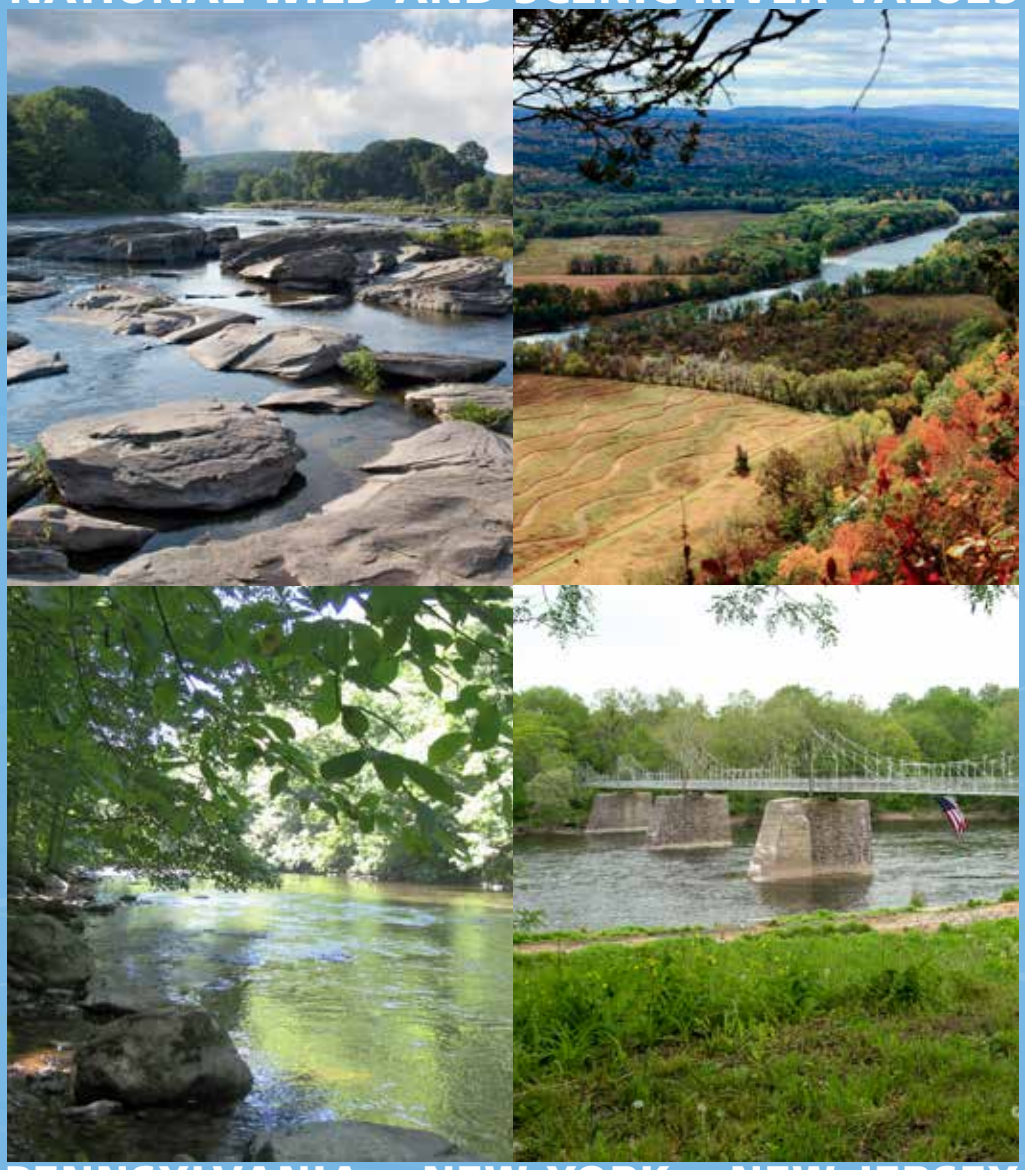
DELAWARE RIVER BASIN

NATIONAL PARK SERVICE | NATIONAL WILD AND SCENIC RIVERS SYSTEM | US DEPARTMENT OF THE INTERIOR

NATIONAL WILD AND SCENIC RIVER VALUES



PENNSYLVANIA • NEW YORK • NEW JERSEY

DELAWARE RIVER BASIN WILD AND SCENIC RIVER VALUES

PENNSYLVANIA, NEW YORK, AND NEW JERSEY

Dear friends of the Delaware River Basin,

What comes to mind when you think about the Delaware River and its tributaries?

Do you think of a beautiful river valley where one can experience solitude in nature and enjoy the incredible scenery of the meandering river and forested hillsides? A family friendly destination that provides great opportunities for boating, fishing, and picnicking? A rare example of a large, undammed river that allows continual natural migration of native fish from the sea to the river headwaters and back? An intact network of aquatic and riparian habitat that supports abundance and diversity of plants, fish, birds, and other animals? A waterway and valley with an incredible cultural history that relays vivid stories about past inhabitants, including native people, European settlers, and early Americans?

The Delaware River basin is all of this, and much more. Because of these unique values, several segments of the Delaware River and its tributaries have been designated for protection under the Wild and Scenic Rivers Act. To help us protect this river system for the benefit and enjoyment of future generations, we have contemplated these special values to determine what makes it outstandingly remarkable.

Knowledgeable people from many agencies and organizations in the region contributed important information, insight, and perspectives on these values, including representatives from the National Park Service, U.S. Fish and Wildlife Service, Delaware River Basin Commission, The Nature Conservancy, and various other river partners from New Jersey, New York, and Pennsylvania.

Based on this hard work and thoughtful input, we are pleased to present to you the outstandingly remarkable values of the designated segments of the Delaware River and its tributaries. The value statements that follow have been developed to provide a strong foundation for the future management and protection of this nationally significant river system—to help us focus our daily attention on the river's most important aspects.

We urge you to read these statements and to share your thoughts with us about what makes the designated segments of the Delaware and its tributaries outstandingly remarkable to you. Thank you for sharing your passion for the Delaware River basin by helping to shape its future!

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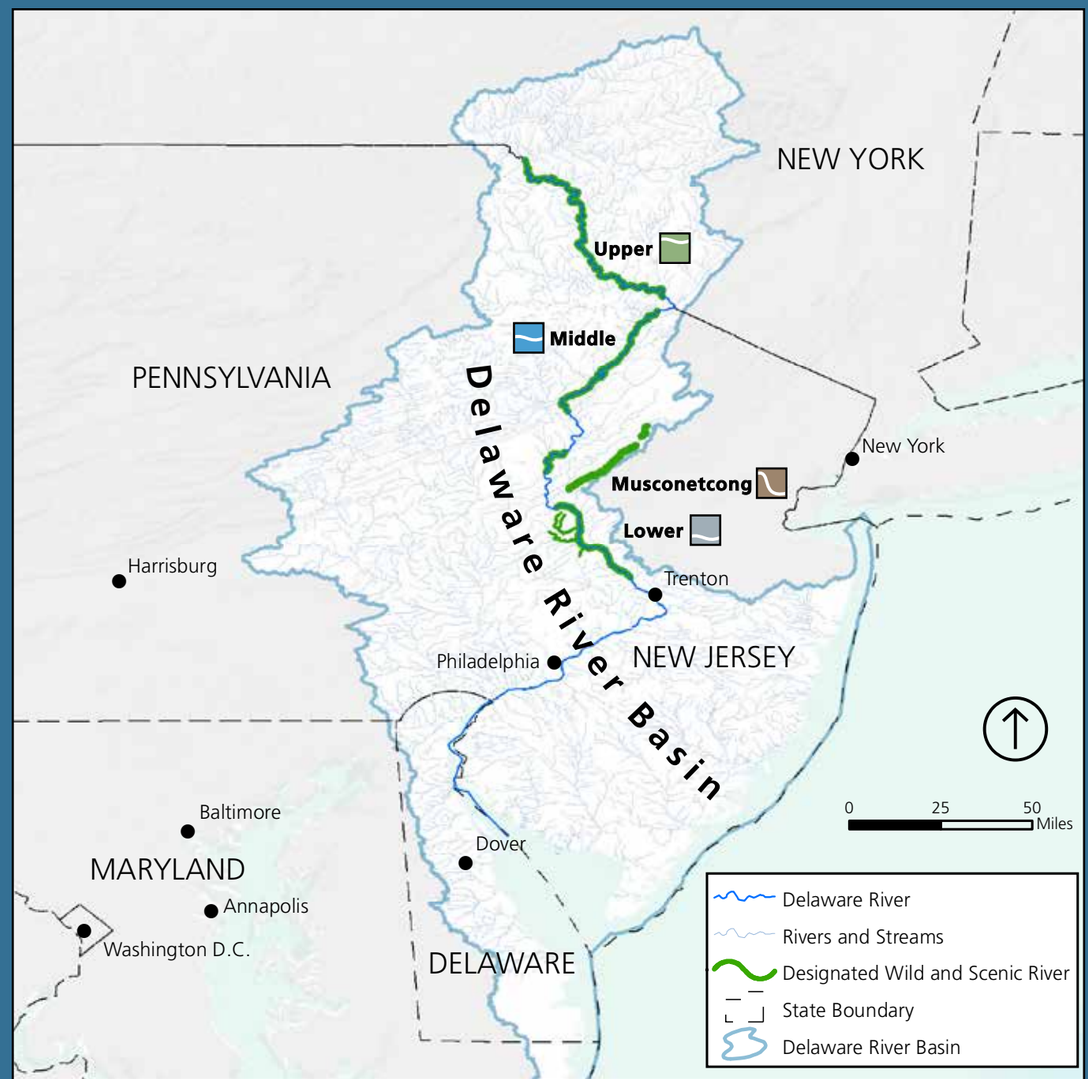
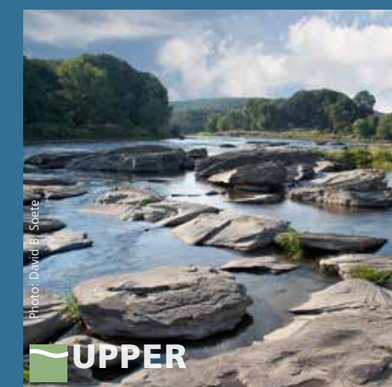
DELAWARE RIVER BASIN WILD AND SCENIC RIVER VALUES





THE WILD AND SCENIC RIVERS ACT AND THE DELAWARE RIVER BASIN

In 1968, Congress passed the Wild and Scenic Rivers Act. The act *"declared to be the policy of the United States that certain selected rivers of the Nation, which with their immediate environments, possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values, shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations."*

Photo: David B. Soete

Each designated river in the national system is to be managed in a way that protects and enhances the values that prompted its designation.

Under the Wild and Scenic Rivers Act, designated rivers are classified as wild, scenic, or recreational. The labels primarily relate to the degree of development along the river, not the proposed uses. And, regardless of the classification, each designated river in the national system is to be managed in a way that protects and enhances the values that prompted its designation. According to the act, the three classifications are defined as follows:

- ***"Wild" river areas*** – Those rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted. These represent vestiges of primitive America.
- ***"Scenic" river areas*** – Those rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads.
- ***"Recreational" river areas*** – Those rivers or sections of rivers that are readily accessible by road or railroad, that may have some shoreline development, and that may have undergone some impoundment or diversion in the past.

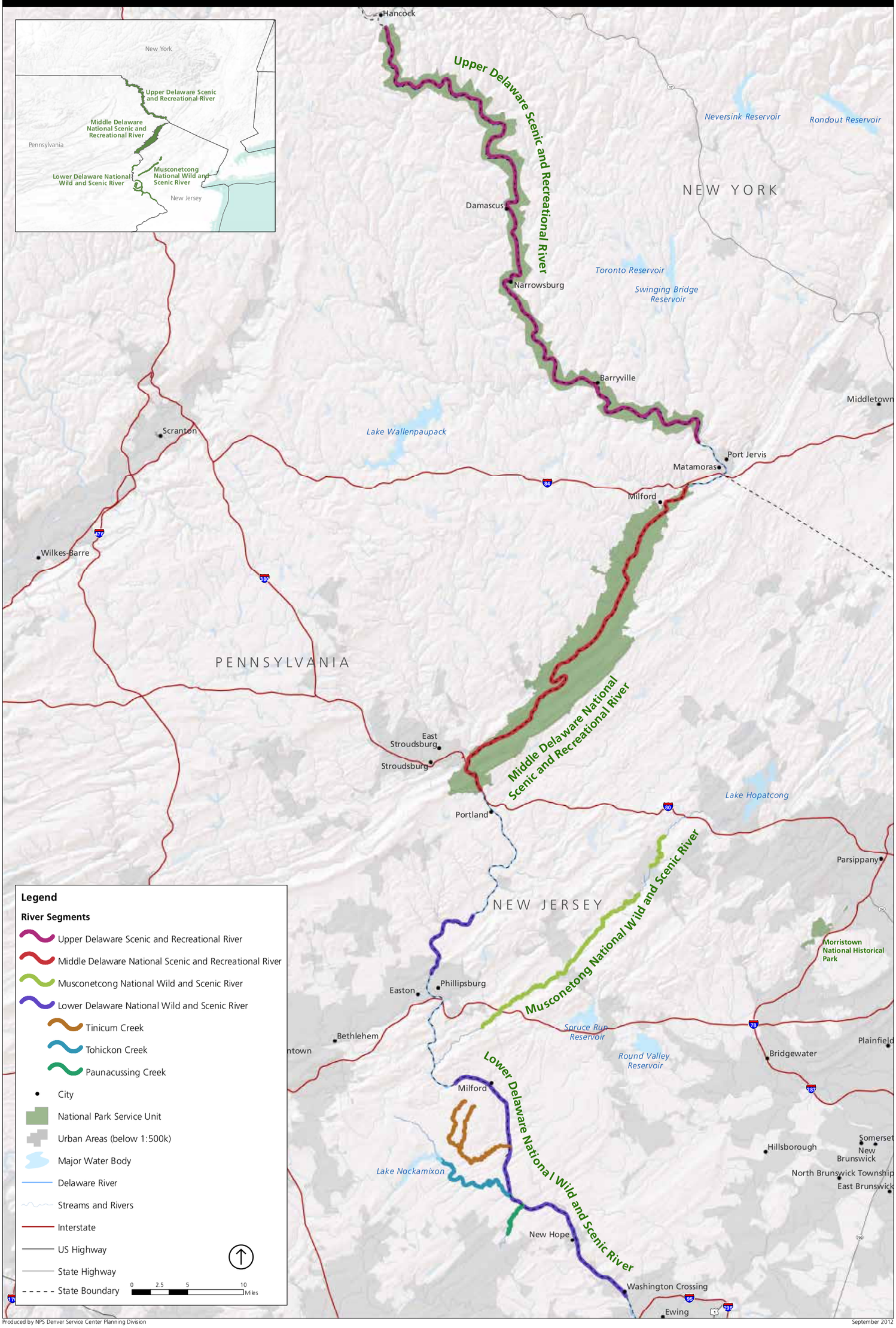
Photo: David B. Soete

In 1978, Congress used the Wild and Scenic Rivers Act to designate the Middle Delaware National Scenic and Recreational River (managed by the Delaware Water Gap National Recreation Area) and Upper Delaware Scenic and Recreational River as national park system units and components of the national wild and scenic river system. Subsequently, in 2000, Congress followed up on these prior designations and acted to designate multiple sections and tributaries of the Lower Delaware National Wild and Scenic River (including Tinicum Creek, Tohickon Creek, and Paunacussing Creek) as a partnership river. Then, in 2006, the fourth river in the Delaware River basin— the Musconetcong National Wild and Scenic River, a tributary to the Delaware—was designated by Congress under the Wild and Scenic Rivers Act as a partnership river and a component of the national wild and scenic river system.

Photo: David B. Soete

Delaware River Basin
Pennsylvania, New York, New Jersey

National Park Service
U.S. Department of the Interior



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WILD AND SCENIC RIVER VALUES OF THE DELAWARE RIVER BASIN

OUTSTANDINGLY REMARKABLE VALUES

Outstandingly remarkable values (ORVs) are defined by the Wild and Scenic Rivers Act as the characteristics that make a river worthy of special protection. Thus, the foundation for wild and scenic river management is a clearly defined set of ORVs. The Interagency Wild and Scenic Rivers Coordinating Council has issued criteria for identifying and defining these values. The criteria guidance states that:

- An ORV must be river related or dependent. This means that a value must
  - be in the river or on its immediate shorelands (generally within 0.25 mile on either side of the river),
  - contribute substantially to the functioning of the river ecosystem, and
  - owe its location or existence to the presence of the river.
- An ORV must be rare, unique, or exemplary at a comparative regional or national scale. Such a value would be one that is a conspicuous example from among a number of similar values that are themselves uncommon or extraordinary.

Based on these criteria and a careful analysis of the designated reaches of the Delaware River and its tributaries, the National Park Service has determined that several ORVs are present. The analysis concluded that the designated segments of the Delaware River basin contain the following ORVs: cultural, ecological, geological, recreational, and scenic. A set of broad statements has been developed that articulates each ORV for the collection of all designated segments of the Delaware basin. These narratives capture the overall, combined values of the river system, as protected under the Wild and Scenic Rivers Act.

An evaluation process for each ORV was then used to determine which river segments contain the different ORVs. The results of this evaluation were used to develop segment-specific ORV statements providing further evidence and support for the broad ORV statements. These segment-specific narratives provide a higher level of detail for the ORVs that are present in each designated segment. The following matrix summarizes the evaluation results and provides organization to the ORV statements and segment-specific descriptions that follow. It indicates which segments of the Delaware River basin possess the above-mentioned ORVs.

In addition to ORVs, the free-flowing condition and water quality of the Delaware and its tributaries are also integral to its designated status. Because free-flowing condition and water quality support the integrity of the ORVs and are key components of future management, they are included as part of this ORV statement.

