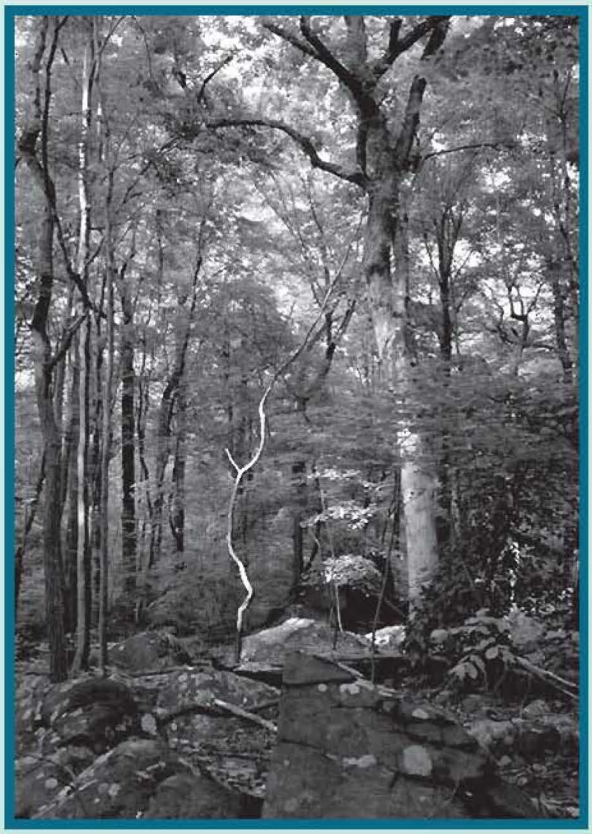
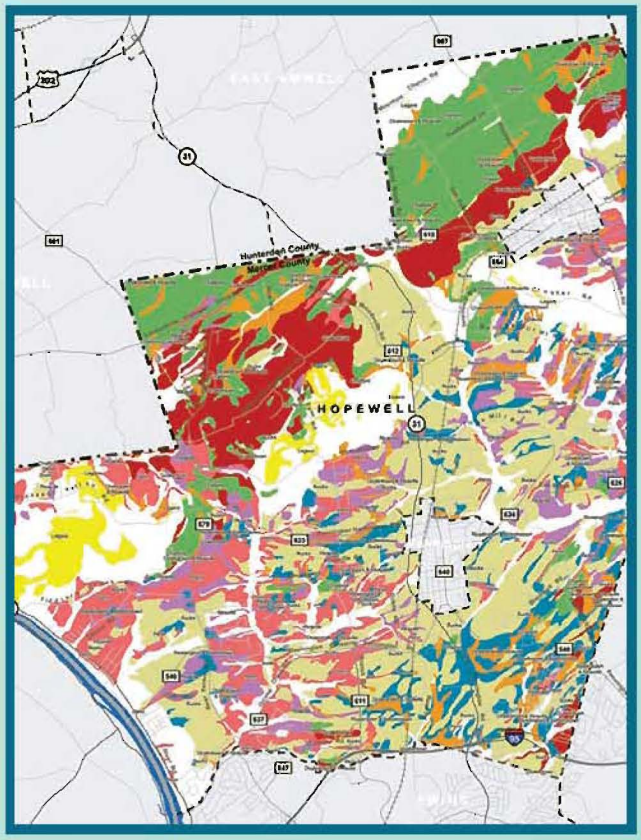
ENVIRONMENTAL RESOURCE INVENTORY

for the TOWNSHIP of

HOPEWELL

MERCER COUNTY, NEW JERSEY





prepared by:

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

with:

The Hopewell Environmental Commission

MAY 2010

The Delaware Valley Regional Planning Commission is dedicated to uniting the region's elected officials, planning professionals and the public with the common vision of making a great region even greater. Shaping the way we live, work and play, DVRPC builds consensus on improving transportation, promoting smart growth, protecting the environment, and enhancing the economy. We serve a diverse region of nine counties: Bucks, Chester, Delaware, Montgomery and Philadelphia in Pennsylvania; and Burlington, Camden, Gloucester and Mercer in New Jersey. DVRPC is the federally designated Metropolitan Planning Organization for the Greater Philadelphia Region — leading the way to a better future.

The symbol in our logo is adapted from the official DVRPC seal, and is designed as a stylized image of the Delaware Valley. The outer ring symbolizes the region as a whole, while the diagonal bar signifies the Delaware River. The two adjoining crescents represent the Commonwealth of Pennsylvania and the State of New Jersey.

DVRPC is funded by a variety of funding sources including federal grants from the U.S. Department of Transportation's Federal Highway Administration (FHWA) and Federal Transit Administration (FTA), the Pennsylvania and New Jersey departments of transportation, as well as by DVRPC's state and local member governments. This ERI was also funded by the Association of New Jersey Environmental Commisions' Smart Growth Assistance Program, supported by the Geraldine R. Dodge Foundation. The authors, however, are solely responsible for the findings and conclusions herein, which may not represent the official views or policies of the funding agencies.

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John Murphy, Deputy Mayor
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The impetus for the creation of this document, and its guidance and review, came from the Hopewell Township Environmental Commission.

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INTRODUCTION

The purpose of an Environmental Resource Inventory is to identify and describe the natural resources of a community. A community's natural resources – its soil, water, air, forests, fields, and waterways – are fundamental to its character. They are the foundation for its economic success and its quality of life. The protection and wise use of those resources is essential to the public health, safety, and welfare of current and future residents. The Environmental Resource Inventory provides the basis for the development of methods to preserve, conserve, and utilize those resources for the community's overall benefit.

Hopewell Township's natural resources have shaped the lives of its inhabitants for thousands of years. The Lenape Indians, who inhabited the lands of the township long before the arrival of Europeans, relied upon fish and game from the area's streams and upland forests. They also made good use of the region's rich agricultural soils. Hopewell's high-quality soils played a crucial role in the township's settlement by Europeans. Almost immediately after their arrival, Quaker settlers began to clear the forest and work the land, cultivating grain, fruits, and vegetables.

This agricultural heritage has come to define the structure and character of Hopewell Township, and even today, Hopewell maintains a robust agricultural community. Indeed, Hopewell ranks tenth among New Jersey's municipalities for active agricultural lands, with over 10,000 acres devoted to cropland and/or pastureland according to New Jersey's Statewide Farmland Assessment. A majority of the township's land has been designated by the State of New Jersey as an Agricultural Development Area (ADA), representing most of the ADAs in Mercer County. Even so, Hopewell is not immune to the development pressures other parts of Mercer County have been contending with in recent years. Between 1990 and 2000, Hopewell's population grew by nearly 40 percent. Documentation of the community's environmental resources is a necessity if Hopewell is to maintain its rural and agricultural heritage, the integrity of its natural resources, its environmental quality, and its high quality of life.

Hopewell's surface waters and groundwater resources, and the terrestrial resources that sustain the area's hydrology, will become increasingly important to its population and to that of neighboring communities as continuing development places increased pressure on diminishing natural resources. Hopewell's wetlands, upland forests, and grasslands, which provide significant habitat for a wide range of plants and animals, will be vital to the continued health of the community and the enjoyment of its citizenry. Knowledge of the township's environmental resources will allow its citizens, board and commission members, and elected officials to make informed decisions as they strive to maintain Hopewell's identity and create a sustainable landscape.

Preparing an Environmental Resource Inventory requires gathering all the existing information that can be found about a township's resources and presenting it in a form that is useful to a broad audience. The inventory reflects a particular moment in time, and it is assumed that it will be updated as new data becomes available.

Several documents and reports were utilized in preparing the *Environmental Resource Inventory for Hopewell Township*, including Hopewell Township's *2002 Master Plan* and the *2001 Hopewell Township Groundwater Resources Report,* as well as a number of reference works. These are listed at the end of this document. The maps and data relating to Hopewell's natural resources are principally derived from the New Jersey Department of Environmental Protection's (NJDEP) Geographic Information System mapping and from *The Landscape Project* produced by the Endangered and Nongame Species Program of the New Jersey Fish and Wildlife Division. Other sources include the U.S. Geologic Service, the New Jersey Geologic Service, and the Federal Emergency Management Agency.

Photo by Jeremy French

Lily pads in a pond.

BRIEF TOWNSHIP HISTORY

Hopewell Township's long history of human settlement well predates the arrival of the first Europeans. Prior to colonization, the Hopewell Valley was home for thousands of years to Native American people. By the time of European colonization, these people called themselves the Lenape. The Lenape (known as the "Delaware" by the British) inhabited an extensive territory throughout the Mid-Atlantic, comprising New Jersey, southern New York, eastern Pennsylvania and northern Delaware. Neighboring tribes considered the Lenape to be the original speakers of the Algonquian language, and referred to them as their "grandfathers" and the "ancient ones". The Lenape were revered as expert mediators and diplomats, and thrived on the area's rich natural resources, using the region's bountiful creeks and forested uplands for hunting, fishing, pottery making and agriculture.

It was these natural resources that first attracted European colonists to southern New Jersey. The earliest settlers were the Swedes, who established "New Sweden" on the Delaware Bay in the early 1600s. New Sweden was quickly conquered by the Dutch in 1655, who were subsequently ousted by the English ten years later. Throughout these waves of colonization, the Lenape slowly disappeared from their lands, either "bought out" by the European colonists, or succumbing to the foreign strains of disease the colonists brought with them. It is thought that by 1640, the Lenape population of New Jersey was reduced to a tenth of what it had been prior to European contact.

Following the ouster of the Dutch by the English, British colonists began to settle the area that would become Hopewell in the 1680s, with the township being formally established by the colonial legislature in 1699–1700. At that time, Hopewell included large parts of what is now Ewing Township and Trenton. For settlers to the Hopewell Valley, the virtual absence of a hostile native population, combined with the rich agricultural land, encouraged a settlement pattern of relatively isolated farmsteads interspersed with small rural hamlets that supplied goods and services. Both the boroughs of Hopewell and Pennington started out as such crossroads communities. Other Hopewell settlements, such as Titusville, Mt. Rose, and Marshalls Corner retain this character today.

New Jersey is sometimes referred to as either the "Cockpit" or "Crossroads" of the Revolution, an allusion to its importance as a battleground during the American Revolution. During the winter of 1776, most of New Jersey was under British occupation. On December 25 of that year, General George Washington led the Continental Army and militia forces, including Hopewell Township's three companies, across the Delaware River at Johnson's Ferry, now Washington's Crossing. This began the "Ten Crucial Days of the Revolution," which provided decisive victories for the colonists at the Battles of Princeton and Trenton, and ultimately changed the course of the war in favor of the colonists. Many Hopewell residents were actively involved in the Revolution, such as John Hart, a signer of the Declaration of Independence.

The late nineteenth century saw a series of transportation developments that would begin to change the rural character of Hopewell. The Mercer & Somerset and Delaware & Bound Brook railroads were both opened in 1874. Access to the railroads reinvigorated farming, bringing new

labor-saving field equipment and well-bred livestock, while opening up access to new markets for the township's agricultural products. In particular, the railroad invigorated dairy farming within the township. The railroads also helped spur the development of Titusville, Pennington, and Hopewell (the latter two of which formally incorporated as separate municipalities in 1890 and 1891, respectively). Simultaneously, the railroads allowed easier travel to Trenton, resulting in an early, subtle form of "suburbanization," as those who lived in the township could more easily "commute" to Trenton.

In the 1920s, the development of Hopewell's road network, specifically the improvement of New Jersey Routes 29 and 31 (then known as New Jersey Route 69), coupled with the rising popularity of the automobile, would provide the impetus for Hopewell's continued growth, ultimately reaching its zenith after World War II. Between 1940 and 1970, Hopewell's population grew by 270 percent. More recently, the establishment of large corporate employers in the area, as well as Hopewell's proximity to New York and Philadelphia, has encouraged professionals and their families to settle in the township. Although the 1970s and 80s were periods of relatively modest growth, the 1990s saw the population grow from 11,590 residents in 1990 to 16,105 residents in 2000, an increase of 39 percent.

Today, Hopewell Township has begun to address the conflict between its rising desirability as a residential community, and its still prevalent agricultural heritage. The development of Hopewell Township's *2002 Master Plan* laid the groundwork for the effective conservation of Hopewell's open space. In conjunction, a number of active conservancy groups in the area have preserved several thousand acres of land since the late 1980s. These groups include the Friends of Hopewell Valley Open Space, the D & R Greenway Land Trust and the Stony Brook Millstone Watershed Association. For more information on these groups, see *Parks, Open Space & Recreation* on *page 110* of this report.

HOPEWELL LOCATION, SIZE, AND LAND USE

Hopewell is an incorporated township located in northwest Mercer County, north of the city of Trenton, which is both the county seat and New Jersey state capital. The township is bordered on its northern edge by the townships of East and West Amwell, both in Hunterdon County. To the east, Hopewell is bounded by the township of Montgomery in Somerset County, and the Mercer County townships of Princeton and Lawrence. To the south, Hopewell is bordered by the Mercer County township of Ewing. The Delaware River forms the township's western boundary, which is also the state's western boundary with Pennsylvania. Within the township itself are two separate municipalities, the boroughs of Pennington and Hopewell. See **Map 1: Hopewell Township**.

Hopewell occupies 37,689 acres, or approximately 60 square miles, and is the largest municipality in Mercer County. Hopewell's land use reflects its natural setting, its agricultural past, and the suburban residential development that has occurred since the end of World War II. The majority of development in the Hopewell Valley has been concentrated in and around the boroughs of Pennington and Hopewell. As a result, Hopewell Township, by itself, is considerably less developed than the boroughs it circumscribes. Approximately 23 percent of the township is classified as "developed" or "urban". Older residential development tends to occur in small parcels fronting county roads, backed by larger tracts of agricultural land. In some places, such as Titusville, historic enclaves have prevailed from colonial times, and constitute a number of historic areas within Hopewell. Newer subdivisions are more typical in the township east of the CSX-owned West Trenton rail line. Developments throughout the township are interspersed with significant tracts of farmland and the forested floodplains of Hopewell's many streams.

Before European settlement, as much as 90 percent of the township was covered with a mostly mixed deciduous hardwood forest consisting of maple, oak, beech, walnut, and ash trees. In the two centuries following initial European settlement, most of Hopewell's forested lands were cleared for agriculture. By 1883, according to one historical census of woodlands, only 11 percent of the township remained forested at that time. Such low levels of forest cover persisted into the early twentieth century, as evidenced by historic aerial photographs showing present day forested areas denuded of trees. However, as agriculture shifted westward, and coal and then electricity came to replace wood as a fuel source, Hopewell's woodlands began to recover. Today, nearly 38 percent of Hopewell is forested. Most of this forest is located in the Sourland Mountains in the northern portion of the township and on Baldpate Mountain to the west.

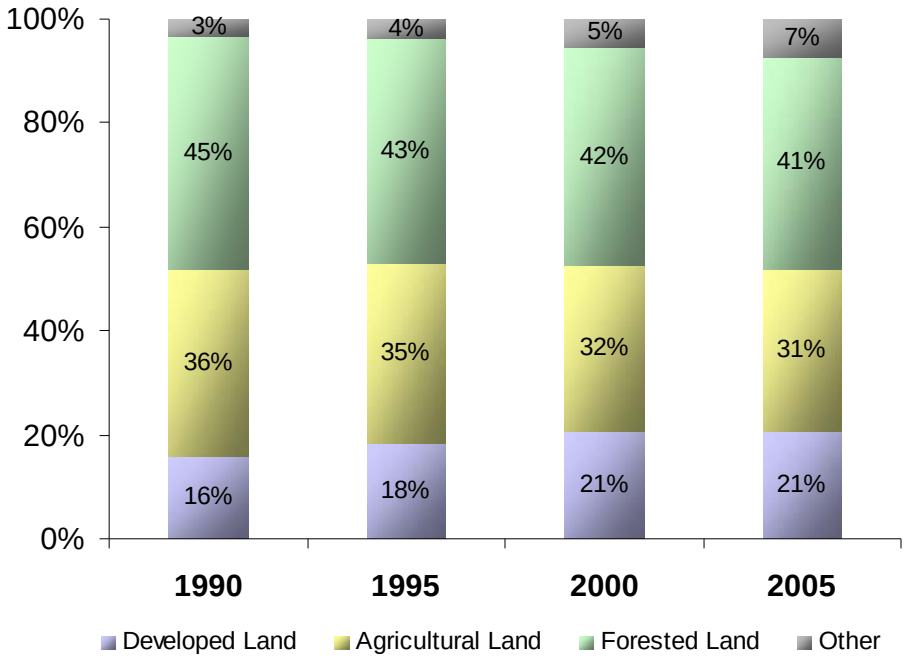
Of Hopewell's remaining land area, 27 percent is dedicated to agricultural uses. The most extensive agricultural crops in Hopewell are soybeans, corn, hay, and other forage crops. Additionally, there are a number of active farms that produce fruits and vegetables and raise pasture animals, as well as a vineyard and winery. Just over 10 percent of Hopewell's total land area consists of wetlands and open water. The wetlands consist of freshwater wooded wetlands,

swamps, marshes, bogs, and small ponds. The remainder of Hopewell's land, 1.6 percent, is classified by NJDEP as barren land.[1]

Over 10,000 acres, or 27 percent, of the township's total land area is preserved as open space. These lands consist of state-, county-, or township-owned parklands, preserved farmland, and privately owned protected open space. See *Parks, Open Space and Recreation* on *page 110* and **Map 20: Protected Open Space.**

Broadly, land use change in Hopewell over the past 15 years has been characterized by a slow accretion of developed land and the simultaneous loss of farmland and forested land. **Figure 1** illustrates land use change within the township between 1990 and 2005, based on DVRPC's land use classification.[2]

Figure 1: Hopewell Township Land Use Change 1990–2005



Source: DVRPC

[1] Barren lands are characterized by thin soil, sand or rocks, and a lack of vegetative cover in a nonurban setting. Barren land is found in nature but can also result from human activities. Extraction mining operations, landfills and other disposal sites compose the majority of human-altered barren lands. Land cleared for development that is not yet built also falls into this category.

[2] DVRPC classifies land into one of 18 major "uses", such as single-family residential, commerical, agriculture, etc. Unlike land cover data, "land use" does not identify different types of natural vegetation. All natural vegetation is classified as either "wooded/forest land" or "vacant land". The category "Other" in Figure 1 includes open water and vacant land.

The passage of the Hopewell Township Master Plan in 2002 has had significant impact on land use within the township. The *2002 Master Plan* established the Mountain Resource Conservation and Valley Resource Conservation Districts. These zoning overlay districts significantly downzoned sizable areas of the township, and opened up the option of cluster development, based on the need to conserve groundwater.

Table 1 shows Hopewell's land cover grouped into general categories based on the New Jersey Department of Environmental Protection's (NJDEP's) 2002 color infrared digital imagery. These categories are also depicted on **Map 3: NJDEP Land Cover (2002).**

Table 2 breaks down the 2002 general land cover categories into detailed land cover categories. These land cover tables should be understood as a snapshot in time of the township, since land use is not static and continues to change over time. For example, **Table 2** lists 25.38 acres of airport facilities, which refer to the Twin Pines Airport, a private airstrip that ceased operation after 2002. The airport was subsequently converted into a municipal park, although this is not reflected in NJDEP's 2002 data. The 2002 Land Cover dataset is the most recent data available from NJDEP.

Table 1: Hopewell Township General Land Cover Classes (2002)

General Land Classes	Acreage	Percentage
Agriculture	10,227.89	27.15%
Barren Land	603.10	1.60%
Forest	14,322.01	38.00%
Urban	8,674.03	23.01%
Water	645.33	1.71%
Wetlands	3,216.33	8.53%
Total	**37,688.69**	**100.00%**

Source: NJDEP, Bureau of Geographic Information Systems

Table 2: Hopewell Township Detailed Land Cover (2002)

Land Cover Categories	Acres	Percent
Agricultural Wetlands (Modified)	304.10	0.81%
Airport Facilities	25.38	0.07%
Altered Lakes	5.06	0.01%
Artificial Lakes	141.04	0.37%
Athletic Fields (Schools)	63.94	0.17%
Bridge Over Water	0.99	0.00%
Cemetery	29.49	0.08%
Commercial/Services	453.54	1.20%
Confined Feeding Operation	1.37	0.00%
Coniferous Brush/Shrubland	741.92	1.97%
Coniferous Forest (10-50% Crown Closure)	405.96	1.08%
Coniferous Forest (>50% Crown Closure)	106.55	0.28%
Coniferous Scrub/Shrub Wetlands	46.46	0.12%

Land Cover Categories	Acres	Percent
Coniferous Wooded Wetlands	8.18	0.02%
Cropland And Pastureland	9,646.84	25.60%
Deciduous Brush/Shrubland	174.19	0.46%
Deciduous Forest (10-50% Crown Closure)	8,242.41	21.87%
Deciduous Forest (>50% Crown Closure)	1,346.31	3.57%
Deciduous Scrub/Shrub Wetlands	74.83	0.20%
Deciduous Wooded Wetlands	2,378.92	6.31%
Disturbed Wetlands (Modified)	15.23	0.04%
Extractive Mining	271.94	0.72%
Former Agricultural Wetland (Becoming Shrubby, Not Built Up)	23.28	0.06%
Herbaceous Wetlands	142.53	0.38%
Industrial	44.05	0.12%
Industrial/Commercial Complexes	6.67	0.02%
Major Roadway	52.94	0.14%
Managed Wetlands in Built-Up Maintained Rec. Area	17.01	0.05%
Managed Wetlands in Maintained Lawn Greenspace	20.30	0.05%
Mixed Deciduous/Coniferous Brush/Shrubland	1,746.28	4.63%
Mixed Forest (>50% Coniferous With 10-50% Crown Closure)	340.87	0.90%
Mixed Forest (>50% Coniferous With >50% Crown Closure)	200.80	0.53%
Mixed Forest (>50% Deciduous With 10-50% Crown Closure)	287.83	0.76%
Mixed Forest (>50% Deciduous With >50% Crown Closure)	81.73	0.22%
Mixed Scrub/Scrub Wetlands (Coniferous Dom.)	67.06	0.18%
Mixed Scrub/Scrub Wetlands (Deciduous Dom.)	67.53	0.18%
Mixed Woodland Wetlands (Coniferous Dom.)	11.49	0.03%
Mixed Woodland Wetlands (Deciduous Dom.)	23.83	0.06%
Natural Lakes	91.91	0.24%
Old Field (< 25% Brush Covered)	566.03	1.50%
Orchards/Vineyards/Nurseries/Horticultural Areas	162.79	0.43%
Other Agricultural	416.88	1.11%
Other Urban Or Built Up Land	847.93	2.25%
Plantation	81.14	0.22%
Recreational Land	482.31	1.28%
Residential, High Density or Multiple Dwelling	122.57	0.33%
Residential, Rural, Single	4,662.76	12.38%
Residential, Single Unit, Low Density	1,244.66	3.30%
Residential, Single Unit, Medium Density	315.38	0.84%
Stormwater Basin	103.86	0.28%
Streams and Canals	411.39	1.09%
Transitional Areas	326.11	0.87%
Transportation/Communications/Utilities	71.58	0.19%
Upland Rights-Of-Way Developed	20.98	0.06%
Upland Rights-Of-Way Undeveloped	125.98	0.33%
Wetland Rights-of-Way	15.58	0.04%
Total	**37,688.69**	**100.00%**

Source: NJDEP, Bureau of Geographic Information Systems

Photo by Jim Gambino

Agriculture is a significant land use in Hopewell – grape vines at Hopewell Valley Vineyards.

PHYSICAL RESOURCES

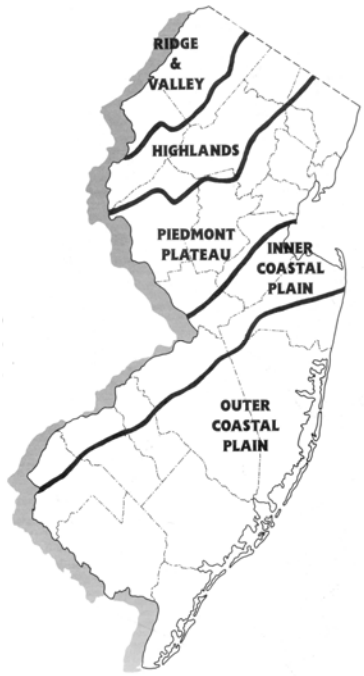
PHYSIOGRAPHY

Physiography is the study of a location in relation to its underlying geology. New Jersey is characterized by four physiographic provinces: the Ridge and Valley, the Highlands, the Piedmont Plateau and the Coastal Plain. The Coastal Plain is further subdivided into the Inner Coastal Plain and the Outer Coastal Plain. The terrain of the four provinces is very diverse, with the rocky terrain of the Northern provinces at one extreme and the sands of the coast at the other.

Hopewell is located at the southern edge of the Piedmont Plateau, just above the fall line, a drop in land level that separates the Piedmont Plateau from the Inner Coastal Plain. This line separates areas with considerable differences in geology, topography, and hydrology.

The fall line runs nearly parallel with U.S. Route 1 from Trenton to New York City and has numerous waterfalls marking its course. It is a boundary between older, consolidated rock in the north and younger, less consolidated rock – mostly gravels and sands – in the south.

Figure 2: Physiographic Regions of New Jersey



The Piedmont Plateau

The Piedmont Plateau extends from Massachusetts to Georgia. This region primarily consists of clayey, moderately fertile soils, and produces fruits, vegetables and livestock in the northern portions, tobacco through the middle portions, and cotton in the southern portions. Hopewell is situated in the southern section of the "northern portion."

The Piedmont Plateau is characterized by slightly folded and faulted Triassic and Jurassic sedimentary rock, and igneous rocks of the Jurassic age. This folding and faulting created the rolling plains of the Piedmont, while the igneous intrusions created the mountainous ridges that characterize the province. At the southern edge of the province, small bands of highly metamorphosed rocks from the Middle Proterozoic to Cambrian period can be found.

In New Jersey, the Piedmont Plateau occupies nearly 1,500 square miles, or one fifth of New Jersey's total land area. The plateau is primarily composed of sandstone, shale and argillite. Generally, the rocks in this province are more susceptible to erosion than the rocks to the north in the Highlands. The soils of the Piedmont Plateau are rich and well watered and the topography is gently rolling, with hills and valleys lying at elevations between 100 and 500 feet.

TOPOGRAPHY AND SURFACE LANDSCAPES

Hopewell Township is the largest municipality in Mercer County, with over 37,000 acres. The topography for most of the township is relatively mild, with gentle slopes, flat areas, and occasional steep slopes. Running northeast from the Delaware River across the northern part of Hopewell is a series of hills, comprised of Belle Mountain, Strawberry Hill, Baldpate Mountain, Mount Canoe, Pennington Mountain, Pheasant Hill and the Sourland Mountains. Most are comprised of igneous diabase rising up through the softer, sedimentary bedrock. A smaller diabase intrusion forms a ridge parallel with Crusher Road.

The highest elevation in the township is found in the northwest, 480 feet above sea level, on top of Baldpate Mountain. The lowest elevations, around 60 feet, are found at the southwest corner of Hopewell on the banks of the Delaware River. Upland forest is found scattered throughout the township, with the largest sections in the northwest, covering Baldpate Mountain, and in the northeast, just above the borough of Hopewell. Upland areas are characterized by rich soils that once supported deciduous forests of oak, maple, beech, hickory, walnut, and ash trees. Large portions of these soils now support agriculture or have been converted to developed uses.

Photo by Tom Ogren

Rolling topography of the Piedmont Plateau.

Steep Slopes

According to Hopewell's Municipal Ordinance 17-116, no development, regrading or removal of vegetation is permitted to occur on slopes greater than 25 percent (the ratio of vertical rise to horizontal distance). On slopes with gradients between 15 and 25 percent, no more than 15 percent of a site's total area may be developed or cleared of vegetation. Dwellings and septic systems must be located on lands with a slope of less than 15 percent.

Only 6.5 percent of Hopewell has slopes of 15 percent or steeper. The steepest slopes are found primarily along the flanks of the Sourland Mountains and Baldpate Mountain in the northern and western portions of the township, as well as along Jacob's Creek, Woolsey Brook and other stream corridors that lead directly to the Delaware River.

Hopewell's steep slopes tend to be well vegetated, although in the case of valleys, farm fields and residential development may extend to the edge of the plateau, potentially resulting in soil instability, erosion, increased stormwater runoff, flooding, and sedimentation of the stream below. This results in degradation of water quality, habitat destruction, and potential damage to property. Erosion on steep slopes is especially prevalent where excessive tree removal has taken place. In these instances, it is important that natural buffers and other stormwater best management practices be used to separate the slope from development and to prevent runoff from eroding the slope.

Where steep slopes remain forested, some very old trees can be found in Hopewell. This conclusion is supported by a 1990 study prepared by Dr. Douglas W. White entitled *The Woodlands of Hopewell Valley.* The study provides a detailed inventory of the township's woodlands, chronicling changes in forest cover and distribution since the mid-nineteenth century (see *Natural Vegetation* on *page 73*). Some of Hopewell's endangered plants listed in the Natural Heritage Database (see **Appendix D**) are found in these habitats. Although some steep-sloped forested valleys have been negatively affected by fertilizers from adjoining farm fields, or by runoff from development and recent flooding, they, along with Hopewell's forested hills, are at present some of Hopewell's healthiest forested areas. Hopewell's steep slopes are depicted on **Map 5: Steep Slopes.**

Table 3: Steep Slopes in Hopewell Township

Slopes	Area (Acres)	Percent
Less than 15%	35,283.9	93.5%
15% to 25%	1,795.3	4.8%
Greater than 25%	638.2	1.7%
Total	**37,717.4**	**100.0%**

Source: NJDEP, Bureau of Geographic Information System

CLIMATE

Geographically situated midway between the North Pole and the equator, New Jersey's climate is varied. The state's temperate, continental climate is influenced by airstreams that vary from hot and humid to dry and cold. Local weather can change rapidly. From May through September, New Jersey is dominated by moist, tropical air that originates in the Gulf of Mexico and is swept in by prevailing winds from the southwest. In winter, winds generally prevail from the northwest, bringing cold, polar air masses from sub-arctic Canada.

New Jersey is divided into five climate zones: North, Central, Southwest, Pine Barrens and Coastal. Hopewell lies within the Central climate zone, which stretches from New York Harbor to the great bend of the Delaware River near Trenton. Hopewell lies near the boundary between the Central Zone and the Northern Zone. This edge is often the boundary between freezing and nonfreezing precipitation during wintertime, and in summer, it often marks the boundary between comfortable and uncomfortable sleeping conditions.

Climate can also vary locally due to human influences. The Piedmont Province, in which Hopewell lies, contains many urban areas, such as Trenton and New Brunswick, whose paved surfaces and buildings affect local temperatures by retaining more heat. Known as the "heat island effect," this causes nighttime temperatures to generally be warmer than surrounding rural areas.

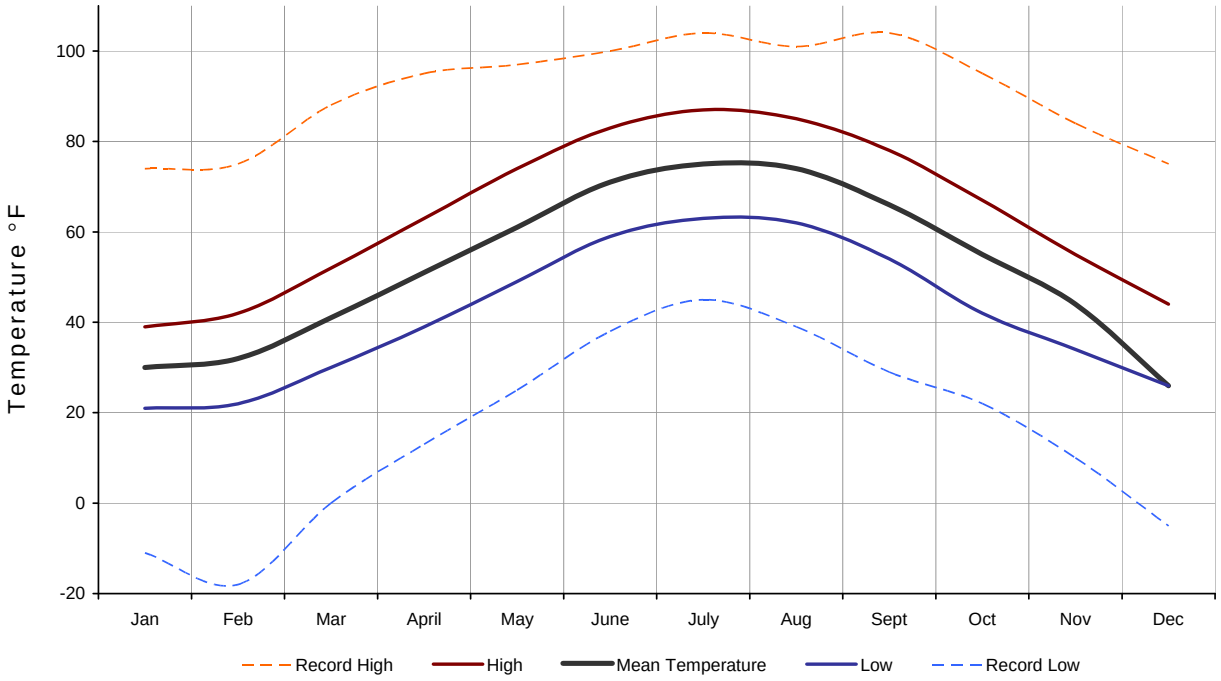
The region's annual mean temperature as recorded by the State Climatologist in Lambertville is 53° F, which is slightly warmer than the statewide mean of 52.2 °F. This average is based on the records dating back to 1895. Hopewell experiences an average temperature of 75° F in July and 30° F in January. In the summer, temperatures in Hopewell rarely exceed 100° F. In the winter, the temperature rarely falls below 10° F for long periods of time. Record temperatures for the region, measured at the State Climatologist station in Lambertville, are a high of 104° F, recorded in 1936, and a low of -18° F, recorded in 1990. Southern New Jersey is sunny for approximately 55 percent of the year.

Precipitation and Storm Events

Average annual precipitation for the township is 48.83 inches, nearly a full inch greater than the statewide annual average of 47.87 inches. Monthly averages for the area show that precipitation is generally well distributed throughout the year. However, rainfall tends to be heavier in summer months. On average, the area receives the most precipitation in July, 5.06 inches, and the least precipitation in February, 2.89 inches. Most summertime precipitation is associated with thunderstorm events. In Mercer County, there are approximately 33 thunderstorms per year. Severe thunderstorms can cause flash flooding along creeks in the township.

Snowfall typically occurs in New Jersey when moist air from the south converges with cold air from the north. The National Climatic Data Center has recorded an average annual snowfall of 18.8 inches in Trenton and 21.4 inches in Lambertville. In Hopewell, snowfall may occur from mid-November to early April, but is most likely to occur from mid-December to mid-March.

Figure 3: Climatic Data for Hopewell Township



Source: Office of the New Jersey State Climatologist

Severe storm events, including thunderstorms, tropical storms, hurricanes, blizzards, ice storms, hail storms, and tornadoes, all occur in Mercer County. Severe storms often result in flooding. During the past several decades, Hopewell has experienced numerous severe flooding events, such as those of August 1955, August 1971, June 1996, September 1999, June 2006, and April 2007. In August 1955, Hurricane Diane dumped record amounts of precipitation on the upper Delaware River basin. The ensuing flood is still the flood of record for the Delaware River. On August 28, 1971, Hurricane Doria dumped several inches of rain on the region, causing severe flooding along the major creeks within Hopewell. On September 17, 1999, the remnants of Hurricane Floyd caused torrential rains, high winds, flooding and widespread devastation across New Jersey. Mercer County received over seven inches of rainfall on this date. The most recent flooding event occurred from the 15th to the 17th of April 2007, when again nearly seven inches of rain fell on some parts of the township and severe flooding occurred along the Delaware River.

Growing Season

Hopewell is within the U.S. Department of Agriculture's (USDA's) Plant Hardiness Zone 6b, the area where annual minimum temperatures are typically between 0° F and 5° F. The USDA's plant hardiness zones were established in 1990. Other groups, such as the Arbor Day Foundation, have reclassified areas based on the most recent ten year trend in weather. The 2006 Arbor Day Foundation Plant Hardiness Zone Map shows Hopewell within Zone 7a, an area with

average annual minimum temperatures between 5° F and 10° F. In Mercer County as a whole, the average length of the agricultural growing season is 173 days. The first frost usually occurs in mid-October and the last frost occurs at the end of April. Temperatures in the winter are usually not low enough to keep the soils frozen for the entire winter season.

Climate Change

Climatologists estimate that over the course of the twentieth century, average global temperatures have risen by 1 degree Fahrenheit, and are expected to rise between 2.5 to 10.4 degrees by 2100. The Office of the New Jersey State Climatologist has recorded temperatures in the state since 1895 and results have corroborated this general warming trend, making the impacts of climate change an important issue for New Jersey communities.

While continuing warming is, of course, to be expected, estimating the impact of climate change on local weather patterns and precipitation is a complicated process with numerous variables and uncertainties. Generally speaking, climate change is expected to increase weather extremes in the Mid-Atlantic region. Wet periods will become wetter, and dry periods will become drier. Such changes in precipitation patterns, along with continued warming, will impact hydrology, agriculture and the composition of natural vegetation in Hopewell Township. A wetter, warmer climate, will likely lead to the infiltration of Hopewell's existing hardwood forests by southern species, such as Southern Yellow Pine. At the same time, more severe and prolonged periods of drought may limit the types of vegetation certain areas can support, with some forests giving way to grasslands and pastures.

The State of New Jersey has undertaken a number of initiatives towards combating climate change. In 2000, the state joined the Regional Greenhouse Gas Initiative (RGGI), a consortium of ten New England and Mid-Atlantic states that have instituted a mandatory CO_2 cap-and-trade system for power utilities. The New Jersey Board of Utilities has also instituted one of the most aggressive Renewable Portfolio Standards in the country. The standards will require power utilities to obtain 20 percent of their power from renewable sources by 2020.

In October, 2008, New Jersey released a new Energy Master Plan that calls for dramatic increases in energy efficiency leading to major reductions in energy use by 2020, and establishes a goal of achieving 30 percent of electric power from renewable sources by 2020. In July 2007, New Jersey's Global Warming Response Act (GWRA) was signed into law by Governor Corzine. The GWRA is one of the most aggressive greenhouse gas emissions control laws in the world. It calls for a statewide reduction in greenhouse gas emissions to 1990 levels by 2020, and a reduction to 80 percent below 2006 levels by 2050. Additionally, the GWRA charges the NJDEP with developing recommendations, including additional legislation, to enable the State to meet the established greenhouse gas emissions reduction goals.

Initiatives to reduce greenhouse gas emissions have also been occurring at the regional level. In 2007, the Delaware Valley Regional Planning Commission began an effort to ultimately reduce emissions associated with climate change. The first major milestone in this process was the publication of a regional greenhouse gas emissions inventory in March 2009. In addition to

calculating aggregate regional emissions for the nine-county Philadelphia metropolitan area (including Mercer County), the inventory allocated emissions to each of the region's nine counties and 353 municipalities. The allocation portion of the inventory establishes a baseline for greenhouse gas reduction efforts undertaken at the municipal level. For more detailed information on greenhouse gas emissions, see *Energy* on *page 107*.

Photo by Andrew Crerand

A winter scene in Hopewell.

Air Quality

CRITERIA POLLUTANTS

Ground level ozone is formed when volatile organic compounds (VOC) and **nitrogen oxides** react with sunlight and heat. Ozone is produced more in the summer months, and is the primary constituent of smog. Ground level ozone is a pulmonary irritant which, even in low levels, can be dangerous to sensitive populations such as people with asthma or emphysema, and the elderly. It can also affect plant growth and is responsible for hundreds of millions of dollars in lost crop production.

Particulate matter (PM), or particle pollution, is made up of dust, ash, smoke, and other small particles formed from the burning or crushing of materials such as wood, rocks, or oil. When ingested, particulate matter can lodge deep in the lungs and can contribute to serious respiratory illnesses such as asthma or lung disease. Particulate matter also creates haze, reduces visibility, and covers buildings in dirty soot.

Carbon monoxide (CO) is a colorless, odorless gas that is formed when carbon in fuel is not burned completely. It is a component of motor vehicle exhaust; therefore higher levels of CO generally occur in areas with heavy traffic congestion. Highest levels of CO in the outside area typically occur during the colder months when air pollution becomes trapped near the ground beneath a layer of rising warm air.

Air quality is one of the most difficult environmental resources to measure because its sources are diffuse and regional in nature. Sources of air pollution include industry, cars, trucks and buses, fires, and dust. Air pollutants can travel extremely far from their source. For example, the burning of coal in the Midwest to generate electricity sends pollutants like sulfur, nitrogen, and particulate matter all the way to the East Coast. Locally-produced sources of air pollution are caused daily by traffic and industrial activities in New Jersey.

Increasing public awareness regarding air pollution led to the passage of a number of state and federal laws, including the original Clean Air Act of 1963 (CAA) and a much stronger Clean Air Act of 1970. In 1990, the CAA was amended and expanded by Congress to include a market approach to reducing air pollution by allowing certain companies to buy and sell emission "allowances," or "credits." The 1990 CAA also required transportation projects receiving federal funding to conform with state air quality goals. The 1990 act also revised the way air toxins were regulated, increasing the number of regulated toxic air pollutants from seven to 187.

In 1970, the USEPA was formed to enforce the CAA. In New Jersey, the USEPA allows NJDEP to enforce the CAA because the state agency developed more stringent air standards and created a State Implementation Plan (see *N.J.A.C. 7:27*). The CAA identified six criteria pollutants – ozone, particulate matter, sulfur dioxide, nitrogen oxides, carbon monoxide, and lead – that are destructive to human health, and the built and natural environments. The EPA, and when enabled, NJDEP, set National Ambient Air Quality Standards (NAAQS) for these pollutants. There are two kinds of NAAQ Standards: the primary standard is based on human health effects, while the secondary standard is based on environmental and property damage.

Between 1970 and 2007, total emissions of the six criteria air pollutants decreased by more than 50 percent. The industrial sector reduced its toxic air emissions by 70 percent during this time period. Stricter emissions standards in the auto industry have made cars 90 percent "cleaner" since 1970. Cars also pollute less because refineries are required to produce cleaner fuels; leaded gasoline was completely banned in 1996.

Under the CAA, the EPA limits the amount of other air pollutants and toxins that are emitted by point sources, such as chemical plants, industrial factories, power plants, and steel mills. The NJDEP Air Quality Permitting Program issues permits for stationary sources of air pollution, such as power plants, oil refineries, dry cleaners, food processing centers, and manufacturing plants, and regulates and monitors their emissions. Currently, twenty-six such sites hold air quality permits in Hopewell.

NJDEP enacted the Emission Statement Rule in 1992 requiring certain sites that have an air quality permit to report specific air contaminants, including carbon monoxide (CO), sulfur dioxide (SO_2), ammonia (NH_3), total suspended particulate matter (TSP), respirable particulate matter (PM_{10} and $PM_{2.5}$), lead (Pb), volatile organic compounds (VOC), nitrogen oxides, and 38 other toxic air pollutants. Currently, no facilities operating within Hopewell fall under these requirements.

NJDEP's Bureau of Air Monitoring maintains a network of 43 continuous monitoring stations across the state, many of which are clustered in the New York metropolitan area. These stations continually monitor some or all of the following criteria pollutants – carbon monoxide, nitrogen oxides, ozone, sulfur dioxide, and particulate matter – as well as meteorological data. In addition, 25 manual monitoring stations operate around the state, providing supplemental data to the 43 continuous monitoring stations. The nearest continuous monitoring stations to Hopewell are located at Rider University in Lawrence Township and in Burlington Township in Burlington County. Washington Crossing State Park is home to a manual monitoring station that measures particulate matter.

CRITERIA POLLUTANTS continued

Nitrogen oxides are a group of highly reactive gases which contain nitrogen and oxygen in varying amounts. Motor vehicles, electric utilities, and homes and businesses that burn fuels emit nitrogen oxides; they can also be found naturally. Nitrogen oxides are primary components in ground-level ozone (smog), acid precipitation, and other toxic chemicals. Acid precipitation can cause lung ailments in humans, property damage, harm to aquatic life, and other environmental and human health problems.

Sulfur dioxide (SO_2) is released into the atmosphere when fuel containing sulfur, such as coal and oil, is burned, and when gasoline is refined from oil. SO_2 dissolves in water vapor to form acid precipitation.

Lead (Pb) is a pollutant that was historically released by cars and trucks burning leaded fuel, but metals processing plants and trash incinerators are the major source of emissions today. Lead tends to be a localized air pollutant, found in urban or high traffic areas, and is deposited in soil and water, harming fish and wildlife.

Nitrogen Oxides

The primary and secondary NAAQS for nitrogen dioxide are both an annual average of 0.053 parts per million (ppm). The New Jersey standards are the same, although they are measured on any twelve month period, not just the calendar year. According to the 2006 *Air Quality Report*, the most recent report as of this writing, the Rider University station recorded an annual average of 0.012 ppm of nitrogen dioxide and 0.009 ppm of nitrogen oxides, well within the standard of 0.053 ppm.

Ground-level Ozone

The amount of ozone has decreased greatly in New Jersey since the 1980s, and one-hour concentrations have not exceeded 0.200 ppm since 1988. For ground-level ozone (O_3) there are two NAAQS: (1) a one-hour concentration of 0.12 ppm, and (2) an eight-hour average concentration of 0.075 ppm. These are the same for both primary and secondary effects. In 2006, the Rider University station exceeded the one-hour maximum concentration of 0.12 ppm on one day when one-hour ground-level ozone was measured at 0.126 ppm, exceeding both the primary and secondary standards for New Jersey. Three of the fourteen sites in New Jersey that measure ground-level ozone exceeded the one-hour standard in 2006. The Rider University station had six days in 2006 that exceeded the eight-hour standard of 0.08 ppm. In 2006, all 14 sites in the state had at least three days that exceeded the eight-hour standard.

Sulfur Dioxide

There are three NAAQS for sulfur dioxide: (1) a yearly average of 0.030 ppm for primary effects; (2) a 24-hour average of 0.140 ppm which cannot be exceeded more than once in a calendar year, also for primary effects; and (3) a 3-hour average of 0.5 ppm which also cannot be exceeded more than once in a calendar year for secondary effects. New Jersey's standards are slightly different in that they use a rolling year unit instead of a calendar year. The yearly average level of sulfur dioxide at the Burlington station in 2005 was 0.003 ppm, the maximum 24-hour average was 0.020 ppm, and the maximum 3-hour average was 0.026 ppm. These levels are well below the state and national standards and below state averages as well.

Particulate Matter

For fine particulate matter ($PM_{2.5}$), there are two NAAQS: (1) an annual average of 15 micrograms per cubic meter ($\mu g/m^3$) for secondary effects and (2) a 24-hour average of 65 $\mu g/m^3$ for primary effects. Particulate matter is measured at the Washington Crossing station, and in 2005 the station recorded an annual average of 10.1 $\mu g/m^3$ and a 24-hour maximum of 39.0 $\mu g/m^3$.

Air Quality Index

EPA created the Air Quality Index (AQI) to indicate a region's air quality by measuring levels of five of the six criteria pollutants (excluding lead). The AQI is focused on the potential human health hazards experienced by breathing unhealthy air. Scores for the AQI range from 0 to 500 and are divided into six color-coded categories, ranging from "Good" to "Hazardous."

The daily score is based on whatever the highest individual pollutant score is reported. For example, if ozone scored 150 and particulate matter scored 100, the daily AQI would be 150 – Unhealthy for Sensitive Groups. The index is used to measure overall air quality by counting the number of days per year when the AQI of each region exceeds 100.

Table 4: Air Quality Index (AQI)

Numerical Air Quality Index (AQI) Rating	Descriptive Rating	AQI Color Code
0 to 50	Good	Green
51 to 100	Moderate	Yellow
101 to 150	Unhealthy for Sensitive Groups	Orange
151 to 200	Unhealthy	Red
201 to 300	Very Unhealthy	Purple
301 to 500	Hazardous	Maroon

Source: NJDEP

New Jersey is subdivided into nine regions which report their respective AQI. Hopewell Township is located in Region 5, which covers Mercer and Burlington counties. Region 5 contains two AQI monitoring stations located at Rider University (Lawrence Township) and Burlington City. The AQI for Region 5 is based on all five of the criteria pollutants highlighted above: carbon monoxide, nitrogen dioxide, ozone, particulates and sulfur dioxide. In 2005, Region 5 reported 321 good days, 37 moderate days, and seven days which were unhealthy for sensitive groups. No unhealthy, very unhealthy, or hazardous days were reported.

Acidic Deposition

A continuing problem in New Jersey is the atmospheric deposition of nitrates (NOx) and sulfates (SOx), fine particles emitted from power plants, motor vehicles, and industrial activities. These particles catalyze with water to form sulfuric and nitric acids which falls to the ground in the form of "acid rain," negatively impacting both public infrastructure and natural ecosystems alike. For ecosystems, these acids deplete soil nutrients and decrease the pH of surface waters, resulting in stunted plant communities and the loss of biodiversity.

Monitoring of atmospheric deposition is conducted by NJDEP at Washington Crossing State Park in the township. Data has shown that while the overall deposition of nitrates and sulfates has fallen since the early 1980s, local ecosystems are still recovering from decades of acid rain and nutrient depletion that occurred prior to the regulation of SOx and NOx. Moreover, data shows that rain with a pH of 4.47, approximately 10 times more acidic than unpolluted rainfall, continues to fall in the Hopewell region.

SOILS

Soil is the foundation for all land uses. A region's soil defines what vegetation is possible, thereby influencing agricultural uses. It also determines how land can be developed for other purposes. Soil is also an invaluable natural resource that cannot be replenished on a human time scale, since it takes about 100 years to produce just one inch of topsoil.

Hopewell lies at the edge of the Piedmont Province and contains a wide variety of soil series. Soils of the Piedmont Province are predominantly silty, shaley, or stony soils. These types of soil are generally slow to absorb precipitation and therefore the Piedmont region experiences large amounts of surface drainage, flooding and siltation. Piedmont soils are underlain by bedrock at depths ranging from two to twenty feet. The township's soils consist of 32 series types and 93 variations within those series (excluding water), as identified by the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS). These are listed in **Table 6: Hopewell Township Soils** and shown on **Map 6: Soils**.

Soil Quality Classification

State and national agricultural agencies classify farmland soils into several categories. Hopewell contains Prime Farmland Soils, Soils of Statewide Importance, Soils of Local Importance and Soils Not Rated for Agricultural Use. Each category of farmland is explained below. See **Table 5: Agricultural Values for Hopewell Soils** for the acreage in each category and **Map 7: Agricultural Quality of Soils** for a depiction of these soils' spatial distribution.

Prime Farmland Soils

The most abundant of all soils in Hopewell are those classified as Prime Farmland (P-1), which occupies forty-three percent of the township's land. Prime Farmlands are lands that have the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops. They can sustain high yields of crops when managed with correct farming methods. Prime Farmland soils are not excessively erodible or saturated with water for long periods of time and do not flood frequently.

The NRCS outlines specific criteria for Prime Farmland classification. According to federal regulation, for soil to be classified as Prime Farmland soil horizons (layers) within a depth of 40 inches must have a pH between 4.5 and 8.4 (mildly acidic to mildly basic). In addition, the soils must have an average temperature above 32 degrees Fahrenheit at a depth of 20 inches. The USDA outlines additional Prime Farmland requirements for mean summer soil temperature, erodibility factor, water table depth, permeability rate, and more. Land classified as Prime Farmland does not have to be farmed but does have to be available for such use.

Soils of Statewide Importance

Over 34 percent of Hopewell's soils are classified as Soils of Statewide Importance (S-1). These soils are close in quality to Prime Farmland and can sustain high yields of crops when correctly

managed with favorable conditions. Under such favorable conditions, these yields may be as high as Prime Farmland yields.

Criteria for establishing Soils of Statewide Importance are determined by state agencies. In New Jersey, soils with a capability class of II or III that do not meet Prime Farmland criteria are rated as Soils of Statewide Importance.

Photo by Tom Ogren

Hopewell's soils are the foundation of its agricultural community.

Soils of Local Importance

Almost 5 percent of Hopewell's soils are classified as Soils of Local Importance (L-1). Soils of Local Importance include those soils that are not of prime or statewide importance, but can support the production of high-value food, fiber and horticultural crops (fruits and vegetables), such as tomatoes, sweet corn, blueberries, strawberries, cranberries, peaches, and nursery crops. More information can be found on the USDA's National Resources Conservation Services' website for New Jersey at: www.nj.nrcs.usda.gov/technical/soils/uniquefarm.html.

Soils Not Rated for Agricultural Use

Several of the soils that are present in Hopewell fall into the category "not rated for agricultural use" by the Natural Resources Conservation Service (NRCS). This category primarily consists of soils not well suited for agricultural use, such as soils disturbed by heavy development, excessively wet soils, and steep slopes. It may also include soils that have not yet been evaluated as to their potential for agricultural use by the NRCS. These soils may or may not be good for agricultural use.

Table 5: Agricultural Values for Hopewell Soils

Designation	Type	Area (acres)	Percent
P-1	Prime Farmland	16,302.54	43.27%
S-1	Statewide Importance	13,621.27	36.14%
L-1	Local Importance	1,746.57	4.63%
Soils Not Rated For Agricultural Use	Wet soils, pits, steep slopes, urban, etc.	5,477.84	14.53%
Water	Water	540.48	1.43%
Totals		**37,688.70**	**100.00%**

Source: NJ Farmlands Inventory, NJ Natural Resources Conservation Service

Hydric Soils

Approximately 10 percent of Hopewell's soils are hydric soils. Approximately 84 percent of Hopewell's hydric soils are rated as either soils of local or statewide importance. An additional 8 percent are classified as prime farmland, and the remaining 8 percent are not rated for agricultural use. Hydric soils, as defined by the National Technical Committee of Hydric Soils, are soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in their subsurface. Specifically, Hopewell's hydric soils are considered poorly drained or very poorly drained, possess a water table at a depth of .5 foot or less during the growing season, and have a permeability equal to or greater than 6.0 in/hr to a depth of 20 inches.

Hydric soils have unique soil properties that distinguish them from nonhydric soils. They support the development of hydrophytic vegetation, and are an important element of wetland areas. If a soil is classified as "hydric," land use may be restricted due to the relationship of hydric soils to wetlands and wetland preservation. Many of Hopewell's hydric soils and wetlands are concentrated in the Sourland Mountain region in the northern part of the township. More detailed descriptions of Hopewell's wetland areas are found in *Surface Water Resources: Wetlands* on *page 40*, and in *Biological Resources: Wetlands* on *page 73*.

