4.0 GEOLOGY, TOPOGRAPHY AND SOILS

4.1 Geologic Province

Hopewell Township is located at 39 441' N, 75 258'W in the New Jersey Coastal Plain which is part of the larger Atlantic Coastal Plain physiogeographic province. The Atlantic Coastal Plain stretches along the Atlantic and Gulf Coasts from Long Island to Mexico and contains one of the most prolific systems of aquifers in the country.[1] In New Jersey, the Coastal Plain covers about 4,200 square miles from the Fall Line, Fall Line, the dividing line separating hard Paleozoic metamorphic rocks of the Appalachian Piedmont to the west from the softer, gently dipping Mesozoic and Tertiary sedimentary rocks of the Coastal Plain, to the Atlantic Ocean[2]. Most of the land is less than 50' above sea level. The Coastal Plain is surrounded by brackish or salt water and is bound by the Delaware River to the west, Delaware Bay to the south and the Atlantic Ocean to the east. The Coastal Plain surface is divided into drainage basins which contribute runoff to a specific stream and its tributaries. Hopewell lies in the Cohansey River Drainage Basin.

4.2 Geologic Framework

The following physiographic and hydro-geologic descriptions are excerpted from the United States Geological Survey (USGS) Report on the New Jersey Coastal Plain Area (Vowinkel and Foster, 1981). The New Jersey Coastal Plain is underlain by a wedge shaped mass of unconsolidated sediments composed of clay, silt, sand and gravel. The wedge thins to a featheredge along the Fall Line and attains a thickness of over six-thousand feet (6,000') at the tip of Cape May County, New Jersey. These sediments range in age from Cretaceous to Holocene and can be classified as continental, coastal or marine deposits. The Cretaceous and Tertiary age sediments generally strike on a northeast-southwest direction and dip gently to the southeast from ten to sixty feet (10 - 60') per mile. The overlying Quaternary deposits, where present, are basically flat lying. The unconsolidated Coastal Plain deposits, are unconformably underlain by a Pre-Cretaceous basement bedrock complex, which consists primarily of Precambrian and early Paleozoic age rocks.

Hopewell Township's geology is made up of predominantly tertiary sands of the Cohansey Sand Formation and to a very small degree the Shiloh Marl Member along the edges of the Cohansey River. The Cohansey Sand is typically light colored quartzose sand with lenses of silt and clay. The Cohansey Sand is exposed throughout most of the outer part of the Coastal Plain and attains a maximum thickness of about two hundred fifty feet (250').

Table 1 below details the layers of the geologic formations of the Coastal Plain of New Jersey.

[1] New Jersey Coastal Plain Aquifer, Lawrence Rinaldo,http://www.epa.gov/region2/water/aquifer/coast/coastpln.htm#123, June 15, 2006
[2] A Tapestry of Time and Terrain: The Union of Two Maps - Geology and Topography http://tapestry.usgs.gov/features/14fallline.htmlhttp://tapestry.usgs.gov/features/14fallline.html

Table 1. Characteristics of the New Jersey Coastal Plain Geology

System	Formation	Thickness	Lithology
Quaternary	Alluvial & Cape May Formation	80'	Sand, silt, black mud
Tertiary	Pennsauken & Bridgeton Formation	200'	Sand, quartz, light-colored clayey, pebbly, glauconite
	Beacon Hill Formation	40'	Gravel, quartz, light-colored sandy
	Cohansey Sand	250'	Sand, quartz, light-colored, medium to coarse-grained, pebbly; local clay beds
	Kirkwood Formation	780'	Sand, quartz, gray to tan, very fine- to medium-grained, micaceous
	Piney Point Formation	220'	Sand, quartz and glauconite, fine- to coarse-grained
	Shark River Marl	140'	Sand, quartz and glauconite, gray, brown, and green, fine- to coarse-grained, clayey and green silty and sandy clay
	Manasquan Formation	180'	Sand, quartz and glauconite, gray, brown, and green, fine- to coarse-grained, clayey and green silty and sandy clay
	Vincentown Formation	100'	Sand, quartz, gray and green, fine- to coarse-grained, glauconitic, and brown clayey, very fossiliferous, glauconite and quartz calcarenite
	Hornerstown Sand	35'	Sand, glauconite, green, medium- to coarse-grained, clayey
Cretaceous	Tinton Sand	25'	Sand, quartz, and glauconite, brown and gray, fine- to coarse grained, clayey, micaceous
	Red Band Sand	150'	Sand, quartz, and glauconite, brown and gray, fine- to coarse grained, clayey, micaceous
	Navesink Formation	50'	Sand, glauconite, and quartz, green, black and brown, medium- to coarse grained, clayey
	Mount Laurel Sand Wenonah Formation	220'	Sand, quartz, brown and gray, fine- to coarse-grained, glauconitic
	Marshalltown Formation	30'	Sand, quartz, and glauconite, gray and black,

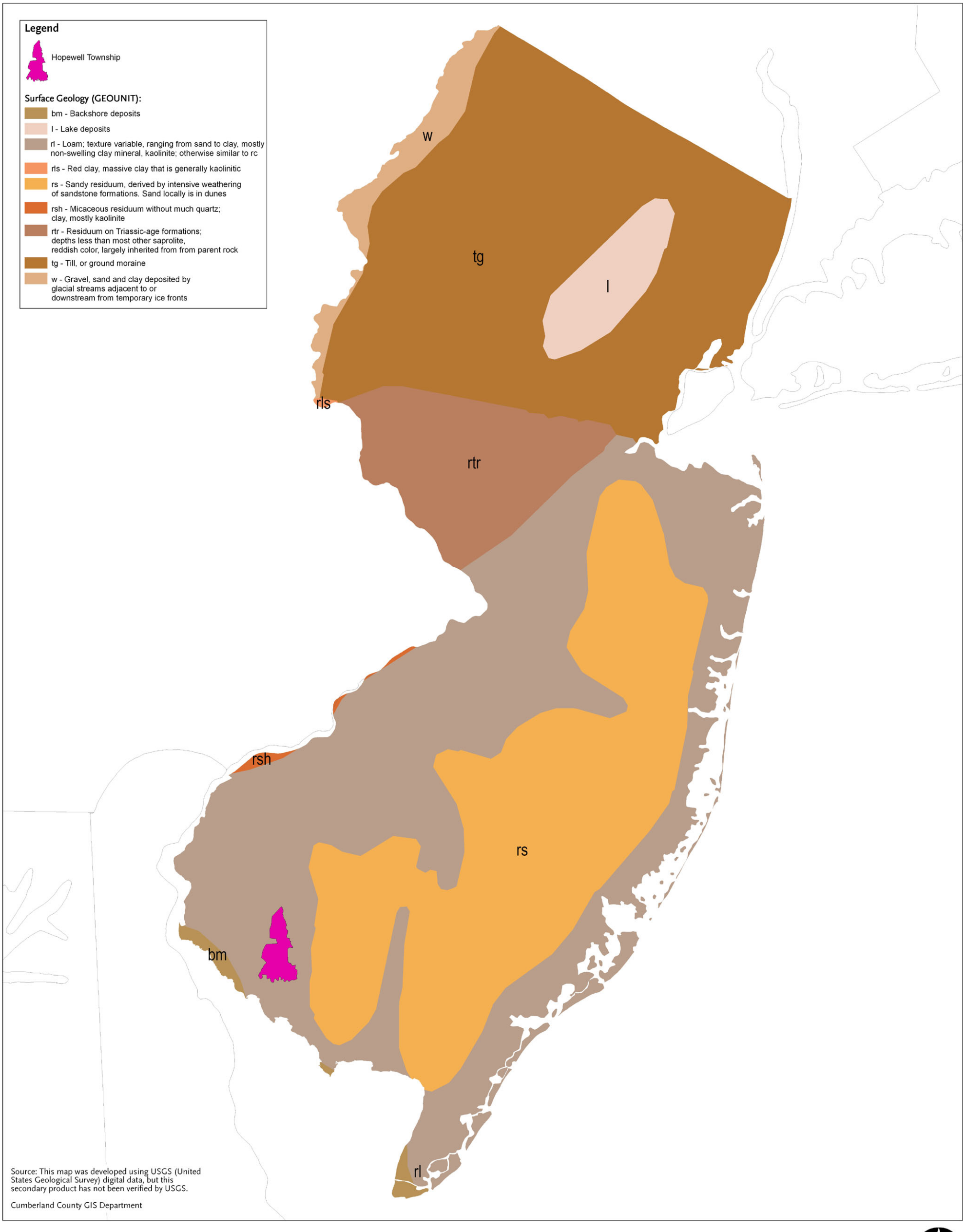
			very fine- to medium-grained, very clayey
	Englishtown Formation	220'	Sand, quartz, tan and gray, fine- to medium-grained; local clay beds
	Woodbury Clay Merchantville Formation	325'	Clay, gray and black, micaceous, glauconitic, silty
	Magothy - Rariton - Potomac Formations	4100'	Sand, quartz, light-gray, fine- to coarse-grained, pebbly, arkosic, dark-gray lignitic clay/red, white and varigated clay/alternating clay, silt, sand and gravel
Pre-Cretaceous	Pre-Cretaceous Unconsolidated rocks and Wissahickon Formation		Precambrian and lower Paleozoic crystalline rocks, metamorphic schist and gneiss; locally Triassic basalt, sandstone, and shale

Legend

Hopewell Township

Surface Geology (GEOUNIT):

- bm - Backshore deposits
- l - Lake deposits
- rl - Loam; texture variable, ranging from sand to clay, mostly non-swelling clay mineral, kaolinite; otherwise similar to rc
- rls - Red clay, massive clay that is generally kaolinitic
- rs - Sandy residuum, derived by intensive weathering of sandstone formations. Sand locally is in dunes
- rsh - Micaceous residuum without much quartz; clay, mostly kaolinite
- rtr - Residuum on Triassic-age formations; depths less than most other saprolite, reddish color, largely inherited from from parent rock
- tg - Till, or ground moraine
- w - Gravel, sand and clay deposited by glacial streams adjacent to or downstream from temporary ice fronts



Source: This map was developed using USGS (United States Geological Survey) digital data, but this secondary product has not been verified by USGS.

Cumberland County GIS Department

0 5 10 20 30 Miles

ENVIRONMENTAL RESOURCE INVENTORY

Surficial Geology

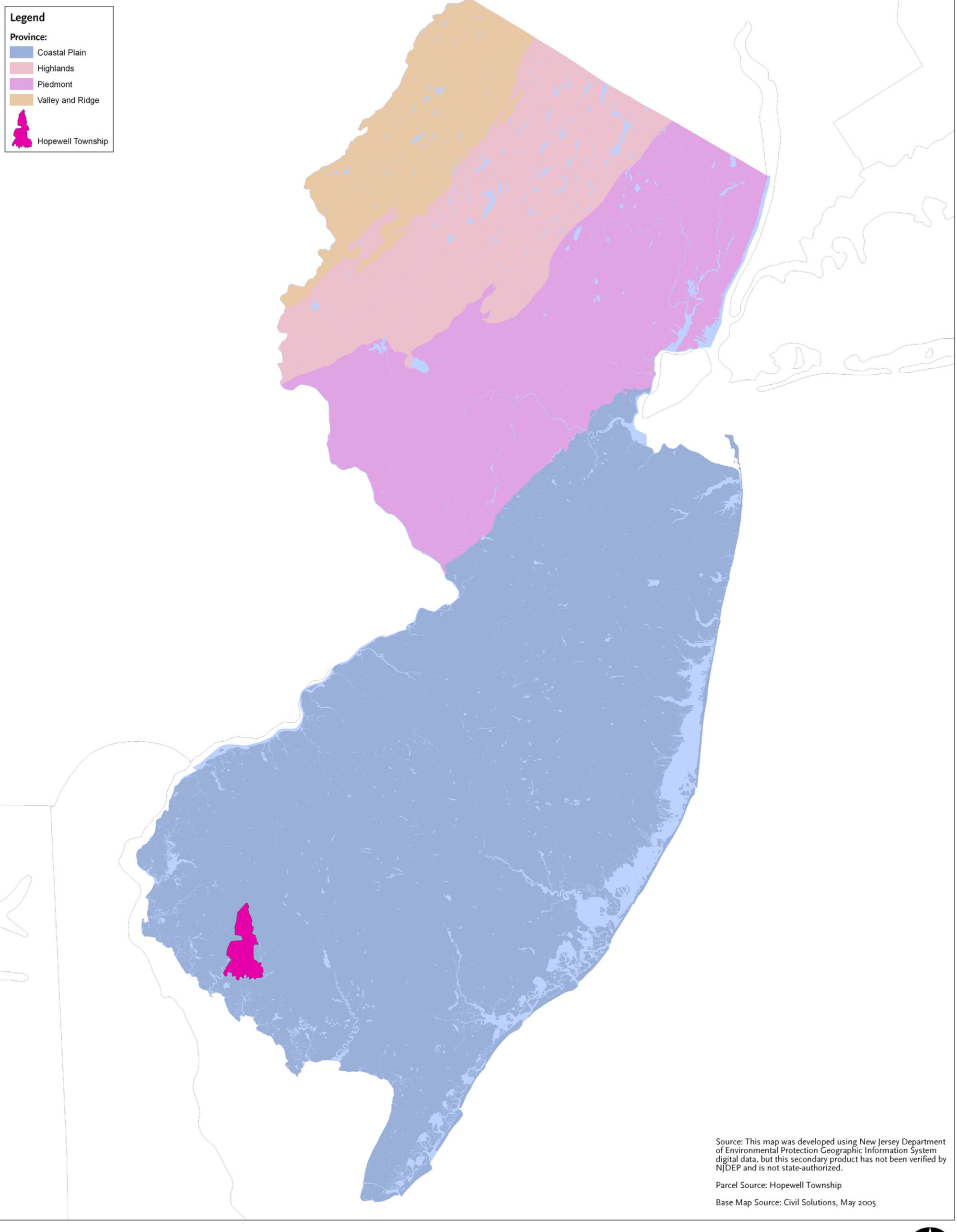
Hopewell Township, Cumberland County, NJ February 2007

Clarke Caton Hintz

Architecture

Planning

Landscape Architecture



ENVIRONMENTAL RESOURCE INVENTORY

Physiographic Provinces

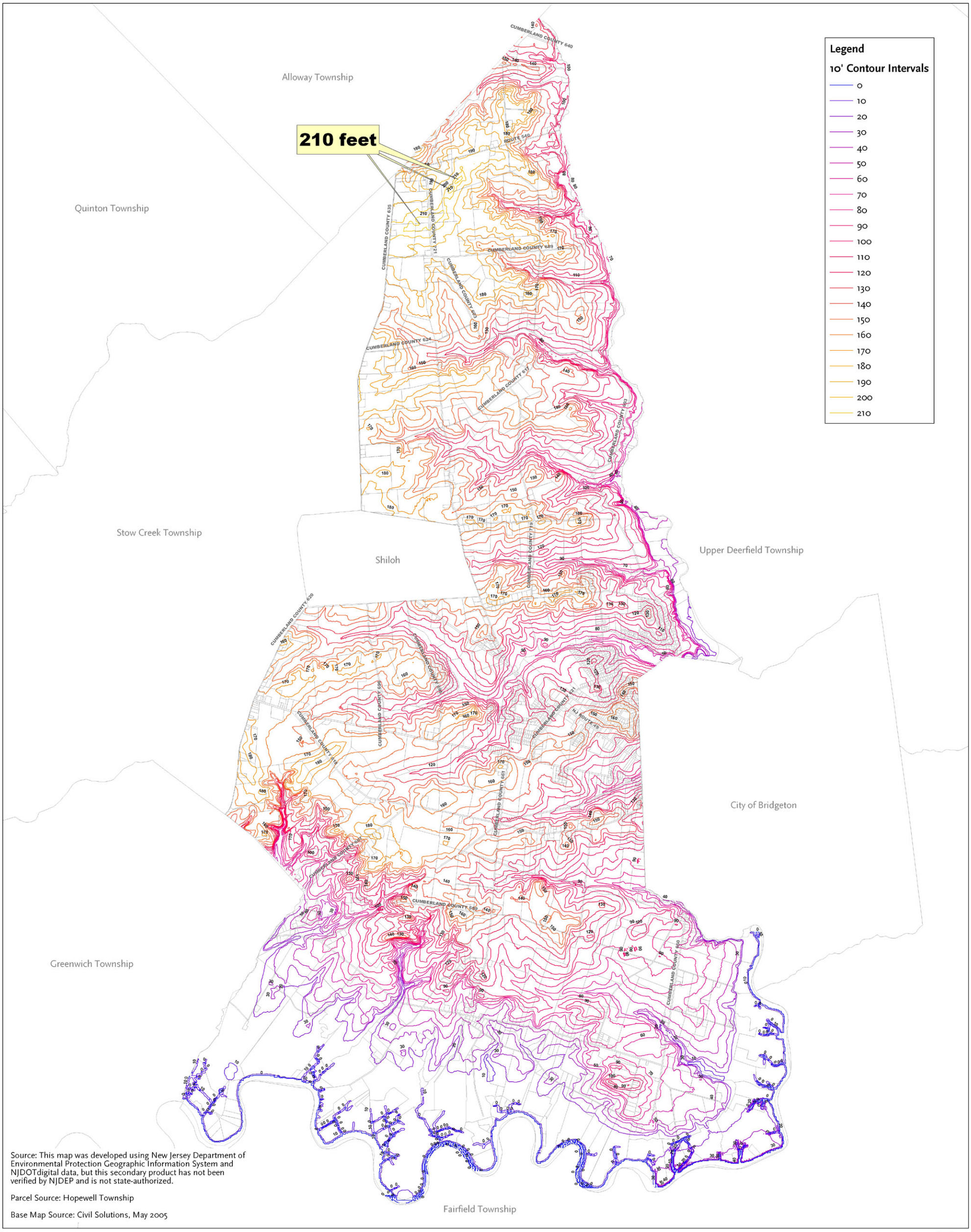
Hopewell Township, Cumberland County, NJ February 2007

Clarke Caton Hintz
Architecture
Planning
Landscape Architecture

4.3 TOPOGRAPHY/STEEP SLOPES

Hopewell Township, like all of Cumberland County, has generally flat topography. The overall change in elevation from the Cohansey River at sea level to the high point in the north near Alloway Township is 210'. In general, the western side of town is slightly higher in elevation than the eastern as the land drains toward the Cohansey River. New Jersey Route 49 which bisects the town through the middle in a south easterly direction from Shiloh to Bridgeton is nearly level across the township at approximately 150' above sea level. The township is large, just over 30 square miles. The Cohansey River which bounds the township to the east drops just 100' over the roughly 6.5 mile length of the township where it joins the Lower Cohansey near sea level. Traveling north from the Cohansey at sea level, the elevation rises very slowly over the tidal wetlands to 30'. From the tidal area to Route 607, approximately 2 miles, the topography increases to 150'. The central portion of the township lies at approximately 150' with a few small rises to 160' or 170'. A small valley lies between Roadstown Rd. and Sewell Road where the landscape drops slightly to 90'. North of Sewell Road to Rt. 689 elevation climbs again to 150-170' then rises again to 180' above Rt. 689. A few higher spots measuring up to 210' are found in the extreme northern portion of Hopewell near Alloway Township.

Eagles nest, Photo by Carol Bell



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

Parcel Source: Hopewell Township

Base Map Source: Civil Solutions, May 2005

0 1,200 2,400 4,800 Feet

ENVIRONMENTAL RESOURCE INVENTORY

Topology

Hopewell Township, Cumberland County, NJ February 2007

Clarke Caton Hintz
Architecture
Planning
Landscape Architecture

4.4 Soils

The word "soil," like many common words, has several meanings. In its traditional meaning, soil is the natural medium for the growth of land plants, whether or not it has discernible soil layers. People consider soil important because it supports plants that supply food, fibers, drugs, and other wants of humans and because it filters water and recycles wastes. Soil covers the earth's surface, except on bare rock, perpetual frost, deep water, or the bare ice of glaciers. The upper limit of soil is the boundary between soil and air, shallow water, or plants. Areas are not considered to have soil if the surface is permanently covered by water too deep (typically more than 2.5 m) for the growth of rooted plants. The lower boundary of soil exists where it meets hard rock or earthy materials which are virtually devoid biological activity. For purposes of classification, the lower boundary of soil is arbitrarily set at 200 cm.[3]

4.5 Soil Profile

Layers of soil at and below the surface are called soil horizons. Each specific soil has horizons near the earth's surface which have been altered by the interactions of climate, weather, and living organisms over time. Examination of the vertical arrangement of these horizon layers is called a soil profile. A profile is used to identify a specific type of soil on a site. For each horizon a specific soil will be identified and recorded. The horizons for a typical soil profile are detailed below.

