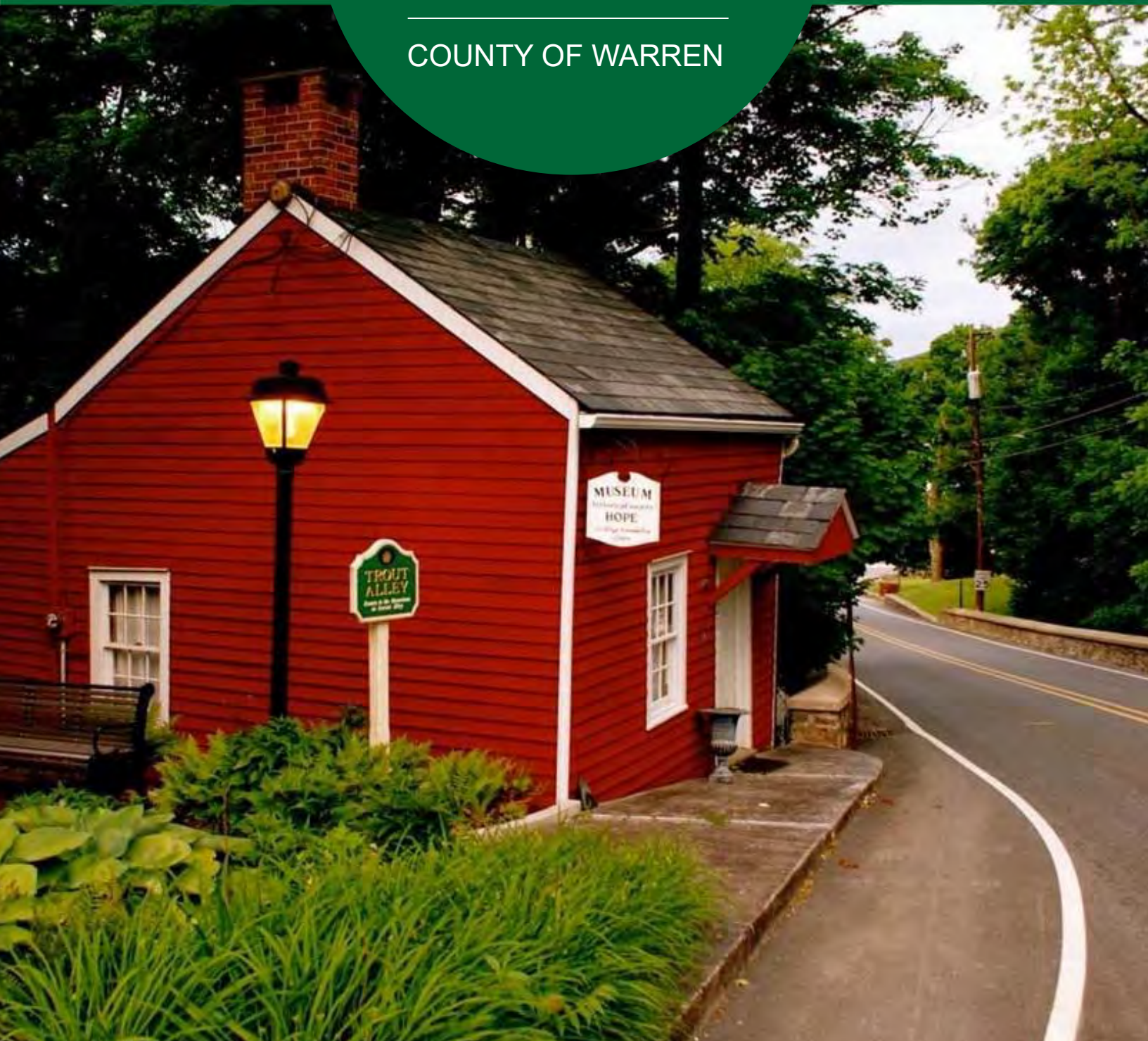


Township of Hope

ENVIRONMENTAL RESOURCE INVENTORY UPDATE

COUNTY OF WARREN



February 2018



ENVIRONMENTAL RESOURCE INVENTORY- 2018 UPDATE

for

Township of Hope County of Warren

Prepared February 8, 2018 by:

The Land Conservancy of New Jersey
an accredited land trust
19 Boonton Avenue
Boonton, NJ 07005



Barbara Heskins Davis

Barbara Heskins Davis, PP, AICP
NJ Professional Planner (License No.: 5926)

**The original document was appropriately signed and sealed
in accordance with Chapter 41, Title 13 of the State Board of Professional Planners.**

ENVIRONMENTAL RESOURCE INVENTORY - 2018 UPDATE

for

Township of Hope County of Warren

Produced by:

The Land Conservancy of New Jersey

David Epstein, President

Barbara Heskins Davis, PP, AICP, Vice President, Programs

Kenneth Fung, GIS Manager

Lisa Leone, Research and Planning Consultant

Thomas Chupela, Planning Intern

For further information please contact:



19 BOONTON AVENUE
BOONTON, NJ 07005
PH: (973)541-1010
FAX: (973)541-1131
TLC-NJ.ORG



Township of Hope
407 County Route 611, Hope, NJ 07844
PH (908) 459-5011
FAX (908) 459-5336
hopetownship.com

The information and maps presented in this report are intended for preliminary review and cannot substitute for on-site testing and evaluations. The maps for the Environmental Resource Inventory were developed using NJDEP Geographic Information System digital data

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Mayor and Township Committee:

Timothy McDonough, Mayor
George Beatty, Deputy Mayor
John “Chris” Kruk, Committeeman

Environmental Commission:

Monica Sobon*, Chairman
Ellen Benoit*, Vice Chairman
Annette Morse*
John Lucas*
Betsy Peterson, Planning Board
Lacey DiTondo*
Patricia Maertens*
Virginia Caballero* and Evan Rupff*, Alternates
George Beatty, Deputy Mayor and Liaison to the Environmental Commission and Green Team

Township Staff:

Judith Fisher, Clerk
Robin Keggan, Deputy Clerk and Secretary to Environmental Commission
Alfia Schemm, Secretary to the Planning Board and Zoning Board of Adjustment

*Member of the Hope Township Green Team

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EXECUTIVE SUMMARY

Hope Township is one of the earliest planned communities in the country, having been established by the German Moravians in 1769.¹ Hope Township is 19.2 square miles (12,288 acres)², with Blairstown and Knowlton Townships to the north, White Township to the west, Liberty and Independence Townships to the south, and Frelinghuysen to the east (*Map 1*).

Hope Township is committed to maintaining its rural charm and protecting its natural resources through the preservation of land and the protection of its environmentally sensitive areas. In 2007, the Township completed its *Environmental Resource Inventory* providing factual data on the community's water resources, underlying geology, and wildlife habitats. The 2007 report has served the Township well in guiding its land use decisions and zoning ordinances.

The *Environmental Resource Inventory (ERI) Update* is based on available data from federal and state resources, as well as municipal resources, including the *2007 Environmental Resource Inventory*. Documentation of the natural resource base – the geology, hydrology, ecology, and wildlife – conveys the scope and condition of the resources upon which the Township relies. Extensive mapping and tables detailing the Township's environmental resource base are included within the *ERI Update*. Sections include information on geology, topography, slopes, hydrology and water resources, soils, flooding, wetlands, wildlife habitat, historic resources, air, and climate change. The *ERI Update* will assist the community as it makes decisions regarding future planning and development.

In 2016, Hope Township received Bronze certification through the Sustainable Jersey program. New Jersey is the first state in the nation to have a comprehensive sustainability program for communities that links certification with strong state and private financial incentives, and a fully resourced program of technical support and training.

The submittal of an updated *Environmental Resource Inventory* will help meet the Township's goal of being a sustainable community. The Environmental Commission will add new material to the *ERI* as it becomes available. Knowledge of the natural resources will allow Township officials and citizens to make informed decisions as they strive to preserve and promote the character of the Township and to create a sustainable community within its landscape.

GEOLOGY

Physiographic Provinces

New Jersey's landscape is divided into four distinctive regions, each characterized by unique geologic processes and landforms, known as physiographic provinces. Physiographic provinces classify landscapes based on terrain texture, rock type, geologic structure and history. These attributes play an important role in determining the natural resources of an area. In New Jersey, beginning in the northwest and proceeding to the southeast, these provinces are identified as the Valley and Ridge, Highlands, Piedmont, and Coastal Plain Provinces. The majority of Hope is located in the Ridge and Valley Province with the southern border of the Township located in the Highlands Province (*Map 2*).

The Ridge and Valley Province covers an area of approximately 536 square miles in the north eastern part of the state and comprises approximately one-fifteenth of the state's total area. The Ridge and Valley is categorized by "steep-sided, linear ridges and broad valleys" and "is underlain by folded and faulted Paleozoic sedimentary rocks" (about 540 to 374 million years old).³ The eastern segment of the Ridge and Valley is comprised of the Kittatinny Valley and Kittatinny Mountain. The Kittatinny Mountain is a broad, even-crested ridge that separates the Kittatinny Valley and upper Delaware River Valley with an elevation ranging from 1,600 to 1,800 feet. The Valley floors range from 400 to 600 feet in elevation. There are two major sub-valleys and numerous tributaries that create a highly dissected topography. In the Ridge and Valley, karst features are found where there is limestone and dolomite.⁴

The Highlands Province occupies an area of approximately 980 square miles to the east of the Valley and Ridge Province and comprises approximately one-eighth of the state. It is generally characterized as a mountainous belt ranging between 10 to 25 miles wide. The rugged topography of the Highlands consists of a series of discontinuous rounded ridges separated by deep, narrow valleys. The Highlands is composed mainly of highly metamorphosed igneous and sedimentary rocks dating from more than a billion years ago. These rocks are relatively resistant to erosion which results in the steep slopes and mountains common in the Highlands. Also found in the Highlands are small areas of slightly younger (about 540 to 900 million years old) metasedimentary rocks and diabase dikes.⁵

Bedrock Geology

The geology of Hope Township can be classified into two layers: bedrock geology and surficial geology. Bedrock geology is the consolidated, underlying rock that extends deep into the earth's crust, and surficial geology is the unconsolidated sedimentary material overlaying bedrock formations, which makes up the parent material for soils. The properties of these layers:

“determine the physical extent of aquifers and the chemical quality of the water they yield. They also control how groundwater recharges and moves through the aquifers, how contaminants seep into and move through soil and groundwater, and where natural hazards like radon, sinkholes, and seismic instability may occur. Finally, these properties establish where geologic resources such as sand, gravel, peat, clay, quarry rock, and mineral ores are

located. Geologic properties also determine the suitability of an area for the use of septic systems, the management of storm water and surface runoff, and the stability of foundations for buildings, bridges, tunnels, and other structure.”⁶

The majority of the bedrock geology of Hope Township is Allentown Dolomite (Oca) (29%) and Bushkill Member (Omb) (26%). Areas where Allentown Dolomite are located have higher aquifer recharge potential. The *Bedrock Geology Map (Map 2* in the *Maps* section) depicts the distribution of bedrock types within the Township and shows their frequency of occurrence. The Allentown Dolomite formation consists of dolomite and less abundant quartzite and shale while the Bushkill Member formation consists of shale, slate and less abundant siltstone and minor dolomite lens. They are located in the Ridge and Valley Province in the Township. The Gneiss and Granite formations (Ybh, Yp, Ypg, Ylo, and Yk) are located in the Highlands Province.

Table 1. Bedrock Geology for Hope Township

<i>Abbrv.</i>	<i>Geologic Name</i>	<i>Lithology Description</i>	<i>Acres^a</i>	<i>Percent</i>
Oca	Allentown Dolomite	Dolomite, and less abundant quartzite and shale	3,393.47	28.99%
Omb	Bushkill Member	Shale, slate, less abundant siltstone, and minor dolomite lens	3,021.62	25.81%
Omr	Ramseyburg Member	Graywacke sandstone and siltstone, shale and slate	1,237.33	10.57%
Obl	Lower Part of Beekmantown Group	Dolomite and minor limestone	1,100.75	9.40%
Obu	Upper Part of Beekmantown Group	Dolomite and minor limestone	682.32	5.83%
Ybh	Hornblende Granite	Granite, medium- to coarse-grained	563.34	4.81%
Yp	Pyroxene Gneiss	Gneiss, fine- to medium-grained	548.19	4.68%
Ojw	Jacksonburg Limestone and Sequence at Wantage undivided	Shaly limestone, arenaceous limestone, and minor dolomite-cobble conglomerate, siltstone, and shale	487.25	4.16%
Yk	Potassic Feldspar Gneiss	Gneiss, fine- to medium-grained	219.54	1.88%
Cl	Leithsville Formation	Dolomite, dolomitic sandstone, siltstone, and shale	214.31	1.83%
Oj	Jacksonburg Limestone	Shaly limestone, arenaceous limestone, and minor dolomite-cobble conglomerate	191.66	1.64%
Ypg	Pyroxene Granite	Granite, medium- to coarse-grained	27.26	0.23%
Ch	Hardyston Quartzite	Conglomeratic sandstone, quartzite, and dolomitic sandstone	11.53	0.10%
Ow	Wantage Sequence	Limestone, dolomite, conglomerate, siltstone, and shale	4.77	0.04%
Ylo	Quartz-Oligoclase Gneiss	Gneiss, medium- to coarse-grained	2.94	0.03%
Total:			11,706.27	100%

^a Acres were measured using the ArcGIS digital mapping software for the tables and maps included in the *ERI Update*.

Surficial Geology

Surficial geology is the unconsolidated materials overlaying bedrock formations. The *Surficial Geology Map (Map 3)* and *Table 2. Surficial Geology for Hope Township* depict and detail the surficial geology in Hope Township. The majority of the surficial geology of the Township is Kittatinny Mountain Till (Qwtk) which covers 8,287 acres or 71% of the Township and is located in the Ridge and Valley Province. It consists of clayey silt to silty sand, with some to many pebbles and cobbles and few to many boulders. It is as much as 150 feet thick, but generally less than 40 feet thick. The second most common surficial geology type is Netcong Till, which makes up 8.91% of the Township and is located within the Highlands Province. This formation consists of silty sand to sandy silt with some to many pebbles and cobbles and some to many boulders. It is as much as 200 feet thick, but is generally less than 30 feet thick.

Table 2. Surficial Geology for Hope Township

<i>Abbrv.</i>	<i>Formation</i>	<i>Lithology</i>	<i>GeoAge</i>	<i>Description</i>	<i>Acres</i>	<i>Percent</i>
Qwtk	Kittatinny Mountain Till	Clayey silt to silty sand with some to many pebbles and cobbles and few to many boulders; olive brown, brown, gray, reddish brown. As much as 150 feet thick, generally less than 40 feet thick.	Late Pleistocene, late Wisconsinan	Deposited directly from glacial ice during the late Wisconsinan glaciation.	8,287.43	71.07%
Qwtn	Netcong Till	Silty sand to sandy silt with some to many pebbles and cobbles and some to many boulders; pale brown, yellowish brown, light gray. As much as 200 feet thick, generally less than 30 feet thick.	Late Pleistocene, late Wisconsinan	Deposited directly from glacial ice during the late Wisconsinan glaciation.	1,038.80	8.91%
Qwfv	Late Wisconsinan Glaciofluvial Plain Deposits	Sand, pebble-to-cobble gravel, minor silt; yellowish brown to reddish brown. As much as 80 feet thick.	Late Pleistocene, late Wisconsinan	Form plains deposited by glacial streams during the late Wisconsinan glaciation.	868.96	7.45%
Qal	Alluvium	Sand, gravel, silt, minor clay and peat; reddish brown, yellowish brown, brown, gray. As much as 20 feet thick.	Holocene and late Pleistocene	Contains variable amounts of organic matter. Deposited in modern floodplains and channels.	781.02	6.70%

Table 2. Surficial Geology for Hope Township

<i>Abbrv.</i>	<i>Formation</i>	<i>Lithology</i>	<i>GeoAge</i>	<i>Description</i>	<i>Acres</i>	<i>Percent</i>
Qs	Swamp And Marsh Deposits	Peat and organic clay, silt, and minor sand; gray, brown, black. As much as 40 feet thick.	Late Pleistocene and Holocene	Deposited in modern freshwater wetlands.	676.50	5.80%
Qaf	Alluvial Fan Deposits	Sand, silt, pebble-to-cobble gravel; reddish brown, yellowish brown to brown. As much as 40 feet thick.	Holocene and late Pleistocene, locally middle Pleistocene	Contain minor amounts of organic matter. Form fans at mouths of steep streams	5.39	0.05%
Qwmrk	Late Wisconsinan Recessional Moraine Deposits, Kittatinny Mountain Till	Kittatinny Mountain Till as in unit Qwtk forming morainic ridges and knolls. As much as 80 feet thick.	Late Pleistocene, late Wisconsinan	Deposited directly from glacial ice along recessional ice margins during the late Wisconsinan glaciation.	2.70	0.02%
					11,660.80	100%

GEOGRAPHY AND TOPOGRAPHY

The Township of Hope is located in northwestern Warren County situated in the Upper Delaware Watershed within the Ridge and Valley and Highlands Provinces of New Jersey, characterized by steep linear ridges and valleys. The majority of Hope Township is in the elevation range between 400 and 680 feet above sea level, with sections of steep slopes reaching 1080 feet (*Map 3A*). Hope Township is located on a valley against the ridgeline.

Hope Township is categorized by a mixed landscape of agricultural land, forests, and wetlands with a relatively flat elevation and a few areas of moderate to severe slopes located along the east-west trending ridge line of Jenny Jump Mountain at the south edge of the Township. This ridgeline has an elevation ranging from 640 feet above sea level with a peak elevation of 1080 feet bordering Liberty Township. This region contains forestland with a majority being preserved as a part of Jenny Jump State Forest.

In general, limiting the disturbance of steep slopes is important in preventing soil loss, erosion, excessive stormwater runoff, and the degradation of surface water as well as maintaining the natural topography and drainage patterns of the land. Disturbing the natural vegetation, topography and drainage patterns of steep slopes often increase the amount and speed of runoff and can cause erosion, soil creep, slumping (sections of soil shifting down and outward on the slope), and landslides. The combination of unstable slopes and greater runoff mean more water and sediment (silt) enter streams during precipitation events. Increases in water volume entering streams can lead to, or exacerbate, flooding downstream. In addition, an increase in the volume entering streams through runoff means less water is percolating through the soil and back into the groundwater to replenish drinking water supplies or provide base flow for streams during drier periods. The increased water runoff also carries larger loads of sediment compared to predevelopment conditions. Excess sediments in streams can harm aquatic life, accelerate the filling of ponds and wetlands, and decrease a stream's aesthetic appearance.

SOILS

Soils Overview

Soils play a critical role in the environment. They support an area's vegetation, absorb rainwater, and provide habitat. The physical and chemical properties of soils reflect a large number of variables, including parent material (bedrock), climate, vegetative cover, animal activities, slopes and drainage patterns, and time. New Jersey's fairly complex bedrock geology, history of glaciations, abundant precipitation, and patterns of human use has led to complex patterns of soil distribution.⁷

Soil Classifications

The official Soil Survey for Warren County was updated in 2016 by the Natural Resources Conservation Service (NRCS), an agency of the United States Department of Agriculture (USDA). The soils map and tables in the *Environmental Resource Inventory Update* are based on the data from that official survey.

The NRCS Soil Survey plots soils by map units.⁸ The Soil Survey names each map unit based on the characteristics of the dominant soil within that unit. These *map unit names* identify the soils by their *soil series* classification(s).

Each map unit name has an associated abbreviation that offers a shorthand version of the naming/classification system. This abbreviation system identifies the soil types by steepness, stoniness, and frequency of flooding as follows:

- Capital letters at the end of the abbreviation indicate the slope
“A” being less steep and “E” being steeper
An example is the Rock outcrop-Farmington-Galway complex, which includes RnfC and RnfD
- Small letters following these capital letters indicate stoniness
“a”, “b”, or “c” indicate the degree of stoniness: stony, very stony, and extremely stony
An example is the Nassau-Manlius complex, which includes NauBh, NauDh, and NauCh
- Small letter “t” at the end of an abbreviation indicates “frequently flooded”
An example is Timakwa muck (TheaAt)

The Soil Survey also categorizes each map unit as one of four *map unit types*: consociations, complexes, associations, and undifferentiated groups. The soils of Hope Township fall into these two groups:

Consociations (Cn) are named for the *dominant soil*. In a consociation, delineated areas use a single name from the dominant component in the map unit. Dissimilar components are minor in extent. Consociations represent 13% of Hope Township's total area. An example of this soil type in Hope Township is Catden muck.

Complexes (Cx) consist of two or more *dissimilar* components that occur in a regularly repeating pattern. The total amount of other dissimilar components is minor in extent. Complexes represent 87% of Hope Township’s total area. An example of this soil type in Hope Township is the Nassau-Manlius complex.

Table 3 identifies the soils in Hope Township.

Table 3. Soils of Hope Township				
<i>Abbrv.</i>	<i>Map Unit Name</i>	<i>Map Unit Type</i>	<i>Acres</i>	<i>% Township</i>
AhcBc	Alden mucky silt loam, gneiss till substratum, 0 to 8 percent slopes, extremely stony	Cn	59.94	0.51%
AhbBc	Alden silt loam, 0 to 8 percent slopes, extremely stony	Cn	117.54	1.00%
CatbA	Catden muck, 0 to 2 percent slopes	Cn	418.12	3.57%
ChkC	Chatfield-Hollis-Rock outcrop complex, 0 to 15 percent slopes	Cx	71.60	0.61%
ChkE	Chatfield-Hollis-Rock outcrop complex, 35 to 60 percent slopes	Cx	555.07	4.74%
ChwBc	Chippewa silt loam, 0 to 8 percent slopes, extremely stony	Cn	134.02	1.14%
FaxC	Farmington-Rock outcrop complex, 0 to 15 percent slopes	Cx	93.80	0.80%
FdwB	Farmington-Wassaic-Rock outcrop complex, 0 to 8 percent slopes	Cx	69.48	0.59%
FrdAb	Fredon-Halsey complex, 0 to 3 percent slopes, very stony	Cx	1,161.49	9.92%
GkanBc	Gladstone loam, 3 to 8 percent slopes, extremely stony	Cn	6.17	0.05%
GkanCc	Gladstone loam, 8 to 15 percent slopes, extremely stony	Cn	6.05	0.05%
HdxAb	Hazen-Hoosic complex, 0 to 3 percent slopes, very stony	Cx	162.39	1.39%
HdxBb	Hazen-Hoosic complex, 3 to 8 percent slopes, very stony	Cx	688.35	5.88%
HhmBc	Hibernia loam, 0 to 8 percent slopes, extremely stony	Cn	49.76	0.43%
HncD	Hollis-Rock outcrop-Chatfield complex, 15 to 35 percent slopes	Cx	249.20	2.13%
HonCb*	Hoosic-Hazen complex, 8 to 15 percent slopes, very stony	Cx	370.50	3.17%
HopEb*	Hoosic-Otisville complex, 25 to 60 percent slopes, very stony	Cx	12.23	0.10%
NauBh	Nassau-Manlius complex, 0 to 8 percent slopes, very rocky	Cx	55.98	0.48%
NauDh	Nassau-Manlius complex, 15 to 35 percent slopes, very rocky	Cx	1,472.34	12.58%
NauCh	Nassau-Manlius complex, 8 to 15 percent slopes, very rocky	Cx	1,114.18	9.52%
NavE	Nassau-Rock outcrop complex, 35 to 60 percent slopes	Cx	400.05	3.42%
NetBb	Netcong loam, 0 to 8 percent slopes, very stony	Cn	66.00	0.56%
NetCb	Netcong loam, 8 to 15 percent slopes, very stony	Cn	227.83	1.95%

Table 3. Soils of Hope Township				
<i>Abbrv.</i>	<i>Map Unit Name</i>	<i>Map Unit Type</i>	<i>Acres</i>	<i>% Township</i>
PaoD	Parker gravelly sandy loam, 15 to 25 percent slopes	Cn	14.84	0.13%
QY	Quarries	Cn	63.72	0.54%
RnfD	Rock outcrop-Farmington-Galway complex, 15 to 35 percent slopes	Cx	2,039.15	17.42%
RnfC	Rock outcrop-Farmington-Galway complex, 8 to 15 percent slopes	Cx	947.5	8.09%
RoefDc	Rockaway loam, thin fragipan, 15 to 35 percent slopes, extremely stony	Cn	146.97	1.26%
RokB	Rockaway-Chatfield-Rock outcrop complex, 0 to 8 percent slopes	Cx	24.55	0.21%
RokD	Rockaway-Chatfield-Rock outcrop complex, 15 to 35 percent slopes	Cx	148.16	1.27%
RokC	Rockaway-Chatfield-Rock outcrop complex, 8 to 15 percent slopes	Cx	57.80	0.49%
TheaAt	Timakwa muck, 0 to 2 percent slopes, frequently flooded	Cn	39.84	0.34%
UdaB	Udorthents, 0 to 8 percent slopes, smoothed	Cn	13.69	0.12%
UdauB	Udorthents-Urban land complex, 0 to 8 percent slopes	Cx	186.37	1.59%
VepBc	Venango silt loam, 0 to 8 percent slopes, extremely stony	Cn	38.33	0.33%
VepCc	Venango silt loam, 8 to 15 percent slopes, extremely stony	Cn	34.42	0.29%
WATER	Water	Cn	116.92	1.00%
WusBc	Wurtsboro-Swartswood complex, 0 to 8 percent slopes, extremely stony	Cx	97.42	0.83%
WusCc	Wurtsboro-Swartswood complex, 8 to 15 percent slopes, extremely stony	Cx	174.01	1.49%
Total:			11,705.80	100%
<i>*Not shown on Web Soil Survey but included from ArcGIS soil data</i>				
<i>Source: NRCS Web Soil Survey</i>				

Major Soil Series

The three most prevalent soil types in Hope Township are Rock outcrop-Farmington-Galway, Nassau-Manlius, and Fredon-Halsey. They account for 65% of the total land area. The remaining soil series in Hope Township account for less than 10% of the total land cover. Water and Urban Land are not considered soil series and are excluded:

- Rock outcrop-Farmington-Galway accounts for 25% of the Township, covering approximately 2,987 acres
- Nassau-Manlius is second and accounts for 23% of the Township, or approximately 2,642 acres
- Fredon-Halsey accounts for 10% of the Township, or approximately 1,161 acres

Table 4. Major Soil Series details the major soils series in Hope Township. The three major soil series within Hope Township are dispersed throughout the Township. The Rock outcrop-Farmington-Galway series is concentrated in the northeastern quadrant of the Township and are found throughout the southern portion, while the Nassau-Manlius Series is concentrated in the northwestern section. The Fredon-Halsey Series is dispersed throughout the southern section of the Township (see *Map 4. Soil Series*). Complete soil series descriptions can be found on the NRCS website.⁹

Table 4. Major Soil Series					
<i>Abbrv.</i>	<i>Map Unit Name</i>	<i>Type</i>	<i>Farmland Type</i>	<i>Acres</i>	<i>%Township</i>
Rock outcrop-Farmington-Galway Series					
RnfD	Rock outcrop-Farmington-Galway complex, 15 to 35 percent slopes	Cx	Not prime farmland	2,039.15	17.42%
RnfC	Rock outcrop-Farmington-Galway complex, 8 to 15 percent slopes	Cx	Not prime farmland	947.50	8.09%
<i>Total Rock outcrop-Farmington-Galway:</i>				2,986.65	25.51%
Nassau-Manlius Series					
NauDh	Nassau-Manlius complex, 15 to 35 percent slopes, very rocky	Cx	Not prime farmland	1,472.34	12.58%
NauCh	Nassau-Manlius complex, 8 to 15 percent slopes, very rocky	Cx	Not prime farmland	1,114.18	9.52%
NauBh	Nassau-Manlius complex, 0 to 8 percent slopes, very rocky	Cx	Not prime farmland	55.98	0.48%
<i>Total Nassau-Manlius Series:</i>				2,642.49	22.57%
Fredon-Halsey Series					
FrdAb	Fredon-Halsey complex, 0 to 3 percent slopes, very stony	Cx	Not prime farmland	1,161.49	9.92%
Total:				7,641.38	65.27%

Soil Characteristics

Agricultural Soils

Prime Farmland is defined by the United States Department of Agriculture (USDA) as land that has the best combination of physical and chemical characteristics for producing food, feed, fiber, forage, and oilseed crops.¹⁰ This classification of soil accounts for 8% of the land in Hope. Areas of Prime Farmland include loamy and very stony soil with a slope of 8% or less (*Map 5*).

Farmland of Statewide Importance contains soils that are also highly productive under the right circumstances but not considered Prime Farmland and account for 5% of the Township. The soil types classified under this tend to have a slope of 8 to 15 percent and can be very stony.

Farmland of Local Importance can be used to produce high value food, fiber, or horticultural crops.¹¹ There are no soils classified as Farmland of Local Importance in Hope Township.

Farmland of Unique Importance can be used for the production of specific high value food and fiber crops (cranberries, fruits, and vegetables) but are not considered Prime Farmland. Catden muck and Timakwa muck fall into this category. These soils account for 4% of Hope’s land.

The majority (82%) of Hope’s land and soils are considered *Not Prime Farmland*. The soil types classified under this tend to be frequently flooded and have a flatter slope (between zero and 2%). **Table 5** details the agricultural soils in Hope Township.

Table 5. Soil Rated for Agricultural Use		
<i>Arability Potential</i>	<i>Acres</i>	<i>Percent</i>
All Areas Are Prime Farmland	916.75	7.83%
Farmland Of Statewide Importance	598.34	5.11%
Farmland Of Local Importance	---	---
Farmland Of Unique Importance	457.96	3.91%
Not Prime Farmland	9,615.83	82.15%
Water	116.92	1%
Total	11,705.80	100%

Erodibility

Soils can be categorized by their susceptibility to *erosion*, the natural process by which wind, moving water, ice, and gravitational forces cause soil and particulate materials to be displaced. While erosion of exposed bedrock occurs over an extended time scale, soil erosion can occur more acutely with more immediate consequences. The consistency of the soil is one factor determining its erodibility potential, with dense, compact, clayey soils being less susceptible and looser loamy soils, with varying levels of clay and sand, being more susceptible. A measure of this susceptibility is the K-factor. The K-factor looks at the soil texture and composition as well as the permeability to determine a number between 0.02 (less susceptible) and 0.69 (more susceptible) that demonstrates the erosion potential for a particular soil. The K-factor is shown in **Table 6**. According to the NRCS, Erosion Hazard for Road/Trail Soils measures the soil loss from unsurfaced roads and trails. It is determined using K-factor, slope, and content of rock fragments. The rating of the Erosion Hazard is described as Slight, Moderate, or Severe. In Hope Township, the soil K-factors range from 0.05 to 0.32 which represent moderate to severe risks of erosion. With these factors taken into account, Hope Township does face a moderate risk of erosion on 26% of land and severe erosion on 55% of land (not including land and water).

Table 6. Erodibility in Hope Township		
<i>Erosion Hazard Road/Trail Rating</i>	<i>Acres</i>	<i>% of Land</i>
Slight	2,199.5	19.4%
Moderate	2,897.3	25.5%
Severe	6,244.2	55.1%
Total Rated Area:	11,341	100%
<i>Source: NRCS Web Soil Survey (Accessed September 2017)^b</i>		

^b Rated Area does not include water (116.9 acres), quarries (63.7 acres), and urban land (186.4 acres)

Topographic Protection (Wind)

According to the Natural Resources Conservation Service (NRCS), the majority of the soils of Hope Township are not subjected to erosion by wind. Wind erosion most often affects soil on bare lands, where sheer force of wind detaches particles protruding from the soil surface. A conservation measure that can minimize damage due to wind erosion is maintaining a surface cover.

Hydric Soils

According to the NRCS, “A hydric soil is a soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part.” Hydric soils are an important element of wetland areas and naturally support wetland vegetation. If a soil is classified as hydric, Federal/State Wetlands Law may restrict land use due to the relationship of hydric soils to wetlands and wetland preservation.¹² The NRCS Soil Survey for Hope Township identifies that 17% of the Township’s soils as hydric and nearly 58% of these hydric soils are Fredon-Halsey complex. These soils include floodplains, river valleys, lake terraces, flood and outwash plains, depressions, and bogs. The hydric soils, their acreages, and typical locations are shown in **Table 7**.

Table 7. Hydric Soils of Hope Township

<i>Abbrev.</i>	<i>Typical Landform</i>	<i>Acres</i>	<i>% Hydric Soils</i>	<i>% of All Soils</i>
AhbBc	Alden silt loam, 0 to 8 percent slopes, extremely stony	117.6	5.8%	1%
AhcBc	Alden mucky silt loam, gneiss till substratum, 0 to 8 percent slopes, extremely stony	60	3%	0.5%
CatbA	Catden muck, 0 to 2 percent slopes	418.2	20.7%	3.6%
ChwBc	Chippewa silt loam, 0 to 8 percent slopes, extremely stony	134.1	6.6%	1.1%
FrdAb	Fredon-Halsey complex, 0 to 3 percent slopes, very stony	1,161.7	57.5%	9.9%
HhmBc	Hibernia loam, 0 to 8 percent slopes, extremely stony	49.8	2.5%	0.4%
TheaAt	Timakwa muck, 0 to 2 percent slopes, frequently flooded	39.8	2%	0.3%
VepBc	Venango silt loam, 0 to 8 percent slopes, extremely stony	38.3	1.9%	0.3%
Total:		2,019.5	100%	17.2%

Source: NRCS Web Soil Survey (Accessed September 2017)

Other Soil Characteristics and Limitations for Use

Other characteristics of soil that determine suitability for development, including its capacity to support foundations without corrosion, limits for septic systems, and hydrological characteristics such as tendency towards ponding and flooding, a shallow water table or potential for frost heave,

can contraindicate development. The NRCS Soil Survey states, “Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes soil poorly suited to basements or underground installations.”

Soil characteristics and limitations for use include the following:

Depth to restrictive layer is the vertical distance from the soil surface to the upper boundary of the restrictive layer. The restrictive layer is a nearly continuous layer, that has one or more physical, chemical, or thermal properties, that significantly impede the movement of water and air through the soil, restrict roots, or otherwise provide an unfavorable root environment. Examples are bedrock, cemented layers, dense layers, and frozen layers. Though not shown in this table, information on the hardness and thickness of the restrictive layer, both of which significantly affect the ease of excavation, can be obtained for specific soil types.

Drainage refers to the relative wetness of the soil under natural conditions as it pertains to wetness due to a water table. Drainage classes refer to the frequency and duration of wet periods under conditions similar to those under which the soil developed. Drainage classes range from excessively drained (water is removed very rapidly and the soils are commonly coarse-textured or shallow) to very poorly drained (water is removed from the soil so slowly that free water remains at or very near the ground surface during much of the growing season and unless artificially drained, most crops cannot be grown).

Capacity [of most limiting layer] to transmit water refers to the ease with which pores in a saturated soil transmit water. This capacity is considered in the design of soil drainage systems and septic tank absorption fields.

Depth to water table indicates a range of expected depth to a saturated zone in the soil, known as a “water table,” that occurs during several months in most years. A saturated zone that lasts for less than a month is not considered a water table.

Flooding is the temporary inundation of an area caused by overflowing streams or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt is not considered flooding and water standing in swamps and marshes is considered ponding rather than flooding. Frequency is expressed as none, very rare, rare, occasional, frequent, and very frequent.

- “None” means that flooding is not probable. The chance of flooding is nearly 0% in any year. Flooding occurs less than once in 500 years.
- “Very rare” means that flooding is very unlikely but possible under extremely unusual weather conditions. The chance of flooding is less than 1% in any year.
- “Rare” means that flooding is unlikely but possible under unusual weather conditions. The chance of flooding is 1-5% in any year.
- “Occasional” means that flooding occurs infrequently under normal weather conditions. The chance of flooding is 5-50% in any year.

- “Frequent” means that flooding is likely to occur often under normal weather conditions. The chance of flooding is more than 50% in any year but is less than 50% in all months in any year.
- “Very frequent” means that flooding is likely to occur often under normal weather conditions. The chance of flooding is more than 50% in all months of any year.

Ponding is standing water in a closed depression. Unless a drainage system is installed, the water is removed only by percolation, transpiration, or evaporation. Frequency is expressed as none, rare, occasional, and frequent.

- “None” means that ponding is not probable;
- “Rare” that it is unlikely but possible under unusual weather conditions (the chance of ponding is nearly 0 to 5% in any year);
- “Occasional” that it occurs, on the average, once or less in two years (the chance of ponding is 5-50% in any year); and
- “Frequent” that it occurs, on the average, more than once in two years (the chance of ponding is more than 50% in any year).

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in centimeters of water per centimeter of soil for each soil layer. The capacity varies depending on soil properties that affect retention of water. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Potential for frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, saturated hydraulic conductivity (K_{sat}), content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained.

Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel or concrete in installations

that intersect soil boundaries or soil layers is more susceptible to corrosion than the steel or concrete in installations that are entirely within one kind of soil or within one soil layer.

Septic limitations refer to effectiveness of a soil type to manage a septic tank absorption field. Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tile or perforated pipe. Only that part of the soil between depths of 24 and 60 inches is evaluated. The ratings are based on the soil properties that affect absorption of the effluent, construction and maintenance of the system, and public health. The most important soil properties that determine septic limitations are saturated hydraulic conductivity (Ksat), depth to a water table, ponding, depth to bedrock or a cemented pan, and flooding. Stones and boulders, ice, and bedrock or cemented pan interfere with installation. Subsidence interferes with installation and maintenance. Excessive slope may cause lateral seepage and surfacing of the effluent in downslope areas. All of the rated soils in Hope Township are classified by the NRCS as “very limited,” which indicates that the soil has at least one feature that is unfavorable for such use, with the expectation of poor performance and high maintenance.¹³

Table 8. Soil Limitations of Hope Township lists the limitations for the soils found in Hope Township.