Photo: Scott Rando

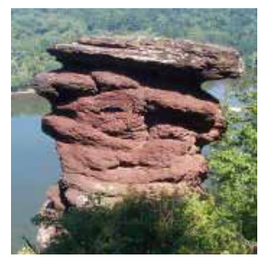


Photo: Dan Mohr

For the purpose of ORV analysis, the designated rivers of the Delaware River basin were divided into the following seven segments. The location map identifies these seven analysis segments. The segments are defined as follows:

Upper Delaware Scenic and Recreational River: From the confluence of the east and west branches (below Hancock, New York) to the existing railroad bridge immediately downstream of Cherry Island in the vicinity of Sparrowbush, New York (73.4 miles)

Middle Delaware National Scenic and Recreational River: Northern boundary of Delaware Water Gap National Recreation Area to the southern boundary (approximately 40 miles)

Musconetcong National Wild and Scenic River: The 3.5-mile stretch from Saxton Falls to the Route 46 bridge and the 20.7-mile stretch from King's Highway bridge to the railroad tunnels at Musconetcong Gorge (24.2 miles)

Lower Delaware National Wild and Scenic River: From river mile 193.8 to the northern border of the city of Easton, Pennsylvania; from just south of the Gilbert Generating Station to just north of the Point Pleasant Pumping Station; from just south of the Point Pleasant Pumping Station to a point 1,000 feet north of the Route 202 bridge; from 1,750 feet south of the Route 202 bridge to the town of Washington Crossing, Pennsylvania (totaling 38.9 miles)

Tinicum Creek: Headwaters of its two upper branches to the Lower Delaware River confluence south of Erwinna and north of Point Pleasant (14.7 miles)

Tohickon Creek: From the Lake Nockamixon dam to the Lower Delaware River confluence near Point Pleasant (10.7 miles)

Paunacussing Creek: Portions passing through Solebury Township to the Lower Delaware River (approximately 3 miles)

RIVER SEGMENT	ORV CATEGORY				
	Cultural	Ecological	Geological	Recreational	Scenic
Upper Delaware River	●	●	●	●	●
Middle Delaware River	●	●	●	●	●
Musconetcong River	●	●	●	●	●
Lower Delaware River	●	●	●	●	●
Tinicum Creek	●		●		●
Tohickon Creek	●	●	●	●	●
Paunacussing Creek	●				●

CULTURAL VALUES

The Delaware River basin is rich and varied in significant historic and cultural sites, from early American Indian history to sites associated with present recreational use such as the Delaware and Hudson Canal Transportation Heritage Corridor hiking/biking trails. Unique among large northeastern rivers, many of these sites are largely intact due to the absence of large-scale industrial and agricultural land use in these river segments of the Delaware River basin.

The Delaware River basin provides evidence of over 12,000 years of American Indian use and occupation, culminating in the Munsee occupation. Minisink was a major center of the regional Indian social network and was the single most important Lenape-Munsee-Delaware community in the Upper Delaware River Valley during historic contact times.

Situated between more accessible areas to the east and south along the Hudson River Valley and Atlantic Coast, and the concentrated British presence associated with the Six Nations to the north, the Delaware Valley provided space for American Revolutionary War patriots to operate. Washington's Crossing, the Minisink Battlefield, Van Campen's Inn, and Military Road are examples of sites along the Delaware River important to the Revolutionary War.

The river valley also provided an extensive transportation network for the extraction of natural resources, including coal, timber, and bluestone, for transfer to the emerging urban centers in the northeastern United States. This history provides a vignette of river-related transportation infrastructure supporting small resource extractive industries that supplied larger-scale industrial development elsewhere. Due to topography, the region's initial transportation system paralleled the river corridor along trails and the river itself, and was succeeded by wagon roads and turnpikes. Later, canals and then railroads also followed the river corridor, allowing farming and dairying to become commercialized. European settlement followed this pattern of river-related transportation, with towns springing up approximately a day's journey apart along the river and at river crossings, fords, ferries, bridges, and aqueducts. Many of the main streets and structures within these towns and hamlets retain their historic integrity and charm, drawing tourists from across the region. The Delaware River Valley also contains numerous national historic landmark (NHL)-listed water transportation-related sites and structures such as the Morris Canal, Delaware Canal, Delaware and Hudson Canal, and Roebling's Delaware Aqueduct, known locally as Roebling Bridge.

Tourism in the valley started in the 1850s with canal boats and expanded by the 1880s with the advent of railroads and construction of hotels serving residents of New York City and Philadelphia. More recently, large natural areas along the mainstem Delaware and its tributaries have been conserved to protect natural values and support recreation, epitomizing a major transformation in public attitudes toward rivers and their resources that started in the late 20th century.

Previously, the Delaware River was valued solely for its water, timber, quarries, and potential for hydropower production. While water supply remains an important function today, conservation of the river's natural and cultural values has supported the development of a heritage tourism industry significant to the Delaware River Valley's continued economic wellbeing.

ECOLOGICAL VALUES

The ecological integrity of the Delaware River system is exceptional among the large river systems of the mid-Atlantic and Northeastern United States.

> As the longest undammed river in the eastern U.S., the Delaware River provides unparalleled access to the full range of habitats for nearly all migratory (diadromous) fish species of the Atlantic Coast.

A combination of exceptionally high water quality, fully functioning floodplains, excellent aquatic and riparian habitats, and the absence of dams on the mainstem contributes to a diverse array of species and a productive, complex food web.

Migratory fish such as the American shad, blueback herring, alewife (federally listed species of concern), sea lamprey, American eel, and shortnose sturgeon (a federally endangered species) maintain their access to key spawning and rearing grounds throughout the Delaware River watershed, from tributary streams in the Catskill Mountains downstream through the mainstem river and tidal estuaries leading to the Atlantic Ocean. Furthermore, the Delaware River occupies a central, core position within the geographic ranges of most of these migratory fish. This core position, combined with the unrivaled connectedness of habitats, underscores the vital role that the Delaware River and its tributaries serve in the long-term persistence of this extraordinary suite of Atlantic migratory fish, most of which are in perilous or declining status.

The migratory fish serve as but one of the key ecological components in a thriving and largely intact array of native species and communities that depend on the connected habitats and quality of the Delaware River and its tributaries. These ecological communities begin with important and globally rare plants and plant communities such as the aquatic indicator species, "threadfoot riverweed" *(Podostemum ceratophyllum),* the globally imperiled calcareous riverside seep and outcrop communities, and the bitternut hickory lowland forest. The ecological integrity of the aquatic invertebrate and freshwater mussel communities is likewise noteworthy, with high abundance and diversity as well as important populations of imperiled species such as the dwarf wedgemussel *(Alasmidonta heterodon)*. The extraordinary complement of migratory fish bolsters a broad guild of native fish, including increasingly rare fish such as the native brook trout and imperiled fish such as the bridle shiner. This diversity and abundance of aquatic species further enhances the riparian and river corridor ecosystem, providing exceptional habitat for species like river otters, mink, black bears, common mergansers, green and blue herons, scarlet tanagers, cerulean warblers, bald eagles, and ospreys. These river corridors and their connection to the Delaware River and tributaries also serve as vital components in the migratory bird flyway of the eastern United States. Together, these interrelated components of aquatic and terrestrial ecosystems complement and enhance the value and function of one another, strengthening their resilience and enhancing their regional importance.

Beyond the habitats and species themselves, interactions among these habitats and species yield ecosystem functions and services unmatched by other large rivers in the region. The lateral connectivity between the river and its extensive undeveloped floodplains moderate flows and reduce peak floods. The high water quality and habitat conditions support an extraordinary abundance of freshwater mussels, which creates a positive feedback loop wherein the mussels maintain and improve water quality through their filter-feeding activity. The combination of both anadromous fish (born in freshwater, migrate to the ocean) and catadromous fish (born in the ocean, migrate to freshwater) provides vital pulses of biomass (energy and nutrients) from the sea to the rivers and in turn provides pulses of biomass from the rivers back to the sea. These ecological processes also provide services essential to our society such as purifying the drinking water for millions in the region, generating fish populations for recreational and commercial fisheries, and reducing the risk of flooding and flood damage.

Photo: David B. Soete

GEOLOGICAL VALUES

The Delaware River traverses the Glaciated Appalachian Plateau Region, the Valley and Ridge Physiographic Province, and the Piedmont Physiographic Province of the Mid-Atlantic Region.

The designated wild and scenic portions of the river system contain a high degree of diverse geological formations that are easily accessible to the public. These features provide evidence of earth's evolution over an approximately billion-year timespan and the influence of many major events in the geologic history of eastern North America. These events include folding and faulting during Appalachian mountain building and the assembly of the supercontinent Pangaea, separation of Pangaea to form the Atlantic Ocean, erosional and depositional forces, volcanic activity, and the extent of ice age glaciers in the region.

The terminal moraine (maximum extent) of the Wisconsinan Glacier (the most recent ice age glacier) began its retreat northward 20,000 years ago. The terminal moraine is a significant feature that crosses the river system.

The Upper Delaware River is the only large river that crosses the small lakes section of the glaciated Appalachian Plateau. Along this upper reach, the river is characterized by glacial and erosional processes displaying a narrow, deep valley with high relief and dramatic rock escarpments. Farther downstream, the Middle Delaware River follows the boundary between the Appalachian Plateau and the Ridge and Valley Physiographic Province before dramatically cutting across the Appalachian Ridge at Delaware Water Gap, a signature geologic feature along Delaware River. Below the gap, the river cuts through a series of transverse geologic formations, including shale and limestone belts and the Little Water Gap at South Mountain.

The northern end of the Lower Delaware River and its tributaries cuts through the Ridge and Valley Physiographic Province, specifically the Great Valley section, reflecting the folding and faulting geology and the rise of the Appalachian Mountains hundreds of millions of years ago. As the Delaware passes the mouth of the Lehigh River at Easton, Pennsylvania, it enters the rocky landscape of the Reading Prong of the New England Province, with its ancient Precambrian and Cambrian formations visible at Riegelsville, Pennsylvania. South of Riegelsville, the river enters the rolling hills of the Piedmont Province (specifically the Gettysburg-Newark Lowland section), which includes most of Bucks County and much of Hunterdon County on the New Jersey side. This Triassic Lowlands geology primarily reflects the sediments that were deposited in basins as the modern continents of Europe, Africa, and North America began to separate from Pangaea to form the Atlantic Ocean. Diverse types of fossils are prevalent at numerous places along the river.

The Musconetcong River, a designated wild and scenic tributary, is a microcosm of the Delaware River, containing many similar geologic features on a smaller scale. In addition, the Musconetcong River contains limestone bedrock formations known as karst. The dissolving solution of limestone causes sinkholes, depressions, caves, solution channels, and irregular bedrock surfaces that add to the dramatic geology of the Delaware River Valley.

The Delaware River system is characterized by a stable yet highly diverse mix of channel types and resulting habitat types. Ancient geologic processes have produced spectacular pools as deep as 113 feet and rapids that provide recreational enjoyment and scenic values. In other places along the river, the recent Holocene glacial deposition and riverine down-cutting and erosion have created island complexes, riffle/pool structures, and floodplain communities. In addition, many of the tributary valleys have narrow, deep gorges with waterfalls tumbling to the river valley below.

Overall, the geologic processes and features of the Delaware River Valley support stable, mature, and complex biological communities. This resilient, healthy river ecosystem includes a variety of micro-climates and habitats that support regionally rare plant and animal communities and optimal riverine macroinvertebrate and fish habitat. The outstandingly remarkable geologic value of the Delaware River is further exemplified by its scientific importance. The river's complex geologic processes and formations provide geologists with a nearly complete record of fluvial deposition through the Holocene. However, debates remain among scientists about how the geology of the river has changed over time, furthering the need for ongoing investigations.

Photo: David B. Soete

RECREATIONAL VALUES

Providing easy recreational access to millions of people in America's most densely populated region, the Delaware River basin provides high quality, natural recreational experiences, which include boating, hunting, fishing, hiking, biking, wildlife viewing, birding, and scenic touring. The Delaware River also provides the opportunity to recreate on the longest undammed river in the eastern United States.

The solitude and picturesque scenery in the Delaware River basin stands in dramatic contrast to the regional metropolitan areas. It provides opportunities for people from diverse backgrounds to enjoy the inspiration of nature, and to rejuvenate and restore themselves.

Traveling through the river basin by foot, bicycle, boat, vehicle, and even excursion trains to view sweeping vistas is a popular source of year-round recreation. Windshield touring allows the visitor to view the tapestry of the Delaware River Valley woven from the geologic and cultural landscape that covers thousands of years of natural and human history. Bicycling routes parallel the entire designated length of the Delaware River offering road cyclists similar experiences while using alternative transportation. The rivers and tributaries provide opportunities for a variety of river trips, ranging from hours to days, for boaters of all abilities. The turns and bends in the river create a sense of remoteness unmatched in the region.

The clear, pristine waters found in the basin draw anglers from across the nation in pursuit of both cold-water and warm-water fish species. Additionally, hunters from across the northeast travel to the area in pursuit of the many big and small game species that can be found in the diverse habitats of the river basin.

Opportunities to experience wildlife along the river are unmatched—visitors travel here to observe black bears that range throughout the river basin. As a critical piece of the Atlantic flyway, the Delaware basin draws birders from across the nation to experience everything from songbirds to waterfowl, to the basin's many raptor species, especially bald eagles.

SCENIC VALUES

The Delaware River and its tributaries flow through narrow valleys framed by steep, densely forested ridges reaching down to the water's edge. This landscape presents an attractive pastoral scene, more tranquil and serene than dramatic or sensational.

Numerous vantage points provide a variety of enclosed and panoramic views. Islands and floodplains, hamlets and farmland, rapids and riffle pools create visual interest and intrigue. The surrounding mixed forests complement the scenery by providing a fall foliage display. The nuances of the changing seasons from spring wildflowers to fall foliage, and the winter fog and ice provide an ever-changing backdrop. The morning mist and evening sunsets add a subtle charm. These scenes have inspired generations of residents, visitors, and artists.

The Delaware River basin exemplifies a mid-Atlantic watershed, crossing many geologic provinces, with scenic values largely preserved from development. The mainstem corridor and designated tributaries provide continuous views of a landscape shaped by geology and historic settlement patterns. The diversity of historic bridges—suspension, stone arch, truss (several are included in the National Register of Historic Places)—is particularly notable. There are many other unique scenic features, including iconic views of the Delaware Water Gap. In addition to the foregoing elements that contribute to the Delaware River's extraordinary scenic values, the area also provides a rare opportunity in the tri-state region / Delaware Valley region to view the Milky Way because of the dark night skies.

Photo: David B. Soete

Upper Delaware Scenic and Recreational River

Pennsylvania, New York

National Park Service
U.S. Department of the Interior

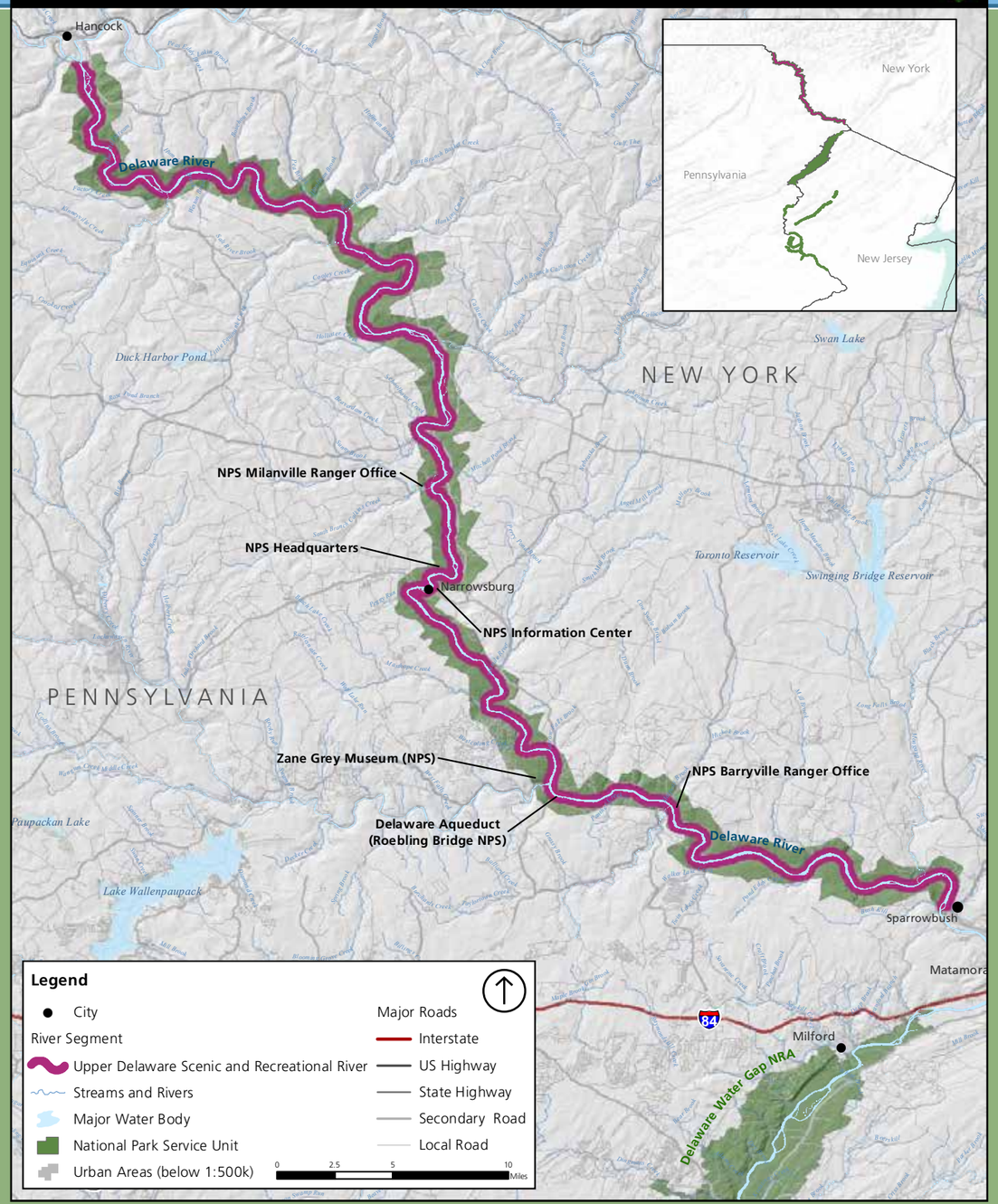


Photo: David B. Soete

UPPER DELAWARE SCENIC AND RECREATIONAL RIVER

The outstandingly remarkable values that make the Upper Delaware Scenic and Recreational River worthy of protection under the Wild and Scenic Rivers Act are described on the following pages.

