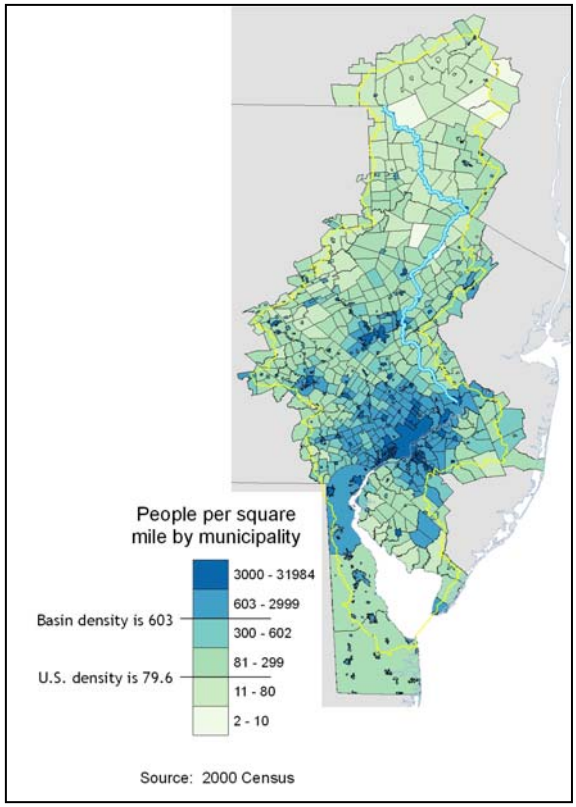


Figure 1-4. Population Density

Watersheds of the Delaware River Basin:

The study area covered by this Plan is composed of the following watershed regions of the Delaware River Basin: Upper Central, Lower Central and small portions of the Upper Estuary. These divisions are depicted in Figure 1-5. As municipal boundaries do not often follow watershed boundaries, watersheds outside the Delaware River Basin are also included in this Plan for those municipalities that are composed of one or more watersheds. These watersheds include small portions of land area that drain to the Wallkill and the Raritan River. These watersheds are described in later portions of this section.

For purposes of assessment and reporting, the *Water Resources Plan for the Delaware River Basin* divides the Delaware River Basin into nine (9) watershed regions. The nine watershed regions are shown below in Figure 1-5.

> Integrating water resource and land management is essential for balancing growth and development needs with water resource stewardship.
>
> Communities that engage in watershed-based planning acknowledge their respective roles as "upstream" and "downstream" stewards of their portion of the watershed, and participate with other communities in the watershed and with partner agencies and organizations can achieve sustainable use and protect water resources. -Water Resources Plan for the Delaware River Basin, Sept. 2004, pg 37.

