

**An INTERACTIVE
ENVIRONMENTAL RESOURCE INVENTORY
FOR THE TOWNSHIP OF BETHLEHEM
Hunterdon County, New Jersey**

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August 2005

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INTRODUCTION

This Environmental Resource Inventory (ERI) is a compilation of materials characterizing the environmental resources of the Township of Bethlehem. Environmental characterization and resource assessment necessarily encompasses a variety of parameters that reflect the complexity of any functioning ecological system. The environmental disciplines describing the natural resources of a defined area include geology, lithology, topography, hydrology, and biology. Additionally, anthropogenic or cultural considerations factor importantly in the broader characterization of a regional environment by accounting for levels of development and land use that effect ecological function. Therefore, roads, population centers, real estate parcel division, and zoning districts must also be expressed. This document therefore endeavors to present the diversity of existing environmentally related material as a cohesive whole.

However, an ERI is more than an encyclopedia of facts or an atlas of pertinent natural resource features. It should serve as a compliment and as of a directing force in a municipality's Master Plan and supply critical guidance and information needed to craft judicious land development related ordinances and guide municipal land preservation initiatives. With this in mind, the content, design and accessibility of information contained within this ERI is intended to allow for the easy, but thorough identification and assessment of sensitive ecological, aesthetic and cultural features within the Bethlehem Township. Thorough knowledge of the environmental resources, and improved access to the information provided by this document, will allow a more informed decision making process regarding future planning, impact analysis, open space acquisition, and utilization of the Townships resources, while at the same time recognizing the need for economic viability and growth. In a state as densely populated as New Jersey, land development is inevitable. This ERI will prove to be highly effective and informative as part of any land development approval and/or planning process. Its use should therefore be highly promoted by the Environmental Commission, Planning Board and Township Committee, as well as by those seeking to develop lands within the Township. This ERI is the first complete reassessment of Bethlehem Township's ERI in more than two decades. Periodic revision is necessary to ensure accurate information and account for changes in land use and development, and to maintain conformity with state mandate.

For the most part, local zoning, along with land development, open space planning and resource protection ordinances and regulations largely determine the intensity, magnitude and character of land development activities. However, the State of New Jersey has been especially active within the last few years with the passage of several watermark legislative and regulatory initiatives that directly affect land development activities for municipalities state-wide. The following provides a brief overview of these rules and regulations and the significance of each with respect to the protection of the Township's natural resources.

The *New Jersey Municipal Land Use Law* (MLUL), enacted in 1975, is the enabling legislation that assigns state land use regulatory authority (e.g., zoning) to municipalities.

The purpose of the MLUL is to encourage land use and land development procedures that ensure public health, safety, welfare, and the protection and preservation of the Township's natural, cultural, historic, and visual environment features and attributes. Through the MLUL Bethlehem Township receives the authority to periodically update the Master Plan, Official Map, Land Use Regulations and all other development review procedures. Intrinsic to this is the integration of the recognition of the ERI as an important and integral tool of any Master Plan update or amendment and the passage of any ordinance intended to protect the environmental, historic and aesthetic attributes of the Township and promote human health and safety.

The *New Jersey State Planning Act* was adopted in 1985 and requires sound land use planning to conserve natural resources, provide housing and public services and promote economic growth. The guiding natural resource protection principle of the State Planning Act is that natural resources should be conserved because the protection of environmental qualities is "vital to the quality of life and economic prosperity." The ERI is a key tool in any such planning initiative as it identifies key resources and sets the tone for their protection. This was most recently reflected in the process on cross-acceptance associated with the latest update of the state plan.

Of particular significance to Bethlehem Township is the recent passage of the State's rules concerning stormwater management, including compliance with the Phase II New Jersey Discharge Elimination Permit (NJPDES) requirements. In 2004 the State of New Jersey adopted the revised Stormwater Management Rules (N.J.A.C. 7:8) and Watershed Management Rules (N.J.A.C. 7:15). The revisions to these rules also affected other key State regulations that often come into play with most developments, specifically the Residential Site Improvement Standards (RSIS) (N.J.A.C. 5:21), the Freshwater Wetlands Protection Act (N.J.A.C. 7:7A), the Flood Hazard Area Control Act (N.J.A.C. 7:13), and the New Jersey Dam Safety Standards (N.J.A.C. 7:20).

The new Stormwater Management Rules provide a framework and incentives for managing runoff and resolving non-point source impairment on a drainage area basis for new development, redevelopment and existing developed areas. Additionally, they establish a hierarchy for implementation of best management practice (BMP) stormwater management measures with initial reliance on low impact development (LID) site design techniques to maintain natural vegetation and drainage patterns before incorporating structural measures. These new rules also establish runoff control performance standards for groundwater recharge, water quality, and water quantity, establish special protection area measures for pristine and exceptional value waters; provide regulatory consistency among local and State regulatory agencies; and provide safety standards for stormwater management basins. Of particular significance to Bethlehem Township because of the number of Category-1 (C-1) streams located within the Township is the Rule's requirement of a 300-foot buffer along C-1 waterbodies and their tributaries. These buffers significantly affect not only the extent of development that can occur adjacent to a stream but also limit the direct discharge of runoff from new development to these waterbodies.

As of February 2, 2004, the stormwater management design requirements pertaining to groundwater recharge, water quality and water quantity must be met for all projects regulated under RSIS. Furthermore, N.J.A.C. 7:8-4 requires that all municipalities within the State of New Jersey adopt a municipal Stormwater Management Plan. Each municipality is assigned a General Permit which mandates that this be completed no later than 12 months from the effective date of the permit authorization. Additionally, N.J.A.C. 7:8-4 mandates that stormwater control ordinances be adopted and implemented for all municipalities in the State no later than 12 months from the date of adoption of the Stormwater Management Plan. There are also specific provisions within N.J.A.C. 7:15 that must be satisfied by Bethlehem Township concerning existing non-point source pollution sources over a 60 month timeframe. The County has recently completed the preparation of a draft model stormwater management ordinance that should assist Bethlehem Township in the preparation of the municipal stormwater ordinance. Additional information on the stormwater rules can be found on the Hunterdon County Planning Board website at <http://www.co.hunterdon.nj.us/stormwater.htm>.

On August 10, 2004 the State of New Jersey passed the *Highlands Water Protection and Planning Act*. The Highlands Region is considered a vital source of drinking water for more than half of New Jersey's families, yielding approximately 379 million gallons of water daily. In addition, the Highlands region contains exceptional natural resources such as contiguous forest lands, wetlands, pristine watersheds and plant and wildlife species habitats. The region also contains many sites of historic significance and provides abundant recreational opportunities. The Highlands Region also hosts approximately 110,000 acres of agricultural lands in active production.

The Highlands Act documents the geographical boundary of the Highlands Region, establishes the Highlands Preservation and Highlands Planning areas, and sets environmental standards on the Preservation area. Lands within Highlands Preservation Area boundaries are subject to strict limitations on the amount of impervious cover; limitations of development on steep slopes, in forested areas, flood zones, and within 300 feet of all water bodies. Highlands Preservation areas are also subject to the implementation of Category 1 (C-1) water quality protections on all waters.

A total of 88 municipalities are included in the Highlands Region, including Bethlehem Township, falls within the boundaries of the Highland Preservation or Planning Areas. Details of the significance of the Act are addressed in Section 20 of this ERI. More information on the Highlands Act is available at <http://www.state.nj.us/dep/highlands/>. 91.4 % of Bethlehem Township lies within the Preservation Area; the balance of the Township is regulated as a Planning Area. The Preservation Area is to be protected through enhanced environmental regulation, transfer and purchase of development rights, acquisition of environmentally valued real estate, and regional planning. Municipal designation as a Preservation Area requires modification of local codes and development regulation to ensure compliance with the Regional Master Plan, which includes the regulation and approval of any major Highlands development (as defined by statute) by NJDEP. Areas within the Planning Area are encouraged, but not required to achieve compliance with the Regional Master Plan. All Highland areas are specifically exempted

from the recently passed Smart Growth Law. The information contained in this ERI is intended to be used in concert with this regulation in evaluating impacts within the Preservation and Planning Areas and for the purpose of assessing the utility of site-specific measures such as the transfer and purchase of development rights, acquisition of environmentally valued lands, and other related planning and land development activities.

In the summer of 2000 the Hunterdon County Planning Board and the North Jersey Resource Conservation and Development Council received a grant from the U.S. Forest Service to fund a two-year planning project, entitled “*Addressing Sprawl – Innovative Community Forestry Strategies*”. A product of this collaborative effort is “*Building Greener Communities – Planning for Woodland Conservation*” (Carter et. al., 2003). This project was undertaken in response to local interest and intends to accomplish the following goals:

- Increase municipal awareness of planning approaches to woodland conservation,
- Provide fair and practical approaches to development options that help conserve woodlands,
- Convey examples of creative site design techniques that maximize woodland conservation,
- Develop technical knowledge among professionals, including builders, contractors, public works departments, etc. through demonstrating “Best Management and Construction Practices” that protect trees during the land development process,
- Address various planning, enforcement and woodland management issues that have been raised by municipalities, and
- Increase municipal participation in the New Jersey Community Forestry Program.

Additional information on this initiative and a copy of the Woodland Conservation Plan is posted on the Hunterdon County Planning Board Web Page at <http://www.co.hunterdon.nj.us/planning>.

Farmland, open space and historic preservation programs have all been critical in the planning process of Bethlehem Township. The significance of these programs is reflected in this ERI, specifically in Section 17. The preservation of farmland, open space and cultural and architectural resources has gained the interest of both the public and private sectors for its cultural and tangible benefits. Interest has taken hold to protect these resources in order to preserve the rural landscape of areas and protect resources and history for future generations. Information concerning the various programs in place to protect farmland, open space and historic and cultural resources is available through the Hunterdon County Agriculture Development Board web page at <http://www.co.hunterdon.nj.us/cadb.programs.htm>.

Finally, of direct relevance to Bethlehem Township is the Spruce Run Initiative, which is discussed in greater detail in Section 22. The Township played an active role in the drafting of the Spruce Run Initiative. Although not a State regulation or law, the Initiative is a planning guide intended to accommodate economic and land development activities and guide land preservation activities in a manner that best protects the water quality and water supply of Spruce Run Reservoir and its tributaries.

In summary, there are, in addition to the Ordinances of Bethlehem Township a number of State-wide rules and regulations and local regional planning efforts that the contents of this ERI recognize. The data, maps and analyses included herein can be helpful the implementation of various land use, land preservation, resource protection and impact mitigation measures needed to meet in part or in full these regulations as well as satisfy Township planning and environmental ordinances and land development/land use design standards.

To this end, the Bethlehem Township ERI presented herein contains individual sections regarding specific environmental inventories based on various categorizations. Each section of the ERI represents a key element of the Township's overall resources, whether these are anthropomorphic or natural. Each section includes a stand alone text which explains the relevance and importance of each resource and a map, developed from the most recent available geographic information services (GIS) database. To facilitate the use of the document, the map accompanying each section of the ERI is presented opposite the text. The electronic version of this ERI also includes hyperlinks that assist in the access and review of information contained within the ERI or available through other sources including County and State sites. Together the maps, text and associated appendices provide a rich, comprehensive and specific description of the Township's resources.

With this document it is possible for the Environmental Commission, Planning Board and Township Committee, as well as Township residents and prospective developers to access and understand the key features, resources and attributes of the Township on a lot-specific scale. As stated earlier, the information contained within this ERI is more than a compilation of geographic or natural resource information. It is intended to educate, guide and benefit all those interested in the long-term protection, management, preservation and wise-use of the resources of Bethlehem Township.

1: SITE LOCATION MAP

The Township of Bethlehem is located in the northwest portion of Hunterdon County and encompasses 20.75 square miles (13,279.87 acres) ([Map 1](#)). The Township is bound to the north by the Musconetcong River, which also forms the Hunterdon-Warren County Line, and the Townships of Washington, Franklin and Pohatcong in Warren County. Adjacent municipalities within Hunterdon County include the Boroughs of Hampton and Glen Gardner to the east and Bloomsbury to the west. The Townships of Lebanon, Union, Alexandria, and Holland form the southern municipal boundary. Bethlehem Township is easily accessible by larger roads and thoroughfares including Interstate 78 and US Route 22. New Jersey Routes 31 and 173 and Hunterdon County Routes 579, 635, 643, and 647 provide secondary access.

Bethlehem Township is still classified as a rural Township. Population data from the 2000 US Census indicate a population of 3,804. In the 10 years preceding the 2000 Census, the population of the Township grew 23.07 % to outrank growth rates in Hunterdon County and New Jersey. This reflects an increase in developmental pressure spurred by suburban growth along the Philadelphia and New York transportation corridor, the accessibility to the Township, and its general quality of life.

Bethlehem Township is characterized by diverse geology, land cover, topography, soils, and plant and wildlife communities. The Musconetcong River, the Musconetcong Valley, Musconetcong Mountain, and Mulhockaway Creek highlight these environmental qualities. Environmentally sensitive features include the significant areas of threatened and endangered species habitat, exceptional resource wetlands, and Category One (C-1) waters. Many of the natural features have been highlighted by the State for special protection and management. Bethlehem Township is also unique in lying in two Watershed Management Areas (WMA) including the Upper Delaware WMA, which drains the headwaters of the Musconetcong River, and the North and South Branch Raritan WMA, which drains the headwaters of Mulhockaway Creek and Spruce Run.

Bethlehem Township is located within the Highlands Region and is afforded special regional regulation through its inclusion in the Highlands Preservation Area. In general, significant development will not be permitted in this area unless specifically approved by the New Jersey Department of Environmental Protection (NJDEP) and the Highlands Council. Nearby natural resource features of significance include Spruce Run, Voorhees State Park, and Round Valley Reservoir and State Park.

2: 2002 AERIAL PHOTOGRAPH

The false color infrared aerial photography used in the preparation of this inventory was obtained from NJDEP ([Map 2](#)). In 2002, NJDEP commissioned a flyover of the entire state to account for recent development changes and improve digital reproduction resolution. The aerial photography provides an overview of Bethlehem Township's Land Use/Land Cover (LU/LC), locations of larger surface waters, developmental features, agricultural sites, and main travel corridors, as they existed at the time of the flyover.

Aerial photography is an important tool in characterizing and creating an inventory of the natural and developmental features of a defined land mass. Aerial photos may also serve as the base coverage to develop topography, soils, and LU/LC maps. Advances in reproduction technology and refined classification methodology increase accuracy and precision of these mapping techniques. However, site specific use of these various map types is not recommended; they are intended only as guidelines. Field verification is still integral for site specific projects due to certain limitations in scale and continual change in LU/LC.

The value of aerial photographs when used alone is the ability to “flesh out” many maps and provide a comprehensive picture with great detail that integrates various individual coverage types. In this map it is possible to easily identify developed areas of the Township and even distinguish between residential and commercial development. With the false infrared, it is possible to distinguish agricultural lands from lawns, forests, and parks because different vegetation types emit different infrared wavelengths. For this reason, lawns and actively cultivated fields appear as dark red areas while forested and barren areas are more subdued. The map also helps to highlight areas of contiguous forested lands. Aerial photographs also serve as historical records that can be used comparatively with older photos to identify changes in LU/LC, infrastructure, and development over time. This is a commonly used diagnostic technique for the completion of Phase I environmental site assessments.

3: ELEVATION RELIEF

This elevation relief depiction is based on the reclassified 10-meter Digital Elevation Model. This model is produced by ArcGIS utilizing the 3-D Analyst Module. The elevation database is supplied by NJDEP. This modeled view is useful for portraying the area's topography and conceptualizing slope. This map is color coded to express relative differences in elevation and slope throughout the Township ([Map 3](#)). Green shades are representative of lower elevations, while brown shades are indicative of higher elevations. Areas of great color change are areas of significant relief, often times slopes in excess of 20%, which is the maximum slope at which development is allowed within the Township due to the Township's inclusion in the Highlands Preservation area. More uniform areas of color are relatively flat and lack significant topographic relief. The importance and relevance of slope is discussed in greater detail in the Steep Slopes section.

The unique topography of Bethlehem Township is derived from its varied geology characterized by faulting and folding. This produces sharp relief and a varied terrain with a difference of over 760 feet from the lowest to the highest point. The lowest elevation in the Township, 228.34 feet above mean sea level, is located in the western corner of the Township along the Musconetcong River. The land adjacent to the Musconetcong River is a relatively flat and low-lying valley associated with a sedimentary geological formation, which largely consists of agricultural lands. However, the western prong south of Bloomsbury Borough is characterized by steep relief. The highest point in the Township is located on Musconetcong Mountain at 989.32 feet above mean sea level south of the intersection between Rte. 579 and Tunnel Road. Musconetcong Mountain is the dominant topographic feature in the Township and occupies most of the southern part of the Township. The mountain is more accurately described as a high ridgeline with numerous peaks of varied height along its length.

It is useful to view equal interval ranges from lowest to highest elevations to more easily discuss Township topography. The lowest and highest intervals respectively account for 14.6 and 13.2% of the Township. The interval ranging from 685 to 837 feet accounts for the greatest percentage of Township area at 29.5%; however, the majority of the Township, 55.4%, lies within the 532 to 837 feet range. The mean elevation of the Township is 628.4 feet. This information describes a land area punctuated by relatively low valleys and relatively high peaks.

4: BEDROCK GEOLOGY

Bethlehem Township is located along the southern margin of the Highlands physiographic province (a geologic unit) and just north of the Piedmont Plateau ([Map 4](#)). The Piedmont province consists of rocks of the Mesozoic Era and ranges in elevation from 500 to 1,400 feet above sea level (valley to ridge).

The Highland province is highly fractured and faulted with intrusional suites and tectonic faulting zones. This province is also known as the Reading Prong. The Reading Prong is a series of geologic materials that are unique to the Highlands of New Jersey, New York, and Pennsylvania, but can be cross-correlated with the South Mountain Rock formations of Pennsylvania, the Virginias, and south. These rocks are generally resistant to erosion and result in steep, tall relief including many escarpments, sheer vertical rock faces, and deeply entrenched river valleys. These severe slopes are accentuated by the extensive faulting and folding of the materials, likely a result of tectonic plate motion. The Reading Prong has also been referred to as the Byram Intrusive Suite and the Lake Hopatcong Intrusive Suite.

Ambient radon concentration is a concern in central New Jersey, because radon concentrations can be naturally high in the native rock. Evidence suggests that sustained radon exposure can increase cancer rates. Geology is a prime determinant of radon concentration. USEPA and USGS designate Hunterdon County as a Zone 1 radon area, the designation of highest priority. This zone has the potential for radon concentrations to exceed 4 pCi/L. The EPA characterization solely represents potential, not actual concentrations, which can only be determined by onsite testing. Radon resistant features for structures include basement and slab vents and basement windows, which promote air exchange.

The bedrock map enclosed herein is general and depicts overall constituents of the rock formation. As with any natural system, there are “gray areas”, and investigations should be conducted to determine the mineralogical constituents and physical properties of the underlying rock and the propensity for materials to form solution cavities. For large developments, geotechnical engineers should determine the stability of bedrock to support structures and determine the effects of the underlying geology.

Two geological formations are observed in Bethlehem Township: the intrusive suite of hard metamorphic and igneous rocks (collectively known as crystalline geology) and a smaller formation of sedimentary rocks. Reading Prong geology includes 80.1% of Township; lithology (rock composition) includes gneiss, granite, and amphibolite, but is dominated by Quartz-Oligoclase Gneiss. This ferrous-rich geology supported the operation of many iron mines within the Township through the 19th century. The low-lying sedimentary formation accounts for 19.9% of Township land area and is adjacent to the Musconetcong River. Lithology of this formation includes limestone, shale, and sandstone, and is dominated by Allentown Dolomite. Sinkholes are a common feature of this type of karst geology, which is defined by the dissolution of the soluble lithology.

5: NRCS SOILS

Soil materials consist of a variable and complex mixture of organic matter, sand, silt, and clay particle. Strata of similar physical and chemical composition form soil horizons. Soil formation occurs under the influence of climate, parent materials including bedrock, flora and fauna, topography, and time. Collectively, these are known as the *soil forming factors*.

Soil units are the base classification code of soil nomenclature. The characterization process is directed by nationwide uniform procedures that account for particulate composition and size, stratification, and topography. These soil units are also extensively characterized by a number of performance characteristics reflective of the structure of that soil. These soil properties would include capability grouping for crop suitability, compaction, strength, shrink-swell potential, available water capacity, and permeability.

Soil plays a vital role in both ecosystem function and cultural development. Soil serves as the structural interface for vegetation and the source of vital nutrient generation; it filters and purifies stormwater, preventing groundwater contamination; it serves as the matrix for groundwater storage; and it stores large amounts of organic carbon. Cultural interaction with soils includes agricultural tillage, development, and engineering projects. Knowledge of soil properties are applied to farm and woodland management; in the selection of sites for roads, buildings, and other structures; and in determinations of suitability for agriculture, industry, recreation, and preservation.

The corresponding soils map depicts the SSURGO soil units data for the Township of Bethlehem ([Map 5](#)). SSURGO is the Soil Survey Geographic Database maintained by the Natural Resources Conservation Service (NRCS), which is a detailed geographical characterization of soils at a unit level. A soil association is defined as a landscape that has a distinctive proportional pattern of soils. The following soil associations are generally described as dominantly deep, loamy, well-drained, generally stony, rocky, and gravelly soils; mainly on the Highlands and the adjacent Piedmont Plateau. The following associations describe the dominant soils of Bethlehem Township.

Rowland-Birdsboro-Raritan Association: Deep, nearly level to gently sloping, well-drained to somewhat poorly drained soils; nonstony soils; on flood plains and terraces. This association accounts for only 3.1% of Township area; it is located in a narrow band along the Musconetcong River.

Duffield-Washington Association: Deep, gently sloping to moderately steep, well-drained soils; some rocky area; on uplands. This association runs in a band through the northern part of the Township and is associated with sedimentary formations. This association accounts for 12.5% of Township soils.

Parker-Edneyville-Califon Association: Deep, gently sloping to steep, excessively drained to somewhat poorly drained, dominantly gravelly, cobbly, or stony soils; on uplands. The dominant association at 84.0%, it is allied with crystalline geology.

6: ERODIBLE SOILS

Erosion is defined as the natural process by which wind, moving water, ice, and gravitational forces displace the solid and particulate materials of the land. Erosion of solid materials, including exposed bedrock, occurs on an extended geological time scale. Soil erodibility occurs on a much shorter time scale and with many more associated acute and chronic consequences. The determination of soil erodibility is a complex process that requires the consideration of soil type and texture. Clay and clayey soils are consistent (compacted, not loose), composed primarily of clay particles, and do not degrade rapidly under duress of erosional factors. Loam soils consist of 7 to 27 % clay particles, 28 to 50% silt particles, and less than 52% sand particles in order of increasing grain sizes. Loamy soils are not as consistent due to the presence of larger particulate silt and sand. In addition to texture and type, erodibility is influenced by atmospheric conditions such as temperature and precipitation, stormwater runoff velocities, slope, and vegetative cover. Anthropogenic factors also influence erosion rates, chief among these being land use, which can exacerbate erosional problems or improve them through conservation practices. Erosional problems include declines in agricultural productivity, channelized flow, streambank instability, waterway sedimentation buildup, and contaminant transport.

The model with the greatest acceptance and use to predict soil erodibility is the Universal Soil Loss Equation (USLE). USLE utilizes six different variables encompassing the influences discussed above to predict erodibility. The list of erodible soils within the Township of Bethlehem was obtained by the National Resource Conservation Service (NRCS). The NRCS has utilized the USLE, but modified it slightly to account for local conditions to produce erodibility codes for the soils of Hunterdon County. The variables utilized are the following: Rainfall and Runoff Erosivity Factor, Soil Erodibility Factor, Slope Length Factor, Slope Steepness Factor, Cover Management Factor, and Erosion Control Factor.

The corresponding map displays the results of the NRCS modified USLE displayed as three categories: Not Highly Erodible (NHE), Potentially Highly Erodible (PHE), and Highly Erodible (HE) ([Map 6](#)). In general, the soils of Bethlehem Township are very susceptible to erosion. Highly Erodible soils cover 41.2% of the Township, while Potentially Highly Erodible Soils are found throughout 53.6% of the Township. Not Highly Erodible and undefined soils are found in just 5.3% of the Township area. Erosion within the Township is largely a function of slope and topography. HE soils are all located on slopes of at least 8%, all PHE soils are located on slopes between 0 and 15%, and NHE soils are located only on slopes less than 8%. Soils in the same series, such as the Parker soils, are differently affected by erosion according to slope.

Erosion can be minimized by limiting development on steep slopes and maintaining vegetative cover. The adoption of best-management practices in compliance with existing state and local watershed and stormwater ordinances can also minimize the effects of sediment loading attributed to erosion.

7: IMPORTANT SOILS OF NEW JERSEY

Open space preservation actions often target agricultural lands. The Highlands Protection Act also highlights the value of agricultural lands and promotes farmland preservation and the practice of agriculture. The initial step in conservation measures is the identification of land deemed valuable. Agriculture productivity is directly influenced by soil characteristics; thus, agricultural lands are characterized by the soil. The mapping of Prime Farmland and Statewide Important Soils is a tool for identifying real and potentially valuable agricultural sites based on soils ([Map 7](#)).

Prime and Unique Farmlands (7 CFR Part 657), an amendment to the federal Farmland Protection Policy Act, directs the State Conservationist under the Natural Resources Conservation Service (NRCS) to prepare a statewide list of soil mapping units that fit defined criteria as Prime Farmland and Important Soils. The identification system in New Jersey relies on previously published Land Capability Classification (LCC) data. Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The principal concerns in managing the soils for the production of crops are maintaining fertility, controlling erosion, and providing drainage. The groups are developed according to the limitations of the soils when used for field crops, the risk of damage when they are used, and the way they respond to treatment.

Prime Farmlands include all those soils in Land Capability Class I and selected soils from Land Capability Class II. Prime Farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber and oilseed crops that is available for agricultural uses. It has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed according to acceptable farming methods. Prime Farmlands are not excessively erodible or saturated with water for long periods and infrequently flood or are protected from flooding.

Soils of Statewide Importance include those soils in land capability Class II and III that do not meet the criteria as Prime Farmland soils. These soils are nearly Prime Farmland and economically produce high yields of crops when treated and managed according to acceptable farming methods. Some may produce yields as high as Prime Farmland if conditions are favorable.

Prime Farmland soils account for 23.1% of Township area. These soils are predominantly located in the plain adjacent to the Musconetcong River, but are also located in the northern tier of the Township. Statewide important soils are more evenly distributed throughout the Township, but are also more fragmented. Statewide important soils account for 25.7% of Township area. While most of the prime farmland soils along the Musconetcong River are actively cultivated or maintained as agricultural land, much of the remaining identified prime farmland and statewide important soils in other areas are not identified as agricultural lands, but as other land uses, primarily as forested lands.

8: SLOPE ANALYSIS

The subject of steep slopes is important for two main reasons: the potential for excessive erosion and the physical limitation of development. Steep slopes present concerns for development, and careful planning is essential to avoid adverse impacts to the surrounding environment. Disturbance of existing vegetation on steep slopes often leads to excessive erosion. This is because the vegetation assists in keeping the soils in place and intact, mitigating the erosive forces of precipitation and wind. When vegetation is removed, the soils on steep slopes become less stable and prone to erosion. This in turn degrades water quality through high turbidity/poor clarity, sediment deposition, and additional pollutant loads of contaminants bound to soil particles. Excessive erosion may also lead to slope failure, posing a hazard to surrounding building and/or transportation corridors. Steep slopes are also treasured for their scenic and environmental qualities. Ravines and steep hillsides often provide impressive scenic vistas. These resources are important to the overall characteristics of the Township. Vegetation on slopes increases not only soil stability, but also wildlife habitat. Limited accessibility also enhances the attractiveness of this habitat to a variety of species, including plants. Steep slopes also serve as natural boundaries between land uses and districts within a community.

The Township of Bethlehem is developing specific regulations regarding development and construction grading on slopes for inclusion in the Critical Areas Ordinance consistent with the Highlands Act. The ultimate goal of steep slope regulation is to control excessive erosion in erosion prone areas. Recommendations state that no activity or improvements should be permitted on slopes of 20% or greater. Activity on slopes 10% to less than 20% should be subject to review and approval of the individual grading plans. Where necessary, transitions shall be made by retaining walls as indicated below. Maximum impervious cover permitted on steep slopes should be reduced to 50% of that permitted in the zone for slopes of 10-20% and no impervious surface cover should be permitted for slopes of 20% and greater. Final graded contours should be no steeper than the pre-development condition with retaining walls near or at the limits of disturbance. The Highlands Act states there shall be no new development on slopes greater than 20% and additional restrictions on slopes greater than 10%.

The majority of Bethlehem Township, 50.4% by area, has slopes from 0% to less than 10%, which characterizes the Township as rolling with areas of high relief ([Map 8](#)). Slopes ranging from 10% to less than 20% account for 30.5% of Township land area, while slopes greater than 20% are confined to 19.0% of Township area. The southwest corner is characterized by steep slopes that consist of ridgelines and parallel hillocks. A continuous ridge running roughly parallel to the Musconetcong River unevenly bisects the Township. Musconetcong Mountain is a series of discontinuous ridgelines and hills that lie near the southeastern municipal boundary. 49.6% of the Township has slopes of 10% or greater, which are areas directly affected by the draft ordinance or Highlands legislation. While greatly limiting development and impervious cover in the steep slope areas, the draft ordinance may protect additional lands. Auxiliary features, such as roads that cross steep slopes, will be limited by slope regulations and may prohibit access to other suitable sites.

9: STREAMS AND WETLANDS

Legal classifications of wetlands are based on a functional definition of wetlands that is commonly called the three-parameter approach and is outlined in the *Federal Manual for Identifying and Delineating Jurisdictional Wetlands*. The three parameters defining wetlands are hydric soils, hydrophytic vegetation that is typically adapted for life in saturated conditions, and area hydrology that is inundated or saturated by surface or groundwater at a frequency and duration to support hydrophytic vegetation. All three parameters must be met to qualify as a wetland. Therefore, areas with hydric soils are not wetlands if they do not meet hydrology and vegetation standards. Wetlands use in New Jersey is regulated by the Freshwater Wetlands Protection Act, N.J.S.A 13:9B-1 et seq.

Formerly regarded as wastelands, wetlands are now recognized as important features of the landscape and provide many functions that are beneficial to people and wildlife. Wetlands are an important component of regional hydrology, storing excess stormwater runoff and serving as a link with groundwater resources. The ability to mitigate runoff quantity is mirrored in the ability to improve runoff quality. Wetlands improve water quality by trapping sediments, nutrients, and other pollutants released in the watershed; these contaminants are generally associated with agricultural, commercial, and residential development. This process is accomplished by plant and microorganism uptake, adsorption to soil particles, and physical filtering created by vegetation.