Finally, the degree to which a soil may be "hydric" can vary dramatically. Soil mapping is an imprecise science, and often, a mixture of soil types may be present within a given area, which is nonetheless mapped as a single "soil" type. For example, many hydric soils are actually interspersed as small pockets within larger nonhydric soils formations, that will be mapped as the

dominant soil type. Consequently, any sort of site development requires a measure of fieldwork beyond countywide soil surveys.

Soil Series

Several soil series appear more frequently within Hopewell than others, and are briefly described as follows.[3]

Bucks

Over 22 percent of Hopewell's soils are in the Bucks series. Bucks soils are deep, well-drained soils, located on upland divides and rolling slopes. These soils are most commonly found in the areas west of Stony Brook and east of Jacobs Creek. They are underlain by silt and gravel that lie above bedrock. Their surface runoff and permeability is moderate. Bucks soils have moderate to severe limitations for disposal of sewage from septic tanks. Much of this soil type has been cleared of mixed oaks, maples, yellow poplar, hickory, and ash. Agriculturally, it is used mostly for growing corn, small grains, soybeans, hay, pasture, and, to a small extent, for vegetables, fruits, and nursery plants. Several of the subtypes found in the township are considered Prime Farmland.

Chalfont

Just over 11 percent of Hopewell's soils are in the Chalfont series, and they are the predominant soils northeast of the Sourland and Pennington Mountains. The Chalfont series consist of deep and very deep, somewhat poorly drained soils, occurring on slopes from 0–25 percent. They are formed from loess, shale and sandstone. Most areas have been cleared and used for cropland, hay and pasture. These soils support mixed hardwoods, principally of oaks and yellow poplar.

Penn

Penn soils occupy nearly 11 percent of the land in Hopewell Township. They are shallow to moderately shallow, well-drained soils occurring on slopes ranging from 0–18 percent. They formed from weathered siltstone and red shale. Permeability is moderate to moderately slow. These soils can grow some crops but the soils cannot hold large amounts of plant nutrients. The depth to bedrock is less than forty inches. In Hopewell, Penn soils pose moderate to severe constraints to development depending on slope and depth to bedrock. They are found extensively along Jacobs Creek.

Quakertown

Quakertown series soils account for over 8 percent of Hopewell's land. These soils are moderately deep, well drained and located on uplands. They have an undulating topography and

[3] Soil Conservation Service. *Soil Survey of Mercer County New Jersey*, USDA and New Jersey Agricultural Experiment Station, January 1972.

slopes ranging from 2–18 percent. Their surface runoff is moderate and their permeability is moderately rapid. Vegetation native to this soil includes oak, hickory, yellow poplar, and ash. Most of this type of soil has been cleared for growing corn, small grain, and grasses. Subseries with steeper slopes present severe limitations to development.

Reaville

Nearly 7 percent of Hopewell's soils are in the Reaville series. The Reaville series consist of moderately deep, moderately well to somewhat poorly drained soils formed from red shale, siltstone and fine grained sandstone. Slopes range from 0–15 percent. Most of this type of soil has been cleared for growing hay, small grain and corn, with some areas being used as pasture. These soils are widely distributed in patches throughout the township.

Readington & Abbottstown

The Readington & Abbottstown group comprises nearly 6 percent of the soils in Hopewell Township, and is widely distributed in small patches on slopes ranging from 0–15 percent. Areas with high water tables and coarse substratum can present moderate to severe limitations for development. Approximately 85 percent of this group was, or continues to be, used for cropland and pasture. Wooded areas consist mostly of hardwoods, mainly hickory and oak.

Readington soils are deep or very deep, moderately well-drained soils, located on concave, nearly level to sloping lower hillsides, upland flats, drainage ways and stream heads. Their permeability is moderate or moderately slow.

Abbottstown series are deep, somewhat poorly drained soils, located on concave upland flats, depressions and drainage ways. Permeability is slow and runoff is moderate on nearly level slopes, high on gentle slopes, and very high on moderately steep or strongly sloping areas.

Doylestown & Reaville

The Doylestown and Reaville group make up roughly 5 percent of the soils in Hopewell.

Doylestown soils are deep, poorly drained soils formed in silty materials, found on concave, upland slopes of 0–5 percent. Doylestown soils have slow permeability. They may be converted to cropland, pastureland or remain wooded, where they support water-tolerant, mixed hardwoods.

Reaville soils are moderately deep, moderately well to somewhat poorly drained soils formed from red shale, siltstone, and fine grained sandstone. Slopes range from 0–15 percent. Most of these types of soils have been cleared for growing hay, small grain, and corn, with some areas being used as pasture.

Legore

Legore series soils comprise just over 3 percent of the township, but are a significant part of the Baldpate Mountain region. Legore series soils are deep, well drained soils found on slopes ranging from 0–50 percent, often with diabase bedrock. They are used for growing general crops, and for pastures and orchards. Native vegetation is mixed hardwoods, dominated by oaks, hickory, and black locust.

Photo by Marjeilen DeMarco

Hopewell's fall harvest.

Table 6: Hopewell Township Soils

SSURGO Soil Code	Soil Name	Acres	Percentage	Designation
AbrB	Abbottstown silt loam, 2-6 % slopes	10.68	0.03%	Statewide Importance
BhmB	Birdsboro loam, 2-6 % slopes	178.70	0.47%	Prime Farmland
BhmB2	Birdsboro loam, 2-6 % slopes, eroded	158.84	0.42%	Prime Farmland
BhmC2	Birdsboro loam, 6-12 % slopes, eroded	86.38	0.23%	Statewide Importance
BhnA	Birdsboro silt loam, 0-2 % slopes	48.50	0.13%	Prime Farmland
BhnB	Birdsboro silt loam, 2-6 % slopes	190.88	0.51%	Prime Farmland
BHRSB	Birdsboro sandy subsoil variant soils, 2-6 % slopes	115.48	0.31%	Prime Farmland
BHRSC	Birdsboro sandy subsoil variant soils, 6-12 % slopes	37.28	0.10%	Statewide Importance
BoyAt	Bowmansville silt loam, 0-2 % slopes, frequently flooded	1,174.54	3.12%	Statewide Importance
BucA	Bucks silt loam, 0-2 % slopes	627.38	1.67%	Prime Farmland
BucB	Bucks silt loam, 2-6 % slopes	5,713.19	15.16%	Prime Farmland
BucB2	Bucks silt loam, 2-6 % slopes, eroded	950.32	2.52%	Prime Farmland
BucC	Bucks silt loam, 6-12 % slopes	268.98	0.71%	Statewide Importance
BucC2	Bucks silt loam, 6-12 % slopes, eroded	839.89	2.23%	Statewide Importance
ChcA	Chalfont silt loam, 0-2 % slopes	704.13	1.87%	Statewide Importance
ChcB	Chalfont silt loam, 2-6 % slopes	2,322.25	6.16%	Statewide Importance
ChcB2	Chalfont silt loam, 2-6 % slopes, eroded	609.22	1.62%	Statewide Importance
ChcBb	Chalfont silt loam, 0-6 % slopes, very stony	105.52	0.28%	Not Rated for Ag Use
ChcC	Chalfont silt loam, 6-12 % slopes	47.98	0.13%	Statewide Importance
ChcC2	Chalfont silt loam, 6-12 % slopes, eroded	456.60	1.21%	Statewide Importance
DOZA	Doylestown & Reaville variant silt loams, 0-2 % slopes	1,038.80	2.76%	Local Importance
DOZB	Doylestown & Reaville variant silt loams, 2-6 % slopes	707.77	1.88%	Local Importance
DOZB2	Doylestown & Reaville variant silt loams, 2-6 % slopes, eroded	133.65	0.35%	Not Rated for Ag Use
DOZC	Doylestown & Reaville variant silt loams, 6-12 % slopes	46.65	0.12%	Not Rated for Ag Use
DOZC2	Doylestown & Reaville variant silt loams, 6-12 % slopes, eroded	1.70	0.00%	Not Rated for Ag Use
HdyD	Hazleton channery loam, 12-18 % slopes	3.00	0.01%	Not Rated for Ag Use
KkoC	Klinesville channery loam, 6-12 % slopes	789.14	2.09%	Not Rated for Ag Use
KkoD	Klinesville channery loam, 12-18 % slopes	2.06	0.01%	Not Rated for Ag Use
KkoE	Klinesville channery loam, 18-35 % slopes	602.48	1.60%	Not Rated for Ag Use
LbhB	Lansdale sandy loam, 2-6 % slopes	57.56	0.15%	Prime Farmland
LbmB	Lansdale loam, 2-6 % slopes	8.08	0.02%	Prime Farmland
LbmCb	Lansdale loam, 0-12 % slopes, very stony	48.40	0.13%	Not Rated for Ag Use
LbmEb	Lansdale loam, 12-30 % slopes, very stony	14.88	0.04%	Not Rated for Ag Use
LbnC2	Lansdale channery loam, 6-12 % slopes, eroded	81.52	0.22%	Statewide Importance
LbnD2	Lansdale channery loam, 12-18 % slopes, eroded	51.79	0.14%	Not Rated for Ag Use
LdmB	Lawrenceville silt loam, 2-6 % slopes	18.49	0.05%	Prime Farmland
LDXA	Lawrenceville & Mt. Lucas silt loams, 0-2 % slopes	85.93	0.23%	Prime Farmland
LDXB	Lawrenceville & Mt. Lucas silt loams, 2-6 % slopes	611.73	1.62%	Prime Farmland
LDXB2	Lawrenceville & Mt. Lucas silt loams, 2-6 % slopes, eroded	306.84	0.81%	Prime Farmland

SSURGO Soil Code	Soil Name	Acres	Percentage	Designation
LDXC2	Lawrenceville & Mt. Lucas silt loams, 6-12 % slopes, eroded	229.23	0.61%	Statewide Importance
LegC	Legore gravelly loam, 6-12 % slopes	161.17	0.43%	Statewide Importance
LegD	Legore gravelly loam, 12-18 % slopes	323.46	0.86%	Not Rated for Ag Use
LegE	Legore gravelly loam, 18-30 % slopes	722.60	1.92%	Not Rated for Ag Use
LemB	Lehigh silt loam, 2-6 % slopes	256.54	0.68%	Statewide Importance
LemB2	Lehigh silt loam, 2-6 % slopes, eroded	137.59	0.37%	Statewide Importance
LemC2	Lehigh silt loam, 6-12 % slopes, eroded	372.93	0.99%	Statewide Importance
LemD2	Lehigh silt loam, 12-18 % slopes, eroded	18.22	0.05%	Not Rated for Ag Use
MonB	Mt. Lucas silt loam, 2-6 % slopes	4.09	0.01%	Prime Farmland
MonBb	Mt. Lucas silt loam, 0-6 % slopes, very stony	201.95	0.54%	Not Rated for Ag Use
MonCb	Mt. Lucas silt loam, 6-12 % slopes, very stony	79.92	0.21%	Not Rated for Ag Use
MopBb	Mt. Lucas-Watchung silt loams, 0-6 % slopes, very stony	111.77	0.30%	Not Rated for Ag Use
MORCE	Mt. Lucas & Neshaminy soils, 0-12 % slopes, very rubbly	128.40	0.34%	Not Rated for Ag Use
NehB	Neshaminy silt loam, 2-6 % slopes	455.80	1.21%	Prime Farmland
NehC	Neshaminy silt loam, 6-12 % slopes	66.68	0.18%	Statewide Importance
NehC2	Neshaminy silt loam, 6-12 % slopes, eroded	49.60	0.13%	Statewide Importance
NehCb	Neshaminy silt loam, 6-12 % slopes, very stony	704.64	1.87%	Not Rated for Ag Use
NehEb	Neshaminy silt loam, 18-35 % slopes, very stony	307.69	0.82%	Not Rated for Ag Use
NehEe	Neshaminy silt loam, 12-30 % slopes, very rubbly	58.15	0.15%	Not Rated for Ag Use
NemCb	Neshaminy-Mt. Lucas silt loams, 6-12 % slopes, very stony	119.20	0.32%	Not Rated for Ag Use
OthA	Othello silt loam, 0-2 % slopes	7.14	0.02%	Statewide Importance
PeoB	Penn channery silt loam, 2-6 % slopes	2,386.90	6.34%	Prime Farmland
PeoC	Penn channery silt loam, 6-12 % slopes	1,375.21	3.65%	Statewide Importance
PeoC2	Penn channery silt loam, 6-12 % slopes, eroded	0.15	0.00%	Statewide Importance
PeoD	Penn channery silt loam, 12-18 % slopes	344.83	0.92%	Not Rated for Ag Use
PHG	Pits, sand & gravel	64.95	0.17%	Not Rated for Ag Use
PomAs	Pope fine sandy loam, 0-2 % slopes, occasionally flooded	127.21	0.34%	Prime Farmland
QukB	Quakertown silt loam, 2-6 % slopes	1,612.38	4.28%	Prime Farmland
QukB2	Quakertown silt loam, 2-6 % slopes, eroded	176.32	0.47%	Prime Farmland
QukC	Quakertown silt loam, 6-12 % slopes	279.53	0.74%	Statewide Importance
QukC2	Quakertown silt loam, 6-12 % slopes, eroded	375.56	1.00%	Statewide Importance
QukD	Quakertown silt loam, 12-18 % slopes	28.27	0.08%	Not Rated for Ag Use
QukD2	Quakertown silt loam, 12-18 % slopes, eroded	1.68	0.00%	Not Rated for Ag Use
QumB	Quakertown channery silt loam, 2-6 % slopes	250.97	0.67%	Prime Farmland
QumC	Quakertown channery silt loam, 6-12 % slopes	137.68	0.37%	Statewide Importance
QumC2	Quakertown channery silt loam, 6-12 % slopes, eroded	185.41	0.49%	Not Rated for Ag Use
QumD2	Quakertown channery silt loam, 12-18 % slopes, eroded	122.60	0.33%	Not Rated for Ag Use
RedC2	Readington silt loam, 6-12 % slopes, eroded	6.55	0.02%	Statewide Importance
REFA	Readington & Abbottstown silt loams, 0-2 % slopes	437.52	1.16%	Prime Farmland
REFB	Readington & Abbottstown silt loams, 2-6 % slopes	1,419.13	3.77%	Prime Farmland
REFB2	Readington & Abbottstown silt loams, 2-6 % slopes, eroded	196.62	0.52%	Prime Farmland

SSURGO Soil Code	Soil Name	Acres	Percentage	Designation
REFC2	Readington & Abbottstown silt loams, 6-12 % slopes, eroded	86.35	0.23%	Statewide Importance
RehA	Reaville silt loam, 0-2 % slopes	421.60	1.12%	Statewide Importance
RehB	Reaville silt loam, 2-6 % slopes	1,473.82	3.91%	Statewide Importance
RehB2	Reaville silt loam, 2-6 % slopes, eroded	384.47	1.02%	Statewide Importance
RehC2	Reaville silt loam, 6-12 % slopes, eroded	262.12	0.70%	Statewide Importance
RepwA	Reaville poorly drained variant silt loam, 0-2 % slopes	5.64	0.01%	Not Rated for Ag Use
RksC	Riverhead gravelly sandy loam, 8-15 % slopes	0.06	0.00%	Statewide Importance
ROPF	Rough broken land, shale	12.66	0.03%	Not Rated for Ag Use
RorAt	Rowland silt loam, 0-2 % slopes, frequently flooded	897.83	2.38%	Statewide Importance
ThoAs	Tioga fine sandy loam, 0-2 % slopes, occasionally flooded	163.68	0.43%	Prime Farmland
UdbB	Udorthents, bedrock substratum, 0-8 % slopes	64.08	0.17%	Not Rated for Ag Use
UdgB	Udorthents, gravelly substratum, 0-8 % slopes	0.25	0.00%	Not Rated for Ag Use
WasA	Watchung silt loam, 0-2 % slopes	36.41	0.10%	Not Rated for Ag Use
WasAe	Watchung silt loam, 0-3 % slopes, very rubbly	35.81	0.09%	Not Rated for Ag Use
WATER	Water	540.48	1.43%	Not Rated for Ag Use

Source: NJDEP (based on Soil Survey of Mercer County)

Soil Constraints for Development

Soil characteristics can severely restrict the use of sites for construction and development. **Table 7: Soil Constraints for Development** records the soils and their possible limitations for building foundations and septic systems. As indicated in the table, the township has some soils that are severely limited for on-site septic systems. Septic systems require soils that have a low water table, below five feet, and slow permeability, which allows for proper drainage of wastewater. With regard to other limitations, high water tables – those five feet or less from the surface – create the potential for erosion, wet basements, alteration of plant life, and early frost for agricultural crops.

Table 7: Soil Constraints for Development

SSURGO Soil Code	Soil Name	Acres	Building w/o Basement	Building w/ Basement	Small Commercial	Septic Systems	Sewage Lagoons	Limits*
AbrB	Abbottstown silt loam, 2-6 % slopes	10.68	C	C	C	C	C	1,2,8,9
BhmB	Birdsboro loam, 2-6 % slopes	178.70	A	A	A	C	C	3,8,9
BhmB2	Birdsboro loam, 2-6 % slopes, eroded	158.84	A	A	A	C	C	3,8,9
BhmC2	Birdsboro loam, 6-12 % slopes, eroded	86.38	B	B	C	C	C	3,8,9
BhnA	Birdsboro silt loam, 0-2 % slopes	48.50	A	A	A	C	C	8,9
BhnB	Birdsboro silt loam, 2-6 % slopes	190.88	A	A	A	C	C	3,8,9
BHRSB	Birdsboro sandy subsoil variant soils, 2-6 % slopes	115.48	A	B	A	C	C	1,2,3,8,9
BHRSC	Birdsboro sandy subsoil variant soils, 6-12 % slopes	37.28	B	B	A	C	C	1,2,3,9
BoyAt	Bowmansville silt loam, 0-2 % slopes, frequently flooded	1,174.54	C	C	C	C	C	1,5,6,8,9
BucA	Bucks silt loam, 0-2 % slopes	627.38	A	A	A	B	B	1,8,9
BucB	Bucks silt loam, 2-6 % slopes	5,713.19	A	A	A	B	B	2,3,8,9
BucB2	Bucks silt loam, 2-6 % slopes, eroded	950.32	A	A	A	B	B	2,3,8,9
BucC	Bucks silt loam, 6-12 % slopes	268.98	B	B	C	B	C	2,3,8,9
BucC2	Bucks silt loam, 6-12 % slopes, eroded	839.89	B	B	C	B	C	2,3,7,8,9
ChcA	Chalfont silt loam, 0-2 % slopes	704.13	C	C	C	C	C	1,2,8,9
ChcB	Chalfont silt loam, 2-6 % slopes	2,322.25	C	C	C	C	C	1,2,3,8,9
ChcB2	Chalfont silt loam, 2-6 % slopes, eroded	609.22	C	C	C	C	C	1,2,3,8,9
ChcBb	Chalfont silt loam, 0-6 % slopes, very stony	105.52	C	C	C	C	C	1,2,3,8,9
ChcC	Chalfont silt loam, 6-12 % slopes	47.98	C	C	C	C	C	1,2,3,8,9
ChcC2	Chalfont silt loam, 6-12 % slopes, eroded	456.60	C	C	C	C	C	1,2,3,8,9
DOZA	Doylestown & Reaville variant silt loams, 0-2 % slopes	1,038.80	C	C	B	C	C	1,2,8,9
DOZB	Doylestown & Reaville variant silt loams, 2-6 % slopes	707.77	B	C	B	C	C	1,2,3,8,9
DOZB2	Doylestown & Reaville variant silt loams, 2-6 % slopes, eroded	133.65	B	C	B	C	C	1,2,3,7,8,9

SSURGO Soil Code	Soil Name	Acres	Building w/o Basement	Building w/ Basement	Small Commercial	Septic Systems	Sewage Lagoons	Limits*
DOZC	Doylestown & Reaville variant silt loams, 6-12 % slopes	46.65	B	C	C	C	C	1,2,3,8,9
DOZC2	Doylestown & Reaville variant silt loams, 6-12 % slopes, eroded	1.70	B	C	C	C	C	1,2,3,7,9
HdyD	Hazleton channery loam, 12-18 % slopes	3.00	C	C	C	C	C	2,3,9
KkoC	Klinesville channery loam, 6-12 % slopes	789.14	B	C	C	C	C	2,3,9
KkoD	Klinesville channery loam, 12-18 % slopes	2.06	C	C	C	C	C	2,3,9
KkoE	Klinesville channery loam, 18-35 % slopes	602.48	C	C	C	C	C	2,3,9
LbhB	Lansdale sandy loam, 2-6 % slopes	57.56	A	A	A	C	C	3,8,9
LbmB	Lansdale loam, 2-6 % slopes	8.08	A	A	A	C	C	2,3,8,9
LbmCb	Lansdale loam, 0-12 % slopes, very stony	48.40	A	A	B	C	C	3,8,9
LbmEb	Lansdale loam, 12-30 % slopes, very stony	14.88	C	C	C	C	C	3,8,9
LbnC2	Lansdale channery loam, 6-12 % slopes, eroded	81.52	B	B	B	C	C	3,8,9
LbnD2	Lansdale channery loam, 12-18 % slopes, eroded	51.79	C	C	C	C	C	3,8,9
LdmB	Lawrenceville silt loam, 2-6 % slopes	18.49	B	C	B	C	C	1,2,3,8,9
LDXA	Lawrenceville & Mt. Lucas silt loams, 0-2 % slopes	85.93	B	C	B	C	C	1,2,8,9
LDXB	Lawrenceville & Mt. Lucas silt loams, 2-6 % slopes	611.73	B	C	B	C	C	1,2,3,8,9
LDXB2	Lawrenceville & Mt. Lucas silt loams, 2-6 % slopes, eroded	306.84	B	C	B	C	C	1,2,3,8,9
LDXC2	Lawrenceville & Mt. Lucas silt loams, 6-12 % slopes, eroded	229.23	B	C	C	C	C	1,2,3,8,9
LegC	Legore gravelly loam, 6-12 % slopes	161.17	B	B	C	C	C	2,3,9
LegD	Legore gravelly loam, 12-18 % slopes	323.46	C	C	C	C	C	2,3,8,9
LegE	Legore gravelly loam, 18-30 % slopes	722.60	C	C	C	C	C	2,3,8,9
LemB	Lehigh silt loam, 2-6 % slopes	256.54	C	C	C	C	C	1,2,3,8,9
LemB2	Lehigh silt loam, 2-6 % slopes, eroded	137.59	C	C	C	C	C	1,2,3,8,9
LemC2	Lehigh silt loam, 6-12 % slopes, eroded	372.93	C	C	C	C	C	1,2,3,8,9
LemD2	Lehigh silt loam, 12-18 % slopes, eroded	18.22	C	C	C	C	C	1,2,3,8,9
MonB	Mt. Lucas silt loam, 2-6 % slopes	4.09	B	C	B	C	C	1,2,3,8,9
MonBb	Mt. Lucas silt loam, 0-6 % slopes, very stony	201.95	B	C	B	C	C	1,2,3,8,9
MonCb	Mt. Lucas silt loam, 6-12 % slopes, very stony	79.92	B	C	C	C	C	1,3,8,9
MopBb	Mt. Lucas-Watchung silt loams, 0-6 % slopes, very stony	111.77	C	C	C	C	C	1,7,8,9
MORCE	Mt. Lucas & Neshaminy soils, 0-12 % slopes, very rubbly	128.40	A	B	B	C	B	2,8,9
NehB	Neshaminy silt loam, 2-6 % slopes	455.80	A	A	A	C	B	3,8
NehC	Neshaminy silt loam, 6-12 % slopes	66.68	B	B	B	C	C	3,8
NehC2	Neshaminy silt loam, 6-12 % slopes, eroded	49.60	B	B	B	B	C	2,3,7,8,9
NehCb	Neshaminy silt loam, 6-12 % slopes, very stony	704.64	A	A	B	C	B	3,8,9
NehEb	Neshaminy silt loam, 18-35 % slopes, very stony	307.69	C	C	C	C	C	2,3,7,8,9

SSURGO Soil Code	Soil Name	Acres	Building w/o Basement	Building w/ Basement	Small Commercial	Septic Systems	Sewage Lagoons	Limits*
NehEe	Neshaminy silt loam, 12-30 % slopes, very rubbly	58.15	C	C	C	C	C	2,3,8,9
NemCb	Neshaminy-Mt. Lucas silt loams, 6-12 % slopes, very stony	119.20	A	A	B	C	C	1,2,3,8,9
OthA	Othello silt loam, 0-2 % slopes	7.14	C	C	C	C	C	1,8,9
PeoB	Penn channery silt loam, 2-6 % slopes	2,386.90	A	B	A	C	C	2,8,9
PeoC	Penn channery silt loam, 6-12 % slopes	1,375.21	B	B	C	C	C	2,3,8,9
PeoC2	Penn channery silt loam, 6-12 % slopes, eroded	0.15	B	B	C	C	C	2,3,9
PeoD	Penn channery silt loam, 12-18 % slopes	344.83	C	C	C	C	C	2,3,9
PHG	Pits, sand & gravel	64.95	n/a	n/a	n/a	n/a	n/a	n/a
PomAs	Pope fine sandy loam, high bottom, 0-2 % slopes, occasional	127.21	C	C	C	C	C	5,9
QukB	Quakertown silt loam, 2-6 % slopes	1,612.38	A	A	A	C	B	2,3,8,9
QukB2	Quakertown silt loam, 2-6 % slopes, eroded	176.32	A	A	A	C	B	2,3,8,9
QukC	Quakertown silt loam, 6-12 % slopes	279.53	B	B	C	C	C	2,3,8,9
QukC2	Quakertown silt loam, 6-12 % slopes, eroded	375.56	B	B	C	C	C	2,3,8,9
QukD	Quakertown silt loam, 12-18 % slopes	28.27	C	C	C	C	C	2,3,8,9
QukD2	Quakertown silt loam, 12-18 % slopes, eroded	1.68	C	C	C	C	C	2,3,8,9
QumB	Quakertown channery silt loam, 2-6 % slopes	250.97	A	A	A	C	B	2,3,8,9
QumC	Quakertown channery silt loam, 6-12 % slopes	137.68	B	B	C	C	C	2,3,8,9
QumC2	Quakertown channery silt loam, 6-12 % slopes, eroded	185.41	B	B	C	C	C	2,3,8,9
QumD2	Quakertown channery silt loam, 12-18 % slopes, eroded	122.60	C	C	C	C	C	2,3,8,9
RedC2	Readington silt loam, 6-12 % slopes, eroded	6.55	B	C	C	C	C	1,2,3,8,9
REFA	Readington & Abbottstown silt loams, 0-2 % slopes	437.52	B	C	B	C	B	1,2,8,9
REFB	Readington & Abbottstown silt loams, 2-6 % slopes	1,419.13	B	C	B	C	C	1,2,3,8,9
REFB2	Readington & Abbottstown silt loams, 2-6 % slopes, eroded	196.62	B	C	B	C	C	1,2,3,8,9
REFC2	Readington & Abbottstown silt loams, 6-12 % slopes, eroded	86.35	B	C	C	C	C	1,2,3,8,9
RehA	Reaville silt loam, 0-2 % slopes	421.60	B	C	B	C	C	1,2,3,9
RehB	Reaville silt loam, 2-6 % slopes	1,473.82	B	C	B	C	C	1,2,3,9
RehB2	Reaville silt loam, 2-6 % slopes, eroded	384.47	B	C	B	C	C	1,2,3,9
RehC2	Reaville silt loam, 6-12 % slopes, eroded	262.12	B	C	C	C	C	1,2,3,9
RepwA	Reaville poorly drained variant silt loam, 0-2 % slopes	5.64	C	C	C	C	C	1,2,7,9
RksC	Riverhead gravelly sandy loam, 8-15 % slopes	0.06	B	B	C	C	C	3,9
ROPF	Rough broken land, shale	12.66	n/a	n/a	n/a	n/a	n/a	n/a
RorAt	Rowland silt loam, 0-2 % slopes, frequently flooded	897.83	C	C	C	C	C	1,5,6,8,9
ThoAs	Tioga fine sandy loam, 0-2 % slopes, occasionally flooded	163.68	C	C	C	C	C	1,4,5,8,9
UdbB	Udorthents, bedrock substratum, 0-8 % slopes	64.08	A	C	A	C	C	1,2,3,9

SSURGO Soil Code	Soil Name	Acres	Building w/o Basement	Building w/ Basement	Small Commercial	Septic Systems	Sewage Lagoons	Limits*
UdgB	Udorthents, gravelly substratum, 0-8 % slopes	0.25	A	A	A	C	C	1,3,4,9
WasA	Watchung silt loam, 0-2 % slopes	36.41	C	C	C	C	C	1,7,8,9
WasAe	Watchung silt loam, 0-3 % slopes, very rubbly	35.81	C	C	C	C	C	1,2,7,8,9
WATER	Water	526.19	n/a	n/a	n/a	n/a	n/a	n/a

Sources: Soil Survey of Mercer County, NJ NRCS

Key to Constraints for Development in Table 7	
A=Slight	Little or no limitation or easily corrected by use of common equipment and techniques
B=Moderate	Presence of some limitation, which normally can be overcome by careful design and management at somewhat greater cost.
C=Severe	Limitations that under normal circumstances cannot be overcome without exceptional, complex or costly measures.

***Explanation of Development Limits**

1	Depth To Saturated Zone
2	Depth To Soft Bedrock
3	Slope
4	Filtering Capacity
5	Flooding
6	Ponding
7	Shrink-Swell
8	Slow Water Movement
9	Seepage

SURFACE WATER RESOURCES

Hopewell has a range of surface waters in the township, with the combination of open water and wetlands covering over 10 percent of the township's land area. These resources are comprised of rivers, streams, canals, swamps and bogs, and lakes and ponds. Hopewell sits adjacent to the Delaware River, one of the major rivers in the eastern United States and a significant contributor to the economic development of the Mid-Atlantic region. Portions of the Delaware River, including a 39 mile stretch north of Washington Crossing, are designated as a national "Wild and Scenic River". The federal Wild and Scenic Rivers Act of 1968 lists rivers of "outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural or other similar values" and provides a legal mandate for the conservation of these rivers and their immediate surroundings. Currently, only one quarter of 1 percent of the nation's rivers are listed.

Photo by James Bennett

Stony Brook in the Stony Brook-Millstone Watershed Preserve.

WATERSHEDS

A watershed is all the land that drains to a particular waterway, such as a river, stream, lake, or wetland. The boundaries of a watershed are defined by the high points in the terrain, such as hills or ridges. A watershed includes not only the waterbody or waterway itself, but also the entire land area that drains to it. Large watersheds are made up of smaller ones, down to the catchment level of a local site. So, for example, the Delaware River watershed is made up of many smaller watersheds, such as the Jacobs Creek watershed, which itself is made up of the smaller watersheds of the tributaries that drain into Jacobs Creek, and so on down to the catchment level. Watersheds are natural ecological units, where soil, water, air, plants, and animals interact in a complex relationship.

The watersheds of Hopewell Township drain westward towards the Delaware River and eastward towards the Raritan Bay. Approximately 44 percent of Hopewell's land drains to the Delaware River by way of the Alexauken, Moore, Jacobs, and Assunpink creeks. The remaining 56 percent drains to the Raritan Bay by way of the Stony Brook and the Millstone River.

Hydrologic Unit Codes

The United States Geological Survey classifies every drainage system in the United States according to a numerical identification code called the Hydrologic Unit Code (HUC). HUCs begin with a number representing the largest drainage area. From there, digits are added as the defined area becomes smaller. For example, the first level divides the entire country into 21 major drainage areas. The numbers to the right represent the most local watershed. HUC-11 codes are 11-digit numbers applied to a drainage area that is approximately 40 square miles in size. Hopewell can be divided into five HUC-11 watersheds: the Alexauken Creek/Moore Creek/Jacobs Creek Watershed, the Assunpink Creek Watershed (above Shipetauken Creek), the Assunpink Creek Watershed (below Shipetauken Creek), the Millstone River Watershed, and the Stony Brook Watershed. HUC-11 watersheds are further subdivided into HUC-14 sub-watersheds, with the identification number for each one having 14 digits. There are eighteen HUC-14 watersheds in Hopewell, listed in **Table 8** and shown on **Map 8: Watersheds in Hopewell Township**.

Assunpink Creek Watershed (above and below Shipetauken Creek)

The Assunpink Creek Watershed (both above and below Shipetauken Creek) covers approximately 1,479 acres in Hopewell, or less than 4 percent of the township. It is located in the township's southeast corner. This area serves as the headwaters for the east branch of the Shabakunk Creek, which converges with the west branch in Lawrence Township before draining into the Assunpink. This watershed features the most impervious surface cover of any of Hopewell's watersheds.

Millstone River Watershed

The Millstone River Watershed is the third largest of Hopewell's five HUC-11 watersheds, covering an area of 4,494 acres, or just under 12 percent of the township's land. It is located in the northeast corner of the township. The Millstone River runs from west to east, flowing into Raritan Bay and the Atlantic Ocean. Its main tributary in Hopewell is Beden Brook. The entire Borough of Hopewell is within this watershed.

Alexauken Creek/Moore Creek/Jacobs Creek Watershed

This watershed is the second largest watershed area in Hopewell, draining nearly 15,000 acres of the township. It consists of numerous small streams that flow directly into the Delaware River. The Alexauken/Moore/Jacobs creek watershed is the least developed in Hopewell, and its streams are the most sensitive to development impacts. Within this watershed, all of the tributaries of the Delaware River within Washington Crossing State Park are designated as Category One (C-1) streams, as are the entire length of Alexauken Creek and all of its tributaries. It should be noted, however, that the Alexauken Creek and its tributaries lie entirely beyond Hopewell's boundaries in West Amwell Township.

Table 8: Watersheds in Hopewell Township

Watershed	USGS Watershed Code (HUC-11 Number)	Stream Classification	Acreage within Hopewell Township	% of Hopewell Land	Sub-watersheds (HUC-14 Numbers within Hopewell)
Assunpink Creek (above Shipetauken Ck)	02040105**230**	FW2-NT	71.72	0.19%	02040105230**060**
Assunpink Creek (below Shipetauken Ck)	02040105**240**	FW2-NT	1,407.46	3.73%	02040105240**010** 02040105240**050**
Millstone River (below/incl Carnegie Lk)	02030105**110**	FW2-NT	4,488.27	11.91%	02030105110**040** 02030105110**050** 02030105110**060** 02030105110**070**
Alexauken Ck / Moore Ck / Jacobs Ck	02040105**210**	Varies	14,977.55	39.74%	02040105210**030** 02040105210**040** 02040105210**050** 02040105210**060** 02040105210**070**
Stony Brook	02030105**090**	Varies	16,742.33	44.42%	02030105090**010** 02030105090**020** 02030105090**030** 02030105090**040** 02030105090**050** 02030105090**060**

Source: NJDEP, Bureau of Geographic Information Systems, 2006

Stony Brook Watershed

The Stony Brook Watershed covers 16,574 acres of Hopewell's land, the largest HUC-11 watershed area in the township. The watershed is drained by the Stony Brook, which is 21 miles long and flows southward and eastward from East Amwell Township in Hunterdon County. It joins the Millstone River at Princeton, which then travels north until it joins the Raritan River and empties into the Raritan Bay and the Atlantic Ocean. Within Hopewell, the portion of Stony Brook downstream of Old Mill Road to the Lawrence Township border is a Category One (C-1) stream. Tributaries to the Stony Brook include Alexander Creek, Baldwins Creek, Cleveland Brook, Duck Pond Run, Honey Branch, Lewis Brook, Peters Brook, and Woodsville Brook. Both the Stony Brook and Millstone River watersheds are within the purview and stewardship of the Stony Brook Millstone Watershed Association.

STREAMS

In Hopewell, there are a total of 107.7 stream miles flowing across the land, 87.8 of which are first or second order, or headwater, streams. Headwater streams are the initial sections of stream channels with no contributing tributaries (first order streams), or they are stream channels formed from only one branching section of tributaries above them (second order streams). The headwaters are where a stream is "born" and actually begins to flow.

Photo by Tom Ogren

Fall foliage along Stony Brook.

Headwaters are of particular importance because they tend to contain a diversity of aquatic species, and the headwaters' condition affects the water quality found downstream. They drain only a small area of land, usually no larger than one square mile (640 acres). Because of their small size, they are highly susceptible to impairment by human activities on the land. Headwaters are important sites for aquatic life at the base of the food chain and often serve as spawning or nursery areas for fish. First and second order streams are narrow and often shallow, and are characterized by relatively small base flows. This makes them subject to greater temperature fluctuations, especially when forested buffers on their banks are removed. They are also easily over-silted by sediment-laden

runoff and their water quality can be rapidly degraded. In addition, first order streams are greatly affected by changes in the local water table because they are fed by groundwater sources.

Hopewell's primary streams include Moore Creek, Jacobs Creek, Woolsey Brook, Beden Brook, Stony Brook, and the Honey Branch. Moore Creek and its tributaries flank the northern slopes of Baldpate Mountain, and comprise over 10 miles of streams, flowing from east to west into the Delaware River. The 11.7 stream miles of Jacobs Creek and its tributaries begin just above Poor Farm Road where it meets Harbourton-Woodsville Road, heading south for approximately 4 miles before turning west and flowing into the Delaware at Hopewell's border with Ewing Township. Woolsey Brook and its tributaries comprise 7.2 miles of streams that drain the area of the township just west of Pennington Borough before entering into Jacobs Creek below Washington Crossing-Pennington Road. The 8.6 mile long Beden Brook begins in the northeast corner of the Township, and flows from north to south, before turning east below Hopewell-Rocky Hill Road. By far the largest stream system, the 27 miles of the Stony Brook and its tributaries begin in Hunterdon County, flowing roughly from north to south through Hopewell until reaching Pennington Borough, where they then flow from west to east, draining the smaller 6.7 mile long Honey Branch just before entering Lawrence Township. Additionally, nearly 4 miles of the Township's western border is made up by the Delaware River.

Table 9: Hopewell Township Streams

Stream Order	Miles
First Order Streams (smallest)	62.04
Second Order Streams	25.79
Third Order Streams	14.51
Fourth Order Streams	1.56
Delaware River	3.82
Total Stream miles	**107.72**

Source: NJDEP

LAKES AND PONDS

Hopewell Township features nearly 270 acres of lakes, ponds, impoundments, and other bodies of water, approximately equally divided between natural and man-made bodies of water. Most are quite small (less than an acre). Hopewell has at least six named waterbodies. Within Rosedale Park, Rosedale Lake is a publically owned lake used for passive recreational activities, such as fishing and is regularly stocked with trout. Curlis Lake, part of the Curlis Lake Woods Nature Preserve, can be accessed via hiking trails. Other lakes in the township include Baldwin Lake, Honey Lake, Hunt's Lake and Blackwell Lake. See **Map 9: Surface Water, Wetlands, and Vernal Pools.**

WETLANDS

Wetlands support unique communities that serve as natural filters and as incubators for many beneficial species. The term "wetland" is applied to areas where the soil is inundated or saturated at a frequency great enough to support vegetation suited for life in saturated soils. The source of water for a wetland can be surface water, such as an estuary, river, stream, lake edge, or groundwater that intersects with a depression in land surface. Under normal conditions, wetlands are those areas that support a prevalence of defined wetland plants on a wetland soil. The U.S. Fish and Wildlife Service designates all large vascular plants as wetland (hydric), nonwetland (nonhydric), or in-between (facultative). Wetland soils, also known as hydric soils, are areas where the land is saturated for at least seven consecutive days during the growing season. While wetlands require the presence of hydric soils, hydric soils are not always necessarily wetlands. Wetlands are classified as either tidal or nontidal. Tidal wetlands can be either saline or freshwater. There are also special wetland categories to denote saturated areas that have been altered by human activities.

New Jersey protects freshwater (interior) wetlands under the New Jersey Freshwater Wetlands Protection Act Rules: *N.J.A.C. A 7:7A.* The law also protects transitional areas, or "buffers," around freshwater wetlands. The New Jersey freshwater wetlands maps provide guidance on where wetlands are found in New Jersey, but they are not the final word. Only an official determination from DEP, called a "letter of interpretation" (LOI), can determine for sure if there are freshwater wetlands on a property. An LOI verifies the presence, absence, or boundaries of freshwater wetlands and transition areas on a site. Activities permitted to occur within wetlands are very limited and most require permits. Additional information on wetlands rules and permits is available through NJDEP and on their website under "land use."

Each of Hopewell's wetlands is considered freshwater. Total wetland acreage in the township is 3,216 acres, of which 2,821 are naturally-occurring wetlands and 395 are wetlands modified by human activities. Of Hopewell's naturally-occurring wetlands, 2,422 acres are classified as forested wetlands, 143 acres are herbaceous wetlands and 256 acres are scrub/shrub wetlands. Many of Hopewell's wetlands are located in the Sourland Mountain region, as well as along Stony Brook and Beden Brook and their tributaries. See **Map 9: Surface Water, Wetlands, and Vernal Pools**.

Hopewell also includes 395 acres of wetland areas that have been altered by human activities. Collectively, these will be referred to as *modified* wetlands in this document.[4] Although they do not typically support natural wetland vegetation, modified wetlands do show obvious signs of soil saturation and exist in areas shown to have hydric soils on U.S. Soil Conservation Service soil surveys. Hopewell's modified wetlands fall into the following categories as defined by the Anderson Land Use Classification system: 304 acres of agricultural wetlands, 15 acres of disturbed wetlands, 23 acres of former agricultural wetlands, and 53 acres of wetlands found in maintained green space, recreational areas, lawns or rights-of-way. A more detailed description of all of Hopewell's wetland areas is found in *Biological Resources: Wetlands, page 73*.

[4] Like interior wetlands, Hopewell Township's modified wetlands are also non-tidal.

Photo by Rachel Mackow

A forest with emerging skunk cabbage in a wetland area.

Agricultural Wetlands

Agricultural wetlands occupy 304 acres of Hopewell Township. These "quasi-wetlands" are found scattered as small sites, primarily in the southeastern and northwestern portions of the township. Agricultural wetlands are modified former wetlands currently under cultivation. These areas still exhibit evidence of soil saturation in aerial infrared photos, but they do not support natural wetlands vegetation. See **Map 9: Surface Water, Wetlands, and Vernal Pools.**

As long as agricultural wetland areas remain in agricultural use, they are exempt from New Jersey Freshwater Wetlands Rules *N.J.A.C. 7:7A*. However, if an agricultural area is removed from agricultural production for more than five years, any wetlands located within that area lose their exempt status. Also, according to *N.J.A.C. 7:7A-2.8(B)2*, "the exemptions apply only as long as the area is used for the exempted activity." Therefore, if the area is used for anything other than farming, the exemption no longer applies.

The Natural Resource Conservation Service sponsors the Wetlands Reserve Program, a voluntary program that offers landowners an opportunity to receive payments for restoring and protecting wetlands on their property, including agricultural wetlands. Restoring agricultural wetlands requires removing them from agricultural use and restoring them to their natural state. This program provides technical and financial assistance to eligible landowners, who can enroll eligible lands through permanent easements, 30-year easements, or restoration cost-share agreements. (See **Appendix B**).

Vernal Pools

Vernal pools are confined depressions, either natural or man-made, that hold water for at least two consecutive months out of the year and are devoid of breeding fish populations. Vernal pools come in an array of forms: isolated depressions within upland forests, seasonally flooded meadows, floodplain swamps, abandoned gravel pits or quarries, and even derelict swimming pools. However, no matter what the structure or genesis of the pool is, all vernal pools either dry out completely or draw down to very shallow levels unsuitable for sustaining fish. Vernal pools are critical sites for certain rare species of frogs and salamanders, called "obligate breeders". The term obligate breeder refers to species that can only reproduce in vernal pools, because the pool's impermanence prevents residence by predators who would consume the eggs and young. Vernal pools also provide habitat for amphibians and reptiles that may breed in them but not exclusively (facultative breeders), or may use the pools at some point in their life cycles.

Vernal pools are so intermittent that their existence as wetlands has frequently not been recognized. Consequently, many of them have disappeared from the landscape, or have been substantially damaged. This, in turn, is a principal cause of the decline of obligate amphibian species.[5]

In an effort to boost the effectiveness of the 1987 wetland protection regulations, which allowed the filling of isolated wetlands up to one acre in size (including vernal pools), the New Jersey Division of Fish and Wildlife began the Vernal Pool Survey project in 2001 to identify, map, and certify vernal pools throughout the state. Once a vernal pool is certified, regulations require that a 75 foot buffer be maintained around the pool. NJDEP's Division of Land Use Regulation oversees this designation and restricts development around vernal pools by denying construction permits. To be certified, vernal pools must: 1) occur in a confined basin or depression without a permanently flowing outlet; 2) provide documented habitat for obligate or facultative vernal pool herptile species; 3) maintain ponded water for at least two continuous months between March and September of a normal rainfall year; and 4) be free of fish populations throughout the year or dry up at some time during a normal rainfall year.

The state has identified 33 potential vernal pools in Hopewell (see **Map 9: Surface Water, Wetlands, and Vernal Pools**). This does not mean that 33 pools are actually present in

[5] Calhoun, A. J. K. and M. W. Klemens. *Conserving Poll-Breeding Amphibians in Residential and Commercial Developments in the Northeastern United States*. MCA Technical Paper Series: No. 5, Metropolitan Conservation Alliance, Wildlife Conservation Society. Bronx, New York, 2002. pp. 2-5.

Hopewell. This information only reflects what is recorded in NJDEPs current geographic data set. The actual number of pools could be larger or smaller. Of the 33 pools identified by NJDEP, four have been confirmed and certified. Field surveys of the remaining pools are planned to determine what species are present and if the pool is still in existence as a natural habitat.

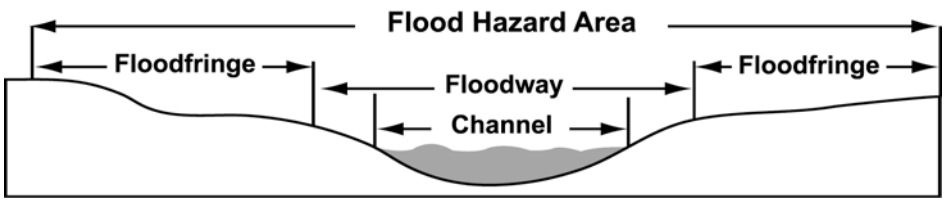
Citizens, local governments, and nonprofit groups can survey pools and submit documentation to NJDEP to have pools certified. Municipalities can provide additional protection for vernal pools by instituting restrictive zoning or negotiating conservation easements on the land surrounding vernal pools. NJDEP's Division of Fish and Wildlife provides detailed guidance on what documentation is needed to certify a vernal pool at: www.state.nj.us/dep/fgw/ensp/vernalpool.htm.

FLOODPLAINS

Areas naturally subject to flooding are called floodplains, or flood hazard areas. Floodplains encompass a floodway, which is the portion of a floodplain subject to high velocities of moving water, and the adjacent flood fringe, which helps to hold and carry excess water during overflow of the normal stream channel (**Figure 4**). The 100-year floodplain is defined as the land area that will be inundated by the overflow of water resulting from a "100-year flood". The term 100-Year Flood is a shorthand reference to a flood event that has a 1 in 100 (1%) chance of occurring in a given year. Due to variances in local rainfall and climate, it is possible that floods with a 1 in 100 chance of happening can occur within a few years or even a few months of each other. The probability of flooding is computed based on historical river flows and flood events. At least ten years of data are required to calculate flood probabilities. This number represents a moving average and can be periodically recalculated to account for changes in flood trends in an area. It is also important to note that 100-year storms may not produce 100-year floods, but the two are often related. Flooding severity is dictated by the intensity of the rainfall, current stream flow and prior ground saturation, among other factors.

For additional information on specific flooding events and concerns in Hopewell, refer to the *Environmental Issues: Flooding* on *page 133*.

Figure 4: Parts of a Flood Hazard Area



Source: NJDEP

Although the term "flood hazard area" and "100-year floodplain" denote similar concepts, NJDEP defines them in slightly different ways. New Jersey's regulations define the flood hazard area as the area inundated by the 100-year flood discharge increased by 25 percent. This type of flood is called the "flood hazard area design flood" and the floodplain resulting from this flood is the area regulated by NJDEP.

Floodplains require protection in order to prevent loss to residents, especially within the boundaries of the floodway. Equally important is the preservation of the environmentally sensitive aquatic communities that exist in floodplains. These communities are often the first link in the food chain of the aquatic ecosystem. In addition, floodplains serve the function of removing and mitigating various pollutants, through the uptake by floodplain vegetation of excess chemical loads in the water and by the filtering of sediments generally. All efforts to keep development out of floodplains will help to preserve the flood-carrying capacity of streams and their water quality.

Most of Hopewell's floodplain areas are located along the Stony Brook and its tributaries. This area is also extensively occupied by forests and wetlands. The majority of the township's remaining floodplain areas are found along Beden Brook, Jacobs Creek, Moore Creek and along the Delaware and Raritan Canal. See **Map 10: Flood Hazard Ares (1996).**

Table 10: Floodplain Acreage

Category	Acres	% Area
100-year	2,104.37	5.583%
500-year	0.83	0.002%
Total Floodplain	**2,105.20**	**5.59%**

Source: Federal Emergency Management Agency

New Jersey's flood hazard area maps are not available in digital form. Consequently, it is only possible to approximate the spatial extent of the flood hazard area in Hopewell by using digitized coverages of the Federal Emergency Management Agency's (FEMA's) Flood Insurance Rate Maps (FIRMs). These maps were produced in conjunction with FEMA's initial Flood Insurance Study for Hopewell Township in 1982, which was updated in 1987 and again in 2001. The boundaries of the 100-year and 500-year floodplains shown on the 1982 FIRMs were digitized by NJDEP in 1996. FEMA's maps show that 2,104 acres of the township's land area falls within the 100-year floodplain. The flood hazard area is presumed to be slightly larger.[6]

[6] Site plan and subdivision applications require detailed engineering studies that depict the boundaries of the flood hazard area, as defined by New Jersey, at a large scale.

FEMA is currently in the process of digitally re-mapping Hopewell's floodplains using LIDAR (Light Detection and Ranging) data. These maps are due to be submitted to Hopewell in 2010 for adoption by the township. Once adopted, the updated digital maps will be available for viewing from the township.

In New Jersey and throughout the country, building in areas subject to flooding is regulated to protect lives, property, and the environment. New Jersey regulates construction in the flood hazard area under the Flood Hazard Area Control Act, *N.J.S.A. 58:16A-50* et seq., and its implementing rules at *N.J.A.C. 7:13*. The New Jersey Department of Environmental Protection adopted a new Flood Hazard Area Control Act on November 5, 2007. In an effort to further improve New Jersey's surface water quality, the redrafted Flood Hazard Control Act imposes additional requirements on property owners in the flood management area. Some of the changes to previous regulations are outlined in **Figure 5.**

Figure 5: Changes to the Flood Hazard Area Control Act

Changes to Flood Hazard Area Control Act (2007)

- Provides greater flexibility in flood hazard area analysis; allows for the use of a greater variety of FEMA maps and calculation techniques than previous regulation.
- Introduces the concept of "Riparian Zone" which includes the stream, its banks and the land and vegetation within a certain distance of all regulated waters. These areas will require flood management permits for a wider variety of uses than the previous regulation.
    - *Riparian zone extends 300 feet from all Category One waters and their upstream tributaries within the same HUC-14 watershed*
    - *Riparian zone extends 150 feet from all trout producing and maintaining streams and their headwaters as well as from areas that support endangered or threatened species*
    - *All other waters will maintain a 50 foot buffer*
- Improves overall flood mitigation by instituting a "zero net loss" criteria for flood storage area statewide.
    - *No more than 20 percent of the flood storage area onsite may be removed and there must not be any net loss in flood storage area in on- and off-site locations combined.*
    - *Flood storage compensation must be made within the same contiguous flood hazard area.*
- Streamlines the permitting process for activities identified to have minimal impacts.
    - *Introduces Permits by Rule*
    - *Introduces General Permits*
    - *Allows for permit transfer with property sale*

Source: NJDEP

SURFACE WATER QUALITY

WATER QUALITY CLASSIFICATIONS

Water quality standards are established by federal and state governments to ensure that water is suitable for its intended use. The federal Clean Water Act (*P.L. 95-217*) requires that, wherever possible, water-quality standards provide water suitable for fish, shellfish and wildlife to thrive and reproduce, and for people to swim and boat.

All waterbodies in New Jersey are classified by NJDEP as either freshwater (FW), pinelands water (PL), saline estuarine water (SE), or saline coastal water (SC). Freshwater is further broken down into freshwater that originates and is wholly within federal or state parks, forests, or fish and wildlife lands (FW1), and all other freshwater (FW2). Additionally, fresh waterbodies are classified as trout-producing (TP), trout-maintaining (TM) or nontrout waters (NT). The water quality for each of these groups must be able to support designated uses that are assigned to each waterbody classification (see *Surface Water Quality Standards N.J.A.C 7:9B-1.12*).

The determination of whether or not water quality is sufficient to meet a body of water's designated use(s) is based on numerous surface water quality parameters. Some examples of surface water quality parameters include fecal coliform, dissolved oxygen, pH, phosphorous, and toxic substances (see *N.J.A.C. 7:9B-1.14*). NJDEP also evaluates water quality by examining the health of aquatic life in a stream.

In addition to the waterbody classifications above, NJDEP has three tiers of "antidegradation designations" for all waters within the state. The most protective tier of antidegradation designation is Outstanding National Resource Waters (ONRW) which include all surface waters classified as FW1 and PL. NJDEP cannot approve any activity which might alter existing water quality in these waters. Hopewell does not contain any ONRW (i.e., FW1 or PL) streams.

The second tier of protection is Category One (C-1). C-1 waters are designated through rulemaking for protection from measurable changes in water quality because of their exceptional ecological significance, exceptional water supply significance, exceptional recreational value, and/or exceptional fisheries. The water quality, aesthetic value, and ecological integrity of C-1 waters should be protected and maintained. FW2, SE, or SC water can be assigned C-1 status.

Within Hopewell, the portion of Stony Brook downstream of Old Mill Road, a small portion of Baldwins Creek west of Stony Brook within the Baldwin Lake Wildlife Management Area, and all the streams within Washington Crossing State Park (i.e., Steele Run) have been assigned C-1 status. Hopewell's stream classifications are listed in **Table 11: Water Quality Classifications of Streams in Hopewell Township**. Normally, streams and tributaries not listed by name in New Jersey's Surface Water Quality Standards (or otherwise not mapped by NJDEP) are, by default, assigned the same classification as the downstream waterbody into which they flow (e.g.

Honey Branch). However, in the case of Stony Brook, NJDEP determined that Stony Brook's tributaries do not qualify for C-1 designation within Hopewell.