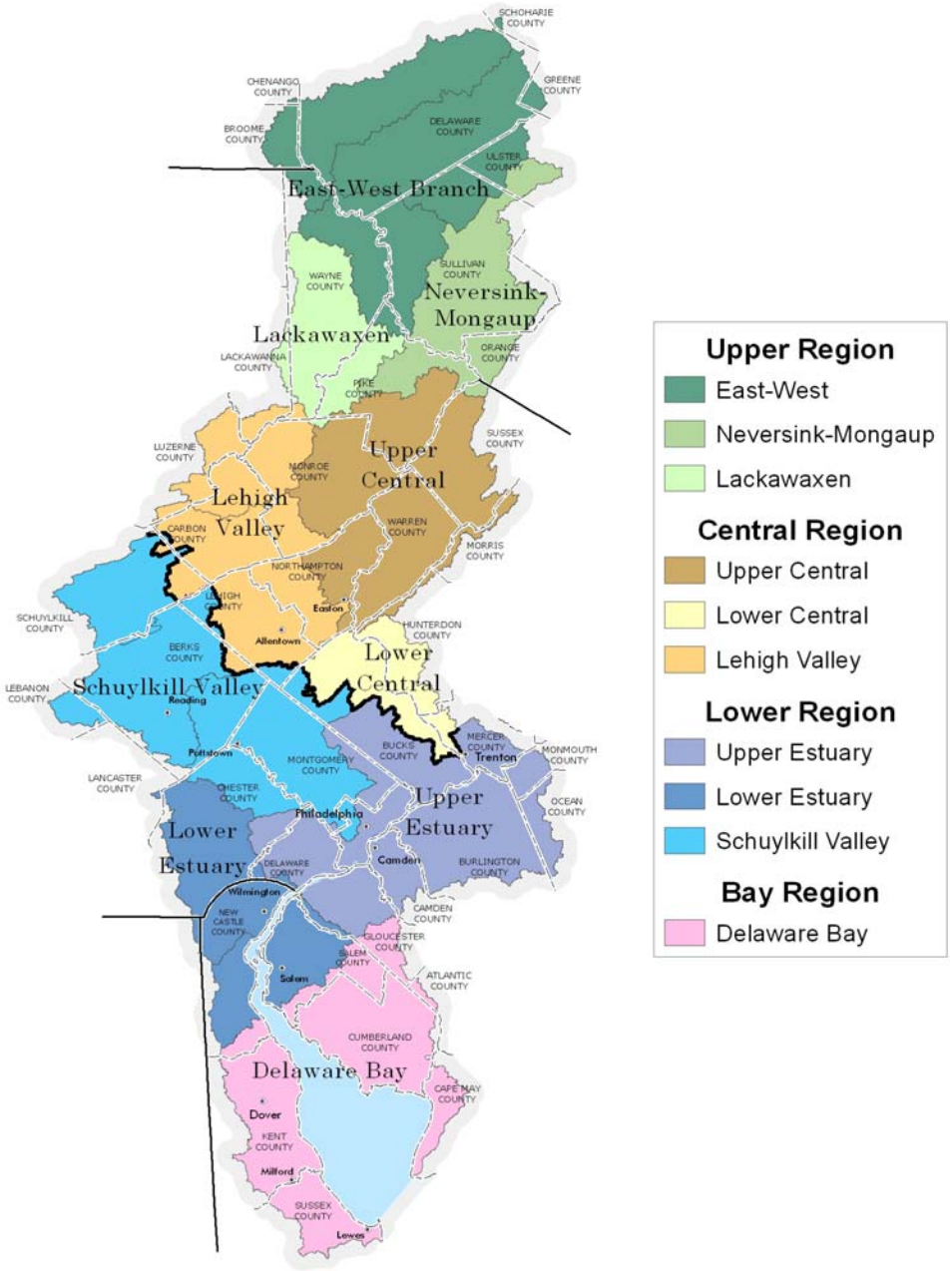


Figure 1-5. Watersheds of the Delaware River Basin

Profile of the Study Area

The proposed study region for this Plan included sixty-four (64) New Jersey municipalities, in Mercer, Hunterdon, Warren and Mercer Counties, which have at least a portion of their land located within the Delaware River Basin. Of the 64 invited to participate, 43 municipalities elected to be a part of the Plan and subsequently met the municipal requirements for satisfactory participation in the Plan.

Demographics

As presented earlier, counties are not represented in this Plan in their entirety. Instead, some municipalities are not included because they fall outside of the Delaware River Basin. Others did fall within the basin, but elected not to participate in this Plan. For brevity in some sections of this Plan, figures such as the census demographics below are reported by county.

Table 1-1: Demographics by County

Census QuickFacts	Mercer County	Hunterdon County	Warren County	Sussex County	New Jersey
Geography:					
Land area (square miles), 2000	225.93	429.94	357.87	521.26	7,417.34
Persons per square mile, 2000	1,552.00	283.7	286.1	276.7	1,134.50
Population:					
Population, 2006 estimate	367,605	130,783	110,919	153,384	8,724,560
Population, percent change, April 1, 2000 to July 1, 2006	4.80%	7.20%	8.30%	6.40%	3.70%
Population, 2000	350,761	121,989	102,437	144,166	8,414,350
Age & Gender:					
Persons under 5 years old, percent, 2006	6.10%	5.30%	5.90%	5.40%	6.40%
Persons under 18 years old, percent, 2006	23.10%	23.20%	24.00%	24.40%	23.90%
Persons 65 years old and over, percent, 2006	12.00%	10.90%	12.60%	9.80%	12.90%
Female persons, percent, 2006	50.90%	50.50%	51.30%	50.40%	51.10%
Ethnicity:					
White, percent, 2006	69.60%	93.10%	93.10%	95.30%	76.40%
Black, percent, 2006	20.60%	2.80%	3.20%	1.70%	14.50%
Native American, percent, 2006	0.20%	0.20%	0.10%	0.10%	0.30%
Asian, percent, 2006	8.10%	3.30%	2.50%	1.80%	7.40%
Hispanic, percent, 2006	12.30%	3.90%	6.00%	5.30%	15.60%
Pacific Islander, percent, 2006	0.20%	<0.05%	<0.05%	<0.05%	0.10%
Foreign born persons, percent, 2000	13.90%	6.30%	5.80%	5.70%	17.50%
Language other than English spoken at home, pct age 5+, 2000	20.20%	8.60%	8.40%	8.30%	25.50%
Education:					
High school graduates, % age 25+, 2000	81.80%	91.50%	84.90%	89.80%	82.10%
Bachelor's degree or higher, % age 25+, 2000	34.00%	41.80%	24.40%	27.20%	29.80%
Persons with a disability, age 5+, 2000	55,055	11,945	15,508	17,976	1,389,811
Household Distribution:					
Housing units, 2006	139,887	48,505	45,076	60,092	3,472,643
Housing units in multi-unit structures, %, 2000	29.00%	13.80%	21.50%	13.60%	36.10%
Median household income, 2004	$57,705	$87,701	$61,281	$71,013	$57,338
Persons below poverty, percent, 2004	8.10%	3.10%	5.40%	4.40%	8.40%

Source U.S. Census Bureau: State and County QuickFacts.

