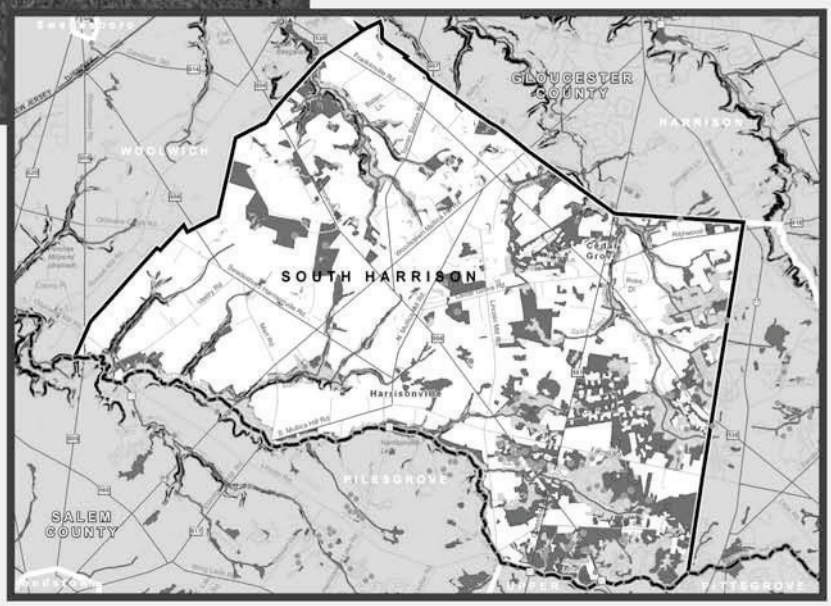
ENVIRONMENTAL RESOURCE INVENTORY

for the TOWNSHIP of

SOUTH HARRISON

GLOUCESTER COUNTY, NEW JERSEY



prepared by:

Delaware Valley
Regional Planning
Commission

with:

The Environmental
Commission of
South Harrison Township

2008

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Township Committee, Township of South Harrison

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Bob Campbell, Deputy Mayor
James McCall
Neil McIntyre
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The impetus for the creation of this document, and its guidance and review, came from the South Harrison Township Environmental Commission.

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Special Thanks to Celeste Keen (South Harrison Township), Leah Furey (Bach Associates), and Christina Arlt (DVRPC intern) for their assistance and coordination during this project.

Source: DVRPC

A view of Algonkin Lake reflects the natural beauty found across the landscape of South Harrison Township.

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 and steps to preserve, conserve, and utilize those resources, although it does not include specific recommendations to those ends. It is, instead, a compendium of all the existing information that can be found about a township's natural resources, presented 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.

South Harrison's wetlands, upland forests, and grasslands, which provide significant habitat for endangered and threatened plants and animals, will be vital to the continued health of the community and the enjoyment of its citizenry. Similarly, surface waters and groundwater resources across the township will become increasingly important to its population and to that of neighboring communities as the character of Southern New Jersey continues to change and develop. Knowledge of the environmental resources of the township will allow its citizens to make informed decisions as they decide South Harrison's future path and forge its emerging identity.

Several documents and reports were utilized in preparing the *Environmental Resource Inventory for South Harrison Township*, including the South Harrison Township Natural Resources Inventory completed in 1991 and the Township's *Master Plan* which was recently revised, along with a number of reference works and online sources. These are listed at the end of this document.

Source: DVRPC

Images of South Harrison Township reflect the diverse and changing landscape.
Left: aged farm buildings, Right: new home construction

The maps and data relating to South Harrison Township's natural resources are derived principally from the New Jersey Department of Environmental Protection's (NJDEP's) Geographic Information System mapping, the *Landscape Project* produced by the Endangered and Nongame Species Program of the New Jersey Division of Fish and Wildlife, reports by the US Geologic Survey and New Jersey Geologic Survey, and mapping data compiled and prepared by the Delaware Valley Regional Planning Commission (DVRPC). Information from these sources that is specific to South Harrison Township has been included whenever it was available. Information from other reports about specific sites has also been incorporated, along with data provided by township and county staffs and consultants. The Environmental Resource Inventory has been reviewed and corrected by members of the Environmental Commission and other township officials.

Somewhat lengthy introductions to some topics, especially surface water monitoring and groundwater, have been included in the ERI to give readers background on these complex topics. Hopefully, that will also assist the Environmental Commission and other township officials to obtain additional data from state sources in the future and to determine the types of investigations that still need to be conducted.

Source: DVRPC

Farms like the one shown here are common sights throughout the landscape of South Harrison Township.

BRIEF TOWNSHIP HISTORY

Today, South Harrison Township is an established, productive farm area with many of its remaining historic buildings characteristic of the colonial and pre-Revolutionary eras. The Township was first incorporated on March 2, 1883, from Harrison Township. Prior to its incorporation, South Harrison Township was originally within Greenwich Township, one of the four incorporated jurisdictions in what is now Gloucester County. Since the creation of the Township, Harrisonville has served as the seat of the community and is still a center of commercial and community activity.

Most pre-European settlements were associated with stream corridors. Indian villages are known to have existed beside both the Raccoon and Oldmans Creeks. The Narraticons lived in the vicinity of the Raccoon. Their name, which is a version of the Indian word for "raccoon," survives in the names of the creek and the main lake in neighboring Woolwich Township– Narraticon Lake. The Kagkakaini Sakins, a sub-tribe of the Lenape Indians, were the original inhabitants along the Mosackas Creek, now called Oldmans Creek. The name "Oldsmans Creek" is a variation on the name "Aldermans Creek," given to the waterway by the Dutch.

In 1638, Swedish settlement came to the Delaware Valley and a colony was established on the east side of the Delaware River that was referred to as "New Stockholm" (also "New Sweden"). This began to grow when the land was purchased by the Swedes from the Indians in 1641. The first settlement was located on the banks of Raccoon Creek and was called "Raccoon" until 1765 when the name was changed to "Swedesborough." Swedish and Finnish inhabitants moved into the area and created homesteads. It was them who gave shelter to the passengers of the first English ship to arrive in 1677, which docked at the Raccoon Creek.

Early settlers raised grain, fruit and vegetables, and tended stock. Peter Kalm, a Finnish botanist and one of the most famous recorders of botany in the colonies, traveled in the region between 1748 and 1751. He began his stay in nearby Swedesboro and in his important account, *Travels in North America*, reported on all kinds of fruit growing on local farms and "peaches so thick on the ground that one could hardly miss stepping on them." Throughout its history, the dominant activity of South Harrison Township has been agricultural in nature, with milk production being the primary agriculture activity until recently.

Waterways were important to South Harrison from the earliest days. Farm products, as well as timber from the rich forests, were conveyed to markets along the wide tidal Raccoon and Oldmans Creeks. Along with other vessels, an early steamboat plied the Raccoon Creek from the wharves at Swedesboro to Philadelphia, carrying produce to the Dock Creek Farmers Market in Philadelphia. Early mills, in the area, that ground flour and sawed lumber relied on the tributaries to these streams to provide their power. Several mills were established along Oldmans and Raccoon Creeks. Dams erected on Oldmans Creek created Harrisonville and Algonkin Lakes.

Travel on roads was nearly impossible during the 18th and early 19th centuries. Road quality was exceedingly poor and bridges were frequently in disrepair or nonexistent. However, the first

highway to cross both Camden and Gloucester Counties, Kings Highway (also called Salem Road or the Great Road), was completed in 1702 and provided an alternative to water travel.

Railroads became an important means of travel and transport of goods, especially farm produce, in the latter half of the 19th century. One of the earliest lines in the southern part of Gloucester County was the Swedesboro Railroad, established in 1854, and subsequently operated by the West Jersey Railroad Company and then the Pennsylvania–Reading Seashore Line. With the advent of the rail line at the western tip of the Township, other industrial activities flourished in the Township, primarily related to the mining of the clays underlying the southern reaches of the Township. The rail line also carried passengers until 1933. It continues to operate today as a freight line.

Highways and trucking began to replace railroad transport of both goods and people after World War II. Automobile transportation corridors provide the framework for land uses today. Many residents commute throughout the tri-state region for employment and for other basic services. This is beginning to make the township something of a bedroom community for the more urbanized portions of southern New Jersey. Although there have been several housing subdivisions in recent years, the township still retains an agriculturally based primary land use, and is still served by and connected to the historic town center of Harrisonville. Characteristics of the landscape include vast areas of fields, woodlots, and wet forests that provide habitat for an array of plant and animal species.

Source: DVRPC

Fruit orchards were once one of the most common crops in South Harrison; but many have been developed.

LOCATION, SIZE, AND LAND USE

South Harrison, an incorporated township located along the southern border of Gloucester County, New Jersey, is bounded by five municipalities: Woolwich Township to the west, Harrison Township to the north, Elk Township to the east, and the Salem County communities of Pilesgrove Township and Upper Pittsgrove Township to the south. Oldmans Creek forms the border between South Harrison and Salem County, with picturesque Harrisonville Lake as a focal point.

South Harrison Township occupies approximately 10,202 acres or 15.9 square miles on the coastal plain of New Jersey. The Township's land use reflects its natural setting, its long agricultural past, and an increase in suburban residential development since the end of World War II. Small commercial areas are scattered throughout the community, with a slight concentration adjacent to Route 45 and in Harrisonville.

Figure 1: South Harrison Township's location

Between 1990 and 2000, South Harrison Township lost over 500 acres of agricultural land to other uses. Despite that loss, nearly 51 percent of South Harrison Township remains classified as agriculture. As sawmills have historically contributed to the economy of South Harrison, it is not surprising that nearly 20 percent of the township is forested. Water and wetlands constitute 14 percent of the township land.

South Harrison's land use/land cover is shown in **Table 1**, grouped into general categories. The categories are based on data provided by the New Jersey Department of Environmental Protection's (NJDEP) and based on its 2002 color infrared digital imagery.

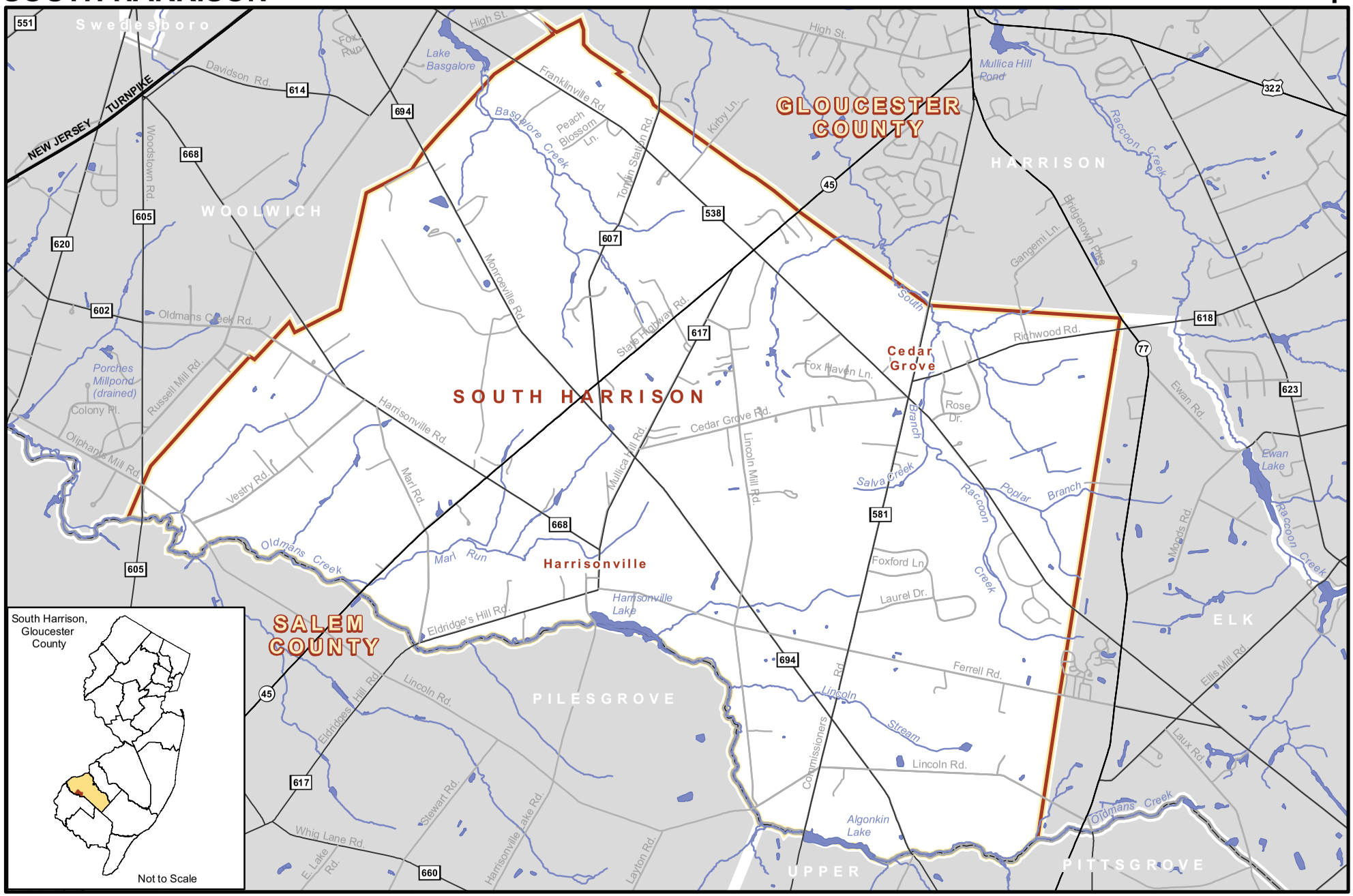
Table 1: South Harrison Township General Land Cover Classes (2002)

General Land Classes	Acres	Percent
Agriculture	5,187.4	50.85
Barren Land	254.9	2.50
Urban	1,339.0	13.12
Forest	1,988.6	19.49
Water	43.1	0.42
Wetlands	1,389.1	13.62
Total	10,202.1	100.00

Source: NJDEP, DVRPC

SOUTH HARRISON

MAP 1: Base Map



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.

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Miles

Delaware Valley Regional Planning Commission
December 2008

SOUTH HARRISON

MAP 2 South Harrison Aerial Photo 2005

This area falls outside the boundary of the DVRPC Region. Therefore, there are no aerials for this particular area.

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.

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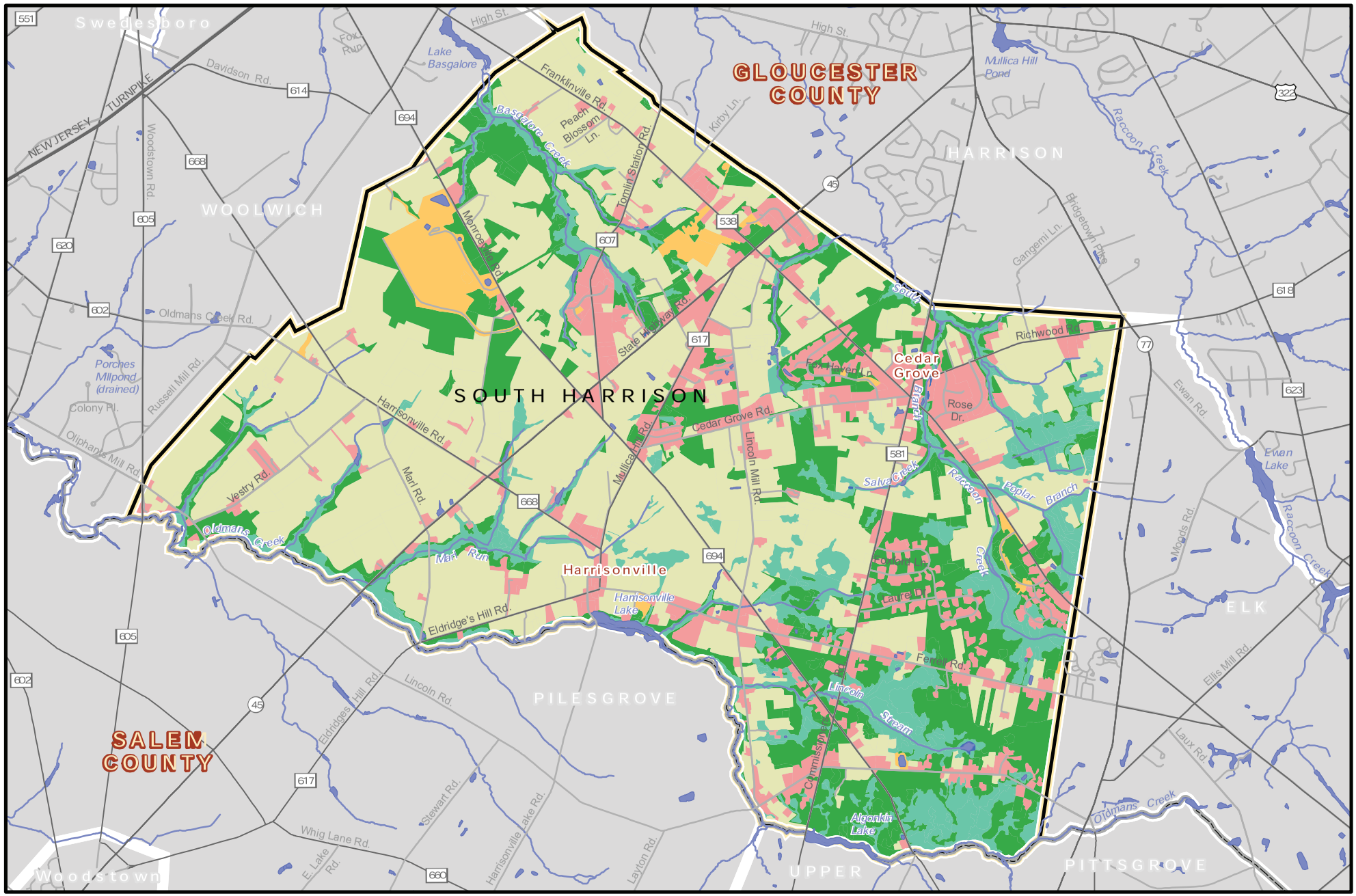
SOUTH HARRISON

MAP 3: NJDEP LandUse/Land Cover (2002)



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.