Wetlands are also critical to biological productivity. Wetlands are among the most productive ecosystems in the world, as evidenced by the wide variety of flora and fauna that they host. Wetland plants provide breeding and nursery sites and resting areas for migratory species. Wetlands are also the permanent home to some of New Jersey's threatened and endangered species. Decomposition of vegetation within wetlands plays an important role in many food webs, as decomposed organic matter forms the base of aquatic and terrestrial food web.

The data source for the wetlands map is NJDEP. In 1986, NJDEP utilized local data and their new, larger scale aerial photographs to produce the wetland data utilized herein, which were updated again in 1995/1997. It is important to note that this data is not field verified and may significantly underestimate wetland area. In addition, the wetlands defined here are based on photographic interpretation, not on field verified surveys, which would follow the three-parameter approach of wetland definition and more accurately define wetland bounds. As such, the wetland boundaries displayed on this map are general and DO NOT preclude the need for formal delineation as part of any development, disturbance, or regulated activity.

Wetlands are estimated to comprise 680.3 acres of Bethlehem Township ([Map 9](#)). The extent of wetlands is limited largely by the relatively steep topography of the Township. Wetlands are largely confined to riparian corridors and plateaus in the eastern portion of the Township. Deciduous wooded wetlands are the predominant wetland type in Bethlehem Township, accounting for 67.6% of all documented wetlands. Agricultural wetlands, the second most common wetland type, account for 16.6% of wetlands.

10: NJDEP SURFACE WATER QUALITY STANDARDS OF NEW JERSEY

State surface waters are classified according to Surface Water Quality Standards (NJAC 7:9B), which were developed to improve impacted surface waters and to protect and maintain the high quality water resources. Waterways are classified in three ways according to their general quality and structure, the occurrence and structure of trout populations, and special resource protection status.

All flowing surface waters within Bethlehem Township are classified as FW2, which are all fresh waters not characterized as FW1 (not subjected to any man-made wastewater discharges or increases in runoff from anthropogenic activities) or PL (surface waters within the Pinelands region) ([Map 10](#)). Designated uses within FW2 waterbodies include the maintenance, migration and propagation of natural and established biota (collection of organisms), contact recreation, industrial and agricultural water supply, public potable water supply, and any other reasonable uses. Within FW2 waters, toxic substances shall not be at levels toxic to humans or aquatic biota, all discharges shall be permitted pursuant to NJPDES, nutrients shall not be in concentrations that render waters unsuitable for designated use (except by natural causes), and there shall not be other changes in use or chemistry that are not deemed reasonable by the state.

In addition, surface water habitats within the State are classified in part on their ability to support trout and other species of fish, because Salmonids (trout family) are reliable indicators of water quality. Specifically, trout have high dissolved oxygen demands and little tolerance to turbidity, metals, and elevated temperatures. All streams within Bethlehem Township are characterized as either Trout Maintenance (TM) or Trout Production (TP). TP streams are those used by trout for spawning and/or nursery purposes, while those classified as TM are those waters with the potential to support trout populations throughout the year. Trout Maintenance waters within the Township include the Musconetcong River, Jaynes Brook, and an unnamed tributary to Spruce Run. Trout Production streams include Spruce Run (Alpaugh Brook), Black Brook Creek, Mulhockaway Creek, Norton Brook, Turkey Hill Brook, and West Portal Creek. Turkey Hill Brook, West Portal Creek, and associated tributaries, drain north to the Musconetcong River, which in turn drains southwest to the Delaware River. All other streams in Bethlehem Township, including Spruce Run, Black Brook Creek, Mulhockaway Creek, and Norton Brook, as well as all associated tributaries, are located within the Raritan River drainage basin.

In the beginning of 2004, new Stormwater Quality rules were adopted, as mandated by the EPA. NJDEP took additional steps to identify and protect high quality water resources. These special water resource protection areas are established along all waters designated Category One (C-1), and perennial or intermittent streams that drain into or upstream of C-1 waters. These areas are established for the protection of water quality, aesthetic value, exceptional ecological significance, exceptional recreational significance, exceptional water supply significance, and exceptional fisheries. The most notable regulation is the implementation of a 300 foot buffer zone on each side of C-1 stream. Other rules deal with designated areas for future development, the creation of a stream corridor protection plan, and cleaner stormwater discharge into the special water protection area, or the C-1 stream itself. For the official rules regarding the special water resources protection areas, please reference the New Jersey Register (N.J.A.C. 7:8-5.5(h)). In addition, all streams located within the Highlands Preservation Area, are afforded 300 foot buffers per the Highlands Water Protection and Planning Act. Thus, all streams within Bethlehem Township are protected by 300 foot buffers, through inclusion in stormwater rules affected areas or the Highlands Preservation Area.

11: FEMA FLOODPLAINS

A floodplain is the relatively flat area adjoining the channel of a natural stream which has been or may be hereafter covered by water. Floodplains are integral parts of the hydrologic cycle of a region for two key reasons. First, floodplains temporarily store floodwaters. During intense precipitation events and periods of high water, floodplains store excess runoff which is then slowly released. This storage capacity slows floodwater velocity and increases the ability of the river channel to discharge floodwater. The second important function of floodplains is the improvement of water quality. As stormwater runoff traverses the floodplain, established vegetation improves water quality by trapping sediments and pollutants before they enter the receiving water. Conversely, floodplains also store excess sediments which are deposited during flooding events. This deposition of nutrient rich sediments in floodplains has historically made farming of these areas attractive. Vegetation along the stream bank also anchors and stabilizes the soils, effectively reducing erosion and providing shade to maintain water temperatures. Floodplains are equally important as wildlife habitat for many rare species, and serve as nursery areas for many fish species.

The source data for the accompanying map was obtained from the Federal Emergency Management Agency (FEMA). Two standard flood zones are commonly described are the 100-year and 500-year flood zones. The 100-year flood zone is also known as the Special Flood Hazard Area. Characterization of flood zones is based upon the statement of flooding probability. Thus, a 100-year flood is described as a flood elevation that has a 1% chance of being equaled or exceeded each year. The Base Flood Elevation (BFE) is the height of the 100-year flood, or base flood, referenced to a controlled vertical scale. The 100-year flood zone can be calculated using the BFE obtained from detailed area-specific hydraulic analyses. Conversely, the 100-year flood zone can be established without a BFE in less well-studied areas through approximations modeled on area topography. Terminology describing flooding events in defined periods is misleading because these flood zones are based on exceedance probabilities not periodicity. Therefore, 100-year flood events may occur closely together within the space of a single year or on time scales greater than 100 years.

While floodplains may be aesthetically pleasing because of the proximity to water, these areas are not recommended for development. Development within floodplains alters storage capacity and flow characteristics elsewhere in the drainage systems. The Township of Bethlehem has addressed the issues concerning floodplain management and has moved to protect those areas in order to maintain water quality and reduce flood damage. Only 2.8% of Bethlehem Township lies within described FEMA flood zones ([Map 11](#)). In part this may be attributed to relatively steep slopes that confine floodplains to small areas. However, flood zones are probably underestimated because smaller headwater tributaries are poorly mapped. 500-year flood zones have not been established for most streams, and only 49.4% of 100-year flood zones have determined base flood elevations.

12: GROUNDWATER RECHARGE AREAS

Aquifers represent a geological unit, which can store and supply significant quantities of groundwater. Aquifer recharge is a function of groundwater recharge rates. Groundwater recharge represents the net amount of water that infiltrates the soil matrix to a point below the root zone of vegetation. Groundwater recharge necessarily accounts for the loss of gross precipitation due to evapotranspiration (physical and biological uptake), consumption, and surface runoff. These losses are determined by impervious cover, slope, and soil properties affecting percolation. The quantity of groundwater making it into the aquifer is based on the geology and aquifer pumping rates, but is less well modeled than groundwater recharge. Factors such as karst geology in sedimentary formations and fractured trap rock affect the transport of groundwater into aquifers.

Approximately 52% of the state's population receives its drinking water from groundwater. Bethlehem Township relies solely on groundwater sources because there are no publicly available water supply systems. Therefore, it is important to identify those critical areas in Bethlehem Township with the highest potential for groundwater recharge in order to protect and preserve this vital resource from contamination and land use practices that would negatively impact either the quality or quantity of available groundwater ([Map 12](#)). The primary goal of the Highlands Protection Act, to preserve the ground and surface water resources of the area through tools to be identified in the Regional Master Plan, requires the characterization of groundwater recharge areas.

The data for this map has been obtained from the New Jersey Geological Survey (NJGS). The NJGS has developed a model for mapping groundwater recharge areas. The model utilizes rainfall data from climate-meteorological monitoring stations, land use/land cover datasets (including impervious surface coverage, wetlands, agricultural, and residential and commercial development), geology, soil types and specific properties, and the extent of wetlands (streams, rivers, lakes, swamps, bogs, etc.). These data are combined to determine the potential in any area for groundwater recharge. This map is grouped according to ranks based on groundwater recharge rates. A single soil unit may have several ranks based on slope, proximity to wetlands, and land use.

In general, there is good groundwater recharge throughout Bethlehem Township relative to demand. Groundwater recharge rates of 13 to 16 inches/yr are calculated for 84.1% of Township area, while additional recharge of varying rates is expected in 6.5% of the Township. Wetlands, open waters, and hydric soil areas are expected to contribute no measurable groundwater recharge; these areas account for 9.25% of Township area. Optimal recharge rates from 17 to 23 inches/yr are found in 2.9% of the Township and consist of small evenly distributed patches.

13: VERNAL POOL LOCATIONS

Vernal pools are narrowly defined ephemeral wetlands that are characterized by hydrologic features and ecological function. These pools are confined basins or depressions lacking means by which the standing water in the pool can drain. To be classified as a vernal pool, standing water must be present in the pool for at least two continuous months between March and September in a year of normal rainfall. Ecologically, vernal pools must harbor documented obligate or facultative vernal habitat species (as listed by NJDEP) and be free of fish populations or dry up for some period during the year. Obligate species may be defined as those species that are dependent on vernal pool habitats at some stage of the life cycle, while facultative species are those species that frequently utilize vernal pools but are capable of reproducing outside of vernal pools.

Vernal pools are recognized as disproportionately diverse habitats within generalized upland settings. In particular, they are associated with various obligate species across taxa that are recognized as threatened or endangered. Characteristic obligate species include the amphibian genus *Ambystoma*, the mole salamanders, and *Rana sylvatic*, Wood Frog, but are equally important to facultative wildlife such as *Clemmys guttata*, Spotted Turtle.

Statewide the number of vernal pools has declined drastically because of increased development and the lack of specific regulatory protection afforded larger, more typically defined wetlands. With the approval of the Freshwater Wetlands Protection Act Rules in 2001 vernal pools became specifically protected, and NJDEP's Endangered and Nongame Species Program established the Vernal Pool Project, which is a dedicated effort to map and survey vernal pools throughout the state. Bethlehem Township also undertook efforts to characterize vernal pools within the municipality when the Environmental Commission ordered the Vernal Pool Study in 2002 ([Map 13](#)).

Volunteers working on the Vernal Pool Study initially delineated 83 candidate sites for vernal pool certification. Of this initial number, 44 of the pools were certified by NJDEP according to criteria requiring documented vernal pool utilization; 5 more have been certified in 2005. Documented species using these pools included Wood Frogs (*Rana sylvatica*), Spotted Salamanders (*Ambystoma maculatum*), Northern Spring Peeper (*Psuedacris crucifer*), Eastern Newt (*Notophthalmus viridescens*), and Common Snapping Turtle (*Chelydra serpentina serpentina*). Most pools were located in concentrated clusters towards the northeast corner and the middle of Bethlehem Township. These areas were closely associated with forested wetlands of minimal slope.

Vernal pools represent a unique natural resource. Filling, altering, draining, or otherwise compromising the hydrological or ecological function of vernal pools should be avoided and any such activity is subject to NJDEP review and approval.

14: LAND USE / LAND COVER

Land Use/Land Cover (LU/LC) is a two-tiered classification system that systematically defines similar land areas according to land utilization and vegetative structure. Specifically, this is an EPA and NJDEP approved method known as the Anderson Classification. LU/LC is an important descriptor of any area because it documents anthropogenic activities and is utilized for environmental characterization.

In 1986, NJDEP commissioned an independent contractor to produce the original LU/LC digital data set. The data set was created by combining existing information about land use with newly flown aerial photographs and digitizing the results. In 1995, NJDEP commissioned another statewide production of aerial photographs. The updated photographs and a more detailed classification system were used to create the 1995/97 LU/LC data set published by NJDEP.

It should be emphasized that LU/LC coverage (or any other coverage derived from LU/LC) is not field verified by either the publishing body of NJDEP nor by Princeton Hydro, and is not a wholly accurate representation of various land uses and vegetative land covers within Bethlehem Township. However, better data and methods, combined with improved technology, made the 1995/97 publication more accurate than previous renditions. The use of LU/LC data for site-specific projects is inappropriate because of limited resolution scales and possible developmental progression over time. The value of this coverage is an accurate portrayal of certain patterns within a land mass, such as high density residential areas, commercial development, and wetlands among others, and an easily manipulated hierarchical classification scheme. The data is quite valuable in depicting, and sometimes predicting trends, within an area, especially by comparing current information with older data sets (which is provided in the digital database of the Township's GIS data set). In addition, LU/LC coverage can serve as the basis of a diagnostic technique for calculating pollutant loading and other environmental metrics.

Bethlehem Township is comprised of 36 separate LU95 LU/LC categories as defined by the State of New Jersey ([Map 14](#)). These diverse classifications are more easily discussed according to land type, denoted as Type 95, which is a more generalized classification scheme. According to Type 95 data, the Township is still predominantly forested land, accounting for 51.3% of the landmass. The largest single LU/LC category in the Township is Deciduous Forest with more than 50% crown closure, accounting for 43.8% of the Township. Agricultural lands account for the next largest land use at 25.7%. While located throughout the Township, the largest area of agricultural lands is a contiguous mass north of Rt. 173 and west of Portal Road. Urban lands, which include low density residential development common in rural areas, accounts for 17.2% of the Township area. Urban lands are evenly dispersed throughout the Township in small pockets. Wetlands comprise 5.1% of the Township land area and are closely associated with stream corridors; open waters are limited to 30.6 acres of the 13,279.7 acres of the Township. Barren lands are similarly small at 52.2 acres.

15: WETLAND FORESTS

Wetland forests are a unique classification of wetlands defined by the presence of, at a minimum, a partial canopy formed by tree or shrub species. Features common to all wetlands, which are federally defined by three (3) identifying characteristics include the prevalence of vegetation typically adapted for saturated soil, the presence of hydric soils, and hydrology that is periodically saturated or inundated during a portion of the year. Therefore, the loosely defined hydrology characteristic can lend a degree of variability in the description of forested wetlands. NJDEP characterizes forested wetlands based on diverse LU/LC classifications. Forested wetlands are valued resources because of the diversity of habitat and species richness they support. Wetland forests are also important components of regional hydrology.

Forested wetlands are in a constant state of change. The dynamic effects of rising and receding floodwaters characterize vegetative composition and natural succession. Regeneration, growth and mortality are evident throughout this system, providing a rich, diverse habitat for both plant and animal species. Bottomland hardwood forests provide crucial wintering habitats for a great number of migratory birds, spawning and nursery grounds for game fish and associated aquatic invertebrates, and habitats for many other mammals, reptiles and amphibians. Forested wetlands ameliorate the effects of seasonal floods and trap particulate and aqueous contaminants. Riparian buffers are crucial to the stability of riverine systems and act to keep stream temperatures low.

Wetland forest area in Bethlehem Township is 521.4 acres or 3.9% of total Township area ([Map 15](#)). While accounting for a relatively minor area of the Township, wetland forests account for 76.7% of all wetlands in the Township indicating their considerable importance. Only two (2) LU/LC types are found within Bethlehem Township: Deciduous Wooded Wetlands and to a lesser extent Deciduous Scrub/Shrub Wetlands. Wetland forests are typically low lying forests within or adjacent to floodplains and are often known as riparian (adjacent to flowing waters) forests. Forested wetlands in Hunterdon County are generally vegetated by canopy forming species including Pin Oak (*Quercus palustris*), Red Maple (*Acer rubrum*) and Sycamore (*Plantanus occidentalis*), while the shrub layer consist of Arrowwood Viburnum (*Viburnum dentatum*), Flowering Dogwood (*Cornus florida*), and Multiflora Rose (*Rosa multiflora*). The understory is composed of various sedges, rushes, ferns, and grasses.

Wetland forests importantly support the formation of vernal pools. Vernal pool identification and State certification has been a priority for Bethlehem Township. These unique ecosystems support a variety of obligate organisms dependent on the pools for reproductive reasons. Many of the species utilizing vernal pools are rare and may be identified on both State and Federal Threatened and Endangered Species lists.

16: UPLAND FORESTS

Upland forests consist of vegetation types commonly thought of as prototypical forests, which excludes wetland forests types such as swamps. The following description of upland forests is based on a subset of NJDEP LU/LC data, utilizing Type 95 LU/LC descriptions. Upland forests include all upland areas covered by woody vegetation. The vegetation can consist of primarily deciduous, coniferous or a mixture and include scrub/shrub and brush areas as well as mature tree stands of various densities. Also included in this category are early stage forest successional stands, commonly referred to as old fields, which are included because of their potential development into forests.

Upland forests are the dominant ecosystem in this part of New Jersey barring development and agricultural land use changes. Forested lands are currently and historically valued for aesthetic, recreational, ecological, and economic value. From an ecological perspective, forests are important because they provide rich habitat for indigenous and migratory wildlife including mammals, birds, and herptiles. Familiar wildlife utilizing forests in New Jersey include White-Tailed Deer (*Odocoileus virginianus*), Black Bear (*Ursus americanus*), Red Fox (*Vulpes vulpes*), Wild Turkey (*Meleagris gallopavo*), migratory Warblers (Parulidae), Timber Rattlesnake (*Crotalus horridus*), and myriad others. Forests also contain a diverse plant assemblage composed of various subgroups based on height or strata. The upland forest community of Hunterdon County is typically composed of various Oaks (*Quercus* sp.), Maples (*Acer* sp.), Hickory (*Carya* sp.), Beech (*Fagus grandifolia*), Eastern Red Cedar (*Juniperus virginiana*), and Eastern Hemlock (*Tsuga canadensis*). Shrub and understory layers have largely been decimated through over-browsing by deer. Forests contribute to area hydrology by increasing infiltration rates of precipitation into groundwater and minimizing sheet erosion due to runoff. Forests remain economically valuable because of timber production and recreational uses including hiking, bird watching, and hunting. Forest preservation is vigorously pursued by many conservation groups representing varied interests including those discussed above.

Bethlehem Township is predominantly forested land, accounting for 6,818.0 acres or 51.3% of Township area ([Map 16](#)). Upland forests are located throughout the Township except for a 1,000 to 6,000 foot swath adjacent to the Musconetcong River along the northern Township line. While upland forests dominate the land cover, other LU/LC are evenly distributed among forested lands; few large contiguous forest plots remain except on steep slopes.

Deciduous forests with greater than 50% crown closure, the intermingling of canopy branches, is the predominant forest type within Bethlehem Township, accounting for 5,747.6 acres or 84.3% of upland forest area. This is a high quality forest type with an assemblage of climax species. Ten (10) additional forest types are recognized in the Township, varying by assemblage, crown closure, and use, such as plantations, which are uniform stands planted for commercial harvest. Forests with coniferous species or mixed coniferous and deciduous species account for 3.6% of forested land mass.

17: OPEN SPACE AND FARMLAND PRESERVATION

Open Space may be defined as any parcel of land or water, essentially unimproved and set aside, dedicated, designated or reserved for public or private use or enjoyment, or for the use and enjoyment of owners and occupants of land adjoining or neighboring such open space provided that such areas may be improved with only those buildings, structures, streets, off-street parking and other improvements that are designed to be incidental to the natural openness of the land. Preserved open space protects water supply and quality, preserves sensitive habitats for endangered and threatened species, and minimizes suburban sprawl. Farmland preservation goals are similar to other open space preservation efforts, which seek to limit development, preserve scenic views, promote agricultural land uses, maintain hydrologic functions, and preserve specialized ecotone habitats.

Preserving and obtaining open space and farmland is largely accomplished through two means: 1) implementation of regulatory constraints requiring that future developments be designed in a manner consistent with local, state, and federal guidelines related to preservation planning and 2) the acquisition of specific properties deemed important as open space by defined criteria. Bethlehem Township has completed an update to the Open Space Plan of 1999, detailing the preservation methodology used by the Township, as well as an inventory of preserved lands and qualified lands. In addition to the Open Space Plan, the Highlands Act and the New Jersey State Development and Redevelopment Plan directly influence future development within the Township and guide preservation of lands.

Bethlehem Township has been very successful in preserving open spaces in the Township ([Map 17](#)). Publicly owned lands have significantly increased in area since 1999 when 973 acres were owned to May 2005 when approximately 2,594 acres were publicly held. This is largely due to past planning efforts and the availability of funding from a variety of sources. Chief among these sources was the Open Space, Recreation and Farmland Preservation Trust Fund created in 1997 to allow Bethlehem Township to purchase properties. In total, Bethlehem Township owns 387 acres including the municipal buildings and three dedicated open space parcels, Heritage Park, Crevelling Park, and “The Bog”. Various other parties own open space parcels or development rights within Bethlehem Township. The State of New Jersey owns about 685 acres, including lands in the Spruce Run Recreational / Clinton Wildlife Management Area and property purchased through the Green Acres Program. Hunterdon County owns approximately 731 acres, including Charlestown Reserve, Tower Hill Park, and Jugtown Mountain Park. Bethlehem Township Board of Education owns two parcels totaling 37 acres. Public and private owned lands, held by various stakeholders such as neighborhood associations, non-profit groups (Audubon and Natural Lands Trust), and utility owned rights-of-way along rail and pipe lines, collectively account for 747 acres of preserved land. The Farmland Preservation Program has preserved several farms totaling 1,397 acres thus far within two Agricultural Development Areas. Around 417 acres are currently pending purchase by the State and the Township.

18: LANDSCAPE HABITAT AND NATURAL HERITAGE DATA

The New Jersey Natural Heritage Program identifies the state's most significant natural areas through a comprehensive inventory of rare plant and animal species and representative natural communities. Specifically, the Natural Heritage Database compiles information of the distribution, biology, status, and preservation needs of identified species and communities. Imperiled species tracked by the database are identified by Federal and State Endangered Species Act, Endangered Plant Species Act, Endangered and Nongame Wildlife Act, and additional rare unlisted species under investigation. The database is continually updated and serves as the comprehensive source of information on rare plants, animals, and natural communities in New Jersey. This information can be used to identify areas of high natural diversity, locate rare species, and supplement field surveys conducted to assess project impacts on natural diversity and critical areas. The Natural Heritage Data is presented in two formats: as a grid or as identified communities with delineated boundaries known as Natural Heritage Priority Sites.

In 1994, the Landscape Project was developed by NJ Division of Fish and Wildlife's Endangered and Nongame Species Program (ENSP), and was adopted to utilize a landscape level approach to imperiled species protection. The landscape approach focuses on large tracts of land, called landscape regions, which are ecologically similar in regards to their plant and animal communities composed of critical wildlife areas. Critical wildlife areas in New Jersey include forest, grassland, forested wetland, emergent wetland and beach/dune. Utilizing a combination of land cover data and an extensive database of rare species locations, the Landscape Project has identified and mapped areas of critical importance for imperiled species within each landscape region. Critical habitat patches are delineated based on the species present and conservation status; areas with federally threatened or endangered species receive the highest ranking, followed by state endangered, state threatened and finally lands suitable for listed species habitat. Ultimately, these maps assist state, local and private agencies in prioritizing conservation acquisitions, guide regulators and planners, provide citizens with conservation tools, and identify contiguous habitats.

In total, the Landscape Project identified four major critical wildlife areas in Bethlehem Township, comprising 11,067 acres ([Map 18](#)). Critical wildlife areas inhabited by state listed endangered species accounted for 8,296 acres or 75% of identified habitats; the two largest critical areas were state endangered forest habitat and state endangered grassland habitat. In addition, state threatened Wood Turtle and federally threatened Eagle habitat types respectively accounted for 2,337 and 74 acres. This classification represents not the potential value, but the realized value of Bethlehem Township's varied ecosystems and high quality wildlife habitat. In contrast, one Natural Heritage Priority site, listed as Vince's Ravine, locally known as Musconetcong Gorge, was identified in the Township. This site was selected for its rare habitat type consisting of mixed Hemlock and deciduous woodland on the steep slope of a ravine. Two grid blocks, approximately 365 acres in size, were partially located in the Township, and identified both precisely known and less precisely known rare plant species or ecological communities within the cell.

19: SEPTIC RESTRICTIONS

Onsite wastewater treatment (septic) systems are the dominant form of wastewater treatment in many rural and suburban townships throughout the region. As such, septic suitability is a key factor in determining whether a parcel of land may be developed for residential or other purposes requiring onsite wastewater treatment. Septic suitability may therefore be better described in terms of septic restrictions. Septic restrictions are based upon those factors that limit the performance of septic systems. There are many physical factors that can limit performance and certain limitations imposed on the discharge of septic effluent in an effort to preserve natural resources; these factors are usually codified by regulations restricting septic system construction.

Septic effluent is nutrient rich, high in minerals and salts, has elevated organic content, and is laden with pathogens. If improperly treated, the seepage of wastewater into surface waters can negatively impact water quality. Septic discharge is also regarded as a threat to drinking water derived from surface or groundwater sources. It is the septic quality of the water, or the presence of toxic microbes including coliform bacteria, that pose a risk to human health.

Septic systems are performance limited by a variety of factors, most of which are linked to local soils and geologic properties. These include, but are not limited to, proximity to surface waters, slope, depth to seasonal high water tables, and soil composition. Soil composition is an important factor in determining wastewater percolation rates. Percolation describes the movement of surface waters infiltrating the soil to groundwater sources. Soils are limited by permeability, coarse rock fragments, compaction, stratification, and composition. Percolation rates may be neither too slow nor too fast if a soil is to provide a suitable level of wastewater treatment and renovation.

In the context of this report, septic suitability is limited strictly by soil properties, without regard to regulatory considerations as defined and detailed in NJAC 7:9A. Restrictions are classified according to the NRCS use limitations of soil units described in county soil surveys. Restrictions are classified as moderate, severe, or undefined based on six (6) specific limitations as follows: 1) fractured rock or excessively coarse substrata, 2) massive rock or hydraulically restrictive substrata, 3) hydraulically restrictive horizon or permeable substratum, 4) excessively coarse horizon, 5) regional zone of saturation, or 6) perched zone of saturation. Restrictions are classified as severe, moderate or undefined. Four (4) soil types in the Township are undefined and include alluvial land, gravel pits, steep stony land Parker material, and water. All undefined types are unsuitable for septic construction due to hydrology, lack of soil, or slope.

Bethlehem Township has limited suitability for septic system construction ([Map 19](#)). 64.2% of the Township has moderate restrictions, while severe restrictions account for 12.2% of the area. Severe restrictions are closely associated with riparian corridors and identified wetlands. Undefined lands, which are not suitable for septic operation, account for the remaining 23.6% of area. These areas are limited to high ridgelines and surface waters.

20: HIGHLANDS PLANNING AND PRESERVATION AREAS

The Highlands Water Protection and Planning Act was signed into law in August 2004. The goal of the act is to protect and preserve the diversity of natural resources within the Highlands region, a landmass of approximately 800,000 acres. A key component of the preservation drive is the protection of drinking water supplies; ground and surface waters in the Highlands provide potable water for approximately half the residents of the State. Aquifers and watersheds are most efficiently protected through the adoption of development restrictions. A secondary component will be the preservation of agricultural lands and the maintenance of contiguous (unbroken) forest tracts. A Regional Master Plan will be established for the Highlands that protects water resources, open space, and natural resources; limits development not compatible with protected resources; and to encourage economic growth and development consistent with the State Development and Redevelopment Plan.

Specifically, the Highlands Act established the geographical boundary of the Highlands Region based on a variety of factors, primarily regional geology ([Map 20](#)). The act also established the zonation of the Highlands into the Preservation Area, the core area defined by ecological sensitivity, and the Planning Area, mostly peripheral and more highly developed than the Preservation Area. The Preservation Area is most important to the regional ecology and is administered by NJDEP with the intention of maintaining or mitigating current land use. The regulatory control measure utilized requires NJDEP to approve all major Highlands development according to enhanced standards specified in the act, unless otherwise exempted. Required regulatory compliance is expected upon the completion of the Regional Master Plan established by the Highlands Water Protection and Planning Council. The Highlands Planning Area is established as zone not subject to the enhanced standards of development required of the Preservation Area. This area, located in the periphery of the Highlands Area adjacent to the Preservation Area will be managed for environmentally sensitive development and growth. Compliance with the Regional Master Plan is voluntary, but encouraged. Preservation techniques will include Transfer of Development Rights (TDR).

Bethlehem Township is wholly located within the delineated bounds of the Highland region. The majority of the Township lies within the Preservation Area, 12,142.8 acres or 91.4% of the Township. The remaining land areas, accounting for 1,137.1 acres or 8.6% of the Township, lie within the Planning Area. As described earlier in the Surface Water Quality Standards section, all waters within the Highlands Preservation Area are protected by the 300 foot development buffer regardless of special water resource protection status. All mapped waters within Bethlehem Township outside the Preservation Area were previously designated as C-1 streams and therefore protected by the 300 foot buffer. Thus, all waters in Bethlehem Township are granted the 300 foot buffer, except where exempted by previous development.

21: STATE PLAN POLICY MAP

The New Jersey State Development and Redevelopment Plan, commonly known as the State Plan, is a planning tool promulgated by the State Planning Commission and the Office of Smart Growth. The stated purpose of the plan is to: coordinate planning activities and establish Statewide planning objectives in the following areas: land use, housing, economic development, transportation, natural resource conservation, agriculture and farmland retention, recreation, urban and suburban redevelopment, historic preservation, public facilities and services, and intergovernmental coordination (N.J.S.A. 52:18A-200(f)). The plan therefore is designed to provide a comprehensive development projection that balances growth and conservation. Approval of the plan is dependent on the Cross-Acceptance Process, whereby local governments and the community discuss the major aspects of the plan in a public forum, which must locally adopt county-wide plans before submission to the state.

The State Plan therefore is driven by the identification of land areas and designation of future land uses. These designated land areas are known as Planning Areas, which are distinct geographic and economic units based on level of development and important natural resources based on a variety of environmental criteria. Planning Areas are supplemented by Centers, which are targeted for development, and Environs, which are adjacent lands. In addition, the plan may identify other more specific land uses such as Parks and Natural Areas, or which are more narrowly defined than Planning Areas. Each Planning Area has specific intentions and Policy Objectives that guide the application of Statewide Policies.