- O Horizon - The top, organic layer of soil, made up mostly of leaf litter and humus (decomposed organic matter).

- A Horizon - The layer called topsoil; it is found below the O horizon and above the E horizon. Seeds germinate and plant roots grow in this dark-colored layer. It is made up of humus (decomposed organic matter) mixed with mineral particles.

- E Horizon - This eluviation (leaching) layer is light in color; this layer is beneath the A Horizon and above the B Horizon. It is made up mostly of sand and silt, having lost most of its minerals and clay as water drips through the soil.

- B Horizon - Also called the subsoil - this layer is beneath the E Horizon and above the C Horizon. It contains clay and mineral deposits (like iron, aluminum oxides, and calcium carbonate) that it receives from layers above it when mineralized water drips from the soil above.

- C Horizon - Also called regolith: the layer beneath the B Horizon and above the R Horizon. It consists of slightly broken-up bedrock. Plant roots do not penetrate into this layer; very little organic material is found in this layer.

- R Horizon - The unweathered rock (bedrock) layer that is beneath all the other layers.[4]

[3] Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Official Soil Series Descriptions [Online WWW]. Available URL: http://soils.usda.gov/technical/classification/osd/index.htm
[4] http://www.enchantedlearning.com/geology/label/soillayers/

4.6 Major Soil Series in Hopewell Township

All soils with a similar profile including similar color, texture, structure, reaction, consistency, mineral and chemical composition are classified as a soil series. In Hopewell Township there are 35 specific soil mapping units representing 19 different soil series[5], see Soil Characteristics Map below. Only 6 of the soil series comprise 84% of the total soils in Hopewell Township. These major soil series are Matapeake 31%, Chillium 16%, Downer 13%, Sassafrass 12%, Appoquinimink 6%, and Mattapex 5%. A description of these important series and their typical profiles follows:

Matapeake Series: 31% of Township, Prime Agricultural Soils

Typical Profile: Matapeake silt loam, in an orchard with shallow cultivation. (Colors are for moist soil.)

Ap--0 to 5 inches; grayish brown (2.5Y 5/2) silt loam; weak fine and medium granular structure; friable; many roots; slightly acid; abrupt smooth boundary. (0 to 10 inches thick)

E--5 to 11 inches; light yellowish brown (2.5Y 6/4) silt loam; weak fine and medium granular and weak fine subangular blocky structure; friable; common roots; strongly acid; clear wavy boundary. (0 to 11 inches thick)

Bt1--11 to 16 inches; yellowish brown (10YR 5/4) silt loam; weak medium subangular blocky structure; friable; slightly sticky, slightly plastic; few roots; strongly acid; clear wavy boundary.

Bt2--16 to 34 inches; strong brown (7.5YR 5/6) silt loam; moderate medium and coarse subangular blocky structure; firm; sticky, plastic; few roots; many medium clay films on ped faces; very strongly acid; gradual smooth boundary. (Combined thickness of the Bt horizon is 15 to 30 inches.)

2BC--34 to 38 inches; strong brown (7.5YR 5/6) sandy loam; weak medium and coarse subangular blocky structure; friable; slightly sticky, slightly plastic; few faint clay films; very strongly acid; clear smooth boundary. (0 to 8 inches thick)

2C1--38 to 58 inches; light yellowish brown (2.5YR 6/4) sandy loam; a few streaks of light gray (5Y 5/2) clean sand; massive; very friable: slightly sticky; very strongly acid; clear smooth boundary.

2C2--58 to 62 inches; pale yellow (5Y 7/3) and yellowish brown (10YR 5/8) loamy sand; single grain, loose; very strongly acid.

[5] SSURGO, Natural Resources Conservation Service,NRCS, Soil Mapping Data.

Chillum Series: 16% of Township, Prime farmland

A--0 to 1 inch; very dark grayish brown (10YR 3/2) silt loam; weak fine granular structure; friable, slightly sticky, nonplastic; many medium roots; strongly acid; clear smooth boundary. (1 to 6 inches thick)

E--1 inch to 8 inches; brown (10YR 4/3) silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many medium roots; very strongly acid; clear smooth boundary. (0 to 8 inches thick)

Bt1--8 to 16 inches; brown (7.5YR 4/4) silt loam; very weak fine and medium subangular blocky structure; friable, slightly sticky, slightly plastic; common roots; few faint clay films on peds; very strongly acid; gradual smooth boundary.

Bt2--16 to 28 inches; strong brown (7.5YR 5/6) silty clay loam; moderate fine, medium, and coarse subangular blocky structure; firm; moderately sticky, moderately plastic; few medium roots; many distinct clay films; very strongly acid; abrupt smooth boundary. (Combined thickness of the Bt horizon is 15 to 40 inches.)

2C1--28 to 32 inches; pale brown (10YR 6/3) gravelly sandy loam; common medium distinct brown (10YR 5/3) and yellowish red (5YR 4/6) mottles; massive; very firm; brittle; 20 percent, by volume rounded quartz pebbles; very strongly acid; clear smooth boundary.

2C2--32 to 96 inches; pale brown (10YR 6/3) extremely gravelly sandy loam; common medium distinct brown (10YR 5/3), dark yellowish brown (10YR 4/4) and yellowish red (5YR 4/6) mottles; massive; very firm; brittle; 65 percent, by volume rounded quartz pebbles; few thin seams of ironstone; very strongly acid.

Downer Series : 13% of Township, Prime Farmland

TYPICAL PEDON: Downer loamy sand (in an area of Downer loamy sand, 0 to 5 percent slopes), in a cultivated field. (Colors are for moist soil.)

Ap--0 to 10 inches; dark grayish brown (10YR 4/2) loamy sand, brown (10YR 5/3) dry; weak fine granular structure; very friable; strongly acid; abrupt smooth boundary. (0 to 11 inches thick)

BA--10 to 18 inches; yellowish brown (10YR 5/6) loamy sand; single grain; loose; few extremely weakly cemented masses of oxidized iron in lower part; very strongly acid; gradual smooth boundary. (0 to 12 inches thick)

Bt--18 to 30 inches; yellowish brown (10YR 5/6) sandy loam; weak fine and medium subangular blocky structure; very friable; common distinct clay bridging of sand grains; very strongly acid; gradual smooth boundary. (10 to 24 inches thick)

C--30 to 80 inches; yellowish brown (10YR 5/6) loamy sand; single grain; loose; very strongly acid.

Sassafras Series : 12% of Township, Prime Farmland

TYPICAL PEDON: Sassafras sandy loam, cultivated. (Colors are for moist soil).

Ap--0 to 9 inches; brown (10YR 5/3) sandy loam; weak very fine subangular blocky structure; very friable; slightly sticky, slightly plastic; few roots; strongly acid, abrupt smooth boundary. (0 to 12 inches thick)

BA--9 to 21 inches; yellowish brown (10YR 5/4) loam; moderate very fine to medium subangular blocky structure; friable; slightly sticky, slightly plastic; few roots; strongly acid; clear smooth boundary. (0 to 12 inches thick)

Bt1--21 to 32 inches; brown (7.5YR 5/4) sandy clay loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; few clay films on faces of peds; very few roots; very strongly acid; clear smooth boundary.

Bt2--32 to 40 inches; strong brown (7.5YR 5/6) sandy loam; weak thick platy structure parting to weak fine subangular blocky structure; friable; slightly sticky, slightly plastic; few clay films on faces of peds; very few roots; very strongly acid; abrupt smooth boundary. (Combined thickness of the Bt horizon is 10 to 20 inches.)

C1--40 to 52 inches; strong brown (7.5YR 5/6) gravelly sandy loam; massive; friable; slightly sticky, nonplastic; very strongly acid; 3 percent small light yellowish brown (10YR 6/4) pockets of clay; clear smooth boundary.

C2--52 to 70 inches; brownish yellow (10YR 6/8) loamy sand; single grain; loose;, nonsticky, nonplastic; 5 percent, by volume fine yellowish brown (7.5YR 5/8) gravel; extremely acid.

Mattapex Series : 5% of Township, Prime Farmland

TYPICAL PEDON: Mattapex loam, cultivated. (Colors are for moist soil.)

Ap--0 to 11 inches; dark grayish brown (10YR 4/2) loam; weak medium granular structure; friable; slightly sticky, slightly plastic; many fine and medium roots; moderately acid; gradual smooth boundary. (0 to 12 inches thick)

BE--11 to 15 inches; yellowish brown (10YR 5/6) loam; weak and moderate medium subangular blocky structure; friable; slightly sticky, slightly plastic; common fine and medium fine roots; strongly acid; gradual smooth boundary. (0 to 8 inches thick)

Bt1--15 to 26 inches; yellowish brown (1OYR 5/6) silty clay loam; moderate medium subangular blocky structure; friable; moderately sticky, slightly plastic; few medium roots common faint yellowish brown (1OYR 5/4) clay films on faces of peds; strongly acid; gradual smooth boundary.

Bt2--26 to 36 inches; light olive brown (2.5Y 5/4) silty clay loam; weak medium subangular blocky structure; firm; moderately sticky, slightly plastic; few distinct yellowish brown (10YR 5/6) clay films on faces of peds; common medium distinct strong brown (7.5YR 5/6) iron accumulations and brownish gray (2.5Y 6/2) iron depletions; very strongly acid; clear wavy boundary. (Combined thickness of Bt is 15 to 40 inches.)

2C1--36 to 60 inches; yellowish brown (10YR 5/4) fine sandy loam; massive; friable; nonsticky, slightly plastic; common medium distinct light gray (2.5Y 7/2) iron depletions and strong brown (7.5YR 5/6) iron accumulations; very strongly acid; clear smooth boundary.

2C2--60 to 65 inches; yellowish brown (10YR 5/4) loamy sand; massive; friable; nonsticky, slightly plastic; common medium distinct light gray (2.5Y 7/2) iron depletions and strong brown (7.5YR 5/6) iron accumulations; very strongly acid.

Appoquinimink Series : 6% of Township, Tidal Estuary

TYPICAL PEDON: Appoquinimink mucky silt loam, on a smooth 0 percent slope, in an estuarine salt marsh. (Colors are for moist soil unless otherwise noted.)

Ag--0 to 6 inches; dark olive gray (5Y 3/2) mucky silt loam; massive; slightly sticky, nonplastic; many fine medium and coarse live roots; few small shell fragments; n value greater than 1.0, soil flows easily between fingers when squeezed; 12 percent organic soil material; neutral; clear smooth boundary. (4 to 12 inches thick)

Cg1--6 to 21 inches; dark gray (5Y 4/1) silt loam; massive; slightly sticky, nonplastic; common very fine, fine, and medium roots and few coarse roots; n value greater than 1.0, soil flows easily between fingers when squeezed; 10 percent organic soil material; neutral; gradual smooth boundary.

Cg2--21 to 32 inches; olive gray (5Y 4/2) silty clay loam; massive; sticky, slightly plastic; common very fine and few fine and medium roots; n value greater than 1.0, material flows easily between fingers when squeezed; 8 percent organic soil material; neutral; clear smooth boundary. (Combined thickness of the Cg horizon is 4 to 36 inches.)

Oa--32 to 43 inches; very dark grayish brown (10YR 3/2) muck, sapric soil material; fiber content is one-tenth of the soil volume after rubbing; 25 percent by weight mineral soil material; few fine roots; neutral; gradual smooth boundary.

Oe--43 to 80 inches; dark brown (7.5YR 3/2) mucky peat, hemic soil material; fiber content is one-third of the soil volume after rubbing; 30 percent by weight mineral soil material; slightly acid. (Combined thickness of the O horizon is more than 16 inches.)

4.7 Soil Classification

In addition to a soil series and a soil profile, soil is also classified broadly into groups which determine suitability for potential land uses within the community. The soil table below lists the following descriptions of Hopewell Township soils.

- Hydrologic Group. Soils are classified by the Natural Resource Conservation Service into four Hydrologic Soil Groups based on the soil's runoff potential. The four groups are A, B, C, and D. A's generally have the smallest runoff potential and are classed as extremely well, or excessively drained and D's the greatest, highly erodable soils. Well-drained soils are the best suited to agriculture and also building sites.

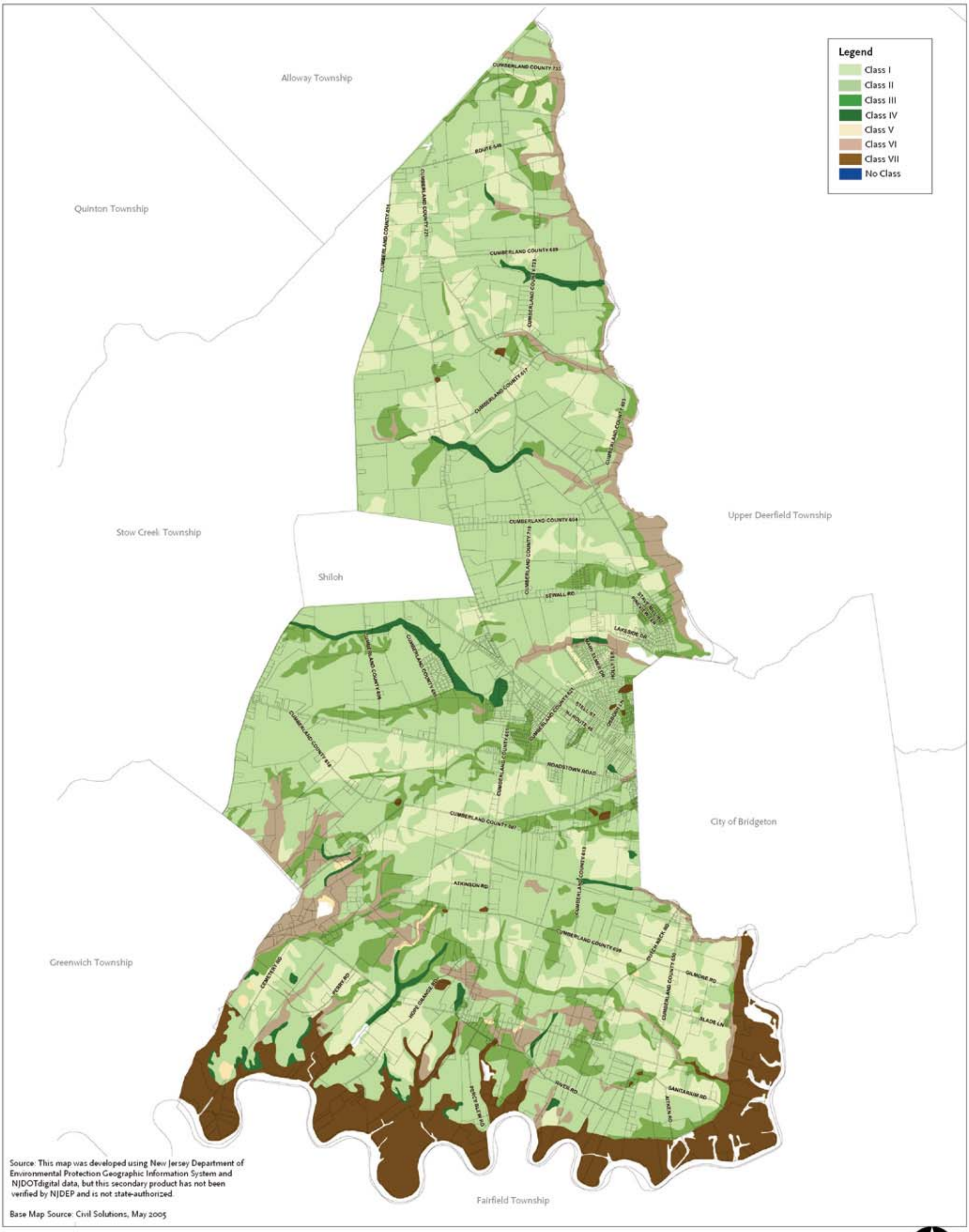
- Drainage Class. Soils are classified by their ability to absorb water. Drainage classes are described as very poorly drained, poorly drained, moderately well drained, well drained, and excessively drained.

- Hydric Soils
  Soils are classed as being hydric or non hydric. Hydric soils are found to a limited extent in Hopewell Township mainly associated around the Cohansey River and the Delaware Estuary. The Natural Resources Conservation Service defines hydric soil as soil which is poorly drained or very poorly drained and during the growing season has either:

  1.) Water table at the surface for sands within a depth of 20 inches.
  2.) Water table within 0.5 foot of the surface for soils with permiabilty of $\geq$ 6 inches/hour within a depth of 20 inches.
  3.) Water table within 1.0 foot of the surface for soils with permeability of < 6.0 inches/hour within a depth of 20 inches.
  4.) Soils which are frequently ponded for long or very long periods during the growing season.
  5.) Soils which are frequently flooded for long or very long periods during the growing season.

- Limitation for Development
  Soil properties influence the development of building sites, including the selection of the site, the design of the structure, construction, septic suitability, and maintenance. Limitations are most often classified as not limited, limited, severely limited.

- Agriculture: Prime, Statewide and Unique Soils
  Soil suitability for agricultural production is also classified by limitation. Land Capability Class I soils have virtually no limitation to agricultural cultivation and little to no conservation management of the soil is necessary. Class II soils have a few very easily managed limitations to production. Together these two soil classes are known as Prime Soils. Prime soils have the best combination of physical and chemical characteristics for producing high yield food, feed, and fiber. Soils with increasing limitations to cultivation and production are classed as III, IV, V. Soils known as Statewide Important soils are generally class III soils with some limitations for agricultural production and which will require special conservation practices to maintain productivity. The Unique soils are characterized as limiting for many types of production but uniquely suited for specialty crops such as cranberries or blueberries. Class V soils are generally classified as Other and are most often associated with wetlands and tidal estuaries and have little to no agricultural value. The characteristics of agricultural soils in Hopewell Township are mapped on the following two pages.

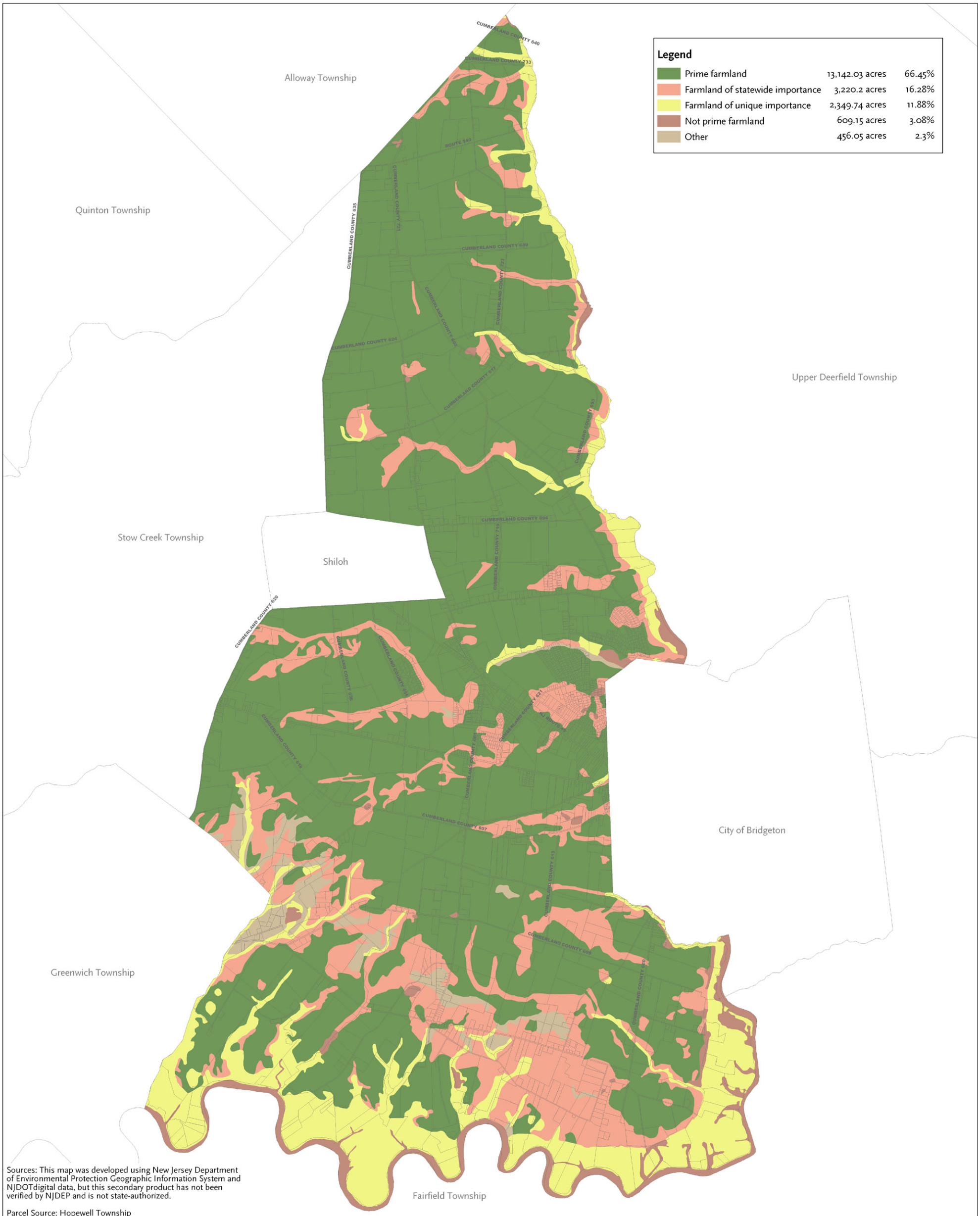


ENVIRONMENTAL RESOURCE INVENTORY

Soil Suitability for Crop Production

Hopewell Township, Cumberland County, NJ February 2007

Clarke Caton Hintz
Architects
Planners
Landscape Architects



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

Parcel Source: Hopewell Township

Base Map Source: Civil Solutions., May, 2005

ENVIRONMENTAL RESOURCE INVENTORY

Important Farmland Soils

Hopewell Township, Cumberland County, NJ February 2007

Clarke Caton Hintz

Architecture

Planning

Landscape Architecture

Hopewell Township soils are excellent for agricultural production. Over 82% of the soils are classified as Prime agricultural soil. Nearly 2,700 acres of farmland in the Township has been permanently protected for agriculture. The moderate rainfall, approximately 42 inches per year, leaches much of the bases and carbonates, from the soil leaving many of the soils very acidic unless limed. Hopewell's soils are also excellent for building and development as very few of the soils are limiting for septic effluent. The following sites in Hopewell have historically been mined for the excellent soils for septic field construction.[6] Township ordinances now prohibit soil mining in Hopewell Township.