Special land use requirements apply to Category One waters through regulations administered by NJDEP. A 300 foot, or "Category One", buffer is required by the Stormwater Management (*N.J.A.C. 7:8*) and the Flood Hazard Area Control Act (*N.J.A.C.7:13*) rules. The Stormwater Management rules state that a 300-foot buffer or Special Water Resource Protection Area (SWRPA) is required for all development that results in a one quarter acre or more increase in impervious surface or 1 acre or more of total disturbance that is adjacent to a C-1 waterway. These rules are available at: www.state.nj.us/dep/rules/.

The Flood Hazard Area Control Act rules require a 300-foot buffer or "Riparian Zone" (RZ) adjacent to C-1 waters. Limited disturbance may be permitted in a RZ under an individual permit or hardship exception. In most cases, the SWRPA and RZ will overlap. The standards protecting vegetation in the RZ and SWRPA do not apply where vegetation did not exist at the time of the establishment of the RZ and SWRPA rules or designation of a stream as Category One. For more information on riparian buffers, see *Inadequate Stream Buffers* beginning on *page 61*.

In addition to these designations, rules adopted by the Delaware and Raritan Canal Commission in June 2009 require a 300-foot buffer for the D & R Canal, and all water courses flowing into the canal.

Table 11: Water Quality Classifications of Streams in Hopewell Township

Stream Name	Classification
Baldwins Creek (within Baldwin Lake WMA)	FW2-NT(C-1)
Baldwins Creek (remainder)	FW2-NT
Beden Brook	FW2-NT
Cleveland Brook	FW2-NT
Delaware & Raritan Canal	FW2-NT
Ewing Creek	FW2-NT
Fiddlers Creek	FW2-TM
Honey Branch	FW2-NT
Jacobs Creek	FW2-NT
Lewis Brook	FW2-NT
Moore Creek	FW2-TM
Peters Brook	FW2-NT
Shabakunk Creek	FW2-NT
Stony Brook (Old Mill Rd to Quaker Rd)	FW2-NT(C-1)
Stony Brook (Source to Old Mill Rd)	FW2-NT
Woodsville Brook	FW2-NT
Woolsey Brook	FW2-NT

Source: NJDEP, Surface Water Quality Standards, N.J.A.C. 7:9B-1.15

All waters not designated as ONRW or C-1 are designated as Category Two (C-2) waters. Similar to C-1, existing water quality should be maintained in C-2 waters. However, lowering of water quality is authorized to accommodate necessary and important social and economic activities. All but two of the C-2 streams in Hopewell Township are classified as FW2-NT, which means that they are freshwater, nontrout producing, nontrout maintaining waters. Moore and Fiddlers creeks are the exceptions, and are classified as FW2-TM, meaning that they are freshwater, trout maintaining streams. See **Table 11: Water Quality Classifications of Streams in Hopewell Township**.

According to NJDEP rules, all FW2 waters must provide for (1) the maintenance, migration and propagation of the natural and established biota; (2) primary and secondary contact recreation (i.e., swimming and fishing); (3) industrial and agricultural water supply; (4) public potable water supply after conventional filtration and disinfection; and (5) any other reasonable uses.

Special Protection Waters

In addition to the regulatory status assigned to streams by NJDEP, in 2005 the Delaware River Basin Commission (DRBC) designated a 75-mile section of the lower Delaware River, including the portion adjacent to Hopewell, as a Special Protection Water. Pursuant to this, approval is now required for all new and expanding municipal and industrial wastewater treatment plants with daily discharge rates averaging over 10,000 gallons. In addition, all new or modified discharges are prohibited unless all nondischarge/load-reduction alternatives are deemed technically and/or financially unfeasible. Finally, all new or expanding water withdrawal or wastewater discharge projects within the drainage area are required to produce a DRBC-approved Nonpoint Source Pollution Control Plan that describes the best management practices put in place to mitigate nonpoint source pollution.

NEW JERSEY'S INTEGRATED WATER QUALITY MONITORING AND ASSESSMENT REPORT

The Federal Clean Water Act (CWA) mandates that states submit biennial reports to the Environmental Protection Agency (EPA) describing the quality of their waters. States must submit two reports: the *Water Quality Inventory Report*, or "305(b) Report," documenting the status of principal waters in terms of overall water quality and support of designated uses; and a list of waterbodies that are not attaining water quality standards – the "303(d) List." States must also prioritize 303(d)-listed waterbodies for Total Maximum Daily Load (TMDL) analyses and identify those high-priority waterbodies for which they anticipate establishing TMDLs in the next two years.

In 2002, 2004, and again in 2006, NJDEP integrated the 303(d) List and the 305(b) Report into a single report according to EPA's guidance. The 2006 *New Jersey Integrated Water Quality Monitoring and Assessment Report* (www.state.nj.us/dep/wms/bwqsa/)[7], released in early 2007,

[7] As of this writing, the 2008 *New Jersey Integrated Water Quality Monitoring and Assessment Report* was only available in draft form.

places the state's waters on one of five "sublists." Sublists 1 and 2 contain waters that are attaining water quality standards. Sublist 3 contains waters for which there is insufficient data to determine their status. Sublist 4 contains waters that do not attain water quality standards, but that meet one of the following three conditions: (1) a TMDL has been completed for the pollutant causing nonattainment; (2) other enforceable pollution control requirements are reasonably expected to result in conformance with the applicable water quality standards; or (3) nonattainment is caused by something other than a pollutant. Sublist 5 contains waters that do not attain their designated use and for which a TMDL is required. Sublist 5 is equivalent to the 303(d) List. See *page XXX* pr a discussion of TMDLs.

NJDEP uses a methodology that reports the attainment of water quality standards required for achieving designated uses on a sub-watershed basis. Rather than placing water quality monitoring stations and their associated stream segments on a sublist for an individual parameter, NJDEP identifies the designated uses applicable to each HUC-14 watershed (assessment unit) and assesses the status of use attainment for each applicable designated use. Designated uses include:

- Aquatic life (general)
- Aquatic life (trout)
- Primary contact recreation (swimming)
- Secondary contact recreation (boating or fishing)
- Drinking water supply
- Industrial water supply
- Agricultural water supply
- Shellfish harvesting
- Fish consumption

The assessment unit is then placed on the appropriate sublist for each use. (Note: not all designated uses are applicable for all HUC-14 watersheds).

NJDEP bases the assessment of entire HUC-14 watersheds on the results of one or more monitoring site(s) within the watershed. The results from monitoring site(s) located within the HUC-14 sub-watershed are extrapolated to represent all the waters within the entire HUC boundary. In practice, the HUC-14 approach provides a more conservative assessment, since any impairment of any waterbody (stream, river, etc.) in a given HUC-14 watershed will result in that entire watershed being listed as impaired for that use/parameter. In addition, where a HUC-14 watershed contains waters of different classification, the more stringent classification is used to assess impairment, and that impairment is then applied to the entire watershed. Because of the extent of extrapolation required for this approach, NJDEP will perform more detailed testing to determine the actual cause, source, and extent of impairment in the HUC-14 watershed before developing a TMDL or taking other regulatory action to address the impairment. See **Table 12: New Jersey Integrated Water Quality Monitoring and Assessment Report (2006)** for the status of each of Hopewell's HUC-14 watersheds.

Table 12: New Jersey Integrated Water Quality Monitoring and Assessment Report (2006)

Assessment Unit ID	Assessment Unit Name	Aquatic Life (General)	Primary Contact Rec.	Secondary Contact Rec.	Drinking Water Supply	Agric. Water Supply	Indus. Water Supply	Fish Consumption
02040105210030-01	Swan Creek (Moore Ck to Alexauken Ck)	Sublist 3	Sublist 3	Sublist 3	Sublist 3	Sublist 3	Sublist 3	Sublist 3
02040105210040-01	Moore Creek	Sublist 5	Sublist 3	Sublist 3	Sublist 3	Sublist 3	Sublist 3	Sublist 3
02040105210050-01	Fiddlers Creek (Jacobs Ck to Moore Ck)	Sublist 3	Sublist 3	Sublist 3	Sublist 3	Sublist 3	Sublist 3	Sublist 3
02040105210060-01	Jacobs Creek (above Woolsey Brook)	Sublist 2	Sublist 4A	Sublist 3	Sublist 2	Sublist 2	Sublist 2	Sublist 3
02040105210070-01	Jacobs Creek (below/incl Woolsey Brook)	Sublist 5	Sublist 4A	Sublist 3	Sublist 2	Sublist 2	Sublist 2	Sublist 3
02040105230060-01	Shipetauken Creek	Sublist 5	Sublist 3	Sublist 3	Sublist 3	Sublist 3	Sublist 3	Sublist 3
02040105240010-01	Shabakunk Creek	Sublist 5	Sublist 4A	Sublist 3	Sublist 3	Sublist 3	Sublist 3	Sublist 5
02040105240050-01	Assunpink Creek (below Shipetauken Ck)	Sublist 5	Sublist 4A	Sublist 4A	Sublist 5	Sublist 2	Sublist 2	Sublist 5
02030105110040-01	Beden Brook (above Province Line Rd)	Sublist 5	Sublist 3	Sublist 3	Sublist 3	Sublist 3	Sublist 3	Sublist 3
02030105110050-01	Beden Brook (below Province Line Rd)	Sublist 5	Sublist 4A	Sublist 3	Sublist 5	Sublist 2	Sublist 2	Sublist 3
02030105110060-01	Rock Brook (above Camp Meeting Ave)	Sublist 2	Sublist 5	Sublist 2	Sublist 2	Sublist 2	Sublist 2	Sublist 3
02030105110070-01	Rock Brook (below Camp Meeting Ave)	Sublist 2	Sublist 4A	Sublist 3	Sublist 3	Sublist 3	Sublist 3	Sublist 3
02030105090010-01	Stony Bk (above 74d 49m 15s)	Sublist 5	Sublist 3	Sublist 2	Sublist 3	Sublist 3	Sublist 3	Sublist 3
02030105090020-01	Stony Bk (74d 48m 10s to 74d 49m 15s)	Sublist 5	Sublist 3	Sublist 3	Sublist 2	Sublist 3	Sublist 3	Sublist 3
02030105090030-01	Stony Bk (Baldwins Ck to 74d 48m 10s)	Sublist 5	Sublist 3	Sublist 3	Sublist 2	Sublist 3	Sublist 3	Sublist 3
02030105090040-01	Stony Bk (74d 46m dam to/incl Baldwins Ck)	Sublist 5	Sublist 3	Sublist 3	Sublist 2	Sublist 3	Sublist 3	Sublist 3
02030105090050-01	Stony Bk (Province Line Rd to 74d 46m dam)	Sublist 5	Sublist 4A	Sublist 3	Sublist 5	Sublist 2	Sublist 5	Sublist 3
02030105090060-01	Stony Bk (Rt 206 to Province Line Rd)	Sublist 5	Sublist 4A	Sublist 3	Sublist 5	Sublist 2	Sublist 5	Sublist 3

Source: NJDEP, Water Monitoring and Standards, 2006

Note: The designated uses, "Aquatic Life (trout)" and "Shellfish Harvesting," are not applicable for any of the HUC-14 watersheds/assessment units in Hopewell Township, and are therefore not included in the above table.

Key to Integrated Report Sublists in Table 12

Sublist	Placement Conditions
Sublist 1	The designated use is assessed and attained AND all other designated uses in the assessment unit area are assessed and attained. (Fish consumption use is not factored into this determination based on EPA guidance).
Sublist 2	The designated use is assessed and attained BUT one or more designated uses in the assessment unit is not attained and/or there is insufficient data to make a determination.
Sublist 3	Insufficient data is available to determine if the designated use is attained.
Sublist 4	The designated use is not attained or is threatened; however, development of a TMDL is not required for one of the following reasons: A. A TMDL has been completed for the pollutant causing nonattainment B. Other enforceable pollution control requirements are reasonably expected to result in the conformance with the applicable water quality standard(s) in the near future and the designated use will be attained through these means C. Nonattainment is caused by something other than a pollutant
Sublist 5	The designated use is not attained or is threatened by a pollutant or pollutants and a TMDL is required.

As shown in **Table 12**, an assessment unit may be listed on one or more sublists (i.e., on Sublist 2 for drinking water, Sublist 3 for aquatic life, etc.). Only if all uses for an individual HUC-14 are assessed and attained can the assessment unit be placed on Sublist 1. In order to determine whether or not an assessment unit supports a designated use, NJDEP has identified a suite of parameters that serve as the minimum data set associated with each designated use.

If one or more designated uses are assessed as "nonattainment" (Sublist 5), the pollutant(s) causing the nonattainment status is identified on the "303(d) List of Impaired Waters with Priority Ranking." When the pollutant causing nonattainment is unknown, the pollutant is listed as "pollutant unknown" or "toxin unknown." The ranking level refers to the priority given an assessment unit when determining the schedule for a TMDL. **Table 13: New Jersey's 303(d) List of Impaired Waterbodies with Priority Ranking** lists the nonattaining assessment units and their pollutants in Hopewell Township.

Table 13: New Jersey's 303(d) List of Impaired Waterbodies with Priority Ranking

Assessment Unit ID	Assessment Unit Name	Parameter	Ranking
02030105090010-01	Stony Bk (above 74d 49m 15s)	Mercury	Medium
		Pollutant Unknown	Low
02030105090020-01	Stony Bk (74d 48m 10s to 74d 49m 15s)	Mercury	Medium
		Pollutant Unknown	Low
02030105090030-01	Stony Bk (Baldwins Ck to 74d 48m 10s)	Mercury	Medium
		Pollutant Unknown	Low
02030105090040-01	Stony Bk (74d 46m dam to/incl Baldwins Ck)	Mercury	Medium
		Pollutant Unknown	Low
02030105090050-01	Stony Bk (Province Line Rd to 74d 46m dam)	Arsenic	Medium
		Phosphorus	High
		Total suspended solids	High
02030105090060-01	Stony Bk (Rt 206 to Province Line Rd)	Arsenic	Medium
		Phosphorus	High
		Total suspended solids	High
02030105110040-01	Beden Brook (above Province Line Rd)	Pollutant Unknown	Low
02030105110050-01	Beden Brook (below Province Line Rd)	Arsenic	Medium
		Phosphorus	High
02030105110060-01	Rock Brook (above Camp Meeting Ave)	Pathogens	High
02040105210020-01	Alexauken Ck (below 74d 55m to 11BA06)	Temperature	Low
02040105210040-01	Moore Creek	Pollutant Unknown	Low
02040105210070-01	Jacobs Creek (below/incl Woolsey Brook)	pH	Medium
02040105230050-01	Assunpink Ck (Shipetauken to Trenton Rd)	Pollutant Unknown	Low
02040105230060-01	Shipetauken Creek	Pollutant Unknown	Low
02040105240010-01	Shabakunk Creek	Mercury	Medium
		Pollutant Unknown	Low
02040105240050-01	Assunpink Creek (below Shipetauken Ck)	Arsenic	Medium
		Lead	Medium
		Mercury	Medium
		Phosphorus	Medium

Source: NJDEP, Water Monitoring and Standards, 2006

WATER QUALITY MONITORING NETWORKS

The determination of whether or not water quality is sufficient to meet an assessment unit's designated use(s) is based on testing results from various water quality monitoring networks. Across the state, NJDEP primarily relies on two water quality monitoring networks: the Ambient Stream Monitoring Network (ASMN) and the Ambient Biomonitoring Network (AMNET). The locations of ASMN and AMNET stations are depicted on **Map 11: Water Quality Sampling Locations**.

Ambient Stream Monitoring Network (ASMN)

NJDEP runs the ASMN in cooperation with the U.S. Geological Survey (USGS). This network contains 115 stations that monitor for nutrients (i.e., phosphorous and nitrogen), bacteria, dissolved oxygen, metals, sediments, chemical, and other parameters. USGS and NJDEP maintain 18 ASMN sites in Mercer County, seven of which are located in Hopewell Township. These sites test for dissolved oxygen, pH, ammonia, nitrogen, phosphorous, metals, and a wide range of organic and inorganic chemicals.

Ambient Biomonitoring Network (AMNET)

AMNET, which is administered solely by NJDEP, evaluates the health of aquatic life as a biological indicator of water quality. This network includes 820 monitoring stations located throughout the state. Each station is sampled once every five years. The first round of sampling for all stations took place between 1992 and 1996 and a second round occurred between 1997 and 2001. A third round of sampling took place between 2002 and 2006.

Currently, there are nine AMNET sites that assess aquatic life within Hopewell's streams. NJDEP performed three rounds of testing on all nine sites. The 1992 round of testing took place between July of 1992 and March of 1994. The 1998 round of testing took place between July of 1997 and April of 1999. The 2003 round of testing took place between May 2003 and September 2004. Each AMNET site was tested for only one water quality parameter – the diversity of aquatic life. In testing this water quality parameter, NJDEP samples streams for benthic (bottom-dwelling) macroinvertebrates (insects, clams, mussels, snails, worms and crustaceans that are large enough to be seen by the naked eye). Macroinvertebrates are studied because if pollution impacts a stream, their populations are adversely affected and require long periods of time to recover. Whereas chemical tests measure water quality on a given day only, the presence or absence of macroinvertebrates is affected by water quality over a longer time period preceding the testing day. NJDEP determines the number of aquatic organisms present and their diversity. The greater the number of organisms and the greater their diversity, the better the surface water quality.

1992 Round

Site AN0398 on Beden Brook, site AN0391 on Stony Brook, site AN0104 on Woolseys Brook, site AN0103 on the Airport Branch of Jacobs Creek (a.k.a. Ewing Creek) and Site AN0101 on

Moore Creek were rated as "Moderately Impaired" for aquatic life support. All other sites were rated as "Nonimpaired," meaning the streams were able to maintain diverse populations of aquatic organisms.

1998 Round

Two of the sites rated "Moderately Impaired" (AN0101 and AN0103) during the first round of testing exhibited enough improvement to be rated as "Nonimpaired". Two more sites (AN0398 and AN0104) also showed a marked improvement, but did not improve enough to be considered "Nonimpaired". One site (AN0391) remained the same. Among those sites rated "Nonimpaired" in the first round, only one site (AN0390 on Jacobs Creek) showed a significant enough decline to be downgraded to "Moderately Impaired". All other sites remained either the same or very close to levels in the previous round.

2003 Round

Changes between NJDEP's second and third rounds of testing were found in three sites. Site AN0391 on Stony Brook, which in the previous two rounds had shown no improvement, was upgraded from "Moderately Impaired" to "Nonimpaired". Site AN0103, on the Airport Branch of Jacobs Creek, which had previously shown improvement, was downgraded to "Moderately Impaired" in the third round. Finally, site AN0101 on Moore's Creek, which also had been upgraded between the first and second rounds, was downgraded to "Severely Impaired", indicating that it was incapable of supporting a diverse range of aquatic life.

Hopewell's AMNET stations are listed in **Table 14: New Jersey AMNET Sampling Locations for Hopewell Township** and are depicted on **Map 11: Water Quality Sampling Locations.**

Knowing the condition of streams and stream banks, and planning for their improvement requires more extensive surveys and more frequent monitoring than the state can provide. The state primarily monitors main channels in nontidal areas and only does biological assessments on a five-year cycle. No 2008 round of monitoring has been reported as yet. Stream surveys by local organizations are much needed, along with regular monitoring of water quality on all of a community's waterways. Fortunately, Hopewell Township has substantial local monitoring.

Table 14: New Jersey AMNET Sampling Locations for Hopewell Township

Site ID	Waterbody	Location	1992 NJ Impairment Score	1998 NJ Impairment Score	2003 NJ Impairment Score
AN0101	Moore Creek	Route 29	Moderately Impaired	Nonimpaired	Severely Impaired
AN0102	Jacobs Creek	Woosamonsa Road	Nonimpaired	Nonimpaired	Nonimpaired
AN0103	Airport Branch of Jacobs Creek	Route 579	Moderately Impaired	Nonimpaired	Moderately Impaired
AN0104	Woolseys Brook	Route 546	Moderately Impaired	Moderately Impaired	Moderately Impaired
AN0105	Jacobs Creek	Route 546	Nonimpaired	Nonimpaired	Non-Impaired
AN0106	Jacobs Creek	Route 29	Nonimpaired	Nonimpaired	Non-Impaired
AN0390	Stony Brook	VanDyke Road	Nonimpaired	Moderately Impaired	Moderately Impaired
AN0391	Stony Brook	Mine Road	Moderately Impaired	Moderately Impaired	Nonimpaired
AN0398	Beden Brook	Aunt Molly Road	Moderately Impaired	Moderately Impaired	Moderately Impaired

Source: NJDEP, Bureau of Freshwater and Biological Monitoring

Other Water Quality Monitoring Networks

In addition to the various networks used by NJDEP, local groups often assess, monitor and document water quality. Since 1992, volunteers of the Stony Brook Millstone Watershed Association (SBMWA) have been performing this task throughout the Stony Brook Millstone Watershed through the StreamWatch program. StreamWatch focuses on measuring the health of local water quality through visual, biological, and chemical observations. StreamWatch data better enables the SBMWA to assess the impacts of pollution on local streams and determine actions necessary to protect and improve water quality for everyone. Currently, StreamWatch data is not utilized by NJDEP for the state's Water Quality Monitoring and Assessment Report.

Approximately four years ago, NJDEP reevaluated their standards for accepting volunteer water quality monitoring data. Organizations conducting volunteer water quality monitoring, such as the SBMWA, may contact NJDEP's Bureau of Water Quality Standards and Assessment and complete a Quality Assurance Project Plan to have their data accepted by NJDEP for official use. In 2009, SBMWA petitioned NJDEP to accept their temperature data for official use.

The SBMWA StreamWatch program maintains seven sites in Hopewell on Stony Brook (SB4 & SB5), Beden Brook (BD4), Honey Brook (HO1, HO2, HO3) and Honey Lake (HL1). These sites test for and provide data on temperature, dissolved oxygen (DO), turbidity, pH, nitrates and phosphates. In 2009, *E. Coli* was added to this list of parameters. SBMWA shares the data it collects with Hopewell on a regular basis. Data show that the Hopewell stations have maintained the minimum state guidelines for temperature, DO, turbidity, nitrates and pH between 1992 and 2008. (SBMWA reports an "annual average" pollutant level over the course of a calendar year.) However, phosphate levels have frequently exceeded the limits set by NJDEP throughout the

data reporting period. Phosphate levels should not be higher than 0.1 parts per million (ppm), but annual averages as high as 0.6 ppm have been recorded. For more information, visit the SBMWA website at: www.thewatershed.org/watershed_home.php

In addition to the StreamWatch program, the Bristol-Myers Squibb Company (BMS) monitors water quality semi-annually at five locations in the Stony Brook watershed and reports results to Hopewell Township, Pennington Borough and the SBMWA. The network monitors parameters similar to those described above. Data collected during 16 monitoring events between September 2001 and August 2009 indicated a maximum phosphorous concentration of 0.4 ppm. However, this maximum concentration was an outlier when compared to the overall results. According to data compiled by BMS, the majority of the testing results recorded between September 2001 and August 2009 achieved the 0.1 ppm surface water quality standard for phosphorous.

FISH CONSUMPTION

Certain fish may contain toxic chemicals, such as PCBs, dioxins, or mercury, which accumulate in their tissues from sediments in waterbodies. Chemical contaminants such as dioxin and PCBs are classified by EPA as probable cancer-causing substances in humans. Elevated levels of mercury can pose health risks to the human nervous system. Infants, children, pregnant women, nursing mothers, and women of childbearing age are considered to be at higher risk from contaminants in fish than other members of the general public. Since 1982, NJDEP has been catching fish at numerous sampling stations throughout the state and testing for contaminant levels of PCBs, dioxins, and mercury, and adopting advisories to guide residents on safe consumption practices. For the general population, NJDEP recommends one meal per month of largemouth bass, one meal per week of the black crappie, and no restrictions on either the chain pickerel or yellow perch. For high-risk individuals, such as infants, children, and pregnant or nursing women, NJDEP recommends they do not eat largemouth bass, consume no more than one meal per month of black crappie and chain pickerel, and no more than one meal per week of yellow perch.

TOTAL MAXIMUM DAILY LOADS

For impaired waters (waters on Sublist 5), the state is required by EPA to establish a Total Maximum Daily Load (TMDL). A TMDL quantifies the amount of a pollutant a waterbody can assimilate (its loading capacity) without violating water quality standards. A TMDL's purpose is to initiate a management approach or restoration plan based on the sources of pollutants, and the percentage reductions of each pollutant that must be achieved to attain water quality standards. These sources can be point sources, such as sewage treatment plants, or nonpoint sources, such as runoff from various types of residential, commercial or agricultural lands.

According to the 2006 *Water Quality Monitoring and Assessment Report*, there are 14 HUC-14 watersheds in Hopewell listed on Sublist 5. Two watersheds are on NJDEP's "two-year TMDL schedule" for phosphorous and total suspended solids: Stony Brook (Province Line Rd. to 74d46m dam) and Stony Brook (Rt 206 to Province Line Rd.). This schedule indicates that

TMDLs for these watersheds should have been completed by December 2008. However, according to the draft *2008 Water Quality Monitoring and Assessment Report*, the TMDLs for these watersheds will be incorporated into a forthcoming TMDL for the Raritan Basin.

Achieving the pollutant loading goals set forth in the TMDLs will require substantial reductions in the amount of phosphorous and total suspended solids from each known source. In general, implementation of a TMDL relies on actions mandated by the Municipal Stormwater Management program, including the ordinances required to be adopted by municipalities under that permit (see **Figure 6**, *page 60* for details on the Statewide Basic Requirements of this program) and on voluntary improvements to land and runoff management in agricultural areas.

CAUSES OF WATER QUALITY IMPAIRMENTS

Stormwater Runoff and Impervious Cover

Stormwater runoff and other nonpoint source pollution (pollution coming from a wide variety of sources rather than from a single point, such as a discharge pipe) have the largest effect on the water quality and channel health of streams in Hopewell Township. These sources are also the most difficult to identify and remediate because they are diffuse, widespread, and cumulative in their effect. Most nonpoint source pollution in Hopewell is known to derive from stormwater drainage off paved surfaces including streets, commercial/industrial areas, and residential sites (with and without detention basins), and from agricultural fields that lack adequate vegetative buffers. Some of this runoff comes to the waterways from similar sources in upstream townships, and some of it derives from Hopewell land uses.

Some examples of nonpoint source pollutants contained in stormwater runoff include the following: excess fertilizers, herbicides, and insecticides from residential lawns and agricultural lands; oil, grease, rubber, and toxic chemicals from automobiles; improper disposal of household wastes; sediment from improperly managed construction sites, croplands and forest lands; salt from streets treated during winter precipitation events; and bacteria and nutrients from livestock, pet wastes, and faulty septic systems.

In March 2003, NJDEP issued a new Stormwater Management Rule, as required by EPA's Phase II Stormwater Management Program for Municipal Separate Stormwater Sewer Systems (MS4). The rule lays out guidance and requirements for management of and education about stormwater at the local level. It applies to all towns in New Jersey, all county road departments, and all public institutional facilities on large sites (such as hospitals and colleges). Beginning in 2004, municipalities were required to obtain a New Jersey Pollution Discharge Elimination System (NJPDES) general permit for the stormwater system and its discharges, within their borders. The stormwater system is considered to be owned and "operated" by the township.

Under the 2004 NJPDES permit, a town must meet certain specific requirements in planning, ordinance adoption, education, management of township facilities, and investigation of parts of the stormwater system. Fulfillment of these statewide basic requirements is scheduled to occur over the course of five years.

The volume of runoff that is carried to a stream also impacts stream channel condition. Increased volume usually results from increased impervious surface within a HUC-14 sub-watershed. As an area becomes developed, more stormwater is directed to the streams from neighborhood storm drains, residential and commercial stormwater facilities, and road drainage. In general, studies have found that levels of impervious cover of 10 percent or more within a sub-watershed are directly linked to increased stormwater runoff, enlargement of stream channels, increased stream bank erosion, lower dry weather flows, higher stream temperatures, lower water quality, and declines in aquatic wildlife diversity. When impervious cover reaches 25–30 percent, streams are found to be severely degraded.[8] Within Hopewell, the areas most impacted by impervious surface are in the Brandon Farms neighborhood in the southeast corner of the township.

Table 15: Acreage of Impervious Surface in Hopewell's Subwatersheds

HUC-14 Subwatershed	Acres In Subwatershed	Acres Covered by Impervious Surfaces	Percent of Subwatershed Covered by Impervious Surface
02040105210040	6,548.68	87.95	1.34%
02030105110060	3,873.39	69.05	1.78%
02030105090010	3,559.14	70.45	1.98%
02030105090020	6,170.43	136.86	2.22%
02040105210060	3,541.30	108.95	3.08%
02040105210050	3,729.37	124.17	3.33%
02030105110040	5,034.50	222.82	4.43%
02030105090050	6,268.31	292.77	4.67%
02030105090030	3,661.90	177.95	4.86%
02030105110070	2,222.78	135.77	6.11%
02040105210030	4,043.47	253.18	6.26%
02030105110050	6,488.77	453.94	7.00%
02040105210070	4,993.75	463.86	9.29%
02030105090060	5,150.89	494.98	9.61%
02030105090040	3,628.95	355.22	9.79%
02040105230060	6,088.68	837.31	13.75%
02040105240010	5,287.65	1,308.97	24.76%
02040105240050	5,832.93	2,094.32	35.91%

Source: NJDEP

[8] Center for Watershed Protection. *Rapid Watershed Planning Handbook: A Comprehensive Guide for Managing Urbanizing Watersheds*. Produced for the U.S. EPA, Office of Wetlands, Oceans and Watersheds. Ellicott City, MD: Center for Watershed Protection, Inc., 1998. pp. 1.21–1.25.

Figure 6: Stormwater Management Basic Requirements

Stormwater Management Statewide Basic Requirements
Towns, Highway Agencies, and Institutions

1. Control post construction stormwater management in new development and redevelopment through:
    - Adoption of a stormwater management plan in accordance with *N.J.A.C. 7:8.*
    - Adoption and implementation of a stormwater control ordinance in accordance with *N.J.A.C. 7:8.* This ordinance requires retention on site of 100% of preconstruction recharge and use of low-impact design in stormwater facilities, among other features.
    - Ensuring compliance with Residential Site Improvement Standards for stormwater management. The RSIS is currently being revised to incorporate the low-impact design and other requirements of the stormwater control ordinance.
    - Ensuring long-term operation and maintenance of Best Management Practices on municipal property.
    - Requiring that new storm drain inlets meet new design standards.
2. Conduct local public education:
    - Distribute educational information (about stormwater requirements, nonpoint source pollution, and stewardship) annually to residents and businesses and conduct a yearly "event" (such as a booth with these messages at a community day).
    - Have all municipal storm drain inlets labeled with some type of "don't dump" message.
    - Distribute information annually regarding fertilizer/pesticide application, storage, disposal, and landscaping alternatives.
    - Distribute information annually regarding proper identification, handling, and disposal of wastes, including pet waste and litter.
3. Control improper disposal of waste through improved yard waste collection and through adoption of ordinances (pet waste, litter, improper dumping, and wildlife feeding).
4. Control solids and floatables through increased street sweeping, retrofitting storm drain inlets during road repairs, and instituting programs for stormwater facility management, for roadside erosion control, and for outfall pipe scouring/erosion.
5. Improve maintenance yard operations, specifically for de-icing material storage, fueling operations, vehicle maintenance, and housekeeping operations.
6. Increase employee training about all of the above.

Source: NJDEP

Agricultural Runoff

With 27 percent of Hopewell's land use dedicated to farming, agriculture-specific nonpoint source pollution becomes a significant issue. According to the EPA, agricultural runoff is the leading contributor of nonpoint source pollution to rivers and lakes in the United States, third leading contributor to the pollution of estuaries, and a significant contributor to groundwater and wetland pollution. Agricultural runoff can carry sediment, nutrients, pathogens, pesticides and salts into local water.

Programs such as the Environmental Quality Incentive Program (EQIP), administered by the Natural Resources Conservation Service (NRCS) of USDA, encourage the "due care" management of agricultural lands, involving the proper levels of fertilizer and pesticide applications to farmland. It funds up to 75 percent of the costs of eligible conservation practices.

These are all programs in which individual landowners volunteer to take part. A list of U.S. Department of Agriculture and New Jersey programs that provide funding and technical assistance on relevant projects for farm landowners is included in **Appendix B: Federal and State Conservation Programs for Farmers and Landowners**.

Inadequate Stream Buffers

A stream buffer is the region immediately beyond the banks of a stream, which serves to limit the entrance of sediment, pollutants, and nutrients into the stream itself. Stream buffers are quite effective at filtering substances washing off the land. The vegetation of the buffer traps sediment and can actually utilize (uptake) a percentage of the nutrients flowing from lawns and farm fields. When forested, a stream buffer reduces erosion, promotes bank stability and serves as a major control of water temperature. The buffer region also serves as a green corridor for wildlife to move between larger forested habitat areas. This greenway can be utilized for recreation by residents as well, through trails, bikeways, and access points to the water for fishing and canoe/kayak launching.

Hopewell's stream corridor protection ordinance provides protection for stream corridors, requiring the maintenance of a vegetated riparian stream buffer 150 feet from the centerline in both directions of all waterways that receive surface water runoff from an upland drainage area of 50 acres or more. These buffer areas are shown on a map prepared by the Stony Brook Millstone Watershed Association entitled *Hopewell Township Stream Centerlines and 150 Foot Buffers*. The map is available at www.hopewelltwp.org/stream150ftbuffer.pdf.

The importance of a healthy, intact buffer zone (also referred to as a "riparian corridor") has been well documented scientifically over the past 20 years, especially for headwater streams. The 2007 revisions to the New Jersey Flood Plain Management Regulations outlined in a previous section directly affect stream buffer requirements. As previously mentioned, the new regulations established the following statewide buffer requirements: a 300 foot riparian buffer on all Category One waters; a 150 foot buffer along trout producing waters and all upstream waters (including tributaries); a 150 buffer on trout maintaining waters and all upstream waters

(including tributaries) within one linear mile as measured along the length of the regulated water; a 150 foot buffer on any segment of a water flowing through an area that contains documented habitat for a threatened or endangered species of plant or animal, which is critically dependent on the regulated water for survival, and all upstream waters (including tributaries) within one linear mile as measured along the length of the regulated water; and 50 foot buffers on all other nontidal waters. These buffers are intended to reduce the direct and indirect impacts of flooding, to improve wildlife habitat, and offer potential passive recreational use, such as walking trails.

The New Jersey Freshwater Wetlands Protection Act incorporates buffer requirements into its wetland protection regulations. The width of the "transition zone" extending beyond a wetland is determined by the value of the wetland, based on its current use and on the documented presence/absence of threatened or endangered species. Municipalities may not establish wetlands buffers that exceed those required by the state statute. However, municipalities can monitor the use of the land within the transition area and take action against encroachments.

Restoration of stream buffers on agricultural lands is supported by various programs of the U.S. Department of Agriculture (USDA) and the New Jersey Department of Agriculture, such as the Conservation Reserve Program (CRP), administered by the USDA's Farm Service Agency (FSA). This program compensates farming landowners for the loss of land being converted to a buffer or other habitat. It also funds or directly creates new buffers where they are absent.

Point Sources of Pollution

Point sources of pollution, which come from a single source or "point," such as an industrial pipe discharge, are regulated by NJDEP through the New Jersey Pollution Discharge Elimination System (NJPDES). New Jersey created NJPDES in response to the Federal Clean Water Act of 1972, which mandated that each state develop water quality standards and regulate the amount of pollution entering bodies of water. The Act classified all water pollution into one of two categories: "point source" pollution and "nonpoint source" pollution, but only required states to regulate point sources.

NJDEP, through the Division of Water Quality and the Bureau of Point Source Permitting, administers the NJPDES program (*N.J.A.C. 7:14A*). Under NJPDES, any facility discharging domestic or industrial wastewater directly into surface or groundwater must apply for and obtain a permit. Rather than creating individually-tailored permits for each and every facility, the Division of Water Quality uses scientific standards to create and issue general permits for different categories of dischargers. Permits are available and required for surface water, groundwater, storm water, combined sewer overflow, and residual discharges. NJDEP enforces the terms of NJPDES permits by visiting discharging facilities and conducting water quality, biological, and toxicological analyses, and thermal impact and cooling water assessments.

Under the Open Public Records Act (OPRA) of 2002, a list of active NJPDES permits is available. As of January 18, 2008 – the last time NJDEP's online active permit report was updated –16 NJPDES permits were issued to individual facilities in Hopewell. Two of the sixteen permits were listed as "expired as of this writing." These are shown in **Table 16: Hopewell Township NJPDES Permits**.

Since the adoption of the Federal Clean Water Act in 1972 and the implementation of NJPDES in subsequent years, water pollution from point sources has decreased drastically. However, as development has continued to spread throughout New Jersey, nonpoint source pollution has increased substantially in recent decades. NJDEP's new Stormwater Management Rules, described above, focus on reducing and controlling nonpoint sources of water pollution.

Table 16: Hopewell Township NJPDES Permits

NJPDES Permit Number	Facility Name	Effective Start Date	Expiration Date	Discharge Category Description	Street Address
NJ0000795	Bristol-Myers Squibb, Co.	8/01/2008	7/31/2013	Discharge to Surface Water	311 Pennington - Rocky Hill Road
NJ0027715	Mercer County Correction Center STP	10/01/2005	9/30/2010	Domestic Surface Water Discharge	Highway 29
NJ0035301*	Stony Brook RSA	04/01/2005	3/31/2009	Domestic Surface Water Discharge	Hopewell STP
NJ0101575	Bristol-Myers Squibb, Co.	02/01/2009	01/31/2014	Discharge to Groundwater	311 Pennington - Rocky Hill Road
NJ0136581*	Moore's Station Quarry	2/1/2002	1/31/2007	Discharge to Groundwater	Route 29 & Pleasant Valley Road
NJ0136581*	Moore's Station Quarry	2/1/2002	1/31/2007	Stormwater	Route 29 & Pleasant Valley Road
NJG0103489*	Hopewell Valley Golf Club	6/1/2003	5/31/2008	GP Sanitary Subsurface Disposal	114 Pennington - Hopewell Road
NJG0105643*	Kooltronic Inc.	6/1/2003	5/31/2008	GP Sanitary Subsurface Disposal	30 Pennington - Hopewell Road
NJG0107760*	Ralston Heights Estates	6/1/2003	5/31/2008	GP Sanitary Subsurface Disposal	Condominium Association
NJG0132527	Bristol-Myers Squibb, Co.	06/01/2007	5/31/2012	Stormwater Basic General Permit	311 Pennington - Rocky Hill Road
NJG0133256*	Washington Crossing State Park	6/1/2003	5/31/2008	GP Sanitary Subsurface Disposal	355 Washington Crossing & Pennington Road
NJG0141780*	Shoprite Supermarket	9/1/2003	5/31/2008	GP Sanitary Subsurface Disposal	2555 Pennington Road
NJG0147656*	Hopewell Twp	5/1/2004	5/31/2008	GP Sanitary Subsurface Disposal	201 Washington Crossing & Pennington Road
NJG0150622*	Hopewell Twp	09/01/2005	2/28/2009	Tier A Municipal Stormwater GP	201 Washington Crossing & Pennington Road
NJG0155764*	Mercer County Correction Center STP	09/01/2005	2/28/2009	Public Complex Stormwater GP	Highway 29
NJG0166308	Mercer County Correction Center STP	10/01/2006	5/31/2011	Wastewater Reuse (ABR)	Highway 29

Source: NJDEP, NJPDES Active Permit List. www.state.nj.us/dep/dwq/database.htm

** Expired permits are still listed on OPRA because the NJPDES sites may still be active, despite not having updated the permit.*

GP = General Permit

GROUNDWATER

AQUIFERS AND GEOLOGICAL FORMATIONS

Principal aquifers in New Jersey are classified into two groups: Coastal Plain aquifers south of the Fall Line, and non-Coastal Plain aquifers north of the Fall Line. Hopewell Township is entirely within the boundary of the Piedmont Physiographic Province, where the permeability of soils is generally slow or moderate and runoff is more rapid.

Hopewell lies in the Newark Basin, a part of the Piedmont Province that extends from the Hudson River Valley to the divide between the Schuylkill and Susquehanna river basins in Pennsylvania. The geology of the Newark Basin is composed of six sedimentary rock formations and two igneous rocks. The deposition of sedimentary material has taken the form of low ridges and valleys that trend from northeast to southwest. The six sedimentary rock formations are the Stockton, Lockatong, Passaic, Feltville, Towaco, and Boonton Formations. Only the Passaic, Lockatong, and Stockton Formations are found in Hopewell Township.

The predominant aquifers within the basin – collectively called the Newark Group – consist of the Passaic, Lockatong, and Stockton Formations. Together, these three bedrock aquifers provide 95 percent of the Newark Basin's water. The Passaic Formation makes up the majority of Hopewell's bedrock geology. In addition, the town features a number of diabase intrusions, sites of volcanic activity where igneous material has risen below the crust and solidified. Over time, these intrusions have been exposed as the softer sedimentary layers covering them have worn away.

Water from bedrock aquifers is drawn from joints and fractures, or networks of fractures, in the rock. The number and size of these joints and fractures decrease with increasing depth below the ground surface. Shallow parts of bedrock aquifers are generally unconfined, meaning they are not bounded by confining layers made of less permeable materials, while deeper sections may be semi-confined or fully confined. Confining beds help slow the entry of any surface contaminants into the groundwater.

Most water in the Newark Group is found within 200 to 300 feet of the land surface. Sixty-five percent of all water is drawn from within 200 feet of the land surface and 85 percent of all water is drawn from within 300 feet of the land surface. Below 500 feet, there are fewer and smaller fractures in the rock, thus storing less groundwater. The water quality of the Newark Basin aquifers tends to be satisfactory. However, large portions of the aquifers are unconfined, or close to the surface of the land, and therefore susceptible to local contamination. The groundwater is generally hard, containing more minerals than are found in surface water.

Passaic Formation

Of the three Newark Group formations, the Passaic Formation underlies the largest portion of Hopewell, 35.9 square miles, or 65.9 percent of the township. The Passaic Formation is one of the best water-bearing geologic formations in the township. The zone of water-storing joints and

fractures in the Passaic Formation is estimated to be 200 to 600 feet thick. It has an extensive system of rock fractures, which enable it to store and move groundwater. The Passaic Formation is composed mostly of red mudstone, as well as subordinate gray, purple, and black mudstone. The formation also is composed of sandstone and conglomerate containing glauberite and gypsum.

Lockatong Formation

The Lockatong Formation can be found in both the northern and southern portions of Hopewell Township, covering 9.2 square miles in the northern section and 2.9 square miles in the southern section, for a total of 20.1 percent of Hopewell's land. The Lockatong Formation is composed of less erodible rocks, such as gray and black shale and siltstone, as well as subordinate purple and red mudstone. The rock has both low permeability and porosity, and the fractures are widely spaced and tight, allowing little infiltration. Of the three formations, it is the poorest for storing water and is one of the lowest yielding aquifers in New Jersey. Soils associated with this formation are generally poorly drained and have a high water table.

Stockton Formation

The Stockton Formation extends as a thin band running from Mercer County northward to Rockland County, New York. In Hopewell, it underlies 3.6 square miles of land, or 5.9 percent of the land area, and is found primarily along the Hopewell Fault escarpment. It is composed of very old sediments, which are highly erodible. The bottom half of the formation is composed of mostly fluvial deposits containing medium-to-coarse grained sandstones, siltstone, and conglomerates, while the upper half of the formation contains fine-grained sandstone and shale. Most water in the Stockton Formation is found within 500 feet of the land's surface in weathered and interconnected fractures. The water is frequently located in unconfined places, although locally it may be found in semi-confined areas, depending on the layers of shale. The Stockton Formation is one of the most productive aquifers in this region. It can yield as much as 50 gallons of water per minute. The soils associated with this formation also are the best in the township for agriculture, septic fields and water retention.

Diabase Intrusions

Diabase can be found underlying Baldpate, Belle, and Pennington Mountains, as well as along Crusher Road. Diabase intrusions comprise 4.6 square miles, or 7.7 percent, of Hopewell Township. Additionally, the heat of these igneous formations produced metamorphic hornfels within 1000 feet of these intrusions. Combined together, these geological features create aquifers with the poorest yields in Mercer County. These rocks feature very few and shallow fractures, leading to median yields of a mere 6 gallons of water per minute for wells located over hornfels, and only 5 gallons of water per minute for wells located over diabase. The majority of water is found within the first 125 feet.

GROUNDWATER RECHARGE

Recharge of groundwater is an important issue for Hopewell Township because of its dependence on aquifers for drinking water supply and agricultural use. The amount of rainwater that actually enters an aquifer and reaches the saturated zone to become groundwater is a function of many factors, including the nature and structure of the aquifer itself, climatic conditions, the nature of the soil, land use, and the vegetation of an area.

The United States Geological Survey (USGS) has conducted extensive studies in the Stony Brook, Jacobs Creek, and Beden Brook basins which provide an accurate estimate of aquifer recharge and groundwater resources of Hopewell Township. Baseflow data was determined during dry periods where surface runoff and interflow would not contribute to streams. During these dry periods, the only contributor to stream baseflow was from groundwater discharge. Since an aquifer should be a balanced natural system where discharge equals recharge, the stream baseflow can be considered equivalent to aquifer recharge.

In 2001, Hopewell Township released the *Hopewell Groundwater Resources Report* to serve as the basis for the development of the *2002 Hopewell Township Master Plan*. Assuming the requirement of 100 gallons per person per day and current household densities of three people per household, the township determined that in order not to exceed dependable groundwater yield, residential development in the Stockton and Passaic formations requires 3.7 acres of land per household, and 9.4 acres per household throughout the Lockatong and Diabase formations. Studies of existing subdivision plans in Hopewell indicate that household size will increase from three people per household to 4.2 people per household. This increase will necessitate even more acreage per dwelling: 5.1 acres throughout the Stockton and Passaic formations, and 13.2 acres throughout the Lockatong and Diabase formations.

In an effort to avoid future groundwater shortages, the *2002 Hopewell Township Master Plan* proposed the creation of two resource conservation districts: the Valley Resource Conservation District (VRC) and the Mountain Resource Conservation District (MRC). These two districts enforce minimum residential lot sizes with regard to the underlying hydrology described above. The VRC is underlain primarily by the Stockton and Passaic formations, and requires minimum lot sizes of 6 acres. The MRC is underlain primarily by the Lockatong and Diabase formations, and requires a 14 acre minimum lot size. In an effort to compensate landowners and developers for the rezoning, the Master Plan suggested a Transfer of Development Rights program within these districts, providing density bonuses to developers who engaged in clustered development. The township has adopted these recommendations into their local zoning ordinances. The legality of these changes was challenged in court in *Greenwood v. Hopewell Township* (2006), and upheld by Judge Linda Fienberg of the New Jersey Superior Court.

GROUNDWATER MONITORING

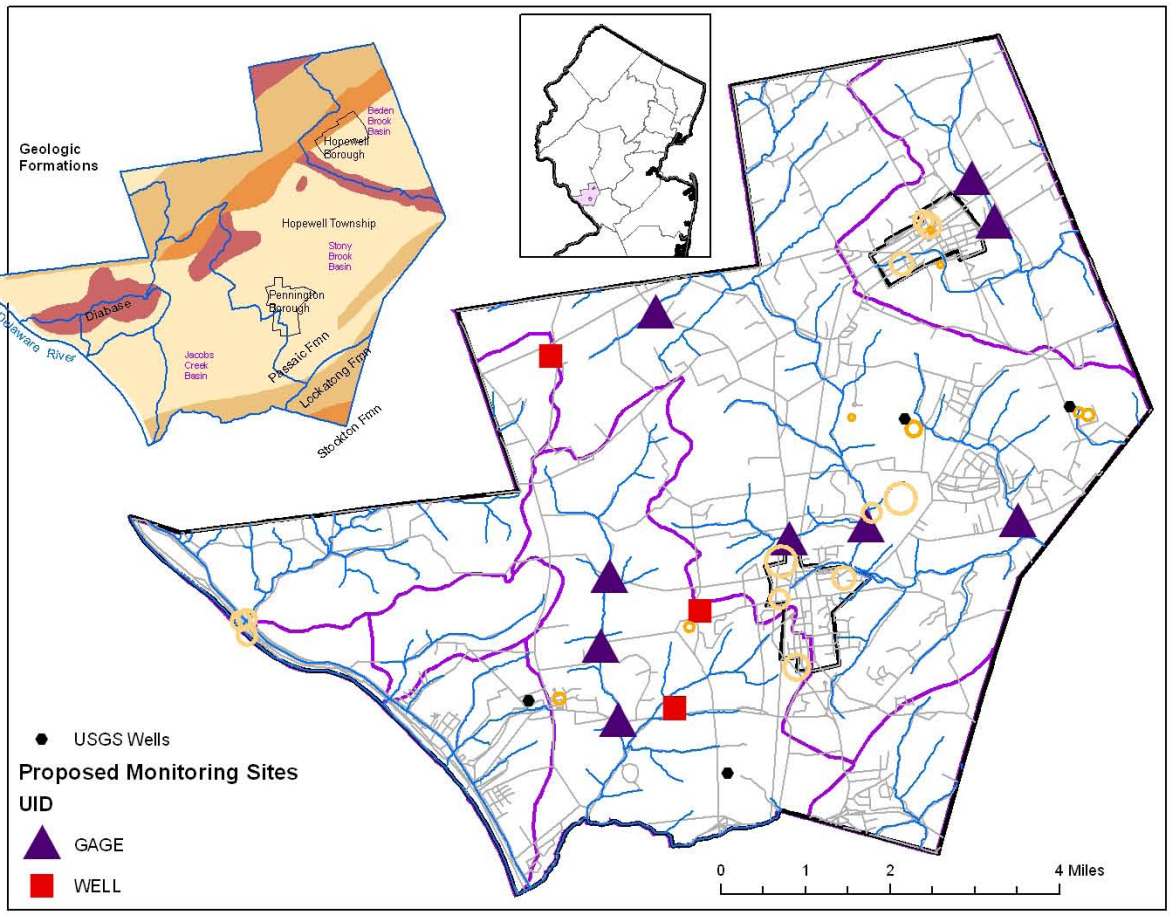
Groundwater levels have been monitored by the USGS for a number of years at four groundwater observation wells in Hopewell Township. These wells are significant resources for continuous evaluation of groundwater levels. However, they constitute neither a complete nor a

comprehensive water resource monitoring network for Hopewell Township, in part because they are not close to the areas of greatest groundwater withdrawals. Groundwater level data are also collected at a private well (subject to errors introduced by use of the well for domestic supply) west of Pennington Borough by Hill Environmental, Inc. There are also several groundwater observation wells in operation on the Bristol-Myers Squibb, Co. (BMS) property east of Pennington Borough that were installed and for which data are reported to the Township pursuant to a Developer's Agreement between the Township and BMS. In addition, Pennington Borough, Hopewell Borough, and BMS report static levels in their supply wells to the NJDEP quarterly pursuant to their water allocation permits. The data from these various monitoring wells are collected and reported in varied formats by different entities and with different quality assurance/quality control standards. Other than a twice yearly recording of stream flow in the Stony Brook carried out by BMS, no consistent stream flow monitoring has been performed in the recent past anywhere in the Township.

In 2008, the monitoring of groundwater and surface water was expanded by the Hopewell Township Environmental Commission under the supervision of the United States Geological Survey (USGS). Funding for the project was provided by Hopewell Township and by a grant from the Delaware River Greenway Partnership (DRGP) operating in conjunction with the National Park Service through the National Wild and Scenic River Management Program.

The expanded monitoring effort includes three groundwater level monitoring wells equipped with electronic data loggers, and six stainless steel V-notch weir low-flow stream gauges as specified by the scope of work for the grant from the DRGP. Three more low-flow gauges are partially complete and will likely be completed in 2010. Initial data collection, quality assurance and quality control, and posting of the data under the auspices of the USGS has begun. The data are expected to be collected and posted on the USGS web site for the foreseeable future, and will be a useful resource in assuring the long-term maintenance and protection of water resources in the region. See **Figure 7** on the facing page.

Figure 7: Existing (USGS) and Proposed* Monitoring Sites in Hopewell Township



Source: Hopewell Township Environmental Commission

**Since the publication of the map above in 2008, six of the nine proposed gages and all three of the proposed wells have been installed. The remaining three gages are projected to be installed by the end of 2010.*

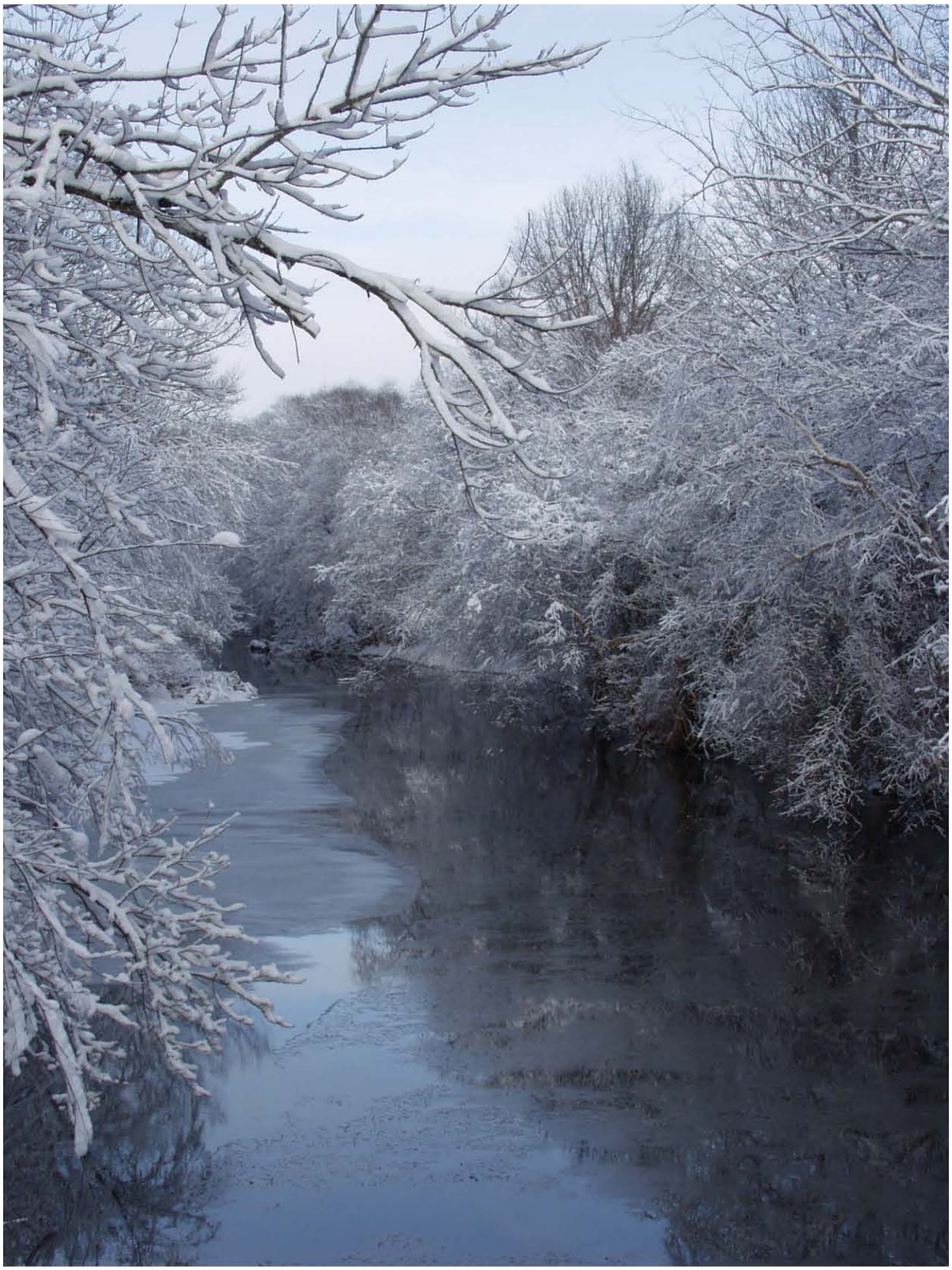


Photo by Elaine Golding-Ferguson

A winter stream.

