Appendix P. Watersheds of New Jersey

Appendix P. Watersheds of New Jersey

Watershed Management Area 1 - Upper Delaware

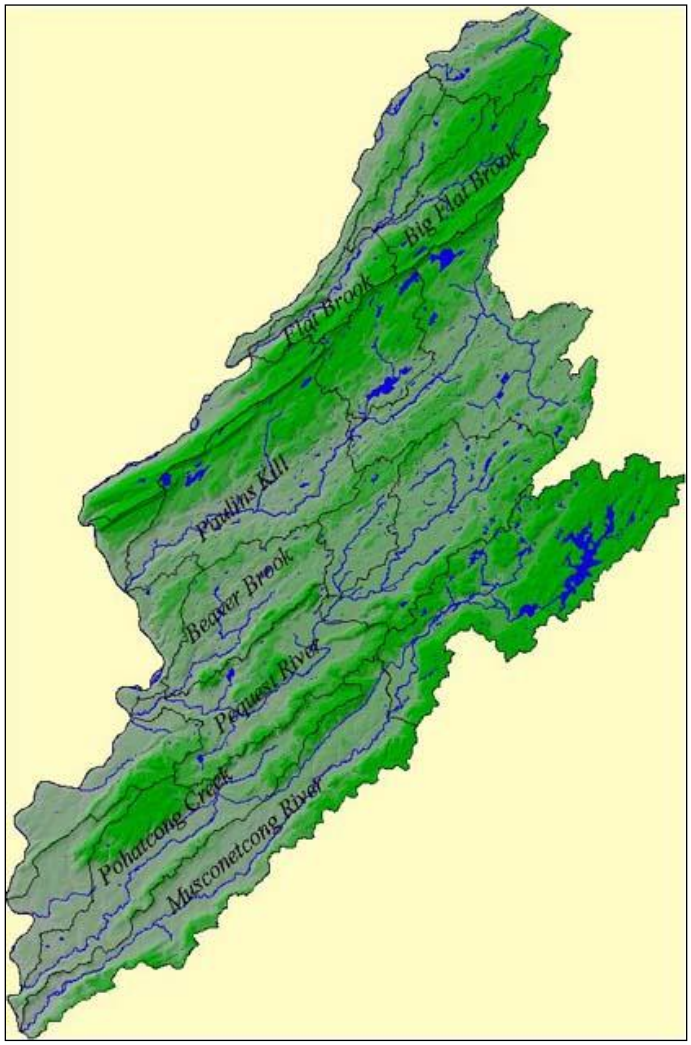
Watershed Management Area 1 (WMA 1) includes portions of Sussex, Morris, Hunterdon, and all of Warren Counties. It contains 54 municipalities. This area, also known as the Upper Delaware River Watershed, encompasses 746 square miles in the mountainous northwestern corner of the state, within the Valley and Ridge and Highlands physiographic provinces.

Within Area 1, as depicted in Figure P-1, there are six major drainage basins:

- Delaware River
- Flat Brook
- Paulins Kill
- Pequest River
- Lopatcong River and Pohatcong River Drainage
- Musconetcong River

These drainage basins flow in a southeasterly direction to the Delaware River, providing an outstanding recreational resource for trout production and maintenance, as well as habitat for an abundance of wildlife including threatened and endangered species.

Figure P-1. WMA 1 – Upper Delaware



Each part of Area 1 has its own characteristics. The 65 square-mile Flat Brook watershed lies within state parks and forest boundaries as well as the Delaware Water Gap Recreation Area. The Flat Brook and its tributaries continue to be among the highest quality surface waters in the State. The Paulins Kill watershed has the most developed centers of this rural area, but it is well recognized for its agriculture and forested area. The water quality ranges from fair to good.

There are many recreational areas in the Pequest River watershed with land use heavily forested and agricultural. As with other watersheds in the northwestern part of the state, there is increasing residential and commercial development. Pohatcong Creek runs 28 miles in Warren County. Both the Pohatcong River and Lopatcong Creek are known for their agricultural features. Water quality is impacted by both agriculture and suburban development. The Musconetcong River runs from Lake Hopatcong to the main stem of the Delaware River. The watershed contains some developed areas but also many forests and farms. Popular with fishermen, the river is an important recreational fishing resource.

Area 1 has been impacted by suburban development over the past decades. As pollution from farming activities such as runoff from crop lands and animal holdings decline, these problems are being replaced with

increasing effects of suburban/urban runoff. The result is increased stream temperatures and elevated levels of sediment, bacteria and phosphorus.

Watershed Management Area 2 – Wallkill

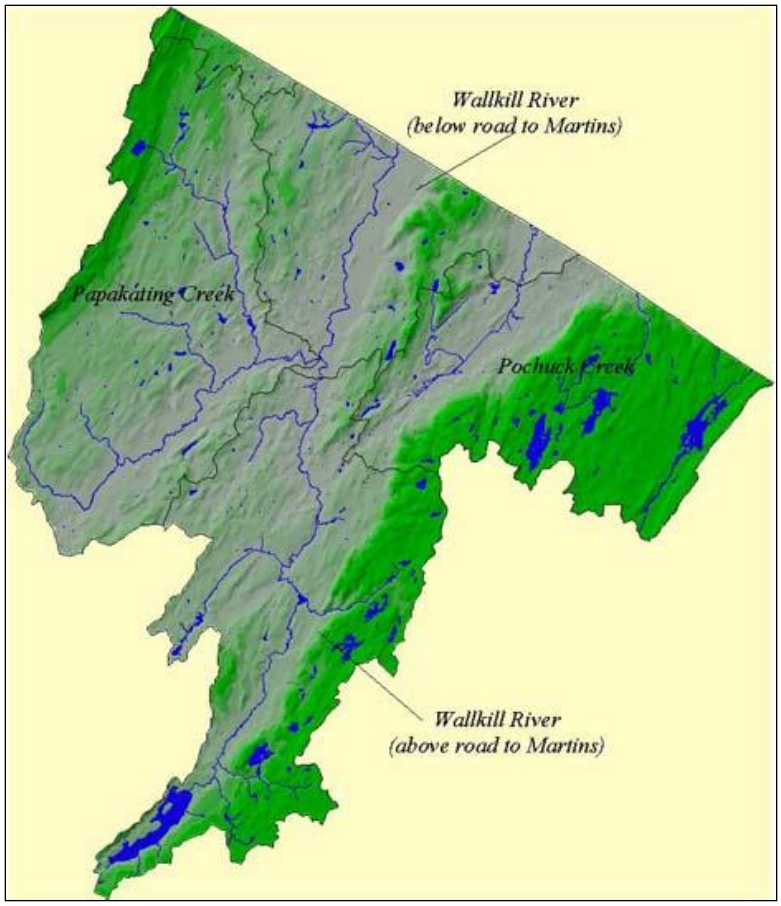
This area is predominantly rural. The largest towns are Vernon, Sparta, Franklin, and Sussex. Key tributaries flowing into the Wallkill include the Papakating (15 miles long) and Pochuck (8 miles long). Creeks, lakes and impoundments in this watershed include Lake Mohawk at the headwaters, Newton Reservoir, Lake Grinnell, Wawayanda Lake and many more.

The four watersheds for Area 2, as shown in Figure P-2, are the:

- Upper Wallkill
- Lower Wallkill
- Papakating Creek
- Black Creek

WMA 2, also known as the Wallkill River Watershed, includes 11 townships in Sussex County. It is recognized as unique because its headwaters begin at Lake Mohawk in Sparta Township and then the river flows north into New York, eventually emptying into the Hudson River.

Figure P-2. WMA 2 – Wallkill



The Wallkill Watershed is about 208 square miles in area. It is composed of a variety of land uses, including rural and centralized residential development, agriculture, commercial, recreational, and industrial usage. The Wallkill River National Wildlife Refuge provides migratory and nesting habitats for numerous birds and waterfowl and is home to several endangered species.

Data collected from monitoring near Sussex and Unionville show mildly elevated phosphorus and bacteria levels in the Wallkill River. Several restoration and protection plans for subwatersheds of the Wallkill River are under development to study the causes of these elevated levels and determine methods to reduce them.