- Ray Harvey: Trench Road Block 82 Lot 3.01 approximately 32.5 acres
- Adamucci Farms: Barretts Run & Trench Roads Block 75 Lots 8 & 9 parts. Operations have been discontinued permitted use was completed.
- Paul Ernest: corner of Greenwich & Bowentown Roads, old borrow pit, use discontinued.

The table below describes the characteristics of the major soil series in Hopewell Township. These soils represent 84% of the soil resources in the municipality. All are prime agricultural soils except Appoquinimink and Mattapex. The Soil Mapping Units map following the table includes an exhaustive listing of all of the soil series in Hopewell Township

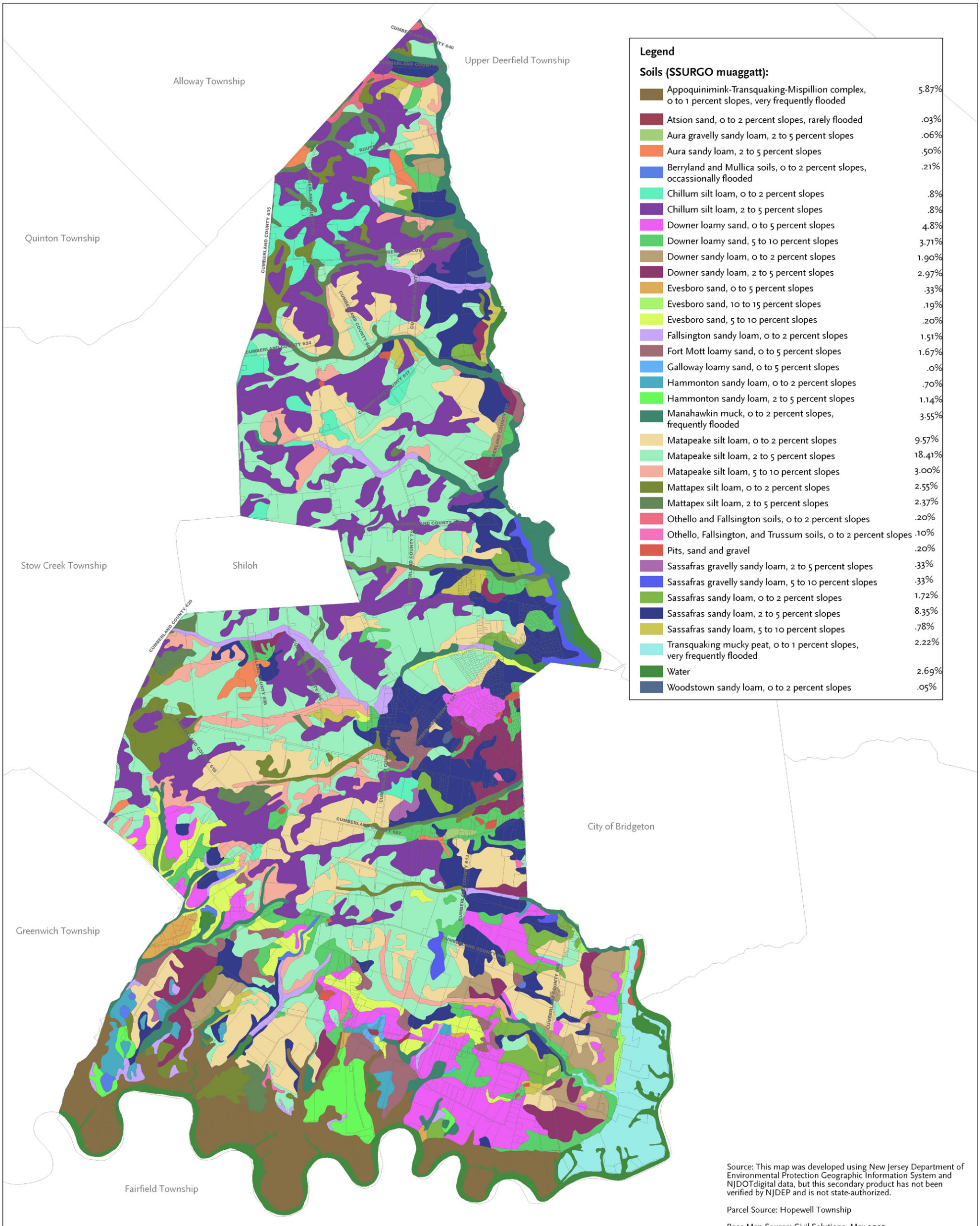
Table 1 Characteristics of major soil series Hopewell Township

Series Name	Soil Type	Label	% of Total	Acres	Use/Vegetation
Matapeake	Silt Loam	MbrA,B,C	31	6127.14	Cultivated Fields/Oaks
Chillum	Silt Loam	ChtA,B	16	3160.56	Cultivated fields/Wooded
Downer	Loamy Sand	DocB,C	9	1683.55	Cultivated Fields
Downer	Sandy Loam	DoeA,B	5	965.97	Cultivated Fields
Sassafras	Sandy Loam	SacA,B,C	11	2144.33	General Crops/ Truck Crops
Sassafras	Gravelly Sandy Loam	SadB,C	1	169.02	General Crops/ Truck Crops
Mattapex	Silt Loam	MbuA,B	5	975.05	Cultivated Fields
Appoquinimink	Fine Silt	AptAv	6	1161.66	Wetlands

[6] Cumberland County Health Department, Engineering Office Staff, Telephone conversation, June 21, 2006.

Series Name	Depth SHWT	Drainage Class	Hydrologic Group	Septic Limitation	Hydric Soil	Acidity
Matapeake	72 +"	Well Drained	B	Not Limited	No	Strongly Acid
Chillum	72 +"	Well Drained	B	Not Limited	No	V. Strongly Acid
Downer	72 +"	Well Drained	B	Not Limited	No	V. Strongly Acid
Downer	72 +"	Well Drained	B	Not Limited	No	V. Strongly Acid
Sassafras	72 +"	Well Drained	B	Not Limited	No	Strongly Acid
Sassafras	72 +"	Well Drained	B	Not Limited	No	Strongly Acid
Mattapex	18"	Mod. Well Drained	C	Very Limited	Yes	Moderately Acid
Appoquinimink	0"	Very Poorly Drained	D	Severely Limited	Yes	Neutral pH

Watercolor of 'Fralinger' Barn, by Carol Bell



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

Parcel Source: Hopewell Township

Base Map Source: Civil Solutions, May 2005

0 1,200 2,400 4,800 Feet

Environmental Resource Inventory

Soil Mapping Units

Hopewell Township, Cumberland County, NJ February 2007

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4.8 Radon

Radon is an invisible, odorless gas that results from the radioactive decay of naturally occurring uranium and radium in the soil and rock. Radon enters a structure at the lowest level and can accumulate in enclosed areas, such as basements. The radioactive gas moves up into the indoor air of the home environment through any crack or opening.

A North American and a European study combined data from several previous residential studies which show definitive evidence of an association between residential radon exposure and lung cancer. The findings of this study effectively end any doubts about the risks to Americans of having radon in their homes. We know that radon is a carcinogen. This research confirms that breathing low levels of radon can lead to lung cancer according to Tom Kelly, Director of EPA's Indoor Environments Division,. [7]

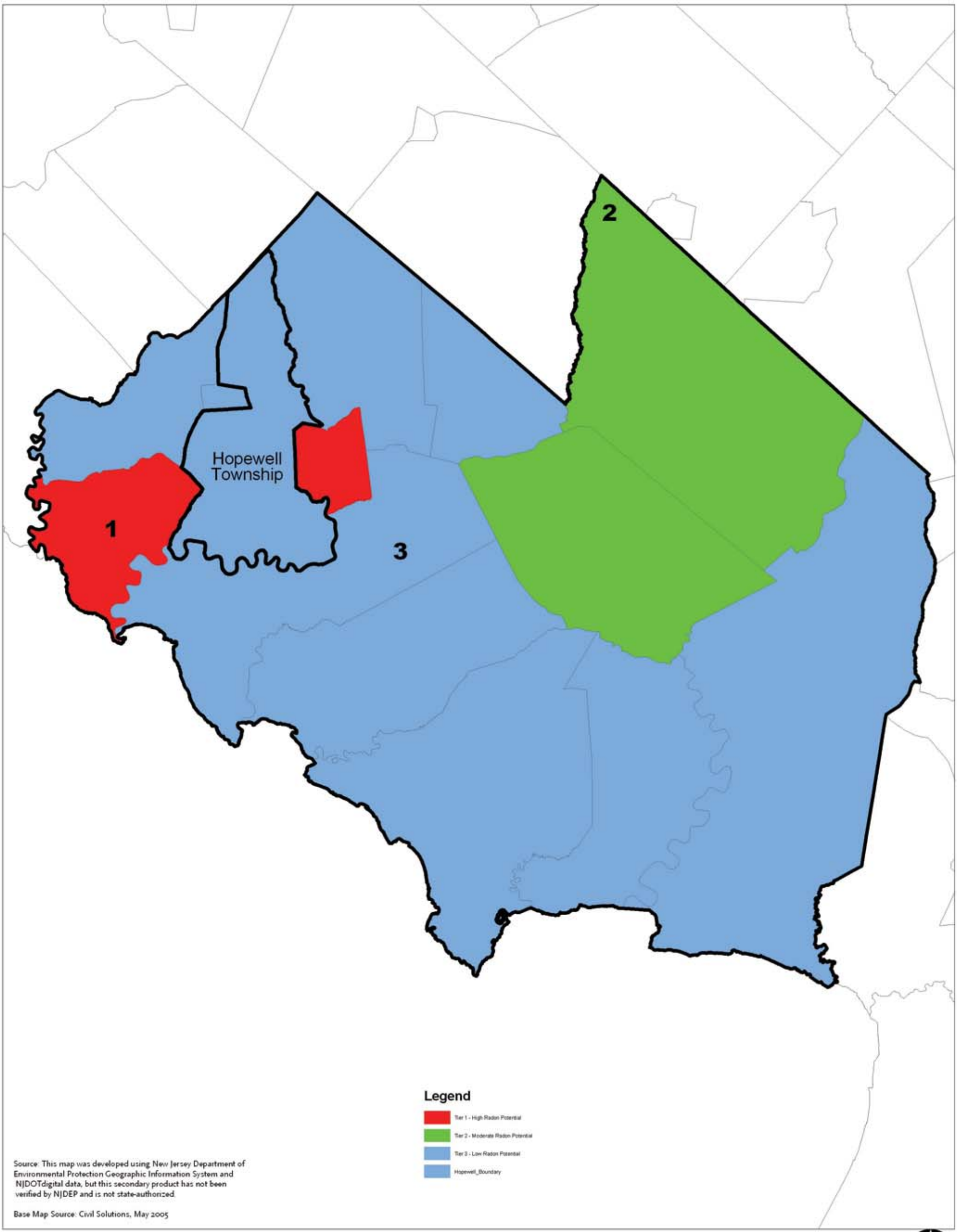
According to the EPA, radon exposure is the second-leading cause of lung cancer in the United States with an estimated 21,000 lung cancer deaths each year. The Surgeon General of the United States issued a Health Advisory in January, 2005 warning Americans about the health risk from exposure to radon in indoor air. The nation's chief physician urged Americans to test their homes to find out how much radon they might be breathing and stressed the need to remedy the problem as soon as possible when the radon level is 4 picocuries/liter or more. [8]

Radiation is measured in the US in curies. The picocurie, pCi, is one trillionth of a curie. The United States average for indoor air radon levels is 1.3pCi/L. The NJDEP recommends remediation at levels exceeding 4pCi/L. The mediation process for removing radon includes installation of a fan driven ventilation system which removes the air from underneath the concrete floor and draws it up and out of the roof through a series of PVC pipes. The typical cost for remediation is approximately $1,200.00. Installers must be certified by the NJDEP.

On January 20, 2005, the New Jersey Department of Environmental Protection instituted a three tiered identification system to classify municipalities according to potential for indoor air quality problems. Hopewell is included in tier 3 The three tiers, low (3) medium (2) and high (1) potential are shown on the Radon Map below.

[7] URL: http://www.uihealthcare.com /news/news/2005/03/21radon.html

[8] http://www.epa.gov/radon/Oct 19, 2006



ENVIRONMENTAL RESOURCE INVENTORY

Radon Potential

Hopewell Township, Cumberland County, NJ February 2007

Clarke Caton Hintz

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Planning

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4.9 Radium in Drinking Water

The NJDEP published a *South Jersey Homeowners Guide to Radioactivity in Drinking Water:Radium.*[9] This publication, dated April 2004, reported elevated levels of naturally occurring radioactivity in the Kirkwood-Cohansey aquifer, the primary aquifer for drinking water in Hopewell Township. Radium dissolves readily into ground water in acidic sandy soils like those present in Hopewell and the surrounding region. Exposure to radium over a long period of time is believed to increase one's lifetime risk of developing cancer. Alpha radiation is the type of particles emitted as radioactive elements decay. The test to detect elevated level of radiation in drinking water is called a gross alpha test and costs about $150.00. The US EPA gross alpha standard for drinking water is 15pCi/L. Well water tested in the Hopewell area has shown high gross alpha tests for radium. The mitigation recommended for levels above 15pCi/L is installation of a water softener or ion exchange water treatment system costing approximately six hundred to eight hundred dollars.

5.0 CLIMATE AND AIR QUALITY

5.1 Climate

The following excerpt is taken in its entirety from the Cumberland County government website. "Climatically speaking, Cumberland County is fortunate. Because of its southerly location, its many miles of frontage on the Delaware Bay, and its site as part of the southern New Jersey peninsula, the county has a relatively mild climate. The modifying influence of the Atlantic Ocean and the Gulf Stream tempers the climate of the region and affords its inhabitants longer summers and milder winters than inland regions of similar latitude. In fact, the entire area of southern New Jersey is distinguished by its lack of extremes. While it has a four season climate, the large nearby bodies of water tend to retard the seasons. At times the high humidity renders the cold of fall and winter very penetrating, and summer heat oppressive. An average annual temperature of 54° F. ranks the area high in the state. Mean seasonal temperatures within the county vary from 2° to 6°. The lowest temperature recorded is 8° below zero and has occurred both in January and February. The highest temperature recorded is 104° and had occurred in both July and August. The average annual temperature ranges from about 56° Fahrenheit in the southern part of the county to about 52° in the north. Average monthly high temperature registered at Bridgeton reaches approximately 77° in July; the average low point is 17° and occurs in January.

There is some variation in the length of the growing season in different parts of the county, but the average length is 191 days in Bridgeton. This is considered a fairly long season which enables the farmers to make very early plantings in the spring and to rely on crops maturing late in the fall. The average date of occurrence of last killing frost in spring is April 16; however the latest recorded frost was May 29. The average date of the first occurrence of killing frost in fall is October 24. The latest recorded killing frost was December 22.

[9] DEP's Radiation Protection and Release Prevention Program, www.state.nj.us/dep/rpp/radwater.htm

From several standpoints, the precipitation aspects of the climate of Cumberland are of more concern than those of temperature. Cumberland County is well-watered by most standards, but it is still among the drier counties of New Jersey. Rainfall during an average year ranges from about 42" in the south to 45" in the north. A 44" average annual precipitation rate, however, ranks Cumberland fairly close to the general average for the state. In the wettest year on record, the county had an average precipitation of 61", 17" more than normal; during one of the driest years on record (1964), the county received only 32" of rainfall. Even in the driest year, however, there seems to be an ample supply of water below ground. In this sense, the county is fortunate that its source of water is underground aquifers rather than surface bodies which are more affected by reduced rainfall. The monthly pattern of precipitation demonstrates the relative uniformity of precipitation throughout the year, with the slightly higher values occurring during the summer months. There is a primary late summer maximum of precipitation and two secondary maxima, one in the fall and another in (early) spring. Precipitation data reflect the late summer maximum characteristic of the Atlantic Coast and are traceable to hurricanes and tropical storms. Some difference between July-August precipitation at different locations within the county may be attributed to summer thundershowers at interior locations as opposed to "cool" bayshore locations. The snowfalls are usually light, and the snow generally melts quickly. Precipitation over the years, nevertheless, when compared with many parts of the United States, has normally been spread fairly evenly throughout the year. However, exceptionally sandy conditions coupled with several drought periods occurring during the growing season have led to local growers to rapidly expand irrigation facilities.

Prevailing wind directions in the county are generally from the north or northeast in the late fall, winter, and spring months and from the southeast, south, or southwest in the summer and early fall months. Normally, the amounts of time during which the sun shines equals 60% of the total possible in the county, which compares with the 50% in the northern New Jersey counties".[10]

5.2 Air Quality

The following chart[11] ranks Cumberland County against other counties in the United States for air quality. Green lines indicate cleanest air for the parameters tested, red lines indicate the worst. By virtue of its location on the highly urbanized northeastern corridor of the US, Cumberland County is within the Philadelphia-Wilmington-Trenton non attainment area for failing to meet the national ambient air quality standards levels for Sulfur Dioxide and Ozone. Level are generally higher than the nationwide average for all six regulated pollutants: Carbon Monoxide, Nitrous Oxide, Volatile Organic Compounds, Sulfur Dioxide, Ozone, and Particulate Material. Not withstanding the national ranking, the NJDEP Air Quality Index Summary listed the Delaware Bay Region, including Hopewell Township, as having 278 days of good air quality, 82 days of moderate air quality, 4 days with unhealthy for sensitive groups and 1 day with unhealthy air quality for the year 2005.[12] A snapshot of real time air quality indicating good air quality ranking for nearby Millville in Cumberland County is also provided.