BIOLOGICAL RESOURCES

When a community protects wildlife and habitat, it is also protecting biodiversity, which is important for the health and productivity of the ecosystem and its inhabitants, including humans. Biodiversity refers to the variety of genetic material within a species population, the variety of species (plants, animals, microorganisms) within a community, and the variety of natural communities within a given region. Biodiversity facilitates adaptation and evolution, improving a species' chance of survival as the environment changes. A diversity of plant and animal species is also necessary to maintain healthy human environments, working landscapes and productive ecosystems. Lower organisms, many not well known, contribute to nutrient cycling, decomposition of organic matter, soil rehabilitation, pest and disease regulation, pollination and water filtering. Once biodiversity declines, it is extremely hard for an ecosystem to recover or replace species.

Photo by Rachel Mackow

Eastern box turtle – often found in the woods and meadows of Hopewell Township.

Scientists have discovered and named somewhere between 1.5 and 1.8 million plant and animal species in the world. Far more species, possibly 10 to 20 times the number of known species, are unknown to science. Alarmingly, this great diversity of species is now diminishing at an

unprecedented rate. Researchers generally agree that the extinction rate is now catastrophically high, somewhere between 1,000 and 10,000 times the rate before human beings began to exert significant pressure on the environment. Given these trends, and barring significant increases in conservation efforts, approximately one-half of the world's species will be gone by the end of this century.[9]

While the decline of biodiversity appears to be a global problem, conservation needs to occur on both global and local levels if it is to succeed. Hopewell Township contains numerous types of habitats, all of which are important for maintaining biodiversity. Upland forests are the most common ecosystem type in Hopewell, but the township also contains significant acreages of herbaceous, scrub/shrub and wooded wetlands. Upland forests, which were once the most abundant type of natural habitat in Hopewell, are scattered throughout the township where land is dry and undeveloped. The following sections will identify and describe in more detail the plant and animal communities that inhabit these unique ecosystems within Hopewell.

[9] Wilson, Edward O. *The Future of Life.* New York: Vintage Books, 2002. pp. 14, 99-102.

NATURAL VEGETATION

A region's vegetation is dependent on many factors, the most important of which are climate and soils. Hopewell's climate is temperate and rainfall averages almost 49 inches per year.[10] A sizable portion of Hopewell's soils are generally well drained, supporting a large diversity of trees and crops. Hopewell also contains a substantial amount of poorly drained soils that exhibit ponding and sustain wetland plants. For a detailed description of Hopewell's soils see *Soils* on *page 22.*

Hopewell's natural vegetation types, along with human-influenced types of land cover, have been tabulated and mapped by NJDEP's 2002 land cover analysis. This data, based on infrared aerial photography, is the most recent available. The designation of a particular land cover as a vegetation type is based on definitions provided by the Anderson Land Use Classification System, created by the USGS.

Table 17: Hopewell Township Natural Vegetation

Vegetation Type	Acres	Percentage
Upland Deciduous Forest	9,588.71	25.44%
Upland Coniferous Forest	512.51	1.36%
Upland Mixed Forest	911.23	2.42%
Brush/Shrubland	2,662.40	7.06%
Lakes, Streams, Canals	753.26	2.00%
Wetlands	2,820.83	7.48%
Modified Wetlands	395.50	1.05%
Plantation	81.14	0.22%
Old Field	566.03	1.50%
Total Vegetation	**18,2941.61**	**48.53%**
Total Land Area	*37,688.70*	*100.00%*

Source: NJDEP (2002 Land Cover)

Wetlands

"Freshwater wetland" or "wetland" is defined as an area that is inundated or saturated by surface or groundwater at a frequency and duration to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation. When designating wetlands, NJDEP uses a "three-parameter approach" (hydrology, soils, and vegetation) enumerated in the 1989 *Federal Manual*. NJDEP also identifies modified wetlands, which are areas that have been altered by human activities and do not support typical natural wetlands vegetation, but which do show signs of soil saturation on aerial infrared surveys.

[10] Office of the New Jersey State Climatologist, Rutgers University.

Wetlands are a critical ecological resource, supporting both terrestrial and aquatic animals and boasting biological productivities far greater than those found on dry land. Wetlands play a vital role in maintaining water quality by cleaning surface and groundwaters. The ecological importance of wetlands, however, has not always been appreciated. For over three centuries, people drained, dredged, filled, and leveled wetlands to make room for development and agriculture. Although the pace of wetland destruction has slowed markedly in the past three decades, human activities destroyed approximately 115 million of the original 221 million acres of wetlands in the United States from the beginning of European settlement to the late 1980s.[11]

The location and type of vegetation are key features for classifying wetlands. Most of the wetlands in Hopewell are found in association with the major streams and their tributaries. There are also many "perched wetlands" – level areas underlain by shallow soils over bedrock or soils heavy with clay that result in saturated soil conditions. These areas often contain vernal pools that provide breeding habitat for several species of frogs and salamanders. Being both inland and north of the tidal reaches of the Delaware River, Hopewell contains no tidal wetlands. Freshwater, deciduous wooded wetlands, particularly along the Shipetauken Creek, the Assunpink Creek, and the Delaware and Raritan Canal, are the dominant category of wetlands in the township. See **Map 9: Surface Water, Wetlands, and Vernal Pools.**

Interior wetlands provide high-quality animal and plant habitat, purify the township's surface and groundwater, and create picturesque landscapes that add immeasurably to the quality of life for township residents. Hopewell has three major types of interior wetlands: (1) wooded wetlands dominated by deciduous trees; (2) scrub/shrub wetlands; and (3) herbaceous wetlands, consisting of low-growing vegetation. See **Map 14: Natural Vegetation (2002)**.

Wooded wetlands (primarily deciduous) occupy about 2,422 acres of Hopewell and support mixed hardwoods that flourish in lowlands. All of the creeks in the township and their tributaries support some wooded wetlands. Closely associated with deciduous wooded wetlands are scrub/shrub wetlands, occupying about 256 acres. Most scrub/shrub wetlands are found along the Shipetauken Creek and its tributaries.

Herbaceous wetlands (i.e. low-growing marshes) occupy 143 acres. These wetlands generally occur along lake edges, in open floodplains, and in former agricultural fields. Herbaceous wetlands are found in close proximity to scrub/shrub and wooded wetlands along the Shipetauken Creek and its tributaries. Herbaceous wetland plants include rice cutgrass, reed cutgrass, reed canary grass, pond lily, tearthumb, arrow-leafed tearthumb, broadleaf cattail, and the common reed (*Phragmites*).

Hopewell's modified wetlands encompass agricultural wetlands, former agricultural wetlands, disturbed wetlands and wetlands that occur in maintained green spaces, such as lawns, golf courses, and stormwater swales. Modified wetlands differ from nonmodified wetlands in that they do not support the typical natural wetlands vegetation found in analogous unaltered natural

[11] Dahl, T.E. *Wetlands losses in the United States 1780s to 1980s*. Washington, D.C.: Department of the Interior, U.S. Fish and Wildlife Service, 1990.

areas, although they do exhibit evidence of soil saturation. In total, modified wetlands occupy 395 acres.

Table 18: Wetlands in Hopewell Township

Wetlands	Acres	Percentage
Coniferous Wooded Wetlands	8.18	0.25%
Deciduous Wooded Wetlands	2,378.92	73.96%
Mixed Woodland Wetlands (Coniferous Dom.)	11.49	0.36%
Mixed Woodland Wetlands (Deciduous Dom.)	23.83	0.74%
Coniferous Scrub/Shrub Wetlands	46.46	1.44%
Deciduous Scrub/Shrub Wetlands	74.83	2.33%
Mixed Scrub/Scrub Wetlands (Coniferous Dom.)	67.06	2.09%
Mixed Scrub/Scrub Wetlands (Deciduous Dom.)	67.53	2.10%
Former Agricultural Wetland (Becoming Shrubby, Not Built Up)	23.28	0.72%
Herbaceous Wetlands	142.53	4.43%
Agricultural Wetlands (Modified)	304.10	9.45%
Disturbed Wetlands (Modified)	15.23	0.47%
Managed Wetlands in Built-Up Maintained Rec. Area (Modified)	17.01	0.53%
Managed Wetlands in Maintained Lawn Greenspace (Modified)	20.30	0.63%
Wetland Rights-of-Way (Modified)	15.58	0.48%
Total	**3,216.33**	**100.00%**

Source: NJDEP (2002 Land Cover)

Upland Forests

Upland areas are those locations without water at or near the soil surface. Most of Hopewell's original upland forests were cleared and converted to farms during the eighteenth and nineteenth centuries. According to an 1883 survey of Hopewell's woods, as little as 11 percent of township land was forested at that time (including both upland and wetland forests). Prior to European settlement, as much as 90 percent of Hopewell was forested. As agriculture moved west, and coal and eventually electricity came to replace wood as a fuel source, Hopewell's woodlands began to recover in the twentieth century. Today, second or third growth upland forests occupy approximately 11,000 acres, or 29 percent of Hopewell's land area. These forested areas are primarily located near stream corridors, on steep slopes, or on soils not well suited for agricultural crops or residential or commercial development . See **Map 14: Natural Vegetation (2002)**.

Photo by Tom Ogren

Upland forest in the fall.

The majority of Hopewell's upland forest is deciduous (9,589 acres). Some of this upland forest has been preserved by the creation of parks and preserves, such as Curlis Lake Woods Preserve, Ted Stiles Preserve at Baldpate Mountain and Stony Brook Millstone Watershed Association Nature Reserve. Forested Sourland Mountain, extending from Lambertville in Hunterdon County to the western end of Hillsborough Township in Somerset County, occupies Hopewell's most northern reaches. Sourland Mountain comprises the largest contiguous expanse of woodlands in central New Jersey, covering nearly 90 square miles. Sourland Mountain itself sits within a larger area of rough terrain referred to as the Sourland *Mountains*, or alternately, The Sourlands.

The composition of Hopewell's upland deciduous forests is largely one of mixed oaks – black, red, pin, and white oaks – joined by other hardwoods, such as ash, tulip, birch, maple, beech, hickory, locust, poplar, and sweetgum. The understory is dominated by flowering dogwood, black cherry, ironwood, and sassafras. Vines, such as wild grapes, Virginia creeper, poison ivy, and greenbriar, as well as the exotic invasive Japanese honeysuckle and Asiatic bittersweet are common. Winterberry, elderberry, silky dogwood, arrowwood viburnum, swamp rose, and buttonbush are common shrubs in moister locations along with sweet pepperbush and swamp azalea.

Coniferous forests cover only about 513 acres of Hopewell. These forests are mostly made up of successional, or pioneer, plants like Eastern red cedar, Virginia pine, scrub pine, and pitch pine, which will eventually be overgrown by dominant deciduous trees, such as oak, ash, and hickory. Hopewell also contains 85 acres of evergreen woods which were at one time old fields that were intentionally planted with white pines and spruce. These are referred to as "plantations" in NJDEP's land cover classification system.

In 1990 Dr. Douglas W. White of Rutgers University prepared the report *The Woodlands of Hopewell Valley*. This report provides an exceptionally detailed assessment of Hopewell's forest resources. The report provides an inventory of woodland distribution, size, and species composition. The report also documents the physical changes in coverage of these woods based on surveys from 1883, 1943 and 1989. Digital copies of *The Woodlands of Hopewell Valley* can be found on the township website by visiting: www.hopewelltwp.org/Woodlands_of_HV.pdf.

Grasslands and Agricultural Lands

Grasslands are considered to be one of the most endangered ecosystems globally. They are threatened by human development, new agricultural technology, grazing, desertification, soil erosion, and invasive species. Grasslands are important habitats that preserve large amounts of open space and provide habitat for specialized species, such as grassland birds. Many species of grassland birds require large contiguous patches of grassland for successful breeding and roosting.

NJDEP defines grassland habitat as brushland, shrubland, or old fields that were cleared or disturbed at one time and then abandoned. Following abandonment, old fields are overgrown by perennial herbs and grasses. These pioneer herbaceous plants remain the dominant species for

three to 20 years. Later, woody plants take over. This habitat is visible, especially along wood edges, roadsides, and in landscapes where mowing is infrequent and where woody plants are not yet the dominant vegetation.

Photo by Rachel Mackow

A fall meadow at the Friends of Hopewell Valley Open Space's Skyview Preserve.

In Hopewell, 3,228 acres, or 12 percent of the land cover, is classified as brushland, shrubland or old fields. Brushland and shrubland are generally found adjacent to residential, commercial and industrial development, while old fields occur more often near agricultural or wetland areas. In addition to brushland, shrubland, and old fields, active agricultural cropland and pastureland is considered suitable "grassland" habitat for species that forage or nest on open land. However, this land is not considered to be natural vegetation. Agricultural cropland and pastureland cover over 27 percent of the township's land area. See **Map 14: Natural Vegetation (2002)**.

LANDSCAPE PROJECT PRIORITY HABITATS

The Landscape Project is a pro-active, ecosystem-level approach for the long-term protection of imperiled species and their important habitats in New Jersey. The project began in 1994 by the N.J. Division of Fish and Wildlife's Endangered and Nongame Species Program (ENSP). Its

goal is to protect New Jersey's biological diversity by maintaining and enhancing imperiled wildlife populations within healthy, functioning ecosystems. While the Landscape Project aims to identify, delineate, and ultimately protect critical habitat for all New Jersey wildlife, the project is an informational tool and does not have its own regulatory program or rules. However, several state regulatory programs which contain specific provisions for the protection of habitats determined to be critical to endangered and threatened wildlife make explicit reference to the information contained in the Landscape Project. These regulatory programs – including the Freshwater Wetlands Protection Act Rules, the Flood Hazard Area Control Act Rules, and the Water Quality Management Planning Rules – should be consulted directly to determine the ways in which they utilize Landscape Project data.

The Landscape Project focuses on large land areas called "landscape regions" that are ecologically similar with regard to their plant and animal communities. Using an extensive database that combines imperiled and priority species location information with land-use/land-cover data, the Endangered and Nongame Species Program has identified and mapped areas of critical importance for imperiled species within each landscape region.

Landscape Project critical habitat maps were developed to provide users with peer-reviewed, scientifically-sound information that is easily accessible via the internet and hard copy. Critical habitat maps were designed for use by anyone, but especially those individuals and agencies who have the responsibility for making land use decisions, i.e., municipal and county planners and local planning boards, state agencies, natural resource and lands managers, and the general public.

Critical area maps can be integrated with planning and protection programs at every level of government – state, county and municipal – and can provide the basis for proactive planning, zoning and land acquisition projects. Most importantly, the critical information contained in the Landscape Project should be used for planning purposes before any actions, such as proposed development, resource extraction (such as timber harvests), or conservation measures occur. Proper planning with accurate, legally and scientifically sound information will result in less conflict. Less time will be wasted, and less money spent, attempting to resolve endangered and threatened species issues.[12]

The Landscape Project ranks four tyopes of habitat: upland forest, forested wetlands, emergent wetlands, and grasslands. It categorizes these habitats into one of five groups according to their importance, five being the highest. Categories three through five include habitats throughout the state that possess two exceptional conditions: (1) a documented occurrence of one or more species on either the federal or state threatened and endangered species lists; and (2) a sufficient amount of habitat type to sustain these species. These habitats are collectively known as "critical habitat." Categories one and two include habitats that either have a documented occurrence of a species of special concern in New Jersey, or are habitat deemed suitable for species that are

[12] New Jersey Division of Fish and Wildlife. *About the Landscape Project.* www.nj.gov/ dep/fgw/ensp/landscape/about.htm

included on the state or federal threatened and endangered species lists, but for which there are no documented occurrences or sightings. These habitats are labeled "suitable habitats."

The Landscape Project identifies both critical and suitable habitats in Hopewell. It is important to preserve both levels of habitat in order to maintain the diversity of species that still exist in the township and to improve the likelihood of survival for endangered and threatened species. See **Map 15: Landscape Project Habitat Priorities (2004)** and **Table 19: Landscape Project Habitat Rankings for Hopewell Township**.

Landscape Project Data on Wetlands Habitat

The Landscape Project divides wetland habitats into two types – emergent and forested wetlands. Emergent wetlands are marshy areas characterized by low-growing shrubs and herbaceous plants in standing water. About 588 acres in Hopewell are identified as priority emergent wetlands habitat, 149 acres of which are ranked as "critical." Animals that can be found in wetland habitats include rare fish, mollusks, crustaceans, and insects. Emergent wetlands are also important habitat for migratory waterfowl and passerines (small perching birds), such as migrating flycatchers and warblers.

Table 19: Landscape Project Habitat Rankings for Hopewell Township

Category	Rank	Acres	% of Total Habitat	% of All Hopewell Land
Emergent Wetlands	Critical Habitat (4)	149.46	0.56%	0.40%
	Suitable Habitat (2)	362.17	1.35%	0.96%
	Suitable Habitat (1)	76.74	0.29%	0.20%
Sub Total		*588.37*	*2.19%*	*1.56%*
Forested Wetlands	Critical Habitat (4)	634.48	2.36%	1.68%
	Critical Habitat (3)	433.84	1.61%	1.15%
	Suitable Habitat (2)	1,389.41	5.17%	3.69%
	Suitable Habitat (1)	218.00	0.81%	0.58%
Sub Total		*2,675.74*	*9.96%*	*7.10%*
Upland Forest	Critical Habitat (4)	4,687.21	17.45%	12.44%
	Critical Habitat (3)	3,952.35	14.71%	10.49%
	Suitable Habitat (2)	5,466.47	20.35%	14.50%
Sub Total		*14,106.03*	*52.51%*	*37.43%*
Grassland	Critical Habitat (3)	664.63	2.47%	1.76%
	Suitable Habitat (2)	7,807.37	29.06%	20.72%
	Suitable Habitat (1)	1,021.32	3.80%	2.71%
Sub Total		*9493.32*	*35.33*	*25.19%*
Total Habitat		**26,863.47**	**100.00%**	**71.28%**
Total Hopewell Land		*37,688.70*		*100.00%*

Source: NJDEP

Hopewell's forested wetlands occupy 2,676 acres, of which 1,068 are ranked as critical. Critical forested wetlands are located along the Stony Brook tributaries north of the Harbourton Ridge, along Beden Brook, and along the Stony Brook tributaries east of the West Trenton Line adjacent to Moores Mill–Mt. Rose Road. Forested wetlands support species such as migratory and nesting warblers, many of which are species of special concern. They can also be home to various rare amphibians (frogs and salamanders).

Landscape Project Data on Upland Forest Habitat

The most common habitat type in Hopewell is upland forest. The Landscape Project ranked 5,467 acres of habitat as suitable and 8,640 acres as critical. The majority of critical upland forest is located in the eastern third of the township, where it is regularly interrupted with development and farmland. The Baldpate Mountain Preserve also provides a significant amount of critical habitat.

Landscape Project Data on Grassland Species Habitat

The Landscape Project designates 9,493 acres of the township as suitable grassland species habitat, of which 665 acres are considered critical. Most of the critical habitat is found in Mercer County Park Northwest. Smaller portions of critical habitat can be found along the Honey Branch and Beden Brook. Grassland-dependent species are the most threatened group of species in New Jersey, primarily because the most common form of grassland habitat – agricultural fields – is the most threatened habitat in the state due to development pressure and rising land values.

Hopewell possesses an extensive amount of suitable habitat in the form of the many farms that comprise the central portion of the township between County Road 579 and NJ Route 31. The designation of agricultural land as grassland habitat occurs for the following reasons: (1) migrating birds cannot visually distinguish cropland from grassland; (2) cropland turns into grassland when it is fallow for one year or more; (3) some crops, like alfalfa and soybeans, provide suitable nesting habitat for several bird species, such as sparrows; (4) all or most endangered and threatened birds are area sensitive, requiring large ranges that include agricultural "grasslands;" and (5) agricultural land provides important disturbance buffers, separating humans and domestic predatory animals like dogs and cats from rare and endangered bird species.

Examples of grassland-dependent species that use grassland habitat for nesting or feeding include the grasshopper sparrow and bobolink, and some species of butterflies and moths. Hopewell's designated grassland habitat also provides suitable habitat for migrating birds.

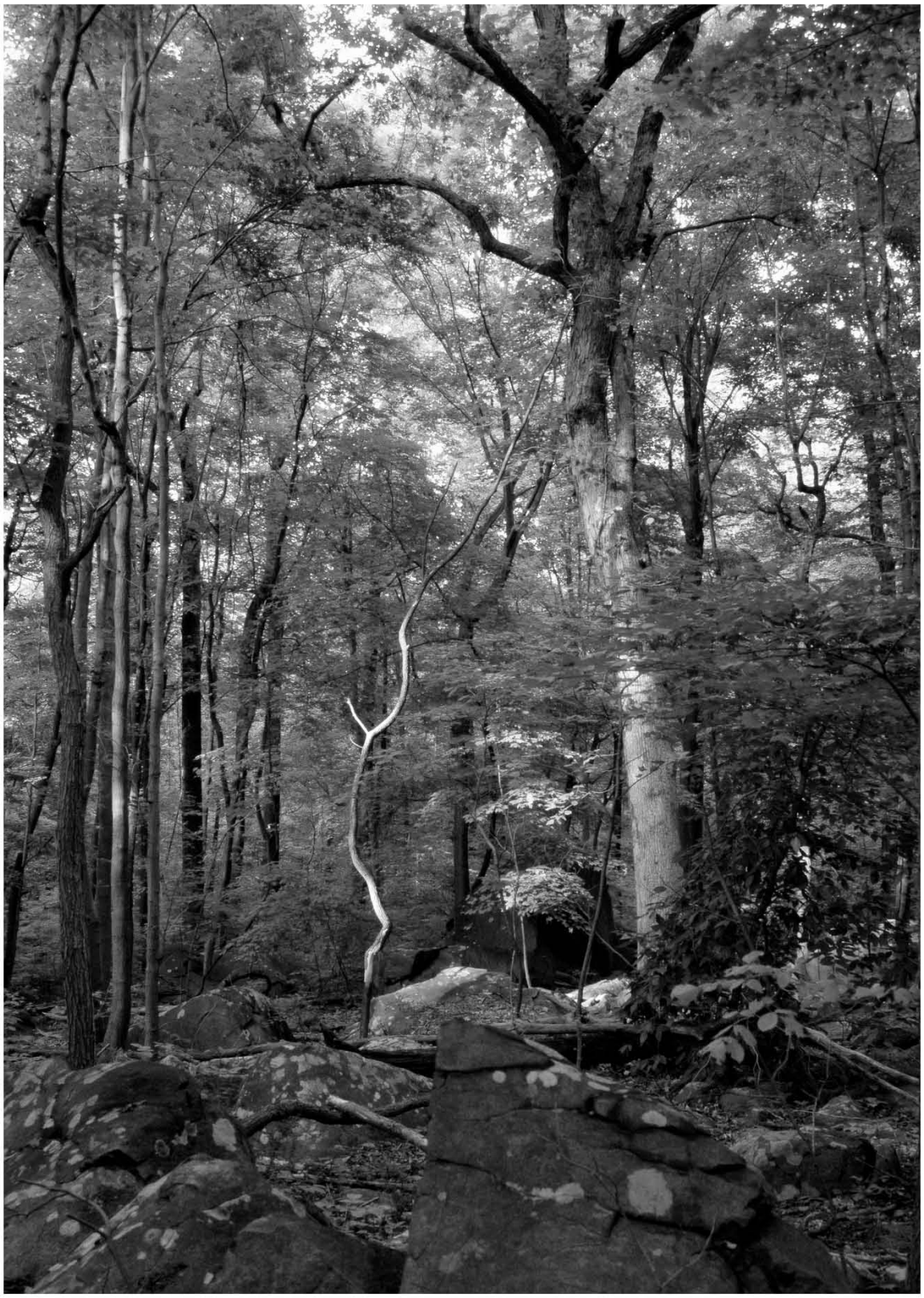


Photo by David Ackerman

Sourland sapling.

ANIMAL COMMUNITIES

Although no comprehensive inventory of the different animal species within New Jersey, Mercer County, or Hopewell Township exists, there are records of sightings, biological studies of range, and assessments of endangered and threatened status that can be used to identify and describe known and possible animal communities in Hopewell. The Washington Crossing Audubon Society has performed two biological surveys that may be useful in assessing the range of Hopewell's biological diversity. **Appendix E** provides the 1999 biological inventory of plants and animal species found on the Pole Farm Property (Mercer County Park Northwest), part of which is located in the southeastern part of the township. In addition, the society conducted a biological inventory for the Alexauken Creek Wildlife Management Area in 2003. Although located in West Amwell Township, the Alexauken Creek Wildlife Management Area shares many characteristics with parts of Hopewell Township, specifically the Ted Stiles Preserve at Baldpate Mountain. This inventory can be obtained by visiting the Washington Crossing Audubon Society's website at www.washingtoncrossingaudubon.org.

Invertebrates

Invertebrates are the basis of a healthy environment and are part of every food chain – either as food for amphibians and fish, or as a part of nutrient cycling systems that create and maintain fertile soils. Though they are the most abundant and diverse animal life forms, they are not generally well recognized and their fundamental role in sustaining natural systems is often not fully appreciated.

Invertebrates consist of insects (beetles, butterflies, moths, ants, dragonflies, termites, bees, flies, wasps, etc.), arachnids (spiders, ticks, and mites), crustaceans (crayfish, microscopic copepods), mollusks (mussels, clams, snails, and slugs), and worms.

Figure 8: The Dragonfly Nymph – a common macroinvertebrate found in New Jersey's waterways.

Dragonflies

Nymph *Adult*

Macroinvertebrates are invertebrates that are visible to the naked eye but smaller than 50 millimeters. Benthic (bottom dwelling) macroinvertebrate communities provide a basis for ecological monitoring because they are "indicator species" and because they are relatively simple to collect from shallow stream bottoms. Monitoring the presence or absence of macroinvertebrates reveals the effect of pollutants over a sustained period of time. The Ambient Biomonitoring Network (AMNET) surveys streams for macroinvertebrate communities, which are an indicator of water quality, as discussed in *Surface Water Quality* on *page 47*.

Threatened and Endangered Invertebrates

There are nine endangered invertebrate species (two beetle species, four butterfly species, and three mussel species) and eight threatened invertebrate species (three butterfly species and five mussel species) in the New Jersey. Nine of these species can be found in Hopewell: the

endangered dwarf wedgemussel, the endangered brook floater, the endangered green floater, the endangered American burying beetle, the threatened triangle floater, the threatened yellow lampmussel, the threatened eastern lampmussel, the threatened tidewater mucket, and the eastern pond mussel. At one time freshwater mussels were abundant in the streams of New Jersey and a major food source for native peoples. Unfortunately, due to destruction of suitable aquatic habitats by dams and pollution, the native mussel population has declined sharply. Of those species on the New Jersey Endangered and Threatened list, the dwarf wedgemussel is listed as endangered under the Federal Endangered Species Act.

Federal Endangered Species Act*

An "Endangered" species is in danger of extinction throughout all or a significant portion of its range.

A "Threatened" species is one that is likely to become endangered in the near future.

New Jersey Endangered Species Act**

An "Endangered" species is in danger of immediate extinction within the state due to one of several factors: loss or degradation of habitat, over exploitation, predation, competition, disease, or environmental pollution.

A "Threatened" species is one that may become endangered if environment conditions continue to deteriorate. It is vulnerable due to one of several factors: small population size, restricted range, narrow habitat affinities, or significant population decline.

A species of "Special Concern" is one that warrants special attention because of the evidence of population decline, environmental deterioration, or habitat modification that would result in becoming Threatened. Special Concern status also extends to species whose population size is unknown or unstudied.

* Definitions adapted from U.S. Fish and Wildlife Service, "Listing a Species and Threatened or Endangered: Section 4 of the Endangered Species Act." Washington, DC: February 2001.
** Definitions adapted from N.J. Division of Fish, Game, and Wildlife, Endangered and Non-game Species Program, "Status Definition." Trenton, NJ: April 2002.

The Federally listed American burying beetle is most likely threatened due to the effects of habitat fragmentation. The reproductive habits of the beetle are unique among invertebrates. In early summer adults seek out the carcasses of small animals. When an adult finds a carcass, it secretes pheromones to attract a member of the opposite sex. The adult pair then moves the carcass to a safe location and buries it several inches below ground, protecting it from other scavengers. The female then lays eggs above the carcass. Both male and female beetle stay with the eggs and tend the larvae as they hatch, feeding them from the preserved carcass as well as removing fungal growths from it. Habitat fragmentation increases competition for carrion, limiting the beetles' reproductive success.

Vertebrates

Vertebrates are less numerous than invertebrates, but their larger size makes them much more visible, and they are thus better studied and recorded. Fish species are fairly well documented, as are mammals. Birds that nest in the township are known, but migrants that depend on Hopewell's wet forests as stopover sites in which to rest and feed are not as thoroughly inventoried.

Mammals

Mammals appear to be abundant because they tend to be larger and live in habitats also ideal for human development. There are over 500 mammal species in New Jersey, of which only nine are listed as endangered and none are listed as threatened by the state. Of the nine species of mammals listed, three species are terrestrial: Indiana bat (*Myotis sodalis*), which is also listed as endangered by the Federal government, bobcat (*Lynx rufus*) and Allegheny woodrat (*Neotoma floridana magister*). The other six species are whales, and thus not likely to be found in Hopewell Township. Some common mammals found in Hopewell include cottontail rabbits, eastern gray squirrels, gophers, voles, mice, skunks, little brown bats, white-tailed deer, opossums, and raccoons.

Deer Management in New Jersey

Management of white-tailed deer is an issue throughout New Jersey. While many residents prize the presence of mammalian life, mammals often come into conflict with humans in suburban and rural areas. The white-tailed deer presents a classic case of this conundrum. Conflicts often arise when humans and deer compete for the same space. In New Jersey, an overabundance of deer has exacerbated these conflicts. According to data gathered by the Friends of Hopewell Valley Open Space, by 1995 New Jersey's deer population was triple that of its pre-European settlement level at over 200,000 deer statewide. While the deer population declined somewhat in the past decade, it is still double that of its pre-European settlement baseline population.
The root causes of deer overabundance include the following: (1) forest fragmentation allowing deer greater access to food; (2) a lack of native predators; (3) creation of supplemental feeding opportunities; (4) the establishment of deer refuges and other areas off-limits to hunting; (5) local ordinances prohibiting hunting; (6) poor access for hunting to land inhabited by deer; (7) suburban housing patterns and "safety zones" preventing hunting and providing year-round food for deer; (8) a high female to male sex ratio in the existing herd; and (9) a general decline in the number of hunters across the state.

Overabundant deer have serious consequences for forests, ecosystems, agriculture, and human property. According to the U.S. Department of Agriculture, deer cause more damage to agricultural crops than any other vertebrate wildlife species, and farmers in densely human-populated areas appear to be the most affected. Faced with competition from deer, farmers must often abandon land, switch to less palatable (and less valuable) crops, sacrifice susceptible areas to protect adjacent areas, or install and maintain expensive deer fencing to protect high-value crops. Deer in suburban area can damage landscape plantings and they also serve as hosts for ticks carrying lyme disease.

Deer can devastate forested areas by overgrazing and destroying seedlings and young trees in the forest understory. Deer prefer to browse native plants and shrubs over nonnative plants, leading to further degradation of forests by allowing invasive species to proliferate. In turn, the elimination of the native understory reduces the abundance of animals that have evolved to depend on those plants for their survival. A healthy forest consisting of a canopy of tall, mature trees, a sub-canopy of smaller tree species, and an understory of tree saplings, seedlings, shrubs, and herbs cannot survive the appetites of the current statewide deer population. In the northern part of New Jersey, deer have destroyed a large part of the native plant understory, placing future forests in serious jeopardy.

Finally, as most motorists are well aware, collisions between deer and automobiles frequently result in serious damage. Data compiled by the Hopewell Police Department show that over the last five years an average of 20 percent of all reported crashes in the township were the result of deer-vehicle collisions. However, "reported crashes" account for only a portion of all deer-vehicle collisions in the township. As **Table 20** shows, reports of struck deer, which are not filed as "crashes", are double or more the number of reported deer crashes.

Table 20: Hopewell Township Deer Incident Statistics

Year	All Crash Reports	Deer Crash Reports	Deer Crashes as % of All Crashes	Struck Deer Calls
2005	642	138	21%	404
2006	699	150	21%	328
2007	753	146	19%	393
2008	779.	186	24%	377
2009*	504	74	15%	232
Totals	**3,377**	**694**	**21%**	**1,734**

Source: Township Of Hopewell Police Department

**2009 data is from January 1 through September 30*

To address deer-related issues, Hopewell Township established a Deer Management Task Force in September 2009. The task force aims to establish a baseline for current forest health to assess the effectiveness of their deer management techniques and has begun compiling data in this regard. The Task Force, which includes 26 members appointed by the mayor, will also work to develop broad public support for deer management, initiate a public education program, and develop a Community Deer Management Plan. The plan will evaluate and select a range of deer management options, coordinate activities across the township, and establish measures to evaluate the program's success.

The New Jersey Agricultural Experiment Station recommends both lethal and nonlethal deer management options for community-based deer management programs. For example, municipalities can extend the hunting season, issue agricultural depredation permits to private landowners, engage in sharp shooting, conduct controlled hunting programs, and employ traps and euthanasia to reduce deer numbers. Alternatively, communities and private landowners can choose to apply more costly, nonlethal deer management strategies, such as installing reflectors

and reducing speed limits on rural roads to decrease deer-vehicle collisions, modifying habitat by planting bad tasting plants on commercial and residential properties, using taste-based and odor-based repellents, contraception, and employing traps and translocation techniques.

While current deer problems should be addressed, it is important to note that conflicts between deer and human populations increase as suburban communities spread into once rural areas.

Birds

There are over 500 species of birds in New Jersey, which is an exceptional number given the state's small size. New Jersey is an important location for migratory birds heading south for winter. Not only is the state an important "rest stop" for birds migrating to warmer climates in Central and South America, but also the New Jersey Atlantic coast and the Delaware Bay are major parts of the Eastern Flyway (established migratory air route) in North America. In spring, the Delaware river is a major route used by birds traveling north to breeding areas.

Photo by Richard Grant

Great blue heron.

Common birds in Hopewell are ducks, woodpeckers, geese, swallows, jays, robins, wrens, sparrows, and some hawks. The threatened grasshopper sparrow and bobolink have been sighted in the township, as has the Cooper's hawk.

Important Bird Areas

The Important Bird Area (IBA) Program began as an international initiative for saving bird and wildlife habitat. In North America, the IBA Program is carried out by chapters of the Audubon Society in 46 states. The state IBA Programs have succeeded in protecting tens of thousands of acres of bird habitat and raised public awareness about habitat protection. In New Jersey, the New Jersey Audubon Society, in cooperation with the New Jersey Endangered and Nongame Species Program (ENSP) and the National Audubon Society, runs the Important Bird and Birding Area (IBBA) program. This program identifies not only Important Bird Areas, but also areas important for bird watching.

For a site to qualify as an IBA, it must meet at least one of four primary criteria. These criteria include: the presence of species of conservation concern; the presence of "regional responsibility species;" the capacity to hold "significant congregations" of one or more bird species; and the presence of exceptionally high numbers of birds during migration relative to the surrounding areas. Hopewell is currently home to three IBAs: Baldpate Mountain IBA, Featherbed Lane IBA, and the Pole Farm IBA. Additionally, Hopewell had formerly been home to the Brandon Farms IBA. This area, however, has recently been converted to residential development, and is no longer viable as avian habitat.

The Featherbed Lane IBA, located on a former 180 acre farm in the Sourland Mountains, is home to the Featherbed Lane Banding Station. The site contains a range of habitats including upland forest, forested wetland, and former agricultural land. The IBA is home to 70 breeding birds including: Cooper's hawks, Kentucky warblers, sharp-shinned hawks, wood thrushes, yellow-billed cuckoos, bobolinks, veeries, eastern meadowlarks, yellow-breasted chats, ruffed grouse, American woodcocks, brown creepers, Carolina and/or black-capped chickadees, hairy woodpeckers, barred owls, scarlet tanagers and Baltimore orioles. Dark-eyed juncos, American tree sparrows, purple finches, hermit thrushes, and at least 44 additional species overwinter in the area. Permanent year-round residents include red-tailed hawks, great horned owls, eastern screech owls, pileated woodpeckers and eastern bluebirds. The quality of habitat at the Featherbed Lane IBA faces numerous challenges including development pressure on adjacent lands, the establishment of invasive plants, an overabundance of deer, feral cats, and the succession of habitats to later stages of forest.

The Baldpate Mountain IBA consists of the 1,100 acre Ted Stiles Preserve at Baldpate Mountain and western portions of the Sourland Mountains. The deciduous forest provides breeding habitat for the red-shouldered hawk (NJ endangered) and the Cooper's hawk (NJ special concern). Additional forest breeding species include yellow-billed cuckoos, chimney swifts, northern flickers, eastern wood-pewees, Kentucky warblers, wood thrushes, and gray catbirds. Shrub/scrub species include wild turkeys, pine warblers, prairie warblers, and eastern towhees. Conservation priority species include hairy woodpeckers, Carolina chickadees, and brown

creepers. Major threats to the habitats of Baldpate Mountain include establishment of nonnative invasive plants including garlic-mustard (*Alliaria petiolata*) and multiflora-rose (*Rosa multiflora*), recreational development and overuse, development pressure, and deer overbrowse.

The Pole Farm IBA is nearly bisected by the Hopewell-Lawrence township boundary. It is bounded by Blackwell Road to the north, Cold Soil Road to the east, Keefe Road to the south, Federal City Road to the west, and Lawrenceville-Pennington Road to the southwest. It is approximately 800 acres and is owned by the Mercer County Park Commission. The habitat of this IBA consists mostly of freshwater wetlands and fallow fields. In addition, there is some shrubland and deciduous forest on the parcel. The Pole Farm IBA is a wintering home for the northern harrier, a New Jersey species of Special Concern. Regional responsibility species, such as the northern flicker, chimney swift, wood thrush and eastern towhee, can also be found on the property. Regional responsibility species are species for which New Jersey has a high responsibility for long-term conservation, even if they are not currently declining or threatened.

The Brandon Farms IBA was listed as an Important Birding Area in 2004. The area comprised nearly 1,800 acres of mixed forest and shrubland in the southeast corner of Hopewell Township extending into Lawrence Township. This area provided habitat for numerous regional responsibility species, including eastern towhees, wild turkeys, wood thrushes, mallards, northern flickers, American woodcocks, and gray catbirds. Unfortunately, attempts to preserve the Brandon Farms IBA failed, and the site has since been fragmented by a number of new residential subdivisions.

Resident Canada Goose Populations

The State of New Jersey now has a "resident" Canada goose population of approximately 100,000 birds that no longer migrate to more southern locales. Due to extensive agricultural production and residential development, much of New Jersey's forest landcover has been opened up, providing ideal habitat for the geese, whose population may double in size in the next five to ten years. While geese provide enjoyable wildlife viewing opportunities for the public, they also cause property and environmental damage. Goose droppings that wash into lakes during storm events can elevate coliform bacteria to unhealthy levels, closing lakes to swimming. Goose droppings can also limit human use of grassy areas in parks, and because geese can be quite aggressive during the nesting season, they can potentially injure humans. Additionally, flying geese are an aviation hazard, causing over a third of all bird-airplane related incidents, and are a threat of particular concern due to Hopewell's proximity to the Trenton Mercer Airport.

Removing geese or preventing them from residing in park areas is a difficult task. Because geese move freely, the most effective management solutions are best conducted at the community level. Canada geese are protected by the Migratory Bird Treaty Act. Therefore, a management program may require the U.S. Department of Agriculture's approval. Management techniques include planting shrubby vegetation around streams, lakes, and ponds to block waterfowl access, discouraging humans from feeding geese, and fertility reduction techniques such as egg addling or removal.

Fish

When European settlers arrived in present day Mercer County, they encountered Native Americans who regularly fished along the inland streams and gathered mussels in the Delaware River. Due to the unintended consequences of urban development, industrial advancement, and mechanized agriculture, the amount and diversity of aquatic life has decreased dramatically throughout most of New Jersey.

The New Jersey Division of Fish and Wildlife, under the Bureau of Freshwater Fisheries, monitors and actively aids the propagation, protection, and management of the state's freshwater fisheries. The Bureau raises several million fish for stocking in suitable waterbodies and conducts research and management surveys. In Hopewell, the Bureau of Freshwater Fisheries stocks Rosedale Lake, Stony Brook, and the D&R Canal with trout annually. Based on survey data supplied by the Bureau, Hopewell's freshwater streams may contain the following fish: red breasted sunfish, blue gill sunfish, white sucker, chain pickerel, pumpkinseed, eastern mudminnow, common shiner, largemouth bass, tessellated darter, and the American eel.

N.J. Department of Environmental Protection Freshwater Fish Advisories

Fishing provides enjoyable and relaxing recreation, and many people like to eat the fish they catch. Fish are an excellent source of protein, minerals, and vitamins, are low in fat and cholesterol, and play an important role in maintaining a healthy, well-balanced diet.

However, certain fish may contain toxic chemicals, such as polychlorinated biphenyls (PCBs), dioxins, or mercury, which accumulate in water and aquatic life. Chemical contaminants such as dioxin and PCBs are classified by the U.S. Environmental Protection Agency as probably cancer-causing substances in humans. Elevated levels of mercury can pose health risks to the human nervous system. Infants, children, pregnant women, nursing mothers, and women of childbearing age are considered to be at higher risk from contaminants in fish than other members of the general public. Since 1982, NJDEP catches fish at numerous sampling stations throughout the state and tests for contaminant levels, adopting advisories to guide residents on safe consumption practices.

NJDEP issued a fish advisory for the following species of fish in Mercer County: largemouth bass, smallmouth bass, striped bass, chain pickerel, yellow bullhead, sunfish, brown bullhead, American eel, striped bass, channel catfish, white catfish, and bluefish. Recreational fishermen and women should regularly check for local fish advisories on NJDEP's Division of Science, Research and Technology website: www.nj.gov/dep/dsr/njmainfish.htm

U.S. EPA General Consumption Guidelines

- If possible, eat smaller amounts of several different types of fish rather than a large amount of one type that may be high in contaminants. Consume species of fish that have lower levels of contaminants, such as fluke or flounder.
- Smaller fish of a species will usually have lower chemical levels than larger fish in the same location because contaminants tend to buildup in the fish over time. It is advisable to eat smaller fish (of legal size) more often than larger fish.

Common Reptiles and Amphibians

Reptiles can be quite elusive when surveys attempt to document them. Amphibians of some types are abundant, such as bullfrogs. Other species are rare because they depend on vernal pools, as was discussed in the *Vernal Pools* section of this document *(page 42)*. In Hopewell Township, the wood turtle, a state listed threatened species, and the spotted turtle and Fowler's toad – species of special concern – have all been sighted in the last several years. The term "species of special concern" applies to species that warrant special attention because of some evidence of decline, inherent vulnerability to environmental deterioration, or habitat modification that would result in their becoming a threatened species. For more information on New Jersey's reptiles and amphibians visit: www.njfishandwildlife.com/ensp/herps_info.htm

Threatened and Endangered Vertebrates

According to the Natural Heritage Database and the Landscape Project, 14 threatened or endangered wildlife species have been sighted in Hopewell over the course of the past several years. Brief descriptions of several of these species and their preferred habitat, provided by the New Jersey Division of Fish and Wildlife, follow.

The Cooper's hawk (*Accipiter cooperii*) is a member of the Accipiter family – woodland hawks that prey on smaller birds – and is especially adapted to fly through dense cover chasing prey. In New Jersey, Cooper's hawks breed in wooded wetlands dominated by red maple or black gum. Adjacent upland pine or mixed oak/pine forests usually provide a buffer for nesting hawks. These hawks generally nest in forests composed of trees 30 years or older, which create a closed canopy. On average, a hawk will place his or her nest more than one-third of a mile away from the nearest human habitation. While other raptor species were threatened due to hunting practices and predator elimination, Cooper's hawk populations were not threatened until widespread suburbanization. Additionally, the pesticide DDT impaired many bird species' reproduction and contributed to declining populations from the 1950s to the 1970s. Populations began to recover due to the nationwide ban of DDT in 1972, coupled with the reforestation of old fields throughout New Jersey. The hawk was listed as endangered in 1974 and downgraded to threatened in 1999. The loss of large, contiguous forests remains a threat to this species and warrants the continued protection of Cooper's hawk nesting habitats.

The barred owl (*Strix varia*) inhabits contiguous old-growth wetland forests. The owls use cavities in large trees for their nests. In northern New Jersey, barred owls live in mixed deciduous wetland or riparian forests. They avoid sites near residential, agricultural, industrial or commercial areas. They prefer lowlands and avoid rocky hillsides. Barred owls were once abundant in the deep-wood swamps of New Jersey, but they diminished in numbers as they were shot by hunters and as habitat was reduced beginning in the 1940s through the cutting of old-growth forests and the filling of wetlands. In 1979 it was listed as a threatened species in New Jersey.

The bobcat (*Felix rufus*) is a member of the Felidae family. Bobcats can occupy a variety of habitats ranging from forests to mixed agricultural areas to rural areas outside of cities. They generally occupy habitats with rocks or dense cover through vines, shrubs or saplings, which provide protection from weather and predators, as well as resting places. In New Jersey, bobcats typically occupy areas of contiguous forest, or fragmented forests interspersed with agricultural areas. In the 1800s, many New Jersey forests were cleared, leading to a decline in the number of bobcats. By the 1970s the animal was believed to have been extirpated from the state. In 1977, the New Jersey Division of Fish, Game and Wildlife started a bobcat restoration project, releasing bobcats from Maine into northern New Jersey. While bobcat numbers today are steady, the animal is still listed as a state endangered species.

The bobolink (*Dolichonyx oryzivorus*) is a small-sized member of the blackbird family. These birds inhabit meadows or agricultural hayfields and pastures during the breeding season. This was an abundant species in New Jersey in the 1700s and 1800s, but by the 1900s, the species began to decline in numbers because of changing agricultural practices. Through modern

farming techniques such as rotation of fields and mowing, agricultural fields became unsuitable for nesting bobolinks. In 1979, the species was listed as a threatened species in New Jersey.

The wood turtle (*Clemmys insculpta*) occupies both aquatic and terrestrial environments. The aquatic habitats are used for feeding, mating, and hibernation while the terrestrial habitats are used for foraging and egg laying. The turtle was fairly common in New Jersey until the 1970s when declines in the species were noted due to stream degradation and loss of habitat. In 1979, the wood turtle was listed as a threatened species in New Jersey. In 1995, the species was proposed for inclusion on the federal endangered species list, but populations throughout the country were considered stable enough to deny the listing.

The bald eagle (*Haliaeetus leucocephalus*) is a large bird of prey, with a wingspan reaching over 8 feet. The bald eagle prefers nesting in old-growth trees near open water, as its diet consists primarily of fish, although it is an opportunistic feeder. Bald eagles may live for up to thirty years in the wild. Bald eagles were prolific in colonial America, but had been nearly eliminated by the mid-twentieth century. A combination of habitat fragmentation, hunting and the use of the bioaccumulating pesticide DDT all contributed to their decline. In 1973, when the Endangered Species Act was passed, New Jersey was home to only one pair of nesting adults. The combination of the Endangered Species Act, the 1972 EPA ban on DDT, and restoration efforts have dramatically improved the bald eagle population, to the point where it was federally re-classified from “endangered” to “threatened” in 1995. In 2008, NJ Fish & Wildlife reported 69 nesting pairs in New Jersey, with the nearest nest to Hopewell located in Princeton township.

The shortnose sturgeon (*Acipenser brevirostrum*) is an anadromous fish, spending most of its life in the brackish waters of the Delaware River and other estuaries, but swimming upstream to spawn. Migratory activity takes place predominantly in the winter and spring, with individual fish breeding for just a few days every three to five years. The fish are long lived, with individual specimens found to be nearly 70 years old being recorded in maritime Canada. Sturgeon are bottom feeders, feeding on mollusks and other invertebrates that live in the riverbed. Due to their size, shortnose sturgeon were often considered to be immature Atlantic sturgeon. While the Atlantic sturgeons can reach lengths of up to 7 feet, shortnose sturgeons average between 1.5 and 2 feet at maturity. Sturgeon are sometimes described as “living fossils” and are thought to be relatively unchanged for the past 200 million years. Due to their long life and late maturity, sturgeon are highly susceptible to pollution and habitat fragmentation. The shortnose sturgeon has been federally recognized as an endangered species since 1967.

See **Appendix C** for a list of *State Endangered and Threatened Species.*

See **Appendix E** for a list of *Plants and Animals of Hopewell’s Mercer County Park Northwest.*

See **Table 21** for a list of *Rare Animal Species and Natural Communities Presently Recorded in the NJ Natural Heritage Database for Hopewell Township.*

See **Table 22** for a list of *Rare Plant Species and Natural Communities Presently Recorded in the NJ Natural Heritage Database for Hopewell Township.*

Table 21: Rare Animal Species and Natural Communities Presently Recorded in the NJ Natural Heritage Database for Hopewell Township

Common Name	Scientific Name	Federal Status	State Status	State Rank
Vertebrates				
American kestrel	*Falco sparverius*	NA	Special Concern	S3B, S3N
bald eagle, foraging	*Haliaeetus leucocephalus*	NA	Endangered	S2B, S1N
barred owl	*Strix varia*	NA	Threatened	S2B, S2N
bobcat	*Lynx rufus*	NA	Endangered	S1
bobolink	*Dolichonyx oryzivorus*	NA	Threatened/ Special Concern	S2B, S3N
Canada warbler	*Wilsonia canadensis*	NA	Stable/Stable	S3B
Cooper's hawk	*Accipiter cooperii*	NA	Threatened/Stable	S2B, S4N
creeper	*Strophitus undulatus*	NA	NA	S3
eastern box turtle	*Terrapene carolina*	NA	Special Concern	S3B
eastern meadowlark	*Sturnella magna*	NA	Special Concern/ Special Concern	S3B, S3N
Fowler's toad	*Bufo woodhousii fowleri*	NA	Special Concern	S3
great blue heron	*Ardea herodias*	NA	Special Concern/ Stable	S3B, S4N
hooded warbler	*Wilsonia citrine*	NA	Declining Species/ Stable	S3B
long-eared owl	*Asio otus*	NA	Threatened/ Threatened	S2B, S2N
red-headed woodpecker	*Melanerpes erythrocephalus*	NA	Threatened/ Threatened	S2B, S2N
shortnose sturgeon	*Acipenser brevirostrum*	Endngrd.	Endangered	S1
spotted turtle	*Clemmys guttata*	NA	Special Concern	S3
veery	*Catharus fuscescens*	NA	Stable/Stable	S3B
wood thrush	*Hylocichla mustelina*	NA	Special Concern/ Stable	S3B
wood turtle	*Clemmys insculpta*	NA	Threatened	S2
worm-eating warbler	*Helmitheros vermivorus*	NA	Stable/Stable	S3B
Invertebrates				
brook floater	*Alasmidonta varicosa*	NA	Endangered	S1
tidewater mucket	*Leptodea ochracea*	NA	Threatened	S2
triangle floater	*Alasmidonta undulata*	NA	Threatened	S2
yellow lampmussel	*Lampsilis cariosa*	NA	Threatened	S2

S1	Critically imperiled in NJ because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres).
S2	Imperiled in NJ because of rarity (6-20 occurrences).
S3	Rare in state with 21 to 100 occurrences (plant species in this category have only 21 to 50 occurrences).
S4	Apparently secure in state, with many occurrences.
B	Refers to the breeding population of the element in the state.
N	Refers to the nonbreeding population of the element in the state.
NA	Data not available.

Source: NJDEP, New Jersey Natural Heritage Program

Note: State status for animals separated by a slash (/) indicate a duel status, referring first to the state breeding population, and secondly to migratory or winter populations.

Table 22: Rare Plant Species and Natural Communities Presently Recorded in the NJ Natural Heritage Database for Hopewell Township

Scientific Name	Common Name	Federal Status	State Status	State Rank
Agrimonia microcarpa	small-fruit grooveburr	NA	NA	S2
Carex frankii	Frank's sedge	NA	NA	S3
Carex willdenowii var. willdenowii	willdenow's sedge	NA	NA	S2
Cercis canadensis	redbud	NA	Endangered	S1
Cuscuta cephalanthi	buttonbush dodder	NA	Endangered	S1
Cynoglossum virginianum var. virginianum	wild comfrey	NA	NA	S2
Cystopteris protrusa	lowland fragile fern	NA	NA	S2
Dicentra canadensis	squirrel-corn	NA	Endangered	S1
Ellisia nyctelea	aunt Lucy	NA	Endangered	S1
Eragrostis frankii	Frank's love grass	NA	NA	S2
Geum vernum	spring avens	NA	NA	S2
Hybanthus concolor	green violet	NA	Endangered	S1
Jeffersonia diphylla	twinleaf	NA	Endangered	S1
Mimulus alatus	winged monkey-flower	NA	NA	S3
Penstemon laevigatus	smooth beardtongue	NA	Endangered	S1
Ranunculus pusillus var. pusillus	low spearwort	NA	NA	S2
Tradescantia ohiensis	Ohio spiderwort	NA	NA	S2
S1	Critically imperiled in NJ because of extreme rarity (5 or fewer occurrences or very few remaining individual acres).			
S2	Imperiled in NJ because of rarity (6-20 occurrences)			
S3	Rare in state with 21 to 50 occurrences. Includes elements that are widely distributed but with small populations/acreage, or with restricted distribution but locally abundant.			
S4	Apparently secure in state, with many occurrences.			
NA	Data not available.			