Agriculture
Barren Land
Developed
Forest
Water
Wetlands

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Table 2 breaks down the 2002 general land use/land cover categories into detailed land cover categories. See also **Map 3: South Harrison NJDEP Land Use/Land Cover (2002).**

Table 2: South Harrison Township Detailed Land Cover (2002)

Land Use Categories	Acres	Percent
Agriculture - Cropland and pastureland	4,006.53	39.27
Forest - deciduous	1,488.51	14.59
Residential, rural, single unit	1,126.14	11.04
Wetlands - wooded (deciduous)	892.51	8.75
Agriculture - Orchards, vineyards, nurseries, horticultural areas	815.34	7.99
Agriculture - Other	365.50	3.58
Altered lands	175.79	1.72
Brush/shrubland - mixed	161.07	1.58
Wetlands - agricultural (modified)	145.86	1.43
Mixed wooded wetlands (coniferous dominated)	136.23	1.34
Brush/shrubland - old field (brush covered)	107.17	1.05
Wetlands - wooded - mixed (deciduous dominated)	97.26	0.95
Forest - mixed (deciduous dominated)	88.17	0.86
Transitional areas	76.04	0.75
Residential, single unit, low density	71.10	0.70
Forest - mixed (coniferous dominated)	47.92	0.47
Wetlands - scrub/shrub (deciduous)	44.53	0.44
Brush/shrubland - deciduous	40.55	0.40
Artificial lakes	40.24	0.39
Forest - coniferous	38.65	0.38
Other urban or built-up land	34.28	0.34
Commercial/Services	18.51	0.18
Residential, single unit, medium density	18.16	0.18
Wetlands - disturbed wetlands (modified)	17.47	0.17
Industrial	16.86	0.17
Wetlands - herbaceous	16.65	0.16
Brush/shrubland - coniferous	16.56	0.16
Wetlands - former agricultural (becoming shrubby, not built-up)	13.88	0.14
Recreational land	13.25	0.13
Residential, high density, multiple dwelling	13.22	0.13
Transportation/Communications/Utilities	12.07	0.12
Wetlands - wooded (coniferous)	11.04	0.11
Stormwater basin	9.05	0.09
Mixed scrub/shrub wetlands (coniferous dominated)	7.43	0.07
Athletic fields (schools)	5.26	0.05
Wetlands - scrub/shrub - mixed (deciduous dominated)	3.99	0.04
Extractive mining	3.07	0.03
Natural lakes	2.88	0.03

Land Use Categories	Acres	Percent
Wetlands - managed in maintained greenspace (modified)	1.53	0.02
Cemetary	1.08	0.01
Phragmites dominate interior wetlands	0.73	0.01
Bridge over water	0.02	0.00
Total Land Cover	**10,202.09**	**100.00**

Source: NJDEP Bureau of Geographic Information System

Source: DVRPC

Cropland and pastureland constitute 39% of the land in South Harrison Township.

NATURAL RESOURCES

PHYSIOGRAPHY

Physiography is the study of a location in relation to its underlying geology. New Jersey is characterized by four physiographic provinces. The rocky terrain of the Appalachian Province is at one extreme, and the sands of the coast are at the other. South Harrison Township is located in the Coastal Plain, the southernmost of these four provinces in New Jersey.

The Atlantic Coastal Plain landscape extends from Massachusetts to Texas, and is divided into Inner and Outer sections. In New Jersey, the Inner Coastal Plain is made up of interbedded sand and clay. Deposits originating in the breakdown of Appalachian and Catskill sedimentary, metamorphic, and igneous rocks are interbedded with layers formed by oceanic (marine) deposition, which occurred as the ocean shoreline advanced and receded over geologic time. The Inner Plain layers date from the Cretaceous Period, 135 to 65 million years ago. Generally, soils of the Inner Coastal Plain are quite fertile.

The Outer Coastal Plain was formed more recently than the Inner Coastal Plain. It was laid down by the ocean and developed during the mid-to-late part of the Cenozoic Period, 65 million years ago to the present. Outer Coastal Plain soils are sandier and less fertile than those of the Inner Plain and do not hold water as well.

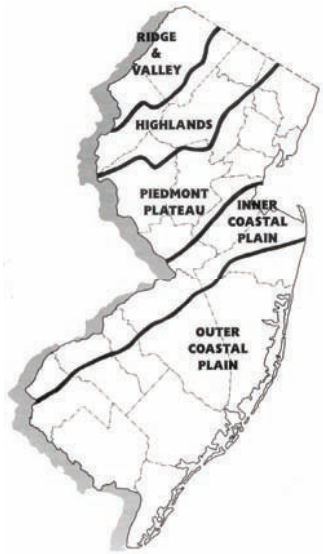


Figure 2: The Physiographic Regions of New Jersey

In the general vicinity of the dividing line between the two segments of the Coastal Plain is a belt of low hills, which runs northeast and southwest through the southern half of New Jersey. These hills are the youngest of the Cretaceous formations and are largely made up of sand and marl formations. The hills taper to fairly low elevations in Gloucester County but can be identified in the township. The Inner Coastal Plain lies to the west of this band of hilly formations and the Outer Coastal Plain lies to the east.

South Harrison Township is nearly bisected by the boundary between the Inner and Outer coastal plains, with rocks dating from both the Cretaceous and Cenozoic periods outcropping in the township. Although portions of South Harrison are in the Outer Coastal Plain, most of the township's soils are generally regarded as agriculturally productive. This is because the drop in soil fertility between the Inner and Outer coastal plains is not immediate, but changes gradually moving west to east across the Outer Coastal Plain. While most of South Harrison has good agricultural soils, a few miles to the east the soils become considerably sandier as the landscape begins to transition into the Pine Barrens.

TOPOGRAPHY AND SURFACE LANDSCAPES

South Harrison Township's position in central Gloucester County has given it a largely upland character with abundant high-quality agricultural soils. The Township varies in topography. The westernmost portion of Oldmans Creek is the lowest point in the township, at 15 feet above sea level. The Gloucester County landfill, also in the western portion of the township, contains the township's highest point (235 feet). However, the highest natural point is a residential area located in the vicinity of St. Johns Lane and Laurel Drive (North of the intersection of Farrell Road and Commissioners Drive), which is 155 feet above sea level.

The upland area is characterized by rich soils that once supported extensive beech-oak forests. Today, South Harrison's upland forests are dominated by beech, oak, maple, and birch trees. Freshwater wetlands and wet forests of sweet gum and red maple occur along the river valleys. The streams are relatively flat, as in all of southern New Jersey, with mostly muddy and/or sandy bottoms, although the bottoms of some stream segments are lined with small rounded rocks and pebbles. The community also exhibits significant wetland forests along its waterways and in the southeastern corner of the Township.

Steep Slopes

Only a small portion of South Harrison Township has slopes over 10 percent (the percent of vertical rise to horizontal distance). However, the steepest slopes are very steep indeed – over 35 percent in some areas along Marl Run. Steep slopes are found almost entirely along the waterways of the township, including a variety of the smaller streams, and especially the south sides of Basgalore Creek and Marl Run and the two unnamed tributaries to Oldmans Creek located in the southwest corner of the township.

In general, development of steep slope areas is inadvisable because it can result in soil instability, erosion, sedimentation of the stream below, increased stormwater runoff, and flooding. This causes habitat destruction, and potential damage to property. Erosion on steep slopes is especially prevalent where excessive tree removal has taken place.

South Harrison's steep slopes are depicted on **Map 4: Steep Slopes**.

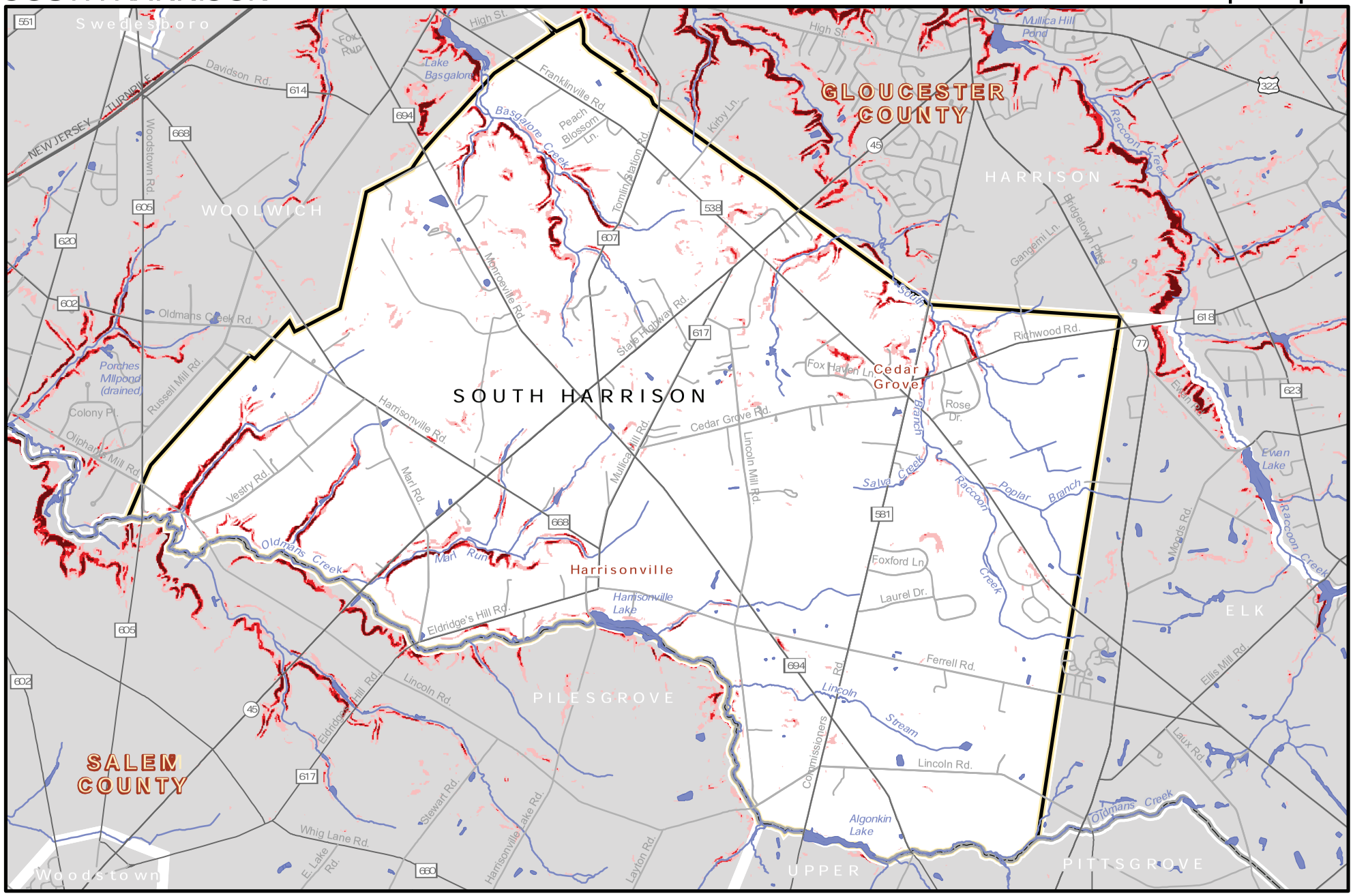
Soils

Soil is the foundation for all land uses. A region's soil defines what vegetation is possible, influencing agricultural uses. It also determines how land can be developed for other purposes. Soil is also a natural resource that cannot be replenished on the human time scale.

South Harrison Township soils consist of 24 series types and 33 variations within those series (excluding water) as identified by the US Department of Agriculture's Natural Resources Conservation Service. These are listed in **Table 4: South Harrison Township Soils** and shown on **Map 5: Soils**.

SOUTH HARRISON

MAP 4: Steep Slopes



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.

SLOPE

- 9.99% or Less
- 10% - 14.99%
- 15% - 19.99%
- 20% or Greater

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Miles

Delaware Valley Regional Planning Commission
December 2008

Soil Quality Classification

State and national agricultural agencies classify farmland soils into several categories. South Harrison contains Prime Farmland soils, Soils of Statewide Importance, and Unique Farmland soils. The majority of South Harrison's land, 85.3 percent, is rich, arable, and valuable soil. Each category of farmland is explained on the following pages. See **Table 3: Agricultural Values for South Harrison Soils** for the acreage in each category and **Map 6: Agricultural Quality of Soils**.

Prime Farmland Soils

About 51 percent (5,222 acres) of South Harrison's soils are considered Prime Farmland (P-1) soils. 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 Farmlands are not excessively erodible or saturated with water for long periods of time and do not flood frequently.

The USDA outlines specific criteria for Prime Farmland classification. For example, according to Prime and Unique Farmlands federal regulations (7 Code of Federal Regulations Part 657), soil horizons within a depth of 40 inches (or within the root zone if the root zone is less than 40 inches) must have a pH between 4.5 and 8.4. The soils must have a mean 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. When identifying qualifying prime soil mapping units within a state, state conservationists are allowed to deviate from the permeability standard or to adopt more stringent criteria for the other requirements.

Land classified as Prime Farmland does not have to be farmed but does have to be available for such use. Thus, water or urban or built-up land does not qualify as Prime Farmland.

Capability Units

I – Soils have few limitations that restrict their use.

II – Soils have moderate limitations that reduce the choice of plants, or that require moderate conservation practices.

III – Soils have severe limitations that reduce the choice of plants, require very careful management, or both.

IV – Soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

V – Soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, woodland, or wildlife habitat.

VI – Soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture, woodland, or wildlife habitat.

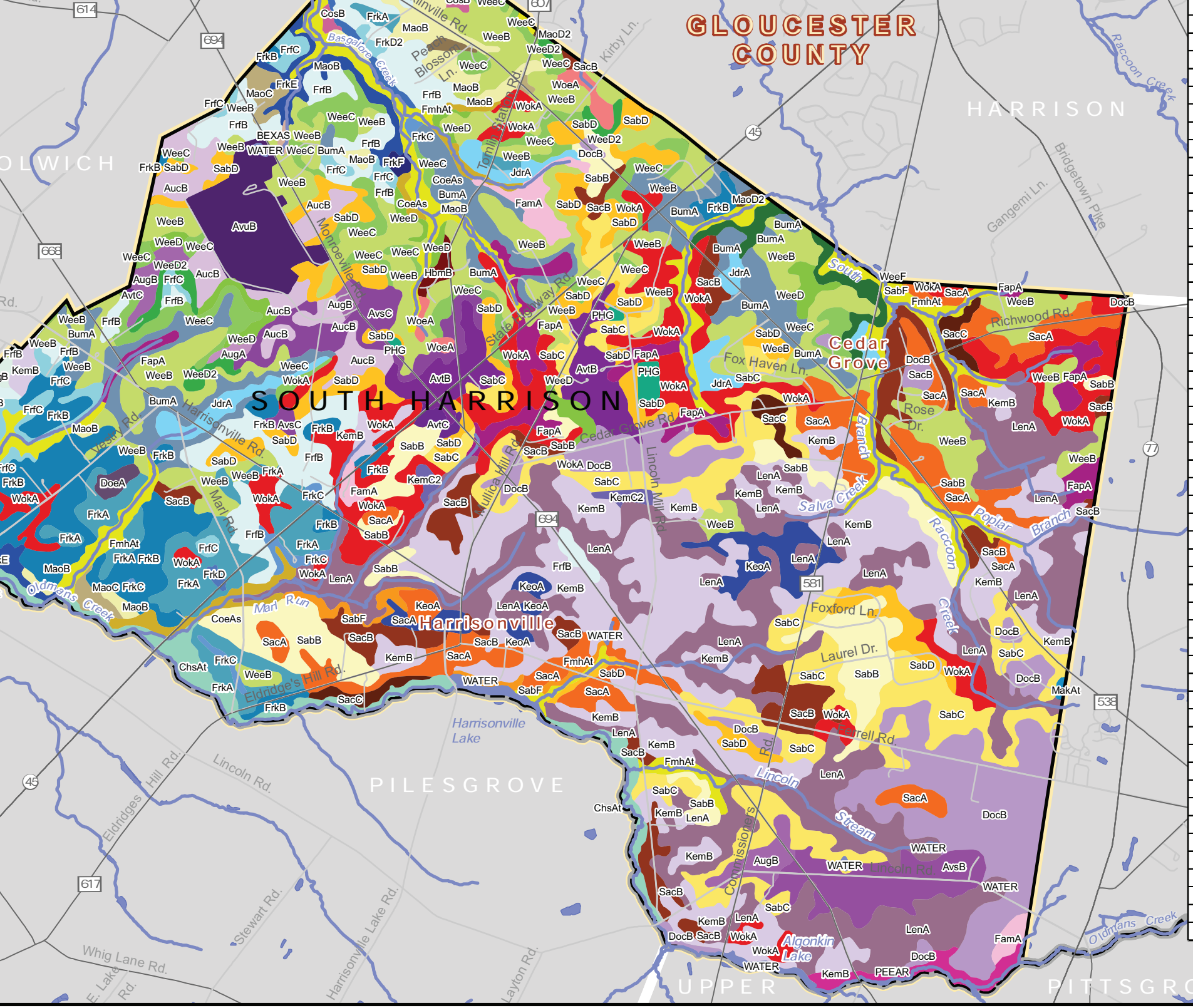
VII – Soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture, woodland, or wildlife habitat.

VIII – Soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, water supply, or to aesthetic purposes.

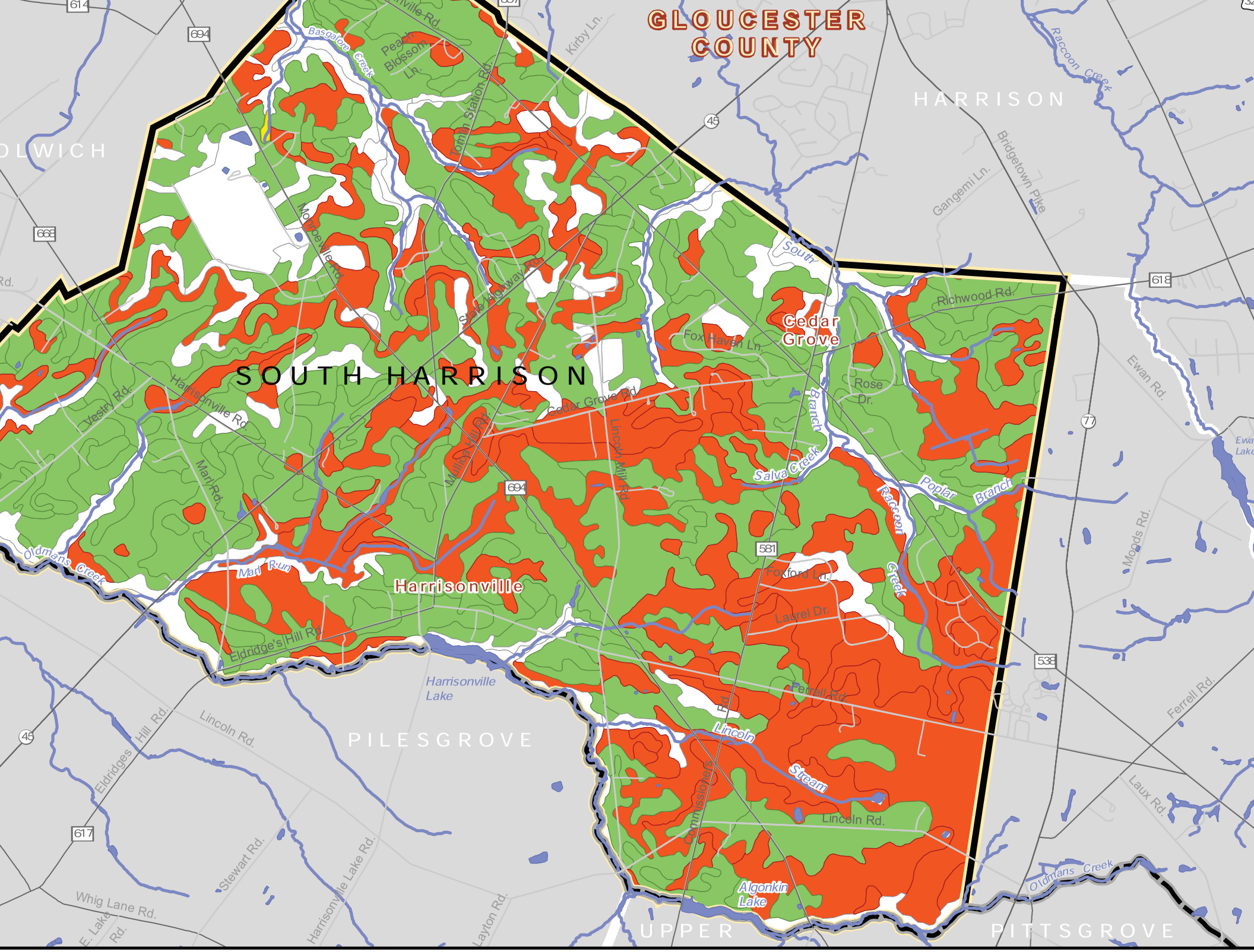
Source: USDA (NRCS), 2008

Soils of Statewide Importance

Just over 34 percent (3,476 acres) of South Harrison'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 under favorable conditions. Under such favorable conditions, these yields may be as high as Prime Farmland yields.