Table 8. Soil Limitations of Hope Township

<i>Abbrv.</i>	<i>Depth to Restrictive Feature (cm)</i>	<i>Drainage</i>	<i>Depth to Water Table (cm)</i>	<i>Available Water Capacity (cm)</i>	<i>Ponding/Flooding</i>	<i>Frost Action Potential</i>	<i>Risk of Corrosion Concrete</i>	<i>Risk of Corrosion Steel</i>	<i>Septic Limitations</i>
AhcBc	>200	Very poorly drained	0	0.17	Frequent	High	Moderate	High	Very limited
AhbBc	>200	Very poorly drained	0	0.16	Frequent	High	Moderate	High	Very limited
CatbA	>200	Very poorly drained	0	0.45	Frequent	High	Moderate	High	Very limited
ChkC	76	Well drained	>200	0.16	None	Moderate	High	Moderate	Very limited
ChkE	76	Well drained	>200	0.11	None	Moderate	High	High	Very limited
ChwBc	33	Poorly drained	0	0.06	Frequent	High	Moderate	High	Very limited
FaxC	38	Well drained	>200	0.15	None	High	Moderate	Moderate	Very limited
FdwB	38	Well drained	>200	0.15	None	High	Moderate	Moderate	Very limited
FrdAb	58	Somewhat poorly drained	36	0.09	None	High	Moderate	High	Very limited
GkanBc	>200	Well drained	>200	0.11	None	Moderate	Moderate	Moderate	Very limited

Table 8. Soil Limitations of Hope Township

<i>Abbrv.</i>	<i>Depth to Restrictive Feature (cm)</i>	<i>Drainage</i>	<i>Depth to Water Table (cm)</i>	<i>Available Water Capacity (cm)</i>	<i>Ponding/ Flooding</i>	<i>Frost Action Potential</i>	<i>Risk of Corrosion Concrete</i>	<i>Risk of Corrosion Steel</i>	<i>Septic Limitations</i>
GkanCc	>200	Well drained	>200	0.11	None	Moderate	Moderate	Moderate	Very limited
HdxAb	>200	Well drained	>200	0.08	None	Moderate	Moderate	Low	Very limited
HdxBb	>200	Well drained	>200	0.08	None	Moderate	Moderate	Low	Very limited
HhmBc	48	Somewhat poorly drained	28	0.10	None	Moderate	High	High	Very limited
HncD	41	Somewhat excessively drained	>200	0.10	None	Moderate	High	High	Very limited
NauBh	33	Somewhat excessively drained	>200	0.13	None	Moderate	Low	Low	Very limited
NauDh	33	Somewhat excessively drained	>200	0.13	None	Moderate	Low	Low	Very limited
NauCh	33	Somewhat excessively drained	>200	0.13	None	Moderate	Low	Low	Very limited
NavE	38	Somewhat excessively drained	>200	0.13	None	Moderate	Low	Moderate	Very limited
NetBb	>200	Well drained	>200	0.10	None	Moderate	High	Moderate	Very limited

Table 8. Soil Limitations of Hope Township

<i>Abbrv.</i>	<i>Depth to Restrictive Feature (cm)</i>	<i>Drainage</i>	<i>Depth to Water Table (cm)</i>	<i>Available Water Capacity (cm)</i>	<i>Ponding/ Flooding</i>	<i>Frost Action Potential</i>	<i>Risk of Corrosion Concrete</i>	<i>Risk of Corrosion Steel</i>	<i>Septic Limitations</i>
NetCb	>200	Well drained	>200	0.10	None	Moderate	High	Moderate	Very limited
PaoD	>200	Somewhat excessively drained	>200	0.09	None	Moderate	Moderate	Moderate	Very limited
PduaCb*	>200	Well drained	>200	0.07	None	Low	High	High	Very limited
PduoEb*	>200	Well drained	>200	0.07	None	Low	High	High	Very limited
QY	0	**	>200	**	None	**	**	**	**
RnfD	0	Well drained	>200	**	None	**	Moderate	Moderate	Very limited
RnfC	0	Well drained	>200	**	None	**	Moderate	Moderate	Very limited
RoefDc	58	Well drained	>200	0.07	None	Moderate	High	Moderate	Very limited
RokB	58	Well drained	>200	0.07	None	Moderate	High	Moderate	Very limited
RokD	58	Well drained	>200	0.07	None	Moderate	High	Moderate	Very limited
RokC	58	Well drained	>200	0.07	None	Moderate	High	Moderate	Very limited
TheaAt	>200	Very poorly drained	0	0.25	Frequent	High	High	High	Very limited
UdaB	>200	Well drained	>200	0.12	None	Low	High	Low	Very limited

Table 8. Soil Limitations of Hope Township

<i>Abbrv.</i>	<i>Depth to Restrictive Feature (cm)</i>	<i>Drainage</i>	<i>Depth to Water Table (cm)</i>	<i>Available Water Capacity (cm)</i>	<i>Ponding/Flooding</i>	<i>Frost Action Potential</i>	<i>Risk of Corrosion Concrete</i>	<i>Risk of Corrosion Steel</i>	<i>Septic Limitations</i>
UdauB	>200	Well drained	>200	0.12	None	Low	High	Low	Very limited
VepBc	41	Somewhat poorly drained	15	0.12	None	High	Moderate	High	Very limited
VepCc	41	Somewhat poorly drained	15	0.12	None	High	Moderate	High	Very limited
WATER	>200	**	>200	**	None	**	**	**	**
WusBc	61	Moderately well drained	46	0.12	None	Moderate	High	High	Very limited
WusCc	61	Moderately well drained	46	0.12	None	Moderate	High	High	Very limited
<p><i>*Not shown in ArcGIS data but included in Web Soil Survey data</i> <i>**Indicated no data available or not rated</i></p>									

Soil Limitations for Building Site Development

Hope Township has several soils that are rated by the NRCS Web Soil Survey as having no limits or some limits on their ability to support dwellings with or without basements and small commercial buildings.

For the purpose of these ratings, dwellings are defined as single-family houses of three stories or less, and small commercial buildings are structures that are less than three stories high and do not have basements. For dwellings without basements and small commercial buildings, the foundation is “assumed to consist of spread footing of reinforced concrete built on undisturbed soil at a depth of 2 feet or at a depth of maximum frost penetration, whichever is deeper.” For dwellings with basements, the foundation is “assumed to consist of spread footings of reinforced concrete built in undisturbed soil at a depth of about 7 feet.” The ratings for dwellings are based on the soil properties that affect excavation and construction costs. The properties that affect the load-supporting capacity include depth to a water table, ponding and flooding, subsidence, linear extensibility (shrink-swell potential), and compressibility. Properties that affect excavation and construction costs are depth to a water table, ponding and flooding, slope, depth to bedrock or cemented pan, hardness of bedrock or cemented pan, and the amount and size of rock fragments.

The ratings are as follows:

- Not limited: Indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected.
- Somewhat limited: Indicates that the soil has features that are moderately favorable for specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected.
- Very limited: Indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected. (*NRCS Web Soil Survey*)

Table 9 details the breakdown of these ratings.

Township Initiatives

The Township Soil Removal and Importation Ordinance addresses soil-related concerns:

- Prohibits quarrying or mining of soils in the Township (Ordinance #93-19).
- Prohibits the removal of more than fifty cubic yards of soil from any property in any one-year period without obtaining a permit from the Hope Township Committee (Ordinance #93-19).
- Prohibits the importation of more than one hundred cubic yards of soil without first acquiring a permit reviewed by the Township Engineer (Ordinance #02-04).

Table 9. Soil Limitation for Building Site Development in Hope Township			
<i>Rating</i>	<i>Dwellings with Basements</i>	<i>Dwellings without Basements</i>	<i>Small Commercial Buildings</i>
Not Rated	QY (63.7) Water (116.9) Total Acres: 180.6 % of Township: 1.5%	QY (63.7) RnfC (947.7) Water (116.9) Total Acres: 1,128.3 % of Township: 9.6%	QY (63.7) Water (116.9) Total Acres: 180.6 % of Township: 1.5%
Not Limited	Hd xpAb (162.4) Hd xpBb (688.5) NetBb (66) RokB (24.6) UdaB (13.7) Uda uB (186.4) Total Acres: 1,141.6 % of Township: 9.8%	Hd xpAb (162.4) Hd xpBb (688.5) NetBb (66) UdaB (13.7) Uda uB (186.4) Total Acres: 1,117 % of Township: 9.5%	Hd xpAb (162.4) Total Acres: 162.4 % of Township: 1.4%
Somewhat Limited	GkanBc (6.2) GkanCc (6.1) NetCb (227.9) PduaCb (370.6) RokC (57.8) Total Acres: 668.6 % of Township: 5.7%	ChkC (71.6) GkanBc (6.2) GkanCc (6.1) NetCb (227.9) PduaCb (370.6) WusBc (97.4) WusCc (174.1) Total Acres: 953.9 % of Township: 8.1%	GkanBc (6.2) Hd xpBb (688.5) NetBb (66) UdaB (13.7) Uda uB (186.4) WusBc (97.4) Total Acres: 1,058.2 % of Township: 9%
Very Limited	AhbBc (117.6) AhcBc (60) CatbA (418.2) ChkC (71.6) ChkE (555.2) ChwBc (134.1) FaxC (93.8) FdwB (69.5) FrdAb (1,161.7) HhmBc (49.8) HncD (249.8) NauBh (56) NauCh (1,114.4) NauDh (1,472.7) NavE (400.2) PaoD (14.8) PduoEb (12.2)	AhbBc (117.6) AhcBc (60) CatbA (418.2) ChkE (555.2) ChwBc (134.1) FaxC (93.8) FdwB (69.5) FrdAb (1,161.7) HhmBc (49.8) HncD (249.2) NauBh (56) NauCh (1,114.4) NauDh (1,472.7) NavE (400.2) PaoD (14.8) PduoEb (12.2) RnfD (2,039.6)	AhbBc (117.6) AhcBc (60) CatbA (418.2) ChkC (71.6) ChkE (555.2) ChwBc (134.1) FaxC (93.8) FdwB (69.5) FrdAb (1,161.7) GkanCc (6.1) HhmBc (49.8) HncD (249.2) NauBh (56) NauCh (1,114.4) NauDh (1,472.7) NavE (400.2) NetCb (227.9)

Table 9. Soil Limitation for Building Site Development in Hope Township			
<i>Rating</i>	<i>Dwellings with Basements</i>	<i>Dwellings without Basements</i>	<i>Small Commercial Buildings</i>
	RnfC (947.7) RnfD (2,039.6) RoefDc (147) RokD (148.2) TheaAt (39.8) VepBc (38.3) VepCc (34.3) WusBc (94.4) WusCc (174.1)	RoefDc (147) RokB (24.6) RokC (57.8) RokD (148.2) TheaAt (39.8) VepBc (38.3) VepCc (34.4)	PaoD (14.8) PduaCb (370.6) PduoEb (12.2) RnfC (947.7) RnfD (2,039.6) RoefDc (147) RokB (24.6) RokC (57.8) RokD (148.2) TheaAt (39.8) VepBc (38.3) VepCc (34.4) WusCc (174.1)
	Total Acres: 9,717.5 % of Township: 83%	Total Acres: 8,509.1 % of Township: 72.7%	Total Acres: 10,307.1 % of Township: 88%
<i>Source: NRCS Web Soil Survey (accessed September 2017)</i>			

HYDROLOGY

Watersheds

“A watershed is a topographic area within which surface water runoff drains into a specific point on a stream or to a water body such as a lake.”¹⁴ A watershed-based approach to natural resource management is considered by state and national agencies to be the most appropriate unit for managing complex environmental problems. Hope Township falls within the Upper Delaware River watershed basin.¹⁵

The United States Geological Survey (USGS) has mapped and identified watersheds using a hierarchical numbering system. This system identifies watersheds using a hydrological unit code (HUC) consisting of up to 14 digits for the smallest watersheds. The HUC11 watershed and sub-watersheds for Hope Township are identified on the watershed map (*Map 6*) and in *Table 10*.

Table 10. HUC 11 Watersheds in Hope Township

<i>WMA</i>	<i>WMA Name</i>	<i>Sub-Watersheds</i>	<i>Acres</i>	<i>Percent</i>
1	Upper Delaware	Beaver Brook (above Hope Village)	2,637.85	22.53%
1	Upper Delaware	Beaver Brook (below Hope Village)	2,874.68	24.56%
1	Upper Delaware	Union Church tributary	1,848.63	15.79%
1	Upper Delaware	Honey Run	4,300.27	36.73%
1	Upper Delaware	Delawanna Creek	30.31	0.26%
1	Upper Delaware	Pequest River (below Bear Swamp)	11.84	0.10%
1	Upper Delaware	Mountain Lake Brook	2.69	0.02%
Total:			11,706.27	100%

Surface Water

Surface water is water that collects on the ground or in a stream, river, lake, wetland, or ocean. Major surface water bodies in Hope Township include Beaver Brook, Honey Run, Brookaloo Swamp, Muddy Brook, Trout Brook, Silver Lake, Locust Lake, and Swayze Mill Pond. Swayze Mill Pond was an old quarry/ gravel pit that was allowed to fill with water after operations ceased.¹⁶

New Jersey’s Surface Quality Standards (SWQS) (N.J.A.C. 7:9) classify Fresh Water 1 (FW1) as the highest level of classification, which is defined as:

“those fresh waters, as designated in N.J.A.C. 7:9B-1.15(j), that are to be maintained in their natural state of quality (set aside for prosperity) and not subjected to any manmade wastewater discharges or increased in runoff from anthropogenic activities. These waters are set aside for prosperity because of their clarity, color, scenic setting, other characteristics of aesthetic value, unique ecological significance, exceptional recreational significance, exceptional water supply significance, or *exceptional* fisheries resource(s).”¹⁷

The general classification for other freshwaters in the State is Fresh Water 2 (FW2).

The presence of trout in a stream meant that the waters are relatively free of chemicals or biological contaminants, and is used to further designate uses. A stream can be classified as Trout Production (TP), Trout Maintenance (TM), or Non-Trout (NT):

- *Trout Production* waters are designated “for use by trout spawning or nursery purposes during their first summer.”
- *Trout Maintenance* waters support trout throughout the year.
- Waters classified as *Non-Trout* do not support trout, either because of their physical nature or due to biological or chemical characteristics ((SWQS) (N.J.A.C.7:9B)).

The waterbodies of Hope Township are all classified as Fresh Water 2 (FW2) waterbodies. The majority (54%) of the streams are classified as Non-Trout (FW2-NT) including Beaver Brook, an unnamed tributary of Beaver Brook, Locust Lake, Muddy Brook, and an unnamed tributary of Muddy Brook. A close majority (45%) of the streams in the Township are classified as Trout Maintenance (FW2-TM) which includes Brookaloo Swamp, Honey Run, an unnamed tributary of Honey Run, Silver Lake, and Trout Brook along with an unnamed tributary of Trout Brook. One waterway, an unnamed tributary of the Delaware River, is classified as a Trout Production Category 1 waterway (FW2-TPC1). *Map 7. Surface Water Use Classifications* depicts the specific water quality designations.

Surface water quality is affected by point sources and non-point sources of pollution, as well as erosion and sedimentation. Point source means any discernible, confined, and discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft from which pollutants are or may be discharged.¹⁸ This includes discharges from sewage treatment plants and factories, stormwater runoff, illegal dumping, and malfunctioning underground storage tanks and septic systems. This term does not include agricultural storm water discharges and return flows from irrigated agriculture.

In contrast to point source pollution, non-point source pollution comes from many different sources. As rainfall or snowmelt moves over and through the ground, it picks up and carries natural and human-made pollutants (such as fertilizers, herbicides and motor oil) and deposits them into surface and groundwater. The effects of pollutants on specific waterways can vary but eventually all are manifested in negative outcomes for drinking water supplies, recreation, fisheries, and wildlife. One of these effects is eutrophication, which, in freshwater systems, is the addition of substances, either man-made or natural, to a water body affecting the primary productivity of that body of water. Nitrates and phosphates promote excessive algae growth. These “blooms” can have negative effects on the ecosystem. This can include clouding of the water which limits sunlight penetration and stops the growth of plants deeper in the water. Additionally, eutrophication can lead to anoxia, a condition where a water body has depleted levels of oxygen –a result of the decomposition of dead phytoplankton.

Water quality can also be negatively impacted by sedimentation, which is the transportation and deposition of eroded materials. A primary cause of sedimentation is development near streams and on steep slopes that reduce vegetative cover and results in exposed soil. The vegetative cover can typically absorb the impact of raindrops, but when it is removed, the exposed soil easily becomes eroded. The eroded soil can then be transported to surface waters where it could contaminate and

increase the turbidity of the water, effectively blocking sunlight to plant species and negatively affecting the health of the aquatic ecosystem.

Groundwater Recharge Areas

Groundwater is the primary drinking and agricultural water source for the residents of New Jersey. The drinking water for Hope Township is supplied by groundwater.¹⁹ Groundwater recharge is the process in which surface water from lakes, streams, or rainwater runoff, flows or seeps downward beneath ground surface, saturating soil or rock. Groundwater is contained in porous rocks and sediments. An area where such water-holding rocks or unconsolidated materials yield a usable quantity for water is called an aquifer, the source from which drinking water is drawn through wells. Protecting the land’s capacity to recharge its aquifers, and limiting development to stay within the capacity of local water resources, is critical to maintaining our water supply.

Aquifer recharge potential was calculated through the combination of a standardized statewide aquifer ranking system and the particular groundwater recharge coverage in the area of interest. Aquifer recharge, or recharge to water-bearing geologic units, is defined as the groundwater that reaches the water table in the uppermost geologic unit with a thickness of 50 feet or greater. Groundwater recharge potential is ranked by average annual infiltration. The composite aquifer/groundwater recharge potential rank highlights the multiple relationships between the groundwater-recharge area ranks (indicative of the infiltration rate) and the underlying water table aquifer ranks (indicative of the aquifer’s capacity to absorb, transmit and supply water) which provides a guide to how well the system in any given area allows groundwater to reach and recharge the aquifer. **Table 11** depicts the ranking system.

<i>Aquifer Rank</i>	<i>Median Well Yield (Gallons/Minute)</i>	<i>Groundwater Rank</i>	<i>Avg. Annual Infiltration (In/Yr)</i>
A	>500	A	17-21
B	>250-500	B	14-16
C	>100-250	C	11-13
D	25-100	D	1-10
E	<25	E	0

There are also hydric soils (L/L), wetlands and open water (W/W) and instances where no recharge is calculated (X/X)
Source: NJDEP NJGS

The aquifer recharge map (**Map 8**) shows the distribution of rankings for Hope Township. This map shows the potential for an aquifer to recharge in a given area. The area with the highest potential for recharge would be ranked A/A (>500gpm/17-21 in/yr). None of Hope Township is ranked A/A; 443 acres are ranked B/A (>250-500 gpm/17-21 in/yr). The largest expanse of the Township, 26% covering 3,058 acres, is ranked B/B (>250-500 gpm/ 14-16 in/yr). Areas where Allentown Dolomite are located have a higher aquifer recharge potential (B/A; B/B; B/C). Bushkill Member and Ramseyburg Member produce low aquifer and groundwater recharge numbers (D/B; D/C). The aquifer/groundwater recharge rankings in Hope Township are shown in **Table 12**.

Table 12. Aquifer/Ground Water Recharge Rankings in Hope Township			
<i>Alpha Rank</i>	<i>Numeric Rank</i>	<i>Acres</i>	<i>% of Township</i>
B/A	21	443.15	3.79%
B/B	22	3,057.93	26.12%
B/C	23	1,098.96	9.39%
B/D	24	5.06	0.04%
D/A	41	710.18	6.07%
D/B	42	2,481.32	21.20%
D/C	43	1,925.22	16.45%
D/D	44	17.58	0.15%
L/L	97	143.95	1.23%
W/W	98	1,803.45	15.41%
X/X	99	19.47	0.17%
Total		11,706.27	100%
<i>Hydric soils (L/L), wetlands and open water (W/W) and instances where no recharge is calculated (X/X)</i>			
<i>Source: NJDEP</i>			

Aquifer Identification

An aquifer is an underground formation of permeable rock or unconsolidated materials that can yield significant quantities of water to wells or springs. The rate of recharge is not the same for all aquifers and that must be considered when pumping water from a well. Pumping too much water too fast draws down the water in the aquifer and eventually causes a well to yield less and less water and even run dry.

Aquifers are typically equated to the type of geologic formation in which they exist. Aquifers in New Jersey are classified as either bedrock or surficial. Bedrock aquifers consist of rock formations while surficial aquifers are formed from unconsolidated materials such as sand, gravel, or glacial sediment. Bedrock aquifers in the Ridge and Valley and Highlands contain water in fractures within the rock while surficial aquifers contain water primarily in the spaces between sand and gravel particles.

Hope Township is made up completely of bedrock aquifers. Jacksonburg Limestone, Kittatinny Supergroup, and Hardyston Quartzite comprise 52% of the bedrock aquifers. Bedrock aquifers in Hope Township are shown on the Bedrock Aquifer Map (*Map 9*) and detailed in *Table 13*.

Table 13. Bedrock Aquifers in Hope Township			
<i>Name</i>	<i>Rank</i>	<i>Acres</i>	<i>Percent</i>
Jacksonburg Limestone, Kittatinny Supergroup, and Hardyston Quartzite	C-B	6,054.20	51.72%
Martinsburg Formation and Jutland Sequence	D	4,297.72	36.71%
Igneous and metamorphic rocks	D	1,354.36	11.57%
Total		11,706.27	100%
<i>Source: NJDEP</i>			

Public Water Supply and Wellhead Protection

The 1986 Federal Safe Drinking Water Act Amendments (*Section 1428, P/L. 93-523, 42 USC 300 et. seq*) directed all states to develop a Well Head Protection Program (WHPP) Plan for both public community (CWS) and public non-community (NCWS) water supply wells. A component of the WHPP is the delineating of Well Head Protection Areas. This delineation is the first step in defining the sources of water to a public water supply in order to prevent and clean up groundwater contamination.

Well Head Protection Areas (WPAs) are delineated for both public community and non-community wells. The delineation for these wells are the two, five, and twelve-year tiers. Each tier represents the horizontal extent of groundwater captured by a well pumping at a specific rate over those periods of time.²⁰ There are no public community wells in Hope Township.

Riparian Zones

In order to better protect the public from hazards of flooding, preserve the quality of surface waters, and protect wildlife and vegetation, the NJDEP has adopted Flood Hazard Area Control Act Rules (N.J.A.C. 7:13)²¹ in order to incorporate more stringent standards for development in flood hazard areas and riparian zones. A riparian zone is land and vegetation within land adjacent to surface waters. Riparian areas in the Ridge and Valley and Highlands include all open waters, flood prone areas, and wildlife corridors (300-foot corridors along each stream bank).

Activity within the regulated area of the flood hazard area and the riparian zone may be restricted if it includes or results in one or more of the following:

1. The alteration of topography through excavation, grading, and/or placement of fill;
2. The clearing, cutting and/or removal of vegetation in a riparian zone;
3. The creation of impervious surface;
4. The storage of unsecured material;
5. The construction, reconstruction, and/or enlargement of a structure; and
6. The conversion of a building into a private residence or a public building

In most area of New Jersey, Category 1 waters require a 300-foot buffer, while other surface waters, such as those classified as FW2-NT are subjected only to a regulated 50-foot riparian zone, measured from the top of the bank, along both side of all waters.

WETLANDS

Wetlands are important natural resources that contribute significantly to an area's social, economic, and environmental health. Among the services they provide are filtration of chemicals, pollutants, and sediment from water, flood control, critical habitat for wildlife, recreation, and tourism. The NJDEP defines a freshwater wetland as "an area that is inundated or saturated by surface water or ground water 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 three-parameter approach (that is, hydrology, soils, and vegetation) enumerated in the 1989 Federal Manual."²² (N.J.A.C. 7:7A) The NJDEP has adopted this manual as the technical basis for identifying and delineating wetlands. Hope Township is home to many wetland areas, typically following the major stream corridors throughout the Township.

The NJDEP regulates virtually all activities in a wetland, including removing vegetation, filling, and placing obstructions. Depending on the environmental value of a particular wetland, there may also be a transition area, or buffer, around the wetland that will require a waiver issued by the NJDEP for any activity within that zone. A wetland containing endangered species habitat would require a 150-foot wide transition area. Wetlands in New Jersey are classified into three different values: exceptional resource value, ordinary resource value, or intermediate resource value:

Exceptional Resource Value Wetland

- Discharges into FW-1 water and FW-2 trout producing waters and their tributaries;
- Is a present habitat for threatened or endangered species; or
- Is a documented habitat for threatened or endangered species, and remains suitable for breeding, resting, or feeding by the species during the normal period these species would use the habitat

Ordinary Resource Value Wetlands

- A freshwater wetland which does not exhibit any of the characteristics of an Exceptional Resource Value Wetland which is:
 - An isolated wetland, as defined at *N.J.A.C. 7:7A-1.4*, which:
 - Is smaller than 5,000 square feet; and
 - Has the uses listed below covering more than 50% of the area within 50 feet of the wetland boundary. In calculating the area covered by a use, NJDEP will only consider a use that was legally existing in that location prior to July 1, 1988, or was permitted under this chapter since that date:
 - Lawns
 - Maintained landscaping
 - Impervious surfaces
 - Active railroad right-of-way
 - Graveled or stoned parking/storage areas and roads
 - A drainage ditch
 - A swale, or

- A detention facility that was uplands at the time it was created regardless of the wetland resource classification of the wetlands under these rules, or the classification of the body of water, as FW-1 or FW-2 trout production, to which is discharges

Intermediate Resource Value Wetlands

- A freshwater wetland of intermediate resource value is any wetland not defined as exceptional or ordinary.

According to the NJDEP 2012 Land Use/Land Cover data, there are 1,428 acres of wetlands within Hope Township occupying approximately 12% of the Township. The wetlands map (**Map 10**) shows the locations of wetlands in Hope Township. **Table 14** presents a summary of wetlands by type. Deciduous wooded wetlands is the dominant type of wetlands in Hope Township, accounting for more than half (58%) of the Township’s wetlands and 7% (833 acres) of the Township’s overall land. The majority of the deciduous wooded wetlands are located along the riparian corridor of the major waterways and adjoining Silver Lake.

Table 14. Wetlands Classifications			
<i>Classifications</i>	<i>Acreage</i>	<i>% of Wetlands</i>	<i>% of Hope Twp.</i>
Deciduous Wooded Wetlands	833.25	58.34%	7.12%
Agricultural Wetlands (Modified)	202.13	14.15%	1.73%
Deciduous Scrub/Shrub Wetlands	179.97	12.60%	1.54%
Herbaceous Wetlands	108.81	7.62%	0.93%
Mixed Scrub/Shrub Wetlands (Deciduous Dom.)	32.59	2.28%	0.28%
Managed Wetland In Maintained Lawn Greenspace	14.98	1.05%	0.13%
Mixed Wooded Wetlands (Deciduous Dom.)	13.94	0.98%	0.12%
Coniferous Wooded Wetlands	8.31	0.58%	0.07%
Phragmites Dominate Interior Wetlands	8.27	0.58%	0.07%
Former Agricultural Wetland (Becoming Shrubby, Not Built-Up)	7.31	0.51%	0.06%
Mixed Wooded Wetlands (Coniferous Dom.)	5.56	0.39%	0.05%
Mixed Scrub/Shrub Wetlands (Coniferous Dom.)	5.41	0.38%	0.05%
Wetland Rights-Of-Way	3.54	0.25%	0.03%
Managed Wetland In Built-Up Maintained Rec Area	2.03	0.14%	0.02%
Coniferous Scrub/Shrub Wetlands	1.71	0.12%	0.02%
Disturbed Wetlands (Modified)	0.45	0.03%	0.004%
Total	1,428.26	100%	12.20%
<i>Source: NJDEP Land Use/Land Cover 2012</i>			

Though this information is based on NJDEP mapped wetlands, unmapped wetlands, which are still subject to NJDEP regulations, may exist in Hope Township. Wetlands require professional delineation before regulated activity could occur in or around them.

VEGETATION

Since 1986, the NJDEP has mapped land use within the state through their Land Use/Land Cover (LU/LC) data sets. Areas are delineated using color infrared images. The latest update of this data occurred in 2012. The NJDEP also maps critical habitat for imperiled and priority species through the Landscape Project, which is a proactive, ecosystem-level approach to the long-term protection of these habitats, rare plant species, and ecological communities through the Natural Heritage Database.

Land Cover

The NJDEP identifies six LU/LC categories: agriculture, barren land, forest, urban, water, and wetlands. Forested areas represent approximately 47% of Hope Township’s land cover, providing critical habitat for wildlife. Wetlands account for approximately 12% and urban land represents 12% of Hope Township’s land cover. Together, wetlands and streams provide riparian corridors providing a different type of habitat for wildlife species.

Table 15 shows the percentage of acreage covered by each land cover type and **Map 11** shows their distribution in the Township.

Table 15. Land Cover		
<i>Land Use Type</i>	<i>Acres</i>	<i>% of Township</i>
Forest	5,508.95	47.06%
Agriculture	3,107.91	26.55%
Wetlands	1,428.26	12.20%
Urban	1,410.48	12.05%
Water	237.19	2.03%
Barren Land	13.49	0.12%
Total	11,706.27	100%
<i>Source: NJDEP Land Use/Land Cover 2012</i>		

Forest Types

According to the 2012 LU/LC data, approximately 5,509 acres, or 47% of Hope Township is classified as forested, with 69% of forest classified as Deciduous Forest with a >50% Crown Closure. The second most prevalent category is Mixed Forest containing >50% Coniferous with >50% Crown Closure, followed by Deciduous Forest with a 10-50% Crown Closure. **Table 16** below displays the complete breakdown.

Table 16. Forest Classifications			
<i>Classification</i>	<i>Acres</i>	<i>% of Category</i>	<i>% of Township</i>
Deciduous Forest (>50% Crown Closure)	3,786.12	68.73%	32.34%
Mixed Forest (>50% Coniferous With >50% Crown Closure)	260.06	4.72%	2.22%
Deciduous Forest (10-50% Crown Closure)	256.99	4.66%	2.20%
Mixed Forest	237.65	4.31%	2.03%

Table 16. Forest Classifications

<i>Classification</i>	<i>Acres</i>	<i>% of Category</i>	<i>% of Township</i>
(>50% Deciduous With >50% Crown Closure)			
Mixed Deciduous/Coniferous Brush/Shrubland	212.30	3.85%	1.81%
Deciduous Brush/Shrubland	187.92	3.41%	1.61%
Coniferous Brush/Shrubland	171.06	3.11%	1.46%
Old Field (< 25% Brush Covered)	142.18	2.58%	1.21%
Coniferous Forest (>50% Crown Closure)	138.64	2.52%	1.18%
Mixed Forest (>50% Deciduous With 10-50% Crown Closure)	37.68	0.68%	0.32%
Coniferous Forest (10-50% Crown Closure)	26.28	0.48%	0.22%
Plantation	26.47	0.48%	0.23%
Mixed Forest (>50% Coniferous With 10-50% Crown Closure)	24.26	0.44%	0.21%
Phragmites Dominate Old Field	1.34	0.02%	0.01%
Total	5,508.95	100%	47.06%

Source: NJDEP

The following definitions set the classification parameters:

Deciduous - This category includes forested lands that contain deciduous tree species. Deciduous trees are those which lose their leaves at the end of the growing season. These trees remain leafless throughout the winter and sprout new leaves the following spring. The average height of the stand is at least 20 feet. A forest stand must have at least 75% canopy coverage from deciduous trees species to be placed in this category. In Hope Township there are 4,043 acres of deciduous forest.

Deciduous Forest, >50% Crown Closure

This category contains deciduous stands with crown closure greater than 50%. Crown closure is the percentage of a forest area occupied by the vertical projections of tree crowns. Crown closure percentages provide a reasonable estimate of stand density. The majority of the deciduous forests in New Jersey are in this category.

Deciduous Forest, 10-50% Crown Closure

Brush/Shrubland - When the vegetation is less than 20 feet high, the area is categorized as brush/shrubland. The following types have been identified in Hope Township and total 713 acres:

Deciduous Brush/Shrubland

This category contains natural forested areas with deciduous species less than 20 feet in height. An area must have greater than 25% brush cover to be placed in this category. This category can also contain inactive agricultural areas that have grown over with brush.

Mixed Deciduous/Coniferous Brush/Shrubland

This category contains natural forested areas less than 20 feet high with a mixture of coniferous and deciduous trees.

Coniferous Brush/Shrubland

Old Field

This category includes open areas that have less than 25% brush cover. The predominant cover types are grasses, herbaceous species, tree seedlings, and/or saplings. Old fields are distinguished from inactive farmland by the amount of brush cover. If a field contains few woody stems (<5%), it should be placed in the inactive farmland category. An area should be placed in the old field category if the amount of brush cover requires extensive brush removal before plowing. In some cases, it may not be established that the previous use was agricultural.

Coniferous - This category includes forested lands that contain coniferous tree species. Coniferous species are those trees commonly known as evergreens. They do not lose their leaves (needles) at the end of the growing season but retain them through the year. Conifers can easily be distinguished from deciduous trees on wintertime color infrared photography because of their high infrared reflectance due to their leaf retention. The stand must be 20 feet high and must be stocked by at least 75% conifers to be labeled as a coniferous stand. This is a small percentage of the forest cover in Hope Township, totaling 165 acres.

Coniferous Forest, >50% Crown Closure

Coniferous Forest, 10-50% Crown Closure

Mixed Forest – When neither coniferous nor deciduous trees represents 75% or more of the forested area, it is classified as Mixed Forest. This category is further broken down according to which type is 50% or greater in prevalence, conifers or deciduous trees, and the extent of crown closure. In Hope Township, Mixed Forest types total 560 acres.

Mixed Forest (>50% Coniferous With >50% Crown Closure)

Mixed Forest (>50% Coniferous With 10-50% Crown Closure)

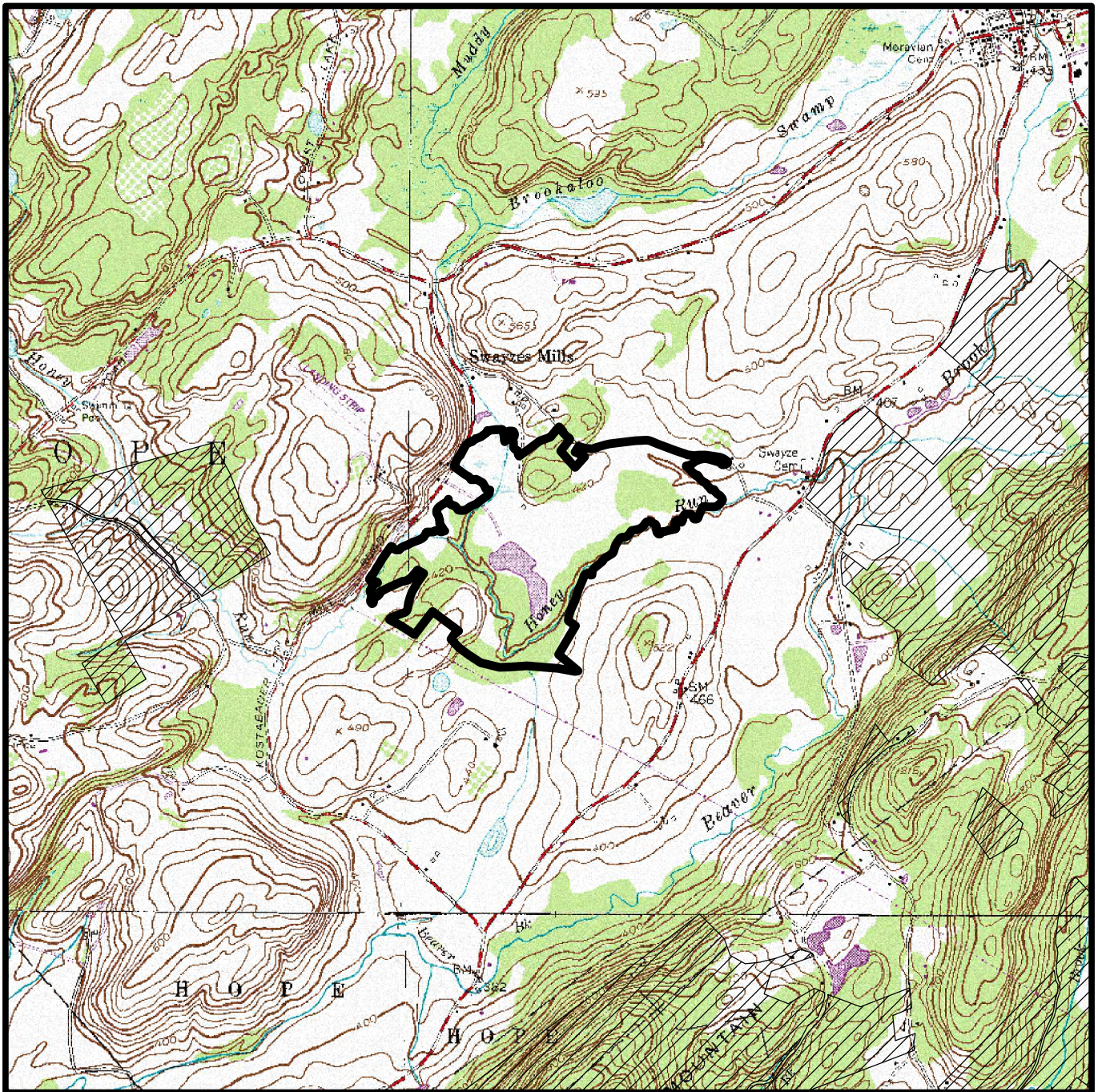
Mixed Forest (>50% Deciduous With >50% Crown Closure)

Mixed Forest (>50% Deciduous With 10-50% Crown Closure)

Natural Heritage Priority Sites

The State of New Jersey is home to a wide range of different ecosystems, some large and dominating, others less pronounced and more vulnerable to development. The NJDEP identifies and maps areas which are considered unique ecosystems and are known as the Natural Heritage Property sites (NHP). Hope Township has two Natural Heritage Priority sites: Swayze and Southtown Sinkhole, **Figure 1** and **Figure 2** respectively. The Swayze site contains a “large water filled sand/gravel pit and adjacent stream corridor” and provides habitat for plant species that are imperiled in the state. The Swayze site has a biodiversity rank of B5 indicating general biodiversity interest. The Southtown Sinkhole site contains a sinkhole pond with wooded limestone uplands and provides habitat for a critically imperiled plant species in the state. The Southtown Sinkhole site has a biodiversity rank of B4 indicating that the site has a “moderate significance on a global level” and contains “a good or excellent occurrence or only viable state occurrence of an element that is critically endangered in the State”. Although the Southtown Sinkhole site is located in neighboring Frelinghuysen Township, the secondary boundary of the site includes the lands that drain towards the pond which encompasses Hope Township.