Source: NJDEP, New Jersey Natural Heritage Program

NATURAL HERITAGE DATABASE AND NATURAL HERITAGE PRIORITY SITES

Natural Heritage Priority (NHP) sites are areas designated by the New Jersey Division of Parks and Forestry's Office of Natural Lands Management as exemplary natural communities within the state that are critically important habitats for rare species. Preserving these areas is a top priority for efforts to conserve biological diversity in New Jersey. Three NHP sites are located in Hopewell, all of which are found along the Delaware River: (1) the Titusville NHP Site, (2) the Strawberry Hill NHP Site and (3) the Goat Hill NHP Site. All three sites have been assigned a biodiversity rank of B4, indicating moderate significance on a global level. Each includes habitat for rare and imperiled plant species.

The Titusville NHP site is located just north of the community of Titusville, along the shorelines of the Delaware River and the D & R Canal. The site contains one state-listed endangered plant species.

The Strawberry Hill NHP site is located just north of the Titusville NHP site, located on steep, rocky bluffs overlooking the Delaware River and the D & R Canal. The site contains three state-listed critically imperiled plant species.

The Goat Hill NHP site is located primarily in the southwest corner of neighboring West Amwell township, with a small portion extending into Hopewell township. The site is located on a steep, wooded hillside above the Delaware River and the D & R Canal. The site contains habitat for all 17 rare and imperiled plant species found in Hopewell Township.

Designation as a Natural Heritage Priority site does not carry any specific requirements or restrictions on the land. Rather, the designation is made because of a site's high biological diversity value. Owners of NHP Sites are encouraged to become informed stewards of the property and to consider working with the local community or nonprofit groups to preserve the land permanently.

NHP designations are based on the records of the Natural Heritage Database, which lists documented sightings of endangered and threatened species. Information on particular sites or species may also be provided by the Nature Conservancy or by the NJDEP Endangered and Nongame Species Program, and especially through the latter agency's Landscape Project. See **Tables 21 and 22** for a list of rare plants and animals recorded for Hopewell Township.

It is important to note that the Natural Heritage Database lists primarily sightings that have been submitted to it, along with some ecological community data. It incorporates both historically and recently documented sightings. Areas without sightings may never have been surveyed. Conversely, land use in areas with sightings may have changed considerably over recent years, and the species once found there may be gone. Local surveys to update the database and regular consultation of records before any development is approved are two measures that would help to increase threatened and endangered species' protections. See "Cautions and Restrictions on Natural Heritage Data," located in **Appendix D**.

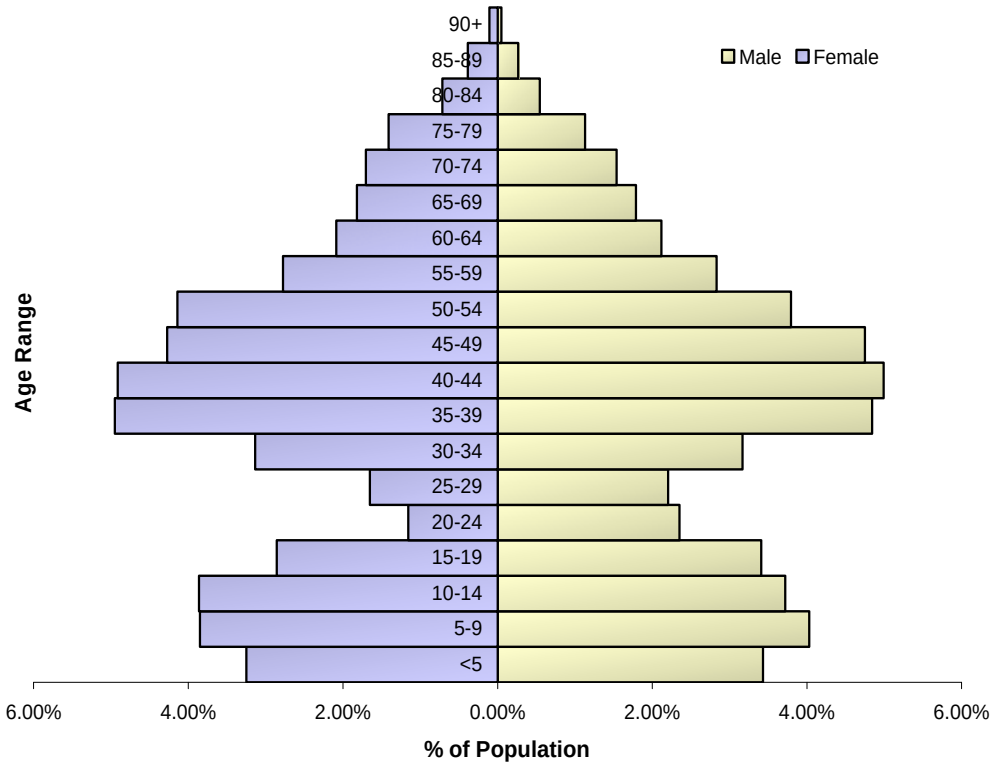
THE BUILT ENVIRONMENT

DEMOGRAPHICS

The 1990 U.S. Census listed a population of 11,590 residents for Hopewell Township. By 2000, the population of Hopewell had grown to 16,105 residents, an increase of 39 percent. The U.S. Census estimated the 2006 population for the township at 17,968. DVRPC projects an increase of 6,700 additional residents by the year 2035.

According to the 2000 Census, 4,575 residents, or 28 percent of Hopewell's total population, are under the age of 20. Of those residents, 3,196 are children between the ages of 5 and 18. This age group represents those residents who are most physically active in the community and most likely to use public recreational facilities. Hopewell's age distribution, as illustrated in **Figure 9**, presents a community composed primarily of middle-aged adults with school-aged children.

Figure 9: Age Pyramid for Hopewell Township (2000)



Source: U.S. Census

Overwhelmingly, Hopewell's residents live in single-family detached homes, which constitute 85.6 percent of the housing stock. As of 2000, over 30 percent of Hopewell's housing stock had been built since 1990, almost entirely as single-family, owner-occupied units, with an average of 3.3 bedrooms per unit. The median home value in 2000 was $252,600. Hopewell's median household income in 2000 was $93,640, more than twice the U.S. median household income of $41,994 at that time. With the prevalence of detached single-family dwellings, Hopewell has many large homes compared to other communities in New Jersey. See **Table 23: Home Size Distribution for Hopewell Township**. According to the 2007 American Housing Survey of the U.S. Census, the median occupied home size was 1,807 square feet.

Table 23: Home Size Distribution for Hopewell Township

Square Footage	Number of Homes	Percentage
Under 2,000	2,830	44.40%
2,000 to 4,000	2,959	46.42%
4,000 to 6,000	509	7.99%
Over 6,000	76	1.19%

Source: Hopewell Township

TRANSPORTATION

Hopewell possesses a strategic location in the Mid-Atlantic region, a driving distance of only 61 miles from New York City and 46.5 miles from Philadelphia. Despite its proximity to such large urban centers, Hopewell has retained much of its rural character. One unfortunate aspect of this, however, is a significant lack of accessible public transportation, both within the township, and between the township and its neighbors. Although traditional settlements such as Titusville and the boroughs of Pennington and Hopewell have developed as compact, walkable communities, automobile dependency is the prevailing reality throughout the Hopewell Valley, especially in newer developments.

Two state highways serve as the primary arterials within Hopewell. NJ Route 29 runs along the Delaware & Raritan Canal from just south of Trenton to Frenchtown in Hunterdon County, and is New Jersey's only designated scenic byway. NJ Route 31 runs from Trenton northwards into Hunterdon and Somerset Counties, and serves as a main street for the Borough of Pennington. This role is complicated by the route's significance as a truck route through the township. Regional connections can be made via Interstate 95, which can be accessed at the southern edge of the township.

County roads provide access and connections throughout the area and reflect the township's land use and distribution of historic centers of activity. The township is served by 19 such roads. The 500 series roads are the more significant roadways, providing inter-county connections. The 600 series roads primarily provide connections within Mercer County. Smaller roads within the township are a mixture of old rural lanes and newer subdivision thoroughfares. Locally, street names reflect Hopewell's traditional pattern of small, crossroads hamlets, and indicate exactly which hamlets they are connecting, such as Pennington-Harbourton Road or the Lambertville-Hopewell Turnpike.

Public transit is extremely limited in Hopewell Township, and commuting statistics reflect this reality. According to data from the 2000 U.S. Census, of Hopewell's 7,435 workers over the age of 16, only 4.4 percent commuted via public transit. Over 83 percent of workers drove alone. The nearest train stations to the township are located in Princeton, Princeton Junction, Trenton, and Hamilton Township. Each station allows access to the Amtrak / New Jersey Transit Northeast Corridor line, which connects cities between Boston and Washington. Additionally, New Jersey Transit's light rail River Line can be accessed at the Trenton station, providing another option between Mercer County and the Camden/Philadelphia area. SEPTA's regional rail service can be accessed at stations in West Trenton (R3 line) and Trenton (R7 line). Commuter bus service is provided by New Jersey Transit (NJT) between Pennington and Trenton via NJ Route 31, and limited service is provided between Lambertville and Hamilton Township via NJ Route 29. For employees of Merrill Lynch & Co., a free shuttle service is provided by the company between their facilities in Hopewell and transit connections to SEPTA in West Trenton and NJT in Hamilton.

New Jersey Transit has proposed a $219 million capital improvement project to restore commuter service along the West Trenton line currently owned by CSX. The project would

connect West Trenton to Newark Penn Station via the Raritan Valley line, and is intended to alleviate congestion on the Northeast Corridor line and facilities. The West Trenton line currently runs through both Hopewell Township and the boroughs of Pennington and Hopewell. Two of the proposed five new stations will dramatically impact Hopewell. One station would be located within Hopewell between the I-95 entrance and the Borough of Pennington, with a second station located in the Borough of Hopewell. However, the project is currently only a candidate project and has no funding attached to it.

Bicycling provides an alternative means of transportation that is predicted to become increasingly important in the future as concerns about fossil fuel use and CO_2 emissions continue to rise. Bicycle lanes provide recreational opportunities and encourage the use of bicycles as basic transportation. While Hopewell does not currently have any designated bike lanes, many county and local roads are well-suited to bicycling. Hopewell also possesses some off-road bicycle trails that are ideal for use by cyclists for both transportation and recreation. One of the more significant trails in the region, the Lawrence-Hopewell trail, is currently in development with some sections opened for use. When completed, the trail will be a 20 mile loop connecting multiple destinations in Lawrence and Hopewell. Through effective trail planning and implementation, the Lawrence-Hopewell Trail, along with other future paths and trails, can be used to link neighborhoods and hamlets with centers of commerce and recreation in the township.

In addition to dedicated bicycle facilities, such as bike lanes and trails, the bicycle level of service (BLOS) or "bicycle compatibility" for all state roads and some local roads within Hopewell Township was evaluated in 2009. Bicycle level of service is determined based on a variety of factors including roadway configuration, traffic volumes and speeds, truck traffic, shoulder width, on-street parking, and pavement condition. The BLOS method produces a numerical score which is translated into a corresponding letter grade (A–F). The grade indicated the relative degree of comfort for a "typical" bicyclist on a given roadway. Roadways with an "A" grade have the highest degree of comfort for bicyclists.

Once compiled, BLOS scores were converted into a "bikescore". For major roadways, BLOS letter grades of "A" and "B" were reclassed as "Excellent", "C" and "D" were reclassed as "Fair", and "E" and "F" were reclassed as "Unfavorable". For minor roadways, the BLOS letter grades were collapsed into two categories, "Favorable" and "Unfavorable". Following this reclassification, the bikescores were made available to the public via a web-based application. Through the application, cyclists with personal experience on Hopewell's roadways could comment on the bikescore for a given roadway segment and indicate if they thought the segment should be upgraded or downgraded. All comments were compiled and evaluated and bikescores were revised where appropriate. The bikescore for Hopewell's roadways is shown on **Map 16: Bicycle Level of Service**.

HISTORIC RESOURCES

Hopewell's long history has been well preserved and is accessible via numerous historic resources. Hopewell hosts eighteen sites on the National and State Registers of Historic Places, including nine historic houses, four historic districts, two farms, a distillery, a mill and one National Historic Landmark. Notably, all of Hopewell Township and Mercer County also fall within the Crossroads of the American Revolution National Heritage Area, officially designated by Congress in 2006 to recognize New Jersey's pivotal role in the American Revolution.

In addition to National and State designations, Hopewell Township has designated 19 sites and structures as local historic landmarks and a single historic district: the Harbourton Rural Historic District. Five of these sites were originally identified in the *2004 Hopewell Township Historic Preservation Plan*. The remaining 14 sites, and the Harbourton district, have been added to the local register since 2004 and are listed in the Land Use and Development Ordinance's historic preservation chapter *(Chapter XVII: Article XV)*. See **Map 17: Hopewell Township Historic Resources** and **Table 24: Sites Listed on the National, State and Local Registers of Historic Places.**

Photo by James Bennett

A home in the Titusville Historic District.

The Hopewell Township Historic Preservation Commission also maintains a list of properties, sites, and structures with State Historic Preservation Officer (SHPO) opinions of eligibility for listing on the National Register of Historic Places. This list is documented in the 2004 historic preservation plan and identifies approximately 20 historic properties beyond those already listed on the National, State and Local Registers (see **Appendix F**). The Commission is responsible for protecting historic structures within the township and educating the public about them. The Commission also advises the State of New Jersey and Mercer County on projects within Hopewell that impact historic structures.

In the mid-1980s, Hopewell Township, with grant assistance from the State of New Jersey, contracted Heritage Studies, Inc. to perform an extensive historic sites survey, focusing on pre-1875 structures both within the township and its boroughs. This survey helped to inform the *1992 Hopewell Township Master Plan*, predecessor to the *2004 Hopewell Township Historic Preservation Plan*. More recently, in 2002-2003, the township contracted Wise Preservation Planning to undertake an "intensive" survey of 45 historic properties in the Harbourton and Pleasant Valley historic districts, along with 22 additional properties. The results of both surveys are accessible with assistance from the township Zoning Officer and Historic Preservation Commission.

These surveys were used, in part, to identify and assess nine potential "local" historic districts in Hopewell Township. In 2008, the Harbourton Rural Historic District became Hopewell's first locally-designated historic district. Recent development has compromised the historic integrity of many of Hopewell's potential districts. Development undertaken without sensitivity to an area's historic context can destroy historic viewsheds, incorporate visually incompatible structures alongside historic ones, and introduce nonnative and invasive species, among other impacts. In 2005, the Hopewell Township Historic Preservation Commission published design guidelines to aid property owners in their stewardship of the township's historic resources. The guidelines can be found on the township's website at: www.hopewelltwp.org/Guidelines-Historic-Properties.html.

There are numerous opportunities to learn about the history of the township's farms and villages. In addition to the Historic Preservation Commission, the Hopewell Valley Historical Society is a nonprofit organization dedicated to preserving and protecting the township's history, as well as making it accessible to the general public. The Society maintains their resources at the Hopewell Township branch of the Mercer County Public Library system. These resources include microfilmed newspapers dating back to the 1880s, historic maps, and photocopies of early photographs, deeds, estate papers, and family records, among other resources.

Washington Crossing State Park offers a number of opportunities to learn about the history of the Hopewell Valley. The site itself was designated a National Historic Landmark in 1961. The Visitor Center Museum offers several galleries of exhibits dedicated to the American Revolution, with a specific emphasis on the major events that took place in Mercer County. Also located in the park are the Swan Historical Foundation Collection and the Johnson Ferry House. The Swan Collection operates the National Museum of the American Revolution, dedicated to military history and featuring over 700 historical objects. The Johnson Ferry House is a colonial

farmhouse and tavern, used by General George Washington after crossing the Delaware to plan the battle of Trenton. In addition to maintaining period furnishings, the house offers living history exhibits on the weekends.

Hopewell possesses a large collection of historic farmsteads, and of special note is the Howell Living History Farm. The 130 acre farm was added to the National Historic Registry in 1977, and is currently operated by the Mercer County Park Commission. The farm uses living history and historic farming techniques to facilitate a number of educational programs, including demonstrations, children's crafts, summer day camps, and a residential internship program.

Hopewell's agricultural heritage also provides another key historic resource. A significant physical element defining Hopewell's historic smallholder farmsteads is the agricultural hedgerow. A hedgerow is a narrow, linear strip of woody vegetation separating agricultural fields. Hedgerows may have been intentionally planted as fences, or they could be remnants of older forests that were cleared for fields, or they may have emerged spontaneously along the edges of old fences and stonewalls. Hedgerows provide many benefits to the local landscape. They help to conserve soil, serve as windbreaks and moderate the temperatures of adjacent fields. They provide habitat for woodland species, serve as corridors for animal movement, and facilitate species which roost in one habitat and feed in another. Long appreciated as important historic resources in England, hedgerows are at risk in New Jersey as farmland is increasingly being converted to residential and commercial land uses and as farms remove hedgerows to make fields larger or more accessible.

There are various mechanisms to enhance historic preservation from the federal to the local level. At the federal level, placing sites and districts on the National Register of Historic Places affords them added consideration in the planning for federally assisted projects, and makes properties eligible for certain tax benefits and grant programs. It does not, however, prevent properties from being altered or demolished. Local historic districts, on the other hand, can be created by municipalities to preserve significant historic sites by regulating the erection, alteration, restoration, and demolition of buildings within the historic district. Historical agencies, like the Hopewell Township Historic Preservation Commission, are government bodies that oversee historic preservation planning and decision making in their communities, and provide for the regulation of historic districts. The establishment of these entities is typically the first step in local preservation efforts.

Table 24: Sites Listed on the National, State & Local Registers of Historic Places

Name	Location	Designation
Andrew Titus House	11 Cedar Lane	Local
Bear Tavern Road Iron Truss Bridge	County Route 579 & Bear Tavern Road over Jacobs Creek	Local
Brown Farmstead (Hoff/Brown House; Bellando/Rapp Property)	166 Church Road	Local
Colonel John Van Cleve Homestead	Poor Farm Road	National & State

Name	Location	Designation
Delaware & Raritan Canal Historic District	Entire canal bed & all land 100 yards to either side of the centerline	National & State
Enos Titus Farmstead	340 Rocky Hill Road	Local
Harbourton Blacksmith's House	1459 Trenton-Harbourton Road	Local
Harbourton Historic District	Harbourton / Rocktown & Harbourton / Mt. Airy roads	National, State & Local
Hart / Hoch House	Intersection of County Route 546 & Scotch Road	National & State
Highfields	Lindbergh Road	National & State
Ichabod Leigh House	Mount Rose-Rocky Hill Road	National & State
Jeremiah Van Dyke House	Featherbed Road	National & State
Jeremiah Woolsey House	237 Pennington-Washington Crossing Road	National, State & Local
John D. Hart House	Curlis Avenue	National & State
Joseph Stout House (Hunt House)	Province Line Rd.	National & State
Lanning/Hunt Farmstead (Dippery Farm)	438 Valley Road	Local
Major Henry Philips House (Holcomb/Ely Farmstead; Birum House)	84 Pleasant Valley Road	Local
Marshall's Corner Schoolhouse	95 Pennington-Hopewell Road	Local
Mine Road Bridge	Mine Road over Stony Brook east of Route 31	Local
Mount Rose Distillery	Pennington-Rocky Hill Road	National, State & Local
Mount Rose General Store	230 Hopewell-Princeton Road	Local
Noah Hunt Farmstead	Blackwell Road at Rosedale Park	National, State & Local
Pennington Methodist Cemetery	Pennington-Titusville Road	Local
Phillips Farm (Howell Living Historic Farm)	Titusville, Hunter Road	National & State
Pleasant Valley Historic District	Wooden's Lane, Hunter, Pleasant Valley and Valley roads	National & State
Runyun-Titus Barn	115 Route 31	Local
Samuel Moore Sr. House (John Welling House)	56 East Curlis Avenue at Birch Street	National, State & Local
Smith/Hunt/Hill Farmstead (Woodward Farm)	170 Marshall's Corner-Woodsville Road	Local
Somerset Roller Mills (Lott's Mills)	1200 Route 29 at Jacobs Creek	National, State & Local
Titusville Historic District	River Drive	National & State
Titusville Store	34 River Drive	Local
Washington Crossing State Park	NJ Route 29 & County Route 546	National & State

Sources: New Jersey Historic Preservation Office, Hopewell Township Master Plan (2002)

TOWNSHIP UTILITIES AND SERVICES

Drinking Water

Residents of Hopewell Township primarily rely on private wells for potable drinking water. Farmland irrigation also taps the aquifers. There is a small municipal water supply in the township, and a limited number of dwellings and businesses are served by the Trenton Water Works, which obtains its water from the Delaware River. The residents of Hopewell and Pennington boroughs, by contrast, rely primarily on public water supply wells for their drinking water.

There are five public community water supply wells located in the township, and ten located in the boroughs, as listed in **Table 25: Public Water Supply Wells** and shown on **Map 18: Public Water Supply Wells**. A public community water supply well is a well that has at least 15 service connections used by year-round residents, or regularly serves at least 25 year-round residents. An example of a public community water supply well is a municipal system that services single-family, residential homes. In Hopewell, public community water supply wells are located at the Mercer County Correctional Center near the intersection of NJ Route 29 and Pleasant Valley Road, and near Washington Crossing State Park off of Bear Tavern Road.

There are also seventy-six public noncommunity water supply wells in the Hopewell area (see **Map 18: Public Water Supply Wells)**. A public noncommunity water supply well is a public water supply well used by institutions and businesses, as opposed to year-round residents, for at least 60 days of the year. These can include wells serving schools, factories, office buildings, rest stops, restaurants, and motels. The public noncommunity water supply wells in Hopewell tap into almost all of the aquifers in the township and are concentrated along NJ Route 31 and in Titusville.

Private wells in Hopewell are most likely drawn from the Passaic Formation. However, there is no comprehensive survey of private wells. Permits for private wells are held by the county health department, but there are many gaps in the records due to various factors, including well age. The 2002 Private Well Testing Act requires state-certified laboratory water testing in order to sell a residential property. Such testing will not identify what aquifers are being drawn upon by private wells, but will eventually provide better documentation of the quality of drinking water from private wells in the area.

Wellhead Protection Areas and Water Supply Wells

Preventing contamination in areas where aquifers (water-bearing formations of rock) intersect the land surface is extremely important in order to maintain a safe drinking water supply. To protect aquifer outcrop areas, NJDEP established the Well Head Protection Program Plan in 1991. The program delineates Well Head Protection Areas (WHPAs) around public community and public noncommunity water supply wells. A WHPA is the area from which a well draws its water within a specified time frame. Once delineated, these areas become a priority for efforts to

prevent and clean up groundwater contamination. Other components of the Well Head Protection Plan include implementing best management practices to protect groundwater, land use planning, and education to promote public awareness of groundwater resources.

Once WHPAs are delineated, potential pollution sources may be managed by owners or municipalities, in relation to the tier locations. Protection of land and restrictions on activities within wellhead zones relating to uses that generate contaminants, and to the storage, disposal, or handling of hazardous materials, is important for maintaining the quality of water in wellhead areas.

Delineating a Wellhead Protection Area (WHPA)

A WHPA consists of three tiers, each based on time of travel to the well:

Tier 1 = two years
Tier 2 = five years
Tier 3 = twelve years

Calculation of the tier boundaries is based on findings of how long specific contaminants can survive in groundwater, how much time would be required for specific remedies to be undertaken, and on the likelihood of natural dilution over distance. The tiers are shown as rings around a well, with the groundwater direction of travel factored in to create plume–like shapes.

Table 25: Public Water Supply Wells

Well ID #	Original Owner	Location	Formation	Aquifer	Depth to Top of Well Screen (feet)	Depth to Bottom of Well Screen (feet)
2704615	Hopewell Twp Water & Sewer	Hopewell Twp	Passaic	Brunswick	105.00	235.00
2711746	Hopewell Twp Water & Sewer	Hopewell Twp	Passaic	Brunswick	50.00	250.00
2717345	Mercer Co Correctional Cntr	Hopewell Twp	Passaic	Brunswick	60.00	340.00
2717346	Mercer Co Correctional Cntr	Hopewell Twp	Passaic	Brunswick	63.00	380.00
2717347	Mercer Co Correctional Cntr	Hopewell Twp	Passaic	Brunswick	50.00	230.00
4800016	Hopewell Boro Water Dept	Hopewell Boro	Passaic	Brunswick	31.00	376.00
2702563	Pennington Water Dept	Pennington Boro	Passaic	Brunswick	43.33	272.50
2704196	Pennington Water Dept	Pennington Boro	Passaic	Brunswick	81.20	300.00
2704536	Pennington Water Dept	Pennington Boro	Passaic	Brunswick	61.20	300.00
2704837	Pennington Water Dept	Pennington Boro	Passaic	Brunswick	43.00	400.00
2704973	Hopewell Boro Water Dept	Hopewell Boro	Brunswick	Brunswick	50.00	380.00
2713316	Pennington Water Dept	Pennington Boro	Passaic	Brunswick	50.00	300.00
2805619	Hopewell Boro Water Dept	Hopewell Boro	Passaic	Brunswick	60.33	237.00
2825121	Hopewell Boro Water Dept	Hopewell Boro	Passaic	Brunswick	167.00	300.00
2836917	Hopewell Boro Water Dept	Hopewell Boro	Passaic	Brunswick	50.00	400.00

Source: NJDEP

Sewer

The majority of Hopewell Township utilizes on-site septic systems to manage sewage, although the township does have a number of approved sewer service areas. Approximately 4,956 acres fall within several sewer districts that are permitted to discharge directly to surface water (See **Map 19: Approved Sewer Service Areas**). Much of this is managed by the Ewing-Lawrence Sewerage Authority, and encompasses the southern corner of the township as well as areas along the Delaware River. The Stony Brook Regional Sewer Authority operates treatment plants in Hopewell and Pennington Boroughs, and both plants serve areas in Hopewell Township. The Bristol-Myers Squibb facility located on Pennington-Rocky Hill Road manages its own surface discharge system, as does the AT&T/Hopewell Business Center on Carter Road. Three facilities have individual NJPDES permits to discharge directly to groundwater: the Hopewell Valley Golf Club, the Hopewell Town Center, and the Hopewell Township Municipal Complex. Finally, the Pennytown Village district along NJ Route 31 uses storage tanks to manage sewage.

In 2004, Township Engineer Paul Pogorzelski of Van Cleef Engineering, completed a report for Hopewell entitled *Recommendations for Wastewater Planning*. The report provides background on wastewater management systems and discusses potential options for treating wastewater within the township. The report builds on the work of an earlier study, *Assessment of Groundwater Quality and Quantity Impacts from Sewer Area Expansion in Hopewell Township, Mercer County* prepared by M^2 Associates, Inc. Both reports are available through the township website at: www.hopewelltwp.org/document_library.html.

Trash/Recycling

Two private companies offer trash removal in Hopewell Township: Raritan Valley and Waste Management. Curbside recycling service is provided every other week by the Mercer County Improvement Authority. Materials recycled include glass, plastic, aluminum, newspapers, cardboard, and paper. The township Public Works Department provides selected waste disposal services, including seasonal pickup of leaves and brush. Residents may also schedule pickup of bulk items, Freon-based appliances, and tires.

Energy

The primary energy sources in Hopewell for residential and business uses include natural gas, fuel oil, and electricity. Electricity in Hopewell is provided by PSE&G and Jersey Central Power and Light. Natural gas is provided almost entirely by the Elizabethtown Gas Company, although PSE&G does service a very small portion of the township south of I-95. Fuel oil is provided by numerous commercial vendors and is used primarily for home heating.

The State of New Jersey released a new Energy Master Plan in October 2008. The Plan has goals of reducing energy consumption by 20 percent by 2020, and deriving 30 percent of electric energy from Class 1 renewable resources by 2020. Hopewell has already dedicated efforts towards these goals: the township has funded the construction of solar panels for the township public works building, retrofitted the lighting systems in all of its municipal buildings, and

mandated sustainability considerations for all new development. In addition, a number of property owners have installed residential photovoltaic systems, a trend that is expected to grow in the next decade.

In 2009, the Delaware Valley Regional Planning Commission released the *Regional Greenhouse Gas (GHG) Emissions Inventory*. The report inventoried emissions in the form of metric tons of CO_2 equivalency units ($MTCO_2E$) for 352 municipalities located within DVRPC's nine-county region, including Hopewell Township. The report reveals that Hopewell has the highest level of per capita emissions in Mercer County, with each resident contributing the equivalent of over 20 metric tons of CO_2 to the atmosphere per year. **Table 26** summarizes the GHG emissions for Mercer County municipalities. The full report is available at: www.dvrpc.org/reports/09038.pdf.

Table 26: Mercer County Greenhouse Gas Emissions by Municipality (2005)

Municipality	Total Emissions ($MTCO_2E$)	Percent County Total	Population 2007	Per Capita ($MTCO_2E$)
East Windsor Twp	325,512	6.4%	26,686	12.2
Ewing Twp	661,833	13.0%	36,536	18.1
Hamilton Twp	1,140,863	22.3%	90,365	12.6
Hightstown Twp	61,100	1.2%	5,271	11.6
Hopewell Boro	16,899	0.3%	2,000	8.5
Hopewell Twp	360,477	7.1%	17,823	20.2
Lawrence Twp	573,923	11.2%	31,863	18.0
Pennington Boro	21,519	0.4%	2,668	8.1
Princeton Boro	136,398	2.7%	13,517	10.1
Princeton Twp	350,403	6.9%	17,490	20.0
Trenton City	812,942	15.9%	82,804	9.8
Washington Twp	199,089	3.9%	11,979	16.6
West Windsor Twp	447,578	8.8%	26,447	16.9
Mercer County Total	**5,108,536**	**100.0%**	**365,449**	**14.0**

Source: DVRPC

The report examined GHG emissions from stationary energy consumption (heating one's home or lighting schools, for example), mobile energy consumption (transportation related emissions) and non-energy related emissions (agricultural methane, land cover change). Stationary energy consumption accounts for the bulk of the township's emissions (71.5 percent), split between residential and commercial sources. Mobile energy consumption accounts for 22.5 percent of emissions, and the remaining GHG emissions, 6 percent of the total, come from non-energy related activities.

Table 27: Hopewell Township Greenhouse Gas Emissions by Source (2005)

Emissions Source	Total Emissions ($MTCO_2$)	Percent Township Total	Per Capita ($MTC0_2$)
Stationary Energy	**257,814**	**71.52%**	**14.4**
Residential	127,064	35.25%	7.1
Commercial	130,750	36.27%	7.3
Mobile Energy	**81,200**	**22.53%**	**4.6**
Non-Energy	**21,462**	**5.95%**	**1.2**
Agriculture	2,285	0.63%	0.1
Landfill	6,732	1.87%	0.4
Wastewater	2,222	0.62%	0.1
Industrial Processes	6,299	1.75%	0.4
Fugitive Methane	3,726	1.03%	0.2
LULUCF	198	0.05%	0.0
Total Emissions	**360,446**	**100.00%**	**20.2**

Source: DVRPC

The research data further reveals that while the residential and commercial sectors contribute relatively equal levels of emissions, emissions from the commercial sector are derived significantly more from electricity usage than those in the residential sector, where heating and cooking fuels have a greater impact. Hopewell residences consumed over 103 million kilowatt hours of electricity in 2005, whereas commercial properties consumed over 160 million kilowatt hours of electricity. Stationary energy consumption data for the industrial sector was excluded at the municipal level within Mercer County due to data availability constraints.

Table 28: Emission Sources for Residential & Commercial Sectors (2005)

Energy Source	Residential		Commercial	
	$MTCO_2$	*Percent*	*$MTCO_2$*	*Percent*
Electricity	64,079	50.4%	100,252	76.7%
Natural Gas	46,680	36.7%	21,342	16.3%
Fuel Oil & Kerosene	16,284	12.8%	8,749	6.7%
Liquefied Petroleum Gas	21	0.0%	4	0.0%
Coal	0	0.0%	1	0.0%
Other Fuels	0	0.0%	401	0.3%
Total	**127,064**	**100.0%**	**130,749**	**100.0%**

Source: DVRPC

For home heating, Hopewell residents rely predominantly upon utility-provided natural gas (45.9 percent) or home fuel oil (45.5 percent). The remaining households of Hopewell rely on electricity, bottled natural gas, wood, or other fuel sources.

Table 29: Residential Heating Source By Type (2000)

Heating Source	Households	Percent
Utility gas	2,526	45.9%
Bottled, tank, or LP gas	209	3.8%
Electricity	197	3.6%
Fuel oil, kerosene, etc.	2,504	45.5%
Coal or coke	0	0.0%
Wood	36	0.7%
Solar energy	0	0.0%
Other fuel	26	0.5%
No fuel used	0	0.0%
Total	**5,498**	**100.0%**

Source: U.S. Census 2000

Education

The Hopewell Valley Regional School District serves over 4,000 students from Hopewell Township and the boroughs of Hopewell and Pennington. The school district has four elementary schools for children enrolled in kindergarten through grade 5: Bear Tavern Elementary School, Hopewell Elementary School, Stony Brook Elementary School, and Toll Gate Grammar School. Bear Tavern Elementary also offers pre-K programs. The school district has one middle school (Timberland Middle School) and a high school (Hopewell Valley Central High School), both located just to the west of Pennington Borough.

Hopewell is also home to several private schools. The Princeton Latin Academy serves grades K through 8 and is affiliated with the Princeton Science Academy high school. The Pennington School is a private college prepatory school for students in grades 6 through 12, and is located in Pennington Borough. Its current enrollment stands at 472 students. Titusville is home to the Titusville Academy, a coeducational facility for students with learning and behavioral disabilities. Eighty-nine students between grades 2 through 12 are currently enrolled.

PARKS, OPEN SPACE AND RECREATION

Residents of Hopewell have access to a wide variety of parks and recreational opportunities throughout the township. The majority of parkland is owned and operated by the Mercer County Parks Commission. The State of New Jersey also plays a significant role in outdoor recreation space, operating both Washington Crossing State Park and the Delaware & Raritan Canal State Park. Hopewell Township manages several smaller parks and facilities, such as Independence Park and the Municipal Athletic Complex, with a focus primarily on providing athletic facilities. The township also manages facilities on private land that has been leased as part of a development agreement. These include the Merrill Lynch Recreation Center and Quarry Field.

In addition to land formally recognized as "parks," government and nonprofit organizations have been highly active in preserving many types of open space in Hopewell. For example, Mercer County, the state, and the township have been actively involved in preserving Hopewell's high-quality farmland. At the same time, nonprofit organizations play an important role in preserving high quality open space, either through conservation easements or fee simple acquisitions. Some of this land is made accessible to the public for passive recreation. See **Table 30: Hopewell Township Protected Open Space**.

Table 30: Hopewell Township Protected Open Space

Open Space Type	Acres
State	2,201
County	3,200
Municipal	538
Nonprofit/Deed Restricted	3,036
Preserved Farmland	1,532
Total	**10,507**

Source: DVRPC

Mercer County Park System

Mercer County owns 3,200 acres of open space in Hopewell Township, offering a wide range of passive and active recreation facilities. These include Baldpate Mountain, Mercer County Park Northwest, Rosedale Park, Valley Road Picnic Area, Curlis Lake Beech Woods, Mercer County Equestrian Center, Mountain View Golf Course, Mercer County Wildlife Center, and Belle Mountain Ski Area (now defunct).

Rosedale Park is located east of Pennington at the border with Lawrence Township. The 472 acre park was initially built around Rosedale Lake in 1969 for flood control purposes. The 38 acre lake is stocked with trout, and used for fishing and boating. The lake is surrounded by picnic and recreational facilities. Visitors can explore the former farms that make up the park grounds, including the historic Hunt House. Nearby, the Equestrian Center offers 243 acres of bridle trails and horse facilities, and offers riding lessons, day camps, and tours. Attached to the Equestrian Center is Mercer Educational Gardens (MEG) established and maintained by the Master Gardeners of Mercer County. The site provides seven different gardens with plants suitable for growing in Mercer County, a meadow restoration funded by the Audubon Society, recognized wildlife habitat, and a compost demonstration site. See www.mgofmc.org/compostsite.html for further information.

Visitors can also explore miles of trails at Baldpate Mountain, Mercer County Park Northwest (the former AT&T "Pole Farm"), and Curlis Lake Beech Woods.

New Jersey State Park System

The 990 acre Washington Crossing State Park, a National Historic Landmark, lets visitors experience American history in a beautiful, natural setting. The park was initially established to mark the location where General George Washington crossed the Delaware with the Continental Army in 1775. The park features a wide variety of facilities, including a visitor's center, open air theater, nature center, observatory, camp grounds, picnic facilities, and 15 miles of trails for hiking, horseback riding and mountain biking. The state also operates the 70 mile long Delaware and Raritan Canal State Park, six miles of which pass through Hopewell Township. See *Greenways & Trails* on *page 115*.

Hopewell Township Park System

The township owns four parks, two of which are primarily oriented towards active recreation. Both the 22 acre Independence Park and 54 acre Municipal Athletic Complex are principally athletic fields and facilities. The Alliger Tract (167 acres) and the Else Tract (60 acres) are undeveloped parcels of open space that the township has acquired for passive recreational purposes. The township also uses the Merrill Lynch Recreation Area as an overflow space when needed.

Photo by Jim Gambino

Active recreation facilities on Bear Tavern Road.

Open Space Preservation

Photo by Jim Gambino

A Permanently Preserved Farm

In addition to its parks, Hopewell residents value other forms of open space. Because Hopewell is faced with continual development pressure, the preservation of existing open space is a concern shared by many in the community. Hopewell actively seeks to obtain open space for passive recreation, farmland preservation and the protection and conservation of sensitive natural resources. The township has two advisory committees that work to protect open space and farmland: the Hopewell Township Open Space Advisory Committee and the Hopewell Township Agricultural Advisory Committee.

Hopewell has backed up its commitment to protecting open space by enacting a voter-approved property tax to raise money for open space acquisition and preservation. As of 2009, Hopewell had an open space tax of five cents on every hundred dollars of assessed property value. This tax generates approximately $2,300,000 annually. These funds can be used in conjunction with a three cent Mercer County open space tax which raises about $9.3 million per year for county-wide projects.

Local nonprofit organizations, such as the Friends of Hopewell Valley Open Space, the D & R Greenway Land Trust and the Stony Brook Millstone Watershed Association, play an increasingly important role in preserving high-quality open space in Hopewell Township. These groups educate township residents and farmers about the importance of open space and work with county and state organizations to identify and acquire parcels.

Friends of Hopewell Valley Open Space (FoHVOS) is a land trust that has worked with government agencies, landowners, and other nonprofits to acquire and preserve over 3,500 acres of open space in Hopewell Township and the boroughs of Hopewell and Pennington, including Curlis Lake Beech Woods and Baldpate Mountain. In addition to purchasing land for preservation, FoHVOS works to develop conservation easements throughout the area.

The D& R Greenway Land Trust's mission is to create a network of open space and greenways throughout Central New Jersey. Since its inception in 1989, the Trust has preserved over 10,000 acres of land valued at over $383 million dollars. Within Hopewell, the Trust has preserved properties along the Stony Brook, Sourland, and Delaware River greenways.

The Stony Brook Millstone Watershed Association is dedicated to improving the natural environment in the Stony Brook and Millstone River's 254 square mile watershed. The Association maintains an extensive education program, and makes their headquarters in Hopewell, where they manage an 860 acre nature reserve featuring 14 miles of hiking trails, a community supported organic farm, nature center and butterfly house. In addition to preservation, the Association is actively involved in water quality monitoring and stream bank restoration and provides municipal assistance, along with an array of education programs.

An important state program that has played a significant role in providing funding to acquire open space is the New Jersey Green Acres Program. Created in 1961, the New Jersey Green Acres Program aims to partner with townships and counties to acquire and preserve open space throughout the state. The program's goal is to create a system of interconnected open spaces to protect and enhance the natural environment of New Jersey for historic, scenic and recreational purposes, and public enjoyment. Since 1961, over $1.5 billion has been used to acquire land and develop parks. In 1999, the Garden State Preservation Trust Act was signed into law, with the intention of creating a stable source of funding for open space, farmland, and historic preservation, as well as recreation development efforts. However, funds allocated through the 1999 Act were anticipated to run out in fiscal year 2008, so in November 2007, New Jersey residents voted to approve a one year extension of the fund. Most recetnly, in November 2009, residents voted to approve a new $400 million dollar reauthorization, which will maintain the program through the end of fiscal year 2011. While the preservation trust fund has been a popular and important program in New Jersey, a dedicated revenue source that could provide long-term stability has yet to be created.

In addition to the State's Green Acres Program, Mercer County offers two open space acquisition programs. These programs are funded through the Mercer County Preservation Trust Fund Tax, a voter-approved tax for open space preservation. The first program attempts to acquire open space of countywide importance, while the second is an assistance program that aids municipalities and nonprofits in acquiring open space.

Mercer County also has a number of farmland preservation programs. Since 1990, the state and county have purchased 1,644 acres of agricultural easements in Hopewell Township at a cost of nearly $18 million dollars, or roughly $11,000 per acre. Of this $18 million, over 70 percent was paid for by the state. Mercer County will also buy farm properties outright. In conjunction with the State Agricultural Development Committee, Mercer County also maintains a farmland conservation program. Farmers are paid 50 percent of the costs of specific conservation projects, such as soil or water conservation practices. In exchange, farmers agree to maintain the land as farmland for the next eight years.

Further acquisition of open space is important throughout the township. In the more rural western portion, there is pressure from developers to convert open land into residential subdivisions. The eastern portion of the township, by contrast, is more densely developed with homes and businesses that contribute runoff to streams, increasing flooding problems. Here, there is a need to preserve land along streams in order to protect and restore vegetated riparian buffers.

Greenways & Trails

One of the most important greenways in Hopewell is the Delaware and Raritan Canal, which runs approximately 6 miles through the western portion of the township along the Delaware River. This canal was built between 1830 and 1834 to fill in a missing link in the inter-coastal waterway that extended from Massachusetts to Georgia. The canal was primarily used to transport coal from the anthracite coal fields in eastern Pennsylvania to New York City. Over the years, the canal's importance for transportation gradually waned with the growth of railroads. After the canal's closure in the 1930s, some portions were filled in to accommodate the state's expanding highway system. By the 1970s, the canal was being heavily used for recreation, and citizen activists rallied to save the canal from total destruction. In 1973, the canal and its remaining structures were entered into the National Register of Historic Places, and in 1974, the state established the Delaware and Raritan Canal State Park. In 1992, the park's trail system was designated a National Recreation Trail.

Today, the Delaware and Raritan Canal State Park is 70 miles long, including the 22 mile feeder canal portion, which parallels the Delaware River from above Frenchtown south to Bordentown, and the main canal portion, which runs from Trenton to New Brunswick. The canal provides canoeing, jogging, hiking, biking, fishing, horseback riding, picnicking, and camping opportunities. The path along the main canal portion is part of the East Coast Greenway, an off-road multi-use trail that will eventually extend from Maine to Florida. Fish, including bass, sunfish, catfish, pickerel, and perch occupy the canal's water year-round, and in the spring the canal is stocked with trout. Fishing is allowed along the entire canal. There are two canoe rental sites, one in Griggstown and one in Princeton, and numerous launch sites. The canal park is also an important wildlife corridor. Recent bird surveys revealed 160 species, with 90 thought to nest in the park. Furthermore, the Delaware and Raritan Canal is a source of public water for agriculture, industry and homes. About 75 million gallons of water are pumped from the canal daily for these purposes.

Hopewell is in its third year of development of a 20 mile bike and walking trail: the Hopewell-Lawrence Trail. The trail, when completed, will connect Hopewell and Lawrence townships and will loop through private property, parkland, business parks, and school campuses. Since the trail proposal was introduced in 2001, four segments have been built, while work on the two remaining sections is underway. In Hopewell, the trail will run from Mercer County Park Northwest, cross into Curlis Lake Beech Woods, run along Pennington-Rocky Hill Road by the Bristol-Myers Squibb campus and then continue through the Stony Brook Millstone Watershed Preserve. The $7 million trail is being financed in part by the Bristol-Myers Squibb Company and the Educational Testing Service in Lawrence, two major corporate anchors on the trail route.

Photo by James Bennett

The Lawrence-Hopewell Trail, a new 20 mile greenway through the township.

Other trails in Hopewell Township include:

- Trails in Washington Crossing State Park
- Trails on Baldpate Mountain
- Trails in Curlis Lake Beech Woods
- Trails in Mercer County Park Northwest
- Trails in The Stony Brook Millstone Watershed Preserve
- Cedar Ridge Preserve Trail
- Kates Trail
- Eames Preserve Trail
- Elks Preserve Trail
- Heritage Trail
- Nayfield Preserve Trail
- Pennington Loop Nature Trail
- Rosedale Park Trails

For additional trail details and maps, visit www.njtrails.org.

Ongoing Threats to Open Space and Natural Areas

In addition to development pressures, Hopewell's natural areas face ongoing and emerging threats to natural ecological balance. Nonnative and invasive species, predator exclusion, fire suppression, and altered hydrology all present challenges to maintaining the balance of Hopewell's natural areas.

Useful Definitions

A Native (indigenous) species occurs in a particular region, ecosystem, and habitat without direct or indirect human actions (Kartesz and Morse, 1997). Species native to North America are generally recognized as those occurring on the continent prior to European settlement (www.dcnr.state.pa.us).

Nonnative (alien, exotic, foreign, introduced, and nonindigenous) organisms are those that occur artificially in locations beyond their known historical natural ranges. Nonnative can refer to species brought in from other continents, regions, ecosystems, and even other habitats (www.dcnr.state.pa.us). Not all nonnative plant species become invasive.

An Invasive plant displays rapid growth and spread, allowing it to establish itself over large areas. Free from the vast and complex array of natural controls present in their native lands, including herbivores, parasites, and diseases, invasive plants may experience rapid and unrestricted growth in new environments. Their phenomenal growth allows them to overwhelm and displace existing vegetation and form dense one-species stands. In addition, a small number of native species, such as cattails, can behave aggressively enough to be considered invasive in some circumstances.

The Impact of Nonnative Species

Nonnative invasive species pose a significant threat to the Hopewell's natural resources. A growing portion of Hopewell's natural vegetation is made up of nonnative, invasive species. Unhindered by naturally occurring diseases, pests, or predators that keep native plant species in balance, some invasive plants can quickly spread and take over large areas while displacing the native plants, insects, and animals. Invasive species not only crowd out native species, they also tend to diminish biodiversity, thereby creating ripple effects throughout an ecosystem, causing both ecological and economic losses.

Nonnative species tend to be inedible for wildlife, or provide food that is lower in nutritional value than the native plant species that they have displaced. Domination of large expanses by nonnative species, therefore, represents a considerable shrinkage in quality habitat for wildlife, even though the land they occupy may be preserved in a legal sense. Some nonnative invasives, such as Japanese stiltgrass and garlic mustard, may be altering the chemistry and porosity of the soil, with long-term consequences for forest health and water quality.

The problem is exacerbated by sprawling development and garden and landscape companies who promote nonnative, deer-resistant plants to homeowners. Much time, effort, and money is spent battling invasive plants where they occur in our parks, waterways, and the numerous agricultural lands and forests found in Hopewell.

To help mitigate this growing problem, a partnership was formed in 2008 between the Friends of Hopewell Valley Open Space (FoHVOS) and the Upper Raritan Watershed Association (URWA). Combining their resources and expertise, together they developed the Central Jersey Invasive Species Strike Team (CJISST), which represents the state's first comprehensive effort toward cooperative management of invasive plants through public-private partnerships. Hopewell is one of 45 current partners of the CJISST. Project partners are reaching out to private landowners and public land managers to encourage them to remove invasive plants from their landscapes and replace them with native plants.

The key to stopping the spread of emerging invasive plants and their negative impacts is Early Detection/Rapid Response (ED/RR). Through 2009, FoHVOS staff and local volunteers surveyed over 7,500 acres and successfully eradicated 200 populations of invasive plants in Hopewell.

Invasive Shrubs

Multiflora rose (*Rosa multiflora*) is the most prevalent nonnative invasive shrub, growing densely in floodplains and uplands. Other common invasives are privet (*Ligustrum*), honeysuckle (*Lonicera*), barberry (*Berberis vulgaris*), and winged euonymus (*Euonymus alatus)*. A relatively new invasive shrub that has become established in Hopewell but has yet to spread across New Jersey is Asian Photinia (*Photinia villosa*).

Invasive Grasses

Japanese stiltgrass (*Microstegium vimineum*) is one of the most prevalent invasive exotic species in Hopewell. An annual grass, it dominates the forest floor and even displaces perennial lawn grasses in low-lying backyards. Phragmites (*Phragmites australis*) and reed canary grass (*Phalaris arundinacea*) frequently invade marshy areas. Carpgrass (*Arthraxon hispidus)* is another increasingly common nonnative, similar in appearance to stiltgrass.

Invasive Vines

Oriental bittersweet (*Celastrus orbiculatus*) and Japanese honeysuckle (*Loniceria japonica*) are common in wooded areas. Porcelain berry (*Ampelopsis brevipedunculata 'Elegans'*) is very aggressive along forest edges, particularly along the canal. Asian wisteria (*Wisteria floribunda*) grows in isolated patches. Unlike most native vines, nonnative vines are apt to strangle and overtop trees, causing them eventually to topple.

Invasive Herbaceous Species

Garlic mustard (*Alliaria petiolata)* is the most widespread invasive wildflower. Lesser celandine (*Ranunculus ficaria*) carpets floodplains in the spring in many areas, growing so densely that other species are excluded. Japanese knotweed (*Fallopia japonica*) grows densely along streambanks. Purple loosestrife (*Lythrum salicaria)* spreads along streambanks and in wet meadows.

To learn more, visit:

- Friends of Hopewell Valley Open Space
  www.fohvos.org
- Central Jersey Invasive Species Strike Team
  www.cjisst.org
- The Native Plant Society of New Jersey
  www.npsnj.org/index.htm
- List of Mercer County, NJ Native Plant Species
  www.npsnj.org/references/native_plants__Mercer.xls
- List of NJ Invasive Plant Species
  www.npsnj.org/invasive_species_0103.htm
- NJDEP 2004 Report - Nonindigenous Plant Species in New Jersey
  www.nj.gov/dep/parksandforests/natural/heritage/InvasiveReport.pdf

Asian Tiger Mosquito

In addition to plants, Hopewell is also affected by nonnative insect and animal species. The Asian Tiger Mosquito (*Aedes albopictus*) recently arrived in Hopewell and is believed to have spread to the Western Hemisphere as a result of the international trade in used tires. It was first found in the United States in 1985 and is now present in more than 30 states.

Unlike most native mosquito species, the Asian Tiger Mosquito is most active in the afternoon. It breeds in artificial containers such as tires, flower pots, cans, rain gutters, and many other artificial water-holding containers. It does not travel far

Figure 10: Asian Tiger Mosquito

Photo by Susan Ellis, Bugwood.org

from its breeding habitat. Because the tiger mosquito does best in residential areas where shade and water-holding containers are common, many urban and suburban communities that experienced little mosquito annoyance in the past are now infested by tiger mosquitoes. Since this mosquito is active in the daytime, not just after dawn and just before dusk like most indigenous mosquito species, it is a likely culprit if people or pets are being bitten in the daytime. Most mosquito spraying done at night will have little effect on tiger mosquitoes. (Daytime spraying may be a violation of label directions if foraging bees are present on blossoms in the application area.) Laboratory studies have found the tiger mosquito to be an efficient vector of many viral disease agents, including yellow fever, West Nile virus, St. Louis encephalitis, and LaCrosse encephalitis.

Control of tiger mosquitoes by conventional methods in the United States has proven to be difficult. The impact of several predators and parasites as biological control agents of larvae has been investigated, but in general, these agents have not yet proven to be highly effective in regulating the number of mosquitoes.

The most promising predators of tiger mosquito larvae are mosquito fish (*Gambusia spp.*) and cannibal mosquitoes (*Toxorhynchitus spp.*). Fish are very effective when stocked in cisterns, water barrels, and ornamental ponds, but the small size and impermanence of many tiger mosquito breeding sites limit the use of fish.

The most effective method of controlling tiger mosquitoes is reducing or eliminating breeding spots, which are never far from where people are being bitten, since the tiger mosquito is a weak flyer with only about a 200 yard lifetime flying radius. Draining or removal of water holding containers, even on a localized basis, will produce remarkable long-term reductions in mosquito annoyance.

See www.mda.state.md.us/plants-pests/mosquito_control/_asian_tiger_mosquito_md.php for more information.

Future Threats to Open Space and Natural Areas

Some of the more prominent emerging invasives that have yet to become established in Hopewell but that could have an ecological, economic, and/or quality-of-life impact in coming years include plants like mile-a-minute, insects like the Emerald Ash Borer (EAB) and Asian Longhorned Beetle (ALB), and fish species such as the snakehead. To aid in monitoring and quick response, it is important that Hopewell residents and municipalities be familiar with these species.

More information about these and other invasive species can be found at:

Mid-Atlantic Exotic Pest Plant Council (www.ma-eppc.org)–both new and established invasive plants; Central Jersey Invasive Species Strike Team (www.cjisst.org)–focuses on emerging invasive plant threats; and Animal and Plant Health Inspection Service (www.aphis.usda.gov), which is leading the effort to combat invasive insects like the ALB and EAB.

Mile-A-Minute Weed

Figure 11: Mile-A-Minute Weed

Photo by Britt Slattery, U.S. Fish & Wildlife Service, Bugwood.org

Mile-a-minute weed (*Polygonum perfoliatum*) is an annual or perennial vine native to eastern Asia. Mile-a-minute weed grows rapidly, outcompeting native species by blocking available light. It infests orchards, openings in forested areas, roadsides, power line cuts, drainage ditches, and recreational areas. Subsequently, wildlife species are affected by diminished food and habitat sources. Mile-a-minute weed is a particular threat to forest regeneration by outcompeting tree seedlings. It is extremely difficult to eradicate with a single herbicide application due to prolonged seed persistence in the soil. The seeds may survive in the soil for up to four years. Mile-a-minute weed also infests recreational and residential areas. Dense thickets of the sharp-spined plants can provide an unpleasant experience for those recreating in the outdoors.

Though mile-a-minute has yet to become a serious problem in Hopewell, monitoring and quick action will be required to prevent it from becoming established in the township.

Emerald Ash Borer

Figure 12: Emerald Ash Borer

Photo by Ken Walker, Victoria Museum, Bugwood.org

Ash trees are common in Hopewell's forests and residential areas. Emerald Ash Borer (EAB) (*Agrilus planipennis*) is an exotic beetle that was discovered near Detroit, Michigan in the summer of 2002 and has since spread eastward through Pennsylvania. EABs probably arrived in the United States on solid wood packing material carried in cargo ships or airplanes originating in its native Asia. Although it has yet to appear in New Jersey, it is possible that it will impact the state in the near future. The larvae of the beetles feed on the inner bark of ash trees, disrupting the tree's ability to transport water and nutrients. In North America, native ash trees have little or no resistance to EAB, and natural enemies have so far had little effect when EAB populations are high. Since its discovery, EAB has killed more than 30 million ash trees in southeastern Michigan alone, costing municipalities, property owners, nursery operators, and forest products industries tens of millions of dollars.