Currently, the third-round of the Cross-Acceptance process has recently been completed. Bethlehem Township participated in the process by submitting a Municipal Plan Comparison Checklist identifying compliance of the Master Plan and various Township policies with state guidelines. This checklist also includes a prioritization of goals consistent with state planning strategies and the underlying concepts.

Two planning areas encompass the majority of Bethlehem Township ([Map 21](#)). These are Planning Area 4 (PA4) Rural and Planning Area 5 (PA5) Environmentally Sensitive. Rural Planning Area (PA4) may include one or more environmentally sensitive features, such as valuable ecosystems or wildlife habitat. This area accounts for 7,915.5 acres or 59.6% the Township. This planning area supports agriculture and related economic development, and development/redevelopment should follow Policy Objectives for PA5. PA5 consists of large contiguous land areas with valuable ecosystems, geological features, and wildlife habitats, and consists of 5,271.0 acres or 39.7% of the Township. These areas are considered irreplaceable and critically important for the protection of watersheds, trout streams, drinking water supplies, aquifer recharge, habitat of threatened and endangered species, prime forested lands, scenic vistas, and wetlands. Policy objectives include preservation of land use, meeting housing requirements, supporting economic development, and natural resource conservation. The remaining lands, 92.5 acres, are identified as State Parks areas, which differ from the other areas in meeting only resource preservation requirements.

22: SPRUCE RUN INITIATIVE

Spruce Run Reservoir is third largest public water supply reservoir in New Jersey. It is located in part within the municipal boundaries of Bethlehem Township. The reservoir's watershed encompasses approximately 27,147 acres, of which 6,341.14 acres occurs within the boundaries of Bethlehem Township. The Spruce Run Initiative evolved in 2001 as a result of a Memoranda of Understanding between municipal governments located within the Spruce Run Reservoir watershed (including Bethlehem Township) and the New Jersey Water Supply Authority. The base goal of the initiative is the protection of the water quality and quantity of the tributaries and of the reservoir itself, while at the same time promoting economic development in a manner that is protective of the area's community character and the watershed's natural resources. One of the initiative's most important objectives is to minimize sprawl type growth and its associated negative environmental and community consequences. The composition of the watershed, as based on 1995 LU/LC data, revealed that 19% of the land was developed, while over 60% of the watershed was classified as undeveloped, with little of these lands dedicated open space. The predominance of undeveloped, unprotected land is unlike that observed in other water supply watersheds, which tend to be wholly or predominantly dedicated for the protection of the water supply. These conditions suggest that the Spruce Run watershed is particularly susceptible to developmental pressure, especially along the Route 31, Route 173 and Interstate 78 corridors. The Spruce Run Initiative was drafted as a cross-municipality planning effort designed to preserve critical lands that drain to the reservoir while at the same time promoting economic development and growth in a manner that minimizes environmental, community and water supply impacts.

The first step of the initiative was the identification of critical areas, having the highest value in preservation of the reservoir's water supply. The selection of critical areas was based on four criteria chosen with the intent of protecting the most sensitive areas in the most cost effective manner practical. The outlined open space preservation criteria include the following groupings: water quality and quantity – highest priority, preservation of wildlife habitat and diversity, agricultural preservation, and preservation of large open spaces and minimization of land cover fragmentation. Areas within the Township and watershed were then evaluated as per these criteria. Land areas satisfying the most criteria were considered of greatest value for preservation. Utilizing the identification of various sites, the initiative outlined project areas, three of which are located in Bethlehem Township including Musconetcong Mountain, Spruce Run, and Mulhockaway Headwaters Project Areas, which extend past the defined watershed boundary. Project Areas are critical areas refined by parcel sizes which must be 100 acres or greater or 30 acres and greater if adjacent to a 100 acre parcel. While Project Areas are the focus of preservation, the initiative recognizes that smaller sized critical areas should also be preserved. The recommended preservation techniques are identical to those identified in the Open Space Plan including the use of Green Acres and Agricultural Development Area programs.

In total, over 5,740 acres were identified as meeting at least one criterion in Bethlehem Township ([Map 22](#)). Of that total, 3,185 acres satisfied at least two criteria, and are to be considered high quality land. The critical areas identified extend along the entire Union Township line and north and east. The highest priority areas, those meeting three or four criteria, are located along the headwater tributaries in the eastern portion of the Township.

23: HISTORIC FEATURES

The identification and preservation of historical sites is important in maintaining the cultural legacy of a defined area. Bethlehem Township, due to its incorporation as a Township in the County of Hunterdon in 1798, has a long history worth preserving. Some of the more significant historic elements of the Township are identified on the Historic Features Map (Figure 23) and presented in Appendix 23. The original inhabitants of the land were the Lenni-Lenape, who have left behind many artifacts, but little in the way of preserved structures or population. While European exploration of the area started in the late 17th century followed by minor colonization of the area, the population grew most dramatically in the early part of the 19th century. The settlers were predominantly Dutch from Holland followed to a lesser degree by French, Germans, Scots, English, and Irish. The diversity of settlement, the evolution of the local economy, and the relatively slow development of the area within the last century has left behind an eclectic array of historical sites. However, there are no sites in Bethlehem Township recognized by the New Jersey or National Register of Historic Places.

Agriculture has been the predominant economic force throughout much of Bethlehem Township's history. As such, there are many surviving farmsteads, farmhouses, and various outbuildings ([Map 23](#)). Aside from the age of the surviving structures, they are also valued for the link with historically important families within the Township. The wide availability of building materials, most importantly stone and wood followed by brick, and the influence of various northern European styles leads to a diversity of forms of significant architectural value. In total, 39 historical sites were identified in the 1979 Hunterdon County Master Plan. In addition to rural structures, village life has been important in the Township for a long period including various services associated with agricultural use such as blacksmithing and milling. The village of West Portal, variously known as Bethlehem and West End, is an important historical district within the Township. Within this district, there are 24 documented historical sites including houses, municipal buildings, and commercial buildings.

The second important commercial enterprise within the Township was the mining of iron ore. Abandoned Iron Mines of Hunterdon County Report (1988) identified 11 mine sites in the hilly terrain of the southern tier of the Township. While iron mining was loosely documented in the 18th century, mining reached its peak from 1850-1890. Commercial mining declined in the Township as veins were depleted and the mining industry boomed in the western states. Mining brought about the growth of villages within the Township and increased transportation infrastructure.

Mining required the use of the rail system, which included two competing rail systems the Lehigh Valley Railroad and the Central Railroad of New Jersey. Today there are 4 recognized historical railway bridges, including the Musconetcong Tunnel, considered an engineering feat at the time of completion. In addition, there was improvements in the roadways as well, including 4 surviving bridges noted for the use of the Pony truss and masonry.

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APPENDIX 1

Site Location Map

Bethlehem Township

Area (acres)	13,279.87
Population, 2000 US Census	3,804

Major Roads

Black Brook Road
Charlestown Road
County Route 579
Hackett Road
Interstate 78
Iron Bridge Road
Ludlow Station Road
Mine Road
NJ Route 173
Staats Road
Tunnel Road
Turkey Hill Road
West Portal Road

APPENDIX 2

2002 Aerial Photograph

The red tone of color infrared aerial photographs is almost always associated with live vegetation. Very intense reds indicate vegetation which is growing vigorously and is quite dense. An irrigated alfalfa field would be an example of such vegetation. An evergreen forest, which may be quite dense vegetatively, will not appear as a similar bright red because its level of growth activity is less, compared to irrigated alfalfa. Knowledge of the vigor and density of vegetation is important to the interpretation of the red colors on color infrared aerial photography. As the vigor and density of vegetation decreases, the tones may change to light reds and pinks. If plant density becomes low enough the faint reds may be overcome by the tones of the soils on which the plants are growing. The ground areas in this case will appear in shades of white, blue, or green depending on the kind of soil and its moisture content. As plant vigor decreases, the vegetation will show as lighter shades of red and pink, various shades of greens, and possible tans. Dead vegetation, wheat stubble as an example, will often be shades of greens or tans.

Bare soils will appear as shades of white, blue, or green in most agricultural regions. In general, the more moist the soil the darker the shade of that particular soil color. Composition of the soil will affect the color tones shown on the photographs. Dry sand will appear white and, with more moisture, may be very light gray or possibly light tan. Clayey soils will generally be darker in color than sands and tend toward tans and bluegreens. Again, wetter clays will be darker shades of the same tones. Soils high in organic matter, like silts and loams will be even darker in color, and usually in shades of blues and greens.

Man-made features will show in the tones that relate to the materials they are made of. Asphalt roads, for example, will be dark blue or black, gravel or dirt roads will show as lighter colors, depending on the soil materials involved in their composition, and concrete roads will appear light in tone, assuming clean concrete. The buildings and streets of towns can be considered in a similar manner, their color dependent on the material they are made of.

Water will appear as shades of blue, varying from nearly black to very pale blue. Clear, clean water will appear nearly black. As the amount of sediment increases, the color becomes increasingly lighter blue. Very shallow water will often appear as the material present in the bottom of the stream. For example, a very shallow stream with a sandy bottom will appear white due to the high level of reflection of the sand.

Orthophotography has a +/- 4.0 ft. horizontal accuracy at 95% confidence level, National Standard for Spatial Data Accuracy (NSSDA), for a 1.0 foot Ground Resolution Distance (GRD). Horizontal accuracy determined as 1.7308 times the RMSE circular error. This requirement will not be applicable in areas where the ground is obscured on the aerial photography by foliage, prevalent smoke, or dense shadow

APPENDIX 3

Elevation Relief

Elevation Metrics (feet above mean sea level)

Mean	Minimum	Maximum
628.4	228.3	989.3

Elevation Range	Area (acres)	% Area
228.3 to 380.5	1940.3	14.6
380.5 to 532.7	2229.9	16.8
532.7 to 684.9	3438.3	25.9
684.9 to 837.1	3917.4	29.5
837.1 to 989.3	1753.4	13.2

APPENDIX 4

Bedrock Geology

Symbol	Geology	Description	Area	%
Sedimentary				
Cl	Leithsville Formation	dolomite, dolomitic sandstone, siltstone, and shale	262.5	2.0
Obl	Lower Part	dolomite and minor limestone	333.5	2.5
Obu	Upper Part	dolomite and minor limestone	104.4	0.8
OCa	Allentown Dolomite	dolomite, and less abundant quartzite and shale	1851.4	13.9
Oj	Jacksonburg Limestone	shaly limestone, arenaceous limestone, and dolomite-cobble	20.7	0.2
Omb	Bushkill Member	shale, slate, less abundant siltstone, and minor dolomite lens	49.4	0.4
Ow	Wantage Sequence	limestone, dolomite, conglomerate, siltstone, and shale	15.1	0.1
			2637.1	19.9
Crystalline				
Ya	Amphibolite	amphibolite, fine- to medium-grained	574.9	4.3
Yam	Migmatite	mixed amphibolite and gneiss	1180.9	8.9
Yb	Biotite-Quartz-Feldspar Gneiss	gneiss, fine- to coarse-grained	100.1	0.8
Yba	Microperthite Alaskite	granite, medium- to coarse-grained	224.5	1.7
Ybh	Hornblende Granite	granite, medium- to coarse-grained	1197.2	9.0
Yd	Diorite	Diorite	12.8	0.1
Yh	Hypersthene-Quartz-Oligoclase Gneiss	gneiss, medium-grained	38.2	0.3
Yla	Albite-Oligoclase Granite	granite, medium- to coarse-grained	265.3	2.0
Ylo	Quartz-Oligoclase Gneiss	gneiss, medium- to coarse-grained	5284.0	39.8
Ymp	Clinopyroxene-Quartz-Feldspar Gneiss	gneiss, fine- to medium-grained	142.0	1.1
Yp	Pyroxene Gneiss	gneiss, fine- to medium-grained	279.2	2.1
Ypa	Pyroxene Alaskite	granite, medium- to coarse-grained	170.8	1.3
Ypg	Pyroxene Granite	granite, medium- to coarse-grained	1128.3	8.5
Yps	Pyroxene Syenite	syenite and quartz syenite, medium- to coarse-grained	44.6	0.3
			10642.8	80.1

APPENDIX 5

NRCS Soils

SSURGO SOILS

SYMBOL	SOIL SERIES	MUNAME	Area	%
AnoB	ANNANDALE	Annandale gravelly loam, 3 to 8 percent slopes	59.16	0.45
AnoC2	ANNANDALE	Annandale gravelly loam, 8 to 15 percent slopes, eroded	26.51	0.20
BhnA	BIRDSBORO	Birdsboro silt loam, 0 to 3 percent slopes	25.19	0.19
BhnB	BIRDSBORO	Birdsboro silt loam, 3 to 8 percent slopes	120.18	0.91
CakA	CALIFON	Califon loam, 0 to 3 percent slopes	69.48	0.52
CakB	CALIFON	Califon loam, 3 to 8 percent slopes	374.08	2.82
CakBb	CALIFON	Califon loam, 0 to 8 percent slopes, very stony	618.12	4.66
ChcB	CHALFONT	Chalfont silt loam, 3 to 8 percent slopes	22.27	0.17
CoaA	COKESBURY	Cokesbury loam, 0 to 3 percent slopes	100.96	0.76
CoaBb	COKESBURY	Cokesbury loam, 0 to 8 percent slopes, very stony	197.73	1.49
DufB	DUFFIELD	Duffield silt loam, 3 to 8 percent slopes	578.85	4.36
DufC2	DUFFIELD	Duffield silt loam, 8 to 15 percent slopes, eroded	175.35	1.32
DugCg	DUFFIELD	Duffield silt loam, 0 to 15 percent slopes, rocky	66.60	0.50
DugDh	DUFFIELD	Duffield silt loam, 15 to 25 percent slopes, very rocky	95.13	0.72
EdnB	EDNEYVILLE	Edneyville gravelly loam, 3 to 8 percent slopes	1479.83	11.15
EdnC2	EDNEYVILLE	Edneyville gravelly loam, 8 to 15 percent slopes, eroded	1577.52	11.88
EdnD	EDNEYVILLE	Edneyville gravelly loam, 15 to 25 percent slopes	336.80	2.54
EDPCC	EDNEYVILLE	Edneyville and Parker loams, 8 to 15 percent slopes, extremely stony	1289.98	9.72
Fmh	ALLUVIAL LAND	Fluvaquents, loamy	1.33	0.01
FN	ALLUVIAL LAND	Fluvaquents and Udifluvents	226.78	1.71
LbtB	LANSDOWNE	Lansdowne silt loam, 3 to 8 percent slopes	37.05	0.28
ParC	PARKER	Parker cobbly loam, 3 to 15 percent slopes	1559.88	11.75
ParD	PARKER	Parker cobbly loam, 15 to 25 percent slopes	562.85	4.24
PHF	PITS, GRAVEL	Pits, gravel	39.08	0.29
RarA	RARITAN	Raritan silt loam, 0 to 3 percent slopes	41.19	0.31
STBF	STEEP STONY LAND, PA	Steep stony land, Parker material	2829.80	21.32
TurB	TURBOTVILLE	Turbotville loam, 3 to 8 percent slopes	75.61	0.57
WadB	WASHINGTON	Washington loam, 3 to 8 percent slopes	596.20	4.49
WadC2	WASHINGTON	Washington loam, 8 to 15 percent slopes, eroded	54.74	0.41
WATER	WATER	Water	35.88	0.27

SOIL ASSOCIATIONS

		%
RBR	Rowland-Birdsboro-Raritan Association	3.12
DW	Duffield-Washington Association	12.54
PEC	Parker-Edneyville-Califon Association	84.06

APPENDIX 5

NRCS Soils Series Descriptions

ALLUVIAL LAND – Alluvial land is on flood plains and is subject to frequent overflow. The material is so variable that a representative profile cannot readily be selected.

ANNANDALE –Consists of deep, gently sloping to strongly sloping, well-drained, loamy soils that formed in old glacial drift or colluvium of highly weathered granitic gneiss. Angular fragments of gneiss, as much as 2 feet in diameter, make up as much as 25 % of the profile. In the landscape these soils occupy high positions.

BIRDSBORO –Consists of deep, nearly level to strongly sloping, well-drained soils that have a stratified sandy or gravelly substratum. These soils formed in deposits of mostly silt loam alluvium derived from material weathered mainly from shale and sandstone. They are on stream terraces above the flood level of the Raritan River and other smaller streams.

CALIFON – Consists of deep, nearly level to gently sloping, moderately well drained to somewhat poorly drained soils. They have a mottled clayey subsoil that is gravelly in places. These soils formed in gneissic glacial till or colluvium. They are on upland flats and concave slopes in the Highlands.

CHALFONT – Consists of deep, nearly level to strongly sloping, somewhat poorly drained, loamy soils that have a fragipan in the lower part of the subsoil.

COKESBURY – Consists of deep, nearly level to gently sloping, poorly drained, loamy soils that formed in material weathered from gneissic rock.

DUFFIELD – Consists of deep, gently sloping to moderately steep, well-drained soils that formed over limestone or limey shale. These soils have many shallow depressions and a few moderately deep, closed depressions.

EDNEYVILLE – Consists of deep, gently sloping to steep, well-drained, gravelly soils that formed over granite gneiss bedrock.

LANSDOWNE – Consists of deep, nearly level to gently sloping, moderately well-drained to somewhat poorly drained soils. These soils formed in material weathered from old, red, shaly glacial till.

PARKER – Consists of deep, gently sloping to steep, somewhat excessively drained, gravelly or cobbly soils that formed in material weathered from granite gneiss. They occur on uplands and are underlain by gneiss bedrock.

PITS, GRAVEL – Former or current pits used for surface mining of gravel and fine stones.

RARITAN – Consists of deep, nearly level to gently sloping, and moderately well drained to somewhat poorly drained soils. These soils formed in deposits of old alluvium derived from material weathered mainly from shale and sandstone. They are on stream terraces above the flood plain. Where these soils are on low terraces along streams, overflow occurs less than 1 year in 5.

STEEP STONY LAND, PARKER MATERIAL – On the surface, stones of gneiss larger than 10 inches in diameter and 3 to 5 feet apart. The soil between the stones is similar to Parker soils. Slopes are 18 to 40 percent. Included are areas where stones may be as much as 30 feet apart. Also included are areas of soil similar to Edneyville soils, but indistinguishable from Parker soils in mapping because of the many stones. In other areas most of the stones have been removed from the surface, but below the surface layer stones make up more than 15 percent of the profile. Most of the surface is cobbly and gravelly.

TURBOTVILLE – Consists of deep, gently sloping, and somewhat poorly drained soils. These soils formed in deposits of old glacial drift. They contain gneiss and limestone fragments.

WASHINGTON – Consists of deep, gently sloping to strongly sloping, well-drained soils. They formed in glacial drift that contained large amounts of limestone and gneiss and chert gravel.

APPENDIX 6

Erodible Soils

Highly Erodible Soils		Area	%
AnoC2	Annandale gravelly loam, 8 to 15 percent slopes, eroded	26.51	0.20
DugDh	Duffield silt loam, 15 to 25 percent slopes, very rocky	95.13	0.72
EdnC2	Edneyville gravelly loam, 8 to 15 percent slopes, eroded	1577.52	11.88
EdnD	Edneyville gravelly loam, 15 to 25 percent slopes	336.80	2.54
ParD	Parker cobbly loam, 15 to 25 percent slopes	562.85	4.24
STBF	Steep stony land, Parker material	2829.80	21.31
WATER	Water	35.88	0.27
Total		5464.50	41.17

Potentially Highly Erodible Soils		Area	%
AnoB	Annandale gravelly loam, 3 to 8 percent slopes	59.16	0.45
BhnB	Birdsboro silt loam, 3 to 8 percent slopes	120.18	0.90
CakB	Califon loam, 3 to 8 percent slopes	374.08	2.82
CakBb	Califon loam, 0 to 8 percent slopes, very stony	618.12	4.65
ChcB	Chalfont silt loam, 3 to 8 percent slopes	22.27	0.17
DufB	Duffield silt loam, 3 to 8 percent slopes	578.85	4.36
DufC2	Duffield silt loam, 8 to 15 percent slopes, eroded	175.35	1.32
DugCg	Duffield silt loam, 0 to 15 percent slopes, rocky	66.60	0.50
EdnB	Edneyville gravelly loam, 3 to 8 percent slopes	1479.83	11.14
EDPCC	Edneyville and Parker loams, 8 to 15 percent slopes, extremely stony	1289.98	9.71
LbtB	Lansdowne silt loam, 3 to 8 percent slopes	37.05	0.28
ParC	Parker cobbly loam, 3 to 15 percent slopes	1559.88	11.75
TurB	Turbotville loam, 3 to 8 percent slopes	75.61	0.57
WadB	Washington loam, 3 to 8 percent slopes	596.20	4.49
WadC2	Washington loam, 8 to 15 percent slopes, eroded	54.74	0.41
Total		7107.90	53.55

Not Highly Erodible Soils		Area	%
BhnA	Birdsboro silt loam, 0 to 3 percent slopes	25.19	0.19
CakA	Califon loam, 0 to 3 percent slopes	69.48	0.52
CoaA	Cokesbury loam, 0 to 3 percent slopes	100.96	0.76
CoaBb	Cokesbury loam, 0 to 8 percent slopes, very stony	197.73	1.49
Fmh	Fluvaquents, loamy	1.33	0.01
FN	Fluvaquents and Udifluvents	226.78	1.71
PHF	Pits, gravel	39.08	0.29
RarA	Raritan silt loam, 0 to 3 percent slopes	41.19	0.31
Total		701.74	5.29

APPENDIX 7

Important Soils of New Jersey

Prime Farmland Soils		Area	% Area
AnoB	Annandale gravelly loam, 3 to 8 percent slopes	52.20	0.39
BhnA	Birdsboro silt loam, 0 to 3 percent slopes	25.19	0.19
BhnB	Birdsboro silt loam, 3 to 8 percent slopes	120.18	0.90
CakA	Califon loam, 0 to 3 percent slopes	62.30	0.47
CakB	Califon loam, 3 to 8 percent slopes	300.47	2.26
DufB	Duffield silt loam, 3 to 8 percent slopes	578.85	4.36
EdnB	Edneyville gravelly loam, 3 to 8 percent slopes	1256.87	9.46
RarA	Raritan silt loam, 0 to 3 percent slopes	41.19	0.31
TurB	Turbotville loam, 3 to 8 percent slopes	68.32	0.51
WadB	Washington loam, 3 to 8 percent slopes	560.67	4.22
Total		3066.25	23.09

Statewide Important Soils		Area	% Area
AnoC2	Annandale gravelly loam, 8 to 15 percent slopes, eroded	26.51	0.20
ChcB	Chalfont silt loam, 3 to 8 percent slopes	22.27	0.17
DufC2	Duffield silt loam, 8 to 15 percent slopes, eroded	175.35	1.32
EdnC2	Edneyville gravelly loam, 8 to 15 percent slopes, eroded	1577.52	11.88
ParC	Parker cobbly loam, 3 to 15 percent slopes	1559.88	11.75
WadC2	Washington loam, 8 to 15 percent slopes, eroded	54.74	0.41
Total		3416.26	25.73

APPENDIX 8

Slope Analysis

Slope Percent Interval	Area (acres)	%
0% - 4.99%	3,003.80	22.62
5% - 9.99%	3,691.34	27.80
10% - 14.99%	2,429.96	18.30
15% - 19.99%	1,625.85	12.24
20% - 24.99%	1,105.78	8.33
25% - 29.99%	652.39	4.91
30% - 34.99%	352.81	2.66
35% - 39.99%	188.15	1.42
40% - 44.99%	98.62	0.74
45% - 49.99%	61.74	0.46
> 50%	67.98	0.51
Total	13,279.87	100.00

APPENDIX 9

Streams and Wetlands

LU95	TYPE95	LABEL95	Acres	% Area
1461	WETLANDS	WETLAND RIGHTS-OF-WAY (MODIFIED)	4.90	0.72
1750	WETLANDS	MANAGED WETLAND IN MAINTAINED LAWN GREENSPACE	4.29	0.63
2140	WETLANDS	AGRICULTURAL WETLANDS (MODIFIED)	113.01	16.61
2150	WETLANDS	FORMER AGRICULTURAL WETLAND-BECOMING SHRUBBY, NOT BUILT-UP)	11.64	1.71
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	459.76	67.59
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	61.67	9.07
6240	WETLANDS	HERBACEOUS WETLANDS	20.70	3.04
7430	WETLANDS	DISTURBED WETLANDS (MODIFIED)	4.29	0.63
TOTAL			680.26	5.12

APPENDIX 10

Surface Water Quality Standards of New Jersey

Anti-Degradation Classification	Linear Stream Miles
Category One	19.45
Category Two	1.67

Stream/Tributary	Class	Trout	C-1/C-2	Category
Spruce Run (Alpaugh Brook)	FW2	TP	C-1	FW2-TP (C-1)
Black Brook Creek	FW2	TP	C-1	FW2-TP (C-1)
Mulhockaway Creek	FW2	TP	C-1	FW2-TP (C-1)
Norton Brook	FW2	TP	C-1	FW2-TP (C-1)
Turkey Hill Brook	FW2	TP	C-1	FW2-TP (C-1)
West Portal Creek	FW2	TP	C-1	FW2-TP (C-1)
Spruce Run Unnamed Tributary	FW2	TM	C-1	FW2-TM (C-1)
Musconetcong River (Jaynes Brook)	FW2	TM	C-2	FW2-TM (C-2)
Musconetcong River	FW2	TM	C-2	FW2-TM (C-2)

Stream/Tributary	Category	Buffer
Spruce Run (Alpaugh Brook)	FW2-TP (C-1)	300'
Black Brook Creek	FW2-TP (C-1)	300'
Mulhockaway Creek	FW2-TP (C-1)	300'
Norton Brook	FW2-TP (C-1)	300'
Turkey Hill Brook	FW2-TP (C-1)	300'
West Portal Creek	FW2-TP (C-1)	300'
Spruce Run Unnamed Tributary	FW2-TM (C-1)	300'
Musconetcong River (Jaynes Brook)	FW2-TM (C-2)	300'
Musconetcong River	FW2-TM (C-2)	300'

APPENDIX 11

FEMA Floodplains

FLOOD ZONE	LABEL	AREA	% AREA
A	Within 100 Year Flood Zone, no Base Flood Elevation determination	161.03	1.21
AE	Within 100 Year Flood Zone, Base Flood Elevation determined	156.93	1.18
X500	Within 500 Year Flood Zone	49.94	0.38
X	Areas Outside of Flood Zone	12905.69	97.23

APPENDIX 12

Groundwater Recharge Areas

Groundwater Recharge Rates

inches per year	Rank	Area	% Area
17 to 23	A	385.75	2.90
13 to 16	B	11172.05	84.13
10 to 12	C	283.96	2.14
1 to 9	D	210.28	1.58
Hydric Soils	L	541.23	4.08
Wetlands and Open Waters	W	686.65	5.17

Associated Soil Types

SERIES	SYMBOL	Ranks					
ALLUVIAL LAND	Ac	L	W				
ANNANDALE	AnB	B	C				
ANNANDALE	AnC2	W					
BIRDSBORO	BdA	B					
BIRDSBORO	BdB	B	W				
CALIFON	CaA	B	W				
CALIFON	CaB	B	C	W			
CALIFON	CbB	B	C	D	W		
CHALFONT	CdB	B	C				
COKESBURY	Co	L	W				
COKESBURY	Cp	L	W				
DUFFIELD	DuB	B					
DUFFIELD	DuC2	B					
DUFFIELD	DvC2	B					
DUFFIELD	DwD2	A	B	W			
EDNEYVILLE	EdB	A	B	C	D	W	
EDNEYVILLE	EdC2	A	B	C	D	W	
EDNEYVILLE	EdD	A	B	C	W		
EDNEYVILLE-PARKER	EeC	A	B	D			
PITS, SAND AND GRAVEL	GP	A	B	D			
LANSDOWNE	LbB	B					
PARKER	PaC	A	B	D	L	W	
PARKER	PaD	A	B	L			
RARITAN	RbA	C					
STEEP STONY LAND, PARKER	SpF	A	B	D			
TURBOTVILLE	TuB	C	W				
WATER	W	W					
WASHINGTON	WaB	B	C	D	W		
WASHINGTON	WaC2	B	W				

APPENDIX 13
Vernal Pool Locations

ID	Date	Comments
8	03/31/03	Wood Frog- eggs & Spotted Salamander- eggs, spermatophores, adult
11	04/02/03	Wood Frog- eggs
12	01/19/03, 03/27/03	Spotted Salamander- eggs
13	02/03/03, 04/02/03	Wood Frog- eggs & Spotted Salamander- eggs
14	2/2/2003	No Information
15	03/27/03, 02/03/03	Wood Frog- eggs, adult
21	4/3/03	No Information
23	03/26/03	Wood Frog- eggs & Spotted Salamander- eggs
24	03/26/03	Wood Frog- eggs & Spotted Salamander- eggs
27	4/01/02	Wood Frog- adults
31	03/31/03	Wood Frog- eggs & Spotted Salamander- eggs, spermatophores
32	03/28/03	Wood Frog- eggs
33	03/28/03	Wood Frog- eggs & Spotted Salamander- eggs
34	03/28/03	Wood Frog- eggs & Spotted Salamander- spermatophore
35	03/28/03	Wood Frog- eggs
36	03/28/03	Wood Frog- eggs, adult & Spotted Salamander-eggs, spermatophores
38	04/03/03	Spotted Salamander- eggs & Spring Peeper- adults
48	12/18/02, 03/25/03	Wood Frog-eggs, adult & Spotted Salamander- eggs
49	12/18/02,03/25/03	Wood Frog- eggs & Spotted Salamander- eggs
50	12/18/02, 03/25/03	Wood Frog- eggs & Spotted Salamander- eggs
51	12/18/02, 03/25/03	Wood Frog- eggs, adult & Spotted Salamander-eggs, spermatophores
53	04/03/03	Spotted Salamander- eggs & Eastern Newt- adults
58	4/1/2002	Wood Frog- adults
59	01/22/03, 04/03/02	Wood Frog- eggs & Spotted Salamander- eggs
60	03/28/03	Wood Frog- eggs, adult & Spotted Salamander-eggs, spermatophores
64	03/28/03	Wood Frog- eggs
65	03/28/03	Wood Frog- eggs
66	03/27/03	Wood Frog- eggs, adult & Common Snapping Turtle- adult
67	03/27/03	Wood Frog- eggs, adult & Spotted Salamander-eggs, spermatophores
68	03/27/03	Wood Frog- eggs, adult & Spotted Salamander-eggs, spermatophores
69	03/25/03	Wood Frog- eggs, adults
70	03/25/03	Wood Frog- eggs, adult & Spotted Salamander-eggs, spermatophores & Spring Peeper- adult
71	03/28/03	Wood Frog- eggs & Spotted Salamander- eggs
72	03/25/03	Wood Frog- adult
73	03/25/03	Wood Frog- eggs
74	03/25/03	Wood Frog- eggs & Spotted Salamander- eggs
75	03/31/03	Wood Frog- eggs & Spotted Salamander- eggs
76	03/31/03	Wood Frog- eggs
78	03/27/03	Wood Frog- eggs, adult & Spotted Salamander-eggs, spermatophores
79	03/27/03	Wood Frog- eggs & Spotted Salamander- eggs
80	03/31/03	Wood Frog- eggs
81	04/02/03	Wood Frog- eggs, adults
82	04/02/03	Wood Frog- eggs, adults
83	04/02/03	Wood Frog- eggs & Spotted Salamander- eggs
x	2005	5 more sites certified in 2005