Figure 1. Swayze Natural Heritage Priority Site



Natural Heritage Priority Site

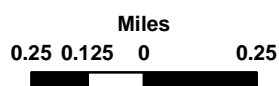
Swayze

Warren County



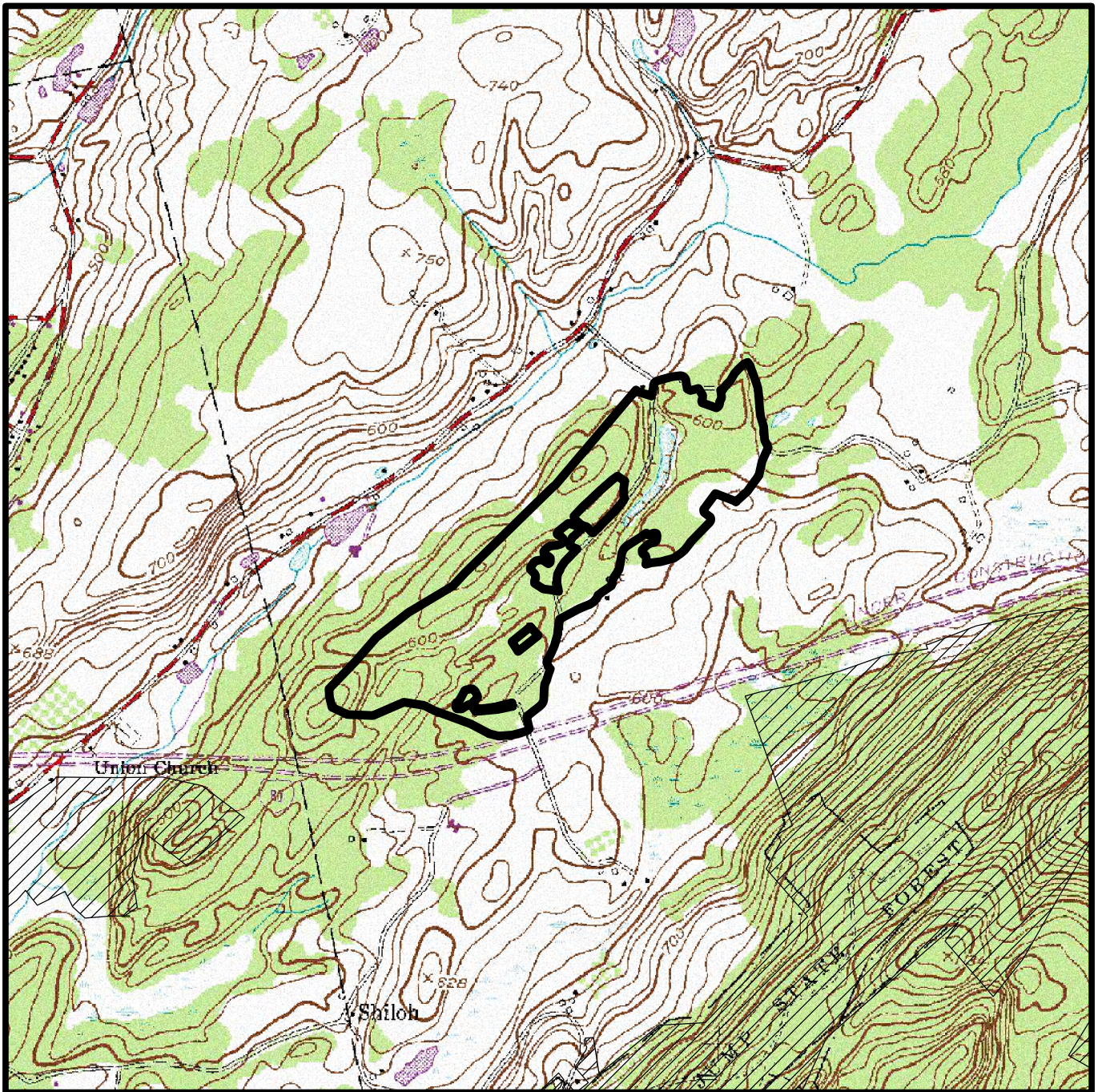
NJ Department of Environmental Protection
Division of Parks and Forestry

Natural Lands Management



 Priority Sites
 Public Land

Figure 2. Southtown Sinkhole Natural Heritage Priority Site



Natural Heritage Priority Site

Southtown Sinkhole

Warren County



NJ Department of Environmental Protection
Division of Parks and Forestry

Natural Lands Management



 Priority Sites
 Public Land

Rare Plant Species

According to the Natural Heritage Database and the Landscape Project (Version 3.3), Hope Township is home to two State Endangered vascular plant species. **Table 17. Rare Plant Species** lists all rare and endangered plant species identified in Hope Township and their rankings. See **Appendix A** for the complete NJDEP Natural Heritage Priority Site list of rare plant and animal species located on or in the immediate vicinity of the Township’s Natural Heritage Priority Sites (Swayze and Southtown Sinkhole). Species listed as State Endangered are defined as those with its survival threatened at the state or national level.

Table 17. Rare Plant Species			
<i>Common Name</i>	<i>Scientific Name</i>	<i>Federal Protection Status</i>	<i>State Protection Status</i>
<i>Vascular Plant Species in the Immediate Vicinity of a Project Site</i>			
Marsh Water-starwort	<i>Callitriche palustris</i>	NA	NA
Tuckerman's Sedge	<i>Carex tuckermanii</i>	NA	Endangered
Scarlet Indian-paintbrush	<i>Castilleja coccinea</i>	NA	NA
Spreading Globe Flower	<i>Trollius laxus ssp. laxus</i>	NA	Endangered
<i>Vascular Plant Species Possibly Located on Project Sites</i>			
Retorse Sedge	<i>Carex retrorsa</i>	NA	NA
Angled Spike-rush	<i>Eleocharis quadrangulata</i>	NA	NA
<i>Source: NJDEP Natural Heritage Database and Landscape Project (Version 3.3) Report</i>			

Ecological Communities

Hope Township is located with the majority of its area in the Ridge and Valley Physiographic Province and its southern border located in the Highlands Province. **Table 18** lists the ecological communities that are found in both provinces and give an example of the ecological communities that could be found in Hope Township.

Table 18. Ecological Communities near Hope Township	
<i>Ridge and Valley Ecological Communities</i>	<i>Highlands Ecological Communities</i>
<ul style="list-style-type: none"> • Ridgetop pitch pine-scrub oak forest • Talus slope • Chestnut oak forest • Northern mixed oak forest • Hemlock-mixed hardwood forest • Sugar maple-mixed hardwood forest • Hardwood swamp • Glacial bog • Inland white cedar swamp • Black spruce swamp • Emergent marsh • Grass-sedge marsh • Shrub swamp 	<ul style="list-style-type: none"> • Ridgetop pitch pine-scrub oak forest • Talus slope • Chestnut oak forest • Northern mixed oak forest • Hemlock-mixed hardwood forest • Sugar maple-mixed hardwood forest • Hardwood swamp • Glacial bog • Inland white cedar swamp • Black spruce swamp • Emergent marsh • Grass-sedge marsh • Shrub swamp

Table 18. Ecological Communities near Hope Township	
<i>Ridge and Valley Ecological Communities</i>	<i>Highlands Ecological Communities</i>
<ul style="list-style-type: none"> • Limestone rock outcrop • Limestone glade • Limestone fen • Limestone pond shore • Pond shore • Successional communities 	<ul style="list-style-type: none"> • Pond shore • Successional communities
<i>Source: Physiographic Provinces and Ecological Communities²³</i>	

WILDLIFE

Critical Habitat

Hope Township may have areas that provide habitat suitable for threatened or endangered species. The NJDEP Landscape Project^c ranks patches of habitat using a numeric system (0 through 5) for purpose of identifying habitat which may be suitable for threatened and endangered species. Habitats identified as Rank 3 through 5 are considered environmentally significant by the NJDEP. The following is a description of each rank:

Rank 5 is assigned to species-specific patches containing one or more occurrences of wildlife listed as endangered or threatened pursuant to the Federal Endangered Species Act or 1973.

Rank 4 is assigned to species-specific patches with one or more occurrences of State endangered species.

Rank 3 is assigned to species-specific patches containing one or more occurrences of State threatened species.

Rank 2 is assigned to species-specific patches that meet habitat-specific suitability requirements such as minimum size criteria for endangered, threatened, or priority wildlife species, but do not intersect with any confirmed occurrences of such species.

Rank 1 is assigned to species-specific patches that meet habitat-specific suitability requirements such as minimum size criteria for endangered, threatened, or priority wildlife species, but that do not intersect with any confirmed occurrences of such species.

Rank 0 is assigned to species-specific patches that do not contain any species occurrences and do not meet any habitat-specific suitability requirements.

According to the NJDEP Landscape Project, Hope Township contains habitat patches Rank 0 through Rank 5 (federal endangered species). The majority of critical habitat is Rank 4 (52%), or patches that contain one or more occurrences of state endangered species. Areas containing habitat Rank 5, patches with federally listed endangered species, cover 14% of the Township (1,584 acres) and are located in the southeastern section on the Township in Jenny Jump State Forest with another patch located in the center of the Township between Brookaloo Swamp and Beaver Brook. Rank 3, patches with State threatened species, make up 11% of the Township and are dispersed in large areas where there are contiguous areas of farmland or forest. Rank 1 and 2 are located throughout the Township, mostly found in areas of farmland and urban areas. Together, these areas make up approximately 12% of the Township. Rank 0, patches with no endangered species, cover 11% of the Township and are along major roadways and developed areas in the Township.

^c Version 3.3, released in 2017

A summary of habitat patches within Hope Township is outlined in **Table 19** and their distribution within the Township is displayed on the endangered species map (**Map 12**).

<i>Rank</i>	<i>Acres</i>	<i>Percent</i>
0	1,309.37	11.19%
1	705.38	6.03%
2	717.17	6.13%
3	1,307.14	11.17%
4	6,082.50	51.96%
5	1,584.70	13.54%
Total	11,706.27	100%

Source: The Landscape Project (Version 3.3, 2017)

Threatened and Endangered Species

Hope Township is home to a wide array of wildlife including endangered and threatened species:

- Federally threatened species: 2;
- State endangered species: 5;
- State Threatened Species: 8; and
- State Species of Special Concern: 19.

A full list of these species can be found in **Table 20**.

<i>Common Name</i>	<i>Scientific Name</i>	<i>Class</i>	<i>Landscape Project Rank</i>	<i>Federal Status</i>	<i>New Jersey Status</i>
Mitchell's Satyr	<i>Neonympha mitchellii</i>	<i>Insecta</i>	5	Federally Listed Threatened	State Endangered
Bog Turtle	<i>Glyptemys muhlenbergii</i>	<i>Reptilia</i>	5	Federally Listed Threatened	State Endangered
Longtail Salamander	<i>Eurycea longicauda longicauda</i>	<i>Amphibia</i>	3	NA	State Threatened
American Kestrel	<i>Falco sparverius</i>	<i>Aves</i>	3	NA	State Threatened
Barred Owl	<i>Strix varia</i>	<i>Aves</i>	3	NA	State Threatened
Bobolink	<i>Dolichonyx oryzivorus</i>	<i>Aves</i>	3	NA	State Threatened
Grasshopper Sparrow	<i>Ammodramus savannarum</i>	<i>Aves</i>	3	NA	State Threatened
Osprey	<i>Pandion haliaetus</i>	<i>Aves</i>	3	NA	State Threatened
Red-headed Woodpecker*	<i>Melanerpes erythrocephalus</i>	<i>Aves</i>	3	NA	State Threatened
Wood Turtle	<i>Glyptemys insculpta</i>	<i>Reptilia</i>	3	NA	State Threatened

**Table 20. Threatened and Endangered Species
(on or in the Immediate Vicinity of Project Sites)**

<i>Common Name</i>	<i>Scientific Name</i>	<i>Class</i>	<i>Landscape Project Rank</i>	<i>Federal Status</i>	<i>New Jersey Status</i>
Bald Eagle	<i>Haliaeetus leucocephalus</i>	<i>Aves</i>	4	NA	State Endangered
Vesper Sparrow	<i>Pooecetes gramineus</i>	<i>Aves</i>	4	NA	State Endangered
Bobcat	<i>Lynx rufus</i>	<i>Mammalia</i>	4	NA	State Endangered
Jefferson Salamander	<i>Ambystoma jeffersonianum</i>	<i>Amphibia</i>	2	NA	Special Concern
Black-billed Cuckoo	<i>Coccyzus erythrophthalmus</i>	<i>Aves</i>	2	NA	Special Concern
Blue-headed Vireo (Solitary Vireo)	<i>Vireo solitarius</i>	<i>Aves</i>	2	NA	Special Concern
Brown Thrasher	<i>Toxostoma rufum</i>	<i>Aves</i>	2	NA	Special Concern
Canada Warbler	<i>Wilsonia canadensis</i>	<i>Aves</i>	2	NA	Special Concern
Cerulean Warbler	<i>Dendroica cerulea</i>	<i>Aves</i>	2	NA	Special Concern
Cooper's Hawk	<i>Accipiter cooperii</i>	<i>Aves</i>	2	NA	Special Concern
Eastern Meadowlark	<i>Sturnella magna</i>	<i>Aves</i>	2	NA	Special Concern
Great Blue Heron	<i>Ardea herodias</i>	<i>Aves</i>	2	NA	Special Concern
Hooded Warbler	<i>Wilsonia citrina</i>	<i>Aves</i>	2	NA	Special Concern
Least Bittern	<i>Ixobrychus exilis</i>	<i>Aves</i>	2	NA	Special Concern
Northern Parula	<i>Parula americana</i>	<i>Aves</i>	2	NA	Special Concern
Red-shouldered Hawk	<i>Buteo lineatus</i>	<i>Aves</i>	2	NA	Special Concern
Veery	<i>Catharus fuscescens</i>	<i>Aves</i>	2	NA	Special Concern
Wood Thrush	<i>Hylocichla mustelina</i>	<i>Aves</i>	2	NA	Special Concern
Worm-eating Warbler	<i>Helmitheros vermivorum</i>	<i>Aves</i>	2	NA	Special Concern
Eastern Box Turtle	<i>Terrapene carolina carolina</i>	<i>Reptilia</i>	2	NA	Special Concern
Northern Copperhead	<i>Agkistrodon contortrix mokasen</i>	<i>Reptilia</i>	2	NA	Special Concern
Spotted Turtle	<i>Clemmys guttata</i>	<i>Reptilia</i>	2	NA	Special Concern

**Only within the immediate vicinity of a Project Site (within 1/4 mile)*

Source: NJDEP Natural Heritage Database and Landscape Project (Version 3.3) Report

Potential Vernal Habitat

Hope Township is home to one confirmed vernal habitat and many potential vernal habitats, also referred to as vernal pools. (*Map 13*) These natural wetland depressions fill with water during the rainy season in fall and remain ponded until the dry weather in early summer causes them to dry out. The vernal pools provide habitat for a wide array of amphibians, reptiles, invertebrates, and many species of wetland vegetation, but cannot support fish populations because of their brief dry period. Certain wildlife species, referred to as “obligate” vernal pool breeders, have evolved with a reliance upon these fish-free breeding sites and cannot successfully reproduce elsewhere. Other wildlife species, referred to as “facultative” vernal pool species, also take advantage of vernal habitats for breeding and/or feeding purposes, but are not limited to performing these functions solely in vernal pools.

The New Jersey Department of Environmental Protection defines a vernal habitat in the Freshwater Wetlands Protection Act Rules (see *N.J.A.C. 7:7A-1.4*) as wetland that meet the following criteria:

1. The wetland must consist of or contain a confined basin or depression without a permanently flowing outlet;
2. The pool must feature evidence of breeding by at least one obligate or two facultative vernal habitat species (these species are identified as *N.J.A.C. 7:7A, Appendix I*);
3. The area must maintain ponded water for at least two continuous months between March and September of a normal rainfall year, and;
4. The area must remain free of fish populations throughout the year, or it must dry up at some time during a normal rainfall year.

Wetland areas featuring a confined basin depression exhibiting the hydrologic and biological criteria established above are said to meet “certification” requirements, and may be referred to as “certified vernal habitats”, or simply “vernal habitat areas”. The NJDEP maps both certified “vernal habitat areas” and potential vernal habitat areas” using New Jersey’s Landscape Project, which is available online on New Jersey GeoWeb at <http://www.nj.gov/dep/gis/geoweb splash.htm>. The mapping depicts a 300-meter radii circle over the estimated center of both “certified” and “potential” vernal habitats. The 300-meter buffer is intended to account for the varying sizes of individual pool, the likely presence of adjacent wetland areas and – significantly- the adjacent dispersal habitats typically utilized by many resident amphibian species. The Landscape Project defines its mapping of vernal habitats as follows:

Potential vernal habitat areas- These are areas identified as possibly containing a vernal pool that meets the criteria of a “vernal habitat” pursuant to N.J.A.C. 7:7A-1.4. These sites include sites that have been field inspected and have been found to meet the physical characteristics of a vernal habitat, but for which biological criteria have not yet been measured, as well as sites that have not been checked by NJDEP staff.

Vernal habitat areas- These are areas that contain pools that have been field-verified by the NJDEP and have been determined to meet both physical and biological characteristics of a vernal habitat in accordance with N.J.A.C. 7:7A-1.4. The Freshwater Wetlands Protection Act Rules (N.J.A.C. 7:7A) protects vernal habitats as wetland areas requiring a

50 foot buffer, or a 150 foot buffer is the pool supports a State threatened or endangered species.

In Hope Township, the Landscape Project mapping identified 19 separate potential vernal habitat polygons and one vernal habitat area. This equates to approximately 1,839 acres potential vernal habitat and 57 acres of vernal habitat area. All potential and certified vernal habitat areas are show on the vernal habitat map (*Map 13*).

Table 21 lists obligate and facultative fauna species found in vernal habitats. Some of these species *may be present* but none are *confirmed* to be present in Hope Township’s potential vernal habitat areas.

Table 21. Obligate and Facultative Fauna Species Found in Vernal Habitats in New Jersey		
<i>Obligate Species</i>	<i>Facultative Species</i>	
Marbled Salamander***	Snapping Turtle	Upland Chorus Frog
Blue-spotted Salamander*	Eastern Mud Turtle	Northern Cricket Frog
Jefferson Salamander***	Spotted Turtle***	New Jersey Chorus Frog
Eastern Tiger Salamander*	Eastern Painted Turtle	Bull Frog
Wood Frog	Red-spotted Newt	Green Frog
Eastern Spadefoot Toad	American Toad	Southern Leopard Frog
Fairy shrimp (order <i>Arnostraca</i>)	Fowler’s Toad***	Four-toed Salamander
	Pine Barrens	Northern Spring Peeper
	Treefrog**	Long-tailed Salamander**
	Northern Gray	Wood Turtle**
	Treefrog	
	Southern Gray	
	Treefrog*	

* State Endangered; ** State threatened; *** Special concern
Source: NJDEP

Description of the 71 species of reptiles and amphibians found in New Jersey, including the obligate and facultative vernal pool species, can be found on the NJDEP Division of Fish and Wildlife at: http://www.nj.gov/dep/fgw/ensp/fieldguide_herps.htm.

LAND USE/LAND COVER

Hope Township has 47% of its total land cover as forest comprised of deciduous, coniferous, and mixed forest. Another 26% is categorized as agricultural lands through the NJDEP Land Use/Land Cover digital orthophotography. **Table 22** presents a breakdown of the six different land use types found within Hope Township and includes a comparison of the land use/land cover in 1986 and what is found in 2012.

Type	1986		2012	
	Acres	Percent	Acres	Percent
Forest	5,527.91	47.22%	5,508.95	47.06%
Agriculture	3,541.61	30.25%	3,107.91	26.55%
Wetlands	1,470.71	12.56%	1,428.26	12.20%
Urban	963.20	8.23%	1,410.48	12.05%
Water	186.36	1.59%	237.19	2.03%
Barren Land	16.48	0.14%	13.49	0.12%
Total	11706.27	100.00%	11,706.27	100%

Forest - Forestland includes any lands covered by woody vegetation other than wetlands. These areas are capable of producing timber and other wood products, and of supporting many kinds of outdoor recreation. Forestland is an important category environmentally because it affects air quality, water quality, wildlife habitat, climate, and many other aspects of the ecology of an area. Forestland makes up 47% of Hope Township and deciduous forest with greater than 50% crown closure comprises 32% of Hope Township area (**Table 16**). Forestland in Hope Township has decreased slightly since 1986 (19 acres).

Agriculture - includes all lands used primarily for the production of food and fiber and some of the structures associated with this production. Of the total land cover, 27% is agricultural. The majority of these lands, 92% or 2,869 acres, is used for cropland and pastureland, while 2.5% is used for orchards, nurseries, and horticultural areas. Confined feeding operations covers 3 acres (less than 1%) of agricultural land, and the remaining 5% (158 acres) is for other agricultural purposes. **Table 23** details a breakdown of the agricultural land classifications in Hope Township. In 1986, agricultural lands made up 30% of the Township. Since 1986, agricultural lands have decreased 434 acres or 4%.

<i>Classification</i>	<i>Acres</i>	<i>% of Category</i>	<i>% of Township</i>
Cropland and Pastureland	2,869.33	92.32%	24.51%
Other Agriculture	157.71	5.07%	1.35%
Orchards/Vineyards/Nurseries/Horticultural Areas	77.55	2.50%	0.66%
Confined Feeding Operations	3.33	0.11%	0.03%
Total:	3,107.91	100%	26.55%

Wetlands - Wetlands are defined as areas saturated by ground and surface waters at a frequency and duration sufficient to support vegetation adapted for life in saturated soil conditions. The wetlands of New Jersey are located around the numerous interior stream systems and along coastal rivers and bays. According to the NJDEP 2012 Land Use/Land Cover data, wetlands in Hope Township occupy 1,428 acres, or 12.2% of the total land area. The sub-classification of deciduous wooded wetland amounts to 58% or 833 acres of wetlands land use and 7% of the total land use in Hope Township (**Table 14**). Deciduous wooded wetlands are defined as “closed canopy swamps dominated by deciduous trees normally associated with watercourses, edges of marshes, and isolated wetlands.”²⁴ Wetlands in the Township have decreased 42 acres since 1986.

Urban - Urban land is categorized by landscapes influenced by human activity. This category includes residential, commercial and services, transportation, industrial complexes, and recreation. Urban land use makes up 12% of the Township’s overall land usage. Residential, rural single unit makes up the majority (63%) of the total urban land uses but only 8% of the overall Township. Urban land impacts the amount of impervious cover within the Township. In 1986, urban land (impervious surfaces) made up 8% of the Township’s total area. In 2012, urban land consisted of 12% of the total Township, a 50% increase. **Table 24** presents a breakdown of the urban land use classifications in Hope Township.

<i>Classification</i>	<i>Acres</i>	<i>% of Category</i>	<i>% of Township</i>
Airport Facilities	16.09	1.14%	0.14%
Athletic Fields (Schools)	2.36	0.17%	0.02%
Cemetery	8.78	0.62%	0.08%
Commercial/Services	38.67	2.74%	0.33%
Industrial	5.58	0.40%	0.05%
Major Roadway	67.45	4.78%	0.58%
Mixed Urban or Built-Up Land	1.88	0.13%	0.02%
Other Urban or Built-Up Land	124.94	8.86%	1.07%
Recreational Land	48.65	3.45%	0.42%
Residential, High Density or Multiple Dwelling	1.26	0.09%	0.01%
Residential, Rural, Single Unit	887.83	62.95%	7.58%
Residential, Single Unit, Low Density	107.97	7.65%	0.92%
Residential, Single Unit, Medium Density	49.39	3.50%	0.42%
Stadium, Theaters, Cultural Centers and Zoos	11.23	0.80%	0.10%
Stormwater Basin	0.54	0.04%	0.005%
Transportation/Communication/Utilities	10.07	0.71%	0.09%
Upland Rights-Of-Way Undeveloped	27.76	1.97%	0.24%
Total	1,410.48	100%	12.05%

Water - All areas within the landmass of New Jersey that are periodically water covered are included in this category. All water bodies should be delineated as they exist at the time of data acquisition, except areas in an obvious state of flood. Water represents 2% of Hope Township's total land area, with 1% identified as artificial lakes. (*Table 25*)

Table 25. Water Classifications in Hope Township			
<i>Classification</i>	<i>Acres</i>	<i>% of Category</i>	<i>% of Township</i>
Artificial Lakes	130.40	54.98%	1.11%
Bridge Over Water	0.52	0.22%	0.004%
Natural Lakes	73.53	31.00%	0.63%
Streams and Canals	32.74	13.80%	0.28%
Total	237.19	100%	2.03%

Barren Land - Barren lands in Hope Township are classified as transitional areas (land under construction). Barren land represents 0.12% (13.5 acres) of the Township's total land area and has seen a 2% decrease since 1986.

Preserved Farmland - Hope Township is 19.2 square miles (12,288 acres) in size. Of this, **7,261 acres** are under farmland assessment, which includes croplands, woodlands, farm structures and wetlands/waterways that occur on an agricultural property.²⁵ Hope Township is home to **1,306 acres** of preserved farmland.²⁶

AIR

Air Quality

Air quality in Hope Township and New Jersey is carefully monitored by the New Jersey Department of Environmental Protection through various regional collection stations that ensure air quality standards are meeting the national standards set by the Clean Air Act. The pollutants measured in the air can vary greatly over the course of a year and even from day to day depending on weather conditions and traffic patterns. The local air testing stations in New Jersey measure maximum pollutant concentration, assess population exposure, determine the impact of major pollution sources, measure background levels, determine the extent of regional pollutant transport, or measure secondary impacts in rural areas. The information gathered is transmitted in real time and consolidated in yearly reports to ensure that both State and National Clean Air Standards are met.

National Clean Air Standards

In 1970, the federal government passed the Clean Air Act, setting standards to be met throughout the country. The Act was amended in 1990, with focus on four areas of pollution: acid rain, urban air pollution, toxic air emissions, and stratospheric ozone depletion. The amendment also introduced a permits program and strengthened enforcement.²⁷

Under the Act, it is the responsibility of the US Environmental Protection Agency (EPA) to set National Ambient Air Quality Standards (NAAQS) for six common pollutants (ozone, carbon monoxide, sulfur dioxide, nitrogen dioxide, fine particulates, and lead) and the responsibility of each state to develop State Implementation Plans (SIPs) to attain and maintain these standards. In New Jersey, that role is assigned to the NJDEP Division of Air Quality (DAQ) and its Bureau of Air Monitoring (BAM), which monitors the State's ambient air monitoring network.

Regional/Local Statistics

The State uses the air quality data from its air monitoring network to determine which areas are in compliance with NAAQS as well as overall trends in air pollution levels. The NJDEP produces yearly reports but also provides real-time reporting through its Air Quality Index website.²⁸ Although there are monitoring sites throughout the state, each site measures a limited set of pollutants; no one site tracks them all. The six pollutants for which standards have been set by the EPA - ozone, sulfur dioxide, carbon monoxide, nitrogen dioxide, particulate matter, and lead, are known as *criteria pollutants*. Over the period of 1990-2010, total emissions of these air pollutants have decreased by more than 41% nationally.²⁹

In New Jersey, according to the NJDEP DAQ website,³⁰ air quality has improved significantly over the last 40 years since the first Earth Day, in 1970, but exceeds the current NAAQS standards for ozone throughout the state and for fine particulates in urban areas (13 counties). New Jersey has attained sulfur dioxide (with the exception of a portion of Warren County, see *Sulfur Dioxide* section below), lead, carbon monoxide, and nitrogen dioxide standards. Additional air pollutants that may cause adverse health effects but are not criteria pollutants are referred to as Hazardous

Air Pollutants (HAPs) or air toxics. The NJDEP DAQ also regulates emissions of these HAPs. For many toxins the State has set its own standards, with stricter requirements than the EPA.

Ozone

Ozone (O₃) is defined by the NJDEP *2015 Ozone Summary*³¹ as a gas that consists of three oxygen atoms. Ozone occurs naturally in the upper atmosphere where it offers protection from harmful ultraviolet rays. However, when found at ground level, ozone can have serious adverse health effects. Ground-level ozone is formed through a chemical reaction that requires nitrous oxides (NO_x), volatile organic compounds (VOCs), and the presence of heat and sunlight. Therefore, as a result of the sunlight and heat necessary for ground-level ozone production, measurements are taken between April 1 and October 31.

The EPA revised National Ambient Air Quality Standards (NAAQS) for ozone in 2008, having determined that the previous standard of 0.08 parts per million (ppm) maximum daily eight-hour averages did not sufficiently protect public health. The revised standard of 0.075 ppm maximum daily 8-hour average went into effect on May 27, 2008. Attainment of the NAAQS is determined by taking the average of the fourth highest daily maximum 8-hour average concentrations that are recorded each year for three years.

New Jersey standards are based on 1-hour averaging with primary standards set at 0.12 ppm and secondary standards set at 0.075ppm.^d They are not as stringent as the revised NAAQS. To date, the effort to lower ozone concentrations has focused on reducing emissions of VOCs. However, improvements have leveled off in recent years, especially with respect to maximum 8-hour average concentrations. According to the NJDEP report, significant further improvements will require reductions in both VOCs and NO_x. Levels of NO_x in New Jersey are largely affected by emissions from regional upwind sources outside of New Jersey.

Statewide, New Jersey is classified as a “marginal” ozone non-attainment area for NAAQS for the 2013-2015 period, with an overall score between 0.062 and 0.073 ppm. The highest 8-hour daily maximum reached 0.092 at the Bayonne Monitoring Station (approximately 47 miles from Hope Township). The ozone monitoring stations closest to Hope Township reported levels close to NAAQS for the period 2013-2015. Columbia Wildlife Management Area (WMA) and Flemington both reached the daily 8 hour maximum for NAAQS standards for highest daily maximum. (***Table 26***)

^d Although the standards have been reduced to 0.070 in 2016, the data collected is from 2015 and is based off the 2015 standards (0.075)

Monitoring Site	1-Hour Average Concentration New Jersey Standards: Primary: 0.12ppm; Secondary: 0.08	8- hour Average Concentrations NAAQS Standard: 0.075 ppm		
	<i>Maximum</i>	<i>Highest Daily Maximum</i>	<i>4th – Highest Daily Maximum</i>	<i>2013-2015 Average of 4th –Highest Daily Max.</i>
Columbia WMA (5.25 mi.)	0.093	0.075	0.066	0.062
Chester (17.5 mi.)	0.084	0.073	0.070	0.070
Flemington (28.5 mi.)	0.090	0.075	0.073	0.070

*Source: NJDEP 2015 Ozone Summary*³²

Sulfur Dioxide

NJDEP’s 2015 *Sulfur Dioxide Summary*³³ defines sulfur dioxide (SO₂) as “a heavy, colorless gas with a suffocating odor that easily dissolves in water to form sulfuric acid. SO₂ gases can be formed when fuels containing sulfur are burned, or when gasoline is extracted from oil.” Most of the sulfur dioxide released into the air comes from electric utilities, followed by fossil fuel combustion, industrial processes, non-road equipment, and on-road vehicles. Sulfur dioxide can be harmful to people (primarily children, the elderly, and asthmatics) and the environment when it reacts with other gases and particulates in the air to form sulfates. These sulfates are a primary cause of reduced visibility in the eastern United States. Sulfur dioxide can also combine with other substances in the atmosphere to form acid rain, which damages forests, crops, aquatic environments, and decays building materials. There are several standards for monitoring SO₂, ranging from 1-hour to annual averaging. The State has both primary and secondary standards. The primary standards are based on the 12-month average for two consecutive years as well as secondary standards for 12-month, 24-hour, and 3-hour averages. New Jersey’s standards differ slightly from national standards, as shown in **Table 27**.

<i>Averaging Period</i>	<i>Standard Type</i>	<i>New Jersey</i>	<i>National^a</i>
12-month average	Primary	80 µg/m ³ (0.03 ppm)	---
12-month average	Secondary	60 µg/m ³ (0.02 ppm)	---
24-hour average	Primary	365 µg/m ³ (0.14 ppm)	---
24-hour average	Secondary	260 µg/m ³ (0.10 ppm)	---
3-hour average	Secondary	1300 µg/m ³ (0.5 ppm)	0.5 ppm
1-hour average ^b	Primary	---	75 ppb

a-National standards are block averages rather than moving averages
b-To attain this standard, the 3-year average of the 99th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 75 ppm

Source: NJDEP 2015 Sulfur Dioxide Summary

Regulations requiring the use of low sulfur fuels in New Jersey have been effective in lowering SO₂ concentrations. In 2015, there were no exceedances of the 1-hour NAAQS recorded at any site. This is in contrast to 2014, when five exceedances were recorded at the Columbia WMA station (approximately 5.25 miles from Hope). The last year an exceedance of the national 3-hour, 24-hour, or 12-month SO₂ standards was recorded in the state was 1980. **Table 28** shows data for the monitoring sites closest to Hope Township that capture SO₂ data.

Table 28. Sulfur Dioxide 2015				
<i>parts per billion (ppb); parts per million(ppm)</i>				
<i>Monitoring Site</i>	<i>3-year Avg. 99th %-ile of Daily Max 1-Hour Avg (ppb)</i>	<i>3-hour Avg Max (ppm)</i>	<i>24-hour Avg Max (ppm)</i>	<i>12-Month Avg Max (ppm)</i>
Columbia WMA (c. 5.25 mi)	55	0.007	0.002	0.001
Chester (c. 17.5 mi.)	8	0.006	0.004	0.000

Source: NJDEP 2015 Sulfur Dioxide Summary

Carbon Monoxide

According to the NJDEP *2015 Carbon Monoxide Summary*,³⁴ carbon monoxide (CO) is a colorless, odorless, poisonous gas formed when carbon in fuels are not entirely burned. The primary creators of carbon monoxide emissions are on-road and off-road vehicles, with boilers, incinerators, and forest fires also contributing. The symptoms of exposure are headaches and nausea with those who have cardiovascular disease being the most affected.

Although there are no national secondary standards, New Jersey has set its secondary standards at the same level as its primary standards and uses a different measuring metric than national standards (**Table 29**). In addition, New Jersey standards are not to be exceeded more than once in any 12-month period.

Table 29. National and New Jersey Ambient Air Quality Standards of Carbon Monoxide			
<i>milligrams per cubic meter (mg/m³); parts per million(ppm)</i>			
<i>Averaging Period</i>	<i>Type</i>	<i>New Jersey</i>	<i>National</i>
1-Hour	Primary	40 mg/m ³ (35 ppm)	35 ppm
1-Hour	Secondary	40 mg/m ³ (35 ppm)	----
8-Hour	Primary	10 mg/m ³ (9 ppm)	9 ppm
8-Hour	Secondary	10 mg/m ³ (9 ppm)	----

Source: NJDEP 2015 Carbon Monoxide Summary

According to the NJDEP report,

“carbon monoxide levels have improved dramatically over the past 39 years. The last time the CO standard was exceeded in New Jersey was in January of 1995. The entire state was officially declared as having attained the CO standard on August 23, 2002.” (NJDEP 2015 CO report)

Because on-road vehicle emissions are a major contributor of CO levels, there is a variation throughout the day, with the highest peaks around 7 to 8 am, and another, lower but more extended rise between 4 and 8 pm. In 2015, of the CO monitoring stations in New Jersey, the East Orange station is the closest in proximity to Hope Township (41.47 mi.). All concentrations were well below the national and state standards (See *Table 30*).

Table 30. Carbon Monoxide 2015				
1-Hour and 8-Hour Averages in Parts per million (ppm) 1-hour standard (35 ppm); 8 hour standard (9 ppm)				
<i>Monitoring Site</i>	<i>Maximum 1-hr Avg.</i>	<i>2nd Highest 1-hr Avg.</i>	<i>Maximum 8-hr Avg.</i>	<i>2nd Highest 8-hr Avg.</i>
East Orange (c. 41.47 mi.)	3	2.9	2.1	2.1
<i>Source: NJDEP 2015 Carbon Monoxide Summary</i>				

Nitrogen Dioxide

According to the NJDEP 2015 *Nitrogen Dioxide Summary*, nitrogen dioxide (NO₂) is a reddish-brown, highly reactive gas that is formed in the air through the oxidation of nitric oxide (NO). When it reacts with other chemicals, it can form ozone, particulate matter and other contributors to acid rain and haze. Oxides of nitrogen (NO_x) are combinations of gases comprising mostly of NO₂ and NO. They are emitted from fuel-related sources, which include vehicle exhaust, the burning of coal, natural gas and oil, industrial processes such as welding, and household gas stoves and heaters. NO is released into the atmosphere as NO_x but easily converts to NO₂.

NO₂ can aggravate or cause respiratory illness and prolonged exposure can permanently damage the lungs. Along with NO, NO₂ can irritate the eyes, nose, throat and lungs and cause nausea and tiredness. The environmental effects of nitrogen oxides can include changes in the composition of the flora in wetland and terrestrial ecosystems, acidification of freshwater bodies, eutrophication of estuarine and coastal waters, increases in levels of toxins harmful to fish and other aquatic life, and decreased visibility.

The levels for the national and state standards are the same; however, national standards are based on calendar year averages, while state standards apply to any 12-month period (*Table 31*). The majority of NO₂ emissions come from vehicle exhaust, therefore, the highest levels occur during the morning and afternoon rush hours. Levels are also higher in winter than in summer.