Adult EAB beetles are dark metallic green in color, one half inch long and one eighth inch wide. Heavily infested trees exhibit canopy die-back, usually starting at the top of the tree. Most of the

canopy will be dead within two years of when symptoms first appear. Although difficult to see, the adult beetles leave a "D"-shaped exit hole in the bark, roughly one eighth inch in diameter, when they emerge in June. Native ash borers leave a circular exit hole.

EAB is primarily spread when people move infested ash nursery trees, logs, or firewood into uninfested areas. Shipments of ash nursery trees and ash logs with bark are now regulated, but transport of infested firewood remains a problem. Ash firewood or logs should never be moved outside a quarantined area.

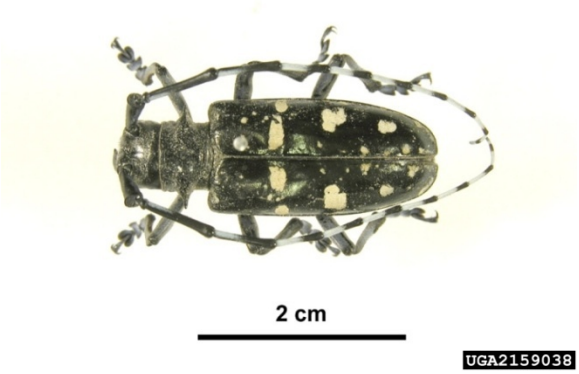
If and when EAB reaches Hopewell, it will severely damage Hopewell's forests and suburban shade trees and greatly impact budgets. The citizens of Hopewell can help by carefully monitoring their ash trees for sign and symptoms of EAB throughout the year. If signs of EAB infestations are spotted, state or county natural resource agencies should be contacted. The USDA also maintains an Emerald Ash Borer toll-free hotline at 1-866-322-4512. See www.emeraldashborer.info for additional information.

Asian Longhorned Beetle

A new and potentially serious threat to some of North America's most beautiful and popular trees is the Asian Longhorned Beetle (ALB) (*Anoplophora glabripennis*). Native to parts of Asia, the beetle is believed to have arrived in North America in the wooden packing material used in cargo shipments from China. Isolated ALB infestations have been discovered in Brooklyn and Amityville, New York, and in Chicago, Illinois. In all instances where ALBs have been found, authorities have reacted quickly to stop the infestation from spreading. Two infestations have been discovered in New Jersey.

Figure 13: Asian Longhorned Beetle

Photo by Ken Walker, Museum Victoria, Bugwood.org



Trees favored by the ALB are predominantly maples, but infestations have also been discovered in horse chestnuts, poplars, willows, elms, mulberries, and black locusts. Chemical and biological agents have thus far proven to be ineffective against the ALB and they have few natural predators in North America. In all reported cases of infestation, the affected trees are cut down and the wood destroyed.

Mature ALBs are large insects with bodies ranging from 1 to 1 and one half inches (2.5-4 cm) in length and antennae which can be as long as 4 inches (10 cm). They are shiny and black with white spots and long antennae banded black and white. These beetles have wings and can fly, although only for short distances because of their size and weight.

The ALB is extremely destructive and heavy infestations can kill otherwise healthy adult trees. The damage is caused by beetle larvae which burrow deep within a tree to feed on its food and water conducting vessels. Continued feeding causes structural defects and eventually kills the life sustaining cambium layer by girdling. Mature beetles then burrow out of the tree leaving holes the diameter of ballpoint pens.

Mature beetles emerge from trees beginning in late May and lasting through October with a frequency peaking in July. Tree infestations can be detected by looking for tell-tail exit holes 3/8 to three fourth inches in diameter (1.5-2 cm) often in the larger branches of the crowns of infested trees. Sometimes sap can be seen oozing from the exit holes with coarse sawdust or 'frass' in evidence on the ground or lower branches.

If the presence of ALBs is detected, local forestry officials should be contacted immediately so that they can takes steps to contain the outbreak. Currently, the only known way to combat the ALB is to destroy the infested trees. See www.asian-longhorned-beetle.com/ for more information.

Snakehead Fish

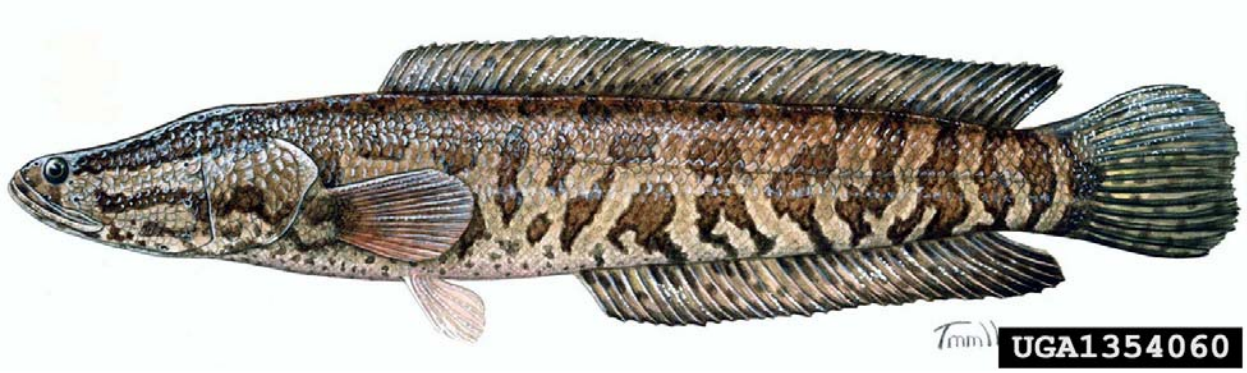
Snakeheads (*Channa*) are a genera of fish native to Asia but imported into the U.S. as aquarium fish and food fish. These predatory fishes are distinguished by a long, cylindrical body, long dorsal fins, snake-like markings, a small head with large scales on top, a large mouth, and sharp teeth. Snakeheads are capable of breathing atomospheric oxygen through the use primitive lungs or "air chambers" located above their gills. As a result, snakeheads can survive out of water for up to four days, and are known to migrate on wet land to other bodies of water by wriggling their body and fins. The snakehead is a "thrust predator," meaning it will eat its prey all at once, striking and swallowing it whole.

Snakeheads are top-level predators that have no natural enemies outside of their native environment, and can therefore cause serious problems to native fish populations and ecosystems if established in U.S. waters. Snakeheads became a national news topic in the U.S. because of the appearance of Northern Snakeheads (*Channa argus*) spawning in a Maryland pond in 2002. Northern Snakeheads became permanently established in the Potomac River in 2004. Non-established specimens have been found in Flushing Meadows-Corona Park, New York, two ponds in FDR Park in Philadelphia, a pond in Massachusetts, and reservoirs in California and North Carolina.

Snakeheads are believed to be introduced into U.S. waters either by the actions of irresponsible pet owners or through intentional release by the live fish food trade. Due to their disruptiveness to nonnative ecosystems, it is illegal to possess live snakeheads in 14 states of the U.S., including New Jersey. If in an enclosed area, snakeheads will try anything to escape. If in an aquarium they will charge at full force and tend to knock over the aquarium or shatter the glass.

Figure 14: Snakehead Fish

Image by Susan Trammell, Bugwood.org



While not present in Hopewell, snakeheads were reported in Philadelphia's FDR Park in 2004 and soon thereafter were discovered in the Delaware River. Although snakeheads have not yet been reported in huge numbers in the Delaware, experience has shown that snakeheads can spread rapidly. In the Potomac River, where snakeheads were also first reported in 2004, many hundreds are now caught each year by fisherman. While snakeheads may be exterminated in confined waterbodies by the use of herbicides, once they are present in open waters, officials are primarily left to study and monitor their spread. USGS tracks confirmed snakehead sightings online at: http://nas.er.usgs.gov/taxgroup/fish/northernsnakeheaddistribution.asp.

ENVIRONMENTAL ISSUES

KNOWN CONTAMINATED SITES

A 2008 NJDEP inventory of Known Contaminated Sites reported 579 contaminated sites in Mercer County. Fifty of these sites are located in Hopewell Township. See **Table 31: Known Contaminated Sites in Hopewell Township** and also **Map 21: Known Contaminated Sites**. Of the 50 contaminated sites in Hopewell, 27 are residential properties. In all likelihood, these residential properties are on the Known Contaminated Sites List due to leaking underground storage tanks.

The NJDEP Known Contaminated Sites List includes former factory sites, landfills, locations of current or former leaking underground storage tanks, sites where chemicals or wastes were once routinely discharged, and places where accidents have resulted in spills and pollution. Contamination may have affected soil, groundwater, surface water or a combination of site conditions. The most dangerous sites, from a human health standpoint, can be listed on the National Priorities List, which makes them eligible for federal cleanup funds under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), commonly known as Superfund (See box, right).

NJDEP maintains a grading system for contaminated sites, which has five levels: B, C1, C2, C3, and D. Sites evaluated as level "B" are the least contaminated and are the easiest to remediate. Sites assigned to the "D" category pose the most serious threats to the environment and require the most complex remedial actions. Sites ranked as "C1" through "C3" fall within the extremes of the B- and D-level sites.

The following section provides more detailed descriptions of some of Hopewell's C3- and D-level sites, which are those with the most serious and complex levels of contamination.

CERLCA, Superfund and the NPL

In 1980, Congress enacted the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), commonly referred to as Superfund and managed by the Environmental Protection Agency (EPA). CERCLA initially taxed petroleum and chemical companies over a period of five years, collecting $1.6 billion. This revenue was then put into the Hazardous Substances Superfund, a trust dedicated to the clean up of uncontrolled or abandoned hazardous waste sites.

CERCLA established prohibitions and requirements concerning closed and abandoned hazardous waste sites, provided for liability of persons responsible for releases of hazardous waste at these sites and established a trust fund to provide for cleanup when no responsible party could be identified.

CERCLA authorizes two kinds of response actions: short term removals, where actions may be taken to address releases or threatened releases requiring prompt response, and long term remedial response actions that permanently and significantly reduce the dangers associated with releases or threats of hazardous substances that are serious, but not immediately life threatening. These actions can be conducted only at sites listed on the EPA's National Priorities List (NPL).

The NPL is a list of the worst hazardous waste sites that have been identified by the EPA. Any site on the NPL is eligible for cleanup using Superfund money. Sites not currently listed on the NPL are not eligible for Superfund money for site remediation. Information regarding sites currently on or eligible for the NPL can be found using the Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS): cfpub.epa.gov/supercpad/cursites/srchsites.cfm

Sites at the C3 remedial level face a multiphase remedial action with high complexity and threatening sites. These sites possess multiple contaminants, some at high concentrations with unknown sources that continue to impact soils, groundwater, and possibly surface waters and

potable surface water resources. Direct contact with contaminated soil is considered dangerous. Sites categorized with the "D" remedial level face all of the challenges inherent to the "C3" remedial level. However, these sites face the additional challenges of multiple sources of contamination and/or multiple releases of contamination (including groundwater).

Princeton Farms Groundwater Contamination (C3 Level Site) – Moores Mill-Mt Rose Road & Howard Way

Princeton Farms is a residential development located off of Moore's Mill-Mt. Rose Road. Sampling conducted by the Hopewell Township Health Department in 1995 identified 12 private potable wells in this area that were contaminated with tetrachloroethylene (also known as perchloroethylene, or PCE) at levels exceeding New Jersey Drinking Water Standards. The source of the contamination is unknown. NJDEP installed Point-Of-Entry Treatment (POET) water filtration systems on the 12 contaminated wells to provide potable water for the residents. NJDEP's Division of Publicly Funded Site Remediation completed a Remedial Action Selection (RAS) for the site in 1997 that concluded the continued use of POET systems in the affected homes was the most cost effective long-term remedy. NJDEP is monitoring and maintaining the POET systems to ensure the units continue to operate effectively, as well as performing additional investigative work at this site to identify possible sources of the groundwater contamination.

AT&T Technologies Inc. (D Level Site) – 300 Hopewell-Princeton Road

The AT&T Technologies site is a former research facility located on Hopewell-Princeton Road. A chemical spill in 1985 contaminated the site with volatile organic compounds (VOCs), principally trichloroethylene (TCE). While onsite soil remediation has been undertaken, TCE has entered into the groundwater supply. The plume currently extends for approximately one mile downgradient, and has impacted residences along Carter Road and Cleveland Road. NJDEP has installed Point-Of-Entry Treatment (POET) water filtration systems on the wells of the impacted residences.

Kooltronic Inc. & The Kings Path Groundwater Contamination (D Level Sites) – Somerset Road & The Kings Path

This Kooltronic Inc. site is an industrial manufacturing facility located in Hopewell Borough, formerly owned by the defense contractor Rockwell International. The site consists of two parts: a main manufacturing facility and a vacant lot across the street that contained an industrial discharge lagoon. The site was found to be contaminated with the VOCs trichloroethylene (TCE) and tetrachloroethylene (PCE). The site has undergone extensive soils remediation, with the contaminated soil having been removed down to bedrock and backfilled. The site is currently in the permitting phase prior to installing a pump and treat system in order to remediate groundwater contamination.

Although the site is located in the borough, the associated plume of contaminated groundwater has moved southeast into the township, contaminating the Kings Path residential development. In 1999, ten private potable wells within the development were sampled by the Hopewell

Township Health Department and found to be contaminated with TCE and PCE at levels exceeding New Jersey Drinking Water Standards. NJDEP installed Point-of-Entry Treatment (POET) water filtration systems on the contaminated wells as an interim remedy to provide potable water for the residents. Sampling of additional wells outside the Kings Path development during 1999 and 2000 by NJDEP's Division of Publicly Funded Site Remediation identified one other home and one vacant lot with contaminated wells. NJDEP subsequently installed a POET system at the affected residences and Kooltronics Inc. installed POET systems in all of the homes in the Kings Path development with contaminant levels below Drinking Water Standards as a precautionary measure. Rockwell International, Hopewell Township, and the Elizabethtown Water Company have negotiated an agreement to install public water lines to the affected area as a permanent remedy. Rockwell International is also conducting a Remedial Investigation (RI) to determine the nature and extent of the soil and groundwater contamination at its facility under the supervision of NJDEP's Division of Responsible Party Site Remediation.

A case manager is assigned to every NJDEP Known Contaminated Site case and can provide further information. The Case Manager can be reached by contacting NJDEP's Site Remediation Program's lead agency, which is listed in the table for each site. For contact information, go to www.state.nj.us/dep/srp/kcs-nj/Mercer/index.html or call 1-800-253-5647.

Table 31: Known Contaminated Sites in Hopewell Township

Name	Address	Status	Status Date	Lead Agency	Remedial Level	PI Number
266 Pennington Harbourton Rd	266 Pennington Harbourton Rd	Active	2/25/2002	BFO-S	C2	G000063149
216 Pleasant Valley Road	216 Pleasant Valley Road	Active	10/15/2001	BFO-S	C1	G000060437
151 Bull Run Road	151 Bull Run Road	Active	9/5/2000	BFO-S	C1	G000044153
289 Hopewell Amwell Road	289 Hopewell Amwell Road	Active	5/10/2000	BFO-S	C1	G000043228
Yard Road Groundwater Contamination	Rte 31 & Yard Road	Active*	11/15/1999	OWR	C1	G000041158
130 Grandview Terrace	130 Grandview Terrace	Active	12/9/1999	BFO-S	C1	G000039592
156 Pleasant Valley Road	156 Pleasant Valley Road	Active	4/9/1999	BFO-S	C2	G000038665
The Kings Path Groundwater Contamination	The Kings Path	Active	7/1/1995	BCM	D	G000037749
Kooltronic Incorporated	Somerset Road	Active	7/28/2000	BCM	D	G000035414
18 Broad Street	18 Broad St	Active	12/5/1997	BFO-S	C2	G000033024
Princeton Farm Groundwater Contamination	Moores Mill-Mt Rose Rd & Howard Way	Active*	7/25/1995	OWR,	C3, C3, C1	G000011713
Morningside Court Groundwater Contamination	Route 31 & Delaware Ave	Active	2/15/1992	OWR	C1	G000009018
AT&T Technologies Incorporated	300 Hopewell Princeton Road	Active	2/4/1997	BISR	D	G000003219
3 East Shore Drive	3 East Shore Dr	Active	3/11/2008	BFO-S	C1	463330
289 Carter Road	289 Carter Road	Active	3/5/2008	BFO-S	C1	462760
St. Michael's Orphanage	130 Hopewell Princeton Road	Active	9/20/2007	BFO-S	C1	448963
16-18 Front Street	16-18 Front St	Active	9/6/2007	BFO-S	B	447833
27 Timberlane Drive	27 Timberlane Dr	Active	7/19/2007	BFO-S	C1	441458

HOPEWELL TOWNSHIP ERI

Name	Address	Status	Status Date	Lead Agency	Remedial Level	PI Number
90 Fiddlers Creek Road	90 Fiddlers Creek Road	Active	6/27/2007	BFO-S	C1	440395
11 Blue Ridge Road	11 Blue Ridge Road	Active	5/30/2007	BFO-S	C1	438241
Hopewell Twp Municipal Building	201 Wash. Crossing-Pennington Road	Active	5/30/2007	BFO-S	Unkown	438182
211 Pennington Rocky Hill Road	211 Pennington Rocky Hill Road	Active	2/22/2007	BFO-S	C2	422887
282 Westcot Boulevard	282 Westcot Bvd	Active	11/29/2006	BFO-S	C1	302696
145 Hopewell Wertsville Road	145 Hopewell Wertsville Road	Active	7/21/2006	BFO-S	C1	292445
79 Blackwell Road	79 Blackwell Road	Active	5/4/2006	BFO-S	C1	287410
4 Bayberry Road	4 Bayberry Road	Active	2/27/2006	BFO-S	C1	282582
11 Blue Spruce Drive	11 Blue Spruce Dr	NFA-A**	1/19/2005	BFO-S	C2	271079
Christensen & Healey Farm	11 Moores Mill Mt Rose Road	Active	8/9/2007	BFO-S	C2	264282
15 Park Lake Avenue	15 Park Lake Avenue	Active	9/19/2005	BFO-S	C1	263043
1403 Trenton Harbourton Road	1403 Trenton Harbourton Road	Active	7/26/2005	BFO-S	C1	259079
2 Blue Spruce Drive	2 Blue Spruce Dr	Active	1/30/2007	BFO-S	C1	252226
Camelot Nursery School	31 Flowers Hill Road	Active	10/28/2004	BFO-S	C1	238866
25 Wrick Ave	25 Wrick Ave	Active	4/30/2003	BFO-S	B	193890
20 Forrest Blend Dr	20 Forrest Blend Dr	Active	12/9/2002	BFO-S	C1	168508
289 Pennington-Lawrenceville Road	289 Pennington-Lawrenceville Road	Active	8/29/2002	BFO-S	C1	163888
Transcontinental Gas Pipeline Pennington M&R	Blackwell Road	Active	1/2/2002	BCM	C3	135832
Hopewell Veterinary Group	230 Hopewell Pennington Road	Active	5/20/1997	BUST	C1, C2	031990
Andy's Auto Repair	130 Broad St W	Active	4/10/1997	BUST	C1, C2	031777
RGH Oil Co	1340 River Road	Active	6/8/1993	BUST	C1, C2	027144
Al's Sunoco Service Station	105 Rte 31 S	Active	9/8/1987	BUST	C1, C2	023687
Union Fire Co.	1396 River Road	Active	4/1/2008	BFO-S	C1	020651
Mercer County Correction Center	Rte 29	Active	4/9/2003	BUST	C1	012758
Hopewell Twp	Rte 546 & Scotch Road	Active	1/20/1990	BUST	C2	011542
Volvo Garage	49 E Broad St	Active	6/14/2004	BUST	C1	009525
2551 Rte 31 & Pennington Cir	Rte 31 & Pennington Cir	Active	6/28/1990	BOMM	C2	007673
Pennington Circle Service Station	226 Rte 31 S	Active	3/19/200	BOMM	C2	007066
Hopewell Delta Corp.	127 Rte 31 & Rte 654	Active	3/17/1992	BOMM	C1, C2	007057
Former Mobil R&D Corporation Facility	311 Pennington-Rocky Hill Road	Active	2/20/2008	CCU	D	005892
Mercer County Voc Schools Sypek	129 Bull Run Road	NFA-A**	12/25/1980	BOMM	C1	005830
Lukoil 57703	2558 Pennington Road	Active	10/27/1987	BUST	C1, C2	003785

Source: NJDEP www.state.nj.us/dep/srp/kcsnj/

* *Site with unknown source of contamination.*
** *Site closed with restrictions.*

Status

Code	Meaning
NFA-A	No further action for a partial area of a site

Lead Agencies Within NJDEP

Initials	Full Name
BCM	Bureau of Case Management
BFO-S	Bureau of Field Operations-Southern
BNCM	Bureau of Northern Case Management
BOMM	Bureau of Operation, Maintenance and Management
BSCM	Bureau of Southern Case Management
BUST	Bureau of Underground Storage Tanks
CAS	Case Assignment Section
INS	Initial Notice Section
OWR	Office of Wellfield Remediation

Explanation of Remedial Levels

Remedial Level	Explanation of Site Complexity
B	A single phase remedial action with a single contaminant affecting only the soil.
C1	A remedial action with simple sites; one or two contaminants localized to soil and the immediate spill or discharge area.
C2	A remedial action with more complicated contaminant discharges; multiple site spills and discharges; more than one contaminant, with both soil and groundwater impacted or threatened.
C3	A multiphase remedial action with high complexity and threatening sites. Multiple contaminants, some at high concentrations with unknown sources, continuing to impact soils, groundwater, and possibly surface waters and potable water resources. Dangerous for direct contact with contaminated soils.
D	Same conditions as C3 except that D levels are also usually designated federal "Superfund Sites."

UNDERGROUND STORAGE TANKS

There are a number of businesses in Hopewell Township that still have underground storage tanks (USTs). These tanks are commonly used to store fuel oil, or in the case of service stations, gasoline or diesel fuel. Corroding and leaking USTs can become a serious threat to the groundwater and soil surrounding them. In 1998, NJDEP required all existing operational tanks to be closed, replaced or upgraded to meet new safety standards. NDJEPs Bureau of Underground Storage Tanks (BUST) regulates these replaced and upgraded tanks, requiring that they be registered, permitted and monitored for leaks at regular intervals. Tanks used for home heating oil, or any heating oil tank under 2,000 gallons, are exempt from these regulations. **Table 32** provides a list of all the USTs registered with NJDEP in Hopewell. Tanks that have created known soil and/or water contamination due to current or past leaks may also be listed on the Known Contaminated Sites List. Detailed information on each of the listed USTs below, such as tank contents, can be found on the NJDEP UST website at: www.nj.gov/dep/srp/bust/bust.htm.

Table 32: Currently Regulated Underground Storage Tanks

PI Number	PI Name	Municipality	Street Address
003785	Lukoil #57703	Hopewell Township	2558 Pennington Rd
009525	Volvo Garage	Hopewell Township	49 E Broad St
011542	Hopewell Twp DPM	Hopewell Township	203 Washington Crossing Pennington Rd
012758	Mercer Cnty Correction Center	Hopewell Township	Rt 29
023687	Al's Sunoco Service Station	Hopewell Township	105 Rt 31S
027144	RGH Oil Co	Hopewell Township	1340 River Rd
031777	Andy's Auto Repair	Hopewell Township	130 Broad St W
031990	Hopewell Veterinary Group	Hopewell Township	230 Hopewell Pennington Rd
001767	N Rt 31 Pennington LLC	Pennington Borough	1 N Rt 31
030035	Castoro GMC Truck Company Inc	Hopewell Borough	71 East Broad St
024008	Leigh's Service Station	Hopewell Borough	59 Princeton Ave
031957	Leigh's Service Station	Hopewell Borough	59 Princeton Ave

Source: NJDEP Site Remediation Program: www.state.nj.us/dep/srp/bust/

GROUNDWATER CONTAMINATION

Three sites in Hopewell have documented groundwater contamination, and are restricted by a Classification Exception Area (CEA) designation. See **Table 33: Sites with CEA Designations**. A CEA can be established for a contaminated site's aquifer, if state drinking-water quality standards are not or will not be met due to: (1) natural groundwater quality; (2) discharges from a NJPDES permitted site; or (3) pollution caused by human activity, sometimes associated with a pollution remedy conducted under a NJDEP Administrative Consent order, within a contaminated site.

A CEA designation suspends aquifer use in the affected areas until state drinking water standards are met. It is not a groundwater remedy; it is an institutional control established in conjunction with an approved remedy. NJDEP may revise or establish a CEA at any time to more accurately reflect the groundwater conditions using current data. If possible, NJDEP or the entity responsible for the remediation or monitoring of the site (known as the responsible party) estimates the duration the CEA will remain in effect. Often, a responsible party applying for a NJPDES permit or submitting a remediation plan for a contaminated site will also submit a CEA designation application, called a CEA Fact Sheet, detailing the aquifer contamination. Information about the dangers of different types of pollutants found in aquifers or wells can be found at the Environmental Defense Scorecard website at: www.scorecard.org.

Table 33: Sites with CEA Designations

Site ID	Name	Approved	Address	Duration (years)	Area (sq ft)	Perimeter (ft)	Depth (ft)	Type of Contamination
NJL800575747	Ardleigh Pond Inc	4/4/02	10 Flower Hill Lane	1.8	5,322.60	263.25	50	Benzene, MTBE
NJD986608651	Exxon Service Station #36324	2/7/06	Pennington Circle & Route 31	4	4,266.70	231.56	25	Benzene, TICS
NJD982280281	Mobil Service Station #15632 (now Lukoil)	10/10/01	Route 31 & Pennington-Lawrenceville Road	Indeter-minate	28,9361.24	2574.37	250	Benzene, MTBE, TBA, TICS, Toulene, Ethylbenzen, Xylenes, Gasoline

Source: NJDEP GIS: www.nj.gov/dep/gis/stateshp.html#CEA

Arsenic

Arsenic is a major source of groundwater contamination in Hopewell Township, with results of the Private Well Testing Act revealing that of 838 wells tested, 240 wells (29 percent) exceeded the state's maximum contamination level of 5 micrograms per liter (see **Appendix A**). Arsenic is listed by the EPA as a known carcinogen, and groundwater contamination may require the installation of a treatment system.

Arsenic is a naturally occurring element found in the earth's crust, and the geology of New Jersey's Piedmont Province enables arsenic to easily mobilize in groundwater, elevating potential contamination throughout the province's aquifers. Additionally, arsenic contamination may be due to the element's use as a pesticide. Arsenic, in the form of chromated copper arsenate, commonly known as tanalith, has been extensively used to preserve wood products against fungus, bacteria and insects. Additionally, prior to the development of synthetic organic compounds, agricultural pesticides were often derived from arsenic.

If a homeowner finds they have contaminated groundwater, NJDEP recommends connecting to a public water supply system if available. If this is not an option, point-of-entry-treatment (POET) systems, which cover entire households, or point-of-use (POU) systems, which cover individual taps, will be required. More information on arsenic contamination can be found on NJDEP's website at: www.state.nj.us/dep/dsr/arsenic/guide.htm.

Radionuclides

Radionuclides are radioactive contaminants emitted from the decay of minerals such as radium and uranium. Although generally occurring at low levels not harmful to public health, human activity can increase these levels. At higher levels, long-term exposure can lead to health problems such as cancer. The EPA has established standards for community water supply systems that set maximum concentration levels of radionuclides, and New Jersey's Private Well Testing Act has revealed that 3 percent of tested wells in the township exceed the levels set by the EPA. Mitigation of radionuclides can be done with a simple home water treatment system.

Specific areas of the township have exhibited higher levels of gross alpha radiation, which is a measure of radionuclides. Homeowners were initially concerned that this was related to industrial activities, due to known TCE contamination and a correlation between TCE contamination and radionuclides (see *Known Contaminated Sites* on *page 125*). However, the radiation has been shown to be uranium based, as opposed to radium based, indicating that these higher levels of gross alpha radiation are more closely related to the fracture zone beneath the residences (a natural phenomenon) rather than adjacent industrial contamination.

RADON

Radon is a radioactive gas that comes from the natural decay of uranium found in nearly all soils. It moves up through the ground to the air above and into all types of homes through cracks and other holes in foundations. A build up of radon contamination within a home can present

residents with a long-term health hazard, specifically, lung cancer. It is invisible, odorless, and tasteless; the only method of detection is to conduct a radon test of the air within a home. Fortunately, radon testing is inexpensive. If radon levels are high in a home, NJDEP suggests the homeowner take the following actions: (1) prevent radon from entering the house by repairing cracks and insulation, and (2) dilute radon concentrations currently in the house by installing ventilation systems.

NJDEP classifies townships into three categories as to the risk of having high radon levels. Tier 1 is the highest level. Hopewell is listed as a Tier 1 municipality with a high risk of having high radon levels in homes. The level at which homeowners should take immediate action is 4.0 picocuries per liter of air. While state law does not require radon testing before a real estate transaction, NJDEP recommends that a contingency clause be included in a sale contract, allowing the buyer to have the home tested for radon and fixing the home if an elevated level of radon gas is discovered. State law (*N.J.A.C. 26:2D-73*) does require, at the time of a real estate transaction, that the seller provide the buyer with a copy of the results of any radon testing if such testing was conducted during tenure. The Hopewell Township Health Department has free literature available regarding radon testing and remediation, and periodically sells home testing kits.

FLOODING

The National Weather Service maintains a station on the Delaware River at Washington Crossing. The station is used for forecasting purposes primarily during times of high water. The flood stage is set at 20 feet. On August 20, 1955, the Delaware River crested to a record peak at Washington Crossing, topping out at 27.77 feet. The third and fourth highest crests occurred in 2005 (23.10 feet) and 2006 (22.54 feet). Serious floods also occurred along the Delaware River in August 1971, January 1996, September 1999, July and September 2004, April 2005, June 2006, and April 2007, although crest heights for these events are not published for the Washington Crossing Station.

According the NJDEP, two major misconceptions about the causes of flooding on the Delaware River are that it is caused by development upriver, and that it can be mitigated by reducing the holding capacity of the reservoirs for New York City. The NJDEP has conducted studies and concluded that neither of these are significant factors in flooding along the lower Delaware. Aerial analysis has shown development in the headwaters to be below the threshold where it would make an impact on flooding, and hydrological models have shown that the spillover from reservoirs into the river makes a negligible contribution to floods when reservoirs are at 96 percent capacity.

The NJDEP has cited the chief causes of flooding to be primarily the result of a wetter climate in the Mid-Atlantic Region. This is further compounded by a greater frequency of tropical weather events, such as storms and hurricanes. The 2004, 2005 and 2006 floods were associated with hurricanes. In general, floods are preceded by a storm event that saturates the local soils. Snowmelt can further compound the problem by adding extra water during the springtime before vegetation can reestablish itself.

One of the most severe flooding events in Hopewell occurred on the evening of June 12, 1996, when heavy rains caused widespread flooding throughout western Mercer County. The storm was considered a 100-year storm event and it dumped more than seven inches of rain on the area in less than four hours and pelted the area with marble- to golf ball-size hail. The sudden rains swelled the Shabakunk Creek and its tributaries. Water rushed into the creek's 100-year floodplain and beyond. Hundreds of roads throughout the Mercer County region were closed due to waters that reached chest level in some places. Basement flooding posed a serious fire hazard when waters got close to outlets, electrical boxes and gas lines.

The 1996 June flood heightened concerns about flooding in the area, and on September 10, 1996, a New Jersey Senate Urban Policy and Planning Committee meeting took place to address some of these concerns. Attendees included township representatives from Trenton, Ewing, and Lawrence, as well as state government officials from agencies such as the Department of Environmental Protection and the Department of Transportation. Officials discussed flood remediation and mitigation strategies, such as de-snagging, bridge replacements, deepening Colonial Lake, putting more water in the Delaware and Raritan Canal, and underground storage retention.

Even before the September 1996 committee meeting, there had been attempts to develop a solution to flooding problems. Several plans were developed, including the Natural Resources Conservation Service (NRCS) comprehensive plan of 1964. This plan suggested building reservoirs (the last of which was built in Hamilton Township in 1994) to contain excess water during storm events. The plan proposed a reservoir on the Shipetauken Creek, but it was not constructed. After severe flooding events in 1975, the NRCS reexamined the Assunpink Creek area to determine the impact of the reservoirs. The agency reported in 1982 that the reservoirs produced only slight mitigation effects, and that "there was nothing else that they, or the federal government, could do to resolve the problem."

A lasting solution to flooding problems in Hopewell and neighboring townships will require preserving, maintaining and restoring wetlands, woodlands and naturally functioning floodplains. Reforestation, the planting of vegetated riparian buffers, and the creation of greenways along waterbodies all help to restore the ability of floodplains to capture, store and retain floodwaters and keep people and structures out of harm's way during flooding events.
Impervious surfaces, such as asphalt, are a large contributor to flooding problems locally because they do not allow water to percolate into the ground. On an impervious surface, water is forced to travel downhill until it can find a place to sink into soil or enter a waterbody. This runoff is greatest after the beginning of a storm or a major snow melt. As impervious surfaces increase, runoff increases in quantity, velocity, temperature, and pollution levels. Development is a large contributor to impervious surfaces through construction of roads, sidewalks, parking lots, driveways, rooftops, and compacted soil. A municipality can lessen these effects by reducing the amount of impervious surfaces within its jurisdiction and by implementing stormwater best management practices (BMPs). Most importantly, development should be kept out of floodplains to the greatest degree possible so floods can occur (as they naturally do) with few impacts to people and property.

OTHER ENVIRONMENTAL CONCERNS

Toxic Releases

Ten facilities in Mercer County filed with the EPA for their annual Toxic Release Inventory (TRI). Although none of these facilities were located in Hopewell Township, these facilities disposed or otherwise released over 3 million pounds of toxic chemicals in 2006, making Mercer County the leader in toxic releases statewide. These chemicals are overwhelmingly ascribed to a single facility, the Mercer Generating Station, located due south of Hopewell on the Delaware River in Hamilton Township. Built in 1960, the Mercer Generating Station is a 77 megawatt power plant, operated by PSE&G, serving southern New Jersey. Releases were primarily in the form of point source air emissions, including 2,800,000 pounds of hydrochloric acid, 210,000 pounds of sulfuric acid and 110,000 pounds of hydrogen fluoride. Other toxins include heavy metals, volatile organic compounds, and complex hydrocarbons.

Historic Pesticides

New Jersey is one of the first states in the nation to address issues relating to toxic pesticide residuals, such as dichloro-diphenyl-trichloroethane (better known as DDT), arsenic, and lead, which remain in the soil from past agricultural operations. In 1996, NJDEP convened a task force to study the extent of the historic pesticide problem in New Jersey and to develop strategies for protecting human health. The task force's findings were issued in an April 1999 report. While the task force examined 18 agricultural sites throughout New Jersey (none in Mercer County), it is estimated that 5 percent of the state's land area is impacted by residues from agricultural pesticides. The primary human health concern of residual contamination is the ingestion of contaminated soil. Therefore, small children who may ingest soil are at the greatest health risk. This issue may affect residents of homes and subdivisions built on former cropland and orchards. Homeowners can take precautions, such as maintaining grass coverage and washing hands and toys after playing in exposed soil. Some developers may be willing to address this problem by testing and removing the existing topsoil and bringing in clean topsoil before construction commences. The development of farmland properties in Hopewell Township have occasionally run into these problems. In one instance, the development of a former chicken farm (closed since the late 1960s) revealed high levels of nitrates.

Deer Ticks

Deer ticks (*Ixodes scapularis)* are the principal vector of Lyme disease in the state of New Jersey. Some have suggested that Lyme disease has become more prevalent in recent years due to the growing presence of deer in suburban areas (see *Deer Management in New Jersey* on *page 85*). Lyme disease is a bacterial infection that initially causes fatigue, fever, muscle aches and joint pain, and, if left untreated, neurological and cardiac problems. Lyme disease can be difficult to diagnose because the initial symptoms are easily construed as other ailments, and deer ticks are extremely small. The most obvious sign is a "bull's eye" rash around a deer tick bite within one to two weeks of becoming infected, but this does not always appear. If this occurs, one should seek medical attention immediately. People can reduce their exposure to Lyme disease by avoiding wooded areas with dense shrubs or tall grasses, wearing solid, light colored clothing outdoors, using insect repellents containing DEET or permethrin, and carefully checking for ticks after leaving tick habitat. More information can be found on the New Jersey Department of Health & Senior Services website at: www.state.nj.us/health/cd/f_lyme.htm.

Figure 15: Deer Tick

Photo by Scott Bauer, USDA

CONCLUSION

Hopewell is a vibrant community whose quality of life is synonymous with its forested hills, its pastoral landscape, and its agricultural heritage. The resources documented in this environmental resource inventory—natural resources, water resources, and biological resources—as well as historic and cultural resources, are key contributors to the character and quality of the Hopewell community. Documentation of these resources provides a foundation for their care, protection and enhancement for the benefit of current and future Hopewell residents. Accomplishing this task will require further planning and policy-making. Fortunately, local officials and community residents have a wide variety of tools at their disposal for this purpose, including municipal land use tools, natural resource protection ordinances and land preservation techniques. Perhaps most importantly, Hopewell is blessed with numerous organizations that continuously work to educate Hopewell residents on the need for, and benefits of, environmental resource protection.

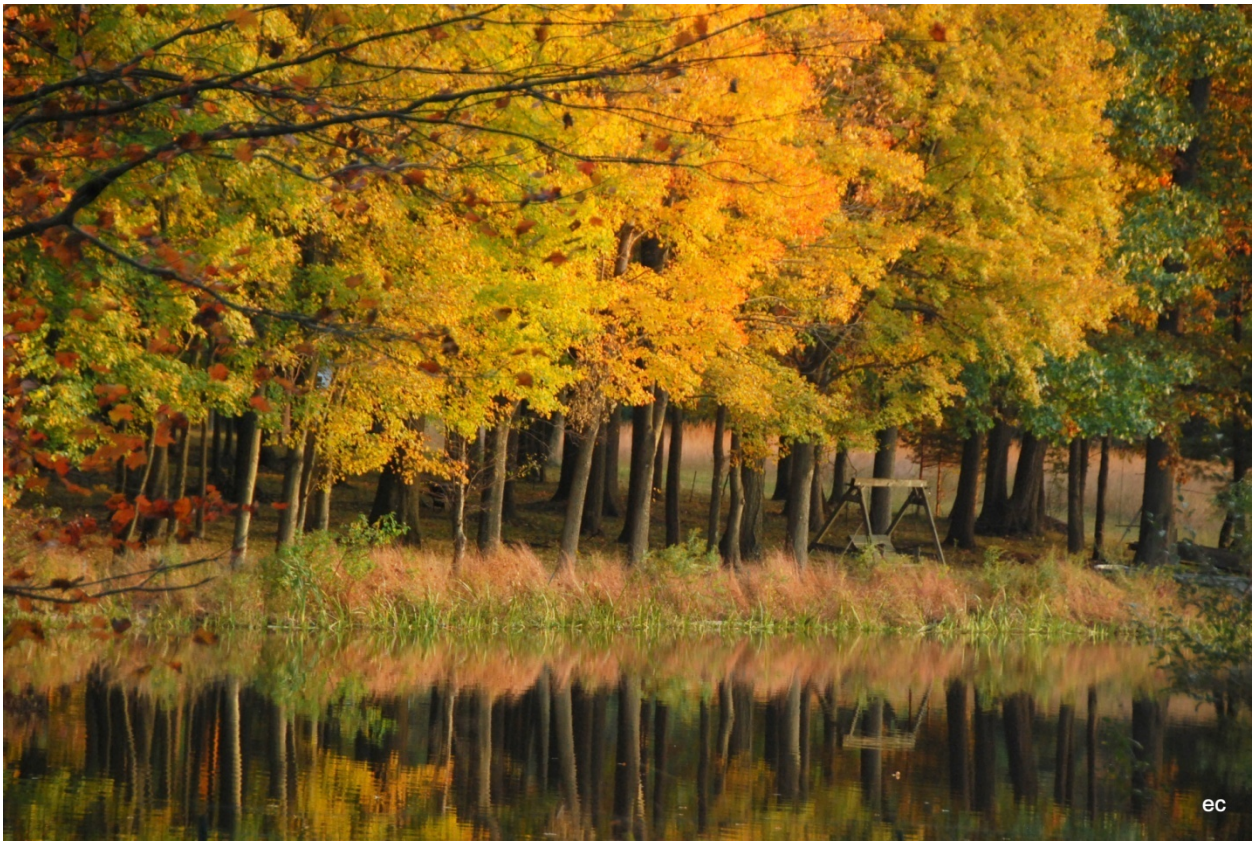


Photo by Eileen Conwayt

Autumn colors reflecting in a stream.

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PRIVATE WELL TESTING ACT

APPENDIX B

FEDERAL AND STATE CONSERVATION PROGRAMS FOR FARMERS AND LANDOWNERS

APPENDIX C

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APPENDIX D

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APPENDIX E

PLANTS AND ANIMALS OF HOPEWELL'S MERCER COUNTY PARK NORTHWEST

APPENDIX F

HOPEWELL TOWNSHIP SITES WITH STATE HISTORIC PRESERVATION OFFICER OPINIONS

APPENDIX G

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APPENDIX A

PRIVATE WELL TESTING ACT

The Private Well Testing Act (PWTA) (*N.J.S.A. 58:12A-26 et seq.*), enacted in 2002 and administered by NJDEP, requires that well water be tested for contaminants when properties served by certain types of drinking water wells are sold or leased. The law does not prohibit the sale of property in cases where the water fails one or more drinking water test standards. Rather, the fundamental goal of the PWTA is to ensure that purchasers and lessees of properties served by private potable wells are fully aware of the quality of the untreated drinking water sources prior to sale or lease. The state law allows the buyer and seller to determine which party will pay for the test, as well as what actions, if any, need to be taken if test results indicate a contaminant is present in the water above an applicable standard. However, individual county health rules may mandate that certain actions are required in order for a real estate transaction to be finalized.

The PWTA program requires that water be tested for primary contaminants (health-based) and secondary parameters (aesthetic characteristics). Primary contaminants are contaminants that may cause a potential health risk if consumed on a regular basis above the established maximum contaminant level (MCL). New Jersey regulates 18 primary contaminants, five more than federal EPA requirements. Primary contaminants include bacteriological (fecal coliform and *E. coli*), Volatile Organic Compounds (VOCs), inorganics (arsenic, lead, mercury, and nitrates), and Radiological (radium decay) substances. A certified laboratory must collect a water sample at a point before the water goes through any treatment. This sample represents the condition of the groundwater in the aquifer, which may be different from water out of a kitchen faucet. Property owners may choose to also have the tap water tested to assure that filters or treatments are working effectively.

Volatile Organic Compounds regulated by NJDEP

- Benzene
- Carbon Tetrachloride
- meta-Dichlorobenzene
- ortho-Dichlorobenzene
- para-Dichlorobenzene
- 1, 1-Dichloroethane
- 1, 2-Dichloroethane
- 1, 1-Dichloroethylene
- *cis* – 1, 2-Dichloroethylene
- *trans* – 1, 2-Dichloroethylene
- 1, 2-Dichloropropane
- Ethylbenzene
- Methyl tertiary butyl ether
- Methylene Chloride
- Monochlorobenzene
- Naphthalene
- Styrene
- 1, 1, 2, 2-Tetrachloroethane
- Tetrachloroethylene
- Toluene
- 1, 2, 4-Trichlorobenzene
- 1, 1, 1-Trichloroethane
- 1, 2, 2-Trichloroethane
- Trichloroethylene
- Vinyl Chloride
- Xylenes (Total)

The PWTA program requires tests for three naturally occurring secondary parameters: pH, iron, and manganese. Secondary drinking water standards address aesthetics, such as corrosivity, taste, and color, and testing for these parameters determines if water is suitable for laundering, plumbing, and showering. For example, due to the nature of soils and geology in southern New Jersey, the groundwaters tend to be acidic (pH below 7), while groundwaters in the northern part are neutral (pH=7) to basic (pH above 7). If the pH is too low (less than 6.5), water has a bitter metallic taste and causes corrosion of pipes and fixtures. If the pH is too high (greater than 8.5), the water has a slippery feel, it tastes like soda, and deposits can form on plumbing fixtures.

Test results are reported by the lab to the person who requested the testing, to NJDEP, and to the local health authority. Suspicious or unexpected results are neither confirmed nor verified by NJDEP. Local health authorities will investigate suspect results, if necessary.

In July 2008, NJDEP released an online report summarizing the well test results reported to the agency between September 2002 and April 2007. Results for 51,028 wells are included, which represent approximately 13 percent of private wells used as potable water supplies in New Jersey. The compilation of water test results is organized by county and municipality, but does not include the names of specific property owners, their addresses, or well locations, because releasing that information is prohibited by law. About 88 percent of the 51,028 wells passed all the required (health-based) standards. Of the 12 percent of wells sampled that exceeded the maximum contaminant level for primary contaminants, the most common reason for failure statewide was gross alpha particle activity (2,209), followed by arsenic (1,445 wells), nitrates (1,399 wells), fecal coliform or E.coli bacteria (1,136 wells), VOCs (702 wells), and mercury (215 wells).

More wells in northern New Jersey were found to have fecal coliform or *E. coli* bacteria than in southern New Jersey. The northern/southern difference is probably due to the different geology in these regions. Northern New Jersey is characterized by limestone subject to solution cavities, fractured bedrock, or gravel water-bearing zones, while the southern part of the state is composed mainly of coastal plain sand and gravel, which appears to provide better protection of groundwater from fecal contaminants.

The test results for Mercer County and Hopewell Township are summarized in the table below. NJDEP's initial report indicates the presence of several drinking water contaminants, including arsenic, gross alpha (radium), nitrates, tetrachloroethelyne (PCE) and trichloroethylene (TCE), in Hopewell's groundwater.

PWTA Sampled Wells over MCL*/Total Sampled Wells (Sept. 2002 – April 2007)

Municipality	Mercury	Fecal coliform/ E. coli	Nitrate	Arsenic (> 5 ug/l)	Gross Alpha	Any VOC** over the MCL
Hopewell Township	*n/a*	*n/a*	*7/896 (0.8%)*	*240/838 (29%)*	*18/594 (3%)*	*26/896 (3%)*
Mercer County	*n/a*	*57/1489 (3.8%)*	*20/1477 (1.3%)*	*273/1350 (20%)*	*45/999 (4.5%)*	*44/1477 (2.4%)*

Source: NJDEP, Division of Science, Research, and Technology (DSRT)

* MCL – Maximum Contaminant Level, set as the limit of a particular substance allowable to achieve a water quality standard
** VOC – Volatile Organic Compound.

APPENDIX B

FEDERAL AND STATE CONSERVATION PROGRAMS FOR FARMERS AND LANDOWNERS

There are several financial and economic incentive programs and technical assistance to help farmers plan and use conservation practices on their farms. The United States Department of Agriculture Natural Resources Conservation Service (NRCS) has a Farm Service Agency office in Freehold, Monmouth County, which serves Mercer County. NRCS staff members are available to work with farmers to help identify their conservation goals and then craft appropriate conservation plans to meet those goals.

Numerous programs provide financial incentives to help farmers voluntarily engage in these practices. Financial incentives can include rental payments to farmers for reserved land, easement payments, and cost sharing, up to 100 percent for some programs, to develop and follow conservation plans.

The **Conservation Reserve Program (CRP)** is offered by NRCS and administered by the Farm Service Agency. It provides technical and financial aid and gives farmers assistance in complying with federal, state and tribal environmental laws. The program encourages farmers to convert highly erodible or environmentally sensitive cropland to vegetative cover, such as native grasses, filter strips or riparian buffers. In exchange, farmers receive rental payments for enrolled land as well as financial assistance for implementing and maintaining conservation practices. The program's website address is: www.nrcs.usda.gov/programs/crp/

The State of New Jersey partnered with the USDA to help farmers protect water quality by establishing a **Conservation Reserve Enhancement Program (CREP)**, which is the New Jersey version of the federal program**.** Under a joint agreement between the USDA and State of New Jersey, $100 million in funding has been provided for farmers to install stream buffers in order to reduce the flow of nonpoint source pollution into the state's waterways. Types of buffers to be installed include trees, shrubs, vegetative filter strips, contour grass strips and grass waterways. Under the program, a landowner installs and maintains approved practices through a 10- or 15-year rental contract agreement. A landowner entering the state Farmland Preservation Program or Green Acres Program also may opt for a permanent easement under the Conservation Reserve Enhancement Program. This would provide additional payment for permanent maintenance of approved conservation practices. The program will pay landowners annual rental and incentive payments for participating in the program, as well as 100 percent of the cost to establish approved practices. Additional information can be found at www.fsa.usda.gov, or contact the local Farm Service Agency (FSA) Office or Soil and Water Conservation District Office.

Another program designed to conserve natural resources is called the **Wetlands Reserve Program (WRP)**. WRP is a voluntary resource conservation program that provides landowners the opportunity to receive financial incentive to restore, protect and enhance wetlands in exchange for returning marginal land from agriculture. WRP is made possible by a

reauthorization in the Food, Conservation and Energy Act of 2008, known as the 2008 Farm Bill. The program has three enrollment options: permanent easement, 30-year easement, or restoration cost-share agreement, which has a minimum 10-year commitment. Applications are accepted on a continuous basis and applications may be obtained and filed at any time. Please see the website for more details: www.nrcs.usda.gov/programs/wrp/

The **Grassland Reserve Program (GRP)** is another conservation program authorized by the 2008 Farm Bill. GRP is a voluntary program that protects grasslands, pasturelands, and rangelands without prohibiting grazing. Participants voluntarily put limitations on the future use of their land while retaining the ability and right to conduct grazing practices, produce hay, mow or harvest for seed production, conduct fire rehabilitation, and construct firebreaks and fences. There are four enrollment options: permanent easement; rental agreement, which is available in 10-, 15-, 20- or 30- year contracts; and restoration agreement. Participants are compensated in different ways according to the enrollment option. For more information and application procedures, visit the GRP website: www.nrcs.usda.gov/programs/grp/

The **Wildlife Habitat Incentives Program (WHIP)** is another voluntary USDA program that targets landowners who want to preserve and protect fish and wildlife habitat on nonfederal lands. WHIP applicants develop a plan of operations outline conservation practices and implementation schedules. The NJ State Conservationist, in conjunction with the State Technical Committee, identifies and prioritizes plans that complement the goals and objectives of relevant fish and wildlife conservation initiative at the state, regional and national levels. If selected, a plan forms the basis of a cost-share agreement, lasting between 1 to 10 years. NRCS will pay for up to 75 percent of costs of implementing conservation practices that protect fish and wildlife habitat. For beginning farmers, socially disadvantaged or limited resource producers, NRCS will pay for up to 90 percent of costs. In New Jersey, a state plan has been developed that targets a number of priority habitat areas: pollinator habitat, grasslands habitat, disturbance-dependent habitat, bog turtle priority species habitat, wetland habitat and Delaware Bay priority habitat. For more information and application procedures, visit the NJ WHIP website: www.nj.nrcs.usda.gov/programs/whip/

The **Environmental Quality Incentives Program (EQIP)** is also a part of the reauthorized 2008 Farm Bill. EQIP is a voluntary program that focuses on conservation that promotes both agricultural production and environmental quality. The program itself offers technical and financial assistance with installation and implementation of structural and management practices on agricultural land. EQIP features a minimum contract term compared to other programs, lasting a maximum of 10 years. Landowners are eligible for incentive and cost-share payments of up to 75 percent, and sometimes up to 90 percent, while still engaging in livestock or agricultural production activities. For more information please visit the website: www.nrcs.usda.gov/programs/eqip

The **Conservation Stewardship Program (CSP)** is a voluntary program administered by the NRCS that replaces the Conservation Security Program. This program is intended to promote conservation and improvement of soil, water, air, energy, plant and animal life, etc., on tribal and private working lands. Working lands refer to a variety of land types, including cropland, grassland, prairie land, improved pasture and rangeland. In some cases, forested lands would

also be included in this category. CSP is available in 50 states as well, as the Caribbean and Pacific Basin areas, and provides equal access to funding. For more information please visit the website: www.nrcs.usda.gov/programs/new_csp/csp.html

The **Farm and Ranch Lands Protection Program (FRPP)** is a voluntary land conservation program that assists farmers to keep their lands for agricultural purposes. FRPP provides matching funds to those provided by state, tribal, local government or nongovernment organizations offering farm and ranch protection programs designed to purchase conservation easements. The FRPP is managed by the NRCS. Conservation easements are purchased by the state, tribal or local entity. The participating landowner agrees not to convert their land to nonagricultural uses and to develop a conservation plan for any highly erodible lands. Landowners do, however, maintain all of their rights to utilize their land for agricultural purposes. For more information about FRPP, please visit the website: www.nrcs.usda.gov/programs/frpp/

The **State Agricultural Development Committee (SADC) in New Jersey** has made soil and water conservation grants available as part of the Farmland Preservation Program. The grants gives landowners up to 50 percent of the funds required for approved soil and water conservation projects. Farms are only eligible if they are already enrolled in a permanent or eight-year easement program. Soil projects can include measures to prevent or control erosion, control pollution on agricultural land, and improve water management for agricultural purposes. Projects must be completed within three years of SADC funding approval. However, under special circumstances, the grant may be renewed for an additional year. For more information, contact the local Soil Conservation District or the State Agricultural Development Committee at (609) 984-2504 or visit the website: www.state.nj.us/agriculture/sadc/sadc.htm for additional details.

The **Landowner Incentive Program (LIP)** is a preservation program for private landowners who wish to protect and conserve rare wildlife habitat and species. LIP is funded by the U.S. Fish and Wildlife Service and is administered by NJDEP's Division of Fish and Wildlife Endangered Nongame Species Program. Participating landowners receive both technical and financial assistance through this competitive grant program. Generally, a five-year minimum commitment is required and longer terms are preferred. A 25 percent cost-share is required of the landowner. While the LIP is seeking funding for additional habitat protection projects, it may be another year before grants are available. To learn more about the program in general visit the website: www.state.nj.us/dep/fgw/ensp/lip_prog.htm.