Watershed Management Area 3 - Pompton, Pequannock, Wanaque, Ramapo

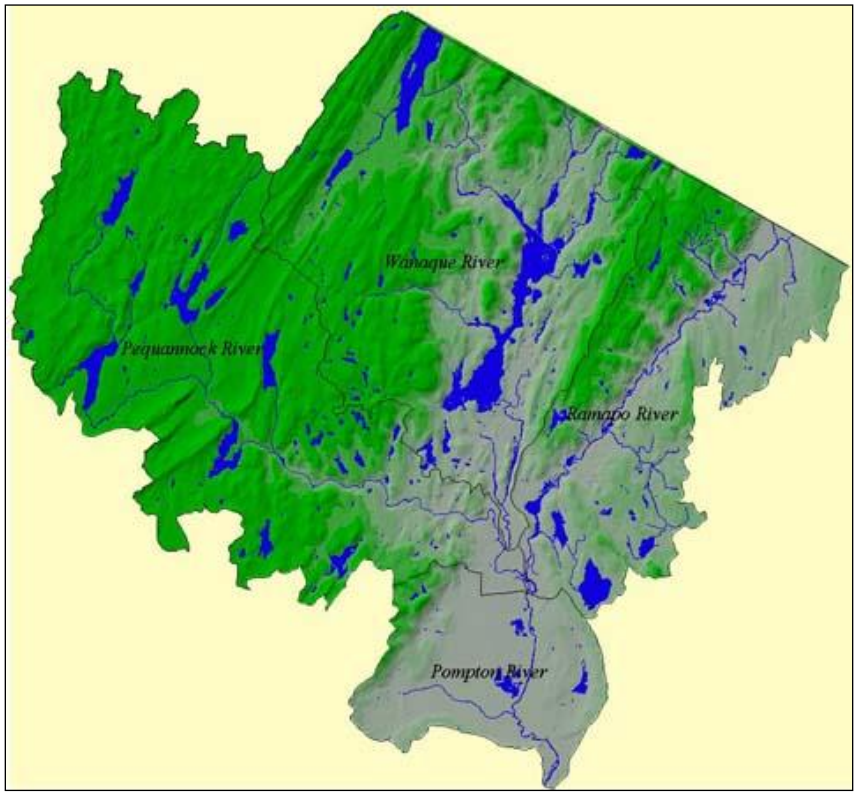
Watershed Management Area 3 (WMA 3) is situated within the water-rich Highlands Province of New Jersey. It lies primarily in Passaic County but also includes parts of Bergen, Morris, and Sussex Counties. With its headwaters in New York State, the Pequannock, Wanaque, and Ramapo Rivers all flow into the Pompton River, a key tributary to the Upper Passaic River.

This area boasts some of New Jersey's major water supply reservoir systems, including the Wanaque Reservoir, the largest surface water reservoir in our state.

As illustrated in Figure P-3, there are four watersheds in Area 3:

- Pompton River
- Ramapo River
- Pequannock River
- Wanaque River Watersheds

Figure P-3. WMA 3 – Pompton, Pequannock, Wanaque, Ramapo



Most of the land in the Pequannock River Watershed is forested and protected for water supply purposes and parklands. The remaining lands are under residential and industrial/commercial use. The Pequannock River experiences excessive summertime water temperatures that could be deleterious to aquatic life.

The majority of land in the Wanaque River Watershed is undeveloped, consisting of reservoirs, parks, and farms. The remaining land is residential with some land being used for industry and commerce.

For Area 3, a key source of nonpoint source pollution is urban/suburban development. Runoff from housing and road construction sites and runoff from urban surfaces and storm sewers have contributed significantly to pollution in the waterways. There is an apparent decline in water quality from siltation and elevated stream temperatures. These sources have degraded the fishery habitat by contributing to excessive situations and elevated stream temperatures.

Watershed Management Area 4 - Lower Passaic, Saddle

Watershed Management Area 4 (WMA 4), shown in Figure P-4, includes the Lower Passaic River (from the Pompton River confluence downstream to the Newark Bay) and its tributaries, including the Saddle River. The drainage area is about 180 square miles and lies within the portions of Passaic, Essex, Hudson, Morris, and Bergen Counties.

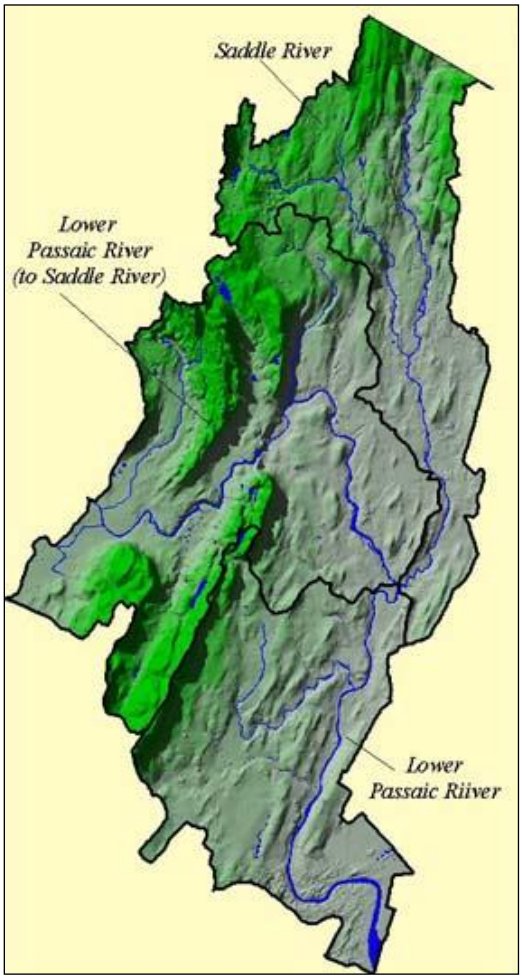
The 129 square miles of land in the Lower Passaic River Watershed is primarily urban/suburban. As a result, water quality conditions along this 33-mile section of the Passaic River are poor, reflective of numerous point sources, significant nonpoint source contributions, and high sediment oxygen demands.

Reflecting the area's industrialized history, the conditions are affected by the number of hazardous waste sites and contamination problems found in these areas.

The Lower Passaic includes a number of waterfalls, culminating in the Great Falls at Paterson.

The Saddle River Watershed has a drainage area of 51 square miles. This watershed is extensively developed and contains many older cities and industrial centers including Newark, Paterson, Clifton, and East Orange. Like the Lower Passaic, the Saddle River's water quality is affected by its industrial past, current point sources of pollution and urban runoff.

Figure P-4. WMA 4 – Lower Passaic, Saddle



Watershed Management Area 5 - Hackensack, Hudson, Pascack

Watershed Management Area 5 (WMA 5) has a drainage area of over 165 square miles. This area includes parts of Hudson and Bergen Counties. As depicted in Figure P-5, there are three watersheds in this area:

- Hackensack River
- Hudson River
- Pascack Brook

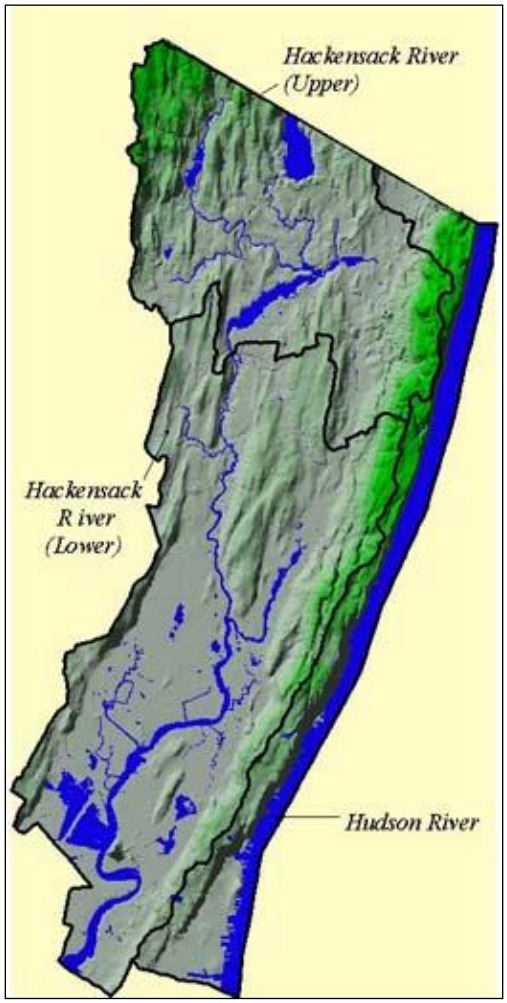
This area is the most populated of all the watershed management areas. About 50% of the land is still undeveloped and more than 30% is residential development. The remaining developed land is commercial/industrial use.

Much of the lower Hackensack River Watershed is tidal marsh known as the Hackensack Meadowlands, home to over 700 plants and animal species including several rare and endangered species.