	AvsC	A
	AvtB	A
	AvtC	A
	AvuB	A
	BEXAS	B
	BumA	B
	ChsAt	C
	CoeAs	C
	CogB	C
	CokA	C
	CosB	C
	DocB	D
	DoeA	D
	FamA	F
	FapA	F
	FmhAt	F
	FrfB	F
	FrfC	F
	FrkA	F
	FrkB	F
	FrkC	F
	FrkD	F
	FrkD2	F
	FrkE	F
	FrkF	F
	HbmB	H
	JdrA	J
	KemB	K
	KemC2	K
	KeoA	K
	LenA	L
	MakAt	M
	MaoB	M
	MaoC	M
	MaoC2	M
	MaoD2	M
	PEEAR	P
	PHG	P
	SabB	S
	SabC	S
	SabD	S
	SabF	S
	SacA	S
	SacB	S
	SacC	S
	WATER	W
	WeeB	W
	WeeC	W
	WeeD	W
	WeeD2	W
	WeeF	W
	WoeA	W
	WokA	W


GLOUCESTER COUNTY
HARRISON
OLWICH
SOUTH HARRISON
Harrisonville
Cedar Grove
PILESGROVE
UPPER
PITTSGROVE
Harrisonville Lake
Algonkin Lake
Basgalore Creek
Peach Blossom Ln.
Tomlin Station Rd.
Kirby Ln.
Raccoon Creek
Bridgetown Pike
Gangemi Ln.
Richwood Rd.
Fox Haven Ln.
Rose Dr.
Cedar Grove Rd.
Lincoln Mill Rd.
Salva Creek
Poplar Branch
Raccoon Creek
Fox Ford Ln.
Laurel Dr.
Ferrell Rd.
Lincoln Stream
Lincoln Rd.
Commissioners Rd.
Oldmans Creek
Marl Run
Eldridge's Hill Rd.
Harrisonville Rd.
Vestry Rd.
Marl Rd.
Mullica Hill Rd.
State Highway Rd.
Monroeville Rd.
Lincoln Rd.
Eldridges Hill Rd.
Stewart Rd.
Harrisonville Lake Rd.
Whig Lane Rd.
Layton Rd.
Ewan Rd.
Moods Rd.
Ferrell Rd.
Laux Rd.
Oldmans Creek
614
694
668
45
618
77
581
538
617

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

Unique Farmland Soils

South Harrison has less than one percent (5.95 acres) of soils ranked as Unique Farmland (U-1) soils. Certain soil qualities, locations, growing seasons, and moisture supplies allow Unique Farmland to support specific specialized crops when properly managed. The USDA outlines specific Unique Farmland criteria: Unique Farmland exhibits specific conditions, including temperature, humidity, air drainage, elevation, aspect, or nearness to market, that support a particular food or fiber crop. In order for lands to be classified as Unique Farmland, the land must also be used for a specific high-value food or fiber crop and have an adequate moisture supply for that crop.

Soils Not Rated

Some of the soils that are present in South Harrison have not been rated for agricultural use by the Natural Resource Conservation Service (NRCS) and are labeled "NR." These unrated soils make up over 14 percent of the soil in the Township. These soils may be best suited for uses other than agricultural crops or they may simply not yet have been assessed for quality by NRCS. NRCS created all the Soil Quality Classifications in 1990 but in 2005, the agency created several new subtypes of soils, which are not yet rated for agricultural use. Soils that are not rated are not necessarily limited. Each soil's land capability class and subclass describe how the soil is limited with respect to different uses, and for what reasons the soil is limited. (See inset box on page 14.)

Table 3: Agricultural Values for South Harrison Soils

Designation	Type	Acres	Percent
P-1	Prime Farmland	5,222.01	51.2%
S-1	Statewide Importance	3,476.08	34.1%
U-1	Unique Farmland	5.95	0.1%
NR	Soils not classified for farmland use: wet soils, pits, steep slopes, made land, etc.	1,471.11	14.4%
Water	Water	26.95	0.3%
Totals		**10,202.09**	100.0%

Source: NJ Important Farmlands Inventory, USDA Natural Resources Conservation Service

Hydric Soils

More than 68 percent of South Harrison's soils are considered hydric soils. 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, and they support the development of hydrophytic

vegetation only. Hydrophytic plants grow either entirely or partially surrounded by water. Hydric soils have unique soil properties, and they are an important element to wetland areas. If a soil is classified as "hydric," land use may be restricted due to the relationship of hydric soils to the definition of wetlands and laws regarding wetland preservation. More detailed descriptions of South Harrison's wetland areas are found in the *Surface Water Resources* section, under "Wetlands" and "Agricultural Wetlands" and the *Biological Resources* section, under "Wetlands."

Typically hydric soils are not considered to be Prime Farmland (P-1) because of their excessive water saturation. However, several soils in South Harrison are classified by the Natural Resource Conservation Service (NRCS) as both Prime Farmland (P-1) and Hydric soils. This indicates that the soil meets the Prime Farmland (P-1) standards but is also a very wet soil. Thus, the only way that this soil can perform at its full potential is if the site is drained, reducing the effect of its hydric characteristics. See Agricultural Wetlands (p.34) for more information on soil drainage.

Soil Series

Several soil series appear more frequently in South Harrison Township than others, and are briefly described as follows according to the NRCS soil database:

Sassafras Series

The most abundant soil series in South Harrison Township is the Sassafras series. About 20 percent (2,047 acres) of South Harrison is made up of Sassafras soils, which are usually found on sandy flats although slopes can range from nearly level to very steep. These soils can support vegetation consisting of mixed oaks and scattered pines. They are considered Prime soils and Farmland of Statewide Importance depending on slope. Sassafras soils are easy to work, have a low natural fertility, and respond to fertilization. (Capability Units I, II, and III, depending on variation)

Westphalia Series

Thirteen percent of South Harrison soils (1,313 acres) are a variation of the Westphalia series. Westphalia soils were formed from a marine deposit of fine sand, and thus, are well-drained and gently sloping. These soils once supported a native forest of mixed oaks, beech, yellow poplar, and holly. These soils are found largely in the northern half of the township closely associated with Marlton and Freehold soils, but have less clay content. Westphalia soils are friable (easy to crumble) and have low natural fertility but respond to fertilization. If cultivated, Westphalia soils may suffer from wind and water erosion, but on level terrain, Westphalia soils are considered Prime soils. (Capability Units II, III, IV, VII depending on slope)

Freehold Series

The third most common soils, making up 12 percent (1,262 acres) of the soils in South Harrison Township, are of the Freehold series. These soils, formed from sandy marine deposits, are mostly gently sloping and well-drained. Around streambeds, these soils may be steeply sloping. Freehold soils occur in close association with Collington, Colts Neck, Marlton, Westphalia, and Woodstown soils. Freehold dominates the southwestern part of the township. Freehold soils are

easily worked for agricultural production and have low to moderate natural fertility. Different variations of these soils will support upland forests of oaks and poplar, which provide high quality wildlife habitat. These soils are well suited to various seasonal crops because variations of Freehold soils warm at different times of the year. Freehold sandy loams are classed as Prime soils. (Capability Units I, II, and IV depending on slope)

Keyport Series

Dominant in the southeastern portion of South Harrison Township, these soils consist of very deep silty and clayey deposits. Due to the high clay content, permeability is very slow, therefore the agricultural uses of these soils are limited to general crops and pasture. Nearly 11 percent (1,107 acres) of the township is made up of soils in the Keyport series. They are typically found on uplands and, during rainy seasons, standing water forms in slight depressions. (Capability Unit IV)

Lenni Series

Close to 11 percent (1,090 acres) of South Harrison Township consists of soils from the Lenni series. Found on lowlands, depressions, and floodplains, Lenni soils consist of very deep poorly drained soil. They are not suitable for cultivated crops, but if properly drained can be considered a farmland of statewide importance. (Capability Unit IV)

Aura Series

About 7 percent (751 acres) of South Harrison soils are part of the Aura series. Aura soils are well-drained and usually occupy the highest elevations in Gloucester County. In South Harrison, Aura soils are most common in the center and western portion of the township. Aura soils occur in association with Sassafras, Downer, and Woodstown soils. Aura soils are moderately permeable in the subsurface layer, but runoff is rapid and erosion can be a problem. Plants with deep roots do not flourish on these soils because their roots cannot penetrate the firm lower layers. The pebbly topsoil impedes the growth of seedlings. Although these soils are low in fertility, they are well suited to growing fruit, flowers, and most types of vegetables. Special care and maintenance is needed to maintain organic matter and soil structure so that water can be absorbed. On level land and gentle slopes, Aura soils are considered Prime. (Capability Unit II, III, IV depending on slope)

Woodstown Series

Woodstown soils occupy 6 percent (566 acres) of South Harrison land and have historically supported oak, beech, poplar, and pitch pine forests. This series encompasses Woodstown and Woodstown-Glassboro variations and is closely associated with Aura, Downer, Freehold and other soils. Woodstown soils are not well-drained. These soils occur on terraces along large streams and in beds of gravel. These are considered prime soils or soils of statewide importance, but cultivation can be hampered by wetness. (Capability Unit II)

Downer Series

Common in the eastern half of the township, Downer soils comprise 5 percent (512 acres) of South Harrison soils. These soils, which are considered to be soils typical of New Jersey agriculture and are listed as Prime Farmland and Farmland of Statewide Importance, are

moderately permeable, have a low available water capacity, are warm early in the calendar year, and are easily worked. While natural fertility is low and added fertilizers leach too easily, Downer soils can support high value crops with proper management and irrigation. (Capability Units II and III depending on variation)

Table 4: South Harrison Township Soils

Soil Code	Soil Description	Acres	Percentage of all Acres	Designation	Hydric Soil*
AhpB	Alloway loam, 2 to 5 percent slopes	0.4	0.0%	P-1	No
AhpC	Alloway loam, 5 to 10 percent slopes	0.5	0.0%	NR	No
AucB	Aura loamy sand, 0 to 5 percent slopes	134.8	1.3%	P-1	No
AugA	Aura sandy loam, 0 to 2 percent slopes	6.2	0.1%	P-1	Yes
AugB	Aura sandy loam, 2 to 5 percent slopes	67.0	0.7%	P-1	No
AvsB	Aura-Sassafras loamy sands, 0 to 5 percent slopes	133.2	1.3%	P-1	No
AvsC	Aura-Sassafras loamy sands, 5 to 10 percent	108.0	1.1%	S-1	No
AvtB	Aura-Sassafras sandy loams, 2 to 5 percent slopes	135.4	1.3%	P-1	No
AvtC	Aura-Sassafras sandy loams, 5 to 10 percent	12.8	0.1%	S-1	No
AvuB	Aura-Urban land complex, 0 to 5 percent slopes	153.8	1.5%	NR	No
BEXAS	Berryland and Mullica soils, 0 to 2 percent slopes,	4.1	0.0%	U-1	Yes
BumA	Buddtown-Deptford complex, 0 to 2 percent	349.5	3.4%	P-1	Yes
ChsAt	Chicone silt loam, 0 to 1 percent slopes, frequently	145.2	1.4%	NR	Yes
CoeAs	Colemantown loam, 0 to 2 percent slopes,	58.3	0.6%	NR	Yes
CogB	Collington loamy sand, 0 to 5 percent slopes	5.1	0.1%	P-1	No
CokA	Collington sandy loam, 0 to 2 percent slopes	6.1	0.1%	P-1	No
CosB	Colts Neck sandy loam, 2 to 5 percent slopes	10.8	0.1%	P-1	No
CosC	Colts Neck sandy loam, 5 to 10 percent slopes	2.4	0.0%	S-1	No
DocB	Downer loamy sand, 0 to 5 percent slopes	499.7	4.9%	S-1	Yes
DoeA	Downer sandy loam, 0 to 2 percent slopes	12.8	0.1%	P-1	Yes
FamA	Fallsington sandy loam, 0 to 2 percent slopes	59.1	0.6%	S-1	Yes
FapA	Fallsington loam, 0 to 2 percent slopes	139.5	1.4%	S-1	Yes
FmhAt	Fluvaquents, loamy, 0 to 3 percent slopes,	417.8	4.1%	NR	Yes
FrfB	Freehold loamy sand, 0 to 5 percent slopes	388.9	3.8%	P-1	Yes
FrfC	Freehold loamy sand, 5 to 10 percent slopes	91.3	0.9%	S-1	No
FrkA	Freehold sandy loam, 0 to 2 percent slopes	269.3	2.6%	P-1	No
FrkB	Freehold sandy loam, 2 to 5 percent slopes	355.3	3.5%	P-1	Yes
FrkC	Freehold sandy loam, 5 to 10 percent slopes	48.4	0.5%	S-1	No
FrkD	Freehold sandy loam, 10 to 15 percent slopes	13.7	0.1%	NR	No
FrkD2	Freehold sandy loam, 10 to 15 percent slopes,	15.4	0.2%	NR	No
FrkE	Freehold sandy loam, 15 to 25 percent slopes	73.2	0.7%	NR	No
FrkF	Freehold sandy loam, 25 to 40 percent slopes	6.6	0.1%	NR	No
HbmB	Hammonton loamy sand, 0 to 5 percent slopes	12.3	0.1%	S-1	Yes
JdrA	Jade Run fine sandy loam, 0 to 2 percent slopes	97.7	1.0%	S-1	Yes
KemB	Keyport sandy loam, 2 to 5 percent slopes	987.0	9.7%	P-1	Yes
KemC2	Keyport sandy loam, 5 to 10 percent slopes, eroded	17.2	0.2%	S-1	No
KeoA	Keyport loam, 0 to 2 percent slopes	101.3	1.0%	P-1	Yes
KeoC	Keyport loam, 5 to 10 percent slopes	1.8	0.0%	S-1	No

Soil Code	Soil Description	Acres	Percentage of all Acres	Designation	Hydric Soil*
LenA	Lenni loam, 0 to 2 percent slopes	1090.1	10.7%	S-1	Yes
MakAt	Manahawkin muck, 0 to 2 percent slopes, frequently flooded	1.9	0.0%	U-1	Yes
MaoB	Marlton sandy loam, 2 to 5 percent slopes	125.6	1.2%	P-1	Yes
MaoC	Marlton sandy loam, 5 to 10 percent slopes	55.8	0.5%	S-1	No
MaoC2	Marlton sandy loam, 5 to 10 percent slopes, eroded	10.8	0.1%	S-1	No
MaoD2	Marlton sandy loam, 10 to 15 percent slopes, eroded	3.8	0.0%	NR	No
PHG	Pits, sand, and gravel	19.7	0.2%	NR	No
SabB	Sassafras loamy sand, 0 to 5 percent slopes	338.1	3.3%	S-1	No
SabC	Sassafras loamy sand, 5 to 10 percent slopes	587.5	5.8%	S-1	No
SabD	Sassafras loamy sand, 10 to 15 percent slopes	361.1	3.5%	NR	No
SabF	Sassafras loamy sand, 15 to 40 percent slopes	34.0	0.3%	NR	No
SacA	Sassafras sandy loam, 0 to 2 percent slopes	396.4	3.9%	P-1	Yes
SacB	Sassafras sandy loam, 2 to 5 percent slopes	279.8	2.7%	P-1	Yes
SacC	Sassafras sandy loam, 5 to 10 percent slopes	50.0	0.5%	S-1	No
WATER	Water	26.9	0.3%	WATER	No
WeeB	Westphalia fine sandy loam, 2 to 5 percent slopes	891.0	8.7%	P-1	Yes
WeeC	Westphalia fine sandy loam, 5 to 10 percent slopes	253.5	2.5%	S-1	No
WeeD	Westphalia fine sandy loam, 10 to 15 percent slopes	75.9	0.7%	NR	No
WeeD2	Westphalia fine sandy loam, 10 to 15 percent slopes, eroded	40.9	0.4%	NR	No
WeeF	Westphalia fine sandy loam, 15 to 40 percent slopes	51.3	0.5%	NR	No
WoeA	Woodstown sandy loam, 0 to 2 percent slopes	26.8	0.3%	P-1	Yes
WokA	Woodstown-Glassboro complex, 0 to 2 percent	539.4	5.3%	P-1	Yes
	Total	**10,202**	**100.0%**		
	Total Farmland Acres	**8,698.1**	**85.3%**		
	Total Non-Farmland Acres	**1,504.0**	**14.7%**		

Source: USDA-Natural Resources Conservation Service 2006

** Soils listed as both P-1 and Hydric may have limitations, such as a high water table or flooding that, when overcome by measures like drainage or flood control, can qualify them as prime (P-1) soils.*

Explanation of Designations

P–1	Prime Farmland
S–1	Statewide Importance
U–1	Unique Farmland
NR	Land not appropriate for farming, e.g. eroded, very steep slopes, pits, permanently wet soils, water, etc.

Soil characteristics can severely restrict the use of sites for construction and development. **Table 5: Soil Limitations for Development** records the soils and their possible limitations for building foundations. This table is a summary of a report on building suitability available from the NRCS

2006 database for Gloucester County soils. It is included here as a general guide and is not intended to eliminate the need for site analysis.

Another primary concern associated with development is a soil's ability to maintain a septic system disposal field. These fields require soils that have a low water table (over five feet below the surface) and high permeability to allow for proper drainage of wastewater. Soils with high water tables (five feet or less from the surface) create a potential for erosion, wet basements, and low permeability, often allowing wastewater to collect near the surface. South Harrison's soils generally rate low for septic drainage field suitability. Because the suitability of a soil for a septic disposal field is very site-specific and relies on many factors, including but not limited to the soil type, there is not an accurate source of soil information on this subject. The best way to determine soil suitability for a septic system is to request a site survey by a professional.