[10] http://www.co.cumberland.nj.us/facts/climate.htm

[11] Scorecard, The Pollution Information Site.
http://www.scorecard.org/envreleases/cap/county.tcl?fips_county_code=34011#maps

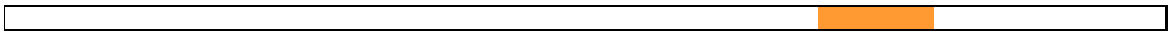
[12] http://www.state.nj.us/dep/airmon/aqi05.pdf

 Air Quality Rankings: Health Risks, Exposure, and Emissions

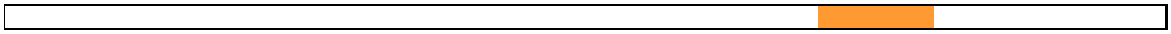
Cleanest/Best Counties in US — Percentile — Dirtiest/Worst Counties in US

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Carbon Monoxide emissions:

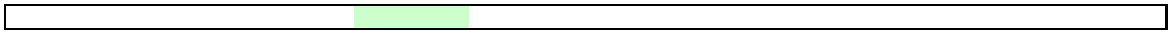


Nitrogen Oxides emissions:

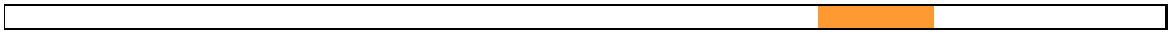


PM-2.5 emissions:

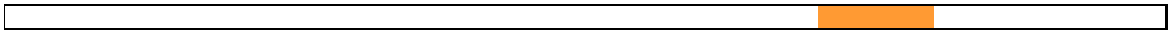
PM-10 emissions:



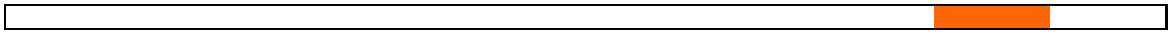
Sulfur Dioxide emissions:



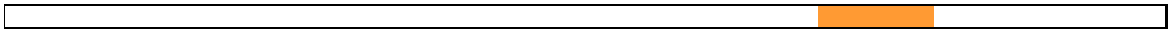
Volatile Organic Compound emissions:



Air Quality Index:



Ozone 1-hour average concentration:

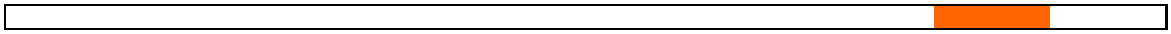


 Air Quality Rankings: Health Risks, Exposure, and Emissions

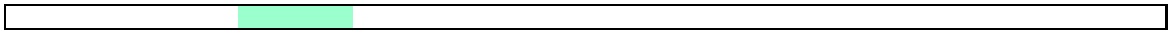
Cleanest/Best Counties in US — Percentile — Dirtiest/Worst Counties in US

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Ozone 8-hour average concentration:



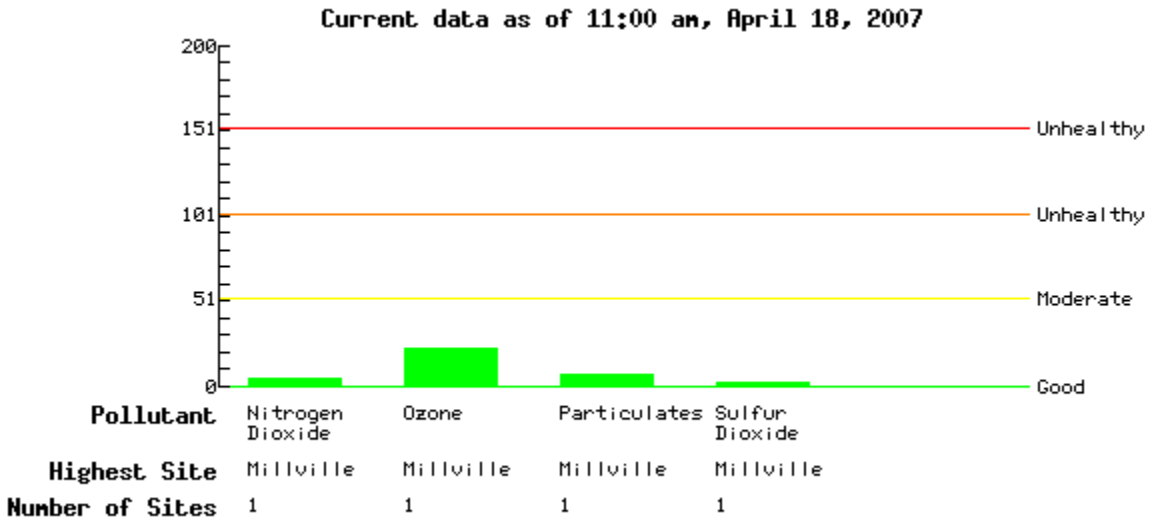
Person-days in exceedance of national air quality standard for ozone (1-hour):



Person-days in exceedance of national air quality standard for ozone (8-hour):

Real Time Air Quality Monitoring.

This chart shows the highest reading in the region for each air pollutant and the monitoring site at which the reading was recorded. The tallest bar determines the overall rating in the region. Values over 100 represent unhealthful levels.[13]



6.0 GROUND WATER, SURFACE WATER, AND WETLANDS.

6.1 Ground Water

Approximately forty percent, 40%, of the potable water in New Jersey comes from ground water.[14] The residents of the Coastal Plain, including Hopewell Township, are even more heavily dependent upon ground water for their drinking water. No economically viable alternative source exists to supply drinking water to the 3 million people dependant upon the aquifer system. The New Jersey Coastal Plain Aquifer System, consisting of five principal aquifers detailed on the map below, supplies more than 75% of the fresh water to the Coastal Plain region. The USEPA has recommended the Coastal Plain Aquifer system be designated as a sole source aquifer as described in the Safe Drinking Water Act.

The Safe Drinking Water Act (SDWA), Public Law 93-523, of December 16, 1974 contains a provision in Section 1424(e), which states that: if the Administrator determines, on his own initiative or upon petition, that an area has an aquifer which is the sole or principal drinking water source for the area and which, if contaminated, would create significant hazard to public health, he shall publish notice of that determination in the Federal Register. After the publication of any such notice, no commitment for Federal financial assistance (through a grant, contract, loan guarantee, or otherwise) may be entered into for any project which the Administrator determines may contaminate such aquifer through a recharge zone so as to create a significant

[13] Current Air Quality Readings, Cumberland/Salem, http://www.state.nj.us/dep/airmon/delbay.htm April 18, 2007.
[14] www.dep/njgs/enviroed/infocircle/mapping.pdf, June14, 2006

hazard to public health, but a commitment for Federal financial assistance may, if authorized under another provision of law, be entered into to plan or design the project to assure that it will not so contaminate the aquifer.

On December 4, 1978 the Environmental Defense Fund, Inc. and Sierra Club New Jersey Chapter petitioned the U.S. Environmental Protection Agency (EPA) Administrator to determine that the Counties of Monmouth, Burlington, Ocean, Camden, Gloucester, Atlantic, Salem, Cumberland, Cape May and portions of Mercer and Middlesex Counties, New Jersey, constitute an area whose aquifer system is "the sole or principal drinking water source for the area and which, if contaminated, would create a significant hazard to public health".[15] Designation of the area as a sole source aquifer will provide additional review of groundwater protection for projects requesting federal funding.

Underlying geology determines but does not entirely define the extent of aquifers and the chemical quality of the water they yield. Hydrogeologic units may differ from the geologic strata because a geologic formation may contain more than one aquifer, a formation may serve as an aquifer in one area and a confining bed in another, or an aquifer may be composed of more than one geologic formation. The aquifers of the Coastal Plain are an interrelated hydrologic system comprised of a series of hydrologic units of varying thicknesses and water bearing capacity. Hopewell Township relies entirely upon the Kirkwood-Cohansey portion of the aquifer system. The Kirkwood- Cohansey system is a water table aquifer which underlies an area of approximately 3,000 square miles. This system is composed of the Kirkwood geologic formation, the Cohansey Sand and to some extent the Beacon Hill Gravel, the Bridgeton Formation, and the Cape May Formation.[16]

6.2 Ground Water Quality

Water quality in the Coastal Plain Aquifer System satisfactorily meets drinking water standards except for local excessive iron concentrations, saltwater intrusion, and infrequent waste disposal violations. Fresh, uncontaminated ground water in the New Jersey Coastal Plain is low in dissolved solids (generally less than 150 milligrams per liter (mg/l). Calcium and bicarbonate are usually dominant ions in solution with smaller amounts of sodium, potassium, magnesium sulfate and chloride. Locally, concentrations of iron and manganese present a problem near the water table because the ground water tends to have a low pH. These waters are treated to make them palatable. The surficial nature of the Kirkwood-Cohansey Aquifer makes it vulnerable to contamination from various land uses such as industrial chemicals (VOCs), agricultural chemicals used for crop protection and residential landscaping, pesticides, and products of septic tank effluent. Historically, no significant quantities of heavy metals, pesticides, organics or coli form bacteria have been found in the artesian aquifers. Except for specific parameters (e.g. iron) and contamination incidents, water quality in the artesian ground water system meets or exceeds Federal and State drinking water standards. The quality of ground water in the outcrop area, on the other hand, is variable, being largely determined by local land uses at the surface. .[17]

[15] www. Epa.gov/region2/water/aquifer/coast/caostpln.htm#19, June 2006.
[16] Zapecza, Otto S.,Hydrogeolgic Framework of the New Jersey Coastal Plain, Regional Aquifer System Analysis, US geological Survey, Open File Report 84-730, Trenton, NJ 1984, p. 32.
[17] ttp://www.epa.gov/region2/water/aquifer/coast/fr_coast.htm

6.3 Private Well Testing Results

All new wells and any properties undergoing a real estate transaction are required to have wells tested. Testing is conducted by private well testing laboratories and results are reported to the State of New Jersey. Cumberland County Health Department compiles data for all wells which have failed for any of the tested parameters. Treatment is required only for rental properties; however, neighbors within 1,000 feet of a failed well site are notified in person and given information detailing the water quality parameter failed and recommending testing.[18] The following spread sheet details the water quality statistics for Cumberland County recorded at Private Well Testing Facilities and reported to the State of New Jersey for failed wells in 2006. A total of 114 wells failed in Hopewell in 2006. Hopewell Township, HW, results are underlined. A list of Certified Laboratories is included in Appendix 2.

Number of Failures for Water Quality Parameters by Township Cumberland County

TWP	VOC	LEAD	MERCURY	NITRATE	BACTERIA	GROSS ALPHA	pH	IRON	MANGANESE
BT	0	2	0	3	0	3	7	5	2
CM	4	18	3	8	5	10	84	37	17
DF	0	14	1	7	0	15	40	8	7
DN	0	1	0	0	1	3	11	11	2
FF	0	16	1	7	2	24	70	20	10
GW	0	1	0	1	0	4	12	4	1
HW	1	15	0	10	2	34	56	19	5
LW	2	20	0	3	0	4	62	26	9
MR	1	9	0	5	3	10	43	29	13
MV	0	17	0	9	1	11	60	23	8
SH	0	2	0	2	0	8	11	2	0
SC	0	2	0	3	0	6	14	4	3
UD	0	23	4	25	1	51	78	24	57
VD	1	13	0	10	3	19	39	12	14

[18] Danielle Crispin, Cumberland County Health Department telephone interview, April 30, 2007.

6.4 Recharge Kirkwood-Cohansey Aquifer System

Natural recharge to the New Jersey Coastal Plain Area occurs primarily through direct precipitation on the outcrop area of the geologic formations. A smaller component of natural recharge to the deeper layers of the system occurs by vertical leakage from the upper layers. The Kirkwood-Cohansey aquifer system is an uppermost, or surficial aquifer layer, existing at land surface throughout Hopewell Township. This configuration exposes the aquifer to a considerable amount of recharge from rainfall, but it also exposes it to possible contamination from various land uses.

Depletion of the aquifer results from baseflow discharge and pumping for public and private consumption. Pumping from wells in the aquifer will deplete the stream baseflow. Pumping for public water supply, coupled with associated sewage removal from the hydrologic system, has a greater depletion effect than well pumpage with waste disposal through septic tanks[19]. Because of the surficial position, the aquifer is hydraulically connected to the streams of the area. The baseflow of the streams, defined as water not flowing directly from storm runoff, is ground water that discharges to the streams. Baseflow is the major part of the total flow of Coastal Plain streams and sustains the flow during dry periods and drought. Based primarily on estimates of ground water contributing to streamflow and basin runoff, several estimates of ground water recharge in the Coastal Plain have been made. Recharge ranges from twelve to twenty (12 - 20) in/yr.

[19] Anthony S. Navoy, Ph.D., U.S. Geological Survey,
http://www.sjwatersheds.org/science/GlouCoGrWaterIssues.pdf .viewed October 23, 2006

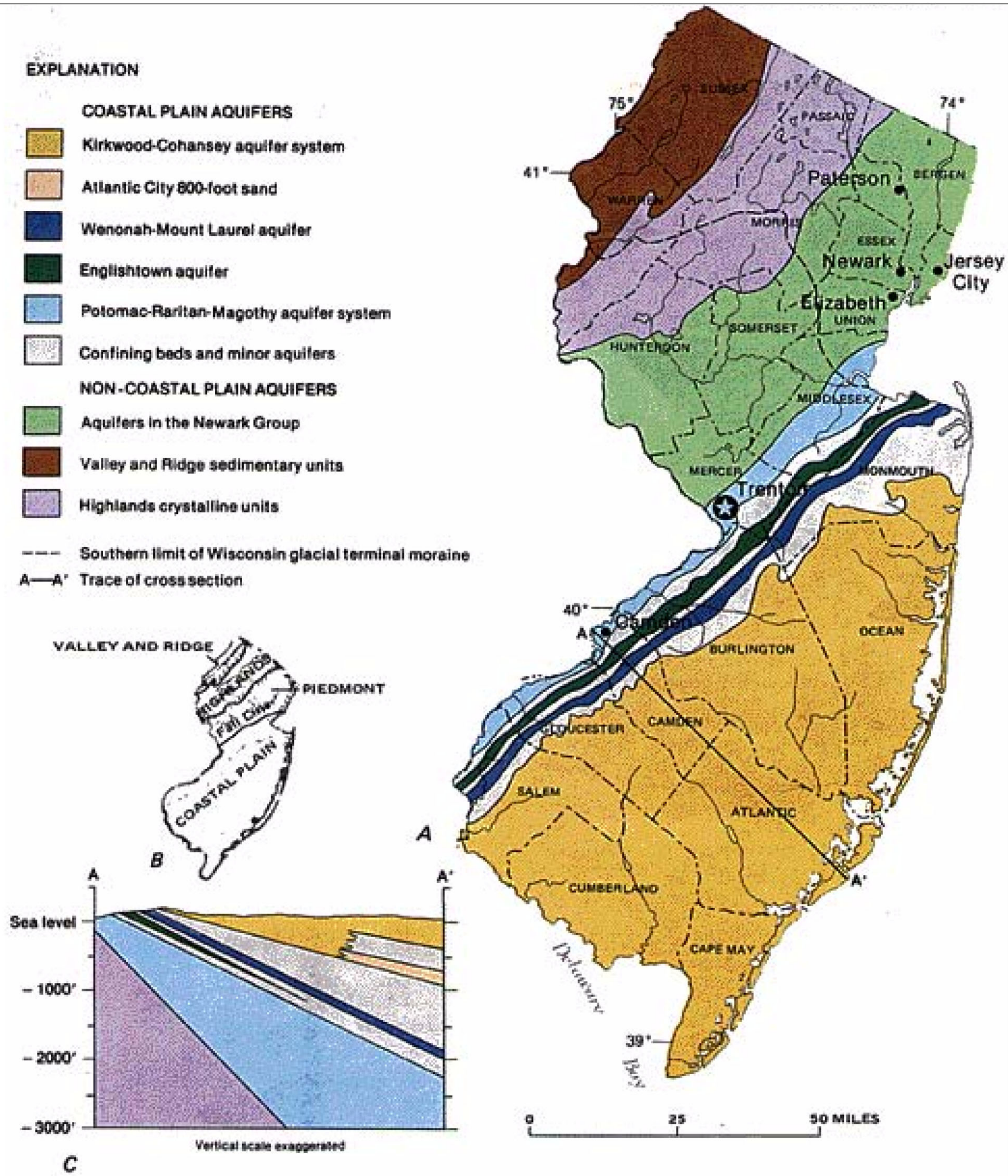
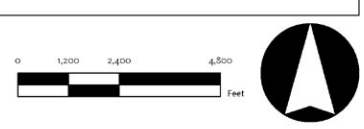


Figure 1. Principal aquifers in New Jersey. *A*, Geographic distribution. *B*, Physiographic diagram and divisions. *C*, Generalized cross section (A-A') of the Coastal Plain. (See table 2 for more detailed description of the aquifers. Sources: *A*, *C*, Compiled by O. S. Zapecza from U.S. Geological Survey files. *B*, Owens and Sohl, 1969; Raisz, 1954.)



Environmental Resource Inventory

Coastal Plain Aquifer

Hopewell Township, Cumberland County, NJ February 2007

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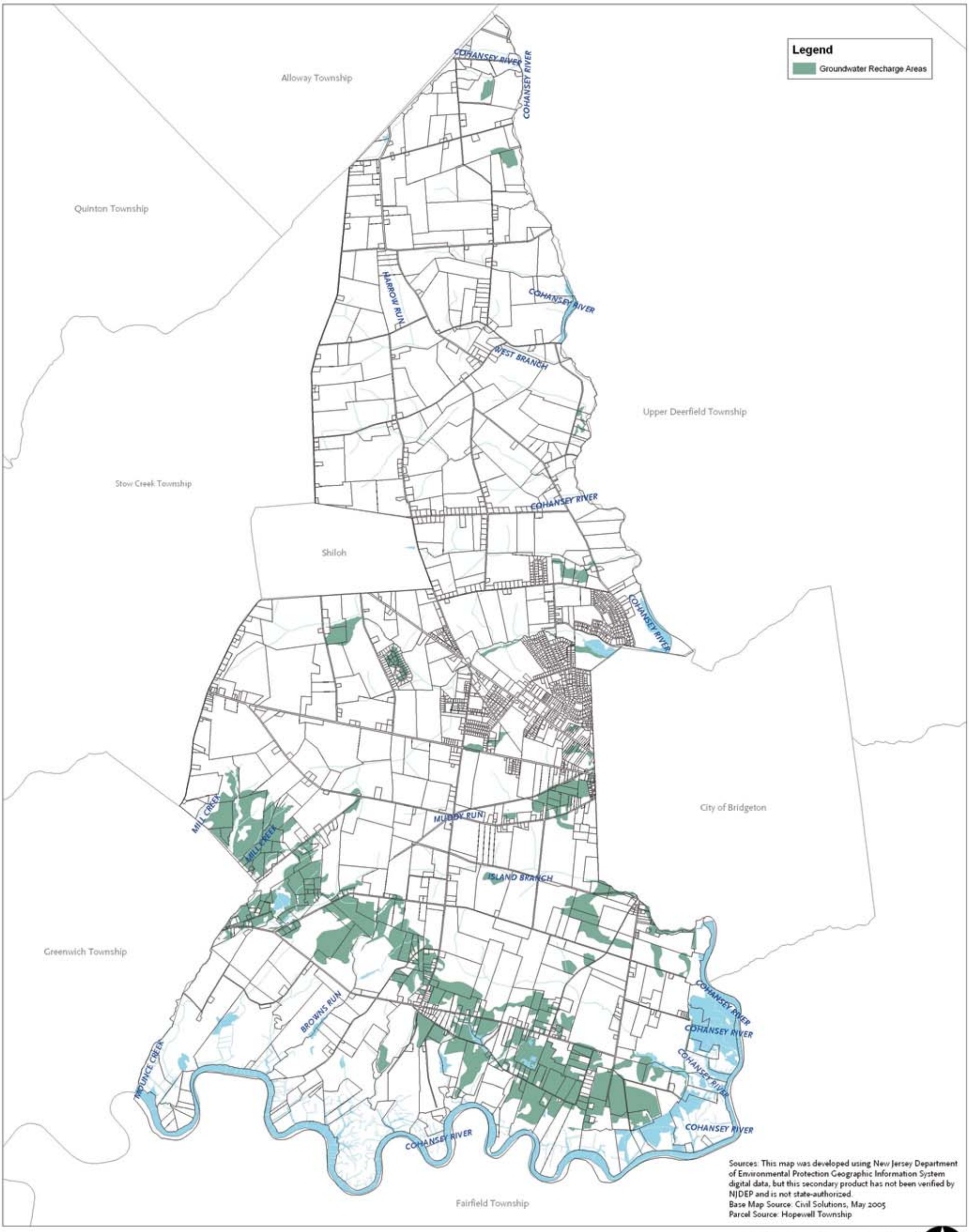


ENVIRONMENTAL RESOURCE INVENTORY

Ground Water Recharge

Hopewell Township, Cumberland County, NJ February 2007

Clarke Caton Hintz
Architecture
Planning
Landscape Architecture

6.5 Wells in Hopewell Township

The majority of residences, farms and businesses have private wells in Hopewell Township. A few residences on the border of the City of Bridgeton are serviced by public water and one farm is serviced by public water, Sunny Slope Farms which processes fruit[20]. As of June 1, 2006, the Cumberland County Department of Health approved 8 wells in Hopewell Township. Four of the new wells were installed for new construction and four were replacements for failing wells at approximately 70 feet depth. Water for new wells is drawn from the sand and water of the Kirkwood-Cohansey aquifer from shallow wells at a typical depth of 95-100 feet in Hopewell. A typical geologic strata log follows[21]:

- Clay 12 feet
- Sand/Gravel 24-34 feet
- Clay 45 feet
- Clay 70 feet
- Sand 85-95 feet

Water testing laboratories and treatment services commonly find contaminant levels high for gross alpha, excessive iron, and nitrates in Hopewell. The state limit for nitrates in drinking water is 10mg/L. Typically Hopewell wells will test at 8-9.5 mg/L. although the level tends to fluctuate with the season, higher in summer and lower in winter.[22]

6.6 Well Head Protection

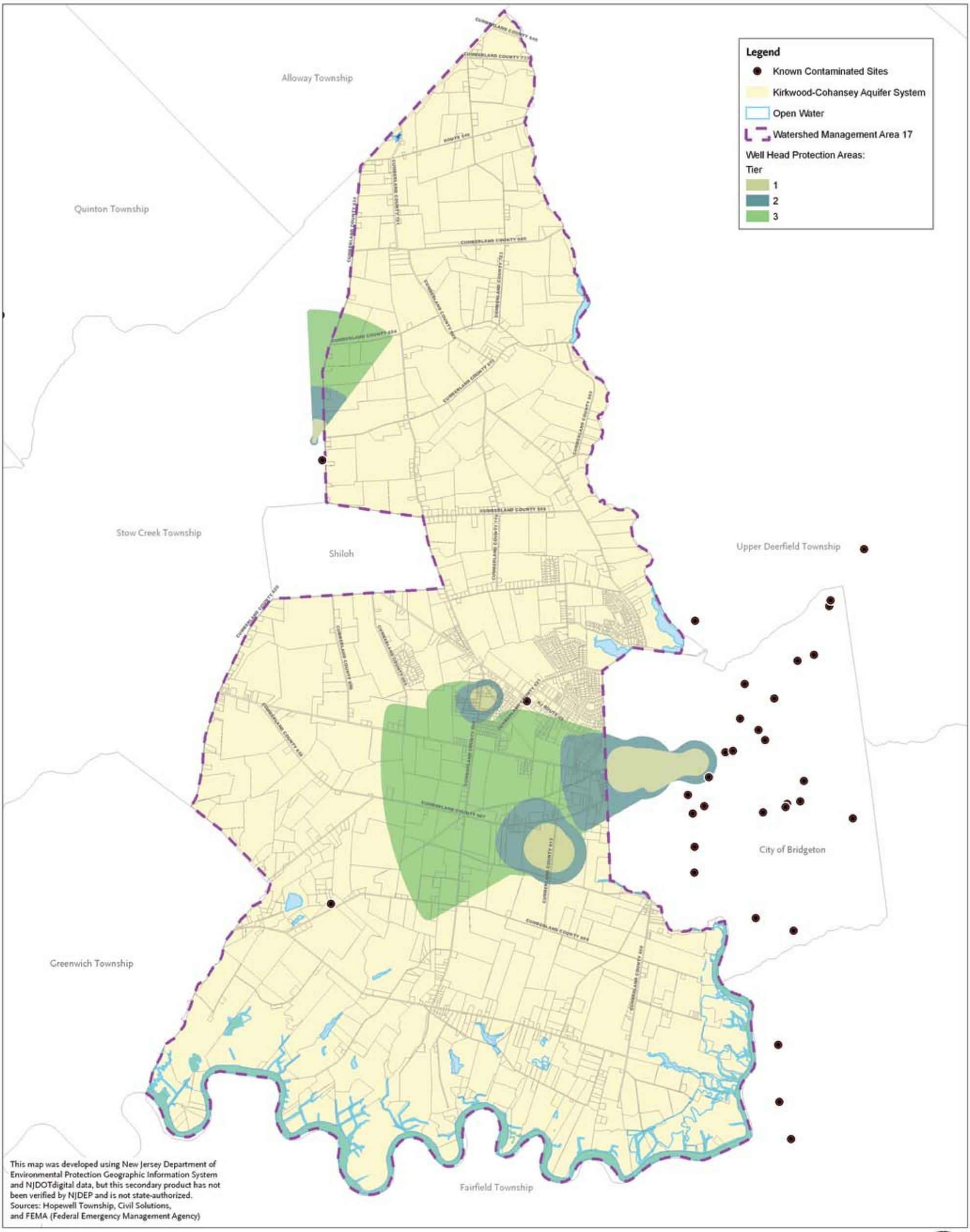
Well head protection is simply protection of the land area surrounding a well from contaminants. The state does not have formal regulations regarding protection of private well heads; however, public water supply wells do have protection measures delineated by the State of New Jersey based upon risk assessments outlined in the Safe Drinking Water Act. The Safe Drinking Water Act Amendments of 1986 established requirements for states to develop Wellhead Protection Programs (WHPPs). A WHPP is a pollution prevention and management program used to protect underground sources of drinking water. These programs were intended by Congress to be a key part of a national ground-water protection strategy to prevent contamination of ground-waters that are used as public drinking water supplies. When a well is pumping nearby ground water flows toward it. The longer the well pumps, the greater the distance from which water will flow through the aquifer to the pumping well. As an example, a community well pumping for two years may draw water from 1,500 feet away. If the well continues to pump for 12 years, it may draw water from over a mile away. The time it takes for a given particle of well water to travel to a pumping well is called time of travel, TOT. The well head protection radius is based on TOT.[23] The protection distance from the well is set by examination of the horizontal extent of ground water captured by a well pumping at a specified rate over two, five, and twelve years. Tier one protection areas have a two year infiltration rate, tier two areas a five year rate, and tier three a

[20] Ted Ritter, Hopewell Township Administrator, Telephone Conversation , June 1, 2006.
[21] Bob Bew, Cumberland County Department of Health, Telephone conversation, June 1, 2006.
[22] Latish Menghani, Vineland Environmental Labs, Telephone conversation, June 1, 2006.
[23] Steven E. Spade and Stephen W. Johnson, NJ Geological Survey, Guidelines for Delineation of Well Head Protection Areas in New Jersey, NJGS open File Report OFR-03-1,http://www.state.nj.us/dep/njgs/whpaguide.pdf

twelve year rate. Confined aquifers generally do not have well head protection areas.[24] GIS maps are produced for well head protection on public water supplies in each county and for the state.

Open land Hopewell Township

[24] Jim Boyle, New Jersey USGS Office, Telephone conversation , June 2006



ENVIRONMENTAL RESOURCE INVENTORY

Well Head Protection & Contaminated Sites

Hopewell Township, Cumberland County, NJ February 2007

Clarke Caton Hintz
Architecture
Planning
Landscape Architecture

6.7 Water Allocation Permits

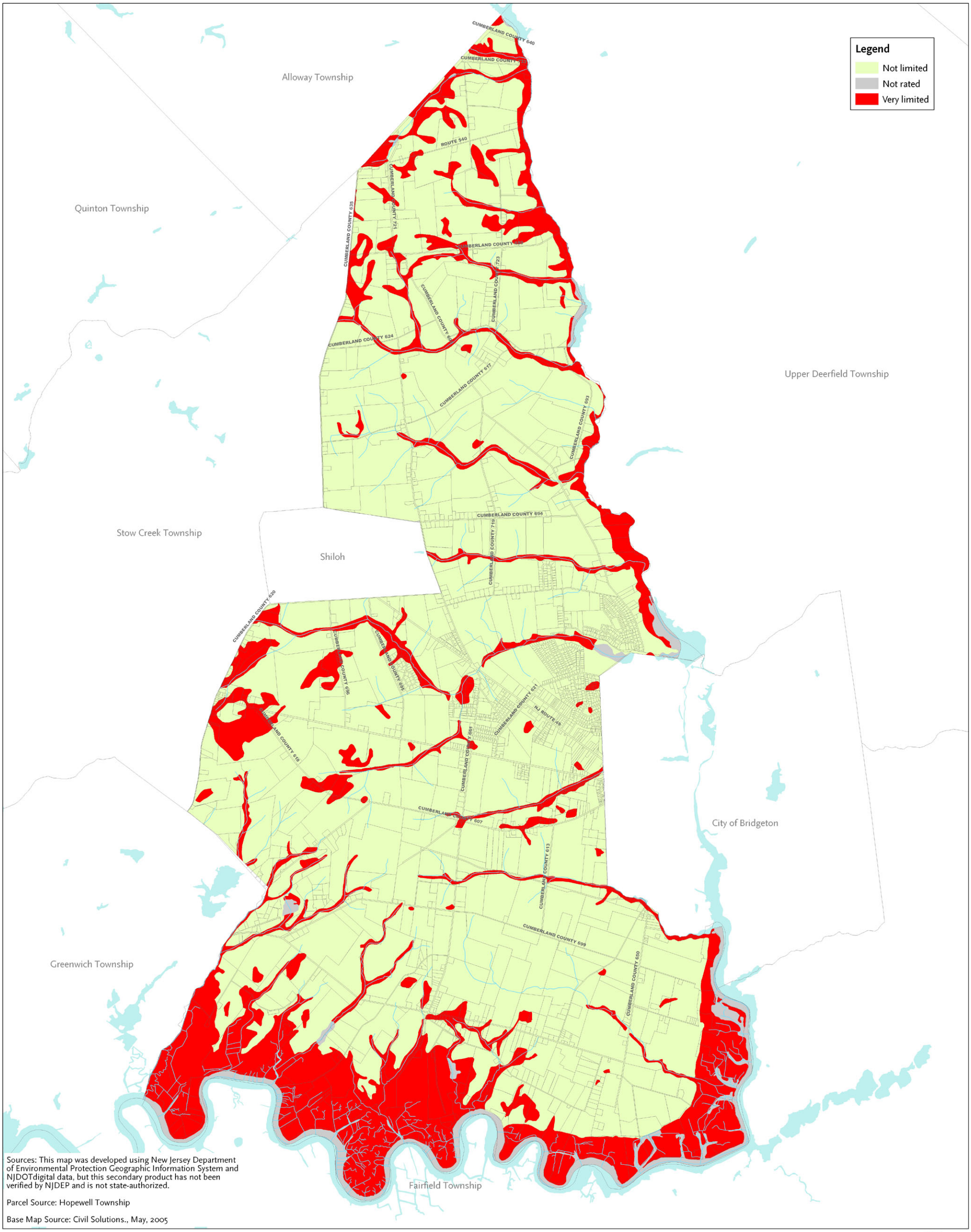
There are 142 agricultural water allocation permits issued in Cumberland County and 26 general permits. General permits are issued for public water supply wells, industrial sites, power generating plants, cooling towers, sand and gravel operations and the like. Cumberland County water use totals 7,100,000 gallons per day.[25] The typical household of four persons uses 260 gallons per day broken down as follows:[26]

- Potable 9%
- Laundry/Dishes 16%
- Toilets 19%
- Shower/Bath 20%
- Lawn Garden 36%

6.8 Septic Systems

Hopewell Township residents and businesses outside of the sewered areas which include the Route 49 corridor, north to the Hopewell Crest School, and south along Route 613 to Route 699, rely upon private septic systems for effluent disposal and filtration. As noted above the soils in Hopewell are particularly well-suited for septic disposal fields. Depth to seasonal high water table is generally not limiting because many of the soil types have water tables below six feet. Only the areas associated with stream corridors or the tidal wetland associated with the Cohansey River are limiting.

[25] Carol Olynyk, NJDEP Water Allocation Office, Telephone Conversation, June 2006.
[26] Sustainable Builders Sourcebook Web Version©Sustainable Sources, 1994-2006.



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

Parcel Source: Hopewell Township

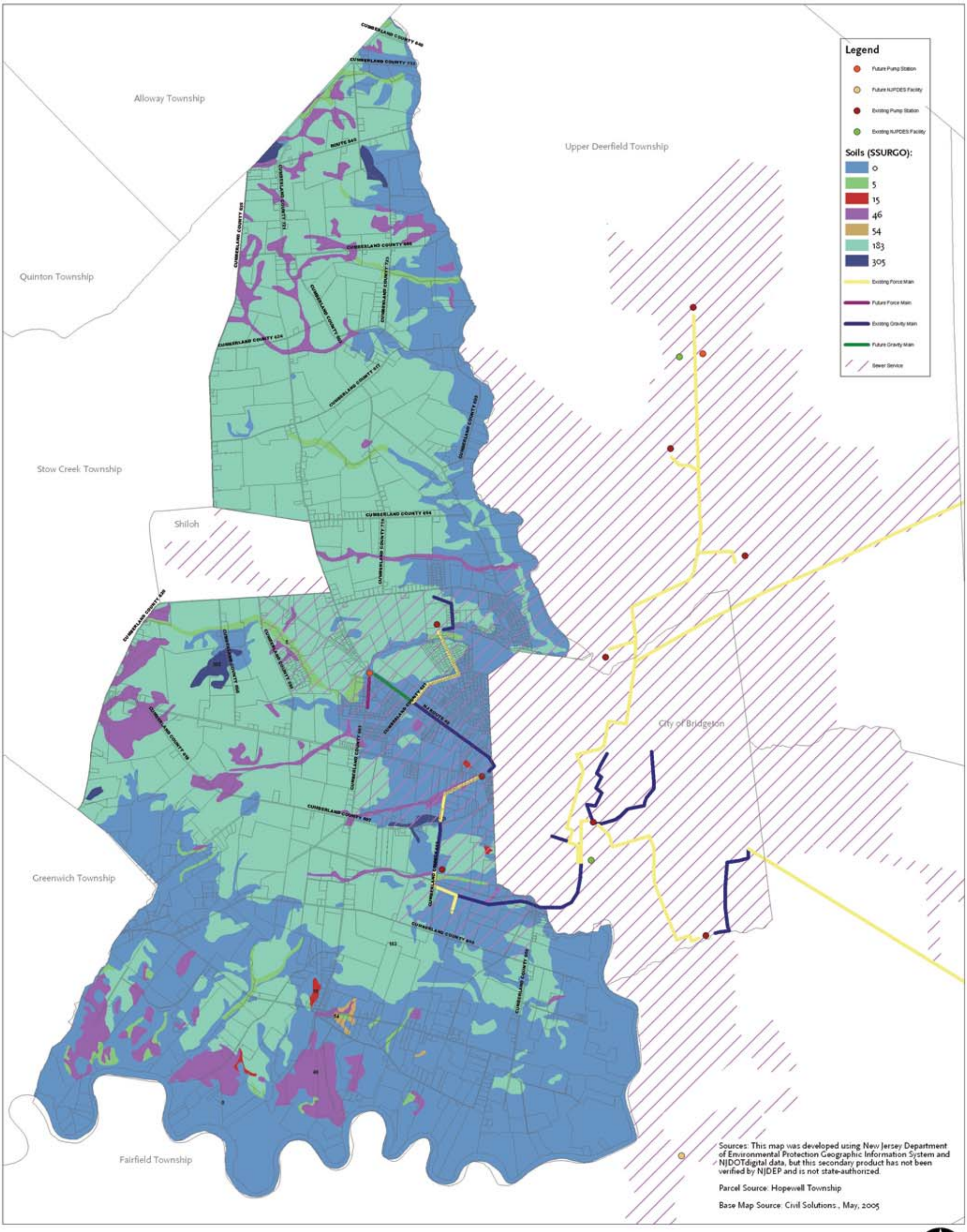
Base Map Source: Civil Solutions., May, 2005

Environmental Resource Inventory

Septic Suitability

Hopewell Township, Cumberland County, NJ February 2007

Clarke Caton Hintz
Architecture
Planning
Landscape Architecture



ENVIRONMENTAL RESOURCE INVENTORY

Depth to Seasonal High Water & Sewer Service

Hopewell Township, Cumberland County, NJ February 2007

Clarke Caton Hintz

Architecture

Planning

Landscape Architecture

The DEP has published a useful introduction to conventional septic systems describing their construction, operation and maintenance. Due to the fact that most residents utilizing a septic system are unaware of the operation and maintenance of their system, this document is hereby incorporated in its entirety

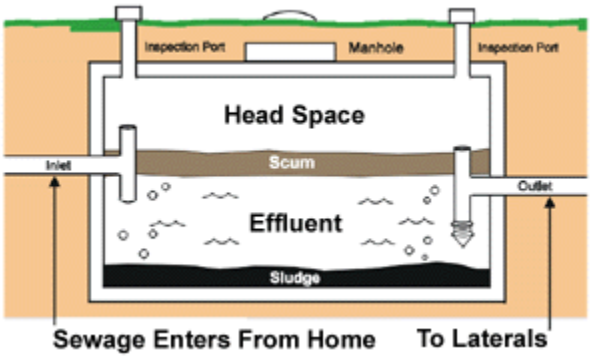
6.9 How a Septic System Works

A typical septic system contains three major components:

A septic tank
An effluent distribution system
An absorption field

When a person flushes the toilet or empties a bathtub or washing machine, the wastewater follows the plumbing, usually by gravity, to the septic tank. At the tank, the solids settle out and the liquid stays long enough to become fermented and to become enriched with beneficial bacteria.

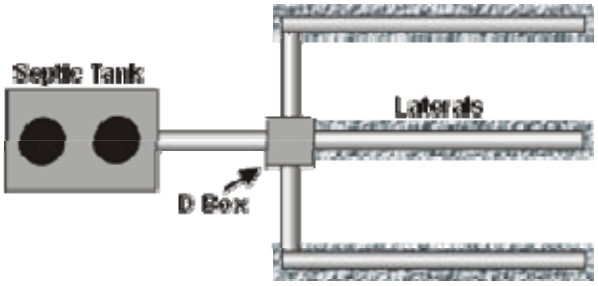
The figure below is a simple drawing of a septic tank.



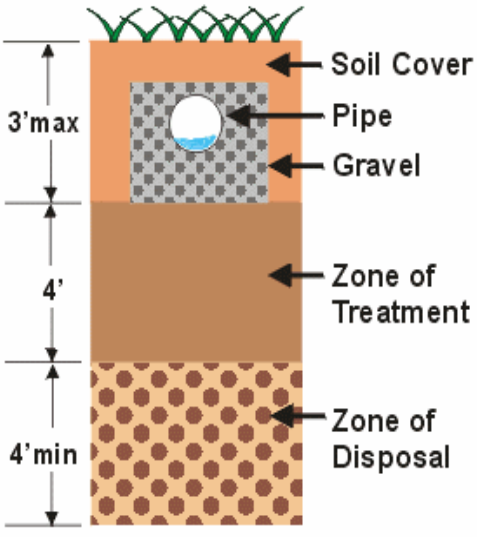
The septic tank is usually made of concrete, fiberglass, or plastic, is typically buried and should be watertight. All septic tanks have baffles (or tees) at the inlet and outlet to insure proper flow patterns. Most septic tanks are single compartment; however, some people install two-compartment tanks or two single compartment tanks in series. While typically designed to hold a minimum of 1000 or more gallons of sewage, the size of the tank may vary depending upon the number of bedrooms in the home and state and local regulatory requirements. The primary purpose of the septic tank is to separate the solids from the liquids and to promote partial break-down of contaminants by microorganisms naturally present in the wastewater. The solids, known as sludge, collect on the bottom of the tank, while the scum floats on the top of the liquid. The sludge and scum remain in the tank and must be pumped out periodically. Solids that are allowed to pass from the septic tank may clog the absorption field. Keeping solids out of the absorption field not only prevents clogging, but also reduces potentially expensive repair or replacement costs and helps ensure the ability of the soil to effectively treat the septic tank effluent. Therefore, an additional safeguard in keeping solids out of the absorption field is the use of effluent filters on the outlet of the septic tank. The wastewater (effluent) coming out of the septic tank may contain many potentially disease-causing microorganisms and other pollutants such as nitrates, phosphates, and chlorides.

After the effluent leaves the septic tank, it is transported either by gravity or by pumps to the distribution box and laterals. The distribution box is included as part of the system to separate the septic tank effluent evenly into a network of distribution lines that make up the absorption field.

The figure below illustrates the distribution system as one would see it from above.