There are many hazardous waste sites and Superfund sites, which are identified as contaminating local surface waters found in this watershed. As a result, the sale and consumption of striped bass and blue crabs is prohibited.

Water quality is primarily affected by nonpoint sources. They include extensive urban/suburban development and the land disposal of waste materials. The river is also impacted by runoff from construction activities, urban surfaces, storm and combined sewer, roads and landfill leachate. These sources have resulted in flooding, habitat destruction and fish community degradation. They have also affected reduction of dissolved oxygen levels, excessive nutrients and accelerated eutrophication.

Figure P-5. WMA 5 – Hackensack, Hudson, Pascack



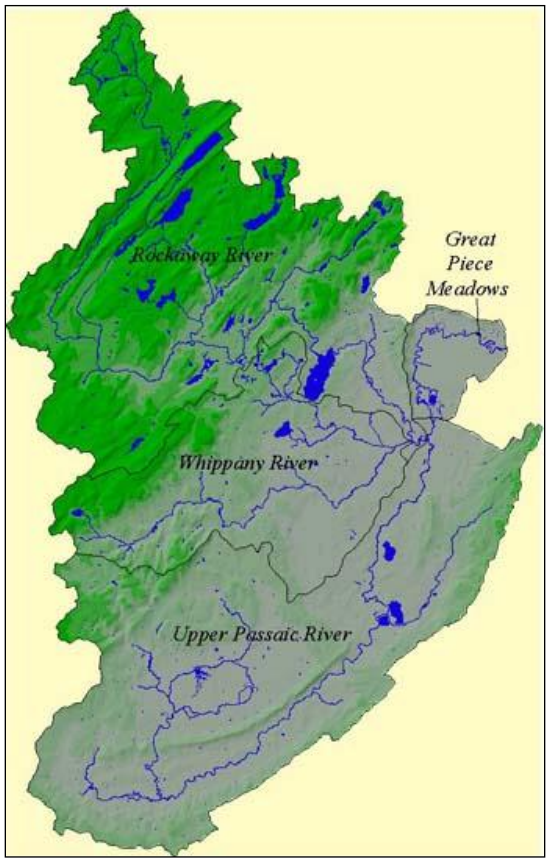
Watershed Management Area 6 - Upper and Mid Passaic, Whippany, Rockaway

Watershed Management Area 6 (WMA 6) represents the area drained by waters from the upper reaches of the Passaic River Basin. This includes the Passaic River from its headwaters in Morris County to the confluence of the Pompton River.

This area is situated in Morris, Somerset, Sussex, and Essex Counties and includes the Upper and Middle Passaic River, Whippany River, and Rockaway River Watersheds, as illustrated in Figure P-6. Extensive suburban development and reliance upon ground water sources for water supply characterize this watershed.

The Upper Passaic River represents a significant source of drinking water for a large portion of northeastern New Jersey. About one half of the land in this watershed is undeveloped or vacant with the rest primarily residential and commercial. This watershed has experienced key development in the more rural undeveloped areas.

Figure P-6. WMA 6 – Upper and Mid-Passaic, Whippany, Rockaway



The land use patterns in the Rockaway River area are complex and include wooded/vacant areas, parklands, and residential development. There are also some areas having industrial and commercial uses. Suburban development is on the rise.

Urban/suburban development is causing the water quality of the Whippany River to be degraded. Runoff from construction activity, stormwater discharges, urban surfaces, and the loss of riparian vegetation are suspected of contributing to siltation in the river. This has resulted in reduction in the trout holding capacity of the waterway.

This area has been severely impacted by urban/suburban development. The quality of water is affected by these conditions. Sources such as construction activities and urban runoff from storm sewers and urban surfaces have resulted in siltation, high stream temperatures and losses of riparian vegetation.

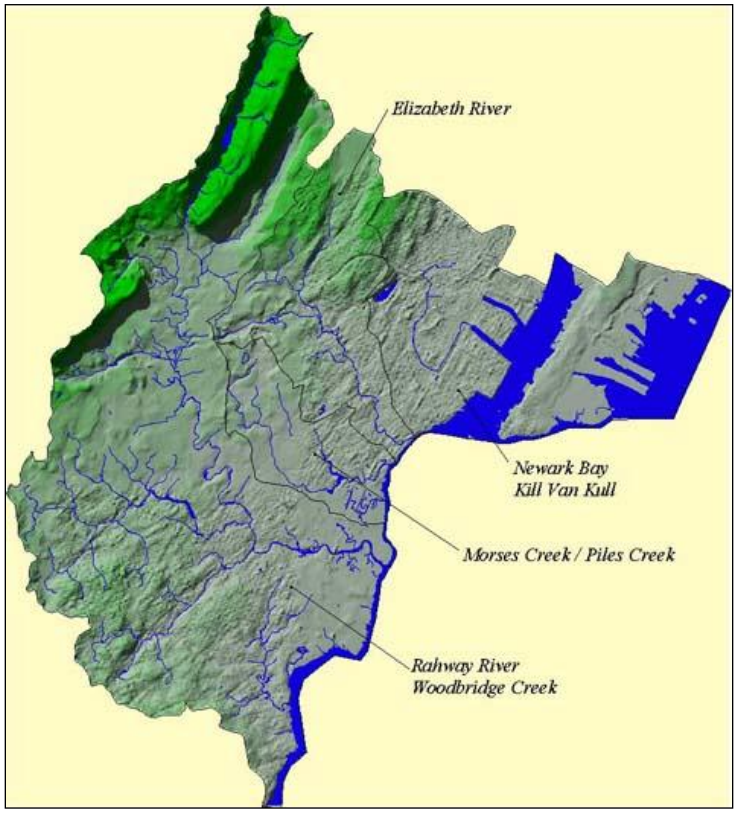
Watershed Management Area 7 - Arthur Kill

Watershed Management Area 7 (WMA 7) is represented by large portions of Essex, Union, and Middlesex Counties.

The mainstem of the Rahway River is 24 miles long, flowing from Union into the Arthur Kill near Linden. It is tidal from the Pennsylvania Railroad Bridge at Rahway down to the mouth. Key tributaries include the East Branch Rahway River, Woodbridge River, and Robinson's Branch. Major impoundments are the Middlesex Reservoir, Orange Reservoir, Lower and Upper Echo Lakes, and Diamond Mill Pond, as shown in Figure P-7.

The Elizabeth River is 11 miles long, much of it channelized for flood control purposes. Land uses in the Rahway and Elizabeth Watersheds are mainly residential, commercial and industrial.

Figure P-7. WMA 7 – Arthur Kill



The water quality of the Rahway and Elizabeth Rivers are reflective of urbanized streams and past industrial uses. Hazardous waste sites are present in these watersheds. Another potential problem could be landfill leachate, which may contribute to the degradation of the tidal Rahway River as well as to the adjacent Arthur Kill, Marshes Creek, and Kings Creek.

Key problems in this watershed include point source pollution, habitat destruction, and flood control. The sources of nonpoint pollution that have been identified include construction activities, storm sewers, urban

surfaces, roads, and combined sewer overflows. All of these conditions have contributed to high stream temperatures, sediment and nutrient loadings, periodic low dissolved oxygen levels and fish kills.

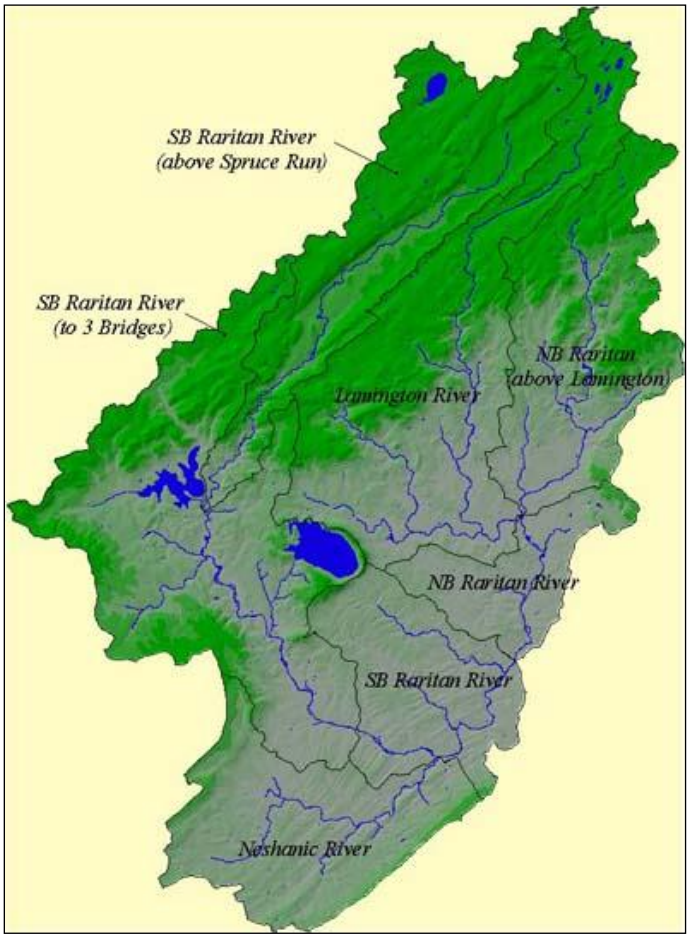
Watershed Management Area 8 - North and South Branch Raritan

Watershed Management Area 8 (WMA 8) includes the North and South Branches of the Raritan River and their tributaries. Large parts of Somerset, Hunterdon, and Morris Counties are included in this area.