Table 31. National and New Jersey Ambient Air Quality Standards for Nitrogen Dioxide			
<i>parts per million (ppm); micrograms per cubic meter (µg/m³)</i>			
<i>Averaging Period</i>	<i>Type</i>	<i>New Jersey</i>	<i>National</i>
12-month average	Primary	100 µg/m ³ (0.053 ppm)	
Annual average	Primary		0.053 ppm (100 µg/m ³)
12-month average	Secondary	100 µg/m ³ (0.053 ppm)	
Annual average	Secondary		0.053 ppm (100 µg/m ³)
1-hour average	Primary		0.100 ppm (190 µg/m ³)
<i>Source: NJDEP 2015 Nitrogen Dioxide Summary</i>			

NO₂ concentrations in New Jersey have fallen steadily since 1975 when the average concentration was 0.040 ppm. Neither the statewide nor the individual station averages have exceeded the health standard of 0.053 ppm, although the highest reporting stations in 1975 came close. The Fort Lee Near Road station is the only station to have exceeded the State or National Standards for 1-hour concentrations, however whether it violates the NAAQS will not be known until 3 years of data are collected. Of the ten reporting stations in 2015, Columbia WMA and Chester are the closest to Hope Township. Chester reported the lowest levels of NO₂ for these two stations (**Table 32**). Although NO₂ concentrations score well within the NAAQS, oxides of nitrogen continue to be of concern because of their role in the formation of other pollutants, particularly ozone and fine particles.

Table 32. Nitrogen Dioxide (NO₂) 2015				
parts per million (ppm) National Standards: 1-Hour (0.100 ppm); 12-Month (0.053 ppm)				
<i>Monitoring Station</i>	1-Hour Average (ppm)		12-Month Average (ppm)	
	<i>2015 98th %-ile</i>	<i>2013-2015 98th %-ile 3- year Avg</i>	<i>Maximum (Running 12 Month)</i>	<i>Calendar Year</i>
Columbia WMA (c. 5.25 mi)	0.051	0.048	0.012	0.012
Chester (c. 17.5 mi.)	0.028	0.035	0.004	0.003
<i>Source: NJDEP 2015 Nitrogen Dioxide Summary</i>				

Particulate Matter

Particulate matter³⁵ can be any manmade or natural particles found in the air, such as dust, dirt, smoke, sea salt, and liquid droplets. At any size, these particles can affect the environment. The total of all particles, of whatever size, is referred to as “Total Suspended Particulates” (TSPs). Particles less than 10 micrometers in diameter (PM₁₀) are called “Inhalable Particulates” because they can be inhaled into and accumulate in the respiratory system. Particles less than 2.5 micrometers (PM_{2.5}), called “Fine Particulates,” are believed to pose the greatest health risk. NAAQs for both Inhalable Particulates (PM₁₀) and Fine Particulates (PM_{2.5}) are set at the same level for both primary (health) and secondary (environmental welfare) standards. At greatest risk are children, the elderly, and individuals with heart and lung diseases, such as asthma.

The EPA abandoned standards for TSPs in favor of the smaller PM₁₀ and PM_{2.5} particulates, however New Jersey still maintains TSP standards (**Table 33**). For PM_{2.5} standards, an annual concentration for a given site is calculated by averaging the annual mean concentrations for the 3 most recent consecutive calendar years, in this case 2013-2015. Similarly, the 24-hour concentration for a given site is calculated by averaging the 98th percentile 24-hour concentrations for each year for the same 3-year period. For PM₁₀ standards, the concentrations are simply calculated as the annual mean and the highest 24-hour average PM₁₀ concentrations.

Table 33. Particulate Matter – 2015 National NAAQs micrograms per cubic meter ($\mu\text{g}/\text{m}^3$)			
<i>Standard</i>	<i>Averaging Period</i>	<i>Type</i>	<i>National</i>
Fine Particulate ($\text{PM}_{2.5}$)	Annual	Primary	12.0 $\mu\text{g}/\text{m}^3$
	Annual	Secondary	15.0 $\mu\text{g}/\text{m}^3$
	24-Hour Average	Primary & Secondary	35 $\mu\text{g}/\text{m}^3$
Inhalable Particulate (PM_{10})	24-Hour Average	Primary & Secondary	150 $\mu\text{g}/\text{m}^3$
<i>Source: NJDEP 2015 Particulate Summary</i>			

In 2015, three New Jersey air monitoring stations measured PM_{10} , 18 measured $\text{PM}_{2.5}$, and one monitored what is known as smoke shade or the coefficient of haze (COH), for which no standard is set. Several stations use the EPA sanctioned Federal Reference Method (FRM) sampling, based on a 24-hour period, but New Jersey also has additional monitors that continuously measure particulate concentrations (TEOMs), providing the real-time data that the FRM cannot. TEOM data is made available to the public via the Air Quality Index.

In 2015, all areas of the State were in attainment for Inhalable Particulates, PM_{10} . The closer of the three PM_{10} monitoring stations to Hope Township is the Newark Firehouse, where the highest daily concentration was $38\mu\text{g}/\text{m}^3$, versus the national standard of $150\mu\text{g}/\text{m}^3$, and the annual mean was $16\mu\text{g}/\text{m}^3$, versus the national standard of $50\mu\text{g}/\text{m}^3$.

All sites met the annual and 24-hour standard for Fine Particulates, $\text{PM}_{2.5}$. The sites closest to Hope Township include Columbia WMA and Chester which had a $9.2\mu\text{g}/\text{m}^3$ and $7.4\mu\text{g}/\text{m}^3$ annual mean concentration respectively, both falling below the National Standard of $15.0\mu\text{g}/\text{m}^3$.

Further breaking down the fine particulate contribution to air pollution, five stations, including Chester, measure 39 components. The five highest contributors are organic carbon, sulfate, nitrate, elemental carbon, and sulfur. The Camden Spruce Street station reported the highest concentration for organic carbon, sulfate, and sulfur. Both organic and elemental carbon is sourced primarily from motor vehicles, and the Camden Spruce Street station is located in a high traffic area.

“Smoke shade” is an indirect measurement of particles in the atmosphere and is used for daily reporting in the Air Quality Index. Smoke shade is measured as a Coefficient of Haze (COH), with a benchmark set at 2.0. Readings above this level are deemed “Unhealthy for Sensitive Groups.” The closest station is Elizabeth Lab and the levels reported were well below the benchmark (**Table 34**). However, it should be noted that although Elizabeth Lab is the closest station to Hope Township monitoring smoke shade, the station is approximately 44 miles away and may not accurately reflect air quality conditions.

Table 34. Particulate Material 2015							
	PM _{2.5} Data			PM ₁₀ Data		Smoke Shade	
	Measured in micrograms per cubic meter (µg/m ³)						
<i>Monitoring Station</i>	<i>Annual Mean Conc.</i>	<i>Highest 24-Hour Conc.</i>	<i>Number of Unhealthy Air Quality Days</i>	<i>Annual Mean Conc.</i>	<i>Highest 24-hr Conc.</i>	<i>Annual Mean Conc.</i>	<i>Highest 24-hr Average</i>
Columbia WMA (5.25 mi)	9.6	32.6	0	---	---	---	---
Flemington	6.8	21.4	0	---	---	---	---
Newark Firehouse	---	---	---	16	38	---	---
Elizabeth Lab	---	---	---	---	---	0.14	1.03

Source: NJDEP 2015 Particulate Summary

Lead

Lead is a hazard to the health of humans and the environment, whether the source is lead in the air, in paint on walls, in our water, or in our soils. When taken into the body, lead circulates via the blood and accumulates in the bones. It affects the oxygen carrying capacity of the blood and can negatively affect the nervous system, kidneys, immune system, reproductive, developmental and cardiovascular systems. It most commonly causes neurological effects in children and cardiovascular effects in adults. On a secondary level, lead from the air or water bodies may accumulate in soils and sediments, adversely affecting biodiversity.

According to the EPA, taking lead out of on-road motor vehicle gasoline has been the primary reason for a decline in lead in the air. Between 1980 and 2010 the EPA reported an 89% decrease in national average. Contributors to lead in the air today include ore and metals processing and leaded aviation fuel. In 2008 the NAAQS level was set at 0.15µg/m³ for a rolling 3 month average. As of 2013, in accordance with the new 2008 standard there are 21 areas nationwide that are in non-attainment with the closest locations being in central Pennsylvania.³⁶

The NJDEP has data for New Jersey stations monitoring lead in the air from 1990 to 1995-1996. Although some stations exceeded NAAQS levels in the early 1990's, all were below the standards by 1996.

Air Toxics

Almost 200 air toxics have been identified on the list of Hazardous Air Pollutants (HAPs) maintained by the EPA. The EPA issues a National-Scale Air Toxics Assessment (NATA), which the NJDEP adapts to evaluate the types and amounts of air toxics people are exposed to in New Jersey. NJDEP compares the estimated NATA air concentrations to their chemical-specific health benchmarks and divides the modeled air concentration by the health benchmark to get a risk ratio. If the risk ratio for a specific chemical is greater than one, it may be of concern, increasing the risk for cancer or other negative health effects. In general, higher population densities result in greater emissions of, and exposure to, air toxics.

In 2015, 10 air toxics measured in Chester exceeded the health benchmarks set by the EPA. These results can be seen in **Table 35**. *Note:* Although the Chester station is the closest monitoring station, it is not wholly reflective of conditions in Hope Township.

Table 35. Air Toxics for Chester Above the Health Benchmark			
<i>Pollutant</i>	<i>Annual Mean ($\mu\text{g}/\text{m}^3$)</i>	<i>Health Benchmark ($\mu\text{g}/\text{m}^3$)</i>	<i>Annual Mean Risk Ratio</i>
Acetaldehyde	1.249	0.45	3
Acrylonitrile	0.081	0.015	5
Benzene	0.469	0.13	4
1,3-Butadiene	0.059	0.033	1.8
Carbon Tetrachloride	0.604	0.067	9
Chloroform	0.115	0.043	3
Chloromethane	1.420	0.56	3
1,2-Dibromoethane	0.003	0.0017	1.7
1,2-Dichloroethane	0.076	0.038	2
Formaldehyde	2.059	0.077	27

Source: NJDEP 2015 Air Toxics Summary

The three chemicals with the highest risk ratios reported at the Chester site are Formaldehyde (27), Carbon Tetrachloride (9), and Acrylonitrile (5).

Formaldehyde. Formaldehyde is used mainly to produce resins used in particleboard products and as an intermediate in the synthesis of other chemicals. The major sources of emissions to the air are forest and wildfires, stationary internal combustion engines and turbines, pulp and paper plants, petroleum refineries, power plants, manufacturing facilities, incinerators, and automobile exhaust emissions.

Carbon Tetrachloride. Carbon Tetrachloride was widely used as a household cleaner, propellant, degreaser, refrigerant, and fumigant. Because of its toxicity and ability to deplete stratospheric ozone it has been phased out of production and use. Despite this, approximately 100 tons are annually emitted by industry in the United States. There have been no emissions reported in New Jersey, however because it degrades slowly in the environment, air levels remain fixed.

Acrylonitrile. Acrylonitrile is a colorless, volatile liquid with a pungent, onion-like odor. It is widely used in industry to produce rubber, resins, plastics, elastomers and synthetic fibers to manufacture carbon fibers used in aircraft, defense, and aerospace industries.

Sources

The source of air toxics varies for each pollutant. On-road mobile sources of air toxics emissions are vehicles; non-road mobile sources include aircraft, trains, lawnmowers and leaf blowers, boats, dirt bikes, and construction vehicles. Nonpoint sources of air toxics emissions include heating, fuel and pesticide use, dry cleaners, and consumer products, such as adhesives, sealants, paint, personal care, and other household products. Point sources are identified by the NJDEP as “large facilities that emit a significant amount of air pollution during manufacturing, power generation, heating,

incineration, or other such activity” as well as “smaller facilities including those that are required to report their emissions under the federal Toxic Release Inventory program and the state’s Community Right-To-Know program” (see *Contaminated Sites* chapter).

Warren County’s air toxic emissions came from mostly mobile sources and non-point sources, with a minimal contribution coming from point sources (see *Figure 3*).³⁷

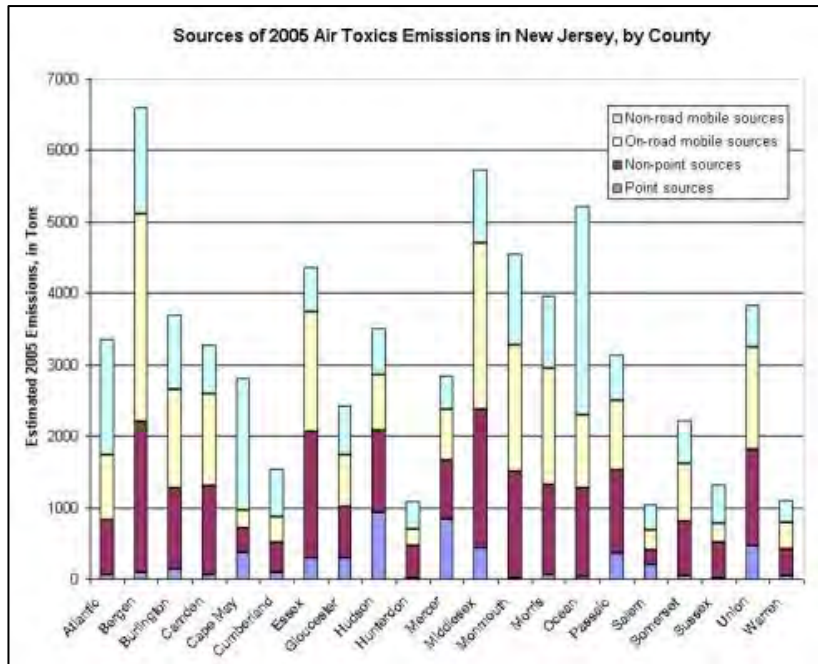


Figure 3. Source of 2005 Air Toxics Emissions in New Jersey, by County

Source: NJDEP

An additional category of contributions to emissions is background and secondary sources. Background concentrations generally cannot be sourced to current, local emissions. Secondary concentrations refer to chemicals that have been transformed in the air from an air pollutant into another chemical, which may have a different level of toxicity.³⁸

Radon

Radon is a naturally occurring radioactive gas. It is a byproduct of the decay of uranium and is found in soil at varying concentrations. Radon is a known health risk, causing lung cancer in smokers and non-smokers alike. Because it can accumulate in closed places such as houses, homeowners in high risk areas are encouraged to have their properties tested. Radon can also work its way into the water supply. The greatest risk of radon from drinking water is that it may escape into indoor air. Testing of drinking water supplies for uranium has been a recent development. If levels exceed the maximum set by the EPA for extended periods of time, kidney damage can occur.

In New Jersey, there is a particularly uranium-rich geological formation, called the Reading Prong, which stretches from Pennsylvania through northwestern New Jersey into southern New York State. Testing of homes built along this geologic formation has revealed high indoor levels of radon

gas. Further testing in New Jersey, beyond the Reading Prong area, has shown additional areas where homes have elevated radon levels.³⁹ These include areas such as Warren County, which is considered a high-risk county for radon presence. All of the municipalities in Warren County rank as Tier 1 (high radon potential), including Hope Township.⁴⁰ The ranking of municipalities in Warren County are listed in *Table 36*. For more information on radon, visit <http://www.nj.gov/dep/rpp/radon/index.htm>.

<i>Municipality</i>	<i>Sample Size</i>	<i>Number of homes with ≥ 4picocuries/ liter (pCi/L)</i>	<i>Percent of homes</i>	<i>Tier Assignment</i>
Allamuchy Township	1022	269	26%	1
Alpha Borough	456	248	54%	1
Belvidere Township	968	526	54%	1
Blairstown Township	1832	946	52%	1
Franklin Township	697	310	44%	1
Frelinghuysen Township	291	175	60%	1
Greenwich Township	1460	597	41%	1
Hackettstown Town	4650	1794	39%	1
Hardwick Township	254	137	54%	1
Harmony Township	320	184	58%	1
Hope Township	425	242	57%	1
Independence Township	928	314	34%	1
Knowlton Township	610	274	45%	1
Liberty Township	816	424	52%	1
Lopatcong Township	1354	498	37%	1
Mansfield Township	1380	565	41%	1
Oxford Township	674	320	47%	1
Phillipsburg Town	3145	1315	42%	1
Pohatcong Township	903	338	37%	1
Washington Township	4659	1615	35%	1
White Township	501	267	53%	1

Source: 2015 Radon Tier Assignment Report⁴¹

Noise and Odors

Noise

The NJDEP, authorized by the Noise Control Act of 1971, N.J.A.C. 7:29, oversees noise control and abatement in New Jersey. The Office of Local Environmental Management (OLEM) works with County Health Departments and municipalities to monitor noise complaints and compliance. The NJDEP does not have a Noise Control Program, but the Noise Information website provides a list of contacts depending on the type of noise: aircraft, highway, commercial or industrial, or residential noise and nuisances. NJDEP has developed a model noise ordinance that can be adopted by local municipalities. The Noise Control Act allows municipalities to adopt noise control ordinances that are more stringent than the State code.⁴²

Odors

According to the NJDEP, “odor is an air contaminant and therefore may be considered air pollution if it is present in a way that unreasonably interferes with the enjoyment of life or property.” Guidelines for odor control are set forth in The Air Pollution Control Act: N.J.S.A. 26:2C-1 et seq. and N.J.A.C. 7:27-1.1 et seq. Odor complaints can be reported to the NJDEP 24 hour toll-free environmental hotline at (877) 927-6337.⁴³ At this time, Hope Township does not have any ordinances regarding odors.

Meteorology and Pollution

Meteorology plays an important role in the distribution of pollution throughout the troposphere, the layer of the atmosphere closest to the earth’s surface. Atmospheric processes such as wind speed and wind direction affect the transport and dispersion of air pollution. Other weather phenomena, such as temperature, humidity, and barometric pressure influence chemical reactions and transformations in the atmosphere that affect air pollutants. By studying meteorological and air pollution data together, scientists and mathematicians have developed reasonably accurate models for predicting the fate of pollutants as they go through the stages of transport, dispersion, transformation, and removal. The Columbia meteorological station monitors and measures temperature, relative humidity, wind speed and direction, barometric pressure, and precipitation.⁴⁴

CLIMATE

Prevailing Air Currents in New Jersey

According to the Office of the New Jersey State Climatologist (ONJSC) at Rutgers University, a “broad, undulating flow from west to east” dominates atmospheric circulation in the middle latitudes of North America, including New Jersey. “These ‘prevailing westerlies’ shift north and south and vary in strength during the course of the year, exerting a major influence on the weather throughout the State.”⁴⁵ In general, most areas in New Jersey receive 25 to 30 thunderstorms per year, with fewer storms near the coast than farther inland. About 5 weak tornados occur each year throughout the state.

Climate Zone

New Jersey is divided into five distinct climate regions, or zones. Differences in geology, distance from the Atlantic Ocean, and prevailing atmospheric flow patterns produce distinct variations in the daily weather between each of these regions. According to the ONJSC publication, “The Climate of New Jersey,” Hope Township falls within the Northern Zone. This zone runs from the northwestern counties of the Sussex, Warren, and Hunterdon, across upper Somerset, most of Morris, and Upper Passaic. The Northern Zone encompasses the Appalachia Uplands consisting mostly of highlands and valleys. Due to the zone’s northern location in the state and mountains, the climate is colder than others in the state. The mountains greatly affect the climate of this region, creating an orographic effect enhancing clouds and precipitation. This zone has the shortest growing season in the state of about 155 days.

Temperature and Precipitation

The ONJSC maintains temperature and precipitation data from monitoring stations throughout the state with some records dating back to the 1890s. The state is divided into three divisions with northern New Jersey falling under Division 1. Division 1 includes the counties of Bergen, Essex, Hudson, Hunterdon, Morris, Passaic, Somerset, Sussex, Union, and Warren. The ONJSC has compiled a Division 1 report with values calculated from an average of monthly temperatures. These show an overall upward trend in mean temperature and precipitation in the northern New Jersey region between 1989 and 2015. This region is both warmer and wetter than the preceding period. (*Figure 4, Figure 5, Figure 6, and Figure 7*)

State Historic Averages

Data from 1895 through 2012 for New Jersey statewide mean annual temperatures and annual precipitation along with yearly cooling and heating day totals for New Jersey from 1890 to 2012 have been collected and graphically represented to show a comparison and historic trend for the state’s climate. This data is represented in *Figure 4, Figure 5, Figure 6, and Figure 7*, which show an overall upward trend in mean temperature and precipitation for New Jersey between 1895 and 2015, as well as an increase in yearly cooling degree days and a reduction in yearly heating degree days.

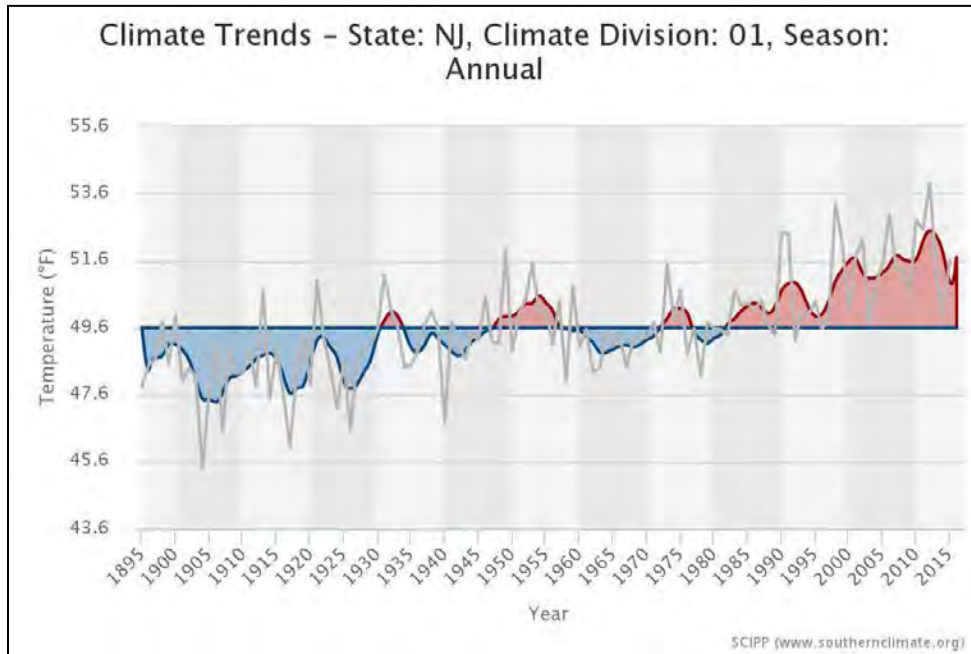


Figure 4. Northern New Jersey Temperature History 1895-2015

Source: ONJSC/Courtesy of SCIP

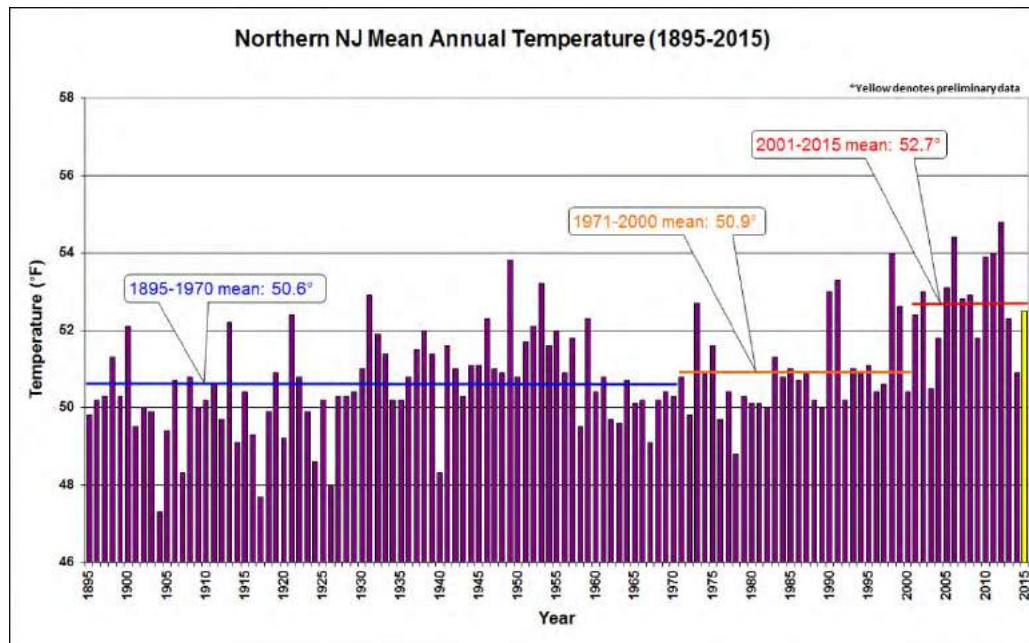


Figure 5. Northern New Jersey Mean Annual Temperatures (1895-2015)

Source: ONJSC

http://climate.rutgers.edu/stateclim_v1/data/north_njhisttemp.html

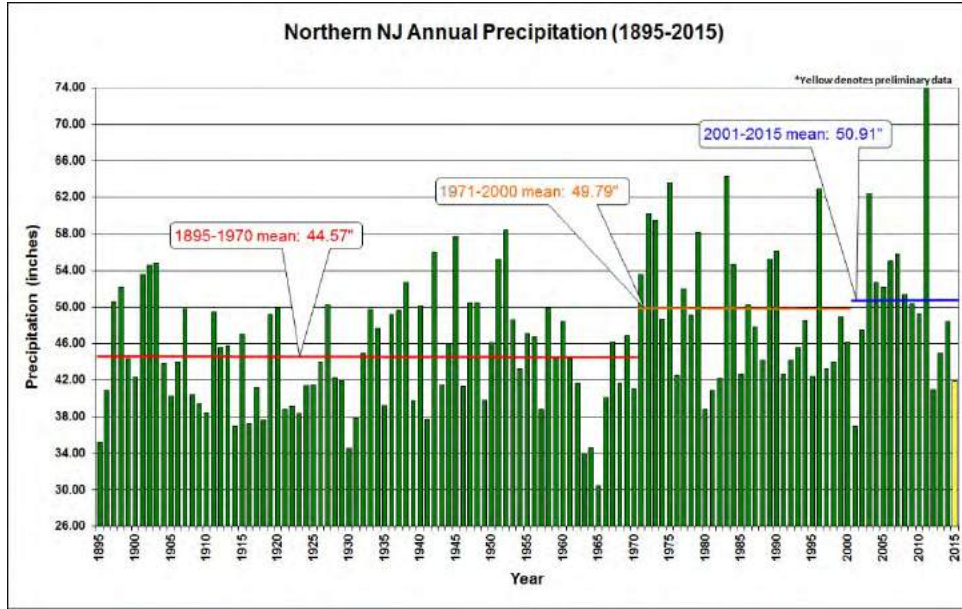


Figure 6. Northern New Jersey Mean Annual Precipitation (1895-2015)

Source: ONJSC

http://climate.rutgers.edu/stateclim_v1/data/north_njhistprecip.html

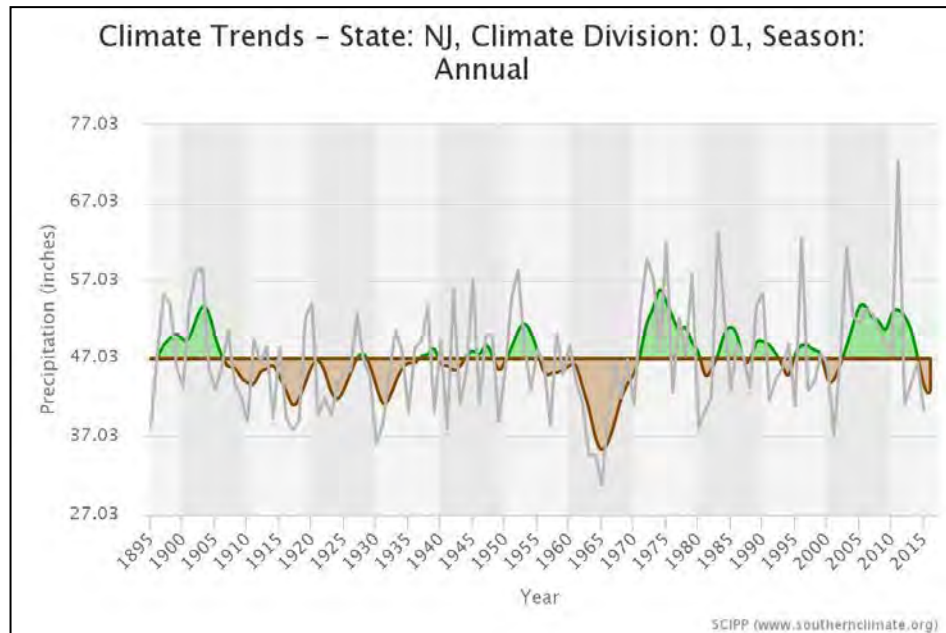


Figure 7. Northern New Jersey Annual Precipitation History 1895-2015

Source: ONJSC/Courtesy of SCIPP

Local Historic Averages

The three ONJSC reporting stations closest to Hope Township are Belvidere, Long Valley, and Andover. **Table 37** shows the monthly and annual historic averages of mean, median, minimum, and maximum temperatures for these three stations. Each station has been gathering data for a different number of years as denoted in the table.

Table 37. Monthly and Annual Mean Temperatures: Historic Averages for Belvidere Bridge, Long Valley, and Andover Aeroflex Airport (°F)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Belvidere Bridge Monitoring Station (1893-present)													
Mean	36.4	39.1	49.3	61.9	72.7	80.7	84.8	82.7	76.5	65.6	52.2	40.0	61.9
Median	36.6	38.8	48.8	61.8	72.9	80.7	84.5	82.7	76.5	65.8	51.9	40.0	62.0
Min	26.3	28.7	40.6	55.7	64.1	72.4	78.7	77.0	68.7	57.9	46.2	28.7	58.7
Max	46.8	48.6	62.4	72.0	80.8	88.4	94.1	89.3	84.4	74.8	59.7	51.2	65.9
Long Valley Monitoring Station (1929-2004)*													
Mean	36.6	39.1	47.6	60.3	70.3	78.4	82.7	80.8	74.1	64.2	52.3	40.4	60.7
Median	36.7	39.3	47.6	60.1	70.0	78.5	83.1	81.0	73.7	64.1	52.7	40.6	61.0
Min	28.1	24.8	39.8	54.6	62.4	71.2	75.1	74.4	68.0	57.4	46.3	29.7	55.7
Max	45.3	47.4	59.4	68.5	77.3	85.1	91.0	86.7	81.3	73.6	59.2	48.9	63.8
Andover Aeroflex Airport (1998-present)													
Mean	36.5	38.9	48.2	61.7	71.1	79.0	83.6	81.7	75.1	62.8	53.0	41.0	61.4
Median	36.1	39.5	48.5	61.4	70.6	79.4	84.2	81.6	74.7	63.1	54.3	41.0	61.7
Min	28.3	28.0	40.3	55.8	65.2	74.5	77.5	77.0	70.7	58.8	47.7	32.7	59.4
Max	43.6	46.8	59.4	66.4	77.4	83.4	89.0	84.5	79.8	69.8	57.4	47.2	63.1
*Long Valley Monitoring Station no longer active as of 2004													
Source: NJ State Climatologist, Rutgers University (Accessed July 5, 2017)													
http://climate.rutgers.edu/stateclim/													

Mean temperatures for the Belvidere Bridge, Andover Aeroflex Airport, and Long Valley monitoring stations, are plotted in **Figure 8**, **Figure 9**, and **Figure 10**, along with the historic mean average. Extreme spikes and drops can be the result of incomplete data for the monitoring period. All of these figures show an upward trend in annual mean temperature.

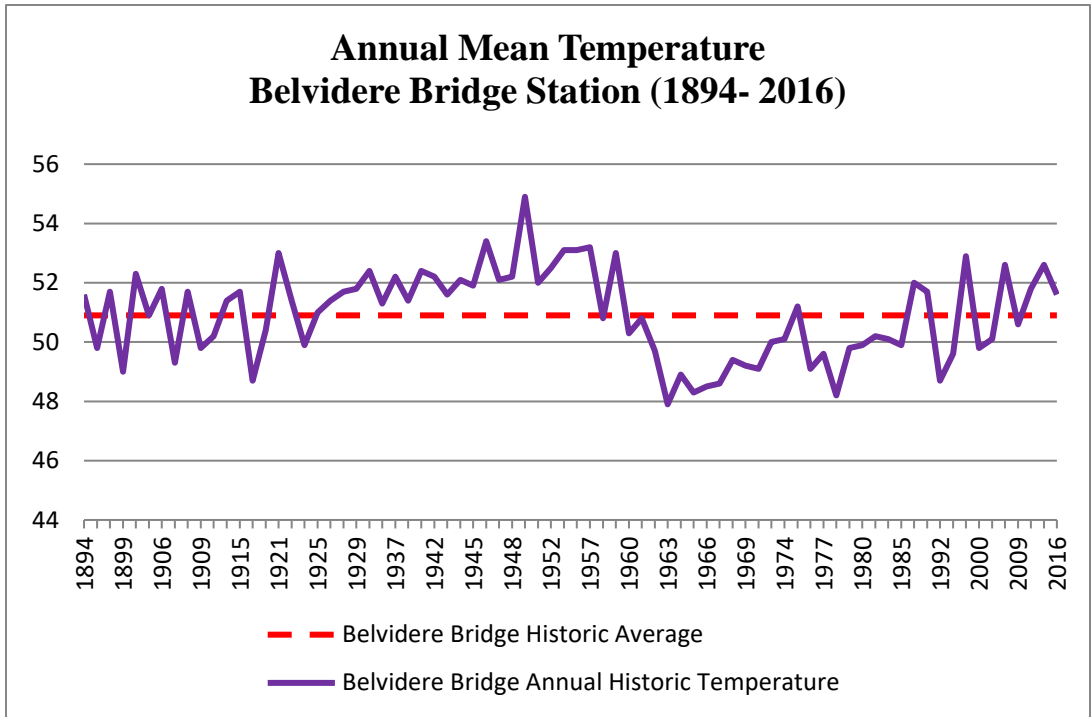


Figure 8. Annual Mean Temperature of Belvidere Bridge Monitoring Station (1894-2016)

Source: https://climate.rutgers.edu/stateclim_v1/monthlydata/index.php?stn=280734&elem=avgt

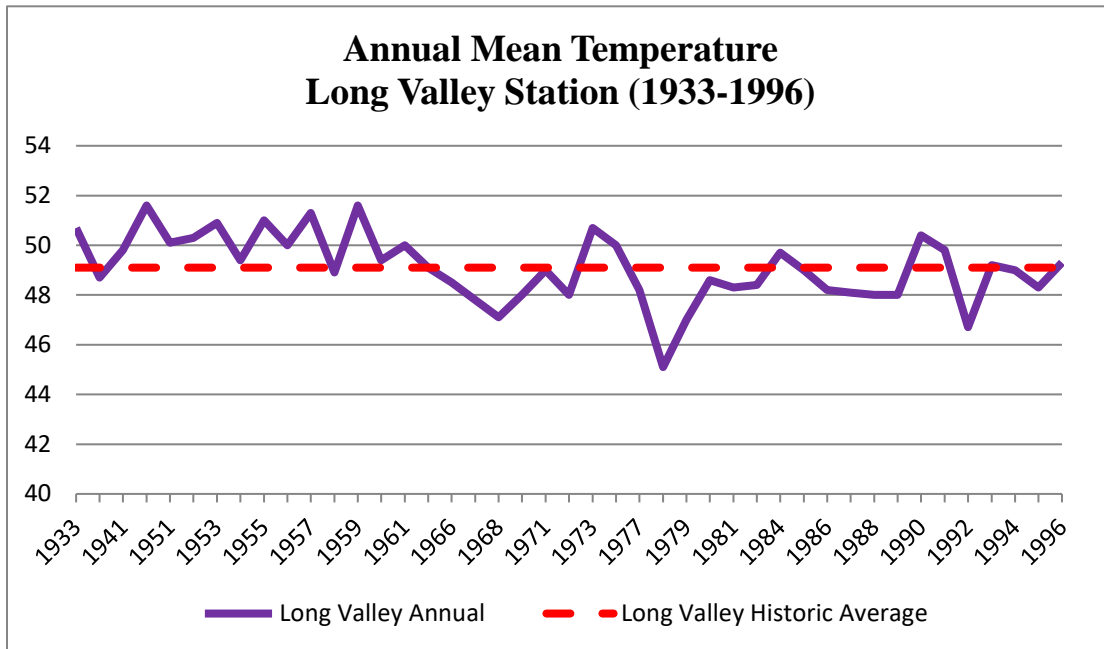


Figure 9. Annual Mean Temperature of Long Valley Monitoring Station

Source: https://climate.rutgers.edu/stateclim_v1/monthlydata/index.php?stn=285003&elem=avgt

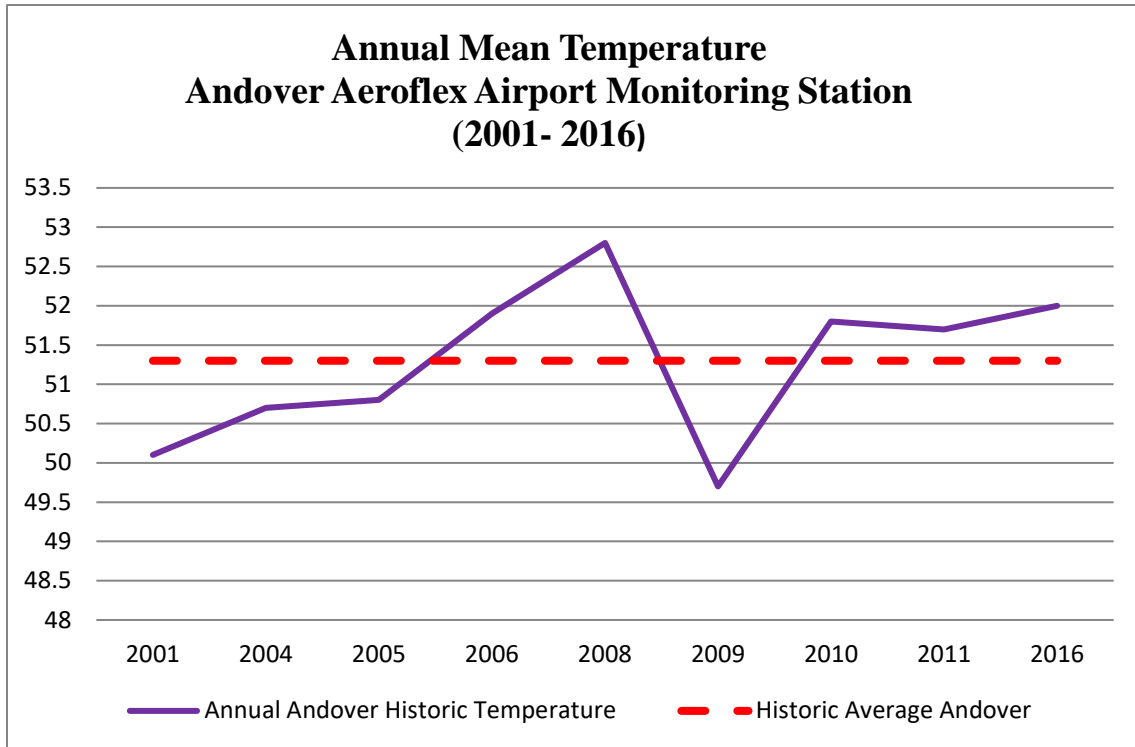


Figure 10. Annual Mean Temperature of Andover Aeroflex Airport Monitoring Station

Source: https://climate.rutgers.edu/stateclim_v1/monthlydata/index.php?stn=K12N&elem=avgt

Table 38 lists monthly and annual historic averages for all precipitation. Historic annual mean precipitation at Belvidere Bridge is 46.07 inches, which is slightly below the average of 46.95 inches for northern New Jersey. Andover’s historic annual mean is 50.21 inches, while Long Valley’s is 51.38, both above the state average for northern New Jersey. *Note:* The Long Valley Monitoring Site was deactivated in 2004, and averages are calculated up until the year 2004. New Jersey’s average mean temperature is based on data recorded into the present and therefore the two averages may not be comparable.