APPENDIX C

STATE ENDANGERED AND THREATENED SPECIES

Birds			
Endangered		**Threatened**	
American Bittern	*Botaurus lentiginosos*	Bobolink	*Dolichonyx oryzivorus* BR
Eagle, bald	*Haliaeetus leucocephalus* BR **	Eagle, bald	*Haliaeetus leucocephalus* NB **
Falcon, peregrine	*Falco peregrinus*	Hawk, Cooper's	*Accipiter cooperii*
Goshawk, northern	*Accipiter gentilis* BR	Hawk, red-shouldered	*Buteo lineatus* NB
Grebe, pied-billed	*Podilymbus podiceps**	Night-heron, black-crowned	*Nycticorax nycticorax* BR
Harrier, northern	*Circus cyaneus* BR	Night-heron, yellow-crowned	*Nyctanassa violaceus*
Hawk, red-shouldered	*Buteo lineatus* BR	Knot, red	*Calidris canutus* BR
Owl, short-eared	*Asio flammeus* BR	Osprey	*Pandion haliaetus* BR
Plover, piping	*Charadrius melodus***	Owl, barred	*Strix varia*
Sandpiper, upland	*Batramia longicauda*	Owl, long-eared	*Asio otus*
Shrike, loggerhead	*Lanius ludovicianus*	Rail, black	*Laterallus jamaicensis*
Skimmer, black	*Rynchops niger* BR	Skimmer, black	*Rynchops niger* NB
Sparrow, Henslow's	*Ammodramus henslowii*	Sparrow, grasshopper	*Ammodramus savannarum* BR
Sparrow, vesper	*Pooecetes gramineus* BR	Sparrow, Savannah	*Passerculus sandwichensis* BR
Tern, least	*Sterna antillarum*	Sparrow, vesper	*Pooecetes gramineus* NB
Tern, roseate	*Sterna dougallii***	Woodpecker, red-headed	*Melanerpes erythrocephalus*
Wren, sedge	*Cistothorus platensis*		

Reptiles			
Endangered		**Threatened**	
Rattlesnake, timber	*Crotalus h. horridus*	Snake, northern pine	*Pituophis m. melanoleucus*
Snake, corn	*Elaphe g. guttata*	Turtle, Atlantic green	*Chelonia mydas***
Snake, queen	*Regina septemvittata*	Turtle, wood	*Clemmys insculpta*
Turtle, bog	*Clemmys muhlenbergii***		
Atlantic hawksbill	*Eretmochelys imbricata***		
Atlantic leatherback	*Dermochelys coriacea***		
Atlantic loggerhead	*Caretta caretta***		
Atlantic Ridley	*Lepidochelys kempi***		

Amphibians			
Endangered		**Threatened**	
Salamander, blue-spotted	*Ambystoma laterale*	Salamander, eastern mud	*Pseudotriton montanus*
Salamander, eastern tiger	*Ambystoma tigrinum*	Salamander, long-tailed	*Eurycea longicauda*
Treefrog, southern gray	*Hyla chrysocelis*	Treefrog, pine barrens	*Hyla andersonii*

Invertebrates			
Endangered		**Threatened**	
Beetle, American burying	*Nicrophorus mericanus***	Elfin, frosted (butterfly)	*Callophrys irus*
Beetle, northeastern beach tiger	*Cincindela d. dorsalis***	Floater, triangle (mussel)	*Alasmidonta undulata*
Copper, bronze	*Lycaena hyllus*	Fritillary, silver-bordered (butterfly)	*Bolaria selene myrina*
Floater, brook (mussel)	*Alasmidonta varicosa*	Lampmussel, eastern (mussel)	*Lampsilis radiata*
Floater, green (mussel)	*Lasmigona subviridis*	Lampmussel, yellow (mussel)	*Lampsilis cariosa*
Satyr, Mitchell's (butterfly)	*Neonympha m. mitchellii***	Mucket, tidewater (mussel)	*Leptodea ochracea*
Skipper, arogos (butterfly)	*Atrytone arogos arogos*	Pondmussel, eastern (mussel)	*Ligumia nasuta*
Skipper, Appalachian grizzled (butterfly)	*Pyrgus wyandot*	White, checkered (butterfly)	*Pontia protodice*
Wedgemussel, dwarf	*Alasmidonta heterodon***		

Mammals		Fishes	
Endangered		**Endangered**	
Bat, Indiana	*Myotis sodalis***	Sturgeon, shortnose	*Acipenser brevirostrum***
Bobcat	*Lynx rufus*		
Whale, black right	*Balaena glacialis***		
Whale, blue	*Balaenoptera musculus***		
Whale, fin	*Balaenoptera physalus***		
Whale, humpback	*Megaptera novaeangliae***		
Whale, sei	*Balaenoptera borealis***		
Whale, sperm	*Physeter macrocephalus***		
Woodrat, Allegheny	*Neotoma floridana magister*		

Source: NJDEP, Division of Fish & Wildlife

**Also on the federal Endangered and Threatened list

APPENDIX D

RARE PLANT & ANIMAL SPECIES PRESENTLY RECORDED IN THE NJ NATURAL HERITAGE DATABASE FOR HOPEWELL TOWNSHIP

Common Name	Scientific Name	State Status*	State Rank*	Global Rank*
Animal Species				
American kestrel	*Falco sparverius*	SC	S3B, S3N	G5
bald eagle - foraging	*Haliaeetus leucocephalus*	E	S1B, S1N	G4
barred owl	*Strix varia*	T/T	S2B, S2N	G5
bobcat	*Lynx rufus*	E	S1	G5
bobolink	*Dolichonyx oryzivorus*	T/SC	S2B, S3N	G5
brook floater	*Alasmidonta varicose*	E	S1	G3
Canada warbler	*Strophitus undulatus*	S/S	S3B	G5
Cooper's hawk	*Accipter cooperii*	T/S	S2B, S4N	G5
creeper	*Strophitus undulates*		S3	G5
eastern box turtle	*Terrapene carolina carolina*	SC	S3	G5T5
eastern meadowlark	*Sturnella magna*	SC/SC	S3N, S3N	G5
Fowler's toad	*Bufo woodhousii fowleri*	SC	S3	G5
great blue heron	*Ardea herodias*	SC/S	S3B, S4N	G5
hooded warbler	*Wilsonia citrine*	D/S	S3B	G5
long-eared owl	*Asio otus*	T/T	S2B, S2N	G5
red-headed woodpecker	*Melanerpes erythrocephalus*	T/T	S2B, S2N	G5
shortnose sturgeon	*Acipenser brevirostrum*	E	S1	G3
spotted turtle	*Clemmys guttata*	SC	S3	G5
tidewater mucket	*Leptodea ochracea*	T	S2	G4
triangle floater	*Alasmidonta undulate*	T	S2	G4
veery	*Catharus fuscenscens*	S/S	S3B	G5
wood thrush	*Hylocichla mustelina*	SC/S	S3B	G5
wood turtle	*Glyptemys insculpta*	T	S2	G4
worm-eating warbler	*Helmitheros vermivorus*	S/S	S3B	G5
yellow lampmussel	*Lampsillis cariosa*	T	S2	G3G4
Vascular Plants				
small-fruit grooveburr	*Agrimonia microcarpa*		S2	G5
Frank's sedge	*Carex frankii*		S3	G5
willdenow's sedge	*Carex willdenowii var. willdenowii*		S2	G5T5
redbud	*Cercis Canadensis*	E	S1	G5T5
buttonbush dodder	*Cuscuta sephalanthi*	E	S1	G5
wild comfrey	*Cynoglossum virginianum var. virginianum*		S2	G5
lowland fragile fern	*Cystopteris protrusa*		S2	G5
squirrel-corn	*Dicentra canadensis*	E	S1	G5
aunt Lucy	*Ellisia nyctelea*	E	S1	G5
Frank's love grass	*Eragrostis frankii*		S2	G5
spring avens	*Geum vernum*		S2	G5

green violet	*Hybanthus concolor*	E	S1	G5
twinleaf	*Jeffersonia diphylla*	E	S1	G5
winged monkey-flower	*Mimulus alatus*		S3	G5
smooth beardtongue	*Penstemon laevigatus*	E	S1	G5
low spearwort	*Ranunculus pusillus var. pusillus*		S2	G5T4
Ohio spiderwort	*Tradescantia ohiensis*		S2	G5

*** Key to Federal and State Status Codes**

E	Endangered species – one whose prospects for survival within the state are in immediate danger due to one or many factors – a loss of habitat, over exploitation, predation, competition, disease. An endangered species require immediate assistance or extinction will probably follow.
T	Threatened species – a species that may become endangered if conditions surrounding the species begin to or continue to deteriorate.
S	Stable species – a species whose population is not undergoing any long-term increase/decrease within its natural cycle.
SC	Special Concern – applies to animal species that warrant special attention because of some evidence of decline, inherent vulnerability to environmental deterioration, or habitat modification that would result in their becoming a Threatened species. This category would also be applied to species that meet the foregoing criteria and for which there is little understanding of their current population status in the state.
S1	Critically imperiled in NJ because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres).
S2	Imperiled in NJ because of rarity (6 to 20 occurrences).
S3	Rare in state with 21 to 50 occurrences. Includes elements which are widely distributed but with small populations/acreage, or with restricted distribution but locally abundant.
S4	Apparently secure in state, with many occurrences.
S5	Demonstrably secure in state and essentially ineradicable under present conditions.
B	Refers to the breeding population of the element in the state.
N	Refers to the nonbreeding population of the element in the state.
G3	Either very rare and local throughout its range or found locally in a restricted range, making it vulnerable to extinction throughout its range.
G4	Apparently secure globally; although it may be quite rare in parts of its range, especially at the periphery.
G5	Demonstrably secure globally; although it may be quite rare in parts of its range, especially at the periphery.

Source: NJDEP, New Jersey Natural Heritage Program

CAUTIONS AND RESTRICTIONS ON NATURAL HERITAGE DATA

The quantity and quality of data collected by the Natural Heritage Program is dependent on the research and observations of many individuals and organizations. Not all of this information is the result of comprehensive or site-specific field surveys. Some natural areas in New Jersey have never been thoroughly surveyed. As a result, new locations for plant and animal species are continuously added to the database. Since data acquisition is a dynamic, ongoing process, the Natural Heritage Program cannot provide a definitive statement on the presence, absence, or condition of biological elements in any part of New Jersey. Information supplied by the Natural Heritage Program summarizes existing data known to the program at the time of the request regarding the biological elements or locations in question. They should never be regarded as final statements on the elements or areas being considered, nor should they be substituted for on-site surveys required for environmental assessments. The attached data is provided as one source of information to assist others in the preservation of natural diversity.

This office cannot provide a letter of interpretation or a statement addressing the classification of wetlands as defined by the Freshwater Wetlands Act. Requests for such determination should be sent to the DEP Land Use Regulation Program, P.O. Box 401, Trenton, NJ 08625-0401.

The Landscape Project was developed by the Division of Fish & Wildlife, Endangered and Nongame Species Program to map critical habitat for rare animal species. Some of the rare species data in the Landscape Project is in the Natural Heritage Database, while other records were obtained from other sources. Natural Heritage Database response letters will list all species (if any) found during a search of the Landscape Project. However, any reports that are included with the response letter will only reference specific records if they are in the Natural Heritage Database. This office cannot answer any inquiries about the Landscape Project. All questions should be directed to the DEP Division of Fish and Wildlife, Endangered and Nongame Species Program, P.O. Box 400, Trenton, NJ 08625-0400.

This cautions and restrictions notice must be included whenever information provided by the Natural Heritage Database is published.

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

APPENDIX E

PLANTS AND ANIMALS OF HOPEWELL'S MERCER COUNTY PARK NORTHWEST

FERNS

Common Name	Scientific name	Family
northern lady fern	*Athyrium filix-femina*	Aspleniaceae
Christmas fern	*Polystichum acrostichoides*	Aspleniaceae
tree clubmoss	*Lycopodium obscurum (dendroideum?)*	Lycopodiaceae
cut-leaved grape fern	*Botrychium dissectum*	Ophioglossaceae
hayscented fern	*Dennstaedtia punctilobula*	Polypodiaceae
sensitive fern	*Onoclea sensibilis*	Polypodiaceae
New York fern	*Thelypteris noveboracensis*	Polypodiaceae

HERBS

Common Name	Scientific name	Family
indian hemp	*Apocynum cannabinum*	Apocynaceae
skunk cabbage	*Symplocarpus foetidus*	Araceae
swamp milkweed	*Asclepias incarnata*	Asclepiadaceae
purple milkweed	*Asclepias purpurascens*	Asclepiadaceae
common milkweed	*Asclepias syrica*	Asclepiadaceae
jewelweed	*Impatiens capensis*	Asclepiadaceae
terrestrial water starwort	*Callitriche terrestris*	Callitrichaceae
wild bergamot	*Monarda fistulosa*	Caprifoliaceae
purple bergamot	*Mondarda media*	Caprifoliaceae
Deptford pink	*Dianthus armeria*	Caryophyllaceae
evening lychnis, white campion	*Lychnis alba*	Caryophyllaceae
yarrow	*Achillea milefolium*	Compositae
ragweed, common	*Ambrosia artemisiifolia*	Compositae
mugwort	*Artemisis vulgaris*	Compositae
many-flowered aster	*Aster ericoides*	Compositae
New England aster	*Aster novae angliae*	Compositae
health aster	*Aster pilosus*	Compositae
small white aster	*Aster vimineus*	Compositae
tickseed sunflower	*Bidens coronata*	Compositae
beggar ticks	*Bidens polylepis*	Compositae
spotted knapweed	*Centaurea maculosa*	Compositae
ox-eye daisy	*Chrysanthemum leucanthemum*	Compositae
chicory	*Cichorium intybus*	Compositae
Canada thistle	*Circium arvense*	Compositae
field thistle	*Circium discolor*	Compositae
bull thistle	*Circium vulgare*	Compositae
horseweed	*Conyza canadensis*	Compositae
fleabane, common & daisy	*Erigeron sp.*	Compositae

HERBS

Common Name	Scientific name	Family
spotted joe-pye weed	*Eupatorium maculatum*	Compositae
boneset	*Eupatorium perforliatum*	Compositae
joe-pye weed	*Eupatorium purpureum (fistulosun?)*	Compositae
grass-leaved goldenrod	*Euthamia graminifolia*	Compositae
sneezeweed	*Helenium autumnale*	Compositae
tall sunflower	*Helianthus giganteus*	Compositae
Jerusalem artichoke	*Helianthus tuberosus*	Compositae
wild lettuce	*Lactuca canadensis*	Compositae
black-eyed susan	*Rudbeckia hirta*	Compositae
tall goldenrod	*Solidago altissima*	Compositae
Canada goldenrod	*Solidago canadensis*	Compositae
late goldenrod	*Solidago gigantea*	Compositae
lance-leaved goldenrod	*Solidage graminifolia*	Compositae
early goldenrod	*Solidago juncea*	Compositae
gray goldenrod	*Solidago nemoralis*	Compositae
rough-stemmed goldenrod	*Solidago rugosa*	Compositae
oyster plant	*Tragopogon porrifolius*	Compositae
New York ironweed	*Vernonia noveboracensis*	Compositae
clotbur/cocklebur	*Xanthium strumarium*	Compositae
field mustard	*Brassica rapa (?)*	Cruciferae
dry oak woodland sedge	*Carex pennsylvanica*	Cyperaceae
sedge	*Carex spp. (several spp.)*	Cyperaceae
woolgrass	*Scirpus cyperinus*	Cyperaceae
bulrush	*Scirpus georgianus (?)*	Cyperaceae
closed or bottle gentian	*Gentiana clausa*	Gentianaceae
redtop (bentgrass)	*Agrostis alba*	Graminaceae
ticklegrass	*Agrostis hyemalis*	Graminaceae
bushy beard-grass	*Andropogon glomeratus*	Graminaceae
little bluestem (broom beardgrass)	*Andropogon scoparius*	Graminaceae
broomsedge	*Andropogon virginicus*	Graminaceae
orchard grass	*Dactylis glomerata*	Graminaceae
smooth crab brass	*Digitalis ischamaemum*	Graminaceae
barnyard grass	*Echinochloa crusgalli*	Graminaceae
spikerush	*Elechris olivacea*	Graminaceae
wild rye	*Elymus virginicus*	Graminaceae
tussock sedge	*Karex stricta*	Graminaceae
fall panicum	*Panicum dicotomiflorum*	Graminaceae
switch grass	*Panicum virgatum*	Graminaceae
reed canary grass	*Phalaris arundinacea*	Graminaceae
common reed grass	*Phragmites communis*	Graminaceae
little blue stem	*Schizachyrium scoparium*	Graminaceae
green bulrush	*Scirpus atrovirers*	Graminaceae
nodding foxtail grass	*Setaria faberi*	Graminaceae

HERBS

Common Name	Scientific name	Family
yellow foxtail grass	*Setaria glauca*	Graminaceae
bristly foxtail	*Setaria sp.*	Graminaceae
indian grass	*Sorgastrum nutans*	Graminaceae
grease grass/purple top	*Tridens flava*	Graminaceae
common St. Johnswort	*Hypericum perforatum*	Guttiferae
soft rush	*Juncus effusus*	Juncaceae
secund rush	*Juncus secundus*	Juncaceae
cut-leaved water-horehound	*Lycopus americanus*	Labiatae
stalked bugleweed	*Lycopus rubellus*	Labiatae
self-heal	*Prunella vulgaris*	Labiatae
narrow-leafed mountain mint	*Pycnanthemum tenuifolium*	Labiatae
mountain mint	*Pycnanthemum muticum*	Labiatae
hairy skullcap	*Scutellaria ellipica*	Labiatae
tick trefoil	*Desmodium sp.*	Leguminosae
round-headed bush clover	*Lespedeza capitata*	Leguminosae
white sweet clover	*Melilotus alba*	Leguminosae
trailing wild bean	*Strophostyles helvola*	Leguminosae
yellow hope clover	*Trifolium agarium*	Leguminosae
red clover	*Trifolium pratense*	Leguminosae
white clover	*Trifolium repens*	Leguminosae
asparagus	*Asparagus officinalis*	Lilaceae
turks-cap lilly	*Lilium superbum*	Liliaceae
false solomon's seal	*Smilacina racemosa*	Lilaceae
purple loosestrife	*Lythrum salicaria*	Lythraceae
velvetleaf	*Abutilon theophrasti*	Malvaceae
Viginia meadow beauty	*Rhexia virginica*	Melastomataceae
purple-leaved willow-herb	*Epilobium coloratum*	Onagraceae
water purslane	*Ludwigia palustris*	Onagraceae
evening primrose	*Oenothera biennis*	Onagraceae
sundrops	*Oenothera fruticosa*	Onagraceae
nodding ladies' tresses	*Spiranthes cernua*	Orchidaceae
yellow wood sorrel	*Oxalis stricta*	Oxalidaceae
pokeweed	*Phytolacca americana*	Phytolaccaaceae
English plaintain	*Plangago lanceolata*	Plantaginaceae
plaintain	*Plantago major?/rugelii?*	Plantaginaceae
deer tongue grass	*Dicanthelium spp.*	Poaceae
Japanese stilt grass	*Microstegium vimineum*	Poaceae
halberd-leaved tearthumb	*Polygonum arifolium*	Polygonaceae
cespitose knotweed	*Polygonum cespitosum*	Polygonaceae
lady's thumb	*Polygonum persicaria*	Polygonaceae
water smartweed	*Polygonum punctatum*	Polygonaceae
arrow-leaved tearthumb	*Polygonum sagittatum*	Polygonaceae
curled cock	*Rumex crispus*	Polygonaceae
Virginia knotweed	*Tovara virginiana*	Polygonaceae

HERBS

Common Name	Scientific name	Family
striped wintergreen	*Chimaphila maculata*	Pyrola
goatsbeard	*Aruncus dioicus*	Rosaceae
white avens	*Genum canadense*	Rosaceae
common cinquefoil	*Potentilla simplex?*	Rosaceae
potentilla	*Potentilla sp.*	Rosaceae
steeplebush	*Spitea tomentosa*	Rosaceae
bedstraw	*Galium sp.*	Rubiaceae
clayton's bedstraw	*Galium tinctorium*	Rubiaceae
partridge berry	*Mitchella repens*	Rubiaceae
purple gerardia	*Gerardia purpurea*	Scrophulariaceae
winged monkeyflower	*Mimulus alatus*	Scrophulariaceae
hairy beardtongue	*Penstemon hirsutus?*	Scrophulariaceae
moth mullein	*Verbascum blattaria*	Scrophulariaceae
common mullien	*Verbascum thapsus*	Scrophulariaceae
horse nettle	*Solanum caolinense*	Solanaceae
black nightshade	*Solanum nigrum*	Solanaceae
cattail	*Typha latifolia*	Typhaceae
queen anne's lace	*Daucus carota*	Umbelliferae
blue vervain	*Verbena hastata*	Verbenaceae

SHRUBS

Common Name	Scientific name	Family
smooth sumac	*Rhus Glabra*	Anacardiaceae
deciduous leaved holly	*Ilex decidua?*	Aquifoliaceae
winterberry	*Ilex verticillata*	Aquifoliaceae
Japanese barberry	*Berberis thunbergii*	Berberidaceae
common elderberry	*Sambucus canadensis*	Caprifoliaceae
maple-leafed viburnum	*Viburnum acerfolium*	Caprifoliaceae
arrowwood	*Viburnum dentatum*	Caprifoliaceae
nannyberry	*Viburnum lentago*	Caprifoliaceae
black haw	*Viburnum prunifolium?*	Caprifoliaceae
winged Euonymus	*Euonumus sp.*	Celastraceae
silky dogwood	*Cornus amomum*	Cornaceae
panicled dogwood	*Cornus racemosa*	Cornaceae
red-osier dogwood	*Cornus sericea*	Cornaceae
black huckleberry	*Gaylussacia bacatta*	Ericaceae
maleberry	*Lyonia ligustrina*	Ericaceae
highbush blueberry	*Vaccinium corymbossum*	Ericaceae
spicebush	*Lindera benzoin*	Lauraceae
bayberry (northern)	*Myrica pennsylvanica*	Myricaceae
autumn olive	*Elaegnus umbellata*	Oleaceae
shadbush	*Amerlanchier arborea*	Rosaceae
hawthorn	*Crategus sp.*	Rosaceae

SHRUBS

Common Name	Scientific name	Family
red chokeberry	*Pyrus arbutifolia*	Rosaceae
American crabapple	*Pyrus coronaria*	Rosaceae
crabapple	*Pyrus sp.*	Rosaceae
multiflora rose	*Rosa multiflora*	Rosaceae
swamp rose	*Rosa palustris?*	Swamp Rose
Virginia rose	*Rosa virginiana*	Rosaceae
common blackberry	*Rubus allegheniensis*	Rosaceae
dewberry	*Rubus flagellaris*	Rosaceae
blackberry	*Rubus pennsylvanicus?*	Rosaceae

TREES

Common Name	Scientific name	Family
Norway maple	*Acer platanoides*	Aceraceae
red maple	*Acer rubrum*	Aceraceae
winged sumac	*Rhus copallina*	Anacardiaceae
staghorn sumac	*Rhus typhina*	Anacardiaceae
river birch	*Betula nigra*	Betulaceae
grey birch	*Betula populifolia*	Betulaceae
honey locust	*Gleditsia triacanthos*	Caesalpiniaceae
flowering dogwood	*Cornus florida*	Cornaceae
eastern red cedar	*Juniperus virginiana*	Cupressaceae
persimmon	*Diospyros virginiana*	Ebenaceae
black locust	*Robinia pseudoacacia*	Fabaceae
American beech	*Fagus grandifolia*	Fagaceae
white oak	*Quercus alba*	Fagaceae
swamp white oak	*Quercus bicolor*	Fagaceae
scarlet oak	*Quercus coccinea*	Fagaceae
pin oak	*Quercus palustris*	Fagaceae
black oak	*Quercus velutina*	Fagaceae
sweet gum	*Liquidambar stryaciflua*	Hamamelidaceae
shagbark hickory	*Carya ovata*	Juglandaceae
mockernut hickory	*Carya tomentosa*	Juglandaceae
sassafras	*Sassafras albidum*	Laueaceae
tulip poplar	*Liriodendron tulipifera*	Magnoliaceae
white ash	*Fraxinum americana*	Oleaceae
green ash	*Fraxinus Pennsylvanica*	Oleaceae
plane tree	*Platanus sp.*	Platanaceae
buckthorn	*Rhamnus cathartica(?)*	Rhamnaceae
princess tree	*Paulownia tomentosa*	Rhamnaceae
apple (Sp.)	*Malus sp.*	Rosaceae

TREES

Common Name	Scientific name	Family
black cherry	*Prunus serotina*	Rosaceae
big-toothed aspen	*Populus grandidentata*	Salicaceae
poplar sp., small toothed	*Populus sp.*	Salicaceae
weeping willow	*Salix babylonica*	Salicaceae
black willow	*Salix nigra*	Salicaceae
willow	*Salix sp.*	Salicaceae
American elm	*Ulmus americana*	Ulmaceae
slippery elm	*Ulmus rubra*	Ulmaceae

VINES

Common Name	Scientific name	Family
poison Ivy	*Toxicodendron radicans*	Anacardiaceae
Japanese honeysuckle	*Lonicera japonica*	Caprifoliaceae
morrow's honeysuckle	*Lonicera morrowii*	Caprifoliaceae
asiatic bittersweet	*Celastrus orbiculatus*	Celastraceae
ivy-leaved morning glory	*Ipomoea heteracea (I.nil)*	Convolvulaceae
small white morning glory	*Ipomoea lacunosa*	Convolvulaceae
common morning glory	*Ipomoea purpurea*	Convolvulaceae
common greenbrier	*Smilax rotundifolia*	Liliaceae
Virginia creeper	*Parthenocissus quinquefolia*	Vitaceae
grape	*Vitis sp.*	Vitaceae
fox grape	*Vitus labrusca?*	Vitaceae

ALGAE

Common Name	Scientific name	Family
stonewort (Green Alga)	*Nitella sp.*	

FUNGI

Common Name	Scientific name	Family
fly agaric	*Amanita muscaria*	Amanitaceae
webcap	*Cortinarius sp.*	Cortinariaceae
pinkgill	*Entoloma sp.*	Entolomataceae
waxycap	*Hygrophorus sp.*	Hygrophoraceae
puffball	*Bovista pila*	Lycoperdacea
vase puffball	*Calvatia cyathiformis*	Lycoperdacea
aastern stinkhorn	*Phallus ravenelii*	Phallaceae
turkeytail	*Coriolus versicolor*	Polyporaceae
coincap	*Collybia sp.*	Tricholomataceae
amethyst tallowgill	*Laccaria amerthystina*	Tricholomataceae
deceiver	*Laccaria lacata*	Tricholomataceae

BIRDS

Common Name	Scientific name	Family
great blue heron	*Ardea herodias*	Ardeidae
snow goose	*Chen caerulescens*	Anatidae
Canada goose	*Branta canadensis*	Anatidae
mute swan	*Cygnus olor*	Anatidae
wood duck	*Aix sponsa*	Anatidae
black vulture	*Coragyps atratus*	Cathartidae
turkey vulture	*Cathartes aura*	Cathartidae
osprey	*Pandion haliaetus*	Accipitridae
northern harrier	*Circus cyaneus*	Accipitridae
sharp-shinned hawk	*Accipiter striatus*	Accipitridae
cooper's hawk	*Accipiter cooperii*	Accipitridae
broad-winged hawk	*Buteo platypterus*	Accipitridae
red-tailed hawk	*Buteo jamaicensis*	Accipitridae
rough-legged hawk	*Buteo lagopus*	Accipitridae
American kestrel	*Falco sparverius*	Falconidae
peregrine falcon	*Falco peregrinus*	Falconidae
ring-necked pheasant	*Phasianus colchicus*	Phasianidae
northern bobwhite	*Colinus virginianus*	Phasianidae
wild turkey	*Meleagris gallopavo*	Meleagrididae
Virginia rail	*Rallus limicola*	Rallidae
killdeer	*Charadrius vociferus*	Charadriidae
ring-billed gull	*Larus delawarensis*	Laridae
herring gull	*Larus argentatus*	Laridae
rock dove	*Columba livia*	Columbidae
mourning dove	*Zenaida macroura*	Columbidae
black-billed cuckoo	*Coccyzus erythropthalmus*	Cuculidae
eastern screech-owl	*Otus asio*	Strigidae
great horned owl	*Bubo virginianus*	Strigidae
common nighthawk	*Chordeiles minor*	Caprimulgidae
chimnet swift	*Chaetura pelagica*	Apodidae
ruby-throated hummingbird	*Archilochus colubris*	Trochilidae
red-bellied woodpecker	*Melanerpes carolinus*	Picidae
downey woodpecker	*Picoides pubescens*	Picidae
hairy woodpecker	*Picoides villosus*	Picidae
northern flicker	*Colaptes auratus*	Picidae
eastern wood-pewee	*Contopus virens*	Tyrannidae
willow flycatcher	*Empidonax traillii*	Tyrannidae
eastern phoebe	*Sayornis phoebe*	Tyrannidae
great crested flycatcher	*Myiarchus crintitus*	Tyrannidae
eastern kingbird	*Tyrannus tyrannus*	Tyrannidae
northern shrike	*Lanius excubitor*	Laniidae
white-eyed vireo	*Vireo griseus*	Vireonidae
yellow-throated vireo	*Vireo-throated Vireo*	Vireonidae

BIRDS

Common Name	Scientific name	Family
red-eyed vireo	*Vireo olivaceus*	Vireonidae
blue jay	*Cyanocitta cristata*	Corvidae
American crow	*Corvus brachyrhynchos*	Corvidae
fish crow	*Corvus ossifragus*	Corvidae
purple martin	*Progne subis*	Hirundinidae
tree swallow	*Tachycineta bicolor*	Hirundinidae
barn swallow	*Hirundo rustica*	Hirundinidae
carolina chickadee	*Parus carolinensis*	Paridae
black-capped chickadee	*Parus atricapillus*	Paridae
tufted titmouse	*Parus bicolor*	Paridae
red-breasted nuthatch	*Sitta canadensis*	Sittidae
white-breasted nuthatch	*Sitta carolinensis*	Sittidae
Carolina wren	*Thryothorus ludovicianus*	Troglodytidae
house wren	*Troglodytes aedon*	Troglodytidae
golden-crowned kinglet	*Regulus satrapa*	Sylviidae
blue-gray gnatcatcher	*Polioptila caerulea*	Sylviidae
eastern bluebird	*Sialia sialis*	Turdidae
veery	*Catharus fuscescens*	Turdidae
wood thrush	*Hylocichla mustelina*	Turdidae
American robin	*Turdus migratorius*	Turdidae
European starling	*Sturnus vulgaris*	Sturnidae
gray catbird	*Dumetella carolinensis*	Mimidae
northern mockingbird	*Mimus polyglottos*	Mimidae
brown thrasher	*Toxostoma rufum*	Mimidae
cedar waxwing	*Bombycilla cedrorum*	Bombycillidae
blue winged warbler	*Vermivora pinus*	Parulidae
yellow warbler	*Dendroica petechia*	Parulidae
chestnut-sided warbler	*Dendroica pennsylvanica*	Parulidae
magnolia warbler	*Dendroica magnolia*	Parulidae
yellow-rumped warbler	*Dendroica coronata*	Parulidae
palm warbler	*Dendroica palmarum*	Parulidae
blackpoll warbler	*Dendroica striata*	Parulidae
black-and-white warbler	*Mniotilta varia*	Parulidae
American redstart	*Setophaga ruticilla*	Parulidae
ovenbird	*Seiurus aurocapillus*	Parulidae
common yellowthroat	*Geothylypis trichas*	Parulidae
Wilson's warbler	*Wilsonia pusilla*	Parulidae
scarlet tanager	*Piranga olivacea*	Thraupidae
rufous-sided towhee	*Pipilo erthrophthalmus*	Fringillidae
chipping sparrow	*Spizella passerina*	Fringillidae
field sparrow	*Spizella pusilla*	Fringillidae
savannah sparrow	*Passerculus sandwichensis*	Fringillidae

BIRDS

Common Name	Scientific name	Family
grasshopper sparrow	*Ammodramus savannarum*	Fringillidae
song sparrow	*Melospiza melodia*	Fringillidae
swamp sparrow	*Melospiza georgiana*	Fringillidae
white-throated sparrow	*Zonotrichia albicollis*	Fringillidae
dark-eyed junco	*Junco hyemalis*	Fringillidae
northern cardinal	*Cardinalis cardinalis*	Fringillidae
rose-breasted grosbeak	*Pheucticus ludovicianus*	Fringillidae
indigo bunting	*Passerina cyanea*	Fringillidae
purple finch	*Carpodacus purpureus*	Fringillidae
house finch	*Carpodacus mexicanus*	Fringillidae
American goldfinch	*Carduelis tristis*	Fringillidae
bobolink	*Dolichonyx oryzivorus*	Icteridae
red-winged blackbird	*Agelaius phoeniceus*	Icteridae
eastern meadowlark	*Sturnella magna*	Icteridae
common grackle	*Quiscalus quiscula*	Icteridae
brown-headed cowbird	*Molothrus ater*	Icteridae
orchard oriole	*Icterus spurius*	Icteridae
northern oriole	*Icterus galbula*	Icteridae
house sparrow	*Passer domesticus*	Ploceidae

VERTEBRATES (Excluding Birds)

Common Name	Scientific name	Family
bluegill sunfish	*Lepomis macrochirus*	Centarchidae
northern spring peeper	*Pseudacris crucifer*	Hylidae
bullfrog	*Rana catesbeiana*	Ranidae
green frog	*Rana clamitans melanota*	Ranidae
pickerel frog	*Rana palustris*	Ranidae
northern two-lined salamander	*Eurycea b. bislineata*	Plethodontidae
redback salamander	*Plethodon cinereus*	Plethodontidae
eastern garter snake	*Thamnophis s. sirtalis*	Colubridae
eastern milk snake	*Lampropeltis t. triangulum*	Colubridae
northern black racer	*Coluber c.constrictor*	Colubridae
common snapping turtle	*Chelydra s. serpentina*	Chelydridae
easten box turtle	*Tarrapene c. carolina*	Emydidae
eastern painted turtle	*Chrysemys p. picta*	Emydidae
spotted turtle	*Clemmys guttata*	Emydidae
wood turtle	*Clemmys insculpta*	Emydidae
eastern cottontail rabbit	*Sylvilagus floridanus*	Leporidae
gray squirrel	*Sciuris carolinensis*	Sciuridae
groundhog	*Marmota monax*	Sciuridae

VERTEBRATES (Excluding Birds)

Common Name	Scientific name	Family
meadow vole	*Microtus pennsylvanicus*	Cricetidae
white-footed mouse	*Peromyscus leucopus*	Cricetidae
raccoon	*Procyon lotor*	Procyonidae
coyote	*Canis latrans*	Canidae
red fox	*Vulpes fulva*	Canidae
house cat	*Felis catus*	Felidae
white-tail deer	*Odocoileus virginianus*	Cervidae
bat (species?)		Vespertilionidae
northern short-tailed shrew	*Blarina brevicauda*	Soricidae
eastern mole	*Scalopus aquaticus*	Talpidae

MOTHS

Common Name	Scientific name	Family
hummingbird clearwing	*Hemaris thysbe*	Sphingidae
luna moth	*Actius luna*	Saturniidae
long-winged dagger moth	*Acronicta longa*	Noctuidae
ipsilon dart	*Agrotis ipsilon*	Noctuidae
copper underwing	*Amphipyra pyramidiodes*	Noctuidae
green cutworm moth	*Anicla infecta*	Noctuidae
velvetbean caterpillar moth	*Anticarsia gemmatalis*	Noctuidae
clover looper moth (female)	*Caenurgina crassiuscula*	Noctuidae
forage looper moth	*Caenurgina erechtea*	Noctuidae
girlfriend underwing	*Catocala amica*	Noctuidae
gaceful underwing	*Catocala gracilis*	Noctuidae
woody underwing	*Catocala grynea*	Noctuidae
the little wife	*Catocala muliercula*	Noctuidae
the bride	*Catocala neogama*	Noctuidae
residua underwing	*Catocala residua*	Noctuidae
ultronia underwing	*Catocala ultronia*	Noctuidae
snowy dart	*Euagrotis illapsa*	Noctuidae
common idia	*Idia aemula*	Noctuidae
American idia	*Idia americalis*	Noctuidae
glossy black idia	*Idia lubricalis*	Noctuidae
ursula wainscot	*Leucania ursula*	Noctuidae
roadside sallow	*Metaxaglaea sp (probably viatica)*	Noctuidae
maple looper moth	*Parallelia bistriaris*	Noctuidae
armyworm moth	*Pseudaletia unipuncta*	Noctuidae
the herald	*Scoliopteryx libatrix*	Noctuidae
variable sallow	*Sericaglaea signata*	Noctuidae
yellow-striped armyworm moth	*Spadoptera ornithogalli*	Noctuidae
fall armyworm moth	*Spodoptera frugiperda*	Noctuidae
lesser or greater black letter dart	*Xestia adela or X. dolosa*	Noctuidae
pael-banded dart	*Xestia badinodis*	Noctuidae

MOTHS

Common Name	Scientific name	Family
horrid underwing (horrid zale)	*Zale horrida*	Noctuidae
lunate zale	*Zale lunata*	Noctuidae
brown-shaded gray	*Anacamptodes defectaria*	Geometridae
grape leaffolder moth	*Desmia funeralis*	Pyralidae

BUTTERFLIES

Common Name	Scientific name	Family
eastern black swallowtail	*Papilio polyxenes*	Papilionidae
eastern tiger Swallowtail	*Pterourus glaucus*	Papilionidae
spicebush swallowtail	*Pterourus troilus*	Papilionidae
cabbage white	*Artogeia rapae*	Pieridae
clouded sulfur	*Colias philodice*	Pieridae
orange sulfur	*Colias eurytheme*	Pieridae
spring azure	*Celestrina ladon*	Lycaenidae
summer azure	*Celestrina neglecta*	Lycaenidae
eastern tailed blue	*Everes comyntas*	Lycaenidae
buckeye	*Junonia coenia*	Nymphalidae
mourning cloak	*Nymphalis antiopa*	Nymphalidae
pearl crescent	*Phyciodes tharos*	Nymphalidae
question mark	*Polygonia interrogationis*	Nymphalidae
great spangled frittilary	*Speyeria cybele*	Nymphalidae
American painted lady	*Vanessa virginiensis*	Nymphalidae
red admiral	*Vanessa atalanta*	Nymphalidae
red-spotted purple	*Basilarchia astyanax*	Nymphalidae
viceroy	*Basilarchia archippus*	Nymphalidae
common wood nymph	*Cercyonis pegala*	Satyridae
little wood satyr	*Megisto cymela*	Satyridae
monarch	*Danaus plexippus*	Danaidae
silver-spotted skipper	*Epargyreus clarus*	Hesperidae
juvenal's duskywing	*Erynnis juvenalis*	Hesperidae
least skipper	*Ancyloxypha numitor*	Hesperidae
dun skipper	*Euphyes ruricola*	Hesperidae
peck's skipper	*Polites peckius*	Hesperidae
little glassy-wing	*Pompeius verna*	Hesperidae
European skipper	*Thmyelicus lineola*	Hesperidae

INSECTS

Common Name	Scientific name	Family
six-spotted green tiger beetle	*Cicindela sexgutta*	Cicindelidae
black-winged damselfly	*Calopteryx maculata*	Calopterygidae
white-tail dragonfly	*Plathemis lydia*	Libellulidae
skimmer species		
praying mantis	*Mantis religosa*	Mantidae

Source: Adapted from Biological Survey of the "Pole Farm," The Washington Crossing Audubon Society, January 1999.

APPENDIX F

HOPEWELL TOWNSHIP SITES WITH STATE HISTORIC PRESERVATION OFFICER OPINIONS

Property	Address	Date of Opinion
Adams House	Federal City Road	6/23/1982
Cider Mill	25-35 Pennington-Rocky Hill Road	6/23/1982
Cool Meadows Farm	County Route 546	6/23/1982
Delaware & Bound Brook Railroad Historic District	-	9/9/2005
Enoch Blackwell House	Blackwell Road	6/23/1982
Gould House	Province Line Road	6/23/1982
Hart/Winner Farmstead Site	-	3/20/1998
Hen's Foot Corner/Terhune House	Cleveland Road	6/23/1982
House #1	Blackwell Road	6/23/1982
House #2	Pennington-Rocky Hill Road	6/23/1982
Joseph P. Blackwell Farm	Blackwell Road	6/23/1982
Kahn House	Rocky Hill Road	6/23/1982
McDougal Farm & Barn	Old Mill Road	6/23/1982
Mount Rose Historic District	County Route 569 & Pennington-Rocky Hill Rd	6/23/1982
Nathaniel Drake House	Pennington-Rocky Hill Road	6/23/1982
Old Cleveland Farm	Cleveland Road	6/23/1982
Old Voorhees Farm House & Tenant House	Rocky Hill Road	6/23/1982
Oldis (Smith-Mershon) Farm	County Route 546	5/17/2004
R.A. Drake House	Pennington-Rocky Hill Road	6/23/1982
Thomas Blackwell House	Elm Ridge Road	6/23/1982

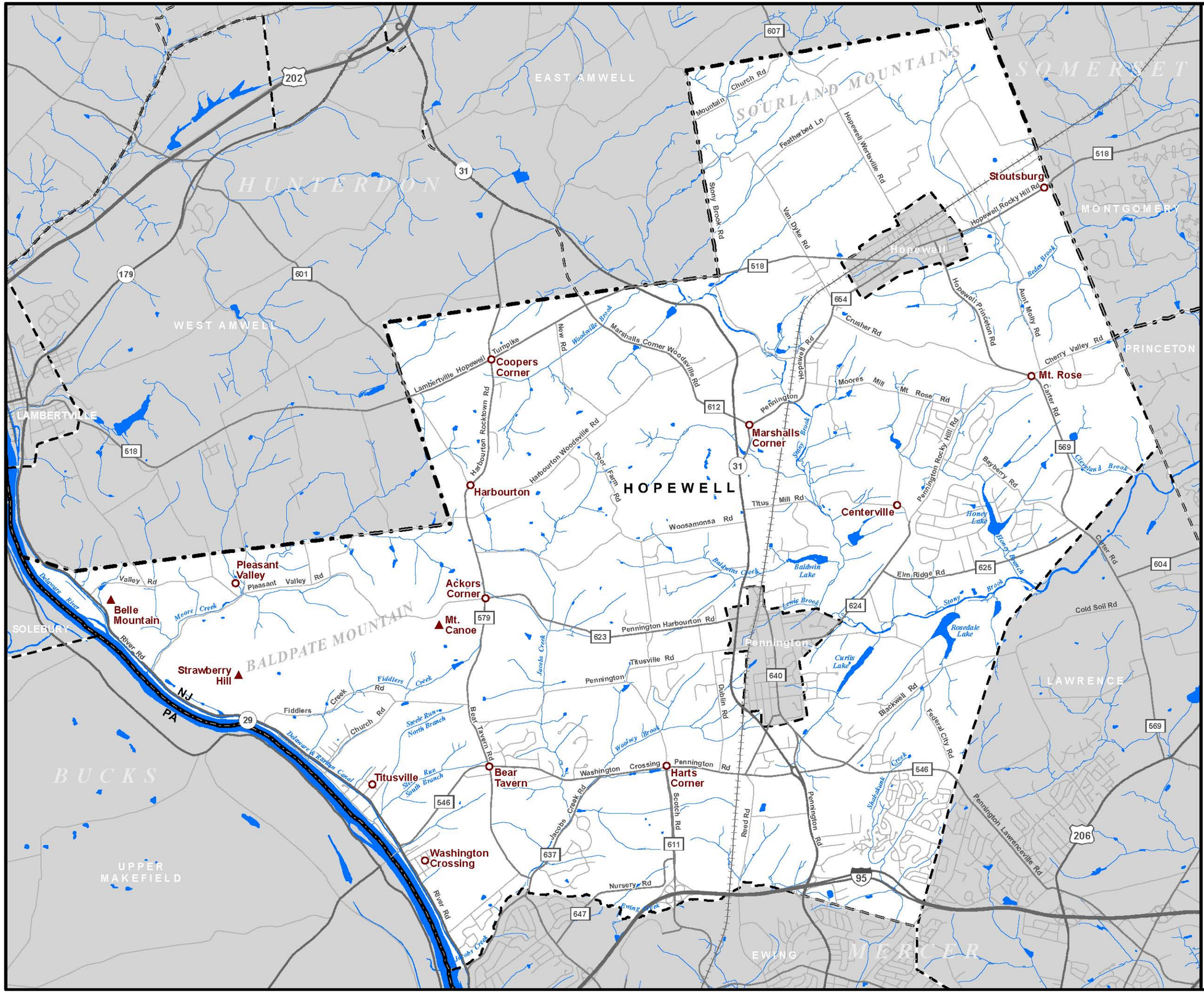
Source: NJ DEP Historic Preservation Office: www.state.nj.us/dep/hpo/

APPENDIX G

MAPS

Map 1: Hopewell Township
Map 2: Aerial Photograph
Map 3: NJDEP Land Cover (2002)
Map 4: Surface Topography
Map 5: Steep Slopes
Map 6: Soils
Map 7: Agricultural Quality of Soils
Map 8: Watersheds
Map 9: Surface Water, Wetlands and Vernal Pools
Map 10: Flood Hazard Areas (1996)
Map 11: Water Quality Sampling Locations
Map 12: Impervious Surface Cover
Map 13: Aquifers and Bedrock Geology
Map 14: Natural Vegetation (2002)
Map 15: Landscape Project Habitat Priorities (2007)
Map 16: Bicycle Level of Service
Map 17: Hopewell Township Historic Resources
Map 18: Public Water Supply Wells
Map 19: Approved Sewer Service Areas
Map 20: Protected Open Space
Map 21: Known Contaminated Sites

Map 1: Hopewell Township



Municipal Boundary
County Boundary
Stream
Lake

N

0 0.25 0.5 1
Miles

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

Sources: NJDEP, NJDOT, DVRPC
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Map 2: Aerial Photograph (2007)

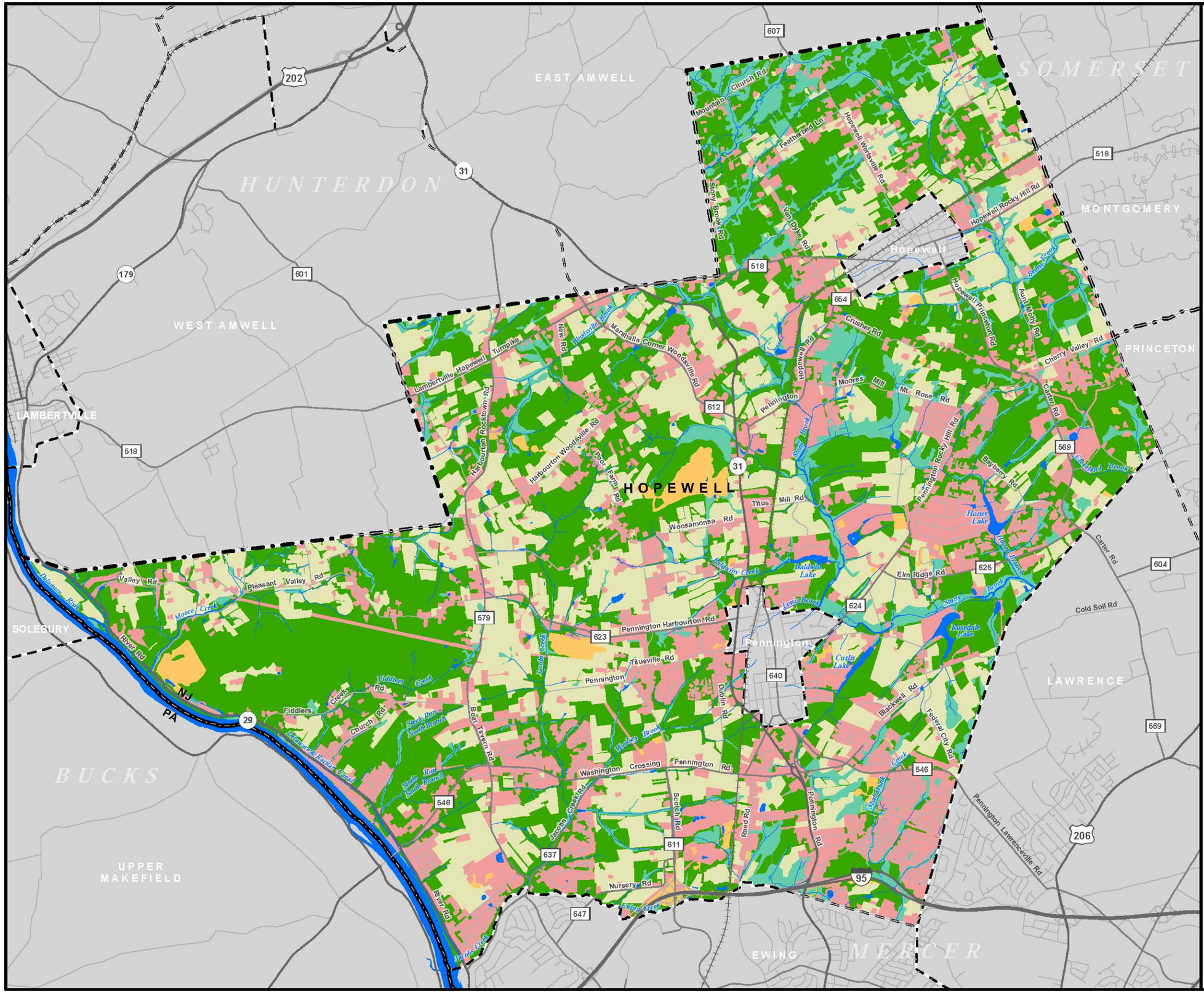
N

0 0.25 0.5 1 Miles

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

Sources: NJDEP, NJDOT, NJOIT, DVRPC
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Map 3: NJDEP Land Cover (2002)



Land Cover Categories

- Agriculture
- Barren Land
- Forest
- Developed
- Water
- Wetlands

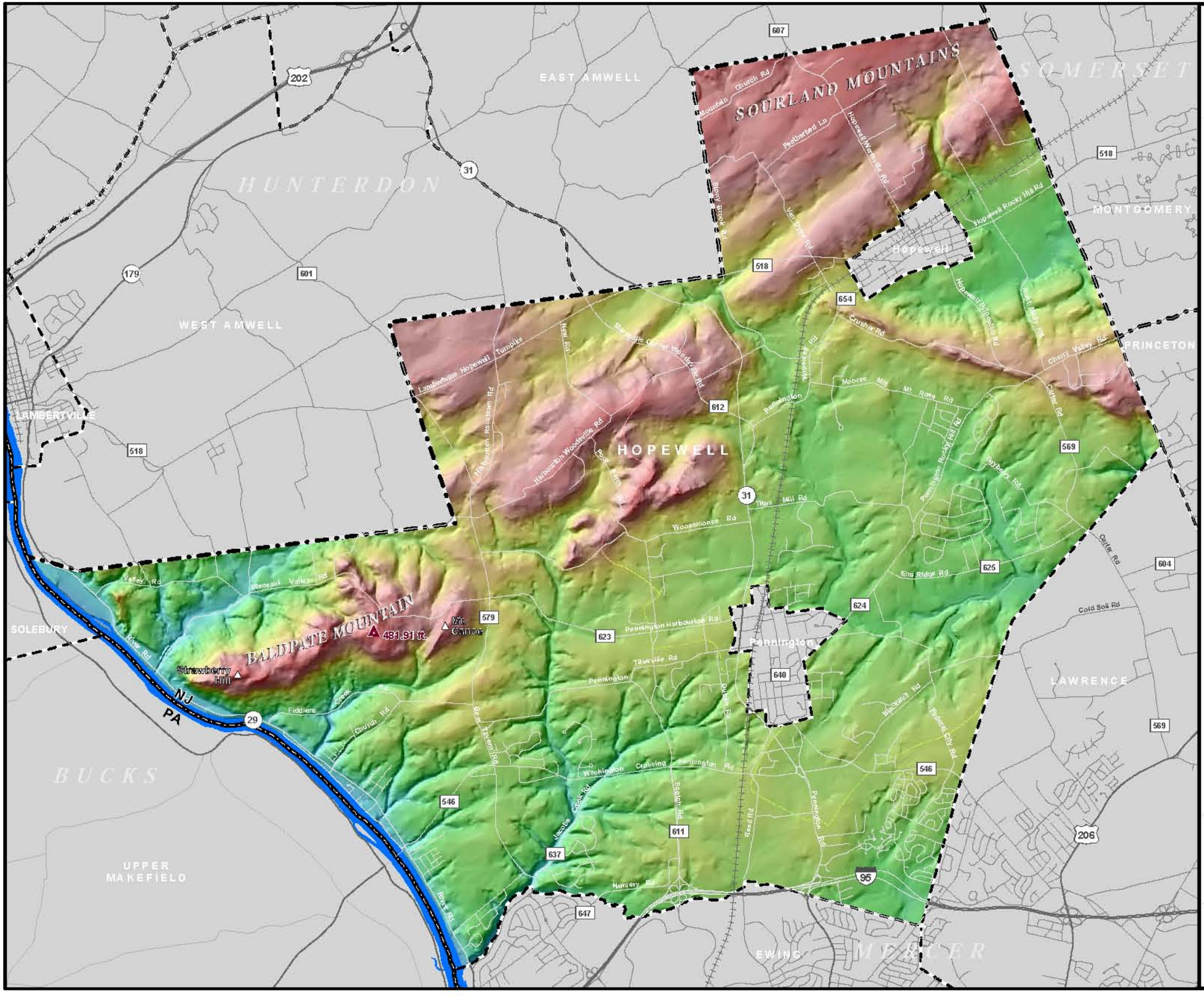
N

0 0.25 0.5 1
Miles

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

Sources: NJDEP, NJDOT, DVRPC
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Map 4: Surface Topography



High : 482 ft.

Low : 19 ft.