Table 5: Soil Limitations for Development

Soil Description	Soil Code	Acres	Building without Basement	Building with Basement
Alloway loam, 2 to 5 percent slopes	AhpB	0.4	B	C
Alloway loam, 5 to 10 percent slopes	AhpC	0.5	B	C
Aura loamy sand, 0 to 5 percent slopes	AucB	134.8	A	A
Aura sandy loam, 0 to 2 percent slopes	AugA	6.2	A	A
Aura sandy loam, 2 to 5 percent slopes	AugB	67.0	A	A
Aura-Sassafras loamy sands, 0 to 5 percent slopes	AvsB	133.2	A	A
Aura-Sassafras loamy sands, 5 to 10 percent slopes	AvsC	108.0	A	A
Aura-Sassafras sandy loams, 2 to 5 percent slopes	AvtB	135.4	A	A
Aura-Sassafras sandy loams, 5 to 10 percent slopes	AvtC	12.8	A	A
Aura-Urban land complex, 0 to 5 percent slopes	AvuB	153.8	NR	NR
Berryland and Mullica soils, 0 to 2 percent slopes, occasionally flooded	BEXAS	4.1	C	C
Buddtown-Deptford complex, 0 to 2 percent slopes	BumA	349.5	C	C
Chicone silt loam, 0 to 1 percent slopes, frequently flooded	ChsAt	145.2	C	C
Colemantown loam, 0 to 2 percent slopes, occasionally flooded	CoeAs	58.3	C	C
Collington loamy sand, 0 to 5 percent slopes	CogB	5.1	B	A
Collington sandy loam, 0 to 2 percent slopes	CokA	6.1	B	A
Colts Neck sandy loam, 2 to 5 percent slopes	CosB	10.8	A	A
Colts Neck sandy loam, 5 to 10 percent slopes	CosC	2.4	A	A
Downer loamy sand, 0 to 5 percent slopes	DocB	499.7	A	A
Downer sandy loam, 0 to 2 percent slopes	DoeA	12.8	A	A
Fallsington sandy loam, 0 to 2 percent slopes	FamA	59.1	C	C
Fallsington loam, 0 to 2 percent slopes	FapA	139.5	C	C
Fluvaquents, loamy, 0 to 3 percent slopes, frequently flooded	FmhAt	417.8	C	C
Freehold loamy sand, 0 to 5 percent slopes	FrfB	388.9	A	A
Freehold loamy sand, 5 to 10 percent slopes	FrfC	91.3	A	A
Freehold sandy loam, 0 to 2 percent slopes	FrkA	269.3	A	A
Freehold sandy loam, 2 to 5 percent slopes	FrkB	355.3	A	A

Soil Description	Soil Code	Acres	Building without Basement	Building with Basement
Freehold sandy loam, 5 to 10 percent slopes	FrkC	48.4	A	A
Freehold sandy loam, 10 to 15 percent slopes	FrkD	13.7	B	B
Freehold sandy loam, 10 to 15 percent slopes, eroded	FrkD2	15.4	B	B
Freehold sandy loam, 15 to 25 percent slopes	FrkE	73.2	C	C
Freehold sandy loam, 25 to 40 percent slopes	FrkF	6.6	C	C
Hammonton loamy sand, 0 to 5 percent slopes	HbmB	12.3	B	C
Jade Run fine sandy loam, 0 to 2 percent slopes	JdrA	97.7	C	C
Keyport sandy loam, 2 to 5 percent slopes	KemB	987.0	B	C
Keyport sandy loam, 5 to 10 percent slopes, eroded	KemC2	17.2	B	C
Keyport loam, 0 to 2 percent slopes	KeoA	101.3	B	C
Keyport loam, 5 to 10 percent slopes	KeoC	1.8	B	B
Lenni loam, 0 to 2 percent slopes	LenA	1090.1	C	C
Manahawkin muck, 0 to 2 percent slopes, frequently flooded	MakAt	1.9	C	C
Marlton sandy loam, 2 to 5 percent slopes	MaoB	125.6	B	C
Marlton sandy loam, 5 to 10 percent slopes	MaoC	55.8	B	C
Marlton sandy loam, 5 to 10 percent slopes, eroded	MaoC2	10.8	B	C
Marlton sandy loam, 10 to 15 percent slopes, eroded	MaoD2	3.8	B	C
Pits, sand, and gravel	PHG	19.7	A	A
Sassafras loamy sand, 0 to 5 percent slopes	SabB	338.1	A	A
Sassafras loamy sand, 5 to 10 percent slopes	SabC	587.5	A	A
Sassafras loamy sand, 10 to 15 percent slopes	SabD	361.1	B	B
Sassafras loamy sand, 15 to 40 percent slopes	SabF	34.0	C	C
Sassafras sandy loam, 0 to 2 percent slopes	SacA	396.4	A	A
Sassafras sandy loam, 2 to 5 percent slopes	SacB	279.8	A	A
Sassafras sandy loam, 5 to 10 percent slopes	SacC	50.0	A	A
Water	WATER	26.9	NR	NR
Westphalia fine sandy loam, 2 to 5 percent slopes	WeeB	891.0	A	A
Westphalia fine sandy loam, 5 to 10 percent slopes	WeeC	253.5	A	A
Westphalia fine sandy loam, 10 to 15 percent slopes	WeeD	75.9	B	B
Westphalia fine sandy loam, 10 to 15 percent slopes, eroded	WeeD2	40.9	B	B
Westphalia fine sandy loam, 15 to 40 percent slopes	WeeF	51.3	C	C
Woodstown sandy loam, 0 to 2 percent slopes	WoeA	26.8	B	C
Woodstown-Glassboro complex, 0 to 2 percent slopes	WokA	539.4	B	C

Source: Soil Survey of Gloucester County, NJ Natural Resource Conversation Service, and Cook College of Rutgers University

Key to Land Use Implications	
A = Not Limited	Little or no limitation(s) or easily corrected by use of normal equipment and design techniques.
B = Somewhat Limited	Presence of some limitation, which normally can be overcome by careful design and management at somewhat greater cost.
C = Very Limited	Limitations that, normally, cannot be overcome without exceptional, complex, or costly measures.
N/R = Not Rated	Limitations are not rated.

CLIMATE

Situated midway between the North Pole and Equator, New Jersey is influenced by hot, cold, dry, and humid airstreams that create highly changeable local weather. From May through September, New Jersey is dominated by moist, tropical air, originating in the Gulf of Mexico and carried by prevailing winds from the southwest. In winter, winds generally prevail from the west and northwest bringing cold, polar air masses from subarctic Canada. In March and April, the South Harrison area experiences the highest average wind speeds of the year, about 11 miles per hour.

The climate in New Jersey varies within five regions: North, Central, Southwest, Pine Barrens, and Coastal. South Harrison is in the Southwest zone, a region that registers some of the highest average daily and evening temperatures. The moderating effect of the nearby Delaware Bay is responsible in part for these higher temperatures. In addition, the area's soils retain the day's warmth into the night while Pine Barrens soils are sandy and exhibit a strong radiational cooling after sunset. Evening temperatures can be as much as 20 degrees lower in the Pine Barrens than in neighboring climate zones. In contrast, the Coastal Zone is generally warmer in the autumn and winter, and cooler in the spring and summer (coinciding with ocean water temperatures) than South Harrison.

Detailed weather data from stations in nearby Woodstown is available from the Office of the New Jersey State Climatologist. The South Harrison area experiences a normal maximum temperature of 88.1°F in July and a normal minimum temperature in January of 24.3°F. The extreme temperatures recorded at the nearby Woodstown station are a low of -13°F on January 22, 1984, and a high of 103°F on July 3, 1966.

The region's annual mean temperature is 55.2°F. This compares with a statewide mean temperature of 52.3°F. Of 36 stations located throughout the state, only one – the Atlantic City Marina (55.3°F) – has a higher annual average mean temperature. The mean temperature in the South Harrison area for July is 76.9°F, surpassed only by Newark (77.2°F), an area which experiences the urban heat island effect. The monthly mean temperature for January is 32.9°F, exceeded only by three southern, coastal stations – Atlantic City Marina (35.2°F), Cape May Point (34.3°F), and Belleplain (33.2°F).

Precipitation and Storm Events

The Southwest climate zone, where South Harrison is located, receives less precipitation than the North, Central, and Coastal regions. The normal average annual precipitation for the area (1971 through 2000) was 45.76 inches compared to a statewide normal annual precipitation of 47.87 inches. The region's lack of orthographic features and greater distance from the Great Lakes-St. Lawrence storm track may explain lower precipitation. South Harrison's location, approximately 60 miles inland, is also less susceptible to heavy rains associated with coastal storms. The South Harrison area receives the most precipitation in July, normally 4.41 inches, and the least precipitation in February, normally 2.89 inches.

Snowfall typically occurs in New Jersey when moist air from the south converges with cold air from the north. In South Harrison, snowfall may occur from mid-October to mid-April, but is most likely to occur from December to March. Snow is on the ground an average of 17 days each year.

Severe storm events, including thunderstorms, tropical storms, blizzards, ice storms, hail storms, and tornadoes, occur in Gloucester County. Tornadoes are infrequent; about five, generally weak, occur in New Jersey each year. Thunderstorms occur in the South Harrison area about 30 days each year, mainly in June, July, and August. In modern history, only hurricanes passing offshore of New Jersey or the remnants of hurricanes have impacted the state. Nevertheless, some of these have been severe. For example, on September 16, 1999, Hurricane Floyd was downgraded to a tropical storm as it passed east of Atlantic City. Floyd caused torrential rains, high winds, and flooding across New Jersey. While not climate-related, earthquakes are another natural hazard that warrants a mention. Although Gloucester County has never experienced an earthquake epicentered in the County, according to NJ DEP data, adjacent Salem County has experienced five earthquakes and Camden County has been the epicenter of three earthquakes.

Growing Seasons

South Harrison is within U.S. Department of Agriculture (USDA) Plant Hardiness Zone 7, where annual minimum temperatures are typically between 0°F and 5°F. In New Jersey, almost all of Gloucester County, adjacent portions of Salem County, and areas along the Atlantic coastline are designated as Zone 7, the warmest USDA Plant Hardiness Zone in New Jersey. The easternmost corner of Gloucester County, as well as neighboring portions of Camden and Atlantic Counties, are considered to be in Zone 6, a slightly cooler climate.

South Harrison's agricultural growing season is approximately six months, or 180 days, from mid-April to mid-October. This is the period between the last spring frost and first autumn frost. However, harvesting of grain crops typically continues throughout November, and winter crops such as broccoli, cauliflower, and cabbage are grown until the first hard freeze, usually in early January. The frost-free growing season in South Harrison is about 60 days longer than in northern New Jersey, where frosts generally end in May and begin in October.

Air Quality

Air quality is one of the most difficult environmental indicators to measure because its sources are diffuse and regional in nature. Air pollutants caused by industry, cars and buses, fires, and dust, can travel extremely far from their point sources. For example, the burning of coal in Ohio, Michigan, and Western Pennsylvania to generate electricity sends pollutants such as 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 complexes in the Delaware Valley.

In 1970, the Environmental Protection Agency (EPA) was formed to enforce the Clean Air Act (CAA). 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 environment. The EPA sets National Ambient Air Quality Standards (NAAQS) for these pollutants based on human health effects, as well as environmental and property damage.

In New Jersey, The NJDEP Bureau of Air Monitoring maintains a network of 43 stations across the state that continually monitors some or all of the following seven parameters: carbon monoxide, nitrogen oxides, ozone, sulfur dioxide, smoke shade, particulate matter, and meteorological data. The monitoring station closest to South Harrison Township is located in Clarksboro, Gloucester County, and measures ozone and sulfur dioxide concentrations. It is an urban scale station, which means that the location is ideal for monitoring pollutants over an area of 10-100 kilometers

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. There is only one active air quality permit (as of December 2007) in South Harrison Township —the Gloucester County Solid Waste Complex (PI#55923).

CRITERIA POLLUTANTS

Ground level ozone is formed when volatile organic compounds (VOC) and **nitrogen oxides** react with sunlight and heat. It is produced more in the summer months, and is the primary constituent of smog. Even in low levels, ground level ozone 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_2) is a colorless, odorless gas that is formed when carbon fuel is not burned completely. It is a component of motor vehicle exhaust; therefore higher levels of CO_2 generally occur in areas with heavy traffic congestion. The highest levels of CO_2 typically occur during the colder months when air pollution becomes trapped near the ground beneath a layer of rising warm air.

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 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.

Source: DVRPC, 2008

Air Quality Index

EPA created the Air Quality Index (AQI) to indicate a metropolitan 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:

Air Quality Index (AQI) Values	Levels of Health Concern	Colors
When the AQI is in this range:	*...air quality conditions are:*	*...as symbolized by this color:*
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: AIRNow

The daily score is based on whatever the highest individual pollutant score is. The index is used to measure overall air quality by counting the number of days per year when the AQI of each metropolitan region exceeds 100, a score equivalent to the NAAQS. Across all metropolitan regions (with populations over 500,000), the number of days per year with an AQI of over 100 has steadily decreased between 1988 and 2001. In 2005, the closest metropolitan region to South Harrison Township, Philadelphia, had 28 days when the AQI exceeded 100.

New Jersey is subdivided into nine regions that each report the AQI. Gloucester County is in Region 8: Southern Delaware Valley. In 2005, this area reported 219 good (green) and 130 moderate (yellow) days, 16 days which were unhealthy for sensitive groups (orange), and 0 unhealthy (red) days.

SURFACE WATER RESOURCES

South Harrison Township lies completely within the Delaware River Basin. The southern half of the land surface drains by way of Oldmans Creek. It also forms the township's border with Salem County and eventually flows directly into the Delaware River. The northern portion of the township drains to the south branch of the Raccoon Creek or to Basgalore Creek – a tributary to the Raccoon Creek main channel.

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 and ridges. Large watersheds are made up of a succession of smaller ones, and smaller ones are made up of the smallest area – the catchment area of a local site. For example, the Delaware River watershed is made up of many smaller watersheds, such as the Raccoon Creek watershed. The Raccoon Creek watershed, in turn, is formed of several subwatersheds, consisting of the land that drains to a major tributary or branch of the creek, such as the Raccoon South Branch subwatershed. These subwatersheds can be further subdivided into smaller ones, each surrounding smaller tributaries that flow to the larger channel, 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. South Harrison Township is within two HUC 11 watersheds – the Raccoon Creek and the Oldmans Creek watersheds.[1] See **Map 7: Watersheds** and **Map 8: Surface Water, Wetlands, and Vernal Pools.** The percentage of South Harrison Township land that is within each of these watersheds is listed in the following table.

Table 6: Watersheds in South Harrison Township

Watershed	USGS Watershed Code (HUC 11 Number)	Stream Classification	Acreage within South Harrison	% of South Harrison land	Subwatersheds (HUC 14 Numbers) within SouthHarrison
Raccoon Creek	02040202**150**	FW2–NT	4,858	47.61%	02040202150050 02040202150040 02040202150030
Oldmans Creek	02040202**160**	FW2–NT/SE1 FW2–NT (C1)*	5,344	52.39%	02040202160030 02040202160020 02040202160010

Source: NJDEP
**Portion within Harrisonville Lake Wildlife Management Area only*

[1] "HUC" stands for Hydrological Unit Code, which is a numerical identification number given to every drainage system in the United States by the U.S. Geological Survey. HUC-11 codes are the 11-digit numbers applied to a part of a drainage area that is approximately 40 square miles in size. In the case of the Raccoon and Oldmans watersheds, the entire watershed is the HUC–11 area. HUC-11 areas are further subdivided into HUC-14 subwatersheds, which are about 7 square miles in size and which have an identification number of 14 digits.

Raccoon Creek Watershed

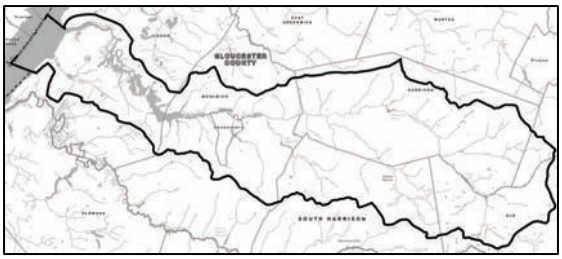


Figure 3: Raccoon Creek Watershed

The Raccoon Creek watershed contains approximately 40 square miles, of which 7 square miles is in South Harrison Township. The main channel, or the North Branch, of the creek is 19 miles in total length and flows from Glassboro and Elk townships across Harrison, and through Woolwich and Logan townships to the Delaware River. While there are several tributaries to the creek, the main one is the South Branch Raccoon Creek, which starts close to the western edge of the border between Elk and South Harrison townships. It flows northwestward across South Harrison and into Harrison Township where it joins the main channel just east of Tomlin Station Road. Less than a mile beyond the juncture of the North and South branches, Raccoon Creek leaves Harrison Township and travels across the centers of Woolwich and Logan where it widens into extensive tidal wetland areas.

Raccoon Creek is navigable from the Delaware River up to Kings Highway in Woolwich. It is also tidal up to a point three-quarters-of-a-mile east of the New Jersey Turnpike in Woolwich. During the 18th and 19th centuries the creek was a transportation corridor for small boats between Mullica Hill and the larger downstream community of Swedesboro, which had wharves and piers from which bigger vessels carried cargo to Philadelphia and other ports.

The largest tributary to the main (north) branch Raccoon Creek within South Harrison is Basgalore Creek. Basgalore Creek begins in South Harrison and travels northwest, forming Lake Basgalore in Woolwich Township before meeting the main channel of the Raccoon Creek near the New Jersey Turnpike. There are also many small, unnamed tributaries to the Raccoon Creek within South Harrison Township.

Source: DVRPC
Raccoon Creek from Tomlin Station Road

The South Branch Raccoon Creek is shorter than the main (north) branch. It begins in Elk and the north east portion of South Harrison townships. One contributor to this Creek in South Harrison is the Poplar Branch which begins in Elk Township and travels west.

Oldmans Creek Watershed

The Oldmans Creek watershed drains approximately 44 square miles and is 20 miles long. Eight square miles of the watershed is in South Harrison Township. The creek forms the boundary between Gloucester and Salem Counties in this area, and flows through seven municipalities to empty into the Delaware River on the north side of Oldmans Township, Salem County. The Creek is tidal up to a point in Woolwich Township (at its confluence with Porches Creek).

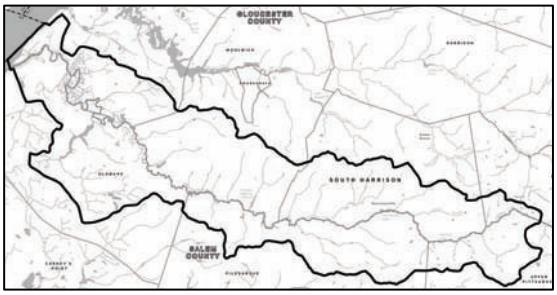


Figure 4: Oldmans Creek Watershed

Pedricktown Marsh, a large tidal marsh located between Logan Township in Gloucester County and Oldmans Township in Salem County, is one of the premier bird areas in the state of New Jersey, an important stopover site for migratory waterfowl, and an ecotourist attraction for many bird watchers from throughout the region. The water quality of Oldmans Creek was very high until about ten years ago when it began to deteriorate as development in the watershed increased. This is a major concern because of the potential effects on the tidal marsh and on the very important habitat it provides.