APPENDIX 14
Land Use / Land Cover

LU95	TYPE95	LABEL95	Acres	% Area
1110	URBAN	RESIDENTIAL, HIGH DENSITY, MULTIPLE DWELLING	0.31	0.00
1120	URBAN	RESIDENTIAL, SINGLE UNIT, MEDIUM DENSITY	10.69	0.08
1130	URBAN	RESIDENTIAL, SINGLE UNIT, LOW DENSITY	117.47	0.88
1140	URBAN	RESIDENTIAL, RURAL, SINGLE UNIT	1644.77	12.39
1200	URBAN	COMMERCIAL/SERVICES	44.07	0.33
1300	URBAN	INDUSTRIAL	33.67	0.25
1400	URBAN	TRANSPORTATION/COMMUNICATIONS/UTILITIES	263.30	1.98
1461	WETLANDS	WETLAND RIGHTS-OF-WAY (MODIFIED)	4.90	0.04
1700	URBAN	OTHER URBAN OR BUILT-UP LAND	139.39	1.05
1750	WETLANDS	MANAGED WETLAND IN MAINTAINED LAWN GREENSPACE	4.29	0.03
1800	URBAN	RECREATIONAL LAND	16.05	0.12
1804	URBAN	ATHLETIC FIELDS (SCHOOLS)	12.11	0.09
2100	AGRICULTURE	CROPLAND AND PASTURELAND	3230.52	24.33
2140	WETLANDS	AGRICULTURAL WETLANDS (MODIFIED)	113.01	0.85
2150	WETLANDS	FORMER AGRICULTURAL WETLAND-BECOMING SHRUBBY, NOT BUILT-UP)	11.64	0.09
2200	AGRICULTURE	ORCHARDS/VINEYARDS/NURSERIES/HORTICULTURAL AREAS	80.41	0.61
2400	AGRICULTURE	OTHER AGRICULTURE	106.04	0.80
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	208.23	1.57
4120	FOREST	DECIDUOUS FOREST (>50% CROWN CLOSURE)	5747.58	43.28
4220	FOREST	CONIFEROUS FOREST (>50% CROWN CLOSURE)	13.42	0.10
4230	FOREST	PLANTATION	10.61	0.08
4312	FOREST	MIXED FOREST (>50% CONIFEROUS WITH >50% CROWN CLOSURE)	25.85	0.19
4321	FOREST	MIXED FOREST (>50% DECIDUOUS WITH 10-50% CROWN CLOSURE)	2.70	0.02
4322	FOREST	MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN CLOSURE)	18.17	0.14
4410	FOREST	OLD FIELD (< 25% BRUSH COVERED)	284.98	2.15
4420	FOREST	DECIDUOUS BRUSH/SHRUBLAND	324.31	2.44
4430	FOREST	CONIFEROUS BRUSH/SHRUBLAND	41.21	0.31
4440	FOREST	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	140.97	1.06
5100	WATER	STREAMS AND CANALS	19.12	0.14
5300	WATER	ARTIFICIAL LAKES	11.54	0.09
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	459.76	3.46
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	61.67	0.46
6240	WETLANDS	HERBACEOUS WETLANDS	20.70	0.16
7300	BARREN LAND	EXTRACTIVE MINING	19.21	0.14
7430	WETLANDS	DISTURBED WETLANDS (MODIFIED)	4.29	0.03
7500	BARREN LAND	TRANSITIONAL AREAS	32.96	0.25
			13279.93	100.00

TYPE95	Area (acres)	% Area
AGRICULTURE	3416.9	25.7
BARREN LAND	52.2	0.4
FOREST	6818.0	51.3
URBAN	2281.8	17.2
WATER	30.6	0.2
WETLANDS	680.2	5.1
TOTAL	13279.7	100.0

APPENDIX 15

Wetland Forests

LU95	LABEL95	Area (ac)	% Area
6210	DECIDUOUS WOODED WETLANDS	459.76	88.17
6231	DECIDUOUS SCRUB/SHRUB WETLANDS	61.67	11.83
TOTAL		521.42	3.93

APPENDIX 16

Upland Forests

LU95	LABEL95	Area (ac)	% Area
4110	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	208.23	3.05
4120	DECIDUOUS FOREST (>50% CROWN CLOSURE)	5747.58	84.30
4220	CONIFEROUS FOREST (>50% CROWN CLOSURE)	13.42	0.20
4230	PLANTATION	10.61	0.16
4312	MIXED FOREST (>50% CONIFEROUS WITH >50% CROWN CLOSURE)	25.85	0.38
4321	MIXED FOREST (>50% DECIDUOUS WITH 10-50% CROWN CLOSURE)	2.70	0.04
4322	MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN CLOSURE)	18.17	0.27
4410	OLD FIELD (< 25% BRUSH COVERED)	284.98	4.18
4420	DECIDUOUS BRUSH/SHRUBLAND	324.31	4.76
4430	CONIFEROUS BRUSH/SHRUBLAND	41.21	0.60
4440	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	140.97	2.07
TOTAL		6818.03	51.34
MIXED and CONIFEROUS FOREST		242.31	3.55

APPENDIX 17
Open Space and Farmland Preservation

Section / Description	Area	Block/Lot	Ownership	Acreage In Township
	State Owned Land			
	Route 614	Block 10 Lot 2	State of New Jersey	52.7
	River Road	Block 42 Lot 1 Block 42 Lot 16 Block 42 Lot 16.01 Block 42 Lot 16.02	State of New Jersey	117.46
Section 6.2.1	Grand Lands – Green Acres	Block 42 Lot 18	State of New Jersey	154
	Iron Bridge Road	Block 43 Lot 8 Block 43 Lot 13 Block 43 Lot 47	State of New Jersey	68.34
Section 6.2.2	Spruce Run/Clinton Wildlife Management Area	Block 48 Lot 6 Block 48 Lot 7	State of New Jersey	116.31
	*Thomas Road	Block 48 Lot 26	State of New Jersey	56.9
	*South Polktown Road	Block 48 Lot 27	State of New Jersey	16.2
	*South Polktown Road	Block 48 Lot 28	State of New Jersey	42.71
	South Polktown Road	Block 48 Lot 41	State of New Jersey	22.9
	Route 31	Block 48 Lot 62	State of New Jersey	37.08
			State Owned Land Subtotal	227 / 684.6
	County Owned Land			
	Staats Road	Block 1 Lot 1, Block 1 Lot 2, Block 2 Lot 1, Block 2 Lot 2	Hunterdon County	35
Section 6.3.3	Jugtown Mountain Park	Block 32 Lot 50 Block 32 Lot 54 Block 32 Lot 55 Block 33 Lot 43, Block 37 Lot 14, Block 37 Lot 15	Hunterdon County	341.17
Section 6.3.2	Tower Hill Park	Block 33 Lot 36 Block 37 Lot 22	Hunterdon County	82.3
	Iron Bridge Road	Block 39 Lot 7	Hunterdon County	20
	Mine Road	Block 39 Lot 18.19	Hunterdon County	39.64
	Haven Hill Lane	Block 43 Lot 14	Hunterdon County	12.05
Section 6.3.1	Charlestown	Block 43 Lot 14.02,	Hunterdon County	240.25

Environmental Resource Inventory (ERI)
Township of Bethlehem
Hunterdon County, New Jersey

	Reserve	Block 43 Lot 42 Block 43 Lot 43 Block 43 Lot 44		
			County Owned Land Subtotal	368 / 730.77
	Township Owned Land			
	*Turkey Hill Road	Block 6 Lot 13	Bethlehem Township	97.27
	Turkey Hill Road	Block 5 Lot 39.01	Bethlehem Township	14.87
	Turkey Hill Road	Block 6 Lot 2	Bethlehem Township	38.49
Section 6.4.1	Heritage Park	Block 26 Lot 2 Block 26 Lot 4	Bethlehem Township	265
	*Fox Farm Road	Block 33 Lot 17	Bethlehem Township	47.78
	*Fox Farm Road	Block 33 Lot 19	Bethlehem Township	51.8
	*Mine Road	Block 33 Lot 47	Bethlehem Township	10.4
	*Norton Church	Block 35 Lot 7	Bethlehem Township	46.43
	*Norton Church	Block 37 Lot 4	Bethlehem Township	47.76
Section 6.4.2	Creveling Park	Block 40 Lot 1	Bethlehem Township	32
Section 6.4.3	The Bog	Block 44 Lot 11	Bethlehem Township	37
			Township Owned Land Subtotal	334 / 340.93
	Bethlehem Township Public Owned Land			
	Municipal Building / Brunswick Pike	Block 27 Lot 14	Bethlehem Township	0.09
	Municipal Building / Mine Road	Block 33 Lot 9	Bethlehem Township	7
			Township Owned Land Subtotal	7.09 / 7.09
	Bethlehem Township Board of Education Owned Land			
Section 6.5	Ethel Hoppock School	Block 27 Lot 9	Board of Education	9
Section 6.5	Thomas Conley School	Block 43 Lot 4	Board of Education	28
			Subtotal Board of Education Owned Land	37
			Total Publicly Owned Land	973 / 1846.82
	* Pending	Acreage not included in totals		417.25

APPENDIX 17
Open Space and Farmland Preservation

Community Owned Lands Area	Block/Lot	Owner	Acreage In Bethlehem Township
NJ Audubon Society Tunnel Road	Block 6 Lot 14 Block 7 Lot 1 Block 8 Lot 3	New Jersey Audubon Society	63
Pacesetter at Bellwood	Block 8 Lot 12	Pacesetter at Bellwood	40.17
Hunterdon Woods	Block 8 Lot 19.09	Hunterdon Woods	3.48
Warren County Rod & Gun Club	Block 26 Lot 4.02	Warren County Rod & Gun Club	36.42
Fox Farm Road	Block 34 Lot 17	Victorian Estates	17.18
Fox Farm Community Assoc.	Block 34 Lot 19 Block 34 Lot 19.09 Block 34.Lot 01 3 Block 34.Lot 02 1 Block 34 Lot 02 10	The Woods at Fox Farm Community Association	75
Hickory Ridge Estates	Block 37 Lot 9, Block 37 Lot 9.07, Block 37 Lot 9.18, Block 37 Lot 9.20, Block 37 Lot 9.35	Hickory Ridge Estates, Inc.	57
Stonebridge Homeowners Association, Inc. Mine Road	Block 39 Lot 13.04	Stone Bridge Homeowners Association, Inc.	15
Valley View Homeowners Association Thomas Road	Block 47 Lot 4.01, Block 47 Lot 4.15	Valley View Homeowners Association	90.98
Rolling Green Development	Block 44 Lot 7.01, Block 44 Lot 7.21 Block 44 Lot 22 Block 48 Lot 24	Homeowners Association	46.8
Mine Road	Block 37 Lot 28	NJWSA	59.61
Conservation Easements			
Staats Road	Block 2 Lot 5.01	Easement	6.04
Turkey Hill Road	Block 5 Lot 51	Easement	31.46
Tunnel Road	Block 8 Lot 5	Green Acres	31.35
Route 579	Block 8 Lot 10, Block 8 Lot 10.02	Green Acres	127.83
Stony Brook Lane	Block 39 Lot 20	Private	4.93
		Total Acreage	291.4 / 625.25

APPENDIX 17

Open Space and Farmland Preservation

Farmland Preservation			
Area	Block/Lot	Ownership	Acreage In Township
Route 614	Block 6 Lot 20	Jogn Delaney	21.3
Route 614	Block 8 Lot 21	Richard Ravenburg	2.3
Bellwood	Block 10 Lot 4	Richard Ravenburg	1.4
Person Road	Block 25 Lot 5	John Parisi	54.8
Person Road	Block 26 Lot 1	Margarete Hajdu	109.19
D Hull Lane	Block 26 Lot 5	Eloise Hagaman	49.47
Asbury – West Portal	Block 27 Lot 4	Jeffrey Modica	58
Route 173	Block 27 Lot 8	Eloise Hagaman	54.21
Beatty Tract	Block 29 Lot 11, Block 30 Lot 2	Bernard & Sharon Beatty	157
Huff Farm	Block 30 Lot 1	Edward & Linda Huff	119
Hidden River Horse Farm	Block 30 Lot 3	Hidden River Farm	152
Cotton Parcel 2	Block 30 Lot 4	Asbury Farms, Inc. c/o Richard Cotton	84
Cotton Parcel 1	Block 30 Lot 5	Asbury Farms, Inc. c/o Richard Cotton	125
Beboer Farm Lane	Block 30 Lot 4.01	Mark Canwright	33.17
Asbury – West Portal	Block 30 Lot 10	Karl Barger	5.75
Asbury – west Portal	Block 32 Lot 5	Jeffrey Modica	25.46
Pheasant Ridge	Block 44 Lot 6	George Bunting	117.92
Hackett Road	Block 44 Lot 12	Richard Branche	57.3
Charlestown Road	Block 44 Lot 22	Troy Ennis	80.59
Charlestown Road	Block 44 Lot 22.03	Troy Ennis	6.99
		Total	637 / 1344.48
2005 Applications			

APPENDIX 17

Open Space and Farmland Preservation

Utilities			
Area	Block/Lot	Owner	Acreage In Bethlehem Township
1000 Route 173	Block 4 Lot 1.01	NJ DOT	2.32
Route 579	Block 5 Lots 1	Norfolk Southern RR	2.34
	Block 5 Lot 2.28	Bloomsbury Water	0.98
Bellwood Park	Block 9 Lots 4.01	Norfolk Southern	10.45
Bellwood Park	Block 10 Lot 1.01	Norfolk Southern	4.53
Bellwood Park	Block 11 Lot 1.01	Norfolk Southern	10.79
Bellwood Park	Block 12 Lot 6.01	Norfolk Southern	8.74
Route 173	Block 16 Lot 2	Norfolk Southern	1.8
Route 173	Block 18 Lot 1	NJ DOT	75
1000 Route 173	Block 24 Lot 1.01	NJ DOT	2.94
Asbury – West Portal	Block 31 Lot 12	NJ Transit	0.07
Mine Road	Block 33 Lot 44	TransContinental Gas	1.77
		Total Acreage	122.1

APPENDIX 18
Landscape Habitat and Natural Heritage Data
Landscape Project

Forest	Area (acres)
Priority	342.22
State Threatened	293.94
State Endangered	6661.18
Total	7297.34

Forested Wetland	
Suitable	224.59
Priority	252.22
State Threatened	0.65
Federal Threatened and Endangered	43.76
Total	521.23

Emergent Wetland	
Suitable	150.25
Total	150.25

Grassland	
Suitable	148.08
Priority Species	1315.44
State Endangered	1635.09
Total	3098.62

Listed Species Habitat	
Wood Turtle (State Threatened)	2337.77
Eagle (Federal Threatened & Endangered)	74.24

Natural Heritage Database

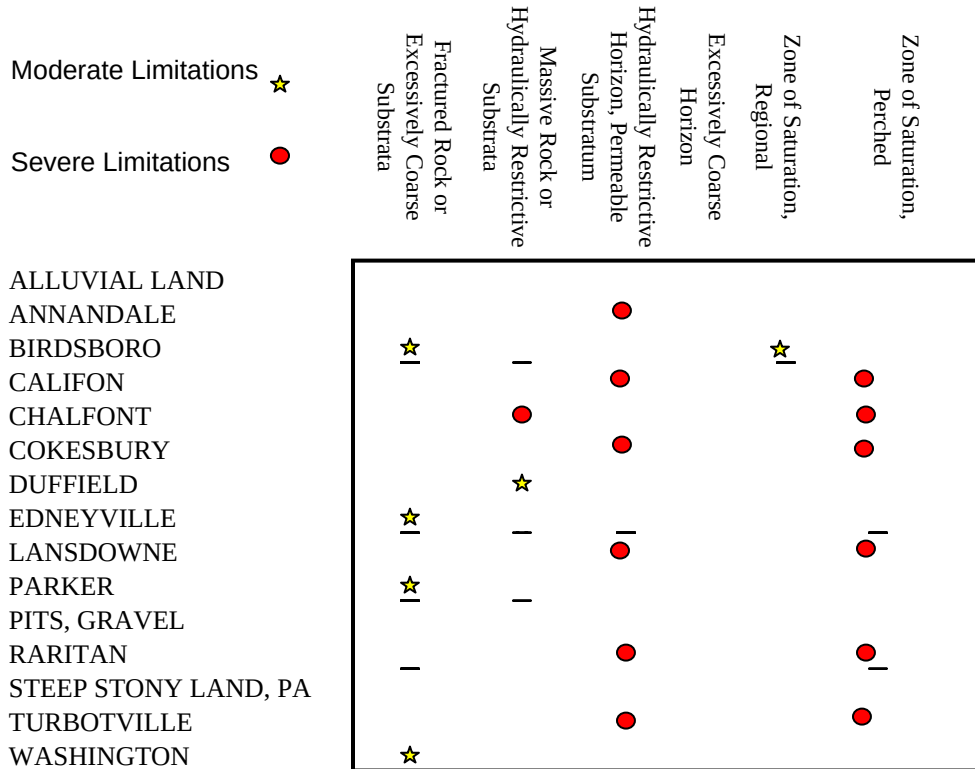
Natural Heritage Grid	Cells in Township
Both	1
M	0*
S	1
	* 5 within 1.5 miles

Natural Heritage Priority Sites	Area (acres)
Vinces Ravine	120.49

Links to Rare Species Lists
<http://www.state.nj.us/dep/fgw/tandespp.htm>
<http://www.nj.gov/dep/parksandforests/natural/heritage/rarelist.html>

APPENDIX 19

Septic Restrictions



Moderate Restrictions	Area	%
BIRDSBORO	145.4	1.1
DUFFIELD	915.9	6.9
EDNEYVILLE	4684.1	35.3
PARKER	2122.7	16.0
WASHINGTON	650.9	4.9
Total	8519.1	64.2

Severe Restrictions	Area	%
ANNANDALE	85.7	0.6
CALIFON	1061.7	8.0
CHALFONT	22.3	0.2
COKESBURY	298.7	2.2
LANSDOWNE	37.0	0.3
RARITAN	41.2	0.3
TURBOTVILLE	75.6	0.6
Total	1622.2	12.2

Undefined	Area	%
ALLUVIAL LAND	228.1	1.7
PITS, GRAVEL	39.1	0.3
STEEL STONY LAND, PA	2829.8	21.3
WATER	35.9	0.3
Total	3132.9	23.6

APPENDIX 20

Highlands Planning and Preservation Areas

Highlands Identification	Area	%
Highlands Preservation Area	12,142.8	91.4
Highlands Planning Area	1,137.1	8.6

APPENDIX 21

[State Plan Policy Map](#)

Planning Areas	Code	Area (acres)	%
Rural	PA4	7915.5	59.6
Environmentally Sensitive	PA5	5271.0	39.7
Parks and Natural Areas	Parks	92.5	0.7

APPENDIX 22

Spruce Run Initiative

Number of Criteria	Area (acres)
One	2,556.87
Two	2,851.10
Three	301.75
Four	32.93
Total	5,742.65

APPENDIX 23

Historic Features

Bethlehem Township			
ID	Site Name	Block	Lot
1	Stone Farmhouse	3	8
2	Frame Dwelling	5	2
3	Frame/Stone Dwelling	5	54
4	Bank Barn	6	15
5	Stoll-Beavers Farmstead	6	19
6	Jarrad House	6	41
7	Case Farmstead	9	6
8	Dwelling	25	1
9	Frame Dwelling	25	3
10	King-Allen Farmstead	25	4
11	Eckman-Willever Farmstead	26	2
12	Frame Dwelling (Demolished)	26	3
13	Large Farmstead	30	2
14	Drake Farmstead	30	3
15	Drake Farmhouse	30	4
16	Henderson Farmhouse	30	6
17	Richey-Vliet Dwelling	30	9
18	Large House	32	13
19	Bigler Farmhouse	32	33.1
20	Frame Dwelling	33	12
21	Evans Dwelling	33	29
22	Frame Dwelling	34	20
23	Henderson-Cole Dwelling	35	5
24	Norton Methodist Church	35	13
25	Stone/Frame Dwelling	36	18
26	Maxwell Farmstead	37	5
27	Wene Farmstead	37	15
28	Garrison Dwelling	37	38
29	Sherman Farmstead	39	13
30	Rodenbaugh Farmstead	39	18
31	McCullough-Henderson Farmstead	40	1
32	Stout-Hulsizer Farmstead	41	1
33	Dwelling	43	6
34	Bank Barn	43	15.6
35	Lake-Yard Farmstead	43	28.2
36	Reamer Farmstead	43	52
37	Moore Farmstead	44	7
38	Hull Stable	44	12
39	Davis House	47	2

APPENDIX 23

Historic Features

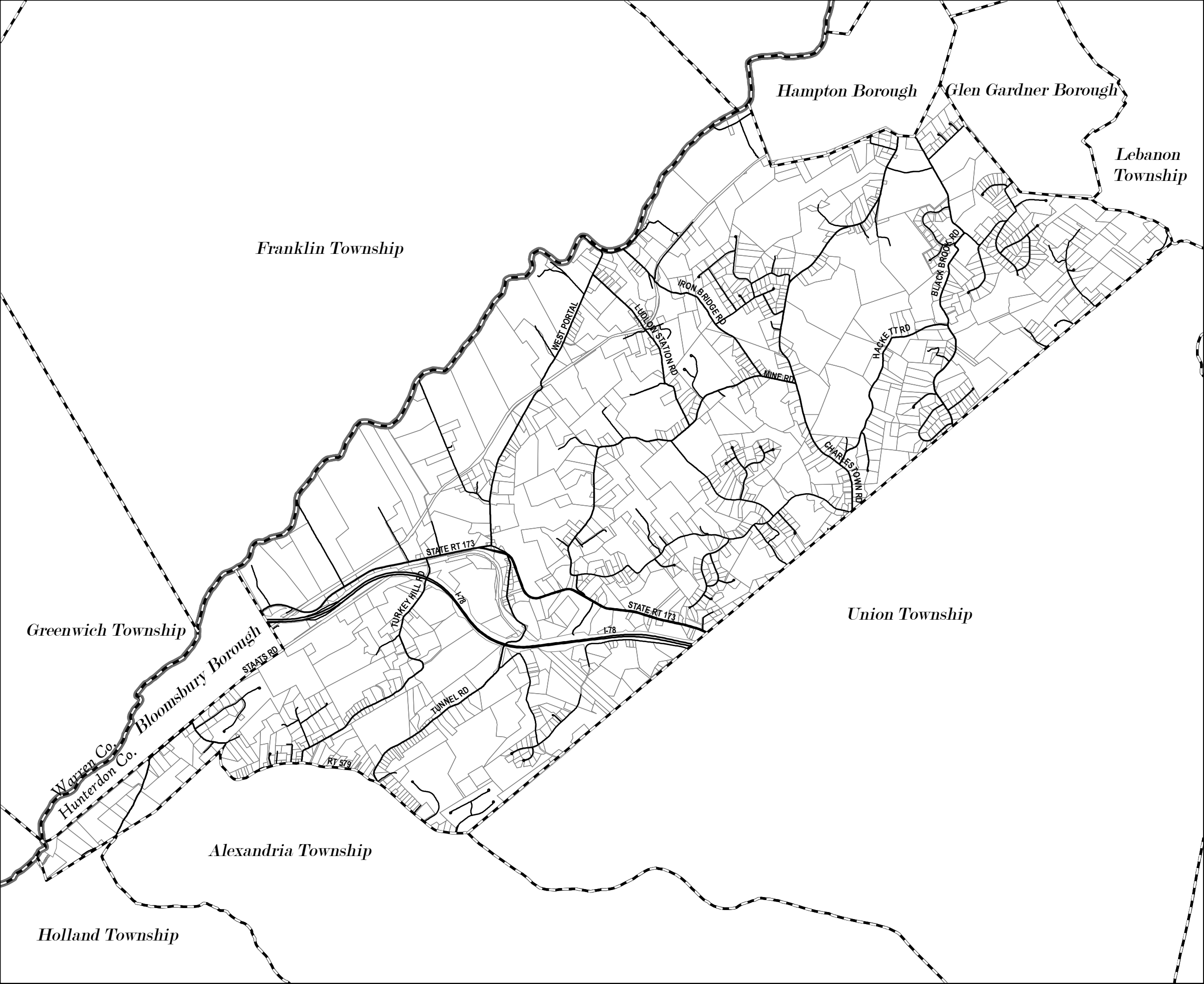
West Portal District			
ID	Site Name	Block	Lot
WP-1	Methodist Episcopal Church	14	2
WP-2		14	3
WP-3		14	4
WP-4		14	5
WP-5		14	10
WP-6		14	11
WP-7		16	5
WP-8		16	6
WP-9		16	7
WP-10		16	8
WP-11		16	9
WP-12		16	11
WP-13		16	13
WP-14		16	14
WP-15		16	15
WP-16	Smith Dwelling	16	16
WP-17	Elizabeth Shoemaker Dwelling	27	11
WP-18	John J. Shoemaker House	27	12
WP-19	Bethlehem Hotel	27	13
WP-20	Bethlehem Town Hall	27	14
WP-21	Bethlehem School House	29	7
WP-22	Frame Dwelling	29	8
WP-23	Duckworth Log Cabin	29	10
WP-24	Cornish Dwelling	32	6

Rail and Road	
ID	Site Name
10-RR	Raritan Valley RR over West Portal-Asbury Road
45-RR	Iron Bridge Road over Raritan Valley RR
46-RR	Lehigh Valley RR over Turkey Hill Road
8-RR	Milford Road over Lehigh Valley RR
B26W	Valley Station Road & Musconetcong River
B36	Valley Road & Musconetcong River
B5W	Ludlow Station Road & unnamed tributary
B8W	West Portal-Asbury Road & Musconetcong River

APPENDIX 23

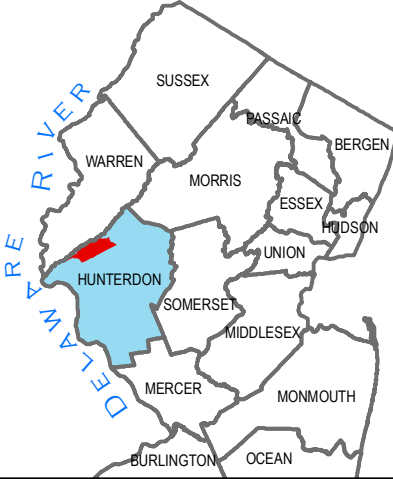
Historic Features

ID	Site Name	Mines	Operation
		Yield (Tons)	
1	West End	184,000	1872-1887
2	Henry	No Record	1800s
3	Unidentified	No Record	
4	Swayze	253,000	Late 1700-1940s
5	Wildcat	Considerable	1876-1879
6	Rodenbaugh	Minor	1876-1880.
7	Asbury	1,000	1854-1868. 1879
8	Van Syckles	4,300	late 1700s. 1864-1875
9	Miller	0	1871, 1879
10	Maberry	300	1880
11	Wean	4,000	1877-1880




Princeton Hydro

NEW JERSEY COUNTY MAP



PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551



0 2,000 4,000
Feet
1 inch equals 4,000 feet

SOURCES:

1. County and Municipal Boundaries obtained from NJ DEP
2. Roads data obtained from the Hunterdon Co. GIS Dept.

Some funding provided by:

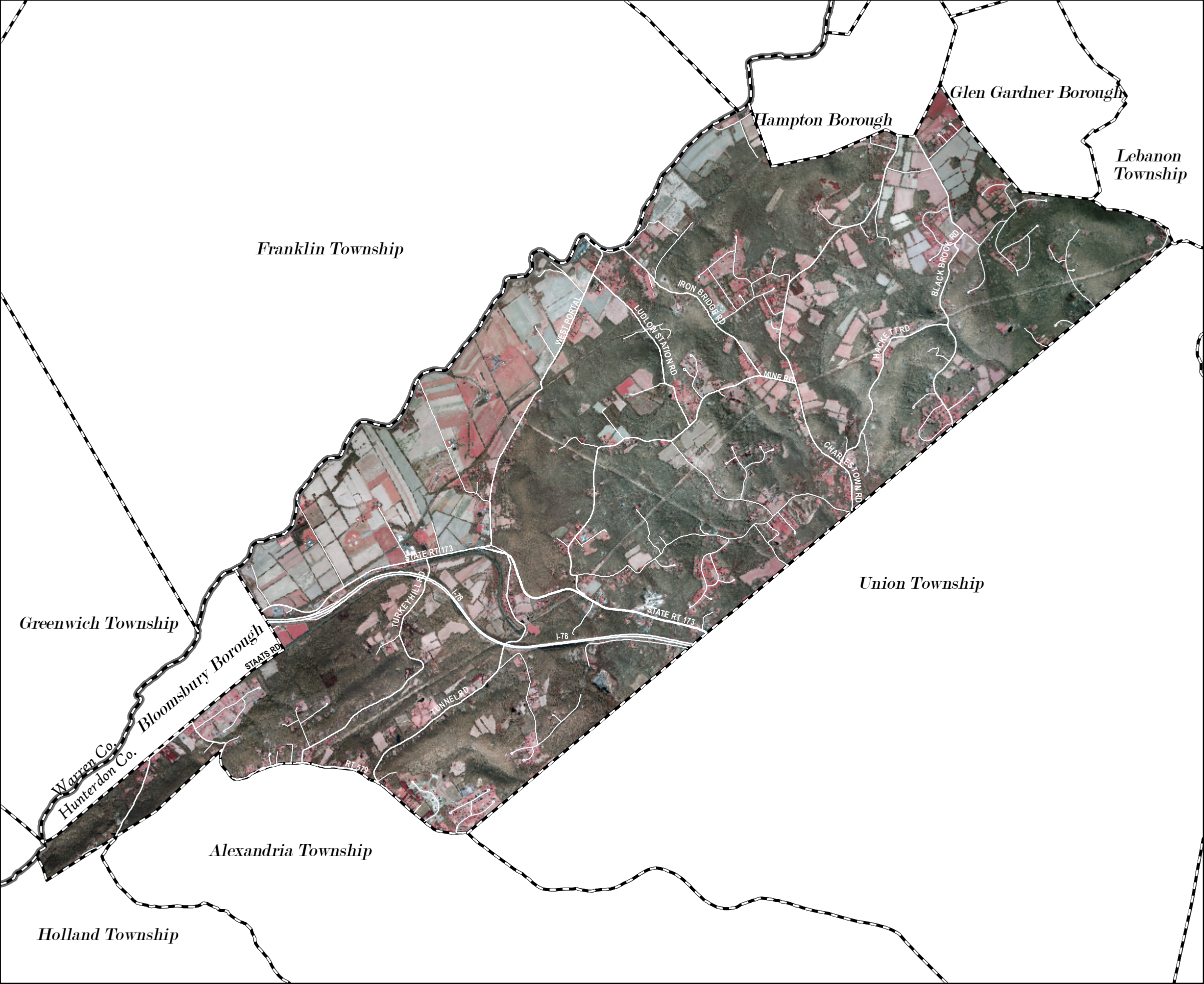
 Association of New Jersey Environmental Commissions

FIGURE 1
SITE LOCATION MAP

**ENVIRONMENTAL
RESOURCE INVENTORY
BETHLEHEM TOWNSHIP
HUNTERDON COUNTY, NJ**

Legend

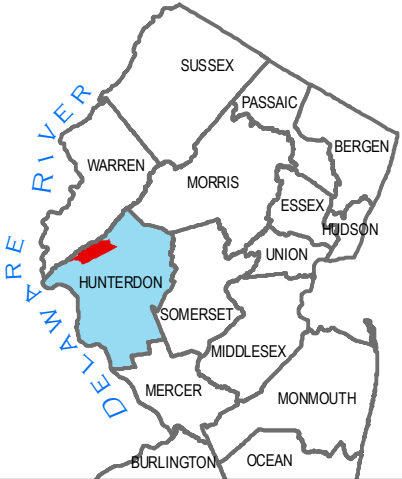
-  Municipal Boundaries
-  County Boundary
-  Parcels
-  Roads





Princeton Hydro

NEW JERSEY COUNTY MAP



PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551



0 2,000 4,000
Feet
1 inch equals 4,000 feet

SOURCES:

1. County and Municipal Boundaries obtained from NJ DEP
2. 2002 Aerial Photographs obtained from the New Jersey Image Warehouse
3. Road data obtained from the Hunterdon Co. GIS Dept.