CULTURAL

"Although it lies just to the west and northwest of the Boston-to-Washington urban corridor, the Upper Delaware River appears relatively untouched by the frenetic pace of the mid-20th century. The Upper Delaware and its riverside communities have managed to retain those qualities and values of earlier times which elsewhere have passed into memory, perishing in the onslaught of industrialization, modernization, urban sprawl, and other similar forces of contemporary life. The counties which form the …region have remained essentially rural… some of these qualities and values may still be seen as they appeared to earlier eyes. This special quality, this pace of daily life, is easily discernible by comparison with the large cities and suburban overflows of the Eastern Megalopolis …"[1]

Photo: Don Hamilton

Dating from the paleo through the transitional period, 437 documented pre-contact archeological sites record a rich cultural tapestry of riverine occupation of aboriginal people who used the river as a trade route. Eighteen archeological sites worthy of more detailed investigation and one site eligible for listing in the National Register of Historic Places (NRHP), taken collectively with the archeological sites on downstream segments, are exemplary of Munsee peoples and their predecessors. Several privately owned archeological sites illustrate the history of early European settlers who arrived in the mid-18th century. Remnants of the early settlements along the river help to convey the history of the early subsistence period to the mid-1700s, including small-scale rural hydro-powered industry in the northeast, while the NRHP-listed Minisink Battleground Park tells the story of a Revolutionary War battle between local residents and militia, and Indians and Tories under the command of Joseph Brant.

Photo: David B. Soete

Extractive industries dependent on water power and water-related transportation spurred an industrial economy, contributing to a pattern of hamlet settlement identifiable today. The timber rafting industry was introduced in the 1760s to transport ship's mast-length logs to Easton and Philadelphia. From the end of the Revolutionary War to the early 1900s, this industry fed the local economy, stripping the hillsides of white pine and hemlock, while contributing to the growth of colonial America.

Early 1800s technological development spurred construction of historic transportation routes dependent on the river and valley geology for defining their routes, each contributing to the cultural profile of the Upper Delaware. Timber, coal, and bluestone transported to coastal markets contributed to growth of the early American economic centers.

1 The Upper Delaware River, A Wild and Scenic River Study, U.S. Bureau of Outdoor Recreation, 1973

The first business in the United States to be capitalized for a million dollars, the Delaware and Hudson (D&H) Canal operated from 1829 to 1898. The 171-mile-long engineering feat included 16 miles of gravity railway, 108 locks over 108 miles, and four cable-suspension aqueducts to connect the coal fields of Pennsylvania with the Hudson River and New York City markets. Roebling's Delaware Aqueduct carried the canal across the Delaware between Lackawaxen, Pennsylvania, and Minisink Ford, New York. North America's oldest existing wire suspension bridge, this NPS-owned National Historic Landmark and National Historic Civil Engineering Landmark received the Presidential Design Award for its adaptive reuse restoration as a one-lane vehicular bridge known locally as Roebling Bridge. The D&H traversed the southern river corridor, paralleling the river for 25 miles between Lackawaxen, Pennsylvania, and Port Jervis, New York, before veering to the northeast. The stone remnants can easily be seen by both boaters on the river and tourists along the Upper Delaware Scenic Byway. Of particular note is Corwin Farm, eligible for listing in the National Register of Historic Places and owned by the National Park Service, a canal-era lock tender's house and barn along an intact portion of the canal.

Photo: David B. Soete

The Erie Railroad, America's first long line railway, connected New York City with the Great Lakes and west. The Port Jervis line traversed the entire river corridor, spurring thriving hamlets as it progressed north and westward, carrying immigrants to the frontier. It also provided transportation to the Upper Delaware region for city workers who found fresh air, restful landscape, and good home cooking at local farms and boarding houses, contributing to "the Catskills and the Poconos," geographic areas famous for hospitality for nearly 150 years. Two early depots, the NRHP-listed Old Cochecton Station and the Callicoon Depot, remain. One notable vacationing fisherman, author Zane Grey, stayed on to establish a home on the Delaware at Lackawaxen, Pennsylvania, where he wrote his earliest articles and books, including "*Riders of the Purple Sage*." The National Park Service owns and manages a museum at the NRHP-listed Zane Grey House.

The railroad, and later New York State Route 97 (the Upper Delaware Scenic Byway), led to construction of several notable NRHP-listed historic bridges using petite and through-truss steel construction methods as well as stone arch construction on nearby tributaries. Many of the homes and commercial buildings dating to the late 1800s and early 1900s are extant; of note are National Register of Historic Places districts in Cochecton, Damascus, Milanville, and Equinunk, in addition to a number of individual National Register of Historic Places listings. Eighty-six historic archeological sites, in addition to 73 individual structures, were identified during a NPS-funded cultural resource survey.

Four-lane highways of the 20th century divert much of today's industrial transportation around the Upper Delaware River corridor, leaving behind an unsullied testimony to a culture dependent on the bucolic Upper Delaware Scenic and Recreational River.

Photo: David B. Soete

ECOLOGICAL

The Upper Delaware River exhibits some of the highest ecological integrity found in any of the large rivers of this region. As the least-developed section of the last major river on the Atlantic Coast, undammed the entire length of its mainstem, the Upper Delaware's wild and scenic, largely ecologically intact, free-flowing character supports key components and processes that contribute to the superb natural resources found here. Exceptional water quality, resulting from a predominately forested landscape, sustains high quality fish and aquatic insect assemblages. Excellent in-channel conditions result in an abundance of riffles, runs, and pools, and a diversity of in-stream habitats. These aquatic conditions, combined with good riparian habitat that is coupled with a functioning floodplain, provides great hydrological connectivity, structure, and function.

Photo: Scott VanArsdale

> The unobstructed river affords access to the full complement of sea-run migratory fish into and above this segment, thus allowing historic fluxes of nutrients, energy, and biomass to and from the ocean. These features combine to provide a complex food web, a wide variety of habitats, and a healthy diversity of species.

Photo: David B. Soete

The riparian area along the river supports rare terrestrial plant communities, such as ice scour rock outcrop, seep communities, and bitternut hickory lowland woodland. The river itself sustains diverse and healthy native aquatic plant communities, including a plentiful population of threadfoot riverweed, a relatively rare aquatic plant that is indicative of excellent water quality. A diversity and extraordinary abundance of freshwater mussels further contribute to water quality and nutrient processing. The Upper Delaware provides habitat for a sizeable population of the federally endangered dwarf wedgemussel, as well as several state threatened and endangered species including bridle shiner, and brook floater mussel.

Photo: David B. Soete

The Upper Delaware River's ecological value extends beyond this segment of river. It provides regionally important high quality historic spawning and rearing habitat for sea-run migratory fish, helping to buttress their larger range-wide populations. In addition to native brook trout, the river and tributaries support thriving recreational fisheries for naturalized rainbow trout and brown trout. The river corridor is also regionally important inland bald eagle wintering habitat for birds from as far away as the maritime provinces of Canada, and serves as a migratory bird stopover along the Atlantic flyway. The Upper Delaware provides drinking water for millions of people, all helping to underscore the Delaware's significance beyond its own watershed.

GEOLOGICAL

The Upper Delaware Scenic and Recreational River is an exceptional example of a deep, narrow river valley cutting across the Small Lakes section of the glaciated portion of the Appalachian Plateau. The overall landscape is a fluvial or stream-cut landscape modified by stream derangements from glacial deposits burying portions of preglacial valleys. Examples of significant geologic features include sandstone cliffs, barbed tributaries, glacial deposits, glacial outwash terraces, diverse channel morphologies, exposed ancient bedrock, bedrock knobs, cutoff incised meanders, island complexes, gorges, and fossils.

Photo: David B. Soete

The area's rolling hills vary in elevation from 800 to 2,000 feet and are characterized as a series of indistinct and irregular escarpments. Relief is generally between 300 and 500 feet, although it ranges to 700 feet in a few locations. Point Mountain, defining the northernmost extent of the wild and scenic river designation, is an isolated bedrock knob formed by glacial meltwater that eroded through a ridgeline between the east and west branches of the Delaware River. Sandstone cliffs, clearly evident at places like Hawks Nest, show ancient river channel deposits that have a wide variety of bedding features, including three types of cross-bedding, ripple marks, current lineation, tool marks, mud cracks, and conglomerates. Fossilized plant and animal remains are found here, such as bony plates from the armored fish of Devonian times, brachiopods and mollusks, a few types of coral, bryozoans, cephalopods, and rare trilobites.

Photo: David B. Soete

Glacial deposits partially fill many of the tributary valleys, especially those that are oriented transverse to the direction of the most recent ice age glacier. The post-glacial Delaware River cut into the bedrock and glacial materials at least 200 feet. Many of the tributary valleys have narrow, deep gorges with a series of waterfalls. These steeper-sloped tributaries have deposited alluvial or debris flow fans on the floodplain. Barbed tributaries, including Shehawken Creek, Calkins Creek, and Callicoon Creek, are another unique geologic anomaly where the streams enter the river in an unusual upstream direction. These barbed tributaries are evidence that the drainage pattern of the river once flowed to the north and were then reversed to the south by erosional forces.

Photo: David B. Soete

The Upper Delaware River has a variety of channel patterns ranging from pool-riffle chains in straight reaches to elongated pool-riffle chains in incised meander reaches to anastomosing channel reaches with a number of islands to short bedrock gorge reaches. For example, the Narrows is a short gorge cut through the bedrock of a preglacial ridge that once occupied the site.

The Narrowsburg Pool is a plunge pool at the downstream end of the Narrows, possibly formed from a submerged waterfall. During flood flows, the river may scour down 150 feet into glacial deposits, subsequently refilling the pool with sediment transported from upstream to an approximate depth of 113 feet at normal flow levels. Skinners Falls, Shohola Rapids, and Staircase Rapids are examples of bedrock-floored rapids where the river has incised through glacial fill and cut into the bedrock of the valley side, in essence bypassing its pre-glacial channel.

The convoluted drainage pattern of the Delaware River system provides a rare combination of drainage anomalies that challenge various explanations of how Appalachian river systems evolved over geologic time. The diversity of valley orientations has produced an equal diversity of geologic hypotheses that try to explain how the pattern came to be.

Photo: David B. Soete

RECREATIONAL

The Upper Delaware River is known for its outstanding recreational activities from tubing the rapids on a hot summer day to relaxing on a hidden deck, slope side in the Pocono or Catskill mountain forests. The river's close proximity and accessibility attracts visitors from major metropolitan areas along the northeast corridor, including Boston, New York City, Philadelphia, and Washington, D.C.

The Upper Delaware provides a relatively undeveloped and varied river setting that is ideal for families and recreationists of all levels.

The river corridor offers a wide variety of recreational activities ranging from heavily used accesses at Skinners Falls, Narrowsburg, Mongaup, and Sparrowbush, to opportunities for solitude while hiking or canoeing various other stretches of the river. River reaches from Lordville to Callicoon, and Narrowsburg to Lackawaxen provide some of the most remote and serene experiences along the Upper Delaware.

The Upper Delaware segment is surrounded primarily by privately owned property, but there are 18 well-marked and easily accessible public access points. These developed boat and canoe launches on both sides of the river are available to the public approximately every 5 river miles. Privately owned and operated access points also exist along the river. All of these facilities, easily accessible by rural roads, include river information and amenities during the periods of heaviest visitor use. Four of the public access sites are staffed by NPS personnel during peak periods, making it easy for visitors to obtain information about recreation opportunities.

River activities include canoeing, kayaking, boating, tubing, rafting, SCUBA diving, snorkeling, swimming, and hunting waterfowl. The Upper Delaware's cold water fishery between Hancock and Callicoon attracts anglers from around the world, especially those interested in fly fishing for its world renowned wild trout. This type of fishing experience is seldom found elsewhere in the region.

Photo: David B. Soete

Other recreational activities include photography, wildlife viewing, bird-watching, picnicking, hunting for both small and big game, and hiking/cross-country skiing at places such as Jensens Ledges, Tusten Mountain Trail, Game Lands 316, Buckhorn Natural Area, Damascus Forest, and Minisink Battleground Park. Sightseeing can be found at numerous scenic overlooks such as Jensens Ledges, Peggy Runway, Indian Ledges, and Hawks Nest, as well as at historic sites such as Roebling's Delaware Aqueduct (known locally as Roebling Bridge) and Zane Grey House. Auto touring and cycling along the Upper Delaware Scenic Byway (New York State Route 97) and New York State Bicycle Route 17 is also popular. Camping at both primitive and developed commercial campgrounds, fall foliage viewing, resorts, downhill skiing, geocaching, scientific research, education activities, and ranger-led activities are also popular. Eagle watching is particularly popular in the Lackawaxen area. The Eagle Institute, a project of the Delaware Highlands Conservancy, operates eagle viewing platforms and provides interpretive services in the area.

Experienced commercial outfitters provide canoe, kayak, and raft rentals, as well as transportation between access points. Guided trips are also available. Commercial fishing guides provide guided fishing trips for both warm and cold water fish species. These guides and outfitters provide opportunities for beginners as well as experienced river users to easily explore the river. The mixture of class I and II rapids (Skinners Falls, Staircase, Mongaup, and Butlers Rift) with riffles, runs, and pools offer a varied and quality recreational experience on the river. Beginners to expert boaters alike can find something on the Upper Delaware to challenge their skills and provide an outstanding boating experience.

The exceptional water quality provides the recreationist remarkably clean water for swimming, tubing, and boating in quiet eddies or swift-moving rapids. The exceptional clarity of the water provides the swimmer, tuber, boater, and SCUBA diver or snorkeler remarkable subsurface visibility. SCUBA diving and snorkeling are particularly popular activities at Narrowsburg and Skinners Falls.

Photo: David B. Soete

Photo: David B. Soete

SCENIC

The scenic quality of the Upper Delaware River is recognized as regionally significant due to its picturesque gorge, riparian vegetation, steep forested slopes and gently rolling hills. The agricultural fields and livestock pastures add variety to this tranquil scene.

> The riffles, runs, rapids, and pools of the river provide an ever-changing visual stimulus that is enhanced by the water clarity providing for amazing views of the landscape, the river bottom, and aquatic life.

Rock outcroppings, cliff faces, and exposed unusual sedimentary formations add to the stimulating visual variety of the Upper Delaware. A number of cascading waterfalls, including Peggy Runway with the largest drop of any waterfall in Pennsylvania, delight the viewer. The contrasting hardwood forest and evergreen stands provide a rich variety of colors and textures across the four seasons. Additional outstanding natural features, landforms, and topographic features include, but are not limited to: Hawks Nest, York Lake Falls, Jensens Ledges/Bouchoux Trail, and Point Mountain. Dark night skies are prevalent.

The Upper Delaware scenery is rich in structures and sites that reflect its history of agricultural and transportation-based development. The historic canal, railroad, petite truss bridges, hotels, inns, taverns, homes, a hillside seminary built with local bluestone, and other unique structures provide beautiful scenic backdrops and a feeling of nostalgia for early American ingenuity. Particularly notable are the Roebling's Delaware Aqueduct (Roebling Bridge) and the privately owned prominent, stately and historic buildings; remnants of the Delaware and Hudson Canal; and Cochecton Station. The Hawks Nest stone wall along the Upper Delaware Scenic Byway provides the best overlook of the unspoiled river valley.