Oldmans Creek has one main channel with several tributaries but no significant branching. Lincoln Stream and Marl Run are the two named tributaries to Oldmans Creek in South Harrison Township, and there are three unnamed tributaries that traverse the township. In addition, Harrisonville and Algonkin Lakes are also located in this watershed.

Streams

There are a total of 32 stream miles flowing across South Harrison Township, over 29 miles of which are first or second order (headwater) streams. That is, they 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.

Table 7: South Harrison Township Streams

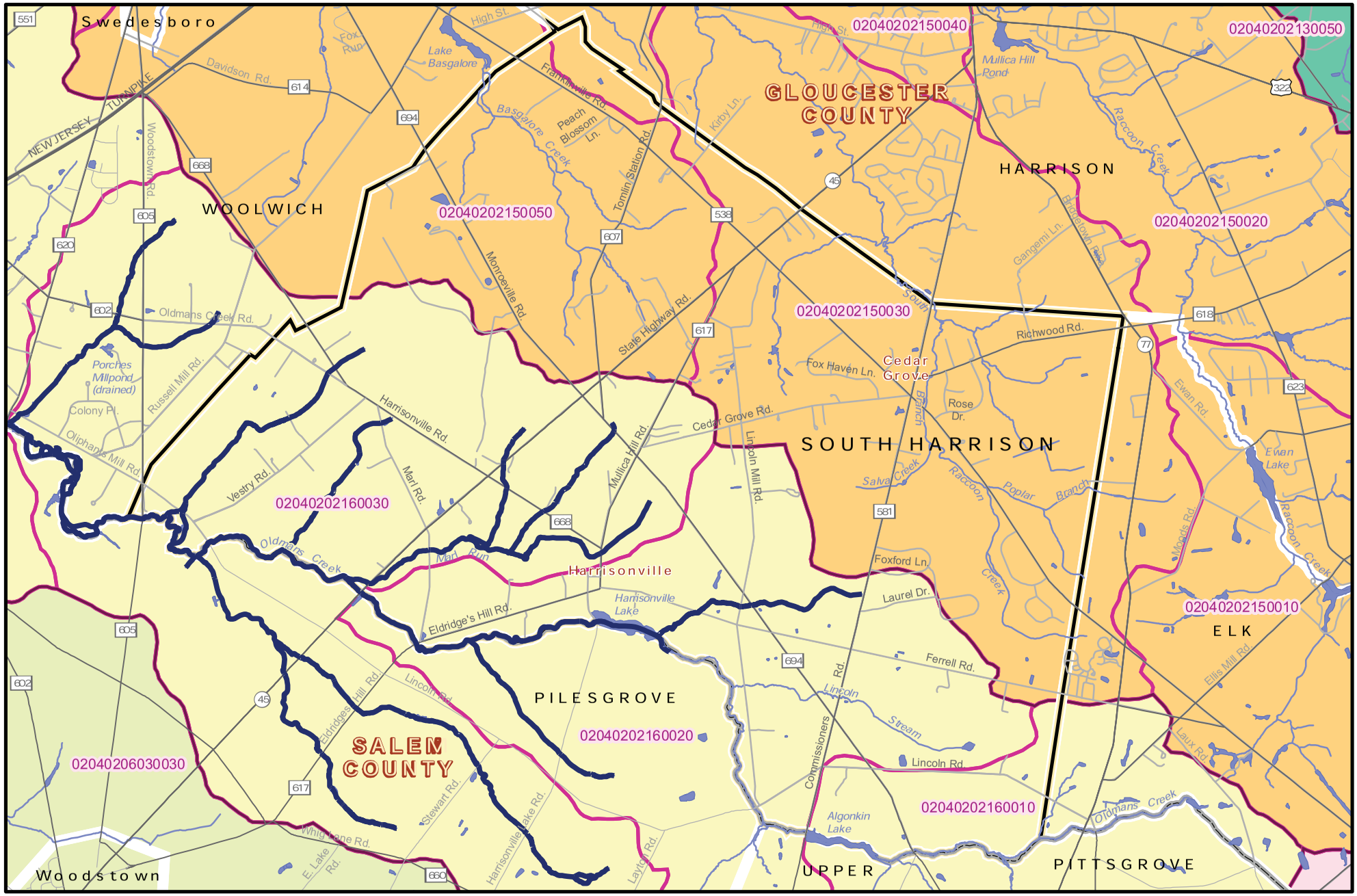
Stream Order	Miles
First Order streams (smallest)	18.7
Second Order streams	10.6
Third Order streams	2.2
Total	**31.5**

Source: NJDEP, Bureau of Geographic Information Systems

Headwaters are of particular importance because they tend to contain a diversity of aquatic species and their condition affects downstream water quality. Because of their small size, they are highly susceptible to impairment by human activities on the land. 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. Headwaters are important sites for the aquatic life that is at the base of the food chain, and often serve as spawning or nursery areas for fish. See **Map 8: Surface Water, Wetlands, and Vernal Pools.**

SOUTH HARRISON

MAP 7: Watersheds



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.

Watersheds

- Oldmans Creek
- Raccoon Creek / Birch Creek
- Salem River
- Still Run / Little Ease Run
- Mantua Creek
- Sub-Watershed (Hydrologic Unit Code 14)
- Category1 - Special Protection Waters

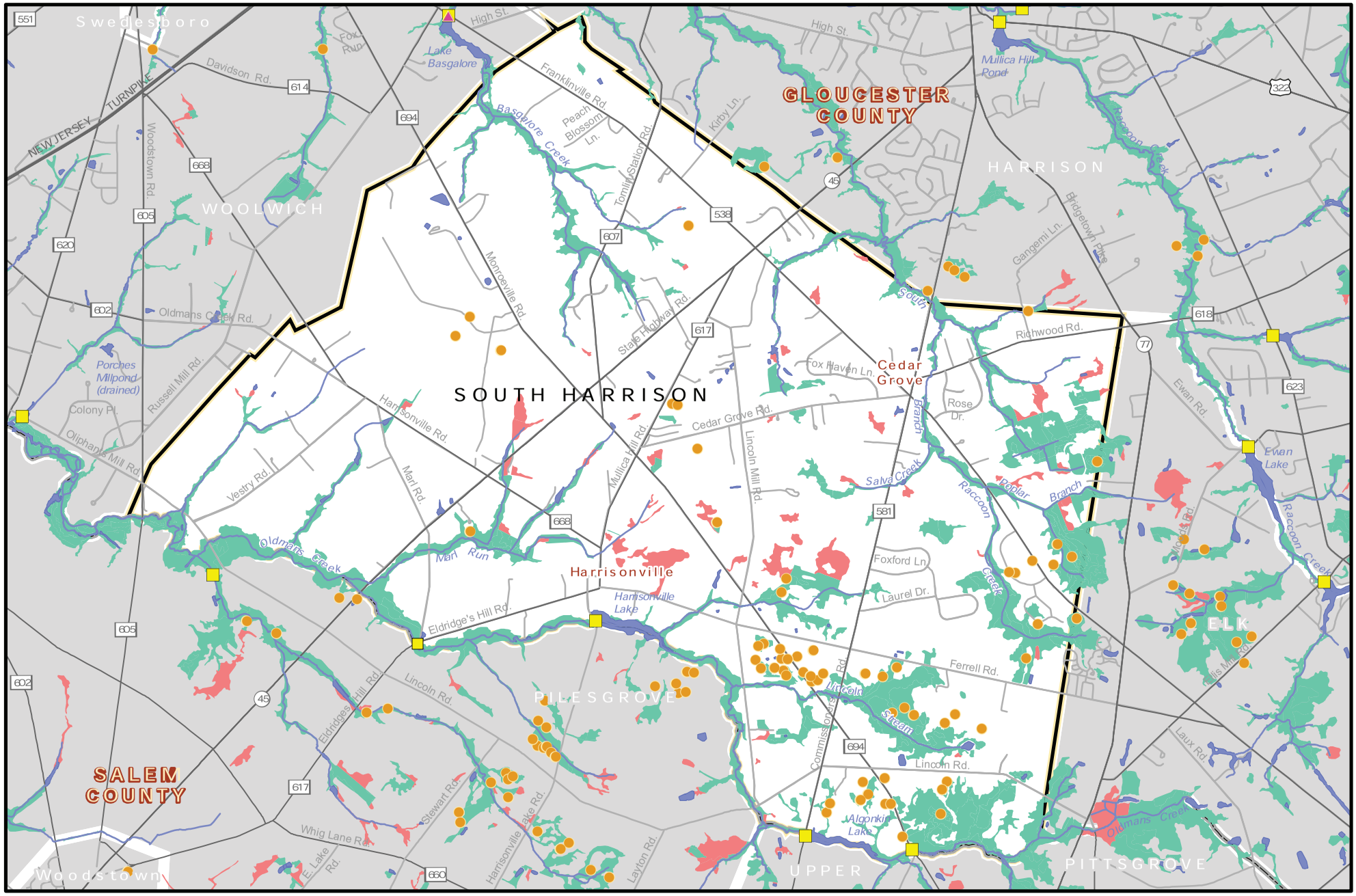
N

0 0.25 0.5 1
Miles

Delaware Valley Regional Planning Commission
December 2008

SOUTH HARRISON

MAP 8 Surface Water, Wetlands, and Vernal Pools



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.

Agricultural Wetlands
Wetlands
Vernal Pool Location
Head of Tide
Dam

N

0 0.25 0.5 1
Miles

Delaware Valley Regional Planning Commission
December 2008

Lakes and Ponds

Naturally occurring lakes and ponds do not exist in southern New Jersey. Artificial lakes and ponds are man-made impoundments of water that are one acre or larger, formed by damming. They are often used for irrigation and flood control. Artificial ponds and lakes may also be the result of an active extractive operation.

In South Harrison, lakes occupy a total of approximately 42 acres (less than one percent of all land area). There are numerous small ponds and water impoundments and two named lakes in the Township: Harrisonville Lake and Algonkin Lake. These lakes are the two largest lakes in South Harrison Township at eleven acres (Harrisonville Lake) and nearly seven acres (Algonkin Lake), respectively. Both lakes are located along Oldmans Creek and create a natural border between Gloucester and Salem Counties. See **Map 8: Surface Water, Wetlands, and Vernal Ponds**.

Source: DVRPC

Harrisonville Lake is an attraction for residents of South Harrison Township and neighboring communities.

As is traditional for artificial lakes, Harrisonville and Algonkin Lakes were created by damming Oldmans Creek. Harrisonville Lake initially provided hydropower to operate both a nearby grist mill and a lumber mill while Algonkin Lake was the primary power source for another local grist mill. Both lakes also served as an ice source for refrigeration for agricultural products. Today these lakes are not utilized to drive the local economy, but they are important recreational assets to residents of South Harrison and adjoining municipalities.

The State of New Jersey is in the process of repairing the dam that creates Harrisonville Lake, due to a void under the dam structure of over 20 feet, which was found during a recent routine inspection. The extent of the project includes improvements to the dam, bridge, parking lot area, embankments on both sides of the roadway, and road reconstruction on both sides of the dam. The project will begin in Spring 2008, and should be completed within three months. The Division of Fish and Wildlife began preparations for this dam reconstruction work recently by lowering the water level of Harrisonville Lake and removing its fish. Upon completion of repairs to the dam, the lake will be refilled and stocked with a variety of fish species.

Wetlands

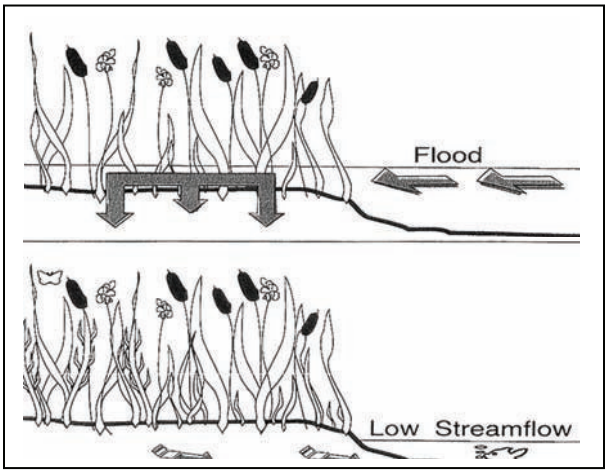
Wetlands support unique communities that serve as natural water filters and as incubators for many beneficial species. The term “wetland” is applied to areas where water meets the soil surface and supports a particular biological community. The source of water for a wetland can be an estuary, river, stream, lake edge, or groundwater that rises close to the land surface. Under

normal circumstances, wetlands are those areas that support a prevalence of defined wetland plants on a wetland soil. The U.S. Fish & Wildlife Service designates all large vascular plants as wetland (hydric), non-wetland (non-hydric), 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.

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 transition 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," can determine for sure if there are freshwater wetlands on a property. An LOI verifies the presence, absence, and boundaries of freshwater wetlands and transition areas on a site. Activities permitted to occur within wetlands are very limited and permits are required for most of them. Additional information on wetlands rules and permits is available through NJDEP and on its web site under "landuse." For a good general introduction to this topic, the Association of New Jersey Environmental Commission's (ANJEC) publication *Freshwater Wetlands Protection in New Jersey*, listed in the **Sources of Information** section, is recommended.

All of South Harrison's wetlands are freshwater. Natural wetlands of all types total 1,388 acres within the township (13.6 percent of total land area), of which 1,133 acres are forested wetlands, and 76 acres are low-growing emergent, scrub/shrub or herbaceous wetlands.
See **Map 8: Surface Water, Wetlands, and Vernal Ponds**.

South Harrison also includes 177 acres of wetland areas that have been altered by human activities and no longer support typical wetland vegetation, or are not vegetated at all. These modified wetland areas do, however, show obvious signs of soil saturation and exist in areas shown to have hydric soils on US Soil Conservation Service soil surveys. Modified wetlands fall into categories defined by the *Anderson Land Use Classification* system, as follows: there are 146 acres of former agricultural wetlands; 18 acres of disturbed wetlands; and 14 acres of former agricultural wetlands that are now becoming shrubby but are not built-up.



Source: The Streams of Washington Township, with permission.

Figure 5: Wetlands: Wetlands vegetation traps and holds flood waters, allowing it to percolate into the ground.

Agricultural Wetlands

Agricultural wetlands occupy 146 acres (just over one percent of total land area) of South Harrison Township. These "quasi-wetlands" are found scattered as small sites primarily in the northeast portion of the Township and also north of Harrisonville. Agricultural wetlands are low-lying areas that once were wet but which have been converted to agricultural use through drainage. These areas still exhibit evidence of soil saturation in aerial infrared photo surveys, but they do not support natural wetland vegetation. See **Map 8: Surface Water, Wetlands, and Vernal Ponds**.

Draining fields for agriculture used to be done using perforated tile pipes that were buried below plow depth and linked together into a network designed to drain excess surface and shallow subsurface water. Called "tile drainage," these systems lowered the water table and introduced more oxygen into the root zone, which resulted in better crop yields. In addition to draining wetlands and areas of hydric soils, field tiles were also commonly used to drain upland areas including ridges and hilltops. While tile drains have allowed more land to become farmable, they also tend to convey nitrogen from the fields into local streams more efficiently than is desired, which can have negative effects on stream health.

Historical photos (left to right) from Concrete Tile for Land Drainage (Portland Cement Association, 1920); "Voice of the Farm" (Firestone, 1938); and Drain the Wet Land (International Harvester, 1921).

Drainage systems can be quite long-lived and require only the periodic maintenance of drainage ditches and outlets. Because little mapping exists identifying the location of tile lines, municipal, county and state boards rarely address their existence as part of development approval processes. Yet, tile systems can pose health concerns when land is developed into residential (or commercial) uses, especially where septic systems are constructed. If a septic system leach field is installed near an unknown existing tile, discharge may seep into the tile line and directly into the local waterway. Lawn chemicals carried through field drains are also a threat to water quality, and wildlife and habitat.

As long as agricultural wetland areas remain in agricultural use, they are exempt from New Jersey's 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.

In addition, if hydric soils are present, certain activities on drained farmland may be regulated by the state of New Jersey. While the Freshwater Wetlands Protection Rules set forth several specific farming, ranching, and silviculture exemptions, those exemptions are subject to another limitation:

> If an area with hydric soils has been drained for farming purposes through the use of drainage structures such as tiles or ditches, the Department shall presume that the area has wetlands hydrology for the purpose of identifying a freshwater wetland under N.J.A.C. 7:7A-2.3. To rebut this presumption of wetlands hydrology, all drainage structures shall be removed or completely disabled and the area shall be left undisturbed for at least one normal rainfall year, after which the presence or absence of wetlands hydrology shall be determined through use of technical criteria, field indicators, and other information, in accordance with the 1989 Federal manual. [7:7A-2.8(b)5]

The Natural Resources Conservation Service sponsors the Wetlands Reserve Program (www.nrcs.usda.gov/programs/wrp), 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.