The main pipe from the septic tank leads to the distribution box or "D-Box" from which an equal amount of effluent is channeled to each of the laterals. The laterals are located underground and become part of the zone of treatment and zone of disposal. The zone of disposal is illustrated in the figure below and works as follows. The effluent is distributed through the perforated pipes, exits through the holes in the pipes, and trickles through the rock or gravel where it is stored until absorbed by the soil. The zone of treatment, which is located in the unsaturated zone of the soil, treats the wastewater through physical, chemical, and biological processes. The soil also acts as a natural buffer to filter out many of the harmful bacteria, viruses, and excessive nutrients, effectively treating the wastewater as it passes through the unsaturated zone before it reaches the groundwater. This treatment primarily occurs at the top of the zone of treatment, where a Biomat develops, consisting of living beneficial bacteria, organic matter, and mineral precipitates. The Biomat provides a substrate for decomposition of the "bad" bacteria. The "clean" wastewater enters the ground water again in the "Zone of Disposal", which is typically permeable soil or rock material that is above the water table. If the zone of treatment has adequate oxygen, which occurs when it is separated from the water table by at least 2 to 4 feet, it effectively converts ammonia nitrogen to nitrate nitrogen, and it reduces the number of harmful bacteria and viruses to levels that are safe for humans.

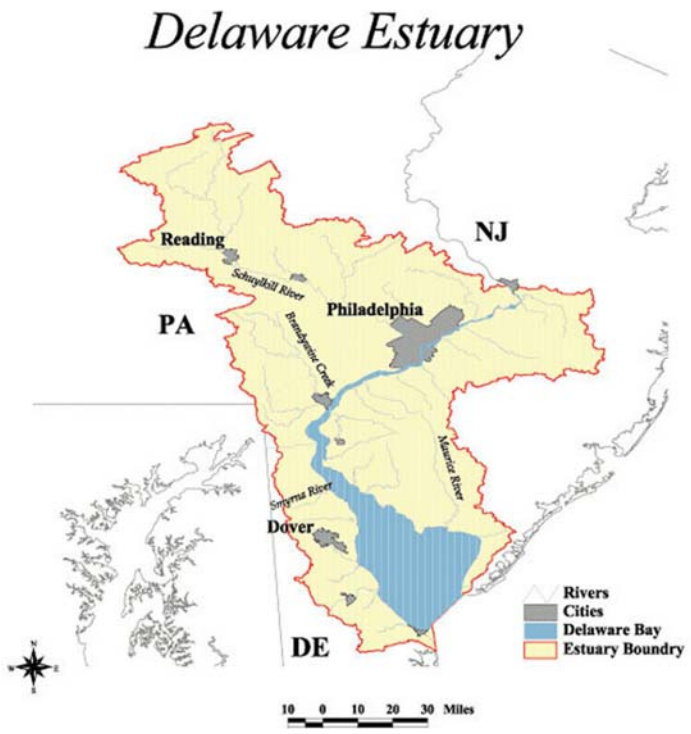


Even after treatment, wastewater still contains nutrients, such as nitrates and phosphates that in excessive amounts may pollute nearby waterways and groundwater supplies. Excessive nutrients in drinking water supplies can be harmful to human health and can degrade lakes and streams by enhancing weed growth and algal blooms. Some of the nutrients are retained or become assimilated by plants and microbes, but much of the nitrate nitrogen and some of the phosphates still discharge to the ground water, and may enter streams and can cause or contribute to the

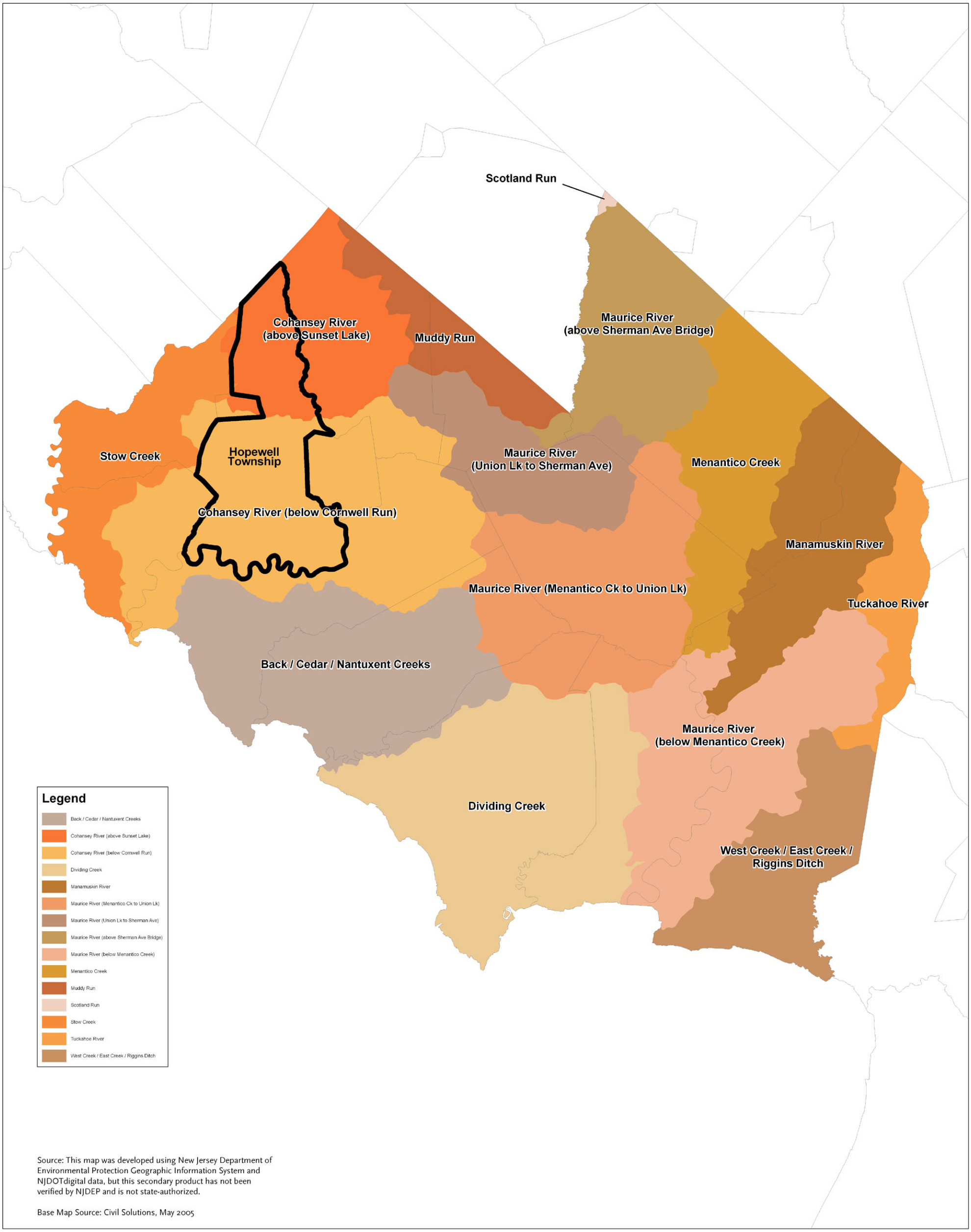
eutrophication. Therefore, though generally safe for humans, the conventional septic system is responsible for a certain amount of water pollution even when the system is working perfectly. Requiring distance setbacks from streams and potable wells provides the final level of protection. With the setbacks in place, and as long as the septic systems are not malfunctioning, homeowners can be assured that both drinking water and surface water are adequately protected.[27] A recommended operation and maintenance document developed by the DEP can be found in appendix 1.

6.10 Surface Water

A drainage basin is a region of land where water from rain or snow melt drains downhill into a body of water, such as a river, lake, dam, estuary, wetland, sea or ocean. The drainage basin includes both the streams and rivers that convey the water as well as the land surfaces from which water drains into those channels. The drainage basin acts like a funnel collecting all the water within the area covered by the basin and channeling it into a waterway. Each drainage basin is separated topographically from adjacent basins by a ridge, hill or mountain, which is known as a water divide or a watershed.[28] The surface water in New Jersey is divided for regulatory and management purposes into watershed management areas. Hopewell Township lies entirely within watershed management area 17, WMA 17, which encompasses almost 561,000 acres across southern New Jersey. WMA 17 includes a number of the state's most valued waterways including the Cohansey River. Historically, this basin has supported communities with a large shellfish and fishing industry. All waterways in this area drain to the Delaware River or Delaware Bay. A total of approximately 2,871 miles of streams have been identified throughout the watershed.[29]



[27] http://www.state.nj.us/dep/dwg/guidelines/septicmn.pdf. Viewed June 2006.
[28] http://en.wikipedia.org/wiki/Drainage_basin
[29] Rutgers Cooperative Research and Extension, Water Resources Program, Characterization and Assessment of WMA #17,watershed management area 17.



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

Base Map Source: Civil Solutions, May 2005

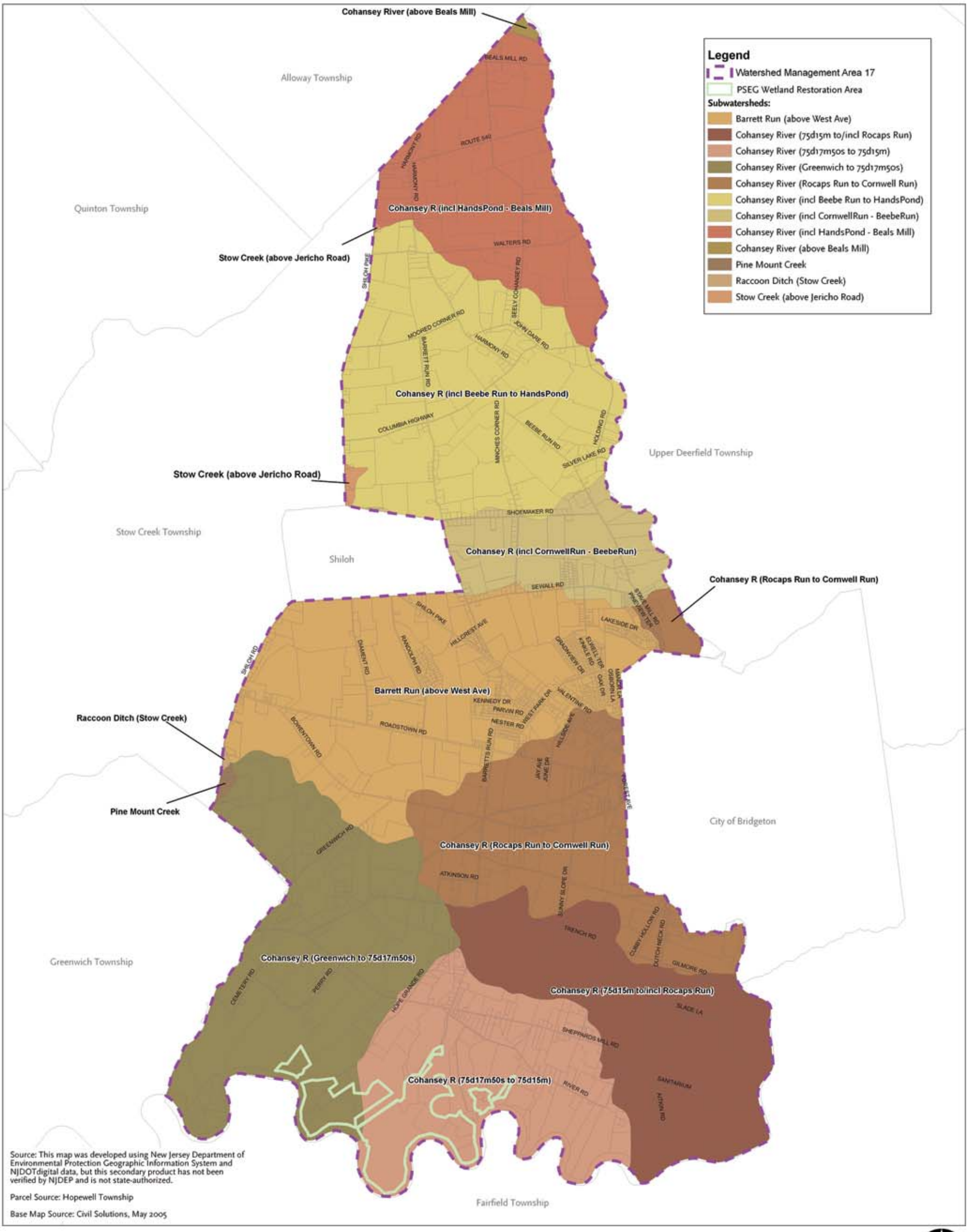
6,0003,000 0 6,000 12,000 18,000
Feet

ENVIRONMENTAL RESOURCE INVENTORY

Watersheds

Hopewell Township, Cumberland County, NJ February 2007

Clarke Caton Hintz
Architecture
Planning
Landscape Architecture



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

Parcel Source: Hopewell Township

Base Map Source: Civil Solutions, May 2005

ENVIRONMENTAL RESOURCE INVENTORY

Subwatersheds & PSEG Wetland Restoration

Hopewell Township, Cumberland County, NJ February 2007

Clarke Caton Hintz
Architecture
Planning
Landscape Architecture

6.11 Surface Water Quality

Water quality standards are set, monitored, and assessed at the watershed level for all surface waterways. Impaired waterways, or those which do not meet or are not expected to meet the surface water quality standards of section 303(d) of the Federal Clean Water Act, must be listed and a total maximum daily load, TMDL, must be established for each pollutant in the waterway. A TMDL allocates the carrying capacity of a water body and assigns the maximum pollutant loading a waterway can assimilate from both point and non-point sources. TMDL's are used to establish effluent limits from water treatment plants and regulated stormwater point sources. In WMA 17, NJDEP has taken action to establish TMDL's for Fecal Coliform at 8 locations including the Cohansey River at Seeley and Phosphorous at five eutrophic lakes including both Sunset and Mary Elmer Lakes in Bridgeton.

Water quality data analysis for the Cohansey River was complied for the following indicators between 1980-2000:

- Nitrate (NO_3). Nitrate levels in the Cohansey River over the sample period from 1980-1997 were variable ranging from 0mg/L in January of 1993 to 3.75mg/L in January of 1980. State criterion limits Nitrate at 10mg/L in drinking water.

- pH. Over the study period, reported by Rutgers University, 1980-1992, pH remained steady at acceptable levels in the Cohansey River samples between 6-8 with no reading exceeding allowable limits of acidity or alkalinity. There were approximately 25 incidents where pH fell below 7 over the time period.

- Fecal Coliform Bacteria. Over the study period, 1980-2000, there were approximately 50 incidents of fecal coliform bacteria colonies exceeding state criterion of 250/100ml sample.

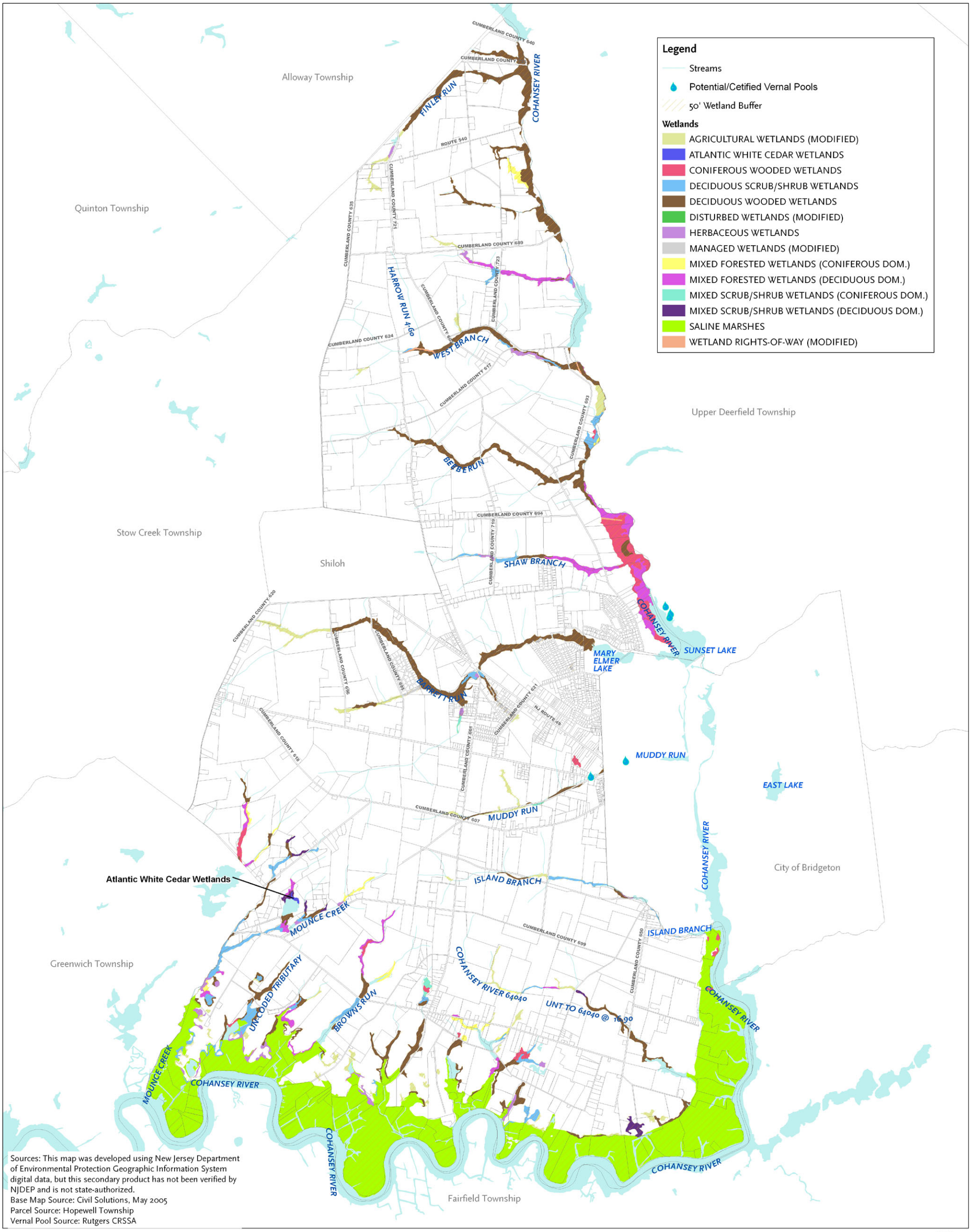
- Temperature. Temperatures in the Cohansey River, over the study period, 1980-1992, remained below 30 C with one exception slightly over 30 C in July 1995.

- Dissolved Oxygen. Dissolved oxygen levels remained above minimum levels of 4mg/L over the entire period 1980-1997.

- Total Phosphorous (PO_4). There were 17 incidents of elevated Phosphorous (PO_4) levels above the limit of 0.1mg/L in the Cohansey River samples over the study period 1980-2000.

- Mercury Hg. Over the study period, there were two incidences of elevated Mercury levels which exceeded the standard for human health, and 17 incidences of Mercury levels which exceeded the level of chronic damage to aquatic organisms.[30]

[30] Rutgers, The State University of New Jersey, Cooperative Research and Extension, WMA 17, Characterization and Assessment, PowerPoint Presentation 2004.



Sources: 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.
Base Map Source: Civil Solutions, May 2005
Parcel Source: Hopewell Township
Vernal Pool Source: Rutgers CRSSA

ENVIRONMENTAL RESOURCE INVENTORY

Wetlands, Streams & Vernal Pools

Hopewell Township, Cumberland County, NJ January 2007

Clarke Caton Hintz
Architecture
Planning
Landscape Architecture

6.12 The Cohansey River

Hopewell Township lies completely within the watershed of the Cohansey River. The scale and connection to the river largely define the environment of township. The Cohansey is nearly 30 miles long, draining 105 square miles of land to the Delaware Bay. The area is relatively flat which results in a number of small tributaries. Sunset Lake in Bridgeton and Mary Elmer Lake are among 20 lakes and ponds in the drainage basin, refer to the streams map.

6.13 Stream Classification

The Cohansey River is classified as a FW2 NT, fresh water 2, non trout producing stream in the upper, freshwater portion and as SE, saline estuarine stream in the lower tidal portion. The Freshwater Wetlands Act *NJSA 13:9B* describes streams as either FW1 or FW2 and further classifies based upon trout production and presence of Threatened and Endangered, T&E, species or habitat. Wetlands associated with streams which have documented or potential habitat for T&E species must be protected by a 150 foot no disturbance buffer on each side of the stream to protect the exceptional water quality resource. A further breakdown of stream classification follows.

- FW1 includes state or federally controlled lands or special holdings. The wetlands which drain into these streams are considered exceptional quality and must include a 150 foot no disturbance buffer on each side of the stream to protect the exceptional water quality resource.

- FW2 includes all other waters, except Delaware River and Pinelands, further classified by trout production capability.

- FW2- TP, trout production stream. The wetlands which drain into these streams are considered exceptional quality and must include a 150 foot no disturbance buffer on each side of the stream to protect the exceptional water quality resource.

- FW2-TM- trout maintenance stream. The wetlands which drain into these streams are considered resources of intermediate value and must be protected by a 50 foot transition buffer on both sides of the stream.