Photo: David B. Soete

Photo: David B. Soete

Photo: David B. Soete

MIDDLE

DELAWARE NATIONAL SCENIC AND RECREATIONAL RIVER

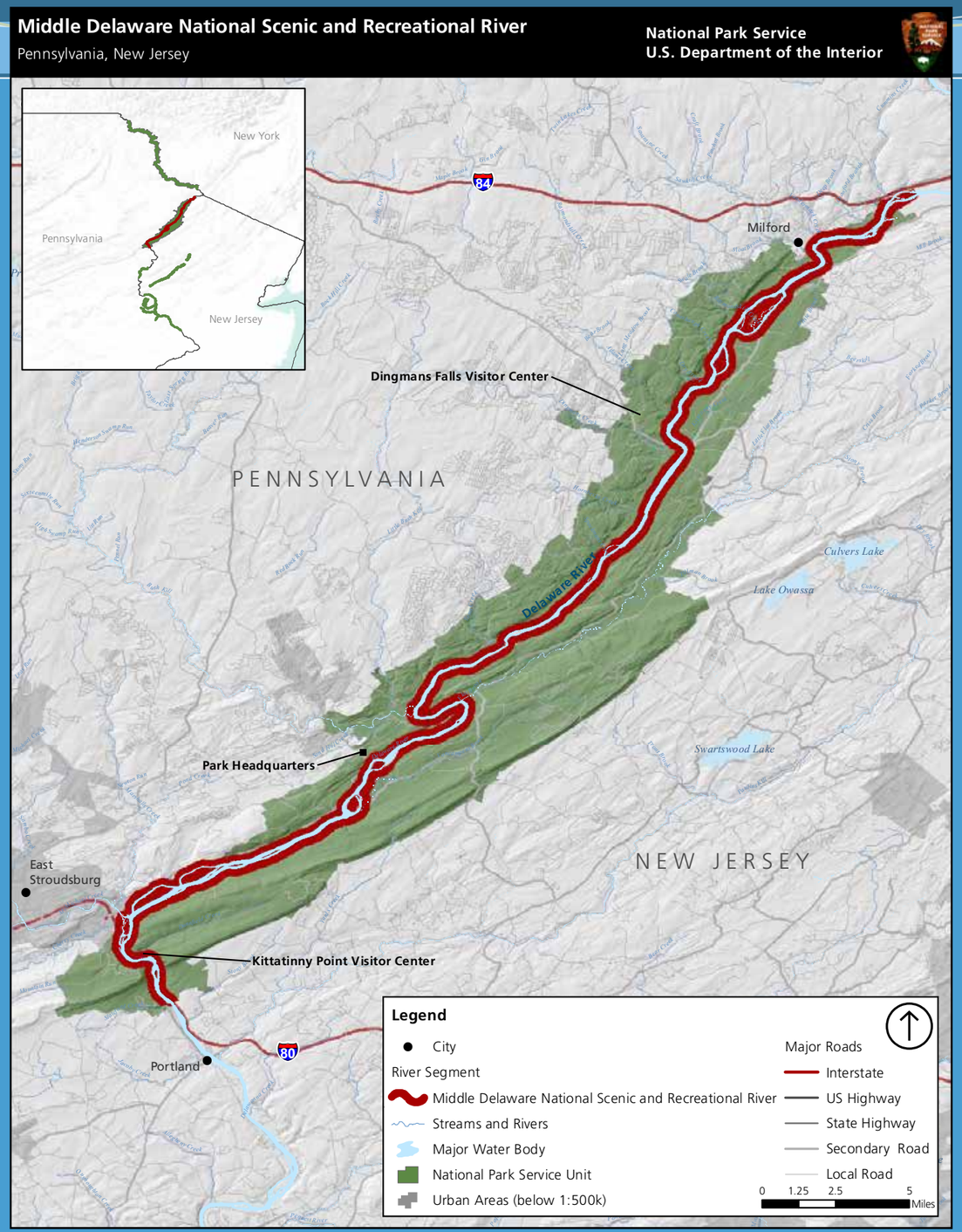


Photo: Jim Davis

MIDDLE DELAWARE NATIONAL SCENIC AND RECREATIONAL RIVER

The outstandingly remarkable values that make the Middle Delaware National Scenic and Recreational River worthy of protection under the Wild and Scenic Rivers Act are described on the following pages.

CULTURAL

The cultural significance of the Middle Delaware River Valley is typified by the continuous human presence throughout the Holocene, which is documented by a rich tapestry of river-focused living.

> The Delaware Water Gap National Recreation Area has close to 500 documented American Indian archeological sites of which over 100 are currently considered NRHP-eligible. Three-quarters of these archeological sites are found in the Middle Delaware River floodplain. This complex of American Indian sites is one of the best preserved in the northeastern United States, making it a high-value research area for archeologists and geo-archeologists.

The southern half of the Middle Delaware includes the Shawnee-Minisink site (ca. 12,900 BP), which remains one of the most spatially intact Clovis sites (Late Paleo-Indian and Early Archaic through Woodland occupations) in eastern North America. In the northern half the intact Minisink National Historic Landmark District, situated on an island and along the riverbank, was occupied by the Munsee people. The NHL district preserves this homeland area and the trails such as Minisink Path to the Atlantic, Minsi Path (or Delaware River Path), and Wyoming-Minisink Trail leading to and from the district.

Photo: Jim Davis

Expansion into the Middle Delaware Valley between 1650 and 1750 by Dutch and English settlers gave rise to construction along the river of the oldest commercial roadways in the northeast, a portion of which is preserved as the Old Mine Road Historic District. Established about 1650 and converted to a wagon road in the 1730s, the 104-mile-long Old Mine Road connected Esopus (Kingston, NY) on the Hudson River with the Pahaquarry Coppermine along the Middle Delaware River. Lying along the road, the Ennis House and Westbrook-Bell House are the oldest standing structures in Sussex County, New Jersey. Both date to the early 1700s. Several additional houses along the route (Abraham Van Campen, Alonso DePue, Smith-Roe) are nearly as old and contribute to both the cultural and historic landscape of the river valley. Landscapes of the colonial past can be seen scattered throughout the Middle Delaware River Valley. During the French and Indian War, settlers constructed approximately 20 forts at strategic crossing points along the river, as well as Military Road, which operated as a military supply route originating in Elizabeth (Elizabeth Town), New Jersey, and terminating at the Van Campen Inn, within view of the Delaware River. Military Road has been preserved as a hiking trail. In 1763, the stout walls of Van Campen Inn served as a shelter for 150 settlers against the threat of Indian attack. Military Road and Van Campen Inn continued to be important sites in the region during the American Revolutionary War, serving as a supply route and a rest stop and quarters for travelers and officers, respectively.

European settlers initiated timber harvesting and rafting in the 1760s, which contributed to the development of Milford, Shawnee-on-Delaware, and Delaware Water Gap, Pennsylvania. Portions of all three are now protected as listed NHL districts. Ferry service occurred at various points along the Middle Delaware River to transport travelers and supplies. Dingmans Ferry operated from 1735 and was temporarily replaced by three different wooden bridges at the site from 1836 through 1860. These wooden bridges were short-lived, succumbing to floods or high wind events. The historic Dingmans Choice Bridge was built near the 1900 ferry location and is the last privately owned toll bridge extant in the region. The many streams and waterfalls that flow into the Middle Delaware provided ample hydro-electric power to supply saw mills, grist mills, woolen mills, ice plants, and electrical power generators. Remains of some of these mills can be seen today along many of the creeks, including the Metz Ice Plant on Sawkill Creek and the woolen mill ruins on Dingmans Creek within the historic George W. Childs Park site.

From the mid-19th through the early 20th centuries, the Middle Delaware region was known as a river-based resort destination. Dozens of hotels served thousands of summer visitors. The Kittatinny Hotel was constructed in 1832 and was the first of the resort hotels at Delaware Water Gap, along what is now Pennsylvania State Route 611. By the end of the Civil War, the hotel could accommodate more than 250 vacationers. The Kittatinny Hotel was destroyed by fire in 1931; however, today's visitors can explore the site ruins and enjoy the views from Resort Point Overlook in the Gap. The privately owned and operated Shawnee Inn and Golf Resort on the shores of the Middle Delaware remains an example of the popular river resorts still in operation. These early hotels led to the year-round weekend resorts in the Pocono Mountains. Camps and summer cabins were also prevalent along the river valley throughout the 20th century. Many of these camps are now public NPS-operated recreation sites such as Poxono Access, Smithfield Beach, and Bushkill Access.

Following a devastating flood in 1955, the U.S. Army Corps of Engineers proposed the Tocks Island Dam project for the Middle Delaware River beginning in 1960. The Tocks Island Dam would have created a reservoir about 40 miles long and a mile wide. The locally based environmental effort that evolved to halt dam planning and construction is an early example of the effectiveness of the emerging environmental movement. This local movement, along with geological limitations and project budget concerns, eventually caused dam construction to be postponed and eventually the project was de-authorized by Congress. In its stead, the Delaware Water National Recreation Area preserves the river valley and its rich cultural history. Congressional designation of the Middle Delaware National Scenic and Recreational River in 1978 helped to support this river's free-flowing condition. The Tocks Island Dam project was officially decommissioned in 1992.

ECOLOGICAL

The Middle Delaware National Scenic and Recreational River is a vital component of and contributes substantially to the exceptional ecological integrity of the Delaware River system among the large rivers of the mid-Atlantic and northeastern United States. Like the Upper Delaware River, this section of the Delaware flows through the Appalachian Plateau and Ridge and Valley geological provinces, but has a lower gradient and more expansive floodplain. A combination of exceptionally high water quality, fully functioning floodplains, excellent aquatic and riparian habitats, and the absence of dams on the mainstem gives rise to a diverse array of species and a productive, complex food web with strong ecological integrity.

The exceptional productivity and ecological integrity of the Middle Delaware River extends from aquatic plants, invertebrates, and fish, to aquatic and riparian mammals and birds. At least 25 native species of aquatic vascular plants inhabit this section of the river and commonly occur in large beds. Threadfoot riverweed, which is intolerant of pollution, occurs in large patches in swift moving water stretches. The diverse aquatic insect assemblage includes a high proportion of pollution-intolerant stoneflies, mayflies, and caddisflies. This section of the Delaware River also supports a high density and eight native species of mussels, including the state-endangered brook floater and state-threatened yellow lampmussel. At least 36 native species of fish also inhabit the Middle Delaware River, from the humble eastern mudminnow to the mighty striped bass. As an integral part of the entire Delaware River system, this section of the river provides a migration corridor, critical habitat, and a stronghold for native migratory (diadromous) fish species like American shad and American eel, which have been in decline in other parts of their range. In addition, the high quality water of the mainstem river provides additional beneficial habitat and a movement corridor for fish species that primarily inhabit tributaries such as native brook trout, naturalized brown and rainbow trout, and other species.

Photo: Dan Smith

The river corridor supports a variety of healthy and extraordinary plant communities and wildlife. Calcareous bedrock outcrops along the river edge support two globally imperiled plant communities. Patches of globally vulnerable Riverside Prairie Grasslands occur on islands and river shores. Floodplain terraces support globally rare plant communities such as the Bitternut Hickory Lowland Forest and Sugar Maple Floodplain Forest. Forests of sycamore and silver maple predominate along the river's edge, while mixed native hardwood, eastern hemlock, and white pine forests extend along the uplands of the river corridor.

> The integrity, diversity, and productivity of aquatic and riparian communities culminates in thriving populations of water-dependent mammals like river otter, beaver, and mink; and birds like common mergansers, green and blue herons, belted kingfishers, rough-winged swallows, cerulean warblers, and ospreys.

Photo: Jim Davis

The Middle Delaware also provides high quality wintering, foraging, and nesting habitat for bald eagles and serves as a migratory bird stopover along the Atlantic flyway. Also, peregrine falcons have re-occupied historic nesting habitat on the river-formed cliffs of the Delaware Water Gap.

GEOLOGICAL

The Middle Delaware National Scenic and Recreational River follows the boundary between two physiographic regions—the Appalachian Plateau and the Ridge and Valley. The river then dramatically cuts across the Appalachian Ridge at Delaware Water Gap, a signature geologic feature along the Delaware River system. The elevation of the valley varies from 300 to 400 feet above sea level and the adjacent highlands rise an additional 600 to 1,000 feet.

In the northern two-thirds of the Middle Delaware, the river flows along the eastern edge of the Pocono Plateau, sharply defined on the west by nearly vertical cliffs composed of Mahantango shale. Waterfalls are a frequent feature as tributary streams drop onto the broad floodplain below. Raymondskill Falls is the tallest waterfall in Pennsylvania at 180 feet. Other scenic waterfalls include Hackers Falls, Adams Falls, Dingmans Falls, Indian Ladders Falls, and Tumbling Waters.

The southern one-third of the Middle Delaware River has a more complex geology. At Bushkill, Pennsylvania, the river swings away from the Poconos and flows through older, more steeply dipping Devonian Buttermilk Falls Limestone. Here the Delaware cuts across a hogback and creates a graceful S-shaped loop known as the Walpack Bend.

> A large rock formation along this section of river is known as Indian Rock, an outcrop diving into the river, where the water is up to 50 feet deep. The area also has doubly plunging folds that form complex outcrop patterns along the shoreline, such as the Five Loaves that look like multiple loaves of bread.

Many fossil localities within the park are represented within these strata. Downstream from Walpack Bend, the river cuts through a zone of weakness in the Shawangunk Formation of Kittatinny Mountain to form the dramatic Delaware Water Gap. Here, the valley is 1,000 feet wide at river level, flaring to 4,000 feet wide at mountain summits. The Delaware Water Gap was designated an Outstanding Scenic and Geologic Feature by the Pennsylvania Geological Survey.

The Middle Delaware River contains a diversity of channel types, alternating between braids to riffle/pools to deep runs and glides and backwater channels surrounding islands. Alluvial fans occur at the mouths of tributaries with the most prominent examples being at Bushkill Creek and Brodhead Creek. A number of islands in the river, ranging in size from one acre to several hundred acres, are composed of alluvial sand and gravel deposits. Named islands include Mashipacong, Minisink, Namanock, Depew, Poxono, Tocks, Depue, Shawnee, Schellenberger, and Arrow. The habitat complexity surrounding these islands supports a wide diversity of mussels, fish, and other aquatic organisms. All along the Middle Delaware River geologically formed microhabitats are found, including calcareous outcrops that support rare plant communities and exposed glacial striations.

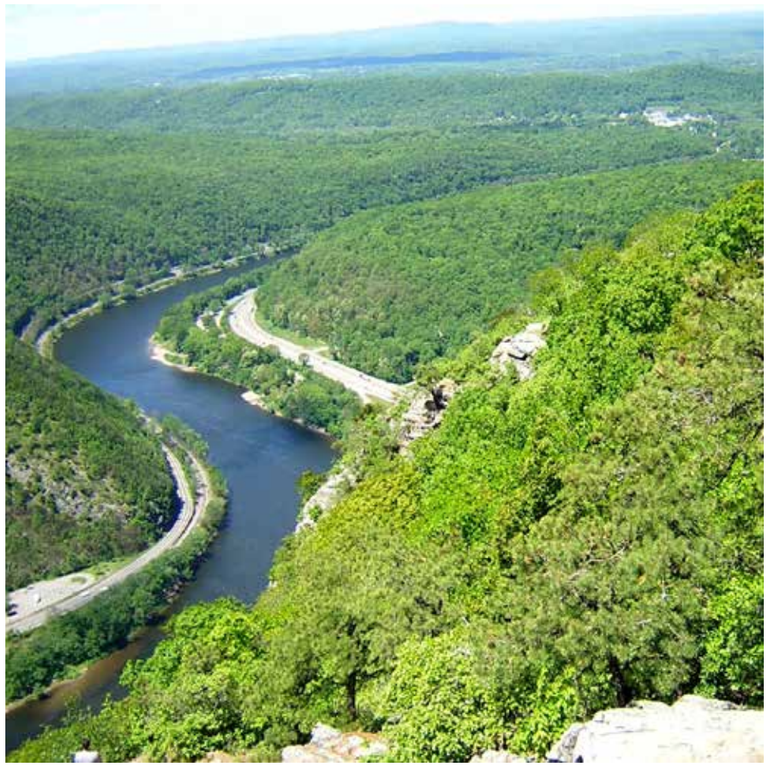
RECREATIONAL

Close proximity to major metropolitan areas encourages first-time adventurers and life-long nature enthusiasts to enjoy the Middle Delaware and the remote natural experiences along the largely undeveloped river shoreline. The Middle Delaware is teeming with a wide variety of outstanding natural and cultural features, which make sightseeing a principal recreational pursuit. Views are framed by Kittitinny Ridge and the sheer cliffs of Pocono Plateau. While the forested mountainsides are interspersed with open grasslands and agricultural fields along the floodplain. From Mashipacong Island, south through Walpack Bend, the river visitor is immersed in striking scenery and nearly quiet solitude. Dramatic cliffs of the Delaware Water Gap can be experienced from multiple vantage points by automobile, foot, bicycle, and boat. Exemplary wildlife viewing and birding are found everywhere throughout the river corridor. Recreationists may be joined by black bears ambling along the riverbank and bald eagles soaring overhead in search of prey.

The Middle Delaware River is surrounded almost completely by the Delaware Water Gap National Recreation Area, providing access to the corridor for a wide variety of quality year-round recreational opportunities.

Developed boat launches and swim beaches along both sides of the river, such as Milford Beach, Dingmans Ferry Access Launch, Bushkill Access Launch, Turtle Beach, and Smithfield Beach, provide amenities such as bathrooms, paved boat launches, canoe launches, and lifeguarded swim beaches along the Middle Delaware River corridor. Less developed canoe access points include Eshback, Namanock, and Poxono. Several other primitive carry-in locations are interspersed between developed launches, providing access approximately every 3 to 5 miles. Foot access can occur anywhere along the river within the recreation area. Ease of access and relatively calm waters of the Middle Delaware River provides boating opportunities for all levels—trips range from a few hours to multiple days. Approximately 65 primitive river campsites along the entire stretch of the Middle Delaware segment are free to the public on a first-come, first-served basis, providing a unique camping experience along the river. Group sites and developed campgrounds such as Dingmans Campground, Valley View Group Campground, and River Bend Group Campground provide opportunities for large groups and families to recreate along the river with some amenities such as potable water and restrooms. Easy access is enhanced by commercial canoe outfitters providing a variety of boating trips, including transportation between access points and in some cases guided overnight canoe trips. Alternative transportation buses, operated by the Monroe County Transportation Authority in partnership with the National Park Service, travel to stops along River Road and U.S. 209 on the Pennsylvania side of the river corridor on summer season weekends, making one-way biking, hiking, and boating trips feasible and trouble-free for recreationists.

Other recreational activities such as small and big game hunting, fishing, bird-watching, wildlife viewing, swimming, photography, scenic touring, hiking, biking, and cross-country skiing are popular along the river corridor. Excellent hiking and cross-country skiing experiences on the ridgetops and river valley occur along the Appalachian National Scenic Trail, the McDade Recreation Trail, Cliff Park trails, and the Red Dot Trail. Short hikes along developed boardwalks and primitive trails lead through hemlock covered ravines to the many waterfalls such as Dingmans Falls, Raymondskill Falls, and Tumbling Waters. Scenic driving is available along the river on Old Mine Road/615, River Road, and U.S. Route 209, with seasonal variations drawing visitors year-round. Old Mine Road affords road cyclists an opportunity to ride the length of the Middle Delaware National Scenic and Recreational River and is recommended by New Jersey Department of Transportation as a cycle touring route as well as being a segment of Adventure Cycling Association's Atlantic Coast Route from Maine to Florida. State Highway 611 and Interstate 80 provide unique views as visitors travel through the majestic Delaware Water Gap formation.