Some funding provided by:



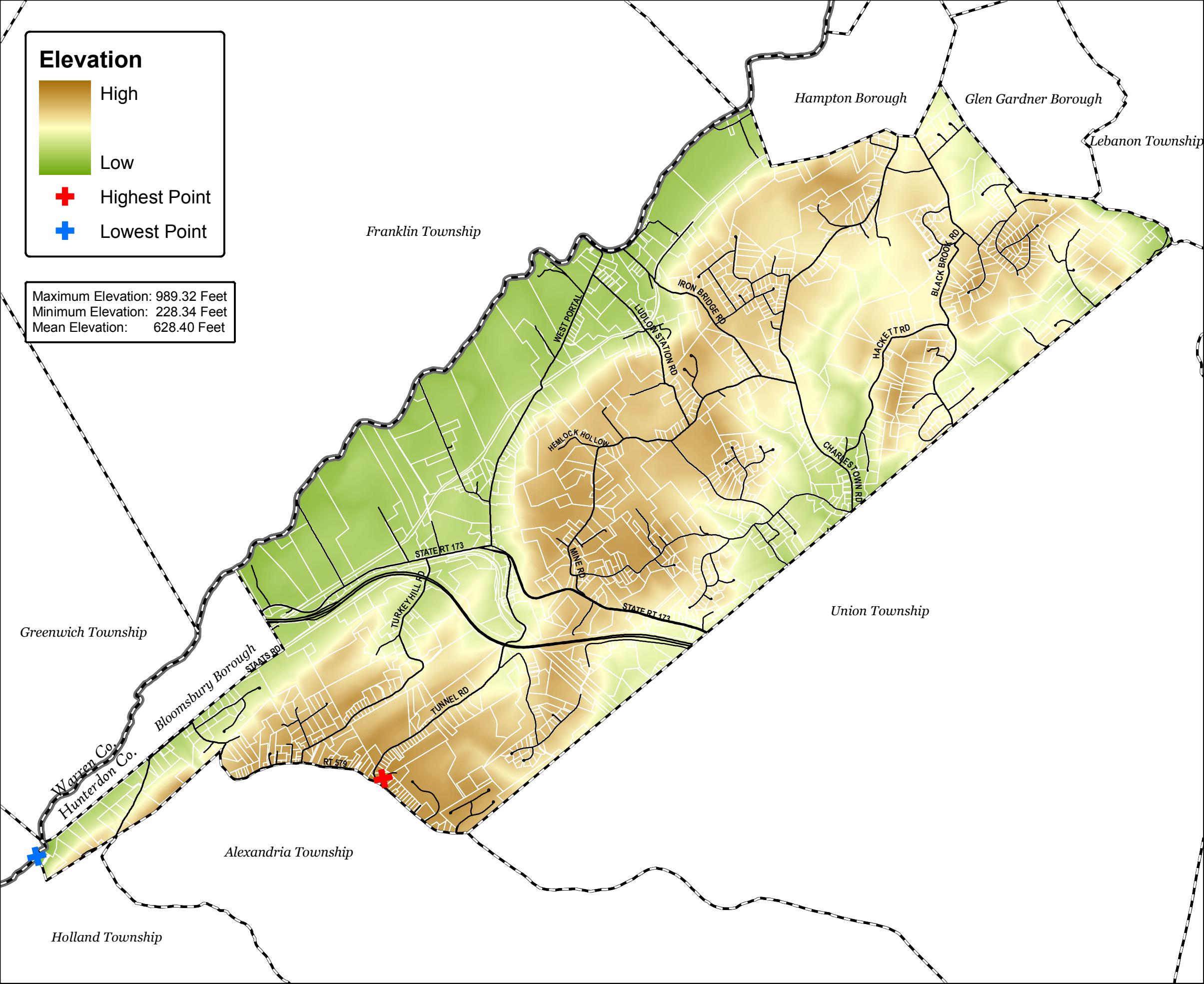
Association of New Jersey Environmental Commissions

FIGURE 2
2002 AERIAL PHOTOGRAPH

**ENVIRONMENTAL
RESOURCE INVENTORY
BETHLEHEM TOWNSHIP
HUNTERDON COUNTY, NJ**

Legend

-  Municipal Boundaries
-  County Boundary
-  Roads



Elevation

High

Low

+

Highest Point

+

Lowest Point

Maximum Elevation: 989.32 Feet
Minimum Elevation: 228.34 Feet
Mean Elevation: 628.40 Feet

Princeton Hydro

NEW JERSEY COUNTY MAP

PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551

0 2,000 4,000 Feet
1 inch equals 4,000 feet

SOURCES:

1. County and Municipal Boundaries obtained from NJ DEP
2. Roads are the 2000 Tiger Line Files
3. This elevation relief image was created using a 10 meter Digital Elevation Model and ESRI's ArcGIS and 3-D Analyst Module

Some funding provided by:

Association of New Jersey Environmental Commissions

**FIGURE 3
ELEVATION RELIEF**

**ENVIRONMENTAL
RESOURCE INVENTORY
BETHLEHEM TOWNSHIP
HUNTERDON COUNTY, NJ**

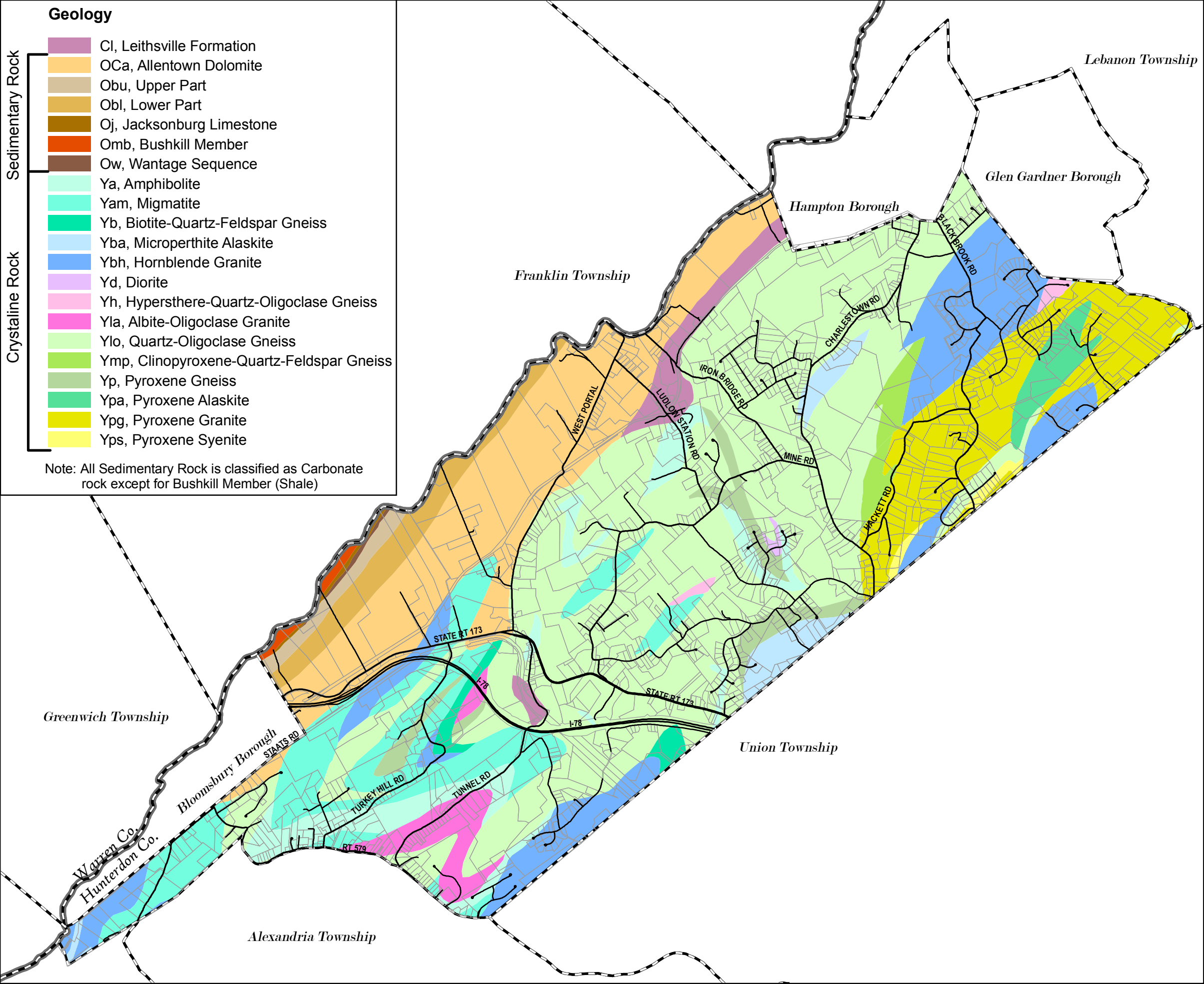
Legend

Municipal Boundaries

County Boundary

Tax Parcels

Roads



Geology

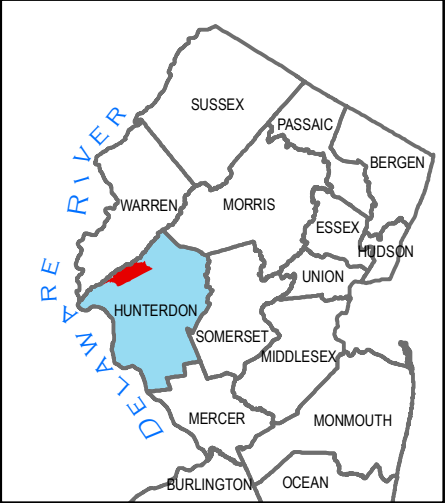
- Sedimentary Rock

 - Cl, Leithsville Formation
 - OCa, Allentown Dolomite
 - Obu, Upper Part
 - Obl, Lower Part
 - Oj, Jacksonburg Limestone
 - Omb, Bushkill Member
 - Ow, Wantage Sequence
- Crystalline Rock

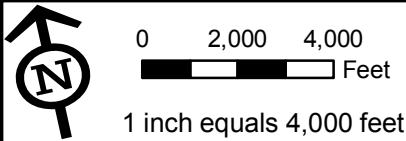
 - Ya, Amphibolite
 - Yam, Migmatite
 - Yb, Biotite-Quartz-Feldspar Gneiss
 - Yba, Microperthite Alaskite
 - Ybh, Hornblende Granite
 - Yd, Diorite
 - Yh, Hypersthene-Quartz-Oligoclase Gneiss
 - Yla, Albite-Oligoclase Granite
 - Ylo, Quartz-Oligoclase Gneiss
 - Ymp, Clinopyroxene-Quartz-Feldspar Gneiss
 - Yp, Pyroxene Gneiss
 - Ypa, Pyroxene Alaskite
 - Ypg, Pyroxene Granite
 - Yps, Pyroxene Syenite

Note: All Sedimentary Rock is classified as Carbonate rock except for Bushkill Member (Shale)

NEW JERSEY COUNTY MAP



PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551



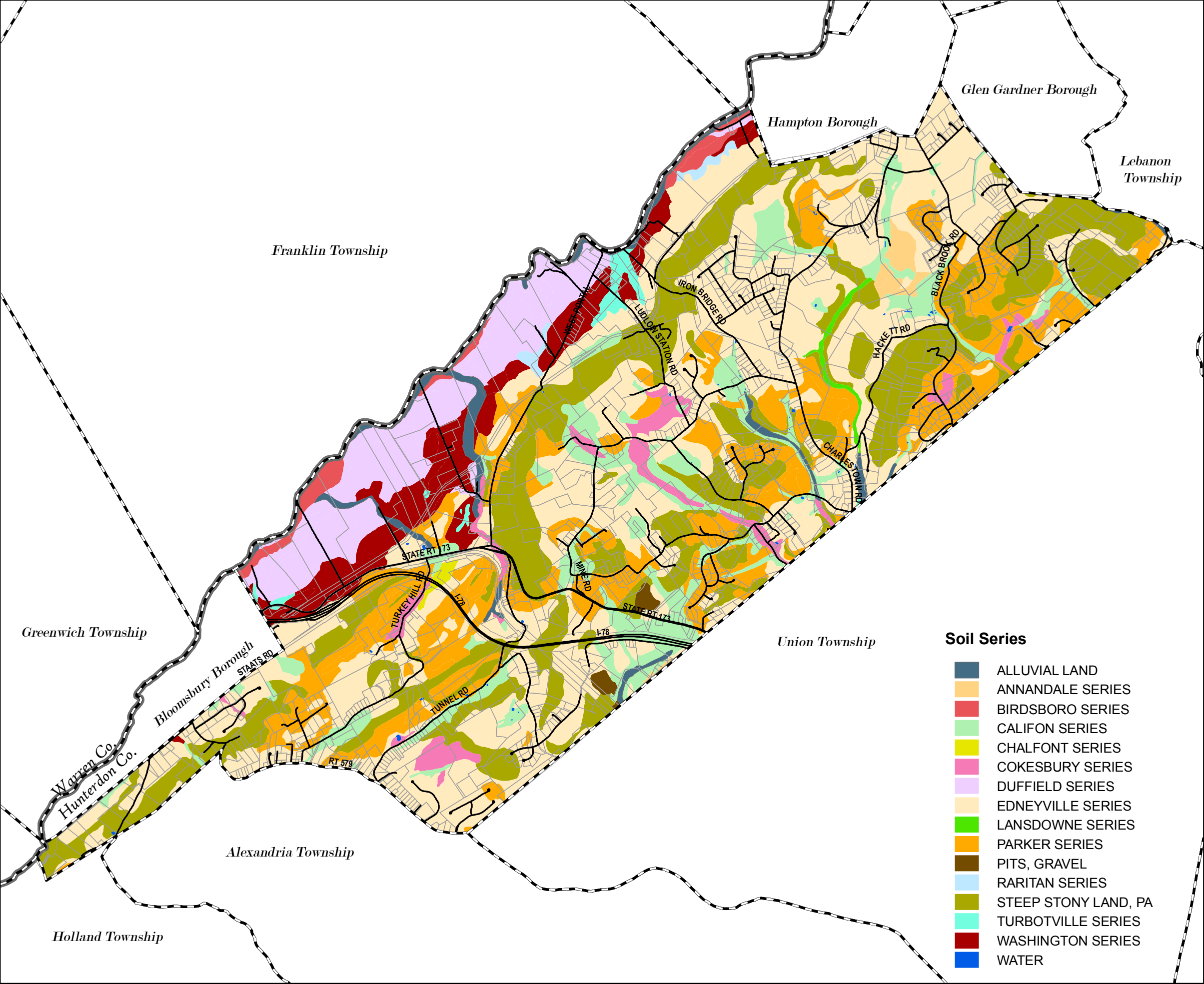
- SOURCES:
1. County and Municipal Boundaries obtained from NJ DEP
 2. Roads data obtained from the Hunterdon Co. GIS Dept.
 3. Geology data obtained from the NJ Geological Survey

Some funding provided by:
 Association of New Jersey Environmental Commissions

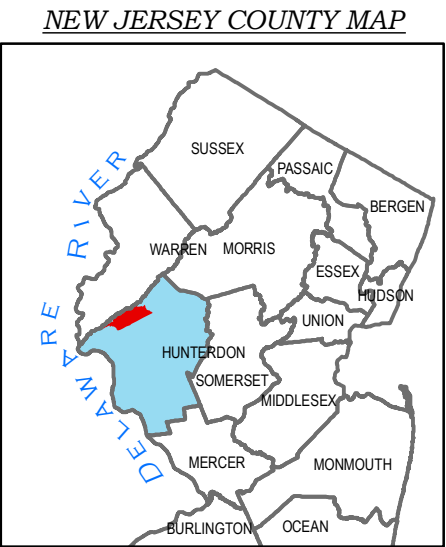
**FIGURE 4
BEDROCK GEOLOGY**

**ENVIRONMENTAL
RESOURCE INVENTORY
BETHLEHEM TOWNSHIP
HUNTERDON COUNTY, NJ**

- Legend**
-  Municipal Boundaries
 -  County Boundary
 -  Tax Parcels
 -  Roads



- Soil Series**
- ALLUVIAL LAND
 - ANNANDALE SERIES
 - BIRDSBORO SERIES
 - CALIFON SERIES
 - CHALFONT SERIES
 - COKEsbury SERIES
 - DUFFIELD SERIES
 - EDNEYVILLE SERIES
 - LANSDOWNE SERIES
 - PARKER SERIES
 - PITS, GRAVEL
 - RARITAN SERIES
 - STEEP STONY LAND, PA
 - TURBOTVILLE SERIES
 - WASHINGTON SERIES
 - WATER



PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551

 0 2,000 4,000 Feet
1 inch equals 4,000 feet

SOURCES:

- County and Municipal Boundaries obtained from NJ DEP
- Road Data obtained from the Hunterdon Co GIS Dept.
- Digital Soil Data obtained from the Natural Resource Conservation Service.

Some funding provided by:

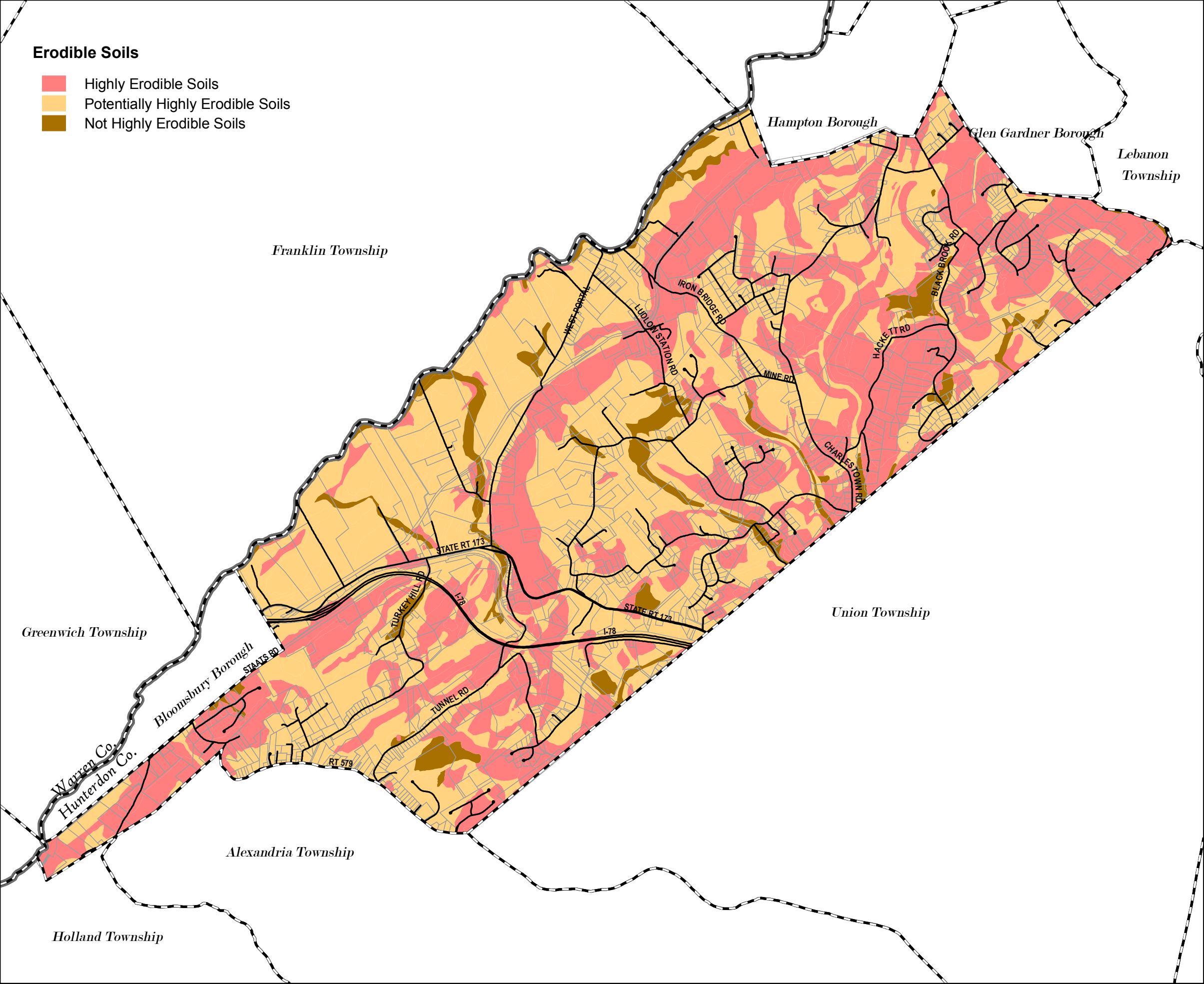
 Association of New Jersey Environmental Commissions

**FIGURE 5
NRCS SOILS**

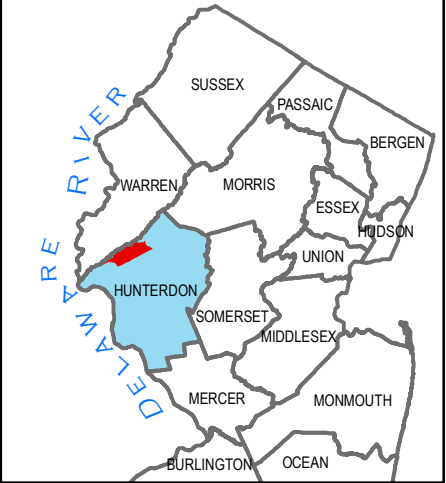
**ENVIRONMENTAL
RESOURCE INVENTORY
BETHLEHEM TOWNSHIP
HUNTERDON COUNTY, NJ**

Legend

-  Municipal Boundaries
-  Tax Parcels
-  County Boundary
-  Roads



NEW JERSEY COUNTY MAP



PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551



0 2,000 4,000
Feet

1 inch equals 4,000 feet

SOURCES:

1. County and Municipal Boundaries obtained from NJ DEP
2. Roads are the 2000 Tiger Line Files
3. SSURGO Soil data and erodible soils classification obtained from the NRCS web site -

Some funding provided by:



Association of New Jersey
Environmental Commissions

**FIGURE 6
ERODIBLE SOILS**

**ENVIRONMENTAL
RESOURCE INVENTORY
BETHLEHEM TOWNSHIP
HUNTERDON COUNTY, NJ**

Legend

- Municipal Boundaries
- Tax Parcels
- County Boundary
- Roads

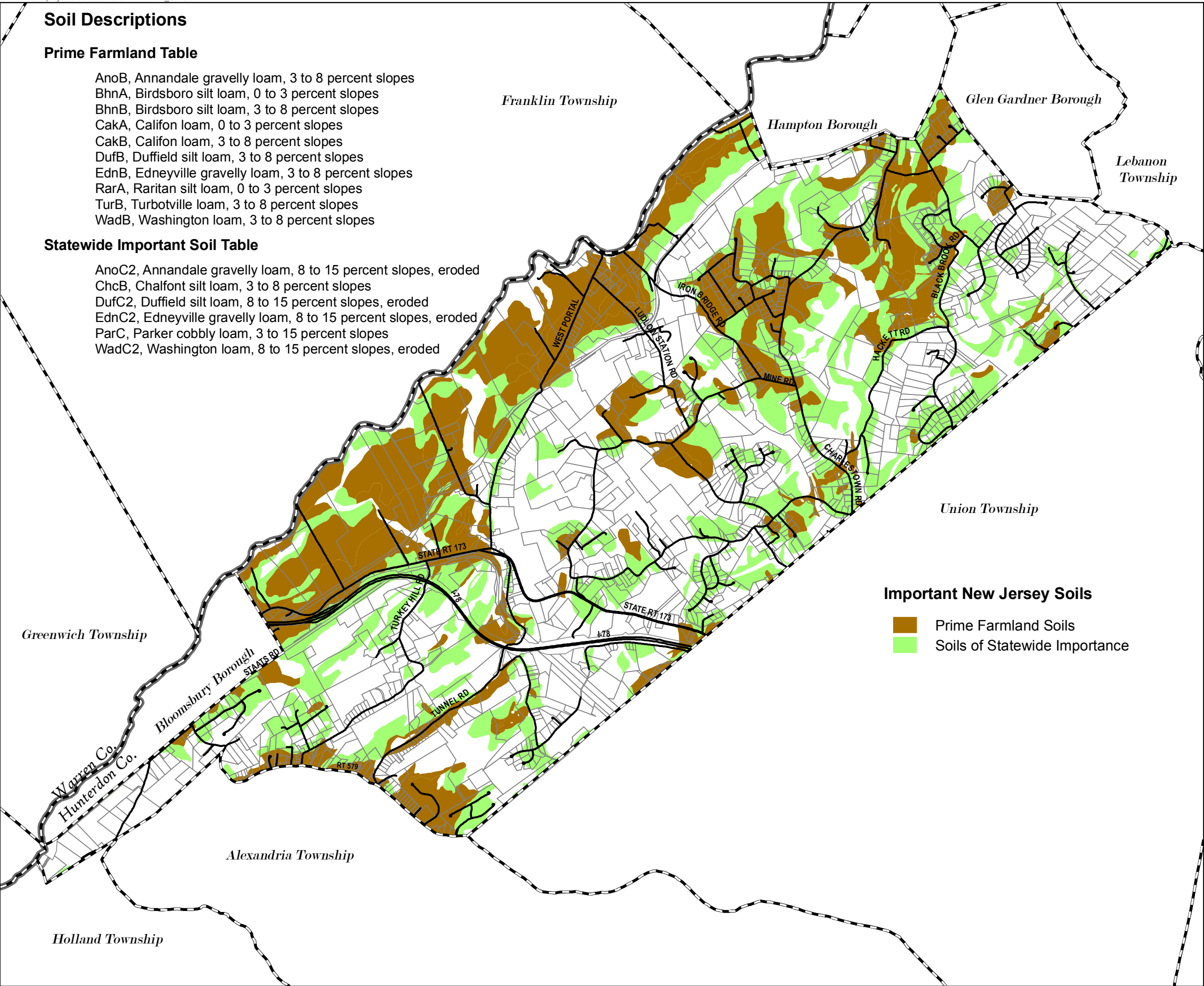
Soil Descriptions

Prime Farmland Table

- AnoB, Annandale gravelly loam, 3 to 8 percent slopes
- BhnA, Birdsboro silt loam, 0 to 3 percent slopes
- BhnB, Birdsboro silt loam, 3 to 8 percent slopes
- CakA, Califon loam, 0 to 3 percent slopes
- CakB, Califon loam, 3 to 8 percent slopes
- DufB, Duffield silt loam, 3 to 8 percent slopes
- EdnB, Edneyville gravelly loam, 3 to 8 percent slopes
- RarA, Raritan silt loam, 0 to 3 percent slopes
- TurB, Turbotville loam, 3 to 8 percent slopes
- WadB, Washington loam, 3 to 8 percent slopes

Statewide Important Soil Table

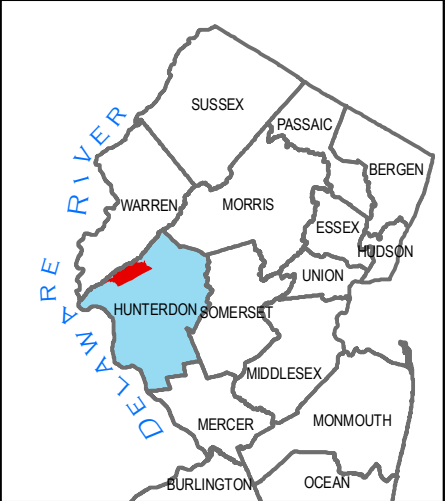
- AnoC2, Annandale gravelly loam, 8 to 15 percent slopes, eroded
- ChcB, Chalfont silt loam, 3 to 8 percent slopes
- DufC2, Duffield silt loam, 8 to 15 percent slopes, eroded
- EdnC2, Edneyville gravelly loam, 8 to 15 percent slopes, eroded
- ParC, Parker cobbly loam, 3 to 15 percent slopes
- WadC2, Washington loam, 8 to 15 percent slopes, eroded



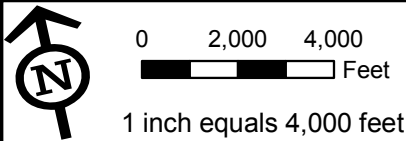
Important New Jersey Soils

- Prime Farmland Soils
- Soils of Statewide Importance

NEW JERSEY COUNTY MAP



PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551



SOURCES:

- 1. County and Municipal Boundaries obtained from NJ DEP
- 2. Roads Data obtained from the Hunterdon Co. GIS Dept.
- 3. SSURGO Soil data and important New Jersey Soils classification obtained from the NRCS web site -

Some funding provided by:

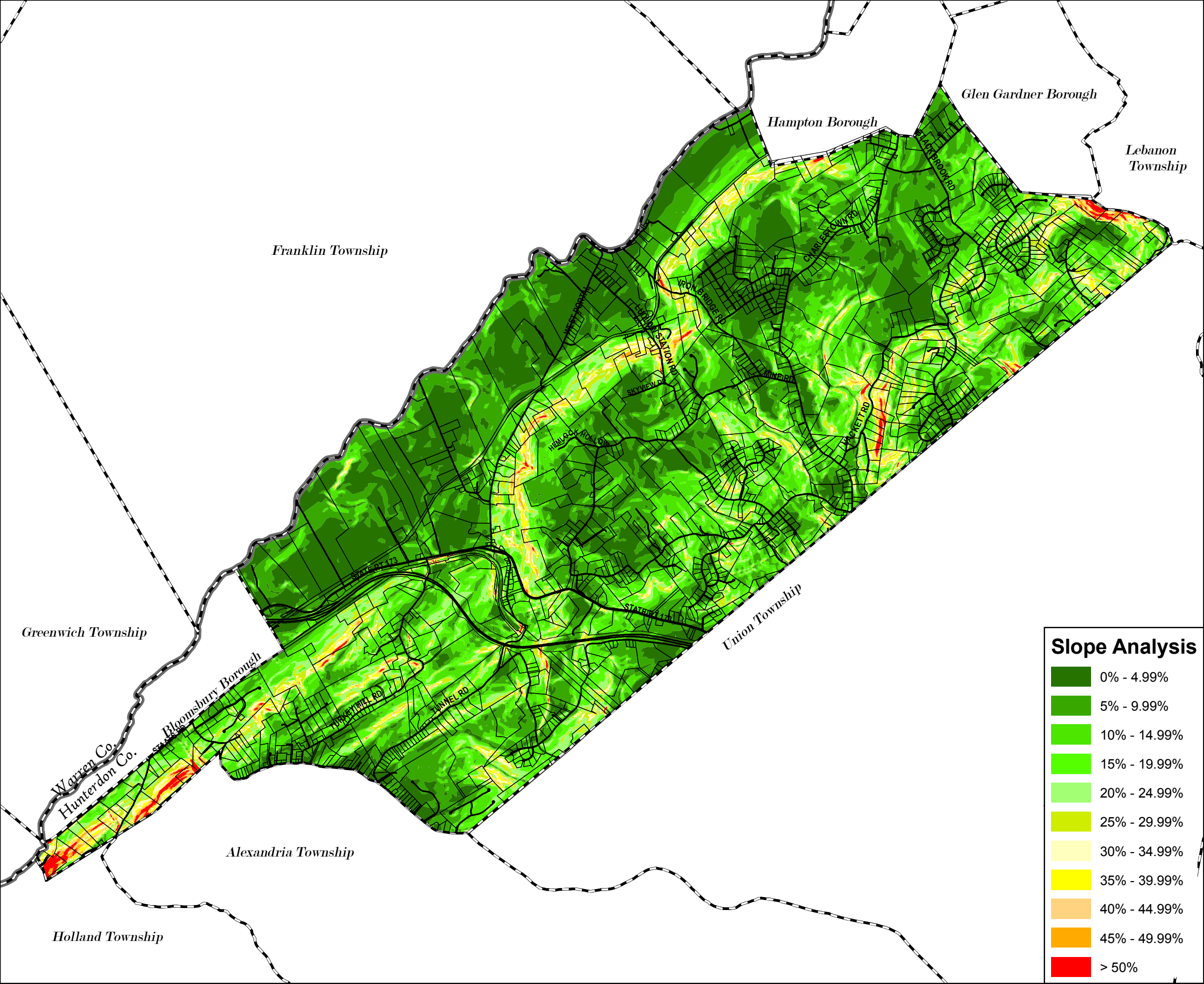
anuec Association of New Jersey Environmental Commissions

FIGURE 7
IMPORTANT SOILS
OF NEW JERSEY

ENVIRONMENTAL
RESOURCE INVENTORY
BETHLEHEM TOWNSHIP
HUNTERDON COUNTY, NJ

Legend

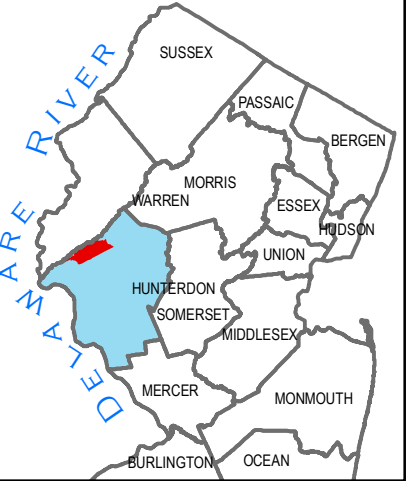
- Municipal Boundaries
- Tax Parcels
- County Boundary
- Roads



Slope Analysis

	0% - 4.99%
	5% - 9.99%
	10% - 14.99%
	15% - 19.99%
	20% - 24.99%
	25% - 29.99%
	30% - 34.99%
	35% - 39.99%
	40% - 44.99%
	45% - 49.99%
	> 50%

NEW JERSEY COUNTY MAP



PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551



0 2,000 4,000
Feet

1 inch equals 4,000 feet

SOURCES:

1. County and Municipal Boundaries obtained from NJ DEP
2. Roads Data obtained from the Hunterdon Co. GIS Dept.
3. Base data for the slope analysis is the 10 meter DEM obtained from NJ DEP. DEM reclassified, utilizing ESRI GIS software, according to Township ordinance guidelines

Some funding provided by:



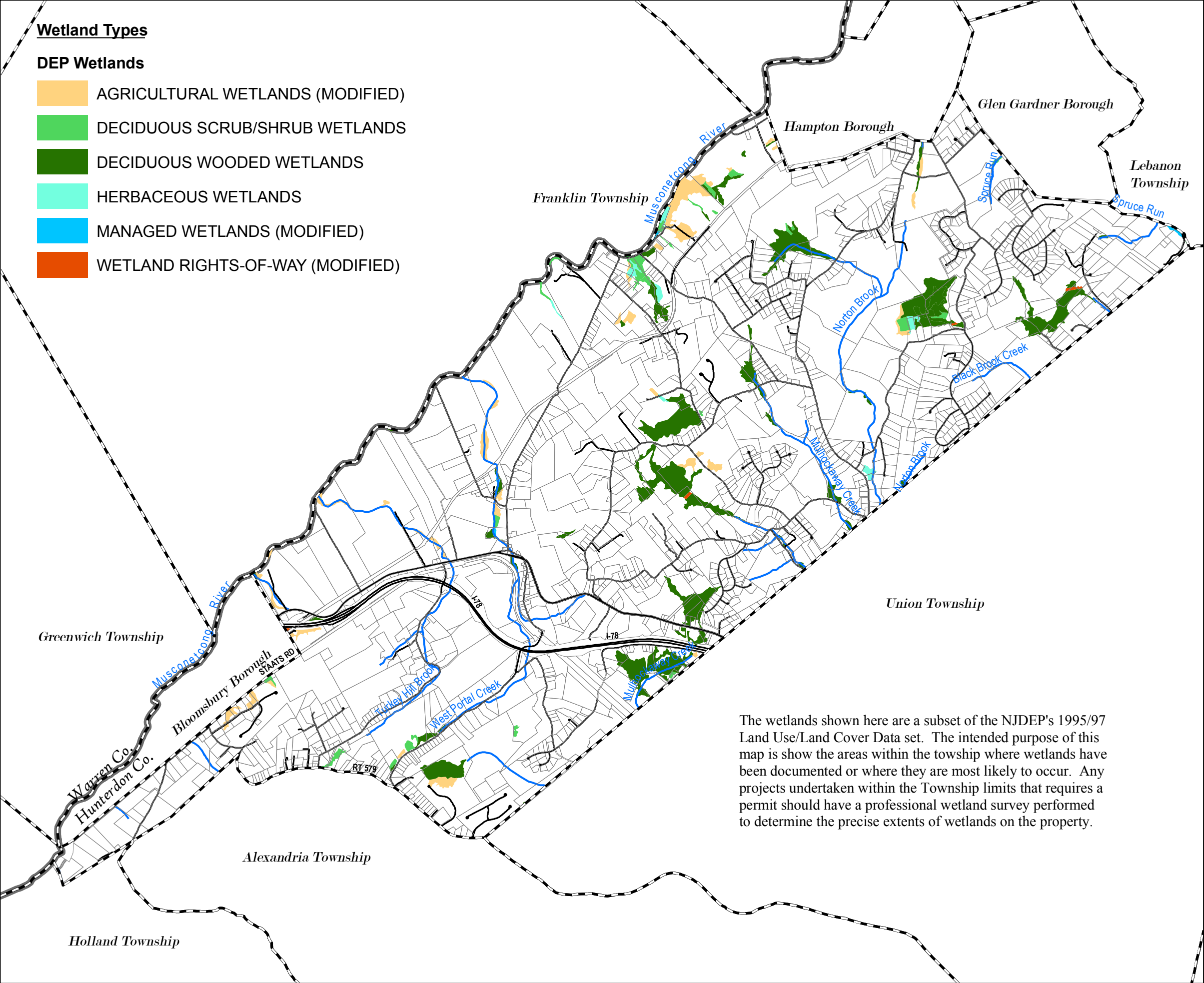
Association of New Jersey
Environmental Commissions

**FIGURE 8
SLOPE ANALYSIS**

**ENVIRONMENTAL
RESOURCE INVENTORY
BETHLEHEM TOWNSHIP
HUNTERDON COUNTY, NJ**

Legend

-  Municipal Boundaries
-  County Boundary
-  Tax Parcels
-  Roads



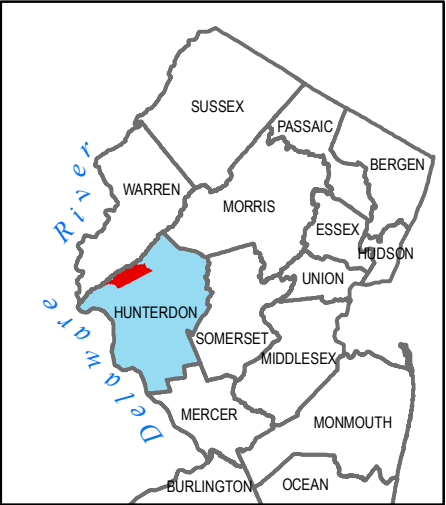
Wetland Types

DEP Wetlands

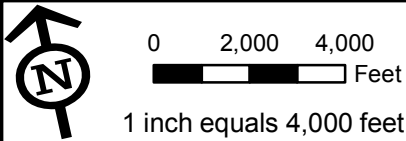
- AGRICULTURAL WETLANDS (MODIFIED)
- DECIDUOUS SCRUB/SHRUB WETLANDS
- DECIDUOUS WOODED WETLANDS
- HERBACEOUS WETLANDS
- MANAGED WETLANDS (MODIFIED)
- WETLAND RIGHTS-OF-WAY (MODIFIED)

The wetlands shown here are a subset of the NJDEP's 1995/97 Land Use/Land Cover Data set. The intended purpose of this map is show the areas within the township where wetlands have been documented or where they are most likely to occur. Any projects undertaken within the Township limits that requires a permit should have a professional wetland survey performed to determine the precise extents of wetlands on the property.

NEW JERSEY COUNTY MAP



PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551



- SOURCES:
1. County and Municipal Boundaries obtained from NJ DEP
 2. Roads Data obtained from the Hunterdon Co. GIS Dept.
 3. Parcel data obtained from Bethlehem Twp.
 4. The DEP Wetland data is a subset of the 1995/97 Land Use/Land Cover GIS data set
- Some funding provided by:*
- ANJEC** Association of New Jersey Environmental Commissions

FIGURE 9
STREAMS AND WETLANDS

**ENVIRONMENTAL
RESOURCE INVENTORY
BETHLEHEM TOWNSHIP
HUNTERDON COUNTY, NJ**

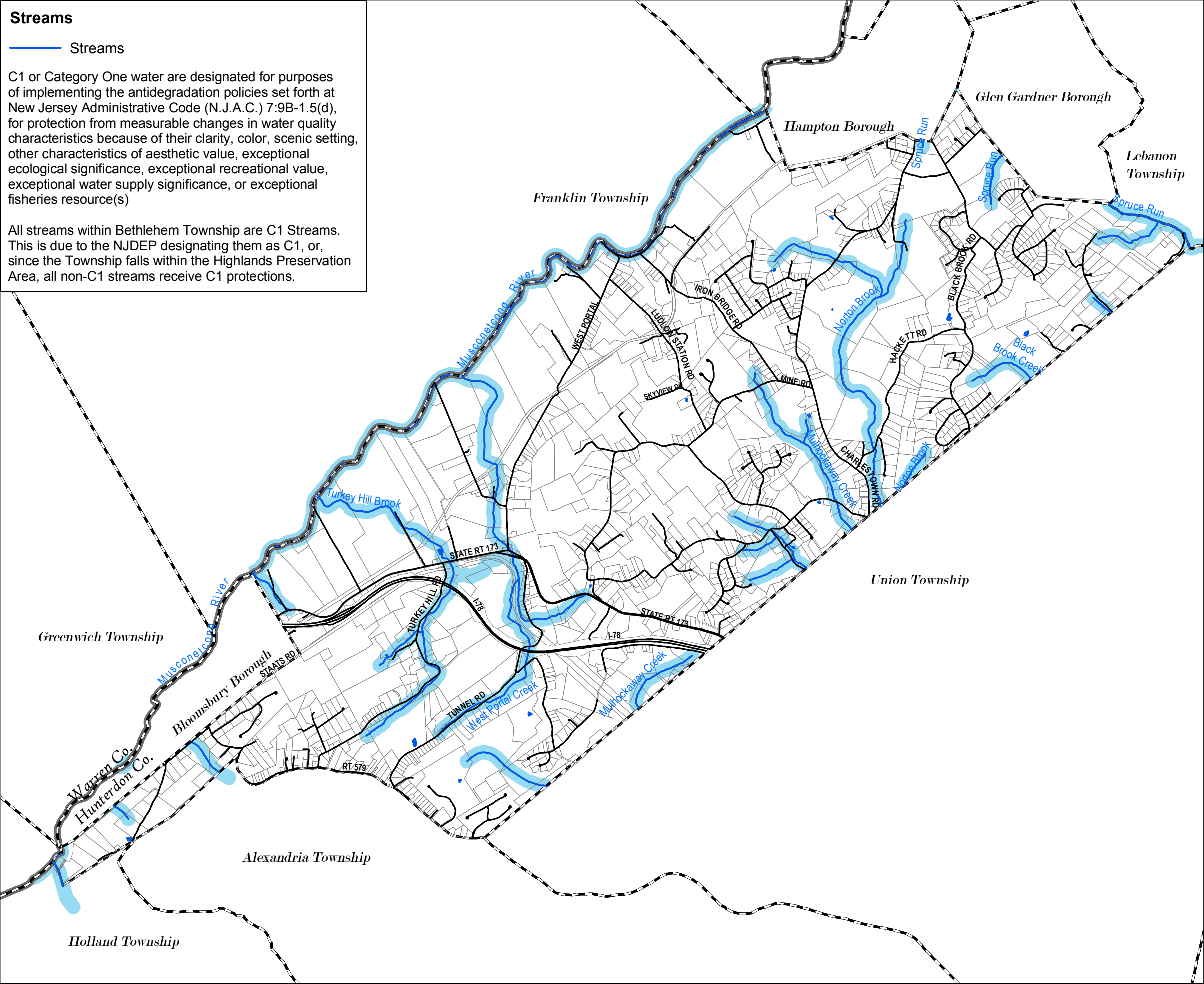
- Legend**
- Municipal Boundaries
 - County Boundary
 - Roads
 - Streams

Streams

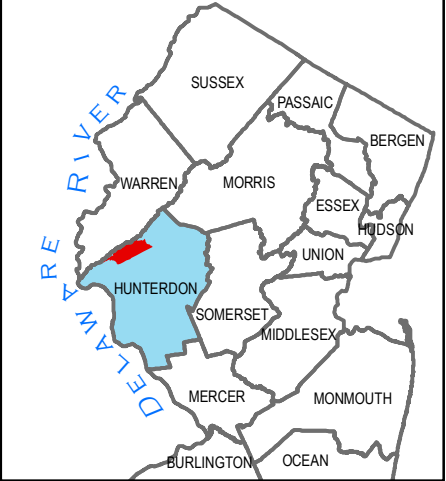
Streams

C1 or Category One water are designated for purposes of implementing the antidegradation policies set forth at New Jersey Administrative Code (N.J.A.C.) 7:9B-1.5(d), for protection from measurable changes in water quality characteristics because of their clarity, color, scenic setting, other characteristics of aesthetic value, exceptional ecological significance, exceptional recreational value, exceptional water supply significance, or exceptional fisheries resource(s)

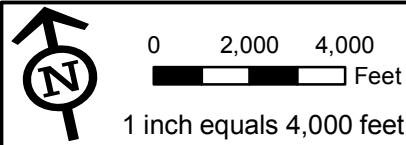
All streams within Bethlehem Township are C1 Streams. This is due to the NJDEP designating them as C1, or, since the Township falls within the Highlands Preservation Area, all non-C1 streams receive C1 protections.



NEW JERSEY COUNTY MAP



PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551



SOURCES:

- 1. County and Municipal Boundaries obtained from NJ DEP
- 2. Roads are the 2000 Tiger Line Files
- 3. Parcel data obtained from Bethlehem Twp.
- 4. Stream classifications and Stormwater Rule Affected Areas obtained from NJDEP

Some funding provided by:

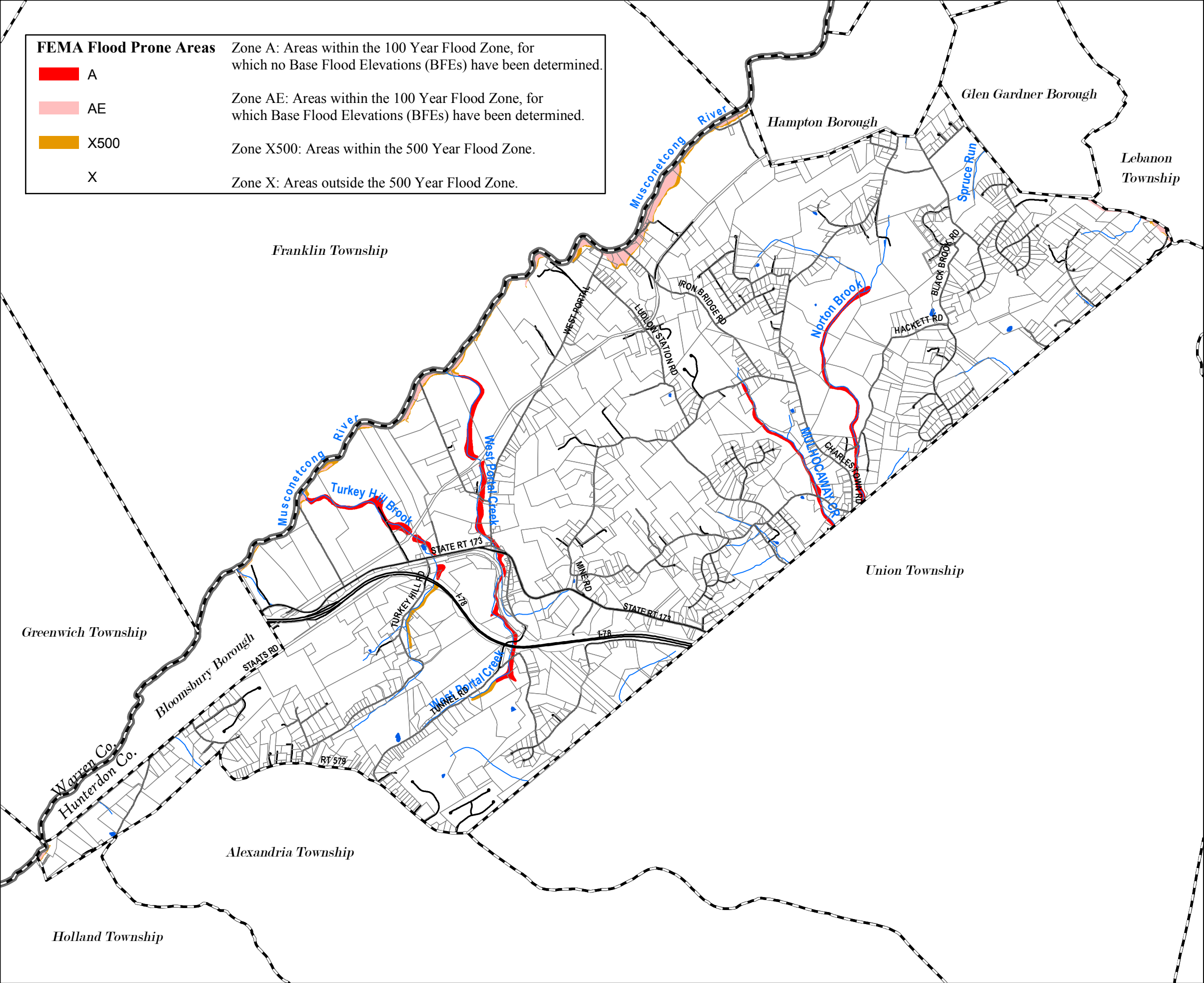
anuec Association of New Jersey Environmental Commissions

FIGURE 10
NJDEP SURFACE WATER QUALITY STANDARDS OF NJ

ENVIRONMENTAL
RESOURCE INVENTORY
BETHLEHEM TOWNSHIP
HUNTERDON COUNTY, NJ

Legend

- Municipal Boundaries
- County Boundary
- Lakes
- Roads
- C1 Stream Buffers (300')



FEMA Flood Prone Areas

A

AE

X500

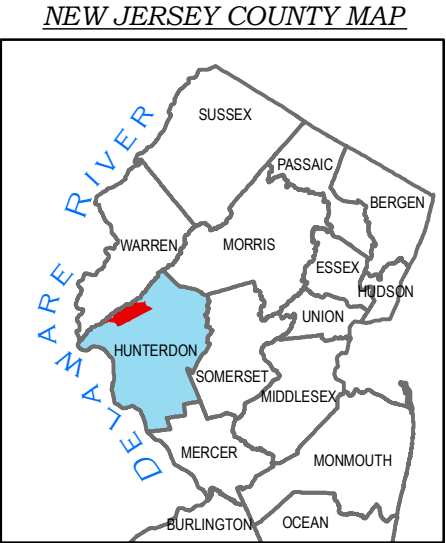
X

Zone A: Areas within the 100 Year Flood Zone, for which no Base Flood Elevations (BFEs) have been determined.

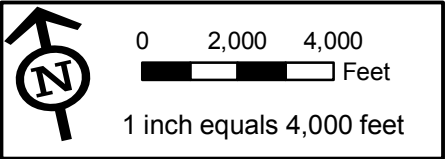
Zone AE: Areas within the 100 Year Flood Zone, for which Base Flood Elevations (BFEs) have been determined.

Zone X500: Areas within the 500 Year Flood Zone.

Zone X: Areas outside the 500 Year Flood Zone.



PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551

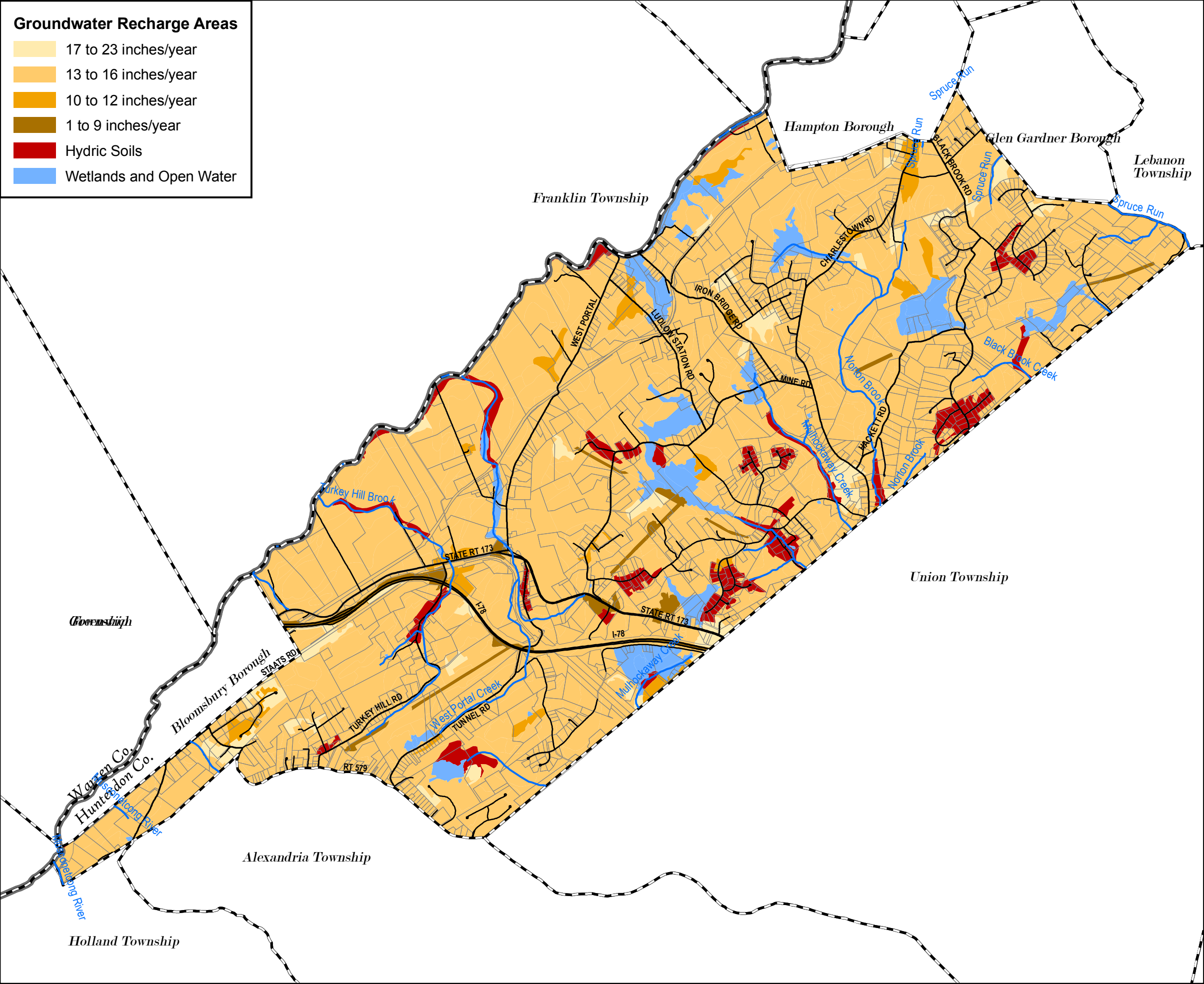


- SOURCES:
1. County and Municipal Boundaries obtained from NJ DEP
 2. Roads Data obtained from the Hunterdon Co. GIS Dept.
 3. Tax Parcels obtained from Bethlehem Township
 4. Floodplain data is the updated Q3 data purchased from FEMA
- Some funding provided by:*
-  Association of New Jersey Environmental Commissions

**FIGURE 11
FEMA FLOODPLAINS**

**ENVIRONMENTAL
RESOURCE INVENTORY
BETHLEHEM TOWNSHIP
HUNTERDON COUNTY, NJ**

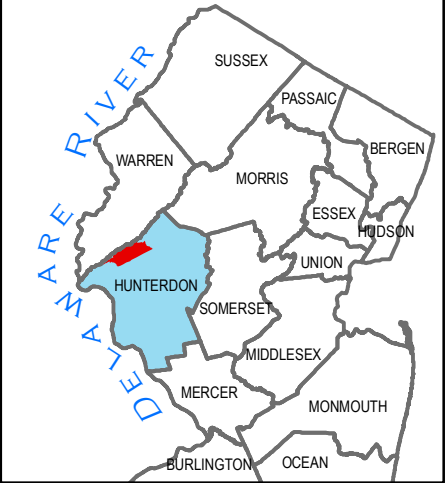
- Legend**
-  Municipal Boundaries
 -  Tax Parcels
 -  Streams
 -  County Boundary
 -  Lakes
 -  Roads



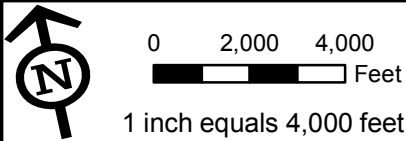
Groundwater Recharge Areas

- 17 to 23 inches/year
- 13 to 16 inches/year
- 10 to 12 inches/year
- 1 to 9 inches/year
- Hydric Soils
- Wetlands and Open Water