Vernal Pools

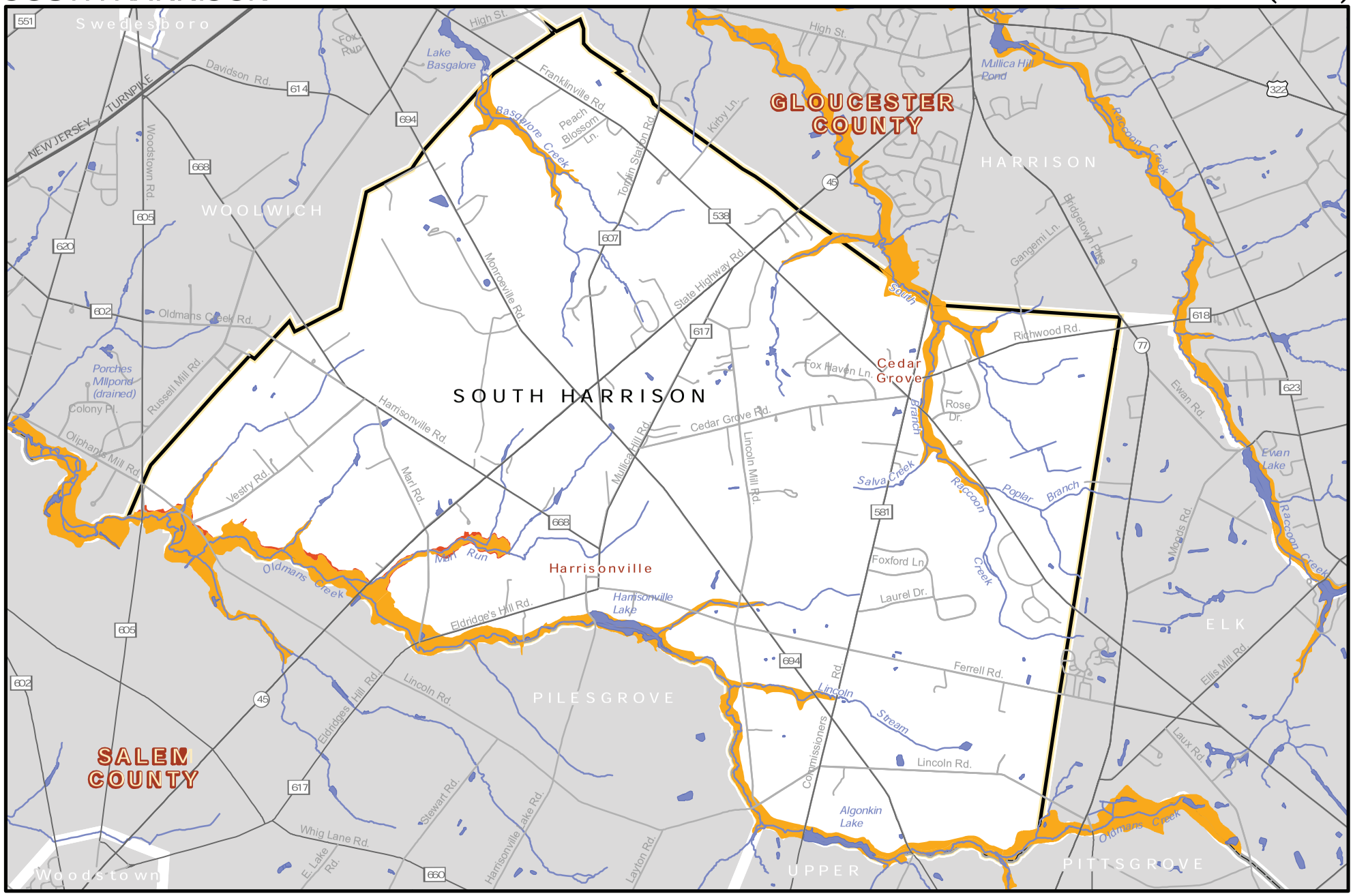
Vernal pools are bodies of water that appear following snowmelt and during spring rains, but that disappear or are dry during the rest of the year. They are highly important sites for certain rare species of frogs and salamanders, called obligate breeders. Obligate breeders will only breed in vernal 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 their obligate amphibian species.

The New Jersey Division of Fish and Wildlife has been conducting a Vernal Pool Survey project since 2001, to identify, map, and certify vernal ponds throughout the state. Once a vernal pond is certified, regulations require that a 75-foot buffer be maintained around the pond. NJDEP's Division of Land Use Regulation oversees this designation and restricts development around vernal ponds by denying construction permits. Local municipalities can provide additional protection by instituting restrictive zoning or negotiating conservation easements on the land surrounding the pond.

SOUTH HARRISON

MAP 9. Flood Hazard Areas (1996)



Sources : NJDEP,FEMA,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.

Flood Zone

100-Year Floodplain

500-Year Floodplain

N

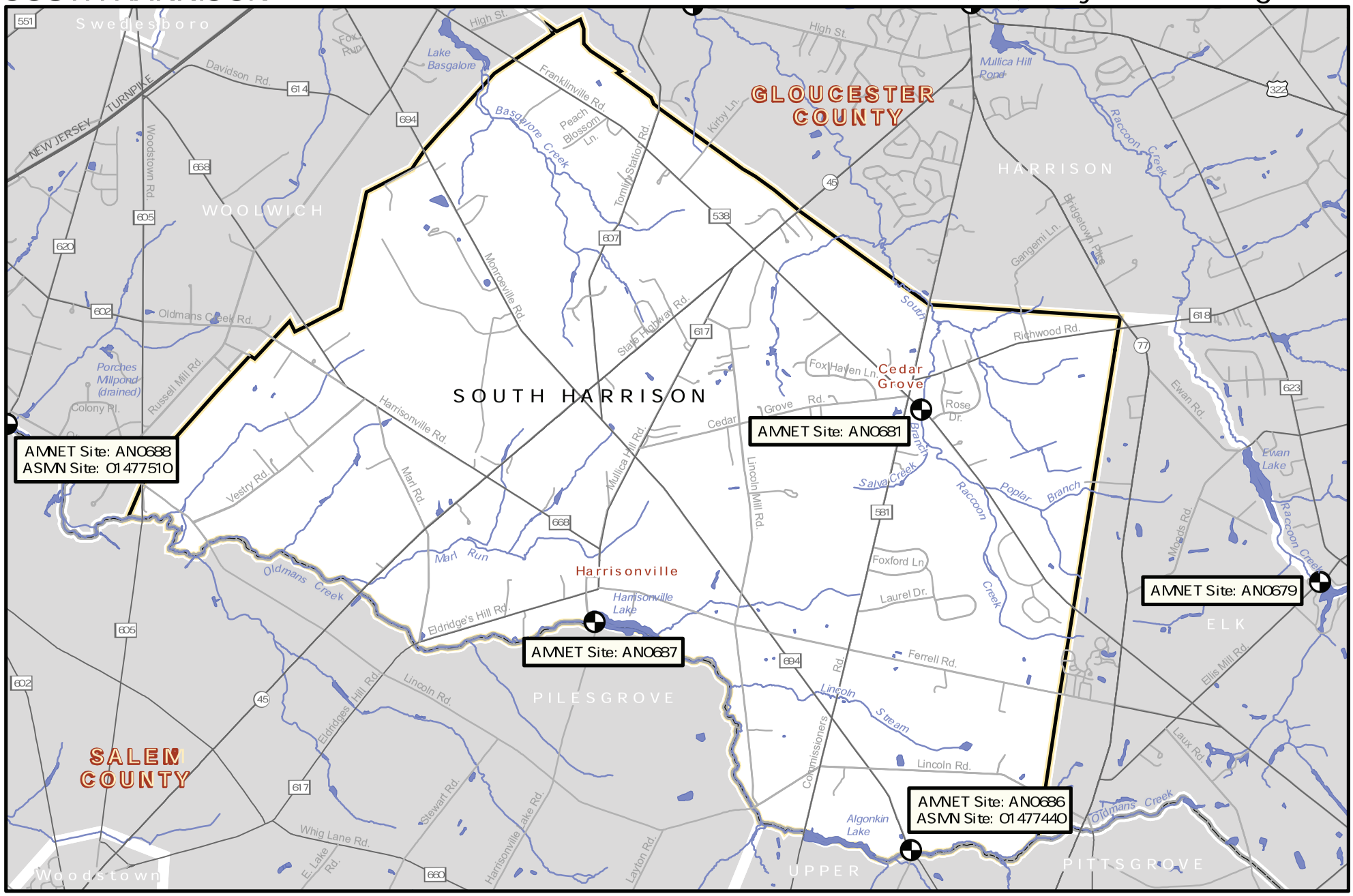
0 0.25 0.5 1

Miles

Delaware Valley Regional Planning Commission
December 2008

SOUTH HARRISON

MAP 10 Water Quality - Monitoring Sites



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.

Monitoring Site

N

0 0.25 0.5 1
Miles

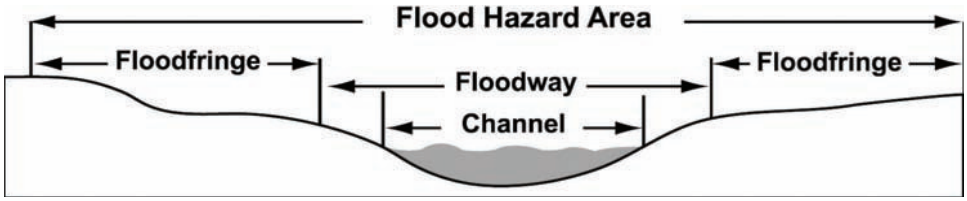
Delaware Valley Regional Planning Commission
December 2008

The state has identified 57 possible vernal pools within South Harrison Township. These pools are concentrated mainly in the southeast portion of the township. Surveys of each pool are planned in order to determine what species are present and, indeed, if the pool is still in existence as a natural habitat. A certified vernal pool is defined as one that occurs in a confined basin without a permanently flowing outlet, has habitat documented for one obligate or two facultative herptile species, maintains ponded water for at least two continuous months between March and September, and is free of fish populations throughout the year. Of the 57 listed pools, two have been visited and confirmed as vernal, although they have not been surveyed to determine if they qualify for certification. See **Map 8: Surface Water, Wetlands, and Vernal Pools** and **Appendix A: Possible Vernal Pools in South Harrison Township, Gloucester County** where pools are listed, along with their Geographic Positioning System coordinates.

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. 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 (a flood that has a one percent chance of occurring in any given year).

Although the terms "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 a flood resulting from the 100-year discharge increased by 25 percent. This type of flood is called the "flood hazard area design flood" and it is the flood regulated by NJDEP.



Source: The Streams of Washington Township, with permission

Figure 6: Parts of a Flood Hazard Area

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 their 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.

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. Activities that are proposed to occur in a flood hazard area will require issuance of a stream encroachment permit or a letter of non-applicability from the NJDEP. Additional information on floodplain activities is available from NJDEP and from its web site under "Landuse."

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 South Harrison by using the Federal Emergency Management Agency's (FEMA's) 100–year floodplain maps. FEMA's maps show that approximately 485 acres or 5% of South Harrison Township's land is within 100 year flood hazard areas, with an additional 16 acres in the 500 year floodplain. Nearly all of South Harrison's floodplain areas are located along the main branch of Oldmans Creek, Raccoon Creek South Branch, and Basgalore Creek. Smaller streams may periodically flood, but the Federal Emergency Management Agency and NJDEP have not delineated these floodplains because the risk to property and human health is usually minor. See **Map 9: Flood Hazard Areas**.

Table 8: Flood Hazard Area Acreage

Category	Acres
100-year floodplain	485
500-year floodplain	16

Source: Federal Emergency Management Agency (FEMA)

SURFACE WATER QUALITY

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). 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*). In addition to being classified as FW1 and FW2, fresh waterbodies are classified as trout-producing (TP), trout maintaining (TM), or nontrout waters (NT). Each of these classifications may also be subject to different water quality standards.

Table 9: Water Quality Classifications of Streams in South Harrison

Streams	Classification
Oldmans Creek	FW 2 – NT/SE1
Oldmans Creek and its tributaries from Porches Run (Woolwich Township) to Harrisonville Lake WMA	FW 2 – NT(C1)
Raccoon Creek (South Branch)	FW 2 – NT/SE2

Source: NJDEP, Surface Water Quality Standards, N.J.A.C. 7:9b;

The South Branch of Raccoon Creek is one of two major streams in South Harrison Township. This waterbody is classified as FW2–NT/SE2, which means that it is both a freshwater stream and an estuarine stream (below head-of-tide in Woolwich Township). Additionally, it is not trout producing or trout maintaining. The bulk of Oldmans Creek, the other major waterbody in South Harrison, is also classified as FW 2 – NT/SE1. The portion of the creek extending from the Porches Run tributary in neighboring Woolwich Township (head of tide) to just beyond Harrisonville Lake, is classified as FW 2 – NT(C1), which means that it is a Category One stream. All tributaries to Oldmans Creek in this area are also classified as FW 2 – NT(C1). Another term for Category One streams is "Special Protection Waters."

Category One waters are considered to be pristine waters or waters of higher ecological significance, and fall under the second highest tier of antidegradation protection. They are protected from measurable changes in water quality due to their unique characteristics. Beginning in 2002, NJDEP upgraded the antidegradation designation of several waterbodies to Category One, including Harrisonville Lake and small portions of Oldmans Creek above the lake and below it, all of which are within the Harrisonville Lake Wildlife Management Area (WMA). In May 2007, NJDEP proposed the establishment of new definitions to identify waterbodies that qualify for an upgrade to Category One status, based upon a finding of exceptional ecological significance. The section of the stream from Harrisonville Lake downstream to head-of-tide (in Woolwich Township) plus all the tributaries to this segment were proposed for C-1 status. That

status was approved as of June 2008. This segment of the creek serves as habitat for federally threatened and state endangered bog turtle populations as well as for the state threatened triangle floater mussel.

Tributary streams that are not explicitly classified by the NJDEP take the classification of the river into which they flow. For example, the Basgalore Creek is classed as FW2-NT because it flows into the Raccoon Creek main channel, which is an FW2-NT waterway. According to NJDEP rules, FW2-NT 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/boating); (3) industrial and agricultural water supply; (4) public potable water supply after conventional filtration and disinfection; and (5) any other reasonable uses.

The determination of whether or not water quality is sufficient to meet a waterbody's designated use(s) is based on measurement of numerous surface water quality parameters. Some examples of surface water quality parameters include fecal coliform, dissolved oxygen, pH, phosphorous, and toxic substances. NJDEP also evaluates water quality by examining the health of aquatic life in a stream.

New Jersey's Integrated Water Quality Monitoring and Assessment Report

The Federal Clean Water Act (Act) mandates that states submit biennial reports to the U.S. Environmental Protection Agency (USEPA) 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. A TMDL is an analysis of the target "load" of a pollutant that a water body can assimilate. It thus defines the water quality goals for the waterway. See page 47 for a more comprehensive discussion of TMDLs.

In 2002, 2004, 2006, and again in 2008, NJDEP integrated the 303(d) List and the 305(b) Report into a single report according to USEPA's guidance. The draft 2008 *Integrated Water Quality Monitoring and Assessment Report,* released in mid 2008, places the state's waters on one of five "sublists." (See http://www.state.nj.us/dep/wms/bwqsa/draft_2008_integrated_report.pdf.) Sublists 1 and 2 contain waters that are attaining 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 non-attainment; (2) other enforceable pollution control requirements are reasonably expected to result in conformance with the applicable water quality standards; or (3) non-attainment 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.

In the 2002 and 2004 Integrated Reports, NJDEP placed each of the state's water quality monitoring stations on a sublist. Stations that tested for more than one water quality parameter, i.e., pH, phosphorous, fecal coliform, dissolved oxygen, temperature, etc., could be placed on different sublists for different parameters. For example, a station could be on Sublist 5 (non-attaining) for phosphorous and Sublist 1 (attaining) for temperature. Individual stream segments (also referred to as waterbodies) were then associated with water quality sampling stations using a methodology established by NJDEP. However, the ability of a waterbody to meet its designated uses was not explicitly stated in the 2002 and 2004 Integrated Reports.

Beginning in 2006, NJDEP revised its methodology so as to report on a subwatershed basis the attainment of water quality standards required for achieving designated uses. Rather than placing water quality monitoring stations and their associated stream segments on a sublist for an individual parameter, NJDEP identified the designated uses applicable to each HUC-14 watershed (assessment unit) and assessed the status of attainment for each applicable designated use. Designated uses include:

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

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

NJDEP based 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 subwatershed were 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 subwatershed being listed as impaired for that use/parameter. In addition, where a HUC-14 subwatershed contains waters of different classification, the more stringent classification was used to assess impairment; and that impairment was 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 10: New Jersey Integrated Water Quality Monitoring and Assessment Report, 2008, for the status of each of South Harrison's HUC-14 subwatersheds.

Table 10: New Jersey Integrated Water Quality Monitoring and Assessment Report, 2008

Assessment Unit ID (HUC-14 subwatersheds)	Assessment Unit Name	Aquatic Life General	Recreation	Drinking Water Supply	Agricultural Water Supply	Industrial Water Supply	Fish Consumption
02040202150030-01	Raccoon Creek SB	Sublist 5	Sublist 4A	Sublist 3	Sublist 3	Sublist 3	Sublist 3
02040202150040-01	Raccoon Creek (Russell Mill Rd to Rt 45)	Sublist 5	Sublist 4A	Sublist 5	Sublist 2	Sublist 2	Sublist 5
02040202150050-01	Raccoon Creek (Swedesboro Rd-Russell Mill Rd)	Sublist 5	Sublist 3	Sublist 3	Sublist 3	Sublist 3	Sublist 3
02040202160010-01	Oldmans Creek (above Commissioners Rd)	Sublist 2	Sublist 4A	Sublist 2	Sublist 2	Sublist 2	Sublist 3
02040202160020-01	Oldmans Creek (Rt 45 to Commissioners Rd)	Sublist 4A	Sublist 4A	Sublist 2	Sublist 2	Sublist 2	Sublist 5
02040202160030-01	Oldmans Creek (Kings Hwy to Rt 45)	Sublist 4A	Sublist 4A	Sublist 2	Sublist 2	Sublist 2	Sublist 3

Source: NJDEP, 2008

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

Key to Integrated Report Sublists

Sublist	Placement Conditions
Sublist 1	The designated use is assessed and attained AND all other designated uses in the assessment unit area 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 are 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 non-attainment 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. Non-attainment 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 10** above, an assessment unit may be listed on one or more sublists depending on the results of the assessment (i.e., on Sublist 2 for drinking water, Sublist 3 for aquatic life, etc.). If one or more designated uses are assessed as "non-attainment" (Sublist 5) the pollutant(s) causing the non-attainment status is identified on the "303(d) List of Impaired Waters with Priority Ranking." The ranking refers to the priority given a specific assessment unit when determining the schedule for a TMDL. **Table 11: New Jersey's 303(d) List of Impaired Waters with Priority Ranking**, lists the non-attaining assessment units and their pollutants in South Harrison Township.

Table 11: New Jersey's 303(d) List of Impaired Waters with Priority Ranking, 2008

Assessment Unit ID	Assessment Unit Name	Parameter	Ranking
02040202150030-01	Raccoon Creek SB	Pollutant Unknown	Low
02040202150040-01	Raccoon Creek (Russell Mill Rd to Rt 45)	Arsenic	Medium
		Chlordane	Medium
		DDD /DDE / DDT	Medium
		Mercury	Medium
		PCBs	Low
		Phosphorous	Medium
		Silver	Medium
		Turbidity	Low

Source: NJDEP, 2008

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).*** NJDEP runs the ASMN network 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. 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.

Ambient Surface Water Monitoring (ASWM) Network

The USGS/NJDEP Ambient Surface Water Monitoring (ASWM) network operates sites at which chemical monitoring is conducted near South Harrison on Oldmans Creek at Porches Mill and Jessups Mill (Salem County). Water quality is also monitored along Raccoon Creek in Mullica Hill and Swedesboro. Sites in Swedesboro also monitor the water quality of Basgalore Creek. These sites are tested for a range of elements, including dissolved oxygen, pH, ammonia, nitrogen, and phosphorous. The station locations are depicted on **Map 10: Water Quality – Nontidal Waters.**

Ambient Biomonitoring Network (AMNET)

There are three AMNET sites that assess aquatic life within South Harrison — two along Oldmans Creek and one on the south branch of Raccoon Creek. Two additional sites are located upstream of the township, one each on Oldmans and Raccoon Creeks.

NJDEP first sampled all three of the AMNET sites in South Harrison in August of 1995. Five years later the three sites were sampled again. Each AMNET site was tested for one water

quality parameter ─ the diversity of the aquatic communities at that site. Specifically, the benthic (bottom-dwelling) macroinvertebrates (insects, worms, mollusks, and crustaceans that are large enough to be seen by the naked eye) are collected. The numbers and types of species present are directly related to water quality. More sensitive species disappear first, as the pollution level increases, followed by moderately sensitive species. As these species "drop out," the diversity of the community drops as well.