See **Figure 11**, **Figure 12**, and **Figure 13** for graphical presentations of this data.

Table 38. Historic Precipitation for Belvidere Bridge, Andover Aeroflex Airport, and Long Valley (inches)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Belvidere Bridge Monitoring Station (1893-present)													
Mean	3.38	3.10	3.66	3.79	3.96	4.18	4.79	4.60	4.05	3.72	3.48	3.72	46.07
Median	3.21	2.81	3.48	3.64	3.66	3.99	4.26	3.91	3.49	3.08	3.29	3.64	45.46
Min	0.55	0.21	0.43	0.74	0.40	1.01	0.77	0.61	0.14	0.13	0.08	0.34	29.09
Max	9.97	9.39	7.73	10.06	10.19	11.20	13.29	14.26	14.31	18.21	8.51	8.99	69.16
Andover Aeroflex Airport (1998-present)													
Mean	3.66	2.81	3.58	3.74	3.73	4.45	4.79	4.55	4.54	4.41	2.95	3.92	50.21
Median	2.96	2.61	3.25	3.02	3.94	3.47	3.31	3.53	3.67	4.24	3.09	4.13	47.47
Min	1.08	0.64	0.75	1.21	0.94	1.12	0.33	1.88	0.77	0.56	1.03	0.81	32.68
Max	14.47	7.69	7.16	7.89	5.28	9.26	18.49	15.19	16.46	17.20	4.98	6.27	77.89
Long Valley Monitoring Station (1929-2004)*													
Mean	3.62	3.07	4.13	4.17	4.46	4.28	4.98	4.82	4.34	3.80	4.30	3.91	51.38
Median	3.04	3.01	3.92	3.93	4.08	3.89	4.12	4.29	3.62	3.35	4.09	3.47	48.80
Min	0.67	0.80	1.62	0.78	0.65	0.22	0.83	0.77	0.39	0.40	0.40	0.53	32.88
Max	12.37	6.01	8.64	11.43	10.69	14.52	12.56	15.50	11.72	10.00	12.46	9.64	68.32

*Long Valley Monitoring Station no longer active as of 2004
Source: NJ State Climatologist, Rutgers University (Accessed July 5, 2017)⁴⁶

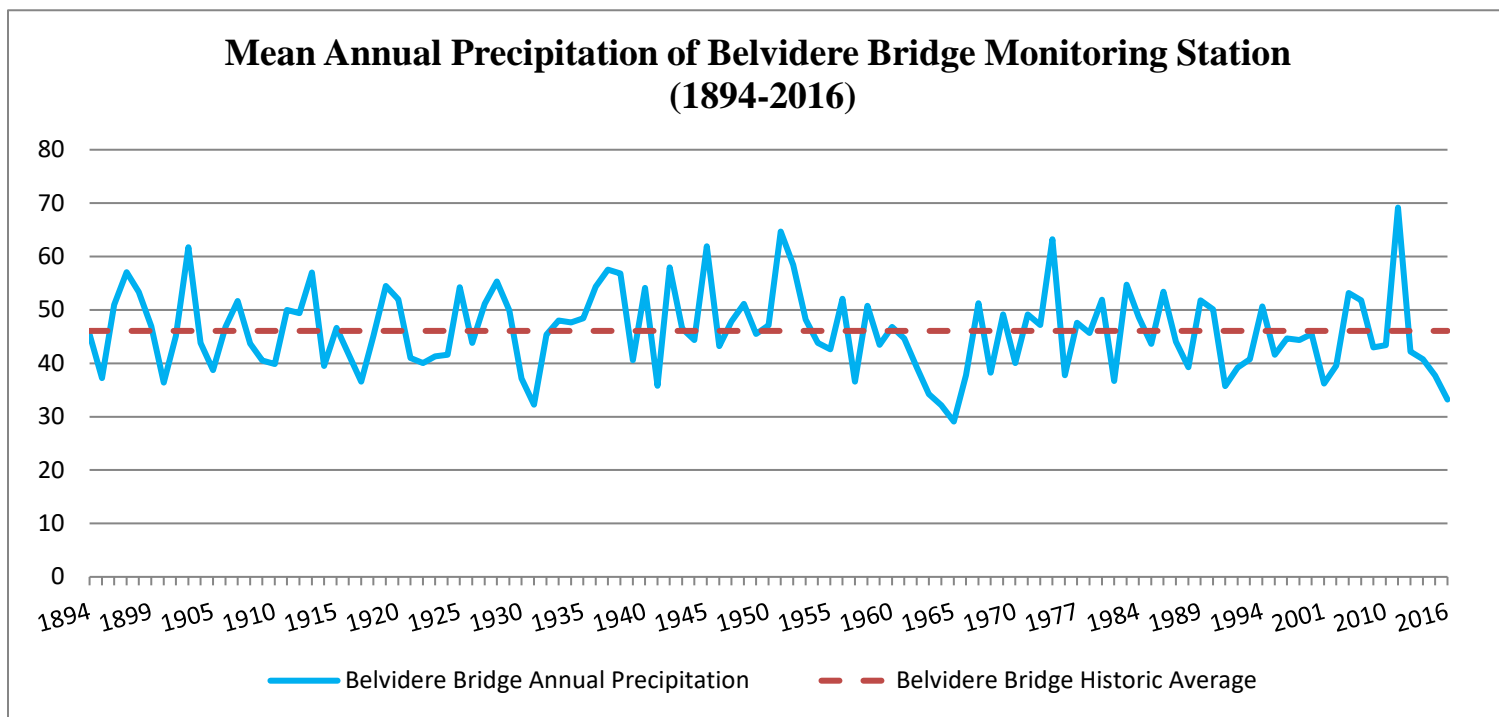


Figure 11. Annual Mean Precipitation of Belvidere Bridge Monitoring Station (1894-2016)

Source: https://climate.rutgers.edu/stateclim_v1/monthlydata/index.php?stn=280734&elem=pcpn

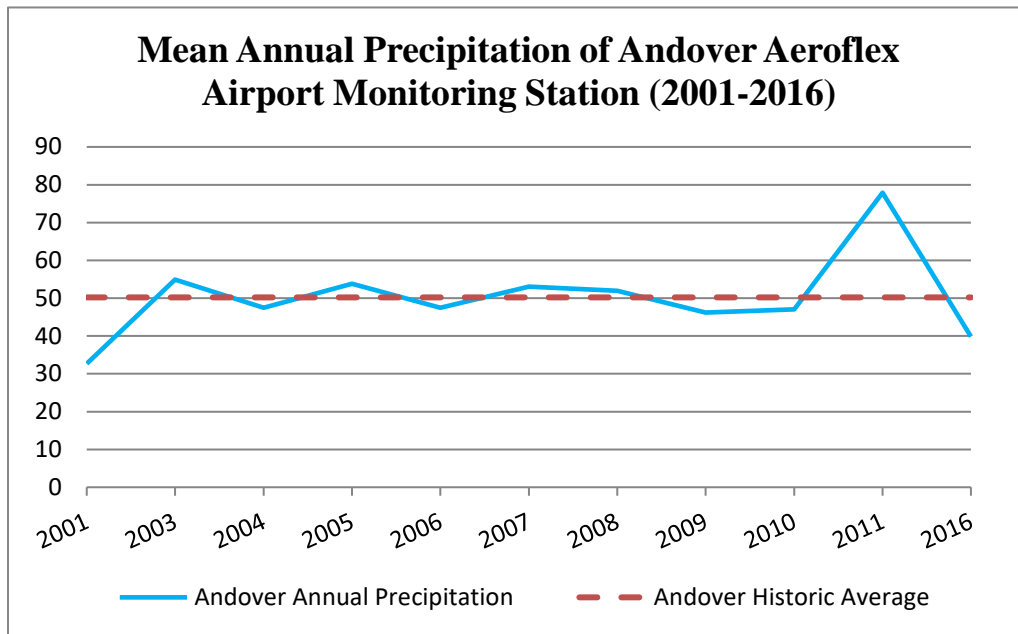


Figure 12. Annual Mean Precipitation of Andover Aeroflex Airport Monitoring Station (2001-2016)

Source: https://climate.rutgers.edu/stateclim_v1/monthlydata/index.php?stn=K12N&elem=pcpn

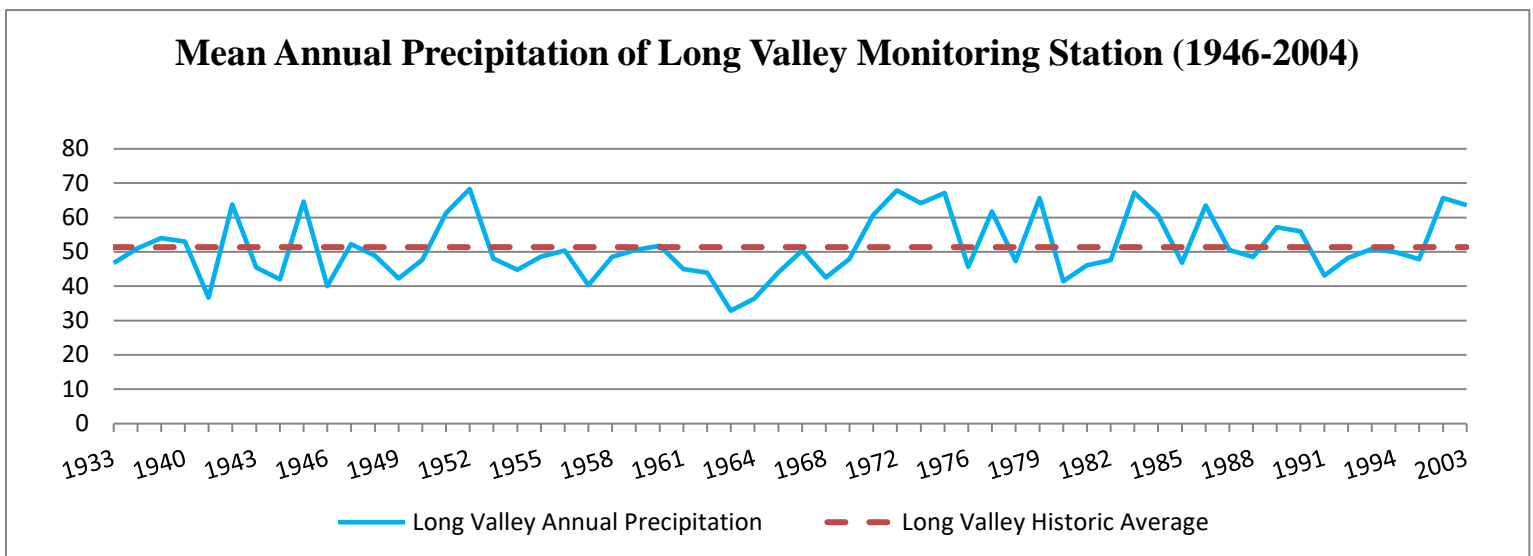


Figure 13. Annual Mean Precipitation of Long Valley Monitoring Station (1946-2004)

Source: https://climate.rutgers.edu/stateclim_v1/monthlydata/index.php?stn=K12N&elem=pcpn

Snowfall amounts are shown in **Table 39**. The table shows the Belvidere Bridge monitoring station receiving approximately 28.2 inches of snow annually from 1893 to the present day. Neither the Andover Aeroflex Airport nor Long Valley monitoring stations measure snowfall.

Table 39. Monthly and Annual Mean Snowfall: Historical Averages for Belvidere Bridge													
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Annual
Belvidere Bridge Monitoring Station (1893-present)													
Mean	0.0	0.0	0.0	0.1	1.3	5.7	9.1	9.3	5.2	0.9	0.0	0.0	28.2
Median	0.0	0.0	0.0	0.0	0.0	4.1	6.3	8.2	3.9	0.0	0.0	0.0	25.6
Min	0.0	0.0	0.0	0.0	0.0	0.0	T	0.0	0.0	0.0	0.0	0.0	T
Max	T	T	0.0	2.8	19.0	29.5	50.0	31.2	25.0	11.5	T	T	78.0
T=trace (<0.1" for snow)													
Source: NJ State Climatologist, Rutgers University, http://climate.rutgers.edu/stateclim/													

Current Normals

Table 40 shows the temperature, and heating and cooling degree day normal, or averages, from 1981-2010. Heating degree days are the number of degrees the average daily temperature is below 65°F. Cooling degree days are the number of degrees the average daily temperature is above 65°F.

Table 40. Monthly Station Normals Belvidere Bridge													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Belvidere Bridge Monitoring Station													
<i>Temperature Normals (°F)</i>													
Mean	28.1	30.7	38.5	49.3	59.3	68.3	73.1	71.6	64.3	52.8	42.9	32.7	51.0
Max	37.2	40.8	49.4	61.4	71.7	80.1	84.6	83.1	76.3	65.1	53.6	41.6	62.1
Min	18.9	20.6	27.7	37.2	46.9	56.5	61.5	60.1	52.3	40.5	32.3	23.9	39.9
<i>Heating Degree Days (the number of degrees the average daily temperature is below 65)</i>													
Heating	1145	960	820	475	210	40	3	9	96	385	662	1000	5805
<i>Cooling Degree Days (the number of degrees the average daily temperature is above 65)</i>													
Cooling	0	0	~0	4	33	139	252	213	75	7	~0	0	723
*Normal = 30 year average (1981-2010)													
**Values of ~0 represent a non-zero degree day that would round to zero													
Source: NJ State Climatologist, Rutgers University ⁴⁷													

Comparison of Current Normals and Historic Averages

Table 41 compares the annual historic averages for the Belvidere Bridge monitoring station against the current normal (i.e. the averages for the current 30-year period of 1981-2010) for temperature. Current Normals show a mean decrease in annual temperature of 10.9°F at the Belvidere Bridge.

Table 41. Historic Averages vs. Station Normals			
Annual Historic Averages 1983-present vs Station Normals 1981-2010: Belvidere Bridge			
	Historic Avg.	Current Normals*	Difference
Temperature (°F)			
Mean	61.9	51.0	-10.9
Max	65.9	62.1	-3.8
Min	58.7	39.9	-18.8

*Normal = 30 year average (1981-2010)
 Source: NJ State Climatologist, Rutgers University⁴⁸

Figure 14 shows the annual heating degree days (HDD) and cooling degree days (CDD) by yearly intervals for the Belvidere Bridge Monitoring Station.

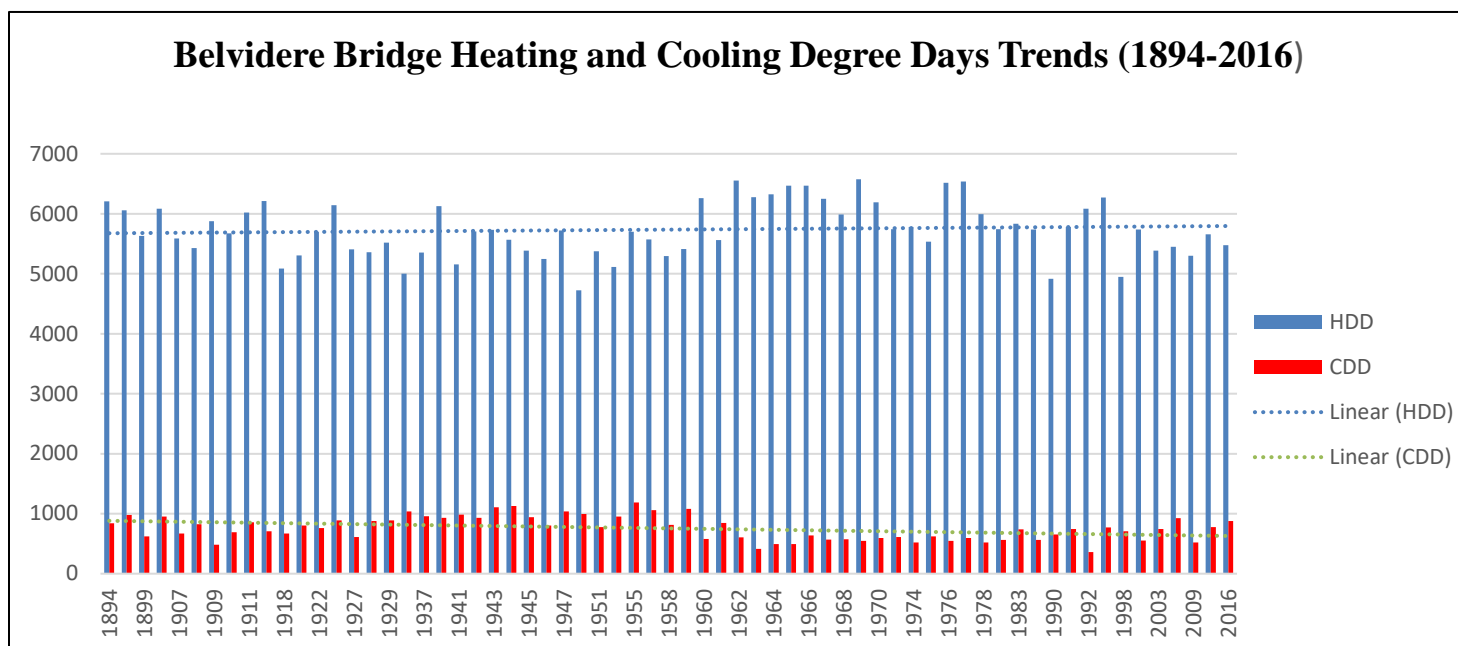


Figure 14. Belvidere Bridge Monitoring Station Heating and Cooling Degree Trends

Extreme Phenomena

Tropical Cyclones

According to the National Oceanic and Atmospheric Administration (NOAA), tropical cyclones are rotating, organized systems of clouds and thunderstorms that originate over tropical or subtropical waters.⁴⁹ Tropical cyclones have four major levels increasing in severity: tropical depression, tropical storm, hurricane, and major hurricane. Storms may start out as major hurricanes and weaken in strength as they travel and make landfall. The season generally runs from spring through fall with most activity for the Mid-Atlantic States occurring in August and September. Tropical cyclones tend to bypass New Jersey due to its protective location slightly to

the west of coastal outcrops to the north and south. When they do affect New Jersey, they are more apt to affect coastal areas, although a few have traveled inland.

Notable recent tropical cyclones are Hurricane Floyd in September 1999, Hurricane Irene in August 2011, and Hurricane Sandy in October 2012. In Chatham Township (30 miles), according to ONJSC, about 264 mm (approx.10 inches) of rain fell during Hurricane Floyd. This rainfall total was gathered from September 15-16, 1999.⁵⁰ In 2011, Hurricane Irene produce 6.34 inches in neighboring Blairstown Township.⁵¹ During Hurricane Sandy in 2012, the Pequest monitoring station in Warren County calculated peak wind gusts at 61 mph.⁵² Rainfall was measured at 2.24 inches at the monitoring station in neighboring White Township.⁵³ Rainfall during Hurricane Sandy was not the primary concern or cause of damage throughout northern New Jersey. Heavy rains and high winds during these storms caused severe local damage that affected roads and bridges, as well as structures and trees. As a result of the damages, power outages were common.

Other recent tropical cyclones affecting New Jersey:

- 2010 – Tropical Storm Hanna took an inland track.
- 2004 – A number of tropical storms and depressions affected the East Coast but missed inland northern New Jersey.
- 2000 – A tropical depression from Hurricane Gordon affected coastal New Jersey.
- 1999 – Hurricane Bret clipped the New Jersey coast in September at a Tropical Storm level.
- 1996 – Hurricane Josephine downgraded to a tropical storm hit inland New Jersey in October.
- 1994 – A tropical depression traveled west and north of New Jersey.
- 1992 – Tropical Storm Earl traveled south and west of New Jersey.
- 1988 – Tropical Storm Chris traveled west to east through northern New Jersey.
- 1985 – Hurricane Gloria skirted the coast of New Jersey.

Landslides

Landslides in New Jersey have generally occurred in the northern and central parts of the state and include slumps, debris flows, rock falls, and rock slides. They are not as common in New Jersey as in other parts of the country. As of March 2017, there were 287 landslides in all of New Jersey as reported by the NJDEP dating back to 1887.⁵⁴ Of the 287 landslides recorded in New Jersey, 14% (39) occurred during the heavy rains of Hurricane Irene in August 2011. Four rockfalls have occurred in Hope Township, all within 2014.

Earthquakes

The NJDEP maintains a database of recorded earthquakes in New Jersey, totaling 201 as of March 2017. They occur more frequently along the fault lines in north-central New Jersey than in other parts of the state. These earthquakes are generally minor in nature, often registering in the category of micro-quakes. The strongest earthquake epicentered, with a magnitude of 5.3, occurred in 1783, north of present-day Picatinny Arsenal in Rockaway Township. The strongest earthquake *felt* in New Jersey had a magnitude of 8.0-8.8 and were epicentered in New Madrid, Missouri in 1811-1812. An earthquake epicentered in Virginia was felt in New Jersey in August 2011.⁵⁵

In New Jersey, damage from earthquakes is rare or minor. The baseline for the hazard ranking is the level of horizontal shaking that have a 2-in-100 chance of being exceeded in a 50-year period. Shaking is expressed as a percentage of the acceleration of falling objects due to gravity. Maps available from the USGS can “form the basis for seismic design provisions of building codes, insurance rate structures, earthquake loss studies, retrofit priorities, and land-use planning”.⁵⁶

Earthquakes are measured by magnitude, intensity (level of shaking), and depth to hypocenter. Magnitude measures the relative size and energy released (when on block or rock, along a fault line, slips over another, causing the ground to vibrate).⁵⁷ The magnitude scale begins at 0 and the highest magnitude ever recorded was 9.5. Of the 201 earthquakes recorded in the database, 61% has a magnitude of 2 or less and are considered “micro earthquakes”. **Table 42** shows the magnitude summary.

Table 42. Magnitude Summary for Earthquakes in New Jersey		
<i>Range</i>	<i>Count</i>	<i>% of Total</i>
<2.0	127	63%
2.1-3.0	61	30.5%
3.1-4.0	11	5.5%
4.1-5.0	1	0.5%
>5.1	1	0.5%
Total	201	100%
<i>Source: NJDEP</i>		

Generally, the intensity of an earthquake relates to its magnitude, with a higher level of intensity occurring at or near the epicenter of a higher magnitude earthquake. The intensity scale ranges from I to VIII or higher. Intensities of VI (felt by all, frightening but damage is slight) or VII (damage negligible in buildings of good design and construction) are generally associated with a magnitude in the 5 range. Intensities of IV (felt by nearly everyone; some shaking, cracking of walls, standing cars rocked) or V (felt by everyone) are generally associated with magnitudes in the 4 range.

Another earthquake measurement is the depth below the surface at which the hypocenter occurs. The hypocenter is the point in the earth where the rupture starts, and the epicenter is the point at the earth’s surface directly above the hypocenter. Depth levels are grouped as shallow, 0-70 km deep; intermediate, 70-300 km deep; and deep, 300-700 km deep. All earthquakes in New Jersey have a shallow depth to hypocenter with the deepest recorded hypocenter at 25 km below the surface for an earthquake occurrence near Sussex in northwestern New Jersey in 1969. **Figure 16** shows the frequency of earthquakes in New Jersey from 1983-2016. The highest annual count was 13 in 1984, and no earthquakes were reported in either 1985 or 2000.

Earthquakes epicentered around Hope Township are listed in **Table 43**. The strongest earthquake recorded within 20 miles of Hope Township was 2.9 magnitude earthquake centered near Schooley’s Mountain in 1957. By comparison, the strongest earthquake in all of New Jersey was along the Long Valley Fault in Morris County in 1783, with a magnitude of 5.3.

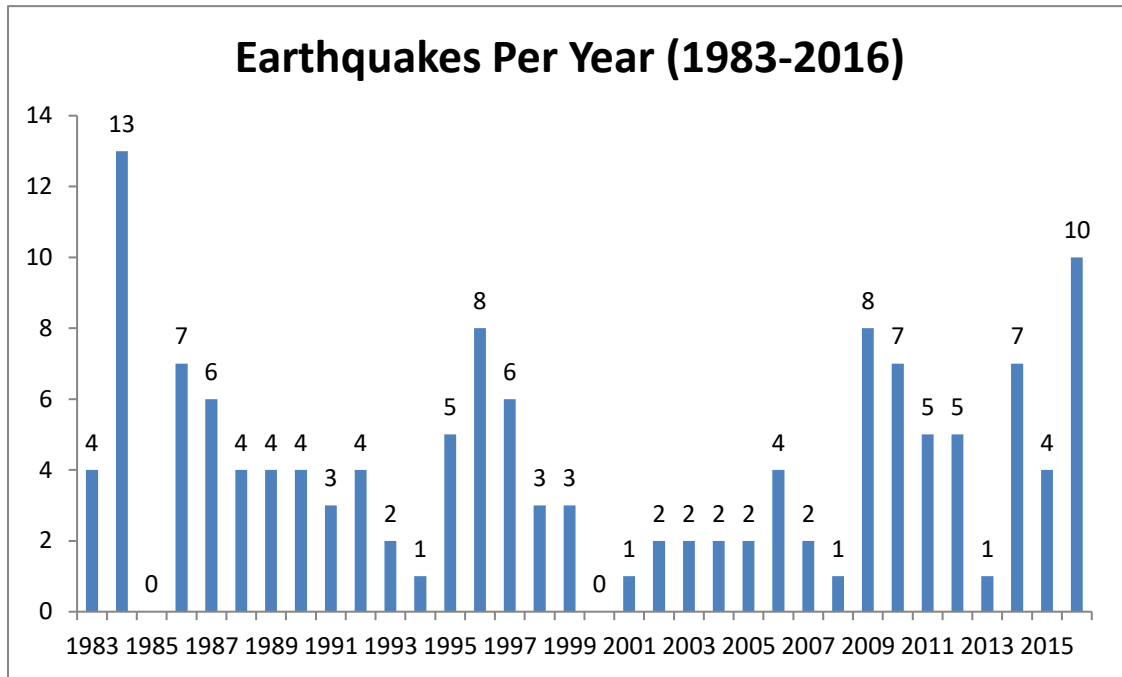


Figure 15. Earthquakes in New Jersey

ID	Date	Time	Lat_N	Long_W	Depth (km)	Magnitude	Location
25	3/23/1957	19:02	40.630	74.830	0.00	2.9	Schooley's Mountain, NJ
30	10/6/1969	02:27	40.950	74.630	0.00	2.1	Ogdensburg, NJ
36	12/5/1976	16:32	40.770	74.760	3.40	1.8	Schooley's Mountain, NJ
39	7/2/1977	11:13	40.700	74.900	7.30	2.3	Hampton, NJ
40	10/27/1977	9:22	41.100	74.600	6.00	1.5	Sparta, NJ
42	12/23/1977	4:55	40.800	74.800	0.00	2.3	Schooley's Mountain, NJ
46	6/16/1978	4:49	41.000	74.6000	0.00	0.0	Sparta, NJ
58	6/21/1981	5:04	41.070	74.590	8.50	1.8	Denville, NJ
62	2/19/1983	5:45	40.650	74.770	6.10	2.7	Oldwick, NJ
63	6/1/1983	9:50	40.870	74.530	5.10	1.5	Dover, NJ
67	5/13/1984	3:18	40.920	74.540	5.60	2.1	Mount Hope, NJ
70	8/2/1984	1:03	40.900	74.710	5.70	1.7	Mount Olive, NJ
71	8/12/1984	21:03	40.920	74.730	3.10	2.4	Byram, NJ
72	8/12/1984	21:12	40.910	74.720	4.66	2.1	Bryam, NJ
73	10/25/1984	7:18	40.890	74.700	7.10	2.0	Near Mount Olive, NJ
74	12/3/1984	1:52	40.930	74.730	1.00	1.5	Byram, NJ
75	12/13/1984	20:13	40.920	74.730	3.70	1.7	Byram, NJ
77	12/15/1984	14:02	40.900	74.710	7.80	1.8	Byram, NJ
78	12/17/1984	6:52	40.930	74.730	4.80	1.6	Byram, NJ
79	2/8/1986	9:18	40.890	74.700	5.70	1.7	Flanders, NJ

Table 43. Earthquakes Epicentered Around Hope Township (20 mile radius)

<i>ID</i>	<i>Date</i>	<i>Time</i>	<i>Lat_N</i>	<i>Long_W</i>	<i>Depth (km)</i>	<i>Magnitude</i>	<i>Location</i>
80	2/23/1986	4:03	40.770	74.900	1.10	1.8	Port Murray, NJ
86	4/24/1987	7:07	40.930	74.730	3.40	1.9	S of Lake Mohawk, NJ
88	8/5/1987	4:47	40.920	74.790	2.60	1.7	SW of Newton, NJ
89	8/6/1987	0:07	40.900	74.780	1.79	1.1	SW of Newton, NJ
90	8/6/1987	0:25	40.910	74.790	1.92	1.1	SW of Newton, NJ
92	4/13/1988	9:48	40.840	74.530	4.82	1.4	Dover, NJ
101	5/10/1990	3:41	40.815	74.541	7.60	1.8	Mt. Freedom, NJ
109	6/7/1992	23:51	40.964	74.564	6.00	0.4	Jefferson Township, NJ
117	10/27/1995	1:46	41.148	74.548	7.00	1.3	NE of Newton, NJ
118	10/27/1995	6:52	41.153	74.560	8.00	1.4	NE of Newton, NJ
123	2/26/1996	16:00	40.930	74.630	6.00	0.0	Neat Mt. Arlington, NJ
147	2/16/2006	23:43:23	41.161	74.535	8.00	2.6	22km NE of Newton, NJ
148	2/17/2006	0:00:30	41.159	74.557	8.00	0.9	20km NE of Newton, NJ
149	2/21/2006	00:31:19	41.163	74.554	5.00	1.3	20.4km NE of Newton, NJ
158	2/16/2009	06:42:35	40.868	74.551	4.00	2.3	2km SSE of Dover, NJ

Source: NJDEP <http://www.state.nj.us/dep/njgs/geodata/dgsdown/njearthquakes.pdf>

Climate Change

In 2007, the Intergovernmental Panel on Climate Change (IPCC) reported that increasing carbon dioxide (CO₂) emissions into the atmosphere, as a result of human activity, has warmed the Earth’s surface by more than 1.3°F during the last century. The Union of Concerned Scientists has indicated temperatures in the northeast are likely to rise in winter and summer over the next several decades. Without a reduction in CO₂ and other Greenhouse Gas (GHG) Emissions, average temperatures may rise by up to 14°F in the summer by 2100. Studies have predicted that by the end of the century the New York City region and cities such as Trenton could experience more than 20 days per summer with temperatures above 100°F.⁵⁸

This warming trend can have impacts on the health of humans and the environment. The predicted effects on humans include heat stress, increased particulates in the air we breathe, and increased occurrences of insect-spread diseases such as West Nile Virus in the winter season of northern climates. Ecosystem repercussions include changes to the water cycle, with the following potential consequences: loss of critical habitat, further stressing some already threatened and endangered species; impacts on water supply and agriculture; more intense rain events; more frequent periods of extended dryness; and increases in fires, pests, disease pathogens, and invasive weed species.⁵⁹

A Greenhouse Gas (GHG) is defined by the NJDEP as:

“an atmospheric gas that slows the rate at which heat radiates into space, thus having a warming effect on the atmosphere. GHGs include water vapor, carbon dioxide (CO₂), methane (CH₄), nitrous oxide, chlorofluorocarbons (CFCs), hydrofluorocarbons (HFCs), and some other halogenated gases.”⁶⁰

To address the effects of GHGs, New Jersey enacted the Global Warming Response Act in 2007. This law requires:

- Stabilization of statewide GHGs to 1990 levels by 2020, and
- A further reduction to 80% below 2006 levels by 2050

According to the NJDEP, New Jersey must meet these limits in order to avoid the most damaging impacts of climate change. In 2012, the latest year for which major sector estimates are available, total estimated emissions were 104.6 million metric tons of CO₂ equivalent (MMTCOe), below the 1990 baseline and 2020 target of 125.6 MMTCOe. The 2050 goal is much more ambitious: to be 80% below the 2006 level, or approximately 25.5 MMTCOe.

In December 2015, the state revised its *Energy Master Plan*. The state *Energy Master Plan* is the strategic vision for the use, management, and development of energy in New Jersey over the next decade. Because fossil fuels such as coal, oil, and natural gas are the largest source of GHGs in the state, the *Energy Master Plan* serves as the platform for discussions about how New Jersey can meet the Global Warming Response Act's 2050 greenhouse gas limit.⁶¹

The transportation sector continues to be the major contributor to GHGs (44% in 2012) and vehicle miles traveled continue to increase while fuel efficiencies have leveled off. In 2012, electricity generation was the second largest contributor at approximately 20% followed by residential at 11%, commercial at approximately 10%, and industrial at approximately 10%, combining for 31% of gross statewide emission. Highly warming gases, waste management, and land clearing contributed approximately 12%, while terrestrial carbon sequestration (forests absorbing carbon) provided an offset of -7.9%.⁶²

The Sustainable Jersey program is a certification program that acknowledges communities that complete qualifying actions toward sustainability. Hope Township is a participating community. Among the qualifying actions are a number of Greenhouse Gas initiatives that can be undertaken by the municipality.

On an individual level, rebates on energy efficient alternatives for household appliances, heating, cooling, and alternative energy systems are available through New Jersey's Clean Energy Program (NJCEP), which are administered by the New Jersey Board of Public Utilities. Commercial, industrial, and local government programs are also available.⁶³

FLOOD HAZARD AREAS

Flood Zones

Federal, state, and municipal governments provide oversight regarding areas prone to flooding through various acts, laws, and ordinances. The intent is to minimize property damage and negative ecological effects by limiting development and protecting positive environmental influences in areas subject to frequent flooding.

At the federal level, the United States Geological Survey (USGS) maps flood prone areas and the Federal Emergency Management Agency (FEMA) evaluates and maps Special Flood Hazard Areas (SFHAs) that can be used in participating communities to determine flood insurance rates. On the state level, the NJDEP delineates Flood Hazard Areas along streams and regulated activities within these areas. In recent years, FEMA and the state have coordinated to integrate NJDEP flood hazard area parameters in FEMA updates. Municipal code may set standards that are stricter than either the state or FEMA.

FEMA Mapping and Flood Insurance Program

Special Flood Hazard, evaluated and mapped by FEMA, and other flood zones are used to create official Flood Insurance Rate Mapping (FIRM) that can be used in participating communities, such as Hope Township, to determine flood insurance rates. Communities can choose to participate in the National Flood Insurance Program (NFIP), which requires mandatory flood insurance in areas mapped as Special Flood Hazard Areas. A Special Flood Hazard Area is defined as “an area that would be inundated by the flood having one percent chance of being equaled or exceeded in any given year,” also known as the base flood or 100-year flood zone. NFIP mapping also includes information of 500-year flood zones and various sublevels within the 100-year zone.⁶⁴ *Map 14* illustrates both the 100-year and 500-year flood zones for Hope Township. Areas along streams and major waterways in Hope Township fall within the 100-year flood zone. The 500-year flood zone is located on Beaver Brook and Honey Run by the Swayze Natural Priority Site.

The majority of the Township is not located in a Flood Zone. 10% of the Township is located within the 100-year flood zone, while less than 1% of the Township (0.83 acres) is located in the 500-year flood zone. *Table 44* outlines the acres of mapping flood zones in Hope Township.

<i>Flood Hazard</i>	<i>Acres</i>	<i>% of Total Municipal Area</i>
100-year Flood (1% annual chance)	1,181.36	10.09%
500-year Flood (0.2% annual chance)	0.83	0.01%
Not in Flood Zone	10,524.09	89.90%
Total Township Acreage:	11,706.27	100%
<i>Source: FEMA DFIRM 2011</i>		

NJDEP Regulated Water Ways

At the state level, New Jersey regulates flood prone areas through the New Jersey Flood Hazard Area Control Act, *N.J.S.A. 58:16A-50 et. seq.*, and its rule, adopted November 5, 2007. The Act recognizes the importance not only of avoiding building in unsafe places, but also preserving the vegetation that “is essential for maintaining bank stability and water quality”. The rules set standards for development in flood hazard areas and areas adjacent to surface waters “in order to mitigate the adverse impacts to flood and the environment that can be caused by such development”. As defined by the rules, a flood hazard area exists along every regulated waterway that has a drainage area of 50 acres or more. Regulated waters are waters that have been delineated in Appendix 2 of the Flood Hazard Control Act (FHCA) rules. In most cases, the delineation includes both the flood hazard area design flood elevation and flood limit. To determine which mapping is available for a particular waterway, or to obtain copies of maps or other information regarding the use or revision of these studies, contact the NJDEP as described at N.J.A.C. 7:13-3.3.⁶⁵

A Flood Hazard Area is defined as the area inundated by the flood hazard area design flood, which is equal to the 100-year flood plus a “factor of safety”. It includes both a floodway and a flood fringe. There are six measures for determining the flood hazard area under the FHCA rules. They include NJDEP delineation method (flood studies are undertaken); FEMA tidal, fluvial and hydraulic methods; and approximation and calculation methods.