SCENIC

The Middle Delaware River is framed by the mountains of the Kittitinny Ridge (New Jersey) and the cliffs of Pocono Plateau (Pennsylvania). From Mashipacong Island south to Walpack Bend, the river visitor is immersed in the striking river valley scenery. The visitor sees a diversity of primarily natural landscapes interspersed with cultural resources ranging from steep forested slopes to the broader floodplain valley, with dramatic bends in the river, culminating at the iconic Delaware Water Gap. The wooded shoreline is punctuated by unique rock formations such as the Five Loaves in Walpack Bend and Godfrey Ridge through which the river bends. Other notable rock features line the banks of the Middle Delaware and include Shad Rocks, Hibachi Rocks, and the Limestone outcrops near the Dingmans Choice Bridge.

Trails traversing the surrounding cliffs and ridgelines provide panoramic vistas of the river. Ridgetop trails include Appalachian National Scenic Trail along Kittatinny Ridge and Cliff Park trails along Milford Cliffs. Mountaintop views from Mount Minsi and Mount Tammany at the climax of the geological wonder, the Delaware Water Gap, provide vivid pictures of the opposite mountain and the river far below. Scenic roadways and trails paralleling both sides of the river wind through the diverse floodplain that includes woodlands, tributary crossings, hemlock ravines, grassland, and agricultural fields. The adjoining landscape includes steep hemlock and rhododendron lined ravines. The many tributaries often include views of unique and dramatic waterfalls. Glimpses of the long human history of the river valley, including Dingmans Choice Bridge, Coppermine and Shawnee Inns, and the historic Old Mine Road, provide visual contrast to the natural backdrop. The Middle Delaware segment is the least developed of the Delaware River valley, and is within the Delaware Water Gap National Recreation Area. Dark night skies are prevalent.

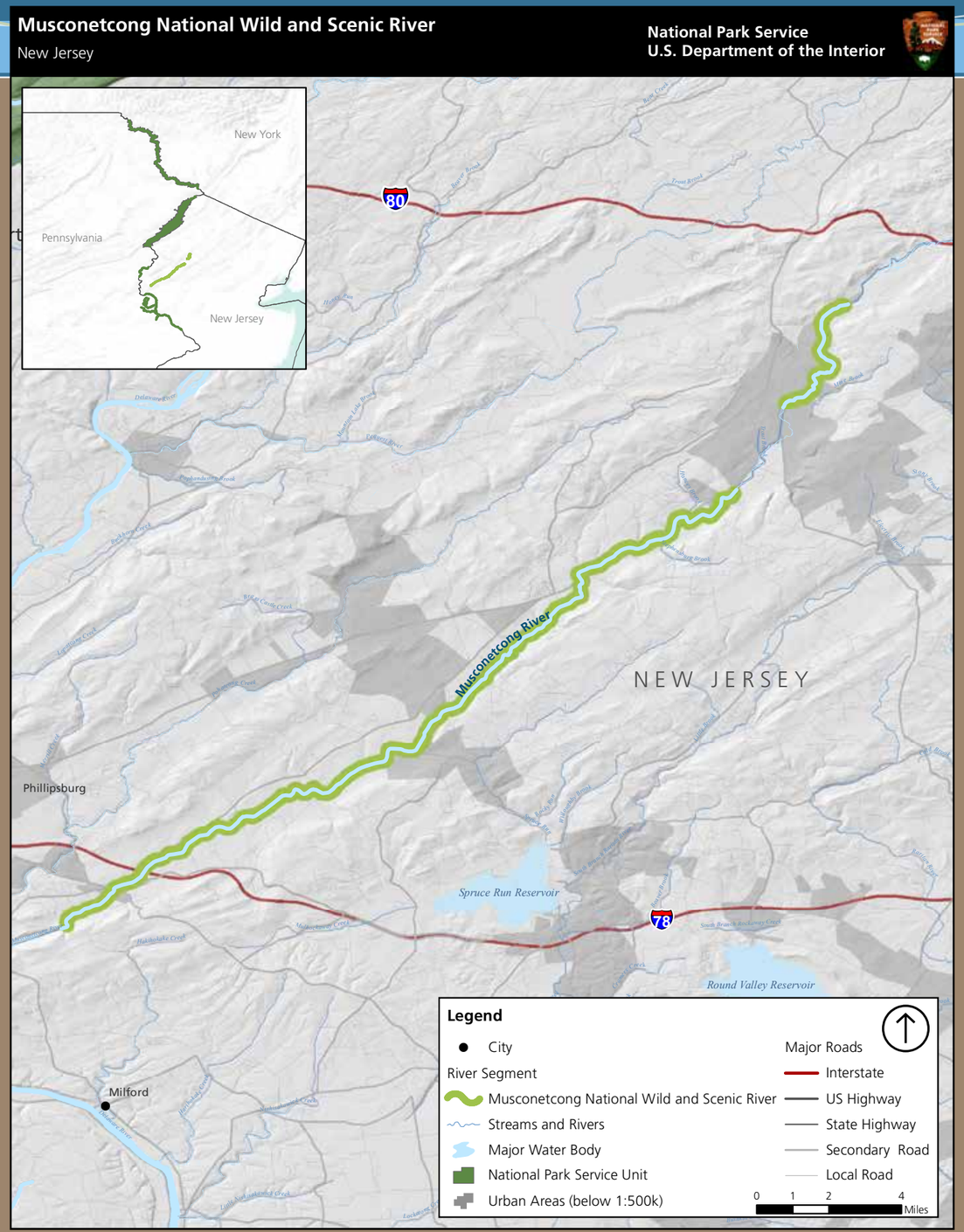
The nuances of the changing seasons such as spring wildflowers, summer greenery, fall foliage, and winter fog and ice provide a striking backdrop for river corridor visitors.

> The river channel variations of riffles, eddies, pools, rapids, and distinct changes in channel direction transform the scenery around every bend of the river.

Large islands such as Minisink, Mashipacong, and Shawnee Islands in addition to numerous smaller islands with diverse vegetation, cobblestone shorelines, bedrock formations, and channel riffles add to the visual diversity.

MUSCONETCONG

NATIONAL WILD AND SCENIC RIVER



MUSCONETCONG NATIONAL WILD AND SCENIC RIVER

The outstandingly remarkable values that make the Musconetcong National Wild and Scenic River worthy of protection under the Wild and Scenic Rivers Act are described on the following pages.

CULTURAL

Human settlement in the Musconetcong River corridor has been traced back 12,000 years during the Paleo-Indian occupation of the area and the retreat of the Wisconsin glacier. Evidence of human habitation has been found at the Plenge site, along the lower Musconetcong River corridor. This site was one of only two major Paleo-Indian archeological site excavations in New Jersey and is considered to be one of the most important in the northeastern United States.

Subsistence agriculture took root in the lower Musconetcong valley at the dawn of the 18th century. The fertile limestone valley was rapidly cleared for cropland—subsistence agriculture gradually evolved into commercial grain and dairy farming. Villages sprang up around the many grist mills and iron forges built along the Musconetcong River. Outstanding historic features can be found in the river-related villages of Stanhope Borough, Waterloo Village, Asbury, and Finesville, and many others. Many of the features of these villages are listed in the National Register of Historic Places.

Colonists constructed dams beginning in the 1750s to power the engines of commerce, creating economic activity that contributed to the prosperity of settlements along the river. The Morris Canal, constructed in the 1840s, intersected the river at Saxton Falls, accelerating the growth of industry in northeastern New Jersey and giving rise to employment in the large coastal cities. The canal is a National Historic Landmark. At least 18 designated and eligible historic sites and districts associated with the river enhance the historic character of the designated segment of the Musconetcong. Beginning in the early 18th century and continuing today, paper mills harnessed the river's power and flushed processed effluent downstream into the Delaware.

ECOLOGICAL

The natural conditions and characteristics of the Musconetcong River maintain the integrity and health of the river's ecological community.

The Musconetcong supports a sustainable population of the native eastern brook trout (including a possible heritage population of native trout) and exceptional spawning areas for this native trout species. The river also supports large populations of sensitive insect species such as stoneflies and mayflies.

The Independence and Allamuchy segments of the river contain the federally endangered dwarf wedgemussel, the federally threatened bog turtle, the state threatened barred owl and the state critically imperiled brook floater, a freshwater mussel that requires a rocky and gravelly riverbed. The river's segment B, which stretches from Washington and Mansfield townships downstream to Franklin and Bethlehem townships, contains the federally endangered Indiana bat, the federally threatened bog turtle, the American burying beetle, the American eel (federal evaluation species), and bald eagles (federally protected). Various state listed species in this segment include the fleshy hawthorn (state endangered), and the state threatened wood turtle and Cooper's hawk. The river's eligible segment C, which stretches from Pohatcong and Holland townships to the confluence of the Delaware River, contains the Alpha Grasslands, which is listed as a Natural Heritage Priority Site.

In addition, the Musconetcong River provides good osprey foraging habitat and contributes to the Delaware basin's role as a migratory bird stopover along the Atlantic flyway. The Musconetcong River corridor also provides wintering and foraging habitat for bald eagles and contains one active eagle's nest.

These ecological values can be attributed to the river's intact hydrologic connectivity to the adjacent floodplains and groundwater aquifer. The presence of limestone karst topography and connection to the aquifer support in-channel conditions and habitat. Above Hackettstown and Mansfield townships, the river generally has very good water quality consisting of cold, clear waters. The river is readily connected to its floodplain, with only limited obstructions along the corridor, which helps sustain quality riparian habitat.

Several dams on the river and areas of development (such as in Hackettstown and Mansfield townships) fragment the river's hydrological sources and riparian habitat and are minor sources of water pollution. The dams do not allow passage of native migratory fish up the Musconetcong, which also prevents ecological processes and aquatic habitat values associated with fish migration from occurring in the river. In addition, the artificial stocking of large quantities of nonnative trout in the river diminishes conditions for native species and processes. Nonetheless, lower stretches of the Musconetcong have direct access to the Lower Delaware River and provide some habitat for native migratory fish. Also, the Musconetcong is the most active dam-removal river in New Jersey, with four dams being removed since June 2008 (seven remain, including the sizeable Warren Glenn Dam). If more dams are removed, then it may be possible for migratory fish to return to the river and benefit the overall ecological integrity of the river.

GEOLOGICAL

The bedrock geology of the Musconetcong watershed has ridges paralleling the river valley and consists primarily of Precambrian metamorphic rocks that contain crystalline gneiss and granites, schist, quartzite, and occasional igneous intrusions. These rocks are not as erodible as the ones found in the river valley. Sedimentary carbonate and shale rocks of Cambrian and Ordovician age underlay the river valley floor from the vicinity of Hackettstown down to Rieglesville. This type of bedrock geology is typical of the New Jersey Highlands.

The terminal moraine of the Wisconsinan Glacier, featured in the upper portion of the Musconetcong watershed, marks the southernmost extent of the most recent ice age glacial period. The geological features of the upper river valley include extensive areas of glacial till, moraines, and stratified drift deposits.

South of the terminal moraine, glacial deposits from earlier ice sheets exist in scattered deposits. Also, gravel outwash from the Wisconsin terminal moraine is found in narrow, intermittent belts the length of the Musconetcong River valley down to the Delaware River confluence.

Photo: Trout Unlimited

Farther downstream, the geology is dominated by limestone bedrock formations known as karst. Limestone bedrock within the river corridor is highly soluble compared to other types of bedrock. The dissolving limestone bedrock causes sinkholes, depressions, caves, solution channels, and irregular bedrock surfaces. Karst provides continuous base flows and cool water, making it ideal trout habitat, but highly susceptible to contamination.

The lower portion of the Musconetcong changes dramatically as it cuts through shale to form a deep, narrow gorge. Below the gorge, the river channel is dominated by shale ledges, boulders, and steep gradients before leveling out as it traverses the Delaware River floodplain.

Photo: Trout Unlimited

RECREATIONAL

The Musconetcong River provides abundant access to a wide variety of recreational opportunities in America's most densely populated region.

While fishing, birding, camping, and hunting are the most popular riverwide activities, the Musconetcong offers outstanding passive recreational opportunities such as birding, wildlife viewing, and photography.

From Saxton Falls to the Route 46 bridge, the river is flanked by relatively undeveloped shoreline. Allamuchy and Stephens state parks offer visitors an outstanding natural experience, fishing and boating access, and serve as an important put-in for the renowned Musconetcong Water Trail. The river's section A provides visitors with a relative sense of solitude, as the river is surrounded by state parks with only limited shoreline development.

The Musconetcong Water Trail, a state designated and regionally significant water trail, offers paddlers opportunities to paddle through the varied landscapes of the Musconetcong River. The trail flows among the eight state wildlife management areas found between the Miller Farmstead and Stone Bridge, to the North Bloomsbury Historic District. Interspersed among these historic and wildlife management areas are additional stretches of river that offer nature experiences with lesser-developed shorelines.

Photo: Trout Unlimited

From the Route 46 bridge to Bloomsbury, opportunities exist for a variety of recreational activities on the river. The variety of recreational opportunities is augmented by numerous river access points, particularly in the river's segment B. This segment of river, bolstered by trout production streams, also provides anglers with outstanding opportunities to pursue a variety of trout species.

Hiking is also a popular activity on the trail networks found at Point and Schooley's mountains. The trail networks on the Hunterdon and Warren County sides of the river lead hikers to outstanding areas for viewing the river valley and beyond.

Photo: Musconetcong Watershed Assoc.

Birdwatching along the Musconetcong is also a popular activity, especially at Merrill's Creek and Point Mountain overlook where visitors can observe the state-endangered barred owl. Visitors are also drawn to the Musconetcong for its scenery, especially between Franklin and Bethlehem townships, and the historic hamlet of Asbury, where the views are particularly dramatic.

SCENIC

The Musconetcong River valley features memorable scenes of family farms, secluded natural areas, and cozy hamlets. Prominent ridges paralleling both sides of the river unmistakably define the valley landscape, playing a major role in determining its regionally exemplary visual character. Scenic diversity ranges from intimate views of the river and its immediate surroundings to sweeping vistas of the river valley from mountaintop overlooks and glimpses of the river and adjacent landscape from the Warren Heritage Byway.

Segment A: Saxton Falls to the Route 46 Bridge

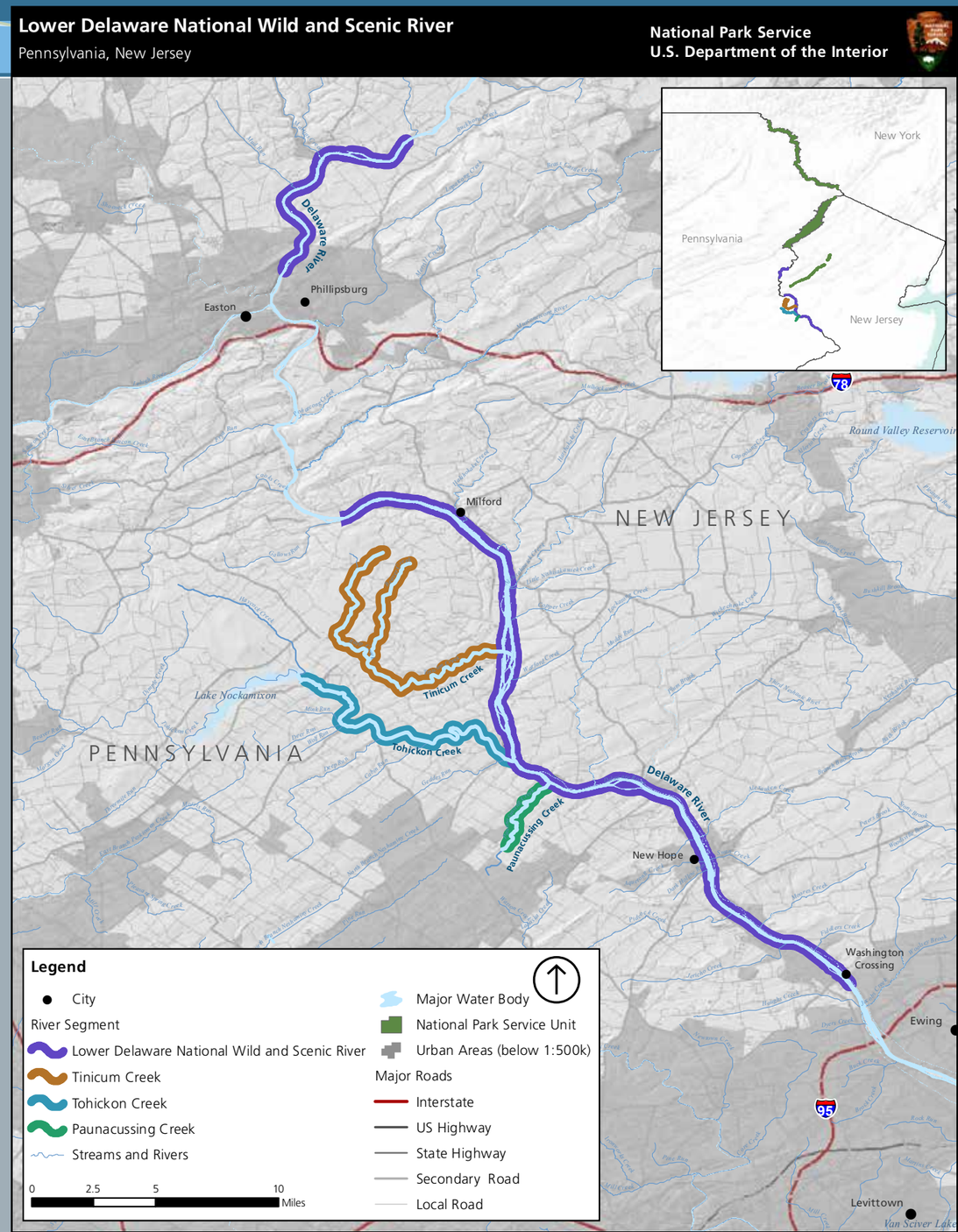
The thickly forested hills of Allamuchy Mountain and Stephens state parks tightly hug the Musconetcong River, giving the northern end of this segment its remote feeling. Protecting more than 2,500 acres of open space, these parks offer views of a variety of habitats supporting critical wildlife. Remnants of Lock 5, the prism and towpath of the Morris Canal are reminders of the river's function as a water source for this world renowned transportation corridor. Approaching Hackettstown, the mountain ranges drop in elevation and back away from the river's edge, opening up views of this urban community.