NEW JERSEY COUNTY MAP



PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551

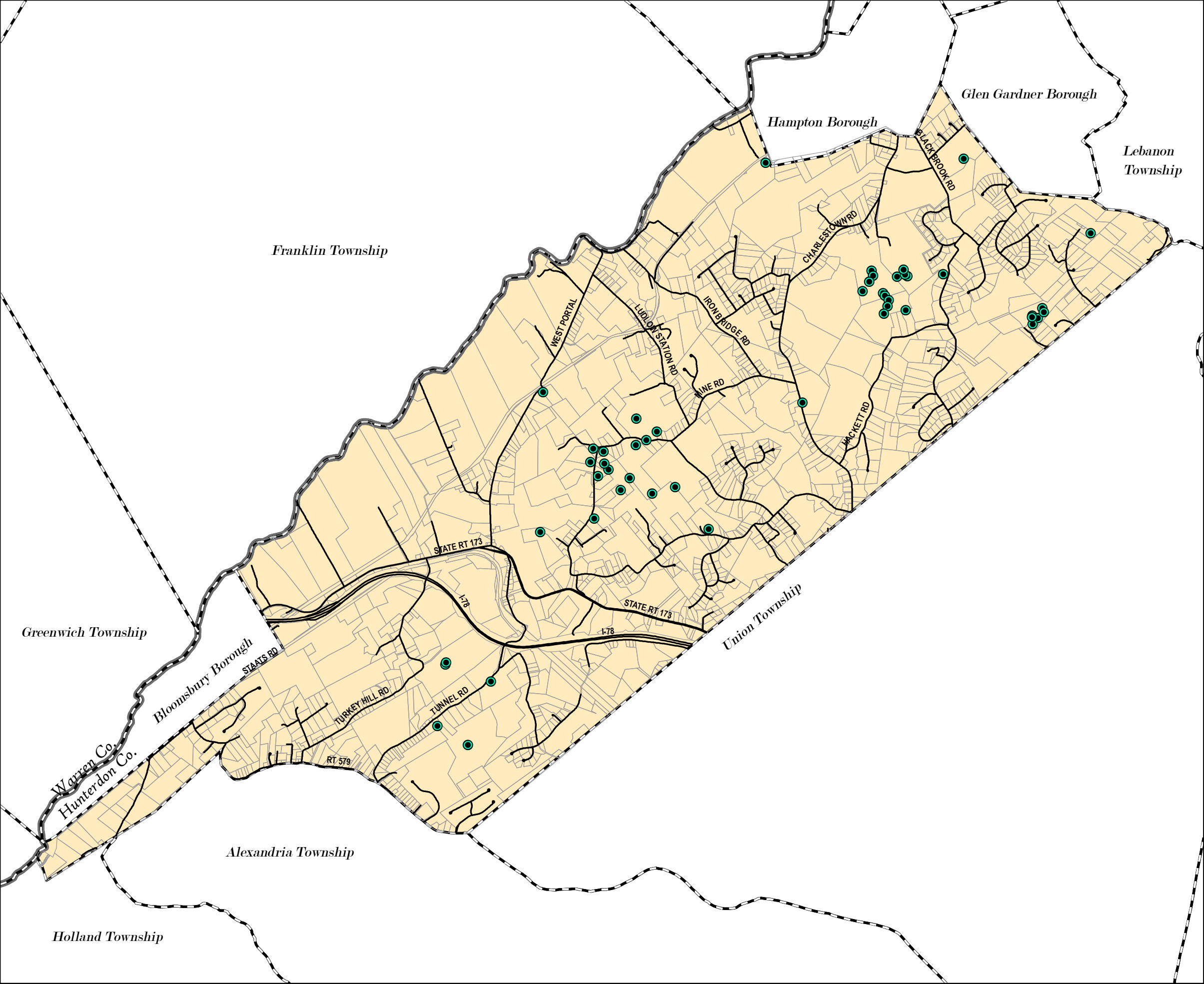


- SOURCES:
1. County and Municipal Boundaries obtained from NJ DEP
 2. Road Data obtained from the Hunterdon Co. GIS Dept.
 3. Parcel data obtained from Bethlehem Twp.
 4. Groundwater Recharge Areas obtained from NJ Geologic Survey. Groundwater Recharge rates calculated from NJGS Geological Survey Report GSR-32 (2002)
- Some funding provided by:
- anvec** Association of New Jersey Environmental Commissions

**FIGURE 12
GROUND WATER
RECHARGE AREAS**

**ENVIRONMENTAL
RESOURCE INVENTORY
BETHLEHEM TOWNSHIP
HUNTERDON COUNTY, NJ**

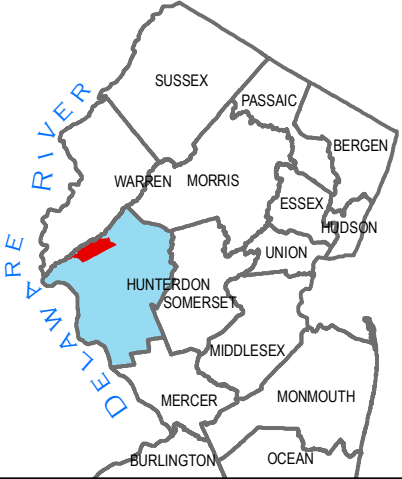
- Legend**
- Municipal Boundaries
 - County Boundary
 - Roads
 - Streams





Princeton Hydro

NEW JERSEY COUNTY MAP



PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551



0 2,000 4,000
Feet

1 inch equals 4,000 feet

SOURCES:

- County and Municipal Boundaries obtained from NJ DEP
- Road data obtained from the Hunterdon Co. GIS Dept.
- Tax Parcel Data obtained from Bethlehem Twp.
- Vernal Pool data obtained from Bethlehem Twp. Vernal Pools located by Bethlehem Twp Volunteers (83) in March, 2005. Only Vernal Pools certified by NJ DEP are displayed on this map (49)

Some funding provided by:



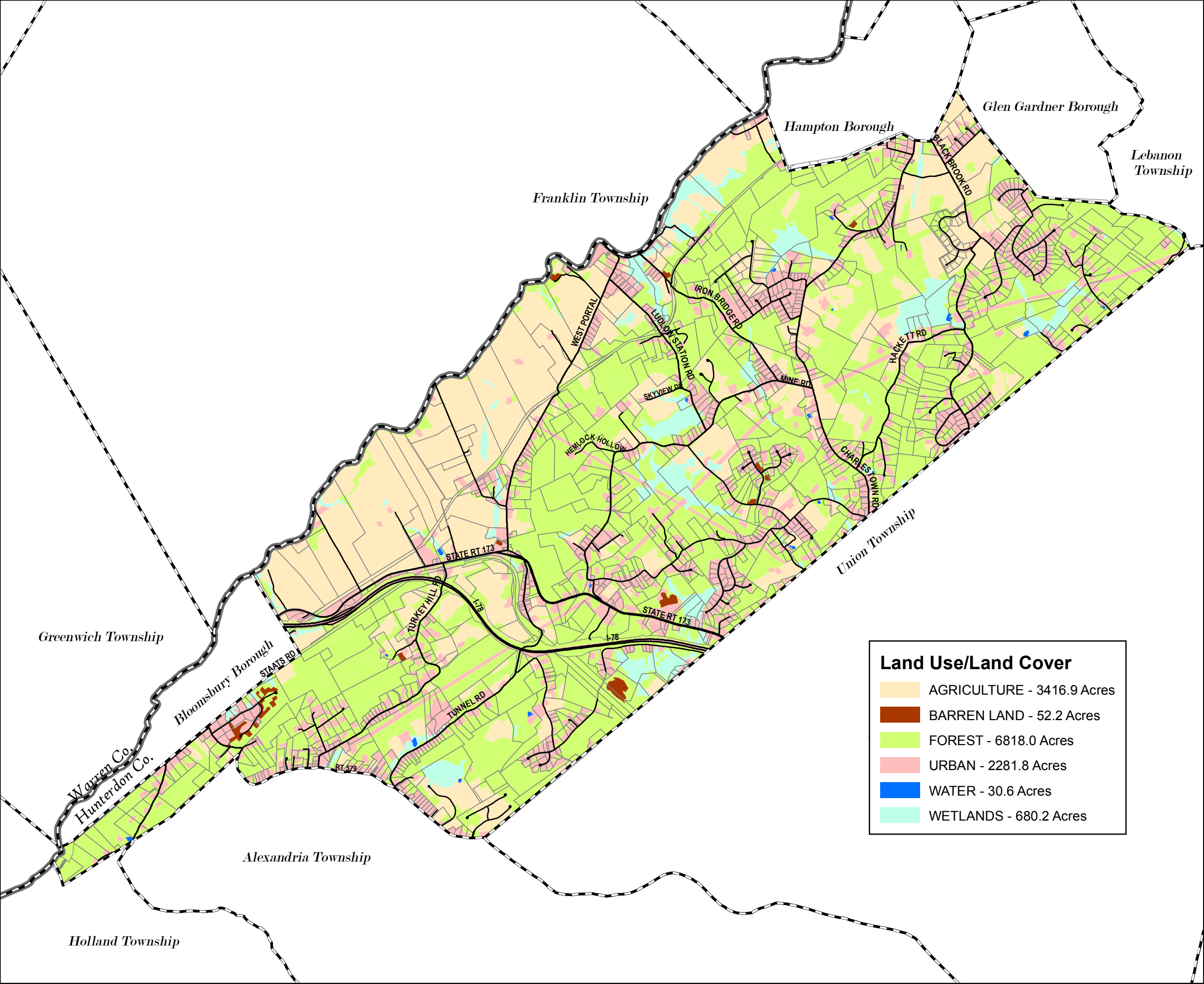
Association of New Jersey Environmental Commissions

**FIGURE 13
VERNAL POOL LOCATIONS**

**ENVIRONMENTAL
RESOURCE INVENTORY
BETHLEHEM TOWNSHIP
HUNTERDON COUNTY, NJ**

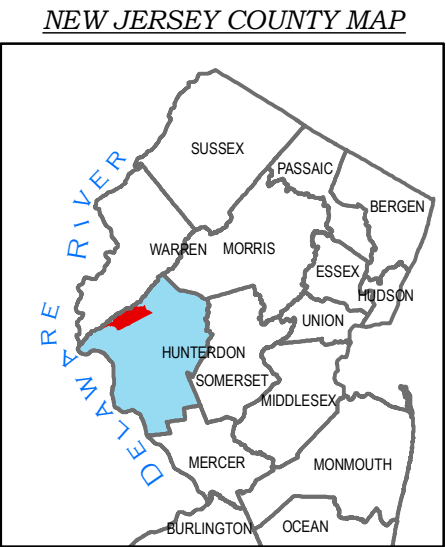
Legend

-  Municipal Boundaries
-  County Boundary
-  Bethlehem Township
-  Tax Parcels
-  Roads
-  Vernal Pools



Land Use/Land Cover

	AGRICULTURE - 3416.9 Acres
	BARREN LAND - 52.2 Acres
	FOREST - 6818.0 Acres
	URBAN - 2281.8 Acres
	WATER - 30.6 Acres
	WETLANDS - 680.2 Acres



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0 2,000 4,000
Feet
1 inch equals 4,000 feet

- SOURCES:
1. County and Municipal Boundaries obtained from NJ DEP
 2. Roads Data obtained from the Hunterdon Co. GIS Dept.
 3. Parcel data obtained from Bethlehem Twp.
 4. Land Use/Land Cover is the NJ DEP 1995 LULC Data set
- Some funding provided by:*
- Association of New Jersey Environmental Commissions

FIGURE 14
LAND USE / LAND COVER

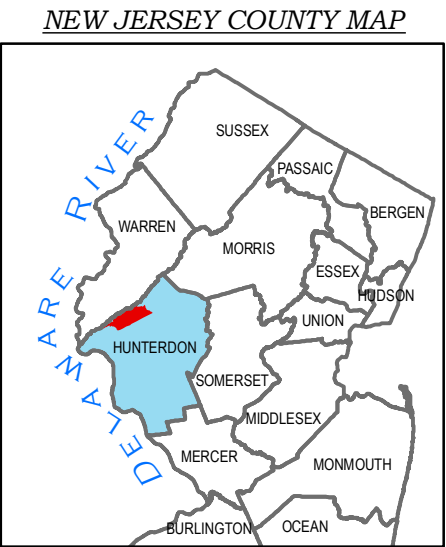
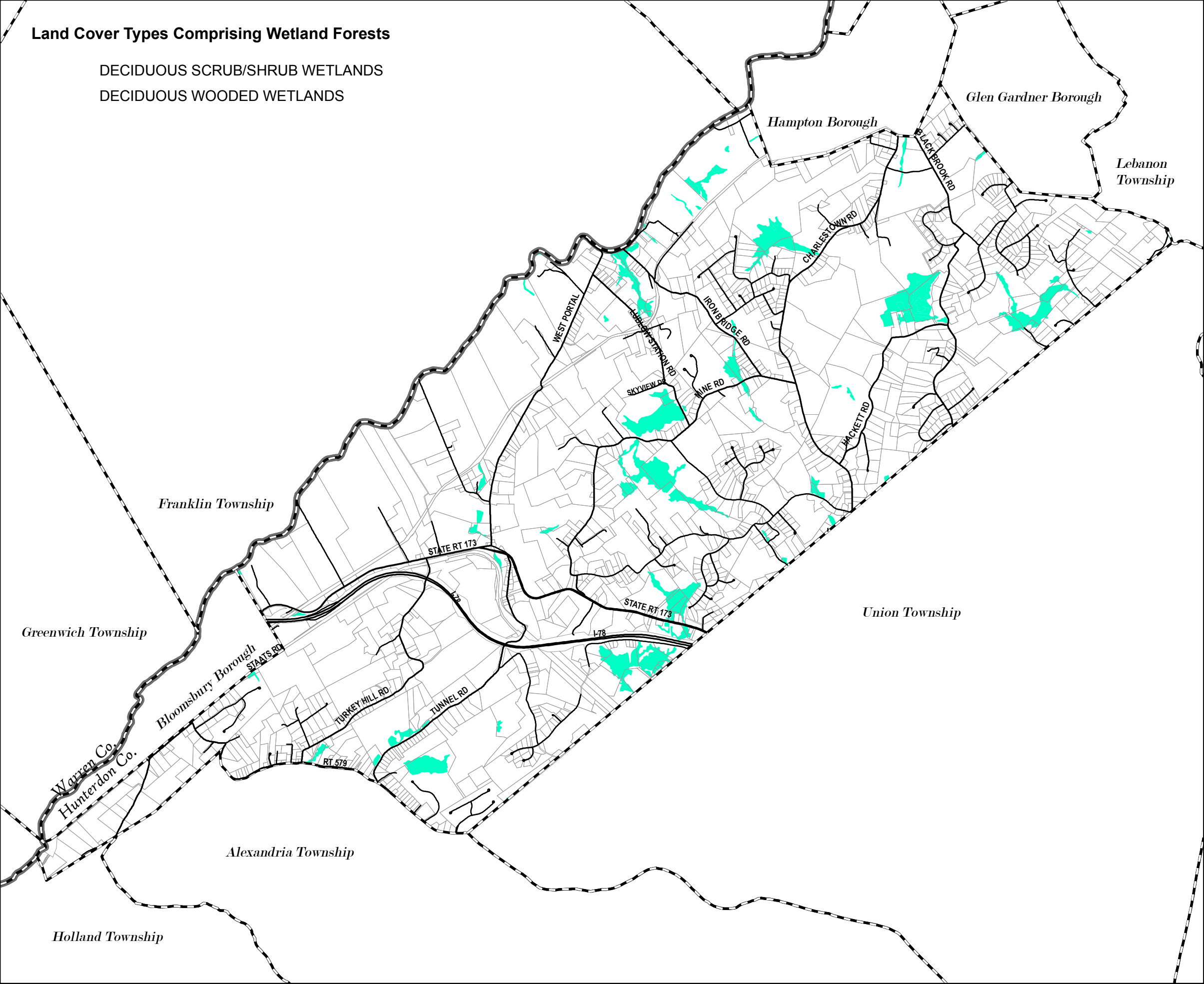
**ENVIRONMENTAL
RESOURCE INVENTORY
BETHLEHEM TOWNSHIP
HUNTERDON COUNTY, NJ**

Legend

- Municipal Boundaries
- County Boundary
- Roads

Land Cover Types Comprising Wetland Forests

- DECIDUOUS SCRUB/SHRUB WETLANDS
- DECIDUOUS WOODED WETLANDS



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0 2,000 4,000 Feet
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SOURCES:

- 1. County and Municipal Boundaries obtained from NJ DEP
- 2. Roads data obtained from the Hunterdon Co. GIS Dept.
- 3. Tax Parcels obtained from Bethlehem Township
- 4. Wetland Forest cover is a subset of the NJ DEP 1995/97 Land Use/Land Cover GIS dataset.

Some funding provided by:

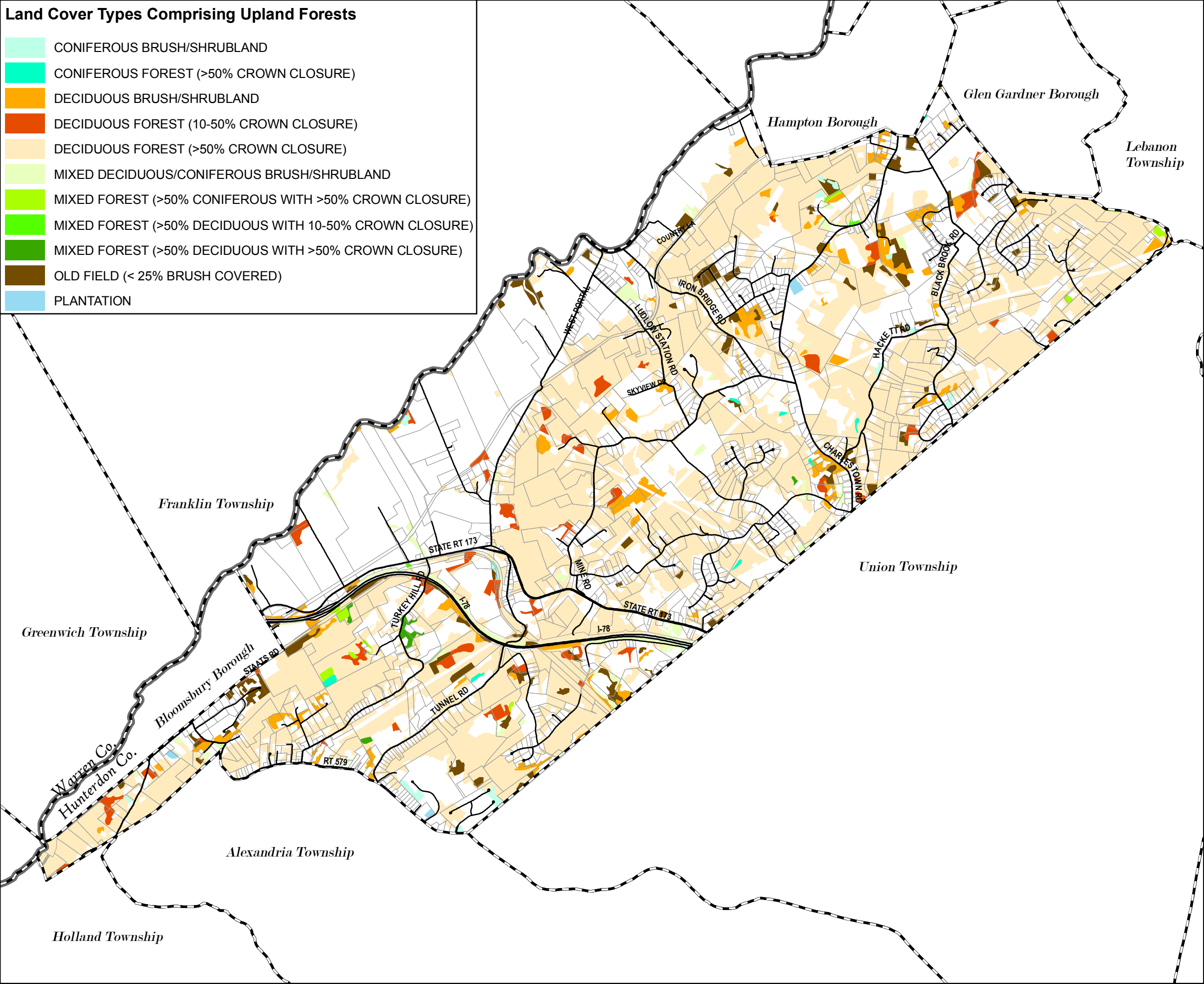
anvec Association of New Jersey Environmental Commissions

**FIGURE 15
WETLAND FORESTS**

**ENVIRONMENTAL
RESOURCE INVENTORY
BETHLEHEM TOWNSHIP
HUNTERDON COUNTY, NJ**

Legend

- Municipal Boundaries
- County Boundary
- Tax Parcels
- Wetland Forests
- Roads



Land Cover Types Comprising Upland Forests

CONIFEROUS BRUSH/SHRUBLAND

CONIFEROUS FOREST (>50% CROWN CLOSURE)

DECIDUOUS BRUSH/SHRUBLAND

DECIDUOUS FOREST (10-50% CROWN CLOSURE)

DECIDUOUS FOREST (>50% CROWN CLOSURE)

MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND

MIXED FOREST (>50% CONIFEROUS WITH >50% CROWN CLOSURE)

MIXED FOREST (>50% DECIDUOUS WITH 10-50% CROWN CLOSURE)

MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN CLOSURE)

OLD FIELD (< 25% BRUSH COVERED)

PLANTATION

NEW JERSEY COUNTY MAP

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0 2,000 4,000
Feet
1 inch equals 4,000 feet

SOURCES:
1. County and Municipal Boundaries obtained from NJ DEP
2. Roads Data obtained from the Hunterdon Co. GIS Dept.
3. Tax Parcels obtained from Bethlehem Township
4. Upland Forest cover is a subset of the NJ DEP 1995/97 Land Use/Land Cover GIS dataset.
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FIGURE 16
UPLAND FORESTS

ENVIRONMENTAL
RESOURCE INVENTORY
BETHLEHEM TOWNSHIP
HUNTERDON COUNTY, NJ

Legend

Municipal Boundaries

County Boundary

Tax Parcels

Roads

Princeton Hydro

Conservation Easement

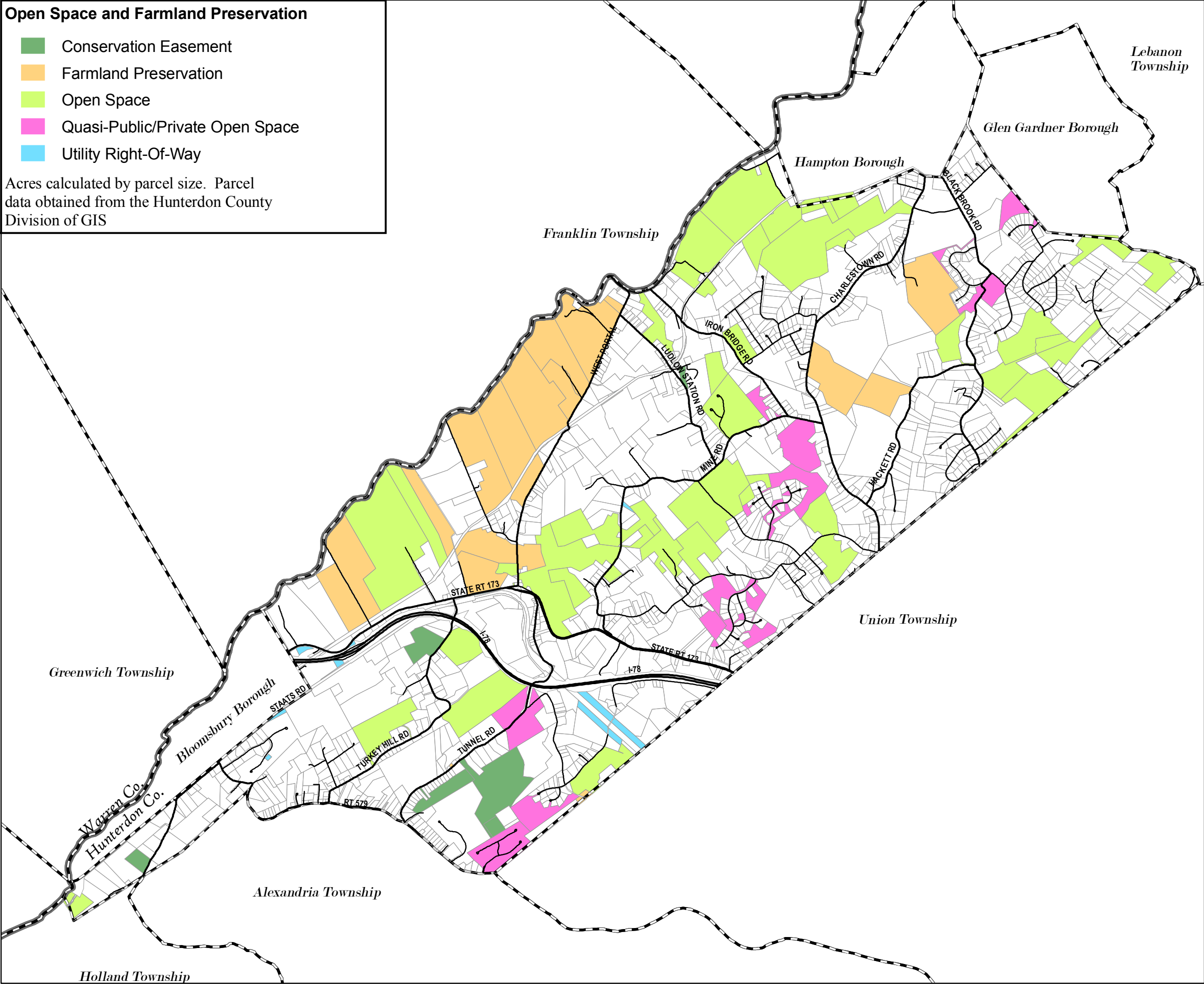
Farmland Preservation

Open Space

Quasi-Public/Private Open Space

Utility Right-Of-Way

Acres calculated by parcel size. Parcel data obtained from the Hunterdon County Division of GIS



NEW JERSEY COUNTY MAP

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0 2,000 4,000 Feet
1 inch equals 4,000 feet

SOURCES:

1. County and Municipal Boundaries obtained from NJ DEP

2. Parcel data obtained from Bethlehem Twp.

3. Open Space Data obtained from Bethlehem Township (Lots and Blocks listed in the Open Space Plan) - 2005

Some funding provided by:

Association of New Jersey Environmental Commissions

FIGURE 17
OPEN SPACE AND
FARMLAND PRESERVATION

ENVIRONMENTAL
RESOURCE INVENTORY
BETHLEHEM TOWNSHIP
HUNTERDON COUNTY, NJ

Legend

Municipal Boundaries

County Boundary

Tax Parcels

Roads

Princeton Hydro

Landscape Habitat within Township

Forest

- Priority Species
- State Threatened
- State Endangered

Forested Wetland

- Suitable
- Priority Species
- State Endangered
- Federal Threat. & Endang.

Wood Turtle Habitat

- State Threatened

Eagle Habitat

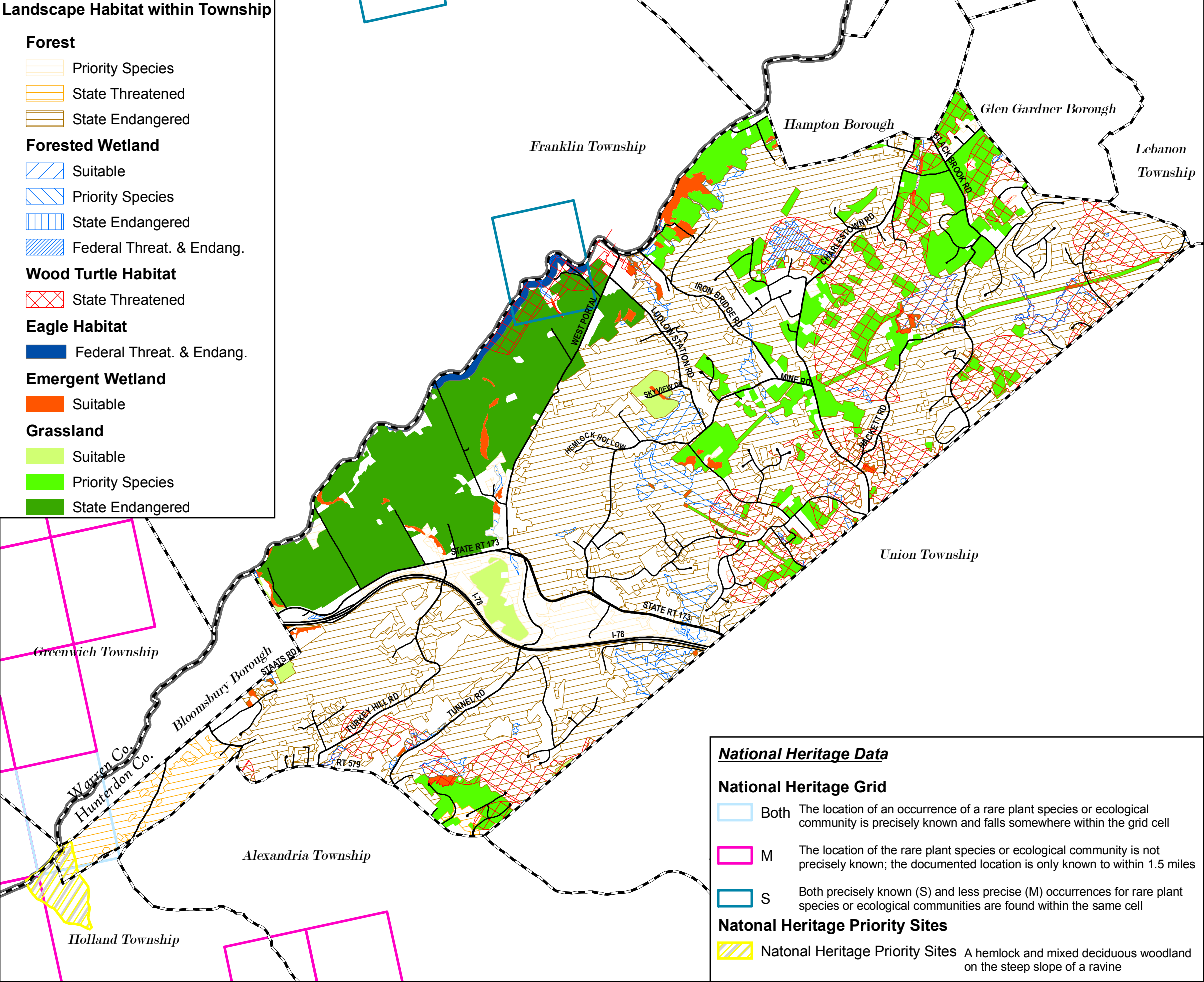
- Federal Threat. & Endang.