- FW2 NT- non trout stream. The wetlands which drain into these streams are considered resources of intermediate value and must be protected by a 50 foot transition buffer on both sides of the stream.

- FW2 Ordinary water resource. No buffer required. These waterways are generally ditches, swales etc.

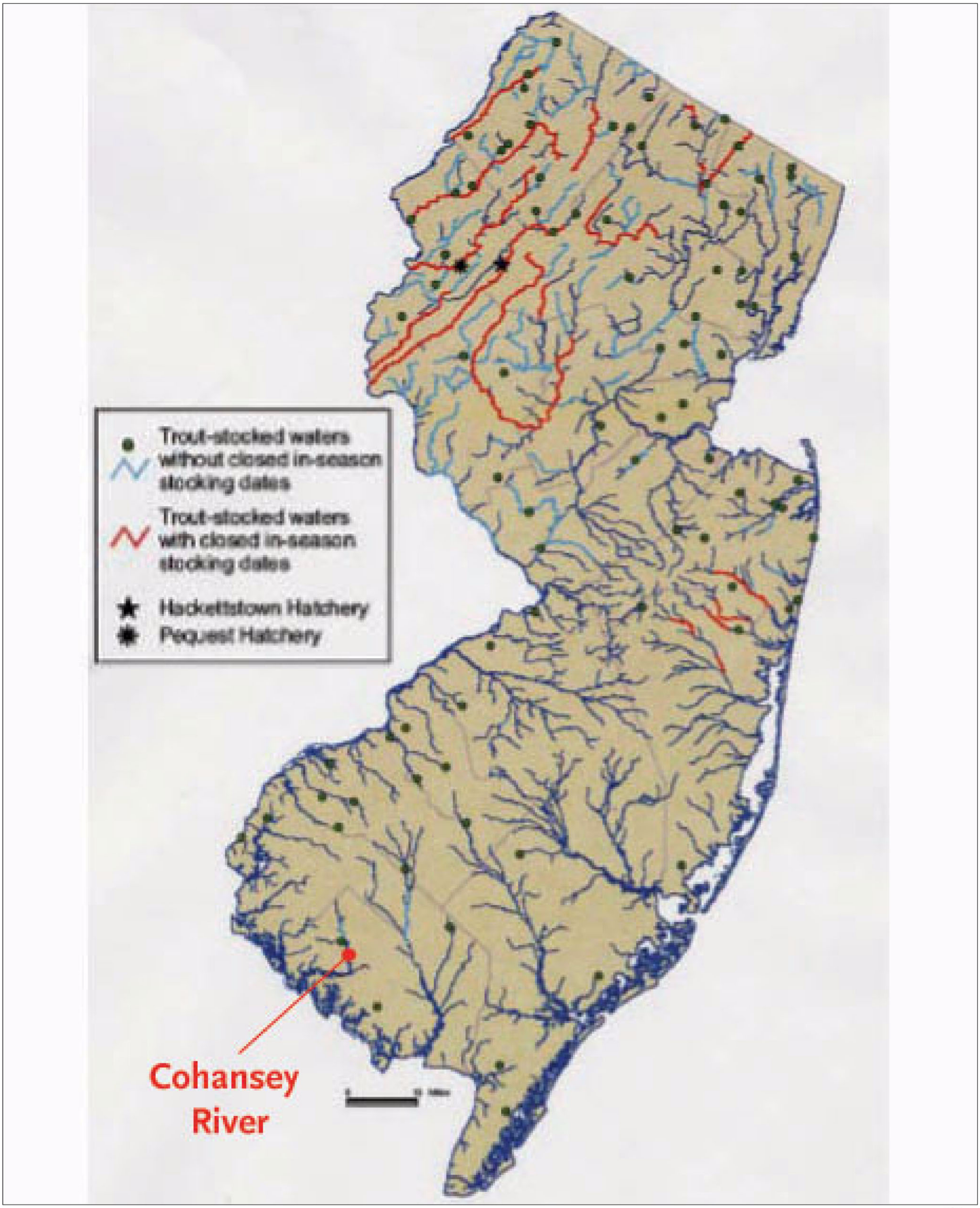
6.14 Category One Streams

New Jersey's Streams may be further classified as Category One, C-1 waters. C-1 waters are those special waters identified for protection from measurable changes in water quality characteristics because of their clarity, color, scenic setting, and other characteristics of aesthetic value, exceptional ecological significance, exceptional recreational significance, exceptional water supply significance, or exceptional fisheries resources. These waters are protected by several regulatory divisions of the New Department of Environmental Protection, NJDEP. The Division of Land Use Regulation has jurisdiction over stream encroachment based upon NJAC 7:13, and wetlands buffer encroachment based upon NJAC 7:7. The Division of Watershed management through the New Jersey Stormwater Management Rules NJAC 7:8, requires C-1 category streams must be protected with a 300 foot special water resource protection zone, SWRP, on both sides of the stream. The inner 150 feet of the SWRP may not be disturbed and disturbance in the outer 150 feet must be reviewed by the Division of Watershed Management. Some limited development may be allowed in the outer 150 feet if the area was previously disturbed, (not wooded). It should be noted that the municipality through its storm water management ordinances is responsible for requiring a review from Division of Watershed Management on any development within the 300 foot SWRP zone around any C-1 stream.

6.15 Future C-1 Designation for the Cohansey

The Cohansey River, a very healthy stream, is exceptionally important for fish and other aquatic organisms, birds including bald eagles, wildlife, water supply and human recreation. Even though the river is defined as a "non trout" stream, the New Jersey Division of Fish and Wildlife cold water fisheries management plan, dated February 2004, indicates a portion of the upper Cohansey River from the Dam at Seeleys Pond to the power line above Sunset Lake, Bridgeton as a trout stocked water without closed in-season stocking dates, refer to map below. [31] Two stocking locations along the upper Cohansey one at Seeley Road and one at Silver Lake Road were stocked with a total of 980 trout during two stocking dates in 2006. The non-trout, NT, designation of the river is largely due to temperatures too warm for trout production in the Cohansey, not poor water quality.[32] The Maurice River which is also located in WMA 17 to the east is defined as a C-1 stream even though it has more TMDL assignments for Fecal Coliform than the Cohansey. The overall water quality of the Cohansey River has been historically quite good. Surface water quality measured between 1980 and 2000 has indicated very few significant water quality impairments. Hopewell Township may continue to research and document the specific attributes of the Cohansey River in order to explore a request to have the designation of the river changed to C-1 or alternately enact a stream corridor protection ordinance.

[31] http://www.state.nj.us/dep/fgw/cwfmp.htm
[32] Lisa Barno, Chief of Fresh Water Fisheries, Division of Fish and Wildlife, New Jersey DEP, telephone interview, November 2006.



Environmental Resource Inventory

Trout Waters & Hatcheries

Hopewell Township, Cumberland County, NJ February 2007

Clarke Caton Hintz
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6.16 Suburbanization and Water Quality Protection

Richard G. Lathrop and Tenley M. Conway of the Grant F. Walton Center for Remote Sensing & Spatial Analysis, Rutgers University,[33] examined the potential build out of the Cohansey River Watershed in an effort to determine the possible water quality impacts which would arise out of sprawling suburban development from the Philadelphia area. The study focused on three build out scenarios permitted by, 1) current zoning, 2) Water Quality Management recommendations, and 3) Coastal Area Facilities Review Act (CAFRA) rules.

The study made projections of increased impervious cover in the watershed based upon the above zoning scenarios. The Natural Resources Conservation Service (NRCS) recognizes percent of impervious coverage as an important environmental indicator of the intensity of human land use and closely correlates with water quality degradation. 10% impervious coverage has been documented as the threshold level at which stream quality impairment begins to be measurable. Arnold and Gibbons (1996) developed a set of impact thresholds: 1) < 10% impervious surface cover can be considered non impacted; 2) between 10-30% cover can be considered impacted; and 3) > 30% cover is generally considered degraded. While these thresholds should not be considered 'hard and fast' breakpoints, they do provide a useful guide in evaluating the comparative risk of water degradation on a watershed scale.[34]

Hopewell Township was identified as the area in the watershed which could have a significant increase in impervious cover at build out. The catchment in southern Hopewell Township is estimated to increase from 4 percent impervious surface cover to 14 percent impervious surface cover at build-out. The catchment in northern Hopewell Township was 1 percent impervious surface in 1995 and could potentially increase to 13 percent by build-out. Recommendations for mitigating the negative effects of increased impervious cover included: Riparian zone protection, land preservation, education and "centers based" development. Hopewell Township is currently re-examining the master plan objectives and revising the zone plan to include a "centers based" approach to land development through a Transfer of Development Rights (TDR) program. In addition, the Township is actively seeking preservation options through the Farmland Preservation and Green Acres programs. The State and Federal Government have funded several projects to improve water quality in the Cohansey watershed. The Watershed Ambassadors Program, an educational program focusing on schools, local events, municipal government, and organizations, is also active in the watershed.

6.17 Funded Projects for Water Quality Protection

Water quality protection projects have a broad funding base in the Cohansey Watershed. Federal grant money through section 319(h) of the Clean Water Act provides remediation funds for non point source and stormwater runoff mitigation projects. The United States Department of Fish and Wildlife (USFW), New Jersey Department of Environmental Protection (NJDEP), Cumberland Soil Conservation District and Private Industry are also contributors. The following

[33] Lathrop, Richard G. and Tenley M. Conway, Grant F. Walton Center for Remote Sensing & Spatial AnalysisCook College - Rutgers UniversityNew Brunswick, NJ 08901, CRSSA Technical Report 2001-03, November 2001.

[34] Arnold, C.L., Jr. and C.J. Gibbons. 1996. Impervious surface coverage: The emergence of a key environmental indicator. *Journal of the American Planning Association* 62(2): 243-258.

list of ongoing and completed projects is not exhaustive but illustrates the extent of environmental attention to the watershed.

- **Section 319(h) NPS Grant: Watershed Restoration Plan for the Upper Cohansey River** Cumberland/Salem Soil Conservation District and Rutgers Cooperative Extension Map land use and impairments, recommend restoration plans.

- **Stormwater Management and Combined Sewer Overflow Abatement Bond - Upper Cohansey River Watershed Management Project (nonpoint source pollution)** Cumberland/Salem Soil Conservation District and Rutgers Cooperative Extension Water quality characterization of upper Cohansey and Harrow Run; agriculture filter strip installation, relocate cattle from wetlands.

- **WMA #17 Characterization and Assessment** Omni Engineering, Fralinger Engineering, and Rutger Cooperative Extension.

- **PSEG Estuary Enhancement Program-** Instituted in 1994 as a requirement of the NJDEPES Permit for the Salem Generating Station in nearby Alloways Creek Township. Restoration of over 20,000 acres of tidal wetlands, installation of 13 fish ladders, land preservation, see sub watersheds map, and enhanced wildlife habitat. Cohansey River Watershed Wetland Restoration Site along southern border of Hopewell Township and installation of fish ladder at Sunset Lake, Bridgeton.

Fish Ladder at Sunset Lake Courtesy of Kenneth A. Strait

6.18 Tidal and Freshwater Wetlands, Vernal Pools

Wetlands are commonly referred to as swamps, marshes, or bogs. However, many wetlands in New Jersey are forested and do not fit the classic picture of a swamp or marsh. Previously misunderstood as wastelands, wetlands are now being recognized for their vital ecological and socioeconomic contributions. Wetlands protect drinking water by filtering out chemicals, pollutants, and sediments that would otherwise clog and contaminate our waters. Wetlands soak up runoff from heavy rains and snow melts, providing natural flood control. Wetlands release stored flood waters during droughts. Wetlands provide critical habitats for a major portion of the State's fish and wildlife, including endangered, commercial and recreational species. Wetlands provide high quality open space for recreation and tourism.[35]

Fresh water wetlands differ from tidal wetland by virtue of tidal wetlands location and association with seawater. Tidal wetlands provide a transition and interface between the sea and the land protecting the land from the ravages the storms and providing a hatchery for most marine species.

Another type of "temporary wetland" is called a vernal pool. A vernal pool is usually a shallow, natural depression in level ground, with no permanent above-ground outlet, that holds water seasonally. They are dry most of the year and fill up in the spring from rains, snow melt and rising ground water. [36] Possibly the largest, most pristine vernal pool in the area exists abutting Elk Lake on Block 76 Lots 32 & 33. This pool is located near the Atlantic White Cedar Wetlands on the Wetlands map, page 49.

[35] ttp://www.state.nj.us/dep/landuse/fww.html#wetlands
[36] http://en.wikipedia.org/wiki/Vernal_pool, April 30, 2007.

6.19 Classification of Wetlands

Section 13:9B-7 of the Freshwater Wetlands Protection Act requires the NJDEP to develop a classification system for freshwater wetlands; criteria include wetlands of exceptional, ordinary and intermediate resource value.[37]

- Exceptional Resource Value
  Freshwater wetlands of exceptional resource value shall be freshwater wetlands which exhibit any of the following characteristics:

  (1)Those which discharge into FW-1 water and FW-2 trout production (TP) waters and their tributaries; or

  (2) Those which are present habitats for threatened or endangered species, or those which are documented habitats for threatened or endangered species which remain suitable for breeding, resting, or feeding by these species during the normal period these species would use the habitat.

- Ordinary Value
  Freshwater wetlands of ordinary value shall be freshwater wetlands which do not exhibit the characteristics enumerated as exceptional resource value and which are certain isolated wetlands, man-made drainage ditches, swales, or detention facilities.

- Intermediate Resource Value
  Freshwater wetlands of intermediate resource value shall be all freshwater wetlands not included as exceptional or ordinary.

6.20 Transition Areas

Freshwater Wetlands protection Act, 13:9B-16. identifies transition areas associated with wetlands as follows:

> (a) There shall be transition areas adjacent only to freshwater wetlands of exceptional resource value and of intermediate resource value. A transition area shall serve as:
>
> > (1) An ecological transition zone from uplands to freshwater wetlands which is an integral portion of the freshwater wetlands ecosystem, providing temporary refuge for freshwater wetlands fauna during high water episodes, critical habitat for animals dependent upon but not

[37] tp://www.state.nj.us/dep/landuse/13_9b.pdf

resident in freshwater wetlands, and slight variations of freshwater wetland boundaries over time due to hydrologic or climatologic effects.

(2) A sediment and storm water control zone to reduce the impacts of development upon freshwater wetlands and freshwater wetlands species.

(b) The width of the transition area shall be determined by the department as follows:

No greater than 150 feet nor less than 75 feet for a freshwater wetland of exceptional resource value;

No greater than 50 feet nor less than 25 feet for a freshwater wetland of intermediate resource value.

Approximately 12% of Hopewell Township is classified as wetlands most of which are associated with the Cohansey River, its tributaries, and the tidal estuary of the Delaware River. These wetlands create important habitat for birds, fish and wildlife. In addition, there is high recreational value to the community and the region through fishing, crabbing, boating and bird watching. The freshwater wetlands and tidal wetlands are protected through the following legislation:

6.21 Freshwater Wetlands protection Act

Freshwater wetlands are defined and protected by the Freshwater Wetlands Protection Act N.J.S.A. 13:9B-1 et seq. as follows:

"Freshwater wetland" means an area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation; provided, however, that the department, in designating a wetland, shall use the 3-parameter approach (i.e. hydrology, soils and vegetation) enumerated in the April 1, 1987 interim-final draft "Wetland Identification And Delineation Manual" developed by the United States Environmental Protection Agency, and any subsequent amendments thereto;

6.22 Wetlands Act of 1970

Tidal wetlands are described and protected by the Wetlands Act of 1970, N.J.S.A. 13-9A-1a et seq. as follows:

The Legislature hereby finds and declares that one of the most vital and productive areas of our natural world is the so-called "estuarine zone," that area between the sea and the land; that this area protects the land from the force of the sea, moderates our weather, provides a home for water fowl and all our fish and shellfish, and assists in absorbing sewage discharge by the rivers of the land; and that in order to promote the public safety, health and welfare, and to

protect public and private property, wildlife, marine fisheries and the natural environment, it is necessary to preserve the ecological balance of this area and prevent its further deterioration and destruction by regulating the dredging, filling, removing or otherwise altering or polluting thereof.

6.23 Regulated Wetlands Activities

All wetlands are protected from detrimental activities through the abovementioned legislation. The New Jersey Department of Environmental Protection, Division of Land Use Regulation issues permits for identification and disturbance in wetlands. A Letter of Interpretation, LOI, is issued only to regulated wetlands to determine presence or absence of wetlands on a specific parcel, and general or site specific permits are issued for encroachment upon or disturbance within a wetland or associated buffer area. Landowners are responsible for obtaining permits and letters of interpretation from the NJDEP. Guidance is given at the NJDEP website under the Water link/ Freshwater Wetlands Program link.

Activities which may not be conducted without a permit include:

- Removal, excavation, disturbance or dredging of soil, sand, gravel, or aggregate material of any kind
- Drainage or disturbance of the water level or water table
- Dumping, discharging or filling with any materials
- Driving of pilings
- Placing of obstructions
- Destruction of plant life which would alter the character of a freshwater wetland, including the cutting of trees

Activities which are prohibited in wetlands include:

- Solid waste disposal
- Sewerage or industrial waste disposal
- Pesticide application
- Storage or disposal of pesticides

6.24 Floodplains:

The Flood Hazard Area Control Act NJSA 58:16A-50, states that it is in the interest of the safety, health, and general welfare of the people of the State that legislative action be taken to empower the Department of Environmental Protection to delineate and mark flood hazard areas, to authorize the Department of Environmental Protection to adopt land use regulations for the flood hazard area, to control stream encroachments, to coordinate effectively the development, dissemination, and use of information on floods and flood damages that may be available, to authorize the delegation of certain administrative and enforcement functions to county governing

bodies and to integrate the flood control activities of the municipal, county, State and Federal Governments.[38]

All water courses have a floodplain. Floodplains are delineated for most of the larger waterways by the State of New Jersey and the Federal Emergency Management Agency (FEMA). Even though the Act requires substantial coordination between the DEP and FEMA, FEMA maps are not used. The floodplain of a stream is divided into the floodway, that portion of the stream channel and floodplain which can reasonably carry a 100 year regulatory flood, and the flood fringe, that portion of the stream plain outside of the floodway. Floodplains are described in terms of how frequently they are subject to flooding. For example, a 25 year floodplain is an area which is inundated by a 25 year storm, a storm of such intensity or duration that it can be expected to occur once in 25 years on average. A regulatory flood area is an area inundated by a 100 year storm. The flood hazard area which is regulated by the Act means the floodway and the flood fringe area. Development is regulated in the flood fringe and generally prohibited in the floodway. The New Jersey Department of Environmental Protection issues stream encroachment permits for all regulated activities within the flood plain. Major permits must submit detailed project specifications and drainage calculations for approval before a stream encroachment permit may be issued.

The Flood Hazard Control Act of 1995, N.J.S.A 58: 16A-50 et seq., sets forth the permitted and prohibited activities in a flood hazard area. Prohibited activities include:

- Dumping of solid or hazardous waste,
- Erection of structures for human or livestock occupancy, including kennels
- Discharge of pesticides,
- Storage of materials or equipment, septic systems,
- Addition of net fill.

The flood prone areas of Hopewell Township are generally associated with the Cohansey River and its associated tributaries.

[38] ://www.state.nj.us/dep/landuse/58_16a.pdf

Environmental Resource Inventory

Floodplains

Hopewell Township, Cumberland County, NJ January 2007

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6.25 Stormwater Management

Since the passage of the Clean Water Act in 1972, the focus of New Jersey's environmental regulation has been on point sources of pollution especially wastewater treatment plants. Great effort has gone into upgrading the sewage treatment plants and improving the cleanliness of effluent which is discharged into the state's waterways. Stormwater runoff, which is classified as non point source pollution, is the focus of new regulations aimed at further reducing the impairment of New Jersey streams.

New Jersey has two primary regulations that address pollution from stormwater runoff: N.J.A.C. 7:8 Stormwater Management Rules and N.J.A.C. 7:14A Stormwater Permitting Rules. The Stormwater Management Rules are directed toward new development and provide the foundation for developing municipal and regional stormwater management plans. For the purpose of these rules, new development is defined as any development that will ultimately result in the disturbance of one or more acres of land or increased impervious surface by one-quarter acre or more (i.e., "major development"). The Stormwater Permitting Rules require municipalities, to obtain New Jersey Pollution Discharge Elimination System (NJPDES) permits for their municipal separate storm sewer systems. These permits require the municipality to develop, implement, and enforce a stormwater management program that improves water quality from storm sewer discharges. Municipalities must prepare and implement a Stormwater Pollution Prevention Plan, (SPPP) which includes a municipal stormwater management plan, along with a stormwater control ordinance, and the incorporation of a local public education program.[39] The permitting process is divided into two tiers based upon population density. Hopewell Township is a Tier B municipality. Tier B municipalities must have stormwater plans and ordinances adopted by April 1, 2006. Hopewell has adopted the stormwater regulations and has implementing ordinances in place.