The South Branch is 51 miles long and flows from western Morris County through central Hunterdon County and into western Somerset where it joins the North Branch, as depicted in Figure P-8. Major tributaries include the Neshanic River, Spruce Run Creek, Mulhockaway Creek, and Cakepoulin Creek. Major impoundments are the Spruce Run and Round Valley Reservoirs.

The land use in the South Branch Raritan River is mostly agricultural, but suburban and industrial development is increasing at a quick rate. The overall water quality is regarded as good. Warm summertime temperatures threaten the aquatic life, especially in the trout maintenance portions of the river. Elevated lead levels may be threatening the aquatic life support use in the river.

Figure P-8. WMA 8 – North and South Branch Raritan



The tributaries of the South Branch Raritan River indicate there is good water quality with slight nutrient enrichment. The North Branch of the Raritan River is 23 miles long and flows from northwestern Morris County through Somerset County to the confluence with the South Branch between the towns of Branchburg

and Raritan. Major tributaries include the Peapack Brook, Rockaway Creek, and Lamington River and the only major impoundment is Ravine Lake. Land use in the North Branch

Raritan River Watershed is primarily rural, woodland, and agriculture with scattered areas of commercial and residential, but there is intense development along the major road corridors of Routes 24 and 206 and interstate highways 22, 287, and 78.

This watershed is experiencing a trend common around the state. There is a decline in farm activity and a rapid increase in suburban nonpoint sources, contributing to the excessive loading of nutrients and sediments to the waterway.

Watershed Management Area 9 - Lower Raritan, South River, Lawrence

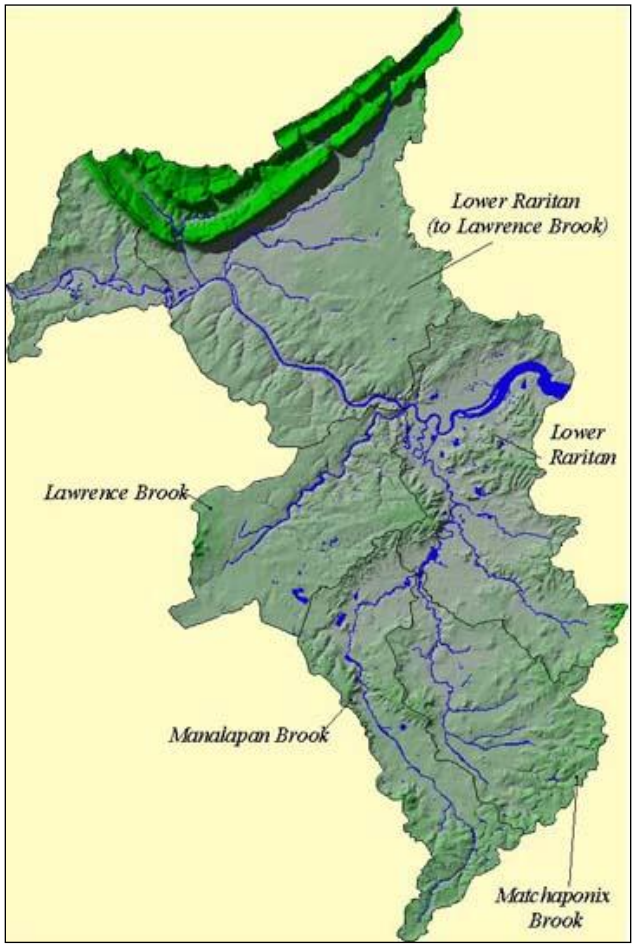
Watershed Management Area 9 (WMA 9) includes the mainstem of the Raritan River, the South River, and Lawrence Brook, as shown in Figure P-9. Middlesex, Somerset, and Monmouth Counties comprise most of the area's political geography.

The Raritan River Basin is the largest river basin situated entirely within our state. The land use in this watershed is mainly urban/suburban, with industrial and commercial centers throughout.

The mainstem of the Raritan River spans from the confluence of the North and South Branches to the Raritan Bay. For the most part, this drainage area is densely populated. There are two low dams in this river, Fieldsville Dam and Calco Dam. Among the many small recreational lakes and ponds in this area are Watchung Lake, Surprise Lake, Spring Lake, and Green Brook Pond (all manmade).

The South River begins at Duhernal Lake in Spotswood and flows to the Raritan River at Sayreville. It is formed by the confluence of the Manalapan and Matchaponix Brooks. Other tributaries include Deep River and Tennants Brook, and major impoundments are Matchaponix Brook and South River.

Figure P-9. WMA 9 – Lower Raritan, South River, Lawrence



Land use in the upper part of this area, the Manalapan and Matchaponix Brooks watersheds, is predominantly agriculture and forests. New industrial and residential development is becoming incorporated into these areas and there is existing, older development in the South River subwatershed.

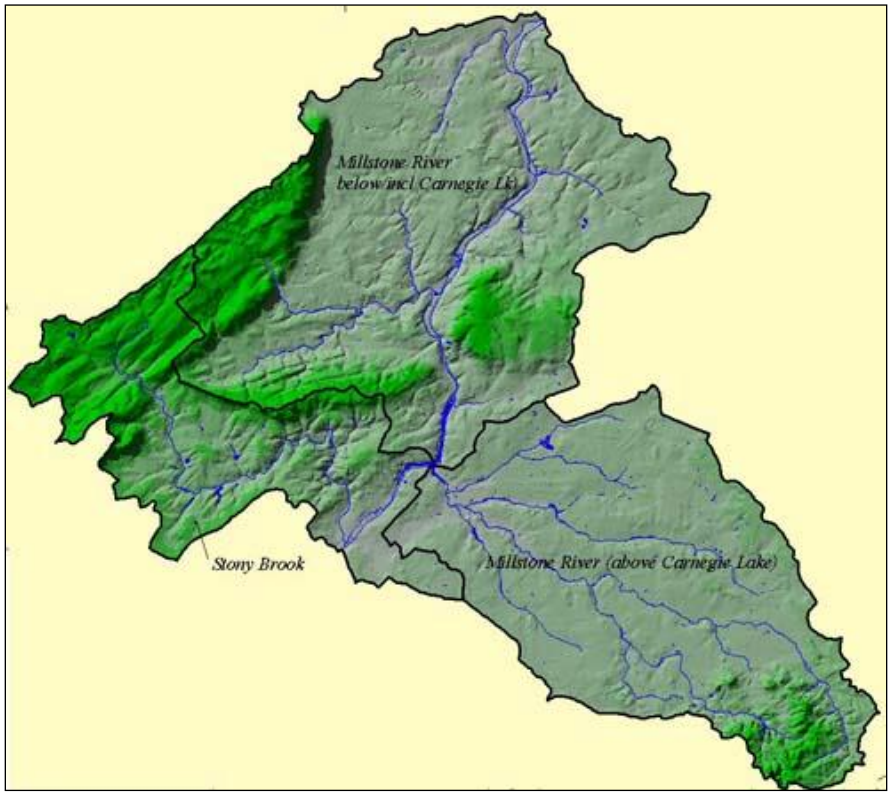
Construction activities and severe stream bank modification have contributed to silt loads and local flooding. There is increasing amounts of runoff from urban surfaces, roads, and storm sewers. These conditions have had an impact on the reduction and quality of fish habitat.

Watershed Management Area 10 - Millstone

Watershed Management Area 10 (WMA 10) includes the Millstone River and its tributaries, delineated in Figure P-10. The Millstone River itself is a tributary to the Raritan River. This watershed is located in portions 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. Major tributaries include Stony Brook, Cranbury Brook, Bear Brook, Ten Mile River, Six Mile River and Bedens Brook and the largest impoundment is Carnegie Lake.