Watershed Divisions

This Plan, in meeting the flood mitigation plan requirements of each municipality, also attempts to employ a watershed management approach to ensure that final mitigation actions address both local jurisdictional needs and regional multi-jurisdictional needs. Flood mitigation planning on a watershed basis is a comprehensive, inclusive and integrated approach that focuses on community-based planning, environmental impacts and economic vitality.

A watershed is an area of land that drains all the streams, rainfall and snowmelt to a common outlet such as a river, lake or mouth of a bay. Each watershed is separated from other watersheds by high points in the terrain, such as hills and ridges. The watershed includes not only the waterway itself, but also the entire land area that drains to it. The decisions each of us makes about use of the resources within our watershed affect its overall health. Watersheds can be defined in varying sizes. A watershed may be very small, like the drainage formed by your own driveway, or very large, like the drainage basin of the Delaware River.

In New Jersey, watersheds are referred to as the name of the water body to which the land area drains and the corresponding Hydrologic Unit Code (HUC). The HUC can range from 2 to 16 digits long- the longer the numeric code, the smaller the watershed area. NJDEP also has divided the state into 21 Watershed Management Areas (WMAs) based on large scale drainage patterns (Figure 1-6). Each WMA encompasses a particular group of major rivers.

The watershed for portions of Sussex County participating municipalities that drain to Hudson River are:

Watershed Management Area 2: **Wallkill**
Watershed Management Area 6: **Upper-Mid Passaic, Whippany, Rockaway**

The watersheds for municipalities that drain to the Delaware River are:

Watershed Management Area 1: **Upper Delaware**
Watershed Management Area 11: **Central Delaware**
Watershed Management Area 20: **Crosswicks Creek**

The watersheds for portions of Hunterdon and Mercer participating municipalities that drain to the Raritan Bay via the Raritan River are:

Watershed Management Area 8: **N&S Branch Raritan**
Watershed Management Area 10: **Millstone**

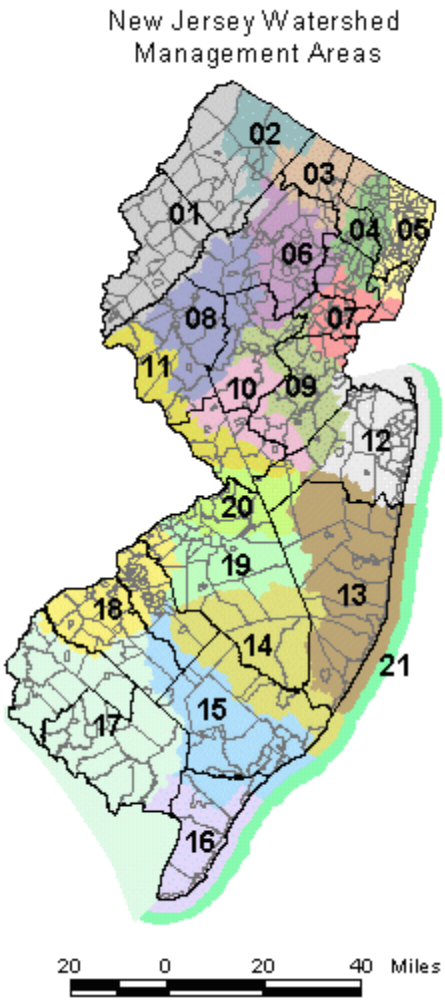


Figure 1-6: NJ Watershed Divisions

As a means of providing an overview of waterways in this Flood Mitigation Plan, the following (presented generally from north to south) is an overview of each Watershed Management Area. Some greater description of the rivers and streams and subsequent areas that experience repetitive flooding can be found in each municipal flood profile and action plan (Section 6).

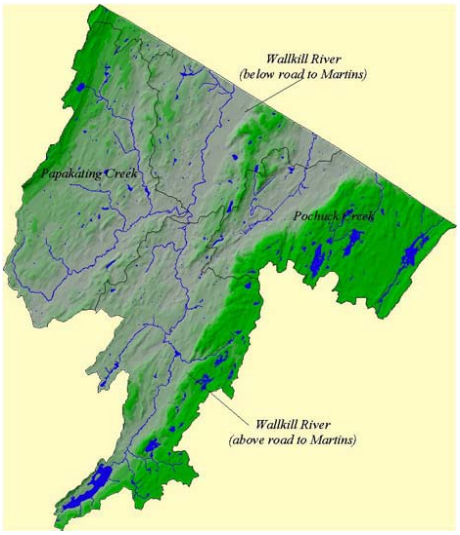


Figure 1-7: WMA 2, Wallkill

Watershed Management Area 2, the Wallkill River Watershed, includes 11 townships in Sussex County. This watershed does not drain to the Delaware. Instead, the Wallkill River Watershed has its headwaters at Lake Mohawk in Sparta Township and flows north into New York State, eventually emptying into the Hudson River.

Four participating municipalities in this Plan have portions of their township that drain to the Wallkill. This includes small portions of Byram, and Montague, in addition to portions of Frankford and Sparta. Key tributaries to the Wallkill in these Townships are the Papakating and Rutgers Creek.