Source: DVRPC
Oldmans Creek in South Harrison Township

In the 1995 (first round) sampling:
All three of the sites in South Harrison were ranked as "moderately impaired."

In the 2000 (second round) sampling:
All three of the sites in South Harrison were ranked as "moderately impaired." The site at Harrison Lake Road, part of the Harrisonville WMA, was the only site to improve between the two testing periods. The site scored at the level of moderate impairment but moved closer to a non-impairment ranking. Diversity assessed at the two other sites in South Harrison decreased slightly but remained in the "moderately impaired" range.

No further sampling since the 2000 – 2001 round has occurred in the South Harrison Township area.

These three AMNET sites are listed in **Table 12: New Jersey AMNET Sampling Locations for South Harrison Waterways** and are also depicted on **Map 10: Water Quality – Nontidal Waters**.

Knowing the actual condition of streams and steam 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. Stream surveys by local organizations are much needed, along with regular monitoring of water quality on all of a community's waterways.

Table 12: New Jersey AMNET Sampling Locations for South Harrison Waterways

Site ID	Waterbody / Station Name	Municipality	Parameters Tested	1995 NJ Impairment Score	2000 NJ Impairment Score	2006 NJ Impairment Score
AN0679	Raccoon Creek at Ellis Mill Rd	Elk	Benthic Macroinvertebrates	9	6	10
AN0681	Raccoon Creek at Swedesboro Rd	South Harrison	Benthic Macroinvertebrates	21	18	22
AN0686	Oldmans Creek at Swedesboro-Monroeville Rd	South Harrison	Benthic Macroinvertebrates	18	12	28
AN0687	Oldmans Creek at Harrisonville Lake Rd	South Harrison	Benthic Macroinvertebrates	18	21	12
AN0688	Oldmans Creek at Kings Hwy	Woolwich	Benthic Macroinvertebrates	18	12	4

Source: NJDEP, Bureau of Freshwater and Biological Monitoring

Key to Impairment Scores

NJ Impairment Score	Biological Assessment
0-6	Severely Impaired
9-21	Moderately Impaired
24-30	Non-impaired

Total Maximum Daily Loads

For impaired waters (waters on Sublist 5), the state is required by the U.S. Environmental Protection Agency 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 identifying the sources of a pollutant and determining the percent reductions of the pollutant that must be achieved by each source. These sources can be point sources, such as sewage treatment plants, or non-point sources, such as runoff from various types of residential, commercial or agricultural lands.

A TMDL goes through four stages; it is "proposed" in a report by NJDEP; "established" when NJDEP finalizes their report; "approved" by EPA Region 2; and "adopted" when NJDEP adopts it as an amendment to a water quality management plan. In general, implementation of a TMDL relies on actions mandated by the Municipal Stormwater Management program, including the ordinances that municipalities are required to adopt under that permit. It also depends on voluntary improvements in land and runoff management of agricultural areas.

A TMDL determines the percentage of reduction needed in order for a stream segment to meet the water quality standard. For fecal coliform impairments, nonpoint and stormwater point sources are the largest contributors because runoff from various lands uses transports fecal coliform from sources such as wild geese populations, farms, and domestic pets during rain events into waterbodies. Nonpoint sources also include inputs from "illicit" sources such as

failing sewage conveyance systems, sanitary sewer overflows, and failing or inappropriately located septic systems.

Reductions in fecal coliform are first determined by calculating a "load" that the stream segment can accommodate and still be below the concentration of the standard, given the range of flows at the monitoring station. TMDLs for fecal coliform were approved in September 2003, for 27 stream segments in the Lower Delaware Water Region.

Within HUC 11# 02040202150, Raccoon Creek, and HUC 11# 02040202160, Oldmans Creek, there are three stream segments with the following TMDL requirements for fecal coliform:

- Raccoon Creek near Swedesboro (site 01477120) requires an 88% reduction
- Oldmans Creek at Jessups Mill (site 01477440) requires a 95% reduction
- Oldmans Creek at Porches Mill (site 01477510) requires a 95% reduction

Reductions in phosphorous are first determined by calculating a "load" that the stream segment can accommodate and still be below the concentration of the standard, given the range of flows at the monitoring station. In September 2005, TMDLs for phosphorus were approved for the following stream segments in South Harrison Township within HUC 11# 02040202160, Oldmans Creek:

- Oldmans Creek at Porches Mill (site 01477510) requires a 67.3% reduction
- Harrisonville Lake requires an 85% reduction*
  **Note: Because the lake drains a large watershed, the overall load reduction necessary to achieve the target conditions is quite substantial.*

To meet this reduction, NJDEP identified the general sources of phosphorous, assigned a reasonable "load" to each source (a "load allocation"), and established the reduction needed from each source. Within this subwatershed, there are no regulated point sources. Nonpoint sources consist of both natural sources (forests, wetlands, water, and barren land) and stormwater sources. Load allocations were formulated based on the type of land uses within the subwatershed.

Causes of Water Quality Impairments

Inadequate Stream Buffers

The stream buffer is the region immediately beyond the banks of a stream that 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.

Source: Brian Marsh
An example of a good wooded buffer along the water's edge.

When forested, a stream buffer promotes bank stability and serves as a major control of water temperature. The buffer region also serves as a green corridor- a greenway, for wildlife to move between larger forested habitat areas. Residents can utilize these greenways for recreation with the addition of trails, bikeways, and access points to water for fishing and canoe/kayak launching.

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. There is less agreement and much continuing research on the appropriate minimum width of a buffer. In literature on this issue, a recommended minimum buffer width of 100 feet is most common, with differing activities permitted in each of three zones within the buffer. Buffers of up to 300 feet are recommended for wildlife corridors and potential passive recreational use, such as walking trails.

Buffers along Special Protection Waters (Category One waterways) are mandated by law at 300 feet on each side. This requirement applies to the stretch of Oldmans Creek from Harrisonville Lake Wildlife Management Area in South Harrison to head-of-tide near Porches Mill in Woolwich Township and to all the tributaries to that segment of the stream.

The New Jersey Freshwater Wetlands Protection Act also 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 buffers on wetlands that exceed those required by the state statute. However, the municipality can make certain that those limits are accurate through its review of the wetlands delineation process, and it can also monitor use of the land within the transition area and take action against encroachments.

There is no requirement to restore buffers that do not already exist. However, restoration of stream buffers on agricultural lands is supported by various programs of the US Department of Agriculture and the New Jersey Department of Agriculture, such as the Conservation Reserve Program (CRP), administered by the USDA's Farm Service Agency (FSA), and the New Jersey version of this program which is labeled as CREP. This program is designed to help farmers reduce impairments from agricultural water runoff sources in an effort to improve water quality. The 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. 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

Source: Nicholas Culver
Cows in a farm pond

conservation practices. These are all programs in which individual landowners volunteer to take part.

Stormwater Runoff

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 South Harrison. 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 the Raccoon Creek and Oldmans Creek watersheds is known to derive from stormwater drainage off paved surfaces such as streets, commercial/industrial areas, and residential sites (with and without detention basins), and from agricultural fields that lack adequate vegetative buffers or that circumvent the buffers through drainage pipes directly to the stream. Some of this runoff comes to the water- ways from similar sources in upstream townships, including runoff from agricultural land uses and from animal husbandry practices. Some of it derives from South Harrison land uses. Specifically, the agricultural land uses in South Harrison may contribute significant silt-laden runoff to the area's streams.

In March 2003, the NJDEP issued a new Stormwater Management Rule, as required by the US Environmental Protection Agency'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, every municipality was required to obtain a New Jersey Pollution Discharge Elimination System (NJPDES) general permit for the stormwater system and its discharges within municipal borders, and to comply over a five-year period.

Stormwater Management Statewide Basic Requirements
Tier B* Towns (South Harrison)

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 has been 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 and regarding proper identification, handling, and disposal of wastes including pet waste and litter
    - Adopt specific ordinances to control waste disposal and other nonpoint sources.

* Tier B municipalities are communities with lower population levels and densities. They have fewer stormwater requirements imposed on them. See the NJDEP Stormwater website www.njstormwater.org for more information.

Source: NJDEP

Figure 7: Stormwater Management Basic Requirements

Impervious Coverage

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 subwatershed. Although impervious surface coverage in South Harrison is currently minimal, township development will cause an increased level of impervious surfaces. 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, scientists have found that levels of impervious cover of 10 percent or more within a HUC-14 subwatershed 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 percent to 30 percent, streams can become severely degraded.

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 water bodies. The Act classified all water pollution into one of two categories:

"point source" pollution and "nonpoint source" pollution (coming from many diffuse sources, such as through stormwater), but only required states to regulate point sources until recently.

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 water or discharging over 2,000 gallons per day to groundwater (usually through a septic system) must apply for and obtain a permit for discharging. Rather than creating individually tailored permits for every facility, the Division of Water Quality uses scientific standards to create and issue general permits for different categories of dischargers. NJDEP enforces the terms of NJPDES permits by visiting discharging facilities and requiring facilities to conduct water quality, biological, and toxicological analyses; and thermal impact and cooling water assessments periodically.

Under the Open Public Records Act (OPRA) of 2002, a list of active NJPDES permits is available. As of November 7, 2007, two NJPDES permits were issued to two individual facilities in South Harrison. These are shown in **Table 13: South Harrison 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. At the same time, as development has continued to spread throughout New Jersey, nonpoint source pollution has increased substantially. NJDEP's new Stormwater Management Rules, described previously, focus on reducing and controlling nonpoint sources of water pollution.

Table 13: South Harrison NJPDES Permits

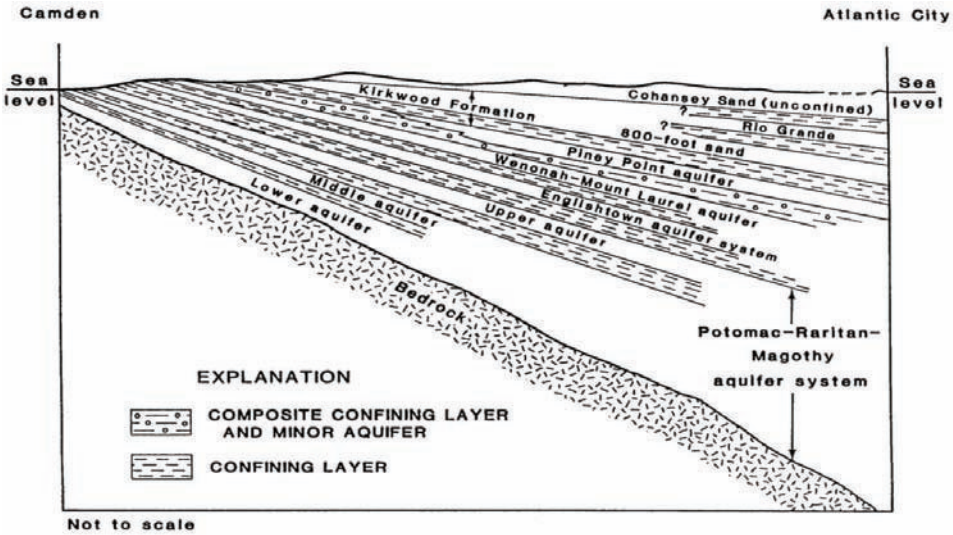
NJPDES Permit #	Facility Name	Effective Start Date	Expiration Date	Discharge Category	Street Address
NJG0083526	Harrisonville Mobile Home Park	06/01/03	05/31/08	Sanitary Subsurface Disposal (GP)	904 Mullica Hill Road
NJG0105848	South Harrison Elementary School	06/01/03	05/31/08	Sanitary Subsurface Disposal (GP)	Mullica Hill Road
NJG0152226	South Harrison Township	09/01/05	02/28/09	Stormwater Discharge	664 Harrisonville Road

Source: NJDEP, NJ OPRA, Active Permit List

GROUNDWATER

The geology of the New Jersey Coastal Plain can be visualized as a tilted layer cake, with its "layers" or strata formed of gravels, sands, silts, and clays. The saturated gravel and sand layers, with their large pore spaces, are the aquifers from which water is drawn. The silt and clay layers, which impede the movement of water, are called confining beds.

A cross section across southern New Jersey from west to east would show that the layers are not horizontal but tilt downward toward the southeast, getting deeper as they cross the state toward the Atlantic Ocean. Because of this tilting, each layer formation emerges on the land surface in a sequential manner. The deepest formations emerge on the surface near the Delaware River. Where a formation emerges is its "outcrop" area. The Potomac-Raritan-Magothy (PRM) formation, the deepest and most abundant aquifer, is a major water source for Inner Coastal Plain communities. Other smaller aquifers on top of the PRM are the Englishtown, the Wenonah-Mount Laurel, and the Kirkwood-Cohansey. The Kirkwood-Cohansey is a formation composed of two thick layers, the Kirkwood (lower) and the Cohansey (upper) that overlie the older formations. It begins generally east of the inner/outer coastal plain divide. South Harrison Township contains a large area of the Cohansey aquifer outcrop area, but is largely covered by the Kirkwood outcrop formation. The Wenonah-Mount Laurel and Vincentown aquifer systems also outcrop in the township.



Source: US Geological Survey

Figure 8: Aquifers of Southern New Jersey along a line from Camden to Atlantic City

Aquifers

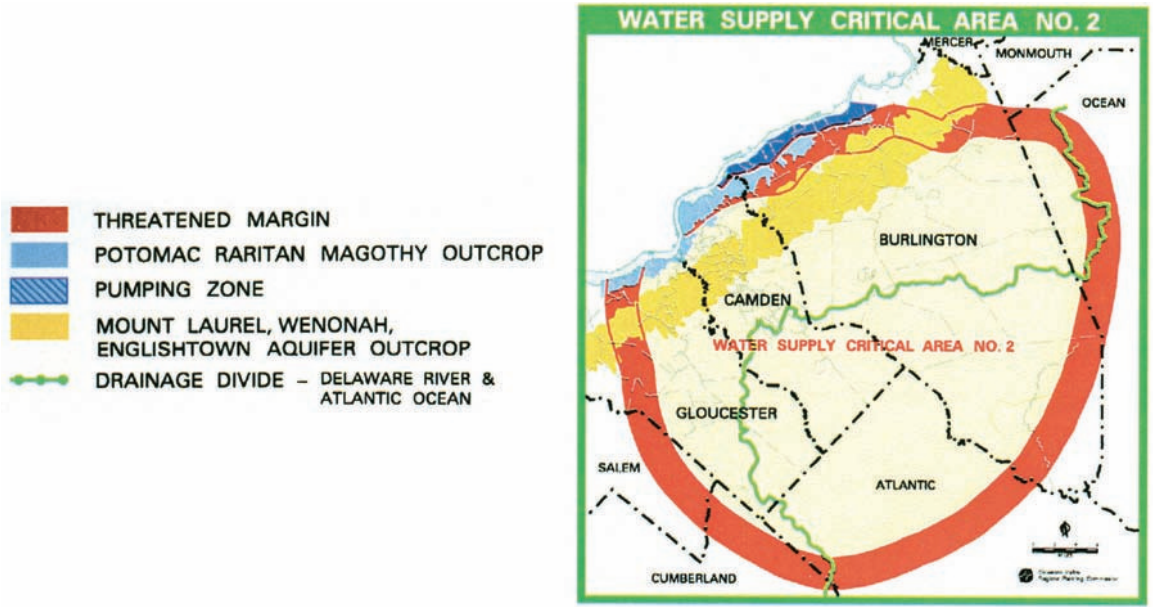
Several aquifers underlie parts of South Harrison Township. Three major aquifers – the Potomac-Raritan-Magothy (PRM), the Wenonah-Mount Laurel, and the Vincentown – provide public and private drinking water for South Harrison residents.

Potomac-Raritan-Magothy Aquifer System (PRM)

The Potomac-Raritan-Magothy (PRM) is the primary source of drinking water for South Harrison residents and businesses. This multiple aquifer system is actually a large series of formations that have been combined and described as a single unit because the individual formations – the Potomac group and the Raritan and Magothy formations – are lithologically indistinguishable from one another over large areas of the Coastal Plain. That is, they are composed of materials laid down by both an advancing and retreating sea across southern New Jersey, and by deposits of material that came from the breakdown and erosion of the Appalachian and Catskill Mountains beginning in the Cretaceous Period (60 to 150 million years ago).

In southern New Jersey, three aquifers have been distinguished within the PRM system – designated as lower, middle, and upper, divided by two confining units or layers between the three water-bearing strata. The aquifers themselves are largely made up of sands and gravels, locally interbedded with silt and clay. The lower aquifer sits on the bedrock surface. Confining beds between the aquifers are composed primarily of very fine-grained silt and clay sediments that are less permeable, and thus reduce the movement of water between the aquifers. They also help to slow the entry of any contaminants on the surface down into the groundwater.

The PRM is the primary source of drinking water to New Jersey residents from Burlington to Salem counties, as well as to communities in Delaware. Because of such high usage, PRM aquifer water levels have declined. The water level drop became so serious that the New Jersey Department of Environmental Protection established Water Supply Critical Area #2 in 1986, which includes South Harrison Township. All water supply companies within Critical Area #2 were given annual limits on water withdrawals in the PRM. Usage from the PRM was cut back by over 20 percent and no increases in pumping were allowed. Piping of treated Delaware River water filled the gap in much of the region.



Source: DVRPC
Figure 9: Water Supply Critical Area No.2

There is increased concern that additional pumping from the aquifer in the borderline areas will necessitate the expansion of the Critical Area boundaries. Thus, water supply companies in Gloucester and Salem counties have and will continue to have difficulty getting approvals from the New Jersey Department of Environmental Protection for any additional water allocations from the PRM.

In Gloucester and Salem counties, use of the lower PRM aquifer for drinking water is limited due to high chloride concentrations (salt water intrusion). This is thought to be very ancient seawater within the lower aquifer, resulting from movement from the southeastern side, which is in contact with ocean water. Whatever the cause, most of the lower aquifer is not usable as a drinking supply. There are also problems with salinity levels in the upper and middle PRM aquifers, especially for wells closest to the Delaware River where pumpage has increased the amount of slightly saline water from the river to be drawn into the aquifers.

The PRM does not outcrop in South Harrison Township; rather it outcrops under and immediately beside the Delaware River in New Jersey and Pennsylvania. River water actually enters and recharges the lower and middle PRM aquifers. Because an outcrop is the area where the aquifer emerges on the land surface, preventing contamination of the land in outcrop areas is extremely important in order to maintain a safe drinking water supply. See **Map 11: Geologic Outcrops** for a depiction of these land areas.

Wenonah-Mount Laurel Aquifer System

The Wenonah-Mount Laurel aquifer is the main source for domestic water wells in the Township. This system is typically found at depths of approximately 100 feet. The Wenonah-Mount Laurel aquifer is composed of the Wenonah Formation and the Mount Laurel Sand Formation, both of late Cretaceous age. It is thickest in Burlington, Camden, Gloucester, and Salem counties, reaching 100 to 120 feet in width from upper to lower elevation. The aquifer outcrops in the northwest and southwest corners of South Harrison.