NJDEP regulated activities in a flood hazard area or riparian zone include:

1. The alteration of topography through excavation, grading, and/or placement of fill;
 2. The clearing, cutting, and/or removal of vegetation in a riparian zone;
 3. The creation of impervious surface;
 4. The storage of unsecured materials;
 5. The construction, reconstruction, and/or enlargement of a structure; and
 6. The conversion of a building into a private residence or a public building.
- (N.J.A.C. 7:13-2.4)*

The appropriate permit must be obtained in order to engage in any of these activities in a regulated area. There are several different categories of permits; permits by rule, general permits and individual permits.

There are areas specific standards, depending on whether or not the area includes a channel, riparian zone, floodway, flood fringe, fishery resource, threatened and endangered species, or acid producing soils. And there are site specific standards for different facets such as storm water management, excavating, filling, building, roads and parking areas. Construction is not necessarily prohibited in a regulated area, but disturbance much be justified

Flooding in Hope Township

Hope Township does not experience severe flooding, as most of the flood hazard areas and streams flood into wetlands. Warren County has completed a Flood Mitigation Plan to pursue several

mitigation actions in response to flooding. Hope Township is not a participating municipality in Warren County's Flood Mitigation Plan.⁶⁶

On a local level, the Hope Township Municipal Code addresses flood hazard areas in Chapter 12, Flood Damage Prevention Code, which specifies strict standards for flood hazard reduction in those areas designated SFHAs as defined by FEMA.

Article 5 Provisions for Flood Hazard Reduction provides the following general standards for building in a flood area:

- *Anchoring*; All new construction, manufactured homes, and substantial improvements shall be anchored to prevent flotation, collapse, or lateral movement of the structure.
- *Construction Materials and Methods*; All new construction and substantial improvements shall be constructed with materials and utility equipment resistant to flood damage, and constructed using methods and practices that minimize flood damage.
- *Utilities*; All new and replacement water supply systems shall be designed to minimize or eliminate infiltration of floodwaters into the system; new and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of floodwaters into the systems and discharge from the systems into floodwaters; on-site waste disposal systems shall be located to avoid impairment to them or contamination from them during flooding; and electrical, heating, ventilation, plumbing and air-conditioning equipment and other service facilities shall be designed and/or located so as to prevent water from entering or accumulating within the components during conditions of flooding.
- *Subdivision Proposals*; All subdivision proposals shall be consistent with the need to minimize flood damage; have public utilities and facilities such as sewer, gas, electrical, and water systems located and constructed to minimize flood damage; have adequate drainage provided to reduce exposure to flood damage; and base flood elevation data shall be provided for subdivision proposals and other proposed development which contain at least fifty (50) lots or five (5) acres (whichever is less).
- *Enclosure Openings*; All new construction and substantial improvements having fully enclosed areas below the lowest floor that are usable solely for parking of vehicles, building access or storage in an area other than a basement and which are subject to flooding shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwaters. (Ord. #11-05).⁶⁷

KNOWN CONTAMINATED SITES

Soil and groundwater contamination is tracked by the state and federal government. This includes the following type of sites and locations:

- ✓ Brownfields- Extensive, long-term remediation sites;
- ✓ Community Right to Know program locations- Point source facilities that require ongoing, continuous monitoring; and
- ✓ Known Contaminated Sites- Point source occurrences that are specific and limited.

The NJDEP Site Remediation Program currently maintains a list of more than 12,000 New Jersey sites that have been confirmed contaminated and are undergoing remedial investigation, cleanup, or awaiting assignment of a Licensed Site Remediation Professional (LSRP). These sites include private residences, active/abandoned manufacturing/commercial properties, and gas stations. The list does not include sites that have been successfully remediated.

There are 3 active Known Contaminated Sites in Hope Township, all non-homeowner

Brownfields

A brownfield is “any former or current commercial or industrial site, currently vacant or underutilized and on which there has been, or there is suspected to have been, a discharge of a contaminant.”⁶⁸ The State of New Jersey encourages municipalities and counties to redevelop their brownfields as part of Smart Growth initiatives. According to the State of New Jersey Brownfield Sitemart, there are no brownfield site locations in Hope Township.⁶⁹

Community Right to Know

The Community Right to Know (CRTK) program is responsible for collecting and disseminating data on hazardous substances produced, stored, or used at companies in New Jersey. Companies or organizations storing certain hazardous substances in levels above specific threshold amounts are required by state and federal law to file annual reports. The Release and Pollution Prevention Report (RPPR) is used to collect information for the NJDEP Community Right to Know and Pollution Prevention programs. The RPPR gathers data on toxic chemical throughput, multi-media environmental released, on-site waste management, and off-site transfers, collectively known as material accounting. The Emergency Planning and Community Right-to-Know Act (EPCRA) is a federal regulation that “established requirements...regarding emergency planning and “Community Right-to-Know” reporting on hazardous toxic chemicals” to increase public knowledge and information about chemical uses.⁷⁰

In 2016 there was one active site in Hope Township that met the threshold for the State CRTK.⁷¹ This site is Sunrise Farms in the Township.⁷²

Known Contaminated Sites

The Known Contaminated Sites List (KCSL) for New Jersey includes those sites and properties within the state where contamination of soil or groundwater has been confirmed at levels equal to or greater than applicable standards. Known Contaminated Sites may include:

- *Active sites* with known contamination, having one or more active cases with any number of pending and closed cases.
- *Pending sites* with confirmed contamination having one or more pending cases, no active cases, and any number of closed cases
- *Closed sites* with remediated contamination, which are those sites having only closed cases, and no active or pending cases

In Hope Township there are 3 active sites (all non-homeowner), 3 pending non-homeowner sites, and 17 closed sites.⁷³ The Known Contaminated Sites within Hope Township are listed in **Table 45** and are shown in **Map 15**. The pending and remediated (closed sites) are listed in **Table 46** and **Table 47**.

Table 45. Active (Non-Homeowner) Contaminated Sites			
<i>Site Name</i>	<i>Site Location</i>	<i>CEA Status</i>	<i>Category</i>
Hope Township Municipal Building	407 Hope Great Meadows Rd	---	B
US Gas	423 Hope Blairstown Rd	Ongoing 03-14-2000	C2
Hope Auto Care	424 Hope-Great Meadows Rd	Ongoing 05-11-2006	D

Source: NJDEP Data Miner (Accessed August 8, 2017, confirmed January 10, 2018)

Table 46. Pending Non-Homeowner Contaminated Sites				
Site ID	PI Number	PI Name	Address	Home Owner
447974	563161	47 Lakeview Avenue oil spill	47 Lakeveiw Avenue	No
67690	G000021675	Lakeview Drive	Lakeview Avenue	No
379195	470239	Route 519 County Road MVA oil spill	Route 519	No

Source: NJDEP Data Miner (Accessed January 10, 2018)

Table 47. Remediated (Closed) Contaminated Sites				
Site ID	PI Number	PI Name	Address	Home Owner
583719	731454	1006 Hope Bridgeville Road	1006 Bridgeville Road	Yes
374219	463739	10 Birch Ridge Road	10 Birch Ridge Road	Yes
435511	547190	175 Lake Just It Road	175 Lake Just It Road	Yes
470481	593860	24 Ridgeway Avenue	24 Ridgeway Avenue	Yes
353848	436764	252 Shiloh Road	252 Shiloh Road	Yes
450186	566101	39 Locust Lake Road	39 Locust Lake Road	Yes
498703	628593	3 Birch Ridge Road	3 Birch Ridge Road	Yes
392874	491501	413 Hope Johnsonburg Road	413 Hope Johnsonburg Road	Yes
433392	544383	46 Lakeview Avenue	46 Lakeview Avenue	Yes
442346	556073	551 Hope Blairstown Road	551 Hope Blairstown Road	Yes
196356	257784	84 Far View Road	84 Far View Road	Yes
416125	521585	87 Far View Road	87 Far View Road	Yes
527767	662697	8 Locust Road	8 Locust Road	Yes
66681	G000008850	Hope Township Sanitary Landfill	Great Meadows Road	No
45718	003829	New Jersey State Police	Hope Blairstown Road	No
185285	243712	Newton Trust	419 Hope Blairstown Road	No
479	020812	Warren County Hope Garage	Route 608	No

Source: NJDEP Data Miner (Accessed January 10, 2018)

The lists are produced by the NJDEP in response to the Brownfields and Contaminated Sites Remediation Act (*N.J.S.A. 58:10-23.16-17*) which required the preparation of a list of sites affected by hazardous substances. It also satisfied obligations under the new Jersey New Residential Construction Off-Site Conditions Disclosure Act (*N.J.S.A. 46:3C1 et seq.*). Sites included in the KCSL report can undergo a wide variety of remedial activities, ranging from relatively simple “cut and scrape” cleanups to highly complex cleanups. The sites with complex contamination issues can have several sources of contamination, which can affect both soil and groundwater at the same time.

The Site Remediation Reform Act, *N.J.S.A. 58:10C-1 et seq.* (SRRA), enacted in 2009, has helped to speed up the remediation process, “thus helping to decrease the threat of contamination to public health and safety to the environment, and to quickly return underutilized properties to productive use.” As of May 7, 2012, with limited exceptions, all remediation in New Jersey, without regard to when remediation was initiated, proceeds under the supervision of an LSRP, without NJDEP approval, following nine requirements set forth at *N.J.S.A. 58:10B-1.3b(1)* through (9).

The active sites are rated with B, C1, C2, C3, or D depending on the type of severity of the contamination defined as follows:

B – Remedial level associated with emergency response, simple removal activities of contaminants, usually no impact to soil or ground water.

C1 – Remedial levels are associated with simple sites one or two contaminants localized to soil and the immediate spill or discharge area.

C2 – Remedial levels are associated within more complicated contaminant discharge such as multiple site spills and discharges, or more than one contaminant, with both soil and groundwater impacted or threatened.

C3 – Remedial levels are associated with highly complex threatening sites. These sites can have multiple contaminants, some at high concentrations with unknown sources continuing to impact soils, groundwater, and possibly surface waters and potable water resources. These sites are dangerous for direct contact with contaminated soils.

D - Same conditions as C3 except that D levels are also usually designated Federal “Superfund Sites”.

The Classification Exception Area (CEA) Status explains an area where one or more standards and designated uses are suspended. (N.J.A.C. 7:9C-1.4)⁷⁴

HISTORIC AND CULTURAL FEATURES

History

Established by German Moravians in 1769, Hope Township is one of the earliest planned communities in Warren County.^e Prior to the arrival of the Moravians, the area was settled by several families who farmed the lands on Jenny Jump Mountain and surrounding areas, including John Samuel Green Jr.'s farm. Moravians from Bethlehem, Pennsylvania would travel through present day Hope Township on their way to New England and would stay overnight with the Green family. After several years, "Mr. Green offered them 1,000 acres of his land to establish a settlement on his farm," and instead of accepting the land as a gift, they purchased the land for 1,000 British pounds. Beaver Brook was a source of waterpower which was used by the Moravians as a means to provide several sources of income for the village. Unlike the earlier settlers in this area, "the Moravians pursued industrial skills and crafts rather than solely farming."

The Grist Mill and its Mill Race, which channeled water to the mill in order to run the grinding wheels to grind flour, continued to be utilized into the 1950's. These were the first industrial buildings built to provide income and develop the community. Soon after, other industries were constructed including the "Distillery, General Store, Log Tavern, a Saw Mill, Oil Mill, Pottery, Tannery, Log Cabins, North and South Farms, permanent limestone residences, Single Sister's Residence and School, Gemeinhaus or Church and "God's Acre", and the Moravian Cemetery".

In 1774, the community was accepted by the Moravian Church and the name was changed from Greenland to Hope in 1775. The community, however, had never become self-supporting and had seen a decline in population so after approximately 40 years, the community was sold and most of the Moravians returned to Nazareth or Bethlehem, Pennsylvania.

In the late 1700's, development began in Mt. Hermon section of the Township where John Honeywell left the majority of his estate for the education of children in Knowlton. In 1798 and into the 1800's, Honeywell Academy was established, followed by a headmaster's house, and the Mt. Hermon Methodist Church. By the 1850 census, Hope's population had reached 1,756 with 145 farms.

The 1800's brought transportation opportunities due to the railroads to the north and south of the Village and the Morris Canal to the south. Through the late 1800's houses and general stores and other services were built in the town center as farmers retired and moved into town. The 1900's brought development to Silver Lake and lots were sold to build summer cottages. By 1918 the population in the Village was 400. A major fire destroyed sections on the Village at the northern end of Route 519 in the 1900's which led to the opening of Route 521 towards Blainstown. Little change has occurred since then in the Village.⁷⁵

^e The information for the History section of the ERI Update is gathered from the Hope Township website.

Historic and Cultural Sites

Hope Township has two sites that are listed on both the State Register and the National Register of Historic Places. Authorized by the National Historic Preservation Act of 1966, the National Park Service’s National Register is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect America’s historic and archaeological resources. Sites listed on the national and state registers are listed in **Table 48** and described below.

Hope Historic District

The Hope Historic District contains buildings that date back from 1769 when the Village was established by the Moravian Community. Many of these buildings were constructed from irregularly faced limestone and have several features typical of Moravian detail including brick-arched window lintels. Notable buildings in the Hope Historic District include the Grist Mill and the Gemeinhaus. Additionally, stone houses and barns are still located within the village and along nearby roads. A Moravian distillery and St. Luke’s Church are also still present there as well.⁷⁶

St. Luke’s Episcopal Church

Located within the Hope Historic District, St. Luke’s Episcopal Church dates back to 1832, and is a “a fine example of the Gothic Revival style built in 1834 of faced limestone.”⁷⁷

Table 48. Historic Sites Listed on the State and National Register

<i>Site Name</i>	<i>Address</i>	<i>National Register</i>	<i>State Register</i>
Hope Historic District	Union, High, Hickory and Walnut Streets; County Route 521; Beaver Brook; Mill Race; County Road 519	7/20/1973 (NR#73001138)	6/13/1973
St. Luke’s Episcopal Church (ID#4707)	346 High Street	3/13/2007 (NR#07000151)	1/11/2007

The following definitions are provided for the abbreviations and terminology used in the table:

National Register (NR) Reference Number: This number is provided for the properties which have been included in the National Register Information System (NRIS) database, which is available online from the National Parks Service.

State Register: The date that a property is listed on the New Jersey Register of Historic Places

Hope Historic District

The historical sites located within Hope Township's Historic District are listed in *Table 49*.

Table 49. Historic Sites in Hope Township Historic District

<i>Site Name</i>	<i>Address</i>
St. Luke's Episcopal Church (ID#4707)	346 High Street
Moravian Grist Mill, c. 1769-1770	Route 519
Moravian Distillery, c.1773	Millbrook Road
Farm Manager's House and Barn, c.1775	Walnut Street
Sites of Peter Worbass and Samuel Green Log Cabins, c. 1769	Walnut Street
Site of Moravian Log Tavern, c.1773	Walnut Street-Cedar Street
Moravian Cemetery, c.1773	High Street
Saw Mill Site , c. 1780	Millbrook Road
Nicolaus Barn, c.1778-1780	Hickory Street
Stephen Nicolaus House, c.1775-1776	Hickory Street
Moravian House, c. 1780	High Street
Canal Era House, c. 1780	High Street
John Weinland House and Shop, c.1787	High Street
Gemeinhaus, c. 1781	Hope Bridgeville Rd (Rt 519)
Leinbach Store, c. 1776	High Street
Long House, c. 1777	Walnut Street
John Schenk House and Shop, c. 1783	Hope Bridgeville Rd (Rt 519)
Moravian Houses, c.1780-1800	Hope Bridgeville Rd (Rt 519)
Single Sisters School, c.1803	Hope Bridgeville Rd (Rt 519)
Howell-Turner House, c. 1838	Walnut Street
Tom's Barn, early 1800's	Cedar Street
St. John's United Methodist Church, c.1832	354 High Street
Federal House, c.1835	Washington Street
James K. Swayze House, c.1836-1836	Hope Bridgeville Rd (Rt 519)
Caleb Swayze House, c. 1832	Hope Bridgeville Rd (Rt 519)
Museum building, early 1800's	323 High Street
Stone Bridge, c. 1810-1820	High Street
Site of Moravian Pottery and Tannery Works, early 1800's	Off High Street, along Beaver Brook
Pre-Victorian House, c. 1820-1850	High Street
Vusler House and Milk Barn, c. 1911	High Street
Cannery, c. 1920	Millbrook Road

Highlights of the Historic District:

Moravian Grist Mill

The Grist Mill was the first industrial complex in the community and included a saw mill, oil mill and blacksmith shop. The Grist mill contains a 1,000-foot-long mill race that was hand cut through solid slate and measures 22-feet deep at its deepest point. Established between 1769 and 1770, the mill was active until the mid-1950's, and was converted into a bed and breakfast in 1986.⁷⁸

Gemeinhaus

The Gemeinhaus acted as the church, community center, and cultural center of the Village. The Gemeinhaus contained a Saal (worship room) where men and women entered separately, women used the left staircase and men used the right. Portions of the original staircases remain today.⁷⁹ This building was later used as the County court house until the present court house was built in Belvidere.

Moravian Log Tavern Site

The Moravian Log Tavern dates back to 1773 and provided lodging and food for travelers that were passing through on their way to Kingston, New York. In 1782, George Washington and his troops dined at the Moravian Log Tavern with Bishop Ettwein on their way to Newburg, New York. The Tavern was later destroyed in a fire, and in 1844 a Christian Church was built on the site. In 1918, a fire started which destroyed much of the Village, including the church. The building was restored in the 1950's and is now the location of the Hope Community Center.⁸⁰

Other Sites of Local Importance

The Swayze Cemetery (also known as the Swayze-Hildebrand Cemetery or Beaver Brook Cemetery) was originally established as a family burial ground with the death of Israel Swayze on August 27, 1774. (**Figure 16**) The Swayze family were large landowners within Hope Township, owning approximately half the land.⁸¹ The cemetery contains 212 burials, 25% being children under the age of 10. Those interred at the cemetery include Revolutionary War and Civil War veterans as well as Samuel Green, who tried to gift, but eventually sold 1,000 acres of land to the Moravians. Samuel Green was the only Moravian who died in Hope who was not interred in Hope's Moravian Cemetery. In 2010, a group of concerned individuals incorporated "Friends of Swayze, Inc.", to raise funds and resources to repair, rebuild and restore the historic cemetery,⁸² as well as "educate the public on the historic significance of the site."⁸³



Figure 16. Swayze Cemetery

Photo: Courtesy of PARASHOOT PRODUCTIONS

APPENDIX

Appendix A. Natural Heritage Priority Sites Species List



State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Parks & Forestry

State Forestry Service

Mail Code 501-04

Office of Natural Lands Management – Natural Heritage Program

P.O. Box 420

Trenton, NJ 08625-0420

Tel. (609) 984-1339 Fax. (609) 984-1427

CHRIS CHRISTIE
Governor

KIM GUADAGNO
Lt. Governor

BOB MARTIN
Commissioner

September 12, 2017

Robin Keggan
Hope Township
407 County Route 611
Hope, NJ 07844

Re: Hope Township Environmental Resource Inventory Update
Hope Township, Warren County

Dear Ms. Keggan:

Thank you for your data request regarding rare species information for the above referenced project site.

Searches of the Natural Heritage Database and the Landscape Project (Version 3.3) are based on a representation of the boundaries of your project site in our Geographic Information System (GIS). We make every effort to accurately transfer your project bounds from the topographic map(s) submitted with the Natural Heritage Data Request Form into our Geographic Information System. We do not typically verify that your project bounds are accurate, or check them against other sources.

We have checked the Landscape Project habitat mapping and the Biotics Database for occurrences of any rare wildlife species or wildlife habitat on the referenced site. The Natural Heritage Database was searched for occurrences of rare plant species or ecological communities that may be on the project site. Please refer to Table 1 (attached) to determine if any rare plant species, ecological communities, or rare wildlife species or wildlife habitat are documented on site. A detailed report is provided for each category coded as 'Yes' in Table 1.

We have also checked the Landscape Project habitat mapping and Biotics Database for occurrences of rare wildlife species or wildlife habitat in the immediate vicinity (within ¼ mile) of the referenced site. Additionally, the Natural Heritage Database was checked for occurrences of rare plant species or ecological communities within ¼ mile of the site. Please refer to Table 2 (attached) to determine if any rare plant species, ecological communities, or rare wildlife species or wildlife habitat are documented within the immediate vicinity of the site. Detailed reports are provided for all categories coded as 'Yes' in Table 2. These reports may include species that have also been documented on the project site.

The Natural Heritage Program reviews its data periodically to identify priority sites for natural diversity in the State. Included as priority sites are some of the State's best habitats for rare and endangered species and ecological communities. Please refer to Tables 1 and 2 (attached) to determine if any priority sites are located on or in the immediate vicinity of the site.

A list of rare plant species and ecological communities that have been documented from the county (or counties), referenced above, can be downloaded from <http://www.state.nj.us/dep/parksandforests/natural/heritage/countylist.html>. If suitable habitat is present at the project site, the species in that list have potential to be present.

Status and rank codes used in the tables and lists are defined in EXPLANATION OF CODES USED IN NATURAL HERITAGE REPORTS, which can be downloaded from http://www.state.nj.us/dep/parksandforests/natural/heritage/nhpcodes_2010.pdf.

NHP File No. 17-4007488-12680

Beginning May 9, 2017, the Natural Heritage Program reports for wildlife species will utilize data from Landscape Project Version 3.3. If you have questions concerning the wildlife records or wildlife species mentioned in this response, we recommend that you visit the interactive web application at the following URL, <https://njdep.maps.arcgis.com/apps/webappviewer/index.html?id=0e6a44098c524ed99bf739953cb4d4c7>, or contact the Division of Fish and Wildlife, Endangered and Nongame Species Program at (609) 292-9400.

For additional information regarding any Federally listed plant or animal species, please contact the U.S. Fish & Wildlife Service, New Jersey Field Office at <http://www.fws.gov/northeast/njfieldoffice/endangered/consultation.html>.

PLEASE SEE 'CAUTIONS AND RESTRICTIONS ON NHP DATA', which can be downloaded from <http://www.state.nj.us/dep/parksandforests/natural/heritage/newcaution2008.pdf>.

Thank you for consulting the Natural Heritage Program. The attached invoice details the payment due for processing this data request. Feel free to contact us again regarding any future data requests.

Sincerely,



Robert J. Cartica
Administrator

c: NHP File No. 17-4007488-12680

Mail Code 501-04 Department of Environmental Protection State Forestry Service Office of Natural Lands Management P.O. Box 420 Trenton, New Jersey 08625-0420 Tel. (609) 984-1339 Fax. (609) 984-1427		<h1><i>Invoice</i></h1>	
		Date	Invoice #
		9/12/2017	12680
Bill to: Hope Township 407 County Route 611 Hope, NJ 07844		Make check payable to: Office of Natural Lands Management And forward with a copy of this statement to: Mail Code 501-04 Office of Natural Lands Management P.O. Box 420 Trenton, New Jersey 08625-0420	
Quantity (hrs.)	Description	Rate (per hr.)	Amount
1	Natural Heritage Database search for locational information of rare species and ecological communities. Project: 17-4007488-12680	\$ 70.00	\$ 70.00
Robin Keggan Project Name: Hope Township Environmental Resource Inventory Update		Total	\$ 70.00

Table 1: On Site Data Request Search Results (6 Possible Reports)

<u>Report Name</u>	<u>Included</u>	<u>Number of Pages</u>
1. Possibly on Project Site Based on Search of Natural Heritage Database: Rare Plant Species and Ecological Communities Currently Recorded in the New Jersey Natural Heritage Database	Yes	1 page(s) included
2. Natural Heritage Priority Sites On Site	Yes	See emailed attachments
3. Rare Wildlife Species or Wildlife Habitat on the Project Site Based on Search of Landscape Project 3.3 Species Based Patches	Yes	4 page(s) included
4. Vernal Pool Habitat on the Project Site Based on Search of Landscape Project 3.3	Yes	2 page(s) included
5. Rare Wildlife Species or Wildlife Habitat on the Project Site Based on Search of Landscape Project 3.3 Stream Habitat File	No	0 pages included
6. Other Animal Species On the Project Site Based on Additional Species Tracked by Endangered and Nongame Species Program	No	0 pages included

**Possibly on Project Site Based on Search of
Natural Heritage Database: Rare Plant Species and
Ecological Communities Currently Recorded in the
New Jersey Natural Heritage Database**

Scientific Name	Common Name	Federal Protection Status	State Protection Status	Regional Status	Grank	Srank	Identified	Last Observed	Location
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Vascular Plants

Carex retrorsa	Retorse Sedge			HL	G5	S2	Y - Yes	1988-08-03	1.2 miles South-southeast of Swayze's Mill; 2.6 miles Southwest of Hope.
Eleocharis quadrangulata	Angled Spike-rush			HL	G4	S3	Y - Yes	1994-07-06	Southeastern corner of abandoned gravel pit 0.7 mile southeast of Swayze Mills.

Total number of records: 2

**Rare Wildlife Species or Wildlife Habitat on the
Project Site Based on Search of
Landscape Project 3.3 Species Based Patches**

Class	Common Name	Scientific Name	Feature Type	Rank	Federal Protection Status	State Protection Status	Grank	Srank
<i>Amphibia</i>								
	Jefferson Salamander	Ambystoma jeffersonianum	On Road	2	NA	Special Concern	G4	S3
	Longtail Salamander	Eurycea longicauda longicauda	Occupied Habitat	3	NA	State Threatened	G5T5	S2
<i>Aves</i>								
	American Kestrel	Falco sparverius	Breeding Sighting	3	NA	State Threatened	G5	S2B,S2N
	Bald Eagle	Haliaeetus leucocephalus	Foraging	4	NA	State	G5	S1B,S2N
	Barred Owl	Strix varia	Breeding Sighting	3	NA	State Threatened	G5	S2B,S2N
	Barred Owl	Strix varia	Non-breeding Sighting	3	NA	State Threatened	G5	S2B,S2N
	Black-billed Cuckoo	Coccyzus erythrophthalmus	Breeding Sighting	2	NA	Special Concern	G5	S3B,S4N
	Blue-headed Vireo (Solitary Vireo)	Vireo solitarius	Breeding Sighting	2	NA	Special Concern	G5	S3B,S4N
	Bobolink	Dolichonyx oryzivorus	Breeding Sighting	3	NA	State Threatened	G5	S2B,S3N
	Brown Thrasher	Toxostoma rufum	Breeding Sighting	2	NA	Special Concern	G5	S3B,S4N
	Canada Warbler	Wilsonia canadensis	Breeding Sighting	2	NA	Special Concern	G5	S3B,S4N

**Rare Wildlife Species or Wildlife Habitat on the
Project Site Based on Search of
Landscape Project 3.3 Species Based Patches**

Class	Common Name	Scientific Name	Feature Type	Rank	Federal Protection Status	State Protection Status	Grank	Srank
	Cerulean Warbler	<i>Dendroica cerulea</i>	Breeding Sighting	2	NA	Special Concern	G4	S3B,S3N
	Cooper's Hawk	<i>Accipiter cooperii</i>	Breeding Sighting	2	NA	Special Concern	G5	S3B,S4N
	Eastern Meadowlark	<i>Sturnella magna</i>	Breeding Sighting	2	NA	Special Concern	G5	S3B,S3N
	Grasshopper Sparrow	<i>Ammodramus savannarum</i>	Breeding Sighting	3	NA	State Threatened	G5	S2B,S3N
	Great Blue Heron	<i>Ardea herodias</i>	Foraging	2	NA	Special Concern	G5	S3B,S4N
	Hooded Warbler	<i>Wilsonia citrina</i>	Breeding Sighting	2	NA	Special Concern	G5	S3B,S4N
	Least Bittern	<i>Ixobrychus exilis</i>	Breeding Sighting-Confirmed	2	NA	Special Concern	G5	S3B,S3N
	Northern Parula	<i>Parula americana</i>	Breeding Sighting	2	NA	Special Concern	G5	S3B,S4N
	Osprey	<i>Pandion haliaetus</i>	Foraging	3	NA	State Threatened	G5	S2B,S4N
	Red-shouldered Hawk	<i>Buteo lineatus</i>	Non-breeding Sighting	2	NA	Special Concern	G5	S1B,S3N
	Veery	<i>Catharus fuscescens</i>	Breeding Sighting	2	NA	Special Concern	G5	S3B,S4N
	Vesper Sparrow	<i>Poocetes gramineus</i>	Breeding Sighting	4	NA	State	G5	S1B,S3N
	Wood Thrush	<i>Hylocichla mustelina</i>	Breeding Sighting	2	NA	Special Concern	G4	S3B,S4N
	Worm-eating Warbler	<i>Helmitheros vermivorum</i>	Breeding Sighting	2	NA	Special Concern	G5	S3B,S4N

**Rare Wildlife Species or Wildlife Habitat on the
Project Site Based on Search of
Landscape Project 3.3 Species Based Patches**

Class	Common Name	Scientific Name	Feature Type	Rank	Federal Protection Status	State Protection Status	Grank	Srank
<i>Insecta</i>								
	Mitchell's Satyr	Neonympha mitchellii mitchellii	Casual Flyby	5	Federally Listed Threatened	State	G2T2	S1
<i>Mammalia</i>								
	Bobcat	Lynx rufus	Capture Location	4	NA	State	G5	S2
	Bobcat	Lynx rufus	Live Individual Sighting	4	NA	State	G5	S2
	Bobcat	Lynx rufus	On Road	4	NA	State	G5	S2
	Bobcat	Lynx rufus	Physical evidence	4	NA	State	G5	S2
	Bobcat	Lynx rufus	Telemetry: Home Range	4	NA	State	G5	S2
<i>Reptilia</i>								
	Bog Turtle	Glyptemys mühlenbergii	Occupied Habitat	5	Federally Listed Threatened	State	G3	S1
	Eastern Box Turtle	Terrapene carolina carolina	Occupied Habitat	2	NA	Special Concern	G5T5	S3
	Northern Copperhead	Agkistrodon contortrix mokasen	Occupied Habitat	2	NA	Special Concern	G5T5	S3
	Spotted Turtle	Clemmys guttata	Occupied Habitat	2	NA	Special Concern	G5	S3

**Rare Wildlife Species or Wildlife Habitat on the
Project Site Based on Search of
Landscape Project 3.3 Species Based Patches**

Class	Common Name	Scientific Name	Feature Type	Rank	Federal Protection Status	State Protection Status	Grank	Srank
	Wood Turtle	Glyptemys insculpta	Occupied Habitat	3	NA	State Threatened	G3	S2

<p>Vernal Pool Habitat on the Project Site Based on Search of Landscape Project 3.3</p>
--

Vernal Pool Habitat Type	Vernal Pool Habitat ID
Vernal habitat area	2977
Potential vernal habitat area	2079
Potential vernal habitat area	2083
Potential vernal habitat area	2090
Potential vernal habitat area	2093
Potential vernal habitat area	2103
Potential vernal habitat area	2105
Potential vernal habitat area	2107
Potential vernal habitat area	2115
Potential vernal habitat area	2120
Potential vernal habitat area	2121
Potential vernal habitat area	2126
Potential vernal habitat area	2138
Potential vernal habitat area	2139
Potential vernal habitat area	2143
Potential vernal habitat area	2145
Potential vernal habitat area	2150
Potential vernal habitat area	2151

**Vernal Pool Habitat on the
Project Site Based on Search of
Landscape Project 3.3**

Vernal Pool Habitat Type	Vernal Pool Habitat ID
Potential vernal habitat area	2153
Potential vernal habitat area	2160
Total number of records: 20	

Table 2: Vicinity Data Request Search Results (6 possible reports)

<u>Report Name</u>	<u>Included</u>	<u>Number of Pages</u>
1. Immediate Vicinity of the Project Site Based on Search of Natural Heritage Database: Rare Plant Species and Ecological Communities Currently Recorded in the New Jersey Natural Heritage Database	Yes	1 page(s) included
2. Natural Heritage Priority Sites within the Immediate Vicinity	Yes	See emailed attachments
3. Rare Wildlife Species or Wildlife Habitat Within the Immediate Vicinity of the Project Site Based on Search of Landscape Project 3.3 Species Based Patches	Yes	3 page(s) included
4. Vernal Pool Habitat In the Immediate Vicinity of Project Site Based on Search of Landscape Project 3.3	Yes	1 page(s) included
5. Rare Wildlife Species or Wildlife Habitat In the Immediate Vicinity of the Project Site Based on Search of Landscape Project 3.3 Stream Habitat File	No	0 pages included
6. Other Animal Species In the Immediate Vicinity of the Project Site Based on Additional Species Tracked by Endangered and Nongame Species Program	No	0 pages included

**Immediate Vicinity of the Project Site
 Based on Search of Natural Heritage Database
 Rare Plant Species and Ecological Communities Currently Recorded in
 the New Jersey Natural Heritage Database**

Scientific Name	Common Name	Federal Protection Status	State Protection Status	Regional Status	Grank	Srank	Identified	Last Observed	Location
<i>Vascular Plants</i>									
Callitriche palustris	Marsh Water-starwort			HL	G5	S2	Y - Yes	1948-08-10	1.5 miles Northeast of Sarepta.
Carex tuckermanii	Tuckerman's Sedge		E	LP, HL	G4	S1	Y - Yes	1923-06-16	1 MI. SOUTH OF SWAYZEE MILL.
Castilleja coccinea	Scarlet Indian-paintbrush			HL	G5	S2	Y - Yes	1970-05-20	3 miles south of Hope, on Route 519.
Trollius laxus ssp. laxus	Spreading Globe Flower		E	LP, HL	G5T3	S1	Y - Yes	1918-05-05	MEADOW WEST OF HOPE.
Total number of records:		4							

**Rare Wildlife Species or Wildlife Habitat Within the
Immediate Vicinity of the Project Site Based on Search of
Landscape Project 3.3 Species Based Patches**

Class	Common Name	Scientific Name	Feature Type	Rank	Federal Protection Status	State Protection Status	Grank	Srank
<i>Amphibia</i>								
	Jefferson Salamander	Ambystoma jeffersonianum	On Road	2	NA	Special Concern	G4	S3
	Longtail Salamander	Eurycea longicauda longicauda	Occupied Habitat	3	NA	State Threatened	G5T5	S2
<i>Aves</i>								
	American Kestrel	Falco sparverius	Breeding Sighting	3	NA	State Threatened	G5	S2B,S2N
	Bald Eagle	Haliaeetus leucocephalus	Foraging	4	NA	State Endangered	G5	S1B,S2N
	Barred Owl	Strix varia	Breeding Sighting	3	NA	State Threatened	G5	S2B,S2N
	Barred Owl	Strix varia	Non-breeding Sighting	3	NA	State Threatened	G5	S2B,S2N
	Black-billed Cuckoo	Coccyzus erythrophthalmus	Breeding Sighting	2	NA	Special Concern	G5	S3B,S4N
	Blue-headed Vireo (Solitary Vireo)	Vireo solitarius	Breeding Sighting	2	NA	Special Concern	G5	S3B,S4N
	Bobolink	Dolichonyx oryzivorus	Breeding Sighting	3	NA	State Threatened	G5	S2B,S3N
	Brown Thrasher	Toxostoma rufum	Breeding Sighting	2	NA	Special Concern	G5	S3B,S4N
	Canada Warbler	Wilsonia canadensis	Breeding Sighting	2	NA	Special Concern	G5	S3B,S4N
	Cerulean Warbler	Dendroica cerulea	Breeding Sighting	2	NA	Special Concern	G4	S3B,S3N
	Cooper's Hawk	Accipiter cooperii	Breeding Sighting	2	NA	Special Concern	G5	S3B,S4N

**Rare Wildlife Species or Wildlife Habitat Within the
Immediate Vicinity of the Project Site Based on Search of
Landscape Project 3.3 Species Based Patches**

Class	Common Name	Scientific Name	Feature Type	Rank	Federal Protection Status	State Protection Status	Grank	Srank
	Eastern Meadowlark	<i>Sturnella magna</i>	Breeding Sighting	2	NA	Special Concern	G5	S3B,S3N
	Grasshopper Sparrow	<i>Ammodramus savannarum</i>	Breeding Sighting	3	NA	State Threatened	G5	S2B,S3N
	Great Blue Heron	<i>Ardea herodias</i>	Foraging	2	NA	Special Concern	G5	S3B,S4N
	Hooded Warbler	<i>Wilsonia citrina</i>	Breeding Sighting	2	NA	Special Concern	G5	S3B,S4N
	Northern Parula	<i>Parula americana</i>	Breeding Sighting	2	NA	Special Concern	G5	S3B,S4N
	Osprey	<i>Pandion haliaetus</i>	Foraging	3	NA	State Threatened	G5	S2B,S4N
	Osprey	<i>Pandion haliaetus</i>	Nest	3	NA	State Threatened	G5	S2B,S4N
	Red-headed Woodpecker	<i>Melanerpes erythrocephalus</i>	Breeding Sighting	3	NA	State Threatened	G5	S2B,S2N
	Red-shouldered Hawk	<i>Buteo lineatus</i>	Non-breeding Sighting	2	NA	Special Concern	G5	S1B,S3N
	Veery	<i>Catharus fuscescens</i>	Breeding Sighting	2	NA	Special Concern	G5	S3B,S4N
	Vesper Sparrow	<i>Poocetes gramineus</i>	Breeding Sighting	4	NA	State Endangered	G5	S1B,S3N
	Wood Thrush	<i>Hylocichla mustelina</i>	Breeding Sighting	2	NA	Special Concern	G4	S3B,S4N
	Worm-eating Warbler	<i>Helmitheros vermivorum</i>	Breeding Sighting	2	NA	Special Concern	G5	S3B,S4N
<i>Insecta</i>								
	Mitchell's Satyr	<i>Neonympha mitchellii mitchellii</i>	Casual Flyby	5	Federally Listed Threatened	State Endangered	G2T2	S1
<i>Mammalia</i>								