Watershed Management Area 6, the Upper-Mid Passaic, Whippany and Rockaway Watershed, represents the area drained by waters from the upper reaches of the Passaic River Basin including the Whippany River and Rockaway River Watersheds and the Passaic River from its headwaters in Morris County to the confluence of the Pompton River. The watershed lies in portions of Morris, Somerset, Sussex and Essex Counties.

Only one participating municipality in this Plan, Sparta Township in Sussex County, has a portion of their township located in the headwaters of the Rockaway River.

Watershed Management Area 1, the Upper Delaware, includes portions of Sussex, Morris, Hunterdon, and all of Warren County. It contains 54 municipalities, of which 27 are participating in this Plan. This area encompasses 746 square miles in the mountainous northwestern corner of the state, within the Valley and Ridge and Highlands physiographic provinces.

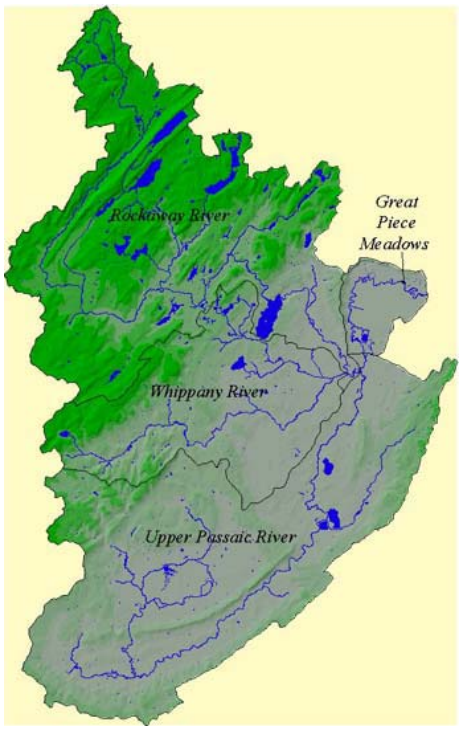


Figure 1-8: WMA 6, Upper-Mid Passaic, Whippany, Rockaway

Within Area 1 there are six major drainage basins: Delaware River, Flat Brook, Paulins Kill, Pequest River,

Lopatcong Creek and Pohatcong Creek, and the Musconetcong River. These major tributaries flow in a southeasterly direction to the Delaware River, and are generally known as outstanding recreational resources for trout production and maintenance, as well as, habitat for an abundance of wildlife including threatened and endangered species.

The 65 square-mile **Flat Brook** watershed lies within state parks and forest boundaries as well as the Delaware Water Gap Recreation Area. Tributaries to the Flat Brook, the Little Flat Brook and the Big Flat Brook, originate in the northwest corner of the state and flow south through the Kittatinny Mountain Ridge until they join together in Sandyston Township to form the Flat Brook. The journey of the Flat Brook is mostly through public land until it joins the Delaware River at Flatbrookville, near Walpack Bend. The river is a classic freestone stream and it continues to be among the highest quality surface waters in the state.

In the 1960s, the proposed dam at Tocks Island on the Delaware River and its 40-mile reservoir would have encompassed the Flat Brook. The dam was a hotbed of controversy in the Delaware Valley for more than ten years, until Congress declared the area part of the national park system, prohibiting development and shelving the project. The federal government collected nearly 70,000 acres of land on both sides of the Delaware during the dam preparations. After the project was scrapped, the land went to the National Park Service and the Delaware Water Gap National Recreation Area was born. Most of the Flat Brook watershed is entirely contained within the Delaware Water Gap National Recreation Area.