The Wenonah-Mount Laurel aquifer is affected by withdrawals from the Englishtown aquifer, which lies below the Wenonah-Mount Laurel. As a result of Englishtown withdrawals, more Wenonah-Mount Laurel water leaks through the confining layer to the Englishtown aquifer. Reductions in the Potomac-Raritan-Magothy Aquifer System also negatively affect water levels in the Wenonah-Mount Laurel aquifer.

PRIVATE DRINKING WELLS

Private wells, supplying potable water, are not routinely monitored like public community water systems (public water) and public non-community wells. Beginning in 2002, the State of New Jersey, under the Private Well Testing Act, required that well water be tested for contaminants when properties are sold or leased. Prior to 2002, each county health department mandated what parameters were to be tested for real estate transactions.

See Appendix B for more details.

Hornerstown and Navesink Composite Confining Units

Overlying the Wenonah-Mount Laurel aquifer and subjacent to the Kirkwood-Cohansey aquifer system lies a complex series of geologic units ranging in age from late Cretaceous to Miocene (23 to 150 million years ago) known as the Hornerstown and Navesink composite confining bed. The confining bed consists of the Navesink formation and, depending on location within the coastal plain, can include other geological units. These geologic formations are dominated by

silty and clayey glauconitic quartz sands, with some formations being permeable enough to function as an aquifer in some locales. In South Harrison Township, Hornerstown sand outcrops alongside the Navesink formation. These layers were formed by the advancing and retreating of the sea across southern New Jersey, and thus are high in glauconite. The confining units have low to moderate permeabilities, and are generally described together. This composite confining unit becomes thicker as it travels eastward.

Kirkwood-Cohansey Aquifer System

The Kirkwood-Cohansey aquifer system is considered one of the largest sources of groundwater in New Jersey. The Kirkwood Formation, along coastal areas, appears as thick clay beds, with interbedded zones of sand and gravel. The Cohansey Sand, also of Miocene age, is coarser grained than the underlying Kirkwood Formation. It contains minor amounts of pebbly sand and interbedded clay. Some local clay beds within the Cohansey Sand are relatively thick.

Although not a major drinking water source for South Harrison residents, the Kirkwood-Cohansey is a primary source for those living in communities to the east and southeast. The surficial nature of the Kirkwood-Cohansey makes it vulnerable to contamination from various land uses. The Kirkwood-Cohansey has a large outcrop area covering most of South Harrison. Industrial chemicals, agricultural chemicals used for crop production and residential landscaping, pesticides, and products of septic tank effluent have all been found in water from the aquifer in various areas in southern New Jersey. Where possible, care must be taken to prevent contamination on the land surface because it can so easily enter the groundwater of this unconfined aquifer (lacking protective clay layers above it). In addition, it is important to site wells to avoid proximity to deleterious land use and contamination.

There is no comprehensive inventory of private wells – their depth or condition – available to municipalities. Well permits are held by the county health department, but there are many gaps in the records due to various factors, including well age. The recently enacted (2002) Private Well Testing Act requires state-certified laboratory water sampling and testing in order to sell a residential property. This will not identify what aquifers are being drawn upon by private wells, but it will eventually provide better documentation of the quality of drinking water from private wells in an area. See **Appendix B: Private Well Testing Act** for more information.

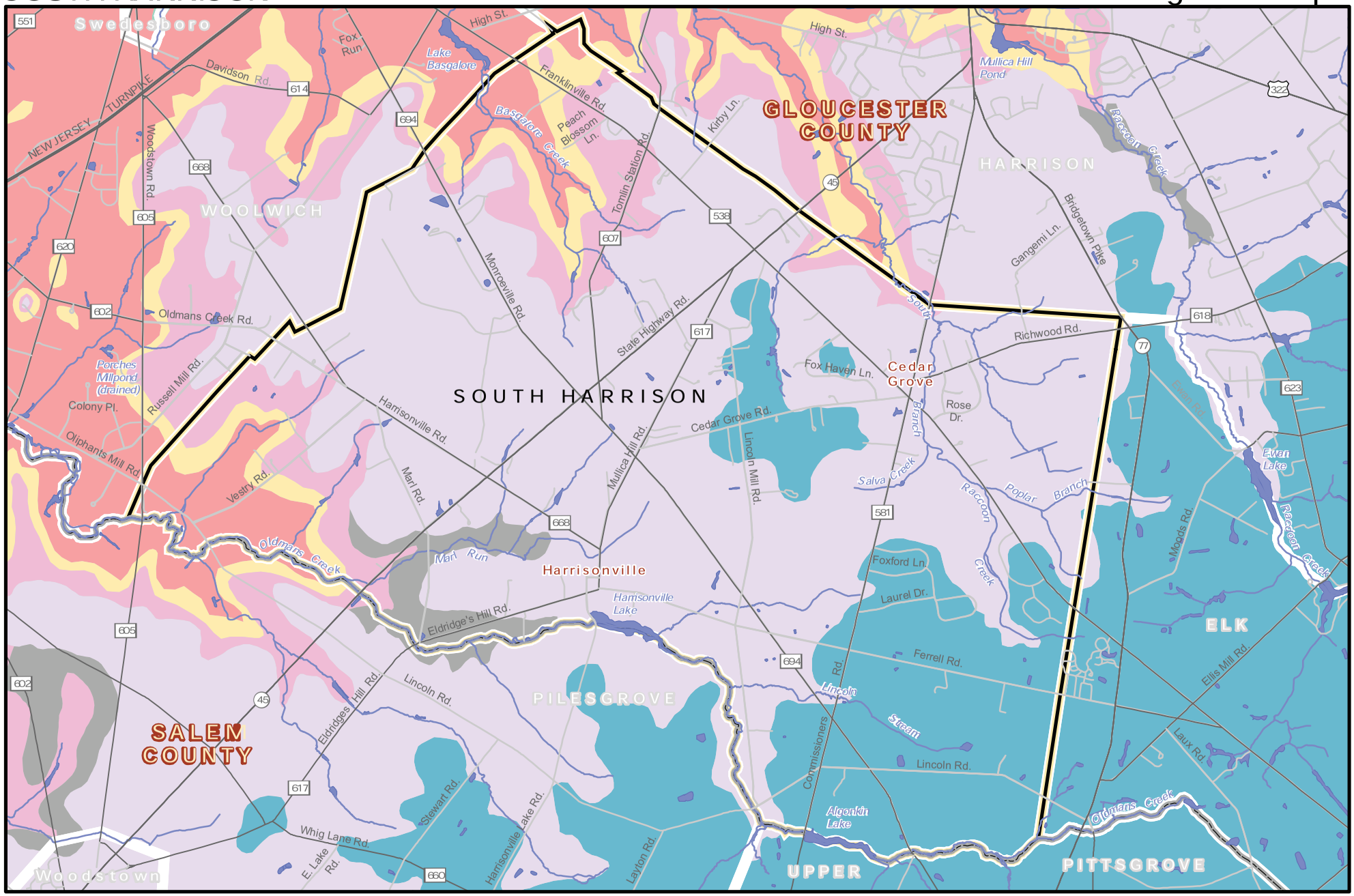
Groundwater Recharge

Recharge of groundwater is an important issue in southern New Jersey because of the 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, and the vegetation of an area.

The New Jersey Geological Survey has developed a methodology for evaluating land areas for their ability to transmit water to the subsurface, using precipitation records, soil surveys, and land use/land cover data. NJDEP has used this methodology to map and rank land areas

SOUTH HARRISON

MAP 11: Geologic Outcrops



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.

Outcrop Formation

- Navesink
- Mt. Laurel
- Kirkwood
- Hornerstown
- Cohansey
- Vincentown

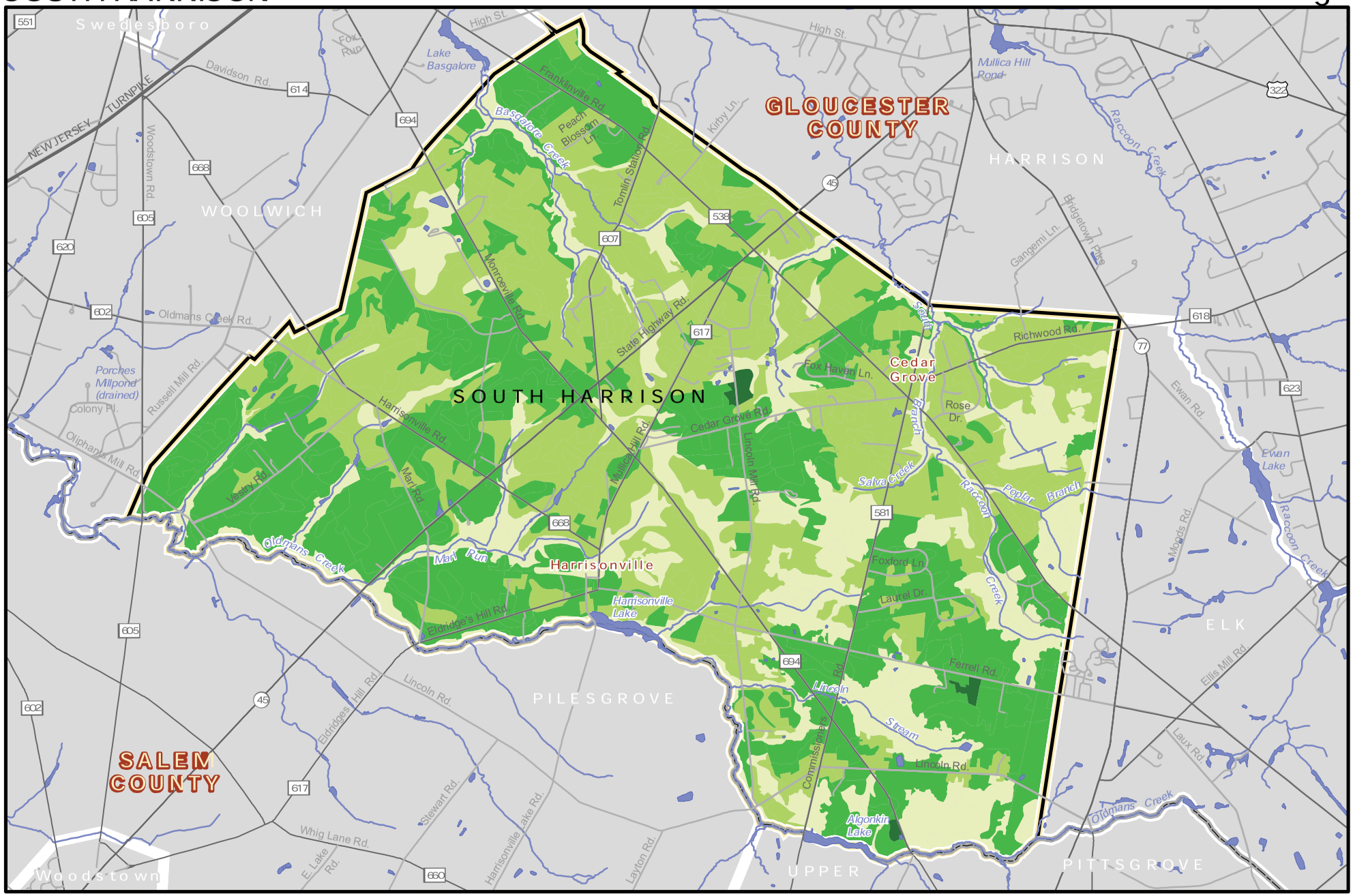
N

0 0.25 0.5 1
Miles

Delaware Valley Regional Planning Commission
December 2008

SOUTH HARRISON

MAP 12 Groundwater Recharge



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.

Inches Per Year

- 7 or Below
- 8 - 9
- 10 - 11
- 12 - 13

N

0 0.25 0.5 1
Miles

Delaware Valley Regional Planning Commission
December 2008

throughout the state as to groundwater recharge potential. Recharge is measured as the amount of precipitation that will reach the water table in one year.

In South Harrison, lands with recharge greater than or equal to 13 inches per acre per year, the highest in the township, are found mainly in the central portion of the Township, north of Cedar Grove Road. Sixty-five percent of lands (6,641 acres) recharge 9 to 12 inches per year. Nearly thirty-five percent (3,540 acres) of South Harrison's land recharges 8 inches or less of groundwater a year. These moderate recharge areas comprise the majority of South Harrison and are scattered throughout the township with a particular concentration in the western half of the municipality. See **Map 12: Groundwater Recharge**.

In general, on high recharge lands, large amounts of paving and high impervious cover will have the most detrimental impact, although they are also usually the places that are most suitable for building because they are on well-drained soils. Conversely, these are also regions where the dilution of substances from septic systems, such as nitrates, may require a larger land area because the soils are usually more "porous." For example, minimum average lot sizes of two to four acres are often needed for proper nitrate dilution from septic systems in areas having ten or more inches per year of groundwater recharge. Some townships that depend entirely on well water and septic tanks require nitrate dilution analysis for every subdivision, no matter how small, to make sure that septic systems do not contaminate groundwater. Nitrate dilution analysis determines the minimum lot size needed for proper dilution of the nitrates generated by a typical septic system. The dilution is by rainfall through the soil and its effectiveness varies by soil type. South Harrison Township does not require nitrate dilution analysis for developments considering that their recently adopted zoning ordinance requires a minimum lot size of 3 acres, which falls within the average lot size required for proper nitrate dilution.

Water Supply Wells

There is one source of public community water supply in South Harrison. Two wells located at the Harrisonville Mobile Home Park serve approximately 100 residents of South Harrison and draw water from the Wenonah-Mount Laurel aquifer. Public water supply wells are listed in **Table 14: Public Water Supply Wells**. Both of the wells pump water from the Wenonah-Mount Laurel aquifer. These public wells are shown on **Map 13: Public Water Supply Wells**.

Table 14: Public Water Supply Wells

Well ID #	Original Owner	Aquifer	Depth to Top of Well (feet)	Depth to Bottom of Well (feet)
3006748	Harrisonville Mobile Home Park	Wenonah- Mount Laurel	141	151
3110357	Harrisonville Mobile Home Park	Wenonah- Mount Laurel	237	244

Source: NJDEP, Bureau of Geographic Information System

Public non-community wells are another part of a public water system. There are two types of non-community water systems, transient and non-transient, referring to the types of populations

who utilize them. A non-transient water system serves at least 25 of the same people daily at a minimum of six months per year, at places like schools, factories, and office parks. A transient non-community water system serves at least 25 people each day, but the population changes each day. These systems are at such places as rest stops, gas stations, and restaurants.
See **Table 15: Public Non-Community Wells** below.

Table 15: Public Non-Community Wells

Well ID #	Original Owner	Well Depth (feet)	Well Type
0816300	Harrisonville School	110	Non-transient
0816303	South Harrison Municipal Building	Not Available	Non-transient
0816304	Stewart Memorial Park	Not Available	Non-transient
0816350	Better Beef (Mullica Hill Cold Storage)	Not Available	Non-transient

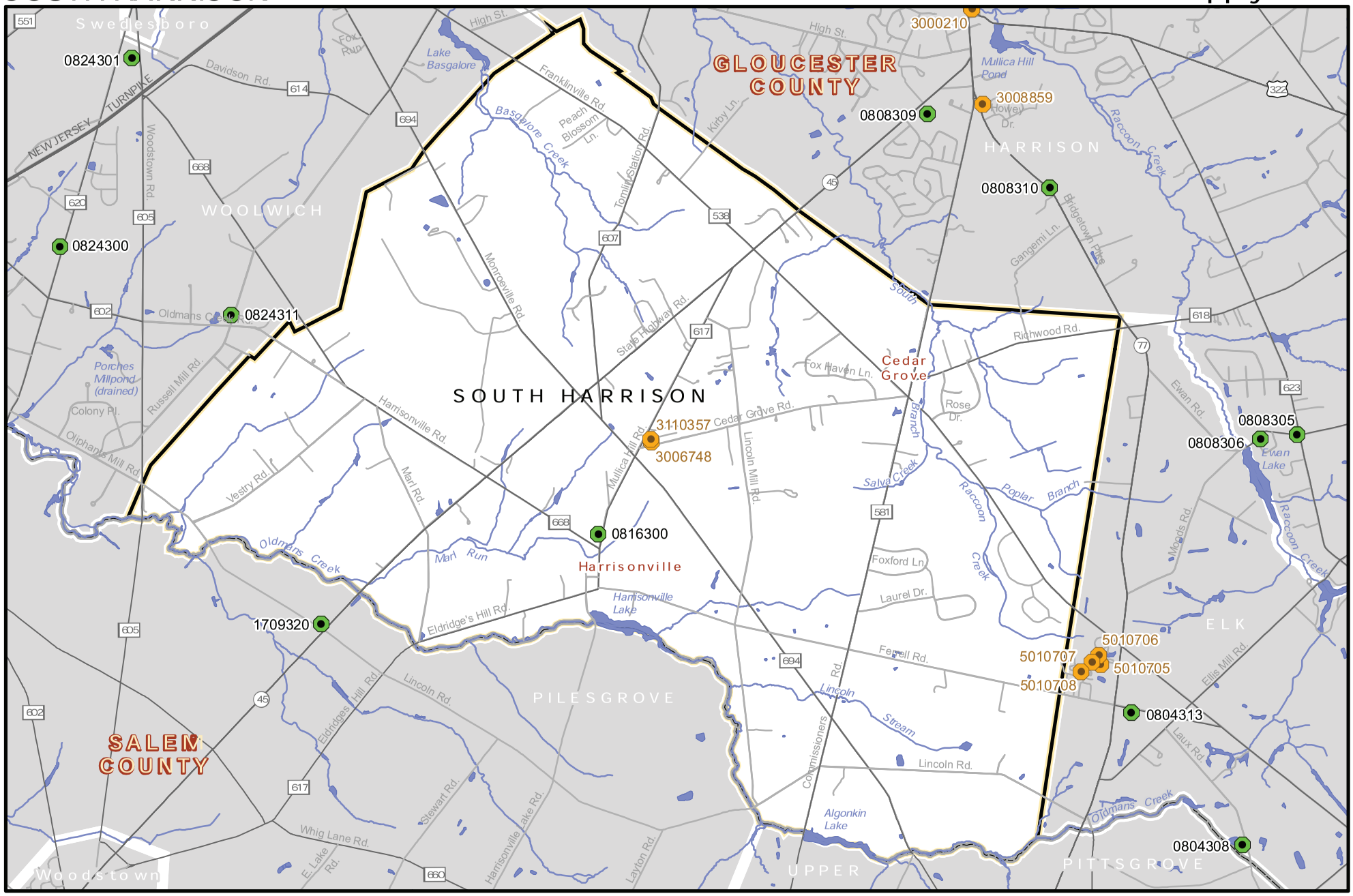
Source: NJDEP, Bureau of Geographic Information System

Source: DVRPC

Both the South Harrison Municipal Building and Mullica Hill Cold Storage have public non-community wells.

SOUTH HARRISON

MAP 13 Public Water Supply Wells



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.

NJ Wells

Public Non-Community Water Supply Well (2004)

Public Community Water Supply Well (2006)

N

0 0.25 0.5 1
Miles

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