Emergent Wetland

- Suitable

Grassland

- Suitable
- Priority Species
- State Endangered



National Heritage Data

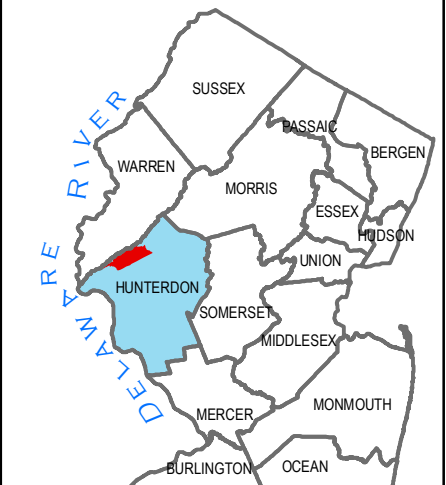
National Heritage Grid

- Both The location of an occurrence of a rare plant species or ecological community is precisely known and falls somewhere within the grid cell
- M The location of the rare plant species or ecological community is not precisely known; the documented location is only known to within 1.5 miles
- S Both precisely known (S) and less precise (M) occurrences for rare plant species or ecological communities are found within the same cell

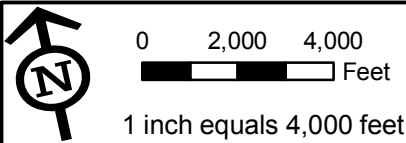
National Heritage Priority Sites

- National Heritage Priority Sites A hemlock and mixed deciduous woodland on the steep slope of a ravine

NEW JERSEY COUNTY MAP



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SOURCES:

- County and Municipal Boundaries obtained from NJ DEP
- Road data obtained from the Hunterdon Co GIS Dept
- Landscape data (v2) created and obtained from the NJ Div. of Fish, Game and Wildlife Ver. 2 released 2002

Some funding provided by:

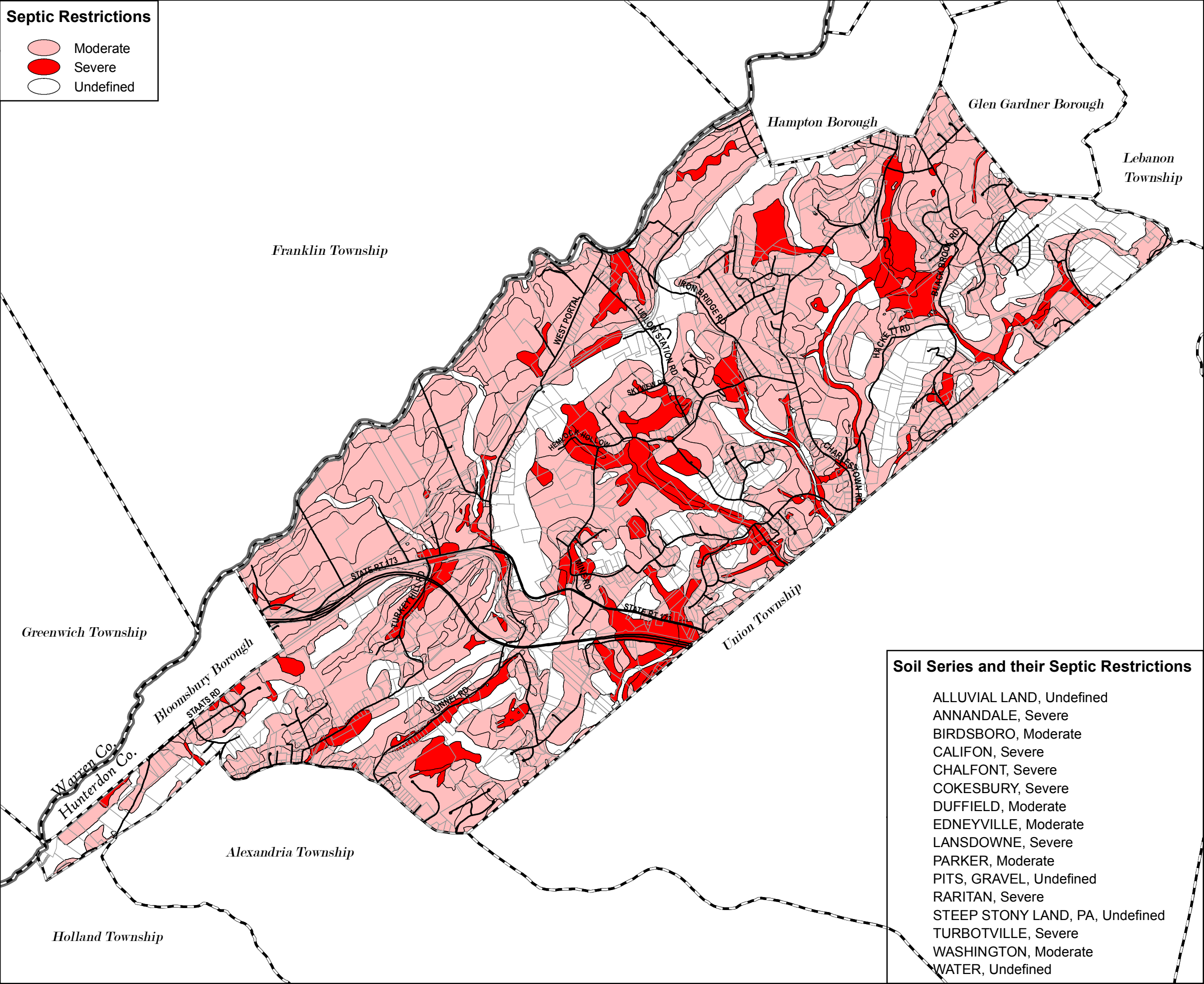
ANJEC Association of New Jersey Environmental Commissions

FIGURE 18
LANDSCAPE HABITAT AND
THE NATURAL HERITAGE DATA

ENVIRONMENTAL
RESOURCE INVENTORY
BETHLEHEM TOWNSHIP
HUNTERDON COUNTY, NJ

Legend

- Municipal Boundaries
- County Boundary
- Roads

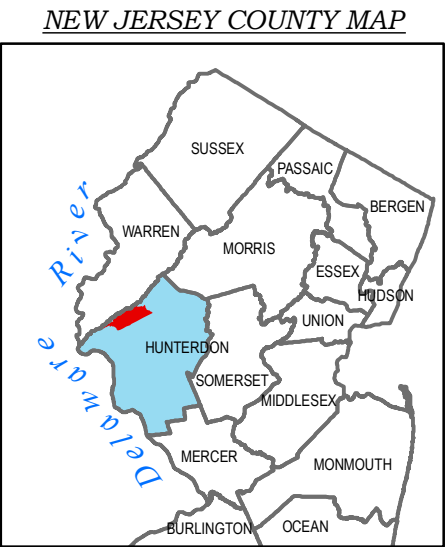


Septic Restrictions

- Moderate
- Severe
- Undefined

Soil Series and their Septic Restrictions

- ALLUVIAL LAND, Undefined
- ANNANDALE, Severe
- BIRDSBORO, Moderate
- CALIFON, Severe
- CHALFONT, Severe
- COKESBURY, Severe
- DUFFIELD, Moderate
- EDNEYVILLE, Moderate
- LANDSLOWNE, Severe
- PARKER, Moderate
- PITS, GRAVEL, Undefined
- RARITAN, Severe
- STEEP STONY LAND, PA, Undefined
- TURBOTVILLE, Severe
- WASHINGTON, Moderate
- WATER, Undefined



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0 2,000 4,000 Feet
1 inch equals 4,000 feet

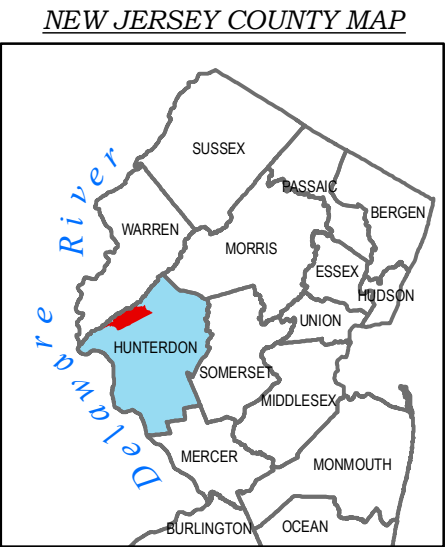
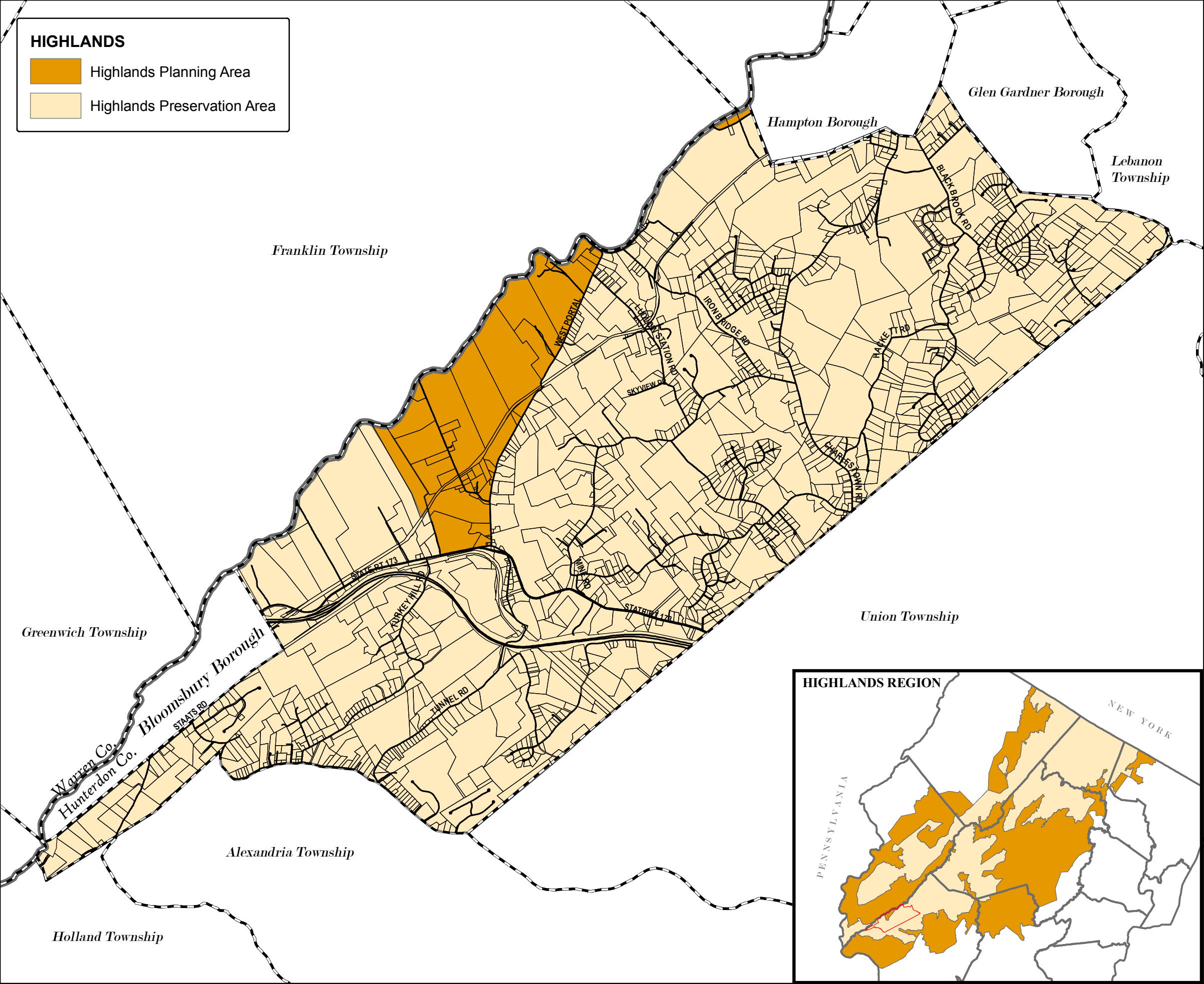
- SOURCES:
- County and Municipal Boundaries obtained from NJ DEP
 - Roads data obtained from the Hunterdon Co. GIS Dept
 - Septic Restrictions based on NRCS soils and Septic Suitability Classifications of NJ soils (as per NJAC 7:9A App. D)
- Some funding provided by:*
- ANJEC** Association of New Jersey Environmental Commissions

**FIGURE 19
SEPTIC RESTRICTIONS**

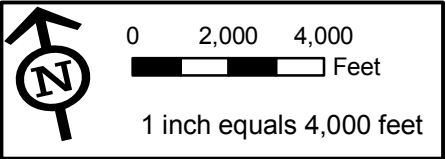
**ENVIRONMENTAL
RESOURCE INVENTORY
BETHLEHEM TOWNSHIP
HUNTERDON COUNTY, NJ**

Legend

- Tax Parcels
- Municipal Boundaries
- County Boundary
- Roads



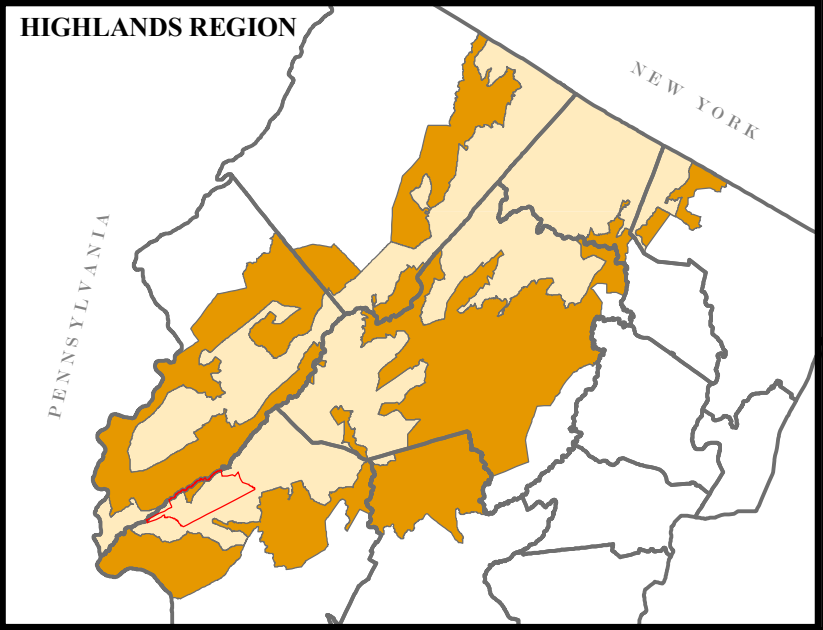
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RINGOES, NJ 08551



- SOURCES:
1. County and Municipal Boundaries obtained from NJ DEP
 2. Roads Data obtained from the Hunterdon Co. GIS Dept.
 3. New Jersey Highlands Planning and Preservation areas spatial data obtained from the NJDEP GIS website.
- Some funding provided by:*
- ANJEC** Association of New Jersey Environmental Commissions

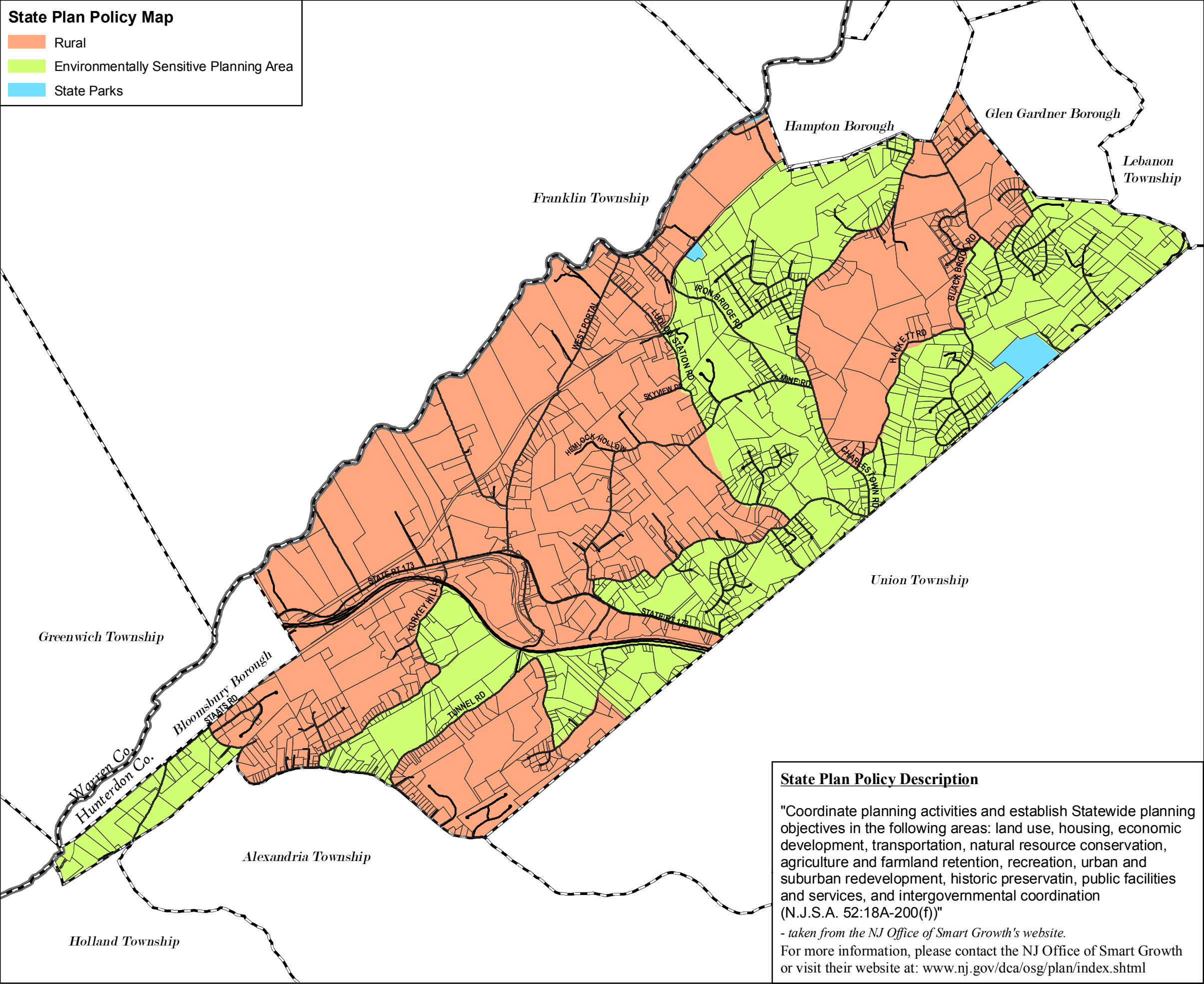
FIGURE 20
HIGHLANDS PLANNING AND PRESERVATION AREAS MAP
ENVIRONMENTAL RESOURCE INVENTORY
BETHLEHEM TOWNSHIP
HUNTERDON COUNTY, NJ

- Legend**
- Municipal Boundaries
 - County Boundary
 - Tax Parcels
 - Roads



State Plan Policy Map

- Rural
- Environmentally Sensitive Planning Area
- State Parks

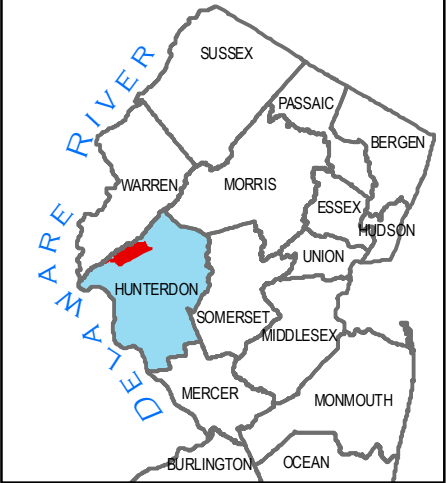


State Plan Policy Description

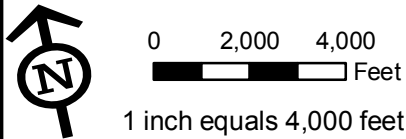
"Coordinate planning activities and establish Statewide planning objectives in the following areas: land use, housing, economic development, transportation, natural resource conservation, agriculture and farmland retention, recreation, urban and suburban redevelopment, historic preservatin, public facilities and services, and intergovernmental coordination (N.J.S.A. 52:18A-200(f))"

- taken from the NJ Office of Smart Growth's website.
For more information, please contact the NJ Office of Smart Growth or visit their website at: www.nj.gov/dca/osg/plan/index.shtml

NEW JERSEY COUNTY MAP



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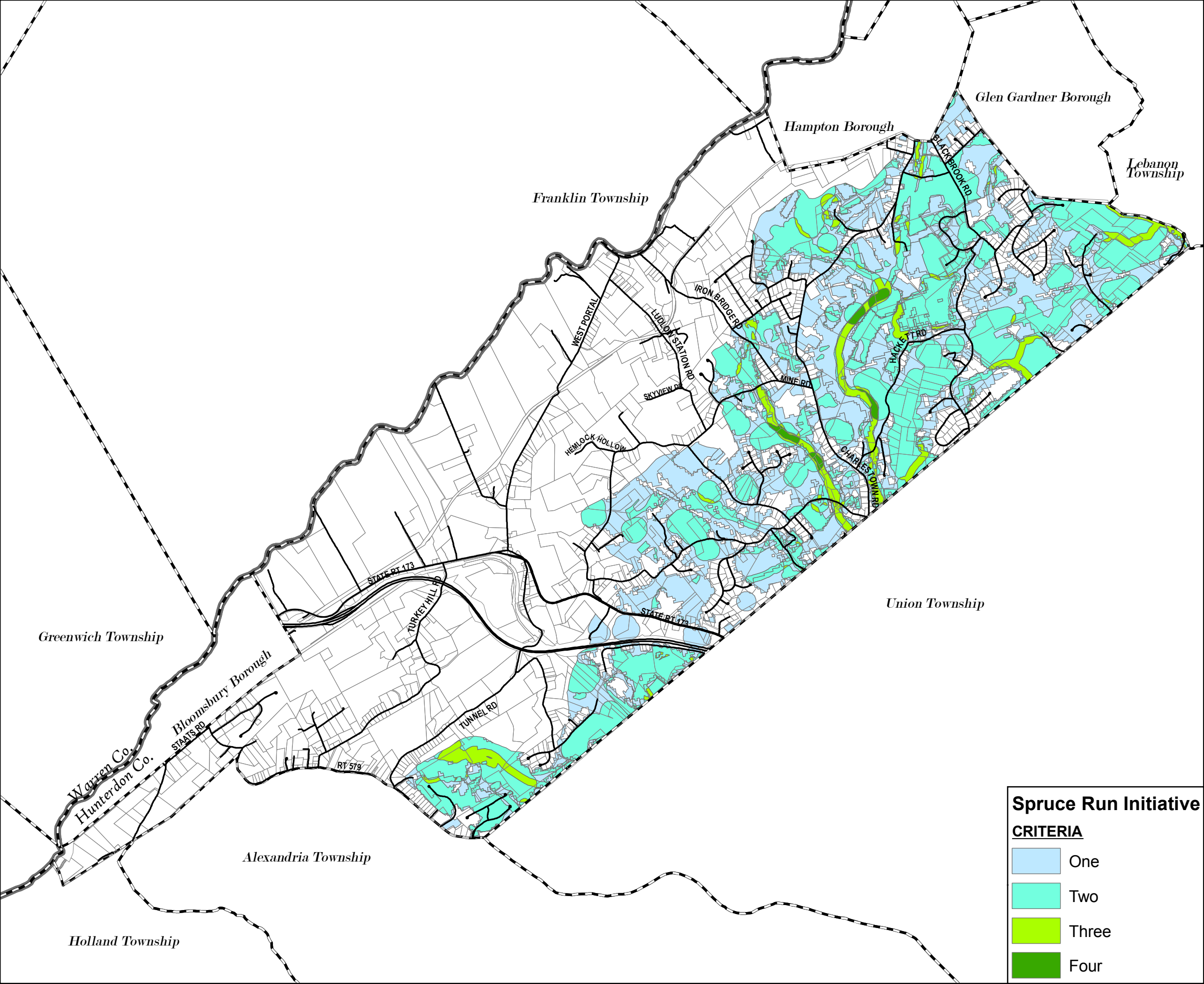
- SOURCES:
1. County and Municipal Boundaries obtained from NJ DEP
 2. Road data obtained from the Hunterdon Co GIS Dept
 3. Parcel data obtained from Bethlehem Twp.
 4. State Plan Policy Data obtained from the NJ Office of Smart Growth.

Some funding provided by:
anvec Association of New Jersey Environmental Commissions

FIGURE 21
STATE PLAN POLICY MAP

ENVIRONMENTAL
RESOURCE INVENTORY
BETHLEHEM TOWNSHIP
HUNTERDON COUNTY, NJ

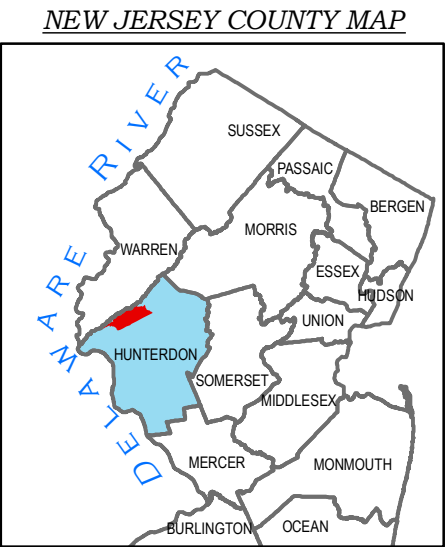
- Legend
- Municipal Boundaries
 - County Boundary
 - Roads



Spruce Run Initiative

CRITERIA

	One
	Two
	Three
	Four



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0 2,000 4,000
Feet
1 inch equals 4,000 feet

SOURCES:

1. County and Municipal Boundaries obtained from NJ DEP
2. Roads Data obtained from the Hunterdon Co. GIS Dept.
3. Parcel data obtained from Bethlehem Twp.
4. Spruce Run Initiative Data obtained from the New Jersey Water Supply Authority.

Some funding provided by:

Association of New Jersey Environmental Commissions

FIGURE 22
SPRUCE RUN INITIATIVE

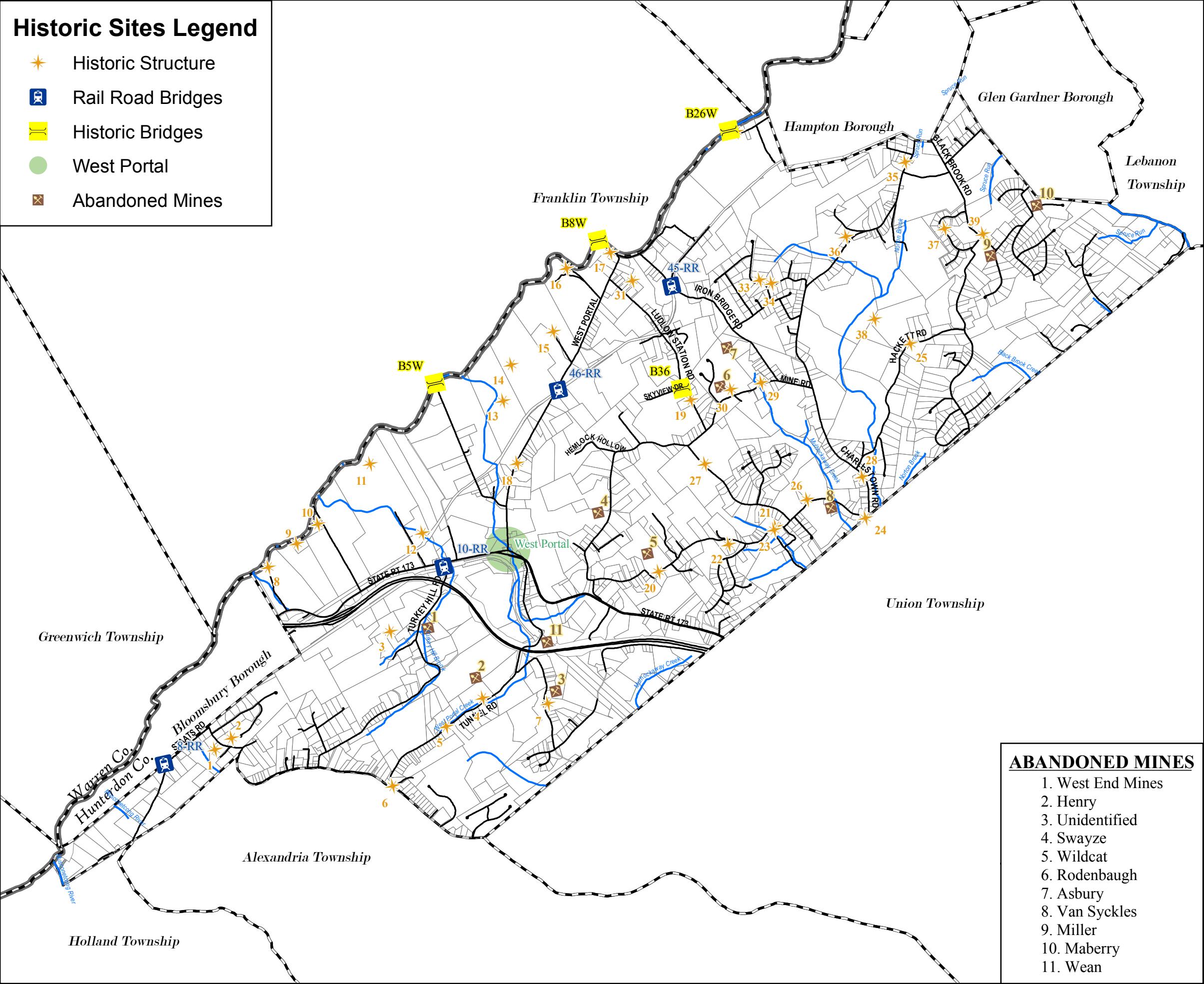
**ENVIRONMENTAL
RESOURCE INVENTORY
BETHLEHEM TOWNSHIP
HUNTERDON COUNTY, NJ**

Legend

	Municipal Boundaries
	County Boundary
	Roads

Historic Sites Legend

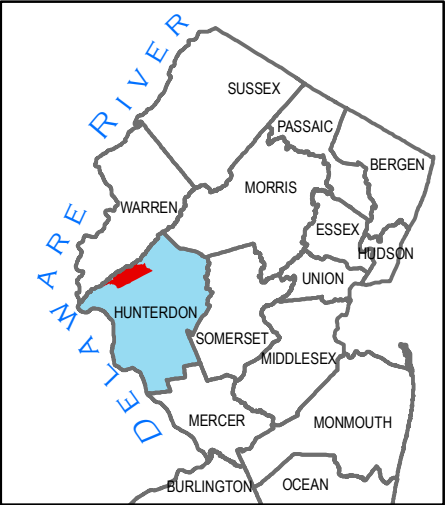
- Historic Structure
- Rail Road Bridges
- Historic Bridges
- West Portal
- Abandoned Mines



ABANDONED MINES

- 1. West End Mines
- 2. Henry
- 3. Unidentified
- 4. Swayze
- 5. Wildcat
- 6. Rodenbaugh
- 7. Asbury
- 8. Van Syckles
- 9. Miller
- 10. Maberry
- 11. Wean

NEW JERSEY COUNTY MAP



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0 2,000 4,000
Feet
1 inch equals 4,000 feet

- SOURCES:
- 1. County and Municipal Boundaries obtained from NJ DEP
 - 2. Roads Data obtained from the Hunterdon Co. GIS Dept.
 - 3. Parcel data obtained from Bethlehem Twp.
 - 4. Abandoned Mines data obtained from Bethlehem Twp. from report entitled "Abandoned Iron Mines Of Hunterdon County, NJ, 1988". Mine locations were heads-up digitized.

Some funding provided by:
anuec Association of New Jersey Environmental Commissions

FIGURE 23
HISTORIC FEATURES

ENVIRONMENTAL
RESOURCE INVENTORY
BETHLEHEM TOWNSHIP
HUNTERDON COUNTY, NJ

Legend

- Municipal Boundaries
- County Boundary
- Streams
- Roads