Segment B: Washington and Mansfield Townships to Franklin and Bethlehem Townships

Alternating scenes of headwater tributaries, farmland, forests, and rural hamlets characterize this visually attractive segment. This pastoral cultural landscape is symbolic of the aesthetics of the Musconetcong watershed. Views of seven state wildlife management areas are interspersed with a variety of historically significant human-made features, such as: grist and graphite mills, lime kilns, a triple stone arch bridge, a steel Pony Pratt truss bridge, and a preserved farm complex, complete with main and tenant housing, overshot bank barn, wagon house, and stone-walled family cemetery.

Riverfront villages contain numerous examples of 18th and 19th century residential, institutional, and commercial architecture found in the area's earliest settlements.

Photo: Musconetcong Watershed Assoc.


Lower Delaware National Wild and Scenic River
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National Park Service
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New York
Pennsylvania
New Jersey
Delaware River
Phillipsburg
Easton
Milford
NEW JERSEY
Round Valley Reservoir
Tinicum Creek
Lake Nockamixon
PENNSYLVANIA
Tohickon Creek
Paunacussing Creek
Delaware River
New Hope
Washington Crossing
Ewing
Levittown
Van Sciver Lake
Legend
City
River Segment
Lower Delaware National Wild and Scenic River
Tinicum Creek
Tohickon Creek
Paunacussing Creek
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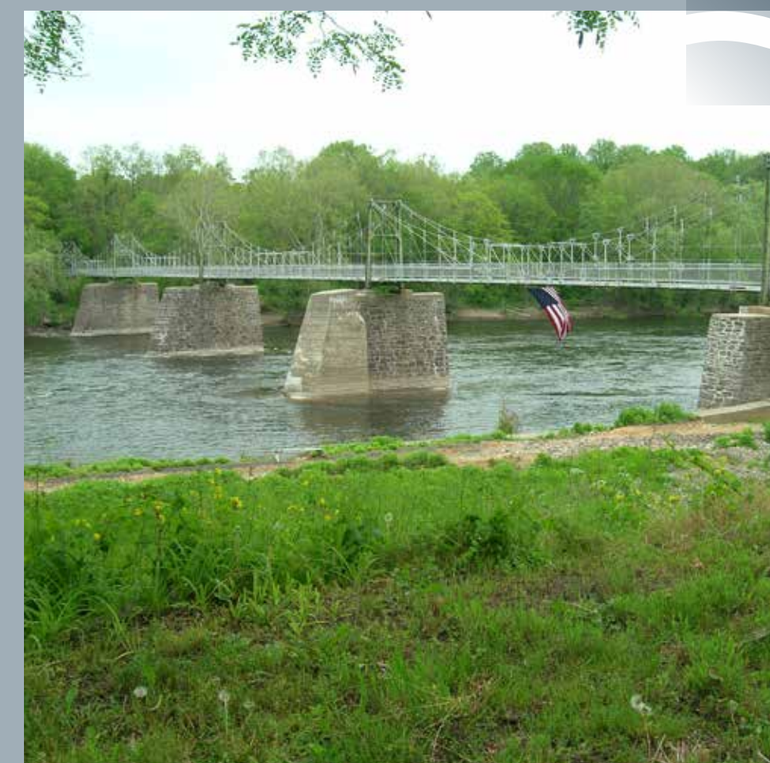


LOWER DELAWARE NATIONAL WILD AND SCENIC RIVER

(INCLUDING TINICUM CREEK, TOHICKON CREEK, AND PAUNACUSSING CREEK)

The outstandingly remarkable values that make the Lower Delaware National Wild and Scenic River worthy of protection under the Wild and Scenic Rivers Act are described on the following pages.

CULTURAL

Lower Delaware River (including Tinicum Creek, Tohickon Creek,and Paunacussing Creek)

The Lower Delaware River, including Tinicum, Paunacussing, and Tohickon creeks, contains historic resources of national significance; it is a microcosm of American history. Sites along the Lower Delaware River and its tributaries indicate early American Indian use of the river for habitation. These include the Del Haven Paleo-Indian site, a rock shelter along Tinicum Creek, and sites at Sandts Eddy, Hendrick Island, and Padula. Tinicum Creek was the origin point of Thomas Penn's Walking Purchase of 1737, which includes areas on all three Delaware segments.

Photo: D&L NHC

The southern terminus of the Lower Delaware segment includes the Washington Crossing historic site. Now a state park on both sides of the river, it is the location of the Revolutionary War commander's famed crossing of the Delaware River on Christmas Day 1776, to surprise the British at Trenton.

By the 1830s, the demand for bulk commodity transport led to construction of canals. The canal systems along both sides of the river, including the Delaware Canal, and Delaware and Raritan Canal, helped to fuel the industrial revolution by moving coal and other goods to urban centers. These are unique examples of canals in the northeast such as the Delaware Canal National Historic Landmark. The W&SR-designated section of the Lower Delaware River includes portions of the Delaware and Lehigh Navigational Canal National Heritage Corridor, designated in 1988. The length of this segment is dotted with historic sites associated with river crossings, railroads, and the canal system, including the Uhlerstown, Lumberville, Point Pleasant, Centre Bridge, and New Hope districts. New Hope is significant not only for its association with the Delaware Canal, but also because artists residing and working there and in the vicinity formed the nucleus of the New Hope school of painting, the first truly American expression of Impressionism. The Delaware River and Tinicum, Tohickon, and Paunacussing creeks were popular subjects.

On the New Jersey side, the Delaware and Raritan canal stops included the Stockton-Prallsville Mills and Lambertville historic districts. Fourteen bridges have served historically as important economic and cultural lifelines between communities of the two states.

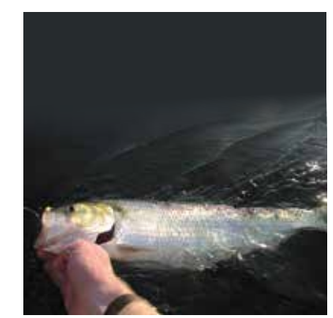
ECOLOGICAL

Lower Delaware River

The Lower Delaware River segment provides the transition through the Ridge and Valley, New England, and Piedmont provinces and encompasses many transition zones for the Delaware River. The sections above the Lehigh River retain many of the ecological qualities in the Upper and Middle Delaware River segments, with high water quality, diverse assemblages of aquatic and riparian species including freshwater mussels, and strong ecological integrity throughout the food web. Below the Lehigh River, water quality and ecological integrity both shift to a lesser status while still maintaining large components of the key riparian and in-stream habitats. Compared to upstream reaches, this reach has higher nutrient concentrations and is warm, with very long pools and fewer riffles. Island habitats are also common and significant for their numbers, acreages, and diversity of species. Among the key ecological players are at least five species of freshwater mussels, including the federally endangered dwarf wedgemussel (*Alasmidonta heterodon*) and the yellow lampmussel (*Lampsilis cariosa*), a federal species of concern. The Lower Delaware supports areas of natural riparian corridors and their characteristic flora and fauna, and a diverse assemblage of native warm water fish, such as walleye (*Sander vitreus*), smallmouth bass (*Micropterus dolomieu*), striped bass (*Morone saxitilis*), perch (*Perca* spp.), and white suckers (*Catostomus commersonii*). Critical to the Lower Delaware River's status in the segment below the Lehigh is the primary spawning ground for the Delaware basin's federally endangered shortnose sturgeon (*Acipenser brevirostrum*) population, which occurs in the zone below the Lambertville-New Hope pool and wing dam.

Photo: D&L NHC

A unifying feature throughout the full extent of the Lower Delaware River is the broad and complete assemblage of migratory fish, from sea lamprey (*Petromyzon marinus*) to American shad (*Alosa sapidissima*) to multiple river herring species.



These migratory fish contribute directly to the ecological integrity of this river segment by maintaining the transfer of nutrients, energy, and biomass to and from the ocean. In addition, the unobstructed connectivity for migratory fish through the Lower Delaware River up through the Middle Delaware, the Upper Delaware, and into the mountainous headwaters underscores the Lower Delaware's vital contribution to the ecological health and value of the entire region.

The Lower Delaware's important position along the Atlantic flyway is evident in supporting foraging and breeding habitat for rare water-dependent bird species. These include the least bittern (*Ixobrychus exilis*), a threatened species in Pennsylvania, Louisiana waterthrush (*Parkesia motacilla*), and cerulean warbler (*Setophaga cerulean*), a federally listed species of concern. Cliff swallows (*Petrochelidon pyrrhonota*), a threatened species in New Jersey, nest in colonies underneath several Lower Delaware bridges. Rare reptile species are associated with wetland habitats along the Lower Delaware corridor—these species include the federally threatened bog turtle (*Clemmys*

muhlenbergii) and the wood turtle (*Glyptemys insculpta*), a threatened species in New Jersey.

Tinicum Creek

Tinicum Creek possesses aquatic and riparian habitat values that support a relatively intact natural community. The exceptional quality of wildlife and plant habitat has resulted in the U.S. Department of Agriculture (USDA) Forest Service designation of Tinicum Creek and a tributary, Rapp Creek, as a "critical treasure" within the Highlands region.

> Tinicum Creek supports an array of diverse plant communities, significant numbers of rare plant and animal species, creek-inhabiting amphibians, and more than 70 bird species—13 of which are rare or of special concern.

Forests dotted with the pineland pimpernel (*Samolus parvifloris*), a state endangered plant, flank the Rapp Creek watershed.

The creek has good hard-bottom aquatic habitat with limited fine sediment deposition that creates conditions for a good representation of native warm water aquatic species. The creek has no federally listed species, but does support a variety of state listed species, including the yellow lampmussel (*Lampsilis cariosa*) (threatened in New Jersey) near the creek's mouth, the redbelly turtle (*Chrysemys rubriventris*) (threatened in Pennsylvania), the osprey *(Pandion haliaetus*) (threatened in Pennsylvania), and wetland/riparian plants such as small beggar-ticks (*Bidens discoidea*) (endangered in Pennsylvania) and pineland pimpernel (species of concern in Pennsylvania). At least nine species of salamanders, seven species of frogs and toads, and six species of turtles can be found here. Tinicum Creek also provides a moderate level of access and habitat for a subset of the migratory fish assemblage in the Delaware River basin. The riparian habitat quality is generally very good, with some fragmentation due to interspersed human uses along the corridor.

Photo: D Bales MD Dept of Natural Resources

This segment has unique and some good quality ecological values on a local or statewide scale. However, overall, the ecological values of this segment do not possess rare, unique, or exemplary qualities. Therefore, Tinicum Creek does not qualify as an ecological ORV.

Tohickon Creek

Similar to Tinicum Creek, Tohickon Creek watershed is designated a critical treasure within the Pennsylvania portion of the Highlands by the USDA Forest Service. The Tohickon Creek watershed sustains hundreds of species of mammals, birds, reptiles, amphibians, and invertebrates. Many of these are species of concern or considered rare or threatened, such as the eastern small-footed bat (*Myotis leibii*), which is threatened in Pennsylvania and a candidate for federal listing, and the cerulean warbler, a federal species of concern. Tohickon Creek's riparian habitat and ecological communities are relatively intact and support a good representation of native riparian and warm water aquatic species, including the yellow lampmussel (threatened in New Jersey), eastern floater (*Pyganodon cataracta*) (species of concern in Pennsylvania), and threadfoot riverweed (*Podostemum ceratophyllum*) (threatened in New York). A dam exists at the upper end of the designated reach, which alters some of the natural ecological and hydrologic processes

of the creek; however, the 4.5-mile section through Ralph Stover State Park and Tohickon Valley Park is ecologically intact and has excellent water quality. This section drops some 160 feet to produce a high-gradient stream that supports a variety of aquatic life. The threadfoot riverweed, a freshwater sponge, coats rocks and submerged sticks. Freshwater mussels inhabit areas of the creek where a suitable sandy or gravelly substrate is present. Tohickon Creek overall has good hard-bottom aquatic habitats with limited fine sediment deposition. The creek is representative of good water quality for this stream type. Riparian habitat quality is also good, with minor fragmentation due to interspersed human uses along the corridor.

> The wooded wetlands and streams of Tohickon Creek provide habitats for at least 20 species of salamanders, frogs, and turtles, including the northern cricket frog *(Acris crepitans)*, listed as endangered in Pennsylvania, and Fowler's toad (Anaxyrus fowleri), a Pennsylvania species of concern.

Photo: Ralph Stover

Tohickon Creek provides relatively limited access for a subset of migratory fish, such as the American eel, in the Delaware basin due to its relatively small size. However, the creek does support populations of at least 24 fish species, a good indicator of stream health and water quality. In addition, Tohickon Creek is designated as a cold-water fishery in Pennsylvania. Fish species include creek chub (*Semotilus atromaculatus*), white sucker, blacknose dace (*Rhinichthys atratulus*), longnose dace (*Rhinichthys cataractae*), fallfish (*Semotilus corporalis*), bluegill (*Lepomis macrochirus*), smallmouth and largemouth bass (*Micropterus dolomieu* and *salmoides*, respectively), and redfin pickerel (*Esox americanus*).

Paunacussing Creek

Photo: Ralph Stover

Paunacussing Creek's riparian habitat and ecological communities are relatively intact, and support a good representation of native riparian and warm water aquatic species. The creek has good hard-bottom aquatic habitats with limited fine sediment deposition. The creek is representative of good water quality for this stream type. Riparian habitat quality is also good, with some fragmentation due to interspersed human uses along the corridor. Due to the creek's relatively small size, it provides only limited access for a subset of the migratory fish in the Delaware basin. Paunacussing Creek is classified as a high-quality cold-water fishery in chapter 93 of title 25 of the Pennsylvania Code, which means that water quality sufficient to support a cold-water fishery should be maintained (i.e., trout species). The creek is high-quality habitat for the brown trout and historically native brook trout. The creek also includes some state listed species, but these are noted as not necessarily rare in the region. There is a relatively high diversity of amphibian and reptile species compared to similar watersheds.

This segment has unique and some good quality ecological values on a local or statewide scale. However, overall, the ecological values of this segment do not possess rare, unique, or exemplary qualities. Therefore, Paunacussing Creek does not qualify as an ecological ORV.

GEOLOGICAL

Lower Delaware River

The Lower Delaware River is shaped by the varied geology through which it has carved its way to the Atlantic Ocean. At the northern end of the Lower Delaware River, it cuts through the folded Ridge and Valley formations created by colliding tectonic plates and the rising modern Appalachian Mountains. The hydro-geomorphology of the river is characterized by riffle/pools, deep runs, and huge glacial boulders, rapids, and ledges.

Photo: D&L NHC

South of Riegelsville, Pennsylvania, the river enters the rolling hills of the Piedmont Province (specifically the Gettysburg-Newark Lowland section). Here, the Triassic Lowlands begin, characterized by hard Brunswick and Lockatong shales that are rich in dinosaur fossils.

The dramatic curve in the river at Upper Black Eddy, Pennsylvania, is the result of hard diabase intrusions created when molten material pushed up into the older lakebeds and cooled—evidenced by the 300-foot dark cliffs towering above the river. The lowlands and intrusion of molten material were formed during the separation of Pangaea as the Atlantic Ocean was forming.

It is at Frenchtown, New Jersey, where river islands become prominent features, built of materials brought to the valley by ice age glaciers of the Pleistocene Epoch between 11,000 and 500,000 years ago. Just north of Stockton, New Jersey, lies a classic example of the Triassic Stockton Arkose. These are well-developed outcrops and some of the best examples visible anywhere in the Delaware Valley region.

The Devil's Tea Table is an outstanding geologic feature that is rare in the northeast region. This Triassic rock layer, perched on the Milford Bluffs, was caused by the erosion of softer sedimentary rock beneath a harder upper layer of rock, creating the "table" effect. Milford Bluffs are nearly vertical, 300-foot south-facing cliffs that expose Triassic Brunswick shale and border conglomerates. They represent the best red shale cliff community in New Jersey. On the opposite side of the river, the north-facing Nockamixon Cliffs of red shale support alpine-arctic flora that is rare in the Continental United States. The cliffs are part of a state-designated natural area within Delaware Canal State Park. The Pennsylvania Geological Survey has designated Nockamixon Cliffs as an Outstanding Scenic Geological Feature of Pennsylvania.

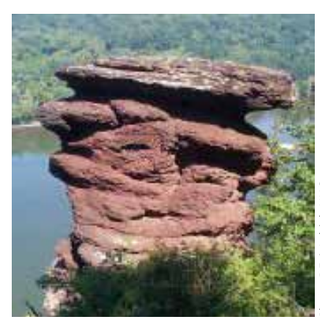


Photo: DE & Lehigh NHC

The Monroe Triassic Border Fault in Durham Township, Pennsylvania, is a National Natural Landmark. It is one of only a few exposed rifts in the eastern United States, most of which are buried deep beneath the continental shelf of the Atlantic Ocean. It represents an outstanding geologic feature associated with the Gettysburg-Newark Lowland section of the Piedmont.