Figure P-10. WMA 10 – Millstone



Land use in the Millstone Watershed is mainly suburban development with scattered agricultural areas although there is extensive, recent development present in the upper portion.

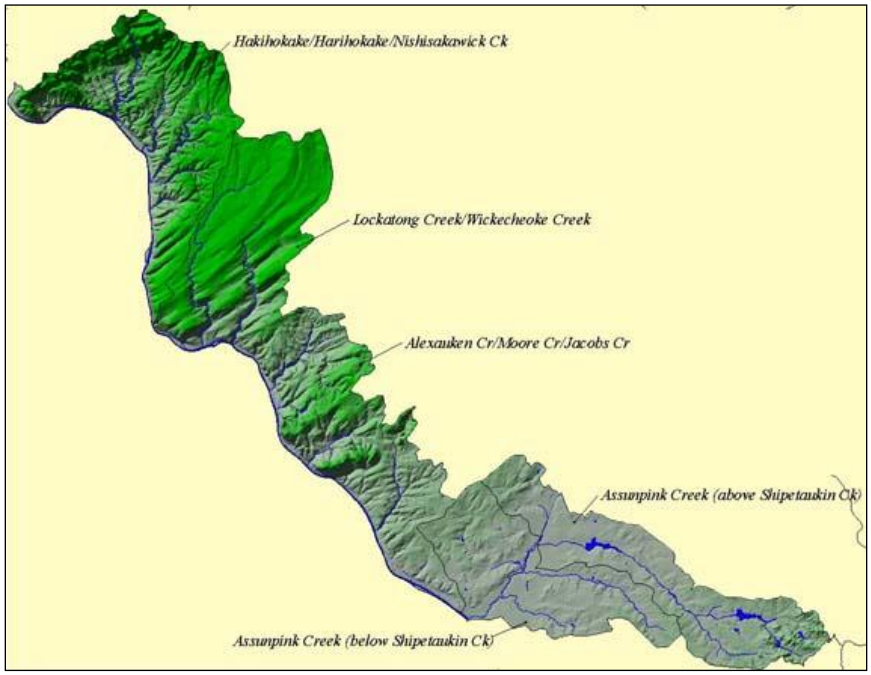
There are many problems in this area, which are associated with suburban development. Some of them include runoff from construction sites, suburban surfaces, storm sewers, and roads. Septic systems are felt to be a potential pollution problem throughout the watershed. And in some areas, this can be a threat to the ground water. It is a combination of agricultural and urban runoff that is suspected of degrading the fish communities in some areas.

Watershed Management Area 11 - Central Delaware

Watershed Management Area 11 (WMA 11), known as the Central Delaware Tributaries, affects the drainage in 24 municipalities within the Hunterdon, Mercer and Monmouth Counties. Area 11 covers approximately 272 square miles and is dominated by the Assunpink Creek and its tributaries to the south and much smaller creeks in the northern portions. The four watersheds in Area 11, presented in Figure P-11, are:

- Lockatong Creek/Wickecheoke Creek
- Hakihokake/Harihokake/Nishisakawick Creek
- Alexauken Creek/Moore Creek/Jacobs Creek
- Assunpink Creek

Figure P-11. WMA 11 – Central Delaware



The area's land uses range from agricultural to urban, most notably in the State's capital city - Trenton. The area has been heavily impacted by suburban development as the population for Area 11 has greatly increased during the past decade. This development has stressed the water resources and affected the water quality.

The land uses for Lockatong Creek/Wickecheoke Creek Watershed is chiefly agriculture and forests. There is residential and commercial development scattered throughout. This area is impacted by runoff from cropland and pastureland. The agricultural sources are believed to be on the decline. They are being replaced by increasing quantities of runoff from road construction and maintenance.

The Assunpink Creek's upper watershed has both agricultural/rural and suburban land uses. Portions of the Assunpink are highly channelized for flood control. As the river flows through Trenton, its watershed becomes highly urbanized and water quality declines.

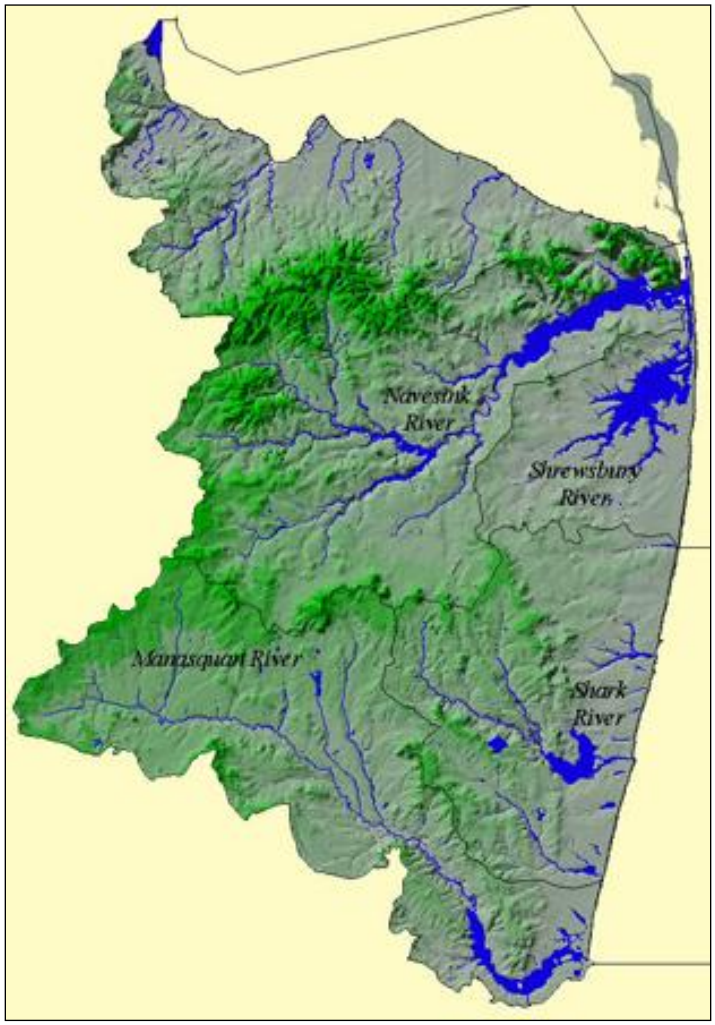
Watershed Management Area 12 - Monmouth

Watershed Management Area 12 (WMA 12) extends from Perth Amboy to Point Pleasant Beach. WMA 12 is composed of an assemblage of coastal subwatersheds, as shown in Figure P-12, all or a portion of which fall into 56 municipalities in the Raritan Bay and Atlantic Coastal drainage basins. The majority of impacted municipalities are in Monmouth County but several lie within the boundaries of Middlesex and Ocean Counties.

WMA 12 is part of the Atlantic Coastal Plain. The soils tend to be sandy closer to the ocean and to have more clay and silt further inland. In general, topography is fairly flat with some hills primarily along the border between the Inner and Outer Coastal Plains. In northern Monmouth County, Mount Mitchell (elevation 260 feet) is part of the Atlantic Highlands and is one of the highest points on the Atlantic Coast in North America.

Land use ranges from agriculture and forested areas to suburban/urban residential and commercial uses. The northern part of WMA 12 is more densely populated than the southern portion. Over the past decade, land use has shifted to more suburban/urban residential uses.