N

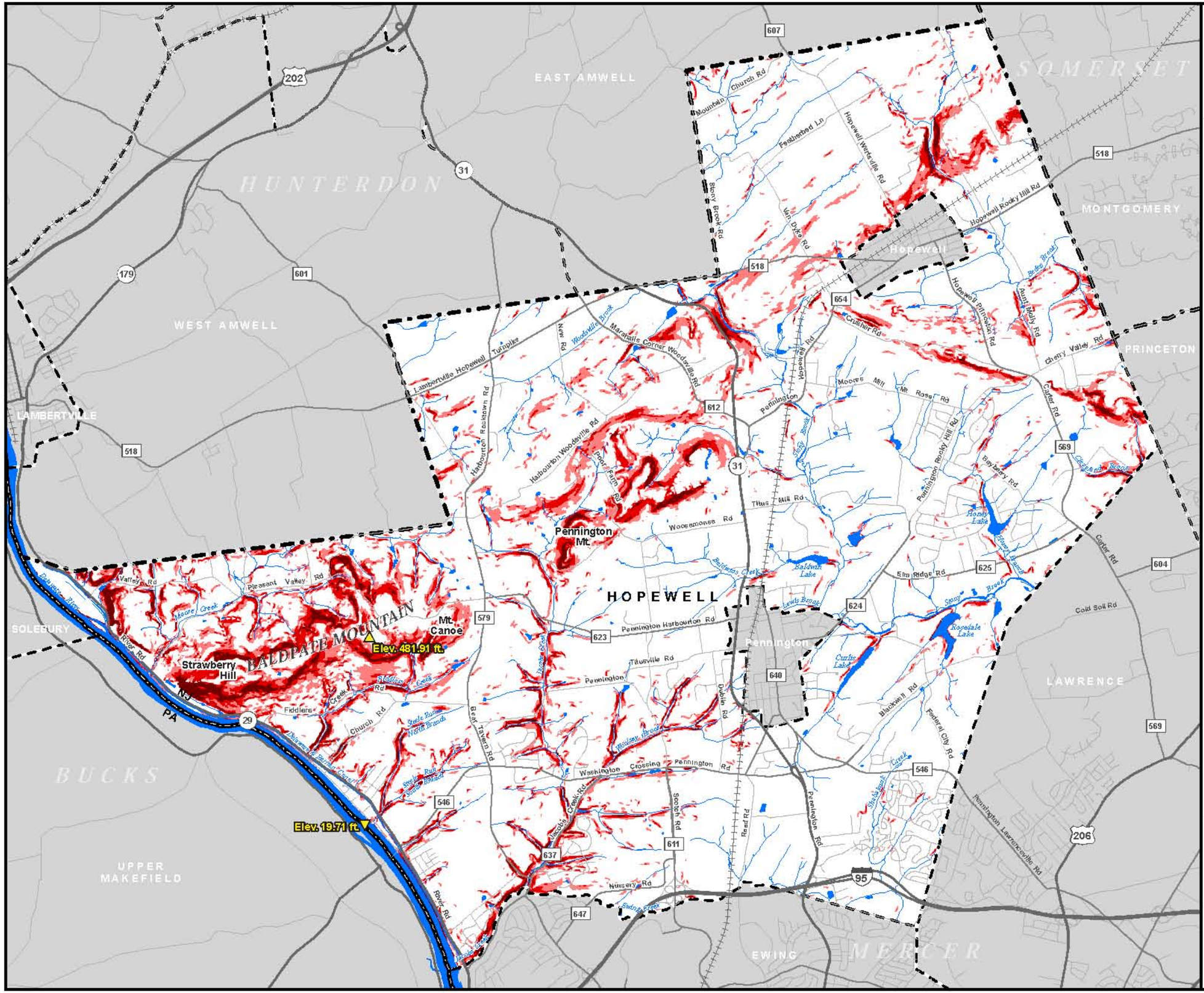
0 0.25 0.5 1

Miles

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

Sources: NJDEP, NJDOT, DVRPC
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Map 5: Steep Slopes



Slope

- Slope < 10%
- Slope = 10% - 14.99%
- Slope = 15% - 24.99%
- Slope >= 25%

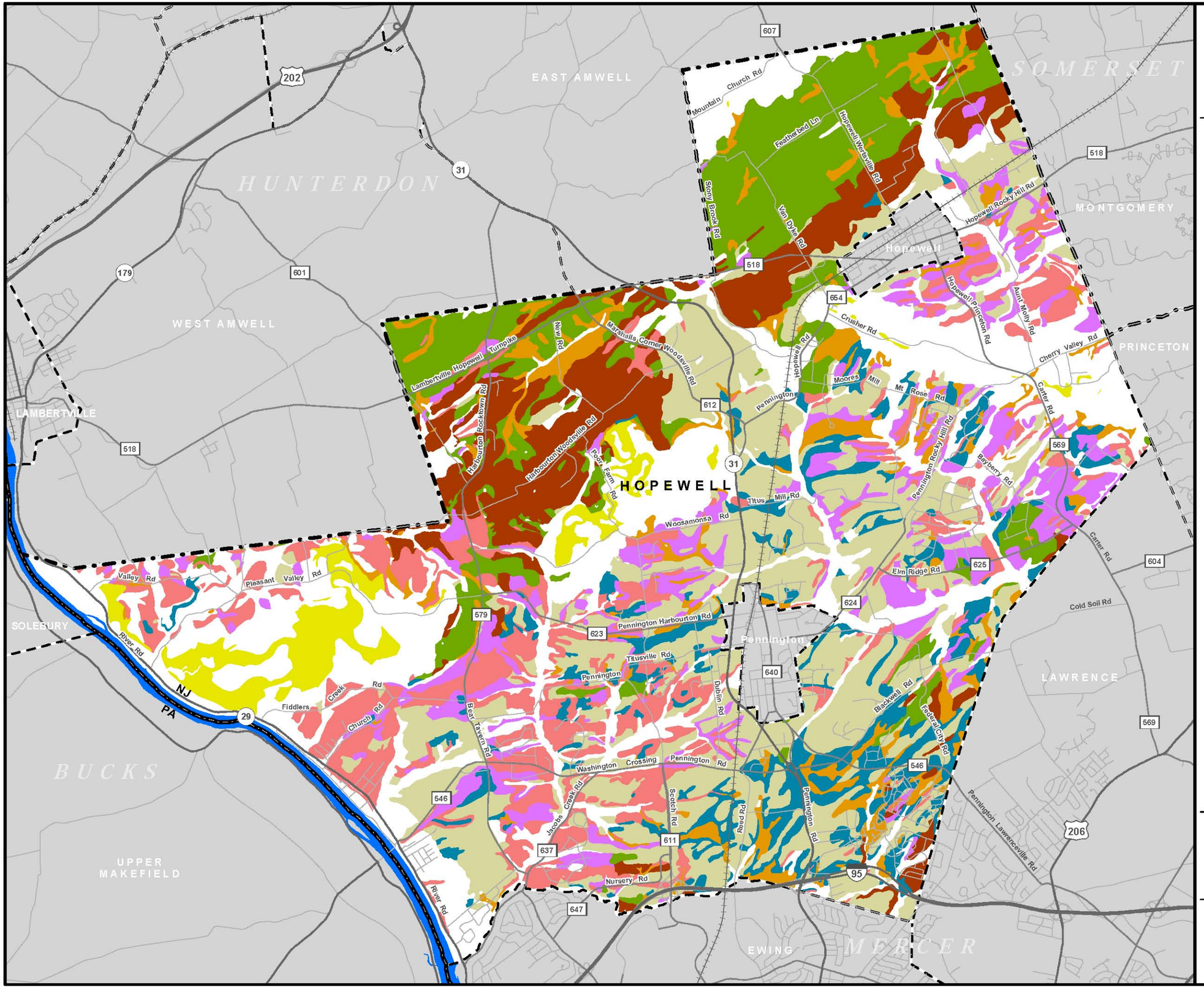
N

0 0.25 0.5 1 Miles

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

Sources: NJDEP, NJDOT, DVRPC
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Map 6: Soils



Soils

- Bucks
- Chalfont
- Doylestown & Reaville
- Legore
- Penn
- Quakertown
- Readington & Abbottstown
- Reaville
- Minor Series

N

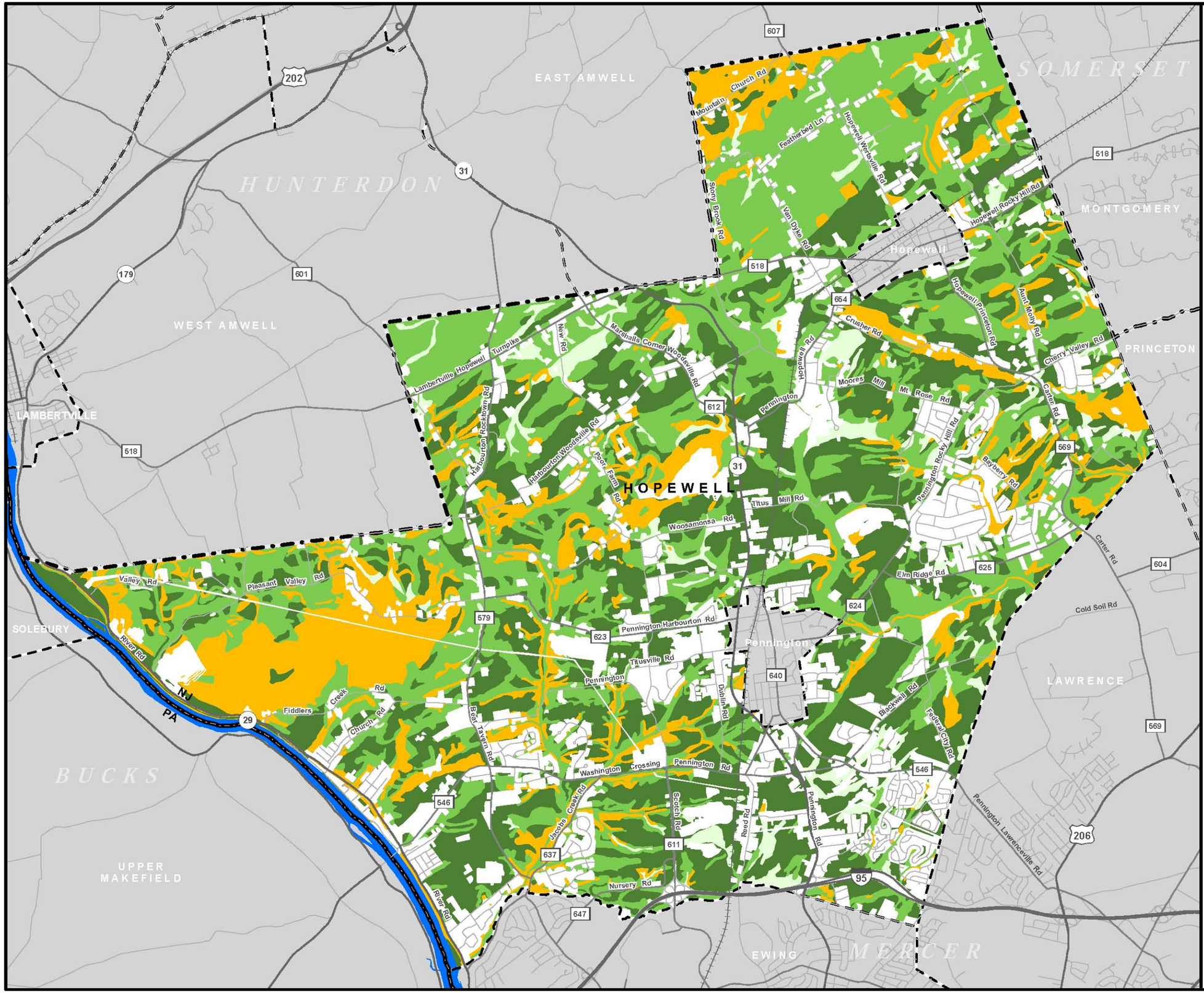
0 0.25 0.5 1

Miles

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

Sources: NJDEP, NJDOT, DVRPC, NRCS
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Map 7: Agricultural Quality of Soils



Soil Designation

- Prime Farmland
- Farmland of Statewide Importance
- Farmland of Local Importance
- Not Rated for Agricultural Use
- Developed Land

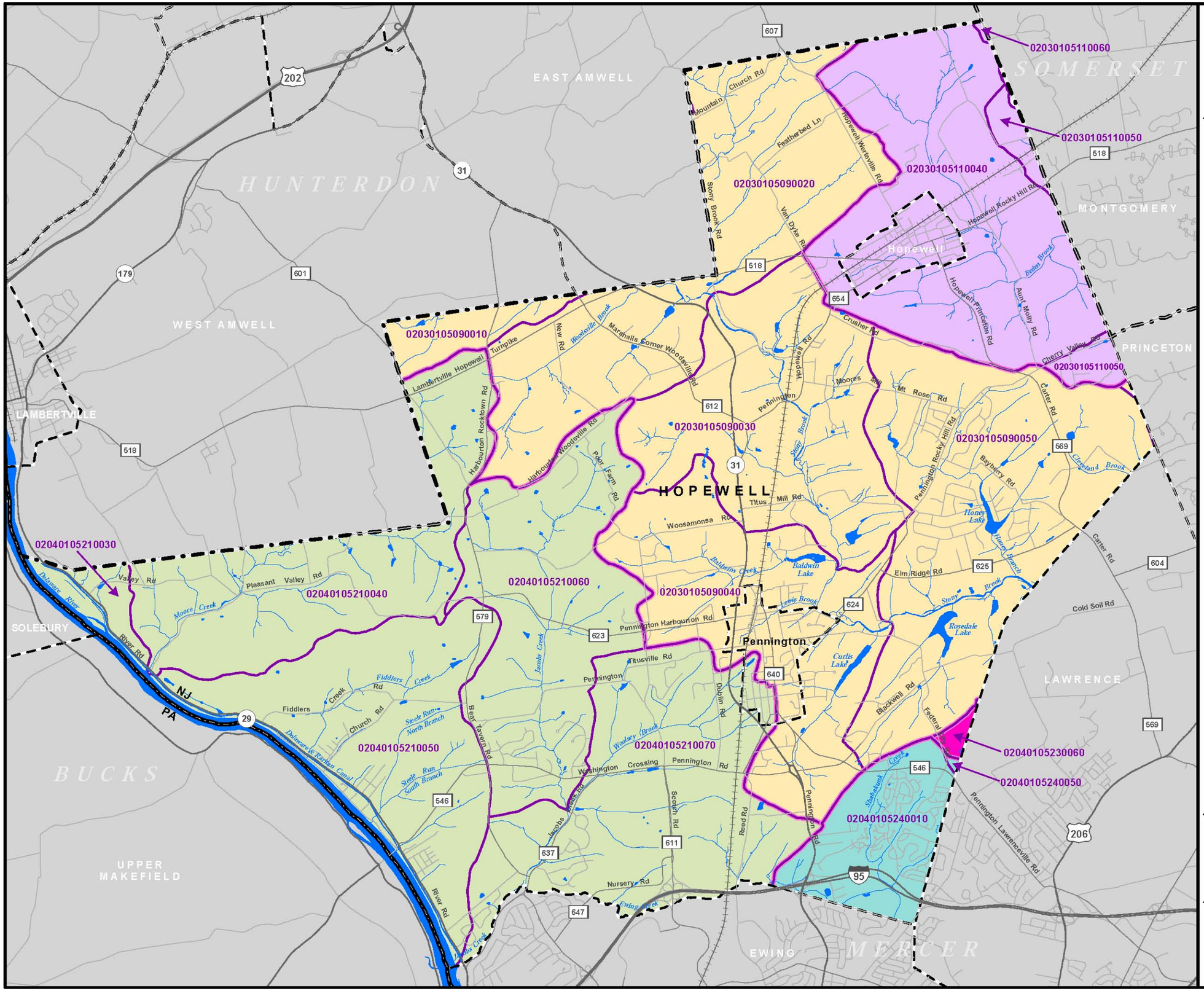
N

0 0.25 0.5 1
Miles

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

Sources: NJDEP, NJDOT, DVRPC, NRCS
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Map 8: Watersheds



HUC 14

HUC 11's

- Millstone River (below/including Carnegie Lake)
- Stony Brook
- Moore Creek/Jacobs Creek
- Assunpink Creek (below Shipetaukin Creek)
- Assunpink Creek (above Shipetaukin Creek)

N

0 0.25 0.5 1
Miles

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

Sources: NJDEP, NJDOT, DVRPC
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Map 9: Surface Water, Wetlands, & Vernal Pools

- Dam
- Potential Vernal Pool
- Vernal Pool
- Stream
- Category 1 Stream
- Lake
- Agricultural Wetlands
- Wetlands

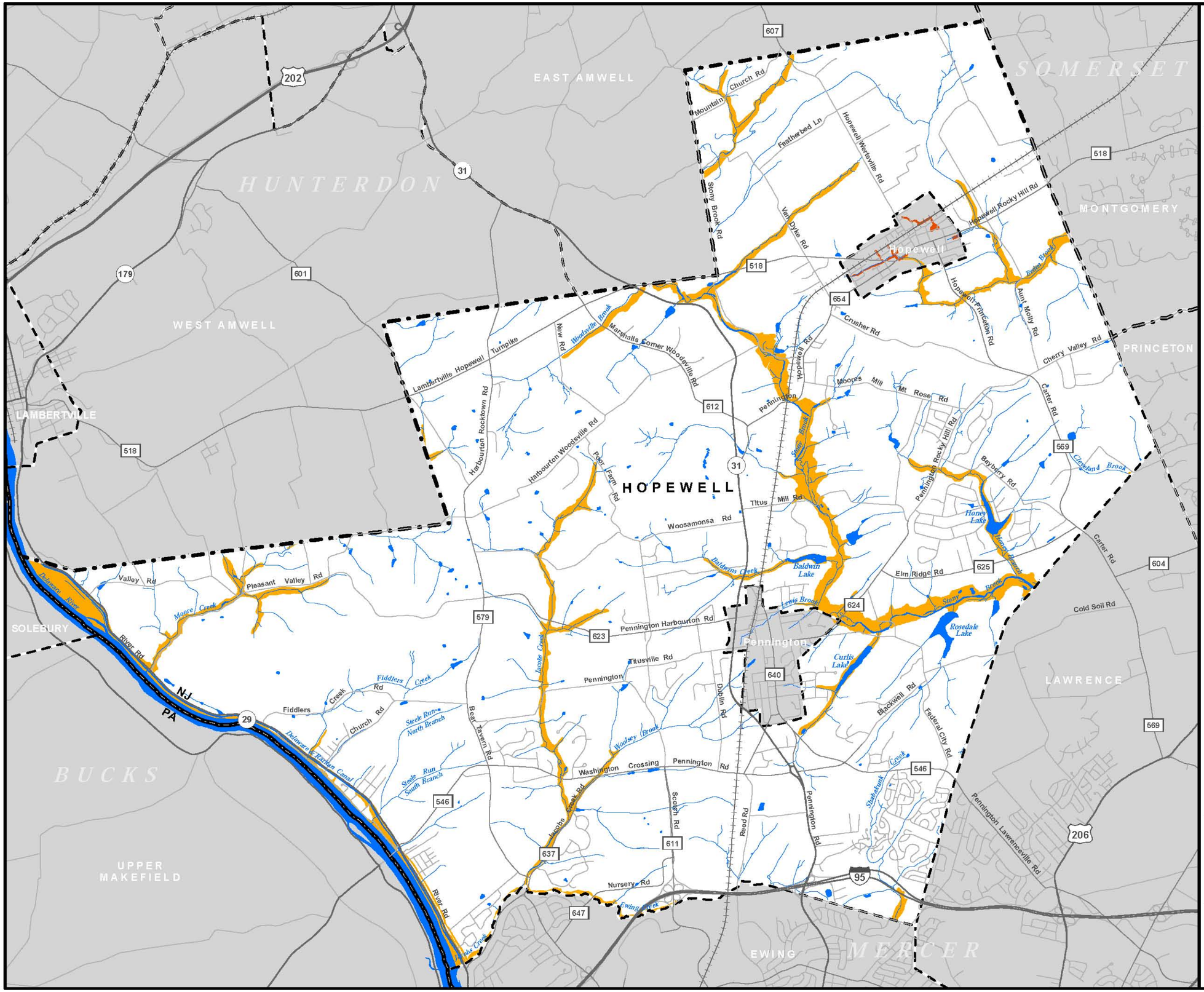
N

0 0.25 0.5 1 Miles

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

Sources: NJDEP, NJDOT, DVRPC
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Map 10: Flood Hazard Areas (1996)



Stream

Lake

Flood Zone

100-Year Floodplain

500-Year Floodplain

N

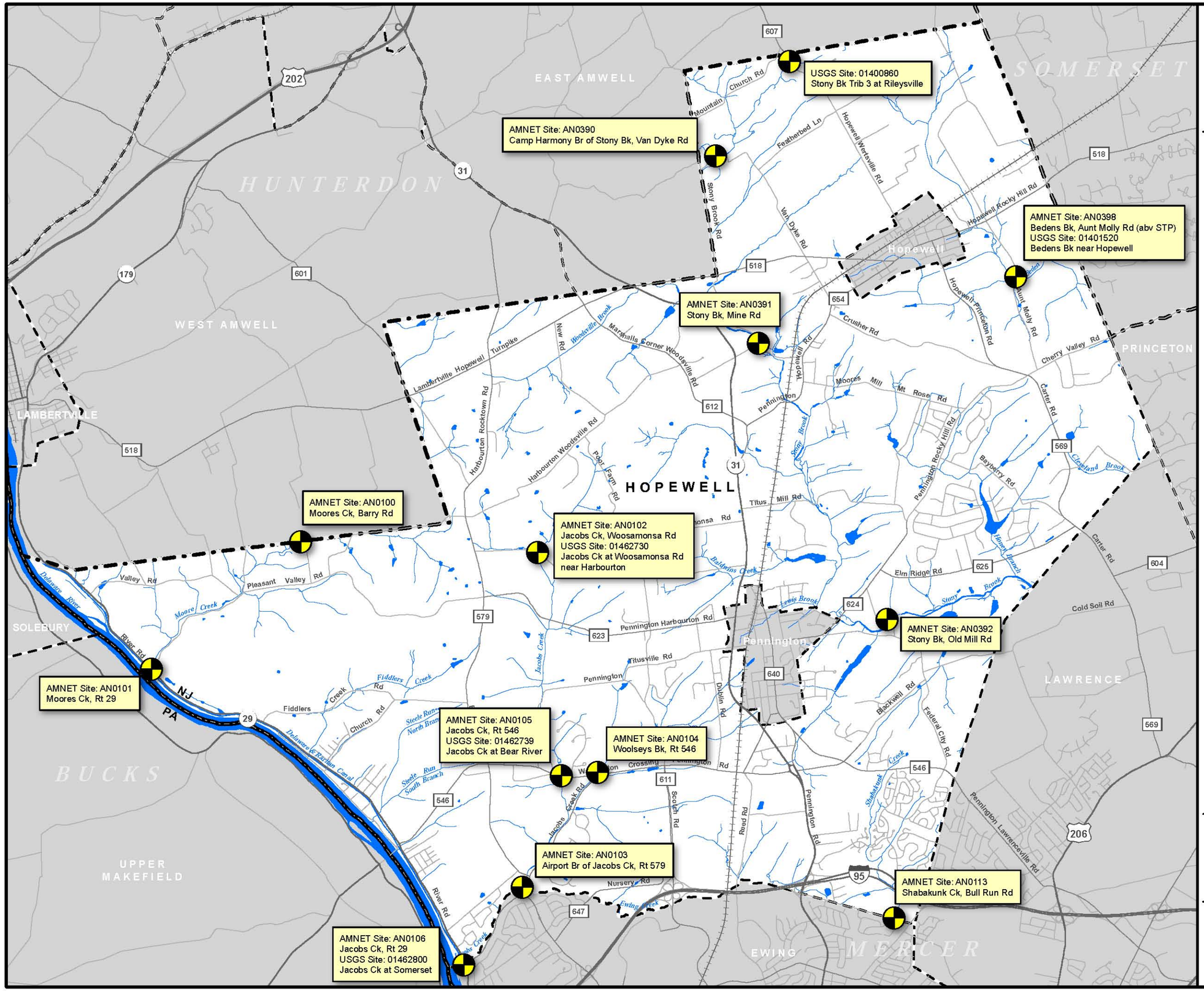
0 0.25 0.5 1

Miles

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

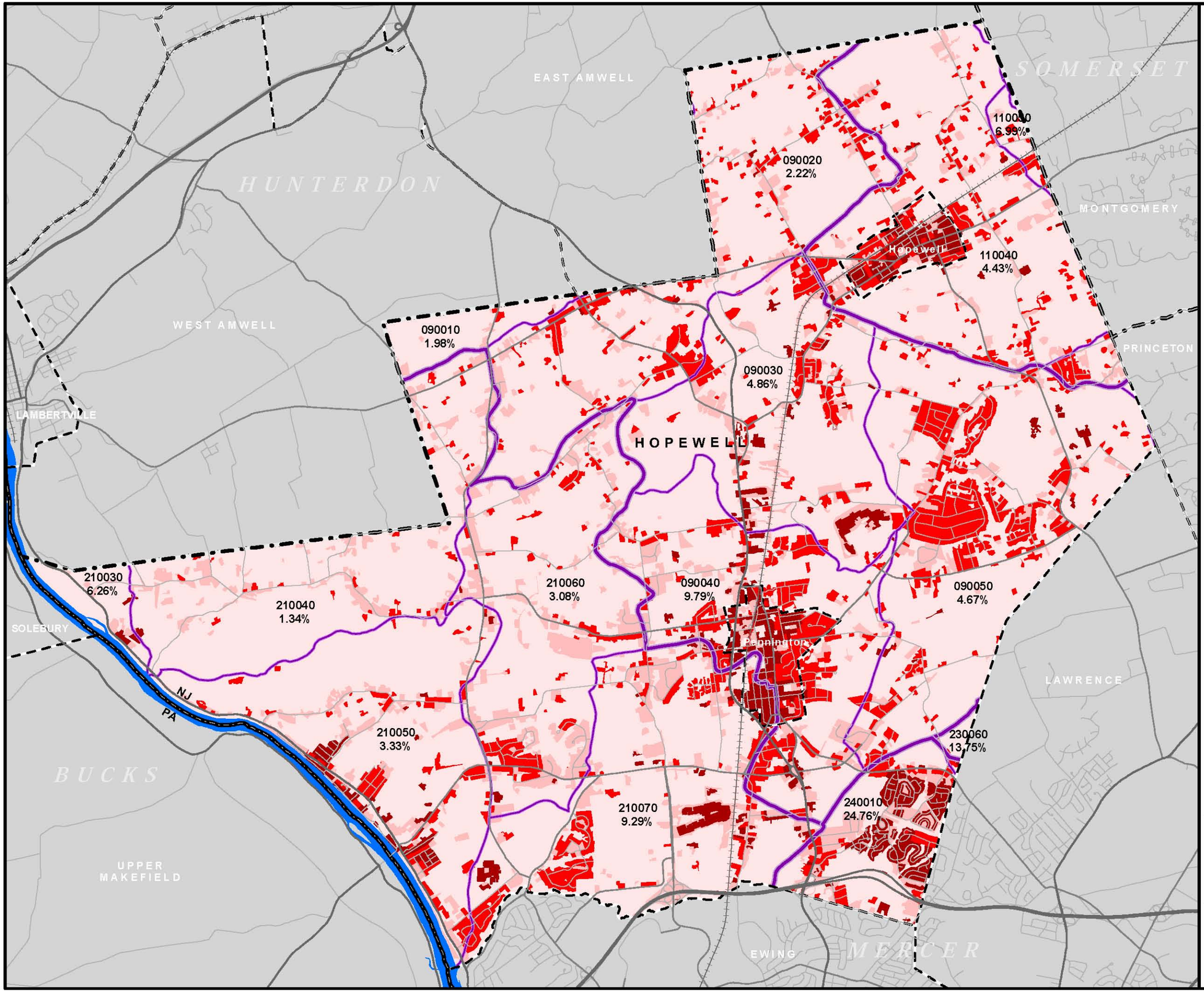
Sources: NJDEP, NJDOT, DVRPC, FEMA
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Map 11: Water Quality Sampling Locations



Sources: NJDEP, NJDOT, DVRPC
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Map 12: Impervious Surface Cover



HUC 11 containing HUC 14

Percent of Impervious Surfaces

- Less than 5%
- 5% - 10%
- 11% - 25%
- Greater than 25%

N

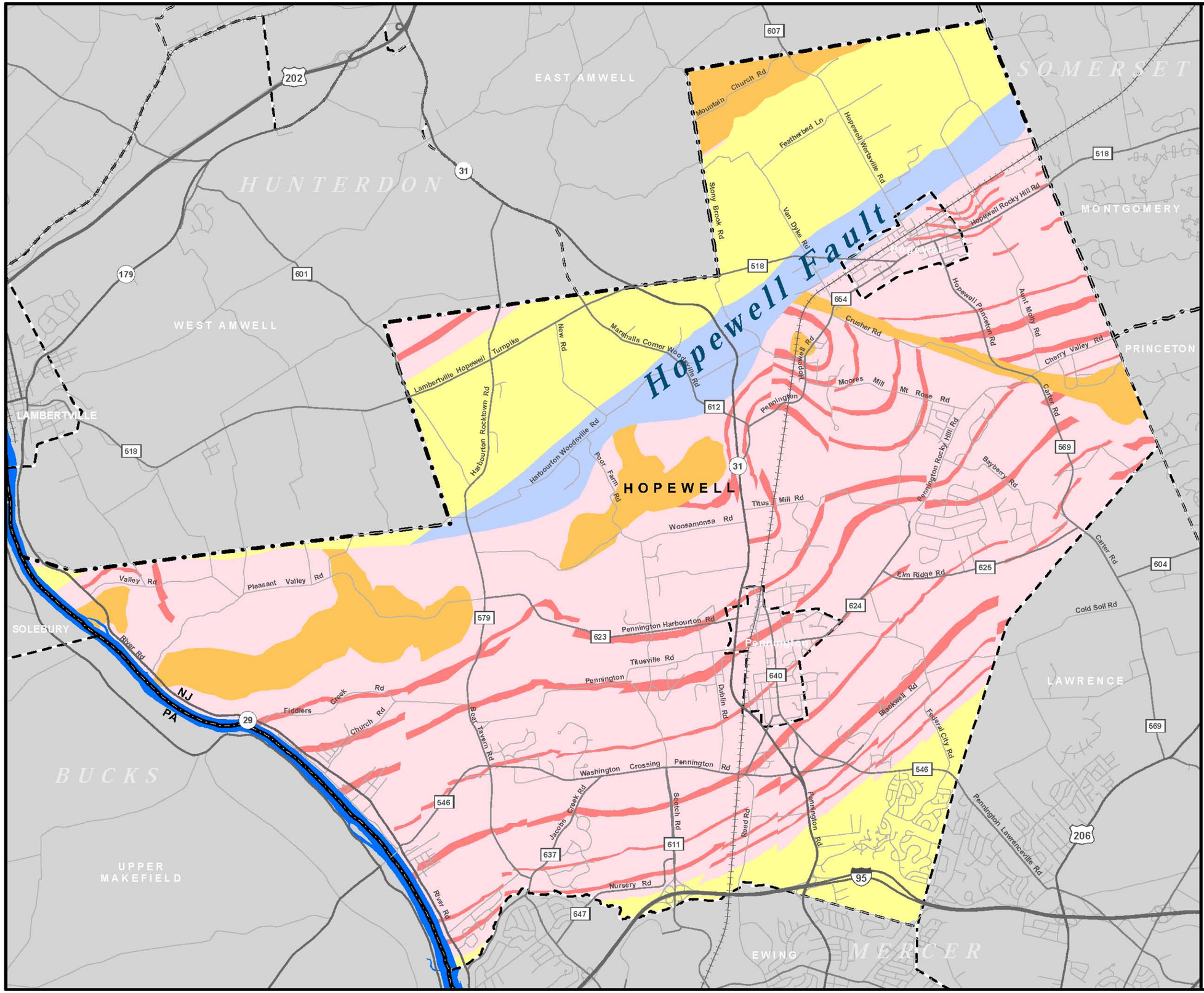
0 0.25 0.5 1

Miles

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

Sources: NJDEP, NJDOT, DVRPC
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Map 13: Aquifers and Bedrock Geology



Bed Outcrop Formations

- Jurassic Diabase
- Lockatong
- Passaic
- Passaic - Gray bed
- Stockton

N

0 0.25 0.5 1

Miles

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

Sources: NJDEP, NJDOT, NJGS, DVRPC
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Map 14: Natural Vegetation (2002)

Vegetation

- Brush/Shrubland
- Brush/Shrubland - Oldfield
- Upland Forest - Coniferous
- Upland Forest - Mixed (Con. Dom.)
- Upland Forest - Deciduous
- Upland Forest - Mixed (Decil. Dom.)
- Wetlands - Modified
- Wetlands - Scrub/Shrub
- Wetlands - Herbaceous
- Wetlands - Wooded - Deciduous
- Wetlands - Wooded Mixed (Decid. Dom.)
- Wetlands - Wooded - Coniferous
- Wetlands - Wooded Mixed (Con. Dom.)

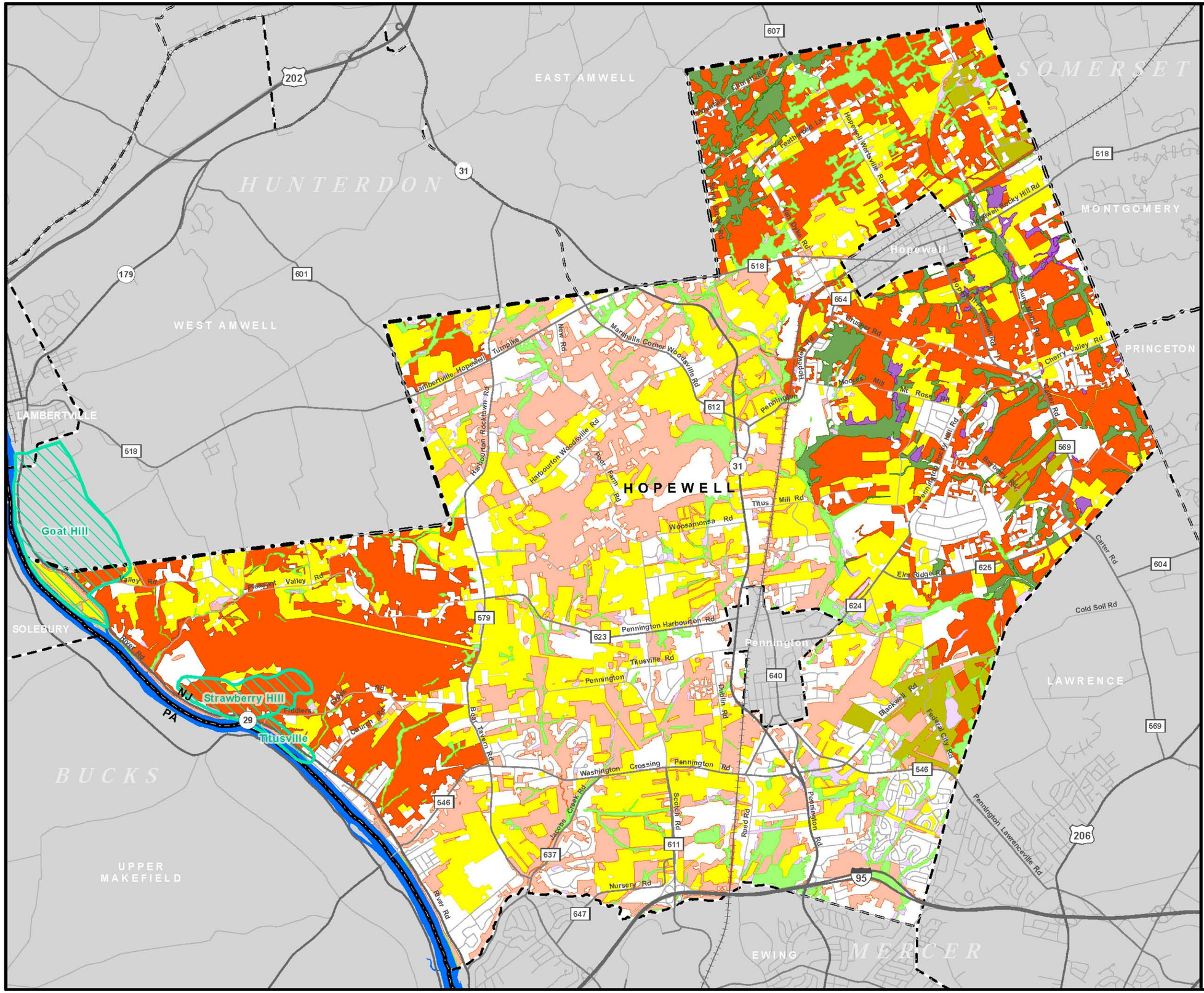
N

0 0.25 0.5 1
Miles

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

Sources: NJDEP, NJDOT, DVRPC
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Map 15: Landscape Project Habitat Priorities (2007)



Boundaries

Natural Heritage Site

Conservation Priority Type

Emergent Wetlands	Upland Forest
Critical Habitat	Critical Habitat
Suitable Habitat	Suitable Habitat

Forested Wetlands	Grasslands
Critical Habitat	Critical Habitat
Suitable Habitat	Suitable Habitat

N

0 0.25 0.5 1
Miles

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

Sources: NJDEP, NJDOT, DVRPC
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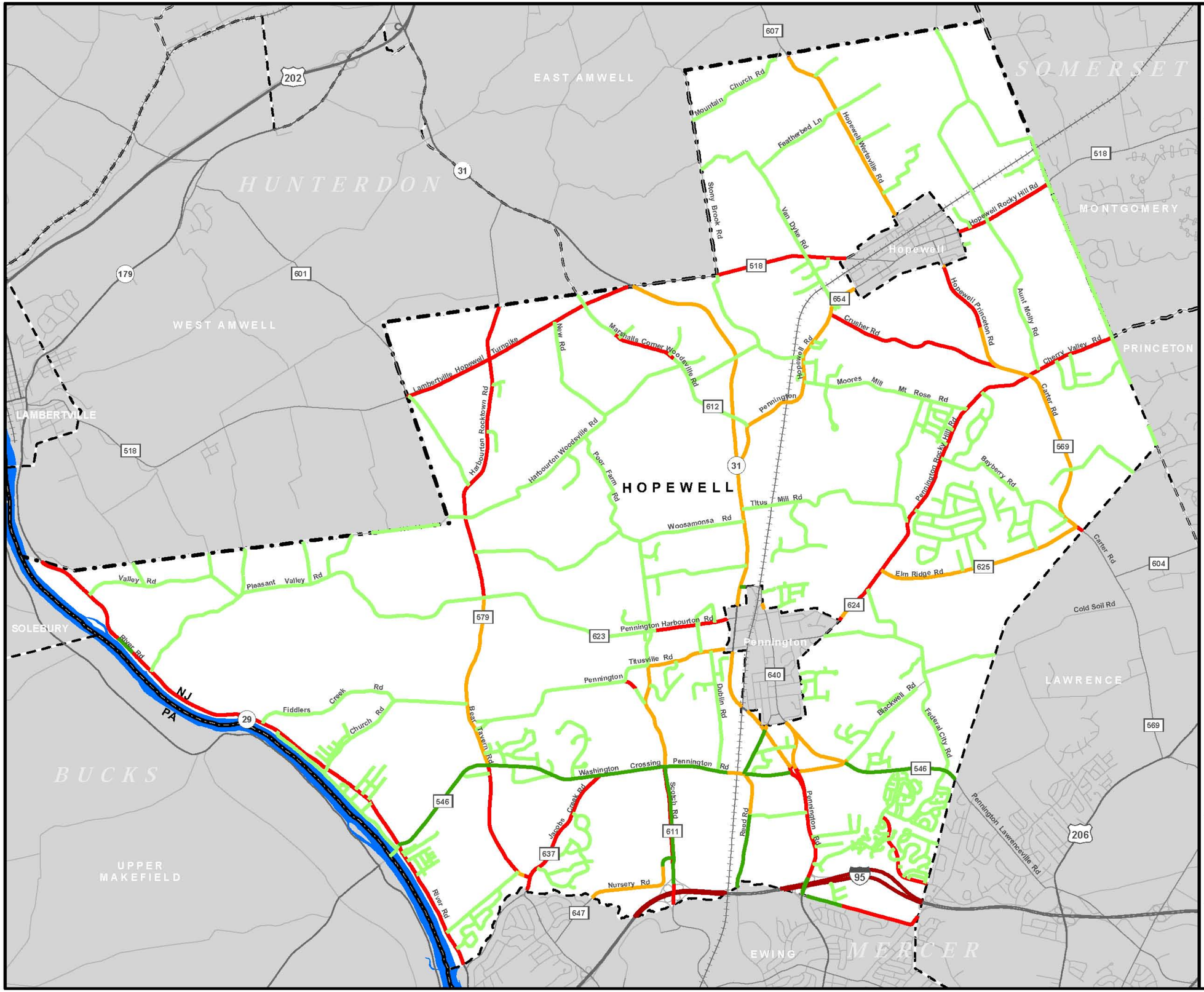
Map 16: Bicycle Level of Service



Bikescore Rating

- Excellent
- Favorable
- Fair
- Unfavorable
- Unbikeable

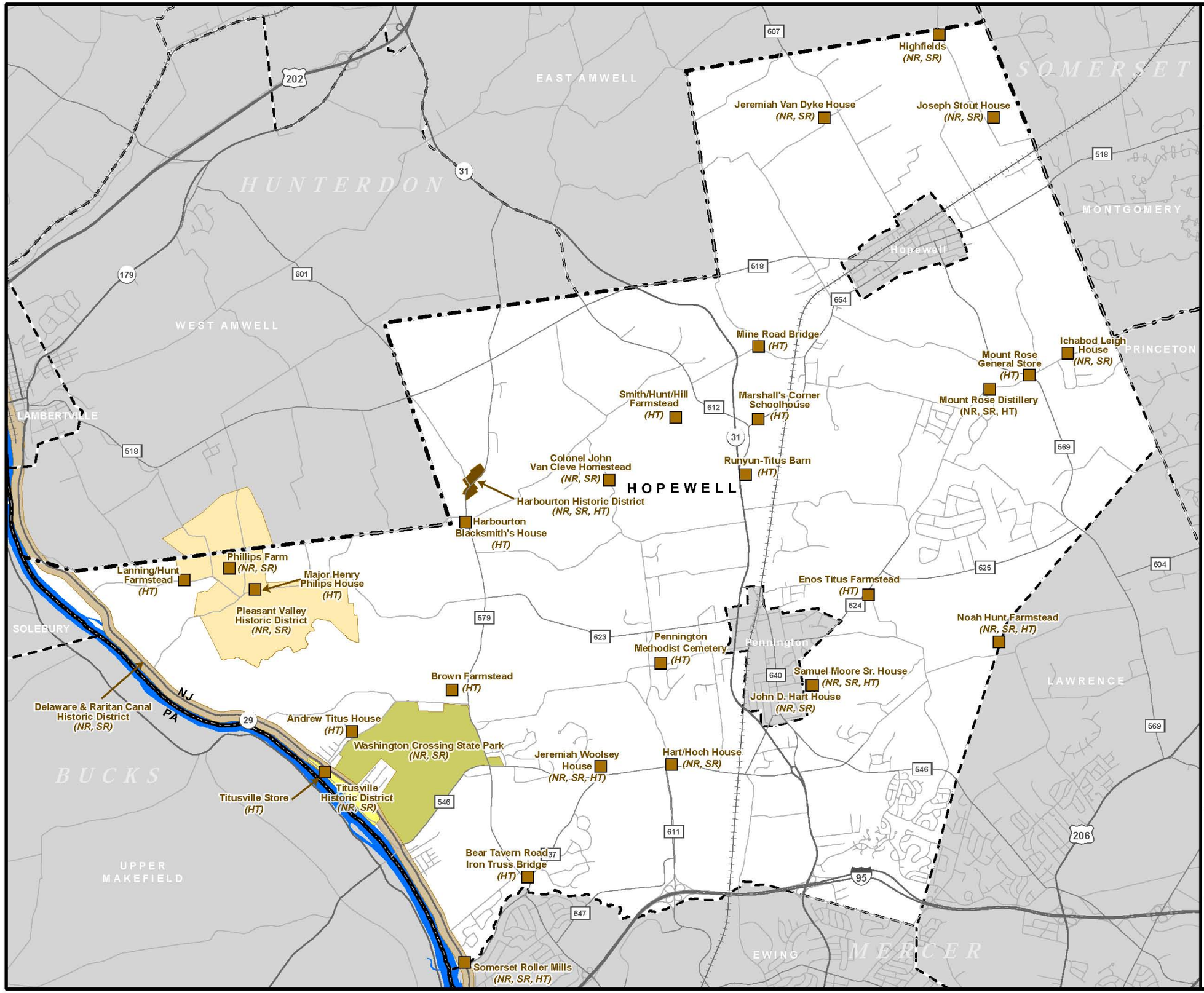
N

0 0.25 0.5 1
Miles

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

Sources: NJDEP, NJDOT, DVRPC
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Map 17: Hopewell Township Historic Resources



Historic Site

Historic Areas

- Delaware & Raritan Canal Historic District
- Harbourton Historic District
- Pleasant Valley Historic District
- Titusville Historic District
- Washington Crossing State Park

NR - National Register *SR* - State Register
HT - Hopewell Township

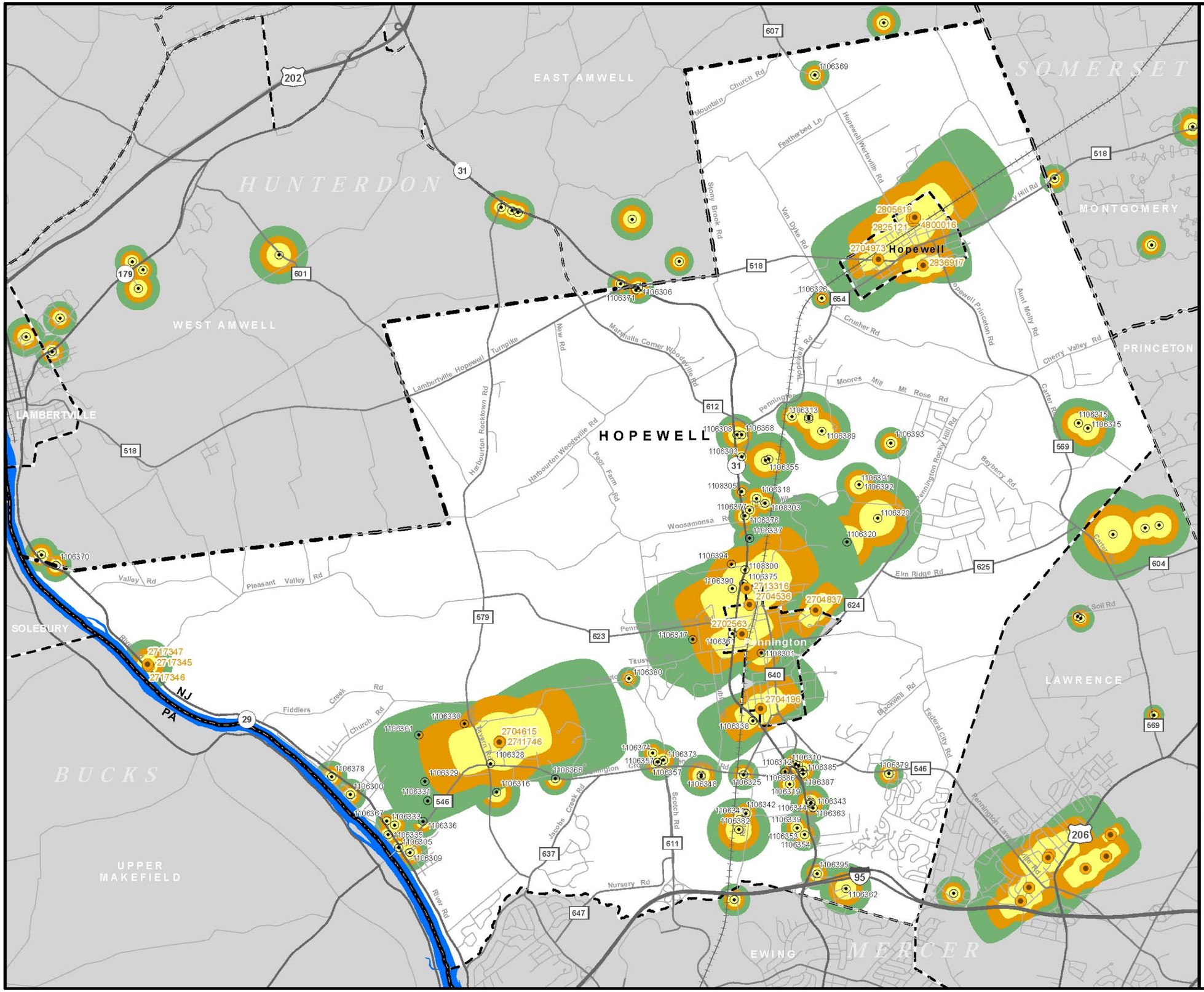
N

0 0.25 0.5 1 Miles

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

Sources: NJDEP, NJDOT, NJHPO, Hopewell Township, DVRPC
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Map 18: Public Water Supply Wells



- Public Non-Community Well
- Community Well

Wellhead Protection Areas
Public Community, 2006
Public Non-Community, 2004
- 2-year time of travel
- 5-year time of travel
- 12-year time of travel

N

0 0.25 0.5 1
Miles

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

Sources: NJDEP, NJDOT, DVRPC
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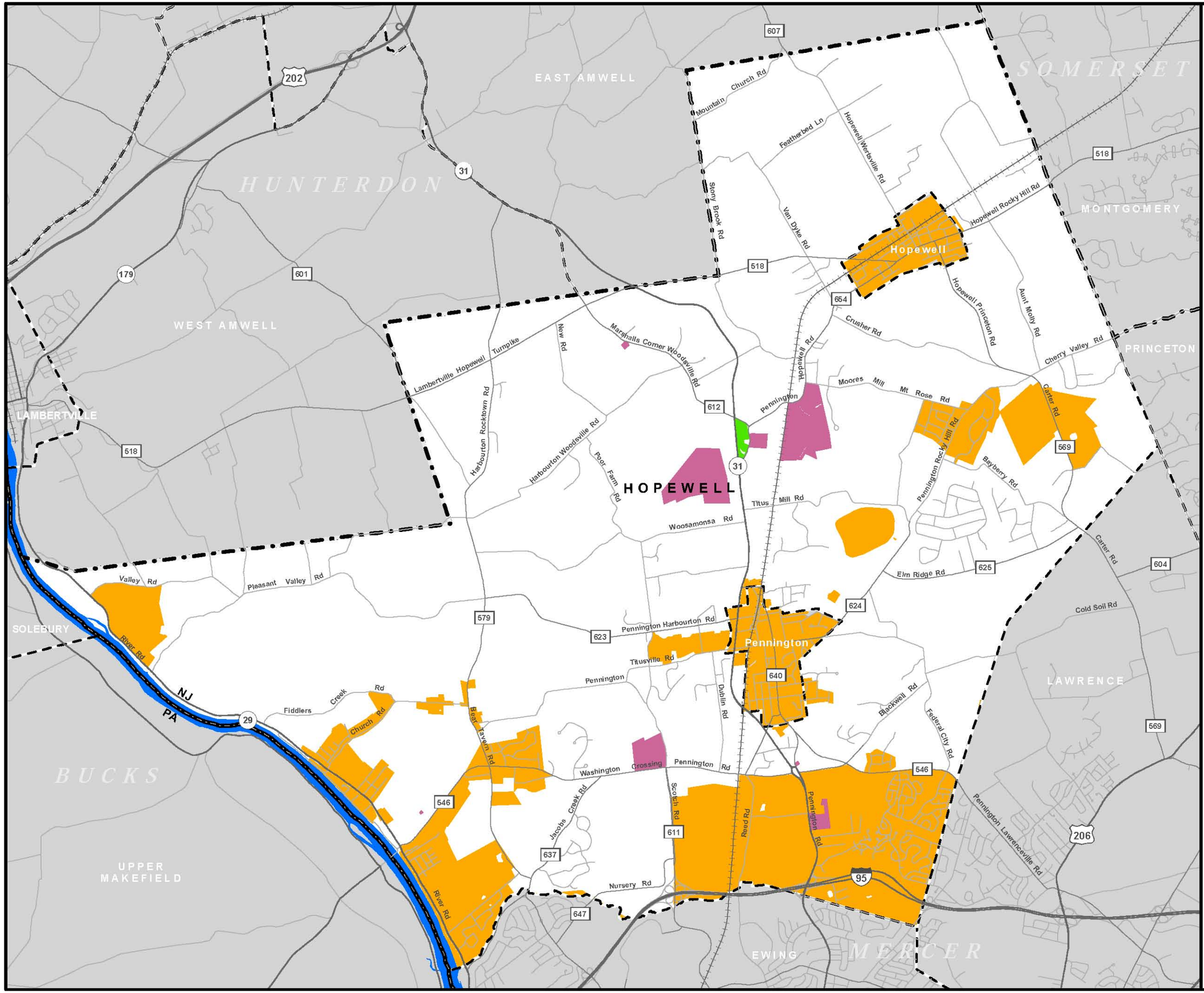
Map 19: Approved Sewer Service Areas



Type of Wastewater Disposal

- Surface Water Discharge
- Holding Tank
- Discharge to Ground Water through an Individual NJPDES Permitted Facility

N

0 0.25 0.5 1
Miles

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

Sources: NJDEP, NJDOT, DVRPC
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Map 20: Protected Open Space

2005 Parcel Boundary

Open Space

- State
- County
- Municipal
- Non-Profit / Private Protected
- Preserved Farmland

N

0 0.25 0.5 1
Miles

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

Sources: NJDEP, NJDOT, DVRPC, Mercer Co. This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Map 21: Known Contaminated Sites

Remediation Level

- B - A single phase remedial action with a single contaminant affecting only the soil.
- C1 - A remedial action with simple sites; one or two contaminants localized to soil and the immediate spill or discharge area.
- C2 - A remedial action with more complicated contaminant discharges; multiple site spills and discharges; more than one contaminant, with both soil and groundwater impacted or threatened.
- C3 - A multiphase remedial action with high complexity and threatening sites. Multiple contaminants, some at high concentrations with unknown sources, continuing to impact soils, groundwater, and possibly surface waters and potable water resources. Dangerous for direct contact with contaminated soils.
- D - Same conditions as C3 except that D levels are also usually designated federal "Superfund Sites."
- Unknown

N

0 0.25 0.5 1 Miles

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

Sources: NJDEP, NJDOT, DVRPC
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Abstract Page

Publication Title:	Environmental Resources Inventory for the Township of Hopewell
Publication Number:	09080
Date Published:	May 2010
Geographic Area Covered:	Hopewell Township, Mercer County
Key Words:	Environment, water quality, watersheds, stormwater, floodplains, wetlands, drinking water, soils, upland forests, grasslands, landscape project, habitat, deer management, historic resources, parks, open space, trails, contaminated sites, conservation, endangered species, Hopewell Township
Abstract:	This report documents the natural and environmental resources of Hopewell Township, Mercer County, New Jersey. The natural resource information includes descriptions, tables and maps of land use, soils, physiography, geology, aquifers, surface waters, floodplains, wetlands, natural vegetation, forests, grasslands and animal communities. The report also documents community resources including open space, parks, trails, historic resources, and public utilities. The report also examines current policies regarding surface water protection, non point source pollution, floodplain management, habitat protection, open space preservation, historic resources and known contaminated sites.

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for the TOWNSHIP of

HOPEWELL

MERCER COUNTY, NEW JERSEY

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