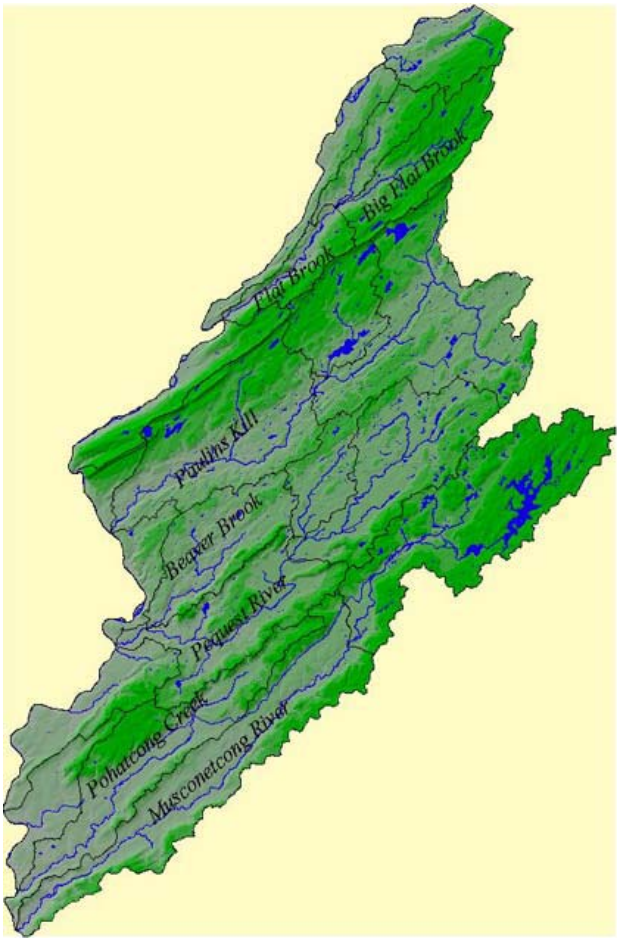


Figure 1-9: WMA 1, Upper Delaware

The **Paulins Kill** is a 28.6 mile long tributary of the Delaware River. The Paulins Kill begins just northwest of Newton, into the northern reaches of Fredon Township. Moore's Brook is one of several small mountain streams that enter the Paulins Kill near its source. The river flows northward into Lafayette Township before curving west where it meets with the combined waters of the Culver Brook and the Dry Brook near the hamlet of Augusta in Frankford Township. The Paulins Kill then flows southwest, through Hampton and Stillwater Townships. The Trout Brook, which rises on Kittatinny Mountain, flows into the Paulins Kill near Middleville in Stillwater Township. A dam was built in the 1920s across the Paulins Kill in Stillwater Township, to create Paulinskill Lake, a narrow, 3-mile long body of water that stretches back into Hampton Township to the north. The Paulins Kill continues its course

southwest, entering Warren County, where it initially forms the border between Frelinghuysen and Hardwick Townships. It enters Blairstown, where it is joined by Blair Creek, as well as Jacksonburg Creek, Dilts Creek and Walnut Creek. Yard's Creek, which rises at the Yard's Creek reservoir in Blairstown, enters the Paulins Kill near the hamlet of Hainesburg in Knowlton Township. Finally, in Warren County its waters enter the Delaware River just south of the Delaware Water Gap at the hamlet of Columbia in Knowlton Township. The Paulins Kill watershed is well recognized for its agriculture and forested area, as well as, recreational opportunities.

The **Pequest River** is a 24.7-mile long tributary of the Delaware River that runs through Sussex and Warren counties. The Pequest starts in the southern portion of Newton and flows southward along the northwestern side of the Allamuchy Mountain ridge near Allamuchy, where it meets Trout Brook. It joins Bear Creek in Bear Swamp and passes through the reclaimed swampy area known as the Great Meadows, lying between the ridges of Jenny Jump Mountain and Cat Swamp Mountain. Some of the land here was drained for cultivation by excavation and clearing of the Pequest and its tributaries. It exits the Great Meadows in a long loop through the gap between Cat Swamp Mountain and Danville Mountain and resumes its course along the southeastern side of Mount Mohepinoke, entering the Pequest Wildlife Management Area. Furnace Brook empties into it as it descends into a small gorge cut between Mt. Mohepinoke and Scotts Mountain. It turns west, and Mountain Lake Brook enters the stream just above Buttzville. It passes west through Bridgeville, turns slightly towards the north, and meets Beaver Brook as it turns southwest again. It tumbles down to Belvidere in a series of falls, where it meets the Delaware River. There are many recreational areas in the Pequest River watershed with land use heavily forested and agricultural.

Lopatcong Creek, a tributary of the Delaware River, originates in Harmony Township and flows southwest to its confluence with the Delaware near the southern end of Phillipsburg. **Pohatcong Creek**, also a tributary of the Delaware River, runs 28 miles in Warren County. It rises in the mountains of eastern Warren County, west of Hackettstown. It flows southwest, in a valley along the northwestern side of the Pohatcong Mountain ridge, which separates its watershed from that of the Musconetcong River. It joins the Delaware in Pohatcong Township, approximately 5 miles south of Phillipsburg. Both the Pohatcong River and Lopatcong Creek are known for their agricultural features.

The **Musconetcong River** is a tributary of the Delaware River, approximately 44 miles long. It flows through the rural mountainous country of northwestern New Jersey. It rises out of Lake Hopatcong, on the border between Sussex and Morris counties. It flows through Lake Musconetcong, then flows southwest, past Stephensburg and New Hampton, passing south of Washington then along the southeastern side of the Pohatcong Mountain ridge. It joins the Delaware across from Riegelsville, Pennsylvania, approximately 10 miles south of Phillipsburg. The watershed contains some developed areas but also many forests and farms. Popular with fishermen, the river is an important recreational fishing resource. On December 22, 2006, 24.2 miles of the Musconetcong River was designated as a component of the National Wild and Scenic Rivers System.

Watershed Management Area 11, known as the Central Delaware Tributaries, includes 24 municipalities within the counties of Hunterdon, Mercer and Monmouth. The predominant drainage funnels to either the Delaware River or the Delaware and Raritan (D&R) Canal. Watershed Management Area 11 covers approximately 272 square miles and is dominated by the Assunpink Creek and its tributaries to the south and smaller creeks in the northern portions. Land uses in this area range from agricultural to urban, most notably in the State Capital, the City of Trenton.