Figure P-12. WMA 12 – Monmouth



Watershed Management Area 13 - Barnegat Bay

Watershed Management Area 13 (WMA 13) drains the central Atlantic section of New Jersey. The Barnegat Bay Watershed is a 660 square mile area encompassing all of the land and water in Ocean County, as well as parts of Monmouth County. The area, as presented in Figure P-13, lies mostly in Ocean County and includes the Barnegat Bay as well as the following subwatersheds:

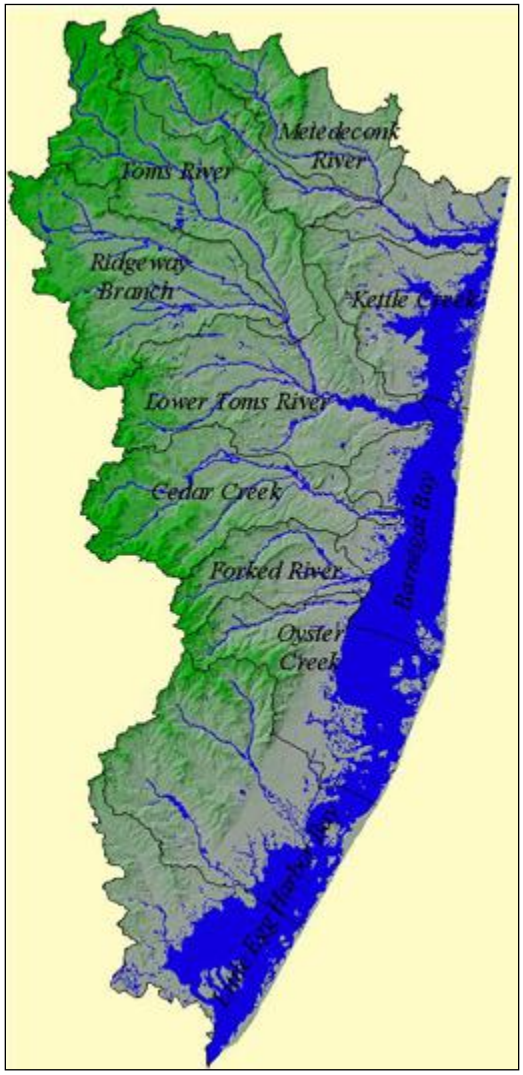
- Metedeconk River
- Toms River
- Forked River
- Cedar Creek

The Toms River drains an area of 124 square miles. It flows from western Ocean and Monmouth Counties southeast to Barnegat Bay at the Town of Toms River, 11 miles north of Barnegat Inlet. This is an area of low relief, containing many small tributaries which feed into the Toms River. The larger tributaries include Davensports Branch, Union Branch, and Wrangle Brook. The watershed also drains a large area of the

Pinelands. Major impoundments include Success Lake and Horicon Lake. Population centers include Toms River, Lakehurst, Dover, and Manchester.

This watershed lies in the Coastal Plain and is about one-half forested, with the remainder residential developments, a military installation and agricultural. There has been a substantial amount of new residential and commercial development throughout the watershed in the past five years.

Figure P-13. WMA 13 – Barnegat Bay



The Barnegat Bay - Little Egg Harbor Estuary is located along the central New Jersey coastline within the Atlantic Coastal Plain physiographic province. Its watershed encompasses most of the 33 municipalities in Ocean County, as well as four municipalities in Monmouth County. Although long recognized for its great aesthetic, economic, and recreational value, this backbay system is now affected by an array of human impacts that potentially threaten its ecological integrity.

The Barnegat Bay Estuary is a 75 square mile environmentally sensitive estuarine system, consisting of aquatic vegetation, shellfish beds, finfish habitats, waterfowl nesting grounds, and spectacular vistas. Its 660 square

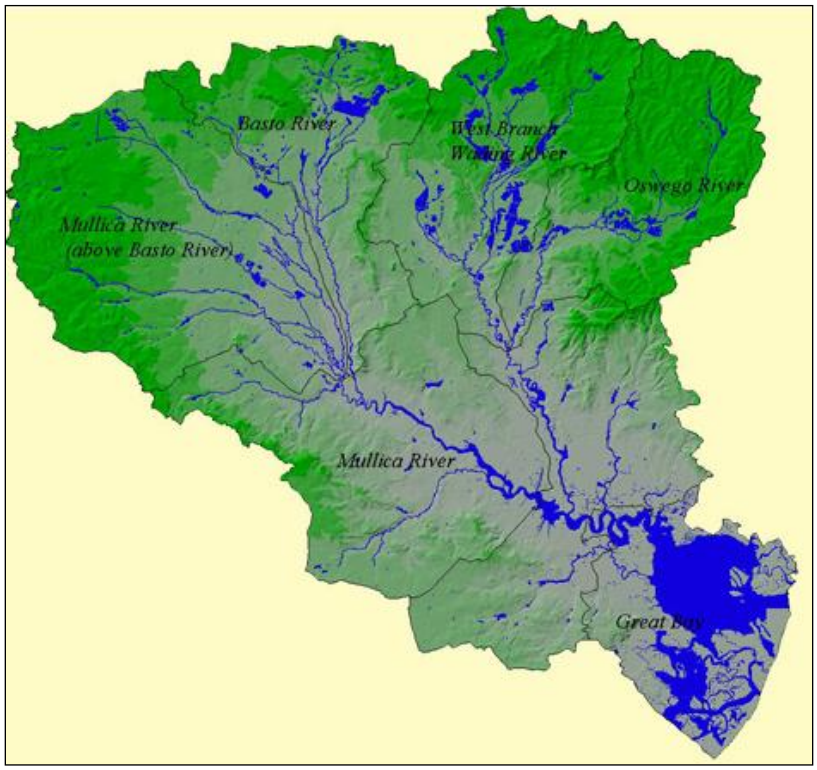
mile watershed is now home for approximately 500,000 people, a population which more than doubles during the summer season.

Watershed Management Area 14 – Mullica

Watershed Management Area 14 (WMA 14) includes watersheds draining portions of the Pinelands of New Jersey, as shown in Figure P-14. Major rivers include:

- Mullica River
- Wading River
- Nochescatauxin Brook
- Atsion Creek
- the Bass River
- Batsto River
- Nescochaque Creek
- Landing Creek
- Hammonton Creek
- Oswego River

Figure P-14. WMA 14 – Mullica



The area lies in Burlington, Atlantic, and Ocean Counties. The Mullica River and tributaries are considered the primary drainage system for the Pinelands. The total area of the drainage basin (Mullica River and tributaries) is some 561 square miles. The area includes the following watersheds: Mullica River, Mechesactauxin Creek, Wading River, Atsion Creek, Batsto River, and Doughty Creek.

The Mullica River empties into Great Bay, a large estuarine system. The population centers are Winslow, Galloway, and Hammonton. About 80% of this watershed consists of state parks and forests, with the remainder being agricultural and developed areas. Much of these waterways are incorporated in the New Jersey Wild and Scenic River System.

Overall, water quality is good and reflective of natural Pinelands conditions. However, the Mullica River is very sensitive to the effects of human activities due to the acidic and low nutrient nature of the pinelands stream environment. Agricultural and suburban runoff can significantly alter natural conditions by adding nutrients and making streams less acidic. These influences are felt in the more developed southern coastal section of the watershed.

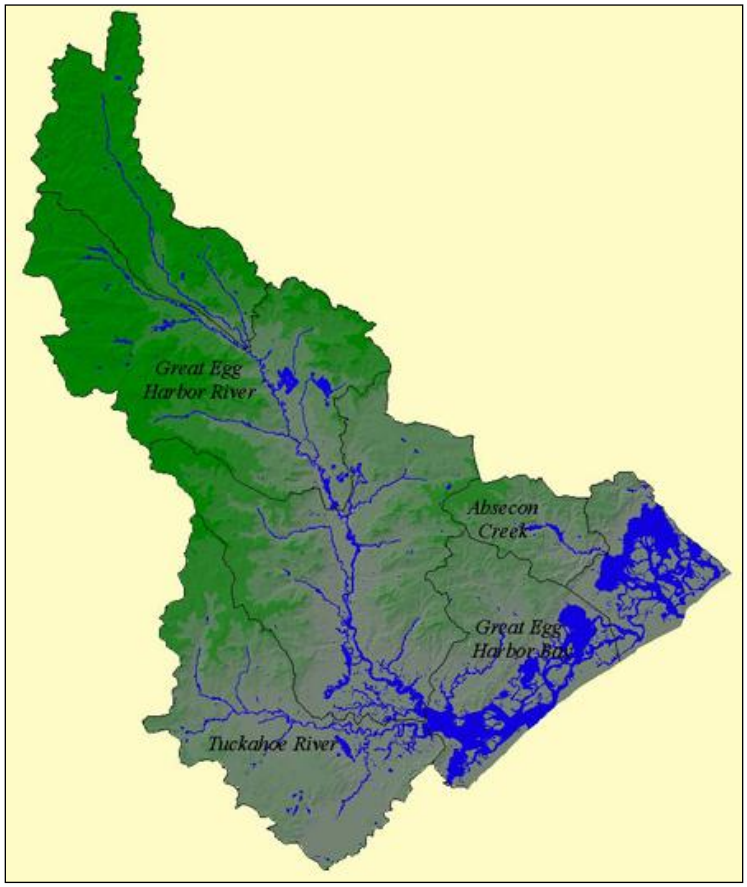
Watershed Management Area 15 - Great Egg Harbor

Watershed Management Area 15 (WMA15) includes watersheds draining to Great Egg Harbor in Atlantic County. The management area encompasses waters draining eastern Gloucester and Camden Counties. The area, as presented in Figure P-15, includes the following watersheds:

- Great Egg Harbor River
- Tuckahoe River
- Absecon Creek
- Patcong Creek

The Great Egg Harbor River is 49 miles long and drains an area of 304 square miles. It originates in eastern Gloucester and Camden Counties, an agricultural and suburban area, before flowing through the Pinelands region. The river drains into Great Egg Harbor Bay before emptying into the Atlantic Ocean. The river is tidal downstream of the dam at Mays Landing.