**Rare Wildlife Species or Wildlife Habitat Within the
Immediate Vicinity of the Project Site Based on Search of
Landscape Project 3.3 Species Based Patches**

Class	Common Name	Scientific Name	Feature Type	Rank	Federal Protection Status	State Protection Status	Grank	Strank
	Bobcat	Lynx rufus	Capture Location	4	NA	State Endangered	G5	S2
	Bobcat	Lynx rufus	Live Individual Sighting	4	NA	State Endangered	G5	S2
	Bobcat	Lynx rufus	On Road	4	NA	State Endangered	G5	S2
	Bobcat	Lynx rufus	Physical evidence	4	NA	State Endangered	G5	S2
	Bobcat	Lynx rufus	Telemetry: Home Range	4	NA	State Endangered	G5	S2
Reptilia								
	Bog Turtle	Glyptemys muhlenbergii	Occupied Habitat	5	Federally Listed Threatened	State Endangered	G3	S1
	Eastern Box Turtle	Terrapene carolina carolina	Occupied Habitat	2	NA	Special Concern	G5T5	S3
	Northern Copperhead	Agkistrodon contortrix mokasen	Occupied Habitat	2	NA	Special Concern	G5T5	S3
	Spotted Turtle	Clemmys guttata	Occupied Habitat	2	NA	Special Concern	G5	S3
	Wood Turtle	Glyptemys insculpta	Occupied Habitat	3	NA	State Threatened	G3	S2

**Vernal Pool Habitat
In the Immediate Vicinity of
Project Site Based on Search of
Landscape Project 3.3**

Vernal Pool Habitat Type	Vernal Pool Habitat ID
Vernal habitat area	2977
Potential vernal habitat area	2081
Potential vernal habitat area	2083
Potential vernal habitat area	2105
Potential vernal habitat area	2146
Potential vernal habitat area	2150
Potential vernal habitat area	2158
Potential vernal habitat area	2160
Potential vernal habitat area	2166
Total number of records:	9

MAPS

Map 1. Base Map

Map 2. Bedrock Geology

Map 3. Surficial Geology

Map 3A. Topography

Map 4. Soil Series

Map 5. Agricultural Soil Categories

Map 6. Watersheds

Map 7. Surface Water Use Classifications

Map 8. Aquifer Recharge Potential

Map 9. Bedrock Aquifer Rankings

Map 10. Wetlands

Map 11. Land Use/ Land Cover

Map 12. Endangered Species





Map 13. Vernal Habitats

Map 14. FEMA Flood Zones


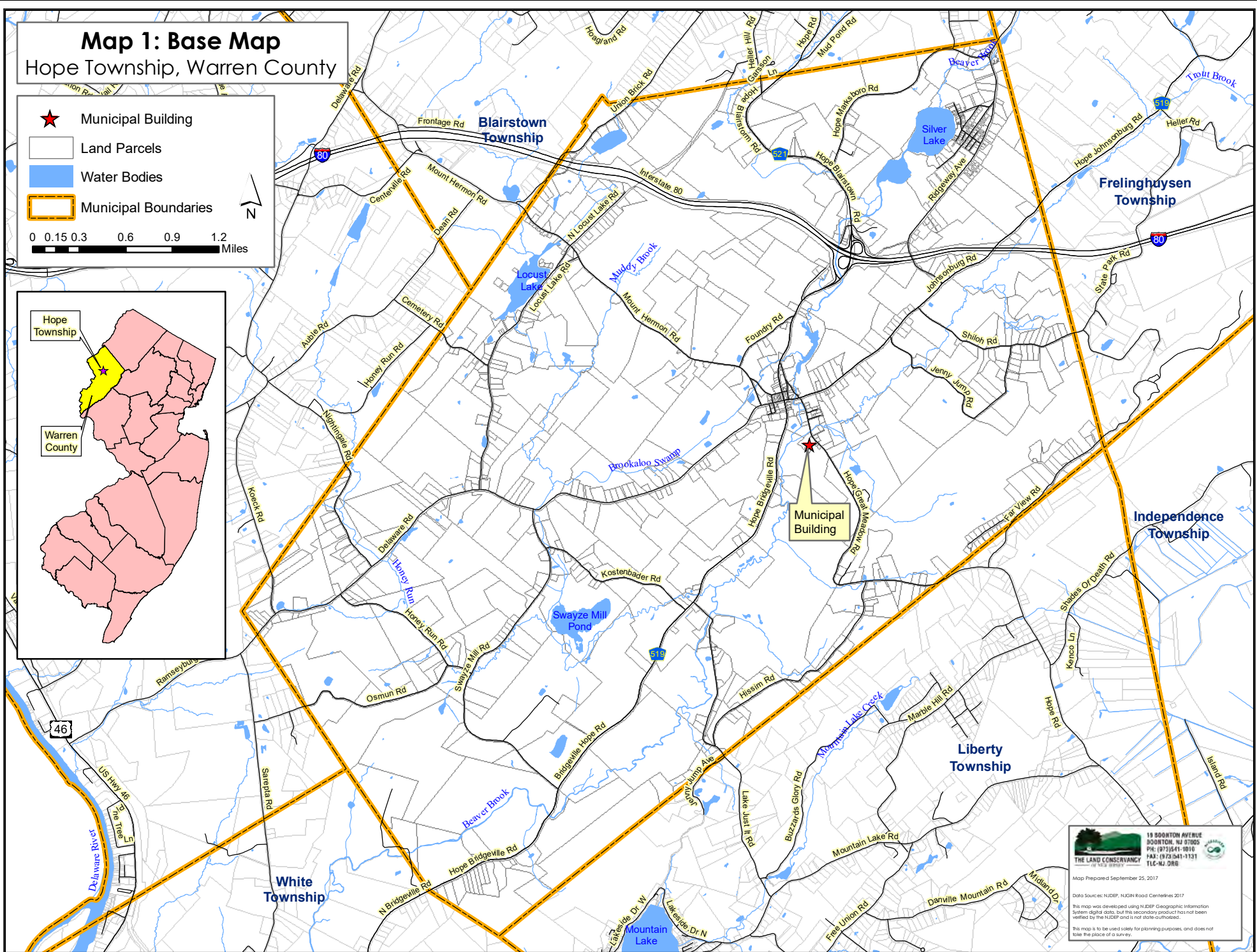
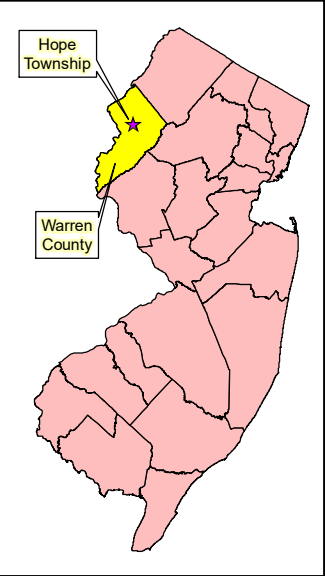
Map 15. Known Contaminated Sites (Non-Homeowner)

Map 1: Base Map

Hope Township, Warren County

-  Municipal Building
-  Land Parcels
-  Water Bodies
-  Municipal Boundaries

0 0.15 0.3 0.6 0.9 1.2 Miles

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Data Source: NJDEP, NJGN Road Centlines 2017

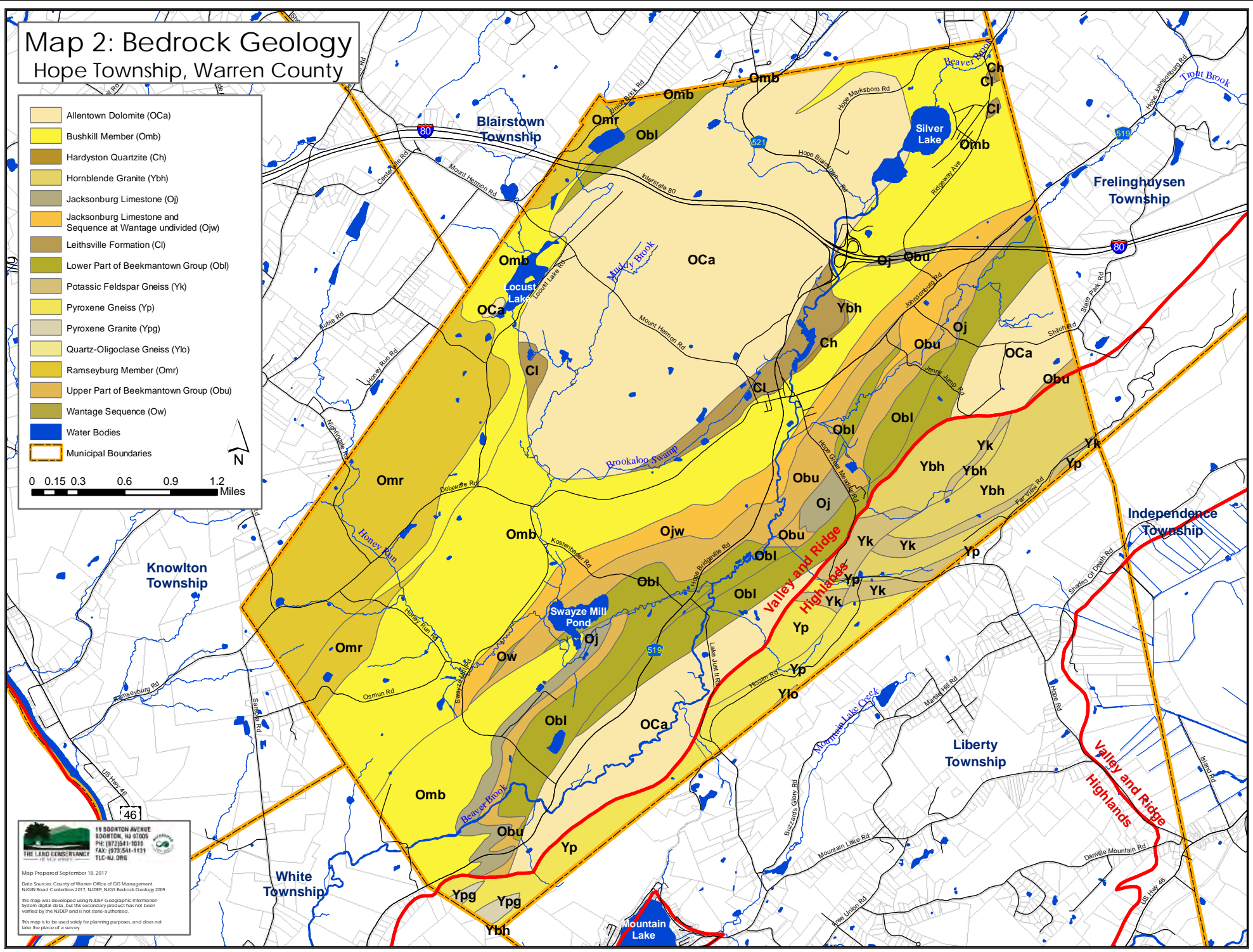
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Map 2: Bedrock Geology Hope Township, Warren County

	Allentown Dolomite (OCa)
	Bushkill Member (Omb)
	Hardyston Quartzite (Ch)
	Hornblende Granite (Ybh)
	Jacksonburg Limestone (Oj)
	Jacksonburg Limestone and Sequence at Wantage undivided (Ojw)
	Leithsville Formation (Cl)
	Lower Part of Beekmantown Group (Obl)
	Potassic Feldspar Gneiss (Yk)
	Pyroxene Gneiss (Yp)
	Pyroxene Granite (Ypg)
	Quartz-Oligoclase Gneiss (Ylo)
	Ramseyburg Member (Omr)
	Upper Part of Beekmantown Group (Obu)
	Wantage Sequence (Ow)
	Water Bodies
	Municipal Boundaries

0 0.15 0.3 0.6 0.9 1.2 Miles












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 Data Sources: County of Warren Office of GIS Management, NGSIN Road Centerlines 2017, NJDEP, NGS Bedrock Geology 2009
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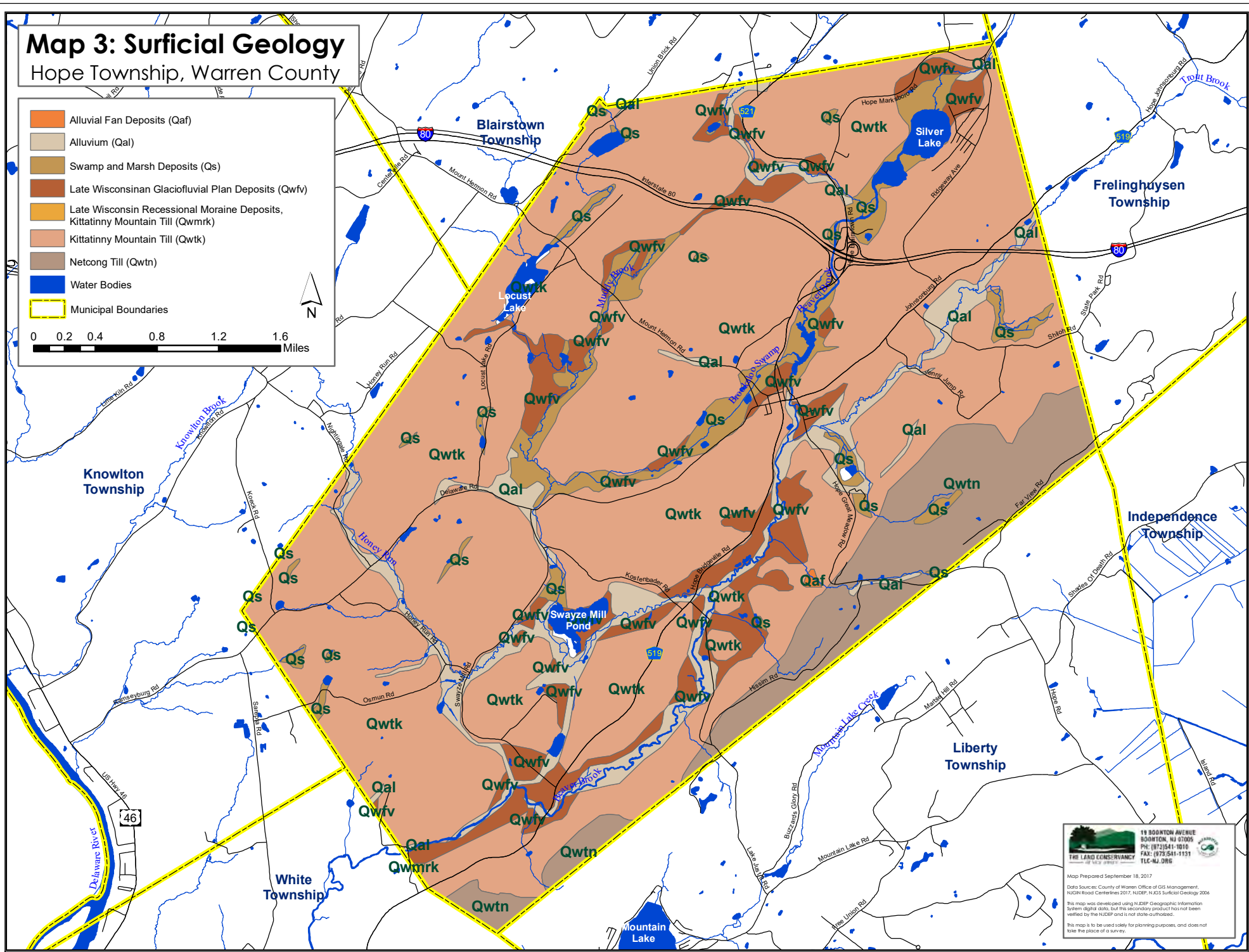
Map 3: Surficial Geology


Hope Township, Warren County

	Alluvial Fan Deposits (Qaf)
	Alluvium (Qal)
	Swamp and Marsh Deposits (Qs)
	Late Wisconsinan Glaciofluvial Plan Deposits (Qwfv)
	Late Wisconsin Recessional Moraine Deposits, Kittatinny Mountain Till (Qwmrk)
	Kittatinny Mountain Till (Qwtk)
	Netcong Till (Qwtn)
	Water Bodies
	Municipal Boundaries

0 0.2 0.4 0.8 1.2 1.6 Miles

N
















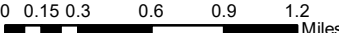

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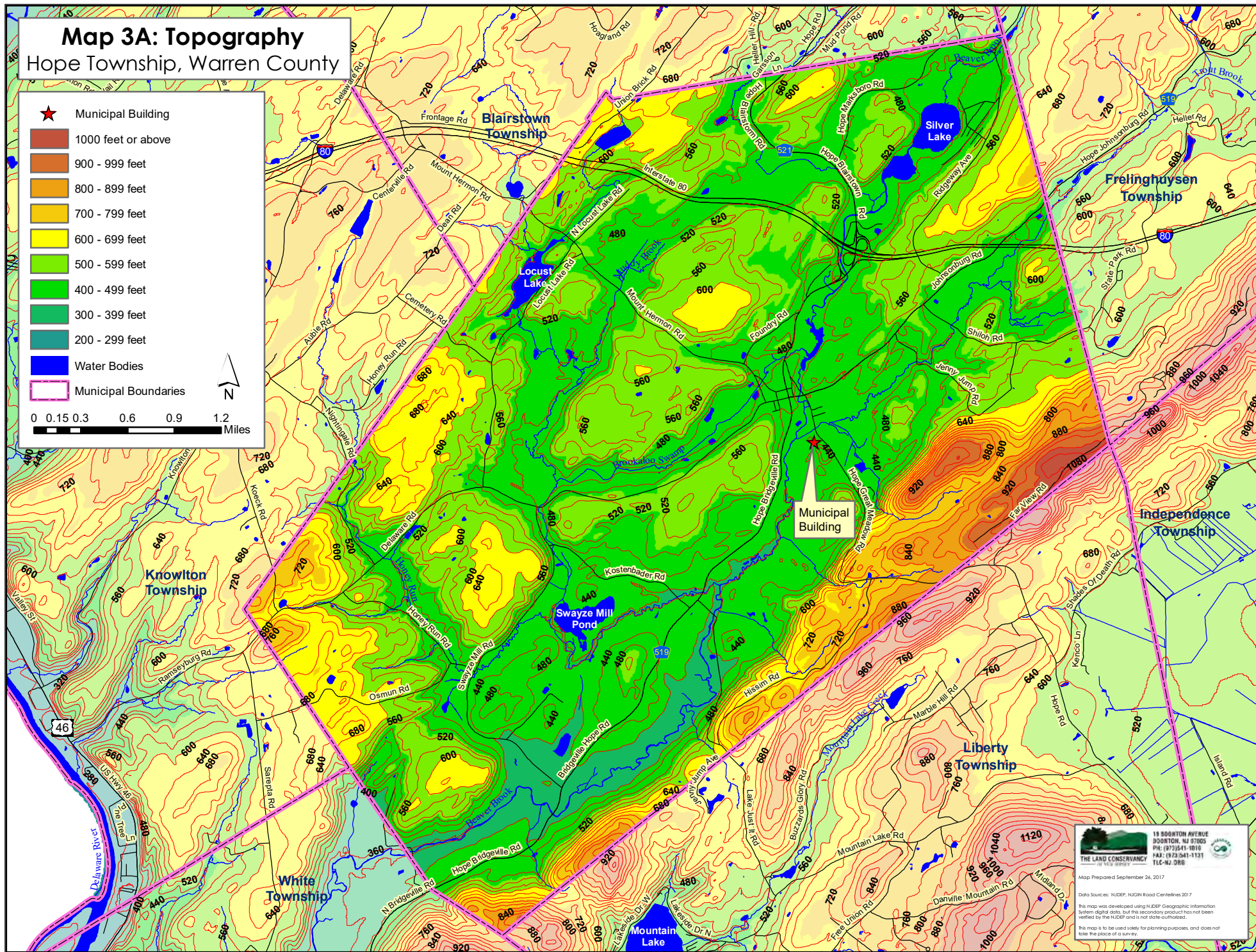
Map Prepared September 18, 2017
 Data Sources: County of Warren Office of GIS Management, NGIN Road Centerlines 2017, NJDEP, NJGS Surficial Geology 2006
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Map 3A: Topography

Hope Township, Warren County

-  Municipal Building
-  1000 feet or above
-  900 - 999 feet
-  800 - 899 feet
-  700 - 799 feet
-  600 - 699 feet
-  500 - 599 feet
-  400 - 499 feet
-  300 - 399 feet
-  200 - 299 feet
-  Water Bodies
-  Municipal Boundaries




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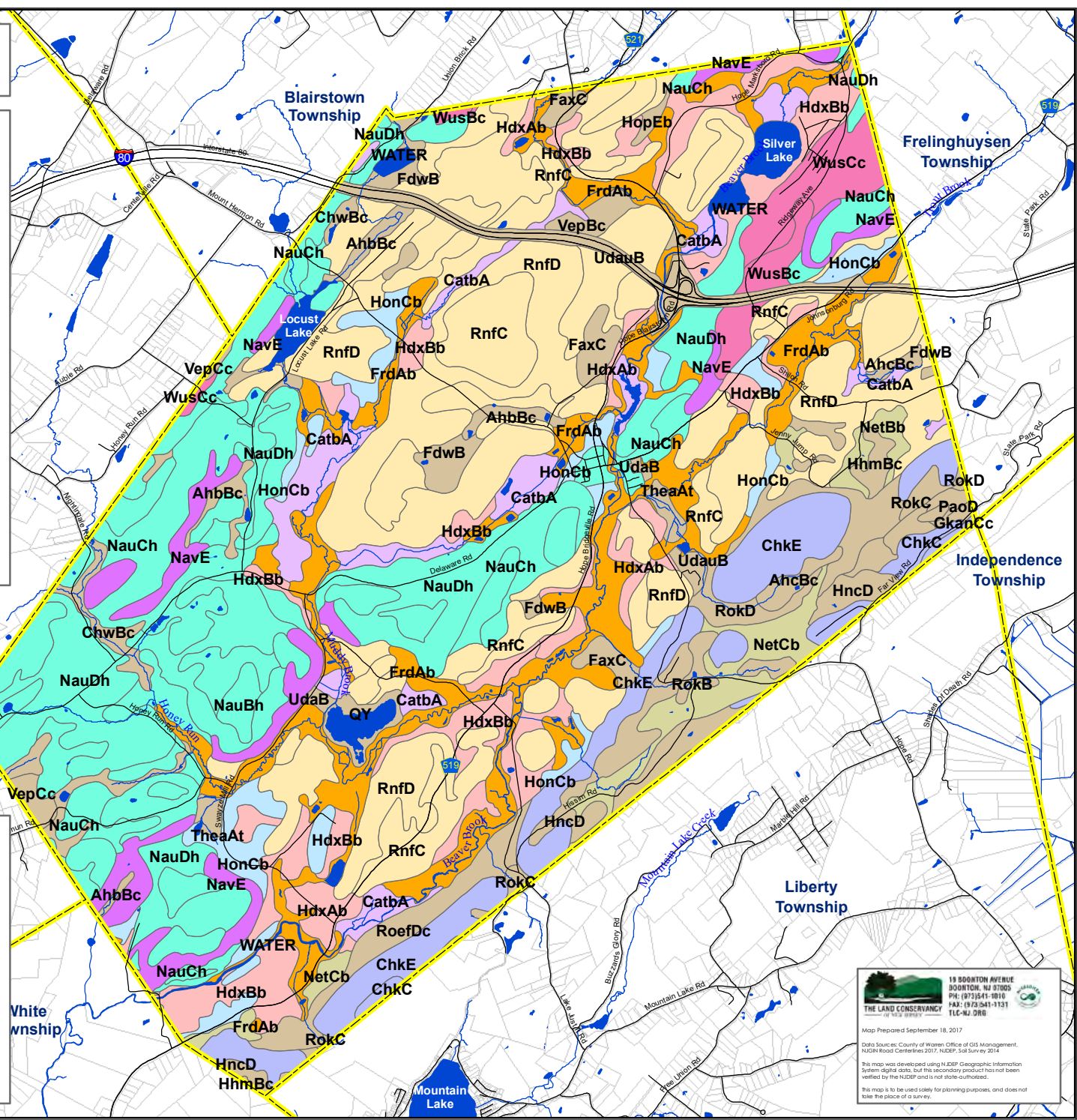
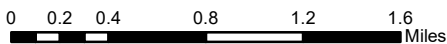
Map Prepared September 24, 2017
 Data Source: NJDEP, NJGRI Road Centelines 2017
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Map 4: Soil Series

Hope Township, Warren County

- Catden Soil Series
Catden muck, 0 to 2 percent slopes (CatbA)
- Chatfield-Holis-Rock series
Chatfield-Holis-Rock outcrop complex, 0 to 15 percent slopes (ChkC)
Chatfield-Holis-Rock outcrop complex, 35 to 60 percent slopes (ChkE)
- Fredon-Halsey Series
Fredon-Halsey complex, 0 to 3 percent slopes, very stony (FrdAb)
- Hazen-Hoosic Series
Hazen-Hoosic complex, 0 to 3 percent slopes, very stony (HdxAb)
Hazen-Hoosic complex, 3 to 8 percent slopes, very stony (HdxBb)
- Hoosic-Hazen Series
Hoosic-Hazen complex, 8 to 15 percent slopes, very stony (HonCb)
- Nassau-Manlius Series
Nassau-Manlius complex, 0 to 8 percent slopes, very rocky (NauBh)
Nassau-Manlius complex, 8 to 15 percent slopes, very rocky (NauCh)
Nassau-Manlius complex, 15 to 35 percent slopes, very rocky (NauDh)
- Nassau-Rock Series
Nassau-Rock outcrop complex, 35 to percent slopes (NavE)
- Netcong loam Series
Netcong loam, 0 to 8 percent slopes, very stony (NetBb)
Netcong loam, 8 to 15 percent slopes, very stony (NetCb)

- Rock outcrop-Farmington-Galway Series
Rock outcrop-Farmington-Galway complex, 8 to 15 percent slopes (RnfC)
Rock outcrop-Farmington-Galway complex, 15 to 35 percent slopes (RnfD)
- Wurtsboro-Swartswood Series
Wurtsboro-Swartswood complex, 0 to 8 percent slopes, extremely stony (WusBc)
Wurtsboro-Swartswood complex, 8 to 15 percent slopes, extremely stony (WusCc)
- Other Soil Types
- Water Body
- Municipal Boundaries



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Data Source: County of Warren Office of GIS Management, NJDEP Road Centerlines 2017, NJDEP, Soil Survey 2014


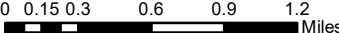
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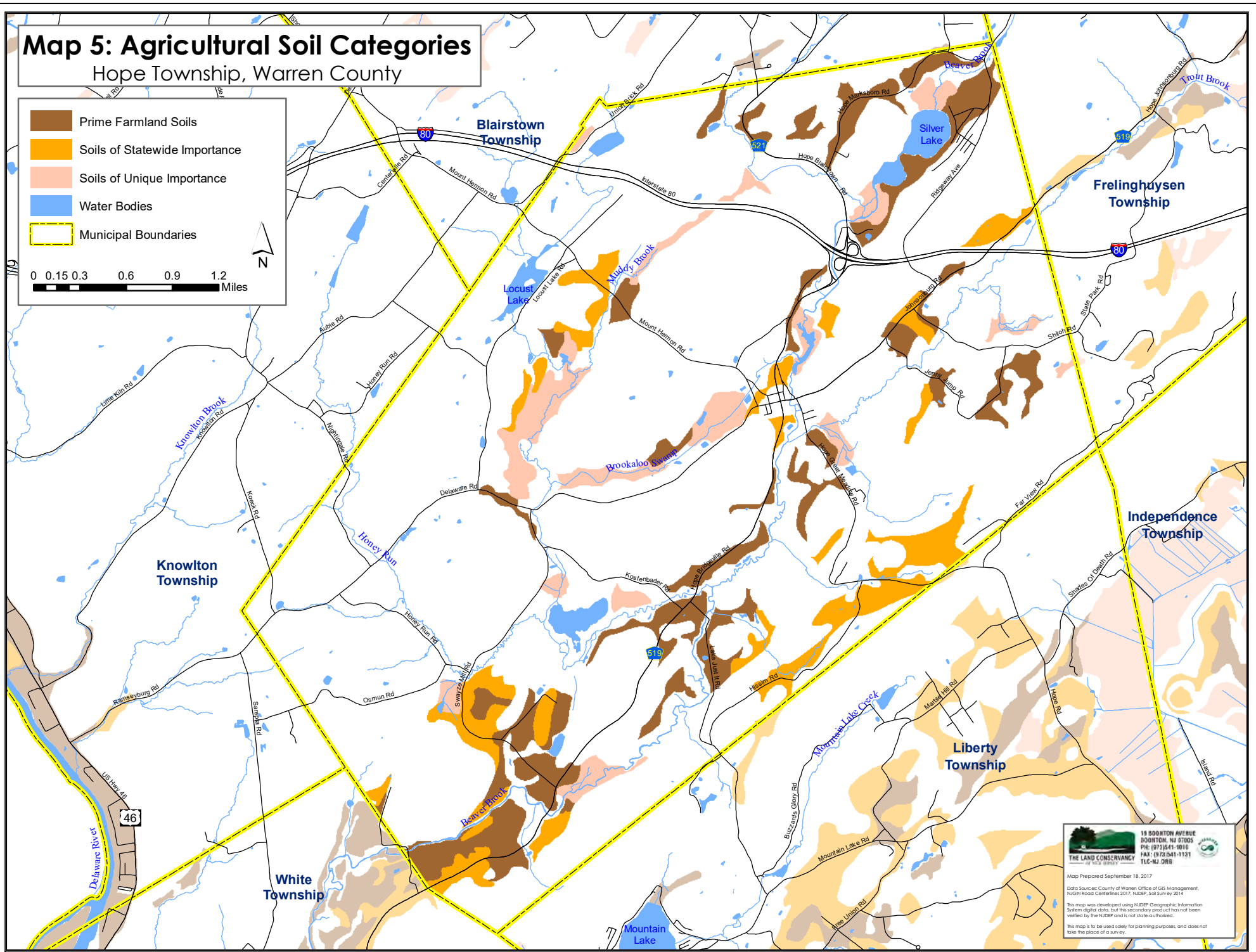
This map is to be used solely for planning purposes, and does not take the place of a survey.


Map 5: Agricultural Soil Categories

Hope Township, Warren County

Prime Farmland Soils
 Soils of Statewide Importance
 Soils of Unique Importance
 Water Bodies
 Municipal Boundaries



 0 0.15 0.3 0.6 0.9 1.2 Miles




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 System digital data, but this secondary product has not been
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Map 6: Watersheds

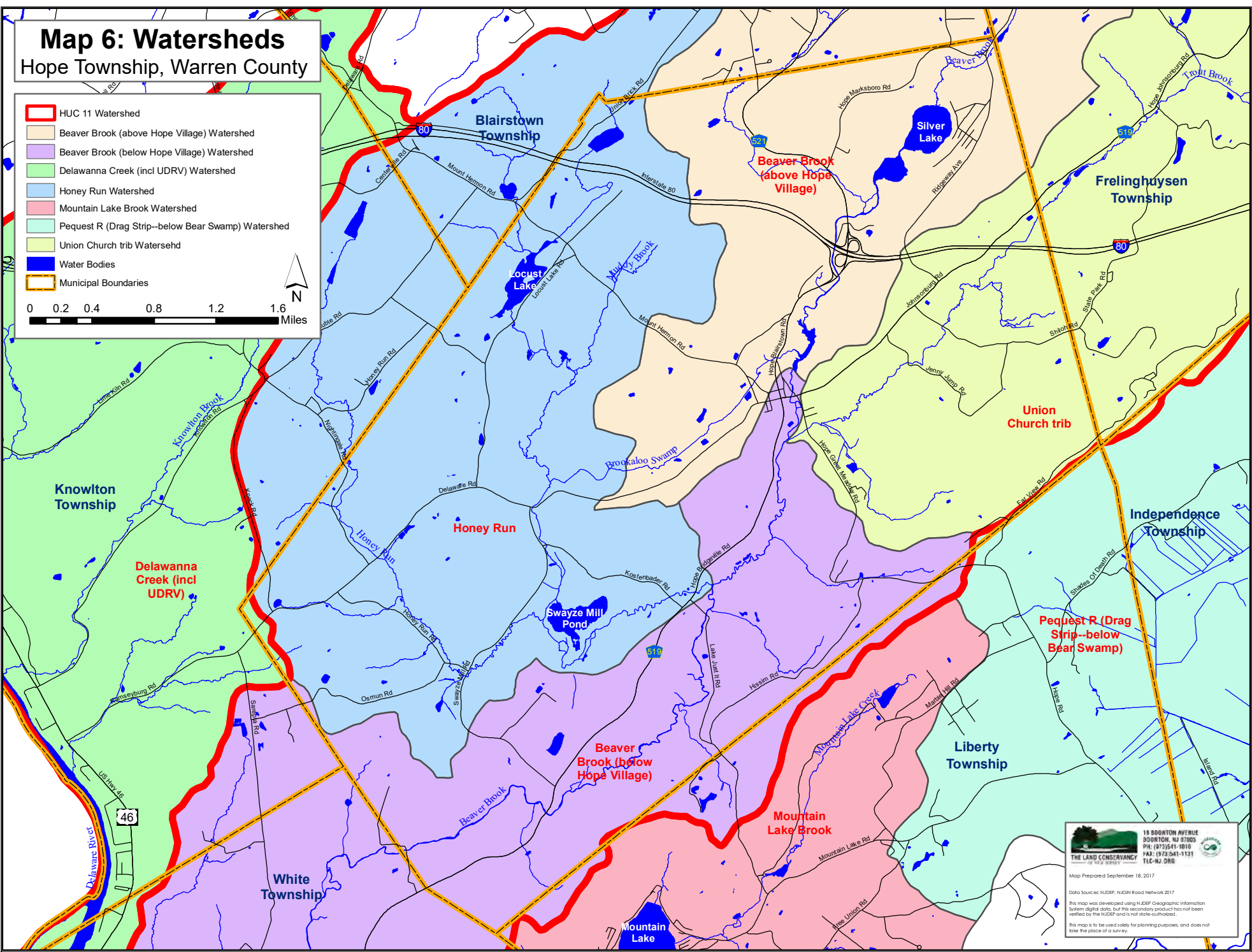
Hope Township, Warren County


Legend

- HUC 11 Watershed
- Beaver Brook (above Hope Village) Watershed
- Beaver Brook (below Hope Village) Watershed
- Delawanna Creek (incl UDRV) Watershed
- Honey Run Watershed
- Mountain Lake Brook Watershed
- Pequest R (Drag Strip--below Bear Swamp) Watershed
- Union Church trib Watersehd
- Water Bodies
- Municipal Boundaries

0 0.2 0.4 0.8 1.2 1.6 Miles

N




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Map Prepared September 18, 2017
 Data Source: NJDEP, NJGRN Road Network 2017
 This map was developed using NJDEP Geographic Information System digital data, but this secondary product has not been verified by the NJDEP and is not state authorized.
 This map is to be used solely for planning purposes, and does not take the place of a survey.

Map 7: Surface Water Use Classifications

Hope Township, Warren County


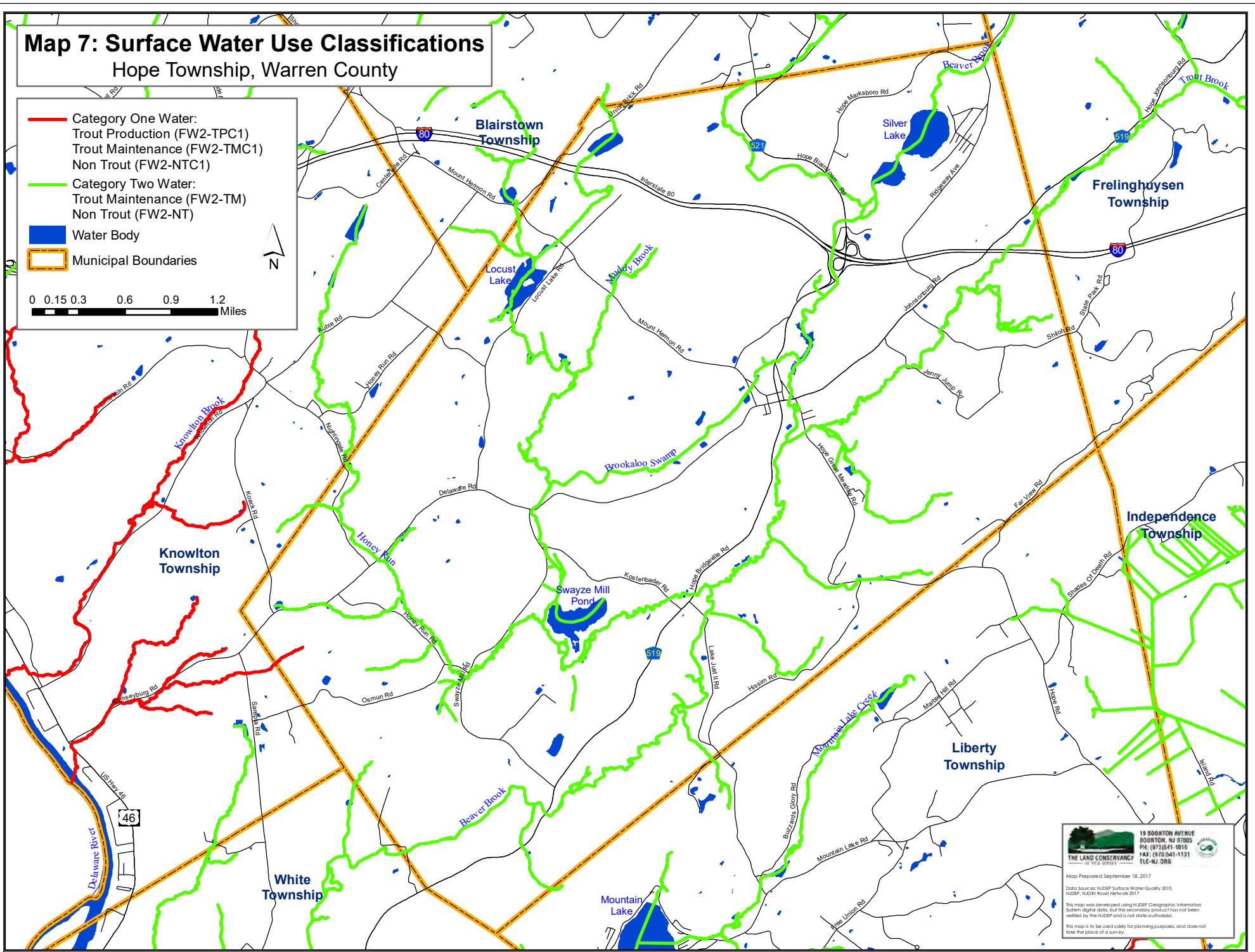
— Category One Water:
 Trout Production (FW2-TPC1)
 Trout Maintenance (FW2-TMC1)
 Non Trout (FW2-NTC1)


— Category Two Water:
 Trout Maintenance (FW2-TM)
 Non Trout (FW2-NT)

■ Water Body

Municipal Boundaries

0 0.15 0.3 0.6 0.9 1.2 Miles


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Map Prepared September 18, 2017
 Data Source: NJDEP Surface Water Quality 2010,
 NJDEP, NJGRN Road Network 2017

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 System digital data, but this secondary product has not been
 verified by the NJDEP and is not state-endorsed.
 This map is to be used solely for planning purposes, and does not
 take the place of a survey.