Within Area 11 there are four major drainage basins: Hakihokake/ Harihokake/ Nishisakawick Creek, Lockatong Creek/ Wickecheoke Creek, Alexauken Creek/ Moore Creek/ Jacobs Creek and the Assunpink Creek.

From north to south, the **Hakihokake, Harihokake and Nishisakawick Creeks** are small tributaries to the Delaware River located in northern Hunterdon County. The three originate in Alexandria Township and generally flow southwest to their confluence with the Delaware. The Hakihokake joins the Delaware at Milford. The Harihokake stays within Alexandria Township and joins the Delaware within Township boundaries. The Nishisakawick Creek and the Little Nishisakawick Creek both have their confluence with the Delaware within the Borough of Frenchtown. Even through the Little Nishisakawick Creek originated in Kingwood Township, the mouth of the Little Nishisakawick Creek is only approximately 200 feet downstream from the mouth of the Nishisakawick Creek.

The **Lockatong Creek** has its headwaters in the southwestern part of Franklin Township and flows through Kingwood and Delaware Townships. The **Wickecheoke Creek** originates in Raritan Township, New Jersey and flows through Croton and Locktown. Turning south, it cuts through a low ridge, is joined by Plum Brook and cuts through a second, slightly larger ridge to the west of Sergeantsville. It reaches the Delaware and Raritan Canal and the Delaware River at the Prallsville Mills to the north of Stockton, NJ.

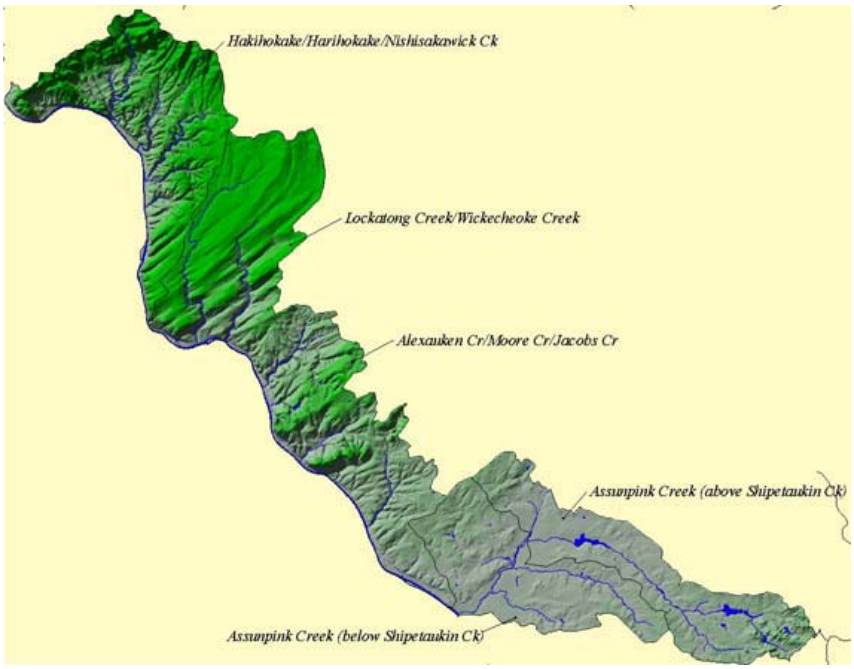


Figure 1-10: WMA 11, Central Delaware

The Lockatong (27.8 sq. mi.) and Wickecheoke Creek (26.5 sq. mi.) watersheds represent nearly 65 percent of the total drainage area to the D&R Canal. The D&R Canal was built in the 1830s to connect the Delaware River to the Raritan River as an efficient and reliable means of

transportation of coal between Philadelphia, Pennsylvania and New York City. The main section of the canal runs from Bordentown on the Delaware to New Brunswick on the Raritan. A feeder canal section stretches 22 miles from Bull's Island near Frenchtown south to Trenton. The feeder canal collects water from higher elevations to the north, and feeds it to the highest section of the main canal, which flows generally north and east to the end. The total length of the entire canal system was approximately 66 miles. The Canal system today is operated and maintained by the NJ Water Supply Authority, a major water purveyor in the state. The Canal serves as the water supply conduit to over 1.5 million Central New Jersey residents. It is also the recreational centerpiece of a 63 mile long linear state park.

The Alexauken Creek/Moore Creek/Jacob's Creek watershed drains a total of 63 square miles of land. It crosses two counties – Hunterdon and Mercer counties, and six municipalities – West Amwell, Hopewell, Hamilton, and Ewing townships; the boroughs of Stockton and Pennington; and the city of Lambertville. **Alexauken Creek and Moore Creek** originate in the Sourland Mountain ridge. The Alexauken heads through Hunterdon County to its confluence with the Delaware River just north of Lambertville. Moore Creek has its confluence with the Delaware in Hopewell Township. **Jacob's Creek** begins in Hopewell Township, at two locations, both near Harbourton Road. From these starting points, the creek flows southeast, through Hopewell Township, into Ewing Township, to form a small portion of the border between the two townships. Finally, it empties into the Delaware River, near Jacob's Creek Road, in Ewing Township.