Figure P-15. WMA 15 – Great Egg Harbor



The watershed's dominant land use is forests, with the remainder agricultural and developed. Population centers include Berlin, Winslow, Monroe, Mays Landing, and Egg Harbor City. The major tributaries are Hospitality Branch, Watering Race, Babcock Creek, Deep Run, South River, and Stephens Creek.

There are many lakes and ponds in this area, but the largest is Lake Lenape, near Mays Landing. Of the approximately 12 New Jersey Pollution Discharge Elimination System (NJPDES) permitted discharges here, about half are municipal and half are industrial/commercial.

Nonpoint source pollution issues related to cropland agriculture dominate the upper reaches of the watershed. In the lower more developed section of the watershed, suburban/urban runoff is the primary contributor.

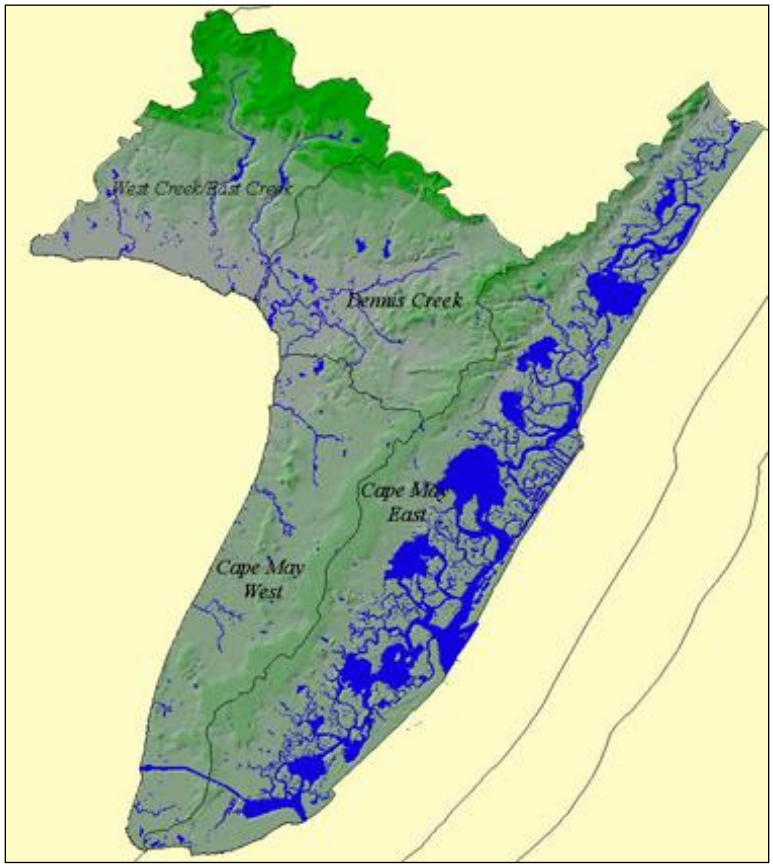
Watershed Management Area 16 - Cape May

Watershed Management Area 16 (WMA 16) includes watersheds draining the Cape May portion of New Jersey. The region includes Cape May County south and east of the Tuckahoe River watershed. The region contains minimal surface water flow. Ground water and shellfish harvesting water quality are the principal water issues. No fixed physical/chemical fresh (surface) water monitoring locations are currently located within this management area. The area, illustrated in Figure P-16, includes the following watersheds:

- Dennis Creek
- Delaware Bay Coastal Drainage
- Cape May Atlantic Coastal Drainage

Cape May County is located at the southern-most portion of New Jersey and represents a continuation of the Atlantic Coastal Plain. The county is 267 square miles in area and is bounded on the north by Atlantic and Cumberland Counties, on the east by the Atlantic Ocean, and on the west and south by the Delaware Bay.

Figure P-16. WMA 16 – Cape May



The region represents a low lying, gently rolling plain whose highest point is 54 feet above sea level and whose surface is largely covered by wet soils and wetlands. Large swamps (Great Cedar, Timber, and Beaver Swamps) occupy the north-central part of the county. Most, if not all, streams are tidal in their lower reaches and terminate by flowing into fresh water swamps that, in turn, discharge into saltwater marshes near the shore.

The county's permanent year-round population is about 77,000 with approximately 42% of the population residing on the barrier islands that comprise the eastern perimeter of the peninsula. The summertime population rises to 564,000 with 69% residing on the barrier islands.

As stated previously, one of the principal water resource issues within this management area is drinking water supply. The resource is largely dependent upon ground water that is in turn highly vulnerable to saltwater intrusion from the west, south and east, especially in the southern portion of the peninsula. The expected increase in population (an expected 68% increase by 2040) is predicted to put further stress on the already overextended water supply.

Watershed Management Area 17 - Maurice, Salem, Cohansey

Watershed Management Area 17 (WMA 17) includes:

- The Cohansey River
- Maurice River
- Salem River
- Alloway, Dividing, Manantico, Manusmuskin, Miles, Mill, Stow, and Whooping Creeks

This area, shown in Figure P-17, includes portions of Atlantic, Cumberland, Gloucester, and Salem Counties; over 39 municipalities; and encompasses 885 square miles. The Cohansey River is nearly 30 miles long, draining 105 square miles of eastern Salem County to the Delaware Bay. This is an area of very low relief, which results in numerous small tributaries. Sunset Lake and Mary Elmer Lake are among 20 major impoundments in this drainage basin. The main land use of this watershed is agriculture, but much of this land is forested.

Figure P-17. WMA 17 – Maurice, Salem, Cohansey

The Maurice River has a drainage area of 386 square miles and meanders south for 50 miles through Cumberland County to the Delaware Bay. The major tributaries of this river are Scotland Run, Manantico Creek, Muskee Creek, Muddy Run, and the Manumuskin River. There are about 20 major lakes in this area, with Union Lake being the largest. The principal land use in this watershed is agriculture.

The Salem River drains an area of 114 square miles and flows 32 miles from Upper Pittsgrove Township west to Deepwater, then south to the Delaware River. The area lies within Salem County, the major population center being Salem City. Much of the lower portions of the river are tidal. Major tributaries of the Salem River include Mannington Creek, Game Creek, Majors Run, and Fenwick Creek. Land use in this watershed is about 40% cropland, with the rest being woodland, tidal/freshwater marsh, urban, and pasture.

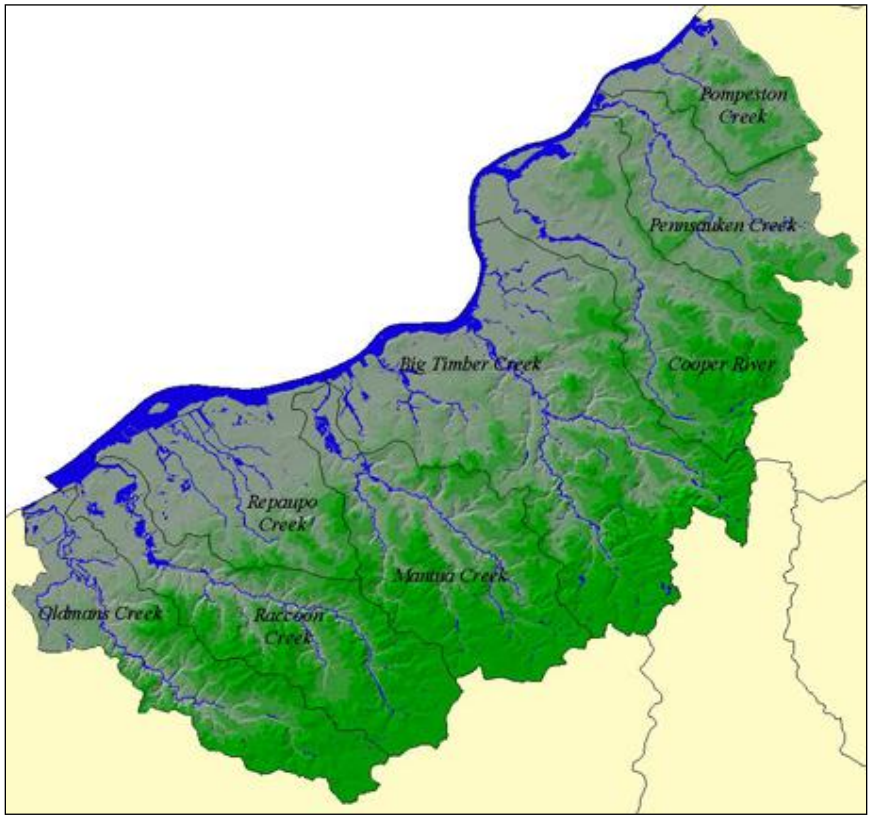
Nonpoint sources of water pollution range from agricultural activities such as tree harvesting, crop production, and animal pastures to urban runoff from construction, septic systems, and urban surfaces.