Tinicum Creek

The Tinicum Creek watershed includes an unusual combination of geologic features that express erosional, volcanic, and glacial processes. The creek lies entirely within the Triassic Lowlands of the Piedmont Physiographic Province, and the geology primarily reflects the separation of Pangaea and the formation of the Atlantic Ocean during the Mesozoic era about 200 million years ago. Sedimentary Triassic rocks in this area include the Lockatong, Brunswick, and Stockton, originating when inland valleys were filled with sediment-bearing lakes and rivers. These deposits are 4,000 to 10,000 feet thick. In the Tinicum Creek watershed, the Brunswick red shale and Lockatong argillite are the primary outcroppings.

Among the volcanic features, Tinicum Creek has "ringing rocks." These rocks are part of an igneous intrusion of diabase dikes and sills that when struck with a hammer produce musical notes. This boulder field is listed as an Outstanding Geological Feature of Pennsylvania and is a potential National Natural Landmark.

Rapp and Beaver creeks, the designated wild and scenic tributaries to Tinicum Creek, originate in the diabase geological area. After meandering through this boulder-strewn and wet forested area, these creeks continue south and enter the Lockatong Formation, incising a valley that eventually becomes 200 feet deep. In this area

the streambed consists of a series of slightly inclined red and gray rock ledges. These ledges are so angular and square that they appear to be human-made. The rock formations result in a series of scenic low waterfalls and pools. Below the Beaver and Rapp creeks confluence with Tinicum Creek, the streambed is predominately Brunswick red shale, siltstone, and mudstone, creating a striking bedrock channel that contributes to a flashy hydrologic system. Steep, vertical cliffs are exposed along the streambed and within the Brunswick Formation.

Tohickon Creek

Tohickon Creek is entirely within the Gettysburg-Newark Lowland section of the Piedmont Physiographic Province—Lower Tohickon Creek cuts through 12 alternating bands of Triassic shales, sandstones, and argillites of the Brunswick and Lockatong formations. The result is a striking landscape of steep, forested slopes interspersed with sheer rock walls. There is a narrow band of diabase in the southeastern portion of the watershed near Point Pleasant, which is part of a larger formation that extends eastward across the Delaware River. This dense igneous rock is associated with dikes and sheets that intruded and metamorphosed the rocks. The resistance of the rock has directed the course of the streams in the area such that most of the streams and ridges in the area are parallel to the strike of the bedding rather than cutting across the beds. These vertical cliffs form a chute along the creek. Lockatong geology is responsible for the distinct pavement-like look of the creekbed in some places. There are also unusual rock formations such as Sentinel Rock. Argillite, Balcony, and Cedar Overlooks in Tohickon Valley Park provide access to these geological formations.

Paunacussing Creek

Paunacussing Creek does not contain outstandingly remarkable geologic values because it does not possess rare, unique, or exemplary geologic qualities. Despite this, the Paunacussing Creek watershed is a good example of the Northern Piedmont landscape within the Delaware River basin. The landscape is within the Newark basin portion of the Triassic Lowland Province. This broad basin is defined by its relatively "young" sedimentary shale bedrock geology (about 220 million years old)—namely the Lockatong Formation and Stockton Formation.

The Stockton and Lockatong formations are generally reddish brown sandstones, also containing conglomerates, shale and mudstone. These shales are moderately resistant to erosion and weathering. Weathering parent material from these Triassic shales directly forms the reddish brown soils that characterize the area. Near the confluence, the elevation drops 300 feet from the top of the palisade to the level of the Delaware riverbed over a relatively short distance of less than 1,000 feet.

RECREATIONAL

Lower Delaware River

The Lower Delaware River's variety of outdoor experiences is significant because of the intimate interrelationship between outdoor recreation, cultural resources, and nature. The range of active and passive recreational experiences is augmented because visitors and residents alike can access the river corridor through a wide range of travel options, including a leisurely drive along the national and state scenic byways; bicycling, hiking, and horseback riding on the extensive multiuse canal towpath trails and various hiking trails on either side of the river. Road cyclists can follow the river south along Adventure Cycling's Atlantic Coast route. In addition, entry to the river is available through numerous public access points.

There are 28 state and locally managed access points along the approximately 70 miles of the Lower Delaware mainstem between Delaware Water Gap and Washington Crossing State Park in New Jersey, including the Sandts Eddy and Frost Hollow access areas north of Easton and various access points along the Delaware Canal (Pennsylvania) and Delaware and Raritan Canal (New Jersey) state parks.

On the Pennsylvania side of the Lower Delaware, there are two state-designated scenic byways that provide access to scenic resources, parks, and recreational destinations almost the entire length of the river corridor. These include the 17-mile Delaware River Valley Scenic Byway and State Routes 32 and 611 of the Delaware River Scenic Drive, totaling 86 miles. In New Jersey, 35 miles of Route 29 is designated a national and state scenic byway—the Delaware River Scenic Byway. Paralleling these scenic byways and the river on the Pennsylvania side, is the 60-mile-long Delaware Canal system from Easton to Bristol, Pennsylvania, and on the New Jersey side the 70-mile-long Delaware and Raritan feeder canal from Frenchtown south to Trenton. The Delaware Canal and the Delaware and Raritan Canal are both designated national recreation trails. A unique part of the Delaware Canal experience is a mule-drawn canal boat ride at New Hope, Pennsylvania.

Trailheads along the Lower Delaware River provide entrée into the vast regional trails network beyond the canal towpath trail system, including the 27-mile Paulinskill Valley Trail in New Jersey, the trail system within Marble Hill Natural Area in Warren County, and trails through Washington Crossing State Park Natural Area. Together with the Delaware River Water Trail that connects all three NPS administered areas, the trails and byways offer multiple ways in which to enjoy the natural beauty of the river valley. In addition to trails, numerous public parks and recreational facilities such as Theodore Roosevelt State Park, Ralph Stover State Park, Nockamixon Lake State Park, Tohickon Valley County Park, Merrill Creek Environmental Preserve, and Giving Pond Recreation Area, to name a

few, are available for outdoor activities. These parks offer environmental and history education programs, nature walks, photographic workshops, picnicking, rock climbing, camping, cross-country skiing, and wildlife observation. The parks, which encompass some of the Delaware River islands including Marshall Island, Treasure Island, and Bulls Island. The parks and islands present many options for water-related activities such as fishing, swimming, boating, and bird-watching.

Along with outdoor recreation, there are long-running cultural events that are intimately connected to the river. Annual shad festivals held in Lambertville, New Jersey, and the Forks of the Delaware River Shad Fishing Tournament in Easton, Pennsylvania, are examples of how recreation and natural resources are interconnected.

Washington Crossing Historic Park in Pennsylvania and its counterpart, Washington Crossing State Park in New Jersey, are major tourist destinations that include the annual December re-enactment of General George Washington's crossing of the Delaware River.

The historic river towns and hamlets, such as New Hope, Lambertville, Stockton, and Frenchtown, are also unique to the region and draw visitors from throughout the tri-state area of New York, New Jersey, and Pennsylvania.

Photo: DE & Lehigh NHC

From Portland, Pennsylvania, south to Point Pleasant, Pennsylvania, several outfitters provide boat rentals and are available to organize the visitor's experience on the river, from tubing, rafting, kayaking, and canoeing to sports fishing. Various challenges are available for boaters with different levels of experience, from class I slow-moving waters suitable for beginners such as Upper Black Eddy to class II rapids like those at Foul Rift and the Lambertville wing dam for more experienced boaters.

Tinicum Creek

Access to Tinicum Creek and its tributaries is limited, public recreation facilities are few, and the area is relatively rural and undeveloped. In spite of these limiting factors, Tinicum Creek can offer diverse recreational experiences. Throughout the seasons, people visit Tinicum Creek watershed to experience the unusual geologic features, wildlife, historic villages, historic structures, and covered bridges that make the area distinctive and scenic.

Photo: DJ Maschek

Erwinna Historic District with its covered bridge is memorable for dramatic views of Swamp Creek as it zig zags over a series of stepped bedrock shelves. Frankenfield is one of the best loved and photographed covered bridges in the area. Masonry walls of the distinctive local stone form buttresses that support the wooden structure painted a deep red. The covered bridge spans a serene and still section of Tinicum Creek. The pony truss bridge over Geigel Hill Road allows views of a swiftly moving section of Tinicum Creek and historic building built into the rock ledge on one side of the creek. Tinicum Park, at the confluence with the Delaware River, is enjoyed by visitors for its expansive view framed by the river on one side and a steep mountain ridge on the other. Lush greenery contrasts with the deep reds of the historic John Stover House and the distinctive red barn, which are framed by trees. The forested cliffs and hills lining both sides of Tinicum Creek contribute to a sense of isolation and being in a different time period. However, because of limited access and a lack of regionally rare, unique, or exemplary recreation opportunities, Tinicum Creek does not contain a recreation ORV.

Tohickon Creek

Visitors to the Tohickon valley come for the recreational opportunities, which are plentiful in the public lands lining Tohickon Creek. The alternating argillite and shale bands of the underlying geology offer striking visual contrast with the surrounding greenery and unusual rock formations such as Sentinel Rock. Recreational opportunities include fishing, rock climbing, and kayaking.

Tohickon Creek offers some of the best kayaking opportunities in the northeast corridor. During high-flow periods and dam releases, typically quiet Tohickon Creek turns into a raging class 3 and 4 whitewater river.

Paddlers from as far away as Maine travel to Tohickon creek to paddle the stretch from Ralph Stover State Park to Point Pleasant.

Ralph Stover State Park includes 45 acres along Tohickon Creek. The park offers easy access to the creek for warm water fishing and kayaking, and easy walking paths. Adjacent to the state park is Tohickon Valley Park, 612 acres of county parkland that includes a playground, picnicking, hiking, fishing, restrooms, and both tent and cabin camping. Also contained within Tohickon Valley Park is a 200-foot rock wall known as "High Rocks." Climbers from throughout the region visit Tohickon valley for this challenging climbing experience. In addition, Stover-Myers Mill County Park offers 26 acres with picnicking, fishing, and tours of the historic mill. The park is distinguished by the early 1800s mill, which is listed in the National Register of Historic Places.

Paunacussing Creek

While Paunacussing Creek has low recreational value regionally, the scenic setting does contribute significantly to its local value. The forested cliffs and hills lining both sides of the Paunacussing below Carversville and the natural setting in many locations contribute to a sense of isolation and being in a different time period, yet it is relatively accessible from nearby canal towns through the Delaware Canal towpath trail. The clear water with its riffles and pools drops in elevation revealing large boulders, distinctive red shale outcroppings, and a wealth of historic resources, which draw visitors from around the area. From Fleecy Dale Road and Old Carversville Road along Paunacussing Creek, a visitor enjoys views of the creek with steep drops, historic farmsteads, and the hand-crafted rock features scattered along the roadways. The historic districts of Mechanicsville and Carversville include stone arch bridges and exceptional examples of period architecture. Because of these scenic features, the reputation of the Paunacussing with artists is noteworthy. However, public recreation access is nearly nonexistent due to the large tracts of privately owned land along the creek; therefore, recreation is not considered an ORV.

SCENIC

Lower Delaware River

The Lower Delaware River corridor is recognized for its unique diversity of scenic resources that are accessible by road, river, trail, and canal. Narrow roads, some of which are designated scenic byways, parallel the entire Lower Delaware River corridor. The Delaware Canal National Historic Landmark, parallels the Lower Delaware River south of Easton, while the Delaware and Raritan Canal follows the river on the New Jersey side. These linear features and their associated landscapes are narrowly framed by wooded steep slopes and cliffs and provide numerous glimpses of the river and opposite shore.

Photo: DE & Lehigh NHC

> Particularly notable are the forested islands, the renowned rock features of cliffs and falls, tumbling streams, steep ravines, and spectacular seasonal foliage. Dramatic features include, but are not limited to: Milford Bluffs, Devil's Tea Table, Tumble Falls, Nockamixon Cliffs, and Cuttalossa Falls.

The river's rapids, pools, and riffles are interspersed with numerous forested islands, including Marshall Island and Bull's Island.

Many of the historic canal towns with their associated bridges are national historic districts and complement the scenery, giving a flavor of earlier times. Notable features include, but are not limited to, Roebling suspension bridge at Riegelsville, Washington Crossing and Bridge, New Hope / Lambertville Bridge and historic districts, Uhlerstown Village and rural historic district, Frenchtown / Uhlerstown Bridge, Lumberville – Raven Rock Bridge.

Photo: DE & Lehigh NHC

Lower Delaware Tributaries (including Tinicum Creek, Tohickon Creek,and Paunacussing Creek)

The tributaries along the Lower Delaware River offer a dramatic rolling landscape of fields and woods, with north-facing slopes of hemlock. Compared to the mainstem of the Delaware, the ravines along these tributaries are notably steeper. Cliffs formed by pronounced outcrops of Stockton bedrock are accessible by narrow winding roads. The area includes high gradient rocky creeks and clear water. The valleys include a mix of smaller historic farms and villages linked by stone-arch and covered wooden bridges. This area is the focus of the New Hope School of Pennsylvania impressionistic painting. Distinctive features include Tinicum Creek's red rock outcrops and Erwinna Historic District; Tohickon Creek, including 200-foot-high sculpted cliffs at Ralph Stover State Park; Doans Cave; Cabin Run and Loux covered bridges; Tohickon Aqueduct as part of the Delaware Canal; striking alternating argillite and shale bands and unusual rock formations such as Sentinel Rock; and Paunacussing Creek – Mechanicsville and Carversville historic districts, stone arch bridges, and Township Scenic Corridor Fleecy Dale Road and Old Carversville Road.

FREE-FLOWING

CONDITION

FREE-FLOWING CONDITION

Definition of free flowing according to the Wild and Scenic Rivers Act, "…existing or flowing in a natural condition without impoundment, diversion, straightening, rip-rapping or other modification of the waterway."

The Delaware River Basin drains 12,756 square miles across the states of Pennsylvania, New York, New Jersey, and Delaware and flows unimpeded for 330 miles from Hancock, New York, to Delaware Bay. The Delaware is the longest undammed river east of the Mississippi. The headwaters contain a number of impoundments and flows are highly regulated by a 1954 U.S. Supreme Court Consent Decree between the Decree Parties of Delaware, New York, New Jersey, the Commonwealth of Pennsylvania, and New York City. Although altered to some extent in the headwaters, the undammed mainstem of the Delaware continues to provide unimpeded flows that support ecological, scenic, recreational, geologic, and cultural ORVs.

Photo: Jim Davis

Draining 0.4% of the nation's land area, the Delaware River provides drinking water for more than 16 million people—more than 5% of the U.S. population.

Regulated releases also provide a critical buffer to prevent saltwater intrusion downstream of the confluence of the Schuylkill and Delaware rivers in Philadelphia, Pennsylvania, protecting the municipal water supplies of Philadelphia and Camden, New Jersey. Four dams exist on tributaries to the Upper Delaware River (table 1), impounding water from approximately 38% of the Upper Delaware watershed. Flows in the Upper Delaware River—especially in the uppermost section—are impacted by two New York City (NYC) reservoirs: the Cannonsville Reservoir on the west branch of the Delaware and the Pepacton Reservoir on the east branch of the Delaware. Flows in the lower section of the Upper Delaware River and the upper section of the Middle Delaware River are impacted by releases from a hydroelectric generating facility (not a NYC reservoir) on the Lackawaxen River, and to a much lesser extent by releases from the Rio hydroelectric generating facility (not a NYC reservoir) on the Mongaup River. A third NYC reservoir on the Neversink River impacts flows downstream of its confluence with the Delaware River, just upstream from the Delaware Water Gap. The decree provides for the diversion of up to 800 million gallons of Middle Delaware River water per day (annual average) to the NYC metropolitan area and requires a minimum daily flow of 1,750 cfs (in nondrought conditions) at Montague, located at the northern end of the Delaware Water Gap National Recreation Area.

In recent years, New York City has diverted an average of about 650 million gallons of water per day, which is equal to about 55% of the "natural" average daily flow at the upstream boundary of the Upper Delaware River (Hancock, New York).

Since the 1954 decree, reservoir releases have been managed through a series of evolving programs based on unanimous agreement by the parties. The Flexible Flow Management Program provides the current framework for managing diversions and releases from NYC reservoirs. This program was designed by the states to support multiple flow management objectives, including water supply; drought mitigation; flood mitigation; protection of the cold tail-water fishery; a diverse array of habitat needs in the mainstem, estuary and bay; recreational goals; and salinity repulsion in the Delaware estuary. The region's annual precipitation can vary greatly from year to year, challenging the Flexible Flow Management Program. In drought years, flow formulas and release patterns from upstream reservoirs may not adequately protect river ecology.

The decree designates the U.S. Geological Survey (USGS) as the River Master to implement the provisions of the 1954 decree. In 1961, the Delaware River Basin Commission (DRBC) was created and includes a representative from each state and one from the federal government (currently the U.S. Army Corps of Engineers). The Delaware River Basin Commission is the primary management entity for the Delaware River. The commission plans and regulates water conservation and use and distribution in the basin based largely on the 1954 decree.

Table 1. Reservoirs Upstream of the Upper Delaware River

Reservoir Name	State	Tributary	River Mile at Tributary Mouth	Date of First Operation	Drainage Area (mi²)	Capacity (billions of gallons)	Main Purpose
Cannonsville	NY	West Branch Delaware River	330	Sept. 1963	454	99	Diversion to NYC
Pepacton	NY	East Branch Delaware River	330	Sept. 1954	372	150	Diversion to NYC
Lake Wallenpaupack	PA	Wallenpaupack Creek to Lackawaxen River	278	1926	228	88	Hydro-electric generation
Rio System	NY	Mongaup River (3 reservoirs)	261	Jan. 1930	116	11	Hydro-electric generation

Due to its proximity to large metropolitan centers and because of the Delaware River Compact, the Delaware River basin is well gauged. Table 2 provides a list of existing USGS gauges of the Upper Delaware.