The upper watershed of the **Assunpink Creek** has both agricultural/rural and suburban land uses. Assunpink Creek is born in rural Monmouth County, about a mile north of Clarksburg. Flowing westwards, it soon enters the Assunpink Wildlife Management Area, where it has been dammed to form Rising Sun Lake. After an unnamed tributary enters from the south, it enters another reservoir, Assunpink Lake. Below Assunpink Lake, the creek flows under Old York Road and flows into Mercer County. New Sharon Branch enters the creek from the south at Carsons Mills. The creek now turns northwest, passing under the New Jersey Turnpike and then U.S. Route 130, just southwest of Windsor. The creek enters Central Mercer County Park, Bridegroom Run enters from the north side as the creek turns west and is impounded to form Mercer County Lake. The Creek then passes under "Quaker Bridge" on Quaker Bridge Road and Interstate 295 before turning southwest and paralleling the Delaware and Raritan Canal. As the river flows through Trenton, its watershed becomes highly urbanized. Portions of the Assunpink are highly channelized for flood control. Miry Run enters near Hutchinson Mills. The canalized stream flows past the Trenton Rail Station and finally empties into the Delaware River in Trenton.

Watershed Management Area 20, Crosswicks Creek, includes 26 municipalities spanning four counties: Burlington, Mercer, Monmouth and Ocean. Although this management area encompasses 253 square miles, the extent of the study region for this Plan is Mercer County.

Crosswicks Creek is 25 miles long and drains an area of 146 square miles to the Delaware River at Bordentown. Its headwaters flow from the Fort Dix and McGuire Air Force Base Military Reserves in a northwesterly direction and then turn sharply south where it meets the Delaware River at the City of Bordentown. Major tributaries include Jumping Brook, Lahaway

Creek, North Run and Doctors Creek. Tides affect this stream up to the Crosswicks Mill Dam. Allentown Lake, Oxford Lake, Prospertown Lake and Imlaystown Lake are major impoundments in the Crosswicks Creek Watershed. Crosswicks Creek is the southernmost waterway included in this Plan.

Figure 1-11: WMA 20, Crosswicks Creek

<u>Watershed Management Area 8</u>, the North and South Branches of the Raritan River and their tributaries, includes large portions of Somerset, Hunterdon, and Morris Counties. The portion of the WMA included in this Plan is solely the South Branch of the Raritan River. The **South Branch** is 51 miles long and flows from western Morris County The South Branch Raritan River is 51 miles long and begins at Budd Lake in Mount Olive Township (Morris County, NJ) and flows through central Hunterdon County into western Somerset County before joining the North Branch of the Raritan River to become the main stem of the Raritan River. The tributary to the South Branch that is included in this Plan is the **Neshanic River**. The two largest reservoirs in New Jersey lie within the South Branch Raritan River watershed, Round Valley Reservoir and Spruce Run Reservoir.

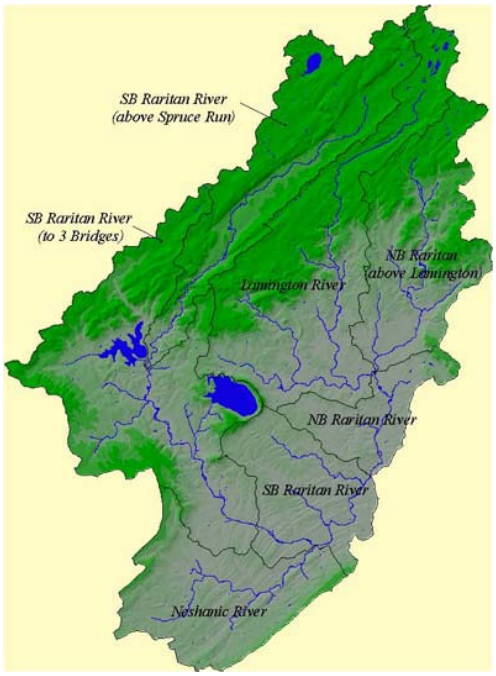


Figure 1-12: WMA 8, Raritan River

Watershed Management Area 10 includes the **Millstone River** and its tributaries. The Millstone River itself is a tributary to the Raritan River. This watershed lies in parts of Hunterdon, Somerset, Middlesex, Mercer and Monmouth Counties. The Millstone River is 38 miles long and flows from Millstone Township in Monmouth County to the Raritan River near Manville and Bound Brook. The tributary to the Millstone included in this Plan is the **Stony Brook** (55.4 sq. mi. drainage area). Other tributaries to the Millstone include Cranbury Brook, Bear Brook, Ten Mile River, Six Mile River and Bedens Brook. Land use in the Millstone Watershed is primarily suburban development with scattered agricultural areas although there is extensive, recent development present in the upper portion.