6.26 Coastal Areas:

Three laws supplement the Municipal Land Use Law to regulate coastal areas:

- Coastal Area Facilities Review Act, CAFRA, NJSA 13:19-1 et seq.
- Tidal Wetlands Act, NJAC 13:19-19 *discussed in wetlands section*
- Waterfront Development Act NJSA 12:5-3

NJSA 12:5-3 a, the Waterfront Development Act, states all plans for the development of any waterfront upon any navigable water or stream of this State or bounding thereon, which is contemplated by any person or municipality, in the nature of individual improvement or development or as a part of a general plan which involves the construction or alteration of a dock, wharf, pier, bulkhead, bridge, pipeline, cable, or any other similar or dissimilar waterfront development shall be first submitted to the Department of Environmental Protection. No such development or improvement shall be commenced or executed without the approval of the Department of Environmental Protection.

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[39] Christopher C. Obropta, Ph.D., & Sandra Goodrow, *New Jersey's Storm Water Regulations,* Rutgers Cooperative Research and Extension, (NJAES), Rutgers, The State University of New Jersey. Fact Sheet 556 , August 2005.

Coastal Area Facilities Review Act, CAFRA, was passed initially in 1973 to control adverse impacts from major industrial sites, public works, power plants, hazardous materials storage, and food processors on water quality and estuarine habitat. Amendments adopted in 1993 expanded CAFRA's jurisdiction to include all development within regulated coastal areas. The Department of Environmental Protection and the State Planning Commission worked together to develop consistent rules which based CAFRA regulations upon the State Development and Redevelopment Plan. Impervious coverage limits which vary by State Planning Area designations are the basis for the CAFRA regulations.

Generally CAFRA will require preparation of an environmental impact statement for activities which fall within the following categories:

- development is located upon the beach or dune
- development is within 150' of the mean high water line MHWL
- development outside of MHWL but is 25+ residential units or 50 parking spaces
- public or industrial uses
- development within 500' of MHWL which includes 75 units or 150 parking spaces

Generally, the closer you are to the water the more likely your property will be regulated. CAFRA contains exemptions for certain minor activities such as maintenance, plantings, decks or similar structures at a residence, rebuilding a damaged structure on the same building footprint (if it was damaged after 7/19/94), and enlarging a dwelling without increasing its footprint or number of units. Hopewell Township has a significant amount of land within the CAFRA regulated area, specifically those lands south of Roadstown Road. If after checking the CAFRA map you think a permit may be required for an activity, the NJDEP website provides guidance and a checklist for review. [40]

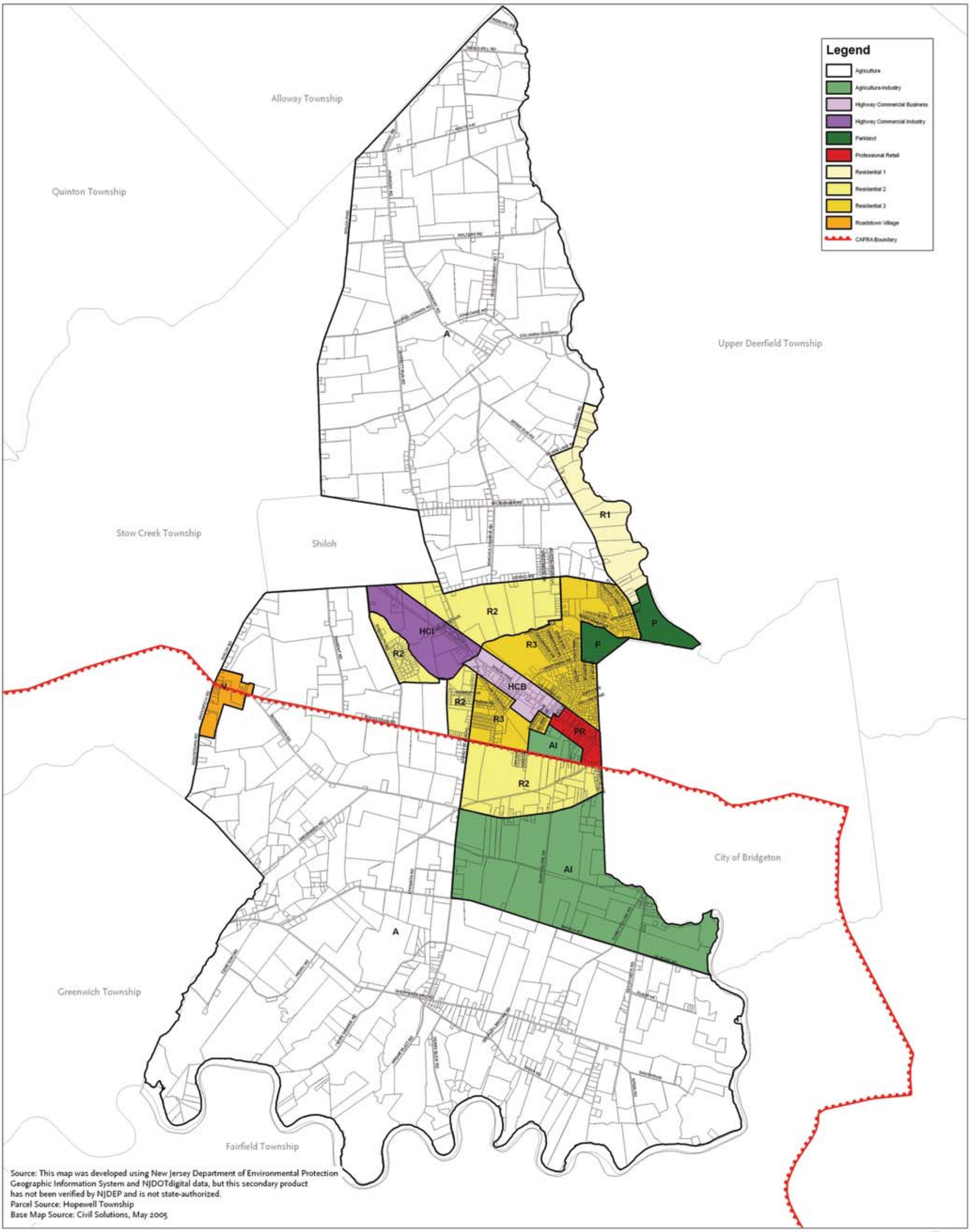
See the CAFRA map below.

7.0 AGRICULTURE, WOODLANDS AND NATIVE VEGETATION:

7.1 Agriculture and Woodland Management

Over 74% of the land area Hopewell Township is assessed for agricultural production. The main commodities produced are vegetables, field crops, fruit orchards and nursery crops. The southern regional office of the New Jersey Forest Service has woodland management plans on file for 9 farms, covering 173.79 acres in Hopewell Township. [41] The most commonly harvested species for saw timber are Oaks, Pines, Tulip Tree and Sweet Gum. Firewood species harvested are most often oak and cherry wood. Some farms replant after timber harvest and some manage timber production through natural regeneration.

[40] www.state.nj.us/dep/landuse/coast.html
[41] Dave Findley, NJ Forest Service Southern Regional Office, telephone interview, June 14, 2006.



Source: This map was developed using New Jersey Department of Environmental Protection Geographic Information System and NJDOTdigital data, but this secondary product has not been verified by NJDEP and is not state-authorized.
Parcel Source: Hopewell Township
Base Map Source: Civil Solutions, May 2005

Environmental Resource Inventory

Zoning & CAFRA Boundary

Hopewell Township, Cumberland County, NJ February 2007

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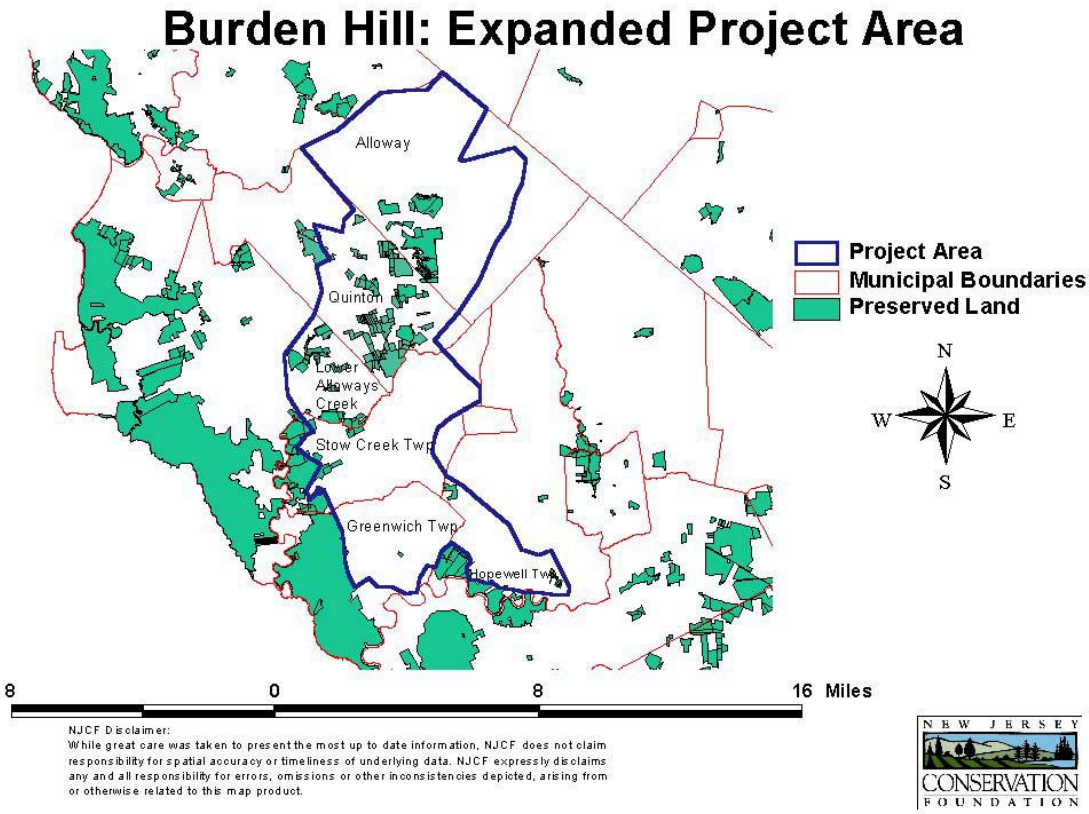
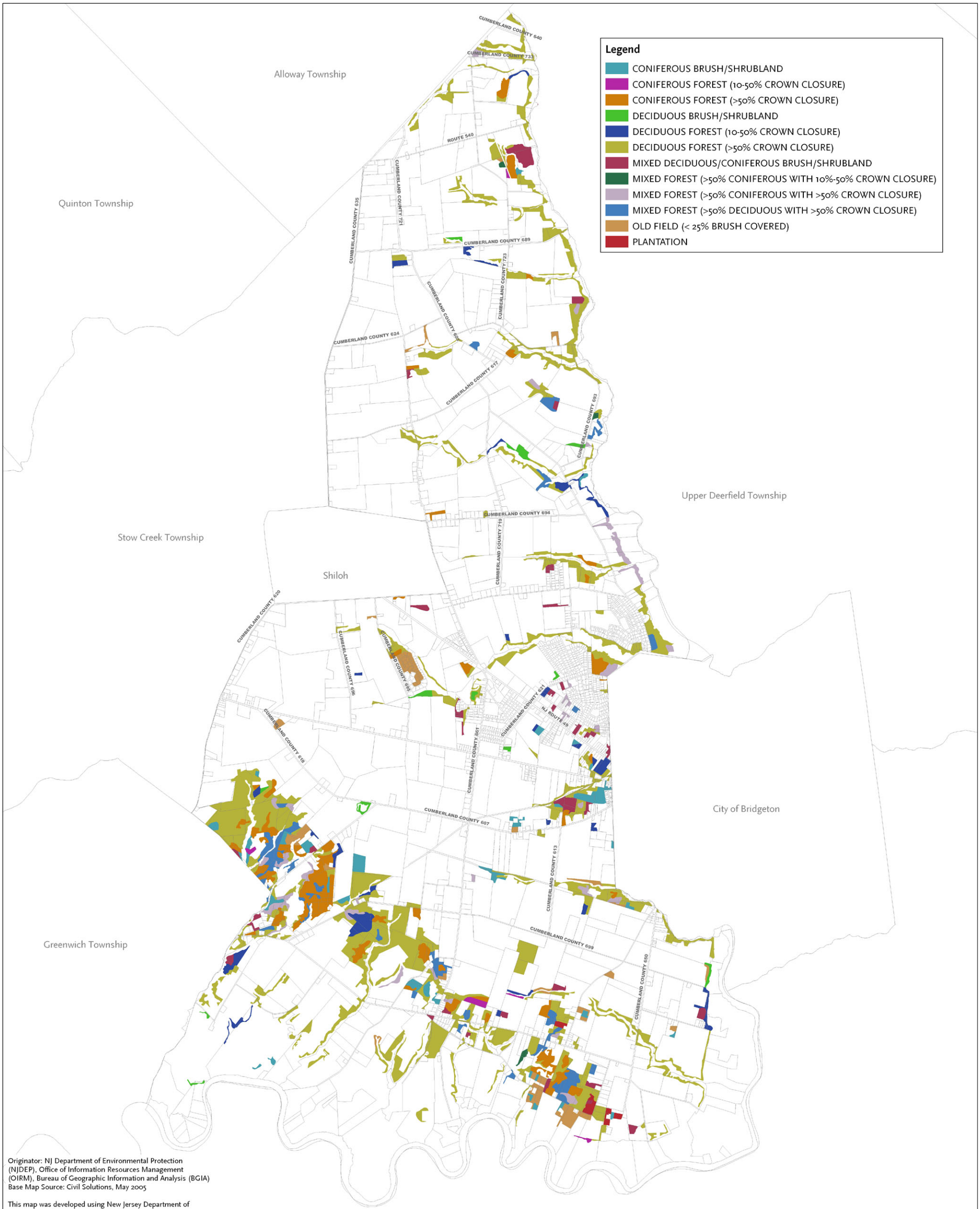
7.2 Mature Trees and Woodlands:

A small finger of the 15,000 acre Burden Hill Forest Complex extends into Hopewell Township. This important upland, highly un-fragmented forest has been added to the area targeted for preservation through the New Jersey Conservation Foundation. The forest provides excellent nesting habitat for migratory neo tropical songbirds. Burden Hill woods are a national stronghold for the federally endangered swamp pink as well as other rare plants. This area has outstanding watershed land with very high infiltration rates for ground water recharge, some as high as 10-15 inches per year. Numerous tributaries and headwaters of Stow and Alloways Creeks can be found in the area.[42] The ridge vegetation consists of pineland, forested headwaters and native vegetation of the coastal plain. In addition, a large stand of Atlantic White Cedar exists adjacent to Elk Lake. An inventory of significant trees in Hopewell Township can be found in appendix 4 of this document. The largest threat to mature woodlands and interconnected forest habitat such as Burden Hill is residential development. In response, a landowner outreach effort has been coordinated in partnership with NJ Green Acres, Natural Lands Trust, Littoral Society, and NJCF to obtain fee purchases and conservation easements on lands for trail and greenway connections through out the forest complex.[43]



[42] Matt Blake, American Littoral Society, electronic communication, April 19, 2007.
[43] Matt Blake, American Littoral Society, telephone interview, June 26, 2006.



Originator: NJ Department of Environmental Protection (NJDEP), Office of Information Resources Management (OIRM), Bureau of Geographic Information and Analysis (BGIA)
Base Map Source: Civil Solutions, May 2005

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.

0 1,200 2,400 4,800 Feet

ENVIRONMENTAL RESOURCE INVENTORY

NJDEP 1995/97 Forest Cover

Hopewell Township, Cumberland County, NJ February 2007

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7.3 Threatened and Endangered Plant Species.

The New Jersey Natural Heritage Database has identified 5 species of rare plants which may have occurrences in Hopewell Township:

▪ *Desmodium viridiflorum*	Velvety tick-treefoil	Imperiled
▪ *Helonias bullata*	Swamp-pink	Endangered
▪ *Nuphar microphyllum*	Sm. Yellow Pond-lily	Endangered
▪ *Rhododendron atlanticum*	Dwarf Azalea	Endangered
▪ *Stachys hyssopifolia*	Hyssop Hedge-nettle	Imperiled

7.4 Invasive species.

Nonindigenous plant species introduced for ornamental purposes can quickly displace native plant species and overtake natural environmental patterns. Eradication of these invasive species on farms and pasturelands is estimated to cost over $30 billion dollars annually in the United States.[44] Parks and recreational areas also require expensive eradication of invasive species. Not all non indigenous plants are invasive. Many species are used in agriculture, medicine or are ornamental and can not escape cultivation or can not reproduce without cultivation. In fact, the largest percentage of economically important crops grown in the United States is not native to North America.[45] However, when a non indigenous species does escape into the environment, natural systems can become severely threatened. Wetlands in New Jersey are especially vulnerable to invasion by purple loosestrife (*Lythrum salicaria).* Purple Loosestrife forms dense monocultures which choke out indigenous plants, reduce biodiversity and alter wildlife habitat. One hundred thousand dollars per year is spent on biological control of Purple Loosestrife in New Jersey funded largely by the state with assistance from the United States Department of Agriculture, and Natural Resources Conservation Service through the Wildlife Habitat Incentive Program, WHIP, for the protection of Bog Turtle habitat. .[46]

Purple Loosetrife[47]

Curly Leaf pondweed

Eurasian Water Milfoil

[44] www.njgov/dep/parksand forests/natural/heritage/Invasive Report.pdf, p. 8.
[45]www.njgov/dep/parksand forests/natural/heritage/Invasive Report.pdf,,p. 10.
[46] www.njgov/dep/parksand forests/natural/heritage/Invasive Report.pdf,,p. 12.
[47] Water milfoil photo courtesy of Virginia Tech Weed Guide, purple loose strife photo courtesy of allcreatures.org and Curly leaf pond weed courtesy of Michigan State University.

The three most invasive species in upland habitats in New Jersey are Multiflora Rose, (*Rosa multiflora),* Autumn Olive (*Eleagnus umbellate),* and Japanese Barberry,(*Berberis thunbergii*). Two of the most invasive aquatic plants in New Jersey are Eurasion water milfoil (*Myriophyllum spicatu*) and curly-leaf pondweed (*Potamogeton crispus*).Invasive aquatic plants are problematic because they reduce dissolved oxygen levels in the water as their thick vegetation decomposes, and are not a valuable food source for water fowl. Aquatic invasives are difficult to control. Herbicides are dangerous to non targeted plants and organisms and mechanical weed harvesters must be used repeatedly during the growing season. Locally, mile-a-minute (*Polygonim perfoliatum*.), Japanese Knotweed (*Polygonum cuspidatum*), and Japanese stiltgrass (*Microstegium vimineum*) are the most problematic invasives.[48]

Japanese Knotweed shoot by "Wildman"

Mile A Minute, by Jil M. Swearingen

[48] Bob Cortica, NJ Department of Environmental Protection, Office of Natural Lands Management, telephone interview, June 8, 2006.

Japanese Stiltgrass

Japanese Barberry

Multiflora rose, by USDA

 Photo by Jil M. Swearingen

The State of New Jersey does not have current legislation which mandates the creation of an official list of invasive species. By executive order #97, Governor McGreevey created the New Jersey Invasive Species Council co-chaired by the DEP and Department of Agriculture. The Council was charged with creating a management strategy for invasive species; however, the program has remained unfunded. *An Overview of Non indigenous Plant Species in New Jersey*, published by the DEP in February 2004 includes fact sheets for 29 non indigenous plant species which aggressively invade natural plant communities in New Jersey.[49]

The Delaware River Invasive Plant Partnership, a regional partnership organized by the Nature Conservancy, works with academic institutions, governments, non profits and volunteers to advance regional coordination and planning for management of invasive species in the Delaware River Watershed.[50]

[49] Snyder, David and Sylvan R. Kaufman. 2004. An Overview of Nonindigenous Plant Species in New Jersey. New Jersey Department of Environmental Protection, Division of Parks and Forestry, Office of Natural Lands Management, Natural Heritage Program, Trenton, NJ . 107 pages.
[50] www.paflora.org/DRIPP home page.htm