Table 2. USGS Discharge Gauges on the Delaware River and Tributaries Upstream of / Within the Upper Delaware River						
USGS Gauge Station No.	Gauge Name	River Mile	Elevation (ft)	Watershed Area (mi²)	Period of Record	Years of Record
01421000	East Branch Delaware River at Fishs Eddy	NA	956	784	1912-	99
01426500	West Branch Delaware River at Hale Eddy	NA	946	595	1912-	99
01427200	Equinunk Creek near Equinunk, PA	NA	890	56.3	1946-	66
01427207	Delaware River at Lordville	322	842	1,590	2006-	5
01427510	Delaware River at Callicoon	304	735	1,820	1975-	37
01428500	Delaware River above Lackawaxen River Near Barryville	279	600	2,020	1940-	71
01432110	Lackawaxen River at Rowland	NA	670	589	2007-	4

Photo: D&L NHC

A number of modifications to the waterway exist on the Delaware River. The following modifications exist within the Upper Delaware River.

Waterway modifications within the Upper Delaware River:

- Village of Hancock sewage treatment plant outfall; river mile 330.5
- New York State Route 97 berm, various points; river mile 258–330.5
- Pennsylvania Route 191 berm, various points; river mile 322–330.5
- New York Central (former Erie) Railroad line berm, various points along either side of river; river mile 258–330.5
- approximately 50 unimproved public, commercially owned and private accesses exist throughout the corridor; river mile 258–330.5
- several buildings, decks, former bridge abutments, stairways and other structures; river mile 258–330.5
- communications and powerlines cross the river at approximately 15 locations
- Lordville Bridge connecting Equinunk, PA, and Lordville, NY; river mile 322
- Kellams Bridge connecting Stalker, PA, and Kellams, NY; river mile 313
- Callicoon Bridge; river mile 304
- Town of Delaware flood diversion channel; river mile 303
- Damascus/Cochecton Bridge; river mile 299
- Milanville/Skinners Falls Bridge; river mile 295
- Eel Weir; river mile 293
- Narrowsburg New York State Department of Environmental Conservation (DEC) Boat Launch and bulkhead; river mile 290
- Narrowsburg Bridge; river mile 289.7
- Narrowsburg sewage treatment plant outfall; river mile 289.5
- Eel Weir; river mile 288
- No. 9 Railroad Bridge; river mile 284
- Roebling's Delaware Aqueduct (Roebling Bridge); river mile 277
- Delaware and Hudson Canal berm, walls and appurtenances, various points; river mile 258-277.5
- D&H Canal Timber Crib Dam Remnants; river mile 277.5
- Shohola/Barryville Bridge; river mile 273
- Pond Eddy Bridge; river mile 265.5
- No. 2 Railroad Bridge at Millrift; river mile 258 (Southern Terminus of the Upper Delaware River)
- Columbia Gas Transmission Corporation; river mile 258.6

Between the southern terminus of the Upper Delaware Scenic and Recreational River and the northern boundary of the Middle Delaware, an additional tributary reservoir modifies the flow regime of the Middle Delaware, into and through the Delaware Water Gap Recreation Area (table 3).

Table 3. Reservoir that modifies the flow of the Middle Delaware River

Reservoir Name	State	Tributary	River Mile at tributary mouth	Date of First Operation	Drainage Area (sq. mi.)	Capacity (billion of gallons)	Main Purpose
Neversink	NY	Neversink River	253.6	1954	92	34.9	Diversion to NYC

A number of USGS stream gauges also exist on the Middle Delaware and its tributaries. Table 3 provides a list of existing USGS gauges in and tributary to the Middle Delaware River (table 4).

Table 4. Existing USGS Gauges in and Tributary to the Middle Delaware River

USGS Gauge Station No.	Gauge Name	River Mile	Elevation (ft.)	Watershed Area (sq mi)	Period of Record	Years of Record
01437500	Neversink River at Godeffroy, NY	NA	459.66	307	1937-	75
01434000	Delaware River at Port Jervis, NY	254.8	415.35	3,070	1904-	98
01438500	Delaware River at Montague, NJ	246.4	369.93	3,480	1939-	73
01440000	Flat Brook Near Flatbrookville, NJ	NA	347.73	64	1923-	89
01439500	Bush Kill at Shoemakers, PA	NA	421.13	117	1908-	104
01440200	Delaware River Near Delaware Water Gap, PA*	214.7	293.64	3,850	2001-	11
01442500	Brodhead Creek at Minisink Hills, PA	NA	301.84	259	1950-	62

* 01440200 discharge period of record 1964–1996; only gauge height recording has been maintained since 2001

A number of waterway modifications exist within the Middle Delaware River as listed below.

Waterway Modifications within the Middle Delaware River:

- Milford Beach Access Area, PA; river mile 246.4
- Rt. 206 Bridge connecting Milford, PA and Montague, NJ; river mile 246.2
- Dingman's Bridge, a private bridge at Dingmans Ferry, PA; river mile 238.6
- Dingmans Access Area, a paved access and boat ramp, PA; river mile 238.6
- Bushkill Access Area, a paved access and boat ramp, PA; river mile 227.6
- Power transmission lines cross river at mile 222.6
- Smaller communication and power lines cross the river at 3 other locations.
- Poxono Access, NJ; river mile 219
- Turtle Beach, NJ; river mile 218.9
- Smithfield Access Area, paved access and boat ramps, PA; river mile 218.1
- Worthington State Park, NJ, paved access area; river mile 214.8
- Shawnee Inn and paved ramp, golf course on river island, PA; river mile 214.7
- Shawnee Inn golf course, small bridge spans channel along PA shore; river mile 214.4
- Private docks along PA shore; river mile 213.2
- Interstate 80 Bridge; river mile 212.2
- Kittatinny Point NPS Visitor Center with boat ramp; river mile 211.5
- Railroad embankment along PA shore; river mile 212.6-209.5
- Tennessee Gas Transmission Line, mile 248.3

Passing downstream from the Delaware Water Gap National Recreation Area at river mile 209.5, the river enters an eligible but undesignated segment of river in the vicinity of Portland, Pennsylvania. The next wild and scenic designated river segment starts just below the PPL Martins Creek generating station at river mile 193.8. The Lower Delaware River's flow regime is modified by reservoirs in tributary watersheds (table 5). Numerous water diversions are within the Lower Delaware: Merrill Creek pumped storage intake; City of Easton water supply; Point Pleasant Diversion (public supply and power generation); Portland, Martins Creek and Gilbert power generating stations; and the New Jersey Water Supply Authority water diversion. There are also numerous municipal and industrial wastewater dischargers to the Lower Delaware and its tributaries. Those that discharge directly to the Lower Delaware include Portland Borough; Portland Generating Station; Martins Creek Generating Station; City of Easton, PA; City of Phillipsburg, NJ; Town of Frenchtown, NJ; and City of Lambertville, NJ. There are also a few small industrial dischargers and some abandoned industrial facilities.

Table 5. Reservoirs that Modify the Flow of the Lower Delaware River							
Reservoir Name	State	Tributary	River Mile at Tributary Mouth	Date of First Operation	Reservoir Drainage Area (mi²)	Capacity Billions of Gallons	Main Purpose
Columbia Lake	NJ	Paulins Kill	207.2	Unknown	177.0	Unknown	Hydropower generation
Beltzville Reservoir	PA	Pohopoco Creek, Lehigh River	183.6	1971	96.4	33.8	Flood Control, Decree Party flow augmentation
Merrill Creek Reservoir	NJ	Lopatcong Creek	182.0	1988	3.7	15.0	Decree Party flow augmentation
Lake Nockamixon	PA	Tohickon Creek	157.5	1973	73.3	21.7	Recreation; Decree Party flow augmt.

The Lower Delaware and its tributaries are also well gauged. Table 6 provides a list of existing USGS gauges in and tributary to the Lower Delaware River.

Table 6. USGS Discharge Gauges on the Delaware River and Tributaries Upstream of/within the Lower Delaware Recreational River*						
USGS Gauge Station No.	Gauge Name	River Mile	Elevation (ft)	Watershed Area (mi²)	Period of Record	Years of Record
01443500	Paulins Kill at Blairstown, NJ	NA	335.9	126	1921-	91
01443900	Yards Creek nr Blairstown, NJ (reservoir outlet)	NA	606.8	5.34	1966-	46
01446000	Beaver Brook near Belvidere, NJ (Pequest River Tributary)	NA	303.4	36.7	1922-	90
01445500	Pequest River near Pequest, NJ	NA	398.8	106	1921-	91
01446500	Delaware River at Belvidere, NJ	197.8	226.4	4,535	1922-	90
01446776	Bushkill Creek Below SR2017 Bridge at Tatamy, PA	NA	335.0	31.1	2005-	7
01446995	Delaware River at U.S. Route 22 Bridge Phillipsburg, NJ	184.0	155.4	4,717	2005-	7
01454700	Lehigh River at Glendon, PA	NA	164.3	1,359	1966-	46
01455090	Lopatcong Creek at Strykers Road at Port Warren, NJ	NA	243.2	9.59	2011-	1
01457000	Musconetcong River near Bloomsbury, NJ	NA	274.8	141	1903-	109
01457500	Delaware River at Riegelsville, NJ (gh)	175.0	125.1	6,328	2002-	10
01458500	Delaware River at Frenchtown, NJ (gh)	165.1	99.9	6,420	2007-	5
01459500	Tohickon Creek near Pipersville, PA	NA	258.96	97.4	1935-	77
01460880	Lockatong Creek at Raven Rock, NJ	NA	100.0	22.9	2005-	7
01461300	Wickecheoke Creek at Stockton, NJ	NA	80.0	26.6	2006-	6
01461500	Delaware River at Stockton, NJ (gh)	152.0	54.0	6,656	2008-	4
01462000	Delaware River at Lambertville, NJ (gh)	148.7	49.0	6,680	2008-	4
01462500	Delaware River at Washington Crossing, NJ (gh)	141.7	26.14	6,735	2010-	2

* Some tributaries have multiple USGS gauges. In those cases, only the gauge nearest to the Delaware River is listed.
(gh) USGS gauge measures continuous gauge height only, not discharge.

A number of waterway modifications listed below exist within designated segments of the Lower Delaware River. In addition to facilities listed, there are extensive reaches of river confined within road, railroad, and canal embankments. Some sections of the Lower Delaware are relatively urbanized. Private docks and boat launch facilities are common, as well as homes, towns, quarries, and various active and abandoned industries.

Waterway modifications within designated segments of the Lower Delaware:

- railroad bridge; river mile 190.6
- industrial wastewater or stormwater outfalls, NJ; river mile 189.7
- Sandts Eddy PA Fish and Boat Commission Access; river mile 189.1
- pipeline crossing; river mile 189.0
- bridge connecting Upper Black Eddy, PA, and Milford, NJ; river mile 168.3
- industrial outfall, NJ; river mile 167.5
- Superfund site, NJ, extensive rock bank stabilization; river mile 167.0
- wastewater or stormwater outfall, NJ; river mile 165.5
- bridge connecting Uhlerstown, PA, and Frenchtown, NJ; river mile 165.1
- wastewater or stormwater outfall, NJ; river mile 164.9
- wastewater outfall, NJ; river mile 164.5
- Kingwood access area, NJ, improved boat ramp; river mile 164.2
- commercial hot dog stand along center channel on private island; river mile 160.7
- major canoe and tube outfitters landing, PA; river mile 157.7
- Byram access area, NJ, improved boat ramp; river mile 156.5
- wing dams extend from PA and NJ shore for NJ diversion; river mile 156.2
- Bulls Island Foot Bridge links PA and NJ state parks; river mile 155.7
- Lockatong Creek overspill from Delaware and Raritan Canal; river mile 154.2
- Wickecheoke Creek overspill from Delaware and Raritan Canal; river mile 152.5
- bridge at Stockton, NJ; river mile 152.0
- pipeline crossing; river mile 150.1
- bridge linking Lambertville, NJ, and New Hope, PA; river mile 148.7
- municipal wastewater discharge outfall, river mile 148.2
- wing dams extend from PA and NJ shores for defunct paper mill raceway, PA; river mile 148.0
- Washington Crossing Bridge; river mile 141.8

Downstream from the southern terminus of the designated wild and scenic segments, the Delaware River flows free to the head of tide at Trenton, NJ, at river mile 134.3.

The Musconetcong River drains northeast to southwest and drains 157 square miles. The river valley is narrow, not more than 6 miles wide at its widest point. The Musconetcong is prone to flash flooding due to the karst geology and narrow width. Flow has been altered since the arrival of European settlers in the early 18th century. Europeans, and possibly the Delaware Nation before them, built fish weirs at various places along the river. Development impacts are still seen today; 11 known dams existed on the Musconetcong River at the time of the river's designation in late 2006. Since 2006, four dams have been removed (Seiber, Gruendyke, Riegelsville, and Finesville). Two larger dams (Hughesville and Warren Glen) remain in the lower segment of the river and serve as the dividing lines between the designated segments B and C.

Of the seven dams left on the Musconetcong, only the two at Hughesville and Warrant Glenn alter the river's flow, which is why segment C was not designated. Penwell Dam, in the upper part of segment B, is large enough that paddlers must portage. One project at the Warren County Rod and Gun Club included excavations and the placement of boulders in the river. Three other projects involved excavation and bio-stabilization measures to improve riparian habitat at Gruendyke and Seber Mill dam sites.

Based on the gauge at Bloomsbury (141 mi^2), the Musconetcong River flows at the down-stream end of segment B average 250 cfs. Low flows typically occur in July and August, and averaged 160, 151, and 157 cfs, respectively, in 2010/2011. High flows typically occur in March, April, and May and averaged 350, 354, and 272, respectively, in 2010/2011. The floods of 2011 were a marked departure from flows seen at any time in the past. The highest flow on record of 8,230 cfs occurred August 28, 2011, during a hurricane event. Substantial property damage was sustained and residential wells were contaminated, especially in the area of Bloomsbury.

Flows of the Musconetcong River are affected by drawdown releases at Lake Hopatcong. Every fifth year, Lake Hopatcong is drawn down 60 inches in late September, and annually in the fall, 26 inches for dock and marina maintenance, increasing flows temporarily. The Lake Hopatcong management plan requires certain flows at various times of the year. The dozens of boat ramps and bridge crossings of the Musconetcong River were all present at the time of designation.

WATER QUALITY

Photo: David B. Soete

WATER QUALITY

Water quality in the nontidal portion of the Delaware River is perhaps the purest of all the large rivers in the mid-Atlantic and northeastern United States.

At most times water quality exceeds federal and state criteria levels. The Delaware River serves as a regional reference condition river for water quality and biological assessments. The uses that are most dependent on the extraordinarily clean water are water-based recreation, water supply that requires little treatment, and excellent habitat for thriving aquatic life.

Photo: David B. Soete

Because of such exceptional water quality, keeping the Delaware River uncontaminated is the primary policy of regulatory agencies. This policy is known as anti-degradation, and is consistent with the Wild and Scenic River Act anti-degradation policy. The entire 197-mile nontidal portion of the Delaware River between Hancock, New York, and Trenton, New Jersey, is classified by the Delaware River Basin Commission as "Special Protection Waters." This represents the longest contiguous reach of anti-degradation waters in the United States. The Upper Delaware Scenic and Recreational River and the Delaware Water Gap National Recreation Area are accorded the highest level of anti-degradation protection by the Delaware River Basin Commission as outstanding basin waters. The Lower Delaware River is classified by the Delaware River Basin Commission as significant resource waters. Both classifications are equivalent to Environmental Protection Agency (EPA) tier III anti-degradation protection of water quality and allow "no measurable change in existing water quality except toward natural conditions."

Photo: David B. Soete

Outstanding basin waters include the additional provision disallowing mixing zones for approved dischargers whereas mixing zones are allowed in significant resource waters. Many tributaries in Pennsylvania, New York, and New Jersey are also afforded a similar level of water quality protection through state regulations, but only those tributaries within the boundaries of Delaware Water Gap National Recreation Area are included as outstanding basin waters by the DRBC Special Protection Waters regulations. Primary regulatory protection of other tributaries within the basin is maintained by the states, although the Delaware River Basin Commission does have some regulatory authority on point source dischargers to tributaries in order to protect the shared interstate waters of the mainstem. The DRBC Special Protection Waters regulations are unique in that they are monitored to determine if "measurable change" is occurring. This monitoring program is conducted through an informal partnership between the National Park Service and the Delaware River Basin Commission called the Scenic Rivers Monitoring Program. Both the Special Protection Waters regulations and the Scenic Rivers Monitoring Program are crucial to maintaining the level of water quality in the designated waters of the mainstem Delaware River.

The anti-degradation policy is very important, not only for river recreation and aquatic life, but also for the water supply for approximately 16 million people in New York, Pennsylvania, New Jersey, and Delaware. The Delaware River watershed is relatively small, comprising only 0.4% of continental U.S. land area; its clean water is a drinking water source for 5% of the U.S. population.

In comparing water quality of the Delaware River and tributary wild and scenic segments, both the Upper and Middle Delaware river segments are the cleanest and healthiest. The Lower Delaware is much more urbanized and historically industrialized and farmed, so water quality is not as good, although it still supports the most stringent of uses. The Musconetcong River water quality is good, supporting reproducing trout populations, but not as good as the Lower Delaware River.

Tohickon Creek is one of the highest water quality streams in Pennsylvania and is classified as a cold water fishery by the state's Department of Environmental Protection. A DRBC study of water quality in the Lower Delaware in 2004 found that, of the 18 Lower Delaware River segments and tributaries analyzed, Tohickon Creek was ranked fourth in overall water quality. Tinicum Creek is designated an exceptional value stream and Paunacussing Creek is designated as a high quality cold water fishery.

Photo: David B. Soete

As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historic places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

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