Watershed Management Area 18 - Lower Delaware

Watershed Management Area 18 (WMA 18) is depicted in Figure P-18 and includes:

- Cooper River
- Big Timber Creek
- Manuta Creek
- Newton Creek
- Oldmans Creek
- Pennsauken Creek
- Pompeston Creek
- Raccoon Creek
- Repaupo Creek
- Woodbury Creek
- Baldwin Run Swamp
- Swede Run Swamp
- Maple Swamp

Figure P-18. WMA 18 – Lower Delaware



This management area covers all or parts of Burlington, Camden and Gloucester Counties, including 68 municipalities, encompassing 391 square miles. The Cooper River is 16 miles long, and its watershed encompasses an area of 40 square miles. The River flows through Camden County to the Delaware River at Camden City.

Big Timber Creek drains an area of 63 miles. The mainstem and most of the south branch divide Gloucester and Camden Counties before flowing into the Delaware River near Brooklawn, south of Camden. Mantua Creek drains an area of 50.9 square miles of land. From its headwaters in Glassboro, Mantua Creek flows 18.6 miles northwest to the Delaware River at Paulsboro.

Oldmans Creek drains an area of 44 square miles and flows on the Coastal Plain to the Delaware River. This Creek, 20 miles long, marks the boundary between Gloucester and Salem Counties. The Pennsauken Creek drains 33 square miles of southwestern Burlington County and northern Camden County. This creek flows into the Delaware River near Palmyra, New Jersey. The North Branch of the Pennsauken is in Burlington County, while the south branch is the boundary between Burlington and Camden Counties.

The Raccoon Creek Watershed contains approximately 40 square miles and drains central Gloucester County. The Creek itself is 19 miles long and flows from Elk Township to the Delaware River, across from Marcus Hook, Pennsylvania.

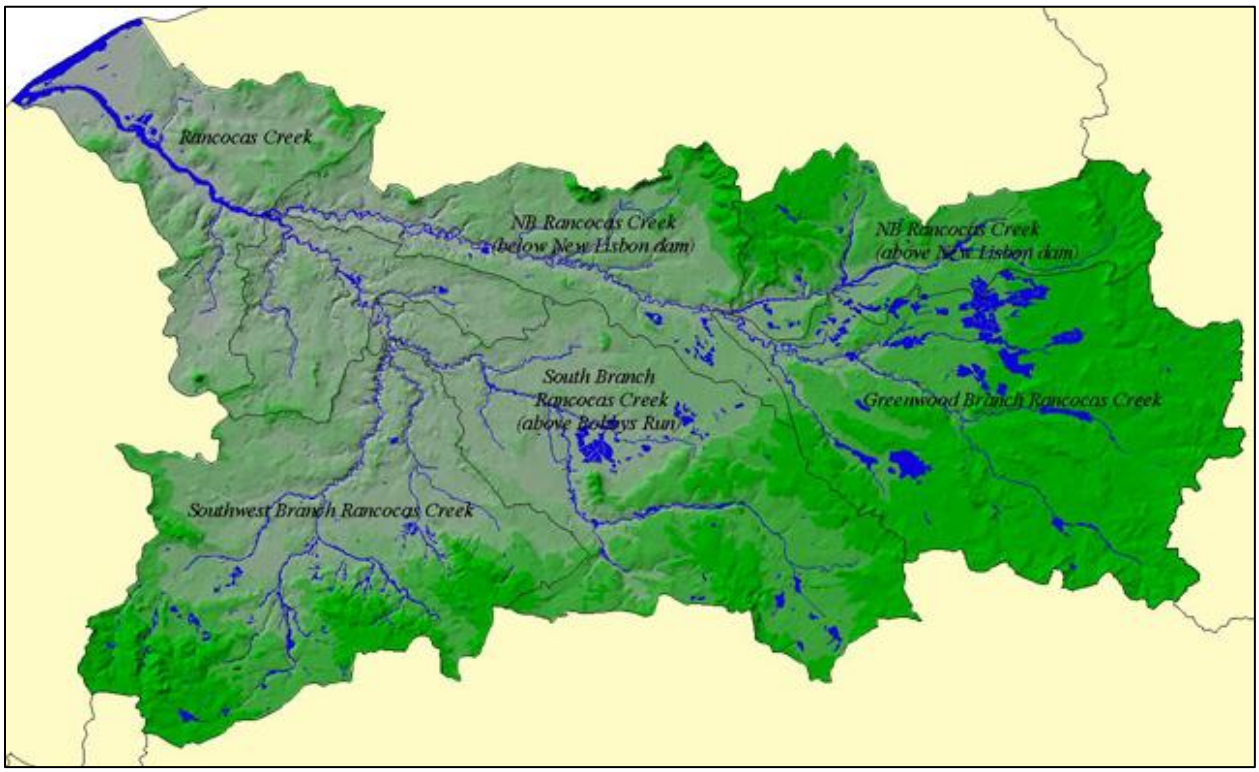
Woodbury Creek is five miles long and drains 18 square miles. It is the smallest watershed in Gloucester County.

Watershed Management Area 19 – Rancocas

Watershed Management Area 19 (WMA 19) is the largest watershed in south central New Jersey. It is composed of:

- the North Branch of the Rancocas Creek
- South Branch of the Rancocas Creek
- Main Stem of the Rancocas Creek, including Mill Creek

Figure P-19. WMA 19 - Rancocas



Portions of Burlington, Camden, and Ocean Counties are included as well as 33 municipalities. Of the 360 square miles in this area, the North Branch drains 167 square miles and the South Branch drains 144 square miles. Starting in Browns Mills, the North Branch is 31 miles long and is fed by the Greenwood Branch, McDonalds Branch, and Mount Misery Brook. The major tributaries to the South Branch include the Southwest Branch Rancocas Creek, Jade Run, Haynes Creek, and Friendship Creek. The watershed extends from the shores of the Delaware River to the interior of the Pinelands.

After the confluence of the north and south branches, the main stem flows about 8 miles and drains an area of approximately 49 square miles before emptying into the Delaware River at Delanco and Riverside.

As part of the Delaware Estuary, tidal influence occurs for about 15 stream miles extending the entire length of the mainstream to the dam at Mount Holly on the North Branch, Vincentown on the South Branch, and Kirby Mills on the Southwest Branch.

Land use is a mix of agriculture, forest and suburban development. Agricultural land is quickly becoming suburban development in this watershed. Runoff from agricultural and suburban development has resulted in elevated pH, bacteria and nutrient levels in many areas.

Watershed Management Area 20 - Assiscunk, Crosswicks, Doctors

Watershed Management Area 20 (WMA 20) includes:

- Assiscunk Creek
- Blacks Creek
- Crafts Creek

- Crosswicks Creek
- Doctors Creek
- Duck Creek
- Mill Creek

This 253 square mile area, shown in Figure P-20, includes 26 municipalities spanning four counties: Burlington, Mercer, Monmouth and Ocean.

Figure P-20. WMA 20 – Assicunk, Crosswicks, Doctors

The largest watershed, Crosswicks Creek, is 25 miles long and drains an area of 146 square miles to the Delaware River at 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, Oakford Lake, Prospertown Lake, and Imlaystown Lake are major impoundments in the Crosswicks Creek Watershed. It also includes the Hamilton/Trenton Marsh.

This area is at the upper reaches of the Delaware Estuary. The streams are tidally influenced although they are considered freshwater.

Nonpoint source issues in the area arise from both agricultural runoff and suburban construction. Elevated levels of phosphorus and fecal coliform bacteria have been noted for some segments of the area.