Map 8: Aquifer Recharge Potential

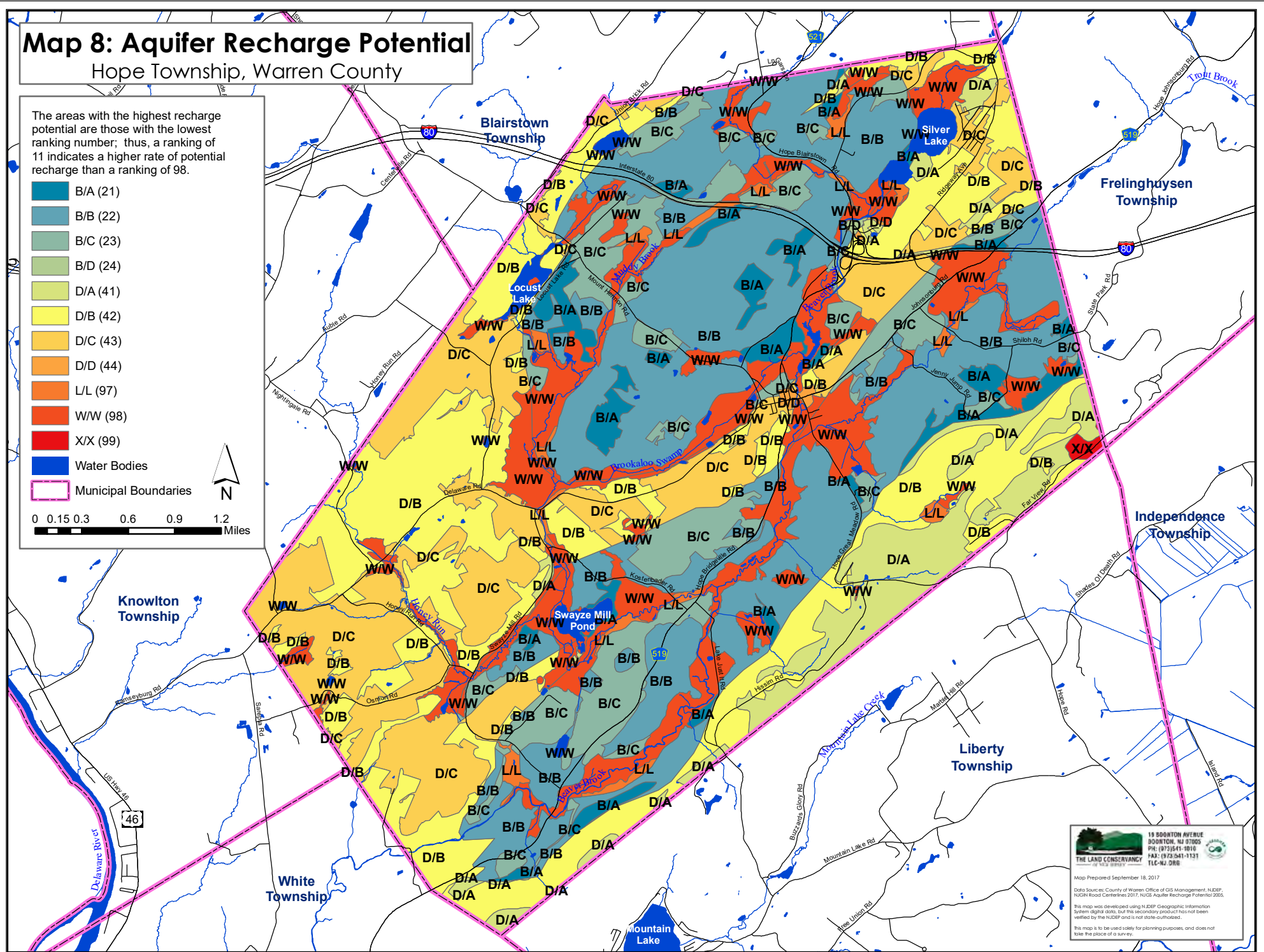
Hope Township, Warren County

The areas with the highest recharge potential are those with the lowest ranking number; thus, a ranking of 11 indicates a higher rate of potential recharge than a ranking of 98.

- B/A (21)
- B/B (22)
- B/C (23)
- B/D (24)
- D/A (41)
- D/B (42)
- D/C (43)
- D/D (44)
- L/L (97)
- W/W (98)
- X/X (99)
- Water Bodies
- Municipal Boundaries



0 0.15 0.3 0.6 0.9 1.2 Miles



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Map Prepared September 18, 2017

Data Source: County of Warren Office of GIS Management; NJDEP NJGH Road Centerlines 2017; NJDEP Aquifer Recharge Potential 2005.

This map was developed using NJDEP Geographic Information System digital data, but this secondary product has not been verified by the NJDEP and is not state-endorsed.

This map is to be used solely for planning purposes, and does not take the place of a survey.

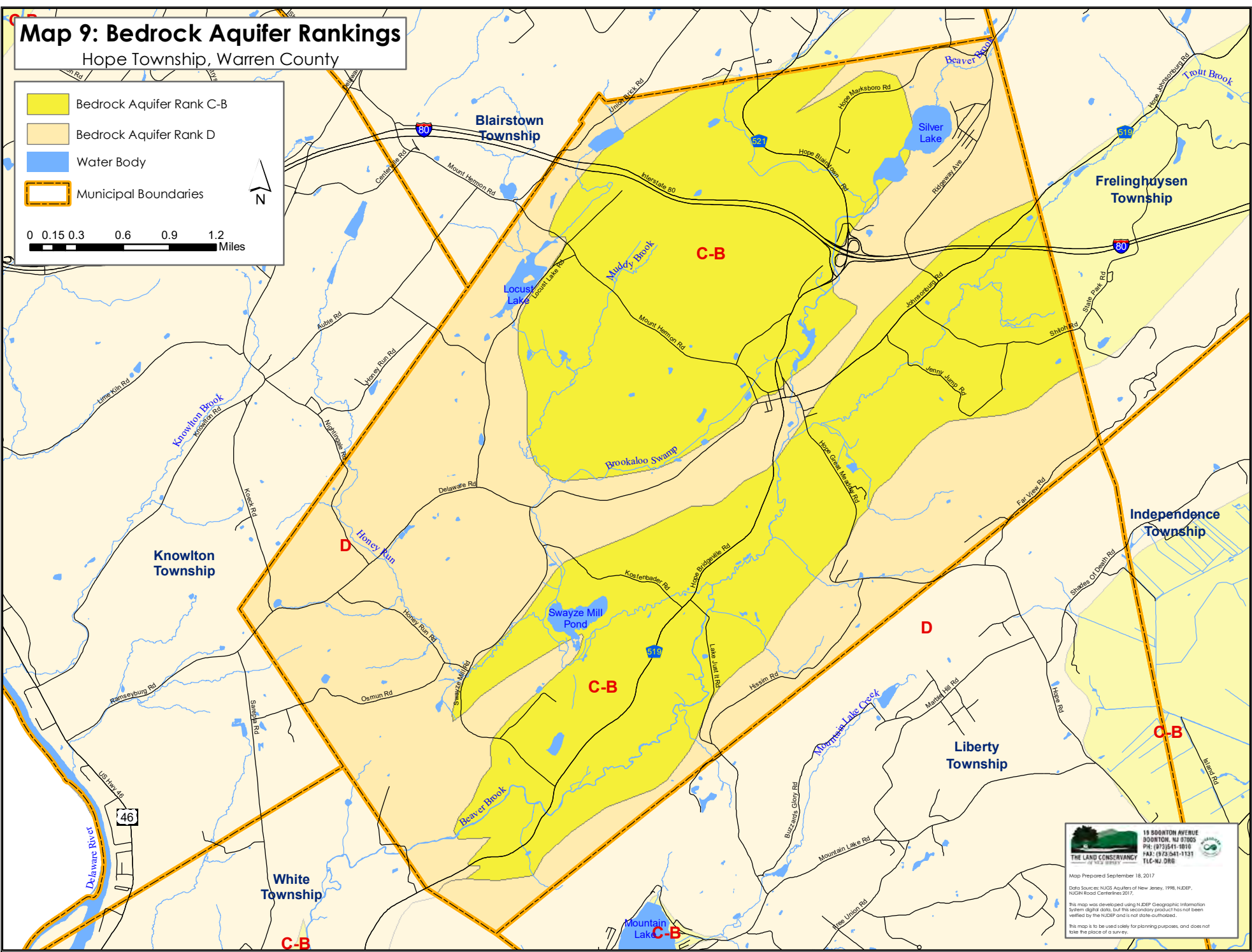
Map 9: Bedrock Aquifer Rankings

Hope Township, Warren County

Legend

- Bedrock Aquifer Rank C-B
- Bedrock Aquifer Rank D
- Water Body
- Municipal Boundaries

0 0.15 0.3 0.6 0.9 1.2 Miles












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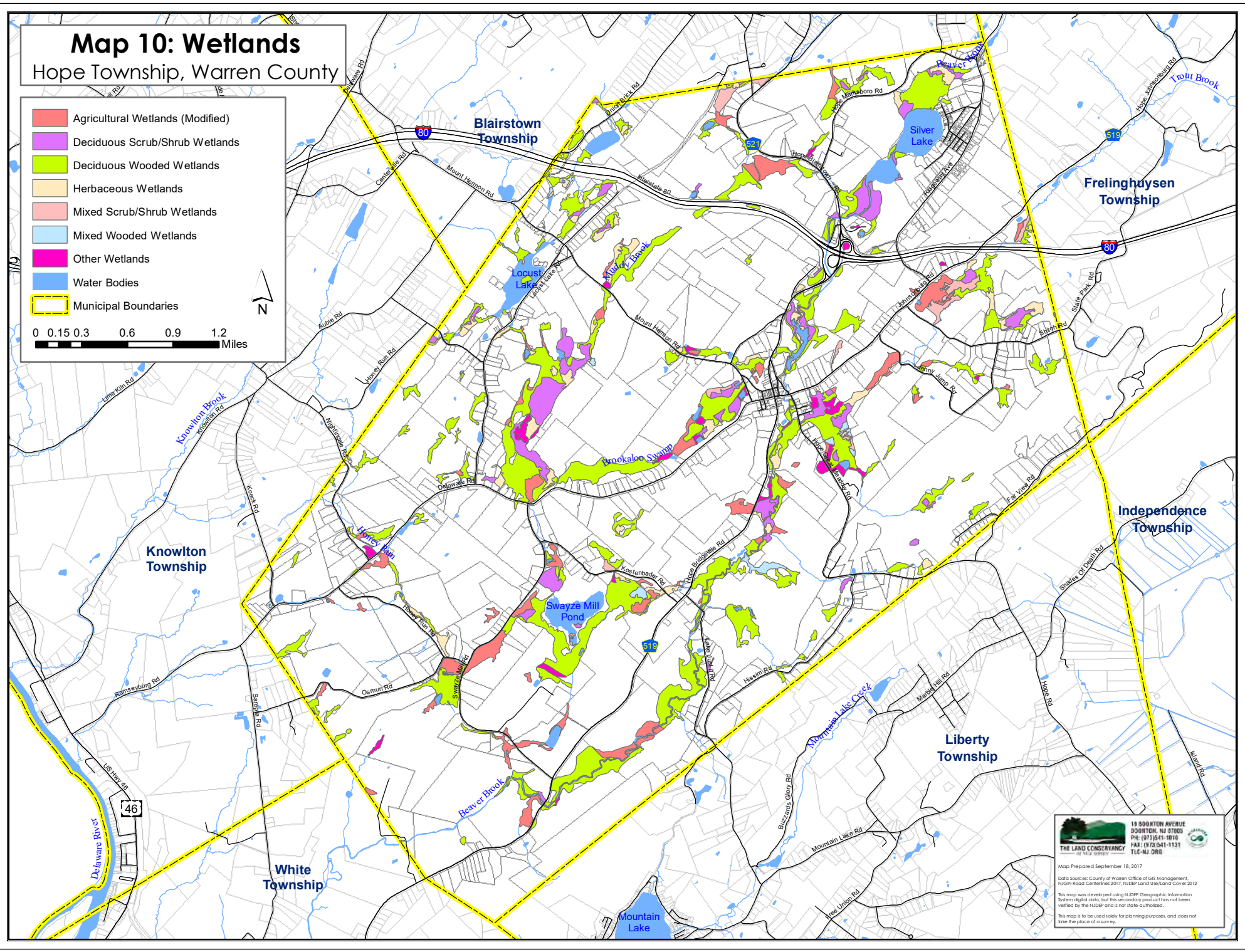
Map Prepared September 18, 2017
Data Source: NJDEP Aquifers of New Jersey, 1998; NJDEP, NJGH Road Centrelines 2017.
This map was developed using NJDEP Geographic Information System digital data, but this secondary product has not been verified by the NJDEP and is not state-endorsed.
This map is to be used solely for planning purposes, and does not take the place of a survey.


Map 10: Wetlands

Hope Township, Warren County

	Agricultural Wetlands (Modified)
	Deciduous Scrub/Shrub Wetlands
	Deciduous Wooded Wetlands
	Herbaceous Wetlands
	Mixed Scrub/Shrub Wetlands
	Mixed Wooded Wetlands
	Other Wetlands
	Water Bodies
	Municipal Boundaries

0 0.15 0.3 0.6 0.9 1.2 Miles












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Map Prepared September 18, 2017
 Data Source: County of Warren Office of GIS Management
 NJGH Road Centerlines 2017, NJDEP Land Use/Land Cover 2012
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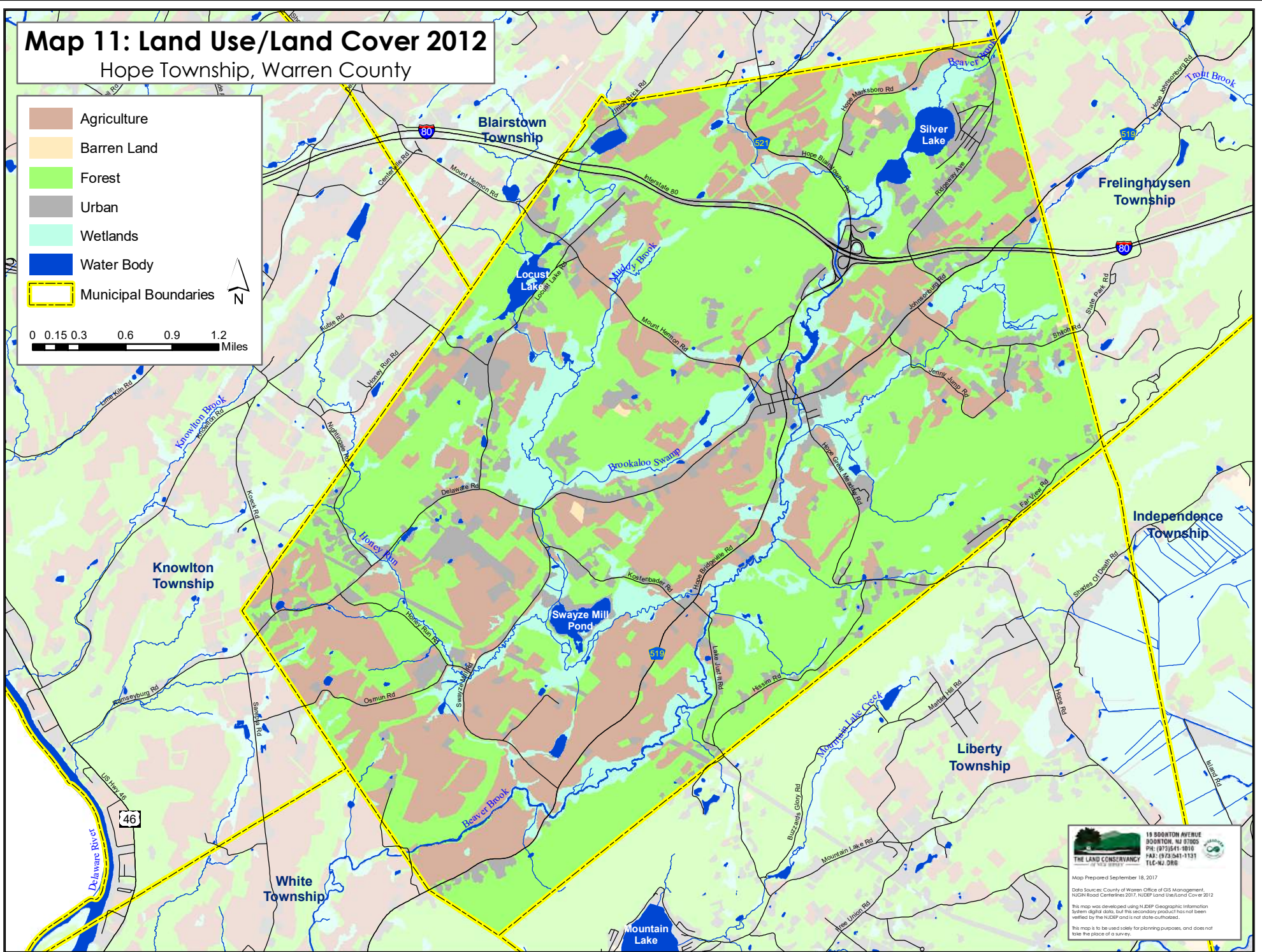
Map 11: Land Use/Land Cover 2012


Hope Township, Warren County

	Agriculture
	Barren Land
	Forest
	Urban
	Wetlands
	Water Body
	Municipal Boundaries

0 0.15 0.3 0.6 0.9 1.2 Miles

North Arrow













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 Data Source: County of Warren Office of GIS Management
 NJGH Road Centerlines 2017, NJDEP Land Use/Land Cover 2012
 This map was developed using NJDEP Geographic Information System digital data, but this secondary product has not been verified by the NJDEP and is not state-endorsed.
 This map is to be used solely for planning purposes, and does not take the place of a survey.

Map 12: Patches with Endangered Species Habitats identified by the NJDEP Landscape Project (2017)

Hope Township, Warren County

Legend

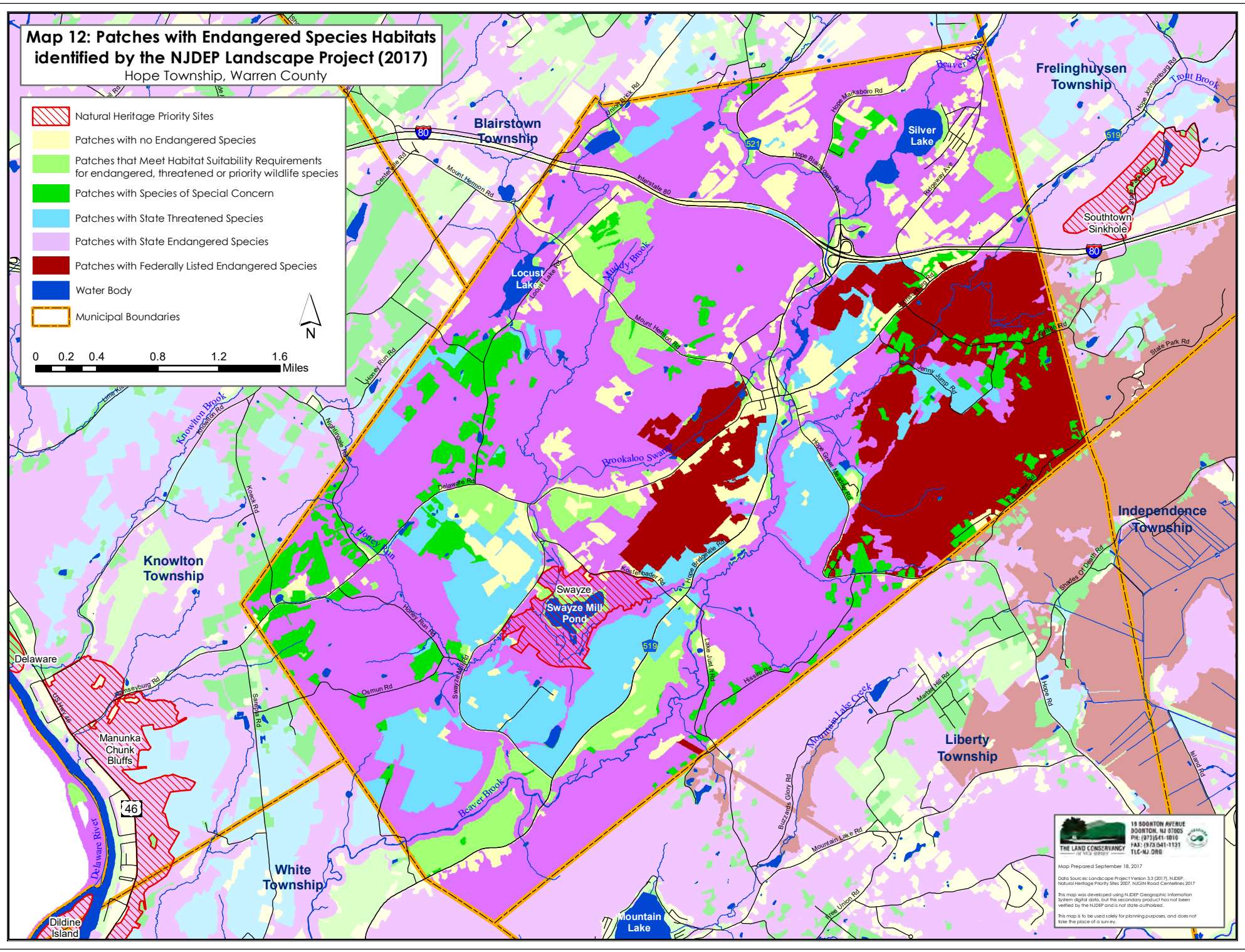
-  Natural Heritage Priority Sites
-  Patches with no Endangered Species
-  Patches that Meet Habitat Suitability Requirements for endangered, threatened or priority wildlife species
-  Patches with Species of Special Concern
-  Patches with State Threatened Species
-  Patches with State Endangered Species
-  Patches with Federally Listed Endangered Species
-  Water Body
-  Municipal Boundaries


Scale

0 0.2 0.4 0.8 1.2 1.6 Miles

North Arrow

N




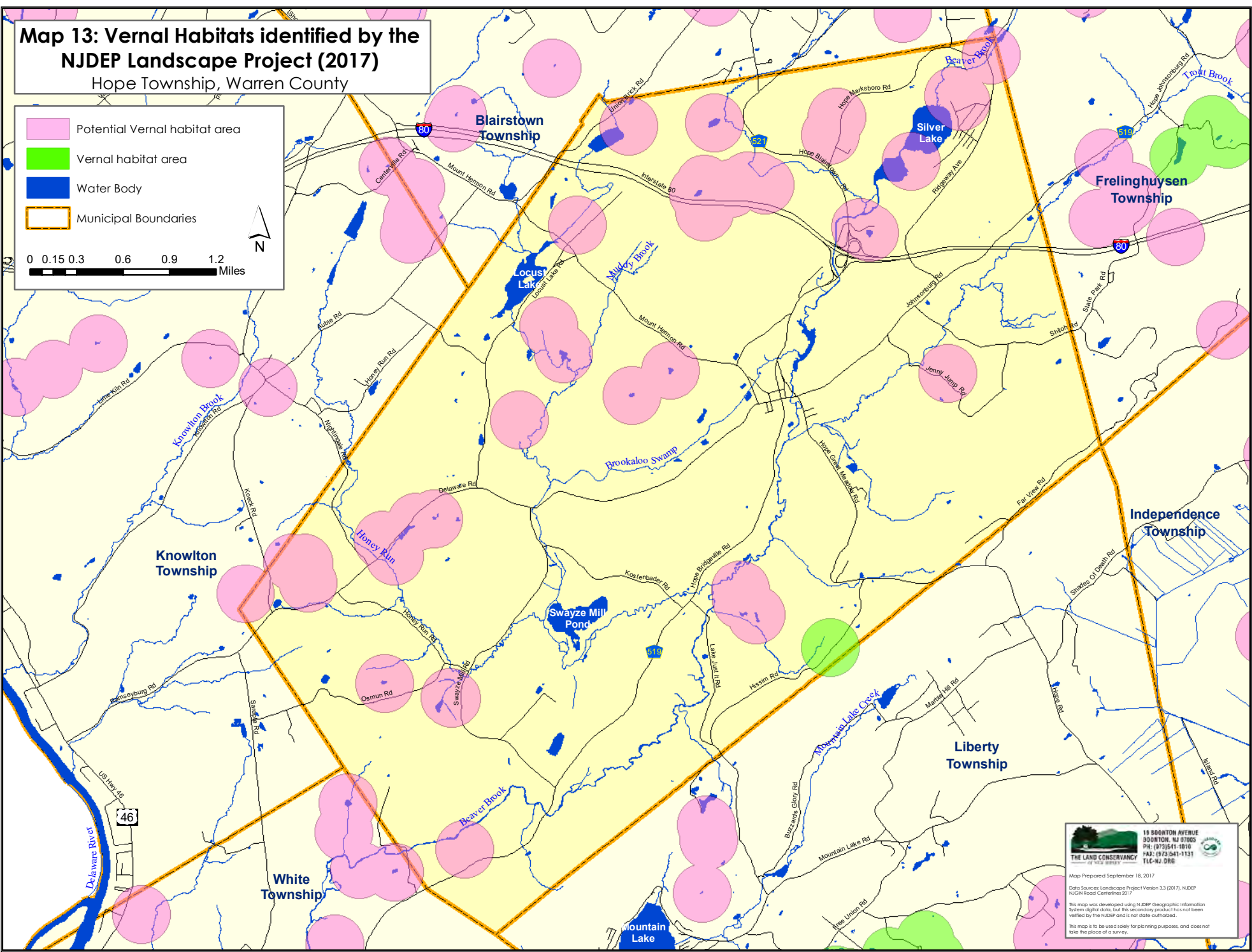

 19 BOONTON AVENUE
 BOONTON, NJ 07005
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 FAX: 973-541-1131
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Map Prepared September 18, 2017
 Data Source: Landscape Project Version 3.3 (2017), NJDEP
 Natural Heritage Priority Sites 2007, NJGIM Road Centelines 2017
 This map was developed using NJDEP Geographic Information
 System digital data, but this secondary product has not been
 verified by the NJDEP and is not state-endorsed.
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Map 13: Vernal Habitats identified by the NJDEP Landscape Project (2017)
 Hope Township, Warren County

Potential Vernal habitat area
 Vernal habitat area
 Water Body
 Municipal Boundaries





0 0.15 0.3 0.6 0.9 1.2 Miles


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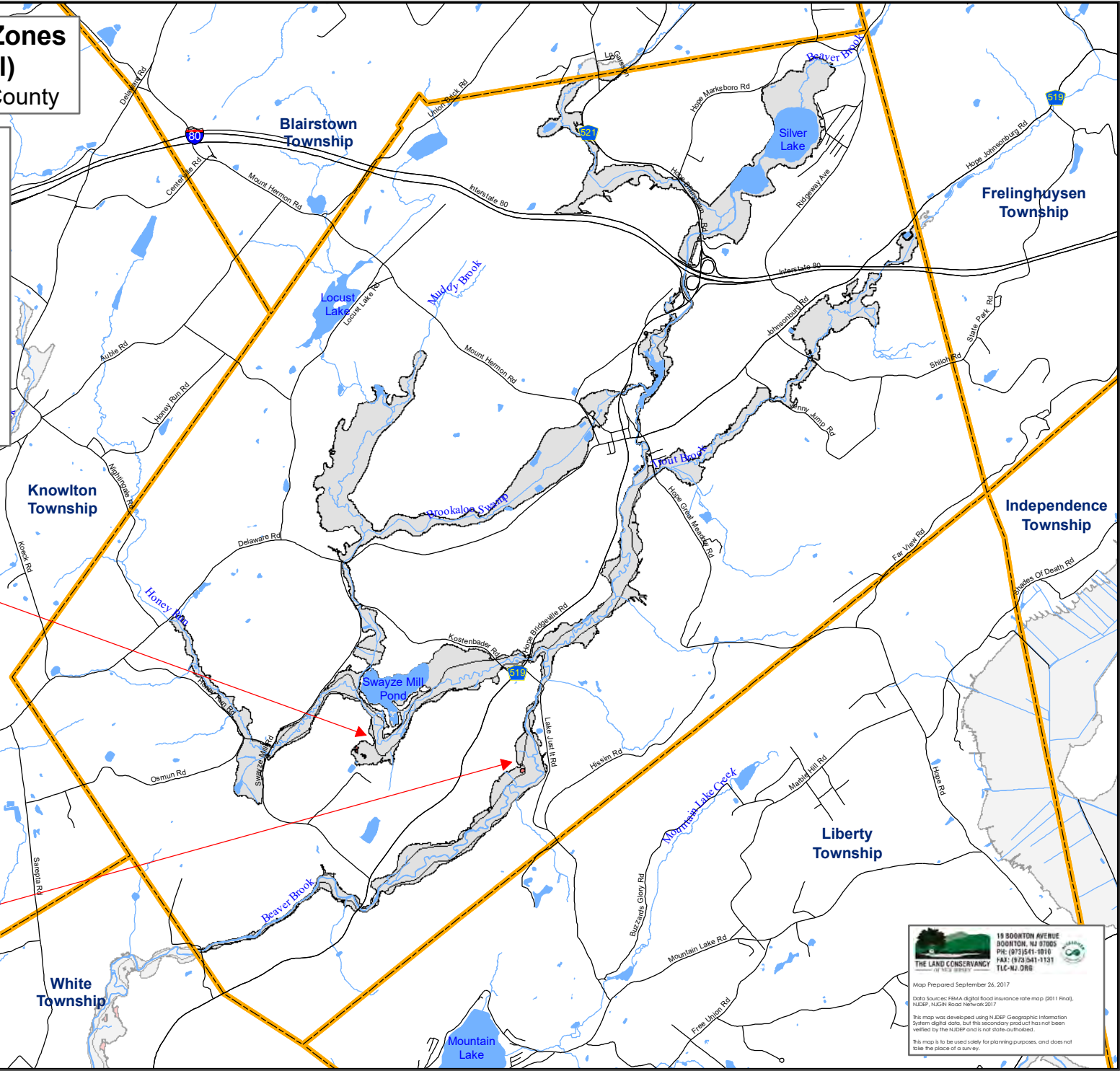
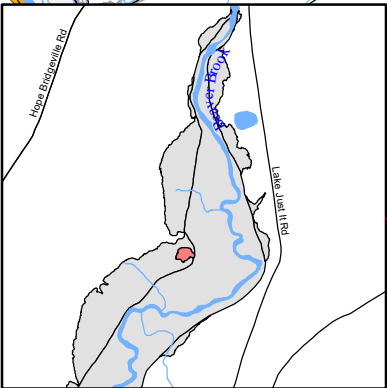
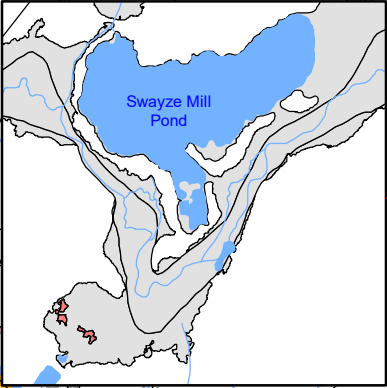
Map Prepared September 18, 2017
 Data Source: Landscape Project Version 3.3 (2017), NJDEP
 NJGH Road Centerlines 2017
 This map was developed using NJDEP Geographic Information
 System digital data, but this secondary product has not been
 verified by the NJDEP and is not state-endorsed.
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Map14: FEMA Flood Zones (2011 DFIRM Final) Hope Township, Warren County

-  1% - Zones A & AE
-  0.2% - Shaded Zone X
-  Water Body
-  Municipal Boundaries

Zone A & AE: Special Flood Hazard Areas where flood insurance is mandatory (100-year flood or base flood).
 Shaded Zone X: identified limits for 500-year flood (0.2 Annual Chance)
 Source: FEMA
 Digital Flood Insurance Rate Map (DFIRM)
 Warren County - Final
 September 29, 2011

0 0.15 0.3 0.6 0.9 1.2 Miles







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 BOONTON, NJ 07005
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 FAX: 973/541-1131
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Map Prepared September 26, 2017
 Data Source: FEMA digital flood insurance rate map (2011 Final), NJDEP, NJGRN Road Network 2017
 This map was developed using NJDEP Geographic Information System digital data, but this secondary product has not been verified by the NJDEP and is not state authorized.
 This map is to be used solely for planning purposes, and does not take the place of a survey.

Map 15: Known Contaminated Sites (Non-Homeowner)


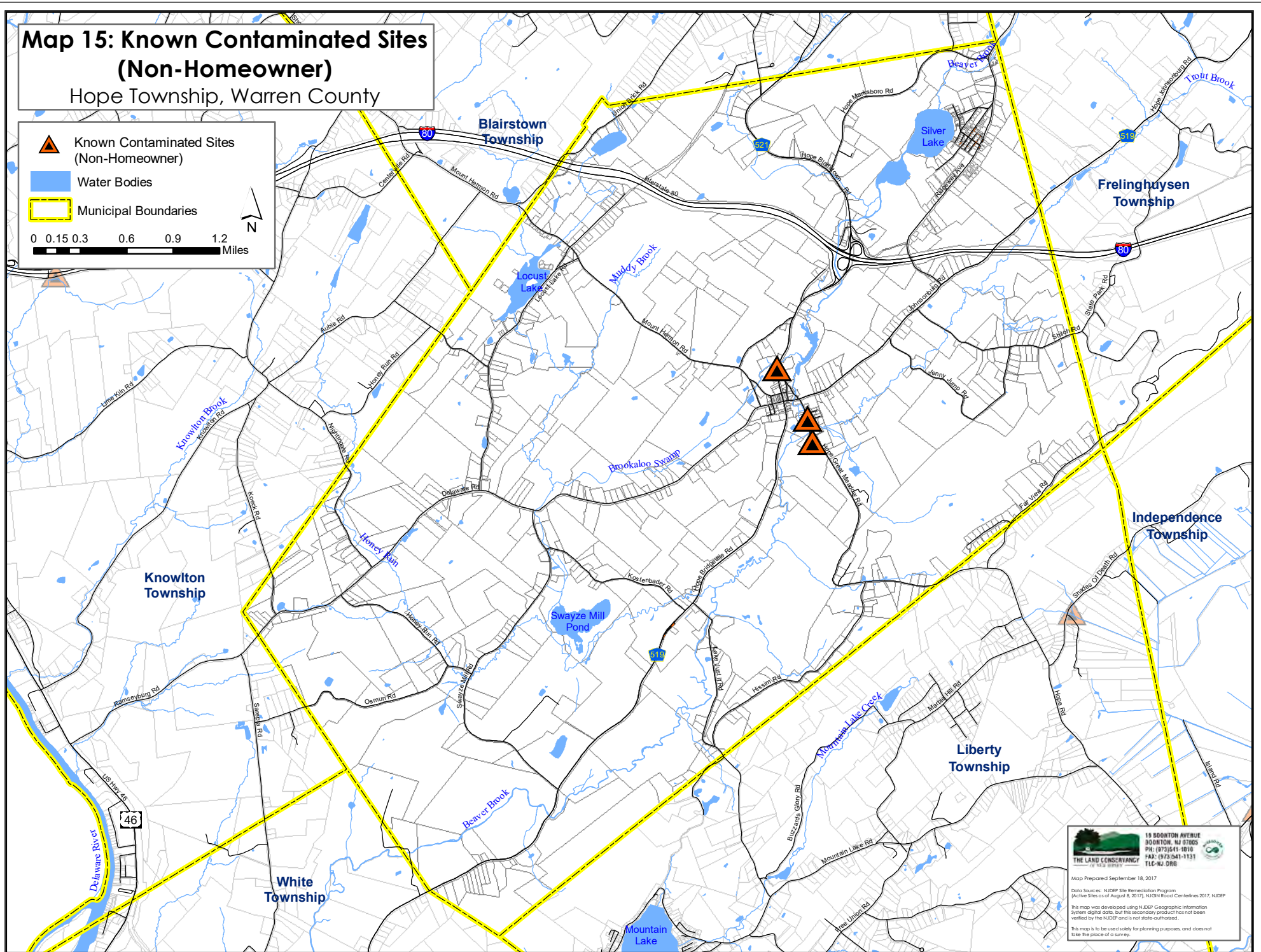
Hope Township, Warren County

 Known Contaminated Sites
(Non-Homeowner)

 Water Bodies

 Municipal Boundaries

0 0.15 0.3 0.6 0.9 1.2 Miles



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Map Prepared September 18, 2017

Data Source: NJDEP Site Remediation Program
(Active Sites as of August 8, 2017), NJGH Road Centelines 2017, NJDEP

This map was developed using NJDEP Geographic Information System digital data, but this secondary product has not been verified by the NJDEP and is not state-endorsed.

This map is to be used solely for planning purposes, and does not take the place of a survey.

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