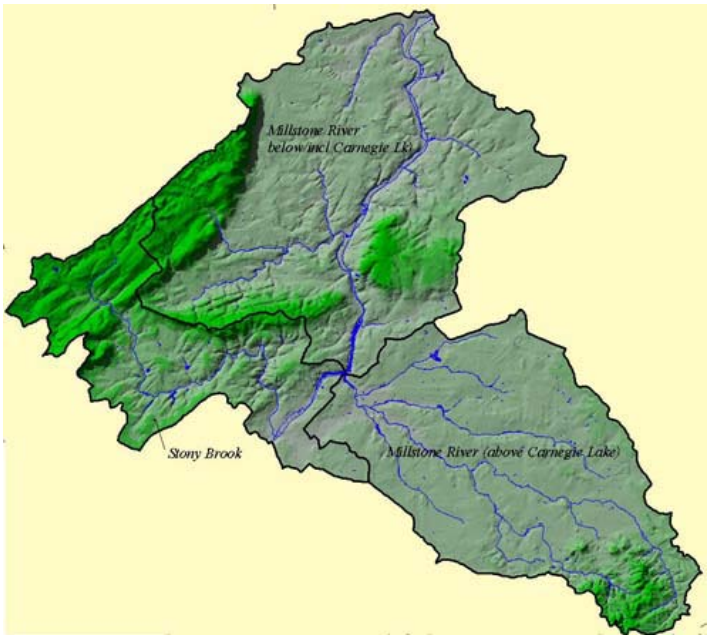


Figure 1-12: WMA 10, Millstone River

Mercer County participating municipalities are composed of portions of Watershed Management Areas 10-Millstone River, 11-Central Delaware, and 20-Crosswicks Creek.

	TOTAL SQUARE MILES	% IN DELAWARE RIVER DRAINAGE BASIN	WATERSHED MANAGEMENT AREAS (WMAs)
MERCER			
EWING TWP	15.1	100%	11
HAMILTON TWP	39.4	100%	11, 20
HOPEWELL TWP	58	50%	10, 11
LAWRENCE TWP	21.9	80%	10, 11
PENNINGTON BOROUGH	1	33%	10, 11
TRENTON CITY	7.5	100%	11, 20

Hunterdon County participating municipalities are composed of portions of Watershed Management Areas 1-Upper Delaware, 8-North and South Branch Raritan, 10-Millstone River, and 11-Central Delaware.

	TOTAL SQUARE MILES	% IN DELAWARE RIVER DRAINAGE BASIN	WATERSHED MANAGEMENT AREAS (WMAs)
HUNTERDON			
DELAWARE TWP	36.9	83%	8, 11
EAST AMWELL TWP	28.1	8%	8, 10, 11
FRANKLIN TWP	23.3	40%	8, 11
FRENCHTOWN BOROUGH	1.1	100%	11
HAMPTON BOROUGH	1.4	100%	1
KINGWOOD TWP	35.6	100%	11
LAMBERTVILLE CITY	1.1	100%	11
LEBANON TWP	31.9	25%	1, 8
MILFORD BOROUGH	1.3	100%	11
RARITAN TWP	38.6	13%	8, 11
STOCKTON BOROUGH	0.6	100%	11
WEST AMWELL TWP	21.6	88%	8, 10, 11

Warren County is entirely part of the Delaware River Basin. Participating municipalities are composed of Watershed Management Area 1, the Upper Delaware.

	TOTAL SQUARE MILES	% IN DELAWARE RIVER DRAINAGE BASIN	WATERSHED MANAGEMENT AREAS (WMAs)
WARREN			
BELVIDERE TWP	1.3	100%	1
BLAIRSTOWN TWP	30.9	100%	1
FRANKLIN TWP	24.1	100%	1
FRELINGHUYSEN TWP	23.6	100%	1
HACKETTSTOWN TOWN	3.6	100%	1
HARDWICK TWP	37.8	100%	1
HARMONY TWP	24	100%	1
INDEPENDENCE TWP	20.1	100%	1
KNOWLTON TWP	26	100%	1
LOPATCONG TWP	6.9	100%	1
MANSFIELD TWP	29.7	100%	1
OXFORD TWP	5.7	100%	1
PHILLIPSBURG TOWN	2.9	100%	1
POHATCONG TWP	14.1	100%	1
WHITE TWP	27.4	100%	1

Sussex County participating municipalities are composed of portions of Watershed Management Areas 1-Upper Delaware, 2 – Wallkill and 6 – Upper-Mid Passaic, Whippany and Rockaway Watershed.

	TOTAL SQUARE MILES	% IN DELAWARE RIVER DRAINAGE BASIN	WATERSHED MANAGEMENT AREAS (WMAs)
SUSSEX			
ANDOVER BOROUGH	1.4	100%	1
BRANCHVILLE BOROUGH	0.6	100%	1
BYRAM TWP	22.5	97%	1, 2
FRANKFORD TWP	34.7	60%	1, 2
FREDON TWP	18	100%	1
MONTAGUE TWP	45.2	98%	1, 2
NEWTON TOWN	3.3	100%	1
SANDYSTON TWP	41.4	100%	1
SPARTA TWP	38.5	50%	1, 2, 6
STILLWATER TWP	27.4	100%	1

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